Appendix I

Risk Assessments

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I-1.0 INTRODUCTION

This appendix presents the results of the human health and ecological risk-screening assessments for the investigations conducted at sites within the Lower Mortandad/Cedro Canyons Aggregate Area at Los Alamos National Laboratory (LANL or the Laboratory). Sites include four solid waste management units (SWMUs) located within Technical Area (TA-05).

Human health and ecological risk-screening assessments were conducted for Solid Waste Management Units (SWMUs) 05-003, 05-004, 05-005(b), and 05-006(c). The SWMUs are described in section 6 of the investigation report and are summarized below.

I-2.0 TA-05 BACKGROUND

TA-05, also known as Beta Site, was established in 1944 as an adjunct test firing site to TA-04 (Alpha Site). Firing activities were conducted at two small firing sites located within the Middle Mortandad/Ten Site portion of TA-05 and one large firing site, known as Far Point Site within the Lower Mortandad/Cedro portion of TA-05. Far Point Site was used briefly during 1944 and 1945 for half-scale mockup tests of the Trinity device. TA-05 was used as a firing site for implosion studies until 1947. After firing activities were halted, several Laboratory groups used the site for a variety of experiments, including the study of hydrogen fires, animal radiation experiments, and beryllium combustion experiments. In late 1959, two experimental reactors known as “Little Eva” and “Godiva” were brought to TA-05 and operated briefly. Little Eva was located inside a trailer, and Godiva was located in an underground chamber (SWMU 05-003). TA-05 was taken out of service in 1959 and underwent decontamination and demolition in 1985 as part of the Los Alamos Site Characterization Program (LASCP).

I-2.1 Site Descriptions and Operational History

I-2.1.1 SWMU 05-003

SWMU 05-003 is a former underground calibration facility (structures 05-20 and 05-21) located at the west end of TA-05 near the edge of Mortandad Canyon. The calibration facility consisted of an aboveground shed (structure 05-20) constructed over a 6-ft-diameter, 35-ft deep access shaft equipped with a ladder to provide facility personnel access to the calibration chamber (structure 05-21), located belowground to the west of the access shaft. The aboveground shed (structure 05-20) was a wooden building that measured 8 ft wide × 12 ft long × 8 ft high. The belowground chamber (structure 05-21) measured 10 ft^2 × 10 ft deep and was used to calibrate neutron detector systems for experiments at TA-49. The base of the access shaft was connected to the calibration chamber by an 8-ft-tall, 9.5-ft-long tunnel. A second 24-in.-diameter shaft extended from the center of the chamber to the surface. The shafts were separated by 15 ft (center to center). The smaller shaft was lined with a 16-in.-diameter casing and capped with concrete, with a 3-in.-diameter opening in the concrete cap. The small shaft was used to direct neutrons from the underground chamber to detectors located above the shaft.

The neutron source used in the calibration facility was a critical assembly called Godiva. This assembly used highly enriched uranium (HEU) and was operated in the underground chamber beneath the smaller shaft. Neutron detectors were placed on the ground surface above the opening in the small shaft. The Godiva assembly could be pulsed every 2 h and produced 2×10^{16} fissions per pulse. Small amounts of HEU would spall off the source with each pulse. Borated paraffin and lead bricks were used as shielding and heavy water was used to moderate the energy and intensity of the neutrons.

The Godiva assembly was installed in the TA-05 underground chamber on November 16, 1959. The chamber was used for approximately 1 mo only. TA-05 officially ceased operation on December 18, 1959. The Godiva assembly was moved to TA-49 where it became operational on January 12, 1960.

The underground calibration chamber (structure 05-21) and the corrugated metal pipe (CMP) liner for the large access shaft are still present at the site. The CMP extends approximately 2.5 ft above the ground surface. The inside of the CMP contains backfill and some vegetation is presently growing in the backfill. An 8.75-ft-wide × 12.5-ft-long concrete pad extends around the CMP. Currently, the area of the smaller shaft is covered with dirt.

I-2.1.2 SWMU 05-004

SWMU 05-004 is a former septic tank (structure 05-13), associated drainlines, and outfall that were located at the west end of TA-05 near the edge of Mortandad Canyon. The tank was constructed in May 1948 to serve building 05-1 (a laboratory) and was decommissioned in place in December 1959. It was constructed of reinforced concrete and was 5 ft^2 × 7 ft deep. As-built drawings show an inlet line running from building 05-1 to the septic tank and an outlet line discharging south into an unnamed tributary of Mortandad Canyon.

From 1948 to 1949, the tank received industrial waste from a laboratory (building 05-1). A 1952 memorandum states that septic tank 05-13 was no longer needed to support the use of building 05-1 and the structure was being returned to Engineering Division for disposition. Historical information shows the tank was free of radiation and high explosive (HE) contamination but notes it contained unspecified toxic chemicals. The types of materials used in building 05-1 are not known. Building 05-1 was inspected in 1959 and found to be free of contamination by toxic materials. A radiation survey of building 05-1 in 1973 detected no radioactive contamination. During the 1985 LASCP, building 05-1 was determined to be free of radioactive and HE contamination and was removed. The septic tank and associated drainlines had been removed before the 1985 LASCP activities. The removal of the tank and piping was confirmed by excavation of the area.

The outfall, a 2-ft wide by 1-ft deep trench cut into the tuff, is located at the edge of the mesa. Stormwater best management practices (BMPs), including straw wattles, are in place above and downslope of the site.

I-2.1.3 SWMU 05-005(b)

SWMU 05-005(b) is an area of potentially contaminated soil associated with a former outfall that was located in TA-05 at the edge of Mortandad Canyon. The outfall served building 05-5 (a shop and darkroom). The outfall is believed to have operated during the same time period as the building, which operated from 1944 to 1959. Building 05-5 supported TA-05 firing site activities, including shop work and processing photographs of experiments conducted at the firing sites. For a brief period in 1952, the calibration of high-range radiation meters was also conducted in the building.

The site currently contains no evidence of the outfall. A capped pipe was present at the ground surface at the former location of building 05-5. The pipe, about 18 in. long, was removed with the debris at SWMU 05-006(c). A drainage channel that collects most of the runoff from the site is present at the edge of the mesa. Stormwater BMPs, including straw wattles, are in place above and downslope of the site.

I-2.1.4 SWMU 05-006(c)

SWMU 05-006(c) is an area of potentially contaminated soil associated with the location of former building 05-5, a shop and darkroom. The shop was 16 ft^2 and the darkroom was 6 wide × 9 ft long. The

building was operational from about 1944 to 1959. The structure was originally used to support firing site activities, including processing photographs of experiments conducted at the TA-05 firing sites. In 1952, J Division temporarily used the building to calibrate high-range radiation meters. A 1959 memorandum indicates this structure was contaminated with HE, as does a 1959 list generated by the Laboratory's H-3 Group. Potential soil contamination associated with SWMU 05-006(c) was reported to also include uranium. Building 05-5 was destroyed by intentional burning on March 5, 1960.

During the 2011 investigation activities, a small amount of burned debris (charred wood, melted glass, and metal) was removed from the former location of building 05-5. An 18 in.-long capped pipe was also removed. Stormwater BMPs, including a soil berm with straw wattles, are in place south of the site.

I-2.2 Sampling Results and Determination of Chemicals of Potential Concern

The data used to identify chemicals of potential concern (COPCs) and to evaluate potential risks or doses to human health and the environment for the Lower Mortandad/Cedro Canyons Aggregate Area sites consisted of all qualified analytical results compiled from both historical sampling activities and the 2011 investigation. Only those data determined to be of decision-level quality following the data-quality assessment (Appendix E) are included in the data sets evaluated in this risk appendix. The data are present in Appendix F (on DVD).

Tables I-2.2-1 to I-2.2-10 summarize the COPCs evaluated for potential risk for each site. Section 5.1 of the investigation report summarizes the COPC selection process. Inorganic chemicals and radionuclides above background values (BVs) or fallout values (FVs) and detected organic chemicals or radionuclides in tuff are retained as COPCs. The risk-screening assessment(s) for a site included all COPCs detected within the depth interval relevant for each exposure scenario. The depth intervals are 0–10 ft below ground surface (bgs) for the residential scenario, 0–5 ft bgs for ecological risk, and 0–1 ft bgs for the industrial scenario. Therefore, the COPCs evaluated for each scenario may differ for the site depending on the depth at which the COPC was identified. Because sampling depths often overlapped during multiple investigations, all samples with a starting depth less than the lower bound of the interval for each scenario were included in the risk assessments.

I-3.0 CONCEPTUAL SITE MODEL

Potential contaminant sources at TA-05 include an underground chamber that housed an experimental reactor, past discharges from outfalls and a septic system, and residual soil contamination associated with decontamination and decommissioning of a former building by burning. COPCs may be found in surface material and may have also migrated into subsurface.

I-3.1 Receptors and Exposure Pathways

The current and reasonably foreseeable future land use for the sites in the Lower Mortandad/Cedro Canyons Aggregate Area is industrial; the receptor being a Laboratory worker. The residential scenario was also evaluated. The construction worker and recreational scenarios are not current and reasonably foreseeable future land uses at any of the sites and were therefore not evaluated.

The primary exposure pathway for human receptors is surface soil and subsurface soil or tuff that may be brought to the surface through intrusive activities. Human receptors may be exposed through direct contact with soil or suspended particulates by ingestion, inhalation, dermal contact, and external irradiation pathways. Direct contact exposure pathways from subsurface contamination to human

receptors are complete for a resident. The exposure pathways are the same as those for surface soil. Sources, exposure pathways, and receptors are shown in the conceptual site model (Figure I-3.1-1).

The sites within the Lower Mortandad/Cedro Canyons Aggregate Area are in a former industrial area, which provides potential habitat for ecological receptors. Exposure pathways are complete to surface soil and tuff for ecological receptors. Exposure is assessed across the site to a depth of 0–5 ft. Weathering of tuff is the only viable natural process that may result in the exposure of receptors to COPCs in tuff. However, because of the slow rate of weathering expected for tuff, exposure to COPCs in tuff is negligible, although it is included in the assessments. Exposure pathways to subsurface contamination below 5 ft are not complete unless contaminated soil or tuff were excavated and brought to the surface. The potential pathways are root uptake by plants, inhalation of dust, dermal contact, incidental ingestion of soil, external irradiation, and food-web transport. Pathways from subsurface releases may be complete for plants. Surface water was not evaluated because of the lack of surface water features. Sources, exposure pathways, and receptors are presented in the conceptual site model (Figure I-3.1-1).

I-3.2 Environmental Fate and Transport

The evaluation of environmental fate addresses the chemical processes affecting the persistence of a chemical in the environment; the evaluation of transport addresses the physical processes affecting mobility of a contaminant along a migration pathway. Migration through soil and tuff depends on properties such as soil pH, rate of precipitation or snowmelt, soil moisture content, soil-tuff hydraulic properties, and properties of the COPCs. Migration into and through tuff also depends on the unsaturated flow properties of the tuff and the presence of joints and fractures.

The most important factor with respect to the potential for COPCs to migrate to groundwater is the presence of saturated conditions. Downward migration in the vadose zone is limited also by a lack of hydrostatic pressure as well as lack of a source for the continued release of contamination. Without sufficient moisture and a source, little or no potential migration of materials through the vadose zone to groundwater occurs.

Contamination at depth is addressed in the discussion of nature and extent presented in the report. Results from the deepest samples collected showed either no detected concentrations of COPCs or low or trace-level concentrations of only a few inorganic, radionuclide, and/or organic COPCs in tuff. The limited extent of contamination is related to the absence of the key factors that facilitate migration, as mentioned above. Given how long the contamination has been present in the subsurface, physical and chemicals properties of the COPCs, and the lack of saturated conditions, the potential for contaminant migration to groundwater is very low.

New Mexico Environment Department (NMED) guidance (NMED 2009, 108070) contains screening levels that consider the potential for contaminants in soil to result in groundwater contamination. These screening levels consider equilibrium partitioning of contaminants among solid, aqueous, and vapor phases and account for dilution and attenuation in groundwater through the use of dilution attenuation factors (DAFs). These DAF soil screening levels (SSLs) can be used to identify chemical concentrations in soil that have the potential to contaminate groundwater (EPA 1996, 059902). Screening contaminant concentrations in soil against these DAF SSLs does not, however, provide an indication of the potential for contaminants to migrate to groundwater. The assumptions used in the development of these DAF SSLs include an assumption of uniform contaminant concentrations from the contaminant source to the water table (i.e., it is assumed that migration to groundwater has already occurred). For these reasons, screening of contaminant concentrations in soil against the DAF SSLs was not performed.

The relevant release and transport processes of the COPCs are a function of chemical-specific properties that include the relationship between the physical form of the constituents and the nature of the constituent transport processes in the environment. Specific properties include the degree of saturation, the potential for ion exchange or sorption, and the potential for natural bioremediation. The transport of volatile organic compounds (VOCs) occurs primarily in the vapor phase by diffusion or advection in subsurface air. The chemical and physical properties of the Lower Mortandad/Cedro Canyons Aggregate Area COPCs are presented in Tables I-3.2-1 through I-3.2-3.

The primary release and transport mechanisms that may lead to the potential exposure of receptors include:

- dissolution and/or particulate transport of surface contaminants from precipitation and runoff,
- airborne transport of contaminated surface soil or particulates,
- continued dissolution and advective/dispersive transport of chemical and radiological contaminants contained in subsurface soil and bedrock,
- biotic perturbation and/or translocation of contaminants in subsurface contaminated media, and
- uptake of contaminants from soil and water by biota.

Contaminant distributions at the sites indicate that after the initial deposition of contaminants from operational activities and historical remediation efforts, elevated levels of contaminants tend to remain concentrated near the original release points.

I-3.2.1 Inorganic Chemicals

In general, and particularly in a semiarid climate such as that found at the sites within the Lower Mortandad/Cedro Canyons Aggregate Area, inorganic chemicals are not highly soluble or mobile in the environment. The primary physical and chemical factors that determine and describe the distribution of inorganic COPCs within the soil and tuff are the water solubility of the inorganic chemical and the soil-water partition coefficient (K_d). Other factors besides the K_d values, such as speciation in soil and oxidation-reduction potential (Eh) and pH, also play a role in the likelihood that inorganic chemicals will migrate. The K_d values provide a general assessment of the potential for migration through the subsurface; chemicals with higher K_d values are less likely to be mobile than those with lower K_d values. Inorganic chemicals with K_d values greater than 40 are very unlikely to migrate through soil towards the water table (Kincaid et al. 1998, 093270). Table I-3.2-1 presents the K_d values for the inorganic COPCs identified at the Lower Mortandad/Cedro Canyons Aggregate Area. Based on this criterion, antimony, cadmium, chromium, lead, and nickel have a low potential to mobilize and migrate through soil and the vadose zone. The K_d values for copper, nitrate, perchlorate, selenium, and silver are less than 40 and may indicate these inorganic chemicals have a greater potential to mobilize and migrate through soil and the vadose zone. These COPCs are discussed further in the following sections. Information about the fate and transport properties of inorganic chemicals was obtained from individual chemical profiles published by the Agency for Toxic Substances and Disease Registry (ATSDR) (ATSDR 1997, 056531). Information for these inorganic chemicals is also available from the ATSDR website at http://www.atsdr.cdc.gov/toxprofiles/index.asp.

- Copper movement in soil is determined by physical and chemical interactions with the soil components. Most copper deposited in soil is strongly adsorbed and remains in the upper few centimeters. Copper will adsorb to organic matter, carbonate minerals, clay minerals, hydrous iron, and manganese oxides. In most temperate soil, pH, organic matter, and ionic strength of the soil solutions are the key factors affecting adsorption. Copper binds to soil much more strongly

than other divalent cations, and the distribution of copper in the soil solution is less affected by pH than other metals. Copper is expected to be bound to the soil and move in the system by way of transport of soil particles by water as opposed to movement as dissolved species. The average soil pH at the four sites in TA-05 is 7.7, so leaching of copper is unlikely.

- Nitrate (and to a lesser degree perchlorate) is highly soluble in water and may migrate with water molecules in saturated soil. As noted above, the subsurface material beneath the Lower Mortandad/Cedro Canyons Aggregate Area sites has low moisture content, which inhibits the mobility of nitrate and perchlorate as well as most other inorganic chemicals.
- Selenium is not often found in the environment in its elemental form but is usually combined with sulfide minerals or with silver, copper, lead, and nickel minerals. In soil, pH and Eh are determining factors in the transport and partitioning of selenium. In soil with a pH of greater than 7.5, selenates, which have high solubility and a low tendency to adsorb onto soil particles, are the major selenium species and are very mobile. The average soil pH at the four sites in TA-05 is 7.7, which indicates that selenium has limited tendency to migrate.
- Silver sorbs onto soil and sediment and tends to form complexes with inorganic chemicals and humic substances in soil. Organic matter complexes with silver and reduces its mobility. Silver compounds tend to leach from well-drained soil so silver may potentially migrate into the subsurface. The extent of silver is defined at depth.

I-3.2.2 Organic Chemicals

Table I-3.2-2 presents the physical and chemical properties (water solubility, organic carbon-water partition coefficient [K_{oc}], logarithm to the base 10 octanol-water partition coefficient [log K_{ow}], and vapor pressure) of the organic COPCs identified for the Lower Mortandad/Cedro Canyons Aggregate Area. Physical and chemical properties of organic chemicals are important when evaluating their fate and transport. The following physiochemical property information illustrates some aspects of the fate and transport tendencies of the Lower Mortandad/Cedro Canyons Aggregate Area COPCs. The information is summarized from Ney (1995, 058210).

Water solubility may be the most important chemical characteristic used to assess mobility of organic chemicals. The higher the water solubility of a chemical, the more likely it is to be mobile and the less likely it is to accumulate, bioaccumulate, volatilize, or persist in the environment. A highly soluble chemical (water solubility greater than 1000 mg/L) is prone to biodegradation and metabolism that may detoxify the parent chemical. Acetone, benzoic acid, diethylphthalate, di-n-butyl phthalate, 2-hexanone, and methylene chloride have water solubilities greater than 1000 mg/L.

The lower the water solubility of a chemical, especially below 10 mg/L, the more likely it will be immobilized by adsorption. Chemicals with lower water solubilities are more likely to accumulate or bioaccumulate and persist in the environment, to be slightly prone to biodegradation, and to be metabolized in plants and animals. The COPCs identified as having water solubilities less than 10 mg/L are acenaphthene; anthracene; Aroclor-1260; benzo[a]anthracene; benzo[a]pyrene; benzo[b]fluoranthene; benzo[g,h,i]perylene; benzo[k]fluoranthene; bis[2-ethylhexyl]phthalate; chrysene; dibenz(a,h)anthracene; fluoranthene; fluorene; indeno[1,2,3-cd]pyrene; phenanthrene; pyrene; and 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD).

The K_{oc} measures the tendency of a chemical to adsorb to organic carbon in soil. K_{oc} values above 500 L/kg indicate a strong tendency to adsorb to soil, leading to low mobility (NMED 2009, 108070). Acenaphthene; acenaphthylene; anthracene; Aroclor-1260; benzo[a]anthracene; benzo[a]pyrene; benzo[b]fluoranthene; benzo[g,h,i]perylene; benzo[k]fluoranthene; bis[2-ethylhexyl]phthalate; chrysene;

dibenz(a,h)anthracene; fluoranthene; fluorene; indeno[1,2,3-cd]pyrene; 2-methylnaphthalene; naphthalene; phenanthrene; pyrene; styrene; 2,3,7,8-TCDD; and 1,2,4-trimethylbenzene have K_{oc} values above 500 L/kg, indicating a very low potential to migrate toward groundwater. The COPCs with K_{oc} values less than 500 L/kg are acetone; benzoic acid; diethylphthalate; di-n-butylphthalate; 2-hexanone; methylene chloride; and toluene.

The K_{ow} is an indicator of a chemical's potential to bioaccumulate or bioconcentrate in the fatty tissues of living organisms. The unitless K_{ow} value is an indicator of water solubility, mobility, sorption, and bioaccumulation. The higher the K_{ow}, the greater the affinity the chemical has for bioaccumulation in the food chain, the greater its potential for sorption in the soil, and the lower its mobility (Ney 1995, 058210). The COPCs with a K_{ow} greater than 1000 include acenaphthene; acenaphthylene; anthracene; Aroclor-1260; benzo[a]anthracene; benzo[a]pyrene; benzo[b]fluoranthene; benzo[g,h,i]perylene; benzo[k]fluoranthene; bis[2-ethylhexyl]phthalate; chrysene; dibenz(a,h)anthracene; di-n-butyl phthalate; fluoranthene; fluorene; indeno[1,2,3-cd]pyrene; 4-isopropyltoluene; 2-methylnaphthalene; naphthalene; phenanthrene; pyrene; and 1,2,4-trimethylbenzene. A K_{ow} of less than 500 indicates high water solubility, high mobility, little to no affinity for bioaccumulation, and degradability by microbes, plants, and animals. Acetone, benzoic acid, diethylphthalate, 2-hexanone, and methylene chloride have K_{ow} values less than 500.

Vapor pressure is a chemical characteristic used to evaluate the tendency of organic chemicals to volatilize. Chemicals with vapor pressure greater than 0.01 millimeters of mercury (mm Hg) are likely to volatilize, and therefore, concentrations at the site are reduced over time; vapors of these chemicals are more likely to travel toward the atmosphere and not migrate toward groundwater. Acetone; 2-hexanone; 4-isopropyltoluene; methylene chloride; 2-methylnaphthalene; naphthalene; styrene; toluene; and 1,2,4-trimethylbenzene have vapor pressures greater than 0.01 mm Hg.

Chemicals with vapor pressures less than 0.00001 mm Hg are less likely to volatilize and, therefore, tend to remain immobile. Anthracene; benzo[a]anthracene; benzo[a]pyrene; benzo[b]fluoranthene; benzo[g,h,i]perylene; benzo[k]fluoranthene; bis[2-ethylhexyl]phthalate; chrysene; dibenz(a,h)anthracene; fluoranthene; indeno[1,2,3-cd]pyrene; and pyrene have vapor pressures less than 0.00001 mm Hg.

In summary, anthracene; benzo[a]anthracene; benzo[a]pyrene; benzo[b]fluoranthene; benzo[g,h,i]perylene; benzo[k]fluoranthene; bis[2-ethylhexyl]phthalate; chrysene; dibenz(a,h)anthracene; fluoranthene; indeno[1,2,3-cd]pyrene; and pyrene are the least mobile and the most likely to bioaccumulate. The more soluble and volatile COPCs acetone, benzoic acid, diethylphthalate, 2-hexanone, methylene chloride, and toluene are more mobile but are also more likely to travel toward the atmosphere and not migrate toward groundwater. Because the organic COPCs were detected at low concentrations and the extent is defined, they are not likely to migrate to groundwater.

I-3.2.3 Radionuclides

Radionuclides are generally not highly soluble or mobile in the environment, particularly in the semiarid climate of the Laboratory. The physical and chemical factors that determine the distribution of radionuclides within soil and tuff are the K_d, the pH of the soil and other soil characteristics (e.g., sand or clay content), and the Eh. The interaction of these factors is complex, but K_d values provide a general assessment of the potential for migration through the subsurface: chemicals with higher K_d values are less likely to be mobile than those with lower values. Radionuclides with K_d values greater than 40 are very unlikely to migrate through soil towards the water table (Kincaid et al. 1998, 093270).

Table I-3.2-3 presents physical and chemical properties of the radionuclide COPCs identified at the Lower Mortandad/Cedro Canyons Aggregate Area sites. Based on K_d values, plutonium-238 and plutonium-239/240 have a very low potential to migrate towards groundwater. The K_d values for uranium-234, uranium-235/236, and uranium-238 are less than 40 and indicate a potential to migrate towards groundwater.

Uranium isotopes were retained as COPCs at the Lower Mortandad/Cedro Canyons Aggregate Area sites. In general, the actinide nuclides form comparatively insoluble compounds in the environment and are therefore not considered biologically mobile. The actinides are transported in ecosystems mainly by physical and sometimes chemical processes. They tend to attach, sometimes strongly, to surfaces, and they tend to accumulate in soil and sediment. Subsequent movement is largely associated with geological processes such as erosion and sometimes leaching. The extent of isotopic uranium is defined.

I-3.3 Exposure Point Concentration Calculations

The exposure point concentrations (EPCs) represent upper bound concentrations of COPCs. For comparison to risk-screening levels, the upper confidence limit (UCL) of the arithmetic mean was calculated when possible and used as the EPC. If an appropriate UCL of the mean could not be calculated or if the UCL exceeded the maximum concentration, the maximum detected concentration (or the maximum detection limit) of the COPC was used as the EPC. Calculation of UCLs of the mean concentration was done using the U.S. Environmental Protection Agency (EPA)'s ProUCL, Version 4.1 (EPA 2010, 109944), which is based on EPA guidance (EPA 2002, 085640, Section 15.4-1). The ProUCL program calculates 95%, 97.5%, and 99% UCLs and recommends a distribution and a UCL. The ProUCL software performs distributional tests on the data set for each COPC and calculates the most appropriate UCL based on the distribution of the data set. The UCL for the recommended calculation method was used as the EPC, and the 95% UCL was selected as the representative UCL. Environmental data may have a normal, lognormal, or gamma distribution but are often nonparametric (no definable shape to the distribution). The ProUCL documentation strongly recommends against using the maximum detected concentration for the EPC. However, the maximum detected concentration was used to represent the EPC when data did not allow a UCL to be calculated.

The summary statistics including the EPC for each COPC for the human health and the ecological risk-screening assessments and the distribution used for the calculation are presented in Tables I-2.2-1 to I-2.2-10. Input and output data files for ProUCL calculations are provided on CD as Attachment I-1.

I-4.0 HUMAN HEALTH RISK-SCREENING ASSESSMENTS

The human health risk-screening assessments were conducted for the four sites within the Lower Mortandad/Cedro Canyons Aggregate Area where extent was defined. All sites were screened for the industrial scenario using data from 0–1 ft bgs and for the residential scenario using data from 0–10 ft bgs. The human health risk-screening assessments compare the EPC of each COPC with SSLs (for inorganic and organic chemicals) or with screening action levels (SALs) (for radionuclides).

I-4.1 SSLs and SALs

Human health risk-screening assessments were conducted using the SSLs obtained from NMED guidance (NMED 2009, 108070) or the EPA regional tables (http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm). The SSLs are based on either a cancer risk of 1×10^{-5} or a hazard quotient (HQ) of 1. The EPA SSLs for carcinogens were multiplied by 10 to adjust from a 10^{-6} cancer risk level to the NMED target cancer risk level of 10^{-5}. Surrogate chemicals were used for some COPCs without a screening

value based on structural similarity or because the COPC is a breakdown product (NMED 2003, 081172). Exposure parameters used to calculate the SSLs are presented in Table I-4.1-1.

Radionuclide SALs are used for comparison with radionuclide COPC's EPCs and were derived using the residual radioactive (RESRAD) model, Version 6.5 (LANL 2009, 107655). The SALs are based on a 15-mrem/yr dose (Soden 2000, 067489). Exposure parameters used to calculate the SALs are presented in Table I-4.1-2.

In addition, vapor intrusion of VOCs into a building was evaluated for the residential scenario at SWMUs 05-004 and 05-006(c). For SWMU 05-004, the vapor-intrusion pathway was evaluated for the locations at the edge of the mesa top where 2-hexanone and 4-isopropyltoluene were detected (locations 05-613786 and 05-613790). Naphthalene and 2-methylnaphthalene were detected only at location 05-613788, which is the location of the inlet line near former building 05-1. However, this location is where all 17 polycyclic aromatic hydrocarbons (PAHs) were detected. The PAHs were not detected below the locations of the former drainlines and septic tank or in the drainage. Therefore, PAHs were not discharged from the building to the septic system. An engineering drawing (LASL 1947, 206411) indicates the access road to building 05-1 was gravel-surfaced with one coat of hot oil penetration, the most likely source of the PAHs detected next to former building 05-1. Because the PAHs are not related to SWMU 05-004, naphthalene and 2-methylnaphthalene were not evaluated under the vapor-intrusion pathway. Because these locations are on the canyon slope, they were not included in the vapor-intrusion pathway. VOCs were not associated with operations at SWMU 05-003, and samples from this site were not analyzed for VOCs. Therefore, the vapor-intrusion pathway at SWMU 05-003 is not applicable and was not evaluated. At SWMU 05-005(b), only two VOCs were detected in one sample each at or near the canyon bottom. Therefore, no complete pathway exists for the vapor intrusion at SWMU 05-005(b), and it is not evaluated for this site.

The potential risk from the vapor-intrusion pathway was assessed using the Johnson and Ettinger model (http://www.epa.gov/swerrims/riskassessment/airmodel/johnson_ettinger.htm) for subsurface vapor intrusion into buildings (EPA 2002, 094114). Because only soil data are available, the advanced soil model (SL-ADV-Feb04.xls) was used to calculate risk-based soil concentrations for VOCs at sites, where appropriate. The maximum detected concentration of each VOC was compared with the risk-based concentration generated by the model for each site. The model inputs and risk-based concentrations generated are provided in Attachment I-2. The HQs and hazard indexes (HIs) were calculated for noncarcinogenic COPCs and total excess cancer risks for carcinogenic COPCs. The NMED target cancer risk level of 1×10^{-5} and a target HI of 1 was applied.

I-4.2 Results of the Human Health Risk-Screening Evaluations

The EPC of each COPC was compared with the SSL/SAL for the appropriate scenario. The EPCs for carcinogenic COPCs were divided by the SSL and multiplied by 1×10^{-5}. The sums of the cancer risks were compared with the NMED target cancer risk level of 1×10^{-5} (NMED 2009, 108070). An HQ is generated for each noncarcinogenic COPC by dividing the EPC by the SSL. The HQs were summed to generate a hazard index (HI). The HI was compared with the NMED target HI of 1 (NMED 2009, 108070). The radionuclide EPCs were divided by the SAL and multiplied by 15 mrem/yr. The total doses were compared with the U.S. Department of Energy (DOE) target level of 15 mrem/yr (Soden 2000, 067489). The results of the human health screening evaluations are presented in Tables I-4.2-1 to I-4.2-24.

I-4.2.1 SWMU 05-003

SWMU 05-003 is a former underground calibration chamber located 35 ft bgs. No potential exposure pathways exist, and samples were not collected between 0–1 ft bgs. A risk-screening assessment was not performed for the industrial scenario.

The result of the human health screening evaluation for the residential scenario at SWMU 05-003 is presented in Table I-4.2-1. No carcinogens or radionuclides were retained as COPCs at the site. The HI is 0.04 for the residential scenario, which is below the NMED target HI of 1 (NMED 2009, 108070). The vapor-intrusion pathway was not evaluated for this site.

I-4.2.2 SWMU 05-004

Calcium does not have a published toxicity value, but is among those elements identified in section 5.9.4 of the Risk Assessment Guidance for Superfund (RAGS) (EPA 1989, 008021) as an essential macronutrient. As an essential nutrient, calcium may be compared with the recommended daily allowance (RDA) for adults and children. The RDA is 1200 mg/d of calcium for an adult and 800 mg/d for a child (National Research Council 1989, 064000, pp. 179–181). If all the daily incidental ingestion of soil were to occur at the location of the maximum concentration detected between 0–10 ft at SWMU 05-004 of 2910 mg/kg, at the EPA default adult soil ingestion rate of 100 mg/d of soil, an adult would ingest approximately 0.42 mg/d of calcium. At the intake level of 0.42 mg/d of calcium, the adult's ingestion of calcium is less than the RDA for calcium of 1200 mg/d. If all the daily incidental ingestion of soil were to occur at the location of the maximum concentration detected between 0–10 ft at SWMU 05-004 of 2910 mg/kg, at the EPA default child soil ingestion rate of 200 mg/d of soil, a child would ingest approximately 0.97 mg/d of calcium. At the intake level of 0.97 mg/d of calcium, the child's ingestion of calcium is less than the RDA for calcium of 800 mg/d. Therefore, no adverse health effects are expected from calcium at the site, and calcium is eliminated as a COPC.

The results of the risk-screening assessments for the industrial scenario are presented in Tables I-4.2-2 and I-4.2-3. No carcinogens were retained as COPCs. The HI is 0.02, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the industrial scenario is 0.1 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489).

The results of the risk-screening assessments for the residential scenario are presented in Tables I-4.2-4 to I-4.2-6. The total excess cancer risk is approximately 4×10^{-5}, which is above the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The elevated cancer risk is due to PAHs that were detected adjacent to former building 05-1. The HI is 0.06, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the residential scenario is 0.5 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489).

The result of the residential vapor-intrusion screening assessment is presented in Table I-4.2-7. No carcinogenic VOCs were detected on the mesa-top portion of the site. The HI is approximately 0.000000002, which is less than the NMED target HI of 1. The vapor intrusion HI did not affect the residential HI presented above.

The cancer risk for the residential scenario is from polycyclic aromatic hydrocarbons (PAHs) detected next to former building 05-1. PAHs were not detected below the locations of the former drainlines and septic tank or at the outfall and in the drainage. Therefore, PAHs were not discharged from the building to the septic system. An engineering drawing (LASL 1947, 206411) indicates the access road to building 05-1 was gravel surfaced with one coat of hot oil penetration. This is most likely the source of the PAHs detected next to former building 05-1. Because the PAHs are not related to SWMU 05-004, the residential

cancer risk and HI were recalculated without the PAHs (Tables I-4.2-~~7~~8 and I-4.2-~~8~~9). The total excess cancer risk is approximately 1×10^{-10}, which is below the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The HI is 0.05, which is below the NMED target HI of 1 (NMED 2009, 108070).

I-4.2.3 SWMU 05-005(b)

The dioxin and furan congener toxicity equivalency factor (TEF) calculations for the industrial scenario are presented in Table I-4.2-~~9~~10. The results of the risk-screening assessments for the industrial scenario are presented in Tables I-4.2-1~~0~~1 to I-4.2-13~~2~~. The total excess cancer risk is 1×10^{-8}, which is below the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The HI is 0.0~~2~~3, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the industrial scenario is 0.02 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489).

The dioxin and furan congener TEF calculations for the residential scenario are presented in Table I-4.2-1~~4~~3. The results of the risk-screening assessments for the residential scenario are presented in Tables I-4.2-1~~5~~4 and I-4.2-1~~7~~6. The vapor-intrusion pathway was not evaluated for this site. The total excess cancer risk is 6×10^{-8}, which is below the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The HI is 0.0~~7~~1, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the residential scenario is 0.1 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489).

I-4.2.4 SWMU 05-006(c)

The dioxin and furan congener TEF calculations for the industrial scenario are presented in Table I-4.2-~~17~~18. The results of the risk-screening assessments for the industrial scenario are presented in Tables I-4.2-~~1~~19~~8~~ to I-4.2-20~~1~~. The total excess cancer risk is 1×10^{-8}, which is below the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The HI is 0.2, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the industrial scenario is 0.02 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489).

The dioxin and furan congener TEF calculations for the residential scenario are presented in Table I-4.2-2~~1~~4. The results of the risk-screening assessments for the residential scenario are presented in Tables I-4.2-2~~2~~3 to I-4.2-24~~5~~. The total excess cancer risk is approximately 5×10^{-8}, which is below the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The HI is 0.~~3~~4, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the residential scenario is 0.04 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489).

The results of the residential vapor-intrusion screening assessment are presented in Tables I-4.2-26 and I-4.2-27. The total excess cancer risk is approximately 3×10^{-8}, which is less than the NMED target cancer risk level of 1×10^{-5}. The HI is approximately 0.0004, which is less than the NMED target HI of 1. The addition of the vapor-intrusion cancer risk to the cancer risk presented above results in a total excess cancer risk for the site of 8×10^{-8}, which is less than the NMED target cancer risk level of 1×10^{-5}. The HI above is not affected by the vapor intrusion HI.

~~**I-4.3 Evaluation of Vapor Intrusion**~~

~~The vapor-intrusion indoor air pathway was not evaluated because structures and buildings have been removed, and no buildings will be constructed in the future at TA-05. In addition, VOCs were typically not used at the TA-05 sites, the sites have only a few VOCs detected with concentrations near or below the estimated quantitation limits (EQLs), and detections were sporadic in nature. Given these conditions, a~~

~~VOC plume is not present at any of these sites that would impact the vapor intrusion pathway, and no complete pathway exists for exposure.~~

I-4.43 Uncertainty Analysis

The human health risk-screening assessments are subject to varying degrees and types of uncertainty. Aspects of data evaluation and COPC identification, exposure assessment, toxicity assessment, and the additive approach all contribute to uncertainties in the risk assessment process. Each or all of these uncertainties may affect the evaluation results.

I-4.43.1 Data Evaluation and COPC Identification Process

A primary uncertainty associated with the COPC identification process is the possibility that a chemical may be inappropriately identified as a COPC when it is actually not a COPC or that a chemical may not be identified as a COPC when it actually should be identified as a COPC. Inorganic chemicals are appropriately identified as COPCs because only those chemicals that are either detected or have detection limits above background are retained for further analysis. However, established BVs may not accurately represent certain subunits of the Bandelier Tuff (e.g., fractured, clay-rich material) that may be encountered during sampling because such data are not included in the background data set. Some inorganic chemicals and radionuclides may also have been retained as COPCs that are not site-related. There are no established BVs for organic chemicals; therefore, all detected organic chemicals are identified as COPCs and are retained for further analysis.

Other uncertainties associated with inorganic and organic chemicals may include errors in sampling, laboratory analysis, and data analysis. However, because some concentrations used in the risk-screening assessments are less than EQLs, data evaluation uncertainties are expected to have little effect on the risk-screening results.

I-4.43.2 Exposure Assessment

The following exposure assessment uncertainties were identified for the risk assessment: (1) the applicability of the standard scenarios, (2) the assumptions underlying the exposure pathways, and (3) the derivation of EPCs.

The current and reasonably foreseeable future land use is industrial. To the degree actual activity patterns are not represented by those activities assumed by the industrial scenario, uncertainties are introduced in the assessment, and the evaluation presented in this assessment overestimates potential risk. An individual may be subject to exposures in a different manner than the exposure assumptions used to derive the SSLs. For the site evaluated, individuals are not on-site at present or in the future for that frequency and duration. The industrial assumptions for the SSLs are that the potentially exposed individual is outside on-site for 8 h/d, 225 d/yr, for 25 yr, and the residential SSLs are based on exposure of 24 h/d, 350 d/yr, and 30 yr (NMED 2009, 108070). As a result, the industrial and residential scenarios evaluated at these sites likely overestimate the exposure and risk.

A number of assumptions are made relative to exposure pathways, including input parameters, whether or not a given pathway is complete, the contaminated media to which an individual may be exposed, and intake rates for different routes of exposure. In the absence of site-specific data, the exposure assumptions used were consistent with default values (NMED 2009, 108070). When several upper-bound values (such as those found in NMED guidance [NMED 2009, 108070]) are combined to estimate exposure for any one pathway, the resulting risk can exceed the 99th percentile and, therefore, can exceed the range of risk that may be reasonably expected. Also, the assumption that residual

concentrations of chemicals in the tuff are available and cause exposure in the same manner as if they were in soil overestimates the potential risk to receptors.

Uncertainty is introduced in the concentration aggregation of data for estimating the EPCs at a site. The use of a UCL is intended to provide a protective, upper-bound estimate of the COPC concentration and is assumed to be representative of average exposure to a COPC across the entire site. Potential risk and exposure from a single location or area with relatively high COPC concentrations may be overestimated if a representative, sitewide value is used. The use of the maximum detected concentration for the EPC overestimates the exposure to contamination because receptors are not consistently exposed to the maximum detected concentration across the site.

SWMU 05-004

The total excess cancer risk for the residential scenario is approximately 4×10^{-5}, which is above the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The cancer risk is primarily from PAHs detected next to former building 05-1. The source of the PAHs is most likely the former access road to building 05-1 that was surfaced with a coat of hot oil penetration and not the former septic tank, associated drainlines, and outfall, which comprise the SWMU (section I-4.2-2). Because the PAHs are not site-related, the residential cancer risk and HI were recalculated without the PAHs (section I-4.2-2). The total excess cancer risk is approximately 1×10^{-10}, which is below the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The HI is approximately 0.05, which is below the NMED target HI of 1 (NMED 2009, 108070).

I-4.43.3 Toxicity Assessment

The primary uncertainty associated with the screening values is related to the derivation of toxicity values used in their calculation. Toxicity values (slope factors [SFs] and reference doses [RfDs]) were used to derive the screening values used in this screening evaluation (NMED 2009, 108070). Uncertainties were identified in five areas with respect to the toxicity values: (1) extrapolation from other animals to humans, (2) individual variability in the human population, (3) the derivation of SFs and RfDs, (4) the chemical form of the COPC, and (5) the use of surrogate chemicals.

Extrapolation from Animals to Humans

The SFs and RfDs are often determined by extrapolation from animal data to humans, which may result in uncertainties in toxicity values because differences exist between other animals and humans in chemical absorption, metabolism, excretion, and toxic response. Differences in body weight, surface area, and pharmacokinetic relationships between animals and humans are taken into account to address these uncertainties in the dose-response relationship. However, conservatism is usually incorporated into each of these steps, resulting in the overestimation of potential risk.

Individual Variability in the Human Population

For noncarcinogenic effects, the degree of human variability in physical characteristics is important in determining the risks that can be expected at low exposures and in determining the no observed adverse effect level (NOAEL). The NOAEL uncertainty factor approach incorporates a factor of 10 to reflect the possible interindividual variability in the human population that can contribute to uncertainty in the risk evaluation. This factor of 10 is generally considered to result in a conservative estimate of risk to noncarcinogenic COPCs.

Derivation of SFs and RfDs

The SFs and RfDs for different chemicals are derived from experiments conducted by different laboratories that may have different accuracy and precision that could lead to an over- or underestimation of the risk.

The uncertainty associated with the toxicity factors for noncarcinogens is measured by the uncertainty factor, the modifying factor, and the confidence level. For carcinogens, the weight of evidence classification indicates the likelihood that a contaminant is a human carcinogen. Toxicity values with high uncertainties may change as new information is evaluated.

Chemical Form of the COPC

COPCs may be bound to the environmental matrix and not available for absorption into the human body. However, the exposure scenarios default to the assumption that the COPCs are bioavailable. This assumption can lead to an overestimation of the total risk.

Use of Surrogate Chemicals

The use of surrogates for chemicals that do not have EPA-approved or provisional toxicity values also contributes to uncertainty in risk assessment. Surrogates were used to establish toxicity values for acenaphthylene; benzo[g,h,i]perylene; and 4-isopropyltoluene based on structural similarity (NMED 2003, 081172). The overall impact of surrogates on the risk assessment is minimal because the COPCs were detected at low concentrations, and the HQs were less than 0.1.

I-4.4~~3~~.4 Additive Approach

For noncarcinogens, the effects of exposure to multiple chemicals are generally not known, and possible interactions could be synergistic or antagonistic, resulting in either an over- or underestimation of the potential risk. Additionally, RfDs used in the risk calculations typically are not based on the same endpoints with respect to severity, effects, or target organs. Therefore, the potential for noncarcinogenic effects may be overestimated for individual COPCs that act by different mechanisms and on different target organs but are addressed additively.

I-4.5~~4~~ Interpretation of Human Health Risk-Screening Results

I-4.5~~4~~.1 Interpretation for SWMU 05-003

Industrial Scenario

SWMU 05-003 is a former underground calibration chamber located 35 ft bgs. No potential exposure pathway exists, and samples were not collected between 0–1 ft bgs. A risk-screening assessment was not performed for the industrial scenario.

Residential Scenario

No carcinogens or radionuclides were retained as COPCs from 0–10 ft at the site. The HI is 0.04 for the residential scenario, which is below the NMED target HI of 1 (NMED 2009, 108070).

Based on the risk-screening assessment results, no potential unacceptable risk and dose exist for the industrial and residential scenarios at SWMU 05-003.

I-4.~~5~~5.2 Interpretation for SWMU 05-004

Industrial Scenario

No carcinogens were retained as COPCs from 0–1 ft at the site. The HI is 0.02, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose is 0.1 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489). The total dose is equivalent to a total risk of 1×10^{-6}, based on a comparison with EPA's outdoor worker preliminary remediation goals (PRGs) for radionuclides (http://epa-prgs.ornl.gov/radionuclides/download/rad_master_prg_table_pci.xls).

Residential Scenario

The total excess cancer risk is approximately 4×10^{-5}, which is above the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The HI is approximately 0.06, which is below the NMED target HI of 1 (NMED 2009, 108070). The residential HI includes the contribution from the vapor-intrusion pathway. The total dose is 0.5 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489). The total dose is equivalent to a total risk of 2×10^{-6}, based on a comparison with EPA's residential PRGs for radionuclides (http://epa-prgs.ornl.gov/radionuclides/download/rad_master_prg_table_pci.xls).

The cancer risk for the residential scenario is due to PAHs that are not site-related (section I-4.2-2). Therefore, the residential carcinogenic and noncarcinogenic screening evaluations were subsequently conducted without the PAHs. The total excess cancer risk is approximately 1×10^{-10}, and the HI is approximately 0.05, which are below the NMED target levels (NMED 2009, 108070).

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial and residential scenarios at SWMU 05-004.

I-4.~~4~~5.3 Interpretation for SWMU 05-005(b)

Industrial Scenario

The total excess cancer risk is 1×10^{-8}, which is below the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The HI is 0.0~~2~~3, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the industrial scenario is 0.02 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489). The total dose is equivalent to a total risk of 6×10^{-9}, based on a comparison with EPA's outdoor worker PRGs for radionuclides (http://epa-prgs.ornl.gov/radionuclides/download/rad_master_prg_table_pci.xls).

Residential Scenario

The total excess cancer risk is 6×10^{-8}, which is below the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The HI is 0.~~1~~07, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the residential scenario is 0.1 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489). The total dose is equivalent to a total risk of 3×10^{-8} based on a comparison with EPA's residential PRGs for radionuclides (http://epa-prgs.ornl.gov/radionuclides/download/rad_master_prg_table_pci.xls).

Based on the risk-screening assessment results, no potential unacceptable risk and dose exist for the industrial and residential scenarios at SWMU 05-005(b).

I-4.~~5~~4.4 Interpretation for SWMU 05-006(c)

Industrial Scenario

The total excess cancer risk is 1×10^{-8}, which is below the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The HI is 0.2, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the industrial scenario is 0.02 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489). The total dose is equivalent to a total risk of 3×10^{-9}, based on a comparison with EPA's outdoor worker PRGs for radionuclides (http://epa-prgs.ornl.gov/radionuclides/download/rad_master_prg_table_pci.xls).

Residential Scenario

The total excess cancer risk is approximately 8~~5~~ $\times 10^{-8}$, which is below the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The HI is 0.3~~4~~, which is below the NMED target HI of 1 (NMED 2009, 108070). The residential cancer risk and HI includes the contribution from the vapor-intrusion pathway. The total dose for the residential scenario is 0.04 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489). The total dose is equivalent to a total risk of 1×10^{-8}, based on a comparison with EPA's residential PRGs for radionuclides (http://epa-prgs.ornl.gov/radionuclides/download/rad_master_prg_table_pci.xls).

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial and residential scenarios at SWMU 05-006(c).

I-5.0 ECOLOGICAL RISK-SCREENING ASSESSMENT

The approach for conducting ecological risk-screening assessments is described in the "Screening Level Ecological Risk Assessment Methods, Revision 2" (LANL 2004, 087630). The assessment consists of the following four parts: (1) a scoping evaluation, (2) a screening evaluation, (3) an uncertainty analysis, and (4) an interpretation of the results.

I-5.1 Scoping Evaluation

The scoping evaluation establishes the breadth and focus of the screening assessment. The ecological scoping checklists for the four sites evaluated within this aggregate area are useful tools for organizing existing ecological information (Attachment I-2). The information in the scoping checklists is used to determine whether ecological receptors may be affected, identify the types of receptors that may be present, and develop the ecological conceptual site model for each site. The sites are in industrially developed areas.

The scoping portion of the assessment indicated that terrestrial receptors were appropriate for evaluating the concentrations of contaminants in soil and tuff samples. Aquatic receptors were not evaluated because no aquatic communities and no aquatic habitat or perennial source of water exist at any of the sites evaluated. The potential exposure pathways for terrestrial receptors in soil and tuff are root uptake, inhalation, soil ingestion, dermal contact, external irradiation, and food-web transport (Figure I-3.1-1). The weathering of tuff is the only viable natural process that may result in the exposure of receptors to contaminants in tuff. Because of the slow rate of weathering expected for tuff, exposure in tuff is negligible, although it is included in the assessment. Plant exposure in tuff is largely limited to fractures near the surface, which does not produce sufficient biomass to support an herbivore population. Consequently, the contaminants in tuff are not available to receptors.

The potential risk was evaluated in the risk-screening assessments for the following ecological receptors representing several trophic levels:

- a plant,
- soil-dwelling invertebrates (represented by the earthworm),
- the deer mouse (mammalian omnivore),
- the Montane shrew (mammalian insectivore),
- the desert cottontail (mammalian herbivore),
- the red fox (mammalian carnivore),
- the American robin (avian insectivore, avian omnivore, and avian herbivore), and
- the American kestrel (avian intermediate carnivore and avian carnivore (surrogate for threatened and endangered [T&E] species).

The rationale for these receptors is presented in "Screening-Level Ecological Risk Assessment Methods, Revision 2" (LANL 2004, 087630). The ecological screening levels (ESLs) are derived for each of these receptors where information was available. The ESLs are based on similar species and are derived from experimentally determined NOAELs, lowest observed adverse effect levels (LOAELs), or doses determined lethal to 50% of the test population. Information relevant to the calculation of ESLs, including concentration equations, dose equations, bioconcentration factors, transfer factors, and toxicity reference values (TRVs), are presented in the ECORISK Database, Release 2.5 (LANL 2010, 110846).

I-5.2 Assessment Endpoints

An assessment endpoint is an explicit expression of the environmental value to be protected. These endpoints are ecologically relevant and help sustain the natural structure, function, and biodiversity of an ecosystem or its components (EPA 1998, 062809). In a screening-level assessment, assessment endpoints are attributes of ecological receptors that may be adversely affected by exposure to hazardous wastes from past operations (EPA 1997, 059370), wherein receptors are populations and communities (EPA 1999, 070086).

The ecological screening assessment is designed to protect populations and communities of biota rather than individual organisms, except for listed or candidate T&E species or treaty-protected species (EPA 1999, 070086). The protection of individual organisms within these designated protected species could also be achieved at the population level; the populations of these species tend to be small, and the loss of an individual adversely affects the species.

In accordance with this guidance, the Laboratory developed generic assessment endpoints to ensure that values at all levels of the food chain are considered in the ecological screening process (LANL 1999, 064137). These general assessment endpoints can be measured using impacts on reproduction, growth, and survival to represent categories of effects that may adversely impact populations. In addition, specific receptor species were chosen to represent each functional group. The receptor species were chosen because of their presence at the site, their sensitivity to the COPCs, and their potential for exposure to those COPCs. These categories of effects and the chosen receptor species were used to select the types of effects seen in toxicity studies considered in the development of the TRVs. Toxicity studies used in the development of TRVs included only those in which the evaluated adverse effect affected reproduction, survival, and/or growth.

The selection of receptors and assessment endpoints is designed to be protective of both the representative species used as screening receptors and the other species within their feeding guilds and the overall food web for the terrestrial and aquatic ecosystems. Focusing the assessment endpoints on the general characteristics of species that affect populations (rather than the biochemical and behavioral changes that may affect only the studied species) also ensures applicability to the ecosystem of concern.

I-5.3 Screening Evaluation

The ecological risk-screening assessments identify chemicals of potential ecological concern (COPECs) based on the comparison of EPCs with ESLs in accordance with Laboratory guidance (LANL 2004, 087630). The EPCs are presented in Tables I-2.2-3, I-2.2-6, and I-2.2-9. The ESLs for all COPCs and receptors evaluated were obtained from the ECORISK Database, Release 2.5 (LANL 2010, 110846) and are presented in Table I-5.3-1.

The risk-screening assessments involve the calculation of HQs for all COPECs and all screening receptors (LANL 2004, 087630). The HQs are the ratios of the EPCs (UCLs, maximum detected concentrations, or maximum detection limits) to the ESLs. The analysis begins with a comparison of the minimum ESL with the EPC for each COPC. The COPCs with HQs greater than 0.3 are identified as COPECs and are evaluated further. The COPECs are evaluated by receptor with individual HQs for a receptor summed to produce an HI. For the purposes of the ecological screening, it is assumed nonradionuclides have common toxicological effects. An HI greater than 1 requires further assessment to determine if exposure to multiple COPECs results in potential adverse impacts to a given receptor population. The HQ and HI analysis is a conservative indication of potential adverse effects and is designed to minimize the potential of overlooking possible COPECs at the site. COPCs without ESLs are retained as COPECs and are evaluated further in the uncertainty section.

I-5.3.1 SWMU 05-003

The ecological scoping checklist for SWMU 05-003 is provided in Attachment I-2. SWMU 05-003 is located in a former industrial area that is currently not in use. The area provides some habitat for ecological receptors. However, samples were collected below 5 ft bgs, and no potential exposure pathways to terrestrial receptors exist. Therefore, an ecological risk screening assessment was not performed at SWMU 05-003.

I-5.3.2 SWMU 05-004

The results of the minimum ESL comparisons are presented in Table I-5.3-2. Antimony, cadmium, lead, selenium, acenaphthene, and benzoic acid have HQs greater than 0.3 and are retained as COPECs.

Table I-5.3-3 presents the HQs and HIs for each receptor/COPEC at SWMU 05-004. The HI analysis indicates that the robin (insectivore), shrew, deer mouse, and plant have HIs greater than 1.

Nitrate and perchlorate do not have ESLs for any receptors. As a result, nitrate and perchlorate are retained as COPECs and discussed in the uncertainty section.

I-5.3.3 SWMU 05-005(b)

The dioxin and furan congener TEF calculations for the ecological receptors are presented in Table I-5.3-4. The results of the minimum ESL comparisons are presented in Table I-5.3-5. Antimony, cadmium, chromium, lead, nickel, selenium, benzoic acid, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and 2,3,7,8-TCDD have HQs greater than 0.3 and are retained as COPECs.

Table I-5.3-6 presents the HQs and HIs for each receptor/COPEC at SWMU 05-005(b). The HI analysis indicates all receptors, except the red fox and cottontail, have HIs greater than 1.

Perchlorate does not have ESLs for any receptors. As a result, perchlorate is retained as a COPEC and discussed in the uncertainty section.

I-5.3.4 SWMU 05-006(c)

The dioxin and furan congener TEF calculations for the ecological receptors are presented in Table I-5.3-7. The results of the minimum ESL comparisons are presented in Table I-5.3-8. Antimony, chromium, copper, lead, nickel, selenium, and 2,3,7,8-TCDD have HQs greater than 0.3 and are retained as COPECs.

Table I-5.3-9 presents the HQs and HIs for each receptor/COPEC at SWMU 05-006(c). The HI analysis indicates all receptors, except the red fox and kestrel (top carnivore), have HIs greater than 1 and are discussed in the uncertainty analysis.

I-5.4 Uncertainty Analysis

The uncertainty analysis describes the key sources of uncertainty related to the screening evaluations. This analysis can result in either adding or removing chemicals from the list of COPECs. The following is a qualitative uncertainty analysis of the issues relevant to evaluating potential ecological risk at each site.

I-5.4.1 Chemical Form

The assumptions used in the ESL derivations are conservative and not necessarily representative of actual conditions. These assumptions include maximum chemical bioavailability, maximum receptor ingestion rates, minimum bodyweight, and additive effects of multiple COPECs. These factors tend to result in conservative ESL estimates, which may lead to an overestimation of the potential risk. The assumption of additive effects for multiple COPECs may result in an over- or underestimation of the potential risk to receptors.

The chemical form of the individual COPCs was not determined as part of the investigation. Toxicological data are typically based on the most toxic and bioavailable chemical species, which are not typically found in the environment. Inorganic, organic, and radionuclide COPECs are generally not 100% bioavailable to receptors in the natural environment because of interference from other natural processes, such as the adsorption of chemical constituents to matrix surfaces (e.g., soil) or rapid oxidation or reduction changes that render harmful chemical forms unavailable to biotic processes. The ESLs were calculated to ensure a conservative indication of potential risk (LANL 2004, 087630), and the values are biased toward overestimating the potential risk to receptors.

I-5.4.2 Exposure Assumptions

The EPCs used in the HQ calculations are UCLs, maximum detected concentrations, or maximum detection limits in the soil, fill, or tuff to depths of 5 ft bgs and are conservative estimates of exposure to each COPEC. The sampling efforts focused on areas of known contamination, and receptors were assumed to ingest 100% of their food and spend 100% of their time at the site. These exposure assumptions for terrestrial receptors in the Lower Mortandad/Cedro Canyons Aggregate Area are likely to overestimate potential ecological exposure and risk.

I-5.4.3 Toxicity Values

The HQs were calculated using ESLs, which are based on NOAELs as threshold effect levels; actual risk for a given COPEC/receptor combination occurs at a higher level, somewhere between the NOAEL-based threshold and the threshold based on the LOAEL. The use of NOAELs leads to an overestimation of potential risk to ecological receptors. ESLs are based on laboratory studies requiring extrapolation to wildlife receptors. Laboratory studies are typically based on artificial and maintained populations with genetically similar individuals and are limited to single chemical exposures in isolated and controlled conditions using a single exposure pathway. Wild species are concomitantly exposed to a variety of chemical and environmental stressors, potentially rendering them more susceptible to chemical stress. On the other hand, wild populations are probably more genetically diverse than laboratory populations, making wild populations, as a whole, less sensitive to chemical exposure than laboratory populations. The uncertainties associated with the ESLs tend to lead to an overestimation of potential risk.

I-5.4.4 Comparison with Background Concentrations

Although inorganic chemicals have been identified as COPCs, a reevaluation of some of the inorganic COPCs is warranted because the EPCs for the depth interval of 0 to 5 ft bgs are maximum detected concentrations or maximum detection limits. The comparison of these EPCs with the range of background concentrations indicates some concentrations were similar to background, and no potential risk exists from exposure. This relationship is presented in Tables I-5.4-1 to I-5.4-3.

SWMU 05-004

The ecological screening assessment for this site is based on the exposure of ecological receptors to contamination to a depth of 5 ft bgs. The EPCs for antimony and selenium are the maximum detected concentrations from 0 to 5 ft bgs (Table I-2.2-3). Antimony and selenium are eliminated as COPECs because their EPCs are similar to background concentrations (Table I-5.4-1).

SWMU 05-005(b)

The ecological screening assessment for this site is based on the exposure of ecological receptors to contamination to a depth of 5 ft bgs. The EPCs for antimony, cadmium, and selenium are the maximum detected concentration or maximum detection limits (no detected concentrations) from 0 to 5 ft bgs (Table I-2.2-6). Antimony, cadmium, and selenium are eliminated as COPECs because their EPCs are similar to background concentrations (Table I-5.4-2).

SWMU 05-006(c)

The ecological screening assessment for this site is based on the exposure of ecological receptors to contamination to a depth of 5 ft bgs. The EPCs for antimony and selenium are the maximum detected concentrations from 0 to 5 ft bgs (Table I-2.2-9). Antimony is retained as a COPEC because it is different from background concentrations, while selenium is eliminated as a COPEC because the EPC is similar to background concentrations (Table I-5.4-3).~~Although concentrations of inorganic chemicals were detected above background, the UCLs for some inorganic chemicals were similar to the range of background concentrations, indicating no potential risk from exposure across the site. This relationship is presented in Tables I-5.4-1 to I-5.4-3. The UCL is intended to represent the average concentration of a contaminant and the reasonable maximum exposure (RME) over time for a receptor at a site. The RME is the maximum exposure that is reasonably expected to occur at a site and represents the average concentration that is contacted over the exposure period. Although the RME concentration does not~~

~~reflect the maximum concentration that could be contacted at any one time, it is regarded as a reasonable estimate of the concentration that could be contacted over time. This is because an assumption of long-term contact with the maximum concentration is generally not reasonable. If the EPCs are similar to the range of background concentrations, then the receptor is exposed to an average concentration, which is comparable with naturally occurring levels across the site. Whether some concentrations are elevated and reflect site releases is incorporated into the UCL calculations. If the EPC is similar to the range of background concentrations, the RME across the site is indistinguishable from background. For example, if the chromium EPC is 15 mg/kg and the ranges of background concentrations are 1.9 to 36.5 mg/kg for soil and 0.25 mg/kg to 13 mg/kg for Qbt 2, 3, 4, the EPC is not a true reflection of potential toxicity. It is also an indication that site concentrations are not substantially different from background concentrations. Therefore, a conclusion that inorganic chemicals with EPCs similar to the range of background concentrations are contributing risk overestimates the potential risk and does not reflect actual exposure and risk.~~

~~**SWMU 05-004**~~

~~The ecological screening assessment for this site is based on the exposure of ecological receptors to contamination to a depth of 5 ft bgs. The EPCs for all the inorganic COPECs are similar to the range of background concentrations, indicating exposure to these inorganic chemicals across the site is similar to background (Table I-5.4-1). Antimony, cadmium, lead, and selenium are eliminated as COPECs because their EPCs are similar to the range of background concentrations.~~

~~**SWMU 05-005(b)**~~

~~The ecological screening assessment for this site is based on the exposure of ecological receptors to contamination to a depth of 5 ft bgs. The EPCs for all the inorganic COPECs are similar to the range of background concentrations, indicating exposure to these inorganic chemicals across the site is similar to background (Table I-5.4-2). Antimony, cadmium, chromium, lead, nickel, and selenium are eliminated as COPECs because their EPCs are similar to the range of background concentrations.~~

~~**SWMU 05-006(c)**~~

~~The ecological screening assessment for this site is based on the exposure of ecological receptors to contamination to a depth of 5 ft bgs. The EPCs for some of the inorganic COPECs are similar to the range of background concentrations, indicating exposure to these inorganic chemicals across the site is similar to background (Table I-5.4-3). Chromium, nickel, and selenium are eliminated as COPECs because their EPCs are similar to the range of background concentrations. Antimony, copper, and lead are retained as COPECs.~~

I-5.4.5 Area Use Factors

In addition to the direct comparison of the EPC with the ESLs, area use factors (AUFs) are used to account for the amount of time that a receptor is likely to spend within the contaminated areas based on the size of the receptor's home range (HR). The AUFs for individual organisms were developed by dividing the size of the site by the HR for that receptor. Because T&E species must be assessed on an individual basis (EPA 1999, 070086), the AUF is used for the Mexican spotted owl based on an HR of 366 ha. The kestrel (top carnivore) is used as the surrogate receptor for the Mexican spotted owl.

The site area for SWMU 05-004 is 0.0~~03~~16 ha, which results in an AUF of 0.0000~~07~~4 for the Mexican spotted owl (Table I-5.4-4). The unadjusted HI for the kestrel (top carnivore) is 0.02 (Table I-5.3-3).

Application of the AUF for the Mexican spotted owl to the HI for the kestrel (top carnivore) results in an adjusted HI 0.000000~~0~~18. Therefore, there are no potential adverse impacts to the Mexican spotted owl.

The site area for SWMU 05-005(b) is 0.0~~13~~18 ha, which results in an AUF of 0.0000~~3~~5 for the Mexican spotted owl (Table I-5.4-4). The unadjusted HI for the kestrel (top carnivore) is 9 (Table I-5.3-6). Application of the AUF for the Mexican spotted owl to the HI for the kestrel (top carnivore) results in an adjusted HI of 0.000~~3~~5. Therefore, there are no potential adverse impacts to the Mexican spotted owl.

The site area for SWMU 05-006(c) is 0.00~~1~~6 ha, which results in an AUF of 0.0000~~03~~2 for the Mexican spotted owl (Table I-5.4-4). The unadjusted HI for the kestrel (top carnivore) is 0.2 (Table I-5.3-9). Application of the AUF for the Mexican spotted owl to the HI for the kestrel (top carnivore) results in an adjusted HI of 0.00000~~0~~64. Therefore, there are no potential adverse impacts to the Mexican spotted owl.

I-5.4.6 Population Area Use Factors

EPA guidance is to manage the ecological risk to populations rather than to individuals, with the exception of T&E species (EPA 1999, 070086). One approach to address the potential effects on populations is to estimate the spatial extent of the area inhabited by the local population that overlaps with the contaminated area. The population area for each receptor is based on the individual receptor HR and its dispersal distance (Bowman et al. 2002, 073475). Bowman et al. (2002, 073475) estimate that the median dispersal distance for mammals is 7 times the linear dimension of the HR (i.e., the square root of the HR area). If only the dispersal distances for the mammals with HRs within the range of the screening receptors are used, the median dispersal distance becomes 3.6 times the square root of the HR (R^2=0.91) (Bowman et al. 2002, 073475). If it is assumed that the receptors can disperse over the same distance in any direction, the population area is circular and the dispersal distance is the radius of the circle. Therefore, the population area for each receptor can be derived by $\pi(3.6\sqrt{HR})^2$ or approximately 40HR.

The population area use factor (PAUF) is calculated by dividing the site area by the population area of the receptor. The PAUFs for the sites are presented in Table I-5.4-4. The HQs are recalculated minus the COPECs eliminated based on similarity to background (section I-5.4.4) and adjusted by multiplying by the PAUFs. If the PAUF is greater than 1, the HQs are not adjusted for that receptor. The HQs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs. The adjusted HIs are presented in Tables I-5.4-5 to I-5.4-7.

I-5.4.7 LOAEL Analysis

SWMUs 05-005(b) and 05-006(c) ha~~s~~ve ~~an~~ HIs greater than 1 for the earthworm and plant (Tables I-5.4-6 and I-5.4-7). To address the HIs and reduce the associated uncertainty~~ies~~, ~~a~~ LOAEL analysi~~e~~s w~~as~~ere conducted using ESLs calculated based on a LOAEL rather than a NOAEL. The LOAEL-based ESLs were calculated based on toxicity information in the ECORISK Database, Release 2.5 (LANL 2010, 110846) and are presented in Table I-5.4-8, along with the basis for each LOAEL used in the ESL calculations. The analysi~~e~~s addresses~~s~~ some of the uncertainties and conservativeness of the ESLs used in the initial screening assessments. ~~The HI analysis was conducted using the LOAEL-based ESLs.~~

I-5.4.8 Site Discussions

SWMU 05-005(b)

The adjusted HIs for SWMU 05-005(b) (Table I-5.4-6) are less than 1 for the kestrel (intermediate and top carnivore); robin (herbivore, omnivore, and insectivore); cottontail; deer mouse; montane shrew; and red fox. The adjusted HIs are greater than 1 for the earthworm and plant, with chromium being the primary COPEC. The LOAEL analysis results in HQs of 0.6 for the earthworm and approximately 1 for the plant (Table I-5.4-9). The LOAEL-based chromium ESL for the plant (12 mg/kg) is less than the maximum Qbt 2,3,4 background concentration (13 mg/kg), indicating the potential ecological risk to the plant is overestimated. In addition, the chromium HQs are not different from the HQs associated with naturally occurring concentrations of chromium.

Field observations made during the site visit found no indication of adverse effects on the plant community (Attachment I-3). Field observations indicated no adverse effects of any kind, and the ecological habitat for all terrestrial receptors, including plants, invertebrates, birds, and mammals, appears to be functioning. Therefore, the HI is not consistent with field observations and does not indicate potential risk to the receptor.

SWMU 05-006(c)

The adjusted HIs for SWMU 05-006(c) (Table I-5.4-7) are less than 1 for the kestrel (intermediate and top carnivore); robin (herbivore, omnivore, and insectivore); cottontail; deer mouse; montane shrew; and red fox. The adjusted HIs are greater than 1 for the earthworm and plant, with chromium being the primary COPEC for the earthworm, and antimony and chromium being the primary COPECs for the plant. The antimony EPC of 2.3 mg/kg is the maximum detected concentration (Table I-2.2-9). Instead of using the maximum detected concentration as the EPC, a 95% UCL of 0.887 mg/kg was calculated using ProUCL (Attachment I-1). The LOAEL analysis using the 95% UCL results in an HQ of 1.8 for antimony for the plant (Table I-5.4-10). The LOAEL-based antimony ESL for the plant (0.5 mg/kg) is equivalent to the Qbt 3 BV (0.5 mg/kg) and less than the maximum soil background concentration (1 mg/kg), indicating the potential ecological risk to the plant is overestimated. The antimony HQ is also not different from an HQ associated with naturally occurring concentrations of antimony. In addition, the LOAEL-based chromium ESLs for the earthworm (23 mg/kg) and the plant (12 mg/kg) are less than less than the maximum soil background concentration (36.5 mg/kg) and the maximum Qbt 2,3,4 background concentration (13 mg/kg), respectively, indicating the potential ecological risks to the earthworm and plant are overestimated.

Field observations made during the site visit found no indication of adverse effects on the plant community (Attachment I-3). Field observations indicated no adverse effects of any kind, and the ecological habitat for all terrestrial receptors, including plants, invertebrates, birds, and mammals, appears to be functioning. Therefore, the HIs are not consistent with field observations and do not indicate potential risk to these receptors.~~**SWMU 05-006(c)**~~

~~The adjusted HIs for SWMU 05-006(c) (Table I-5.4-7) are less than 1 for the kestrel (intermediate and top carnivore); robin (herbivore, omnivore, and insectivore); cottontail; deer mouse; Montane shrew; red fox, and earthworm. The adjusted HI is greater than 1 for the plant with antimony being the primary COPEC. The antimony EPC of 2.3 mg/kg is the maximum detected concentration (Table I-2.2-9). Instead of using the maximum detected concentration as the EPC, a 95% UCL of 0.887 mg/kg was calculated using ProUCL (Attachment I-1). The LOAEL analysis using the 95% UCL results in an HQ of 1.8 for antimony and an HI of 2 for the plant (Table I-5.4-9). The LOAEL-based ESL of antimony for the plant is equivalent~~

~~to the Qbt 3 BV (both 0.5 mg/kg) and less than the maximum soil background concentration (1 mg/kg), indicating the potential ecological risk to the plant is overestimated. Therefore, the 95% UCL is within the range of soil background concentrations, indicating exposure of the plant to antimony across the site is similar to background.~~

~~Field observations made during the site visit found no indication of adverse effects on the plant community (Attachment I-2). Field observations indicated no adverse effects of any kind, and there appears to be a functioning ecological habitat for all terrestrial receptors, including plants, invertebrates, birds, and mammals. Therefore, the HI is not consistent with field observations and does not indicate potential risk to these receptors.~~

I-5.4.9 COPECs without ESLs

Several COPECs do not have ESLs for any receptor in release 2.5 of the ECORISK Database (LANL 2010, 110846) because literature searches for relevant toxicity data for these chemicals have not been completed. In an effort to address this uncertainty and provide a quantitative assessment of potential ecological risk, several online toxicity databases have been searched to determine if any relevant toxicity information is available. The online databases searched were EPA Ecotox Database, EPA Office of Pesticide Programs Aquatic Life Benchmarks, U.S. Army Corps of Engineers/EPA Environmental Residue-Effects, California Cal/Ecotox Database, Pesticide Action Network Pesticide Database, U.S. Army Wildlife Toxicity Assessment Program, USDA Integrated Pesticide Management Database, American Bird Conservancy Pesticide Toxicity Database, and Oak Ridge National Laboratory Risk Assessment Information System. Toxicity data were obtained for several COPECs and receptors as a result of this online database search. However, several COPECs did not have any relevant toxicity data in the online databases listed above.

In the absence of a chemical-specific ESL, COPEC concentrations can be compared with the ESLs for a surrogate chemical. Comparison to surrogate ESLs provides an estimate of potential effects of a chemically related compound and a line of evidence to indicate the likelihood that ecological receptors are potentially impacted.

Some COPECs without ESLs do not have chemical-specific toxicity data or surrogate chemicals to be used in the screening assessments and cannot be assessed quantitatively for potential ecological risk. These COPECs are often infrequently detected across the site. In these cases, comparisons to residential human health SSLs are presented as part of a qualitative assessment. The comparison of COPEC concentrations to residential human health SSLs is a viable alternative for several reasons. Animal studies are used to infer effects on humans and is the basic premise of modern toxicology (EPA 1989, 008021). In addition, toxicity values derived for the calculation of human health SSLs are often based on potential effects that are more sensitive than the ones used to derive ESLs (e.g., cellular effects for humans versus survival or reproductive effects for terrestrial animals). The EPA also applies uncertainty factors or modifying factors to ensure the toxicity values are protective (i.e., they are adjusted by uncertainty factors to values much lower than the study results). COPEC concentrations compared with these values are an order of magnitude or more below the SSLs, which corresponds to uncertainty factors of 10 or more. Therefore, it is assumed the differences in toxicity would not be more than an order of magnitude for any given chemical. The relative difference between values provides a weight of evidence that the potential toxicity of the COPC is likely to be low or very low to the receptor(s).

I-5.4.9.1 SWMU 05-004

No ESLs are available in the ECORISK Database, Release 2.5 (LANL 2010, 110846) for nitrate and perchlorate. In addition, no toxicity data were found as a result of the online database searches.

Nitrate was detected in 26 samples with a maximum concentration of 71.8 mg/kg. The NMED residential SSL for nitrate is 125,000 mg/kg, indicating that potential toxicity is low. Because of the potential low toxicity, nitrate is eliminated as a COPEC.

Perchlorate was detected in eight samples with a maximum concentration of 0.00346 mg/kg. The NMED residential SSL for perchlorate is 54.8 mg/kg, indicating that potential toxicity is low. Because of the potential low toxicity, perchlorate is eliminated as a COPEC.

I-5.4.9.2 SWMU 05-005(b)

No ESL is available in the ECORISK Database, Release 2.5 (LANL 2010, 110846) for perchlorate. In addition, no toxicity data were found as a result of the online database searches.

Perchlorate was detected in six samples with a maximum detected concentration of 0.00107 mg/kg. The NMED residential SSL for perchlorate is 54.8 mg/kg, indicating that potential toxicity is low. Because of the potential low toxicity, perchlorate is eliminated as a COPEC.

I-5.5 Interpretation of Ecological Risk-Screening Results

I-5.5.1 Receptor Lines of Evidence

Based on the ecological risk-screening assessments, several COPECs were identified at SWMUs 05-004, 05-005(b), and 05-006(c). Receptors were evaluated using several lines of evidence: minimum ESL comparisons, HI analyses, comparison with background concentrations, potential effects to populations (individuals for T&E species), and LOAEL analysis.

Red Fox (Carnivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the red fox, were less than 0.3.
- The HI analysis indicated that the HI for the red fox was less than 1 at all three sites.

These lines of evidence support the conclusion that no potential ecological risk to the red fox exists at SWMUs 05-004, 05-005(b), and 05-006(c).

Kestrel (Top Carnivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the kestrel (top carnivore), were less than 0.3.
- The HI analysis indicated that the HIs for the kestrel (top carnivore) were less than 1 at SWMUs 05-004 and 05-006(c).
- Several COPECs were eliminated because their EPCs were similar to background concentrations.
- The HI for SWMU 05-005(b) was adjusted by the PAUF, which is the ratio of the site area to the kestrel's population area. The adjusted HI was less than 1 for the kestrel (top carnivore).
- The kestrel (top carnivore) is a surrogate for the Mexican spotted owl. The HIs were adjusted by the AUF, which is the ratio of the site area to the individual HR. The AUF-adjusted HIs were less than 1 at all three sites.

These lines of evidence support the conclusion that no potential ecological risk to the kestrel (top carnivore) or the Mexican spotted owl exists at SWMUs 05-004, 05-005(b), and 05-006(c).

Kestrel (Intermediate Carnivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the kestrel, were less than 0.3.
- The HI analysis indicated that the HI for the kestrel (top carnivore) was less than 1 at SWMU 05-004.
- Several COPECs were eliminated because their EPCs were similar to background concentrations.
- The HIs for SWMUs 05-005(b) and 05-006(c) were adjusted by the PAUFs, which is the ratio of the site area to the kestrel's population area. The adjusted HIs were less than 1 for the kestrel (intermediate carnivore).

These lines of evidence support the conclusion that no potential ecological risk to the kestrel (intermediate carnivore) exists at SWMUs 05-004, 05-005(b), and 05-006(c).

Robin (Herbivore, Omnivore, Insectivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the robin (herbivore, omnivore, insectivore), were less than 0.3.
- The HI analysis indicated that the HI for the robin (herbivore) was less than 1 at SWMU 05-004.
- Several COPECs were eliminated because their EPCs were similar to background concentrations.
- The HIs were adjusted by the PAUFs, which is the ratio of the site area to the robin's population area. The adjusted HIs were less than 1 for the robin (herbivore, omnivore, insectivore).

These lines of evidence support the conclusion that no potential ecological risk to the robin (herbivore, omnivore, insectivore) exists at SWMUs 05-004, 05-005(b), and 05-006(c).

Deer Mouse (Omnivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the deer mouse, were less than 0.3.
- Several COPECs were eliminated because their EPCs were similar to background concentrations.
- The HIs were adjusted by the PAUF, which is the ratio of the site area to the deer mouse's population area. The adjusted HI was less than 1 for the deer mouse at all three sites.

These lines of evidence support the conclusion that no potential ecological risk to the deer mouse exists at SWMUs 05-004, 05-005(b), and 05-006(c).

Desert Cottontail (Herbivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the cottontail, were less than 0.3.

- The HI analysis indicated that the HI for the cottontail was less than 1 at SWMU 05-004 and equivalent to 1 at SWMU 05-005(b).
- Several COPECs were eliminated because their EPCs were similar to background concentrations.
- The HI for SWMU 05-006(c) was adjusted by the PAUF, which is the ratio of the site area to the cottontail's population area. The adjusted HI was less than 1 for the cottontail.

These lines of evidence support the conclusion that no potential ecological risk to the cottontail exists at SWMUs 05-004, 05-005(b), and 05-006(c).

Montane Shrew (Insectivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the shrew, were less than 0.3.
- Several COPECs were eliminated because their EPCs were similar to background concentrations.
- The HIs were adjusted by the PAUFs, which is the ratio of the site area to the shrew's population area. The adjusted HI was less than 1 for the shrew at all three sites.

These lines of evidence support the conclusion that no potential ecological risk to the Montane shrew exists at SWMUs 05-004, 05-005(b), and 05-006(c).

Earthworm (Invertebrate)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the earthworm, were less than 0.3.
- The HI analysis indicated that the HI for the earthworm was less than 1 at SWMU 05-004.
- Several COPECs were eliminated because their EPCs were similar to background concentrations.
- A LOAEL analysis conducted resulted in an HI less than 1 at SWMU 05-005(b) and an HI of approximately 2 at SWMU 05-006(c). The LOAEL-based chromium ESL for the earthworm (23 mg/kg) is less than less than the maximum soil background concentration (36.5 mg/kg), indicating the potential ecological risk to the earthworm is overestimated. In addition, the chromium HQs are not different from HQs associated with naturally occurring concentrations of chromium.~~This results in the HIs being less than 1 for the earthworm at SWMUs 05-005(b) and 05-006(c).~~

These lines of evidence support the conclusion that no potential ecological risk to the earthworm exists at SWMUs 05-004, 05-005(b), and 05-006(c).

Plant

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the plant, were less than 0.3.
- Several COPECs were eliminated because their EPCs were similar to background concentrations.

- The adjusted HIs for the plant at SWMUs 05-004 and 05-005(b) werewas less than 1.
- A LOAEL analysis conducted resulted in an HQ of approximately 1 for the plant at SWMU 05-005(b). The LOAEL-based chromium ESL for the plant (12 mg/kg) is less than the maximum Qbt 2,3,4 background concentration (13 mg/kg), indicating the potential ecological risk to the plant is overestimated. In addition, the chromium HQs are not different from HQs associated with naturally occurring concentrations of chromium.
- For the LOAEL analysis at SWMU 05-006(c), Aa 95% UCL was calculated for antimony at SWMU 05-006(c). A LOAEL analysis was conducted using the 95% UCL, which resulted in an HQ of 1.8 for antimony and an HI of approximately 2. The LOAEL-based antimony ESL for the plant (0.5 mg/kg) is equivalent to the Qbt 3 BV (0.5 mg/kg) and is less than the maximum soil background concentration (1 mg/kg), indicating the potential ecological risk to the plant is overestimated. In addition, the LOAEL-based chromium ESL for the plant (12 mg/kg) is less than the maximum soil background concentration (36.5 mg/kg) and the maximum Qbt 2,3,4 background concentration (13 mg/kg), respectively, indicating the potential ecological risk to the plant is overestimated.The 95% UCL for antimony is similar to the range of background concentrations, indicating exposure of plant to antimony across the site is similar to background.
- The plant communities were evaluated at all sites during site visits. No evidence of adverse impacts of contamination to the plant community based on field observations was found during site visits; the plant community is typical of the surrounding area and appears healthy. Field observations indicated no adverse effects of any kind, and there appears to be functioning ecological habitat for all terrestrial receptors, including plants, invertebrates, birds, and mammals.

These lines of evidence support the conclusion that no potential ecological risk to the plant exists at SWMUs 05-004, 05-005(b), and 05-006(c).

I-5.5.2 COPECs with No ESLs

The COPECs with no ESLs were evaluated and were eliminated. The analysis of COPECs with no ESLs supports the conclusion that no potential ecological risk to any receptor exists at SWMUs 05-004, 05-005(b), and 05-006(c).

I-5.5.3 Summary

No potential ecological risk exists at SWMU 05-003 because no potential exposure pathways for ecological receptors exist at SWMU 05-003.

Based on evaluations of the minimum ESL, HI analysis, comparisons to background, potential effects to populations (individuals for T&E species), and LOAEL analysis, no potential ecological risk exists at SWMUs 05-004, 05-005(b), and 05-006(c).

I-6.0 CONCLUSIONS AND RECOMMENDATIONS

I-6.1 Human Health

The human health risk-screening assessments indicated no potential unacceptable risks or doses exist for the industrial and residential scenarios at SWMUs 05-003, 05-005(b) and 05-006(c). The total excess cancer risks were below the NMED target risk level of 1×10^{-5} (NMED 2009, 108070), the HIs were less than the NMED target HI of 1 (NMED 2009, 108070), and the total doses were below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489) for both scenarios at these sites.

The human health risk-screening assessments indicated no potential unacceptable risks or dose exist for the industrial scenario at SWMU 05-004. The HI (0.06) was below the NMED target HI of 1 (NMED 2009, 108070) and the total dose (0.1 mrem/yr) was below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489) for the residential scenario. The total excess cancer risk for the residential scenario at SWMU 05-004 was approximately 4×10^{-5}, which is above the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). Because the cancer risk was primarily from non-site-related PAHs, the risk was recalculated without these organic chemicals. The recalculated total excess cancer risk for the residential scenario was approximately 1×10^{-10}, which is below the NMED target risk level (NMED 2009, 108070). Therefore, there were no potential unacceptable risks or dose for the residential scenario at SWMU 05-004.

No radionuclides were identified as COPCs at SWMU 05-003. The total doses at SWMUs 05-004, 05-005(b), and 05-006(c) were equivalent to total risks ranging from 3×10^{-9} to 2×10^{-6}, based on a comparison with EPA's PRGs for radionuclides (http://epa-prgs.ornl.gov/radionuclides/download/rad_master_prg_table_pci.xls).

I-6.2 Ecology

No potential ecological risk exists at SWMU 05-003 because there are no potential exposure pathways to ecological receptors at SWMU 05-003.

No potential ecological risks exist for any receptor at SWMUs 05-004, 05-005(b), and 05-006(c) based on minimum ESL comparisons, HI analyses, comparisons to background concentrations, potential effects to populations (individuals for T&E species), and LOAEL analysis.

I-7.0 REFERENCES

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Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau 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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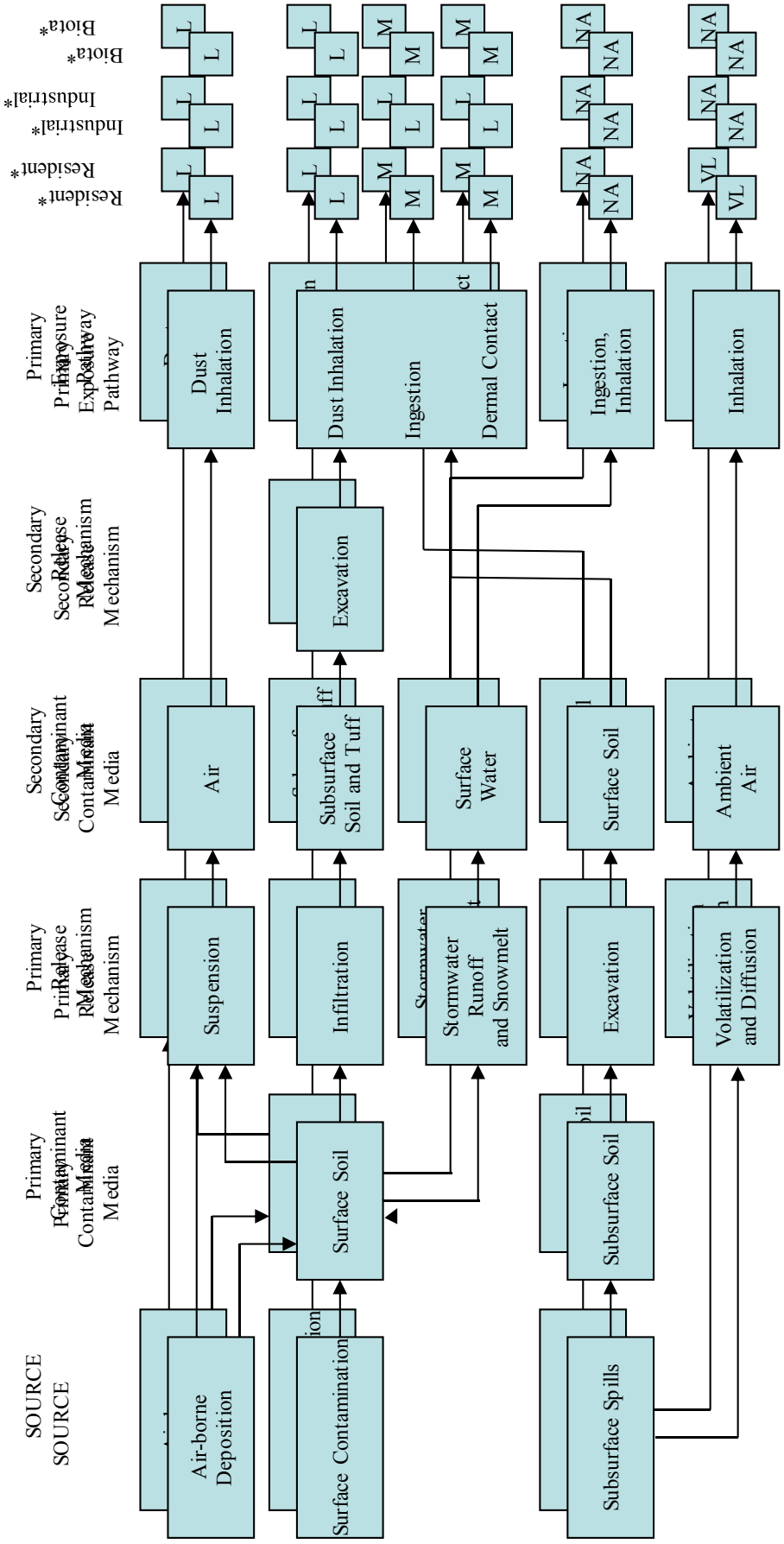

* Very Low (VL), Low (L), and Moderate (M) designations indicate the pathway is a potentially complete pathway and is evaluated in the risk assessments.
* Very Low (VL), Low (L), and Moderate (M) designations indicate the pathway is a potentially complete pathway and is evaluated in the risk assessments.
Not Applicable (NA) indicates the pathway is incomplete and is not evaluated in the risk assessments.

Figure I-3.1-1 Conceptual site model for Lower Mortandad/Cedro Canyons Aggregate Area

Table I-2.2-1
EPCs for SWMU 05-003 for the Residential Scenario

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	2	0	1.03(U)	1.03(U)	n/a*	1.03(U)	Maximum detection limit
Selenium	2	0	0.94(U)	1.05(U)	n/a	1.05(U)	Maximum detection limit

Note: Data qualifiers are defined in Appendix A.

* n/a = Not applicable.

Table I-2.2-2
EPCs for SWMU 05-004 for the Industrial Scenario

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	5	0	0.385(U)	0.832(U)	n/a[a]	0.832(U)	Maximum detection limit
Cadmium	13	9	0.029	0.55(U)	Normal	0.0911	95% KM(t)
Calcium	13	13	680	3700	Normal	2255	95% Student's-t
Copper	13	13	1.1	6.2	Normal	4.313	95% Student's-t
Lead	13	13	5	16.4	Normal	12.67	95% Student's-t
Nitrate	5	5	1.23	5.27	n/a	5.27	Maximum detected concentration
Perchlorate	5	1	0.000646	0.00226(U)	n/a	0.000646[b]	Maximum detected concentration
Selenium	13	0	0.51(U)	1.1(U)	n/a	1.1(U)	Maximum detection limit
Organic Chemicals (mg/kg)							
Benzoic acid	14	2	0.272	3.5(U)	n/a	0.61[b]	Maximum detected concentration
Styrene	5	1	0.00035	0.00109(U)	n/a	0.00035[b]	Maximum detected concentration
Radionuclides (pCi/g)							
Plutonium-239/240	10	4	-0.00303(U)	0.041	n/a	0.041	Maximum detected concentration
Uranium-234	10	10	0.772	4.71	Nonparametric	2.161	95% Student's-t
Uranium-235/236	10	1	0.0206(U)	0.206	n/a	0.206	Maximum detected concentration
Uranium-238	10	10	0.878	4.66	Nonparametric	2.234	95% Student's-t

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] The maximum concentration of the data set is a nondetect (U or UJ); thus, the maximum detected concentration is less than the maximum concentration.

Table I-2.2-3
EPCs for SWMU 05-004 for Ecological Risk

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	21	1	0.12	1.04(U)	n/a[a]	0.12[b]	Maximum detected concentration
Cadmium	29	11	0.029	0.55(U)	Gamma	0.147	95% KM(t)
Calcium	29	29	278	3700	Normal	1755	95% Student's-t
Copper	29	29	0.69	8.43	Normal	3.79	95% Student's-t
Lead	29	29	4.7	16.4	Gamma	10.01	95% Approximate gamma
Nitrate	20	19	0.958	71.8	Nonparametric	20.41	95% KM(Chebyshev)
Perchlorate	20	4	0.000646	0.00346	n/a	0.00346	Maximum detected concentration
Selenium	29	3	0.345	1.11(U)	n/a	0.371[b]	Maximum detected concentration
Organic Chemicals (mg/kg)							
Acenaphthene	29	1	0.0339(U)	0.36(U)	n/a	0.0852[b]	Maximum detected concentration
Benzoic acid	29	5	0.216	3.5(U)	n/a	0.61[b]	Maximum detected concentration
2-Hexanone	21	1	0.00508(U)	0.0793	n/a	0.0793	Maximum detected concentration
Methylene chloride	21	3	0.00222	0.011(U)	n/a	0.00236[b]	Maximum detected concentration
Styrene	21	1	0.00035	0.005(U)	n/a	0.00035[b]	Maximum detected concentration
Radionuclides (pCi/g)							
Plutonium-239/240	30	5	-0.00361(U)	0.098	n/a	0.098	Maximum detected concentration
Uranium-234	30	30	0.764	4.71	Nonparametric	1.461	95% Student's-t
Uranium-235/236	30	7	0.0206(U)	0.206	n/a	0.206	Maximum detected concentration
Uranium-238	30	30	0.734	4.66	Nonparametric	1.498	95% Student's-t

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] The maximum concentration of the data set is a nondetect (U or UJ); thus, the maximum detected concentration is less than the maximum concentration.

Table I-2.2-4
EPCs for SWMU 05-004 for the Residential Scenario

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	30	2	0.12	1.04(U)	n/a[a]	0.505[b]	Maximum detected concentration
Cadmium	38	12	0.029	0.55(U)	Gamma	0.144	95% KM(t)
Calcium	38	38	278	3700	Normal	1636	95% Student's-t
Copper	40	38	0.69	13.8	Gamma	4.408	95% KM(BCA)
Lead	39	39	3.78	54.1	Nonparametric	12	95% Student's-t
Nitrate	30	26	0.958	71.8	Nonparametric	20.28	95% KM(Chebyshev)
Perchlorate	29	8	0.00052	0.00346	Normal	0.00144	95% KM(t)
Selenium	40	7	0.345	1.1(U)	n/a	0.406[b]	Maximum detected concentration
Organic Chemicals (mg/kg)							
Acenaphthene	39	2	0.0336(U)	0.36(U)	n/a	0.0852[b]	Maximum detected concentration
Acenaphthylene	39	2	0.0102	0.36(U)	n/a	0.0242[b]	Maximum detected concentration
Anthracene	39	2	0.0336(U)	0.36(U)	n/a	0.334[b]	Maximum detected concentration
Benzo(a)anthracene	39	2	0.0336(U)	1.61	n/a	1.61	Maximum detected concentration
Benzo(a)pyrene	39	2	0.0336(U)	1.55	n/a	1.55	Maximum detected concentration
Benzo(b)fluoranthene	39	2	0.0336(U)	3.04	n/a	3.04	Maximum detected concentration
Benzo(g,h,i)perylene	39	2	0.0336(U)	0.769	n/a	0.769	Maximum detected concentration
Benzo(k)fluoranthene	39	2	0.0336(U)	0.899	n/a	0.899	Maximum detected concentration
Benzoic acid	39	6	0.216	3.5(U)	n/a	0.61[b]	Maximum detected concentration
Chrysene	39	2	0.0336(U)	3.13	n/a	3.13	Maximum detected concentration
Dibenz(a,h)anthracene	39	2	0.0336(U)	0.36(U)	n/a	0.188	Maximum detected concentration
Diethylphthalate	39	1	0.0824	0.377(U)	n/a	0.0824[b]	Maximum detected concentration
Fluoranthene	39	3	0.0118	3.42	n/a	3.42	Maximum detected concentration
Fluorene	39	2	0.0174	0.36(U)	n/a	0.11[b]	Maximum detected concentration
2-Hexanone	30	3	0.00505(U)	0.0793	n/a	0.0793	Maximum detected concentration
Indeno(1,2,3-cd)pyrene	39	2	0.0336(U)	0.74	n/a	0.74	Maximum detected concentration
4-Isopropyltoluene	30	1	0.000429	0.005(U)	n/a	0.000429[b]	Maximum detected concentration
Methylene chloride	30	3	0.00222	0.011(U)	n/a	0.00236[b]	Maximum detected concentration
2-Methylnaphthalene	39	1	0.0152	0.36(U)	n/a	0.0152[b]	Maximum detected concentration

Table I-2.2-4 (continued)

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Naphthalene	39	1	0.0145	0.36(U)	n/a	0.0145[b]	Maximum detected concentration
Phenanthrene	39	2	0.0336(U)	1.42	n/a	1.42	Maximum detected concentration
Pyrene	39	2	0.0336(U)	2.64	n/a	2.64	Maximum detected concentration
Styrene	30	1	0.00035	0.005(U)	n/a	0.00035[b]	Maximum detected concentration
Radionuclides (pCi/g)							
Plutonium-239/240	40	5	-0.0111(U)	0.098	n/a	0.098	Maximum detected concentration
Uranium-234	40	40	0.764	4.71	Nonparametric	1.345	95% Student's-t
Uranium-235/236	40	11	0.0206(U)	0.206	Nonparametric	0.0747	95% KM(t)
Uranium-238	40	40	0.734	4.66	Nonparametric	1.369	95% Student's-t

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] The maximum concentration of the data set is a nondetect (U or UJ); thus, the maximum detected concentration is less than the maximum concentration.

Table I-2.2-5
EPCs for SWMU 05-005(b) for the Industrial Scenario

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	12	3	0.348	1.09(U)	n/a[a]	0.834[b]	Maximum detected concentration
Cadmium	12	0	0.02(U)	0.544(U)	n/a	0.544(U)	Maximum detection limit
Chromium	12	12	1.88	25	Nonparametric	12.87	95% Chebyshev (Mean, Sd)
Copper	12	11	0.81	5.25	Normal	3.944	95% KM (t)
Lead	12	12	7.7	29.8	Gamma	16.08	95% Approximate gamma
Nickel	12	12	1.57	13	Nonparametric	7.27	95% Chebyshev (Mean, Sd)
Perchlorate	10	2	0.000776	0.00222(U)	n/a	0.00107[b]	Maximum detected concentration
Selenium	12	0	0.44(U)	1.07(U)	n/a	1.07(U)	Maximum detection limit
Organic Chemicals (mg/kg)							
Benzoic acid	9	1	0.538	0.739(U)	n/a	0.538[b]	Maximum detected concentration
Di-n-butylphthalate	9	1	0.0774	0.369(U)	n/a	0.0774[b]	Maximum detected concentration
Fluoranthene	9	1	0.0116	0.0369(U)	n/a	0.0116[b]	Maximum detected concentration
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	9	8	4.9E-07(U)	7.18E-06	Gamma	3.884E-06	95% KM (BCA)
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	9	6	4.82E-07(U)	1.66E-06	n/a	1.66E-06	Maximum detected concentration
Isopropyltoluene[4-]	9	1	0.000748	0.00111	n/a	0.000748[b]	Maximum detected concentration
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	9	8	1.18E-06(U)	6.99E-05	Approximate Gamma	3.536E-05	95% KM (BCA)
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	9	4	9.64E-07(U)	2.85E-06	n/a	2.85E-06	Maximum detected concentration
Pentachlorodibenzofuran [2,3,4,7,8-]	9	1	4.39E-07(U)	6.65E-07	n/a	6.65E-07	Maximum detected concentration
Toluene	9	1	0.000326	0.00111 (U)	n/a	0.000326[b]	Maximum detected concentration
Radionuclides (pCi/g)							
Plutonium-238	12	1	-0.00722(U)	0.0225	n/a	0.0225	Maximum detected concentration
Plutonium-239/240	12	2	-0.00139(U)	0.0282	n/a	0.0282	Maximum detected concentration
Uranium-235/236	12	7	0.02	0.103	n/a	0.103	Maximum detected concentration

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] The maximum concentration of the data set is a nondetect (U or UJ); thus, the maximum detected concentration is less than the maximum concentration.

Table I-2.2-6
EPCs for SWMU 05-005(b) for Ecological Risk

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	33	6	0.346	1.09(U)	n/a[a]	0.834[b]	Maximum detected concentration
Cadmium	32	0	0.02(U)	0.544(U)	n/a	0.544(U)	Maximum detection limit
Chromium	33	33	0.687	45.9	Nonparametric	12.77	95% Chebyshev (Mean, Sd)
Copper	33	29	0.48(U)	5.25	Normal	2.693	95% KM (t)
Lead	33	33	3.9	29.8	Lognormal	10.72	95% Student's t
Nickel	33	33	0.783	23.7	Nonparametric	7.471	95% Chebyshev (Mean, Sd)
Perchlorate	26	6	0.000581	0.00222(U)	n/a	0.00107[b]	Maximum detected concentration
Selenium	33	0	0.43(U)	1.07(U)	n/a	1.07(U)	Maximum detection limit
Organic Chemicals (mg/kg)							
Acenaphthene	27	1	0.0334(U)	0.34(U)	n/a	0.0444[b]	Maximum detected concentration
Benzoic acid	25	1	0.538	3.4(U)	n/a	0.538[b]	Maximum detected concentration
Bis(2-ethylhexyl)phthalate	25	1	0.29	0.369(U)	n/a	0.29[b]	Maximum detected concentration
Di-n-butylphthalate	25	1	0.0774	0.369(U)	n/a	0.0774[b]	Maximum detected concentration
Fluoranthene	25	1	0.0116	0.34(U)	n/a	0.0116[b]	Maximum detected concentration
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	24	11	4.8E-07(U)	7.18E-06	Gamma	1.962E-06	95% KM (t)
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	24	8	4.8E-07(U)	1.66E-06	Normal	7.864E-07	95% KM (t)
Isopropyltoluene[4-]	24	1	0.000748	0.00111	n/a	0.000748[b]	Maximum detected concentration
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	24	14	9.64E-07(U)	6.99E-05	Gamma	1.638E-05	95% KM (BCA)
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	24	4	9.5E-07(U)	2.85E-06	n/a	2.85E-06	Maximum detected concentration
Pentachlorodibenzofuran [2,3,4,7,8-]	24	1	4.39E-07(U)	6.65E-07	n/a	6.65E-07	Maximum detected concentration
Toluene	24	1	0.000326	0.00111 (U)	n/a	0.000326[b]	Maximum detected concentration
Radionuclides (pCi/g)							
Plutonium-238	33	1	-0.00958(U)	0.0225	n/a	0.0225	Maximum detected concentration
Plutonium-239/240	33	2	-0.012(U)	0.0282	n/a	0.0282	Maximum detected concentration
Uranium-235/236	33	11	0.01(U)	0.103	Normal	0.04	95% KM (t)

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] The maximum concentration of the data set is a nondetect (U or UJ); thus, the maximum detected concentration is less than the maximum concentration.

Table I-2.2-7
EPCs for SWMU 05-005(b) for the Residential Scenario

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	38	6	0.327(U)	1.09(U)	n/a[a]	0.834[b]	Maximum detected concentration
Cadmium	36	0	0.02(U)	0.544(U)	n/a	0.544(U)	Maximum detection limit
Chromium	36	36	0.687	45.9	Nonparametric	11.9	95% Chebyshev (Mean, Sd)
Copper	36	31	0.48(U)	5.25	Normal	2.589	95% KM (t)
Lead	36	36	3.9	29.8	Lognormal	10.41	95% Student's t
Nickel	36	36	0.783	23.7	Nonparametric	6.988	95% Chebyshev (Mean, Sd)
Perchlorate	31	6	0.000581	0.00222(U)	n/a	0.00107[b]	Maximum detected concentration
Selenium	36	0	0.43(U)	1.07(U)	n/a	1.07(U)	Maximum detection limit
Organic Chemicals (mg/kg)							
Acenaphthene	31	1	0.0334(U)	0.34(U)	n/a	0.0444[b]	Maximum detected concentration
Benzoic acid	28	1	0.538	3.4(U)	n/a	0.538[b]	Maximum detected concentration
Bis(2-ethylhexyl)phthalate	28	1	0.29	0.369(U)	n/a	0.29[b]	Maximum detected concentration
Di-n-butylphthalate	28	1	0.0774	0.369(U)	n/a	0.0774[b]	Maximum detected concentration
Fluoranthene	28	1	0.0116	0.34(U)	n/a	0.0116[b]	Maximum detected concentration
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	27	11	4.31E-07(U)	7.18E-06	Gamma	1.808E-06	95% KM (t)
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	27	8	4.31E-07(U)	1.66E-06	Normal	7.553E-07	95% KM (t)
Isopropyltoluene[4-]	27	1	0.000748	0.00111	n/a	0.000748[b]	Maximum detected concentration
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	27	16	8.61E-07(U)	6.99E-05	Gamma	1.435E-05	95% KM (BCA)
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	27	4	8.61E-07(U)	2.85E-06	n/a	2.85E-06	Maximum detected concentration
Pentachlorodibenzofuran [2,3,4,7,8-]	27	1	4.39E-07(U)	6.65E-07	n/a	6.65E-07	Maximum detected concentration
Toluene	27	1	0.000326	0.00111 (U)	n/a	0.000326[b]	Maximum detected concentration
Radionuclides (pCi/g)							
Plutonium-238	36	1	-0.00958(U)	0.0225	n/a	0.0225	Maximum detected concentration
Plutonium-239/240	36	2	-0.012(U)	0.0282	n/a	0.0282	Maximum detected concentration
Uranium-235/236	36	14	0.01(U)	0.103	Normal	0.0428	95% KM (t)

Note: Data qualifiers are defined in Appendix A.

[a] n/a= Not applicable.

[b] The maximum concentration of the data set is a nondetect (U or UJ); thus, the maximum detected concentration is less than the maximum concentration.

Table I-2.2-8
EPCs for SWMU 05-006(c) for the Industrial Scenario

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	15	6	0.39(U)	2.3	n/a[a]	2.3	Maximum detected concentration
Chromium	15	15	0.64	10.8	Normal	5.338	95% Student's-t
Copper	15	15	1.27	317	Lognormal	130.7	95% Chebyshev (Mean, Sd)
Lead	18	18	9.29	337	Nonparametric	148	95% Chebyshev (Mean, Sd)
Nickel	15	15	1.14	28.2	Nonparametric	12.13	95% Chebyshev (Mean, Sd)
Selenium	15	3	0.347	1.1	n/a	1.1	Maximum detected concentration
Silver	15	4	0.1(U)	0.511(U)	n/a	0.31[b]	Maximum detected concentration
Organic Chemicals (mg/kg)							
Acetone	10	2	0.00172	0.0056(U)	n/a	0.00203[b]	Maximum detected concentration
Aroclor-1260	10	2	0.0014	0.00372(U)	n/a	0.0015[b]	Maximum detected concentration
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	10	9	4.62E-07(U)	8.92E-06	Normal	4.3446E-06	95% KM (t)
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	10	6	4.62E-07(U)	2.7E-06	n/a	2.7E-06	Maximum detected concentration
Hexachlorodibenzodioxin[1,2,3,6,7,8-]	10	1	4.62E-07(U)	5.08E-07	n/a	5.08E-07	Maximum detected concentration
Isopropyltoluene[4-]	10	3	0.000383	0.00145	n/a	0.00145	Maximum detected concentration
Methylene chloride	10	5	0.00219	0.00545(U)	n/a	0.00286[b]	Maximum detected concentration
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	10	10	1.49E-06	5.77E-05	Gamma	3.271E-05	95% Approximate gamma
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	10	6	9.24E-07(U)	3.44E-06	n/a	3.44E-06	Maximum detected concentration
Tetrachlorodibenzofuran[2,3,7,8-]	10	1	2.67E-07(U)	9.63E-07	n/a	9.63E-07	Maximum detected concentration
Toluene	10	3	0.000943	0.00136(U)	n/a	0.0013[b]	Maximum detected concentration
Trimethylbenzene[1,2,4-]	10	1	0.000461	0.00112(U)	n/a	0.000461[b]	Maximum detected concentration
Radionuclides (pCi/g)							
Uranium-235/236	13	5	0.03(U)	0.103	n/a	0.103	Maximum detected concentration

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] The maximum concentration of the data set is a nondetect (U or UJ); thus, the maximum detected concentration is less than the maximum concentration.

Table I-2.2-9
EPCs for SWMU 05-006(c) for Ecological Risk

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	29	7	0.34(U)	2.3	n/a[a]	2.3	Maximum detected concentration
Chromium	29	29	0.64	187	Nonparametric	40.69	95% Chebyshev (Mean, Sd)
Copper	29	27	0.63	317	Nonparametric	70.5	95% KM (Chebyshev)
Lead	35	35	5.1	337	Nonparametric	95.91	95% Chebyshev (Mean, Sd)
Nickel	29	29	0.731	89.4	Nonparametric	21.46	95% Chebyshev (Mean, Sd)
Selenium	29	5	0.316	1.1	n/a	1.1	Maximum detected concentration
Silver	29	7	0.1(U)	0.511(U)	n/a	0.31[b]	Maximum detected concentration
Organic Chemicals (mg/kg)							
Acetone	18	2	0.00172	0.0056(U)	n/a	0.00203[b]	Maximum detected concentration
Aroclor-1260	18	3	0.0014	0.00372(U)	n/a	0.0018[b]	Maximum detected concentration
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	18	14	4.41E-07(U)	8.92E-06	Gamma	3.1436E-06	95% KM (BCA)
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	18	8	4.41E-07(U)	2.7E-06	Approximate Gamma	1.3246E-06	95% KM (t)
Hexachlorodibenzodioxin[1,2,3,6,7,8-]	18	1	4.41E-07 (U)	5.08E-07	n/a	5.08E-07	Maximum detected concentration
Isopropyltoluene[4-]	18	5	0.000383	0.00145	n/a	0.00145	Maximum detected concentration
Methylene chloride	18	7	0.00219	0.00545(U)	n/a	0.00343[b]	Maximum detected concentration
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	18	16	8.81E-07(U)	5.77E-05	Gamma	2.0191E-05	95% KM (BCA)
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	18	8	8.81E-07(U)	3.44E-06	Approximate Gamma	1.4876E-06	95% KM (t)
Tetrachlorodibenzofuran[2,3,7,8-]	18	1	1.66E-07(U)	9.63E-07	n/a	9.63E-07	Maximum detected concentration
Toluene	18	5	0.000937(U)	0.00133	n/a	0.00133	Maximum detected concentration
Trimethylbenzene[1,2,4-]	18	1	0.000461	0.00112(U)	n/a	0.000461[b]	Maximum detected concentration

Table I-2.2-9 (continued)

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Radionuclides (pCi/g)							
Uranium-235/236	27	10	0.01(U)	0.103	Normal	0.0443	95% KM (t)

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] The maximum concentration of the data set is a nondetect (U or UJ); thus, the maximum detected concentration is less than the maximum concentration.

Table I-2.2-10
EPCs for SWMU 05-006(c) for the Residential Scenario

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	37	8	0.34(U)	2.3	Normal	0.794	95% KM (t)
Chromium	37	37	0.64	187	Nonparametric	32.36	95% Chebyshev (Mean, Sd)
Copper	37	34	0.63	317	Nonparametric	56.24	95% KM (Chebyshev)
Lead	46	46	5.1	337	Nonparametric	80.76	95% Chebyshev (Mean, Sd)
Nickel	37	37	0.657	89.4	Nonparametric	17.2	95% Chebyshev (Mean, Sd)
Selenium	37	5	0.316	1.1	n/a[a]	1.1	Maximum detected concentration
Silver	38	9	0.1(U)	2.22	Nonparametric	0.287	95% KM (t)
Organic Chemicals (mg/kg)							
Acetone	26	2	0.00172(U)	0.0056(U)	n/a	0.00203[b]	Maximum detected concentration
Aroclor-1260	26	3	0.0014	0.00372(U)	n/a	0.0018[b]	Maximum detected concentration
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	26	18	4.41E-07(U)	8.92E-06	Gamma	2.413E-06	95% KM (Percentile Bootstrap)
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	26	9	4.41E-07(U)	2.7E-06	Gamma	1.0231E-06	95% KM (t)
Hexachlorodibenzodioxin[1,2,3,6,7,8-]	26	1	4.41E-07(U)	5.08E-07	n/a	5.08E-07	Maximum detected concentration
Isopropyltoluene[4-]	26	6	0.000383	0.00145	n/a	0.00145	Maximum detected concentration

Table I-2.2-10 (continued)

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Methylene chloride	26	11	0.00213	0.00545(U)	Normal	0.00275	95% KM (t)
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	26	22	8.81E-07(U)	5.77E-05	Gamma	1.5288E-05	95% KM (BCA)
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	26	8	8.81E-07(U)	3.44E-06	Approximate Gamma	1.3371E-06	95% KM (t)
Tetrachlorodibenzofuran[2,3,7,8-]	26	1	1.66E-07(U)	9.63E-07	n/a	9.63E-07	95% KM(Chebyshev)
Toluene	27	9	0.000327	0.00164	Normal	0.00101	95% KM (t)
Trimethylbenzene[1,2,4-]	26	1	0.000461	0.00112(U)	n/a	0.000461[b]	Maximum detected concentration
Radionuclides (pCi/g)							
Uranium-235/236	35	16	0.01(U)	0.103	Normal	0.0483	95% KM (t)

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] The maximum concentration of the data set is a nondetect (U or UJ); thus, the maximum detected concentration is less than the maximum concentration.

Table I-3.2-1
Physical and Chemical Properties of Inorganic COPCs

COPC	Soil-Water Partition Coefficient, K_d[a] (cm^3/g)	Water Solubility[a] (g/L)
Antimony	45	Insoluble
Cadmium	75	Insoluble
Chromium	850	Insoluble
Copper	35	Insoluble
Lead	900	Insoluble
Nickel	65	Insoluble
Nitrate	0.0356	Soluble
Perchlorate	na[b]	245
Selenium	5	Insoluble
Silver	8.3	Insoluble

[a] Information from http://rais.ornl.gov/cgi-bin/tools/TOX_search?select=chem_spef.
[b] na = Not available.

Table I-3.2-2
Physical and Chemical Properties of Organic COPCs

COPC	Water Solubility[a] (mg/L)	Organic Carbon Coefficient K_{oc}[a] (L/kg)	Log Octanol-Water Partition Coefficient, Log K_{ow}[a]	Vapor Pressure[a] (mm Hg at 25°C)
Acenaphthene	3.6E+00[b]	6.12E+03	3.92E+00[b]	2.5E-03[b]
Acenaphthylene	1.61E+01	5.03E+03	3.94E+00	6.68E-03
Acetone	1.00E+06[b]	1.98E+00	-2.40E-01[b]	2.31E+02[b]
Anthracene	4.34E-02[b]	2.04E+04	4.45E+00[b]	2.67E-06[b]
Aroclor-1260	2.84E-04[b]	5.30E+05[c]	8.27E+00[b]	4.05E-05[b]
Benzo(a)anthracene	9.40E-03[b]	2.31E+05	5.76+00[b]	1.90E-06[b]
Benzo(a)pyrene	1.62E-03[b]	7.87E+05	6.13E+00[b]	5.49E-09[b]
Benzo(b)fluoranthene	1.50E-03[b]	8.03E+05	5.78E+00[b]	5.00E-07[b]
Benzo(g,h,i)perylene	2.60E-04[b]	2.68E+06	6.63E+00[b]	1.00E-10[b]
Benzo(k)fluoranthene	8.00E-04[b]	7.87E+05	6.1E+00[b]	9.65E-10[b]
Benzoic acid	3.40E+03[b]	1.45E+01	1.87E+00[b]	7.00E-04[b]
Bis(2-ethylhexyl)phthalate	2.70E-01[b]	1.65E+05	7.60E+00[b]	1.42E-07[b]
Chrysene	6.30E-03[b]	2.36E+05	5.81E+00[b]	6.23E-09[b]
Dibenz(a,h)anthracene	1.03E-03	2.62E+06	6.54E+00	1.39E-11
Diethylphthalate	1.08E+03	1.05E+02	2.42E+00	2.10E-03
Di-n-butyl phthalate	1.46E+03	4.50E+00	4.7E+00[b]	2.01E-05
Fluoranthene	2.06E-01[c]	7.09E+04[c]	5.16E+00[c]	9.22E-06[c]
Fluorene	1.89E+00[b]	1.13E+04	4.18E+00[b]	8.42E-04[b]

Table I-3.2-2 (continued)

COPC	Water Solubility[a] (mg/L)	Organic Carbon Coefficient K_{oc}[a] (L/kg)	Log Octanol-Water Partition Coefficient, Log K_{ow}[a]	Vapor Pressure[a] (mm Hg at 25°C)
Hexanone[2-]	1.72E+04	1.50E+01	1.38E+00	1.16E+01
Indeno(1,2,3-cd)pyrene	1.90E-04[b]	2.68E+06	6.70E+00[b]	1.25E-10[b]
Isopropyltoluene[4-]	2.34E+01[b]	na[d]	4.10E+00[b]	1.64E+00[b]
Methylene chloride	1.30E+04[b]	2.37E+01	1.30E+00[b]	4.30E+02[b]
Methylnaphthalene[2-]	2.46E+01	2.98E+03	3.86E+00	5.50E-02
Naphthalene	3.10E+01	1.84E+03	3.30E+00	8.50E-02
Phenanthrene	1.15E+00[b]	2.08E+04	4.46E+00[b]	1.12E-04[b]
Pyrene	1.35E-01[b]	6.94E+04	4.88E+00[b]	4.50E-06[b]
Styrene	3.10E+02	5.18E+02	2.95E+00	6.4E+00
TCDD[2,3,7,8-]	2.00E-04	1.46E+05	na	na
Toluene	5.26E+02	2.68E+02	2.73E+00	2.84E+01
Trimethylbenzene[1,2,4-]	5.70E+01	7.18E+02	3.63E+00	2.10E+00

[a] Information from http://rais.ornl.gov/cgi-bin/tools/TOX_search, unless noted otherwise.

[b] Information from http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm.

[c] Information from NMED (2009, 108070).

[d] na = Not available.

Table I-3.2-3
Physical and Chemical Properties of Radionuclide COPCs

COPC	Soil-Water Partition Coefficient, K_d[a] (cm^3/g)	Water Solubility[b] (g/L)
Plutonium-238	4500	Insoluble
Plutonium-239/240	4500	Insoluble
Uranium-234	0.4	Insoluble
Uranium-235/236	0.4	Insoluble
Uranium-238	0.4	Insoluble

[a] Superfund Chemical Data Matrix (EPA 1996, 064708).

[b] Information from http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm.

Table I-4.1-1
Exposure Parameter Values Used to Calculate Chemical SSLs for the Residential and Industrial Scenarios

Parameter	Residential Values	Industrial Values
Target HQ	1	1
Target cancer risk	10^{-5}	10^{-5}
Averaging time (carcinogen)	70 yr × 365 d	70 yr × 365 d
Averaging time (noncarcinogen)	Exposure duration × 365 d	Exposure duration × 365 d
Skin absorption factor	Semivolatile organic compound = 0.1	Semivolatile organic compound = 0.1
	Chemical-specific	Chemical-specific
Adherence factor–child	0.2 mg/cm^2	n/a[a]
Body weight–child	15 kg (0–6 yr of age)	n/a
Cancer slope factor–oral (chemical-specific)	(mg/kg-d)$^{-1}$	(mg/kg-d)$^{-1}$
Cancer slope factor–inhalation (chemical-specific)	(mg/kg-d)$^{-1}$	(mg/kg-d)$^{-1}$
Exposure frequency	350 d/yr	225 d/yr
Exposure duration–child	6 yr	n/a
Age-adjusted ingestion factor	114 mg-yr/kg-d	n/a
Age-adjusted inhalation factor	11 m^3-yr/kg-d	n/a
Inhalation rate–child	10 m^3/d	n/a
Soil ingestion rate–child	200 mg/d	n/a
Particulate emission factor	6.61 × 10^9 m^3/kg	6.61 × 109 m^3/kg
Reference dose–oral (chemical-specific)	(mg/kg-d)	(mg/kg-d)
Reference dose–inhalation (chemical-specific)	(mg/kg-d)	(mg/kg-d)
Exposed surface area–child	2800 cm^2/d	n/a
Age-adjusted skin contact factor for carcinogens	361 mg-yr/kg-d	n/a
Volatilization factor for soil (chemical-specific)	(m^3/kg)	(m^3/kg)
Body weight–adult	70 kg	70 kg
Exposure duration[b]	30 yr	25 yr
Adherence factor–adult	0.07 mg/cm^2	0.2 mg/cm^2
Soil ingestion rate–adult	100 mg/d	100 mg/d
Exposed surface area–adult	5700 cm^2/d	3300 cm^2/d
Inhalation rate–adult	20 m^2/d	20 m^2/d

Note: Parameter values are from NMED (2009, 108070).

[a] n/a = Not applicable.

[b] Exposure duration for lifetime resident is 30 yr. For carcinogens, the exposures are combined for child (6 yr) and adult (24 yr).

Table I-4.1-2
Parameters Values Used to Calculate
Radionuclide SALs for the Residential and Industrial Scenarios

Parameters	Residential, Adult	Residential, Child	Industrial, Adult
Inhalation rate (m^3/yr)	7305[a]	3652.5[b]	19,481[c]
Mass loading (g/m^3)	1.5×10^{-7}[d]	1.5×10^{-7}[d]	1.5×10^{-7}[d]
Outdoor time fraction	0.0599[e]	0.2236[f]	0.2053[g]
Indoor time fraction	0.8984[h]	0.7347[i]	0
Soil ingestion (g/yr)	36.5[j]	73[k]	97.4[l]

[a] Calculated as [10 m^3/d × 350 d/yr] / [indoor + outdoor time fractions], where 10 m^3/d is the daily inhalation rate of a child (NMED 2009, 108070).

[b] Calculated as [20 m^3/d × 350 d/yr] / [indoor + outdoor time fractions], where 20 m^3/d is the daily inhalation rate of an adult (NMED 2009, 108070).

[c] Calculated as [20 m^3/d × 225 d/yr] / [indoor + outdoor time fractions], where 20 m^3/d is the daily inhalation rate of an adult and 225 d/yr is the exposure frequency (NMED 2009, 108070).

[d] Calculated as [1/ $6.6 \times 10^{+9}$ m^3/kg) × 1000 g/kg, where $6.6 \times 10^{+9}$ m^3/kg is the particulate emission factor (NMED 2009, 108070).

[e] Calculated as [1.5 h/d × 350 d/yr] / 8766 h/yr, where 1.5 h/d is an estimate of time spent outdoors for an adult 12 yr and older (EPA 1997, 066598, Section 15.4-1).

[f] Calculated as [5.6 h/d × 350 d/yr] / 8766 h/yr, where 5.6 h/d is an estimate of time spent outdoors for a 3–11-yr-old child (EPA 1997, 066598, Section 15.4-1).

[g] Calculated as [8 h/d × 225 d/yr] / 8766 h/yr, where 8 h/d is an estimate of the average length of the work day.

[h] Calculated as [24-1.5 h/d × 350 d/yr] / 8766 h/yr.

[l] Calculated as [24-5.6 h/d × 350 d/yr] / 8766 h/yr.

[j] Calculated as [0.1 g/d × 225 d/yr] / [indoor + outdoor time fractions], where 0.1 g/d is the adult soil ingestion rate (NMED 2009, 108070).

[k] Calculated as [0.2 g/d × 350 d/yr] / [indoor + outdoor time fractions], where 0.2 g/d is the child soil ingestion rate (NMED 2009, 108070).

[l] Calculated as [0.1 g/d× 225 d/yr] / [indoor + outdoor time fractions], where 0.1 g/d is the adult soil ingestion rate (NMED 2009, 108070).

Table I-4.2-1
Residential Noncarcinogenic Screening Evaluation for SWMU 05-003

COPC	EPC (mg/kg)	Residential SSL* (mg/kg)	HQ
Antimony	1.03(U)	31.3	3.3E-02
Selenium	1.05(U)	391	2.7E-03
		HI	**0.04**

Note: Data qualifiers are defined in Appendix A.

* SSLs are from NMED (2009, 108070).

Table I-4.2-2
Industrial Noncarcinogenic Screening Evaluation for SWMU 05-004

COPC	EPC (mg/kg)	Industrial SSL[a] (mg/kg)	HQ
Antimony	0.832(U)	454	1.8E-03
Cadmium	0.0911	1120	8.1E-05
Copper	4.313	45400	9.5E-05
Lead	12.67	800	1.6E-02
Nitrate	5.27	1820000	2.9E-06
Perchlorate	0.000646	795	8.1E-07
Selenium	1.1(U)	5680	1.9E-04
Benzoic acid	0.61	2500000[b]	2.4E-07
Styrene	0.00035	51200	6.8E-09
		HI	**0.02**

Note: Data qualifiers are defined in Appendix A.

[a] SSLs from NMED (2009, 108070), unless otherwise noted.

[b] SSL from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

Table I-4.2-3
Industrial Radionuclide Screening Evaluation for SWMU 05-004

COPC	EPC (pCi/g)	Industrial SAL* (pCi/g)	Total Dose (mrem/yr)
Plutonium-239/240	0.041	210	0.003
Uranium-234	2.161	1500	0.022
Uranium-235/236	0.206	87	0.036
Uranium-238	2.234	430	0.078
		Total Dose	**0.1**

* SALs from LANL (2009, 107655).

Table I-4.2-4
Residential Carcinogenic Screening Evaluation for SWMU 05-004

COPC	EPC (mg/kg)	Residential SSL* (mg/kg)	Cancer Risk
Benzo(a)anthracene	1.61	6.21	2.6E-06
Benzo(a)pyrene	1.55	0.621	2.5E-05
Benzo(b)fluoranthene	3.04	6.21	4.9E-06
Benzo(k)fluoranthene	0.899	62.1	1.4E-07
Chrysene	3.13	621	5.0E-08
Dibenz(a,h)anthracene	0.188	0.621	3.0E-06
Indeno(1,2,3-cd)pyrene	0.74	6.21	1.2E-06
Methylene chloride	0.00236	199	1.2E-10
Naphthalene	0.0145	45	3.2E-09
		Total Excess Cancer Risk	**4E-05**

* SSLs from NMED (2009, 108070).

Table I-4.2-5
Residential Noncarcinogenic Screening Evaluation for SWMU 05-004

COPC	EPC (mg/kg)	Residential SSL[a] (mg/kg)	HQ
Antimony	0.505	31.3	1.6E-02
Cadmium	0.144	77.9	1.8E-03
Copper	4.408	3130	1.4E-03
Lead	12	400	3.0E-02
Nitrate	20.28	125000	1.6E-04
Perchlorate	0.00144	54.8	2.6E-05
Selenium	0.406	391	1.0E-03
Acenaphthene	0.0852	3440	2.5E-05
Acenaphthylene	0.0242	1720[b]	1.4E-05
Anthracene	0.334	17200	1.9E-05
Benzo(g,h,i)perylene	0.769	1720[b]	4.5E-04
Benzoic acid	0.61	240000[c]	2.5E-06
Diethylphthalate	0.0824	48900	1.7E-06
Fluoranthene	3.42	2290	1.5E-03
Fluorene	0.11	2290	4.8E-05
Hexanone[2-]	0.0793	210[c]	3.8E-04
Isopropyltoluene[4-]	0.000429	3210[d]	1.3E-07
Methylnaphthalene[2-]	0.0152	310[c]	4.9E-05
Phenanthrene	1.42	1830	7.8E-04
Pyrene	2.64	1720	1.5E-03
Styrene	0.00035	8970	3.9E-08
		HI	**0.06**

[a] SSLs from NMED (2009, 108070), unless otherwise noted.

[b] Pyrene used as a surrogate based on structural similarity.

[c] SSL from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

[d] Isopropylbenzene used as surrogate based on structural similarity.

Table I-4.2-6
Residential Radionuclide Screening Evaluation for SWMU 05-004

COPC	EPC (pCi/g)	Residential SAL* (pCi/g)	Total Dose (mrem/yr)
Plutonium-239/240	0.098	33	0.045
Uranium-234	1.345	170	0.119
Uranium-235/236	0.0747	17	0.066
Uranium-238	1.369	87	0.236
		Total Dose	**0.5**

* SALs from LANL (2009, 107655).

Table I-4.2-7
Residential Noncarcinogenic
Screening Evaluation of Vapor Intrusion for SWMU 05-004

COPC	EPC (mg/kg)	Vapor-Intrusion Risk-Based Concentration[a] (mg/kg)	HQ
Hexanone[2-]	0.0793	271[b]	1.5E-09
Isopropyltoluene[4-]	0.000429	125[c]	3.4E-11
		HI	**0.000000002**

[a] Vapor-intrusion risk values generated by the Johnson and Ettinger advanced soil model.
[b] Butanone(2-) used as a surrogate based on structural similarity.
[c] Isopropylbenzene used as a surrogate base on structural similarity.

Table I-4.2-~~8~~7
Residential Carcinogenic Screening Evaluation for SWMU 05-004 without PAHs

COPC	EPC (mg/kg)	Residential SSL* (mg/kg)	Cancer Risk
Methylene Chloride	0.00236	199	1.2E-10
		Total Excess Cancer Risk	**1E-10**

* SSLs from NMED (2009, 108070).

Table I-4.2-~~9~~8
Residential Noncarcinogenic Screening Evaluation for SWMU 05-004 without PAHs

COPC	EPC (mg/kg)	Residential SSL[a] (mg/kg)	HQ
Antimony	0.505	31.3	1.6E-02
Cadmium	0.144	77.9	1.8E-03
Copper	4.408	3130	1.4E-03
Lead	12	400	3.0E-02
Nitrate	20.28	125000	1.6E-04
Perchlorate	0.00144	54.8	2.6E-05
Selenium	0.406	391	1.0E-03
Benzoic acid	0.61	240000[b]	2.5E-06
Diethylphthalate	0.0824	48900	1.7E-06
Hexanone[2-]	0.0793	210[b]	3.8E-04
Isopropyltoluene[4-]	0.000429	3210[c]	1.3E-07
Methylnaphthalene[2-]	0.0152	310[b]	4.9E-05
Stylene	0.00035	8970	3.9E-08
		HI	**0.05**

[a] SSLs from NMED (2009, 108070), unless otherwise noted.
[b] SSL from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).
[c] Isopropylbenzene used as surrogate based on structural similarity.

Table I-4.2-109
Dioxin/Furan Calculation for SWMU 05-005(b) for the Industrial Scenario

COPCs	EPC (mg/kg)	TEF*	Toxic Equivalency Calculation
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	3.88E-06	0.01	3.88E-08
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	1.66E-06	0.01	1.66E-08
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	3.54E-05	0.0003	1.06E-08
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	2.85E-06	0.0003	8.55E-10
Pentachlorodibenzofuran[2,3,4,7,8-]	6.65E-07	0.3	2.00E-07
		TCDD[2,3,7,8-] Sum	**2.66E-07**

* TEFs from www.who.int/ipcs/assessment/tef_update/en/print.html.

Table I-4.2-110
Industrial Carcinogenic Screening Evaluation for SWMU 05-005(b)

COPC	EPC (mg/kg)	Industrial SSL* (mg/kg)	Cancer Risk
TCDD[2,3,7,8-]	2.66E-07	0.000204	1.3E-08
		Total Excess Cancer Risk	**1E-08**

* SSLs from NMED (2009, 108070).

Table I-4.2-121
Industrial Noncarcinogenic Screening Evaluation for SWMU 05-005(b)

COPC	EPC (mg/kg)	Industrial SSL[a] (mg/kg)	HQ
Antimony	0.834	454	1.8E-03
Cadmium	0.544(U)	1120	4.8E-04
Chromium	12.87	2920[b] 1570000[b]	48.2-4E-036
Copper	3.944	45400	8.7E-05
Lead	16.08	800	2.0E-02
Nickel	7.27	22700	3.2E-04
Perchlorate	0.00107	795	1.3E-06
Selenium	1.07(U)	5680	1.9E-04
Benzoic acid	0.538	2500000[c]	2.2E-07
Di-n-butylphthalate	0.0774	68400	1.1E-06
Fluoranthene	0.0116	24400	4.8E-07
Isopropyltoluene[4-]	0.000748	14900[d]	5.0E-08
Toluene	0.000326	57900	5.6E-09
		HI	**0.023**

Note: Data qualifiers are defined in Appendix A.

[a] SSLs from NMED (2009, 108070), unless otherwise noted.

[b] SSL for chromium(III/VI).

[c] SSL from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

[d] Isopropylbenzene used as surrogate based on structural similarity.

Table I-4.2-132
Industrial Radionuclide Screening Evaluation for SWMU 05-005(b)

COPC	EPC (pCi/g)	Industrial SAL* (pCi/g)	Total Dose (mrem/yr)
Plutonium-238	0.0225	240	1.4E-03
Plutonium-239/240	0.0282	210	2.0E-03
Uranium-235/236	0.103	87	1.8E-02
		Total Dose	**0.02**

* SALs from LANL (2009, 107655).

Table I-4.2-143
Dioxin/Furan Calculation for SWMU 05-005(b) for the Residential Scenario

COPCs	EPC (mg/kg)	TEF*	Toxic Equivalency Calculation
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	1.81E-06	0.01	1.81E-08
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	7.55E-07	0.01	7.55E-09
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	1.44E-05	0.0003	4.31E-09
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	2.85E-06	0.0003	8.55E-10
Pentachlorodibenzofuran[2,3,4,7,8-]	6.65E-07	0.3	2.00E-07
		TCDD[2,3,7,8-] Sum	**2.30E-07**

* TEFs from www.who.int/ipcs/assessment/tef_update/en/print.html.

Table I-4.2-154
Residential Carcinogenic Screening Evaluation for SWMU 05-005(b)

COPC	EPC (mg/kg)	Residential SSL* (mg/kg)	Cancer Risk
Bis(2-ethylhexyl)phthalate	0.29	347	8.4E-09
TCDD[2,3,7,8-]	2.30E-07	0.000045	5.1E-08
		Total Excess Cancer Risk	**6E-08**

* SSLs from NMED (2009, 108070).

Table I-4.2-165
Residential Noncarcinogenic Screening Evaluation for SWMU 05-005(b)

COPC	EPC (mg/kg)	Residential SSL[a] (mg/kg)	HQ
Antimony	0.834	31.3	2.7E-02
Cadmium	0.544(U)	77.9	7.0E-03
Chromium	11.9	113000219[b]	5.41.1E-024
Copper	2.589	3130	8.3E-04
Lead	10.41	400	2.6E-02
Nickel	6.988	1560	4.5E-03
Perchlorate	0.00107	54.8	2.0E-05
Selenium	1.07(U)	391	2.7E-03
Acenaphthene	0.0444	3440	1.3E-05
Benzoic acid	0.538	240000[c]	2.2E-06
Di-n-butylphthalate	0.0774	6110	1.3E-05
Fluoranthene	0.0116	2290	5.1E-06
Isopropyltoluene[4-]	0.000748	3210[d]	2.3E-07
Toluene	0.000326	5570	5.9E-08
		HI	**0.071**

Note: Data qualifiers are defined in Appendix A.

[a] SSLs from NMED (2009, 108070), unless otherwise noted.

[b] SSL for chromium(III~~V~~I).

[c] SSL from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

[d] Isopropylbenzene used as surrogate based on structural similarity.

Table I-4.2-176
Residential Radionuclide Screening Evaluation for SWMU 05-005(b)

COPC	EPC (pCi/g)	Residential SAL* (pCi/g)	Total Dose (mrem/yr)
Plutonium-238	0.0225	37	9.1E-03
Plutonium-239/240	0.0282	33	1.3E-02
Uranium-235/236	0.0428	17	3.8E-02
		Total Dose	**0.1**

* SALs from LANL (2009, 107655).

Table I-4.2-1817
Dioxin/Furan Calculation for SWMU 05-006(c) for the Industrial Scenario

	EPC (mg/kg)	TEF*	Toxic Equivalency Calculation
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	4.34E-06	0.01	4.34E-08
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	2.70E-06	0.01	2.70E-08
Hexachlorodibenzodioxin[1,2,3,6,7,8-]	5.08E-07	0.1	5.08E-08
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	3.27E-05	0.0003	9.81E-09
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	3.44E-06	0.0003	1.03E-09
Tetrachlorodibenzofuran[2,3,7,8-]	9.63E-07	0.1	9.63E-08
		TCDD[2,3,7,8-] Sum	**2.28E-07**

* TEFs from www.who.int/ipcs/assessment/tef_update/en/print.html.

Table I-4.2-1918
Industrial Carcinogenic Screening Evaluation for SWMU 05-006(c)

COPC	EPC (mg/kg)	Industrial SSL* (mg/kg)	Cancer Risk
Aroclor-1260	0.0015	8.26	1.8E-09
Methylene chloride	0.00286	1090	2.6E-11
TCDD[2,3,7,8-]	2.28E-07	0.000204	1.1E-08
		Total Excess Cancer Risk	**1E-08**

* SSLs from NMED (2009, 108070).

Table I-4.2-2019
Industrial Noncarcinogenic Screening Evaluation for SWMU 05-006(c)

COPC	EPC (mg/kg)	Industrial SSL[a] (mg/kg)	HQ
Antimony	2.3	454	5.1E-03
Chromium	5.338	2920[b] 1570000[b]	3.41.8E-036
Copper	130.7	45400	2.9E-03
Lead	148	800	1.9E-01
Nickel	12.13	22700	5.3E-04
Selenium	1.1	5680	1.9E-04
Silver	0.31	5680	5.5E-05
Acetone	0.00203	851000	2.4E-09
Isopropyltoluene[4-]	0.00145	14900[c]	9.7E-08
Toluene	0.0013	57900	2.2E-08
Trimethylbenzene[1,2,4-]	0.000461	260[d]	1.8E-11
		HI	**0.2**

[a] SSLs from NMED (2009, 108070).

[b] SSL for chromium(VI).

[c] Isopropylbenzene used as surrogate based on structural similarity.

[d] SSL from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

Table I-4.2-2120
Industrial Radionuclide Screening Evaluation for SWMU 05-006(c)

COPC	EPC (pCi/g)	Industrial SAL* (pCi/g)	Total Dose (mrem/yr)
Uranium-235/236	0.103	87	0.018
		Total Dose	**0.02**

* SALs from LANL (2009, 107655).

Table I-4.2-2221
Dioxin/Furan Calculation for SWMU 05-006(c) for the Residential Scenario

COPCs	EPC (mg/kg)	TEF*	Toxic Equivalency Calculation
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	2.41E-06	0.01	2.41E-08
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	1.02E-06	0.01	1.02E-08
Hexachlorodibenzodioxin[1,2,3,6,7,8-]	5.08E-07	0.1	5.08E-08
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	1.53E-05	0.0003	4.59E-09
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	1.34E-06	0.0003	4.01E-10
Tetrachlorodibenzofuran[2,3,7,8-]	9.63E-07	0.1	9.63E-08
		TCDD[2,3,7,8-] Sum	**1.86E-07**

* TEFs from www.who.int/ipcs/assessment/tef_update/en/print.html.

Table I-4.2-2322
Residential Carcinogenic Screening Evaluation for SWMU 05-006(c)

COPC	EPC (mg/kg)	Residential SSL* (mg/kg)	Cancer Risk
Aroclor-1260	0.0018	2.22	8.1E-09
Methylene chloride	0.00275	199	1.4E-10
TCDD[2,3,7,8-]	1.86E-07	0.000045	4.1E-08
		Total Excess Cancer Risk	**5E-08**

* SSLs from NMED (2009, 108070).

Table I-4.2-2423
Residential Noncarcinogenic Screening Evaluation for SWMU 05-006(c)

COPC	EPC (mg/kg)	Residential SSL[a] (mg/kg)	HQ
Antimony	0.794	31.3	2.5E-02
Chromium	32.36	219[b] 113000[b]	2.91.5E-041
Copper	56.24	3130	1.8E-02
Lead	80.76	400	2.0E-01
Nickel	17.2	1560	1.1E-02
Selenium	1.1	391	2.8E-03
Silver	0.287	391	7.3E-04
Acetone	0.00203	67500	3.0E-08
Isopropyltoluene[4-]	0.00145	3210[c]	4.5E-07
Toluene	0.00101	5570	1.8E-07
Trimethylbenzene[1,2,4-]	0.000461	62[d]	7.4E-11
		HI	**0.34**

[a] SSLs from NMED (2009, 108070).

[b] SSL for chromium(III-VI).

[c] Isopropylbenzene used as surrogate based on structural similarity.

[d] SSL from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

Table I-4.2-2524
Residential Radionuclide Screening Evaluation for SWMU 05-006(c)

COPC	EPC (pCi/g)	Residential SAL* (pCi/g)	Total Dose (mrem/yr)
Uranium-235/236	0.0483	17	0.043
		Total Dose	**0.04**

* SALs from LANL (2009, 107655).

Table I-4.2-26
Residential Noncarcinogenic
Screening Evaluation of Vapor Intrusion for SWMU 05-006(c)

COPC	EPC (mg/kg)	Vapor-Intrusion Risk-Based Concentration[a] (mg/kg)	HQ
Acetone	0.00203	10700	1.9E-07
Isopropyltoluene[4-]	0.00145	22.3[b]	6.5E-05
Toluene	0.00164	22.3	7.4E-05
Trimethylbenzene[1,2,4-]	0.000461	2.04	2.3E-04
		HI	**0,0004**

[a] Vapor-intrusion risk values generated by the Johnson and Ettinger advanced soil model.
[b] Isopropylbenzene used as a surrogate base on structural similarity.

Table I-4.2-27
Residential Carcinogenic
Screening Evaluation of Vapor Intrusion for SWMU 05-006(c)

COPC	EPC (mg/kg)	Vapor-Intrusion Risk-Based Concentration* (mg/kg)	Cancer Risk
Methylene Chloride	0.00343	1.3	2.6E-08
		Total Excess Cancer Risk	**3E-08**

* Vapor-intrusion risk values generated by the Johnson and Ettinger advanced soil model.

Table I-5.3-1
ESLs for Terrestrial Receptors

Analyte	Red Fox	Carnivorous Kestrel	Omnivorous Kestrel	Robin (Herbivore)	Robin (Omnivore)	Robin (Insectivore)	Cottontail	Shrew	Deer Mouse	Earthworm	Plant
Inorganic Chemicals (mg/kg)											
Antimony	45	na*	na	na	na	na	2.9	0.26	0.48	78	5.00E-02
Cadmium	510	5.80E+02	2	4.4	0.54	0.29	9.9	0.27	0.51	140	32
Chromium	3.00E+04	3.70E+04	7.70E+03	1.90E+03	1.10E+03	830	1.30E+04	750	1.90E+03	2.3	2.40
Copper	3.80E+03	1.60E+03	110	38	22	15	270	38	64	80	70
Lead	3.70E+03	810	120	21	16	14	370	72	120	1700	120
Nickel	1.20E+03	2.90E+03	160	160	38	21	5.00E+02	9.7	20	280	38
Selenium	84	97	5.6	1	0.87	0.75	2.1	0.66	0.83	4.10	0.52
Silver	4.10E+03	8.40E+02	19	11	4.3	2.6	150	14	24	na	560.00
Organic Chemicals (mg/kg)											
Acenaphthene	6.20E+03	na	na	na	na	na	490	120	160	na	0.25
Acenaphthylene	5.20E+03	na	na	na	na	na	500	120	160	na	na
Acetone	2.90E+03	30000.00	1200.00	7.50	14.00	170.00	1.4	15	1.2	na	na
Anthracene	5.80E+03	na	na	na	na	na	1.10E+03	210	310	na	6.80
Aroclor-1260	0.14	4.60	3.70	46	1.7	0.88	3.00E+03	10	20	na	na
Benzo(a)anthracene	32	na	na	na	na	na	6.2	3	3.4	na	18
Benzo(a)pyrene	380	na	na	na	na	na	280	53	85	na	na
Benzo(b)fluoranthene	250	na	na	na	na	na	130	38	52	na	18
Benzo(g,h,i)perylene	94	na	na	na	na	na	540	24	47	na	na
Benzo(k)fluoranthene	400	na	na	na	na	na	350	62	100	na	na
Benzoic Acid	350	na	na	na	na	na	4.2	1.0	1.3	na	na
Bis(2-ethylhexyl)phthalate	1.2	3.30E-02	4.50E-02	20	4.00E-02	0.02	2.70E+03	0.59	1.1	na	na
Chrysene	25	na	na	na	na	na	6.5	2.4	3.1	na	na
Dibenzo(a,h)anthracene	54	na	na	na	na	na	95	12	22	na	na

Table I-5.3-1 (continued)

Analyte	Red Fox	Carnivorous Kestrel	Omnivorous Kestrel	Robin (Herbivore)	Robin (Omnivore)	Robin (Insectivore)	Cottontail	Shrew	Deer Mouse	Earthworm	Plant
Diethylphthalate	6.50E+05	na	na	na	na	na	8.00E+03	3.60E+03	3.60E+03	na	100
Di-n-butyl phthalate	5.00E+03	0.24	6.80E-02	0.39	2.10E-02	1.10E-02	1.60E+04	180	370	na	160
Fluoranthene	360	na	na	na	na	na	260	22	38	10	na
Fluorene	9.30E+03	na	na	na	na	na	1.10E+03	250	340	3.7	na
Hexanone[2-]	na	500	2.6	0.47	0.41	0.36	na	na	na	na	na
Indeno(1,2,3-cd)pryene	270	na	na	na	na	na	590	62	110	na	na
Isopropyltoluene[4-]	3.10E+03	na	na	na	na	na	61	23	25	na	na
Methylene Chloride	1.70E+03	na	na	na	na	na	3.4	9	2.6	na	1.60E+03
Methylnaphthalene[2-]	130	na	na	na	na	na	16	2.5	3.8	na	na
Naphthalene	1.20E+03	590	100	3.4	5.7	16	12	27	9.7	na	1
Phenanthrene	290	na	na	na	na	na	59	10	15	5.5	na
Pyrene	360	na	na	na	na	na	110	22	32	10	na
Styrene	na	na	na	na	na	na	na	na	na	1.2	300
Tetrachlorodibenzodioxin[2,3,7,8-]	1.20E-06	na	na	na	na	na	4.80E-05	2.90E-07	5.80E-07	5	na
Toluene	3.10E+03	na	na	na	na	na	61	23	25	na	200
Trimethylbenzene[1,2,4-]	7.60E+03	na	na	na	na	na	35	47	24	na	na
Radionuclides (pCi/g)											
Plutonium-238	3.00E+04	1.30E+05	3.20E+04	8.30E+03	2.10E+03	2.00E+03	1.20E+05	9.20E+04	1.10E+05	44	1.10E+05
Plutonium-239/240	3.30E+04	1.60E+05	3.40E+04	8.60E+03	2.10E+03	2.10E+03	1.70E+05	1.10E+05	1.50E+05	47	1.60E+05
Uranium-234	4.50E+04	1.90E+05	1.20E+05	4.80E+04	1.40E+04	1.40E+04	9.60E+04	9.40E+04	9.10E+04	51	1.40E+04
Uranium-235/236	4.80E+03	1.00E+04	1.00E+04	9.00E+03	6.40E+03	6.40E+03	5.10E+03	5.10E+03	5.10E+03	55	4.00E+03
Uranium-238	2.00E+03	4.20E+03	4.10E+03	3.90E+03	3.40E+03	3.40E+03	2.10E+03	2.10E+03	2.10E+03	55	1.80E+03

Note: Values from ECORISK Database, Release 2.5 (LANL 2010, 110846).

* na = Not available.

Table I-5.3-2
Minimum ESL Comparison for SWMU 05-004

COPCs	EPC	Minimum ESL	Receptor	HQ	COPEC
Inorganic Chemicals (mg/kg)					
Antimony	0.12	0.05	Plant	**2.40**	**Yes**
Cadmium	0.147	0.27	Shrew	**0.54**	**Yes**
Copper	3.79	15	Robin (Insectivore)	0.25	No
Lead	10.01	14	Robin (Insectivore)	**0.72**	**Yes**
Selenium	0.371	0.52	Plant	**0.71**	**Yes**
Organic Chemicals (mg/kg)					
Acenaphthene	0.0852	0.25	Plant	**0.34**	**Yes**
Benzoic acid	0.61	1	Shrew	**0.61**	**Yes**
2-Hexanone	0.0793	0.36	Robin (Insectivore)	0.22	No
Methylene chloride	0.00236	2.6	Deer Mouse	0.001	No
Styrene	0.00035	1.2	Earthworm	0.0003	No
Radionuclides (pCi/g)					
Plutonium-239/240	0.098	47	Earthworm	0.002	No
Uranium-234	1.461	51	Earthworm	0.029	No
Uranium-235/236	0.206	55	Earthworm	0.004	No
Uranium-238	1.498	55	Earthworm	0.027	No

Note: Bolded values indicate HQ greater than 0.3.

Table I-5.3-3
HI Analysis for SWMU 05-004

COPECs	EPC (mg/kg)	Red Fox	Carnivorous Kestrel	Omnivorous Kestrel	Robin (Herbivore)	Robin (Omnivore)	Robin (Insectivore)	Cottontail	Shrew	Deer Mouse	Earthworm	Plant
Antimony	0.12	2.7E-03	na*	na	na	na	na	4.1E-02	**4.6E-01**	2.5E-01	1.5E-03	**2.4E+00**
Cadmium	0.147	2.9E-04	2.5E-04	7.4E-02	3.3E-02	2.7E-01	**5.1E-01**	1.5E-02	**5.4E-01**	2.9E-01	1.1E-03	4.6E-03
Lead	10.01	2.7E-03	1.2E-02	8.3E-02	**4.8E-01**	**6.3E-01**	**7.2E-01**	2.7E-02	1.4E-01	8.3E-02	5.9E-03	8.3E-02
Selenium	0.371	4.4E-03	3.8E-03	6.6E-02	**3.7E-01**	**4.3E-01**	**4.9E-01**	1.8E-01	**5.6E-01**	**4.5E-01**	9.0E-02	**7.1E-01**
Acenaphthene	0.0852	1.4E-05	na	na	na	na	na	1.7E-04	7.1E-04	5.3E-04	na	**3.4E-01**
Benzoic acid	0.61	1.7E-03	na	na	na	na	na	1.5E-01	**6.1E-01**	**4.7E-01**	na	na
HI		0.01	0.02	0.2	0.9	1	**2**	0.4	**2**	**2**	0.1	**4**

Note: Bolded values indicate HQ greater than 0.3 or HI greater than 1.0.

* na = Not available.

Table I-5.3-4
Dioxin/Furan Calculation for SWMU 05-005(b) for the Ecological Receptors

COPCs	EPC (mg/kg)	TEF*	Toxic Equivalency Calculation
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	1.96E-06	0.01	1.96E-08
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	7.86E-07	0.01	7.86E-09
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	1.64E-05	0.0003	4.91E-09
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	2.85E-06	0.0003	8.55E-10
Pentachlorodibenzofuran[2,3,4,7,8-]	6.65E-07	0.3	2.00E-07
		TCDD[2,3,7,8-] Sum	**2.33E-07**

* TEFs from www.who.int/ipcs/assessment/tef_update/en/print.html.

Table I-5.3-5
Minimum ESL Comparison for SWMU 05-005(b)

COPCs	EPC	Minimum ESL	Receptor	HQ	COPEC
Inorganic Chemicals (mg/kg)					
Antimony	0.834	0.05	Plant	**16.68**	**Yes**
Cadmium	0.544(U)	0.27	Shrew	**2.01**	**Yes**
Chromium	12.77	2.3	Earthworm	**5.55**	**Yes**
Copper	2.693	15	Robin (Insectivore)	0.18	No
Lead	10.72	14	Robin (Insectivore)	**0.77**	**Yes**
Nickel	7.471	9.7	Shrew	**0.77**	**Yes**
Selenium	1.07(U)	0.52	Plant	**2.06**	**Yes**
Organic Chemicals (mg/kg)					
Acenaphthene	0.0444	0.25	Plant	0.18	No
Benzoic acid	0.538	1	Shrew	**0.54**	**Yes**
Bis(2-ethylhexyl)phthalate	0.29	0.02	Robin (Insectivore)	**14.5**	**Yes**
Di-n-butylphthalate	0.0774	0.011	Robin (Insectivore)	**7.04**	**Yes**
Fluoranthene	0.0116	10	Earthworm	0.00116	No
4-Isopropyltoluene	0.000748	23	Shrew	0.00003	No
Toluene	0.000326	23	Shrew	0.00001	No
2,3,7,8-TCDD	2.33E-07	2.90E-07	Shrew	**0.80**	**Yes**
Radionuclides (pCi/g)					
Plutonium-238	0.0225	44	Earthworm	0.00051	No
Plutonium-239/240	0.0282	47	Earthworm	0.0006	No
Uranium-235/236	0.04	55	Earthworm	0.00073	No

Notes: Bolded values indicate HQ greater than 0.3. Data qualifiers are defined in Appendix A..

Table I-5.3-6
HI Analysis for SWMU 05-005(b)

COPECs	EPC (mg/kg)	Red Fox	Carnivorous Kestrel	Omnivorous Kestrel	Robin (Herbivore)	Robin (Omnivore)	Robin (Insectivore)	Cottontail	Shrew	Deer Mouse	Earthworm	Plant
Antimony	0.834	0.019	na*	na	na	na	na	0.288	**3.208**	**1.738**	0.011	**16.68**
Cadmium	0.544(U)	0.001	0.001	0.272	0.124	**1.007**	**1.876**	0.055	**2.015**	**1.067**	0.004	0.017
Chromium	12.77	0.0004	0.008~~0~~	0.002	0.007	0.012	0.015	0.001	0.017	0.007	**5.552**	**5.321**
Lead	10.72	0.003	0.013	0.089	**0.510**	**0.670**	**0.766**	0.029	0.149	0.089	0.006	0.089
Nickel	7.471	0.006	0.003	0.047	0.047	0.197	**0.356**	0.015	**0.770**	**0.374**	0.027	0.197
Selenium	1.07(U)	0.013	0.011	0.191	**1.070**	**1.230**	**1.427**	**0.510**	**1.621**	**1.289**	0.261	**2.058**
Benzoic acid	0.538	0.002	na	na	**na**	**na**	**na**	0.128	**0.538**	**0.414**	na	na
Bis(2-ethylhexyl)phthalate	0.29	0.242	**8.788**	**6.444**	0.015	**7.250**	**14.50**	1.07E-04	**0.492**	0.264	na	na
Di-n-butyl phthalate	0.0774	1.55E-05	**0.323**	**1.138**	0.198	**3.686**	**7.036**	4.84E-06	0.0004	0.0002	na	0.0005
2,3,7,8-TCDD	2.33E-07	0.194	na	na	na	na	na	0.005	**0.803**	**0.402**	4.66E-08	na
HI		0.5	**9**	**8**	**2**	**14**	**26**	1	**10**	**6**	**6**	**24**

Notes: Bolded values indicate HQ greater than 0.3 or HI greater than 1.0. Data qualifiers are defined in Appendix A.
* na = Not available.

Table I-5.3-7
Dioxin/Furan Calculation for SWMU 05-006(c) for the Ecological Receptors

COPCs	EPC (mg/kg)	TEF*	Toxic Equivalency Calculation
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	3.14E-06	0.01	3.14E-08
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	1.32E-06	0.01	1.32E-08
Hexachlorodibenzodioxin[1,2,3,6,7,8-]	5.08E-07	0.1	5.08E-08
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	2.02E-05	0.0003	6.06E-09
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	1.49E-06	0.0003	4.46E-10
Tetrachlorodibenzofuran[2,3,7,8-]	9.63E-07	0.1	9.63E-08
		TCDD[2,3,7,8-] Sum	**1.98E-07**

* TEFs from www.who.int/ipcs/assessment/tef_update/en/print.html.

Table I-5.3-8
Minimum ESL Comparison for SWMU 05-006(c)

COPCs	EPC	Minimum ESL	Receptor	HQ	COPEC
Inorganic Chemicals (mg/kg)					
Antimony	2.3	0.05	Plant	**46**	**Yes**
Chromium	40.69	2.3	Earthworm	**17.69**	**Yes**
Copper	70.5	15	Robin (Insectivore)	**4.70**	**Yes**
Lead	95.91	14	Robin (Insectivore)	**6.85**	**Yes**
Nickel	21.46	9.7	Shrew	**2.21**	**Yes**
Selenium	1.1	0.52	Plant	**2.12**	**Yes**
Silver	0.31	2.6	Robin (Insectivore)	0.12	No
Organic Chemicals (mg/kg)					
Acetone	0.00203	1.2	Deer Mouse	0.002	No
Aroclor-1260	0.0018	0.14	Red Fox	0.013	No
4-Isopropyltoluene	0.00145	23	Shrew	0.0001	No
Methylene chloride	0.00343	2.6	Deer Mouse	0.001	No
Toluene	0.00133	23	Shrew	0.0001	No
1,2,4-Trimethylbenzene	0.000461	24	Deer Mouse	0.00002	No
2,3,7,8-TCDD	1.98E-07	2.90E-07	Shrew	**0.68**	**Yes**
Radionuclides (pCi/g)					
Uranium-235/236	0.0443	55	Earthworm	0.001	No

Note: Bolded values indicate HQ greater than 0.3.

Table I-5.3-9
HI Analysis for SWMU 05-006(c)

COPECs	EPC (mg/kg)	Red Fox	Carnivorous Kestrel	Omnivorous Kestrel	Robin (Herbivore)	Robin (Omnivore)	Robin (Insectivore)	Cottontail	Shrew	Deer Mouse	Earthworm	Plant
Antimony	2.3	0.05	na*	na	na	na	na	**0.79**	**8.85**	**4.79**	0.03	**46.0**
Chromium	40.69	0.001	0.001	0.01	0.02	0.04	0.05	0.003	0.05	0.02	**17.69**	**16.95**
Copper	70.5	0.02	0.04	**0.64**	**1.86**	**3.20**	**4.70**	0.26	**1.86**	**1.10**	**0.88**	**1.01**
Lead	95.91	0.03	0.12	**0.80**	**4.57**	**5.99**	**6.85**	0.26	**1.33**	**0.80**	0.06	**0.80**
Nickel	21.46	0.02	0.01	0.13	0.13	**0.56**	**1.02**	0.04	**2.21**	**1.07**	0.08	**0.56**
Selenium	1.1	0.01	0.01	0.20	**1.10**	**1.26**	**1.47**	**0.52**	**1.67**	**1.33**	0.27	**2.12**
2,3,7,8-TCDD	1.98E-07	0.17	na	na	na	na	na	0.004	**0.68**	**0.34**	3.96E-08	na
HI		0.3	0.2	**2**	**8**	**11**	**14**	**2**	**17**	**9**	**19**	**67**

Note: Bolded values indicate HQ greater than 0.3 or HI greater than 1.0.

* na = Not available.

Table I-5.4-1
Comparison of EPCs with Background Concentrations for Inorganic COPECs at SWMU 05-004

COPEC	EPC (mg/kg)	Soil Background Concentrations[a] (mg/kg)	Sediment Background Concentrations[a] (mg/kg)	Tuff Background Concentrations[a] (mg/kg)
Antimony	0.12	0.1–1.0	0.83[b]	0.5[b]
Selenium	0.371	0.1–1.7	0.3[b]	0.3[b]

[a] Background concentrations from LANL (1998, 059730).
[b] BV used.

Table I-5.4-2
Comparison of EPCs with Background Concentrations for Inorganic COPECs at SWMU 05-005(b)

COPEC	EPC (mg/kg)	Soil Background Concentrations[a] (mg/kg)	Sediment Background Concentrations[a] (mg/kg)	Tuff Background Concentrations[a] (mg/kg)
Antimony	0.834	0.1–1.0	0.83[b]	0.5[b]
Cadmium	0.544(U)	0.2–2.6	0.4[b]	0.1–1.5
Selenium	1.07(U)	0.1–1.7	0.3[b]	0.3[b]

Note: Data qualifiers are defined in Appendix A.
[a] Background concentrations from LANL (1998, 059730).
[b] BV used.

Table I-5.4-3
Comparison of EPCs with Background Concentrations for Inorganic COPECs at SWMU 05-006(c)

COPEC	EPC (mg/kg)	Soil Background Concentrations[a] (mg/kg)	Tuff Background Concentrations[a] (mg/kg)
Antimony	2.3	0.1–1.0	0.5[b]
Selenium	1.1	0.1–1.7	0.3[b]

Note: Bolded COPEC is retained.
[a] Background concentrations from LANL (1998, 059730).
[b] BV used.

~~**Table I-5.4-1**~~
~~**Comparison of EPCs with Background Concentrations for Inorganic COPECs at SWMU 05-004**~~

~~COPEC~~	~~EPC (mg/kg)~~	~~Soil Background Concentrations[a] (mg/kg)~~	~~Tuff Background Concentrations[a] (mg/kg)~~
~~Antimony~~	~~0.12~~	~~0.1–1.0~~	~~0.5[b]~~
~~Cadmium~~	~~0.147~~	~~0.2–2.6~~	~~1.63[b]~~
~~Lead~~	~~10.01~~	~~2–28~~	~~1.6–15.5~~
~~Selenium~~	~~0.371~~	~~0.1–1.7~~	~~0.3[b]~~

~~[a] Background concentrations from LANL (1998, 059730).~~
~~[b] BV used.~~

Table I-5.4-2
Comparison of EPCs with Background Concentrations for Inorganic COPECs at SWMU 05-005(b)

COPEC	EPC (mg/kg)	Soil Background Concentrations[a] (mg/kg)	Tuff Background Concentrations[a] (mg/kg)
Antimony	0.834	0.1–1.0	0.5[b]
Cadmium	0.544(U)	0.2–2.6	1.63[b]
Chromium	12.77	1.9–36.5	0.25–13
Lead	10.72	2–28	1.6–15.5
Nickel	7.471	1–29	0.5–7
Selenium	1.07(U)	0.1–1.7	0.3[b]

Note: Data qualifiers are defined in Appendix A.
[a] Background concentrations from LANL (1998, 059730).
[b] BV used.

Table I-5.4-3
Comparison of EPCs with Background Concentrations for Inorganic COPECs at SWMU 05-006(c)

COPEC	EPC (mg/kg)	Soil Background Concentrations[a] (mg/kg)	Tuff Background Concentrations[a] (mg/kg)
Antimony	2.3	0.1–1.0	0.5[b]
Chromium	40.69	1.9–36.5	0.25–13
Copper	70.5	0.25–16	0.25–6.2
Lead	95.91	2–28	1.6–15.5
Nickel	21.46	1–29	0.5–7
Selenium	1.1	0.1–1.7	0.3[b]

Note: Bolded COPEC is retained.
[a] Background concentrations from LANL (1998, 059730).
[b] BV used.

Table I-5.4-4
PAUFs and AUFs for Ecological Receptors at SWMUs 05-004, 05-005(b), and 05-006(c)

Receptor	HR[a] (ha)	Population Area (ha)	PAUF for SWMU 05-004 Site area = 0.016 ha	PAUF for SWMU 05-005(b) Site area = 0.018 ha	PAUF for SWMU 05-006(c) Site area = 0.006 ha
American Kestrel	106	4240	4E-06	4E-06	1E-06
American Robin	0.42	16.8	1E-03	1E-03	4E-04
Deer Mouse	0.077	3.1	5E-03	6E-03	2E-03
Montane Shrew	0.39	15.6	1E-03	1E-03	4E-04
Desert Cottontail	3.1	124	1E-04	1E-04	5E-05
Red Fox	1038	41,520	4E-07	4E-07	1E-07
Mexican Spotted Owl[b]	366	n/a[c]	4E-05	5E-05	2E-05

Note: PAUF is calculated as the area of the site divided by the population area.
[a] Values from EPA (1993, 059384).
[b] Value for Mexican spotted owl is the AUF based on individual HR.
[c] n/a = Not applicable.

~~**Table I-5.4-4**~~
~~**PAUFs and AUFs for Ecological Receptors at SWMUs 05-004, 05-005(b), and 05-006(c)**~~

~~Receptor~~	~~HR[a] (ha)~~	~~Population Area (ha)~~	~~PAUF for SWMU 05-004 Site area = 0.003 ha~~	~~PAUF for SWMU 05-005(b) Site area = 0.013 ha~~	~~PAUF for SWMU 05-006(c) Site area = 0.001 ha~~
~~American Kestrel~~	~~106~~	~~4240~~	~~6E-08~~	~~3E-07~~	~~2E-08~~
~~American Robin~~	~~0.42~~	~~16.8~~	~~6E-07~~	~~3E-06~~	~~2E-07~~
~~Deer Mouse~~	~~0.077~~	~~3.1~~	~~2E-04~~	~~7E-04~~	~~6E-05~~
~~Montane Shrew~~	~~0.39~~	~~15.6~~	~~2E-05~~	~~1E-04~~	~~8E-06~~
~~Desert Cottontail~~	~~3.1~~	~~124~~	~~2E-04~~	~~8E-04~~	~~6E-05~~
~~Red Fox~~	~~1038~~	~~41,520~~	~~8E-04~~	~~4E-03~~	~~3E-04~~
~~Mexican spotted owl[b]~~	~~366~~	~~n/a[c]~~	~~7E-06~~	~~3E-05~~	~~3E-06~~

~~Note: PAUF is calculated as the area of the site divided by the population area.~~
~~[a] Values from EPA (1993, 059384).~~
~~[b] Value for Mexican spotted owl is the AUF based on individual HR.~~
~~[c] n/a = Not applicable.~~

Table I-5.4-5
Adjusted HIs at SWMU 05-004

COPECs	EPC (mg/kg)	Red Fox	Carnivorous Kestrel	Omnivorous Kestrel	Robin (Herbivore)	Robin (Omnivore)	Robin (Insectivore)	Cottontail	Shrew	Deer Mouse	Earthworm	Plant
Cadmium	0.147	1.2E-10	1.0E-09	3.0E-07	3.3E-05	2.7E-04	5.1E-04	1.5E-06	5.4E-04	1.5E-03	1.1E-03	4.6E-03
Lead	10.01	1.1E-09	4.8E-08	3.3E-07	4.8E-04	6.4E-04	7.2E-04	2.7E-06	1.4E-04	4.2E-04	5.9E-03	8.3E-02
Acenaphthene	0.0852	5.6E-12	na*	na	na	na	na	1.7E-08	7.1E-07	2.7E-06	na	**0.34**
Benzoic Acid	0.61	6.8E-10	na	na	na	na	na	1.5E-05	6.1E-04	2.4E-03	na	na
Adjusted HI		2E-09	5E-08	6E-07	5E-04	9E-04	1E-03	2E-05	1E-03	4E-03	7E-03	0.4

Note: Bolded values indicate HQ greater than 0.3.

* na = Not available.

~~**Table I-5.4-5**~~
~~**Adjusted HIs at SWMU 05-004**~~

~~COPECs~~	~~EPC (mg/kg)~~	~~Red Fox~~	~~Carnivorous Kestrel~~	~~Omnivorous Kestrel~~	~~Robin (Herbivore)~~	~~Robin (Omnivore)~~	~~Robin (Insectivore)~~	~~Cottontail~~	~~Shrew~~	~~Deer Mouse~~	~~Earthworm~~	~~Plant~~
~~Acenaphthene~~	~~0.0852~~	~~4.1E-12~~	~~na*~~	~~na~~	~~na~~	~~na~~	~~na~~	~~1.7E-08~~	~~5.6E-07~~	~~2.1E-06~~	~~na~~	~~**0.34**~~
~~Benzoic acid~~	~~0.61~~	~~5.2E-10~~	~~na~~	~~na~~	~~na~~	~~na~~	~~na~~	~~1.4E-05~~	~~4.8E-04~~	~~1.9E-03~~	~~na~~	~~na~~
~~**Adjusted HI**~~		~~5E-10~~	~~na~~	~~na~~	~~na~~	~~na~~	~~na~~	~~1E-05~~	~~5E-04~~	~~0.002~~	~~na~~	~~0.3~~

~~Note: Bolded values indicate HQ greater than 0.3.~~

~~* na = Not available.~~

Table I-5.4-6
Adjusted HIs at SWMU 05-005(b)

COPECs	EPC (mg/kg)	Red fox	Carnivorous Kestrel	Omnivorous Kestrel	Robin (Herbivore)	Robin (Omnivore)	Robin (Insectivore)	Cottontail	Shrew	Deer Mouse	Earthworm	Plant
Chromium	12.77	1.6E-10	1.2E-09	8.0E-09	7.0E-06	1.2E-05	1.5E-05	1.0E-07	1.7E-05	4.2E-05	**5.552**	**5.321**
Lead	10.72	1.2E-09	5.2E-08	3.6E-07	5.1E-04	6.7E-04	7.7E-04	2.9E-06	1.5E-04	5.3E-04	0.0063	0.089
Nickel	7.47	2.4E-09	1.2E-08	1.9E-07	4.7E-05	2.0E-04	3.6E-04	1.5E-06	7.7E-04	2.2E-03	0.027	0.197
Benzoic acid	0.538	8.0E-10	na*	na	na	na	na	1.3E-05	5.4E-04	2.5E-03	na	na
Bis(2-ethylhexyl)phthalate	0.29	9.7E-08	3.5E-05	2.6E-05	1.5E-05	7.3E-03	1.5E-02	1.1E-08	4.9E-04	1.6E-03	na	na
Di-n-butyl phthalate	0.0774	6.2E-12	1.3E-06	4.6E-06	2.0E-04	3.7E-03	7.0E-03	4.8E-10	4.0E-07	1.2E-06	na	5.0E-04
2,3,7,8-TCDD	2.33E-07	7.8E-08	na	na	na	na	na	5.0E-07	8.0E-04	2.4E-03	4.7E-08	na
Adjusted HI		2E-07	4E-05	3E-05	8E-04	0.01	0.02	2E-05	0.003	0.009	**6**	**6**

Note: Bolded values indicate HQ greater than 0.3 or HI greater than 1.0.
* na = Not available.

~~**Table I-5.4-6**~~
~~**Adjusted HIs at SWMU 05-005(b)**~~

~~COPECs~~	~~EPC (mg/kg)~~	~~Red fox~~	~~Carnivorous Kestrel~~	~~Omnivorous Kestrel~~	~~Robin (Herbivore)~~	~~Robin (Omnivore)~~	~~Robin (Insectivore)~~	~~Cottontail~~	~~Shrew~~	~~Deer Mouse~~	~~Earthworm~~	~~Plant~~
~~Benzoic acid~~	~~0.538~~	~~4.6E-10~~	~~na*~~	~~na~~	~~na~~	~~na~~	~~na~~	~~1.3E-05~~	~~4.2E-04~~	~~1.7E-03~~	~~na~~	~~na~~
~~Bis(2-ethylhexyl)phthalate~~	~~0.29~~	~~7.2E-08~~	~~2.5E-05~~	~~1.9E-05~~	~~1.1E-05~~	~~5.3E-03~~	~~1.1E-02~~	~~1.1E-08~~	~~3.9E-04~~	~~1.1E-03~~	~~na~~	~~na~~
~~Di-n-butyl phthalate~~	~~0.0774~~	~~4.6E-12~~	~~9.4E-07~~	~~3.3E-06~~	~~1.5E-04~~	~~2.7E-03~~	~~5.2E-03~~	~~4.8E-10~~	~~3.4E-07~~	~~8.4E-07~~	~~na~~	~~4.8E-04~~
~~2,3,7,8-TCDD~~	~~2.33E-07~~	~~5.8E-08~~	~~na~~	~~na~~	~~na~~	~~na~~	~~na~~	~~4.8E-07~~	~~6.3E-04~~	~~1.6E-03~~	~~4.7E-08~~	~~na~~
~~**Adjusted HI**~~		~~1E-07~~	~~3E-05~~	~~2E-05~~	~~2E-04~~	~~0.008~~	~~0.02~~	~~1E-05~~	~~0.001~~	~~0.004~~	~~5E-08~~	~~5E-04~~

~~* na = Not available.~~

Table I-5.4-7
Adjusted HIs at SWMU 05-006(c)

COPECs	EPC (mg/kg)	Red Fox	Carnivorous Kestrel	Omnivorous Kestrel	Robin (Herbivore)	Robin (Omnivore)	Robin (Insectivore)	Cottontail	Shrew	Deer Mouse	Earthworm	Plant
Antimony	2.3	5.0E-09	na*	na	na	na	na	4.0E-05	3.5E-03	1.0E-02	0.03	**46**
Chromium	40.69	1.0E-10	1.0E-09	1.0E-08	8.0E-06	1.6E-05	2.0E-05	1.5E-07	2.0E-05	4.0E-05	**17.69**	**16.95**
Copper	70.5	2.0E-09	4.0E-08	6.4E-07	7.4E-04	1.3E-03	1.9E-03	1.3E-05	7.4E-04	2.2E-03	**0.88**	**1.01**
Lead	95.91	6.6E-09	2.5E-07	1.7E-06	2.5E-03	3.2E-03	3.7E-03	1.9E-05	7.7E-04	2.3E-03	0.06	**0.8**
Nickel	21.46	2.0E-09	1.0E-08	1.3E-07	5.2E-05	2.2E-04	4.1E-04	2.0E-06	8.8E-04	2.1E-03	0.08	**0.56**
2,3,7,8-TCDD	1.98E-07	1.7E-08	na	na	na	na	na	2.0E-07	2.7E-04	6.8E-04	4.0E-08	na
	Adjusted HI	3E-08	3E-07	2E-06	0.003	0.005	0.006	7E-05	0.006	0.02	**19**	**65**

Note: Bolded values indicate HQ greater than 0.3 or HI greater than 1.0.

* na = Not available.

~~**Table I-5.4-7**~~
~~**Adjusted HIs at SWMU 05-006(c)**~~

~~COPECs~~	~~EPC (mg/kg)~~	~~Red Fox~~	~~Carnivorous Kestrel~~	~~Omnivorous Kestrel~~	~~Robin (Herbivore)~~	~~Robin (Omnivore)~~	~~Robin (Insectivore)~~	~~Cottontail~~	~~Shrew~~	~~Deer Mouse~~	~~Earthworm~~	~~Plant~~
~~Antimony~~	~~2.3~~	~~1.5E-08~~	~~na*~~	~~na~~	~~na~~	~~na~~	~~na~~	~~7.9E-05~~	~~7.0E-03~~	~~1.9E-02~~	~~0.03~~	~~**46.0**~~
~~Copper~~	~~70.5~~	~~5.5E-09~~	~~1.3E-07~~	~~1.9E-06~~	~~1.4E-03~~	~~2.3E-03~~	~~3.4E-03~~	~~2.6E-05~~	~~1.5E-03~~	~~4.4E-03~~	~~**0.88**~~	~~**1.01**~~
~~Lead~~	~~95.91~~	~~7.7E-09~~	~~3.4E-07~~	~~2.3E-06~~	~~3.3E-03~~	~~4.4E-03~~	~~5.0E-03~~	~~2.6E-05~~	~~1.1E-03~~	~~3.2E-03~~	~~0.06~~	~~**0.80**~~
~~2,3,7,8-TCDD~~	~~1.98E-07~~	~~4.9E-08~~	~~na~~	~~na~~	~~na~~	~~na~~	~~na~~	~~4.1E-07~~	~~5.4E-04~~	~~1.4E-03~~	~~4.0E-08~~	~~na~~
	~~**Adjusted HI**~~	~~8E-08~~	~~5E-07~~	~~4E-06~~	~~0.005~~	~~0.007~~	~~0.008~~	~~1E-04~~	~~0.01~~	~~0.03~~	~~1~~	~~**48**~~

~~Note: Bolded values indicate HQ greater than 0.3 or HI greater than 1.0.~~

~~* na = Not available.~~

Table I-5.4-8
Summary of LOAEL-Based ESL for Terrestrial Receptors

COPEC	Receptor	LOAEL-Based TRV	TRV Unit	LOAEL-Based ESL (mg/kg soil)	Approach to Deriving the LOAELs/LOECs
Antimony	Plant	0.5	mg/kg	5.0E-01	The lowest observed effect concentration (LOEC) is derived from a LOEC with an unspecified exposure duration by applying an uncertainty factor of 0.1. The no observed effect concentration (NOEC) was derived from the same LOEC, except an uncertainty factor of 0.01 was applied.
Copper	Plant	497	mg/kg soil	4.97E+02	LOEC is extrapolated from EPA geometric mean NOEC data set (http://www.epa.gov/ecotox/ecossl/pdf/eco-ssl_copper.pdf). Applied an uncertainty factor of 5 for maximum acceptable toxicant concentrations (MATCs) and 10 for effective concentrations for 20% of the population (EC_{20}s) and calculated the geometric mean.
Lead	Plant	576	mg/kg soil	5.70E+02	LOEC is extrapolated from EPA geometric mean NOEC dataset (http://www.epa.gov/ecotox/ecossl/pdf/eco-ssl_lead.pdf). Applied an uncertainty factor of 5 for MATCs and calculated the geometric mean.

Notes: Some COPECs (e.g., inorganic chemicals from EPA Eco-SSL documents) do not have LOAELs or LOECs. In these cases, an uncertainty factor of 10 was applied to the NOAEL/NOEC (i.e., EC_{10} and EC_{20}) data in accordance with the acknowledged uncertainty between the LOAEL/LOEC and NOAEL/NOEC in Dourson and Stara (1983, 073474), Calbrese and Baldwin (1993, 110405), and EPA (http://www.epa.gov/epawaste/hazard/tsd/td/combust/ecorisk.htm). In the cases where EPA used MATCs for the NOAEL/NOEC data, an uncertainty factor of 5 was used to adjust to the LOAEL/LOEC because the MATC is between the NOAEL/NOEC and the LOAEL/LOEC.

Table I-5.4-8
Summary of LOAEL-Based ESL for Terrestrial Receptors

COPEC	Receptor	LOAEL-Based TRV	TRV Unit	LOAEL-Based ESL (mg/kg soil)	Approach to Deriving the LOAELs/LOECs
Antimony	Plant	0.5	mg/kg	5.00E-01	The lowest observed effect concentration (LOEC) is derived from a LOEC with an unspecified exposure duration by applying an uncertainty factor of 0.1. The no observed effect concentration (NOEC) was derived from the same LOEC, except an uncertainty factor of 0.01 was applied.
Chromium	Earthworm	23.94	mg/kg soil	2.30E+01	The total chromium LOEC is equal to the chromium(VI) LOEC multiplied by 7. The chromium(VI) LOEC is the geometric mean calculated from the same data set as the geometric mean NOEC for chromium(VI).
	Plant	12.6	mg/kg soil	1.20E+01	The total chromium LOEC is equal to the chromium(VI) LOEC multiplied by 7. The chromium(VI) LOEC is the geometric mean calculated from the same data set as the geometric mean NOEC for chromium(VI).
Copper	Earthworm	530	mg/kg soil	5.30E+02	The LOEC is extrapolated from the EPA geometric mean NOEC data set (http://www.epa.gov/ecotox/ecossl/pdf/eco-ssl_copper.pdf). An uncertainty factor of 5 is applied for the maximum allowable toxicity concentrations (MATCs) and 10 for effective concentrations (EC) 20s and the geometric mean was calculated.
	Plant	497	mg/kg soil	4.97E+02	The LOEC is extrapolated from the EPA geometric mean NOEC data set (http://www.epa.gov/ecotox/ecossl/pdf/eco-ssl_copper.pdf). An uncertainty factor of 5 is applied for the MATCs and 10 for EC for 20% of the population (EC_{20}) and the geometric mean was calculated.
Lead	Plant	576	mg/kg soil	5.70E+02	The LOEC is extrapolated from the EPA geometric mean NOEC data set (http://www.epa.gov/ecotox/ecossl/pdf/eco-ssl_lead.pdf). An uncertainty factor of 5 is applied for MATCs and the geometric mean was calculated.
Nickel	Plant	276	mg/kg soil	2.70E+02	The LOEC is extrapolated from the EPA geometric mean NOEC data set (http://www.epa.gov/ecotox/ecossl/pdf/eco-ssl_nickel.pdf). An uncertainty factor of 5 is applied for MATCs and the geometric mean was calculated.

Notes: Some COPECs (e.g., inorganic chemicals from EPA Eco-SSL documents) do not have LOAELs or LOECs. In these cases, an uncertainty factor of 10 was applied to the NOAEL/NOEC (i.e., EC_{10} and EC_{20}) data in accordance with the acknowledged uncertainty between the LOAEL/LOEC and NOAEL/NOEC in Dourson and Stara (1983, 073474), Calbrese and Baldwin (1993, 110405), and EPA (http://www.epa.gov/epawaste/hazard/tsd/td/combust/ecorisk.htm). In the cases where EPA used MATCs for the NOAEL/NOEC data, an uncertainty factor of 5 was used to adjust to the LOAEL/LOEC because the MATC is between the NOAEL/NOEC and the LOAEL/LOEC.

Table I-5.4-9
HI Analysis Using LOAEL-Based ESL for SWMU 05-005(b)

COPECs	EPC (mg/kg)	Earthworm	Plant
Chromium	12.77	**0.6**	**1.1**
	HI	0.6	1

Note: Bolded values indicate HQ greater than 0.3 or HI greater than 1.

Table I-5.4-10
HI Analysis Using LOAEL-Based ESL for SWMU 05-006(c)

COPECs	EPC (mg/kg)	Earthworm	Plant
Antimony	0.887	n/a*	**1.8**
Chromium	40.69	**1.8**	**3.4**
Copper	70.5	0.13	0.14
Lead	95.91	n/a	0.17
Nickel	21.46	n/a	0.08
	HI	**2**	**6**

Note: Bolded values indicate HQ greater than 0.3 or HI greater than 1.
*n/a = Not applicable.

~~**Table I-5.4-9**~~
~~**HI Analysis Using LOAEL-Based ESL for SWMU 05-006(c)**~~

~~COPECs~~	~~EPC (mg/kg)~~	~~Plant~~
~~Antimony~~	~~0.887~~	~~**1.8**~~
~~Copper~~	~~70.5~~	~~0.14~~
~~Lead~~	~~95.91~~	~~0.17~~
	~~**HI**~~	~~**2**~~

~~Note: Bolded values indicate HQ greater than 0.3 or HI greater than 1.~~