Appendix H

Risk Assessments

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H-1.0 INTRODUCTION

This appendix presents the results of the human health and ecological risk-screening evaluations conducted in support of the environmental characterization of sites within the Threemile Canyon Aggregate Area, located in the western portion of Los Alamos National Laboratory (LANL or the Laboratory). The evaluations of potential risk at 25 solid waste management units (SWMUs) and areas of concern (AOCs) are based on decision-level data from historical (1994 and 1998) and 2009–2010 investigations.

H-2.0 BACKGROUND

Brief descriptions of the Threemile Canyon Aggregate Area SWMUs and AOCs assessed for potential risk and dose are presented below.

H-2.1 Site Descriptions and Operational History

Former Technical Area 12 (TA-12), also known as L-Site, was constructed during World War II and used as an explosives testing facility. An open area was used as the firing site where a number of shots were detonated, including one 70-kg charge (LANL 1996, 054086, p. 1-1). In 1950, a radiation test bunker was constructed at former TA-12 to conduct radiation experiments on animals using a radioactive lanthanum-140 source. Because of these radiation experiments, a section of the perimeter became contaminated. In 1951, DE-1 began using the area, firing several shots per month (LANL 1994, 034755). By 1960, the entire site was vacated, and activities ceased. Activities at former TA-12 ceased in the early 1950s. In 1960, the structures were decontaminated, decommissioned, and intentionally burned (LANL 1996, 054086, p. 1-1). A Laboratory group used part of the site during the Vietnam War for “Mortar Locator” experiments, which involved using an acetylene gas gun. Former TA-12 is no longer used for Laboratory operations (LANL 1994, 034755, p. 1-8). In 1989, the Laboratory redefined TA boundaries. Most of former TA-12 is now within the boundary of TA-67, and the remaining area is within the boundary of TA-15. Two former TA-12 sites in this investigation [AOCs 12-004(a) and 12-004(b)] are located in the northeast corner of TA-15. The other eight former TA-12 sites are located in the western portion of TA-67. In 2000, the Cerro Grande fire moved through former TA-12, damaging or destroying vegetation and remaining surface debris (LANL 1994, 034755, p. 1-8).

TA-14 was established during World War II and used by X Division to test explosives beginning in 1944 (LANL 1996, 054086, p. 1-1). This site was used primarily for close-observation work on small explosives charges. Tests were conducted in open and closed firing chambers (LANL 1996, 054086, p. 1-1). Some of these tests used radioactive materials (LANL 1994, 034755). In 1994, experimental high explosive (HE) was subjected to performance testing. TA-14 remains active with scheduled tests at the firing area and bullet test facility (LANL 1994, 034755, p. 1-11). In May 2000, the Cerro Grande fire moved through this area, and surface structures were damaged or destroyed, along with surface and over-story vegetation.

TA-15 was established in 1945 as a firing site area. Current activities at TA-15 consist of HE research, development, and testing, mainly through hydrodynamic testing and dynamic experimentation. Many large explosive tests have taken place with the concurrent scattering of large amounts of natural uranium or depleted uranium (DU) and, to a lesser extent, beryllium and lead (LANL 1994, 040595).

TA-36 is located east of TA-15 and south of Pajarito Road. TA-36 contains four active firing sites (Eenie, Meenie, Minie, and Lower Slobovia) that support explosives testing. The firing sites and associated buildings are used for a wide variety of nonnuclear ordinance tests for the U.S. Department of Defense. Activities include shipping, receiving, transporting, and testing HE; developing diagnostic techniques; testing

armor/anti-armor systems; and testing weapons components and guns (LANL 1993, 015313, p. 2-5). TA-36 operations associated with the Threemile Canyon Aggregate Area include a laboratory and an experiment facility located on a mesa top south of Threemile Canyon and west of TA-18.

H-2.1.1 SWMUs 12-001(a) and 12-001(b)

SWMU 12-001(a) is a belowground, steel-lined firing pit and aboveground steel cover (structure 12-4). The firing pit is located on the north side of Redondo Road. The firing pit began operation in 1944 (LANL 1994, 034755, p. 5-1-1). The hexagonal steel structure is 10.5 ft long × 10.5 ft wide × 11.5 ft deep. A steel cover, a large box filled with soil, is 20 ft long × 22 ft wide × 5 ft high. The base of the cover is at ground level and has 1-ft-high × 7-ft-long openings on four sides. The cover has a 5-ft × 5-ft hole in the center used to lower explosives into the firing area. Recovery shots, which used uranium, were conducted in the pit. Activities ceased in 1953, but the pit remains in place (LANL 1996, 055073, p. 1).
SWMU 12-001(a) was evaluated with a drainage located within Consolidated Unit 12-001(a)-99 in the area below SWMU 12-001(a).

SWMU 12-001(b) is a firing pit located on the north side of Redondo Road. The open pit was 21 ft long × 17 ft wide × 3 ft deep, and the pit was used for calorimetric experiments but only for a short period in 1945. Following World War II, the pit was used to fire HE shots using lead and uranium. This site ceased operations in the 1950s (LANL 1994, 034755, p. 5-1-5).

H-2.1.2 SWMU 12-002

SWMU 12-002 is a small area approximately 3 ft^2 that was used on one occasion to burn scrap HE. In 1962, a can containing approximately 0.5 lb of HE was discovered during a property survey and burned to destroy the HE (Anderson 1962, 004860; LANL 1994, 034755, p. 6-3). The location of SWMU 12-002 now lies beneath the asphalt pavement of Redondo Road.

H-2.1.3 AOC 12-004(a)

AOC 12-004(a) consists of the lanthanum radiation experiment site at former TA-12 and the surrounding area, including a drainage (LANL 1994, 034755, p. 5.2-1). The site contains a soil-bermed radiation shelter (structure 12-8) and three vertical poles. The shelter and poles are constructed in a line parallel to a drainage channel that flows southwest from Redondo Road into Threemile Canyon. The northernmost pole is located in a drainage 30 ft south of Redondo Road. The second pole is located 58 ft south of the first pole. The radiation shelter and the third pole are located 40 ft south of the second pole (LANL 1996, 054086, pp. 5-18–5-24).

H-2.1.4 AOC 12-004(b)

AOC 12-004(b) was an aluminum pipe at the edge of Redondo Road, about 78 ft north of a radiation shelter (structure 12-8). The pipe was set vertically in the ground and protruded 8 in. aboveground without a cover. The pipe's outer opening diameter was 25.5 in., its inner diameter was 18 in., and its length was 3 ft. The inside of the pipe was filled with soil. Remnant fragments of HE were observed at the site in 1959 (Blackwell 1959, 005773). The pipe was removed during the 2009–2010 investigation.

H-2.1.5 AOC C-12-001

AOC C-12-001 is an area of potential soil contamination at former TA-12, associated with the former trim building 12-1. The trim building was built in 1944 and was used to prepare HE for detonation. The building was 16 ft long × 16 ft wide × 9 ft high and of wood-frame construction with soil on three sides and on top. Activities at former TA-12 ceased in the early 1950s. Building 12-1 was destroyed in 1960 by intentional burning. Some noncombustible debris was in place when the Operable Unit 1085 work plan was written (LANL 1994, 034755) but has since been removed.

H-2.1.6 AOC C-12-002

AOC C-12-002 is an area of potential soil contamination associated with former control building 12-2. Built in 1945 of wood-frame construction, the building measured 8 ft long × 8 ft wide × 8 ft high, with soil on three sides and on top. The structure was located south of Redondo Road. Activities at former TA-12 ceased in the early 1950s, and the control building was destroyed in 1960 by intentional burning.

H-2.1.7 AOC C-12-003

AOC C-12-003 is an area of potential soil contamination at former TA-12 associated with a former HE-storage magazine (building 12-3) for the former TA-12 firing sites. The magazine, built in 1944 of wood-frame construction, was 6 ft long × 6 ft wide × 7 ft high, with soil on three sides and on top. The building was located north of Redondo Road. Activities at former TA-12 ceased in the early 1950s. In 1960, intentional burning destroyed building 12-3.

H-2.1.8 AOC C-12-004

AOC C-12-004 is an area of potential soil contamination at former TA-12 associated with former generator building 12-5. The generator building was built of wood-frame construction and was originally located next to a former junction box (structure 12-6). In 1952, the generator building was relocated 10 ft north of the former control building 12-2. Activities at former TA-12 ceased in the early 1950s. The building was destroyed in 1960 by intentional burning (LANL 1996, 054086, pp. 5-12–5-15).

H-2.1.9 AOC C-12-005

AOC C-12-005 is the location of a former junction box (structure 12-6) at former TA-12. The junction box was used to support experiments at the SWMUs 12-001(a) and 12-001(b) firing sites. The junction box was 3 ft long × 3 ft wide × 4 ft high and was surrounded on three sides by a soil berm. The junction box served as a relay between former control building 12-2 and the two firing sites and housed diagnostic equipment, signal cables, and electrical power equipment. Approximately 750 ft of detonation wire connected the junction box to building 12-2. The junction box, constructed in 1945, was not used after 1953; it was intentionally burned in 1960 (LANL 1994, 034755, p. 5-1-5).

H-2.1.10 AOC C-14-006

AOC C-14-006 is an area of potential soil contamination at TA-14 associated with an HE-storage magazine, former building 14-9, located 60 ft northwest of building 14-22. The magazine, which was constructed of wood, was 6 ft long × 6 ft wide × 6 ft high. A soil berm surrounded three sides, and soil covered the top of the structure. The magazine was built in 1945 and removed in 1952. The former magazine location is covered with loose fill. An asphalt road that circled the magazine is still visible (LANL 1996, 054086, pp. 5-61–5-64).

H-2.1.11 AOC 15-005(c)

AOC 15-005(c) consists of an outdoor container storage area for explosives, located near storage building 15-41 in the central portion of TA-15 near Firing Site C. The ground surface on the northern, western, and eastern sides of the building is unpaved, and an asphalt road (Priscilla Road) runs along the southern side. The operational period of this site is not known (LANL 1993, 020946, p. 10-18).

H-2.1.12 SWMU 15-007(c)

SWMU 15-007(c) is an underground shaft (structure 15-264) at TA-15 that was used to conduct a single test involving approximately 2 tons of HE in 1972. This test was designed to determine the ability of tuff to absorb the explosion. The explosion was confined to the bottom of the shaft, which was filled with layers of magnetite, cement, sand grout, bentonite, sand, and gravel. HE was the only material used in the underground test (LANL 1993, 020946, p. 5-9). Pieces of 0.25-in.-diameter lead shot were scattered on the concrete pad at the surface of the shaft. The source of this lead was probably the bags of lead shot used for instrument shielding during the experiment. Lead shot is also present on the soil on three sides of the pad (LANL 1997, 056562, p. 1).

H-2.1.13 SWMU 15-007(d)

The SWMU 15-007(d) shaft (structure 15-265) was used in 1972 to conduct a single test involving beryllium, HE, and tritium. This test was designed to determine the ability of tuff to absorb the explosion. The explosion was confined to the bottom of the shaft, which was filled with layers of magnetite, cement, sand grout, bentonite, sand, and gravel. Pieces of 0.25-in.-diameter lead shot were scattered on the concrete pad at the surface of the shaft. The source of this lead was probably the bags of lead shot used for instrument shielding during the experiment. Lead shot is also present on the soil on three sides of the pad (LANL 1997, 056562, p. 1).

H-2.1.14 SWMU 15-008(b)

SWMU 15-008(b) is a surface disposal area at TA-15, located north of Firing Site R-44 [SWMU 15-006(c)] and extending along the edge of the mesa and downslope into Threemile Canyon. The surface disposal area covers approximately 8.5 acres. Firing Site R-44 was built in 1951 for diagnostic tests of weapons components and used extensively until 1978 and sporadically until 1992 (LANL 1993, 020946, p. 6-8; LANL 1995, 050294, p. 4-73). Soil and debris from the firing site activities were disposed of at SWMU 15-008(b).

H-2.1.15 AOC 15-008(g)

AOC 15-008(g) is the location of a former pile of broken sandbags located in TA-15 at Firing Site R-45 [SWMU 15-006(d)]. The sandbags were used as shielding for the explosives tests carried out at the firing site (LANL 1996, 054977, p. 5-103). Firing Site R-45 was constructed in 1951 and used until 1992 for experiments involving small amounts of explosives. A site visit in 2008 determined the sandbags had been removed.

H-2.1.16 SWMU 15-009(b)

SWMU 15-009(b) is a septic system located at TA-15 Firing Site R-45. The septic system consists of a tank (structure 15-61), a seepage pit, associated drainlines, and a former outfall (LANL 2003, 102118). The septic tank was constructed in 1951 of reinforced concrete with a 540-gal. capacity (LANL 1990, 007512). This septic system received effluent from restroom facilities in the firing site control building 15-45 (LANL 1990, 007512). The septic tank originally discharged to an outfall. In the 1970s, a 4-ft-diameter × 50-ft-deep seepage pit was constructed to receive effluent from the tank, and the outfall pipe was plugged (LANL 2003, 102118).

H-2.1.17 SWMU 15-009(c)

SWMU 15-009(c) is a septic system located at TA-15 Firing Site R-44. The septic system consists of a tank (structure 15-62), its associated drainlines, and an outfall (LANL 2003, 102119). The septic tank was constructed in 1951 of reinforced concrete with a 540-gal. capacity (LANL 1990, 007512). The septic system received effluent from restroom facilities in the firing site control building 15-44 (LANL 1994, 040595, p. 7). The drainlines were constructed of cast iron and discharged to an outfall into the south fork of Threemile Canyon. The outfall is located approximately 25 ft downgradient of the tank (LANL 2003, 102119). An engineering drawing showed that the outfall has been plugged (LANL 2003, 102119).

H-2.1.18 SWMU 15-009(h)

SWMU 15-009(h) is a septic system located at the Ector firing site on the eastern side of TA-15 (LANL 2003, 102117). The septic system consists of a tank (structure 15-282), associated drainlines, and a drain field. The septic tank was constructed in the late 1970s of reinforced concrete with a 905-gal. capacity and flowed to a drain field (LANL 1990, 007512; LANL 1994, 040595, p. 8). The septic system received effluent from restroom facilities in the Ector firing site control building 15-280 (LANL 1990, 007512). In the 1990s, the sanitary waste drainlines that served this septic system were rerouted to the SWSC plant and are currently active (LANL 2003, 102117).

H-2.1.19 SWMU 15-010(b)

SWMU 15-010(b) is a settling tank (structure 15-147) (LANL 2004, 102120) located in the northwest corner of TA-15 near former shop building 15-8. The tank is constructed of concrete and measures 5 ft long × 5 ft wide × 5.5 ft deep with an approximate 900-gal. capacity (LANL 1990, 007512). The settling tank served former building 15-8, which housed HE-machining operations during the 1950s, and discharged to an outfall at the edge of Threemile Canyon (LANL 1993, 020946, p. 10-25). The tank was constructed in 1947 and was originally designed to be a septic tank; however, subsequent engineering records confirm the tank was also used as an HE settling tank.

H-2.1.20 AOC 15-014(h)

AOC 15-014(h) consists of three outfalls located in the northwest corner of TA-15. The outfalls served a former laboratory and office (former building 15-40). All three outfalls daylight north of former building 15-40 and discharge to Threemile Canyon (LANL 1990, 007512; LANL 1993, 020946, p. 10-22).

The western-most outfall is a former National Pollutant Discharge Elimination System– (NPDES-) permitted outfall that received industrial effluent, including wastewater from a photographic laboratory from former building 15-40. This outfall consists of an 8-in.-diameter vitrified-clay pipe (VCP) that daylights approximately 75 ft north of the northwest corner of former building 15-40 (LANL 1990, 007512; LANL 1993, 020946, p. 10-22). The outfall was removed from the NPDES permit in 1994 (Dale 1998, 057524).

The middle outfall is a former NPDES-permitted outfall that received noncontact cooling water, roof runoff, and floor-drain effluent from former building 15-40. The floor drains received water from drain valves in a potable water system. This outfall consists of an 8-in.-diameter VCP that daylights approximately 100 ft north of the northeast corner of former building 15-40 (LANL 1990, 007512; LANL 1993, 020946, p. 10-22). The outfall was removed from the NPDES permit in 1990 (EPA 1990, 012454).

The eastern-most outfall receives storm water from yard drains and is located north and east of former building 15-40. This outfall consists of a 12-in.-diameter corrugated metal pipe that daylights approximately 75 ft northeast of the northeast corner of former building 15-40 (LANL 1990, 007512; LANL 1993, 020946, p. 10-22). From the outfall, an approximately 60-ft-long ditch connects to a 30-ft-long, 12-in.-diameter corrugated metal pipe that accommodates drainage beneath a security fence.

H-2.1.21 SWMU 36-002

SWMU 36-002 is a former sump (former structure 36-49) located at TA-36, approximately 40 ft northwest of building 36-48 near the edge of Threemile Canyon (LASL 1965, 102122). The sump consisted of a 4-ft-diameter × 4.5-ft-long section of corrugated metal pipe placed into an unlined 8-ft-deep excavation. The excavation and the interior of the pipe were filled with 3-in.-diameter rocks to a depth of approximately 2 ft belowgrade. The remainder of the excavation outside the pipe was backfilled to grade with soil, and the pipe was covered with a metal cover (LANL 1993, 015313, p. 5-13). The sump had an inlet pipe from building 36-48 that consisted of 4-in.-diameter VCP.

The sump was constructed in 1965 and received water from two sinks in building 36-48 (LANL 1993, 015313, p. 5-13). Building 36-48 was initially used for shot assembly and for controlled-temperature experiments. DU was cut, lapped, and polished in the building. One of the sinks connected to the sump had a chemical-resistant coating. The building was used infrequently, less than 10 times per year (LANL 1993, 015313, p. 5-15). The sinks were disconnected from the sump in 1993, and the sump was removed (LANL 1993, 015313, p. 5-15; LANL 1995, 062839, p. 1-1).

H-2.1.22 SWMU 36-003(a)

SWMU 36-003(a) is a septic system located at TA-36 approximately 115 ft east of building 36-1. The septic system consists of a septic tank (structure 36-17), associated drainlines, a manhole (structure 36-38), a distribution box/drain field, and a seepage pit (LASL 1965, 102122; LANL 2004, 102121). The septic tank is a single-chamber tank constructed of reinforced concrete with an 1160-gal. capacity. The drain field consists of four 200-ft-long perforated tile pipes spaced 10 ft apart. The drain field was replaced with the seepage pit in late 1973 or early 1974.

This septic system was constructed in 1949 and received effluent from the restroom facilities in an office and laboratory in building 36-1. In addition to sanitary wastes, spent photoprocessing chemicals from x-ray developing may have been discharged to the septic system (LANL 1993, 015313, pp. 5-24, 5-27). The main guard station at TA-36 (building 36-22) was later added to the septic system. In 1988, the guard station was disconnected from the septic tank and rerouted to an adjacent septic system. In 1992, the sanitary waste drainlines that previously served SWMU 36-003(a) were rerouted to the SWSC plant and

are currently active (LANL 1993, 015313, pp. 5-22–5-23). In 1995, the septic tank was decontaminated by steam cleaning and the tank was filled with concrete.

H-2.1.23 SWMU 36-008

SWMU 36-008 is a surface disposal area located at TA-36 on the south rim of Threemile Canyon behind building 36-1. The disposal area covers an estimated 1 to 2 acres and extends below the building over the steeply sloping edge of the mesa. The dates the site was used for disposal are not known, but the site appears to be associated with building 36-1 (an office and laboratory), which was constructed in 1949. Materials disposed of at the site included laboratory glassware, metal cans, metal pipe, miscellaneous metal pieces, and other debris. This disposal area was revealed in June 2000 after the Cerro Grande fire burned the vegetation surrounding the site. As part of the emergency response actions associated with the fire, approximately 5 yd^3 of debris was collected from the site, segregated, and staged for disposal. Also, as part of the emergency response action, storm water best management practices were implemented to prevent erosion (LANL 2000, 068656).

H-2.1.24 SWMU C-36-003

SWMU C-36-003 is a former NPDES-permitted outfall located at TA-36 on the south rim of Threemile Canyon, north of office and laboratory building 36-1. The outfall received effluent from a floor drain and spent photoprocessing chemicals from a sink in building 36-1 (an office and laboratory). The outfall became operational shortly after building 36-1 was constructed in 1949. During its operation, the outfall discharged a steady stream of liquid that ran downstream for approximately 35 ft (LANL 1993, 015313, pp. 5-63 to 5-64). During a July 1994 sampling effort, it was found that the photoprocessing unit was no longer plumbed to the outfall; instead, a floor drain in room 6 of building 36-1 was plumbed to the outfall (LANL 1995, 053985, p. 1-16). This outfall was removed from the NPDES permit by 2001 (EPA 2001, 082282). SWMU C-36-003 is entirely contained within the footprint of SWMU 36-008, so risk is evaluated for these sites as a single unit.

H-2.2 Investigation Sampling

The final data set used to identify chemicals of potential concern (COPCs) for the Threemile Canyon Aggregate Area and used in this appendix to evaluate the potential risks to human health and the environment are the qualified analytical results from historical sampling activities (1994 and 1999) and the 2009–2010 investigation. Only those data determined to be of decision-level quality following the data quality assessment (Appendix D) are included in the final data set evaluated in this appendix.

H-2.3 Determination of COPCs

Section 5.0 of the supplemental investigation report summarizes the COPC selection process. Only COPCs detected above background (inorganic chemicals and naturally occurring radionuclides), with detection limits greater than background values (BVs) (inorganic chemicals), and detected (organic chemicals, inorganic chemicals with no BVs, and fallout radionuclides were retained. The industrial scenario and the ecological screening used data for samples collected from 0.0–1.0 ft and 0.0–5.0 ft below ground surface (bgs), respectively. The recreational scenario also used data for samples collected from 0.0–1.0 ft bgs. The residential scenario used data for samples collected from 0.0–10.0 ft bgs. However, sampling depths often overlapped because of multiple investigations; therefore, samples with a starting depth less than the lower bound of the interval were included in the risk-screening assessments for a given scenario, as appropriate.

Tables H-2.3-1 to H-2.3-531 summarize the COPCs evaluated for potential risk for each site in the Threemile Canyon Aggregate Area. Some of the COPCs identified in this report may not be evaluated for potential risk under one or more scenarios because they were not within the specified depth intervals associated with a given scenario.

H-3.0 CONCEPTUAL SITE MODEL

The primary mechanisms of release related to historical contaminant sources are described in detail in the historical investigation report (LANL 2008, 102244) and summarized in section 2.0 of the approved investigation work plan (LANL 2008, 105673; NMED 2008, 104256). Releases from sites within the Threemile Canyon Aggregate Area may have occurred as a result of air emissions, surface releases, subsurface leaks, or effluent discharges. Previous sampling results indicated contamination from inorganic chemicals, organic chemicals, and radionuclides (LANL 2010, 111324.14; NMED 2010, 111458).

H-3.1 Receptors and Exposure Pathways

The primary exposure pathway for human receptors is surface soil and subsurface soil/tuff that may be brought to the surface through intrusive activities. Migration of contamination to groundwater through the vadose zone is unlikely given the depth to groundwater (greater than 1000 ft bgs). 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 the resident ~~and the construction worker~~, where appropriate. Migration of contamination to groundwater through the vadose zone is unlikely given the depth to groundwater (greater than 1000 ft bgs) at the site. The exposure pathways are the same as those for surface soil. Sources, exposure pathways, and receptors are shown in the conceptual site model (CSM) (Figure H-3.1-1).

New Mexico Environment Department (NMED) guidance (NMED 2015, 600915) requires that sites larger than 2 acres be evaluated to determine if beef ingestion is a plausible and complete exposure pathway. The SWMUs and AOCs within the Threemile Canyon Aggregate Area are generally smaller than 2 acres. The exceptions are SWMUs 12-001(a), 12-001(b), and 15-008(b), and AOC 15-014(h). In addition, grazing is not allowed on Laboratory property. Therefore, further evaluation of the beef ingestion pathway is not necessary.

Many of the sites in the Threemile Canyon Aggregate Area are in industrial areas on Laboratory property. The developed sites provide minimal or no potential habitat for ecological receptors, especially where the sites are covered with asphalt. Some sites [SWMUs 15-007(d), 15-009(h), and 36-002] were not evaluated for industrial exposure because samples were not collected from the 0.0−1.0 ft depth interval. 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 5.0 ft (ecological) or 10.0 ft (human health) are not complete unless contaminated soil or tuff was excavated and brought to the surface.

Considering unpaved sites or areas where potential habitat is present, exposure pathways are complete to surface soil and tuff for ecological receptors. The potential pathways are root uptake by plants, inhalation of vapors (burrowing animals only), 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 exposure was not evaluated because surface water features do not exist. Sources, exposure pathways, and receptors are presented in the CSM (Figure H-3.1-1).

H-3.2 Environmental Fate and Transport

The evaluation of environmental fate addresses the chemical processes affecting the persistence of chemicals in the environment, and the evaluation of transport addresses the physical processes affecting mobility along a migration pathway. Migration into soil and tuff depends on precipitation or snowmelt, soil moisture content, depth of soil, soil 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 also limited by a lack of hydrostatic pressure as well as the 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 in the supplemental investigation report. Results from the deepest samples collected at most sites showed either no detected concentrations of COPCs or low- to 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 discussed above. Given how long the contamination has been present in the subsurface, the physical and chemicals properties of the COPCs, and the lack of saturated conditions, the potential for contaminant migration to groundwater is very low.

NMED guidance (NMED 2015, 600915) 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) may 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). Furthermore, this assumption is inappropriate for cases such as these Threemile Canyon Aggregate Area sites where sampling has shown that contamination is vertically bounded near the surface and the distance from the surface to the water table is large. 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 and the potential for ion exchange (barium and other inorganic chemicals) 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.

Current potential transport mechanisms that may lead to exposure include

- dissolution and/or particulate transport of surface contaminants during precipitation and runoff events,
- airborne transport of contaminated surface soil,

- continued dissolution and advective/dispersive transport of chemical contaminants contained in subsurface soil and tuff as a result of past operations,
- disturbance of contaminants in shallow soil and subsurface tuff by Laboratory operations, and
- disturbance and uptake of contaminants in shallow soil by plants and animals.

Contaminant distributions at the sites indicate that after the initial deposition of contaminants from operational activities and historical remediation efforts, elevated levels of COPCs tend to remain concentrated in the vicinity of the original release points. The primary potential release and transport mechanisms identified for Threemile Canyon Aggregate Area include direct discharge; precipitation, sorption, and mechanical transport; dissolution and advective transport in water; and volatilization, diffusion, and dispersion. Less significant transport mechanisms include wind entrainment and, given the asphalt pavement covering most sites, dispersal of surface soil and uptake of contaminants from soil and water by biota.

Gas or vapor-phase contaminants such as VOCs are likely to volatilize to the atmosphere from near-surface soil and sediment and/or migrate by diffusion through air-filled pores in the vadose zone. Migration of vapor-phase contaminants from tuff into ambient air may occur by diffusion or advection driven by barometric pressure changes.

H-3.2.1 Inorganic Chemicals

In general, and particularly in a semiarid climate, inorganic chemicals are not highly soluble or mobile in the environment, although there are exceptions. The physical and chemical factors that determine the distribution of inorganic COPCs within the soil and tuff at the Threemile Canyon Aggregate Area are the soil-water partition coefficient (K_d) of the inorganic chemicals, the pH of the soil, soil characteristics (such as sand or clay content), and oxidation-reduction potential (Eh). The interaction of these factors is complex, but the K_d values provides 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 ones. 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 H-3.2-1 presents the K_d values and water solubility for the inorganic COPCs for the Threemile Canyon Aggregate Area. Based on this criterion, the following COPCs have a low potential to mobilize and migrate through soil and the vadose zone: aluminum, antimony, barium, beryllium, cadmium, chromium, cobalt, lead, manganese, mercury, nickel, thallium, vanadium, and zinc. The K_d values for arsenic, copper, cyanide, iron, perchlorate, selenium, silver, and uranium are less than 40 and may indicate a greater potential to mobilize and migrate through soil and the vadose zone beneath the sites.

It is important to note that other factors besides the K_d values (e.g., speciation in soil, oxidation-reduction potential, pH, and soil mineralogy) also play significant roles in the likelihood that inorganic chemicals will migrate. The COPCs with K_d values less than 40 are discussed further below. 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, and http://www.atsdr.cdc.gov/toxprofiles/index.asp).

Arsenic may undergo a variety of reactions, including oxidation-reduction reactions, ligand exchange, precipitation, and biotransformation. Arsenic forms insoluble complexes with iron, aluminum, and magnesium oxides found in soil and in this form, arsenic is relatively immobile. However, under low pH and reducing conditions, arsenic can become soluble and may potentially leach into groundwater or result in runoff of arsenic into surface waters. Arsenic is expected to have low mobility under the environmental conditions (neutral to slightly alkaline soil pH and oxidizing near-surface conditions) present at the Threemile Canyon Aggregate Area.

Copper movement in soil is determined by physical and chemical interactions with the soil components. Most copper deposited in soil will be strongly adsorbed and remains in the upper few centimeters of soil. Copper will adsorb to organic matter, carbonate minerals, clay minerals, or 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. Soil in the area is neutral to slightly alkaline, so the leaching of copper is not a concern at this site. 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.

Cyanide tends to adsorb onto various natural media, including clay and sediment; however, sorption is insignificant relative to the potential for cyanide to volatilize and/or biodegrade. At soil surfaces, volatilization of hydrogen cyanide is a significant mechanism for cyanide loss. Cyanide at low concentrations in subsurface soil is likely to biodegrade under both aerobic and anaerobic conditions. Cyanide is present at the site in trace to low levels and is not expected to be mobile.

Iron is naturally occurring in soil and tuff and may be relatively mobile under reducing conditions. Iron is sensitive to soil pH conditions, occurring in two oxidation states, iron(III), the insoluble oxidized form, and iron(II), the reduced soluble form. Most iron in well-drained neutral-to-alkaline soil is present as precipitates of iron(III) hydroxides and oxides. With time, these precipitates are mineralized and form various iron minerals, such as lepidcrocite, hematite, and goethite. Iron is not expected to be mobile in the neutral to slightly alkaline, well-drained soil at the Threemile Canyon Aggregate Area.

Perchlorate is somewhat soluble in water and may migrate with water molecules in saturated soil. As noted above, the subsurface material beneath the 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 soil pH in the Threemile Canyon Aggregate Area is neutral to slightly alkaline, indicating that selenium is not likely to migrate.

Natural processes, such as the weathering of rock and the erosion of soil release silver to air and water. 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 that they may potentially migrate into the subsurface. Site conditions are neutral to slightly alkaline and silver is not expected to be mobile.

Uranium is a natural and commonly occurring radioactive element that is present in nearly all rock and soil. The mobility of uranium in soil and its vertical transport to groundwater depend on properties of the soil such as pH, Eh, concentration of complexing anions, porosity of the soil, soil-particle size, and sorption properties as well as the amount of water available. In general, the actinide nuclides form comparatively insoluble compounds in the environment and therefore are 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 tend to accumulate in soil and sediment, which ultimately serve as strong reservoirs. Subsequent movement is largely associated with geological processes such as erosion and sometimes leaching.

H-3.2.2 Organic Chemicals

Table H-3.2-2 presents the physical and chemical properties (organic carbon-water partition coefficient [K_{oc}], logarithm to the base 10 octanol/water partition coefficient [log K_{ow}], and solubility) of the organic COPCs identified for the Threemile Canyon Aggregate Area. The 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 of COPCs at the Threemile Canyon Aggregate Area. 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. Several detected at the Threemile Canyon Aggregate Area sites have water solubilities greater than 1000 mg/L, including acetone; benzoic acid; bromodichloromethane; 2-butanone; chlorodibromomethane; chloroform; chloromethane; 2-chloronaphthalene; di-n-butylphthalate; 1,1-dichloroethene; 2-hexanone; HMX (1,3,5,7-tetranitro-1,3,5,7-tetrazocine); methylene chloride; trichloroethene; and 2,4,6-trinitrotoluene.

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, are slightly prone to biodegradation, and are metabolized in plants and animals. The COPCs identified as having water solubilities less than 10 mg/L are anthracene; Aroclor-1242; Aroclor-1254; Aroclor-1260; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(g,h,i)perylene; benzo(k)fluoranthene; bis(2-ethylhexyl)phthalate; butylbenzylphthalate; chrysene; di-n-octylphthalate; dibenzofuran; fluoranthene; indeno(1,2,3-cd)pyrene; phenanthrene; and pyrene.

Vapor pressure is a chemical characteristic used to evaluate the tendency of organic chemicals to volatize. Chemicals with vapor pressure greater than 0.01 mmHg 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 towards groundwater. Acetone; bromodichloromethane; 2-butanone; chlorodibromomethane; chloroform; chloromethane; 4-chlorotoluene; 1,1-dichloroethene; ethylbenzene; 2-hexanone; 4-isopropyltoluene; methylene chloride; styrene; tetrachloroethene; toluene; trichloroethene; 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; 1,2-xylene; and 1,3-xylene+1,4-xylene have vapor pressures greater than 0.01 mmHg.

Chemicals with vapor pressures less than 0.000001 mm Hg are less likely to volatilize and, therefore, tend to remain immobile. Many of the polycyclic aromatic hydrocarbons (PAHs); bis(2-ethylhexyl)phthalate; di-n-octylphthalate; HMX; PETN (pentaerythritol tetranitrate); RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine); TATB (triaminotrinitrobenzene); and tetryl have vapor pressures less than 0.000001 mm Hg.

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} above 1000, the greater the affinity the chemical has for bioaccumulation/bioconcentration in the food chain, the greater the potential for sorption in the soil, and the lower the mobility (Ney 1995, 058210). Butylbenzenes, ethylbenzene, HMX, isopropylbenzene, 4-isopropyltoluene, PAHs, phthalates, tetrachloroethene, trimethylbenzenes, and xylenes all have a K_{ow} greater than 1000. A K_{ow} of less than 500 indicates high water solubility, mobility, little to no affinity for bioaccumulation, and degradability by microbes, plants, and animals. Acetone; benzoic acid;

bromodichloromethane; 2-butanone; chlorodibromomethane; chloroform; chloromethane; 1,1-dichloroethene; 2-hexanone; methylene chloride; PETN; TATB; tetryl; and trichloroethene all have a K_{ow} much less than 500.

The K_{oc} measures the tendency of a chemical to adsorb to organic carbon in soil. K_{oc} values above 500 cm^3/g indicate a strong tendency to adsorb to soil, leading to low mobility (NMED 2015, 600915). Most organic COPCs have K_{oc} values above 500 cm^3/g, indicating a very low potential to migrate toward groundwater. The organic COPCs with K_{oc} values less than 500 cm^3/g include acetone; 4-amino-2,6-dinitrotoluene; benzoic acid; bromodichloromethane; 2-butanone; chlorodibromomethane; chloroform; chloromethane; 2-chloronaphthalene; 4-chlorotoluene; di-n-butylphthalate; 1,1-dichloroethene; 2-hexanone; HMX; methylene chloride; RDX; tetrachloroethene; toluene; trichloroethene; 2,4,6-trinitrotoluene; 1,2-xylene; and 1,3-xylene+1,4-xylene.

Aroclors, PAHs, and phthalates are the least mobile and the most likely to bioaccumulate. Acetone; benzoic acid; 1,1-dichloroethene; methylene chloride; tetrachloroethene; and toluene are more soluble and volatile and are more likely to travel toward the atmosphere and not migrate toward groundwater. Because the organic COPCs were detected at low concentrations and extent is defined, they are not likely to migrate to groundwater.

H-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 H-3.2-3 gives physical and chemical properties of the radionuclide COPCs identified at the Threemile Canyon Aggregate Area sites. Based on K_d values, americium-241, cesium-137, plutonium-238, and plutonium-239 have a very low potential to migrate towards groundwater at the sites within the Threemile Canyon Aggregate Area. The K_d values for tritium, uranium-234, uranium-235/236, and uranium-238 are less than 40 and indicate a potential to migrate towards groundwater.

Uranium is a natural and commonly occurring radioactive element that is present in nearly all rock and soil. The mobility of uranium in soil and its vertical transport to groundwater depend on properties of the soil such as pH, Eh, concentration of complexing anions, porosity of the soil, soil-particle size, and sorption properties as well as the amount of water available. In general, the actinide nuclides form comparatively insoluble compounds in the environment and therefore are 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 tend to accumulate in soil and sediment, which ultimately serve as strong reservoirs. Subsequent movement is largely associated with geological processes such as erosion and sometimes leaching.

Tritium's initial behavior in the environment is determined by the source. If it is released as a gas or vapor to the atmosphere, substantial dispersion can be expected, and the rapidity of deposition is dependent on climatic factors. If tritium is released in liquid form, it is diluted in surface water and is subject to physical dispersion, percolation, and evaporation (Whicker and Schultz 1982, 058209, p. 147). Tritium activities in the subsurface at the area of elevated radioactivity are low (generally <1 pCi/g), indicating the area of elevated radioactivity is not a significant source of tritium, although this radionuclide is relatively

mobile. Because tritium migrates in association with moisture, the low moisture content of the subsurface limits the potential for tritium to migrate to groundwater.

H-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. The UCLs were calculated using all available decision-level data within the depth range of interest. If an appropriate UCL of the mean could not be calculated or if the UCL exceeded the maximum concentration, the maximum detected concentration of the COPC was used as the EPC (maximum detection limits were used as the EPCs for some inorganic COPCs). 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 H-2.3-1 to H-2.3-534.

Calculation of UCLs of the mean concentrations was done using the EPA ProUCL 5.0.00 software (EPA 2013, 251074), which is based on EPA guidance (EPA 2002, 085640). The ProUCL program calculates 95%, 97.5%, and 99% UCLs and recommends a distribution and UCL. The 95% UCL for the recommended calculation method was used as the EPC. 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. 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. The maximum detected concentration was used to represent the EPC for COPCs only when the detects were too few to calculate a UCL. Input and output data files for ProUCL calculations are provided on CD as Attachment H-1.

H-4.0 HUMAN HEALTH RISK-SCREENING EVALUATIONS

The human health risk-screening assessments were conducted for each site within the Threemile Canyon Aggregate Area. All sites were screened for the residential scenario using data from 0.0–10.0 ft bgs. Sites were also screened for the industrial scenario using data from 0.0–1.0 ft bgs, where available. SWMUs 12-001(a),12-001(b), and 12-002 and AOC C-12-005 were evaluated for the recreational scenario using data from 0.0–1.0 ft bgs. The human health risk-screening assessments compared either the 95% UCL of the mean concentration, the maximum detected concentration, or the maximum detection limit of each COPC with SSLs for chemicals and screening action levels (SALs) for radionuclides.

For most constituents, the residential exposure scenario is the most protective, and the residential scenario is used for evaluating whether a site is appropriate for corrective action complete without controls. Although potential exposure to construction workers is not expected at Threemile Canyon Aggregate Area based on current and foreseeable land use, sites being recommended for corrective action complete without controls must not pose an unacceptable risk to construction workers. For some constituents, the construction worker SSL is less than the residential SSL and the residential exposure scenario may not also be protective of construction workers. Therefore, sites posing no potential unacceptable risk under the residential scenario were evaluated to determine whether the residential exposure scenario was also protective of construction workers. If not, the construction worker scenario was evaluated to determine whether the site could be recommended for corrective action complete without controls.

H-4.1 Human Health SSLs and SALs

Human health risk-screening assessments were conducted using SSLs for the industrial and residential scenarios obtained from NMED guidance (NMED 2015, 600915). The NMED SSLs are based on a target hazard quotient (HQ) of 1 and a target cancer risk of 1×10^{-5} (NMED 2015, 600915). If SSLs were not available from NMED guidance, the EPA regional screening tables (http://www.epa.gov/risk/risk-based-screening-table-generic-tables) were used. The EPA regional screening levels 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}. Recreational SSLs were obtained from Laboratory guidance (LANL 2015, 600336) and are based on the same target risk levels as the NMED SSLs. Surrogate chemicals were also used for some COPCs without an SSL based on structural similarity or because the COPC is a breakdown product (NMED 2003, 081172). Exposure parameters used to calculate the industrial, recreational, and residential SSLs are presented in Table H-4.1-1.

Radionuclide SALs were used for comparison with radionuclide COPC EPCs and were derived using the RESRAD model, Version 7.0 (LANL 2015, 600929). The SALs are based on a 25-mrem/yr dose as authorized by U.S. Department of Energy (DOE) Order 458.1. Exposure parameters used to calculate the residential, industrial, and recreational SALs are presented in Tables H-4.1-2, H-4.1-3, and H-4.1-4, respectively.

H-4.2 Results of Human Health Screening Evaluation

The EPC of each COPC was compared with the SSLs for the industrial, recreational, and residential scenarios, as appropriate. For carcinogenic chemicals, the EPCs were divided by the SSL and multiplied by 1×10^{-5}. The sum of the carcinogenic risks was compared with the NMED target cancer risk level of 1×10^{-5}. For noncarcinogenic chemicals, an HQ was generated for each 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. The radionuclide EPCs were divided by the SAL and multiplied by 25 mrem/yr. The total doses were compared with the DOE target level of 25 mrem/yr, as authorized by DOE Order 458.1. The results are presented in Tables H-4.2-1 to H-4.2-110 and are described below for each SWMU and AOC evaluated.

Sites posing no unacceptable risk under the residential scenario may be recommended for corrective action complete if the residential scenario is also protective of construction workers. For the sites at Threemile Canyon Aggregate Area, the following COPCs have construction worker SSLs less than residential SSLs: aluminum; barium; manganese; nickel; 1,1-dichloroethene; 1,2-xylene; and 1,3-xylene+1,4-xylene. The maximum EPC for of each of these COPCs was compared with the construction worker SSL. The ratio of the maximum EPC to the construction worker SSL (i.e., the maximum HQ) was 0.98 for manganese, 0.36 for aluminum, and less than 0.05 for all other COPCs. Thus, manganese is the only COPC that could potentially pose an unacceptable construction worker risk. If manganese is a COPC at a site, the construction worker scenario was evaluated to determine whether the site can be recommended for corrective action complete without controls. Because manganese is associated with noncarcinogenic risk, only the construction worker HI was evaluated and the residential scenario is protective of construction worker cancer risk at all sites. All construction worker SALs are equal to or greater than residential SALs and the residential scenario is protective of construction workers for all sites.

H-4.2.1 SWMUs 12-001(a) and 12-001(b)

The results of the risk-screening assessment for the industrial scenario are presented in Tables H-4.2-1, H-4.2-2, and H-4.2-3. The total excess cancer risk for the industrial scenario is 8×10^{-7}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The industrial HI is 0.03, which is less than the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.09 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

The results of the risk-screening assessment for the recreational scenario are presented in Tables H-4.2-4, H-4.2-5, and H-4.2-6. The total excess cancer risk for the recreational scenario is 1×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The recreational HI is 0.07, which is less than the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.03 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-7, H-4.2-8, and H-4.2-9. The total excess cancer risk for the residential scenario is 3×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is approximately 1, which is equivalent to the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.9 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Manganese is a COPC at SWMUs 12-001(a) and 12-001(b) and may potentially pose an unacceptable noncarcinogenic risk to the construction worker. Construction worker risk for SWMUs 12-001(a) and 12-001(b) was evaluated using the EPCs for the residential scenario (Table H-2.3-2) since both residential and construction worker scenarios consider the 0.0 ft to 10.0 ft bgs interval. The noncarcinogenic risk screening results for the construction worker at SWMUs 12-001(a) and 12-001(b) are presented in Table H-4.2-10. The construction worker HI is 2, which is greater than the NMED target of 1 (NMED 2015, 600915). The primary contributor to construction worker noncarcinogenic risk is manganese. The residential scenario is protective of the construction worker for cancer risk and total dose.

H-4.2.2 SWMU 12-002

The results of the risk-screening assessment for the industrial scenario are presented in Table H-4.2-110. No carcinogenic COPCs were identified. The industrial HI is 0.04, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified.

The results of the risk-screening assessment for the recreational scenario are presented in Table H-4.2-121. No carcinogenic COPCs were identified. The recreational HI is 0.08, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-132 and H-4.2-143. The total excess cancer risk for the residential scenario is 1×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is approximately 1, which is equivalent to the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified.

Manganese is not a COPC at SWMU 12-002 and the residential exposure scenario is also protective of construction workers.

H-4.2.3 AOC 12-004(a)

The results of the risk-screening assessment for the industrial scenario are presented in Tables H-4.2-154, H-4.2-165, and H-4.2-176. The total excess cancer risk for the industrial scenario is 5×10^{-7}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The industrial HI is 0.02, which is less than the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.4 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-187, H-4.2-198, and H-4.2-2019. The total excess cancer risk for the residential scenario is 7×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is 0.3, which is less than the NMED target HI of 1 (NMED 2015, 600915). The total dose is 1 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Manganese is not a COPC at AOC 12-004(a) and the residential exposure scenario is also protective of construction workers.

H-4.2.4 AOC 12-004(b)

The results of the risk-screening assessment for the industrial scenario are presented in Tables H-4.2-210 and H-4.2-221. The total excess cancer risk for the industrial scenario is 1×10^{-8}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The industrial HI is 0.07, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-232 and H-4.2-243. The total excess cancer risk for the residential scenario is 8×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is 0.6, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified.

Manganese is not a COPC at AOC 12-004(b) and the residential exposure scenario is also protective of construction workers.

H-4.2.5 AOC C-12-001

The results of the risk-screening assessment for the industrial scenario are presented in Tables H-4.2-254 and H-4.2-265. The total excess cancer risk for the industrial scenario is 2×10^{-7}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The industrial HI is 0.003, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-276 and H-4.2-287. The total excess cancer risk for the residential scenario is 2×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is 0.5, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified.

Manganese is not a COPC at AOC C-12-001 and the residential exposure scenario is also protective of construction workers.

H-4.2.6 AOC C-12-002

The results of the risk-screening assessment for the industrial scenario are presented in Table H-4.2-298. No carcinogenic COPCs were identified. The industrial HI is 0.04, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-3029 and H-4.2-310. The total excess cancer risk for the residential scenario is 2×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is 0.6, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified.

Manganese is not a COPC at AOC C-12-002 and the residential exposure scenario is also protective of construction workers.

H-4.2.7 AOC C-12-003

The results of the risk-screening assessment for the industrial scenario are presented in Tables H-4.2-321 and H-4.2-332. The total excess cancer risk for the industrial scenario is 2×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The industrial HI is 0.005, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified.

The results of the risk-screening assessment for the residential scenario are presented in Tables H 4.2-343 and H-4.2-354. The total excess cancer risk for the residential scenario is 5×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is 0.3, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified.

Manganese is not a COPC at AOC C-12-003 and the residential exposure scenario is also protective of construction workers.

H-4.2.8 AOC C-12-004

The results of the risk-screening assessment for the industrial scenario are presented in Tables H-4.2-365 and H-4.2-376. The total excess cancer risk for the industrial scenario is 7×10^{-7}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The industrial HI is 0.1, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-387 and H-4.2-398. The total excess cancer risk for the residential scenario is 2×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is 0.6, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified.

Manganese is not a COPC at AOC C-12-004 and the residential exposure scenario is also protective of construction workers.

H-4.2.9 AOC C-12-005

The results of the risk-screening assessment for the industrial scenario are presented in Tables H-4.2-4039 and H-4.2-410. The total excess cancer risk for the industrial scenario is 4×10^{-6},

which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The industrial HI is 0.008, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified.

The results of the risk-screening assessment for the recreational scenario are presented in Tables H 4.2-421 and H-4.2-432. The total excess cancer risk for the recreational scenario is 7×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The recreational HI is 0.02, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified.

The results of the risk-screening assessment for the residential scenario are presented in Tables H 4.2-443 and H-4.2-454. The total excess cancer risk for the residential scenario is 1×10^{-5}, which is equivalent to the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is 0.1, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified.

Manganese is not a COPC at AOC C-12-005 and the residential exposure scenario is also protective of construction workers.

H-4.2.10 AOC C-14-006

The results of the risk-screening assessment for the industrial scenario are presented in Tables H-4.2-465 and H-4.2-476. The total excess cancer risk for the industrial scenario is 4×10^{-7}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The industrial HI is 0.002, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified.

The results of the risk-screening assessment for the residential scenario are presented in Tables H 4.2-487 and H-4.2-498. The total excess cancer risk for the residential scenario is 1×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is 0.03, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified.

Manganese is not a COPC at AOC C-14-006 and the residential exposure scenario is also protective of construction workers.

H-4.2.11 AOC 15-005(c)

The results of the risk-screening assessment for the industrial scenario are presented in Tables H-4.2-5049, H-4.2-510, and H-4.2-521. The total excess cancer risk for the industrial scenario is 2×10^{-7}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The industrial HI is 0.1, which is less than the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.3 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

The results of the risk-screening assessment for the residential scenario are presented in Tables H 4.2-532, H-4.2-543, and H-4.2-554. The total excess cancer risk for the residential scenario is 1×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is 0.8, which is less than the NMED target HI of 1 (NMED 2015, 600915). The total dose is 1 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Manganese is not a COPC at AOC 15-005(c) and the residential exposure scenario is also protective of construction workers.

H-4.2.12 SWMU 15-007(c)

The results of the risk-screening assessment for the industrial scenario are presented in Tables H-4.2-565 and H-4.2-576. The total excess cancer risk for the industrial scenario is 4×10^{-7}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The industrial HI is 20, which is greater than the NMED target HI of 1 (NMED 2015, 600915). The elevated HI is from lead. No radionuclide COPCs were identified.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-587, H-4.2-598, and H-4.2-6059. The total excess cancer risk for the residential scenario is 3×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is 26, which is greater than the NMED target HI of 1 (NMED 2015, 600915). The elevated HI is from lead and antimony. The total dose is 0.1 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

SWMU 15-007(c) poses potential unacceptable risk for the industrial and residential scenarios and will not be recommended for corrective action complete without controls. Therefore, it was not necessary to evaluate construction worker risk to determine whether the site could be recommended for corrective action complete without controls.

H-4.2.13 SWMU 15-007(d)

The samples at SWMU 15-007(d) were collected from depths greater than 0.0−1.0 ft bgs; therefore, no complete exposure pathways exist for the industrial scenario.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-610 and H-4.2-621. No carcinogenic COPCs were identified. The residential HI is 0.03, which is less than the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.09 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Manganese is not a COPC at SWMU 15-007(d) and the residential exposure scenario is also protective of construction workers.

H-4.2.14 SWMU 15-008(b)

The results of the risk-screening assessment for the industrial scenario are presented in Tables H-4.2-632, H-4.2-643, and H-4.2-654. The total excess cancer risk for the industrial scenario is 9×10^{-7}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The industrial HI is 11, which is greater than the NMED target HI of 1 (NMED 2015, 600915). The elevated HI is from lead. The total dose is 2 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-665, H-4.2-676, and H-4.2-687. The total excess cancer risk for the residential scenario is 8×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is 12, which is greater than the NMED target HI of 1 (NMED 2015, 600915). The elevated HI is primarily from lead. The total dose is 8 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

SWMU 15-008(b) poses potential unacceptable risk for the industrial and residential scenarios and will not be recommended for corrective action complete without controls. Therefore, it was not necessary to

evaluate construction worker risk to determine whether the site could be recommended for corrective action complete without controls.

H-4.2.15 AOC 15-008(g)

The results of the risk-screening assessment for the industrial scenario are presented in Tables H-4.2-698 and H-4.2-7069. No carcinogenic COPCs were identified. The industrial HI is 0.5, which is less than the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.1 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-710 and H-4.2-721. No carcinogenic COPCs were identified. The residential HI is 1, which is equivalent to the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.5 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Manganese is not a COPC at AOC 15-008(g) and the residential exposure scenario is also protective of construction workers.

H-4.2.16 SWMU 15-009(b)

The results of the risk-screening assessment for the industrial scenario are presented in Tables H-4.2-732, H-4.2-743, and H-4.2-754. The total excess cancer risk for the industrial scenario is 3×10^{-7}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The industrial HI is 0.2, which is less than the NMED target HI of 1 (NMED 2015, 600915). The total dose is 18 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-765, H-4.2-776, and H-4.2-787. The total excess cancer risk for the residential scenario is 1×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is 2, which is greater than the NMED target HI of 1 (NMED 2015, 600915). The elevated HI is primarily from uranium. The total dose is 46 mrem/yr, which is greater than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The dose is primarily from isotopic uranium.

SWMU 15-009(b) poses potential unacceptable risk for the residential scenario and will not be recommended for corrective action complete without controls. Therefore, it was not necessary to evaluate construction worker risk to determine whether the site could be recommended for corrective action complete without controls.

H-4.2.17 SWMU 15-009(c)

The results of the risk-screening assessment for the industrial scenario are presented in Tables H-4.2-798, H-4.2-8079, and H-4.2-810. The total excess cancer risk for the industrial scenario is 2×10^{-7}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The industrial HI is 0.02, which is less than the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.1 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-821, H-4.2-832, and H-4.2-843. The total excess cancer risk for the residential scenario is 5×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is 0.2, which is less than the NMED target HI of 1 (NMED 2015, 600915). The total dose is 1 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Manganese is not a COPC at SWMU 15-009(c) and the residential exposure scenario is also protective of construction workers.

H-4.2.18 SWMU 15-009(h)

The samples at SWMU 15-009(h) were collected from depths greater than 0.0−1.0 ft bgs; therefore, no complete exposure pathways exist for the industrial scenario.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-854, H-4.2-865, and H-4.2-876. The total excess cancer risk for the residential scenario is 2×10^{-10}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is 0.07, which is less than the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.7 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Manganese is not a COPC at SWMU 15-009(h) and the residential exposure scenario is also protective of construction workers.

H-4.2.19 SWMU 15-010(b)

The results of the risk-screening assessment for the industrial scenario are presented in Tables H-4 2-887, H-4.2-898, and H-4.2-9089. The total excess cancer risk for the industrial scenario is 2×10^{-7}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The industrial HI is 0.02, which is less than the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.8 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-910, H-4.2-921, and H-4.2-932. The total excess cancer risk for the residential scenario is 1×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is 0.4, which is less than the NMED target HI of 1 (NMED 2015, 600915). The total dose is 2 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Manganese is not a COPC at SWMU 15-010(b) and the residential exposure scenario is also protective of construction workers.

H-4.2.20 AOC 15-014(h)

The results of the risk-screening assessment for the industrial scenario are presented in Tables H-4 2-943, H-4.2-954, and H-4.2-965. The total excess cancer risk for the industrial scenario is 1×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The industrial HI is 0.07, which is less than the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.5 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

The results of the risk-screening assessment for the residential scenario are presented in Tables H 4.2-976, H-4.2-987, and H-4.2-998. The total excess cancer risk for the residential scenario is 3×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is 1, which is equivalent to the NMED target HI of 1 (NMED 2015, 600915). The total dose is 1 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Manganese is not a COPC at AOC 15-014(h) and the residential exposure scenario is also protective of construction workers.

H-4.2.21 SWMU 36-002[JJM1]

The samples at SWMU 36-002 were collected from depths greater than 0.0−1.0 ft bgs; therefore, no complete exposure pathways exist for the industrial scenario.

The results of the risk-screening assessment for the residential scenario are presented in Tables H 4.2-100~~99~~, H-4.2-10~~10~~, and H-4.2-10~~21~~. The total excess cancer risk for the residential scenario is 6×10^{-11}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is 0.4, which is less than the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.01 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Manganese is not a COPC at SWMU 36-002 and the residential exposure scenario is also protective of construction workers.

H-4.2.22 SWMU 36-003(a)

The results of the risk-screening assessment for the industrial scenario are presented in Table H-4 2-10~~3~~2. No carcinogenic COPCs were identified. The industrial HI is 0.002, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-10~~4~~3 and H-4.2-10~~5~~4. The total excess cancer risk for the residential scenario is 3×10^{-8}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is 0.2, which is less than the NMED target HI of 1 (NMED 2015, 600915). No radionuclide COPCs were identified.

Manganese is not a COPC at SWMU 36-003(a) and the residential exposure scenario is also protective of construction workers.

H-4.2.23 SWMU~~s~~ 36-008 ~~and C-36-003~~

The results of the risk-screening assessment for the industrial scenario are presented in Tables H-4.2-10~~6~~5, H-4.2-10~~7~~6, and H-4.2-10~~8~~7. The total excess cancer risk for the industrial scenario is 1×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The industrial HI is 0.1, which is less than the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.6 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-10~~9~~8, H-4.2-1~~1~~09, and H-4.2-11~~1~~0. The total excess cancer risk for the residential scenario is 3×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is 0.9, which is less than the NMED target HI of 1 (NMED 2015, 600915). The total dose is 2 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Manganese is not a COPC at SWMU 36-008 and the residential exposure scenario is also protective of construction workers.

H-4.2.24 SWMU C-36-003

The results of the risk-screening assessment for the industrial scenario are presented in Tables H-4.2-112, H-4.2-113, and H-4.2-114. The total excess cancer risk for the industrial scenario is 4×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The industrial HI is 0.2, which is less than the NMED target HI of 1 (NMED 2015, 600915). The total dose is 0.9 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-115, H-4.2-116, and H-4.2-117. The total excess cancer risk for the residential scenario is 1×10^{-5}, which is equivalent to the NMED target risk level of 1×10^{-5} (NMED 2015, 600915). The residential HI is 1, which is equivalent to the NMED target HI of 1 (NMED 2015, 600915). The total dose is 2 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Manganese is a COPC at SWMU C-36-003 and may potentially pose an unacceptable noncarcinogenic risk to the construction worker. Construction worker risk for SWMU C-36-003 was evaluated using the EPCs for the residential scenario (Table H-2.3-53) since both residential and construction worker scenarios consider the 0.0 ft to 10.0 ft bgs interval. The noncarcinogenic risk-screening results for the construction worker at SWMU C-36-003 are presented in Table H-4.2-118. The construction worker HI is 2, which is greater than the NMED target of 1 (NMED 2015, 600915). The primary contributor to construction worker noncarcinogenic risk is manganese. The residential scenario is protective of the construction worker for cancer risk and total dose.

H-4.3 Vapor Intrusion Pathway

NMED guidance (NMED 2015, 600915) requires an evaluation of the vapor intrusion pathway. The vapor intrusion pathway of VOCs into a building was evaluated where appropriate. The evaluation can be qualitative for a potentially complete pathway if the following criteria are met:

- Volatile and toxic compounds are minimally detected.
- Concentrations are below NMED's vapor intrusion screening levels for soil-gas and/or groundwater. There is no suspected source(s) for volatile and toxic compounds.
- Concentrations are decreasing with depth (for soil).

Because only bulk soil data are available for these subaggregates, the vapor intrusion screening levels are not applicable for the evaluation. Residential soil screening values were calculated 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 for these Threemile Canyon Aggregate Area sites, the advanced soil model (SL-ADV-REV2-4.xls) was used to calculate risk-based soil concentrations for VOCs at sites, where appropriate. The maximum detected concentration of VOC COPCs was compared with the risk-based concentration generated by the model for each site. The model inputs and risk-based concentrations generated are provided on CD as Attachment H-2. HQs and HIs were calculated for noncarcinogenic COPCs and total excess cancer risks for carcinogenic COPCs. The NMED target risk level of 1×10^{-5} and NMED target HI of 1 were applied.

The vapor intrusion pathway was qualitatively evaluated as part of the residential scenario for some of the sites in this report. Among the factors to consider for the vapor intrusion pathway to be relevant to human health risk is the current extent of structures and their proximity to the VOC source. One may also consider if construction of buildings is possible or proposed in the reasonably foreseeable future. Structures exist in the Threemile Canyon Aggregate Area but they differ considerably in whether they are actively used.

SWMUs 36-008 and C-36-003 are located on the south rim and slope of Threemile Canyon and not suitable for placement of a structure. Therefore, the vapor intrusion pathway was not evaluated for these sites.

No VOCs were detected at SWMUs 12-001(a) and 12-001(b), 12-002, 15-007(c), 15-007(d), and 15-008(b), AOCs 12-004(a), 12-004(b), C-12-001, C-12-002, C-12-003, C-12-004, C-12-005, and 15-008(g). Therefore, the vapor intrusion pathway is incomplete for these sites. The potential for the vapor intrusion pathway is discussed for each of the remaining sites.

None of the site descriptions indicated that solvents were used at these sites, and in most cases these sites are inactive or removed. Therefore, there are no suspected sources of VOCs other than small quantities possibly used in photographic laboratories.

H-4.3.1 AOC C-14-006

AOC C-14-006 is an area of potential soil contamination at TA-14 associated with an HE-storage magazine. The magazine was built in 1945 and removed in 1952. The site description does not indicate a history of solvent usage.

The VOCs were minimally detected at this site. Three VOCs (acetone, 4-isopropyltoluene, and toluene) were detected in 2 samples each. The detected concentrations were less than or slightly greater than the EQLs and decreased with depth. The site description indicated that solvents were not used so no sources of VOCs are present. In addition, the structure has been removed and the site is inactive. The vapor intrusion pathway is therefore potentially complete based on NMED guidance (NMED 2015, 600915) but no additional evaluation is necessary.

H-4.3.2 AOC 15-005(c)

AOC 15-005(c) consists of an outdoor container storage area for explosives, located near storage building 15-41 in the central portion of TA-15 near Firing Site C. The operational period of this site is not known, but it has not been active since the 1990s. This site description does not indicate a history of solvent usage.

Six of seven VOCs were minimally detected at this site with one or two detected concentrations. Xylene[1,3-1,4-xylene had 5 detected concentrations. The detected concentrations of ethylbenzene, 2-methylnaphthalene, naphthalene, toluene, and 1,3-xylene+1,4-xylene were less than the estimated quantitation limits (EQLs). Acetone and 4-isopropyltouene had one or two concentrations greater than the EQLs, and the concentrations decreased with depth. The site description indicated that solvents were not used at the site and thus no sources of VOCs are present. In addition, the structure has been removed and the site is inactive.

Acetone was detected in two samples from 0.0−0.5 ft bgs (0.0144 mg/kg and 0.0188 mg/kg) and was not detected in the samples collected at 2.0−3.0 ft bgs at these locations. Isopropyltoluene[4-] was detected in two samples from 0.0−0.5 ft bgs (0.00049 mg/kg and 0.00151 mg/kg) and was not detected in the samples collected at 2.0−3.0 ft bgs at these locations. Xylene[1,3-]+1,4-xylene was detected in five samples. Two of the detected concentrations were at location 15-610556 at similar concentrations (0.000474 mg/kg and 0.000556 mg/kg) and below the EQLs. The other three detected concentrations were in the surface samples (0.0–0.5 ft bgs), and 1,3-xylene+1,4-xylene was not detected in the deeper samples.

Because acetone and 4-isopropyltoluene had concentrations exceeding EQLs these VOCs were evaluated in the screening assessment. The result of the residential vapor intrusion screening assessment is presented in Table H-4.3-1. The HI is approximately 0.003, which is less than the NMED target HI of 1 (NMED 2015, 600915). The result does not change the HI calculated as a result of exposure to soil, discussed in section H-4.2.

The screening of the bulk soil data using the Johnson and Ettinger model indicates that the soil has not been impacted. The vapor intrusion pathway is therefore potentially complete based on NMED guidance (NMED 2015, 600915) but no additional evaluation is necessary.

H-4.3.3 SWMU 15-009(b)

SWMU 15-009(b) is a septic system located at Firing Site R-45. The septic system consists of a tank (structure 15-61), a seepage pit, associated drainlines, and a former outfall. This septic system received effluent from restroom facilities in the firing site control building 15-45. The site description does not indicate a history of solvent usage.

Seven of 10 VOCs were minimally detected at this site with 1 or 2 detected concentrations. The detected concentrations of 2-butanone; methylene chloride; 2-methylnaphthalene; naphthalene; 1,2,4-trimethylbenzene; 1,2-xylene; and 1,3-xyene+1,4-xylene were less than the EQLs. Acetone, 4-isopropyltoluene, and toluene had several concentrations greater than the EQLs.

Acetone was detected in seven samples. Two locations had two detected concentrations each and the higher concentrations were at the shallower depth (location 15-610834: 0.0226 mg/kg from 15.0–17.0 ft bgs and 0.00428 mg/kg from 17.0–18.0 ft bgs; location 15-610835: 0.036 mg/kg from 7.0-8.0 ft bgs and 0.0221 mg/kg from 12.0–13.0 ft bgs). For each of the other three detected concentrations, there was a single detection per location and acetone was not detected in the deeper samples.

Isopropyltoluene[4-] was detected in nine samples. Two locations had two detected concentrations, each and the higher concentrations were at the shallower depth (location 15-610830: 0.00316 mg/kg from 7.0−8.0 ft bgs and 0.000314 mg/kg from 12.0–13.0 ft bgs; location 15-610835: 0.0061 mg/kg from 7.0–8.0 ft bgs and 0.00159 mg/kg from 12.0–13.0 ft bgs). For each of the other five detected concentrations there was a single detect per location in the shallow samples, and 4-isopropyltoluene was not detected in the deeper samples.

Toluene was detected in eight samples. Three locations had two detected concentrations each and the higher concentrations were at the shallower depth (location 15-610830: 0.0102 mg/kg from 7.0–8.0 ft bgs and 0.000504 mg/kg from 12.0–13.0 ft bgs; location 15-610834: 0.000704 mg/kg from 15.0–16.0 ft bgs and 0.000321 mg/kg from 17.0–18.0 ft bgs; location 15-610835: 0.00445 mg/kg from 7.0–8.0 ft bgs and 0.00276 mg/kg from 12.0–13.0 ft bgs). At location 15-610331, there was a detected concentration at the shallower depth, and toluene was not detected in the deeper sample. At location 15-610836, toluene was only detected in the deeper sample (0.000323 mg/kg at 12.0–13.0 ft bgs) below the EQL.

Because acetone, 4-isopropyltoluene, and toluene had concentrations exceeding EQLs, these VOCs were evaluated in the screening assessment. The result of the residential vapor intrusion screening assessment is presented in Table H-4.3-2. The HI is approximately 0.002, which is less than the NMED target HI of 1 (NMED 2015, 600915). The result does not change the HIs calculated as a result of exposure to soil, discussed in section H-4.2.

The screening of the bulk soil data using the Johnson and Ettinger model indicates that the soil has not been impacted. The vapor intrusion pathway is therefore potentially complete based on NMED guidance (NMED 2015, 600915) but no additional evaluation is necessary.

H-4.3.4 SWMU 15-009(c)

SWMU 15-009(c) is a septic system located at TA-15 Firing Site R-44. The septic system consists of a tank (structure 15-62), its associated drainlines, and an outfall. The septic system received effluent from restroom facilities in the firing site control building 15-44. The site description does not indicate a history of solvent usage.

Two of five VOCs were minimally detected at this site with one or two detections of 1,2,4-trimethylbenzene and 1,3-xylene+1,4-xylene. The detected concentrations were less than the EQLs. Acetone, 4-isopropyltoluene, and toluene had several concentrations greater than the EQLs.

Acetone was detected in five samples. The detected concentrations were at five different locations and were in the deeper samples at four locations. Three of the four concentrations in the deeper samples were above the EQLs. The other detected concentration was in a surface sample and decreased with depth.

Isopropyltoluene[4-] was detected in five samples. Two locations had two detected concentrations and the higher concentration was at the shallower depth or the concentrations were similar (location 15-610839: 0.000477 mg/kg from 0.0–0.8 ft bgs and 0.000553 mg/kg from 1.0–2.5 ft bgs; location 15-610851: 0.00428 mg/kg from 0.0–0.7 ft bgs and 0.00128 mg/kg from 1.0–2.0 ft bgs). The other detected concentration was in a surface sample and decreased with depth.

Toluene was detected in seven samples. One location had two detected concentrations and the higher concentration was at the shallower depth (location 15-610851: 0.0122 mg/kg from 0.0–0.7 ft bgs and 0.00206 mg/kg from 1.0–2.0 ft bgs). Two detected concentrations were in surface samples and decreased with depth and three concentrations were only detected in the deeper samples below the EQLs.

Because acetone, 4-isopropyltoluene, and toluene had concentrations exceeding EQLs, these VOCs were evaluated in the screening assessment. The result of the residential vapor intrusion screening assessment is presented in Table H-4.3-3. The HI is approximately 0.0001, which is less than the NMED target HI of 1 (NMED 2015, 600915). The result does not change the HIs calculated as a result of exposure to soil, discussed in section H-4.2.

The screening of the bulk soil data using the Johnson and Ettinger model indicates that the soil has not been impacted. The vapor intrusion pathway is therefore potentially complete based on NMED guidance (NMED 2015, 600915) but no additional evaluation is necessary.

H-4.3.5 SWMU 15-009(h)

SWMU 15-009(h) is a septic system located at the Ector firing site on the eastern side of TA-15 (LANL 2003, 102117). The septic system consists of a tank (structure 15-282), associated drainlines, and a drain field. The septic system received effluent from restroom facilities in the Ector firing site control building 15-280. In the 1990s, the sanitary waste drainlines that served this septic system were rerouted to the SWSC plant and are currently active. The site description does not indicate a history of solvent usage.

The VOCs were minimally detected at this site with 1 or 2 detected concentrations of acetone, ethylbenzene, and 2-hexanone. The detected concentrations were less than or slightly greater than the EQLs. The site description indicated that solvents were not used so no sources of VOCs are present. In addition, the structure is inactive. The vapor intrusion pathway is therefore potentially complete based on NMED guidance (NMED 2015, 600915) but no additional evaluation is necessary.

H-4.3.6 SWMU 15-010(b)

SWMU 15-010(b) is a settling tank (structure 15-147) located in the northwest corner of TA-15 near former shop building 15-8. The settling tank served former building 15-8, which housed HE-machining operations during the 1950s, and discharged to an outfall at the edge of Threemile Canyon. The tank was constructed in 1947 and originally designed to be a septic tank; however, subsequent engineering records confirm the tank was also used as an HE settling tank. The site description does not indicate a history of solvent usage.

Four of seven VOCs were minimally detected at this site with one or two detected concentrations of 1,1-dichloroethene, styrene, tetrachloroethene, and 1,3-xylene+1,4-xylene. Acetone, methylene chloride, and toluene were detected in seven, five, and six samples, respectively. The detected concentrations of 1,1-dichloroethene, methylene chloride, styrene, tetrachloroethene, and 1,3-xylene+1,4-xylene were less than the EQLs. Acetone and toluene had several concentrations greater than the EQLs.

Acetone was detected in seven samples. Two locations had two detected concentrations with the higher concentration at the shallower depth at one location and the higher concentration at the deeper depth at the other location. Acetone was detected in the surface sample at location 15-610869 and decreased with depth and was detected only in the deeper samples at two locations (concentration at location 15-610871 was below the EQL).

Toluene was detected in six samples. The detected concentrations were at six different locations with concentrations decreasing with depth at three locations and the concentration detected only in the deeper sample at three locations.

Because acetone and toluene had concentrations exceeding EQLs, these VOCs were evaluated in the screening assessment. The result of the residential vapor intrusion screening assessment is presented in Table H-4.3-4. The HI is approximately 0.0002, which is less than the NMED target HI of 1 (NMED 2015, 600915). The result does not change the HIs calculated as a result of exposure to soil, discussed in section H-4.2.

The screening of the bulk soil data using the Johnson and Ettinger model indicates that the soil has not been impacted. The vapor intrusion pathway is therefore potentially complete based on NMED guidance (NMED 2015, 600915) but no additional evaluation is necessary.

H-4.3.7 AOC 15-014(h)

AOC 15-014(h) consists of three outfalls located in the northwest corner of TA-15. The outfalls served a former laboratory and office (former building 15-40). The building and therefore the potential sources of VOCs have been removed. All three outfalls daylight north of former building 15-40 and discharge to Threemile Canyon. The majority of the samples are from the drainage below the outfalls on the slope of Threemile Canyon in an area not suitable for the placement of a structure. Locations 15-610503, 15-610522, and 15-610526 are on the mesa top below the drainlines and are evaluated for the vapor intrusion pathway. The site description does not indicate a history of solvent usage, but it is possible solvents were used as part of photographic processing.

The VOCs were minimally detected in the mesa top samples at this site with 1 to 2 detected concentrations of acetone, toluene, 1,2-xylene, and 1,3-+1,4-xylene. The detected concentrations at the three locations were less than the EQLs. The site description indicated that solvents were not used so no sources of VOCs are present. In addition, the building has been removed and the site is inactive. The vapor intrusion pathway is therefore potentially complete based on NMED guidance (NMED 2015, 600915) but no additional evaluation is necessary.

H-4.3.8 SWMU 36-002

SWMU 36-002 is a former sump (former structure 36-49) located at TA-36, approximately 40 ft northwest of building 36-48 near the edge of Threemile Canyon. The sump was constructed in 1965 and received water from two sinks in building 36-48. Building 36-48 was initially used for shot assembly and for controlled-temperature experiments. DU was cut, lapped, and polished in the building. One of the sinks connected to the sump had a chemical-resistant coating. The building was used infrequently, less than 10 times per year. The sinks were disconnected from the sump in 1993, and the sump was removed. The site description does not indicate a history of solvent usage.

The VOCs were minimally detected at this site with one detected concentration of ethylbenzene. The detected concentration was less than the EQLs and decreased with depth. The site description indicated that solvents were not used so no sources of VOCs are present. In addition, the structure has been removed and the site is inactive. The vapor intrusion pathway is therefore potentially complete based on NMED guidance (NMED 2015, 600915) but no additional evaluation is necessary.

H-4.3.9 SWMU 36-003(a)

SWMU 36-003(a) is a septic system located at TA-36 approximately 115 ft east of building 36-1. The septic system consists of a septic tank (structure 36-17), associated drainlines, a manhole (structure 36-38), a distribution box/drain field, and a seepage pit. This septic system was constructed in 1949 and received effluent from the restroom facilities in an office and laboratory in building 36-1. In addition to sanitary wastes, spent photoprocessing chemicals from x-ray developing may have been discharged to the septic system. The main guard station at TA-36 (building 36-22) was later added to the septic system. In 1988, the guard station was disconnected from the septic tank and rerouted to an adjacent septic system. In 1992, the sanitary waste drainlines that previously served SWMU 36-003(a) were rerouted to the SWSC plant and are currently active (LANL 1993, 015313, pp. 5-22–5-23). In 1995, the septic tank was decontaminated by steam cleaning and the tank was filled with concrete. The site description does not indicate a history of solvent usage, but it is possible that solvents were used as part of photographic processing.

The VOCs were minimally detected at this site with 1 or 2 detected concentrations of 4-isopropyltoluene and 1,2,4-trimethylbenzene. The detected concentrations were less than the EQLs, except for one concentration of 4-isopropyltoluene.

Because of the potential for VOC sources, the detected VOCs were evaluated in the screening assessment. The result of the residential vapor intrusion screening assessment is presented in Table H-4.3-5. The HI is approximately 0.0004, which is less than the NMED target HI of 1 (NMED 2015, 600915). The result does not change the HIs calculated as a result of exposure to soil, as discussed in section H-4.2.

The screening of the bulk soil data using the Johnson and Ettinger model indicates that the soil has not been impacted. The vapor intrusion pathway is therefore potentially complete based on NMED guidance (NMED 2015, 600915) but no additional evaluation is necessary.

H-4.4 Essential Nutrients

NMED guidance (NMED 2015, 600915) has SSLs for evaluation of essential nutrients. The maximum concentrations of calcium and magnesium were compared with the appropriate NMED essential nutrient SSLs at those sites where they were identified as COPCs. The results of the comparisons found calcium and magnesium to be substantially less than their respective SSLs, as presented in Table H-4.4-1. Further evaluation of calcium and magnesium at these sites is not necessary.

H-4.5 Uncertainty Analysis

H-4.5.1 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 the chemicals detected or that have detection limits above background are retained for further analysis. No established BVs for organic chemicals, and all detected organic chemicals are identified as COPCs and are retained for further analysis. Other uncertainties may include errors in sampling, laboratory analysis, and data analysis. However, because concentrations used in the risk-screening evaluations include those detected below the estimated quantitation limits and nondetects above BVs, data evaluation uncertainties are expected to have little effect on the risk-screening results.

H-4.5.2 Exposure Evaluation

The current and reasonably foreseeable future land use for the Threemile Canyon Aggregate Area 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 industrial SSLs. For the sites evaluated, individuals might not be 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, and 25 yr (NMED 2015, 600915). The residential SSLs are based on an exposure of 24 h/d, 350 d/yr, and 30 yr (NMED 2015, 600915). As a result, the industrial and residential scenarios evaluated at these sites likely overestimate the exposure and risk. The recreational scenario assumes 1 h/event, 200 events per year, for 30 yr and overestimates the exposure for a visitor to SWMUs 12-001(a) and 12-001(b), SWMU 12-002, and AOC C-12-005. In addition, the child exposure assumed for this scenario is not likely because of the current and reasonably foreseeable future land use and the access restrictions in place for these sites, except for the proposed Manhattan Project National Historical Park.

A number of assumptions are made relative to exposure pathways, including input parameters, completeness of a given pathway, 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 2015, 600915). When several upper-bound values (as are found in NMED 2015, 600915) are combined to estimate exposure for any one pathway, the resulting risk estimate 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 result in exposure in the same manner as if they were in soil overestimates the potential exposure and risk to receptors.

Uncertainty is introduced in the concentration aggregation of data for estimating the EPCs at a site. Risk from a single location or area with relatively high COPC concentrations may be underestimated by using a representative site-wide value. The use of a UCL is intended to provide a protective upper-bound (i.e., conservative) COPC concentration and is assumed to be representative of the 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 site-wide 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. In addition, the maximum detection limit was used as the EPC for some inorganic COPCs with elevated detection limits above BVs.

Several sites within the Threemile Canyon Aggregate Area have potential risks that are equivalent to or exceed NMED target levels. The potential risks are overestimated for some of these sites because of uncertainties associated with the EPCs and/or the COPCs.

SWMUs 12-001(a) and 12-001(b)

The construction worker HI was 2, primarily from manganese (HQ = 0.98). The EPC for manganese is 456 mg/kg, which is approximately equal to the construction worker SSL of 464 mg/kg. Manganese was detected above the soil BV (671 mg/kg) in 3 of 67 soil samples with a maximum concentration of 2150 mg/kg, and was not detected above the Qbt 2,3,4 BV in 10 tuff samples or above the sediment BV in 3 sediment samples. The construction worker SSL is less than the soil BV, that is, it is comparable with naturally occurring manganese levels. Although site concentrations of manganese in soil are statistically different from background, the distribution of concentrations, other than the maximum concentration, is similar to background (Figure G-16). Thus, the construction worker risk due to potential exposure to manganese is similar to background and the site contribution to construction worker risk is overestimated. The construction worker HI without manganese is 0.9. No other COPC has a HQ greater than 0.3. Note also that SWMUs 12-001(a) and 12-001(b) are located in a buffer area and there are no active Laboratory operations in this area. The potential for future construction projects and exposure to construction workers is minimal.

SWMU 12-002

The residential HI at SWMU 12-002 was approximately 1 (1.27) primarily from cobalt (HQ = 0.62) and iron (HQ = 0.345). The EPC for iron was 18,900 mg/kg, which was the maximum of two concentrations with the other being below the Qbt 2,3,4 BV (14,500 mg/kg). The maximum concentration was below the maximum Qbt 2,3,4 background concentration (19,500 mg/kg) and overestimated the risk. Given the other concentration was background it is highly likely that the maximum concentration was also background and was not the result of site operations. Without iron the residential HI is 0.9.

AOC C-12-005

The residential total excess cancer risk at AOC C-12-005 was approximately 1×10^{-5} (1.18×10^{-5}) from chromium. The EPC was a 95% UCL (114 mg/kg), which was strongly biased by the maximum concentration (196 mg/kg). The other nine concentrations were below the soil BV or below or close to the maximum soil background concentration (36.5 mg/kg). In addition, the AOC was the location of a former junction box, which served as a relay between former control building 12-2 and the two firing sites and housed diagnostic equipment, signal cables, and electrical power equipment. Any chromium that might be associated with the junction box is trivalent chromium. If the trivalent chromium residential SSL

(117,000 mg/kg) is compared to the EPC the HQ is 0.001; there is no excess cancer risk as trivalent chromium is a noncarcinogen.

SWMU 15-007(c)

The industrial and residential HIs at SWMU 15-007(c) are greater than 1 (20 and 26), with lead being the only contributor (industrial) or primary contributor (residential) with HQs of 19.4 and 18.2, respectively. Because the lead SSL is based upon blood lead levels, lead is evaluated separately from the other noncarcinogenic COPCs. The lead EPCs at SWMU 15-007(c) (residential 7290 mg/kg and industrial 15,500 mg/kg) are substantially above the SSLs. Without lead, the industrial HI is reduced to approximately 0.5, which is less than the NMED target HI but the residential HI without lead is approximately 8, which is greater than the NMED target HI. Almost all of the remaining residential HI is from antimony (HQ = 7.8).

SWMU 15-008(b)

The industrial and residential HIs at SWMU 15-008(b) are greater than 1 (11 and 12), with lead being the only contributor (industrial) or primary contributor (residential) with HQs of 10.8 and 11, respectively. Because the lead SSL is based upon blood lead levels, lead is evaluated separately from the other noncarcinogenic COPCs. The lead EPCs at SWMU 15-008(b) (residential 4400 mg/kg and industrial 8610 mg/kg) are substantially above the SSLs. Without lead, the industrial HI is reduced to approximately 0.1, which is less than the NMED target HI and the residential HI without lead is approximately 1, which is equivalent to the NMED target HI. The residential HI is also from copper (HQ = 0.45) and uranium (HQ = 0.39).

AOC 15-008(g)

The residential HI at AOC 15-008(g) was approximately 1 (HI = 1.36), with lead being the primary contributor with an HQ of 0.77. Because the lead SSL is based upon blood lead levels, lead is evaluated separately from the other noncarcinogenic COPCs. The lead EPC was 309 mg/kg, which is less than the residential SSL. Without lead, the HI is reduced to approximately 0.6, which is less than the NMED target HI.

AOC 15-014(h)

The residential HI at AOC 15-014(h) was approximately 1 (HI =1.48), with Aroclor-1254 being the primary contributor (HQ = 0.6). Minor contributors to the HI included lead, antimony, and selenium. The EPC for Aroclor-1254 was the maximum concentration (0.704 mg/kg) of four detected concentrations, which overestimated the risk. If the 95% UCL is calculated for the data set, a 95% UCL of approximately 0.15 mg/kg is obtained. Using the 95% UCL results in a HQ of 0.13 for Aroclor-1254 and reduces the residential HI to 0.99. Because the lead SSL is based upon blood lead levels, lead is evaluated separately from the other noncarcinogenic COPCs. The lead EPC was 19.3 mg/kg, which was less than the residential SSL. Without lead, the HI is further reduced to 0.94, which is below the NMED target HI. In addition, the EPCs for antimony and selenium were the maximum detection limits (i.e., neither were detected in any samples). This also serves to overestimate the residential risk. Therefore, the residential HI is less than 1.

SWMU C-36-003

The construction worker HI at SWMU C-36-003 was 2, with manganese being the primary contributor (HQ = 0.97). The EPC for manganese was 452 mg/kg, which is approximately equal to the construction worker SSL of 464 mg/kg. Manganese was detected above the sediment BV (543 mg/kg) in 2 of 6 sediment samples with a maximum concentration of 860 mg/kg, and was not detected above the soil BV in 9 soil samples or above the Qbt 2,3,4 BV in 1 tuff sample. The construction worker SSL is less than the soil BV (671 mg/kg) and sediment BV, that is, it is comparable with naturally occurring manganese levels. The sediment samples at SWMU C-36-003 were collected from a drainage on a canyon slope rather than in the canyon bottom, whereas the sediment BVs are for canyon sediments (LANL 1998, 059730). The sediment samples collected at SWMU C-36-003 may be more similar to soil than to canyon sediment and the maximum concentration was less than or equivalent to the 4 highest manganese soil background concentrations (1100 mg/kg, 1000 mg/kg, 950 mg/kg, and 860 mg/kg). Thus, the construction worker risk due to potential exposure to manganese is similar to background and the site contribution to construction worker risk is overestimated. The construction worker HI without manganese is approximately 1. Note also that SWMU C-36-003 is located on a steep canyon slope and the potential for future construction projects and exposure to construction workers at this location is minimal. The next largest HQ contributor to the construction worker scenario after manganese is total chromium (HQ=0.68). The chromium EPC is greater than background and 6 of the 16 samples are also greater than the maximum chromium soil background concentration (36.5 mg/kg). So given that 10 of the 16 samples are within the range of background, risks to the construction worker from chromium are somewhat overstated.

H-4.5.3 Toxicity Evaluation

The primary uncertainty associated with the SSLs is related to the derivation of toxicity values used in their calculation. Toxicity values (reference doses [RfDs] and slope factors [SFs]) were used to derive the SSLs used in this risk-screening evaluation (NMED 2015, 600915). Uncertainties were identified in five areas with respect to the toxicity values: (1) extrapolation from other animals to humans, (2) interindividual variability in the human population, (3) the derivation of RfDs and SFs, (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 in chemical absorption, metabolism, excretion, and toxic responses between animals and humans. 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 in each of these steps, resulting in the overestimation of potential risk.

Individual Variability in the Human Population. For noncarcinogenic effects, the degree of variability in human physical characteristics is important both in determining the risks that can be expected at low exposures and in defining the no observed adverse effect level (NOAEL). The NOAEL uncertainty factor approach incorporates a 10-fold factor to reflect individual variability within 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 RfDs and SFs. The RfDs and SFs 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 environment matrix and not available for absorption into the human body. However, it is assumed 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 the risk assessment. Surrogates were used to provide SSLs for acenaphthylene; Aroclor-1268; benzo(g,h,i)perylene; 4-isopropyltoluene; TATB; and 1,3-xylene+1,4-xylene based on structural similarity. The overall impact of surrogates on the risk assessment is minimal because these COPCs were generally detected at low concentrations (less than 1 mg/kg).

H-4.5.4 Additive Approach

For noncarcinogens, the effects of exposure to multiple chemicals are generally unknown, and possible interactions could be synergistic or antagonistic, resulting in either an overestimation 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 or by different modes of action but are addressed additively.

H-4.6 Interpretation of Human Health Risk-Screening Results

H-4.6.1 SWMUs 12-001(a) and 12-001(b)

Industrial Scenario

The total excess cancer risk for the industrial scenario is 8×10^{-7}, which is less than the NMED target risk level of 1×10^{-5}. The industrial HI is 0.03, which is less than the NMED target HI of 1. The total dose is 0.09 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the industrial scenario is equivalent to a total risk of 2×10^{-6}, based on conversion from dose using RESRAD Version 7.0.

Recreational Scenario

The total excess cancer risk for the recreational scenario is 1×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The recreational HI is 0.07, which is less than the NMED target HI of 1. The total dose is 0.03 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the recreational scenario is equivalent to a total risk of 3×10^{-7}, based on conversion from dose using RESRAD Version 7.0.

Residential Scenario

The total excess cancer risk for the residential scenario is 3×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The residential HI is 1, which is equivalent to the NMED target HI of 1. The total dose is 0.9 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the residential scenario is equivalent to a total risk of 1×10^{-5}, based on conversion from dose using RESRAD Version 7.0.

Construction Worker Scenario

The residential exposure scenario is protective of construction workers for carcinogenic and radionuclide COPCs. The construction worker HI is 0.9 (see section H-4.5.2, Uncertainty Analysis), which is less than the NMED target HI of 1.

H-4.6.2 SWMU 12-002

Industrial Scenario

No carcinogenic COPCs were identified. The industrial HI is 0.04, which is less than the NMED target HI of 1. No radionuclide COPCs were identified.

Recreational Scenario

No carcinogenic COPCs were identified. The recreational HI is 0.08, which is less than the NMED target HI of 1. No radionuclide COPCs were identified.

Residential Scenario

The total excess cancer risk for the residential scenario is 1×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The residential HI is 0.9 (see section H-4.5.2, Uncertainty Analysis), which is less than the NMED target HI of 1. No radionuclide COPCs were identified. The residential exposure scenario is also protective of construction workers.

H-4.6.3 AOC 12-004(a)

Industrial Scenario

The total excess cancer risk for the industrial scenario is 5×10^{-7}, which is less than the NMED target risk level of 1×10^{-5}. The industrial HI is 0.02, which is less than the NMED target HI of 1. The total dose is 0.4 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the industrial scenario is equivalent to a total risk of 7×10^{-6}, based on conversion from dose using RESRAD Version 7.0.

Residential Scenario

The total excess cancer risk for the residential scenario is 7×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The residential HI is 0.3, which is less than the NMED target HI of 1. The total dose is 1 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the residential scenario is equivalent to a total risk of 2×10^{-5}, based on conversion from dose using RESRAD Version 7.0.

The residential exposure scenario is also protective of construction workers.

H-4.6.4 AOC 12-004(b)

Industrial Scenario

The total excess cancer risk for the industrial scenario is 1×10^{-8}, which is less than the NMED target risk level of 1×10^{-5}. The industrial HI is 0.07, which is less than the NMED target HI of 1. No radionuclide COPCs were identified.

Residential Scenario

The total excess cancer risk for the residential scenario is 8×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The residential HI is 0.6, which is less than the NMED target HI of 1. No radionuclide COPCs were identified.

The residential exposure scenario is also protective of construction workers.

H-4.6.5 AOC C-12-001

Industrial Scenario

The total excess cancer risk for the industrial scenario is 2×10^{-7}, which is less than the NMED target risk level of 1×10^{-5}. The industrial HI is 0.003, which is less than the NMED target HI of 1. No radionuclide COPCs were identified.

Residential Scenario

The total excess cancer risk for the residential scenario is 2×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The residential HI is 0.5, which is less than the NMED target HI of 1. No radionuclide COPCs were identified.

The residential exposure scenario is also protective of construction workers.

H-4.6.6 AOC C-12-002

Industrial Scenario

No carcinogenic COPCs were identified. The industrial HI is 0.04, which is less than the NMED target HI of 1. No radionuclide COPCs were identified.

Residential Scenario

The total excess cancer risk for the residential scenario is 2×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The residential HI is 0.6, which is less than the NMED target HI of 1. No radionuclide COPCs were identified.

The residential exposure scenario is also protective of construction workers.

H-4.6.7 AOC C-12-003

Industrial Scenario

The total excess cancer risk for the industrial scenario is 2×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The industrial HI is 0.005, which is less than the NMED target HI of 1. No radionuclide COPCs were identified.

Residential Scenario

The total excess cancer risk for the residential scenario is 5×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The residential HI is 0.3, which is less than the NMED target HI of 1. No radionuclide COPCs were identified.

The residential exposure scenario is also protective of construction workers.

H-4.6.8 AOC C-12-004

Industrial Scenario

The total excess cancer risk for the industrial scenario is 7×10^{-7}, which is less than the NMED target risk level of 1×10^{-5}. The industrial HI is 0.1, which is less than the NMED target HI of 1. No radionuclide COPCs were identified.

Residential Scenario

The total excess cancer risk for the residential scenario is 2×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The residential HI is 0.6, which is less than the NMED target HI of 1. No radionuclide COPCs were identified.

The residential exposure scenario is also protective of construction workers.

H-4.6.9 AOC C-12-005

Industrial Scenario

The total excess cancer risk for the industrial scenario is 4×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The industrial HI is 0.008, which is less than the NMED target HI of 1. No radionuclide COPCs were identified.

Recreational Scenario

The total excess cancer risk for the recreational scenario is 7×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The recreational HI is 0.02, which is less than the NMED target HI of 1. No radionuclide COPCs were identified.

Residential Scenario

The total excess cancer risk for the residential scenario is approximately 1×10^{-5} (see Uncertainty Analysis, section H-4.5.2), which is equivalent to the NMED target risk level of 1×10^{-5}. There is no excess cancer risk if the chromium EPC is compared to the trivalent chromium SSL. The residential HI is 0.1, which is less than the NMED target HI of 1. No radionuclide COPCs were identified.

The residential exposure scenario is also protective of construction workers.

H-4.6.10 AOC C-14-006

Industrial Scenario

The total excess cancer risk for the industrial scenario is 4×10^{-7}, which is less than the NMED target risk level of 1×10^{-5}. The industrial HI is 0.002, which is less than the NMED target HI of 1. No radionuclide COPCs were identified.

Residential Scenario

The total excess cancer risk for the residential scenario is 1×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The residential HI is 0.03, which is less than the NMED target HI of 1. No radionuclide COPCs were identified.

The residential exposure scenario is also protective of construction workers.

H-4.6.11 AOC 15-005(c)

Industrial Scenario

The total excess cancer risk for the industrial scenario is 2×10^{-7}, which is less than the NMED target risk level of 1×10^{-5}. The industrial HI is 0.1, which is less than the NMED target HI of 1. The total dose is 0.3 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the industrial scenario is equivalent to a total risk of 5×10^{-6}, based on conversion from dose using RESRAD Version 7.0.

Residential Scenario

The total excess cancer risk for the residential scenario is 1×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The residential HI is 0.8, which is less than the NMED target HI of 1. The total dose is 1 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the residential scenario is equivalent to a total risk of 2×10^{-5}, based on conversion from dose using RESRAD Version 7.0.

The residential exposure scenario is also protective of construction workers.

H-4.6.12 SWMU 15-007(c)

Industrial Scenario

The total excess cancer risk for the industrial scenario is 4×10^{-7}, which is less than the NMED target risk level of 1×10^{-5}. The industrial HI is 20, which is greater than the NMED target HI of 1. The elevated HI is from lead. No radionuclide COPCs were identified.

Residential Scenario

The total excess cancer risk for the residential scenario is 3×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The residential HI is 26, which is greater than the NMED target HI of 1. The elevated HI is primarily from lead and antimony. The total dose is 0.1 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the residential scenario is equivalent to a total risk of 1×10^{-6}, based on conversion from dose using RESRAD Version 7.0.

H-4.6.13 SWMU 15-007(d)

Industrial Scenario

The samples at SWMU 15-007(d) were collected from depths greater than 0.0−1.0 ft bgs; therefore, no complete exposure pathways exist for the industrial scenario.

Residential Scenario

No carcinogenic COPCs were identified. The residential HI is 0.03, which is less than the NMED target HI of 1. The total dose is 0.09 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the residential scenario is equivalent to a total risk of 9×10^{-7}, based on conversion from dose using RESRAD Version 7.0.

The residential exposure scenario is also protective of construction workers.

H-4.6.14 SWMU 15-008(b)

Industrial Scenario

The total excess cancer risk for the industrial scenario is 9×10^{-7}, which is less than the NMED target risk level of 1×10^{-5}. The industrial HI is 11, which is greater than the NMED target HI of 1. The elevated HI is from lead. The total dose is 2 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the industrial scenario is equivalent to a total risk of 4×10^{-5}, based on conversion from dose using RESRAD Version 7.0.

Residential Scenario

The total excess cancer risk for the residential scenario is 8×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The residential HI is 12, which is greater than the NMED target HI of 1. The elevated HI is primarily from lead. The total dose is 8 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the residential scenario is equivalent to a total risk of 1×10^{-4}, based on conversion from dose using RESRAD Version 7.0.

H-4.6.15 AOC 15-008(g)

Industrial Scenario

No carcinogenic COPCs were identified. The industrial HI is 0.5, which is less than the NMED target HI of 1. The total dose is 0.1 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the industrial scenario is equivalent to a total risk of 3×10^{-6}, based on conversion from dose using RESRAD Version 7.0.

Residential Scenario

No carcinogenic COPCs were identified. The residential HI is approximately 1 (see Uncertainty Analysis, section H-4.5.2), which is equivalent to the NMED target HI of 1. The HI is primarily from lead. The lead EPC is less than the residential SSL and the HI without lead is 0.6. The total dose is 0.5 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the residential scenario is equivalent to a total risk of 7×10^{-6}, based on conversion from dose using RESRAD Version 7.0.

The residential exposure scenario is also protective of construction workers.

H-4.6.16 SWMU 15-009(b)

Industrial Scenario

The total excess cancer risk for the industrial scenario is 3×10^{-7}, which is less than the NMED target risk level of 1×10^{-5}. The industrial HI is 0.2, which is less than the NMED target HI of 1. The total dose is 18 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the industrial scenario is equivalent to a total risk of 3×10^{-4}, based on conversion from dose using RESRAD Version 7.0.

Residential Scenario

The total excess cancer risk for the residential scenario is 1×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The residential HI is 2, which is greater than the NMED target HI of 1. The elevated HI is primarily from uranium. The total dose is 46 mrem/yr, which is greater than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The dose is primarily from isotopic uranium. The total dose for the residential scenario is equivalent to a total risk of 6×10^{-4}, based on conversion from dose using RESRAD Version 7.0.

H-4.6.17 SWMU 15-009(c)

Industrial Scenario

The total excess cancer risk for the industrial scenario is 2×10^{-7}, which is less than the NMED target risk level of 1×10^{-5}. The industrial HI is 0.02, which is less than the NMED target HI of 1. The total dose is 0.1 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the industrial scenario is equivalent to a total risk of 2×10^{-6}, based on conversion from dose using RESRAD Version 7.0.

Residential Scenario

The total excess cancer risk for the residential scenario is 5×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The residential HI is 0.2, which is less than the NMED target HI of 1. The total dose is 1 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the residential scenario is equivalent to a total risk of 1×10^{-5}, based on conversion from dose using RESRAD Version 7.0.

The residential exposure scenario is also protective of construction workers.

H-4.6.18 SWMU 15-009(h)

Industrial Scenario

The samples at SWMU 15-009(h) were collected from depths greater than 0.0−1.0 ft bgs; therefore, no complete exposure pathways exist for the industrial scenario.

Residential Scenario

The total excess cancer risk for the residential scenario is 2×10^{-10}, which is less than the NMED target risk level of 1×10^{-5}. The residential HI is 0.07, which is less than the NMED target HI of 1. The total dose is 0.7 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the residential scenario is equivalent to a total risk of 9×10^{-6}, based on conversion from dose using RESRAD Version 7.0.

The residential exposure scenario is also protective of construction workers.

H-4.6.19 SWMU 15-010(b)

Industrial Scenario

The total excess cancer risk for the industrial scenario is 2×10^{-7}, which is less than the NMED target risk level of 1×10^{-5}. The industrial HI is 0.02, which is less than the NMED target HI of 1. The total dose is 0.8 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the industrial scenario is equivalent to a total risk of 1×10^{-5}, based on conversion from dose using RESRAD Version 7.0.

Residential Scenario

The total excess cancer risk for the residential scenario is 1×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The residential HI is 0.4, which is less than the NMED target HI of 1. The total dose is 2 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the residential scenario is equivalent to a total risk of 3×10^{-5}, based on conversion from dose using RESRAD Version 7.0.

The residential exposure scenario is also protective of construction workers.

H-4.6.20 AOC 15-014(h)

Industrial Scenario

The total excess cancer risk for the industrial scenario is 1×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The industrial HI is 0.07, which is less than the NMED target HI of 1. The total dose is 0.5 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the industrial scenario is equivalent to a total risk of 7×10^{-6}, based on conversion from dose using RESRAD Version 7.0.

Residential Scenario

The total excess cancer risk for the residential scenario is 3×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The residential HI is 1 (see section H-4.5.2, Uncertainty Analysis), which is equivalent to the NMED target HI of 1. Using the 95% UCL for Aroclor-1254 reduces the residential HI to 0.99. Because the lead SSL is based upon blood lead levels, lead is evaluated separately from the other noncarcinogenic COPCs. The lead EPC was less than the residential SSL, and without lead the HI is further reduced to 0.94, which is below the NMED target HI. The total dose is 1 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the residential scenario is equivalent to a total risk of 2×10^{-5}, based on conversion from dose using RESRAD Version 7.0.

The residential exposure scenario is also protective of construction workers.

H-4.6.21 SWMU 36-002

Industrial Scenario

The samples at SWMU 36-002 were collected from depths greater than 0.0−1.0 ft bgs; therefore, no complete exposure pathways exist for the industrial scenario.

Residential Scenario

The total excess cancer risk for the residential scenario is 6×10^{-11}, which is less than the NMED target risk level of 1×10^{-5}. The residential HI is 0.4, which is less than the NMED target HI of 1. The total dose is 0.01 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the residential scenario is equivalent to a total risk of 1×10^{-8}, based on conversion from dose using RESRAD Version 7.0.

The residential exposure scenario is also protective of construction workers.

H-4.6.22 SWMU 36-003(a)

Industrial Scenario

No carcinogenic COPCs were identified. The industrial HI is 0.002, which is less than the NMED target HI of 1. No radionuclide COPCs were identified.

Residential Scenario

The total excess cancer risk for the residential scenario is 3×10^{-8}, which is less than the NMED target risk level of 1×10^{-5}. The residential HI is 0.2, which is less than the NMED target HI of 1. No radionuclide COPCs were identified.

The residential exposure scenario is also protective of construction workers.

H-4.6.23 SWMUs 36-008 ~~and C-36-003~~

Industrial Scenario

The total excess cancer risk for the industrial scenario is 1×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The industrial HI is 0.1, which is less than the NMED target HI of 1. The total dose is 0.6 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the industrial scenario is equivalent to a total risk of 9×10^{-6}, based on conversion from dose using RESRAD Version 7.0.

Residential Scenario

The total excess cancer risk for the residential scenario is 3×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The residential HI is 0.9, which is less than the NMED target HI of 1. The total dose is 2 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the residential scenario is equivalent to a total risk of 2×10^{-5}, based on conversion from dose using RESRAD Version 7.0.

The residential exposure scenario is also protective of construction workers.

H-4.6.24 SWMU C-36-003

Industrial Scenario

The total excess cancer risk for the industrial scenario is 4×10^{-6}, which is less than the NMED target risk level of 1×10^{-5}. The industrial HI is 0.2, which is less than the NMED target HI of 1. The total dose is 0.9 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the industrial scenario is equivalent to a total risk of 1×10^{-5}, based on conversion from dose using RESRAD Version 7.

Residential Scenario

The total excess cancer risk for the residential scenario is 1×10^{-5}, which is equivalent to the NMED target risk level of 1×10^{-5}. The carcinogenic risk is primarily from chromium. The residential HI is 1, which is equivalent to the NMED target HI of 1. The noncarcinogenic risk is primarily from silver, copper, Aroclor-1254, and lead. The total dose is 2 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the residential scenario is equivalent to a total risk of 3×10^{-5}, based on conversion from dose using RESRAD Version 7.

Construction Worker Scenario

The residential exposure scenario is protective of construction workers for carcinogenic and radionuclide COPCs. The construction worker HI is approximately 1 (without manganese, see section H-4.5.2, Uncertainty Analysis), which is equivalent to the NMED target HI of 1.

H-5.0 ECOLOGICAL RISK-SCREENING EVALUATIONS

The approach for conducting ecological evaluations is described in the “Screening Level Ecological Risk Evaluation Methods, Revision 4” (LANL 2015, 600982). The evaluation consists of four parts: a scoping evaluation, a screening evaluation, an uncertainty analysis, and an interpretation of the results.

H-5.1 Scoping Evaluation

The scoping evaluation establishes the breadth and focus of the screening evaluation. The ecological scoping checklist is a useful tool for organizing existing ecological information (Attachment H-3). The information was used to determine whether ecological receptors might be affected, identify the types of receptors that might be present, and develop the ecological conceptual site model for the Threemile Canyon Aggregate Area sites (Attachment H-3). Some of the area on the mesa top is developed and provides minimal potential habitat for ecological receptors. The quality of the habitat varies and, in some cases, some sites have native grasses, forbs, and trees that are suitable habitat for ecological receptors.

The scoping evaluation indicated that terrestrial receptors were appropriate for evaluating the concentrations of COPCs in soil and tuff. Exposure is assessed across a site to a depth of 0.0–5.0 ft bgs (LANL 2015, 600982). Aquatic receptors were not evaluated because no aquatic communities and no aquatic habitat or perennial source of water exist at any of the sites. The depth of the regional aquifer (greater than 1000 ft bgs) and the semiarid climate limit transport to groundwater. The potential exposure pathways for terrestrial receptors in soil and tuff are root uptake, inhalation, soil ingestion, dermal contact, and food web transport (Attachment H-3). 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 unavailable to receptors.

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

- plants
- soil dwelling invertebrates (represented by the earthworm)
- the deer mouse (mammalian omnivore)
- the montane shrew (mammalian insectivore)
- desert cottontail (mammalian herbivore)
- red fox (mammalian carnivore)
- American robin (avian insectivore, avian omnivore, and avian herbivore)
- American kestrel (avian insectivore and avian carnivore [surrogate for threatened and endangered (T&E) species (primarily the Mexican spotted owl)])

The rationale for using these receptors is presented in “Screening Level Ecological Risk Evaluation Methods, Revision 4” (LANL 2015, 600982). The Mexican spotted owl is the only T&E species known to frequent the area and may use the Threemile Canyon Aggregate Area for foraging.

H-5.2 Assessment Endpoints

An assessment endpoint is an explicit expression of the environmental value to be protected. The 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 ecological evaluation, receptors represent the populations and/or communities, and assessment endpoints are any adverse effects on the chosen ecological receptors. The purpose of the ecological evaluation is to protect populations and communities of biota rather than individual organisms, except for listed or candidate T&E species and treaty-protected species, when individuals must be protected (EPA 1999, 070086). Populations of

protected species tend to be small, and the loss of an individual adversely affects the species as a whole (EPA 1997, 059370).

In accordance with this guidance, the Laboratory developed generic assessment endpoints (LANL 1999, 064137) to ensure that values at all levels of ecological organization are considered in the ecological screening process. 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 toxicity reference values (TRVs). Toxicity studies used in the development of TRVs included only studies in which the adverse effect evaluated 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 the applicability to the ecosystem of concern.

H-5.3 Ecological Risk Screening Evaluation

The ecological screening evaluation identifies chemicals of potential ecological concern (COPECs) and is based on the comparison of EPCs (95% UCLs, maximum detected concentrations, or maximum detection limits) to ecological screening levels (ESLs). The EPCs used in the assessments for the Threemile Canyon Aggregate Area are presented in Tables H-2.3-1 through Table H-2.3-51.

The ESLs were obtained from the ECORISK Database, Version 3.3 (LANL 2015, 600921) and are presented in Table H-5.3-1. 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 TRVs, are presented in the ECORISK Database, Version 3.3 (LANL 2015, 600921).

The analysis begins with a comparison of the minimum ESL for a given COPC to the EPC. The HQ is defined as the ratio of the EPC to the concentration that has been determined to be acceptable to a given ecological receptor (i.e., the ESL). The higher the contaminant levels relative to the ESLs, the higher the potential risk to receptors; conversely, the higher the ESLs relative to the contaminant levels, the lower the potential risk to receptors. The HQs greater than 0.3 are used to identify COPECs requiring additional evaluation (LANL 2015, 600982). Individual HQs for a receptor are summed to derive an HI; COPCs without ESLs are retained as COPECs and evaluated further in the uncertainty section. An HI greater than 1 indicates further assessment may be needed to ensure exposure to multiple COPECs at a site will not lead to 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.

H-5.3.1 SWMUs 12-001(a) and 12-001(b)

The results of the minimum ESL comparisons are presented in Table H-5.3-2. Antimony, barium, chromium, cobalt, copper, manganese, nickel, selenium, vanadium, and RDX are retained as COPECs because the HQs were greater than 0.3.

Potential ecological risks associated with aluminum are based on soil pH. Aluminum is retained only in soil with a pH lower than 5.5, in accordance with EPA guidance (EPA 2003, 085645). Aluminum was eliminated as a COPEC and was not evaluated further because the soil pH for the Threemile Canyon Aggregate Area is neutral to slightly alkaline.

Calcium, iron, magnesium, and perchlorate do not have ESLs, are retained as COPECs, and are discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-3. The HI analysis indicates that the robin (all feeding guilds), cottontail, shrew, deer mouse, earthworm, and plant have HIs greater than 1. The HI for the kestrel (intermediate carnivore) was equivalent to 1. The COPECs and receptors are discussed in the uncertainty section.

H-5.3.2 SWMU 12-002

The results of the minimum ESL comparisons are presented in Table H-5.3-4. Antimony, barium, chromium, cobalt, copper, nickel, selenium, and vanadium are retained as COPECs because the HQs were greater than 0.3.

Calcium and iron do not have ESLs, are retained as COPECs, and are discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-5. The HI analysis indicates that the robin (all feeding guilds), shrew, deer mouse, and plant have HIs greater than 1. The HI for the kestrel (intermediate carnivore), cottontail, and earthworm were equivalent to 1. The COPECs and receptors are discussed in the uncertainty section.

H-5.3.3 AOC 12-004(a)

The results of the minimum ESL comparisons are presented in Table H-5.3-6. Barium, chromium, cobalt, copper, nickel, selenium, vanadium, benzoic acid, and di-n-butylphthalate are retained as COPECs because the HQs were greater than 0.3.

Potential ecological risks associated with aluminum are based on soil pH. Aluminum is retained only in soil with a pH lower than 5.5, in accordance with EPA guidance (EPA 2003, 085645). Aluminum was eliminated as a COPEC and was not evaluated further because the soil pH for the Threemile Canyon Aggregate Area is neutral to slightly alkaline.

Calcium, magnesium, and perchlorate do not have ESLs, are retained as COPECs, and are discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-7. The HI analysis indicates that the kestrel (intermediate carnivore), robin (all feeding guilds), shrew, deer mouse, and plant have HIs greater than 1. The COPECs and receptors are discussed in the uncertainty section.

H-5.3.4 AOC 12-004(b)

The results of the minimum ESL comparisons are presented in Table H-5.3-8. Arsenic, barium, chromium, cobalt, copper, lead, nickel, selenium, vanadium, and Aroclor-1254 are retained as COPECs because the HQs were greater than 0.3.

Potential ecological risks associated with aluminum are based on soil pH. Aluminum is retained only in soil with a pH lower than 5.5, in accordance with EPA guidance (EPA 2003, 085645). Aluminum was eliminated as a COPEC and was not evaluated further because the soil pH for the Threemile Canyon Aggregate Area is neutral to slightly alkaline.

Calcium, magnesium, and perchlorate do not have ESLs, are retained as COPECs, and are discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-9. The HI analysis indicates that the robin (all feeding guilds), shrew, deer mouse, earthworm, and plant have HIs greater than 1. The HI for the kestrel (intermediate carnivore) was equivalent to 1. The COPECs and receptors are discussed in the uncertainty section.

H-5.3.5 AOC C-12-001

The results of the minimum ESL comparisons are presented in Table H-5.3-10. Barium, chromium, cobalt, nickel, selenium, Aroclor-1242, and Aroclor-1254 are retained as COPECs because the HQs were greater than 0.3.

Potential ecological risks associated with aluminum are based on soil pH. Aluminum is retained only in soil with a pH lower than 5.5, in accordance with EPA guidance (EPA 2003, 085645). Aluminum was eliminated as a COPEC and was not evaluated further because the soil pH for the Threemile Canyon Aggregate Area is neutral to slightly alkaline.

Calcium and perchlorate, do not have ESLs, are retained as COPECs, and are discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-11. The HI analysis indicates that the robin (all feeding guilds), shrew, deer mouse, and plant have HIs greater than 1. The HI for the kestrel (intermediate carnivore) was equivalent to 1. The COPECs and receptors are discussed in the uncertainty section.

H-5.3.6 AOC C-12-002

The results of the minimum ESL comparisons are presented in Table H-5.3-12. Antimony, barium, chromium, cobalt, copper, nickel, selenium, vanadium are retained as COPECs because the HQs were greater than 0.3.

Potential ecological risks associated with aluminum are based on soil pH. Aluminum is retained only in soil with a pH lower than 5.5, in accordance with EPA guidance (EPA 2003, 085645). Aluminum was eliminated as a COPEC and was not evaluated further because the soil pH for the Threemile Canyon Aggregate Area is neutral to slightly alkaline.

Calcium and perchlorate, do not have ESLs, are retained as COPECs, and are discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-13. The HI analysis indicates that the robin (all feeding guilds), shrew, deer mouse, and plant have HIs greater than 1. The HIs for the kestrel (intermediate carnivore), cottontail, and earthworm were equivalent to 1. The COPECs and receptors are discussed in the uncertainty section.

H-5.3.7 AOC C-12-003

The results of the minimum ESL comparisons are presented in Table H-5.3-14. Antimony, barium, chromium, cobalt, and selenium are retained as COPECs because the HQs were greater than 0.3.

Perchlorate does not have ESLs, is retained as a COPEC, and is discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-15. The HI analysis indicates that the robin (all feeding guilds), cottontail, shrew, deer mouse, and plant have HIs greater than 1. The COPECs and receptors are discussed in the uncertainty section.

H-5.3.8 AOC C-12-004

The results of the minimum ESL comparisons are presented in Table H-5.3-16. Antimony, barium, chromium, cobalt, copper, lead, nickel, selenium, silver, and vanadium are retained as COPECs because the HQs were greater than 0.3.

Potential ecological risks associated with aluminum are based on soil pH. Aluminum is retained only in soil with a pH lower than 5.5, in accordance with EPA guidance (EPA 2003, 085645). Aluminum was eliminated as a COPEC and was not evaluated further because the soil pH for the Threemile Canyon Aggregate Area is neutral to slightly alkaline.

Calcium, iron, and perchlorate do not have ESLs, are retained as COPECs, and are discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-17. The HI analysis indicates that the kestrel (intermediate carnivore), robin (all feeding guilds), shrew, deer mouse, and plant have HIs greater than 1. The HIs for the cottontail and earthworm were equivalent to 1. The COPECs and receptors are discussed in the uncertainty section.

H-5.3.9 AOC C-12-005

The results of the minimum ESL comparisons are presented in Table H-5.3-18. Antimony and chromium are retained as COPECs because the HQs were greater than 0.3.

Perchlorate does not have ESLs, is retained as a COPEC, and is discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-19. The HI analysis indicates that the robin (all feeding guilds), cottontail, shrew, and deer mouse have HIs greater than 1. The COPECs and receptors are discussed in the uncertainty section.

H-5.3.10 AOC C-14-006

The results of the minimum ESL comparisons are presented in Table H-5.3-20. Antimony and chromium are retained as COPECs because the HQs were greater than 0.3.

Perchlorate, 4-isopropyltoluene, and TATB do not have ESLs, are retained as COPECs, and are discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-21. The HI analysis indicates that all receptors have HIs less than 1.

H-5.3.11 AOC 15-005(c)

The results of the minimum ESL comparisons are presented in Table H-5.3-22. Antimony, barium, chromium, cobalt, copper, lead, selenium, vanadium, and bis(2-ethylhexyl)phthalate are retained as COPECs because the HQs were greater than 0.3.

Iron, perchlorate, ethylbenzene, 4-isopropyltoluene, and 1,3-xylene+1,4-xylene do not have ESLs, are retained as COPECs, and are discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-23. The HI analysis indicates that the kestrel (intermediate carnivore), robin (all feeding guilds), shrew, deer mouse, and plant have HIs greater than 1. The HIs for the cottontail and earthworm were equivalent to 1. The COPECs and receptors are discussed in the uncertainty section.

H-5.3.12 SWMU 15-007(c)

The results of the minimum ESL comparisons are presented in Table H-5.3-24. Antimony, chromium, copper, lead, nickel, selenium, silver, and zinc are retained as COPECs because the HQs were greater than 0.3.

Perchlorate and TATB do not have ESLs, are retained as COPECs, and are discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-25. The HI analysis indicates that the red fox, kestrel (both feeding guilds), robin (all feeding guilds), cottontail, shrew, deer mouse, earthworm, and plant have HIs greater than 1. The COPECs and receptors are discussed in the uncertainty section.

H-5.3.13 SWMU 15-007(d)

The results of the minimum ESL comparisons are presented in Table H-5.3-26. Antimony and selenium are retained as COPECs because the HQs were greater than 0.3.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-27. The HI analysis indicates that the shrew, deer mouse, and plant have HIs greater than 1. The HIs for the robin (all feeding guilds) were equivalent to 1. The COPECs and receptors are discussed in the uncertainty section.

H-5.3.14 SWMU 15-008(b)

The results of the minimum ESL comparisons are presented in Table H-5.3-28. Antimony, barium, beryllium, cadmium, chromium, copper, lead, manganese, nickel, selenium, uranium, vanadium, zinc, Aroclor-1242, and Aroclor-1254 are retained as COPECs because the HQs were greater than 0.3.

Calcium, iron, perchlorate, Aroclor-1268, and TATB do not have ESLs, are retained as COPECs, and are discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-29. The HI analysis indicates that the red fox, kestrel (both feeding guilds), robin (all feeding guilds), cottontail, shrew, deer mouse, earthworm, and plant have HIs greater than 1. The COPECs and receptors are discussed in the uncertainty section.

H-5.3.15 AOC 15-008(g)

The results of the minimum ESL comparisons are presented in Table H-5.3-30. Antimony, cobalt, copper, lead, and selenium are retained as COPECs because the HQs were greater than 0.3.

Calcium and TATB do not have ESLs, are retained as COPECs, and are discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-31. The HI analysis indicates that the kestrel (intermediate carnivore), robin (all feeding guilds), cottontail, shrew, deer mouse, and plant have HIs greater than 1. The COPECs and receptors are discussed in the uncertainty section.

H-5.3.16 SWMU 15-009(b)

The results of the minimum ESL comparisons are presented in Table H-5.3-32. Antimony, barium, cadmium, chromium, copper, cyanide, lead, selenium, uranium, uranium-234, and uranium-238 are retained as COPECs because the HQs were greater than 0.3.

Perchlorate and 4-isopropyltoluene do not have ESLs, are retained as COPECs, and are discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-33. The HI analysis indicates that the kestrel (all feeding guilds), robin (all feeding guilds), cottontail, shrew, deer mouse, and plant have HIs greater than 1. The HI for the earthworm was equivalent to 1. The COPECs and receptors are discussed in the uncertainty section.

H-5.3.17 SWMU 15-009(c)

The results of the minimum ESL comparisons are presented in Table H-5.3-34. Chromium, cyanide, selenium, and bis(2-ethylhexyl)phthalate are retained as COPECs because the HQs were greater than 0.3.

Perchlorate, 1,2,4-trimethylbenzene, 4-isopropyltoluene, and 1,3-xylene+1,4-xylene do not have ESLs, are retained as COPECs, and are discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-35. The HI analysis indicates that the kestrel (both feeding guilds), robin (all feeding guilds), shrew, deer mouse, and plant have HIs greater than 1. The COPECs and receptors are discussed in the uncertainty section.

H-5.3.18 SWMU 15-009(h)

The results of the minimum ESL comparisons are presented in Table H-5.3-36. Antimony is retained as a COPEC because the HQs were greater than 0.3.

Perchlorate does not have ESLs, is retained as a COPEC, and is discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-37. The HI analysis indicates that all receptors have HIs less than 1.

H-5.3.19 SWMU 15-010(b)

The results of the minimum ESL comparisons are presented in Table H-5.3-38. Antimony, cadmium, chromium, mercury, selenium, vanadium, bis(2-ethylhexyl)phthalate, and di-n-butylphthalate are retained as COPECs because the HQs were greater than 0.3.

Iron, perchlorate, and 1,3-xylene+1,4-xylene do not have ESLs, are retained as COPECs, and are discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-39. The HI analysis indicates that the kestrel (both feeding guilds), robin (all feeding guilds), shrew, deer mouse, earthworm, and plant have HIs greater than 1. The HI for the cottontail was equivalent to 1. The COPECs and receptors are discussed in the uncertainty section.

H-5.3.20 AOC 15-014(h)

The results of the minimum ESL comparisons are presented in Table H-5.3-40. Antimony, barium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, silver, vanadium, Aroclor-1254, benzoic acid, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and di-n-octylphthalate are retained as COPECs because the HQs were greater than 0.3.

Potential ecological risks associated with aluminum are based on soil pH. Aluminum is retained only in soil with a pH lower than 5.5, in accordance with EPA guidance (EPA 2003, 085645). Aluminum was eliminated as a COPEC and was not evaluated further because the soil pH for the Threemile Canyon Aggregate Area is neutral to slightly alkaline.

Iron, perchlorate, ethylbenzene, 4-isopropyltoluene, 1,2,4-trimethylbenzene, 1,2-xylene, and 1,3-xylene+1,4-xylene do not have ESLs, are retained as COPECs, and are discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-41. The HI analysis indicates that the kestrel (both feeding guilds), robin (all feeding guilds), cottontail, shrew, deer mouse, earthworm, and plant have HIs greater than 1. The COPECs and receptors are discussed in the uncertainty section.

H-5.3.21 SWMU 36-002

The results of the minimum ESL comparisons are presented in Table H-5.3-42. Antimony, barium, cobalt, copper, nickel, and selenium are retained as COPECs because the HQs were greater than 0.3.

Magnesium and perchlorate do not have ESLs, are retained as COPECs, and are discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-43. The HI analysis indicates that the robin (omnivore and insectivore), shrew, deer mouse, and plant have HIs greater than 1. The HI for the robin (herbivore) was equivalent to 1. The COPECs and receptors are discussed in the uncertainty section.

H-5.3.22 SWMU 36-003(a)

The results of the minimum ESL comparisons are presented in Table H-5.3-44. Antimony, beryllium, nickel, and selenium are retained as COPECs because the HQs were greater than 0.3.

Perchlorate, 4-isopropyltoluene, and 1,2,4-trimethylbenzene do not have ESLs, are retained as COPECs, and are discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-45. The HI analysis indicates that the robin (omnivore and insectivore), shrew, deer mouse, and plant have HIs greater than 1. The HIs for the robin (herbivore) and cottontail were equivalent to 1. The COPECs and receptors are discussed in the uncertainty section.

H-5.3.23 SWMU~~s~~ 36-008 ~~and C-36-003~~

The results of the minimum ESL comparisons are presented in Table H-5.3-46. Antimony, barium, cadmium, chromium, copper, cyanide, lead, mercury, nickel, selenium, silver, vanadium, zinc, Aroclor-1254, benzoic acid, bis(2-ethylhexyl)phthalate, and di-n-butylphthalate are retained as COPECs because the HQs were greater than 0.3.

Potential ecological risks associated with aluminum are based on soil pH. Aluminum is retained only in soil with a pH lower than 5.5, in accordance with EPA guidance (EPA 2003, 085645). Aluminum was eliminated as a COPEC and was not evaluated further because the soil pH for the Threemile Canyon Aggregate Area is neutral to slightly alkaline.

Magnesium; perchlorate; bromodichloromethane; chlorodibromomethane; chloromethane; 2-chloronaphthalene; 4-chlorotoluene; 4-isopropyltoluene; TATB; 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; 1,2-xylene; and 1,3-xylene+1,4-xylene do not have ESLs, are retained as COPECs, and are discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-47. The HI analysis indicates that the kestrel (both feeding guilds), robin (all feeding guilds), cottontail, shrew, deer mouse, earthworm, and plant have HIs greater than 1. The COPECs and receptors are discussed in the uncertainty section.

H-5.3.24 SWMU C-36-003

The results of the minimum ESL comparisons are presented in Table H-5.3-48. Antimony, cadmium, chromium, copper, cyanide, lead, manganese, mercury, nickel, selenium, silver, zinc, Aroclor-1254, benzoic acid, and di-n-butylphthalate are retained as COPECs because the HQs were greater than 0.3.

Calcium, nitrate, perchlorate, bromodichloromethane, chlorodibromomethane, isopropyltoluene[4-], trimethylbenzene[1,2,4-], and xylene[1,3-]+xylene[1,4-] do not have ESLs, are retained as COPECs, and are discussed in the uncertainty section.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.3-49. The HI analysis indicates that the kestrel (both feeding guilds), robin (all feeding guilds), cottontail, shrew, deer mouse, earthworm, and plant have HIs greater than 1. The COPECs and receptors are discussed in the uncertainty section.

H-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 for sites. The following narrative contains a qualitative uncertainty analysis of the issues relevant to evaluating the potential ecological risk at these Threemile Canyon Aggregate Area sites.

H-5.4.1 Chemical Form

The assumptions used in the ESL derivations were 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. Most of these factors tend to result in conservative estimates of the ESLs, 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, largely a limitation on analytical quantitation of individual chemical species. Toxicological data are typically based on the most toxic and bioavailable chemical species not likely found in the environment. The inorganic, organic, and radionuclide, COPECs are generally not 100% bioavailable to receptors in the natural environment because of 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 2015, 600982) , and the values were biased toward overestimating the potential risk to receptors.

H-5.4.2 Exposure Assumptions

The EPCs used in the calculations of HQs were the 95% UCL, the maximum detected concentration, or the maximum detection limit to a depth of 5.0 ft, thereby conservatively estimating the exposure to each COPC. As a result, the exposure of individuals within a population was evaluated using this specific concentration, which was assumed constant throughout the exposure area. The sampling also 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. The assumptions made regarding exposure for terrestrial receptors results in an overestimation of the potential exposure and risk because COPECs varied across the site and were infrequently detected.

H-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 likely 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 may result in an under- or overestimation of potential risk.

H-5.4.4 Area Use Factors

In addition to the direct comparison of the EPC with the ESLs, area use factors (AUF) are used to account for the amount of time a receptor is likely to spend within the contaminated areas based on the size of the receptor's home range (HR). The AUF for individual organisms is calculated 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. The HR for the Mexican spotted owl is 366 ha (EPA 1993, 059384). The site areas and AUFs for each site are presented in Table H-5.4-1. The kestrel (top carnivore) is used as the surrogate receptor for the Mexican spotted owl.

Eight sites had HIs for the kestrel (top carnivore) equivalent to or above 1. Application of the AUFs for the Mexican spotted owl to the HIs for the kestrel (top carnivore) resulted in adjusted HIs ranging from 0.00009 to 0.07. Therefore, there are no potential adverse impacts to the Mexican spotted owl at any of the sites.

H-5.4.5 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 at these Threemile Canyon Aggregate Area sites is to estimate the spatial extent of the area inhabited by the local population that overlaps with the contaminated area. The population area for a receptor is based on the individual receptor HR and its dispersal distance. 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 (Bowman et al. 2002, 073475), the median dispersal distance becomes 3.6 times the square root of the HR (R^2=0.91). If it is assumed that the receptors can disperse 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 can be derived by $\pi(3.6\sqrt{HR})^2$ or approximately 40HR.

H-5.4.5.1 SWMUs 12-001(a) and 12-001(b)

The area of SWMUs 12-001(a) and 12-001(b) is approximately 1.82 ha. The population area use factors (PAUFs) are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-2). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for SWMUs 12-001(a) and 12-001(b) are less than 1 for all receptors, except for the deer mouse, which had an adjusted HI of 2, and the robin (insectivore), which had an adjusted HI equivalent to 1. The plant had an unadjusted HI of 8 and the earthworm had an unadjusted HI of 3 (Table H-5.4-3).

H-5.4.5.2 SWMU 12-002

The area of SWMU 12-002 is approximately 0.000232 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-4). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for SWMU 12-002 are less than 1 for all receptors. The plant had an unadjusted HI of 6 and the earthworm had an unadjusted HI equivalent to 1 (Table H-5.4-5).

H-5.4.5.3 AOC 12-004(a)

The area of AOC 12-004(a) is approximately 0.271 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-6). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for AOC 12-004(a) are less than 1 for all receptors. The plant had an unadjusted HI of 4 and the earthworm had an unadjusted HI of 0.7 (Table H-5.4-7).

H-5.4.5.4 AOC 12-004(b)

The area of AOC 12-004(b) is approximately 0.000513 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-8). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for AOC 12-004(b) are less than 1 for all receptors. The plant had an unadjusted HI of 6 and the earthworm had an unadjusted HI of 2 (Table H-5.4-9).

H-5.4.5.5 AOC C-12-001

The area of AOC C-12-001 is approximately 0.00353 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-10). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for AOC C-12-001 are less than 1 for all receptors. The plant had an unadjusted HI of 4 and the earthworm had an unadjusted HI of 0.7 (Table H-5.4-11).

H-5.4.5.6 AOC C-12-002

The area of AOC C-12-002 is approximately 0.00422 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-12). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for AOC C-12-002 are less than 1 for all receptors. The plant had an unadjusted HI of 6 and the earthworm had an unadjusted HI equivalent to 1 (Table H-5.4-13).

H-5.4.5.7 AOC C-12-003

The area of AOC C-12-003 is approximately 0.0101 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-14). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for AOC C-12-003 are less than 1 for all receptors. The plant had an unadjusted HI of 4 and the earthworm had an unadjusted HI of 0.7 (Table H-5.4-15).

H-5.4.5.8 AOC C-12-004

The area of AOC C-12-004 is approximately 0.00391 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-16). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for AOC C-12-004 are less than 1 for all receptors. The plant had an unadjusted HI of 6 and the earthworm had an unadjusted HI equivalent to 1 (Table H-5.4-17).

H-5.4.5.9 AOC C-12-005

The area of AOC C-12-005 is approximately 0.00261 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-18). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for AOC C-12-005 are less than 1 for all receptors. The plant had an unadjusted HI of 0.4 and the earthworm had an unadjusted HI of 0.05 (Table H-5.4-19).

H-5.4.5.10 AOC 15-005(c)

The area of AOC 15-005(c) is approximately 0.111 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-20). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for AOC 15-005(c) are less than 1 for all receptors. The plant had an unadjusted HI of 6 and the earthworm had an unadjusted HI equivalent to 1 (Table H-5.4-21).

H-5.4.5.11 SWMU 15-007(c)

The area of the SWMU 15-007(c) is approximately 0.0508 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-22). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for SWMU 15-007(c) are less than 1 for all receptors, except for the robin (insectivore) and deer mouse, which had adjusted HIs of 2 and 3, respectively, and the robin (herbivore and omnivore), which had an adjusted HIs equivalent to 1 (Table H-5.4-23). The plant had an unadjusted HI of 84 and the earthworm had an unadjusted HI of 8 (Table H-5.4-23).

H-5.4.5.12 SWMU 15-007(d)

The area of SWMU 15-007(d) is approximately 0.0267 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-24). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for SWMU 15-007(d) are less than 1 for all receptors. The plant had an unadjusted HI of 2 and the earthworm had an unadjusted HI of 0.3 (Table H-5.4-25).

H-5.4.5.13 SWMU 15-008(b)

The area of the SWMU 15-008(b) is approximately 3.12 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-26). The HQs and HIs are recalculated using the PAUFs. The HI for the deer mouse is not adjusted because the PAUF is 1. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for SWMU 15-008(b) are less than 1 for all receptors, except for the robin (herbivore, omnivore, and insectivore), shrew, and deer mouse which had adjusted HIs of 47, 65, 80, 22, and 67, respectively (Table H-5.4-27). The plant had an unadjusted HI of 69 and the earthworm had an unadjusted HI of 25 (Table H-5.4-27).

H-5.4.5.14 AOC 15-008(g)

The area of AOC 15-008(g) is approximately 0.00254 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-28). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for AOC 15-008(g) are less than 1 for all receptors. The plant had an unadjusted HI of 6 and the earthworm had an unadjusted HI of 0.9 (Table H-5.4-29).

H-5.4.5.15 SWMU 15-009(b)

The area of SWMU 15-009(b) is approximately 0.0165 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-30). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for SWMU 15-009(b) are less than 1 for all receptors. The plant had an unadjusted HI of 22 and the earthworm had an unadjusted HI equivalent to 1 (Table H-5.4-31).

H-5.4.5.16 SWMU 15-009(c)

The area of SWMU 15-009(c) is approximately 0.273 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-32). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for SWMU 15-009(c) are less than 1 for all receptors. The plant had an unadjusted HI of 3 and the earthworm had an unadjusted HI of 0.3 (Table H-5.4-33).

H-5.4.5.17 SWMU 15-010(b)

The area of the SWMU 15-010(b) is approximately 0.267 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-34). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for SWMU 15-010(b) are less than 1 for all receptors, except for the robin (insectivore), which had adjusted HI of 2, and the robin (omnivore), which had an adjusted HI equivalent to 1 (Table H-5.4-35). The plant had an unadjusted HI of 2 and the earthworm had an unadjusted HI of 6 (Table H-5.4-35).

H-5.4.5.18 AOC 15-014(h)

The area of the AOC 15-014(h) is approximately 1.36 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-36). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for AOC 15-014(h) are less than 1 for all receptors, except for the robin (omnivore and insectivore), and deer mouse, which had adjusted HIs of 4, 7, and 3, respectively, and the robin (herbivore) and shrew, which had adjusted HIs equivalent to 1 (Table H-5.4-37). The plant had an unadjusted HI of 6 and the earthworm had an unadjusted HI of 8 (Table H-5.4-37).

H-5.4.5.19 SWMU 36-002

The area of SWMU 36-002 is approximately 0.00356 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-38). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for SWMU 36-002 are less than 1 for all receptors. The plant had an unadjusted HI of 3 and the earthworm had an unadjusted HI of 0.6 (Table H-5.4-39).

H-5.4.5.20 SWMU 36-003(a)

The area of SWMU 36-003(a) is approximately 0.0591 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-40). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for SWMU 36-003(a) are less than 1 for all receptors. The plant had an unadjusted HI of 4 and the earthworm had an unadjusted HI of 0.5 (Table H-5.4-41).

H-5.4.5.21 SWMU~~s~~ 36-008 ~~and C-36-003~~

The area of the SWMU~~s~~ 36-008 ~~and C-36-003~~ is approximately 0.452 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-42). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for SWMU~~s~~ 36-008 ~~and C-36-003~~ are less than 1 for all receptors, except for the robin (all feeding guilds), and deer mouse, which had adjusted HIs of 2, 5, 8, and 2, respectively (Table H-5.4-43). The plant had an unadjusted HI of 9 and the earthworm had an unadjusted HI of 52 (Table H-5.4-43).

H-5.4.5.22 SWMU C-36-003

The area of SWMU C-36-003 is approximately 0.0165 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.4-44). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for SWMU C-36-003 are less than 1 for all receptors. The plant had an unadjusted HI of 21 and the earthworm had an unadjusted HI of 24 (Table H-5.4-45).

H-5.4.6 LOAEL Analysis

Some of these sites has HIs greater than 1 for one or more receptors. To address the HIs and reduce the associated uncertainty, analyses were conducted using ESLs calculated based on a LOAEL rather than an NOAEL. The LOAEL-based ESLs were calculated based on toxicity information in the ECORISK Database, Release 3.3 (LANL 2015, 600921) and are presented in Table H-5.4-44. The analyses address some of the uncertainties and conservativeness of the ESLs used in the initial screening assessments. HI analyses and adjusted HI analyses were conducted using the LOAEL-based ESLs.

H-5.4.7 Site Discussions

H-5.4.7.1 SWMUs 12-001(a) and 12-001(b)

The HIs for SWMUs 12-001(a) and 12-001(b) are greater than 1 for the robin (insectivore), deer mouse, earthworm, and plant, with barium, cobalt, manganese, selenium, vanadium, and RDX being the primary COPECs for one or several receptors. The HI analysis using LOAEL-based ESLs resulted in HIs of 2 for the robin (insectivore), approximately 1 for the deer mouse, 0.5 for the earthworm, and 2 for the plant (Table H-5.4-45). The adjusted HI analysis using LOAEL-based ESLs resulted in HIs of less than 1 for the robin (insectivore) and the deer mouse (Table H-5.4-46).

Barium was detected in all 80 samples in the 0.0−5.0 ft depth interval with an EPC of 213 mg/kg. The EPC, which represents the average exposure concentration, is within the range of soil background concentrations. The plant LOAEL-based ESL for barium is 260 mg/kg, which is similar to the soil BV and is below the maximum soil background concentration. Manganese was detected in all 80 samples in the 0.0−5.0-ft depth interval with an EPC of 456 mg/kg. The EPC, which represents the average exposure concentration, is within the range of soil and Qbt 2,3,4 background concentrations. The plant

LOAEL-based ESL for manganese is 1100 mg/kg, which the same as the maximum soil background concentration. Selenium was not detected in any of the 80 samples and the EPC (1.34 mg/kg) was the maximum detection limit, which is below the maximum soil background concentration (1.7 mg/kg). The use of the detection limit as the EPC overestimates the potential exposure to the plant. Vanadium was detected in all 80 samples in the 0.0−5.0-ft depth interval with an EPC of 27.6 mg/kg. The EPC, which represents the average exposure concentration, is within the range of soil background concentrations. The data indicate the exposure to COPECs is similar to background and the potential for ecological risk to plants is overestimated.

In addition, field observations made during the site visit found no indication of adverse effects from COPECs on the plant community (Attachment H-3). The site is not developed, with habitat for ecological receptors, including plants. Therefore, the HI does not indicate potential risk to plants.

H-5.4.7.2 SWMU 12-002

The HIs for SWMU 12-002 are equivalent to or greater than 1 for the earthworm and plant, with barium, cobalt, selenium, and vanadium being the primary COPECs. The HI analysis using LOAEL-based ESLs resulted in HIs of 0.06 for the earthworm and 2 for the plant (Table H-5.4-47).

Barium was detected in both samples from the 0.0−5.0-ft depth interval with an EPC of 191 mg/kg, the maximum concentration of two samples. The use of the maximum concentration overestimates the potential risk and is within the range of soil background concentrations. The plant LOAEL-based ESL for barium is 260 mg/kg, which is similar to the ~~the~~ soil BV and is below the maximum soil background concentration. Selenium was not detected in either sample and the EPC (1.1 mg/kg) was the maximum detection limit, which is below the maximum soil background concentration (1.7 mg/kg). The use of the detection limit as the EPC overestimates the potential exposure to the plant. Vanadium was detected in both samples in the 0.0−5.0 ft-depth interval with an EPC of 27.1 mg/kg, the maximum concentration of two samples. The use of the maximum concentration overestimates the potential risk and is within the range of soil background concentrations. The data indicate exposure to COPECs is similar to background and the potential for ecological risk to plants is overestimated.

In addition, field observations made during the site visit found no indication of adverse effects from COPECs on the plant community (Attachment H-3). The site is not developed, with habitat for ecological receptors, including plants. Therefore, the HI does not indicate potential risk to plants.

H-5.4.7.3 AOC 12-004(a)

The HI for AOC 12-004(a) is greater than 1 for the plant, with barium, cobalt, and selenium being the primary COPECs. The HI analysis using LOAEL-based ESLs resulted in an HI of 0.8 for the plant (Table H-5.4-48).

H-5.4.7.4 AOC 12-004(b)

The HIs for AOC 12-004(b) are greater than 1 for the earthworm and plant, with barium, cobalt, selenium, and vanadium being the primary COPECs for the plant and arsenic and barium being the primary COPECs for the earthworm. The HI analysis using LOAEL-based ESLs resulted in HIs of 0.1 for the earthworm and 2 for the plant (Table H-5.4-49).

Barium was detected in all eight samples in the 0.0−5.0-ft depth interval with an EPC of 246 mg/kg. The EPC, which represents the average exposure concentration, is within the range of soil background concentrations. The plant LOAEL-based ESL for barium is 260 mg/kg, which is similar to the soil BV and

is below the maximum soil background concentration (the maximum concentration is also below the maximum soil background concentration). Selenium was detected in four of the eight samples and the EPC (1.1 mg/kg) was the maximum concentration. The use of the maximum concentration overestimates the potential risk and is below the maximum soil background concentration (1.7 mg/kg). Vanadium was detected in all eight samples in the 0.0−5.0-ft depth interval with an EPC of 30.3 mg/kg. The EPC, which represents the average exposure concentration, is within the range of soil background concentrations. The data indicate exposure to COPECs is similar to background and the potential for ecological risk to plants is overestimated.

In addition, field observations made during the site visit found no indication of adverse effects from COPECs on the plant community (Attachment H-3). The site is not developed, with habitat for ecological receptors, including plants. Therefore, the HI does not indicate potential risk to plants.

H-5.4.7.5 AOC C-12-001

The HI for AOC C-12-001 is greater than 1 for the plant, with barium, cobalt, and selenium being the primary COPECs. The HI analysis using LOAEL-based ESLs resulted in an HI equivalent to 1 (0.97) for the plant (Table H-5.4-50).

In addition, field observations made during the site visit found no indication of adverse effects from COPECs on the plant community (Attachment H-3). The site is within an industrially developed area, with habitat for ecological receptors, including plants. Therefore, the HI does not indicate potential risk to plants.

H-5.4.7.6 AOC C-12-002

The HIs for AOC C-12-002 are equivalent to for the earthworm and greater than 1 for the plant, with barium, cobalt, selenium, and vanadium being the primary COPECs for the plant and barium being the primary COPEC for the earthworm. The HI analysis using LOAEL-based ESLs resulted in HIs of 0.07 for the earthworm and 2 for the plant (Table H-5.4-51).

Barium was detected in all 10 samples in the 0.0−5.0-ft depth interval with an EPC of 223 mg/kg. The EPC, which represents the average exposure concentration, is within the range of soil background concentrations. The plant LOAEL-based ESL for barium is 260 mg/kg, which is similar to the soil BV and is below the maximum soil background concentration. Selenium was not detected in any of the 13 samples and the EPC (1.15 mg/kg) is the maximum detection limit, which is below the maximum soil background concentration (1.7 mg/kg). The use of the detection limit as the EPC overestimates the potential exposure to the plant. Vanadium was detected in all 10 samples in the 0.0−5.0-ft depth interval with an EPC of 28.2 mg/kg. The EPC, which represents the average exposure concentration, is within the range of soil background concentrations. The data indicate exposure to COPECs is similar to background and the potential for ecological risk to plants is overestimated.

In addition, field observations made during the site visit found no indication of adverse effects from COPECs on the plant community (Attachment H-3). The site is within an industrially developed area, with habitat for ecological receptors, including plants. Therefore, the HI does not indicate potential risk to plants.

H-5.4.7.7 AOC C-12-003

The HI for AOC C-12-003 is greater than 1 for the plant, with barium, cobalt, and selenium being the primary COPECs. The HI analysis using LOAEL-based ESLs resulted in an HI of 0.9 for the plant (Table H-5.4-52).

H-5.4.7.8 AOC C-12-004

The HIs for AOC C-12-004 are equivalent to 1 for the earthworm and greater than 1 for the plant, with barium, cobalt, lead, selenium, and vanadium being the primary COPECs for the plant. The HI analysis using LOAEL-based ESLs resulted in HIs of 0.07 for the earthworm and 2 for the plant (Table H-5.4-53).

Barium was detected in all 10 samples in the 0.0−5.0-ft depth interval with an EPC of 214 mg/kg. The EPC, which represents the average exposure concentration, is within the range of soil background concentrations. The plant LOAEL-based ESL for barium is 260 mg/kg, which is similar to the soil BV and is below the maximum soil background concentration. Selenium was not detected in any of the 10 samples and the EPC (1.14 mg/kg) was the maximum detection limit, which is below the maximum soil background concentration (1.7 mg/kg). The use of the detection limit as the EPC overestimates the potential exposure to the plant. Vanadium was detected in all 10 samples in the 0.0−5.0-ft depth interval with an EPC of 28.1 mg/kg. The EPC, which represents the average exposure concentration, is within the range of soil background concentrations. The data indicate exposure to COPECs is similar to background and the potential for ecological risk to plants is overestimated.

In addition, field observations made during the site visit found no indication of adverse effects from COPECs on the plant community (Attachment H-3). Field observations indicated the site is within an industrially developed area, with habitat for ecological receptors, including plants. Therefore, the HI does not indicate potential risk to plants.

H-5.4.7.9 AOC 15-005(c)

The HIs for AOC 15-005(c) are greater than 1 for the earthworm and plant, with barium, cobalt, lead, selenium, and vanadium being the primary COPECs. The HI analysis using LOAEL-based ESLs resulted in HIs of 0.1 for the earthworm and 2 for the plant (Table H-5.4-54).

Barium was detected in all 20 samples in the 0.0−5.0-ft depth interval with an EPC of 205 mg/kg. The EPC, which represents the average exposure concentration, is within the range of soil background concentrations. The plant LOAEL-based ESL for barium is 260 mg/kg, which is similar to the soil BV and is below the maximum soil background concentration. Selenium was not detected in any of the 20 samples and the EPC (1.48 mg/kg) was the maximum detection limit, which is below the maximum soil background concentration (1.7 mg/kg). The use of the detection limit as the EPC overestimates the potential exposure to the plant. Vanadium was detected in all 20 samples in the 0.0−5.0-ft depth interval with an EPC of 27.4 mg/kg. The EPC, which represents the average exposure concentration, is within the range of soil background concentrations. The data indicate exposure to COPECs is similar to background and the potential for ecological risk to plants is overestimated.

In addition, field observations made during the site visit found no indication of adverse effects from COPECs on the plant community (Attachment H-3). The site is minimally developed, with habitat for ecological receptors, including plants. Therefore, the HI does not indicate potential risk to plants.

H-5.4.7.10 SWMU 15-007(c)

The HIs for the SWMU 15-007(c) are equivalent to for the robin (herbivore and omnivore) and greater than 1 for the robin (insectivore), deer mouse, earthworm, and plant, with antimony, lead, selenium, and zinc being the primary COPECs for one or several receptors. The HI analysis using LOAEL-based ESLs resulted in HIs of 174 for the robin (herbivore), 221 for the robin (omnivore), 260 for the robin (insectivore), 42 for the deer mouse, 1 for the earthworm, and 18 for the plant (Table H-5.4-55). The

adjusted HI analysis using LOAEL-based ESLs resulted in HIs of 0.5 for the robin (herbivore), 0.7 for the robin (omnivore), 0.8 for the robin (insectivore), and 0.7 for the deer mouse (Table H-5.4-56).

The maximum concentrations of antimony (243 mg/kg) and lead (63,700 mg/kg) were reported at location 15-610814 from the 0.0−0.5-ft depth interval. Antimony was detected in two of 47 samples and lead was detected in all 47 samples. The other detected concentration of antimony was 1.76 mg/kg, and the next highest lead concentration was 200 mg/kg. The EPCs without the maximum concentrations are 1.76 mg/kg for antimony and 55.7 mg/kg for lead, which results in HQs of 0.002 and 0.007 for the earthworm and 0.03 and 0.1 for the plant. Therefore, the elevated risks are limited to a small portion of SWMU 15-007(c) and given the area of the SWMU 15-007(c) is approximately 0.0508 ha, the potential for population impacts from elevated antimony and lead is low. Selenium was not detected in any of the 47 samples and the EPC (2.11 mg/kg) was the maximum detection limit. The use of the detection limit as the EPC overestimates the potential exposure to the plant. In addition, there is potential unacceptable risk for human health at this SWMU under the industrial scenario.

In addition, field observations made during the site visit found no indication of adverse effects from COPECs on the plant community (Attachment H-3). The site is not developed, with habitat available for ecological receptors, including plants. Therefore, the HI does not indicate potential risk to plants.

H-5.4.7.11 SWMU 15-007(d)

The HI for SWMU 15-007(d) is greater than 1 for the plant, with selenium being the primary COPEC. The HI analysis using LOAEL-based ESLs resulted in an HI of 0.3 for the plant (Table H-5.4-57).

H-5.4.7.12 SWMU 15-008(b)

The HIs for SWMU 15-008(b) are greater than 1 for the robin (all feeding guilds), shrew, deer mouse, earthworm, and plant, with antimony, barium, beryllium, cadmium, copper, lead, manganese, nickel, selenium, uranium, vanadium, zinc, and Aroclor-1242 being the primary COPECs for one or several receptors. Of these COPECs, only copper and lead are substantially greater background. The HI analysis using LOAEL-based ESLs resulted in HIs of 118 for the robin (herbivore), 156 for the robin (omnivore), 190 for the robin (insectivore), 57 for the shrew, 35 for the deer mouse, 4 for the earthworm, and 13 for the plant (Table H-5.4-58). The adjusted HI analysis of the using LOAEL-based ESLs resulted in HIs of 22 for the robin (herbivore), 29 for the robin (omnivore), 35 for the robin (insectivore), 11 for the shrew, 35 for the deer mouse (Table H-5.4-59). In addition, there is potential unacceptable risk for human health at this SWMU under the industrial scenario.

H-5.4.7.13 AOC 15-008(g)

The HI for AOC 15-008(g) is greater than 1 for the plant, with antimony, cobalt, copper, lead, and selenium being the primary COPECs. The HI analysis using LOAEL-based ESLs resulted in an HI equivalent to 1 for the plant (Table H-5.4-60).

Lead was detected in all eight samples in the 0.0−5.0-ft depth interval with an EPC of 309 mg/kg but only the maximum concentration (370 mg/kg) was substantially above background; the only other concentration above the soil BV was 32.7 mg/kg. In addition, AOC 15-008(g) is a small site with an area of 0.00254 ha. Although HR and population area information are not available for plants, it is unlikely that lead at AOC 15-008(g) would have population impacts on plants. Selenium was not detected in any of the eight samples and the EPC (1.28 mg/kg) was the maximum detection limit, which is below the maximum soil background concentration (1.7 mg/kg). The use of the detection limit as the EPC overestimates the

potential exposure to the plant. The data indicate exposure to COPECs is similar to background and the potential for ecological risk to plants is overestimated.

Field observations made during the site visit found no indication of adverse effects from COPECs on the plant community (Attachment H-3). Therefore, the HI does not indicate potential risk to plants.

H-5.4.7.14 SWMU 15-009(b)

The HIs for SWMU 15-009(b) are greater than 1 for the earthworm and plant, with barium, selenium, uranium, uranium-234, and uranium-238 being the primary COPECs. The HI analysis using LOAEL-based ESLs resulted in HIs of 0.04 for the earthworm and 3 for the plant (Table H-5.4-61).

Barium was detected in all eight samples in the 0.0−5.0-ft depth interval with an EPC of 94 mg/kg. The EPC is within the range of soil background concentrations. The plant LOAEL-based ESL for barium is 260 mg/kg, which is similar to the EPC and the soil BV and is below the maximum soil background concentration. Selenium was not detected in any of the eight samples and the EPC (1.59 mg/kg) was the maximum detection limit, which is below the maximum soil background concentration (1.7 mg/kg). The use of a detection limit as the EPC overestimates the potential exposure to the plant. Uranium was detected in all eight samples in the 0.0−5.0-ft depth interval with an EPC of 417 mg/kg. The EPC is heavily influenced by the maximum concentration (615 mg/kg at location 15-610531); the next highest uranium concentration (52 mg/kg) is at the same location as the maximum concentration but in the deeper sample, and the remaining uranium concentrations above BVs are 25% or less than the maximums. Because SWMU 15-009(b) is a small site (0.0165 ha), it is unlikely that the COPECs would have population impacts on plants. The data indicate exposure to COPECs across the site is similar to background and the potential for ecological risk to plants is overestimated.

In addition, field observations made during the site visit found no indication of adverse effects from COPECs on the plant community (Attachment H-3). Therefore, the HI does not indicate potential risk to plants.

H-5.4.7.15 SWMU 15-009(c)

The HI for SWMU 15-009(c) is greater than 1 for the plant, with selenium being the primary COPEC. The HI analysis using LOAEL-based ESLs resulted in an HI of 0.4 for the plant (Table H-5.4-62).

H-5.4.7.16 SWMU 15-010(b)

The HIs for the SWMU 15-010(b) are equivalent to 1 for the robin (omnivore) and greater than ~~than~~ 1 for the robin (insectivore), earthworm, and plant, with mercury, selenium, and di-n-butylphthalate being the primary COPECs for one or several receptors. The HI analysis using LOAEL-based ESLs resulted in HIs of 4 for the robin (omnivore), 10 for the robin (insectivore), 0.6 for the earthworm, and 0.2 for the plant (Table H-5.4-63). The adjusted HI analysis using LOAEL-based ESLs resulted in HIs of 0.07 for the robin (omnivore) and 0.2 for the robin (insectivore) (Table H-5.4-64).

H-5.4.7.17 AOC 15-014(h)

The HIs for the AOC 15-014(h) are equivalent to 1 for the robin (herbivore) and shrew and greater than 1 for the robin (omnivore and insectivore), deer mouse, earthworm, and plant, with barium, cadmium, cobalt, mercury, selenium, vanadium, Aroclor-1254, benzoic acid, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and di-n-octylphthalate being the primary COPECs for one or several receptors. The HI for the shrew (1.007) has no COPECs with HQs greater than 0.3 and is not evaluated further. The HI analysis using LOAEL-based ESLs resulted in HIs of 0.5 for the robin (herbivore), 4 for the robin

(omnivore), 7 for the robin (insectivore), 2 for the deer mouse, 0.8 for the earthworm, and 1 for the plant (Table H-5.4-65). The adjusted HI analysis using LOAEL-based ESLs resulted in HIs of 0.04 for the robin (herbivore), 0.3 for the robin (omnivore), 0.6 for the robin (insectivore), and 0.7 for the deer mouse (Table H-5.4-66).

Barium was detected in all 49 samples in the 0.0−5.0-ft depth interval with an EPC of 142 mg/kg. The EPC, which represents the average exposure concentration, is within the range of soil background concentrations. The plant LOAEL-based ESL for barium is 260 mg/kg, which is similar to the soil BV and is below the maximum soil background concentration. Selenium was not detected in any of the 49 samples and the EPC (1.5 mg/kg) was the maximum detection limit, which is below the maximum soil background concentration (1.7 mg/kg). The use of the detection limit as the EPC overestimates the potential exposure to the plant. The data indicate exposure to COPECs is similar to background and the potential for ecological risk to plants is overestimated.

In addition, field observations made during the site visit found no indication of adverse effects from COPECs on the plant community (Attachment H-3). The site is within a former industrially developed area, with habitat for ecological receptors, including plants. Therefore, the HI does not indicate potential risk to plants or other biota.

H-5.4.7.18 SWMU 36-002

The HI for SWMU 36-002 is greater than 1 for the plant, with barium and selenium being the primary COPECs. The HI analysis using LOAEL-based ESLs resulted in an HI of 0.7 for the plant (Table H-5.4-67).

H-5.4.7.19 SWMU 36-003(a)

The HI for SWMU 35-003(a) is greater than 1 for the plant, with beryllium, nickel, and selenium being the primary COPECs. The HI analysis using LOAEL-based ESLs resulted in an HI of 0.6 for the plant (Table H-5.4-68).

H-5.4.7.20 SWMU~~s~~ 36-008 ~~and C-36-003~~

The HIs for SWMU~~s~~ 36-008 ~~and C-36-008~~ are greater than 1 for the robin (all feeding guilds), deer mouse, earthworm, and plant, with antimony, barium, copper, mercury, selenium, silver, zinc, bis(2-ethylhexyl)phthalate, and di-n-butylphthalate being the primary COPECs for one or several receptors. The HI analysis using LOAEL-based ESLs resulted in HIs of 3 for the robin (herbivore), 18 for the robin (omnivore), 32 for the robin (insectivore), 3 for the deer mouse, 5 for the earthworm, and 1 for the plant (Table H-5.4-69). The adjusted HI analysis using LOAEL-based ESLs resulted in HIs of 0.09 for the robin (herbivore), 0.5 for the robin (omnivore), 0.8 for the robin (insectivore), and 0.5 for the deer mouse (Table H-5.4-70).

Copper was detected in all 107 samples in the 0.0−5.0-ft depth interval with an EPC of 315 mg/kg. The plant LOAEL-based ESL for copper is 490 mg/kg, with only 2 concentrations above the LOAEL-based ESLs. The highest copper concentrations (4870 mg/kg and 2720 mg/kg) were detected at different locations approximately 35 ft apart. Copper concentrations at upgradient and downgradient locations are 2 orders of magnitude less or are not above background. Therefore, the extent of the copper concentrations exceeding the LOAEL-based ESLs is limited to these 2 locations and possibly the area between. Mercury was detected in 104 of 107 samples in the 0.0−5.0-ft depth interval with an EPC of 2.34 mg/kg. The earthworm LOAEL-based ESL for mercury is 0.5 mg/kg, which is only 0.4 mg/kg above the mercury BVs. The highest mercury concentrations (25 mg/kg, 22 mg/kg, 14.8 mg/kg, 10.3 mg/kg, and

2.32 mg/kg) are at three locations (25 mg/kg and 22 mg/kg at location 15-610607; 14.8 mg/kg and 10.3 mg/kg at location 15-610588; and 2.32 mg/kg at location 15-610609). Location 15-610609 is approximately 20 ft downgradient from location 15-610607, and these locations are approximately 60 ft west of location 15-610588. The other mercury concentrations were less than 2 mg/kg with most concentrations being less than 1 mg/kg. The extent of the site potentially impacted by elevated mercury concentrations is limited to only 2 or 3 locations and possibly the area between.

The area in and around SWMU~~s~~ 36-008 ~~and C-36-008~~ encompasses less than 0.5 ha, and only a small fraction of that area contains COPEC concentrations that could potentially impact soil invertebrates and/or plants. Because of the limited area impacted by COPECs, the potential for population effects is highly unlikely. In addition, field observations made during the site visit found no indication of adverse effects from COPECs on the plant community (Attachment H-3). The site is adjacent to an industrially developed area, with habitat present for ecological receptors on the canyon slope. Therefore, the HIs do not indicate potential risks to plants or other biota.

H-5.4.7.24 SWMU C-36-003

The HIs for SWMU C-36-003 are greater than 1 for the earthworm and plant, with copper, lead, manganese, mercury, nickel, selenium, and zinc being the primary COPECs. The HI analysis using LOAEL-based ESLs resulted in an HI of 3 for the earthworm and an HI of 3 for the plant (Table H-5.4-73). Copper, manganese, mercury, and zinc contributed to the LOAEL-based HI for these receptors.

Copper was detected in all 16 samples in the 0.0−5.0 ft depth interval with an EPC of 936 mg/kg with 6 results above background. The plant LOAEL-based ESL for copper is 490 mg/kg, and 1 out of 16 samples is greater than that level. The four largest results for copper are 2720 mg/kg, 309 mg/kg, 27.8 mg/kg, and 25.2 mg/kg, and no other results were greater than 20 mg/kg. The copper EPC without the maximum concentration is 309 mg/kg, which is less than the copper plant LOAEL-based ESL. The extent of the site that is potentially impacted by elevated copper concentrations is limited to a single location out of 8 locations. Manganese was detected in all 16 samples in the 0.0−5.0 ft depth interval with an EPC of 452 mg/kg with 2 results above background. The plant LOAEL-based ESL for manganese is 1100 mg/kg, and none of the 16 samples are greater than that level. The 3 largest results for manganese are 860 mg/kg, 587 mg/kg, and 576 mg/kg, and no other results were greater than 500 mg/kg. The maximum soil background concentration is 1100 mg/kg, which is greater than the maximum detected concentration. This indicates that the potential for ecological risks to plants from manganese is overestimated. Mercury was detected in 14 of 16 samples in the 0.0−5.0 ft depth interval with an EPC of 0.342 mg/kg with 11 results above background. The invertebrate LOAEL-based ESL for mercury is 0.5 mg/kg, and 2 out of 16 samples are greater than that level. The 3 largest results for mercury are 0.815 mg/kg, 0.582 mg/kg, and 0.461 mg/kg, and no other results were greater than 0.4 mg/kg. The extent of the site that is potentially impacted by elevated mercury concentrations is limited to 1 out of 8 locations. Zinc was detected in all 16 samples in the 0.0−5.0 ft depth interval with an EPC of 490 mg/kg and 8 results above background. The earthworm LOAEL-based ESL for zinc is 930 mg/kg and the plant LOAEL-based ESL for zinc is 810 mg/kg, and 1 out of 16 samples is greater than those levels. The 3 largest results for zinc are 1320 mg/kg, 235 mg/kg, and 89.7 mg/kg, and no other results were greater than 80 mg/kg. The extent of the site that is potentially impacted by elevated zinc concentrations is limited to a single location out of 8 locations.

In addition, AOC C-36-003 is a small site with an area of 0.0165 ha. Although HR and population area information is not available for earthworms and plants, it is unlikely that COPECs at AOC C-36-003 would have population impacts on earthworms and plants. Field observations made during the site visit found no indication of adverse effects from COPECs on the plant community (Attachment H-3). Therefore, the HI does not indicate potential risk to plants or other biota.

H-5.4.8 Chemicals without ESLs

Several COPECs do not have ESLs for any receptor in version 3.3 of the ECORISK Database (LANL 2015, 600921). In an effort to address this uncertainty and to provide a quantitative assessment of potential ecological risk, several online toxicity databases searches were conducted to determine if any relevant toxicity information is available. The online searches of the following databases were conducted: 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, U.S. Department of Agriculture Integrated Pesticide Management Database, American Bird Conservancy Pesticide Toxicity Database, and Oak Ridge National Laboratory Risk Assessment Information System. 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.

Toxicity data are not available for calcium; iron; magnesium; nitrate; perchlorate; Aroclor-1268; bromodichloromethane; chlorodibromomethane; chloromethane; 2-chloronaphthalene; 4-chlorotoluene; ethylbenzene; 4-isopropyltoluene; TATB; 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; 1,2-xylene; and 1,3-xylene+1,4-xylene. For calcium, iron, magnesium, nitrate, perchlorate, bromodichloromethane, chlorodibromomethane, and chloromethane no surrogate or other toxicity information is available. For the other COPECs, surrogates are used based on structural similarity to evaluate the potential toxicity.

Calcium was identified as a COPC from 0.0−5.0 ft at 13~~2~~ sites with maximum concentrations ranging from 1570 mg/kg to 27,600 mg/kg. As presented in Table H-4.4-1, concentrations of calcium are substantially less than the NMED essential nutrient SSLs. Calcium is eliminated as a COPEC.

Iron was identified as a COPC from 0.0−5.0 ft at seven sites with maximum concentrations ranging from 16,000 mg/kg to 22,300 mg/kg. The concentrations are below or similar to the maximum Qbt 2,3,4 background concentration (19,500 mg/kg) and below the maximum soil background concentration (36,000 mg/kg). The maximum iron concentration is also approximately one-third the NMED residential SSL (54,800 mg/kg). Iron is eliminated as a COPEC.

Magnesium was identified as a COPC from 0.0−5.0 ft at four sites with maximum concentrations ranging from 1730 mg/kg to 2800 mg/kg. As presented in Table H-4.4-1, concentrations of magnesium are substantially less than the NMED essential nutrient SSLs. Magnesium is eliminated as a COPEC.

Nitrate was identified as a COPC from 0.0−5.0 ft at ~~one~~ eight site~~s~~ with ~~a~~ maximum concentration~~s~~ ~~of~~ ranging from 1.57 mg/kg to 540 mg/kg. The NMED residential SSL for nitrate is 125,000 mg/kg, indicating that potential toxicity is very low. Because nitrate is infrequently detected at elevated concentrations and the potential very low toxicity, nitrate is eliminated as a COPEC.

Perchlorate was identified as a COPC from 0.0−5.0 ft at 23~~2~~ sites with concentrations ranging from 0.000533 mg/kg to 0.668 mg/kg. After the original preparation of this report in 2015, the LANL ECORISK Database was updated to include soil ESLs for perchlorate (LANL 2017, 602538). The minimum ESL and LOAEL-based ESL for perchlorate in the ECORISK Database Version 4.1 are 0.12 mg/kg and 0.24 mg/kg, respectively, and the receptor is the robin (herbivore diet). Only one perchlorate result is greater than the LOAEL-based ESL at SWMUs C-36-003 and 36-008. The EPC for perchlorate is 0.256 mg/kg at SWMU C-36-003 or slightly greater than the LOAEL-based ESL. The SWMU C-36-003 area is 0.0165 ha compared with a population area of 16.8 for the robin. The EPC for perchlorate is 0.0438 mg/kg at SWMU 36-008 or less than the ESL. The SWMU 36-008 area is 0.452 ha compared with a population area of 16.8 for the robin. Risks to the robin from perchlorate and adjusted by the population area are not likely (adjusted robin HQ at SWMU C-36-003 would be 0.002 and adjusted robin HQ at SWMU 36-008 would be 0.01). ~~The NMED residential SSL for perchlorate is 54.5 mg/kg, indicating that~~

~~potential toxicity is low.~~ Because of the potential low ~~toxicity~~ecological risk resulting from use of the ECORISK Database Version 4.1 ESLs and LOAEL-based ESLs, perchlorate is eliminated as a COPEC.

Aroclor-1268 was identified as a COPC from 0.0−5.0 ft at one site at a concentration of 0.0205 mg/kg. The minimum ESL for Aroclor-1260 (0.88 mg/kg for the robin insectivore) is used to screen Aroclor-1268 and results in a maximum HQ of 0.02. Because the maximum HQ is less than 0.3, Aroclor-1268 is eliminated as a COPEC.

Bromodichloromethane was identified as a COPC from 0.0−5.0 ft at ~~one~~ two sites at a maximum concentration of 0.00117 mg/kg. The NMED residential SSL for bromodichloromethane is 6.19 mg/kg, indicating that potential toxicity is low. Because bromodichloromethane is infrequently detected and the potential toxicity is low, bromodichloromethane is eliminated as a COPEC.

Chlorodibromomethane was identified as a COPC from 0.0−5.0 ft at ~~one~~ two sites at a maximum concentration of 0.000635 mg/kg. The NMED residential SSL for chlorodibromomethane is 13.9 mg/kg, indicating that potential toxicity is low. Because chlorodibromomethane is infrequently detected and the potential toxicity is low, chlorodibromomethane is eliminated as a COPEC.

Chloromethane was identified as a COPC from 0.0−5.0 ft at one site at a concentration of 0.000633 mg/kg. The NMED residential SSL for chloromethane is 6260 mg/kg, indicating that potential toxicity is very low. Because chloromethane is infrequently detected and the potential toxicity is very low, chloromethane is eliminated as a COPEC.

Chloronaphthalene[2-] was identified as a COPC from 0.0−5.0 ft at one site at a concentration of 0.0215 mg/kg. The minimum ESL for naphthalene (1 mg/kg for the plant) is used to screen the 2-chloronaphthalene concentration and results in a maximum HQ of 0.02. Because the maximum HQ is less than 0.3, 2-chloronaphthalene is eliminated as a COPEC.

Chlorotoluene[4-] was identified as a COPC from 0.0−5.0 ft at one site at a concentration of 0.000496 mg/kg. The minimum ESL for toluene (23 mg/kg for the shrew) is used to screen 4-chlorotoluene and results in a maximum HQ of 0.00002. Because the maximum HQ is less than 0.3, 4-chlorotoluene is eliminated as a COPEC.

Ethylbenzene was identified as a COPC from 0.0−5.0 ft at two sites with concentrations ranging from 0.000395 mg/kg to 0.00076 mg/kg. The minimum ESL for benzene (24 mg/kg for the deer mouse) is used to screen the ethylbenzene concentrations and results in a maximum HQ of 0.00003. Because the maximum HQ is less than 0.3, ethylbenzene is eliminated as a COPEC.

Isopropyltoluene[4-] was identified as a COPC from 0.0−5.0 ft at eight sites with concentrations ranging from 0.000343 mg/kg to 0.0893 mg/kg. The minimum ESL for toluene (23 mg/kg for the shrew) is used to screen 4-isopropyltoluene and results in a maximum HQ of 0.004. Because the maximum HQ is less than 0.3, 4-isopropyltoluene is eliminated as a COPEC.

TATB was identified as a COPC from 0.0−5.0 ft at ~~six~~ nine sites with concentrations ranging from 0.303 mg/kg to 28.6 mg/kg. The minimum ESL for 1,3,5-trinitrobenzene (10 mg/kg for the earthworm) is used to screen TATB and results in a maximum HQ of approximately 3. The earthworm LOAEL-based ESL for 1,3,5-trinitrobenzene is 28 mg/kg and results in an HQ of approximately 1 using the overall maximum concentration. The potential risk to the earthworm is overestimated by the maximum concentration. TATB is eliminated as a COPEC.

Trimethylbenzene[1,2,4-] was identified as a COPC from 0.0−5.0 ft at ~~five~~ six sites with concentrations ranging from 0.000343 mg/kg to 0.00499 mg/kg. The minimum ESL for benzene (24 mg/kg for the deer mouse) is used to screen 1,2,4-trimethylbenzene and results in a maximum HQ of 0.0002. Because the maximum HQ is less than 0.3, 1,2,4-trimethylbenzene is eliminated as a COPEC.

Trimethylbenzene[1,3,5-] was identified as a COPC from 0.0−5.0 ft at one site with a maximum concentration of 0.00569 mg/kg. The minimum ESL for benzene (24 mg/kg for the deer mouse) is used to screen 1,3,5-trimethylbenzene and results in a maximum HQ of 0.0002. Because the maximum HQ is less than 0.3, 1,3,5-trimethylbenzene is eliminated as a COPEC.

Xylene[1,2-] was identified as a COPC from 0.0−5.0 ft at three sites with concentrations ranging from 0.000349 mg/kg to 0.000616 mg/kg. The minimum ESL for total xylene (1.4 mg/kg for the shrew) is used to screen the 1,2-xylene concentrations and results in a maximum HQ of 0.0004. Because the maximum HQ is less than 0.3, 1,2-xylene is eliminated as a COPEC.

Xylene[1,3-]+1,4-xylene was identified as a COPC from 0.0−5.0 ft at ~~six~~ seven sites with concentrations ranging from 0.000369 mg/kg to 0.00114 mg/kg. The minimum ESL for total xylene (1.4 mg/kg for the shrew) is used to screen the 1,3-xylene+1,4-xylene concentrations and results in a maximum HQ of 0.0008. Because the maximum HQ is less than 0.3, 1,3-xylene+1,4-xylene is eliminated as a COPEC.

H-5.5 Interpretation of Ecological Risk Screening Results

H-5.5.1 Receptor Lines of Evidence

Based on the ecological risk-screening assessments, several COPECs (including COPECs without an ESL) were identified for the Threemile Canyon Aggregate Area sites. Receptors were evaluated using several lines of evidence: minimum ESL comparisons, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and the relationship of EPCs and detection limits to background concentrations.

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.
- The HIs were greater than 1 for the plant at all sites, except at AOCs C-12-005 and C-14-006.
- The HI analyses using the LOAEL-based ESLs resulted in HIs less than or equivalent to 1 for all sites, except for SWMUs 12-001(a) and 12-001(b), 12-002, 15-007(c), 15-008(b), 15-009(b), and 15-009(h) and AOCs 12-004(b), and 15-005(c).
- Field observations made during the site visits found no indication of adverse effects on the plant community from COPECs. In addition, many of the areas in and/or around the TA-15 and TA-36 sites are industrially developed with structures, roads, and other paved areas and do not provide good quality habitat.
- As discussed in section H-5.4.7, the potential risks to the plant are overestimated and/or are not representative of most sites.
- The potential risks to the plants are limited to a small portion of SWMU 15-007(c) and given the area is approximately 0.0508 ha, the potential for population impacts is low. There is the potential for adverse effects to the plants at SWMU 15-008(b).

These lines of evidence support the conclusion no potential ecological risk to the plants exists at the Threemile Canyon Aggregate Area, except potentially at SWMU 15-008(b).

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 HIs were greater than or equivalent to 1 for the earthworm at all sites, except at SWMUs 15-007(d), 15-009(c), 15-009(h), and 36-002 and AOCs 12-004(a), C-12-001, C-12-003, C-12-005, C-14-006, and 15-008(g).
- The HI analyses using the LOAEL-based ESLs resulted in HIs less than or equivalent to 1 for all sites, except SWMUs 15-008(b), 36-008, and C-36-003.
- As discussed in section H-5.4.7.20, the potential risks to the earthworm are overestimated and/or not representative.
- There is the potential for adverse effects to the earthworm at SWMU 15-008(b).

These lines of evidence support the conclusion no potential ecological risk to the earthworm exists at the Threemile Canyon Aggregate Area, except potentially at SWMU 15-008(b).

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.
- The HIs were greater than 1 for the shrew at all sites, except at AOC C-14-006 and SWMU 15-009(h), which had HIs less than 1.
- The HIs were adjusted by the PAUF, which is the ratio of the site area to the shrew's population area. The adjusted HIs were less than or equivalent to 1 for all sites, except for SWMU 15-008(b).
- The LOAEL-based ESL analyses adjusted by the PAUF resulted in HIs less than 1, except for SWMU 15-008(b).

These lines of evidence support the conclusion that no potential ecological risk to the montane shrew exists at the Threemile Canyon Aggregate Area, except potentially at SWMU 15-008(b).

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.
- The HIs were greater than 1 for the deer mouse at all sites, except at AOC C-14-006 and SWMU 15-009(h), which had HIs less than 1.
- The HIs were adjusted by the PAUF, which is the ratio of the site area to the deer mouse's population area. The adjusted HIs were less than 1 at all sites, except at SWMUs 12-001(a) and 12-001(b), 15-007(c), 15-008(b), and 36-008~~, and C-36-008~~ and AOC 15-014(h), which had HIs greater than 1.
- The LOAEL-based ESL analyses adjusted by the PAUF resulted in HIs less than 1, except for SWMU 15-008(b).

- These lines of evidence support the conclusion that no potential ecological risk to the deer mouse exists at the Threemile Canyon Aggregate Area, except potentially at SWMU 15-008(b).

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 HIs were equivalent to or greater than 1 for the cottontail at all sites except at SWMUs 15-007(d), 15-009(c), 15-009(h), and 36-002 and AOCs 12-004(a), 12-004(b), C-12-001, and C-14-006.
- The HIs were adjusted by the PAUF, which is the ratio of the site area to the cottontail's population area. The adjusted HIs were less than 1 for all sites.

These lines of evidence support the conclusion that no potential ecological risk to the cottontail exists at the Threemile Canyon Aggregate Area.

Red Fox (Carnivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the fox, were less than 0.3.
- The HIs were greater than or equivalent to 1 for the red fox at SWMUs 15-007(c) and 15-008(b).
- The HIs were adjusted by the PAUF, which is the ratio of the site area to the red fox's population area. The adjusted HIs were less than 1 for all sites.

These lines of evidence support the conclusion that no potential ecological risk to the red fox exists at the Threemile Canyon Aggregate Area.

Robin (All Feeding Guilds)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the robin, were less than 0.3.
- The HIs were greater than or equivalent to 1 for the robin (all feeding guilds) at all sites, except at AOC C-14-006 and SWMU 15-009(h), which had HIs less than 1.
- The HIs were adjusted by the PAUF, which is the ratio of the site area to the robin's population area. The adjusted HIs were less than 1 at all sites, except at SWMUs 15-007(c), 15-008(b), 15-010(b), and 36-008~~, and C-36-003~~ and AOC 15-014(h), which had HIs greater than 1. The adjusted HI for the robin (insectivore) was equivalent to 1 at SWMUs 12-001(a) and 12-001(b).
- The LOAEL-based ESL analyses adjusted by the PAUFs resulted in HIs less than 1, except for SWMU 15-008(b).

These lines of evidence support the conclusion that no potential ecological risk to the robin (all feeding guilds) exists at the Threemile Canyon Aggregate Area, except potentially at SWMU 15-008(b).

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 (intermediate carnivore), were less than 0.3.
- The HIs were greater than or equivalent to 1 for the kestrel (intermediate carnivore) at all sites, except at SWMUs 15-007(d), 15-009(h), 36-002, and 36-003(a) and AOCs C-12-003, C-12-005, and C-14-006, which had HIs less than 1.
- The HIs were adjusted by the PAUF, which is the ratio of the site area to the kestrel's population area. The adjusted HIs were less than 1 for all sites.

These lines of evidence support the conclusion that no potential ecological risk to the kestrel (intermediate carnivore) exists at the Threemile Canyon Aggregate Area.

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 HIs were less than 1 for the kestrel (top carnivore) at all sites, except at SWMUs 15-007(c), 15-008(b), 15-009(b), 15-009(c), 15-010(b), and 36-008, and C-36-003 and AOC 15-014(h), which had HIs greater than 1.
- The HIs were adjusted by the PAUF, which is the ratio of the site area to the kestrel's population area. The adjusted HIs were less than 1 for all sites.
- The kestrel (top carnivore) is a surrogate for the Mexican spotted owl. The HIs were adjusted by the Mexican spotted owl AUFs. The adjusted HIs were less than 1 at all sites.

These lines of evidence support the conclusion that no potential ecological risks to the kestrel (top carnivore) and the Mexican spotted owl exist at the Threemile Canyon Aggregate Area.

H-5.5.2 COPECs with No ESLs

COPECs without ESLs were eliminated based on comparisons to surrogate ESLs or human health SSLs. The analysis of COPECs without ESLs supports the conclusion that no potential ecological risk to receptors exists at the Threemile Canyon Aggregate Area sites, except at SWMU 15-008(b).

H-5.5.3 Summary

Based on evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist for the Threemile Canyon Aggregate Area sites. There is the potential for adverse effects to several receptors from copper and lead at SWMU 15-008(b).

H-6.0 CONCLUSIONS

H-6.1 Human Health Risk

SWMUs 15-007(d), 15-009(h), and 36-002 were not evaluated for the industrial scenario because no samples were collected from the 0.0–1.0 ft depth interval. The total excess cancer risks for the industrial scenario at the other SWMUs/AOCs were less than the 1×10^{-5} target risk level. The HIs were less than or equivalent to the target level of 1 at all SWMUs/AOCs, except at SWMUs 15-007(c) and 15-008(b). The potential unacceptable noncancer risks at these two SWMUs under the industrial scenario were from lead.

The recreational scenario was applicable at SWMUs 12-001(a) and 12-001(b), SWMU 12-002, and AOC C-12-005. There were no potential unacceptable risks or doses for these sites under the recreational scenario. The total excess cancer risks were less than the 1×10^{-5} target risk level and the HIs were less than 1.

Most of the SWMUs/AOCs ~~sites~~ had total excess cancer risks and HIs below or equivalent to the target risk levels under the residential scenario. Three sites had HIs above 1 under the residential scenario; SWMU 15-007(c) (lead and antimony), SWMU 15-008(b) (lead), and SWMU 15-009(b) (uranium).

For SWMUs/AOCs not posing an unacceptable residential risk or dose, the residential scenario was also protective of construction workers, except for potential noncarcinogenic risk at SWMUs 12-001(a) and 12-001(b) and SWMU C-36-003, where manganese was a COPC. Noncarcinogenic construction worker risk was evaluated for SWMUs 12-001(a) and 12-001(b) and SWMU C-36-003, and HIs were equivalent to or below the target level of 1.

The total doses were below the target dose limit of 25 mrem/yr as authorized by DOE Order 458.1 for the industrial, recreational, and residential scenarios at all but one SWMU. The residential total dose was greater than the target dose limit at SWMU 15-009(b) from isotopic uranium. The total doses were equivalent to total risks ranging from 4×10^{-9} to 3×10^{-4} for the industrial scenario, 3×10^{-7} for the recreational scenario, and from 1×10^{-8} to 6×10^{-4} for the residential scenario, based on conversion from dose using RESRAD Version 7.0.

Sites at former TA-12, TA-14, TA-15, and TA-36 are not accessible by the public and are not planned for release by DOE in the foreseeable future. Therefore, an as low as reasonably achievable (ALARA) evaluation for radiological exposure to the public is not currently required. Should DOE's plans for releasing these areas change, an ALARA evaluation will be conducted at that time. ~~It should be noted that the Laboratory addresses considerations for radiation exposures to workers under the Laboratory's occupational radiological protection program in compliance with 10 Code of Federal Regulations 835. The Laboratory's radiation protection program implements ALARA and consists of the following elements: management commitment, training, design review, radiological work review, performance assessments, and documentation.~~

H-6.2 Ecological Risk

Based on evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and COPECs without ESLs, no potential ecological risks to the earthworm, plant, American robin, American kestrel, deer mouse, montane shrew, desert cottontail, red fox, and Mexican spotted owl exist at most of the Threemile Canyon Aggregate Area sites. There is the potential for adverse effects to the robin, shrew, deer mouse, earthworm, and plant at SWMU 15-008(b).

H-7.0 REFERENCES

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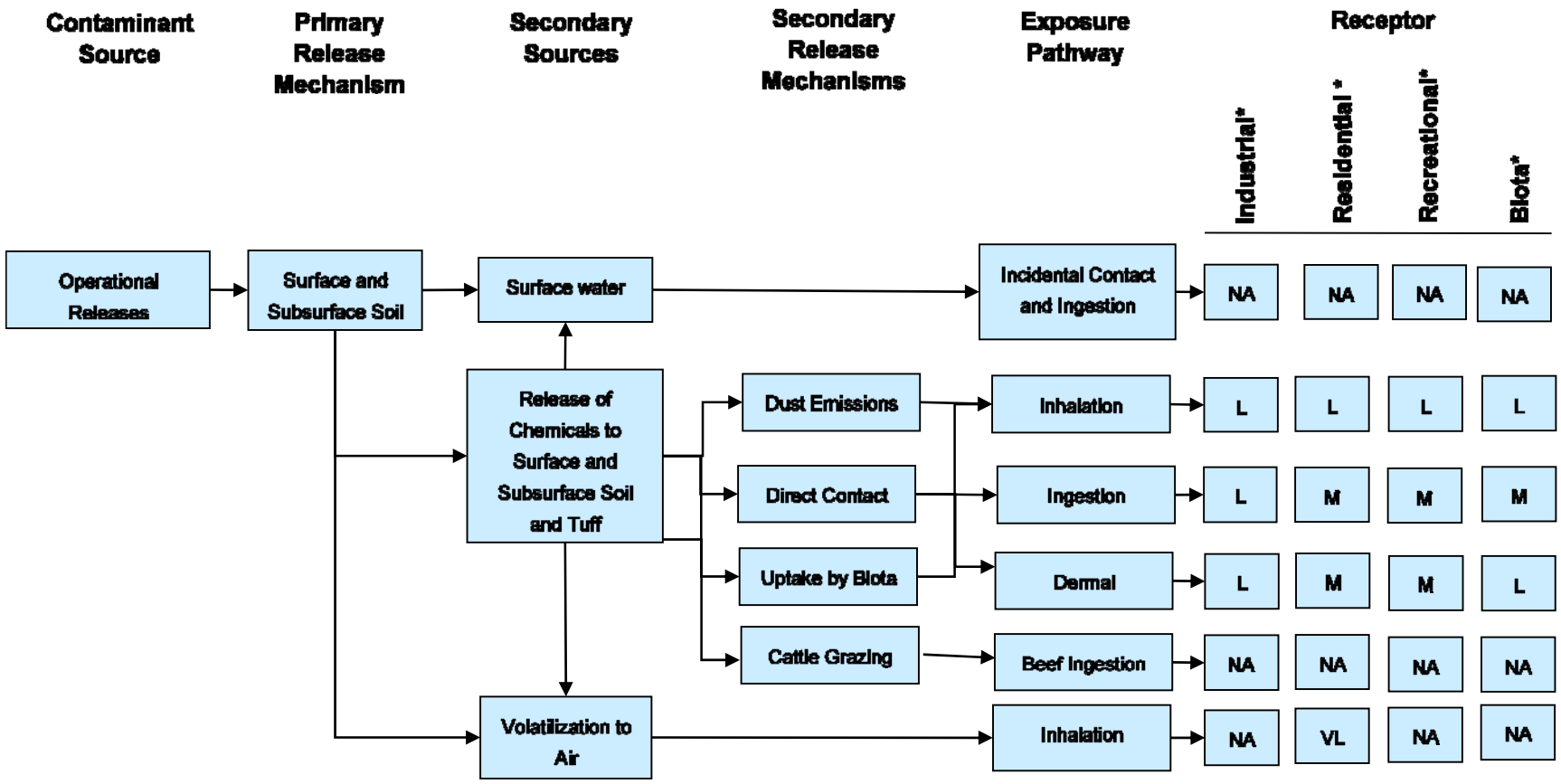

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Very Low (VL), Low (L), and Moderate (M) designations indicate the pathway is a potentially complete pathway and is evaluated in the risk assessments.
Not Applicable (NA) indicates the pathway is incomplete and is not evaluated in the risk assessments.

Figure H-3.1-1 Conceptual site model for the Threemile Canyon Aggregate Area