Human Health Risk Assessment for the Engineering Evaluation/Cost Analysis

Ross-Adams Mine Site
Tongass National Forest, Prince of Wales Island, Alaska

Version 2.0

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EXECUTIVE SUMMARY

A two-tiered human health risk assessment, composed of a screening level human health risk assessment (SLRA), and a follow-on site-specific human health risk assessment (SSRA), have been performed for the Ross-Adams Mine Site (the Site). The risk assessment has been performed to support the development of an Engineering Evaluation/Cost Assessment (EE/CA) which will define removal actions to be performed at the Site. The risk assessment uses historic and recently collected Site data and information described fully in the Site Characterization Report (Tetra Tech, 2010a).

The Ross Adams Mine is located in a naturally mineralized area that includes significant outcrops of geologic formations with elevated concentrations of natural uranium and thorium. The nearby explored but undeveloped I&L Zone exhibits radiological characteristics similar in nature to those observed at the Site during the characterization surveys. This indicates that pre-mining gamma radiation and radon concentrations would have been significantly elevated over regional background. The mined areas of the Site include mine rock piles that are composed of durable rock rather than unconsolidated materials (soils), and exhibit very sparse vegetation.

The nature of the Site is such that risks to human health were assessed for nonradionuclide (chemical) exposures and radionuclide exposure through direct contact pathways as well as risks from inhalation of radon decay products, and direct gamma radiation exposures. Receptors of concern were identified as hypothetical mineral exploration worker, U.S. Forest Service (USFS) Worker, Area Visitor, and Subsistence Receptor. Media of concern were soil, surface water, stream sediment, marine sediment, radon in air, and gamma radiation.

Screening Level Risk Assessment

The screening level risk assessment compared maximum Site concentrations of each detected analyte to published occupational screening levels (EPA, 2010 and EPA, 2007) for the media of concern. Screening levels based on default occupational exposure parameters were chosen for selecting COPCs for this Site, because the default occupational parameters provide a very conservative screen compared to anticipated Site exposures. The screening levels included ingestion, dermal contact, inhalation, and external exposures for each medium as appropriate. Soil was evaluated on a mine-level basis, but data for all other media were not divided into exposure areas.

Based on the screening level risk evaluation, the following substances were selected as COPCs and retained for the detailed SSRA site-specific risk assessment, including subsistence exposure pathways:

- Radon in Air
- Gamma Radiation
- Soil: Arsenic, Uranium, Th-232, Ra-228, Th-228, U-235, U-238, U-234, Th-230, Ra-226, Pb-210, Po-210
- Surface Water: Manganese, Uranium; Gross alpha, Gross beta, Ra-228, Ra-226, Th-228, Th-230, Po-210, U-234, U-235, U-238, Pb-210
- Stream Sediment: Th-232, Ra-228, U-234, U-235, U-238, Th-230, Ra-226, Pb-210
- Marine Sediment: Arsenic; Th-232, Ra-228, U-235, U-238, U-234, Th-230, Ra-226, Pb-210

Site-Specific Risk Assessment

Using the COPCs selected in the screening level evaluation, a site-specific risk assessment (SSRA) was conducted. The site-specific HHRA evaluated subsistence activities, as well as direct contact pathways, using exposure parameters more specific to the Site. Data were aggregated for soil, radon and gamma to calculate an exposure point concentration while the maximum detected value was retained as the exposure point concentration for all other media. Site-specific workers, area visitors and subsistence food pathways are evaluated in the SSRA.

Site-specific workers included both a mineral exploration worker and a USFS worker, consistent with planned future use of the Site. These occupational receptors were assumed to be exposed to Site media through incidental soil and sediment ingestion, dermal contact with soil and sediment, inhalation of particulates, external exposure to soil and sediment, inhalation of radon, and gamma radiation exposure. Exposure frequency and duration for the mineral worker were 120 days/year for 3 years; for the USFS worker, they were 10 days/year for 25 years. Most other exposure parameters were similar for these two receptors, and were based on typical adult exposures.

The area visitor was assumed to be present at the Site for 14 days per year for 30 years. These are considered upper-bound estimates of exposure frequency and duration as the remote location and lack of facilities at the Site would likely limit the length of time an area visitor would choose to spend there. In addition, if mineral exploration or development activities are occurring at the Site, it is not likely to be a desirable location for recreational activities. The area visitor was assumed to be exposed to Site media through incidental soil and sediment ingestion, dermal contact with soil and sediment, inhalation of particulates, external exposure to soil and sediment, ingestion of surface water, inhalation of radon, and gamma radiation exposure. Exposure parameters were selected to be representative of both child and adult exposures.

The subsistence food pathway was evaluated for deer, berries, seaweed, sea cucumbers, and fish. These food substances are present at the Site and represent a substantial portion of native subsistence diets. Ingestion rates of these foods were estimated from Alaska Department of Fish and Game Subsistence Food Division databases for the community of Hydaburg, with additional information for the community of Craig when data were not available for Hydaburg. Ingestion of potentially impacted deer meat was assessed by fractionating the amount of time a deer could spend in contact with the impacted mine levels relative to the typical grazing range for a deer. For berries, the fraction of fruit collected from potentially impacted areas was determined by divided the total acreage of impacted soil to the total acreage of the Site. These are conservative estimates, as the mine levels and roads containing impacted soil are minimally vegetated and do not constitute prime foraging areas. For marine food substances, the amount of food that could be collected from the affected dock area relative to the area of the west Arm of Kendrick Bay was estimated by divided the affected acreage by the acreage of the west Arm.

The SSRA evaluated the annual dose and lifetime risk to receptors from direct gamma radiation and inhalation of radon decay products. Annual dose of gamma radiation to each receptor is very time dependent. The gamma radiation doses were calculated using an apportionment of time that was not necessary for the assessment of any other exposure pathway.

Annual Dose and Lifetime Risk from Exposure to Radon in Air

Inhalation of Rn-222 decay products represents the most significant component of background radiation exposure, excluding medical procedures, received by all members of the public

regardless of where they reside (NCRP, 2009). Radon concentrations across the Site are extremely variable, ranging from measured values at background (less than 5.8 pCi L^{-1}) to a concentration at the 300-Foot Level mine portal that exceeded the capacity of the detection system (greater than 1215 pCi L^{-1}). Given the size of the Site and the average wind speed, the average equilibrium fraction for radon would be less than 0.1. A 95 Upper Confidence Limit on the Mean (UCLM) of measured ambient radon concentrations from the 2009 field study, excluding the concentrations measured at the portals, was used to calculate risks to workers and Site visitors. This calculation assumes they would spend all of their time in the areas represented by the radon measurements. This is a conservative assumption, as the radon measurements were purposively collected for Site characterization rather than to obtain a true average for the Site and likely overestimate true exposure concentrations.

However, based on the very conservative calculation, inhalation of the decay products of Rn-222 constitutes the greatest single contributor to the total risk to a Site visitor or worker on the Ross-Adams Mine Site with the following annual estimated doses and risks:

Site visitor: Exposure = (0.086 WL)(14 d/y)(24 h/d)/170 h/M = 0.17 WLM/y
Dose = (0.17 WLM/y)(1000 mrem/WLM) = 170 mrem/y; Risk = 3.3×10^{-3}

Mineral Exploration Worker: Exposure = (0.086 WL)(120 d/y)(12 h/d)/170 h/M = 0.73 WLM/y
Dose = (0.73 WLM/y)(1000 mrem/WLM) = 730 mrem/y; Risk = 4.2×10^{-3}

Forest Service Worker: Exposure = (0.086 WL)(10 d/y)(12 h/d)/170 h/M) = 0.06 WLM/y
Dose = (0.06 WLM/y)(1000 mrem/WLM) = 60 mrem/y; Risk = 2.0×10^{-3}

Annual Dose and Risk from Exposure to Direct Gamma Radiation

The potential annual radiation doses from direct gamma radiation exposure were calculated using the dose rate and annual frequency of exposure for each receptor. The annual dose for external gamma exposure was multiplied by a dose conversion factor to obtain the annual effective dose (UNSCEAR, 2000). The lifetime risks under the defined exposure scenarios were estimated using the International Commission on Radiological Protection (ICRP) detriment-adjusted risk coefficient (ICRP, 2007). The external and dermal risks for contact with soils with elevated radionuclide concentrations were estimated using a risk calculator as described in the site-specific risk assessment.

The annual radiation dose rates to the hypothetical mineral exploration workers, USFS workers, and area visitors were calculated assuming the individuals divide their time on the Site per their predicted activities on the Site. The Site visitor was assumed to camp on the OSA, thus spending a larger fraction of his or her time in that area. The workers were assumed to be daily visitors to the Site, thus spending a larger fraction of their time in the mined areas rather than the OSA. The fractional distribution was based on best professional judgment, but it is worth noting that different assumptions regarding the fraction of time spent on the OSA would not change the annual dose by more than a factor of two.

The dose rates for the adult visitor and workers were modified to calculate an effective dose that takes into account self-shielding of sensitive organs by the body. For adults the dose rates were multiplied by a factor of 0.7 to obtain the effective dose (UNSCEAR, 2000). The effective dose for a child visitor was obtained by multiplying the dose rate by a factor of 0.8.

The calculated annual effective doses and lifetime risks are given in the Table ES-1.

Table ES-1. Calculated Annual Effective Dose and Lifetime Risk from Gamma Radiation Exposure

	Annual Effective Dose (mrem/y)	Lifetime Risk
Site Visitor – Adult	31	5.1×10^{-4}
Site Visitor – Child	35	5.3×10^{-4}
Mineral Exploration Worker	108	1.3×10^{-4}
Forest Service Worker	9	9.2×10^{-5}

Summary of Radiation Doses and Risks

The estimated radiation doses and risks are summarized in Tables ES-2 and ES-3. Approximately 90 to 95 percent of the projected radiation risk to the hypothetical receptors is from inhalation of radon decay products.

Table ES-2. Summary of Estimated Lifetime Radiation Risks

Lifetime Radiation Risk Estimates	Site Visitor	Mineral Exploration Worker	Forest Service Worker
Radon Decay Product Inhalation	3.3×10^{-3}	4.2×10^{-3}	2.0×10^{-3}
Direct Gamma Exposure	5.1×10^{-4}	1.3×10^{-4}	9.2×10^{-5}
Total Risk	3.8×10^{-3}	4.3×10^{-3}	2.1×10^{-3}

Table ES-3. Summary of Estimated Annual Radiation Dose

Annual Dose Estimates	Site Visitor (mrem/y)	Mineral Exploration Worker (mrem/y)	Forest Service Worker (mrem/y)
Radon Decay Product Inhalation	170	730	60
Direct Gamma Exposure	31 (35)	108	9
Total Annual Dose	201 (205)	838	69

Direct Contact Exposures and Subsistence Food Exposures

In addition to the gamma and radon assessments, the SSRA estimated the risks and noncarcinogenic hazard indices associated with direct exposures and exposure through subsistence food pathways to chemicals and radionuclides in soil, sediment and surface water.

Nonradionuclides in soil do not pose a risk above 1E-6 or HI above 1.0 by any pathway. For the area visitor, radionuclide exposure through soil ingestion presents the largest risk (2.7E-05). The risk from ingestion of soil is higher for the area visitor than for other receptors, despite a limited exposure frequency, because the soil ingestion rate for children is twice as high as that for adults. The short amount of time that an area visitor spends at the Site causes the external exposure risk from radionuclides in soil to be below 1E-6, while for the mineral exploration worker it is 3.1E-06 and for the USFS worker it is 2.2E-06. With the exception of soil ingestion by the area visitor receptor, all soil-related risks are below 1E-05 and are acceptable per ADEC guidance

(ADEC, 2010). Soil ingestion and external exposure risks to the area visitor were attributable mainly to U-238, U-234, Th-230, Ra-226, and Pb-210.

Surface water ingestion was evaluated only for the area visitor, as occupational receptors would have their own water supply. The surface water risks totaled 1.95E-05, which is an overestimate because it was conservatively estimated using the maximum detected concentration of each radionuclide COPC. It is unlikely that any receptor would consistently be exposed to the maximum detected concentrations of COPC in surface water, which for radionuclides all occurred in runoff at the 300-Foot Level portal. Concentrations of radionuclides downstream and outside of the portal area are non-detect to half as high as those at the portal. Surface water in Kendrick Creek downstream of the portal, which is a more likely source of drinking water, has sampling results that are less than 0.5 pCi/L for most radionuclides, and many are non-detect results. Risks associated with those concentrations would be one order of magnitude or more lower than risks based on the maximum concentrations.

Exposure to marine sediments posed a total risk of 2.2E-06 for the area visitor; risks to the occupational receptors were below 1E-06. These risks are also likely to be an overestimate-, as they are based on daily exposure to the maximum detected concentration in marine sediment. Most visitors would not contact marine sediment for 14 days, and the presence of water would act to further shield from external or direct contact exposures.

For the subsistence resource user, the total risk from all subsistence foods was 1.0E-06. This is below levels of concern, and not likely to be achieved as there is no indication that the Site or the dock area are a subsistence hunting or gathering area.

Conclusions

Figure ES-1 summarizes the results of the SSRA, providing a tabulated view of COPCs assessed, pathways assessed, and a list of the COPCs that posed risks in excess of 1E-6 by media and pathway after evaluation in the SSRA. Of the COPCs listed, radon and gamma radiation pose much higher risks than risks associated with direct contact and subsistence exposures. Based on this finding, risks from radon and gamma exposures were used to guide the analysis of remedial alternative in the EE/CA.

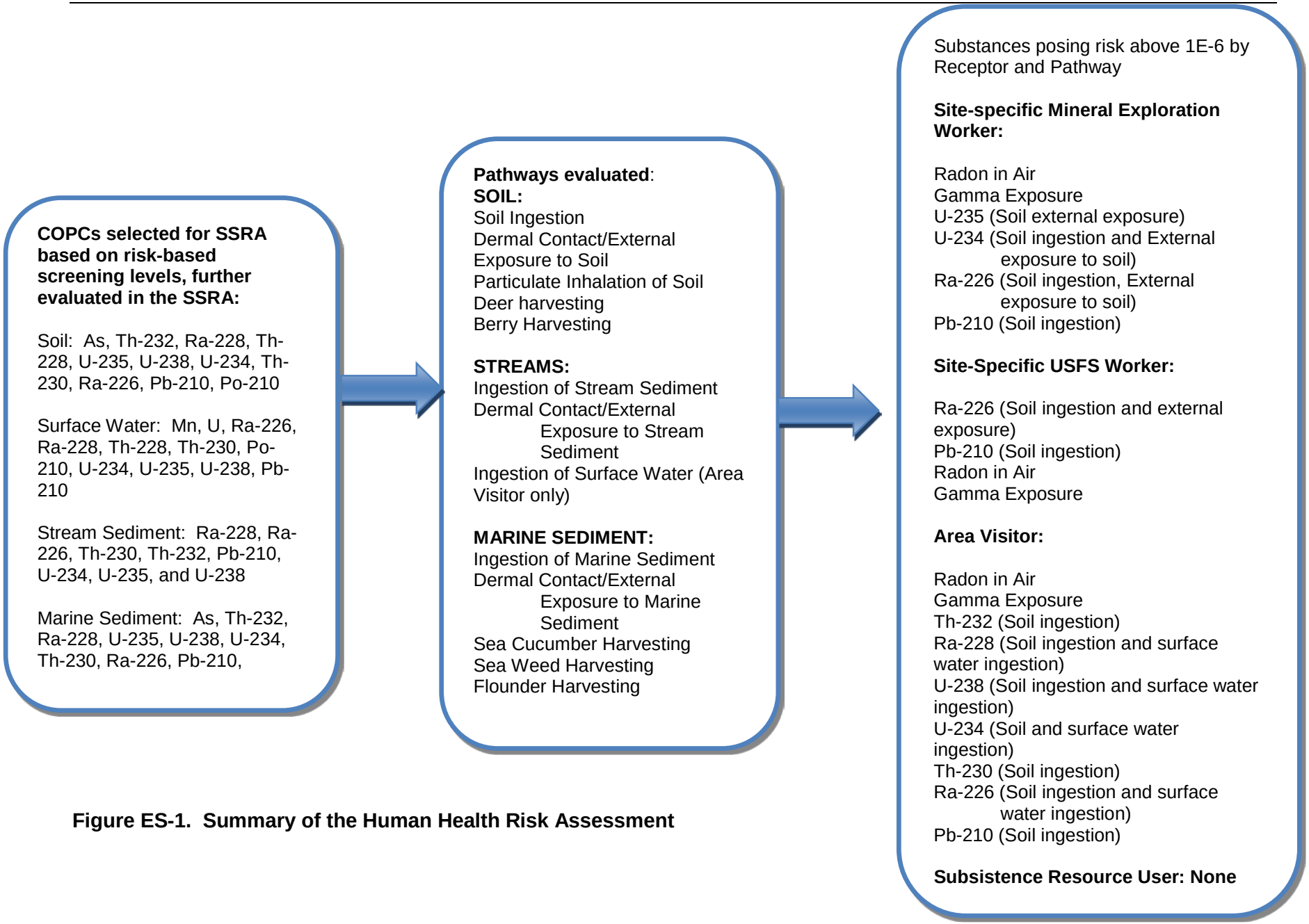


Figure ES-1. Summary of the Human Health Risk Assessment

1.0 INTRODUCTION

A two-tiered human health risk assessment, composed of a screening level human health risk assessment (SLRA) and a follow-on site-specific human health risk assessment (SSRA), have been performed for the Ross-Adams Mine Site (herein referred to as the Site) (Figure 1). This risk assessment has been performed for Advanced Environmental Sciences, Inc. to support the development of an Engineering Evaluation/Cost Assessment (EE/CA), which will define removal actions to be performed at the Site. The risk assessment uses historic and recently collected Site data and information described fully in the Final Site Characterization Report (Tetra Tech, 2010a). The risk assessments performed in the SLRA and the SSRA and the conclusions are described in this report.

The nature of Site is such that risks to human health are assessed for nonradionuclide (chemical) exposures, radionuclide exposure through direct contact pathways, exposure to radon, and gamma exposures.

1.1 Purpose of the Risk Assessment

The purpose of the risk assessments performed is to support the development of the EE/CA, which will define removal actions to be performed at the Site. The SLRA, the first phase of the risk assessment, provides a conservative estimate of potential risk associated with exposure to potentially affected media (soil, surface water, sediment, and air) present at the Site. The SLRA compared the historic data and data collected in 2009, which documented the chemical and radionuclide concentrations present in soil, surface water, stream and marine sediments, and air. In the SLRA, maximum concentrations were compared to a set of conservative screening level concentrations to identify potential risk and, thus, identify constituents of potential concern (COPCs) that are to be further evaluated in the SSRA, and to gain an understanding about the media, pathway, and locations associated with potential human health risk. The information and understanding developed by the SLRA, and specifically, the COPCs, provide the basis for the SSRA.

The purpose of the SLRA is to provide a conservative estimate of potential risks associated with exposure to mine rock, radon in air, soil, surface water, stream sediment, and marine sediment at the Site. This was accomplished by identifying specific COPCs (including metals, metalloids, and radionuclides), the media, and the pathways responsible for potential human health risk. The SLRA begins by considering all chemicals detected at the Site and potential exposure pathways to humans, using default assumptions. The results of the SLRA are more closely evaluated in a SSRA that more specifically characterizes potential risks to human health associated with the Site, using parameters that more closely estimate exposure to the Site and focusing on the chemicals identified as COPCs.

The SSRA provides a more detailed assessment of media, locations, chemicals and radionuclide concentrations, and pathways that could pose potential risk. The detailed assessment assists in identifying the specific conditions of potential risk at the Site in terms of location, media, and materials, and the nature of the risk with respect to specific chemicals or radionuclides. Thus, the SSRA focuses on the pathways and chemicals with the greatest potential for human health risk, given the current conditions of the Site. The data and methods used in the SSRA focus on those COPCs that may pose risks and the pathways that are associated with that potential risk and provide the basis for determining if sufficient data exist to proceed to EE/CA development.

This report provides a detailed description of the two tiers of the human health risk assessment performed and the results and conclusion of the assessments. The risk assessment performed here is consistent with Alaska Department of Environmental Conservation (ADEC) and other guidance (ADEC, 2005, 2008a, 2008b, 2010). Details describing Site visits, data collection, and laboratory analyses are presented in the Final Site Characterization Report (Tetra Tech, 2010a) and are summarized below.

1.2 Site History

The Ross-Adams Uranium Mine is located on the southeastern slopes of Bokan Mountain within the Kendrick Creek watershed in Alaska. The high natural radioactivity of the uranium and thorium mineralization at the surface of the Ross-Adams deposit led to its discovery by airborne radiometric survey of the area in 1955. The Ross-Adams ore deposit outcropped at an elevation of approximately 970 feet on the southeastern flank of Bokan Mountain. The mine was initially developed by open-pit mining in 1957 and later by underground operations from three portals. The mine has three major surface expressions, named after their approximate elevations: the "900-Foot Level;" the "700-Foot Level;" and the "300-Foot Level." In the late 1950s, the ore deposit was mined from an open pit at the 900-Foot Level. After the surficial deposit was mined, ore was mined in the early 1960s by driving an approximately 500-foot long tunnel at the 700-Foot Level to intersect the ore deposit, with a raise connecting it to the open pit. An additional phase of underground mining occurred in 1971 by driving the 300-Foot Level adit tunnel. Mine rock, including rock developed in driving the 700-Foot Level and 300-Foot Level tunnels, was placed near the portals at all levels. Ore produced from all levels was conveyed via haul roads to ore staging areas and barge loading docks on the north shore of the west arm of Kendrick Bay. All ore was shipped off site for processing.

The Bokan Mountain Intrusive Complex, in which the Ross-Adams deposit is located, is comprised of rare rock types and is unique in southeast Alaska. Emplacement of the Bokan Intrusive Complex included uranium, thorium, and rare earth element mineralization. Mineral exploration continues in the Bokan Mountain region. Currently, active exploration for both uranium and rare earth ore deposits is occurring in the Kendrick Creek watershed under U.S. Forest Service (USFS) permit. More than 30 uranium and rare earth element (REE) occurrences have been identified at Bokan Mountain that are related to the Bokan Intrusive Complex (Figure 2). The enrichment (mineralization) of the Bokan Intrusive Complex rocks with uranium and thorium results in a radioactive signature distinctive from that of the surrounding non-mineralized rocks (Figure 3). The I&L Zone, which is a nearby smaller and lower grade deposit immediately to the northwest of the 900-Foot Level, represents an analogue for conditions that potentially existed at the 900-Foot Level prior to mining.

The Site is defined in the Scope of Work (SOW) to the Administrative Settlement Agreement and Order on Consent (ASAOC) (USFS, 2009) to include the mine, haul roads, ore staging area, former barge loading area, and downstream potentially impacted areas including the Kendrick Creek delta (Figure 4). An access road between the 900-Foot Level haul road and the I&L Zone was constructed at some point during regional exploration, using mine rock in some areas; the lower portion of the I&L access road is included in the Site definition.

The principal surface features associated with former mine operations include:

- 900-Foot Level — open pit, mine portal and air vent shaft, north and south mine rock piles, and mine rock embankments at specific locations along the access road to the 700-Foot Level;

- 700-Foot Level — mine portal and mine rock pile;
- 300-Foot Level — mine portal with mine water drainage and mine rock pile;
- Former Ore Staging Area (OSA) — located on the northern shore of the west arm of Kendrick Bay, with residual ore materials including some oversized rock at the ground surface and piled along the eastern perimeter;
- Former Ore Loading Docks — two remnant rock ramps (western and eastern) extend from the OSA area into the west Arm of Kendrick Bay and the remnants of a third and older ramp are located approximately 600 feet west of the existing floating dock;
- Mine and Haul Roads (including the I&L access road) — primary roads constructed for exploration and mine access which served as haul roads connecting the 700-Foot, 900-Foot, and 300-Foot levels to the OSA and loading docks at Kendrick Bay.

The Site is approximately 38 air miles southwest of Ketchikan, Alaska. The nearest towns are Metlakatla, 28 miles to the northeast across Clarence Strait, and Hydaburg, 33 miles to the northwest on the western side of Prince of Wales (POW) Island. The Site is located within the semi-remote recreational area of the Tongass National Forest (TNF) within the Eudora Roadless System (USFS, 2003). While access is unrestricted, the Site is remote and only accessible by float plane or boat or overland by hiking through several miles of trail-less rugged terrain. A floating dock at the location of one of the historic barge loading docks remains functional. There are no established USFS roads or hiking trails connecting the Site to either other USFS or POW communities or roads. The Site has one permanent structure, which is a small cabin owned and maintained by the Dotson family.

Site terrain varies from moderate slopes along the margin of the west Arm of Kendrick Bay shoreline and around the OSA to rugged, steep slopes with dense forest cover and incised steam channels that restrict access even by foot. Soil conditions at the Site are also variable, ranging from barren rock, rock rubble, and thin patches of poorly drained soils at higher elevations, such as at the 700-Foot and 900-Foot levels, to moderately deep, moderately to well drained organic soil with forest litter cover at lower elevations.

Kendrick Creek and its main tributaries, Mine Fork Creek and Cabin Creek, drain the eastern side of Bokan Mountain. Mine Fork Creek originates above the 900-Foot Level and joins with Kendrick Creek at the 300-Foot Level. The 700-Foot Level Creek, a minor tributary to Mine Fork Creek, originates near the 700-Foot Level. Kendrick Creek flows to the east into the west Arm of Kendrick Bay. Cabin Creek joins with Kendrick Creek near the west Arm of Kendrick Bay.

Kendrick Bay is a 5-mile long fiord that opens to Clarence Strait on the east side of POW Island. Typical of fiords in southwest Alaska, Kendrick Bay is characterized by a steep, narrow intertidal zone between the low and high water lines and a subtidal zone below the low water line. Commercial fishing is known to occur at the mouth of Kendrick Bay, and an aquaculture facility is located on the South Arm of Kendrick Bay; however, both these uses occur several miles from the Site.

The climate of the area is maritime due to the close proximity of the Pacific Ocean. The area experiences frequent and relatively heavy precipitation with October through December usually the wettest months. The annual total precipitation averages over 100 inches with snow occurring at higher elevations.

1.2.1 Previous Investigations

Two environmental investigations were previously performed at the Site to evaluate the nature and extent of mine-related materials and migration/exposure pathways in media to potential receptors. A Removal Preliminary Assessment (RPA) (BLM, 1998) was conducted by the U.S. Bureau of Land Management (BLM) that summarizes environmental data collected in 1995 and 1997. In 2004, the USFS conducted the Preliminary Assessment/Site Investigation (PA/SI) (KSI, 2004). Data and information from these previous investigations were used to identify data gaps for additional sampling and data collection activities defined in the SOW and guided the development of the Expanded Site Investigation (ESI). In addition, numerous mineral investigation and economic geology studies have been performed at the Site and regional area. The information provided by these investigations has also been used to provide additional characterization of the mineralization that occurs in the Bokan Mountain area of the Site.

1.2.2 Expanded Site Investigation

Tetra Tech, with assistance from the Prince Of Wales Tribal Enterprise Consortium (POWTEC) and R&M Engineering-Ketchikan, Inc., performed the ESI for the Companies (Tetra Tech, 2010a). Field work was performed during three events in June, July, and September 2009. Data were collected to characterize the physical, chemical, and radiological conditions of the mine features and environmental media consisting of soil, surface water, stream sediment, marine sediment, and air. Field investigations included gamma radiation surveys, radon air monitoring, and sampling of soil, surface water, stream sediment, and marine sediment. Over 182,000 data points representing approximately 185 acres were generated during the gamma radiation surveys. A total of 86 soil samples, 45 surface water samples, 12 stream sediment samples, 30 marine sediment samples, and 26 long-term and four short-term radon measurements were obtained. Soil, surface water, and stream and marine sediment samples were analyzed for metals and radionuclides in the natural thorium (Th) and uranium (U) decay series.

Gamma radiation surveys, material sampling (soil), and radon (air) monitoring of mine features and adjacent areas, including the mine rock piles at the 900-Foot, 700-Foot, and 300-Foot levels, mine and haul roads, ore storage area, and loading dock areas were completed. Gamma radiation surveys were also conducted along the Kendrick Creek channel from its mouth upstream to the 300-Foot Level mine rock pile, within the Kendrick Creek Bay delta intertidal area, and a limited area of the naturally mineralized and un-mined I&L zone. Short-term and long-term radon monitoring was also performed at the open pit and portals at the 900-Foot (including the air shaft), 700-Foot, and 300-Foot levels.

Samples were collected at 18 surface water locations in Kendrick Creek and tributaries in June, July, and September 2009 and at 12 stream sediment locations in July 2009. Water quality samples were collected of the mine drainage from the 300-Foot Level portal in June, July, and September 2009, which captured the range of flow conditions typical for the Site.

Water samples of a spring (groundwater expression) near the OSA were also collected in June, July, and September 2009. Marine sediment was collected at 22 intertidal sampling locations within the Kendrick Creek Bay delta and at eight subtidal sampling locations in the west Arm of Kendrick Bay in July 2009.

Samples were collected at locations upstream and/or distant from the mine features to provide background reference data for air (radon), soils, surface water, stream sediment, and marine sediment. Gamma radiation surveys were performed to define the spatial extent of the mine feature areas and to define local background gamma exposure rates. A limited gamma radiation

survey was also performed in the I&L Zone to provide additional data to evaluate background gamma exposure rates in an unmined, mineralized area.

Several mine camps were operated over the life of mining operations and significant exploration occurred after mining ended leaving behind debris, particularly at the OSA and 300-Foot Level. An inventory was conducted to catalogue the types, locations, and quantities of miscellaneous solid wastes, petroleum products, abandoned vehicles, and other materials that remain at the Site. Soil samples were collected at four of the waste locations and analyzed for gasoline range organics (GROs) and diesel range organics (DROs), with one sample from the vicinity of the former generator shack at the 300-Foot Level analyzed for polychlorinated biphenyls (PCBs).

As part of the ESI, an engineering assessment was performed to document the physical/engineering aspects of both mine-related and natural features. The engineering assessment included the visual inspection, mapping, surveying, and description of the physical dimensions, locations, conditions, and stability of mine-related features (mine rock piles, water diversion structures, roads, and mine openings) and natural features (landslides). Civil surveying was also performed to delineate the physical footprints of mine rock piles and road embankments in the 900-Foot and 700-Foot levels, and the perimeter of the OSA. Surveying of the 300-Foot Level mine rock pile boundary could not be performed due to rugged, steep terrain and dense vegetation. The assessment was performed to refine material quantities, define engineering constraints and identify constructability conditions in support of the EE/CA.

The above data and information address previously identified data gaps and, along with the data and information provided by previous investigations, provide the interpretive basis for the characterization presented in the SCR. The results and conclusions of the ESI are summarized below.

1.2.2.1 Engineering Assessment

An engineering field reconnaissance was conducted during the second sampling event to support the Engineering Assessment of the man-made and natural features at the Site. The field reconnaissance included visual inspection and observation of the key Site features, including mine rock piles, portals, mine and haul roads, and the ore staging areas. A key finding of the engineering assessment was that the mine rock piles and roads constructed of mine and non-mineralized material exhibited a high degree of stability. No slope failures or progressive raveling of material from the surface of the mine rock piles were noted. At all mine rock piles, there are insufficient fines content in the surficial materials to facilitate the development of rilling or gullying. Exceptions were noted in a few isolated and highly localized areas of the haul road surfaces, where concentrated runoff was observed to have created shallow ruts and/or gullies; however, deposition of the eroded material was not observed beyond the discernable road embankment toes. No materials were observed on the mine rock piles and haul road surfaces, which were judged to be sufficiently fine as to be susceptible to wind transport; dense canopy and ground cover, where present, also effectively prevent wind erosion.

Overall, very limited evidence was observed of the migration of materials beyond the toes of the mine rock piles. Although some material may have been transported short distances by gravity and/or water prior to stabilization of the surfaces and toes by vegetation, the mine rock piles appear to have been relatively stable for many years. The apparent stability of the mine rock piles and road embankments can be attributed to several primary factors, including:

1. the coarse grain size and correspondingly higher internal friction angle (a measure of soil strength) of the materials;
2. pile and embankment slopes do not exceed the maximum natural angle (angle of repose) for the materials; and
3. where present, dense and damp to wet ground cover serve to stabilize the surfaces from wind and runoff erosion.

Based on these observations, it is apparent that the mine rock piles and road embankments are relatively stable, and have not been susceptible to observable off-site migration by wind or water erosion processes.

1.2.2.2 Gamma Radiation Surveys

Comprehensive, high-density gamma radiation surveys were conducted to define the range and extent of gamma exposure rates for the mine features (900-Foot, 700-Foot, and 300-Foot levels, mine and haul roads, and the OSA and ore loading docks) and adjacent areas. Gamma surveys were also performed of the Kendrick Creek stream channel, Kendrick Bay intertidal zone, and a limited area of the I&L Zone. Correlations were established between measured gamma exposure rates and the activity of uranium, thorium, radium and other radionuclides in surface soil. The gamma surveys and radionuclide correlations provide detailed information to define the limits of mine rock areas and to characterize adjacent areas.

Figures 5 through 8 summarize the results of the gamma radiation surveys for the Site. Data presented on these figures represent unshielded gamma exposure rates measured at 3 feet above the ground surface in interval units of microroentgen per hour (µR/hr). The lowest interval of less than 20 µR/hr corresponds to the upper range of background gamma exposure rates determined for non-mineralized areas at the Site. The unshielded gamma measurements define the limits of gamma exposure rates representative of the radiation exposure and risk to humans at a specific location; however, the measurements likely overestimate the extent and boundaries of mine rock areas.

Figure 5 illustrates the Site-wide results of the gamma radiation surveys for the mine and haul roads, Kendrick Creek stream channel, Kendrick Bay intertidal zone, and the I&L Zone. Figures -6 through 8 depict the gamma exposure rates measured in the 300-Foot Level, combined 700-Foot and 900-Foot levels, and the OSA and loading docks. Pertinent results of the gamma radiation surveys include:

- *Kendrick Creek Channel:* The Kendrick Creek stream channel between the 300-Foot Level and the mouth of the creek was surveyed. With the exception of limited areas downstream of the 300-Foot Level, the measured gamma exposure rates in the Kendrick Creek channel are relatively low (less than 20 to 30 µR/hr). Isolated areas of gamma readings ranging up to approximately 160 µR/hr were measured downstream of the 300-Foot Level mine rock pile in the primary channel of Kendrick Creek. These gamma exposure rates are due to individual mine rocks observed in the channel downstream of the 300-Foot Level mine rock pile. Visual observations and the gamma measurements indicate that mineralized durable, cobble- and boulder-sized mine rock are the sources of the gamma radiation. This is an important characteristic and contrasts with more widely distributed fine-grained material resulting from the breakdown and erosion of the mine rock.

- *Kendrick Bay Intertidal Zone:* Gamma exposure rates ranging up to 2,858 µR/hr in the intertidal zone are limited to a localized area immediately adjacent to the remnant rock loadout ramps and are associated with individual ore rocks. Gamma exposure rates of the intertidal zone west of the dock area, including the majority of the Kendrick Creek delta, are relatively low (less than 20 µR/hr).
- *I&L Zone:* While the gamma rates are variable, gamma values as high as 2,124 µR/hr were measured over the naturally mineralized and un-mined I&L Zone.
- *Mine and Haul Roads:* Gamma exposure rates ranging up to a maximum of approximately 850 µR/hr were measured in specific areas of the upper portion of the original haul road to the 900-Foot Level, the upper portion of the haul road to the 300-Foot Level, and near the OSA. Gamma exposure rates along the lower southern reach of the I&L spur road ranged up to a maximum of 874 µR/hr. The identified areas of the mine and haul roads may have resulted from the use of mine rock to repair the roads or from ore spilled during haulage. In areas where the roads were constructed with mine rock or where ore may have been spilled during haulage, visual observations and the gamma measurement indicate that mineralized coarse durable cobbles and boulders are the sources of the gamma radiation, rather than distributed fine-grained soils that are subject to erosion.
- *300-Foot Level:* Gamma exposure rates of up to 2,460 µR/hr were measured for the mine rock pile at the 300-Foot Level. The extent of the mine rock pile was defined by lower gamma measurements around the perimeter of the 300-Foot Level area except for an area downslope of the haul road on the eastern side; the steepness and/or dense vegetation in this area prohibited access.
- *700-Foot Level:* Gamma readings of up to 4,206 µR/hr were measured for the 700-Foot level mine rock pile. With the exception of the area to the east-southeast of the 700-Foot Level portal, the extent of the 700-Foot Level rock pile was delineated by lower gamma measurements surrounding the pile.
- *Open Pit and 900–Foot Level:* Gamma exposure rates of up to 3,353 µR/hr are present over the open pit and the area immediately south of the pit. Gamma readings of up to 2,623 µR/hr and 1,700 µR/hr were measured for the north and south mine rock piles, respectively, at the 900-Foot Level. The extent of the 900-Foot Level rock piles were delineated by lower gamma measurements in the area surrounding the piles.
- *OSA and Former Ore Loading Docks:* A maximum gamma exposure rate of 4,100 µR/hr was measured in the central portion of the OSA. A deposit of mine rock was identified on the eastern perimeter of the OSA with gamma readings of about 2,000 µR/hr. The gamma survey extended to the intertidal zone, encompassing the two remnant rock loadout ramps. In the intertidal zone, measured gamma exposure rates ranging up to 2,858 µR/hr are limited to an area about 100 feet east of the remnants of the rock loadout ramp for the 1971 dock and to about 150 feet west of the existing dock ramp. The gamma survey and visual inspection indicates that pieces of ore in the immediate vicinity of the rock ramps represent the source of direct gamma radiation. Visual observations and the gamma measurements indicate that the coarse durable pieces of ore are the sources of the gamma radiation, rather than distributed fine-grained sediments that are subject to erosion. The unshielded surveys overestimate the areal extent and exposure rates of materials in a variable or low gamma field due to shine from higher gamma-emitting scattered rocks.

The gamma surveys also provided information to assess background gamma exposure rates for mineralized and non-mineralized areas of the Site. Quantifying background conditions at a former uranium mine in complex geologic conditions such as the Ross-Adams Site is a difficult task in the absence of actual pre-mining data. The Bokan Mountain Intrusive Complex is a circular stock of approximately 3 kilometers in diameter. The peralkaline granite stock is surrounded by a metamorphic zone consisting of quartz monzonite and quartz diorite intrusives. The general enrichment (mineralization) of uranium, thorium, and other rare metals in the Bokan Intrusive Complex peralkaline granite and the surrounding quartz monzonite and quartz diorite intrusives requires the use of different background levels when discussing select environmental media (e.g., soils, gamma radiation) as various features are underlain by differing rock assemblages (mineralized versus non-mineralized) at the Site.

Due to the complex geologic conditions at the Site, local background gamma exposure rates are highly variable and require that different background levels be defined that reflect the natural variability (Figure 3). Background gamma radiation levels were determined separately for mineralized (peralkaline granite) and non-mineralized (undifferentiated granite and diorite intrusives) areas of the Site. Due to the extreme variability of exposure rates in undisturbed mineralized areas, it is not reasonable to establish a single background gamma value. The fact that the Ross-Adams ore deposit was discovered by an aerial radiometric survey and that initial mining was performed via an open shallow pit confirms that natural, pre-mining gamma exposure rates on and near the ore deposit were likely very high.

Gamma exposure rate measurements taken in the I&L Zone are assumed to represent the minimum for pre-mining background in the mineralized area at the Site. The I&L Zone has been prospected for uranium, but never mined. Since it has not been mined, the I&L Zone is assumed to be of lower grade and less mineralized than the Ross-Adams deposit; thus, pre-mining background gamma levels of the Ross-Adams deposit were likely higher. Gamma exposure rates for the I&L Zone ranged from approximately 10 µR/hr to 1,700 µR/hr with a maximum measured value of 2,124 µR/hr.

Background gamma exposure rates for non-mineralized areas were determined by independent evaluation of gamma data measured in the OSA, Kendrick Creek channel, and the west Arm of Kendrick Bay intertidal area. Evaluation of the gamma data for these separate areas resulted in comparable background ranges in the gamma exposure rates for non-mineralized areas. Gamma exposure surveys indicate that the background gamma radiation rates for undisturbed non-mineralized areas vary up to approximately 20 µR/hr.

1.2.2.3 Soil Media

Soil samples were collected that are representative of fine-grained material within the rock pile areas or fine-grained soil at the margins of the mine features that likely have been influenced by historic mining activities. The extent of soils influenced by the mine features is limited to identified areas immediately adjacent to mine rock at the 300-Foot, 700-Foot, and 900-Foot levels, along defined areas of the mine and haul roads, and in the OSA and rock loadout ramps associated with the ore loading docks. The concentrations of metals and activities of radionuclides of soil samples collected from and adjacent to the mine rock areas vary over a wide range.

Based on the gamma radiation survey results, soil samples have been affected in identified areas within the OSA to varying degrees. Soil along the mine and haul roads have also been affected by mine rock used to repair the roads or from spills during ore haulage.

Similar to background gamma radiation, soil background levels were determined separately for mineralized (peralkaline granite) and non-mineralized (undifferentiated granite and diorite intrusives) areas of the Site. The OSA and 300-Foot Level locations are considered to be underlain by essentially non-mineralized bedrock, and the 700-Foot and 900-Foot levels are considered to be underlain by mineralized bedrock to varying degrees. Soil samples collected at locations away from the mine features were used to assess the local background levels for the mineralized and non-mineralized areas.

1.2.2.4 Surface Water Media

Based on available data, water flows continuously from the 300-Foot Level portal and drains to Mine Fork Creek upstream of its confluence with Kendrick Creek, which subsequently flows along the 300-Foot Level mine rock pile. The drainage from the 300-Foot Level portal has the highest metal concentrations and radionuclide activities of surface water quality samples collected at the Site. Total uranium concentrations in water samples collected at the portal in 2009 ranged from 0.11 to 0.24 mg/L, lead concentrations ranged from 0.00022 to 0.00028 mg/L, total zinc concentrations ranged from 0.024 to 0.038 mg/L, arsenic concentrations were below the laboratory reporting limit of 0.01 mg/L, and radium-226 activity ranged from 4.3 to 7.8 pCi/L. These parameters are representative of the distribution and trends in metal concentrations and radionuclide activities.

Concentrations of metals, including zinc, and radionuclides are the highest in Kendrick Creek adjacent to the 300-Foot Level mine rock pile, but decrease downstream. Constituent concentrations generally decreased with increased stream flow during the September sampling event.

The concentrations of several metals and activities of radionuclides in samples collected from Mine Fork Creek and drainages originating in the vicinity of the 700-Foot Level mine rock pile and the 900-Foot Level open pit and mine rock piles exceeded background surface water concentrations.

Local background reference concentrations of metals and radionuclides in surface water were evaluated using data from sampling locations upstream of the mine feature areas. These sampling locations are considered representative of surface water quality above the outcrop area of the Ross-Adams mine. Background that includes the influence of the natural mineralization of the Ross-Adams area prior to mining is not possible due to the influence of the mine rock, but these upstream samples are considered to be the best data available for evaluating background surface water quality. These background samples likely underestimate the metal concentrations and radionuclide activities of surface water from the mineralized area prior to mining.

1.2.2.5 Stream Sediment Media

Most metals and radionuclides exhibit similar trends in streambed sediments. The maximum observed metals concentrations and radionuclides activities in stream sediment occurs at the sample collected from the 300-Foot Level portal drainage. As a result, the highest observed metal concentrations and radionuclide activities in Kendrick Creek sediment, particularly for uranium and radionuclides, typically occur at the sample location immediately downstream of the 300-Foot Level mine rock pile.

Similar to surface water, the concentrations of metals in Kendrick Creek sediments decrease in samples downstream of the 300-Foot Level and, in lower reaches of Kendrick Creek, sediment metal concentrations are low. Radionuclide activities of stream sediment in Kendrick Creek also

quickly decrease in the downstream direction and, by a point just above the Cabin Creek confluence, the activities of radionuclides are at or below the background radionuclide activities for stream sediment.

Simiar to surface water, background reference values for stream sediment were determined from sampling locations upstream of the mine features and the outcrop of the Ross-Adams mine deposit. Due to the present influence of the mine rock, background that reflects the natural mineralization of the Ross-Adams area prior to mining is not possible. These upstream samples are considered to be the best data available for evaluating background stream sediment quality, but likely underestimate the metal concentrations and radionuclide activities of stream sediment from the mineralized area prior to mining.

1.2.2.6 Groundwater

Due to the generally thin soils and exposed bedrock at the higher elevations of the Site, including the 700-Foot and 900-Foot levels, the occurrence of shallow groundwater is likely to be very minimal and discontinuous. In addition, the steepness of the creeks in their upper reaches inhibits the accumulation of alluvial material, and bedrock exposure in the creek beds is common. Within the lower reaches of Kendrick Creek, the stream gradient decreases sufficiently to allow the development of alluvium. Due to the likely interaction with surface water and shallow alluvial groundwater in lower Kendrick Creek, the quality of shallow groundwater is represented by surface water quality.

1.2.2.7 Kendrick Bay Marine Sediments

Drainage from the mineralized terrain in the Kendrick Creek watershed is to the west Arm of Kendrick Bay. The numerous uranium, thorium and rare earth REE mineral deposits present on Bokan Mountain and located in the Kendrick Creek watershed have been actively explored for over 50 years. Available information indicates that metal concentrations and radionuclide activities of the marine sediments in the west Arm of Kendrick Bay reflect the natural weathering processes of the naturally mineralized terrain.

Kendrick Creek enters the bay in the westernmost portion of the west Arm of Kendrick Bay. The delta formed by Kendrick Creek has a relatively flat gradient which results in a wide intertidal area. This area possesses a very diverse and abundant array of marine life. Away from the Kendrick Creek delta the intertidal zone is much steeper, resulting in a narrower band that is exposed during low tide and typical of fiords. Boulders and cobbles dominate the intertidal zone away from the Kendrick Creek delta. Marine sediment samples in the west Arm of Kendrick Bay were collected from the intertidal zone (between the low and high water lines) and from the subtidal zone (below the low water line).

The gamma survey and physical inspection documented the presence of pieces of ore within the intertidal zone in a discrete area limited to approximately 100 feet east of the remnants of the 1971 rock loadout ramp and to approximately 150 feet west of the existing dock rock ramp. The ore was likely spilled during ore loading operations. Intertidal zone sediments in the swale between the two ramps confirm the presence of ore-related metals and radionuclides in this area. The intertidal zone sediment sample data indicate that the intertidal zone sediments on the Kendrick Creek delta represent a local background population.

Sub-marine gamma survey results (KSI, 2004) and the subtidal zone sediment sample data indicate the influence of spilled ore is limited to the immediate vicinity of the rock loadout ramps. Gamma values, concentrations of metals, and the activities of uranium and thorium and their

decay products are highest in the sediments closest to the former floating dock, with the highest values closer to shore. The subtidal sediment sample data indicate that the metals (e.g., arsenic and lead) concentrations and radionuclide activities in the subtidal sediments a further distance from the rock loadout ramps represent local background. Furthermore, arsenic concentrations in the subtidal sediments are consistent with regional southeastern Alaska data and correlate with the organic rich marine sediments.

1.2.2.8 Air Media (Radon)

Radon concentrations at the Site are variable depending on the locations of the radon monitoring stations with respect to the mine features (mine rock piles and portals), the presence of naturally occurring mineralized background conditions, and localized atmospheric and topographic conditions. Pertinent results of radon monitoring of the mine features, measured as the average concentration over the detector exposure period, include:

- *Portals and Open Pit:* The portals and air shaft present avenues for radon emissions from the underground mine workings. A radon concentration of 373 picocuries per liter (pCi/L) was measured at the central portion of the open pit. Long-term radon concentrations measured at the 900-Foot Level portal and the air shaft were 163.3 ρCi/L and 39.2 ρCi/L, respectively. The long-term radon concentration measured at the 700-Foot Level portal was 22.3 ρCi/L.
- The highest radon concentration of 445 ρCi/L was measured at the 300-Foot Level portal. However, radon concentrations were lower at downstream monitoring locations in the steep-sided Kendrick Creek channel below the portal. The radon concentration measured approximately 100 feet southeast and topographically below the portal was 136 ρCi/L. Further downstream, approximately 300 feet from the 300-Foot Level portal, the measured radon concentration was 76.3 ρCi/L.
- *Mine Rock Piles:* Radon concentrations at the 300-Foot Level mine rock pile ranged from 5.8 to 22.3 ρCi/L. Radon concentrations up to 40.1 ρCi/L were measured at the 700-Foot Level mine rock pile. Radon levels associated with the mine rock piles at the 900-Foot Level varied from 133.4 ρCi/L (north pile) to 192 ρCi/L (south pile).
- *OSA and Loading Docks:* Radon concentrations of 64.1 ρCi/L and 92.9 ρCi/L were measured at detectors located at the perimeter of the OSA and near the existing dock. Radon concentrations less than the non-mineralized background value were attained at the radon monitoring locations that ring the OSA at distances ranging from approximately 150 to 300 feet.

Radon quickly disperses in the atmosphere and radon levels approach background levels within short distances from the mine features. The one exception to this is in the steep-sided Kendrick Creek channel downstream of the 300-Foot Level portal, where higher radon levels persist for more than 300 feet below the portal.

Based on radon measurements performed at background locations and areas away from mine feature areas, a radon concentration of 5.8 ρCi/L is considered to represent the maximum background value for non-mineralized areas away from areas of naturally occurring mineralization and economic mineral deposits.

1.2.2.9 Air Dust and Particulates

Site air quality is not impacted by mine material dust or particulates because the topography, vegetation and wet climatic conditions at the Site and the generally coarse nature of the mine

materials inhibit the generation of wind-borne material. However, for purposes of the SSRA exposure to airborne particulates was evaluated for the mineral exploration and USFS workers to address the potential for exposure via this pathway.

1.2.2.10 Conclusions of the Expanded Site Investigation

The ESI provided the data and information necessary to characterize the physical, chemical and radiological conditions of the Site and address the data gaps identified in the PA/SI (KSI, 2004), as required by the SOW. The results of the ESI indicate that the influences of mining activities related to the Ross-Adams mine are limited to the vicinity of the mine feature areas. These mine features are:

- The open pit
- The mine portals (900-Foot, 700-Foot, and 300-Foot levels) and air shaft
- The mine rock piles at the 900-Foot, 700-Foot, and 300-Foot levels and adjacent soils
- Specific areas of Site mine and haul roads
- The OSA and adjacent soils
- The rock loadout ramps

The data and information collected in the ESI (chemical, radiologic and physical) is sufficient to determine the chemical and radiological characteristics and the boundaries/locations of mine features at the Site. The gamma radiation survey data provide definitive information to differentiate between the boundaries of the mine features, adjacent areas, and natural mineralized background conditions. Further, the gamma correlation sample results demonstrate that gamma exposure measurements provide a reliable method to assess the radionuclide activities of soils. The results of the gamma radiation surveys and soil sampling indicate that the influences from the mine rock piles at the 300-Foot, 700-Foot, and 900-Foot levels, mine rock along areas of the haul roads, the OSA and rock loadout ramps are confined to discrete and defined areas. The concept of local background is critical to the understanding of the Site conditions because of the influence of the natural mineralization exposed at the surface throughout the 900-Foot and 700-Foot Levels.

Mine features at the Site are the underground mine workings; mine rock piles and associated soil at the 900-Foot and 700-Foot levels; the mine rock pile and portal drainage at the 300-Foot Level; and mine materials present in the mine and haul roads, the Ore Staging Area, and the loadout ramps. The area and location of these mine features and the nature and extent of the chemical and radiological constituents have been documented and quantified. In addition to mine features, the drums and stained soils at the generator shack area of the 300-Foot Level are considered a source for petroleum hydrocarbons.

The release mechanisms from the underground mine workings are radon emissions to air and leaching of other radionuclides and metals to mine water drainage. The portals and air shaft present avenues for radon emissions from the underground mine workings. Radon emissions also occur from the mine rock piles. Radon quickly disperses in the atmosphere and radon levels approach background levels within short distances from the mine features. The one exception is the radon concentration in the air flow from the 300-Foot Level portal, which has the highest measured radon concentration at the Site, with higher radon levels persisting for more than 300 feet downstream of the portal in the steep-sided Kendrick Creek channel. The exposure to radon would be through inhalation to receptors below the portal. Other radon sources include background radon emissions from the naturally mineralized geology.

Mine water drainage, primarily from the 300-Foot Level portal, reports to surface water in Kendrick Creek, and surface water is considered an exposure medium through which human and ecological receptors (terrestrial and freshwater aquatic) could be exposed to certain metals and radionuclide constituents. However, the steep gradient of Kendrick Creek to below the 300-Foot Level is considered negligible spawning and rearing habitat for all salmonids.

Mine rock present at the 900-Foot, 700-Foot and 300-Foot levels, haul and mine roads, the OSA and at the rock loadout ramps are potential sources of metals and radionuclides that can cause exposure by direct contact, direct gamma radiation, or be released to soils, surface water, sediments and air media. Potential release mechanisms include erosion, leaching, runoff, gamma emissions and radon emissions.

Direct exposure to gamma radiation within or in close proximity to the mine features is a potentially complete pathway to humans. The gamma radiation survey data provide definitive information to differentiate between the boundaries of the mine features, adjacent soils, and natural mineralized background conditions. The gamma measurements define the limits of gamma exposure representative of the radiation exposure to receptors at a specific location. In addition, the gamma radiation measurements have been demonstrated to provide reliable information for soil radionuclide activities.

Leaching of radionuclides and select metals or runoff from mine rock piles to surface water can result in receptors potentially being exposed through direct contact with or ingestion of surface water and stream sediment. The results of surface water samples collected from Mine Fork Creek and drainages originating in the vicinity of the 700-Foot Level mine rock pile and the 900-Foot Level open pit and mine rock piles indicates that leaching and runoff from mine rock represents a minimal release mechanism for metals and radionuclides. Trends in the metal concentrations and radionuclide activities of stream sediment in Kendrick Creek are similar to trends in surface water concentrations. The highest observed metal concentrations and radionuclide activities in Kendrick Creek sediment typically occur at the sample location immediately downstream of the 300-Foot Level mine rock pile. Metal concentrations and radionuclide activities in stream sediment decrease downstream and in lower reaches of Kendrick Creek, metal concentrations and radionuclide activities are at or below the background values for stream sediment.

Marine sediments can present potential direct contact exposure pathways as well as external radiation and food-chain exposures to both humans and ecological receptors. Except where discrete ore rocks are present in a limited area of the rock loadout ramps, the metal concentrations and radionuclide activities of sediment were found to be within the intertidal and subtidal zones are within local background levels in the SCR.

1.3 Land Use

The Site is located within the semi-remote recreational area of the TNF (USFS, 2008b), and is within the Eudora Roadless System (USFS, 2003). The TNF Land and Resource Management Plan (USFS, 2008a, 2008b) has designated the Site for mineral exploration and timber production, surrounded by areas of semi-remote recreational uses with old growth forests to the northwest and bounded to the west by the Prince of Wales Wilderness Area. The Site is not restricted for recreational use, but its remote location and lack of facilities limit recreational opportunities. The Site has one existing structure, which is a small cabin that has been used and maintained by the Dotson family (also referred to as the Seraphim cabin). The future of this cabin is unclear, but its existence is not consistent with future uses of the Site as determined by the TNF Master Plan.

Access to the Site, while unrestricted, is by float plane or boat or overland on foot. Hiking to the Site from the Prince of Wales Wilderness Area to the west or from Moira Sound to the north is possible, but would involve hiking through several miles of wilderness area. It is unclear if there are any trails in the area. There are no roads to the area per the USFS Master Plan Map and the Site is not on the Prince of Wales Road Network. Figure 1 presents a map of the Ross-Adams Site and surrounding wilderness areas.

The following subsections describe current, future, and subsistence uses of the Site, as well as a discussion of off-site land uses within four miles of the Site. The following descriptions are graphically depicted in the revised conceptual site model (CSM) discussed in Section 2.2 and presented in Figure 9.

1.3.1 Current Use

The most recent use of the Site is for mineral exploration on mining claims held by Ucore. In the past, the Dotson Family conducted mineral exploration and occasionally stayed in the cabin located approximately 200 yards from the Ore Storage Area (OSA). Per information presented in the 2004 PA/SI (KSI, 2004), the Dotson's used the cabin seasonally for varying amounts of time. The PA/SI stated that the Dotson family members were present during the 2004 Site investigation, and while one family member was present during Tetra Tech sampling in September 2009, none were using the cabin during Tetra Tech's sampling efforts in June and July. As noted above, this cabin is not consistent with planned Site use.

The Site is designated for mineral exploration or timber production as permitted by the USFS (USFS, 2008a). Active mineral exploration has occurred at the Site for the past three years (2007 – 2009, Landmark Alaska 2009). Other current uses of the Site could be an occasional area visitor, or a USFS worker at the Site on a temporary basis, for the purposes of wildlife or biota surveys, or other evaluations of the forest land.

Commercial fishing can occur in Kendrick Bay and an aquaculture facility is located in the South Arm of Kendrick Bay. A report by the ADNR (1998) indicated that intense commercial harvest was occurring at the entrance to Kendrick Bay. Commercial sea cucumber harvesting, if conducted in the West Arm, would occur on a three-year rotational basis. However, marine waters at the head of the West Arm are relatively unproductive because of restricted circulation (KSI, 2004).

1.3.2 Future Site Use

The USFS Master Plan for the TNF has designated the Site for mineral exploration or timber production, as well as being semi-remote recreational land. If the land is used for timber production purposes, it is unlikely that recreational visitors would simultaneously use the land, both for safety reasons and desirability of recreational experience. The USFS Master Plan for the TNF does not appear to include any other type of development for this Site. Based on the Master Plan, area visitors, mineral exploration workers, and USFS workers were selected as potential future receptors.

1.3.3 Subsistence Use of the Site

Subsistence use of land and marine resources is an important facet of native Alaskan traditional practices. Subsistence uses of the Site may occur, both currently and in the future, although the Site is remote from any population center. The distance from population centers may decrease the desirability of the Site as a subsistence area, given that areas closer to population centers would provide the same harvesting opportunities.

Hydaburg, 33 miles northwest of the Site, is the nearest community to the Site with subsistence data available from the State of Alaska Community Profile Database. As described in the Community Economic Development Plan for Hydaburg (Okleasik, 2005), Hydaburg is a largely native population of nearly 400 people. In 1967, The US Haida Nation (Haida) received a Congressional settlement "for trespass on traditional lands in the Tongass National Forest and Glacier Bay Monument" (Okleasik, 2005). In 1971, the Haida were granted 23,000 acres of land through the Alaska Native Claims Settlement Act. The grant was through the formation of two state-chartered organizations, Sealaska Corporation (Southeast Alaska Regional Corporation) and the Haida Corporation. Sealaska land holdings in 2009 are 290,000 acres of surface estates, although the land holdings may not be geographically contiguous or near the Site (Sealaska, 2009). However, it is possible that members of the Haida Nation consider the Site to be part of their traditional hunting grounds. Assuming that the 23,000 acres of Haida land is most often used for traditional hunting and harvesting, and that potentially impacted areas of the Site total approximately 17.4 acres (Tetra Tech, 2010a), impacted areas comprise only 0.08 percent of land potentially used for subsistence harvesting. The 17.4 impacted acres of the entire Site (approximately 1900 acres) comprises 0.9 percent of the Site. However, it should be noted that the Haida tribe does not consider the Ross-Adams area to be a desirable hunting or gathering area, based on cultural beliefs and traditional practices. Locations closer to Hydaburg are considered more desirable for subsistence food gathering purposes (Community Meeting in Hydaburg, December 14, 2010).

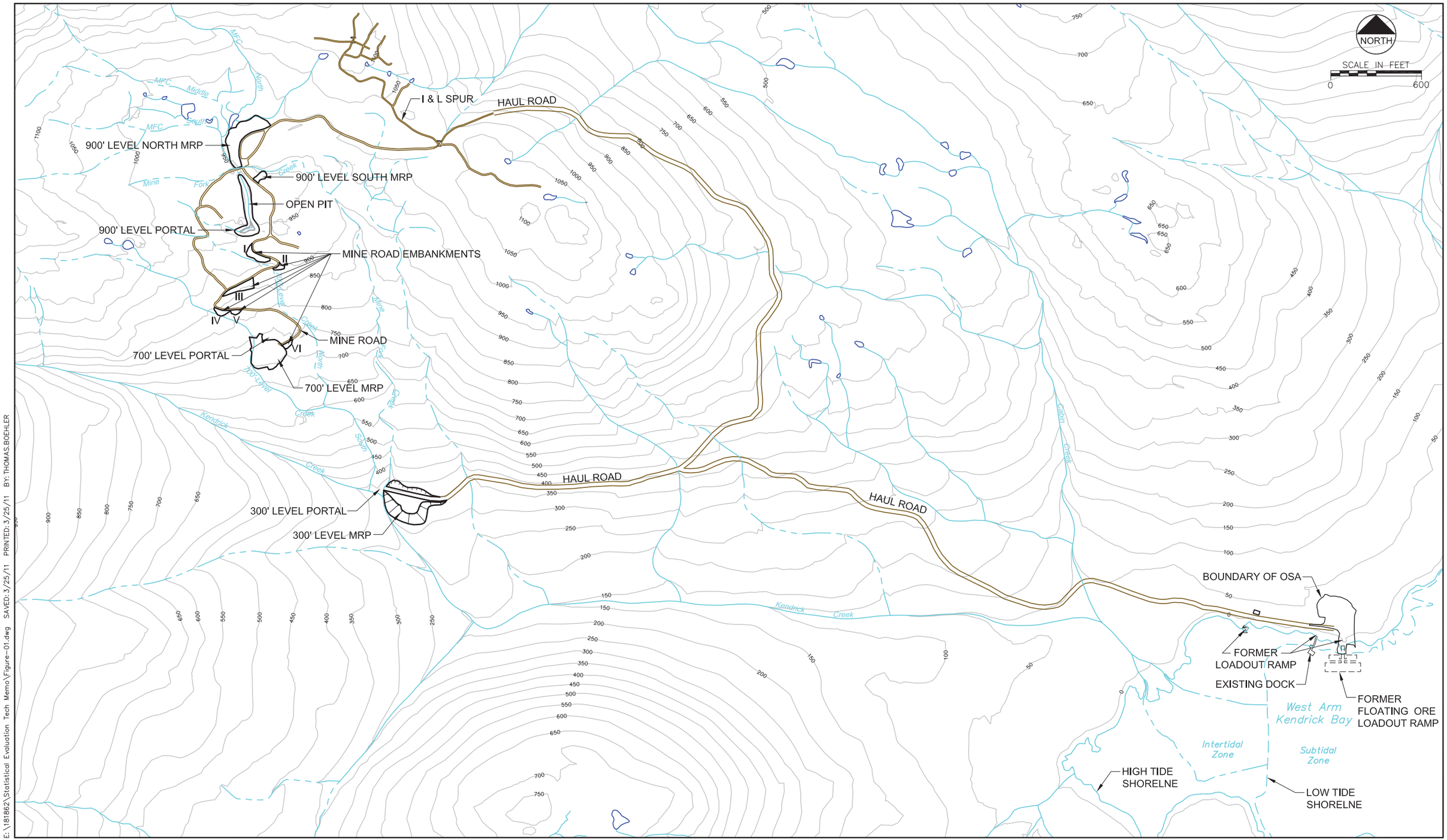
Subsistence food gathering was selected for evaluation as a potential current and future exposure.

1.3.4 Off-Site Land Use

The Site is located within the semi-remote recreational area of the TNF (USFS, 2008b), and is within the Eudora Roadless System (USFS, 2003). The South Prince of Wales Wilderness Area is approximately three miles to the west of the Site. There are no permanent populations within 15 miles of the Site. The nearest towns are Metlakatla, 28 miles to the northeast across Clarence Strait, and Hydaburg, 33 miles to the northwest on the west side of Prince of Wales Island.

The State of Alaska owns a parcel of land approximately three miles east of the Site. ADNR (1998) designated it a general use area, with no development planned within the 20 year period from 1998 (i.e., until 2018). According to ADNR (1998), general use is defined as "land which may have a number of uses but for which a specific resource allocation decision is not possible" due in part to inaccessibility and remoteness and that development is not likely to occur within the next 20 years. Specific to the land parcel, ADNR (1998) states that current demand for land at Kendrick Bay is low. Settlement is expected to occur only in conjunction with timber production or mineral exploration, all of which would be subject to the USFS management plan and permitting. The "settlement" area designated for the parcel is a strip of land starting at the coast and extending 400 feet inland.

Kendrick Bay is used for commercial and recreational fishing. A commercial aquaculture facility, owned by the Southern Southeast Regional Aquaculture Association, is located in the south Arm of Kendrick Bay and consists of juvenile salmon holding pens. Kendrick Bay is part of a terminal fishery for chum salmon (SSRAA, 2009). Within 15 miles of the Site, Kendrick Bay waters may be used for commercial fishing of shrimp, sea cucumbers, and red urchins. It is assumed that subsistence fishing may occur within all parts of Kendrick Bay.



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Project No. 181862

CONTOUR INTERVAL = 50 FEET
BASE MAP PRODUCED FROM AERIAL PHOTOGRAPHY FLOWN: AUGUST 8, 2005.
COMPILED BY: EAGLE MAPPING LTD.

April 2015

Figure 1
Site Map
Ross-Adams Site

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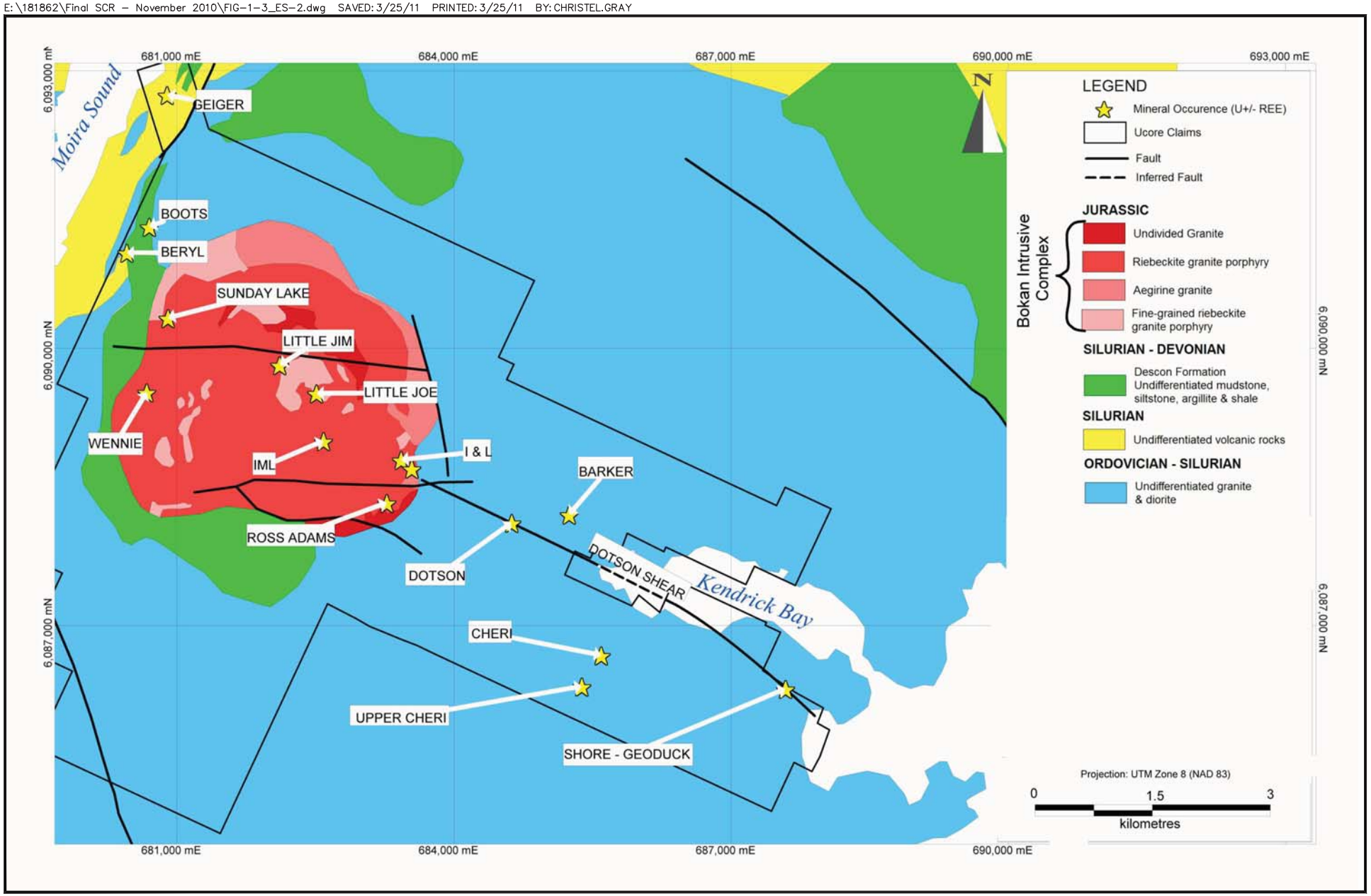

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Source: www.ucoreuranium.com

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Figure 2
Ross-Adams Site
Regional Geology and Mineral Occurrences

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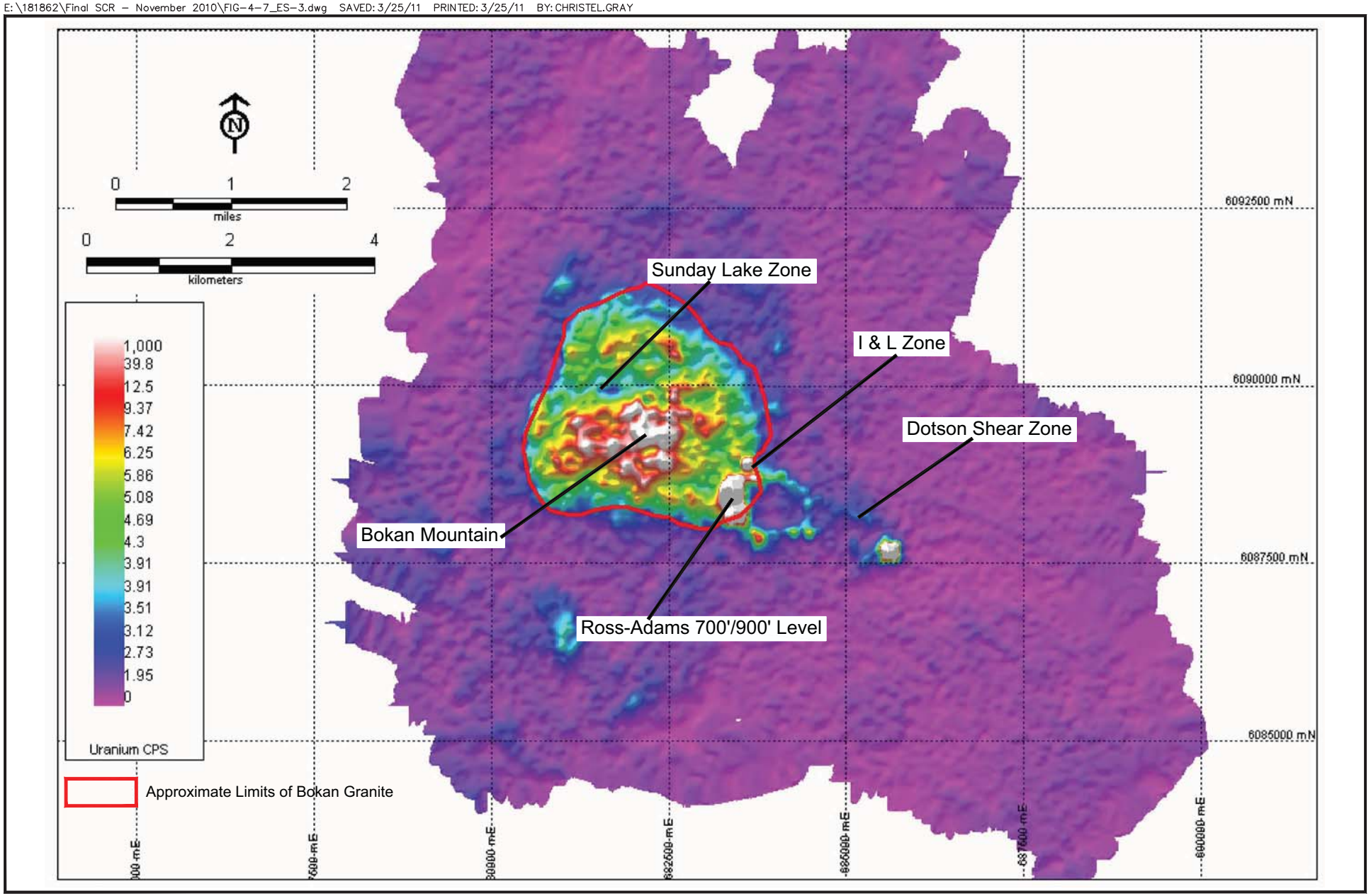

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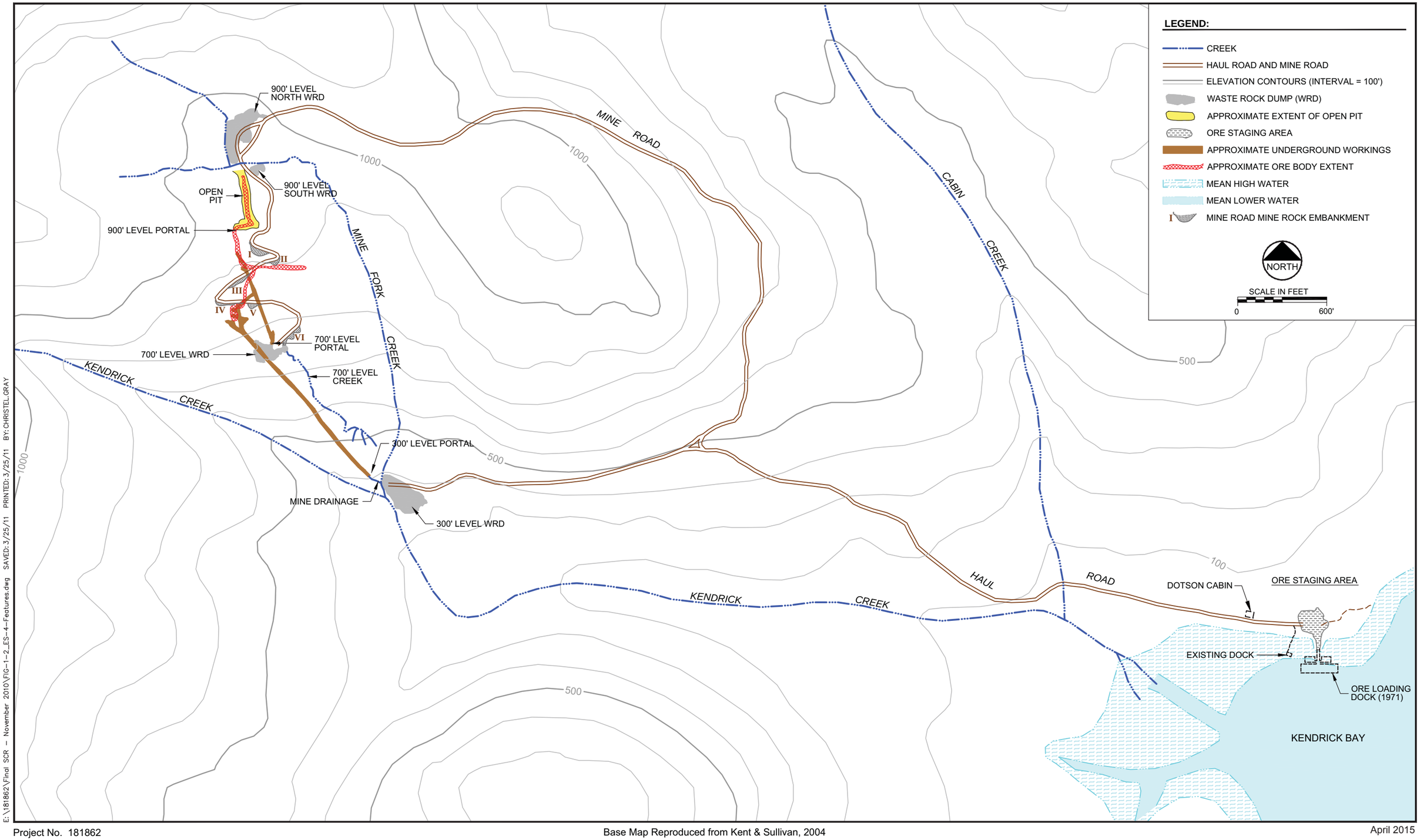
Notes:
1. Used By Permission From Ucore Uranium.
2. UTM Grid WGS 84 Zone 8.

Figure 3
Bokan Mountain Airborne Radiometric Survey (2007)



E:\181862\Final SCR – November 2010\FIG-1-2_ES-4-Features.dwg SAVED: 3/25/11 PRINTED: 3/25/11 BY: CHRISTEL GRAY

Project No. 181862

Base Map Reproduced from Kent & Sullivan, 2004

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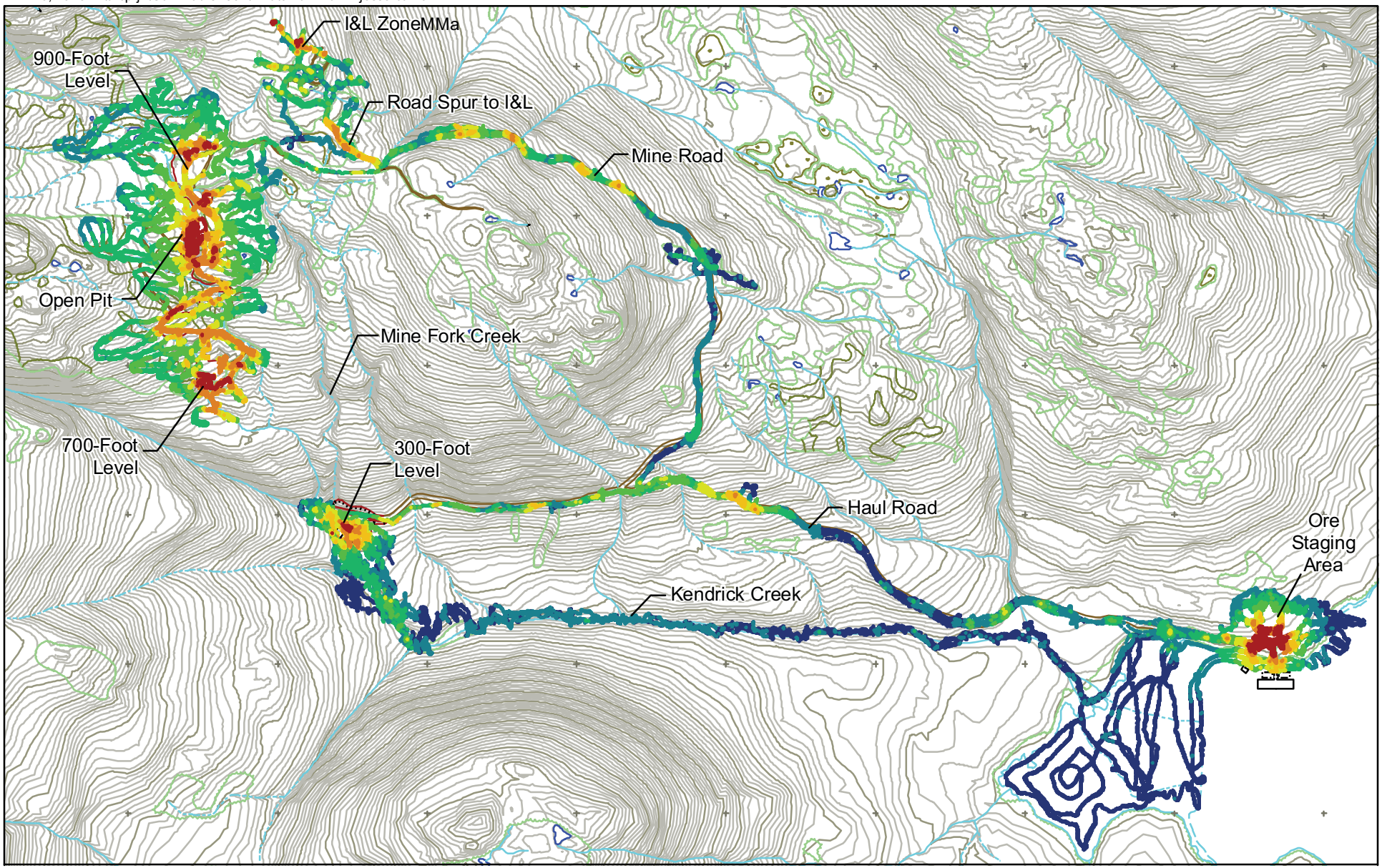
Figure 4
Ross-Adams Site
Major Site Features

FEB 19, 2010 N:\arcprj2\Gamma\181862\mxd\6-1a.mxd BY:jesse.carver



Gamma Exposure Rate (uR/hr)

<20	80-160	631-1250
20-40	160-316	>1250
40-80	316-631	

N

Feet

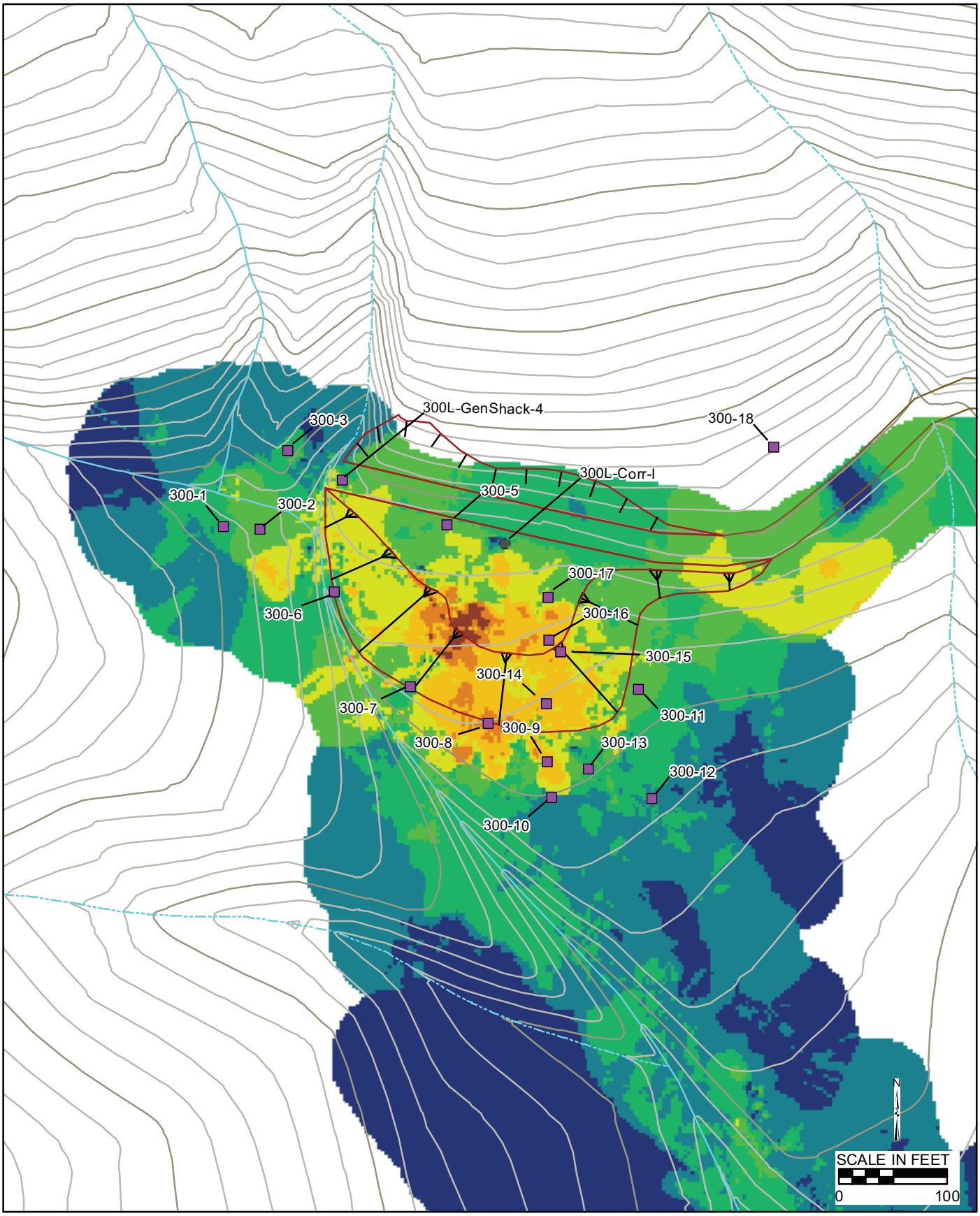
0 1,000

April 2015

Figure 5

Ross-Adams Site

Unkriged Site Map



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April 2015

Gamma Exposure Rate (uR/hr)

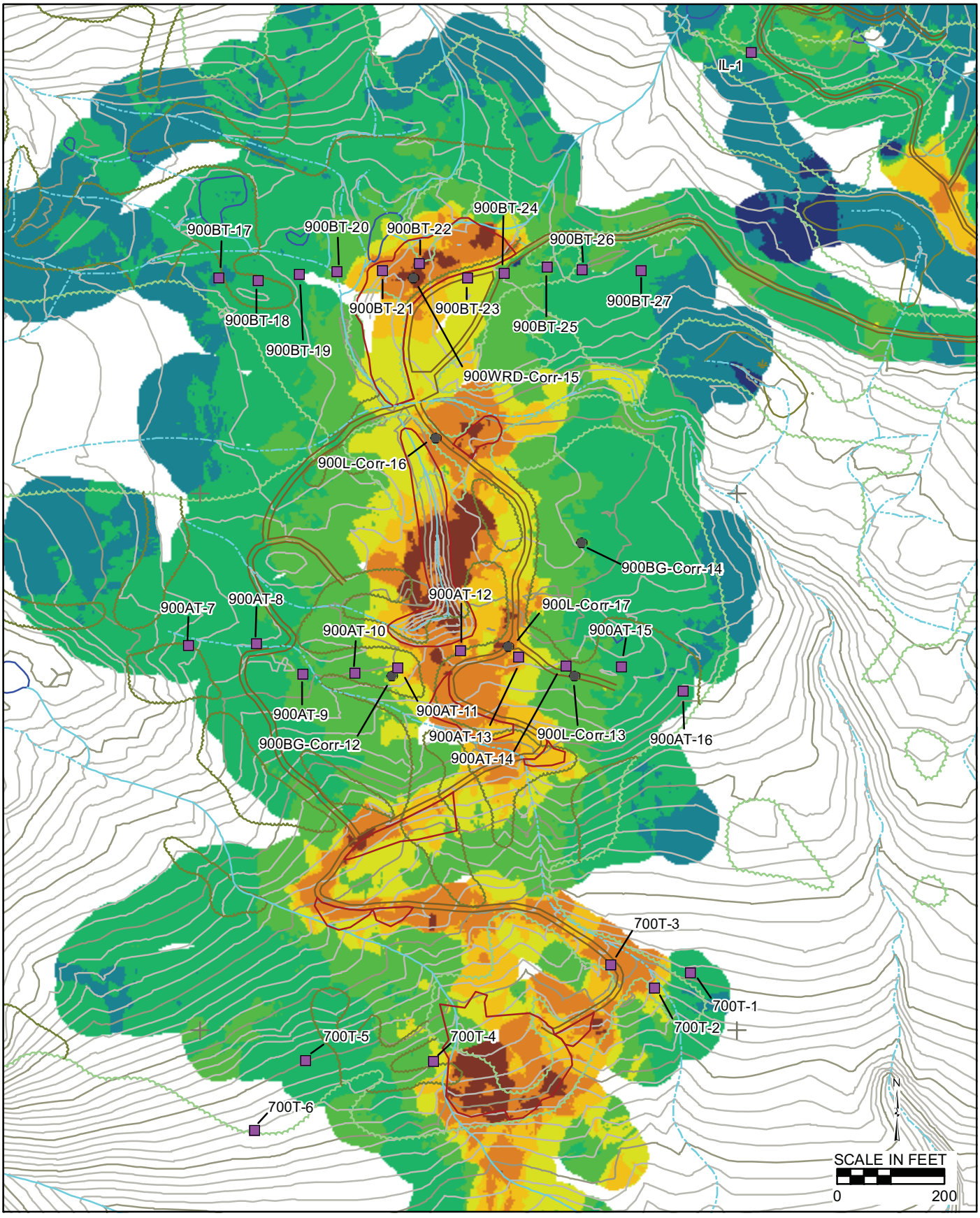
<20	80-160	631-1250
20-40	160-316	>1250
40-80	316-631	

Outside of Limits of Gamma Survey

Gamma/Soil Correlation Plot Sample

Discrete Soil Sample

Figure 6
Ross-Adams Site
Gamma Survey
300 Level Kriged Site Map



FEB 19, 2010 N:\arcprj2\Gamma\181862\mxd\6-3.mxd BY:jesse.carver

April 2015

Gamma Exposure Rate (uR/hr)

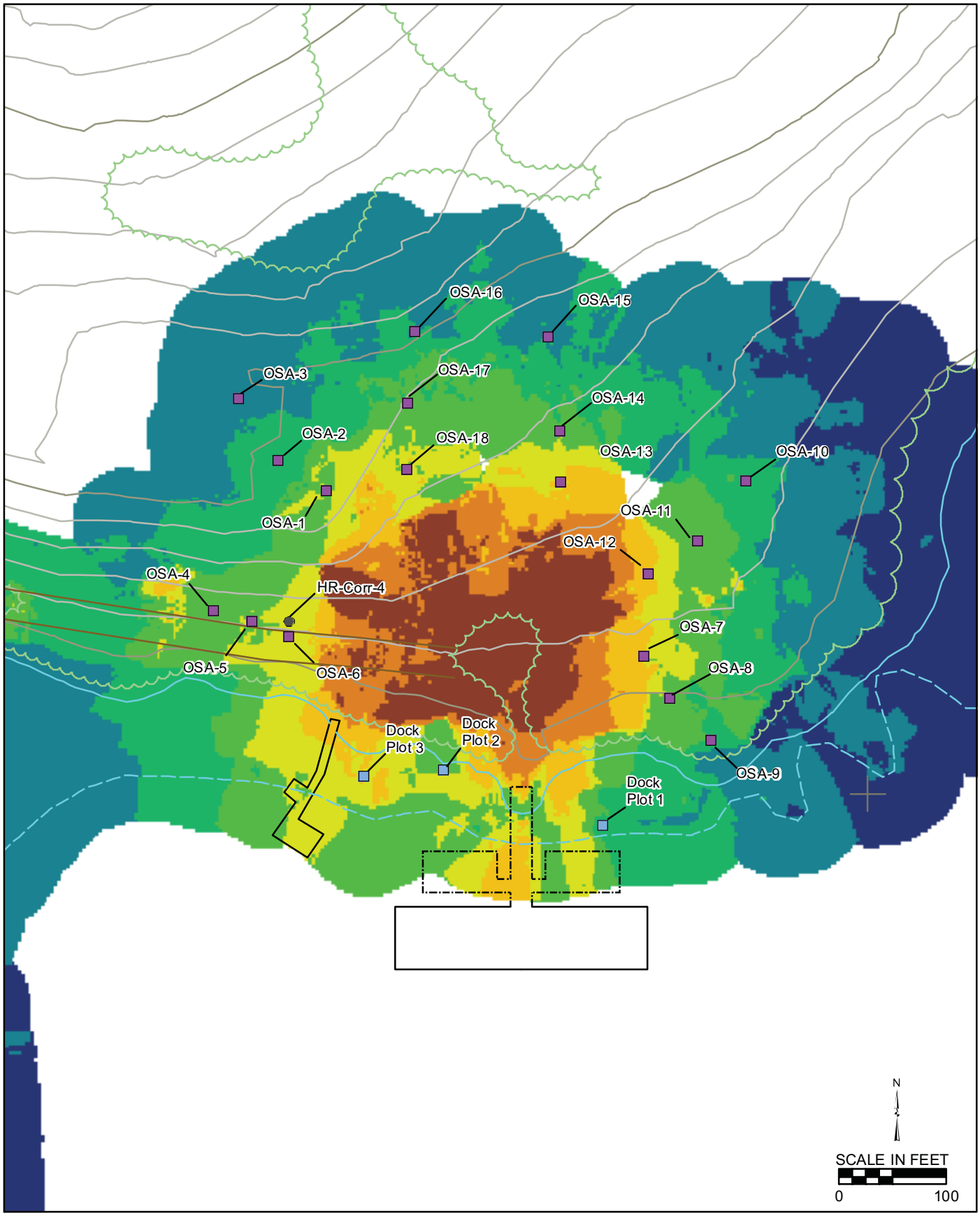
<20	80-160	631-1250
20-40	160-316	>1250
40-80	316-631	

Outside of Limits of Gamma Survey

Gamma/Soil Correlation Plot Sample

Discrete Soil Sample

Figure 7
Ross-Adams Site
Gamma Survey
900/700 Level Kriged Site Map



FEB 19, 2010 N:\arcprj2\Gamma\181862\mxd\6-4.mxd BY:jesse.carver

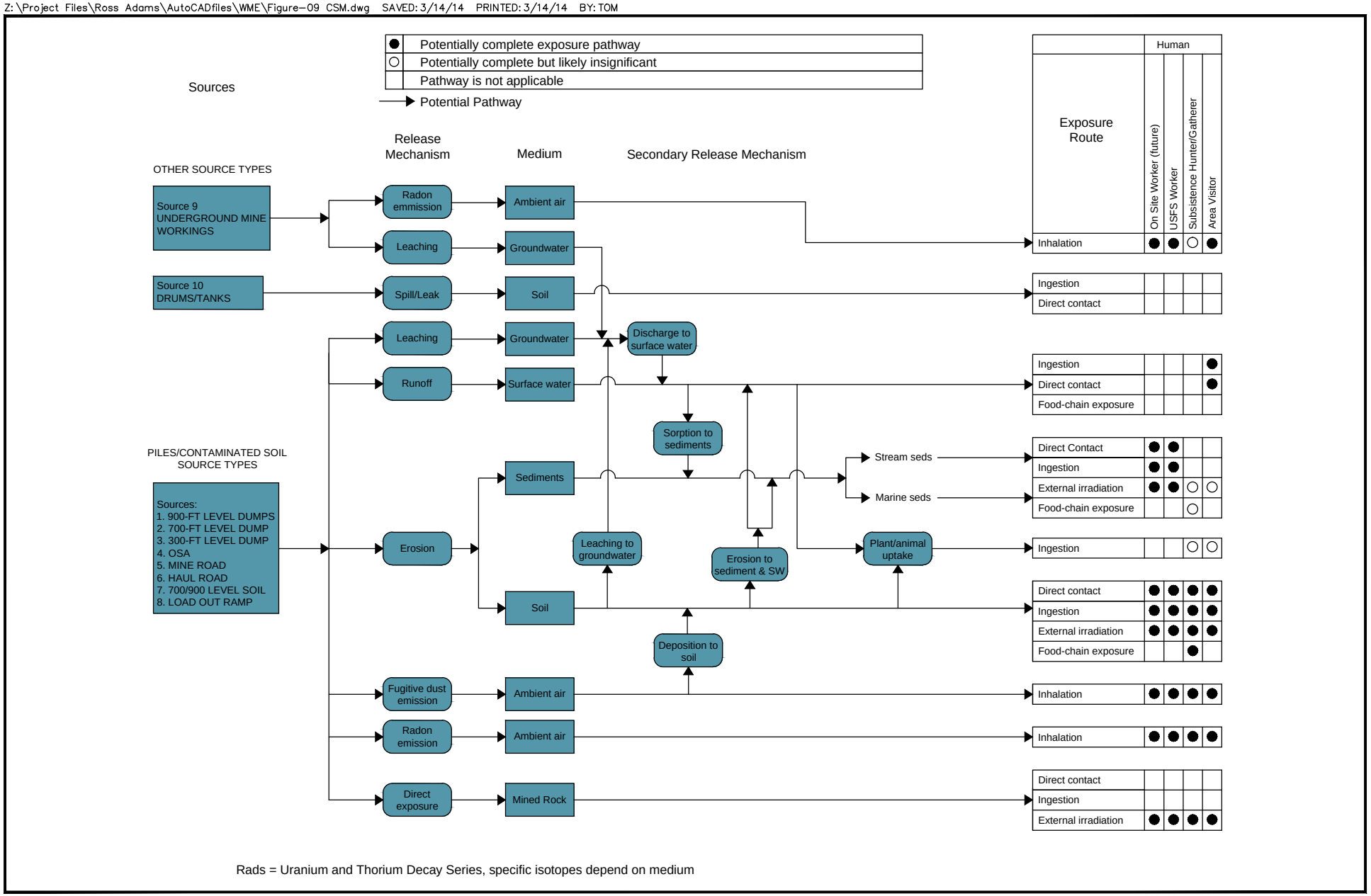
April 2015

Gamma Exposure Rate (uR/hr)

<20	80-160	631-1250
20-40	160-316	>1250
40-80	316-631	

- Outside of Limits of Gamma Survey
- Gamma/Soil Correlation Plot Sample
- Discrete Soil Sample
- Mine Rock Point Count Plot

Figure 8
Ross-Adams Site
OSA Level
Kriged Site Map



Rads = Uranium and Thorium Decay Series, specific isotopes depend on medium

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Figure 9
Revised Conceptual Site Model
Ross-Adams Site

2.0 RISK ASSESSMENT METHODOLOGY

Per ADEC guidance (2010), risk assessments organize and interpret technical information for use by decision makers. Risk assessment is the scientific process of evaluating the toxic properties of compounds and the conditions of human exposure to determine the likelihood that an exposed population will be adversely affected. Following the risk assessment model presented by ADEC (2010) and EPA (1989), a human health risk assessment is composed of the four following components:

- Data evaluation and identification of chemicals of concern (COPCs)
- Exposure assessment
- Toxicity assessment
- Risk characterization

Estimated health risks are calculated based on an estimated dose (either chemical intake or radionuclide/radiation exposure). This estimate integrates the chemical or radionuclide concentration in air, water or soil, or the radionuclide exposure rate, the key exposure parameters (such as food ingestion or air inhalation rates and exposure/residence periods) for likely human receptors, and chemical- and isotope-specific toxicity data. The calculated risks are then summed and evaluated in light of risk criteria provided by ADEC (2008a, 2008b, 2010).

Exposure to chemicals and isotopes can only occur if there is a complete pathway by which humans can be exposed to soil, foods, water, or air impacted by the chemicals or isotopes. Therefore, an evaluation of exposure pathways is the first part of an exposure assessment. Potential doses are then estimated based on an evaluation of likely human routes of exposure to the chemicals. Human health risk is then based on these estimated doses.

In this report, a two-tiered approach was employed for the risk assessment. First, a screening level risk assessment (SLRA), as outlined in Table 1, is performed to provide a conservative estimate of potential risk, based on maximum Site concentration of all detected chemicals and default occupational exposures of up to 250 days per year for 25 years, and to identify the COCPs that are evaluated in more detail in the SSRA. The SSRA quantifies potential exposure under current Site conditions to Site users through subsistence food pathways, and to area visitors or site-specific occupational receptors through direct exposure pathways. The SSRA uses exposure parameters more realistic for these potential Site users and are specific to the subsistence food pathways for this Site.

The components of the risk assessment are discussed below, with information regarding both the SLRA (presented in Section 3.0) and SSRA (presented in Section 4.0).

2.1 Media

At this Site, the environmental media of interest have been defined as soil, air, sediment (freshwater and marine) and surface water. Groundwater is shallow or nonexistent, and unused and therefore not considered an exposure medium. The chemicals of interest at the Site are metals (inorganics) and radionuclides related to the mineral deposit mined at the Ross-Adams mine. Gamma radiation levels are also elevated. Radon gas is present in higher-than-background concentrations due to the uranium resource mineralization and is evaluated as well. No significant quantities of volatile chemicals remain at the Site. (A few diesel fuel organics were

detected at very specific sampling locations and were removed from further consideration through the screening evaluation; see Section 3.3). In the SSRA, subsistence food ingestion was evaluated using concentrations modeled from environmental media to subsistence foods for COPCs selected in the SLRA. In this way, subsistence foods were evaluated as an exposure medium.

As described in the Site Characterization Report (Tetra Tech, 2010a), samples were collected from mine rock and soil, radon in air, surface water, stream sediment, and marine sediment in compliance with the Sampling and Analysis Plan (Tetra Tech, 2009). Comprehensive, high-density gamma radiation surveys were also conducted. Varying numbers of samples were collected and analyzed to support background and Site characterization for mine rock and soil, radon, surface water, stream sediment, marine sediment, and gamma exposure rates at each mine level.

2.1.1 Background Data

Background data were collected in the PA/SI (KSI, 2004) and by Tetra Tech in 2009 (Tetra Tech 2010a) for the media. The following discussion addresses the background data for soil, surface water, stream sediment, and marine sediment and describes the selection of a background threshold value (BTV) used to evaluate Site data relative to background. Background data for radon and gamma exposure rates are discussed in Section 4.8.

Soil samples were collected to characterize background and Site features. Background at the Site is composed of mineralized soil (900- and 700-Foot Levels) and non-mineralized soil (300-Foot Level and Ore Staging Area). A total of up to 23 samples were available for the mineralized soil background data set, and up to five for the non-mineralized soil background. The datasets contained Tetra Tech data collected in 2009 (Tetra Tech, 2010), as well as soil data from the Kent and Sullivan PA/SI (2004). Not all samples were analyzed for a complete suite of metals and radionuclides, so the number of samples varies by analyte. Table 2 summarizes the mineralized soil background data; Table 3 summaries the non-mineralized soil background data. The approximate risk from exposure to these background values, based on comparison to occupational screening levels, is provided as well.

Table 1. Methodology and Exposure Parameters for Screening Levels Used in the Screening Level Risk Assessment[1]

Soil and Sediment: Maximum Detected Concentration of each Metal and Radionuclide	Occupational Screening Levels for Soil and Sediment (ADEC 2011 Method 3 calculator, and EPA 2010) Ingestion: 100 mg/day; 250 days/year (225 days/year for radionuclides); 25 years; 70 kg worker
	Inhalation: 20 m3/day; 250 days/year (225 days/years for radionuclides); 25 year; 70 kg worker
	Dermal Contact/External: 5700 cm2/day; 250 days/year; 25 years; 70 kg worker; radionuclides only: 8 hour workday, area correction factor of 0.9; 225 days/year; radionuclide-specific decay constant
Surface Water: Maximum Detected Concentration of each Metal and Radionuclide	Screening Level for Surface Water (in order of use):
	AWQC Water+ Fish OR
	AWQC Drinking Water OR
	Risk-based Ingestion: 2 L/day, 350 days/year, 30 years, 70 kg person

[1] Sources: ADEC 2008a, 2008b, 2010, 2011; EPA 2010

Table 2a. Mineralized Surface Soil Background Data for Metals Compared to Human Health-Based Benchmarks(1)

Analyte	Frequency of Detection	Minimum Detected Concentration	Maximum Detected Concentration	95UPL of Background samples	AK Occupational SL (2)	Occupational HI	Occupational Risk
Aluminum	23/23	130	15,000	13,720	>1E6	1.4E-02	
Antimony	7/11	0.014	0.087	0.0809	410	2.0E-04	
Arsenic	21/23	0.024	4.9	2.398	16		1.5E-06
Barium	18/23	0.56	14	11.09	204,000	5.4E-05	
Beryllium	14/23	0.022	1.3	1.007	2,000	5.0E-04	
Cadmium	2/23	0.097	0.15	(3)	620	2.4E-04	
Chromium	20/23	0.11	10	9.16	3.10E+03	3.0E-03	
Cobalt	7/23	0.083	6.5	3.031	310	9.8E-03	
Copper	21/23	0.095	6.5	3.574	40,900	8.7E-05	
Iron	23/23	340	46,000	40,400	715,000	5.7E-02	
Lead	23/23	0.79	190	171.2	800	--	
Manganese	23/23	1.8	390	382.5	24,500	1.6E-02	
Mercury	1/10	<0.033	0.066	(3)	310	2.1E-04	
Molybdenum	15/23	0.13	16	7.432	5,100	1.5E-03	
Nickel	19/23	0.072	2.7	1.616	20,400	7.9E-05	
Selenium	16/23	0.035	3.2	1.753	5,100	3.4E-04	
Silver	1/10	0.047	0.047	(3)	5,100	9.2E-06	
Thallium	3/10	0.032	0.075	(3)	82	9.1E-04	
Vanadium	22/23	0.45	26	12.44	7,200	1.7E-03	
Zinc	23/23	1.9	350	308	307,000	1.0E-03	
Uranium	23/23	1.4	140	114.8	3,100	3.7E-02	
Data from KSI 2004 and Tetra Tech 2009 sampling					**TOTAL**	**1.4E-01**	**1.5E-06**

(1) All concentrations are mg/kg.

(2) As calculated by ADEC Method 3 calculator (ADEC, 2011)

(3) Too few detections for calculations; use maximum value

NA = No value available

U = Non-detect; the value shown is the detection limit and 1/2 DL was used for screening.

Table 2b. Mineralized Surface Soil Background Data for Radionuclides Compared to Human Health-based Benchmarks(1)

Analyte	Frequency of Detection	Minimum Detected Concentration	Maximum Background Concentration	95UPL Background	EPA Rad PRG Outdoor Worker (2)	Occupational Risk
Th-232 Decay Chain						
Th-232	23/23	0.63	56	47.12	1.89E+01	2.5E-06
Ra-228	23/23	1.11	57.2	48.96	8.40E+00	5.8E-06
Th-228	23/23	0.81	59	50.08	1.21E+02	4.1E-07
Pb-212	23/23	1.19	57.5	49.3	5.92E+03	8.3E-09
Bi-212	10/23	1.2	63	28.5	3.33E+04	8.6E-10
U-235 Decay Chain						
U-235	3/23	0.08	1	(3)	3.86E-01	2.6E-06
Pa-231	--		--	--	1.25E+00	--
Ac-227	--		--	--	1.14E+01	--
Th-227	--		--	--	1.78E+02	--
U-238 Decay Chain						
U-238	7/7	1.31	9.4	9.4	3.67E+01	2.6E-07
Th-234	13/23	2.7	94	41.4	3.05E+03	1.4E-08
U-234	7/7	1.56	8.6	8.6	3.23E+01	2.7E-07
Th-230	23/23	1.6	83	68.86	2.00E+01	3.4E-06
Ra-226	23/23	2.29	95	78.5	3.64E+00	2.2E-05
Pb-214	23/23	1.78	82	67.56	7.25E+04	9.3E-10
Bi-214	23/23	1.65	73	60.36	1.29E+04	4.7E-09
Pb-210	23/23	1.66	38	32.18	4.18E+00	7.7E-06
Po-210	20/20	0.32	31.2	30.16	2.73E+02	1.1E-07
					Total	**4.5E-05**

(1) All concentrations are pCi/g. Site and background samples are from the PA/SI (KSI 2004) and the SCR (Tetra Tech 2010a)

(2) EPA Radiological PRGs 2010 - Outdoor Worker at 1E-6 risk

(3) Too few detections for calculations; use maximum value

The mineralized soil background data is composed of two samples from the I&L Zone, and up to 21 samples collected from outside the impacted areas of the 900- and 700-Foot Levels for both metals and radionuclides. Of these, only ten samples were analyzed for antimony, mercury, silver, and thallium; 22 were analyzed for manganese; only seven samples were analyzed for U-238 and U-234; and 20 were analyzed for Po-210. The range of detected values reflects the heterogeneous nature of the mountain.

Some of the maximum background concentrations are located in the I&L Zone, far away from the mine levels or roads and unassociated with any mine work. Outlier tests were conducted to identify potential outliers, but all samples were retained because these samples: (1) are representative of native geology; (2) are not part of Site activities (such as mine rock); and (3) have not been impacted by Site activities; they are likely representative of the heterogeneity of the underlying ore. The wide variability observed in the data is consistent with that noted by Eakins (1970), Staaz (1978), and Bureau of Mines (Warner and Barker 1989) in investigations that occurred prior to mining activities (Eakins, 1970) or in areas unrelated to the Ross-Adams mine (Staaz, 1978 and Warner and Barker 1989). Therefore, the highest values were determined not to be outliers, but rather are representative of pre-mining conditions.

Because up to 23 samples were available for the mineralized background data set, a 95th percent upper prediction limit value was calculated for use as the background threshold value. The background threshold value (BTV) was used to evaluate maximum Site concentrations in relation to background. ProUCL software was used to determine potential BTVs for the mineralized area. The non-detect data were included in the analysis, and ProUCL used methods other than substituting ½ the detection limit for non-detect data in determining potential BTV. In most cases, Kaplan-Meier (KM) method was recommended by the software when non-detect results were present. Nonparametric results were used, but the software was directed to determine background statistics assuming normal, lognormal, and gamma distributions as well, for comparative purposes. The nonparametric upper prediction limit (95UPL) was selected as the representative background value. The Upper Prediction Limit (UPL) is defined as the upper boundary of a prediction interval for an independently obtained observation. If the distributions of the Site data and the background data are comparable, then a new (next) observation coming from the site population (e.g., site) should lie at or below the UPL95 with a probability of 0.95 (95 percent). The 95UPL is, in general, the BTV value recommended by ProUCL (EPA, 2007). Table 2 presents the minimum detected, maximum detected, and 95UPL concentration when calculated for the mineralized soil background data set. If an insufficient number of detected results or samples were available to estimate the 95UPL for an analyte, the maximum detected value was used. It should be noted that the maximum concentration of Th-234 of 94 pCi/g is not consistent with the maximum concentrations of U-234 and U-238 of 8.6 and 9.4 pCi/g, respectively. As these radioisotopes occur naturally in equilibrium, the maximum values should be very similar. However, the maximum concentration of Th-234 was detected in a sample not analyzed for U-234 or U-238. It is expected that, had the sample been analyzed for uranium as well, the maximum concentrations of U-234 and U-238 would be close to 90 pCi/g.

The background dataset for the non-mineralized area, which includes the 300-Foot Level, Haul Road, and OSA, consisted of a total of up five samples (three from Tetra Tech sampling efforts and two from Kent and Sullivan, 2004). The samples from the Kent and Sullivan report (2004) did not include results for all metals, and therefore only three samples were available for some analytes. A dataset of five samples or less is too small for reliable calculation of a 95UPL. Therefore, the maximum detected value of each analyte was retained as the background threshold value. The background data summary and comparison to occupational screening values for the non-mineralized soil is presented in Table 3.

Table 3a. Nonmineralized Surface Soil Background Data for Metals Compared to Human Health-Based Benchmarks(1)

Analyte	Frequency of Detection	Minimum Detected Concentration	Maximum Detected Concentration	AK Occupational SL (2)	Occupational HI	Occupational Risk
Aluminum	5/5	6,400	21,000	>1E6	2.1E-02	
Antimony	1/1	0.051	0.051	410	1.2E-04	
Arsenic	3/5	1.9	5.1	16		3.2E-06
Barium	2/3	6.1	8.9	204,000	4.4E-05	
Beryllium	2/3	0.21	0.58	2,000		2.9E-10
Cadmium	0/3	0.49 U	0.5 U	620	4.0E-04	
Chromium	3/3	11	21	3.10E+03	6.8E-03	
Cobalt	3/3	2.8	18	310	5.8E-02	
Copper	3/3	0.34	13	40,900	3.2E-04	
Iron	5/5	10,000	54,000	715,000	7.6E-02	
Lead	5/5	2.7	31	800	--	
Manganese	5/5	130	4,000	24,500	1.6E-01	
Mercury	1/1	0.055	0.055	310	1.8E-04	
Molybdenum	3/3	0.95	9.5	5,100	1.9E-03	
Nickel	3/3	2.5	6.9	20,400	3.4E-04	
Selenium	3/3	0.44	2.7	5,100	5.3E-04	
Silver	0/1	1 U	1 U	5,100	9.7E-05	
Thallium	1/1	0.023	0.023	82	2.8E-04	
Vanadium	3/3	32	92	7,200	1.3E-02	
Zinc	3/3	9.5	24	307,000	7.8E-05	
Uranium	5/5	3	11	3,100	3.5E-03	
Data from KSI 2004 and Tetra Tech 2009 sampling				**Total**	**3.5E-01**	**3.2E-06**

(1) All concentrations are mg/kg.

(2) As calculated by ADEC Method 3 calculator (ADEC, 2011)

NA = No value available

U = Non-detect; the value shown is the detection limit and 1/2 DL was used for screening.

Table 3b. Nonmineralized Surface Soil Background Data for Radionuclides Compared to Human Health-based Benchmarks(1)

Analyte	Frequency of Detection	Minimum Detected Concentration	Maximum Detected Concentration	EPA Rad PRG Outdoor Worker(2)	Occupational Risk
Th-232 Decay Chain					
Th-232	5/5	0.91	1.24	1.89E+01	6.6E-08
Ra-228	4/5	1.13	2.2	8.40E+00	2.6E-07
Th-228	5/5	0.93	1.6	1.21E+02	1.3E-08
Pb-212	2/5	1.05	14.8	5.92E+03	2.5E-09
Bi-212	2/5	12.4	15.1	3.33E+04	4.5E-10
U-235 Decay Chain					
U-235	2/5	0.77	0.33 U	3.86E-01	4.3E-07
Pa-231	--	--	--	1.25E+00	--
Ac-227	--	--	--	1.14E+01	--
Th-227	--	--	--	1.78E+02	--
U-238 Decay Chain					
U-238	3/3	4.46	4.46	3.67E+01	1.2E-07
Th-234	3/5	8.9	8.9	3.05E+03	2.9E-09
U-234	3/3	4.52	4.52	3.23E+01	1.4E-07
Th-230	5/5	1.22	2.56	2.00E+01	1.3E-07
Ra-226	5/5	1.95	7.1	3.64E+00	2.0E-06
Pb-214	5/5	1.57	14	7.25E+04	1.9E-10
Bi-214	5/5	1.42	12.5	1.29E+04	9.7E-10
Pb-210	3/3	0.9	3.69	4.18E+00	8.8E-07
Po-210	3/3	0.6	4.09	2.73E+02	1.5E-08
				Total	**4.0E-06**

(1) All concentrations are pCi/g. Site and background samples are from the PA/SI (KSI 2004) and Tetra Tech 2009

(2) EPA Radiological PRGs 2010 - Outdoor Worker at 1E-6 risk

Background data for surface water is from the Tetra Tech sampling conducted in 2009 (Tetra Tech, 2010a) and surface water data in the PA/SI (KSI, 2004). A range of 7 to 18 samples were available for the metals and 7 to 15 samples for radionuclides (three for gross alpha and gross beta), but as only a few analytes had both sufficient sample size and sufficient number of detected results for statistical calculations, the maximum detected background values were used as the background threshold value. The background surface water data are summarized in Table 4, with the screening levels used in the screening level risk assessment.

Table 4a. Surface Water Background Data for Metals Compared to Human Health-Based Benchmarks(1)

Analyte	Frequency of Detection	Minimum Detected Concentration	Maximum Background Concentration	GWSL (2)	AK WQ Criteria (6)	HI
Aluminum	15/15	52	200	37,000	NA	5.4E-03
Antimony	3/10	0.0082	0.17	15	14	1.2E-02
Arsenic (3)	0/10	<0.5	10 U	0.57	10	5.0E-01
Barium	7/7	1.2	8.7	7,300	2000	4.4E-03
Beryllium	5/10	0.035	0.24	73	4	6.0E-02
Cadmium	13/18	0.005	0.3	37	5	6.0E-02
Chromium (4)	1/10	0.45	0.45	55,000	NA	8.2E-06
Cobalt	5/7	0.035	0.19	11	NA	1.7E-02
Copper	7/15	0.03	3	1,500	NA	2.0E-03
Iron	5/7	12	140	26,000	NA	5.4E-03
Lead	5/13	0.03	0.44	15	NA	2.9E-02
Manganese	7/7	0.78	12	880	50	2.4E-01
Mercury (5)	6/11	0.0004	0.011	11	0.05	2.2E-01
Molybdenum	1/7	0.84	0.84	180	NA	4.7E-03
Nickel	3/10	0.3	0.85	700	610	1.4E-03
Selenium	6/10	0.075	0.17	180	50	3.4E-03
Silver	4/10	0.01	0.01	180	NA	5.6E-05
Thallium	3/10	0.0013	0.0051	3	1.7	3.0E-03
Uranium	15/16	0.014	1.6	110	30	5.3E-02
Vanadium	0/7	10U	10U	256	NA	2.0E-02
Zinc	7/14	3.6	28	11,000	9100	3.1E-03
					Total	**1.2E+00**

(1) All concentrations are ug/L. Site samples are from the PA/SI (KSI 2004) and Tetra Tech 2009 sampling.

(2) Screening Level from ADEC 2009 or EPA 2009 when not available from ADEC; Lead value is MCL

(3)Total Arsenic

(4) Total Chromium

(5) Total Mercury

(6) Alaska Water Quality Criteria, from ADEC 2003; values are for human health water consumption and aquatic organisms when available; otherwise, values are ADEQ drinking water standard (marked with *)

NA = No value available

ND – Non-detect

U = Non-detect; the value shown is the detection limit and 1/2 DL is used for screening.

Table 4b. Surface Water Background Data for Radionuclides Compared to Human Health-Based Benchmarks(1)

Analyte	Frequency of Detection	Minimum Detected Concentration	Maximum Background Concentration	EPA Rad Tap Water PRG (2)	MCL (3)	Risk
Gross Alpha	2/3	0.86	4.2	NA	15	
Gross Beta	1/3	1.74	3.8	NA	15	
Th-232 Decay Chain						
Th-232	3/8	0.013	0.032	0.524	15	6.1E-08
Ra-228	0/14	0.05U	0.23 U	0.0509	5	2.2E-06
Th-228	3/8	0.046	0.15	0.494	15	3.0E-07
U-235 Decay Chain						
U-235	1/8	0.031	0.031	0.76	20	4.1E-08
U-238 Decay Chain						
U-238	4/7	0.043	0.165	0.827	20	2.0E-07
U-234	5/8	0.075	0.193	0.748	20	2.6E-07
Th-230	1/8	0.159	0.159	0.581	15	2.7E-07
Ra-226	2/15	0.72	0.88	9.14E-04	5	9.6E-04
Pb-210	2/12	0.68	0.87	0.0601	5	1.4E-05
Po-210	0/8	0.09U	0.13 U	0.14	5	4.6E-07
					Total	9.8E-04

(1) All concentrations are pCi/L. Site samples are from the PA/SI (KSI, 2004) and Tetra Tech 2009 sampling.
(2) EPA PRGs for Radionuclides, risks set to 1E-6
(3) ADEC Standard for Ra-226 and Ra-228 is 5 pCi/L total; MCL for all Uranium isotopes is a proposed value

The stream sediment background dataset is composed of samples from Kent and Sullivan (2004) and Tetra Tech (2010a). Up to six samples were identified as background samples, although these samples were not analyzed for all metals and radionuclides. Therefore, the number of results for each analyte varied from two to six. There were not enough results to reliably estimate a 95UPL; therefore, the maximum detected value was selected as representative of background. Stream sediment background data are summarized in Table 5.

Table 5a. Stream Sediment Background Data for Metals Compared to Human Health-based Benchmarks(1)

Analyte	Frequency of Detection	Minimum Detected Concentration	Maximum Detected Concentration	AK Occupational SL (2)	Occupational HI	Occupationa Risk
Aluminum	5/5	680	13,000	>1E6	1.3E-02	
Antimony	2/2	0.22	0.043	410	1.0E-04	
Arsenic	6/6	0.68	10	16		6.3E-07
Barium	1/2	16	16	204,000	7.8E-05	
Beryllium (3)	2/2	0.57	2.7	2,000	1.4E-03	
Cadmium	1/2	0.12	0.12	620	1.9E-04	
Chromium	2/2	0.19	13	3.10E+03	4.2E-03	
Cobalt	2/2	0.25	6.7	310	2.2E-02	
Copper	1/2	5.6	5.6	40,900	1.4E-04	
Iron	5/5	3,800	31,000	715,000	4.3E-02	
Lead	6/6	5.2	22	800	2.8E-02	
Manganese	5/5	39	1,500	24,500	6.1E-02	
Mercury	1/2	0.0088	0.0088	310	2.8E-05	
Molybdenum	1/2	1.2	1.2	5,100	2.4E-04	
Nickel	1/2	7	7	20,400	3.4E-04	
Selenium	0/3	0.098U	0.49 (u)	5,100	4.8E-05	
Silver	1/2	0.05	0.05	5,100	9.8E-06	
Thallium	2/2	0.042	0.061	82	7.4E-04	
Vanadium	2/2	1.7	28	7,200	3.9E-03	
Zinc	2/2	13	64	307,000	2.1E-04	
Uranium	6/6	2.1	4.1	3,100	1.3E-03	
				Total	**1.8E-01**	**6.3E-07**

(1) All concentrations are mg/kg dry weight. Site samples are from the PA/SI (KSI, 2004) and the SCR (Tetra Tech, 2010a).

(2) EPA 2009 Human Health Based Screening Level (occupational exposure) at risk = 1E-5 and HI = 1.0.

(3) Revised for direct contact pathways only; inhalation of sediments is not a complete exposure pathway.

Table 5b. Stream Sediment Background Data for Radionuclides Compared to Human Health-Based Benchmarks(1)

Analyte	Frequency of Detection	Minimum Detected Concentration	Maximum Detected Concentration	EPA Rad PRG Outdoor Worker (2)	Risk-Outdoor
Th-232 Decay Chain					
Th-232	6/6	0.75	2.45	1.89E+01	1.3E-07
Ra-228	6/6	0.76	2.27	8.40E+00	2.7E-07
Th-228	6/6	0.68	2.41	1.21E+02	2.0E-08
Pb-212	--		--	5.92E+03	--
Bi-212	--		--	3.33E+04	--
U-235 Decay Chain					
U-235	2/6	0.042	0.07	4.17E-01	1.7E-07
Th-227	--		--	1.78E+02	5.3E-08
U-238 Decay Chain					
U-238	5/5	0.86	2.46	3.67E+01	6.7E-08
Th-234	1/6	2.25	2.25	3.05E+03	7.4E-10
U-234	5/5	1.16	2.72	3.23E+01	8.4E-08
Th-230	6/6	1.53	4.63	2.00E+01	2.3E-07
Ra-226	6/6	0.67	4.9	3.64E+00	1.3E-06
Pb-214	--	--	--	7.25E+04	--
Bi-214	--	--	--	1.29E+04	--
Pb-210	3/3	2.23	3.19	4.18E+00	7.6E-07
Po-210	3/3	1.99	2.83	2.73E+02	1.0E-08
Tl-208	--	--	--	3.73E+04	--
				Total	**3.1E-06**

(1) All Concentrations are in pCi/g. Site and background samples are from the PA/SI (KSI, 2004) and TetraTech 2009 sampling.

(2) EPA Radiological PRGs 2007a Outdoor Worker assumptions, risk = 1.0E-6

Marine sediment background data consisted of samples collected by Tetra Tech in 2009 and Kent and Sullivan (2004). The samples were collected from the intertidal and subtidal areas of the shoreline at Ross-Adams Site. A total of up to 29 samples were identified for the background data set, and it was possible to calculate a 95UPL value for most analytes, as shown in Table 6. As with the mineralized soil background, ProUCL software was used to determine potential BTVs for the mineralized area. The non-detect data were included in the analysis, and ProUCL used methods other than substituting ½ the detection limit for non-detect data in determining potential BTV. In most cases, the Kaplan-Meier (KM) method was recommended by the software when non-detect results were present. Nonparametric results were used, but the software was directed to determine background statistics assuming normal, lognormal, and gamma distributions as well, for comparative purposes. The nonparametric upper prediction limit (95UPL) was selected as the representative background value. The 95UPL is, in general, the BTV value recommended by ProUCL (EPA, 2007). If the 95UPL could not be calculated for analyte due to insufficient number of samples or insufficient number of detected results, the maximum value was used as the BTV.

Table 6a. Marine Sediment Background Data for Metals Compared to Human Health-based Benchmarks(1)

Analyte	Frequency of Detection	Minimum Detected Concentration	Maximum Background (Sub- and Intertidal)	95UPL Background (Sub and Intertidal)	AK Occupational SL (2)	Occupational HI	Occupational Risk
Aluminum	29/29	5,700	11,000	11,000	>1E6	1.1E-02	
Antimony	10/10	0.022	0.24	0.24	410	5.9E-04	
Arsenic	29/29	1.4	22	22	16		1.4E-05
Barium	27/27	12	56	54.4	204,000	2.7E-04	
Beryllium (3)	26/27	0.28	1.2	0.983	2,000	4.9E-04	
Cadmium	22/27	0.097	5.4	4.568	620	7.4E-03	
Chromium	27/27	8.5	29	29	3.10E+03	9.4E-03	
Cobalt	27/27	2.5	6.4	6.24	310	2.0E-02	
Copper	27/27	1.5	30	29.6	40,900	7.2E-04	
Iron	29/29	11,000	25,000	22,500	715,000	3.1E-02	
Lead	29/29	1.3	36	28.85	800	--	
Manganese	29/29	140	860	770	24,500	3.1E-02	
Mercury	4/10	0.058	0.06	0.0601	310	1.9E-04	
Molybdenum	26/27	0.21	10	11.47	5,100	2.2E-03	
Nickel	27/27	6.6	21	21	20,400	1.0E-03	
Selenium	24/27	0.035	3.2	2.759	5,100	5.4E-04	
Silver	1/10	0.055	0.055	(4)	5,100	1.1E-05	
Thallium	10/10	0.026	0.2	0.2	82	2.4E-03	
Vanadium	27/27	20	43	43	7,200	6.0E-03	
Zinc	27/27	30	110	110	307,000	3.6E-04	
Uranium	29/29	0.7	19	18	3,100	5.8E-03	
					Total	**1.3E-01**	**1.4E-05**

(1) All concentrations are mg/kg. Site and background samples are from the PA/SI (KSI, 2004) and Tetra Tech 2009 sampling.

(2) EPA 2009 Human Health Based Screening Level (occupational exposure) at risk = 1E-5 and HI = 1.0.

(3) Revised for direct contact pathways excluding inhalation; inhalation is not a complete exposure pathway for marine sediment.

Table 6b. Marine Sediment Background Data for Radionuclides Compared to Human Health-Based Benchmarks(1)

Analyte	Frequency of Detection	Minimum Detected Concentration	Maximum Background (Sub-and Intertidal)	95UPL Background (Sub and Intertidal)	EPA Rad PRG Outdoor Worker(2)	Outdoor Worker Risk
Th-232 Decay Chain						
Th-232	29/29	0.05	5.15	5.105	1.89E+01	2.7E-07
Ra-228	28/29	0.66	3.96	3.534	8.40E+00	4.2E-07
Th-228	29/29	0.49	5.18	4.535	1.21E+02	3.7E-08
Pb-212	29/29	0.41	5.1	4.68	5.92E+03	7.9E-10
Bi-212	13/29	0.5	5.4	4.307	3.33E+04	1.3E-10
U-235 Decay Chain						
U-235	21/29	-0.63	0.44	0.302	4.17E-01	7.2E-07
Th-227	--		--	--	1.78E+02	--
U-238 Decay Chain						
U-238	12/12	0.65	7.8	7.8	3.67E+01	2.1E-07
Th-234	11/19	2.6	9.5	7.064	3.05E+03	2.3E-09
U-234	12/12	0.66	7.9	7.9	3.23E+01	2.4E-07
Th-230	29/29	0.75	9.3	8.85	2.00E+01	4.4E-07
Ra-226	29/29	0.72	7.32	6.225	3.64E+00	1.7E-06
Pb-214	29/29	0.67	6.43	5.425	7.25E+04	7.5E-11
Bi-214	29/29	0.4	5.18	4.49	1.29E+04	3.5E-10
Pb-210	28/28	1.32	9.3	8.535	4.18E+00	2.0E-06
Po-210	27/27	1.31	13	12.4	2.73E+02	4.5E-08
Tl-208	26/27	1.37	1.57	1.348	3.73E+04	3.6E-11
					Total	**6.2E-06**

(1) All Concentrations are in pCi/g. Site and background samples are from the PA/SI (KSI, 2004) and Tetra Tech 2009 sampling.

(2) EPA Radiological PRGs 2007a Outdoor Worker assumptions, risk set to 1.0E-6.

2.1.2 Site Data

This subsection describes the Site data relied upon for the screening level and site-specific risk assessments. Soil results are discussed by mine level, although in the site-specific risk assessment, the soil data are aggregated (see Section 4.3). Surface water, stream sediment, and marine sediment, are discussed as well. For all data, detection limits were compared to the appropriate health-based screening values to ensure that detection limits were low enough. In all cases, the detection limits were acceptable.

Site data for the mineralized areas included samples from Tetra Tech sampling efforts and the PA/SI (KSI, 2004). The 900-Foot Level soil data are presented in Table 7 for metals and radionuclides. Between five and ten results were available for the analytes. At the 700-Foot Level, up to four sample results were available for the SLRA (Table 8). For the Mine Road and I&L Spur Road, one sample from the Mine Road, and two samples from the I&L spur, comprise the data set as shown in Table 9.

Table 7a. Soil Data Summary - 900-Foot Level Mine

Chemical	Frequency of Detection	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Arithmetic Mean Concentration (mg/kg)
Aluminum	10/10	830	5,000	2283
Antimony	5/5	0.06	0.49	0.16
Arsenic	10/10	0.43	11	3.67
Barium	8/9	3.7	190	75.1
Beryllium	9/9	0.14	1.2	0.76
Cadmium	1/9	<0.49	1.8	0.42
Chromium	8/9	0.17	0.6	0.40
Cobalt	7/9	0.1	0.63	0.40
Copper	8/9	1.9	11	5.63
Iron	10/10	4,900	27,000	12840
Lead	10/10	11	120	67.9
Manganese	10/10	46	770	424.7
Mercury	1/5	0.039	0.039	0.02
Molybdenum	9/9	0.64	7.9	2.47
Nickel	9/9	0.087	0.39	0.22
Selenium	6/9	0.025	0.99	0.30
Silver	0/5	<0.98	<9.9	1.39
Thallium	4/5	0.042	0.17	0.17
Uranium	10/10	11	1,000	487.8
Vanadium	9/9	0.26	6.2	3.42
Zinc	9/9	31	2,700	383.44

Table 7b. Soil Data Summary - 900-Foot Level Mine

Radionuclide	Frequency of Detection	Minimum Detected Concentration (pCi/g)	Maximum Detected Concentration (pCi/g)	Arithmetic Mean Concentration (pCi/g)
Th-232 Decay Chain				
Th-232	10/10	6.7	307	135.72
Ra-228	10/10	6.2	272	123.85
Th-228	10/10	7	359	148.22
Pb-212	10/10	6.28	277	130.68
Bi-212	10/10	7.3	298	140.59
U-235 Decay Chain				
U-235	8/10	0.33	19.5	8.84
Pa-231	--	--	--	--
Ac-227	--	--	--	--
Th-227	--	--	--	--
U-238 Decay Chain				
U-238	5/5	4.83	317	178.47
Th-234	10/10	11.6	420	192.99
U-234	5/5	4.35	298	164.87
Th-230	10/10	5.6	680	299.41
Ra-226	10/10	5.3	631	282.58
Pb-214	10/10	7.24	561	236.57
Bi-214	9/9	8.1	479	238.76
Pb-210	9/9	8.7	510	213.27
Po-210	8/8	6	527	200.59

Table 8a. Soil Data Summary - 700-Foot Level Mine

Chemical	Frequency of Detection	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Arithmetic Mean Concentration (mg/kg)
Aluminum	4/4	1,900	9,700	4325
Antimony	1/1	0.031	0.031	0.031
Arsenic	4/4	1.8	16	5.75
Barium	3/3	10	42	27
Beryllium	2/3	0.6	1.2	0.68
Cadmium	0/3	<0.48	<0.49	<0.049
Chromium	3/3	1.4	7.2	3.73
Cobalt	3/3	0.69	1.8	1.23
Copper	3/3	2.5	4.7	3.63
Iron	4/4	7,300	26,000	13825
Lead	4/4	32	290	105
Manganese	4/4	93	740	415.75
Mercury	0/1	<0.033	<0.033	<0.033
Molybdenum	3/3	1.5	4.6	3.47
Nickel	3/3	0.73	1.8	1.09
Selenium	2/3	0.25	0.32	0.27
Silver	0/1	<0.96	<0.96	<0.96
Thallium	1/1	0.038	0.038	0.038
Uranium	4/4	140	1,900	617.5
Vanadium	3/3	5.2	10	6.87
Zinc	3/3	19	130	76.33

Table 8b. Soil Data Summary - 700-Foot Level Mine

Radionuclide	Frequency of Detection	Minimum Detected Concentration (pCi/g)	Maximum Detected Concentration (pCi/g)	Arithmetic Mean Concentration (pCi/g)
Th-232 Decay Chain				
Th-232	4/4	26.7	123	65.95
Ra-228	4/4	22.1	71.2	54.4
Th-228	4/4	24.4	81	53.85
Pb-212	4/4	23.2	78.3	59.1
Bi-212	4/4	27.7	68	57.43
U-235 Decay Chain				
U-235	3/4	6	19.7	8.19
Pa-231	--	--	--	--
Ac-227	--	--	--	--
Th-227	--	--	--	--
U-238 Decay Chain				
U-238	2/2	30.4	278	154.2
Th-234	4/4	43.5	309	149.88
U-234	2/2	28.7	295	161.85
Th-230	4/4	36.7	221	115.43
Ra-226	4/4	31.6	139	108.15
Pb-214	4/4	25.1	118	89.28
Bi-214	4/4	24.2	105	80.05
Pb-210	4/4	6.6	147	74.15
Po-210	3/3	23.7	121	69.63

Table 9a. Soil Data Summary - Mine Road / I&L Spur

Chemical	Frequency of Detection	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Arithmetic Mean Concentration (mg/kg)
Aluminum	3/3	2,100	5,600	3533.33
Antimony	1/2	0.35	<1	0.68
Arsenic	3/3	1.1	8.1	3.9
Barium	2/2	3.9	130	66.95
Beryllium	2/2	0.48	0.84	0.66
Cadmium	1/2	0.12	<0.49	0.18
Chromium	2/2	1	1.7	1.35
Cobalt	2/2	0.29	0.58	0.44
Copper	2/2	1.8	5.8	3.8
Iron	3/3	5,800	36,000	20266.7
Lead	3/3	31	110	80.33
Manganese	3/3	32	580	384
Mercury	0/2	<0.033	<0.033	<0.033
Molybdenum	2/2	1.8	6.4	4.1
Nickel	2/2	0.39	0.53	0.46
Selenium	0/2	<0.49	<0.5	<0.5
Silver	0/2	<0.98	<0.99	<0.99
Thallium	0/2	<0.98	<0.99	<0.99
Uranium	3/3	27	730	392.33
Vanadium	2/2	4.3	6.2	5.25
Zinc	2/2	18	160	89

Table 9b. Soil Data Summary - Mine Road / I&L Spur

Radionuclide	Frequency of Detection	Minimum Detected Concentration (pCi/g)	Maximum Detected Concentration (pCi/g)	Arithmetic Mean Concentration (pCi/g)
Th-232 Decay Chain				
Th-232	3/3	13.5	187	106.83
Ra-228	3/3	8.1	122	80.03
Th-228	3/3	11.1	180	100.7
Pb-212	3/3	8	125	82.33
Bi-212	3/3	8.1	127	84.37
U-235 Decay Chain				
U-235	3/3	0.7	9.8	5.8
Pa-231	--	--	--	--
Ac-227	--	--	--	--
Th-227	--	--	--	--
U-238 Decay Chain				
U-238	1/1	176	176	--
Th-234	3/3	13.1	198	106.03
U-234	1/1	164	164	164
Th-230	3/3	21.2	346	202.4
Ra-226	3/3	15.6	245	160.53
Pb-214	3/3	12.4	209	129.13
Bi-214	3/3	11.8	192	118.6
Pb-210	2/2	10.4	150	80.2
Po-210	--	--	--	--

Site data for the non-mineralized areas are presented in Table 10 for the 300-Foot Level mine, Table 11 for the Haul Road, and Table 12 for the Ore Staging Area/Shoreline. The data for the 300-level mine are from Tetra Tech sampling efforts as no soil samples were reported in the PA/SI for the 300-Foot Level mine (KSI, 2004); up to 18 samples were available for this mine level. The results show one to almost two orders of magnitude variation from the minimum to maximum concentrations for each analyte, reflecting the heterogeneous nature of the Site. The data for the Haul Road is solely from Tetra Tech sampling as well; no soil samples were reported for the Haul Road area in the PA/SI. The variability of data is lower than that of the 300-Foot Level mine data, but still reflects the heterogeneity of the mountain. The Ore Staging Area/Shoreline data are presented in Table 12; up to 14 samples from the Tetra Tech sampling and the PA/SI report were identified as Site data for the Ore Staging Area.

Table 10a. Soil Data Summary - 300-Foot Level Mine

Chemical	Frequency of Detection	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Arithmetic Mean Concentration (mg/kg)
Aluminum	18/18	690	57,000	9762.8
Antimony	4/4	0.15	0.79	0.36
Arsenic	18/18	0.21	33	4.52
Barium	17/18	17	120	51.61
Beryllium	17/18	0.46	13	2.41
Cadmium	17/18	0.1	9.5	0.97
Chromium	18/18	0.73	62	14.97
Cobalt	18/18	0.28	54	10.01
Copper	18/18	3.2	65	17.94
Iron	18/18	5100	36,000	17950
Lead	18/18	12	180	70.78
Manganese	14/14	130	6,700	1255
Mercury	3/4	0.033	0.15	0.07
Molybdenum	18/18	1.9	18	7.05
Nickel	18/18	0.34	130	18.1
Selenium	12/18	0.024	3.5	0.92
Silver	0/3	<0.98	<0.99	<0.99
Thallium	3/4	0.029	0.39	0.69
Uranium	18/18	3.1	1,900	276.56
Vanadium	18/18	1.3	50	18.71
Zinc	18/18	15	1,800	218.11

Table 10b. Soil Data Summary - 300-Foot Level Mine

Radionuclide	Frequency of Detection	Minimum Detected Concentration (pCi/kg)	Maximum Detected Concentration (pCi/g)	Arithmetic Mean Concentration (pCi/g)
Th-232 Decay Chain				
Th-232	18/18	1.2	136	54.93
Ra-228	18/18	1.72	178	50.58
Th-228	18/18	1.46	143	60.94
Pb-212	18/18	1.99	190	54.92
Bi-212	17/18	4.6	206	57.94
U-235 Decay Chain				
U-235	6/18	2.1	50	5.53
Pa-231	--	--	--	--
Ac-227	--	--	--	--
Th-227	--	--	--	--
U-238 Decay Chain				
U-238	3/3	2.23	700	362.41
Th-234	18/18	4.1	1,030	142.77
U-234	3/3	2.13	730	386.71
Th-230	18/18	2.04	222	67.72
Ra-226	18/18	3.72	447	100.04
Pb-214	18/18	3.06	356	81.95
Bi-214	18/18	2.64	337	73.92
Pb-210	18/18	2.74	138	47.75
Po-210	17/17	2.29	187	62.23

Table 11a. Soil Data Summary - Haul Road

Chemical	Frequency of Detection	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Arithmetic Mean Concentration (mg/kg)
Aluminum	8/8	3,300	15,000	8514
Antimony	8/8	0.26	0.76	0.48
Arsenic	8/8	0.22	1.3	0.87
Barium	7/8	15	39	27.57
Beryllium	5/8	0.24	1	0.6
Cadmium	4/8	0.067	0.18	0.27
Chromium	8/8	2.8	28	12.09
Cobalt	8/8	1.2	13	5.11
Copper	8/8	4.1	15	8.53
Iron	8/8	11,000	30,000	18142.9
Lead	8/8	4.4	50	20.49
Manganese	8/8	180	770	370
Mercury	0/8	<0.033	<0.033	<0.033
Molybdenum	8/8	0.36	2.2	0.97
Nickel	8/8	1.5	13	5.97
Selenium	1/8	0.43	0.43	0.63
Silver	0/8	<0.99	<1.0	--
Thallium	0/8	<0.99	<2	--
Uranium	8/8	6	160	54.33
Vanadium	8/8	6.1	52	25.16
Zinc	8/8	24	74	47.86

Table 11b. Soil Data Summary - Haul Road

Radionuclide	Frequency of Detection	Minimum Detect (pCi/g)	Maximum Detect (pCi/g)	Arithmetic Mean Concentration (pCi/g)
Th-232 Decay Chain				
Th-232	8/8	2.4	30.9	12.79
Ra-228	8/8	0.9	44.8	14.09
Th-228	8/8	2.77	28.7	12.33
Pb-212	8/8	1.46	45	15.02
Bi-212	8/8	0.5	49	15.13
U-235 Decay Chain				
U-235	8/8	-0.58	4.4	1.14
Pa-231	--	--	--	--
Ac-227	--	--	--	--
Th-227	--	--	--	--
U-238 Decay Chain				
U-238	--	--	--	--
Th-234	8/8	1.3	64.6	24.59
U-234	--	--	--	--
Th-230	8/8	3.21	80	23.34
Ra-226	8/8	1.88	97	28.69
Pb-214	8/8	1.8	83.7	24.12
Bi-214	8/8	1.25	74.9	21.86
Pb-210	8/8	2.41	63	19.4
Po-210	--	--	--	--

Table 12a. Soil Data Summary - Ore Staging Area / Shoreline

Chemical	Frequency of Detection	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Arithmetic Mean Concentration (mg/kg)
Aluminum	12/12	3,000	28,000	9875
Antimony	4/4	0.021	0.37	0.12
Arsenic	11/14	0.22	6.8	2.09
Barium	7/8	13	39	22.35
Beryllium	5/8	0.25	0.85	0.46
Cadmium	3/8	0.078	0.088	0.18
Chromium	8/8	3	18	11.84
Cobalt	8/8	1.9	7.2	4.18
Copper	8/8	6.5	36	13.5
Iron	12/12	6,900	46,000	21658
Lead	14/14	2.9	87	23.81
Manganese	12/12	150	680	339.17
Mercury	2/4	0.057	0.06	0.04
Molybdenum	7/8	0.46	1.3	0.84
Nickel	8/8	2.1	10	6.59
Selenium	7/10	0.19	1.1	0.45
Silver	0/4	<0.96	<1.0	<1.0
Thallium	3/4	0.024	0.027	0.14
Uranium	14/14	20	2,600	350.14
Vanadium	8/8	15	52	28.63
Zinc	8/8	15	61	38.25

Table 12b. Soil Data Summary - Ore Staging Area / Shoreline

Radionuclide	Frequency of Detection	Minimum Detect (pCi/g)	Maximum Detect (pCi/g)	Arithmetic Mean Concentration (pCi/g)
Th-232 Decay Chain				
Th-232	14/14	2.16	84	31.5
Ra-228	13/14	0.75	82	31.93
Th-228	14/14	2.49	100	34.01
Pb-212	14/14	2.2	94	35.73
Bi-212	12/14	0.35	82	34.4
U-235 Decay Chain				
U-235	9/14	0.77	41	5.94
Pa-231	--	--	--	--
Ac-227	--	--	--	--
Th-227	--	--	--	--
U-238 Decay Chain				
U-238	7/7	9.5	557	102.79
Th-234	13/14	0.5	527	101.73
U-234	7/7	9.1	562	103.74
Th-230	14/14	3.82	223	60.28
Ra-226	14/14	2.96	148	51.78
Pb-214	14/14	2.11	159	50.62
Bi-214	14/14	2.9	138	44.86
Pb-210	10/10	6.9	163	49.91
Po-210	9/9	6.7	179	55.57

The surface water data are presented in Table 13. Forty-one sampling results are available for Ra-228 and Ra-226, 39 for Pb-210, 36 for cadmium, copper, uranium, and zinc, and 35 for aluminum. Most other metals had 15 sampling results and most other radionuclides had 16 or 18 results. These results are from surface water bodies at all areas of the Site and do not characterize only one area.

Table 13a. Surface Water Site Data

Chemical	Frequency of Detection	Minimum Detect (ug/L)	Maximum Detect (ug/L)	Arithmetic Mean Concentration (ug/L)
Aluminum	33/35	42	290	121.8
Antimony	3/15	0.012	0.012	0.07
Arsenic	0/15	<10	<10	<10
Barium	15/15	0.61	28.0	12.4
Beryllium	14/15	0.021	0.30	0.18
Cadmium	36/36	0.006	0.31	0.06
Chromium	1/15	0.35	0.35	2.34
Cobalt	10/15	0.02	0.13	0.77
Copper	17/36	0.1	0.88	0.93
Iron	13/15	6.7	630	87.93
Lead	15/15	0.053	0.67	0.20
Manganese	15/15	0.41	100	15.12
Mercury	13/23	0.0008	0.0052	0.029
Molybdenum	2/15	4.4	6.2	5.04
Nickel	4/15	0.3	0.85	1.23
Selenium	12/15	0.072	0.14	0.46
Silver	2/15	0.025	0.03	0.021
Thallium	10/15	0.0014	0.014	0.029
Uranium	36/36	0.12	240	19.4
Vanadium	0/15	<10	<10	<10
Zinc	34/36	2.8	49	11.77

Table 13b. Surface Water Site Data

Radionuclide	Frequency of Detection	Minimum Detect (pCi/L)	Maximum Detect (pCi/L)	Arithmetic Mean Concentration (pCi/L)
Th-232	12/18	0.02	0.284	0.07
Ra-228	9/41	1.28	7.2	0.88
Th-228	10/18	0.111	1.04	0.22
Pb-212	NA	--	--	--
Bi-212	NA	--	--	--
U-235	5/16	-0.002	3.42	0.51
Pa-231	NA	--	--	--
Ac-227	NA	--	--	--
Th-227	NA	--	--	--
U-238	16/16	0.081	79	10.61
Th-234	NA	--	--	--
U-234	16/16	0.114	96	12.77
Th-230	9/18	0.132	0.95	0.2
Ra-226	18/41	0.2	7.8	0.77
Pb-214	NA	--	--	--
Bi-214	NA	--	--	--
Pb-210	6/39	0.64	5.4	0.36
Po-210	5/25	0.3	1.31	0.17

NA = Not Analyzed

Stream sediment data had between 5 and 15 results per analyte, as shown in Table 14. Data were from Tetra Tech sampling (Tetra Tech, 2010a) and the PA/SI (KSI, 2004). Again, the stream sediment samples were from various surface water locations and represent a range of concentrations associated with potentially impacted streams at the Site.

Table 14a. Stream Sediment Site Data

Analyte	Frequency of Detection	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Arithmetic Mean Concentration (mg/kg)
Aluminum	15/15	1,100	12,000	6,906.7
Antimony	5/15	0.06	0.23	0.13
Arsenic	15/15	0.79	6.3	3.11
Barium	9/9	6.8	72	48.2
Beryllium	9/9	0.49	1.8	0.95
Cadmium	8/9	0.12	0.82	0.38
Chromium	9/9	1	26	15.11
Cobalt	9/9	0.33	9.7	5.07
Copper	8/9	3.6	25	8.74
Iron	15/15	3,000	83,000	22,733.3
Lead	15/15	5.7	64	20.37
Manganese	15/15	150	2600	800
Mercury	0/5	< 0.033	< 0.033	<0.033
Molybdenum	9/9	0.52	11	4.36
Nickel	9/9	0.29	31	16.1
Selenium	7/9	0.064	4	1.22
Silver	5/5	0.086	0.22	0.14
Thallium	5/5	0.066	0.2	0.10
Uranium	15/15	2	270	40.6
Vanadium	9/9	1.8	53	29.5
Zinc	9/9	22	230	127.3

Table 14b. Stream Sediment Site Data

Analyte	Frequency of Detection	Minimum Detected Concentration (pCi/g)	Maximum Detected Concentration (pCi/g)	Arithmetic Mean Concentration (pCi/g)
Th-232 Decay Chain				
Th-232	15/15	0.59	33.2	6.17
Ra-228	15/15	0.89	47.6	7.78
Th-228	15/15	0.88	38.6	6.93
Pb-212	15/15	1.09	35	6.5
Bi-212	6/15	1.6	38	6.66
U-235 Decay Chain				
U-235	7/15	0.045	3.8	0.59
Th-227				
U-238 Decay Chain				
U-238	11/11	1.17	60.8	9.64
Th-234	9/15	3.2	96	13.73
U-234	11/11	1.07	56.8	9.14
Th-230	15/15	0.96	70	10.98
Ra-226	15/15	1.44	114	16.57
Pb-214	15/15	1.57	94	12.83
Bi-214	15/15	1.37	85.4	11.4
Pb-210	9/9	1.75	38.5	7.54
Po-210	9/9	1.41	53.3	9.10

Marine sediment data from the dock area were selected as representing Site conditions. Three to seven results per analyte were available from Tetra Tech sampling (Tetra Tech, 2010) and the PA/SI (KSI, 2004) as shown in Table 15. Four samples were from the PA/SI and three were collected in 2009.

Table 15a. Marine Sediment Data Summary

Chemical	Frequency of Detection	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Arithmetic Mean Concentration (mg/kg)
Aluminum	7/7	5,600	23,000	10,342.9
Antimony	2/2	0.039	0.14	0.09
Arsenic	7/7	1.6	49	12.39
Barium	3/3	11	27	19
Beryllium	2/3	0.5	1.2	0.65
Cadmium	1/3	0.91	0.91	0.47
Chromium	3/3	9.7	19	14.9
Cobalt	3/3	2.3	5.9	4.23
Copper	3/3	4.2	17	12.4
Iron	7/7	12,000	51,000	25,142.9
Lead	7/7	1.6	44	19.83
Manganese	7/7	130	550	358.6
Mercury	0/2	<0.033	<0.033	<0.033
Molybdenum	2/3	1.2	4.6	2.1
Nickel	3/3	7.7	13	10.9
Selenium	2/3	0.14	1	0.46
Silver	0/2	<0.99	<1.0	<1.0
Thallium	2/2	0.037	0.085	0.06
Uranium	7/7	0.78	390	142.25
Vanadium	3/3	21	31	26
Zinc	3/3	44	67	59

Table 15b. Marine Sediment Data Summary

Radionuclide	Frequency of Detection	Minimum Detected Concentration (pCi/g)	Maximum Detected Concentration (pCi/g)	Arithmetic Mean Concentration (pCi/g)
Th-232 Decay Chain				
Th-232	7/7	0.65	117	35.24
Ra-228	7/7	0.77	45.4	17.88
Th-228	7/7	0.46	123	33.98
Pb-212	7/7	0.81	48.3	18.96
Bi-212	6/7	0.7	46.3	19.29
U-235 Decay Chain				
U-235	5/7	1.09	8.7	2.68
Pa-231	---	---	---	---
Ac-227	---	---	---	---
Th-227	---	---	---	---
U-238 Decay Chain				
U-238	6/6	0.44	137	46.69
Th-234	5/7	21.8	121	37.8
U-234	6/6	0.45	132	45.23
Th-230	7/7	0.59	222	67.17
Ra-226	7/7	0.19	64	26.11
Pb-214	7/7	0.78	82	25.65
Bi-214	7/7	0.63	75.2	23.01
Pb-210	3/3	12	15.2	13.77
Po-210	3/3	18.5	41.6	27.37

2.2 Conceptual Site Models

The PA/SI (KSI, 2004) performed in 2004 provided a preliminary assessment of potential risk using a small data set and screening level approach to assessing the data. The primary purpose of the PA/SI was to identify if a release of hazardous materials had occurred at the Site and provide an initial characterization of potential sources. The PA/SI identified data gaps that needed to be filled in order to perform a complete site characterization and provided a preliminary description of the relationship of potential sources, pathways, media, and receptors in a conceptual site model (CSM). The information developed by the PA/SI was used by Newmont as the starting point for its ESI performed in 2009. The Site Characterization Report containing sampling data and Site information collected by Newmont was approved in December 2010 and forms the basis for the risk assessments (both human health and ecological) undertaken. The CSM presented in the PA/SI has been revised based on the additional information and data obtained in 2009 and the revised CSM is presented in Figure 9. The revised CSM presented in Figure 9 directs the screening level and site-specific risk assessments presented here and more accurately describes the potential exposure pathways based on realistic Site use.

As reflected in the CSM, Site use is determined by the Tongass National Forest Master Plan (USFS, 2008a), as described in Section 1.3. Specifically, residential use is not an option, and

future uses focus on mineral exploration and semi-remote wilderness recreation. Commercial fishing is not considered, as subsistence use is more likely and would provide an estimate of risk associated with the personal retention of a commercial harvest. Individual exposures would be higher for subsistence fishers and retained portions of commercial harvests than the exposure rate of commercially harvested fish which are then sold in various markets.

The occupational exposures possible for this Site include a mineral exploration worker and a USFS worker. Mineral exploration is a future use of the Site based on the Tongass National Forest Master Plan. Currently, such workers are present at this Site on an intermittent basis, and work is weather dependent. As workers are housed in ships anchored off-shore and water is provided, exposure to the Site occurs only during work hours and does not include subsistence pathways. Similarly, a USFS worker could occasionally work at the Site for the purposes of wildlife surveys or other non-intrusive projects. Again, direct contact pathways with soil and perhaps stream sediment, as well as inhalation, are the most likely complete pathways, while subsistence pathways are not complete.

Area visitors may also use the Site, as recreational uses are consistent with the TNF Master Plan. Such uses would be time-limited, as the Site is remote, lacks any facilities, and can be reached only by boat, float plane, or extensive hiking from Moira Sound. Recreational visits in the TNF are typically limited to 14 days without a special permit from the USFS. The Ross-Adams Site does have bears and extensive stays without a more permanent shelter could be hazardous. The area visitor is evaluated in the SSRA only, as this receptor is site-specific. Exposure pathways considered potentially complete for this receptor are direct exposure to soil and stream sediment, water ingestion, and inhalation.

Subsistence food pathways considered potentially complete are harvesting of deer, berries, fish, sea cucumbers, and seaweed. The subsistence food gatherer is assumed to collect a year's supply of food from the Site, and the foods selected are considered representative of items that could be harvested from this Site. The subsistence food pathways are evaluated in the SSRA, as food ingestion pathways are site-specific and published screening values are not available for these pathways.

2.3 Exposure Pathways

Estimated health risks are calculated based on an estimated dose (either chemical intake or radionuclide and radiation exposure). This estimate integrates the chemical or radionuclide concentration in air, water or soil, or the radionuclide exposure rate, the key exposure parameters (such as food ingestion or air inhalation rates and exposure periods) for likely human receptors (recreational Site users, occupational receptors), and chemical- and isotope-specific toxicity data. The calculated risks are then summed and evaluated in light of risk criteria provided in ADEC guidance.

Human exposure can only occur if there is a complete pathway to chemicals in soil, food, water, or air. Therefore, an evaluation of exposure pathways is the first step in the human health screening evaluation. Potential doses are then estimated based on an evaluation of likely human routes of exposure to the chemicals. Human health risk is then based on these estimated doses. For the Site, exposure pathways are potentially complete for soil, surface water, and stream and marine sediment, mine rock and radon inhalation. Food pathways are also evaluated in the SSRA. Exposure pathways for each medium are discussed below and are presented in the CSM (Figure 9).

Site soil exposure pathways include ingestion, dermal contact, and soil particulate suspension followed by inhalation; for radioisotopes, external exposure and radon inhalation is also evaluated. For sediment, the pathways included ingestion and dermal contact; for radionuclides, external exposure from sediment materials is also considered. Surface water was evaluated as a potential drinking water supply, and where credible, for fish and water ingestion using Alaska Water Quality Criteria. With the exception of Cabin Creek (which is not impacted by former or current Site operations), the creeks are not currently used for drinking water. Above the 300-Foot Level mine, Site creeks do not support fish habitat.

For the Screening Level Risk Assessment, occupational screening levels are used. The screening values assume an exposure frequency of 250 days per year and an exposure duration of 25 years for the Site (ADEC, 2010, 2011). (Radionuclide screening levels assume a 225 day per year exposure for 25 years (EPA, 2007a)). This occupational land use scenario is consistent with the USFS Land and Resource Management Plan for the Tongass National Forest (USFS, 2008a, 2008b), which designates this site as a semi-remote recreational wilderness, with potential timber production and mineral exploration activities; however, given the Site's location and lack of development, occupational screening levels based on default exposure assumptions are expected to markedly overestimate potential exposures for both occupational and recreational receptors. It is unlikely that recreational, US Forest Service, or exploration activities would in fact involve an individual being exposed for 25 years for up to 250 days per year. Current mineral exploration activities in the vicinity are weather limited in this remote location. Timber production does not currently take place at the Site. Recreational access and use is also limited by the Site's remote location, lack of facilities, and weather conditions. The SSRA focuses the health risk analyses on mineral exploration and recreational activities, using exposure parameters that better represent the intermittent nature of mineral exploration and recreational use of the Site. Use of the default screening values, however, will identify chemicals of potential concern and be protective of exposures to the Site, as the nature and extent of default exposure assumptions exceed those of the potential Site receptors.

Exposure parameters used for the occupational land-use screening evaluation are based on default assumptions presented in ADEC (2010). Preliminary Screening Levels (PSLs) used in the SLRA for non-radionuclides were calculated by ADEC's Method 3 calculator (ADEC, 2011). EPA Preliminary Remediation Goals for Radionuclides (EPA, 2007a) for outdoor workers were used to evaluate radionuclides in soil, surface water, and sediment, and to select radionuclide COPCs for the site-specific HHRA. Use of screening values as the first step in the risk assessment process is consistent with ADEC guidance (ADEC, 2010). Table 1 summarizes the parameters used to select COPCs in the SLRA. Occupational screening levels were calculated using ADEC's Method 3 calculator (ADEC, 2011). Radionuclide screening levels are from the EPA tables (EPA, 2010).

The site-specific human health risk assessment assumes that subsistence activities could occur at the Site, in addition to recreational or occupational Site uses. The chemicals evaluated in the site-specific assessment are those that exceeded occupational screening levels in the SLRA, and were determined to be COPCs at that conservative level of analysis.

The exposure parameters and equations applied in the SSRA are presented in Section 4.0. Site-specific direct contact risks were calculated using Risk Assessment Information System (RAIS) tools (ORNL, 2009), while risks from subsistence food pathways were separately calculated using the equations and assumptions specific to the Site. Details of the SSRA are presented in Section 4.0

2.3.1 Screening Level Soil and Sediment Exposure Pathways

For the screening level risk evaluation, soil ingestion, dermal contact, particulate inhalation, and external exposure (radionuclides only) were quantitatively evaluated. Screening Levels (SLs) from the ADEC Method 3 calculator were used for the screening evaluation for inorganics. Radionuclides were evaluated using risk-based preliminary remediation goals (PRGs) from EPA (2010). In the SLRA, soil screening levels were used to evaluate sediment as well, although sediment is far less likely to be contacted on a daily basis or to the same extent as soil. Maximum site concentrations were used for the SLRA risk estimates. Analytes with risks over 1E-6 or above a hazard index of 0.1 were evaluated for inclusion the SSRA.

2.3.2 Screening Level Water Exposure Pathways

In the SLRA, surface water in creeks was evaluated as a potential drinking water source and for fish ingestion per ADEC guidance, as a screening level analysis. Alaska water quality criteria for water ingestion and fish ingestion were utilized. If a "water+fish" value was not available, then the applicable Alaska drinking water standard was used. Where a surface water quality standard was not available, the groundwater screening level concentration (based on use as tap water) was applied to estimate risk in the screening level analysis (EPA, 2009b, 2010; ADEC, 2008b). Again, maximum detected concentrations were used in the SLRA. The screening levels assume that the surface water is used as a residential water supply, which greatly overestimates exposure at this Site, but allows for a conservative selection of chemicals of potential concern that are further evaluated in the SSRA. Chemicals that exceeded background and the above standards (risk exceeding 1E-6 or hazard index exceeding 0.1) were further evaluated quantitatively in the SSRA for water ingestion by the area visitor receptor.

2.3.3 Screening Level Air Exposure Pathway – Particulate Inhalation

Inhalation of inorganic chemicals and radionuclides was evaluated in the screening level evaluation, using published values available from the EPA (EPA, 2009b, 2010) for an occupational receptor. All radionuclides were evaluated for this pathway, as particulate inhalation is included in the EPA screening values for radionuclides. The inorganic chemicals barium, beryllium, cadmium, and chromium were evaluated based on particulate inhalation, per ADEC guidance (ADEC, 2008b). Radon exposure was separately assessed as described in Section 2.3.4.

2.3.4 Screening Level Exposure Pathway - Radon Inhalation and Direct Radiation Exposure

The Ross Adams Mine Site is in a mineralized area. Surface and sub-surface rock and soil contain elevated levels of naturally occurring radioactive materials, including uranium and thorium and their decay products (Figure 10). As a consequence, inhalation of radon decay products and direct exposure to gamma radiation are significant sources of radiation dose and comprise the major component of human health risk to workers and members of the public visiting the Site. The principal risk from radiation dose, whether from inhalation of radon decay products or exposure to direct gamma radiation, is an increased risk of cancer. The risk is assumed to be proportional to the radiation dose.

2.3.4.1 Inhalation of Radon Decay Products

Radon is the immediate decay product of radium and is a member of the natural uranium and thorium decay chains. It is an inert radioactive gas; that is, it does not generally interact chemically. Radon is ubiquitous in the environment but is present in higher concentrations in mineralized areas with elevated natural uranium and thorium concentrations. The two important

naturally occurring isotopes of radon are radon-222 (Rn-222) and radon-220 (Rn-220). Radon-222 is part of the U-238 decay series; Rn-220 is a member of the Th-232 decay series. Radon-222 has a half-life of approximately 3.8 days; Rn-220 has a half-life of approximately 55 seconds. Both radon isotopes contribute to the radiation dose from natural background; however, because of its longer half-life, Rn-222 is generally considered the more important of the two isotopes and the more hazardous in terms of human health risk.

Radon in the atmosphere is breathed in and out with little interaction in the human body, and therefore produces only a small radiation dose. However, Rn-222 decays to solid radioactive isotopes of polonium (Po-218, Po-214, and Po-210), bismuth (Bi-214 and Bi-210), and lead (Pb-214 and Pb-210). Polonium-218, Pb-214, Bi-214, and Po-214 are called short-lived decay products because their half-lives range from less than a millisecond to approximately 27 minutes. These nuclides accumulate in the air relatively rapidly from the decay of Rn-222. The relative concentrations of these nuclides are dependent on the "age" of the air. When radon is released from soil, rocks, or other sources the decay products are left behind in the solid material. It takes approximately four hours for all of the short-lived decay products of Rn-222 to reach "equilibrium" or their maximum concentrations relative to the parent Rn-222 in air. Rn-220 also decays to isotopes of polonium, lead, and bismuth. Because of the very short half-life of the Rn-220, its decay products do not build in to equilibrium in unconfined spaces.

At the Site, radon emanates primarily from the ore and mine rock on the surface and from the mine portals and airshaft. The radon is rapidly dispersed in the air by wind and diffusion. Therefore the radon decay products, that are the source of the radiation dose to humans, do not have much time to accumulate. The concentrations of the decay products can be calculated based on the average age of the radon at the receptor location and the rate of dispersion of the gas. Radon decay product concentrations are expressed as a special unit called the "working level".

Radon decay products are known carcinogens. Inhalation of radon decay products can cause lung cancer but has not been demonstrated to result in any other adverse health effect at levels likely to be encountered at the Site.

Radon gas concentrations were measured at a variety of locations on and in the vicinity of the Site including the portals. The radon detectors measured Rn-222 and Rn-220 combined. Dose and risk calculations were performed assuming all of the measured radon was Rn-222. This is a conservative assumption since the health risk associated with Rn-220 is less that that associated with Rn-222. Radon dose was calculated using the exposure parameters provided in Section 4. Radon decay product concentrations were estimated based on measured radon gas concentrations and air dispersion parameter values.

2.3.4.2 Direct Gamma Radiation Exposure

Direct gamma radiation levels were measured across all areas of the Ross Adams Mine and the nearby undeveloped I&L Zone using a scanning measurement system that coupled a NaI gamma radiation detector to a geographic positioning system (GPS) that recorded gamma exposure rate, time, and latitude/longitude coordinates at one-second intervals as the surveyor moved across the Site. The method is described in detail in the Site Characterization Report (Tetra Tech, 2010a). A total of several hundred thousand exposure rate measurements were recorded and displayed on Site maps. The NaI detector used for the Site scan has an energy-dependent response. That is, the instrument exposure rate reading in microroentgen per hour (uR/hr) is a relative value rather than an absolute measure of the actual exposure rate. For the purpose of

estimating potential annual radiation dose and lifetime risk, the average exposure rate reading was adjusted using a site-specific factor for converting the exposure rate to dose rate described in the Site Characterization Report (Tetra Tech, 2010).

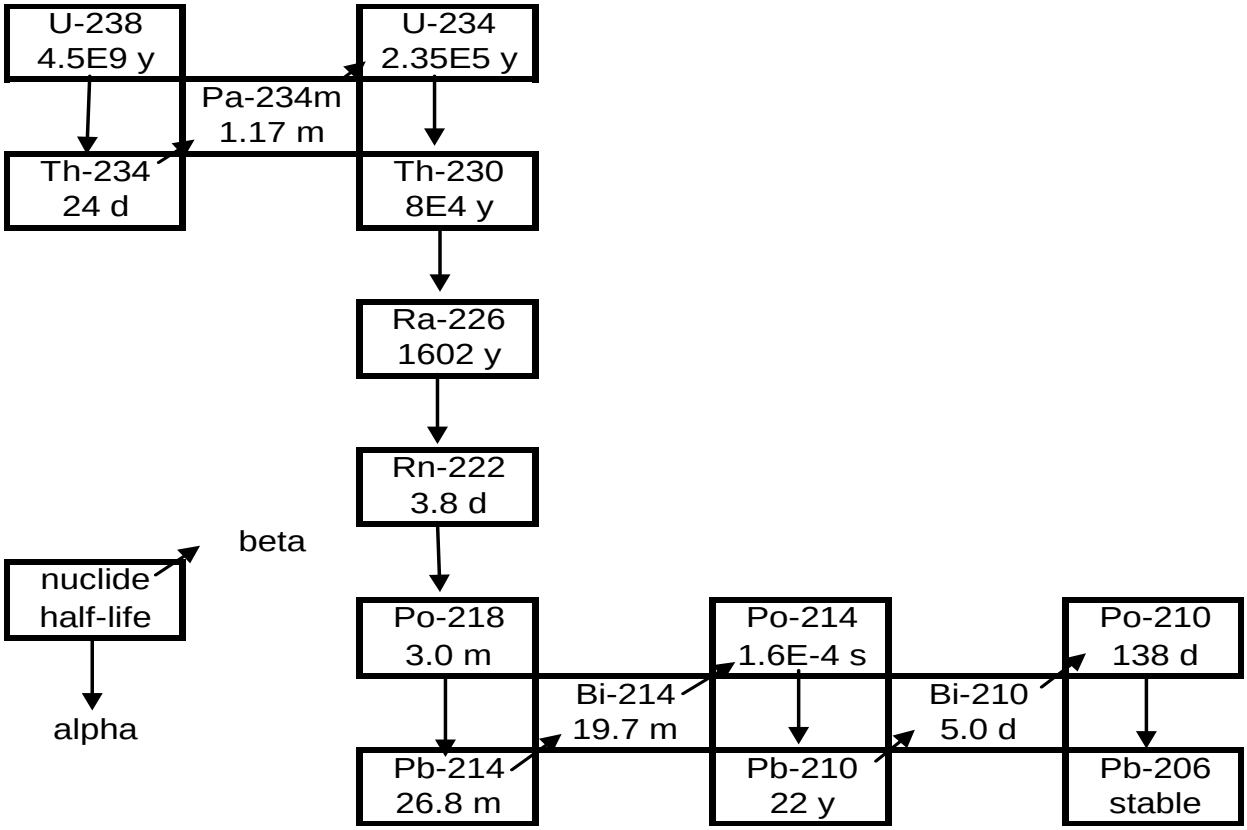

Figure 10. Uranium Decay SeriesUranium Decay Series

2.4 Screening Level Exposure Point Concentration

As described in the Final Site Characterization Report (Tetra Tech, 2010a), samples were collected during 2009 from soil, surface water, stream sediment and marine sediment, and analyzed for inorganic chemical and radioisotope concentrations. Additionally, data are available from the previous Site investigation (KSI, 2004) for soil, surface water, and sediment. These two data sets comprised the data used for the quantitative risk assessments, both at the screening level and the site-specific assessment. While data from other historical Site investigations are available (Eakins, 1970; USBLM, 1998) and were evaluated in the Final Site Characterization Report (Tetra Tech, 2010a), changes in laboratory detection limits over time can obscure the identification of a current exposure concentration, and thereby compromise the risk assessment calculations. Therefore, for the human health and ecological risk assessments, only data from Tetra Tech's 2009 sampling effort and Kent and Sullivan's PA/SI (2004) were used in the quantitative assessment of risk. Further, "rock" data from the PA/SI were not included in the risk assessment as particle size is too large to be considered an exposure medium for human receptors.

For the purposes of the screening level risk assessment, all chemicals detected were included. Again, for the conservative purposes of a screening analysis, the *maximum* detected concentration, either from the Tetra Tech sampling efforts in 2009, or from the Kent and Sullivan

report's results for soil and sediment (2004), were used as exposure point concentrations in the SLRA. If an analyte was not detected in any sample, the detection limit was evaluated to determine if it was below screening values and it was evaluated in the SLRA at one-half the detection limit for the purposes of the screening level evaluation. Chemicals above the risk-based screening level concentrations from ADEC (2008b, 2011) and EPA (2010) were carried through as COPCs for the SSRA. In the SSRA, data were aggregated and upper 95 percent confidence limits were calculated for the exposure point concentration for soil. Exposure point concentrations used in the SSRA are described in Section 4.3.

As described previously, background concentrations for each media were available from Tetra Tech 2009 sampling efforts (Tetra Tech, 2010a) or Kent and Sullivan sampling (KSI, 2004). Background data are presented in Tables 2 through 6 for each medium of interest, with the 95UPL values shown for mineralized soil and marine sediment. The maximum concentration of analytes in all other media were used as the background threshold value against which maximum Site concentrations were evaluated. Site data are also presented by medium in Tables 7 through 15; for the screening level assessment, the maximum detected concentrations were used to calculate screening level risks and to select COPCs for inclusion in the SSRA.

2.5 Toxicity Values

Toxicity values were first selected using ADEC guidance as the primary reference (2008a, 2008b, 2010). Values unavailable from ADEC were selected from the EPA's Integrated Risk Information System (IRIS) database, or from EPA Regional Screening Levels. Chemical-specific values used in the SSRA for the COPCs are presented in Table 33. For radionuclides, all toxicity values were selected from the EPA Preliminary Remediation Goals for Radionuclides (EPA, 2010), and are presented in Table 34.

For purposes of a human health risk assessment, adverse health effects are classified into two broad categories: non-carcinogens and carcinogens. The following sections describe the toxicity assessment of non-carcinogens and carcinogens and the role of toxicity values in risk assessment.

2.5.1 Carcinogenic Effects

Numerical estimates of cancer potency for chemicals identified as carcinogens are presented as cancer slope factors (CSFs). As stated by EPA (1989), the CSF *"…is a plausible upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime. The slope factor is used to estimate an upper-bound probability of an individual developing cancer as a result of a lifetime of exposure to a particular level of a potential carcinogen."* CSFs are expressed in units of risk per mg/kg-day. CSFs are derived by calculating the 95 percent upper confidence limit (95UCL) on the slope of the linearized portion of the dose-response curve using the multistage cancer model on study data. Use of the 95UCL of the slope means that there is only a five percent chance that the probability of a response could be greater than the estimated value for the experimental data used. Cancer slope factors assume no threshold for effect (i.e., all exposures to a chemical are assumed to be associated with some risk; or, there is no threshold below which the risk is negligible or unlikely). If there are, in fact, thresholds for cancer, the true risks could be zero at sufficiently low doses. The CSFs used in the SSHRA risk assessment are presented in Section 4 for both non-radionuclides and for radionuclides. Screening levels used in the SLRA have toxicity values incorporated in them, from ADEC's published screening values, ADECs Method 3 calculator, EPA's Integrated Risk Information System database (EPA, 2011), and EPA screening values for radionuclides (EPA, 2010).

Radionuclides are all classified as Group A (known) carcinogens by the EPA. The toxicity values for external radiation are central estimates of lifetime attributable radiation cancer incidence risk, for each year of exposure to external radiation from photon-emitting radionuclides, expressed in units of risk/year per pCi/gram soil. Ingestion and inhalation slope factors, expressed as risk/pCi, are central estimates in a linear model of age-averaged, lifetime attributable radiation cancer incidence per unit of activity.

Cancer risks are expressed as the upper-bound, increased likelihood of an individual to develop cancer as a result of exposure to a particular chemical. For example, a cancer risk of 1E-04 refers to an upper-bound increased chance of one in ten thousand of developing cancer over a lifetime (0.01 percent risk). For the screening level risk assessment, the maximum concentration was divided by the screening level, then multiplied by a risk of 1E-5 (the basis for the carcinogenic screening levels from the ADEC Method 3 calculator). The following equation is used to estimate excess cancer risk:

*Cancer Risk = (Maximum Concentration / Screening Level) * 1E-5*

The risks were summed for all chemicals for geographically specific portions of the Site.

2.5.2 Non-Cancer Effects

For the purpose of assessing risks associated with non-cancer effects, the EPA assumes that a threshold for adverse health effects exists upon exposure to a chemical. In setting a reference dose (RfD), the level at which no adverse effects were observed is used when available, modified by uncertainty factors or modifying factors to account for variation in the general population, extrapolation from animals to humans, or to account for the type of study or effect observed (EPA, 1989). Non-cancer effects were evaluated using RfDs in ADEC guidance and developed by the EPA. In general, the RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime of exposure (EPA, 1989).

RfDs are expressed as acceptable daily doses in milligrams of compound per kilogram of body weight per day (mg/kg-day). Most RfDs are based on oral exposure data. The RfDs used in the site-specific risk assessment are presented in Section 4. All screening values used in the SLRA have toxicity values incorporated in them, from ADEC's published screening values, ADECs Method 3 calculator, EPA's Integrated Risk Information System database (EPA, 2011) and EPA screening values for radionuclides (EPA, 2010).

The potential for non-cancer effects due to exposure to an individual chemical is expressed as the hazard quotient (HQ). The HQ for the screening level evaluation is the ratio of the exposure concentration of a chemical to the corresponding chemical-specific screening level. The following equation is used to estimate the HQ in the screening level evaluation:

Hazard Quotient = Maximum Site Concentration / Screening Level

The sum of the hazard quotients across for all pathways for all COPCs is the hazard index (HI). If the HQ or HI exceeds1.0, then there is a possibility of adverse non-cancer health effects from exposure to the Site.

3.0 SCREENING LEVEL RISK ASSESSMENT

Screening level risk calculations are presented below. In the screening level evaluation, occupational exposure to maximum observed concentrations was evaluated as a conservative screening level exposure scenario, and used to select chemicals of potential concern (COPCs) for the subsequent SSRA. The occupational scenario is the reasonable maximum exposure for this Site based on current and future land uses, is consistent with TNF Master Plan for this area, and is a more extensive exposure scenario than other likely Site users. Note that other Site exposures are addressed in the site-specific human health risk assessment presented in Section 4.0.

Screening level risks and hazard indices (HIs) were calculated by comparing maximum Site concentrations to risk-based screening levels for an outdoor occupational receptor calculated by ADEC's Method 3 Calculator for nonradionuclides (ADEC, 2011) or selected from EPA's Preliminary Remediation Goals for Radionuclides (EPA, 2010). The purpose is to estimate the likelihood, incidence, and magnitude of the potential human health effects from exposure to the chemicals at the Site and select COPCs. Both carcinogenic risks and non-carcinogenic HIs are presented for the screening level evaluation in this section. For clarity, the soil assessments were conducted on a mine level-by-mine level basis. Output from ADEC's Method 3 calculator and the radionuclide screening levels are attached in Appendix A.

Chemicals posing a risk above 1E-6 or with a HI above 0.1 based on the occupational screening levels were evaluated for retention as COPCs. Residential screening levels are presented in the screening evaluation tables, per ADEC guidance. These levels were not used to select COPCs, since the residential exposure scenario is not a current or future anticipated Site use. In addition, maximum Site concentrations were compared to background levels for each medium. For the mineralized soil areas (900-Foot Level, 700-Foot Level, and mine road/I&L Spur) and the marine sediment data, 95 upper prediction limit concentrations (95UPL) were used to represent the background threshold value, as discussed in Section 2.1.1. As described there, the Upper Prediction Limit (UPL) is defined as the upper boundary of a prediction interval for an independently obtained observation. If the distributions of the Site data and the background data are comparable, then a new (next) observation coming from the site population (e.g., site) should lie at or below the UPL95 with a probability of 0.95 (95 percent). The 95UPL is, in general, the BTV value recommended by ProUCL (EPA, 2007). For all other media, the maximum background concentration was used because there were too few samples or too few detected values for statistical calculations.

The following subsections describe the screening level assessments for soil, surface water, stream sediment, marine sediment, and radon. COPCs selected through this process are summarized by media in Section 3.8 and evaluated in the SSRA to provide a site-specific estimate of risk.

3.1 Soil - Direct Contact

Risks and hazard indices from long-term exposure to soil by a hypothetical occupational receptor are presented by mine level and road areas. Table 16 presents metals data; Table 17 contains results for the radionuclides. Both residential and occupational screening levels are presented in the tables, but only results for the occupational screening are discussed below. Residential screening values were provided for information only, per ADEC guidance, and not discussed as there are no permanent Site residents, no nearby residential areas, and no plans for future residential development at the Site or surrounding areas; residential exposure is not consistent

with the USFS Master Plan for this Site. For metals, the risk-based screening levels included the pathways of soil ingestion and dermal contact; particulate inhalation is evaluated separately for barium, beryllium, cadmium, and chromium per ADEC guidance (Section 3.2). For radionuclides, the screening levels include soil ingestion, external exposure, and particulate inhalation.

At the 900-Foot Level, the total hazard index was 0.42 and nonradionuclide risk was 6.9E-06 using the maximum detected concentrations and occupational screening levels. This calculated risk was entirely due to arsenic, which was retained as a COPC. Uranium was associated with a HI of 0.32 and retained as a COPC. No other metals posed a risk above of 1E-6 or HI greater than 0.1. Radionuclides at the 900-Foot Level posed a total risk to the occupational receptor of 4.5E-04. Radionuclides posing an individual risk greater than 1E-06 were the natural thorium chain nuclides Th-232, Ra-228, Th-228, U-235, and the natural uranium chain nuclides U-238, U-234, Th-230, Ra-226, Pb-210, and Po-210. These were carried forward in the site-specific HHRA.

Table 16. Surface Soil Data for Metals Compared to Human Health-Based Benchmarks[1]

Analyte	Maximum of Site Samples	Maximum Background (mg/kg)	Background UPL	Maximum > Background UPL?	AK Residential SL[2]	AK Occupational SL[3]	Residential HI	Residential Risk	Occupational HI	Occupational Risk	COPC?	COPC Rationale
Underlain by Granite - 900-Foot Level												
Aluminum	5000	15000	13720	No	83000	>1E6	6.0E-02		5.0E-03		No	BSL, BBL
Antimony	0.49	0.087	0.0809	**Yes**	33	410	1.5E-02		1.2E-03		No	BSL
Arsenic	11	4.9	2.398	**Yes**	3.7	16		3.0E-05		6.9E-06	**Yes**	ASL
Barium	190	14	11.09	**Yes**	16600	204000	1.1E-02		9.3E-04		No	BSL
Beryllium	1.2	1.3	1.007	**Yes**	170	2000		7.1E-08		6.0E-09	No	BSL
Cadmium	1.8	0.15	(4)	**Yes**	65	620	2.8E-02		2.9E-03		No	BSL
Chromium	0.6	10	9.16	No	250	3100	2.4E-03		1.9E-04		No	BSL,BBL
Cobalt	0.63	6.5	3.031	No	25	310	2.5E-02		2.0E-03		No	BSL,BBL
Copper	11	6.5	3.574	**Yes**	3300	40900	3.3E-03		2.7E-04		No	BSL
Iron	27000	46000	40400	No	58100	715000	4.6E-01		3.8E-02		No	BSL,BBL
Lead	120	190	171.2	No	400	800					No	BSL, BBL
Manganese	770	390	382.5	Yes	2000	24500	3.9E-01		3.1E-02		No	BSL
Mercury	0.039	0.066	(4)	No	25	310	1.6E-03		1.3E-04		No	BSL,BBL
Molybdenum	7.9	16	7.432	**Yes**	410	5100	1.9E-02		1.5E-03		No	BSL
Nickel	0.39	2.7	1.616	No	1700	20400	2.3E-04		1.9E-05		No	BSL,BBL
Selenium	0.99	3.2	1.753	No	410	5100	2.4E-03		9.7E-05		No	BSL,BBL
Silver	0.99 (U)	0.047	(4)	**Yes**	410	5100	1.2E-03		2.1E-03		No	BSL; ND
Thallium	0.17	0.075	(4)	**Yes**	6.6	82	2.6E-02		2.1E-03		No	BSL
Vanadium	6.2	26	12.44	No	580	7200	1.1E-02		8.6E-04		No	BBL; BSL
Zinc	2700	350	308	**Yes**	24900	307000	1.1E-01		8.8E-03		No	BSL
Uranium	1000	140	114.8	**Yes**	250	3100	4.0E+00		3.2E-01		**Yes**	ASL
						TOTAL	**5.2E+00**	**3.0E-05**	**4.2E-01**	**6.9E-06**		

Table 16 (continued). Surface Soil Data for Metals Compared to Human Health-Based Benchmarks[1]

Analyte	Maximum of Site Samples	Maximum Background (mg/kg)	Background UPL	Maximum > Background UPL?	AK Residential SL[2]	AK Occupational SL[3]	Residential HI	Residential Risk	Occupational HI	Occupational Risk	COPC?	COPC Rationale
Underlain by Granite – 700-Foot Level												
Aluminum	9700	15000	13720	**No**	83000	>1E6	1.2E-01		9.7E-03		No	BSL, BBL
Antimony	0.031	0.087	0.0809	No	33	410	9.4E-04		7.6E-05		No	BSL, BBL
Arsenic	16	4.9	2.398	**Yes**	3.7	16		4.3E-05		1.0E-05	**Yes**	ASL
Barium	42	14	11.09	Yes	16600	204000	2.5E-03		2.1E-04		No	BSL
Beryllium	1.2	1.3	1.007	Yes	170	2000		7.1E-08		6.0E-09	No	BSL
Cadmium	0.49 (U)	0.15	(4)	**Yes**	65	620	3.8E-03		4.0E-04		No	BSL, ND
Chromium	7.2	10	9.16	No	250	3100	2.9E-02		2.3E-03		No	BSL, BBL
Cobalt	1.8	6.5	3.031	No	25	310	7.2E-02		5.8E-03		No	BSL, BBL
Copper	4.7	6.5	3.574	**Yes**	3300	40900	1.4E-03		1.1E-04		No	BSL
Iron	26000	46000	40400	**No**	58100	715000	4.5E-01		3.6E-02		No	BSL, BBL
Lead	290	190	171.2	**Yes**	400	800					No	BSL
Manganese	740	390	382.5	Yes	2000	24500	3.7E-01		3.0E-02		No	BSL
Mercury	0.033(U)	0.066	(4)	No	25	310	6.6E-04		5.3E-05		No	BSL, BBL
Molybdenum	4.6	16	7.432	No	410	5100	1.1E-02		9.0E-04		No	BSL, BBL
Nickel	1.8	2.7	1.616	Yes	1700	20400	1.1E-03		8.8E-05		No	BSL, BBL
Selenium	0.32	3.2	1.753	No	410	5100	7.8E-04		6.3E-05		No	BSL, BBL
Silver	0.96 (U)	0.047	(4)	Yes	410	5100	1.2E-03		9.4E-05		No	BSL, ND
Thallium	0.038	0.075	(4)	No	6.6	82	5.8E-03		4.6E-04		No	BSL, BBL
Vanadium	10	26	12.44	No	580	7200	1.7E-02		1.4E-03		No	BSL, BBL
Zinc	130	350	308	No	24900	307000	5.2E-03		4.2E-04		No	BSL, BBL
Uranium	1900	140	114.8	**Yes**	250	3100	7.6E+00		6.1E-01		**Yes**	ASL
						TOTAL	**8.7E+00**	**4.3E-05**	**7.0E-01**	**1.0E-05**		

Table 16 (continued). Surface Soil Data for Metals Compared to Human Health-Based Benchmarks[1]

Analyte	Maximum of Site Samples	Maximum Background (mg/kg)	Back-ground UPL	Maximum > Background?	AK Residential SL[2]	AK Occupational SL[3]	Residential HI	Residential Risk	Occupational HI	Occupational Risk	COPC?	COPC Rationale
Underlain by Granite - Mine Road and I&L Road Spur												
Aluminum	5600	15000	13720	No	83000	>1E6	6.7E-02		5.6E-03		No	BSL,BBL
Antimony	0.35	0.087	0.0809	**Yes**	33	410	1.1E-02		8.5E-04		No	BSL
Arsenic	8.1	4.9	2.398	**Yes**	3.7	16		2.2E-05		5.1E-06	**Yes**	ASL
Barium	130	14	11.09	**Yes**	16600	204000	7.8E-03		6.4E-04		No	BSL
Beryllium	0.84	1.3	1.007	No	170	2000		4.9E-08		4.2E-09	No	BSL,BBL
Cadmium	0.12	0.15	(4)	No	65	620	1.8E-03		1.9E-04		No	BSL,BBL
Chromium	1.7	10	9.16	No	250	3100	6.8E-03		5.5E-04		No	BSL,BBL
Cobalt	0.58	6.5	3.031	No	25	310	2.3E-02		1.9E-03		No	BSL,BBL
Copper	5.8	6.5	3.574	**Yes**	3300	40900	1.8E-03		1.4E-04		No	BSL
Iron	36000	46000	40400	No	58100	715000	6.2E-01		5.0E-02		No	BSL, BBL
Lead	110	190	171.2	No	400	800					No	BSL, BBL
Manganese	580	390	382.5	**Yes**	2000	24500	2.9E-01		2.4E-02		No	BSL
Mercury	0.033 (U)	0.066	(4)	No	25	310	6.6E-04		5.3E-05		No	BSL,BBL
Molybdenum	6.4	16	7.432	No	410	5100	1.6E-02		1.3E-03		No	BSL,BBL
Nickel	0.53	2.7	1.616	No	1700	20400	3.1E-04		2.6E-05		No	BSL,BBL
Selenium	0.5 (U)	3.2	1.753	No	410	5100	6.1E-04		4.9E-05		No	BSL, BBL
Silver	0.99 (U)	0.047	(4)	**Yes**	410	5100	1.2E-03		9.7E-05		No	BSL, ND
Thallium	0.99 (U)	0.075	(4)	**Yes**	6.6	82	7.5E-02		6.0E-03		No	BSL, ND
Vanadium	6.2	26	12.44	No	580	7200	1.1E-02		8.6E-04		No	BSL, BBL
Zinc	160	350	308	No	24900	307000	6.4E-03		5.2E-04		No	BSL, BBL
Uranium	730	140	114.8	**Yes**	250	3100	2.9E+00		2.4E-01		**Yes**	ASL
						TOTAL	**4.1E+00**	**2.2E-05**	**3.3E-01**	**5.1E-06**		

Table 16 (continued). Surface Soil Data for Metals Compared to Human Health-Based Benchmarks[1]

Analyte	Maximum of Site Samples	Background Samples	Maximum > Background?	AK Residential SL[2]	AK Occupational SL[3]	Residential HI	Residential Risk	Occupational HI	Occupational Risk	COPC?	COPC Rationale
Underlain by Quartz Monzonite – 300-Foot Level											
Aluminum	57000	21000	**Yes**	83000	>1E6	6.9E-01		5.7E-02		No	BSL
Antimony	0.79	0.051	**Yes**	33	410	2.4E-02		1.9E-03		No	BSL
Arsenic	33	5.1	**Yes**	3.7	16		8.9E-05		2.1E-05	**Yes**	ASL
Barium	120	8.9	**Yes**	16600	204000	7.2E-03		5.9E-04		No	BSL
Beryllium	13	0.58	**Yes**	170	2000		7.6E-07		6.5E-08	No	BSL
Cadmium	9.5	0.5 (U)	**Yes**	65	620	1.5E-01		1.5E-02		No	BSL
Chromium	62	21	**Yes**	250	3100	2.5E-01		2.0E-02		No	BSL
Cobalt	54	18	**Yes**	25	310	2.2E+00		1.7E-01		No	BSL[5]
Copper	65	13	**Yes**	3300	40900	2.0E-02		1.6E-03		No	BSL
Iron	36000	54000	No	58100	715000	6.2E-01		5.0E-02		No	BSL, BBL
Lead	180	15	**Yes**	400	800					No	BSL
Manganese	6700	4000	**Yes**	2000	24500	3.4E+00		2.7E-01		No	BSL[5]
Mercury	0.15	0.055	**Yes**	25	310	6.0E-03		4.8E-04		No	BSL
Molybdenum	18	9.5	**Yes**	410	5100	4.4E-02		3.5E-03		No	BSL
Nickel	130	6.9	**Yes**	1700	20400	7.6E-02		6.4E-03		No	BSL
Selenium	3.5	2.7	**Yes**	410	5100	8.5E-03		6.9E-04		No	BSL
Silver	0.99 U	1 (U)	**Yes**	410	5100	1.2E-03		9.7E-05		No	BSL
Thallium	0.39	0.023	**Yes**	6.6	82	5.9E-02		4.8E-03		No	BSL
Vanadium	50	92	No	580	7200	8.6E-02		6.9E-03		No	BSL, BBL
Zinc	1800	24	**Yes**	24900	307000	7.2E-02		5.9E-03		No	BSL
Uranium	1900	11	**Yes**	250	3100	7.6E+00		6.1E-01		**Yes**	ASL
					TOTAL	**1.5E+01**	**9.0E-05**	**1.2E-00**	**2.1E-05**		

Table 16 (continued). Surface Soil Data for Metals Compared to Human Health-Based Benchmarks[1]

Analyte	Maximum of Site Samples	Background Samples	Maximum > Background?	AK Residential SL[2]	AK Occupational SL[3]	Residential HI	Residential Risk	Occupational HI	Occupational Risk	COPC?	COPC Rationale
Underlain by Quartz Monzonite - Haul Road											
Aluminum	15000	21000	No	83000	>1E6	1.8E-01		1.5E-02		No	BSL,BBL
Antimony	0.76	0.051	**Yes**	33	410	2.3E-02		1.9E-03		No	BSL
Arsenic	1.3	5.1	No	3.7	16		3.5E-06		8.1E-07	No	BSL,BBL
Barium	39	8.9	**Yes**	16600	204000	2.3E-03		1.9E-04		No	BSL
Beryllium	1	0.58	**Yes**	170	2000		5.9E-08		5.0E-09	No	BSL
Cadmium	0.18	0.5 (U)	No	65	620	2.8E-03		2.9E-04		No	BSL,BBL
Chromium	28	21	**Yes**	250	3100	1.1E-01		9.0E-03		No	BSL
Cobalt	13	18	No	25	310	5.2E-01		4.2E-02		No	BSL,BBL
Copper	15	13	**Yes**	3300	40900	4.5E-03		3.7E-04		No	BSL
Iron	30000	54000	No	58100	715000	5.2E-01		4.2E-02		No	BSL,BBL
Lead	50	15	**Yes**	400	800					No	BSL
Manganese	770	4000	No	2000	24500	3.9E-01		3.1E-02		No	BSL,BBL
Mercury	0.033 (U)	0.055	No	25	310	6.6E-04		5.3E-05		No	BSL,BBL
Molybdenum	2.2	9.5	No	410	5100	5.4E-03		4.3E-04		No	BSL,BBL
Nickel	13	6.9	**Yes**	1700	20400	7.6E-03		6.4E-04		No	BSL
Selenium	0.43	2.7	No	410	5100	1.0E-03		8.4E-05		No	BSL,BBL
Silver	1 (U)	1 (U)	No	410	5100	1.2E-03		9.8E-05		No	BSL, ND
Thallium	2 (U)	0.023	**Yes**	6.6	82	7.6E-02		6.1E-03		No	BSL, ND
Vanadium	52	92	No	580	7200	9.0E-02		7.2E-03		No	BSL,BBL
Zinc	74	24	**Yes**	24900	307000	3.0E-03		2.4E-04		No	BSL
Uranium	160	11	**Yes**	250	3100	6.4E-01		5.2E-02		No	BSL
					TOTAL	**2.6E+00**	**3.6E-06**	**2.1E-01**	**8.2E-07**		

Table 16 (continued). Surface Soil Data for Metals Compared to Human Health-Based Benchmarks[1]

Analyte	Maximum of Site Samples	Background Samples	Maximum > Background?	AK Residential SL[2]	AK Occupational SL[3]	Residential HI	Residential Risk	Occupational HI	Occupational Risk	COPC?	COPC Rationale
Underlain by Quartz Monzonite - Ore Staging Area / Load-out Ramp Area											
Aluminum	28000	21000	**Yes**	83000	>1E6	3.4E-01		2.8E-02		No	BSL
Antimony	0.37	0.051	**Yes**	33	410	1.1E-02		9.0E-04		No	BSL
Arsenic	6.8	5.1	**Yes**	3.7	16		1.8E-05		4.5E-06	**Yes**	ASL
Barium	39	8.9	**Yes**	16600	204000	2.3E-03		1.9E-04		No	BSL
Beryllium	0.85	0.58	**Yes**	170	2000		5.0E-08		4.3E-09	No	BSL
Cadmium	0.088	0.5 (U)	No	65	620	1.4E-03		1.4E-04		No	BSL, BBL
Chromium	18	21	No	250	3100	7.2E-02		5.8E-03		No	BSL, BBL
Cobalt	7.2	18	No	25	310	2.9E-01		2.3E-02		No	BSL,BBL
Copper	36	13	**Yes**	3300	40900	1.1E-02		8.8E-04		No	BSL
Iron	46000	54000	No	58100	715000	7.9E-01		6.4E-02		No	BSL,BBL
Lead	87	31	**Yes**	400	800					No	BSL
Manganese	680	4000	No	2000	24500	3.4E-01		2.8E-02		No	BSL, BBL
Mercury	0.06	0.055	**Yes**	25	310	2.4E-03		1.9E-04		No	BSL
Molybdenum	1.3	9.5	No	410	5100	3.2E-03		2.5E-04		No	BSL, BBL
Nickel	10	6.9	**Yes**	1700	20400	5.9E-03		4.9E-04		No	BSL
Selenium	1.1	2.7	No	410	5100	2.7E-03		2.2E-04		No	BSL, BBL
Silver	1 (U)	1 (U)	No	410	5100	1.2E-03		9.8E-05		No	BSL, ND
Thallium	0.027	0.023	**Yes**	6.6	82	4.1E-03		3.3E-04		No	BSL
Vanadium	52	92	No	580	7200	9.0E-02		7.2E-03		No	BSL, BBL
Zinc	61	24	**Yes**	24900	307000	2.4E-03		2.0E-04		No	BSL
Uranium	2600	11	**Yes**	250	3100	1.0E+01		8.4E-01		**Yes**	ASL
					TOTAL	**1.2E+01**	**1.8E-05**	**1.0E+00**	**4.3E-06**		

(1) All concentrations are mg/kg.
(2) ADEC values as calculated by ADEC Method 3 calculator
(3) From ADEC Web-based calculator at risk = 1E-5 and HI = 1.0
(4) Cannot compute UPL; use maximum
(5) Maximum site concentrations of manganese and cobalt at 300' Level were below screening levels when accounting for contribution of background.
Residential screening presented per ADEC guidance but not used to select COPCs
NA = No value available
U = Non-detect; the value shown is the detection limit and 1/2 DL was used for screening.
ASL = Above Screening Level, BSL = Below Screening Level, ABL = Above Background Level, BBL = Below or Equivalent to Background Level
Data from KSI 2004 and Tetra Tech 2009 sampling

Table 17. Surface Soil Data for Radionuclides Compared to Human Health-based Benchmarks[1]

Analyte	Maximum of Site Samples	Maximum Back-ground [4]	Background 95UPL	EPA Rad-PRG Residential [2]	EPA Rad PRG Outdoor Worker[3]	Maximum > Background UPL?	Residential Risk	Occupational Risk	COPC?	COPC Rationale
Underlain by Granite – 900-Foot Level										
Th-232 Decay Chain										
Th-232	307	56	47.12	3.07E+00	1.89E+01	**Yes**	1.0E-04	1.6E-05	**Yes**	ASL
Ra-228	272	57.2	48.96	2.69E-01	8.40E+00	**Yes**	1.0E-03	3.2E-05	**Yes**	ASL
Th-228	359	59	50.08	2.34E+01	1.21E+02	**Yes**	1.5E-05	3.0E-06	**Yes**	ASL
Pb-212	277	57.5	49.3	3.55E+03	5.92E+03	**Yes**	7.8E-08	4.7E-08	No	BSL
Bi-212	298	63	28.5	2.05E+04	3.33E+04	**Yes**	1.5E-08	8.9E-09	No	BSL
U-235 Decay Chain										
U-235	19.5	1	(5)	1.92E-01	3.86E-01	**Yes**	1.0E-04	5.1E-05	**Yes**	ASL
Pa-231	--	--		4.37E-01	1.25E+00	**--**	--	--	No	ND
Ac-227	--	--		2.50E+00	1.14E+01	**--**	--	-	No	ND
Th-227	0.17 U	--		1.05E+02	1.78E+02	**--**	8.1E-10	4.8E-10	No	BSL
U-238 Decay Chain										
U-238	317	9.4	9.4	4.48E+00	3.67E+01	**Yes**	7.1E-05	8.6E-06	**Yes**	ASL
Th-234	420	94	41.4	1.27E+03	3.05E+03	**Yes**	3.3E-07	1.4E-07	No	BSL
U-234	298	8.6	8.6	4.02E+00	3.23E+01	**Yes**	7.4E-05	9.2E-06	**Yes**	ASL
Th-230	680	83	68.86	3.46E+00	2.00E+01	**Yes**	2.0E-04	3.4E-05	**Yes**	ASL
Ra-226	631	95	78.5	1.99E-01	3.64E+00	**Yes**	3.2E-03	1.7E-04	**Yes**	ASL
Pb-214	561	82	67.56	4.48E+04	7.25E+04	**Yes**	1.3E-08	7.7E-09	No	BSL
Bi-214	479	73	60.36	7.95E+03	1.29E+04	**Yes**	6.0E-08	3.7E-08	No	BSL
Pb-210	510	38	32.18	3.35E-01	4.18E+00	**Yes**	1.5E-03	1.2E-04	**Yes**	ASL
Po-210	527	31.2	30.16	3.82E+01	2.73E+02	**Yes**	1.4E-05	1.9E-06	**Yes**	ASL
							6.3E-03	**4.5E-04**		

Table 17 (continued). Surface Soil Data for Radionuclides Compared to Human Health-based Benchmarks[1]

Analyte	Maximum of Site Samples	Maximum Back-ground [4]	Back-ground UPL	EPA Rad-PRG Residential [2]	EPA Rad PRG Outdoor Worker[3]	Maximum > Background?	Residential Risk	Occupational Risk	COPC ?	COPC Rationale
700-Foot Level Mine										
Th-232 Decay Chain										
Th-232	123	56	47.12	3.07E+00	1.89E+01	**Yes**	4.0E-05	6.5E-06	**Yes**	ASL
Ra-228	71.2	57.2	48.96	2.69E-01	8.40E+00	**Yes**	2.6E-04	8.5E-06	**Yes**	ASL
Th-228	81	59	50.08	2.34E+01	1.21E+02	**Yes**	3.5E-06	6.7E-07	No	BSL
Pb-212	78.3	57.5	49.3	3.55E+03	5.92E+03	**Yes**	2.2E-08	1.3E-08	No	BSL
Bi-212	68	63	28.5	2.05E+04	3.33E+04	**Yes**	3.3E-09	2.0E-09	No	BSL
U-235 Decay Chain										
U-235	19.7	1	(5)	1.92E-01	3.86E-01	**Yes**	1.0E-04	5.1E-05	**Yes**	ASL
Pa-231	--	--		4.37E-01	1.25E+00	**--**	--	--	No	ND
Ac-227	--	--		2.50E+00	1.14E+01	**--**	--	-	No	ND
Th-227	6.31	--		1.05E+02	1.78E+02	**--**	6.0E-08	3.5E-08	No	BSL
U-238 Decay Chain										
U-238	278	9.4	9.4	4.48E+00	3.67E+01	**Yes**	6.2E-05	7.6E-06	**Yes**	ASL
Th-234	309	94	41.4	1.27E+03	3.05E+03	**Yes**	2.4E-07	1.0E-07	No	BSL
U-234	295	8.6	8.6	4.02E+00	3.23E+01	**Yes**	7.3E-05	9.1E-06	**Yes**	ASL
Th-230	221	83	68.86	3.46E+00	2.00E+01	**Yes**	6.4E-05	1.1E-05	**Yes**	ASL
Ra-226	139	95	78.5	1.99E-01	3.64E+00	**Yes**	7.0E-04	3.8E-05	**Yes**	ASL
Pb-214	118	82	67.56	4.48E+04	7.25E+04	**Yes**	2.6E-09	1.6E-09	No	BSL
Bi-214	105	73	60.36	7.95E+03	1.29E+04	**Yes**	1.3E-08	8.1E-09	No	BSL
Pb-210	147	38	32.18	3.35E-01	4.18E+00	**Yes**	4.4E-04	3.5E-05	**Yes**	ASL
Po-210	121	31.2	30.16	3.82E+01	2.73E+02	**Yes**	3.2E-06	4.4E-07	No	BSL
							1.8E-03	**1.7E-04**		

Table 17 (continued). Surface Soil Data for Radionuclides Compared to Human Health-based Benchmarks[1]

Analyte	Maximum of Site Samples	Maximum Background [4]	Back-ground UPL	EPA Rad-PRG Residential [2]	EPA Rad PRG Outdoor Worker[3]	Maximum > Back-ground?	Residential Risk	Occupational Risk	COPC?	COPC Rationale
Mine Road/I&L Spur										
Th-232 Decay Chain										
Th-232	187	56	47.12	3.07E+00	1.89E+01	**Yes**	6.1E-05	9.9E-06	**Yes**	ASL
Ra-228	122	57.2	48.96	2.69E-01	8.40E+00	**Yes**	4.5E-04	1.5E-05	**Yes**	ASL
Th-228	180	59	50.08	2.34E+01	1.21E+02	**Yes**	7.7E-06	1.5E-06	**Yes**	ASL
Pb-212	125	57.5	49.3	3.55E+03	5.92E+03	**Yes**	3.5E-08	2.1E-08	No	BSL
Bi-212	127	63	28.5	2.05E+04	3.33E+04	**Yes**	6.2E-09	3.8E-09	No	BSL
U-235 Decay Chain										
U-235	9.8	1	(5)	1.92E-01	3.86E-01	**Yes**	5.1E-05	2.5E-05	**Yes**	ASL
Pa-231	--	--		4.37E-01	1.25E+00	**--**	--	--		
Ac-227	--	--		2.50E+00	1.14E+01	**--**	--	-		
Th-227	9.2	--		1.05E+02	1.78E+02	**--**	8.8E-08	5.2E-08	No	BSL
U-328 Decay Chain										
U-238	176	9.4	9.4	4.48E+00	3.67E+01	**Yes**	3.9E-05	4.8E-06	**Yes**	ASL
Th-234	198	94	41.4	1.27E+03	3.05E+03	**Yes**	1.6E-07	6.5E-08	No	BSL
U-234	164	8.6	8.6	4.02E+00	3.23E+01	**Yes**	4.1E-05	5.1E-06	**Yes**	ASL
Th-230	346	83	68.86	3.46E+00	2.00E+01	**Yes**	1.0E-04	1.7E-05	**Yes**	ASL
Ra-226	245	95	78.5	1.99E-01	3.64E+00	**Yes**	1.2E-03	6.7E-05	**Yes**	ASL
Pb-214	209	82	67.56	4.48E+04	7.25E+04	**Yes**	4.7E-09	2.9E-09	No	BSL
Bi-214	192	73	60.36	7.95E+03	1.29E+04	**Yes**	2.4E-08	1.5E-08	No	BSL
Pb-210	150	38	32.18	3.35E-01	4.18E+00	**Yes**	4.5E-04	3.6E-05	**Yes**	ASL
Po-210	--	31.2	30.16	3.82E+01	2.73E+02	--	--	--	No	--
							2.4E-03	**1.8E-04**		

Table 17 (continued). Surface Soil Data for Radionuclides Compared to Human Health-based Benchmarks[1]

Analyte	Maximum of Site Samples	Back-ground [4]	EPA Rad-PRG Residential [2]	EPA Rad PRG Outdoor Worker[3]	Maximum > Background?	Residential Risk	Occupational Risk	COPC?	COPC Rationale
300-Level Mine									
Th-232 Decay Chain									
Th-232	136	1.24	3.07E+00	1.89E+01	**Yes**	4.4E-05	7.2E-06	**Yes**	ASL
Ra-228	178	2.2	2.69E-01	8.40E+00	**Yes**	6.6E-04	2.1E-05	**Yes**	ASL
Th-228	143	1.6	2.34E+01	1.21E+02	**Yes**	6.1E-06	1.2E-06	**Yes**	ASL
Pb-212	190	14.8	3.55E+03	5.92E+03	**Yes**	5.4E-08	3.2E-08	No	BSL
Bi-212	206	15.1	2.05E+04	3.33E+04	**Yes**	1.0E-08	6.2E-09	No	BSL
U-235 Decay Chain									
U-235	50	0.33 (U)	1.92E-01	3.86E-01	**Yes**	2.6E-04	1.3E-04	**Yes**	ASL
Pa-231	---	--	4.37E-01	1.25E+00	**--**	--	--		
Ac-227	---	--	2.50E+00	1.14E+01	**--**	--	-		
Th-227	--	--	1.05E+02	1.78E+02	**--**	--	-	--	
U-238 Decay Chain									
U-238	700	4.46	4.48E+00	3.67E+01	**Yes**	1.6E-04	1.9E-05	**Yes**	ASL
Th-234	1030	8.9	1.27E+03	3.05E+03	**Yes**	8.1E-07	3.4E-07	No	BSL
U-234	730	4.52	4.02E+00	3.23E+01	**Yes**	1.8E-04	2.3E-05	**Yes**	ASL
Th-230	222	2.56	3.46E+00	2.00E+01	**Yes**	6.4E-05	1.1E-05	**Yes**	ASL
Ra-226	447	7.1	1.99E-01	3.64E+00	**Yes**	2.2E-03	1.2E-04	**Yes**	ASL
Pb-214	356	14	4.48E+04	7.25E+04	**Yes**	7.9E-09	4.9E-09	No	BSL
Bi-214	337	12.5	7.95E+03	1.29E+04	**Yes**	4.2E-08	2.6E-08	No	BSL
Pb-210	138	3.69	3.35E-01	4.18E+00	**Yes**	4.1E-04	3.3E-05	**Yes**	ASL
Po-210	187	4.09	3.82E+01	2.73E+02	**Yes**	4.9E-06	6.8E-07	No	BSL
						4.0E-03	**3.7E-04**		

Table 17 (continued). Surface Soil Data for Radionuclides Compared to Human Health-based Benchmarks[1]

Analyte	Maximum of Site Samples	Back-ground [4]	EPA Rad-PRG Residential [2]	EPA Rad PRG Outdoor Worker[3]	Maximum > Background?	Residential Risk	Occupational Risk	COPC?	COPC Rationale
Haul Road									
Th-232 Decay Chain									
Th-232	30.9	1.24	3.07E+00	1.89E+01	**Yes**	1.0E-05	1.6E-06	**Yes**	ASL,ABL
Ra-228	44.8	2.2	2.69E-01	8.40E+00	**Yes**	1.7E-04	5.3E-06	**Yes**	ASL,ABL
Th-228	28.7	1.6	2.34E+01	1.21E+02	**Yes**	1.2E-06	2.4E-07	No	BSL
Pb-212	45	14.8	3.55E+03	5.92E+03	**Yes**	1.3E-08	7.6E-09	No	BSL
Bi-212	49	15.1	2.05E+04	3.33E+04	**Yes**	2.4E-09	1.5E-09	No	BSL
U-235 Decay Chain									
U-235	4.4	0.33 (U)	1.92E-01	3.86E-01	**Yes**	2.3E-05	1.1E-05	**Yes**	ASL,ABL
Pa-231	---	--	4.37E-01	1.25E+00	**--**	--	--	--	--
Ac-227	---	--	2.50E+00	1.14E+01	**--**	--	--	--	--
Th-227	--	--	1.05E+02	1.78E+02	**--**	--	--	--	--
U-238 Decay Chain									
U-238	--	4.46	4.48E+00	3.67E+01	**--**	--	--	--	--
Th-234	64.6	8.9	1.27E+03	3.05E+03	**Yes**	5.1E-08	2.1E-08	No	BSL
U-234	--	4.52	4.02E+00	3.23E+01	**--**	--	--	--	--
Th-230	80	2.56	3.46E+00	2.00E+01	**Yes**	2.3E-05	4.0E-06	**Yes**	ASL
Ra-226	97	7.1	1.99E-01	3.64E+00	**Yes**	4.9E-04	2.7E-05	**Yes**	ASL
Pb-214	83.7	14	4.48E+04	7.25E+04	**Yes**	1.9E-09	1.2E-09	No	BSL
Bi-214	74.9	12.5	7.95E+03	1.29E+04	**Yes**	9.4E-09	5.8E-09	No	BSL
Pb-210	63	3.69	3.35E-01	4.18E+00	**Yes**	1.9E-04	1.5E-05	**Yes**	ASL
						9.0E-04	**6.4E-05**		

Table 17 (continued). Surface Soil Data for Radionuclides Compared to Human Health-based Benchmarks[(1)]

Analyte	Maximum of Site Samples	Back-ground [(4)]	EPA Rad-PRG Residential [(2)]	EPA Rad PRG Outdoor Worker[(3)]	Maximum > Background?	Residential Risk	Occupational Risk	COPC?	COPC Rationale
Ore Staging Area/Shoreline									
Th-232 Decay Chain									
Th-232	84	1.24	3.07E+00	1.89E+01	**Yes**	2.7E-05	4.4E-06	**Yes**	ASL
Ra-228	82	2.2	2.69E-01	8.40E+00	**Yes**	3.0E-04	9.8E-06	**Yes**	ASL
Th-228	100	1.6	2.34E+01	1.21E+02	**Yes**	4.3E-06	8.0E-07	No	BSL
Pb-212	94	14.8	3.55E+03	5.92E+03	**Yes**	2.6E-08	1.6E-08	No	BSL
Bi-212	82	15.1	2.05E+04	3.33E+04	**Yes**	4.0E-09	2.5E-09	No	BSL
U-235 Decay Chain									
U-235	41	0.33 (U)	1.92E-01	3.86E-01	**Yes**	2.1E-04	1.1E-04	**Yes**	ASL
Pa-231	--	--	4.37E-01	1.25E+00	**--**	--	--	--	ND
Ac-227	--	--	2.50E+00	1.14E+01	**--**	--	--	--	ND
Th-227	5.7	--	1.05E+02	1.78E+02	**--**	5.4E-08	3.2E-08	No	BSL
U-238 Decay Chain									
U-238	557	4.46	4.48E+00	3.67E+01	**Yes**	1.2E-04	1.5E-05	**Yes**	ASL
Th-234	527	8.9	1.27E+03	3.05E+03	**Yes**	4.1E-07	1.7E-07	No	BSL
U-234	562	4.52	4.02E+00	3.23E+01	**Yes**	1.4E-04	1.7E-05	**Yes**	ASL
Th-230	223	2.56	3.46E+00	2.00E+01	**Yes**	6.4E-05	1.1E-05	**Yes**	ASL
Ra-226	148	7.1	1.99E-01	3.64E+00	**Yes**	7.4E-04	4.1E-05	**Yes**	ASL
Pb-214	159	14	4.48E+04	7.25E+04	**Yes**	3.5E-09	2.2E-09	No	BSL
Bi-214	138	12.5	7.95E+03	1.29E+04	**Yes**	1.7E-08	1.1E-08	No	BSL
Pb-210	163	3.69	3.35E-01	4.18E+00	**Yes**	4.9E-04	3.9E-05	**Yes**	ASL
Po-210	179	4.09	3.82E+01	2.73E+02	**--**	4.7E-06	6.6E-07	No	BSL
						2.1E-03	**2.5E-04**		

(1) All concentrations are pCi/g. Site and background samples are from the PA/SI (Kent and Sullivan 2004) and Tetra Tech 2009 sampling
(2) EPA Radiological PRGs 2011 residential exposure assumptions, at 1E-6 risk
(3) EPA Radiological PRGs 2011 Outdoor Worker at 1E-6 risk
(4) Background is based on Soil-01 and Soil-02
(5) UPL cannot be computed; use maximum
NA = No value available
Residential screening presented per ADEC guidance but not used to select COPCs
ASL = Above Screening Level, BSL = Below Screening Level, ABL = Above Background Level, BBL = Below or Equivalent to Background Level

Nonradionuclides at the 700-Foot Level posed a total HI of 0.7 and total risk of 1.0E-05 to the hypothetical worker (exposure scenario as defined previously). Arsenic posed the entire risk, and the maximum concentration of 16 mg/kg was above background levels. Arsenic was therefore selected as a COPC to be carried beyond this screening level. Uranium was associated with an HI of 0.61 and retained as a COPC. No other nonradionuclides posed a risk above 1E-6 or HI above 0.1. Radionuclides at the 700-Foot Level posed a total risk of 1.7E-4. Radionuclides posing an individual risk of more than 1E-6 were selected as COPCs, and included Th-232, Ra-228, U-235, U-238, U-234, Th-230, Ra-226, and Pb-210.

Samples from the Mine Road and the I&L Spur Road were associated with an HI of 0.33 and risk of 5.1E-06 from arsenic. Arsenic was retained as a COPC for this area. Uranium was detected at a maximum concentration of 730 mg/kg and was retained as a COPC because it was associated with a HI of 0.24. Radionuclides posed a total risk of 3.7E-4 and radionuclides selected as COPCs were Th-232, Ra-228, Th-228, U-235, U-238, U-234, Th-230, Ra-226, and Pb-210.

At the 300-Foot Level, the total hazard index was 1.2. Risk from nonradionuclides was 2.1E-05, due entirely to arsenic. At a maximum concentration of 33 mg/kg, arsenic exceeded background and screening levels, and was retained as a COPC. Uranium was detected at a maximum concentration of 1,900 mg/kg and was also retained as a COPC with an associated HI of 0.61. Manganese was associated with an HI of 0.27, but was not retained as a COPC because the background concentrations of manganese were associated with an HI of 0.16; the Site attributable HI from manganese would not significantly impact the total HI. Similarly, the HI associated with cobalt was 0.17, but the background HI for cobalt was 0.06. The Site-associated HI from cobalt would not significantly impact the total HI. Further, cobalt and manganese were not associated with an HI above 0.1 at any other mine level or the OSA. Their maximum concentrations at the 300-Foot Level mine are not indicative of an elevated concentration overall. Total radionuclide risk was 3.7E-4, and COPCs were Th-232, Ra-228, Th-228, U-235, U-238, U-234, Th-230, Ra-226, and Pb-210.

Samples from the Haul Road were associated with a total HI of 0.21 and nonradionuclide risk of 8.2E-07. No individual analyte was associated with an HI above 0.1. Therefore, non-radionuclides were not selected as COPCs. Radionuclide risk totaled 6.4E-05, and COPCs were Th-232, Ra-228, U-235, Th-230, Ra-226, and Pb-210. All posed individual risks above 1E-6.

At the Shoreline/Ore Staging Area, the total HI was 1.0 and total nonradionuclide risk was 4.3E-6. Arsenic posed the entire nonradionuclide risk and was retained as a COPC. Uranium was detected at a maximum concentration of 2,600 mg/kg, was associated with a HI of 0.84, and was retained as a COPC. No other non-radionuclide posed a risk above 1E_6 or HI above 0.1. Radionuclide risk for this area totaled 2.5E-04, and COPCs were Th-232, Ra-228, U-235, U-238, U-234, Th-230, Ra-226, and Pb-210.

In summary, arsenic and uranium were the only nonradionuclides selected as COPC for inclusion in the SSRA. Arsenic was above screening levels in all areas except the Haul Road. Similarly, uranium was above 1/10 of its screening level at all exposure units except the Haul Road. With respect to radionuclides, the specific isotopes selected as COPCs and carried forward to the SSRA are summarized in Table 18.

Table 18. Summary of Radionuclide COPCs for Soil

Radionuclide	900 Level	700 Level	Mine Road/ I&L Spur	300 Level	Haul Road	OSA
Th-232	X	X	X	X	X	X
Ra-228	X	X	X	X	X	X
Th-228	X			X		
U-235	X	X	X	X	X	X
U-238	X	X	X	X		X
U-234	X	X	X	X		X
Th-230	X	X	X	X	X	X
Ra-226	X	X	X	X	X	X
Pb-210	X	X	X	X	X	X
Po-210	X					

3.2 Particulate Inhalation

Particulate inhalation was evaluated for barium, beryllium, cadmium, and chromium per ADEC guidance (2008b). The occupational screening values for particulate inhalation (EPA, 2009b) and maximum soil concentrations were compared, and risks and HIs were far below levels of concern, as shown below (Table 19). Barium is considered noncarcinogenic, while the other three chemicals were evaluated as carcinogens.

Table 19. Screening Values for Particulate Inhalation

Chemical	Maximum Detected Concentration (mg/kg)	Occupational Screening Level (mg/kg)	Risk (HI)	Evaluate further?
Barium	160	3.0E+6	(0.00005)	No
Beryllium	13	1.2E+5	1.1E-10	No
Cadmium	9.5	6.0E+4	1.6E-10	No
Chromium	62	200	3.1E-07	No
		Total Risk (HI)	3.1E-07	

Radionuclide PRGs already include the particulate inhalation pathway and therefore were not independently assessed as particulates. The estimated risks based on the radionuclide PRG comparison include risks from particulate inhalation.

3.3 Diesel Range Organics and Gas Range Organics

Screening levels for DRO and GRO as published by ADEC (2008c) were used to evaluate detected concentrations at four sampling locations in the Site collected by Tetra Tech, as shown below (Table 20). In all cases, the Site concentrations were below the screening levels; DRO and GRO were therefore not furthered considered as COPCs. The PA/SI presented concentrations of DRO of 12,000 mg/kg at the 300-Foot Level but these concentrations were not confirmed with

the more current sampling (300-Foot Level Generator Shack and Tank samples). Therefore, the more current samples were used to assess the Site.

Table 20. Petroleum-Range Screening Levels from Table B2, 18 AAC 75

Location	DRO (mg/kg)	GRO(mg/kg)	DRO SL (mg/kg)	GRO SL (mg/kg)	Evaluate Further?
300 Generator Shack	3200	0.44	8250	1400	No
300 Tank	630	0.11	8250	1400	No
900 L Battery	32	0.434	8250	1400	No
OSA UST Dock	7000	0.19	8250	1400	No

3.4 Surface Water

The surface water screening evaluation data are shown in Table 21 for non-radionuclides, and in Table 22 for radionuclides. For non-radionuclides, the maximum concentrations for most chemicals were below Alaska Water Quality Criteria or background levels. Manganese, mercury and uranium were the only non-radionuclides exceeding screening levels; manganese and uranium were retained as COPCs for further consideration. Mercury was below background values and not furthered considered, even though it was associated with a HI of 0.1. Manganese exceeded the water quality criteria for fish and water ingestion, but did not exceed risk-based concentrations for water ingestion. Uranium at its maximum concentration exceeded Alaska water quality criteria and its risk-based concentration for water ingestion.

Risks from radionuclides in surface water were estimated using EPA tap water PRGS (EPA, 2010). COPCs were gross alpha and beta, Ra-228, Th-228, U-235, U-238, U-234, Th-230, Ra-226, Pb-210, and Po-210. Th-232 was below its risk-based screening level and not retained as a COPC.

Table 21. Surface Water Data for Metals Compared to Human Health-Based Benchmarks[1]

Analyte	Maximum of Site Samples	Background Samples Conc. (Total)	GWSL[2]	AK WQ Criteria[6]	Maximum > Background?	Maximum > GWSL?	Maximum > AK WQC?	HI	COPC?	COPC Rationale
Antimony	0.019	0.17	15	14	No	No	No	1.4E-03	No	BSL, BBL
Arsenic	10 U	10 U	0.57[3]	10	No	--	No		No	BSL, BBL
Aluminum	290	200	37000	NA	**Yes**	No	NA	7.8E-03	No	BSL
Barium	28	8.7	7300	2000	**Yes**	No	No	1.4E-02	No	BSL
Beryllium	0.3	0.24	73	4	Yes	No	No	7.5E-02	No	BSL
Cadmium	0.31	0.3	37	5	**Yes**	No	No	6.2E-02	No	BSL
Calcium	18000	--	NA	NA	**--**	No	NA	NA	No	Essential Nutrient
Chromium	0.35	0.45	55000[4]	NA	No	No	NA	6.4E-06	No	BSL, BBL
Cobalt	0.13	0.19	11	NA	No	No	NA	1.2E-02	No	BSL, BBL
Copper	0.88	3	1500	NA	No	No	NA	5.9E-04	No	BSL, BBL
Iron	630	140	26000	NA	**Yes**	No	NA	2.4E-02	No	BSL
Lead	0.67	0.44	15	NA	**Yes**	No	NA	4.5E-02	No	BSL
Manganese	100	12	880	50	**Yes**	No	**Yes**	2.0E+00	**Yes**	ASL
Mercury	0.0052	0.011	11[5]	0.05	**No**	No	No	1.0E-01	**No**	BBL
Magnesium	1800	--	NA	NA	**--**	NA	NA	NA	No	Essential Nutrient
Molybdenum	6.2	0.84	180	NA	**Yes**	No	NA	3.4E-02	No	BSL
Nickel	0.85	0.85	700	610	**No**	No	No	1.4E-03	No	BSL
Potassium	620	--	NA	NA	--	No	NA	NA	No	Essential Nutrient
Selenium	0.14	0.17	180	50	No	No	No	2.8E-03	No	BSL, BBL
Silver	0.03	0.01	180	NA	**Yes**	No	NA	2.8E-04	No	BSL
Sodium	4900	--	NA	NA	**--**	NA	NA	NA	No	Essential Nutrient
Thallium	0.014	0.0051	3	1.7	**Yes**	No	No	8.2E-03	No	BSL
Uranium	240	1.6	110	30	**Yes**	**Yes**	**Yes**	8.0E+00	**Yes**	Above all levels
Vanadium	10 U	10 U	256	NA	No	No	NA	2.0E-02	No	BSL, BBL
Zinc	49	28	11000	9100	**Yes**	No	No	5.4E-03	No	BSL
							TOTAL	**1.0E+01**		

(1) All concentrations are ug/L. Site samples are from the PA/SI (KSI, 2004) and Tetra Tech 2009 sampling
(2) Screening Level from ADEC 2010 or EPA 2009b when not available from ADEC; Lead value is MCL
(3) Arsenic III (4) Chromium III (5) Total Mercury
(6) Alaska Water Quality Criteria, from ADEC 2008d; values are for human health water consumption and aquatic organisms when available; otherwise, values are ADEQ drinking water standard (marked with *)
NA = No value available U = Non-detect; the value shown is the detection limit and 1/2 DL is used for screening.
ASL = Above Screening Level, BSL = Below Screening Level, ABL = Above Background Level, BBL = Below or Equivalent to Background Level

Table 22. Surface Water Data for Radionuclides Compared to Human Health-Based Benchmarks (1)

Analyte	Maximum of Site Samples	Background Conc.	EPA Rad Tap Water PRG (2)	MCL (3)	Maximum > Background?	Maximum >EPA PRG Tap Water	Maximum > MCL?	Risk	COPC?	COPC Rationale
Gross Alpha	34.6	4.2	NA	15	**Yes**	NA	**Yes**		**Yes**	Above MCL
Gross Beta	19.1	3.8	NA	15	**Yes**	NA	**Yes**		**Yes**	Above MCL
Th-232 Decay Chain										
Th-232	0.284	0.032	0.524	15	**Yes**	No	No	5.4E-07	No	BSL
Ra-228	7.2	0.23 U	0.0509	5	**Yes**	**Yes**	**Yes**	1.4E-04	**Yes**	ASL, Above MCL
Th-228	1.04	0.15	0.494	15	**Yes**	**Yes**	No	2.1E-06	**Yes**	ASL but below MCL
U-235 Decay Chain										
U-235	3.42	0.031	0.76	20	**Yes**	**Yes**	No	4.5E-06	**Yes**	ASL, ABL but below MCL
U-238 Decay Chain										
U-238	79	0.165	0.827	20	**Yes**	**Yes**	**Yes**	9.6E-05	**Yes**	ASL, ABL, Above MCL
U-234	96	0.193	0.748	20	**Yes**	**Yes**	**Yes**	1.3E-04	**Yes**	ASL, ABL, Above MCL
Th-230	0.95	0.159	0.581	15	**Yes**	**Yes**	No	1.6E-06	**Yes**	ASL, ABL but below MCL
Ra-226	7.8	0.88	0.000914	5	**Yes**	**Yes**	**Yes**	8.5E-03	**Yes**	ABL, ASL, Above MCL
Pb-210	5.4	0.87	0.0601	5	**Yes**	**Yes**	**Yes**	9.0E-05	Yes	ASL, ABL, above MCL
Po-210	1.31	0.13 U	0.14	5	**Yes**	**Yes**	No	9.4E-06	**Yes**	ASL but below MCL
							TOTAL	9.0E-03		

(1) All concentrations are pCi/L. Site samples are from the PA/SI (KSI, 2004) and Tetra Tech 2009 sampling
(2) EPA PRGs for Radionuclides, risks set to 1E-6
(3) ADEC Standard for Ra-226 and Ra-228 is 5 pCi/L total; MCL for all Uranium isotopes is a proposed value
ASL = Above Screening Level, BSL = Below Screening Level, ABL = Above Background Level, BBL = Below or Equivalent to Background Level

Risks from radionuclides in surface water were estimated using EPA tap water PRGS (EPA, 2007a). COPCs were gross alpha and beta, Ra-228, Th-228, U-235, U-238, U-234, Th-230, Ra-226, Pb-210, and Po-210. All other radionuclides were either below screening levels or at background levels.

3.5 Stream Sediment

Stream sediment was evaluated using the same screening levels as soil. This resulted in a very conservative estimate, as it is unlikely that stream sediment would be contacted by human receptors as frequently as soil. Using the occupational screening levels, the total HI from non-radionuclides was 0.38. Manganese was associated with an HI of 0.11, but the background concentration contributed an HI of 0.06. The remaining contribution of manganese of 0.05 was not significant and manganese was not retained as a COPC. No other analyte posed an HI above 0.1 and the total HI was not in excess of 1.0; therefore, no non-radionuclides were selected as COPCs for stream sediment. Arsenic in stream sediment was determined to be at background levels. Particulate inhalation of sediment was not assessed, as particle suspension and inhalation is not a complete exposure pathway for wet materials. Results are presented in Table 23.

For radionuclides, the total risk was estimated to be 6.5E-05. Radionuclides posing risks greater than 1E-06 and retained as COPCs were Th-232, Ra-228, U-235, U-238, U-234, Th-230, Ra-226, and Pb-210. Results are presented in Table 24.

3.6 Marine Sediment

Marine sediment was evaluated using the same screening levels as soil, although sediment is not likely to be contacted as frequently or to the same extent as soil. Inhalation of particulates was not assessed as it is not a complete exposure pathway for sediment. Results are presented in Table 25for non-radionuclides and Table 26 for radionuclides. Based on the maximum detected value, arsenic at a risk of 3.1E-05 was retained as a COPC. Arsenic exceeded the screening level concentration of 16 mg/kg and was retained as a COPC. All other inorganics posed a total HI of 0.23 and were not retained as COPCs.

Radionuclides in marine sediment posed a total risk of 7.4E-5 to the hypothetical occupational receptor. COPCs were Th-232, Ra-228, U-235, U-238, U-234, Th-230, Ra-226, and Pb-210.

3.7 Radon Inhalation and Gamma Radiation Exposure

As noted in Section 2.3.4, radiation dose from radon gas inhalation and direct gamma radiation exposure comprise a significant fraction of the total risk to an on-Site visitor or worker. The maximum measured ambient radon gas concentration and direct gamma radiation exposure rate for each major portion of the Site (excluding portals and invalid measurements) are given in Table 27. The maximum measured direct gamma radiation readings were adjusted to account for the energy dependency of the NaI detector as described in Section 2.3.4. The following equation for adjusting the exposure rate reading to dose was derived from a cross-calibration between the exposure rates measured by the NaI detector system and the dose rates recorded using a Bicron microrem meter (Tetra Tech, 2010a):

$$D = (7X10^{-5}X^2) + (0.4253X) - 0.1324$$

Where: D = dose rate (urem/hour)
X = NaI measured exposure rate (uR/hr)

Table 23. Stream Sediment Data for Metals Compared to Human Health-based Benchmarks(1)

Analyte	Maximum of Site Samples	Background Conc.	AK Residential SL(2)	AK Occupational SL(3)	Maximum > Background?	Occupational HI	COPC?	COPC Rationale
Aluminum	12000	13000	83000	>1E6	No	1.2E-02	No	BSL,BBL
Antimony	0.23	0.043	33	410	**Yes**	5.6E-04	No	BSL
Arsenic	6.3	10	3.7	16	No	(4)	No	BBL
Barium	72	16	16600	204000	**Yes**	3.5E-04	No	BSL
Beryllium(5)	1.8	2.7	170	2000	No	9.0E-04	No	BSL, BBL
Cadmium	0.82	0.12	65	620	**Yes**	1.3E-03	No	BSL
Chromium	26	13	250	3100	**Yes**	8.4E-03	No	BSL
Cobalt	9.7	6.7	25	310	**Yes**	3.1E-02	No	BSL
Copper	25	5.6	3300	40900	**Yes**	6.1E-04	No	BSL
Iron	27000	31000	58100	715000	No	3.8E-02	No	BSL, BBL
Lead	64	22	400	800	**Yes**	8.0E-02	No	BSL
Manganese	2600	1500	2000	24500	**Yes**	1.1E-01	No	BSL
Mercury	0.033 U	0.0088	25	310	**Yes**	5.3E-05	No	BSL
Molybdenum	11	1.2	410	5100	**Yes**	2.2E-03	No	BSL
Nickel	31	7	1700	20400	**Yes**	1.5E-03	No	BSL
Selenium	4	0.49 U	410	5100	**Yes**	7.8E-04	No	BSL
Silver	0.22	0.05	410	5100	**Yes**	4.3E-05	No	BSL
Thallium	0.2	0.061	6.6	82	**Yes**	2.4E-03	No	BSL
Vanadium	53	28	580	7200	**Yes**	7.4E-03	No	BSL
Zinc	230	64	24900	307000	**Yes**	7.5E-04	No	BSL
Uranium	270	4.1	250	3100	**Yes**	8.7E-02	No	BSL
						3.8E-01		

(1) All concentrations are mg/kg dry weight. Site samples are from the PA/SI (Kent and Sullivan, 2004) and Tetra Tech 2009 sampling
(2) From ADEC Method 3 calculator
(3) From ADEC Web-based calculator at risk = 1E-5 and HI = 1.0
(4) Not a COPC - below background
(5) Revised for direct contact pathways only; inhalation of sediments is not a complete exposure pathway.
U = Non-detect; the value shown is the detection limit and 1/2 DL is used for screening.
ASL = Above Screening Level, BSL = Below Screening Level, ABL = Above Background Level, BBL = Below or Equivalent to Background Level

Table 24. Stream Sediment Data for Radionuclides Compared to Human Health-Based Benchmarks[1]

Analyte	Maximum of Site Samples (pCi/g)	Background (pCi/g)	EPA Rad-PRG Residential [2]	EPA Rad PRG Outdoor Worker[3]	Maximum > Background ?	Risk-Residential	Risk-Outdoor	COPC ?	COPC Rationale
Th-232	33.2	2.45	3.07E+00	1.89E+01	**Yes**	1.1E-05	1.8E-06	**Yes**	ASL
Ra-228	47.6	2.27	2.69E-01	8.40E+00	**Yes**	1.8E-04	5.7E-06	**Yes**	ASL
Th-228	38.6	2.41	2.34E+01	1.21E+02	**Yes**	1.6E-06	3.2E-07	No	BSL
Pb-212	35	--	3.55E+03	5.92E+03	**--**	9.9E-09	5.9E-09	No	BSL
Bi-212	38.5	--	2.05E+04	3.33E+04	**--**	1.9E-09	1.2E-09	No	BSL
U-235	3.8	0.07	1.92E-01	4.17E-01	**Yes**	2.0E-05	9.1E-06	**Yes**	ASL
Th-227	19 U	--	1.05E+02	1.78E+02	**--**	9.0E-08	5.3E-08	No	BSL
U-238	60.8	2.46	4.48E+00	3.67E+01	**Yes**	1.4E-05	1.7E-06	**Yes**	ASL
Th-234	96	2.25	1.27E+03	3.05E+03	**Yes**	7.6E-08	3.1E-08	No	BSL
U-234	56.8	2.72	4.02E+00	3.23E+01	**Yes**	1.4E-05	1.8E-06	**Yes**	ASL
Th-230	70	4.63	3.46E+00	2.00E+01	**Yes**	2.0E-05	3.5E-06	**Yes**	ASL
Ra-226	114	4.9	1.99E-01	3.64E+00	**Yes**	5.7E-04	3.1E-05	**Yes**	ASL
Pb-214	94	--	4.48E+04	7.25E+04	**--**	2.1E-09	1.3E-09	No	BSL
Bi-214	85.4	--	7.95E+03	1.29E+04	**--**	1.1E-08	6.6E-09	No	BSL
Pb-210	38.5	3.19	3.35E-01	4.18E+00	**Yes**	1.1E-04	9.2E-06	**Yes**	ASL
Po-210	53.3	2.83	3.82E+01	2.73E+02	**Yes**	1.4E-06	2.0E-07	No	BSL
Tl-208	10.2	--	2.31E+04	3.73E+04	**--**	4.4E-10	2.7E-10	No	BSL
						9.5E-04	**6.5E-05**		

(1) All Concentrations are in pCi/g. Site and background samples are from the PA/SI (KSI, 2004) and Tetra Tech 2009 sampling
(2) EPA Radiological PRGs 2010 residential exposure assumptions, risk = 1.0E-6
(3) EPA Radiological PRGs 2010 Outdoor Worker assumptions, risk = 1.0E-6
Residential screening presented per ADEC guidance but not used to select COPCs
ASL = Above Screening Level, BSL = Below Screening Level, ABL = Above Background Level, BBL = Below or Equivalent to Background Level

Table 25. Marine Sediment Data for Metals Compared to Human Health-based Benchmarks[1]

Analyte	Maximum of Site Samples	Maximum Background	Background UPL	AK Residential SL[2]	AK Occupational SL[3]	Residential HI	Residential Risk	Occupational HI	Occupational Risk	COPC?	COPC Rationale
Aluminum	23000	11000	11000	83000	>1E6	2.8E-01		1.1E-02		No	BSL
Antimony	0.14	0.24	0.24	33	410	4.2E-03		3.4E-04		No	BSL,BBL
Arsenic	49	22	22	3.7	16		1.3E-04		3.1E-05	**Yes**	ASL
Barium	27	56	54.4	16600	204000	1.6E-03		1.3E-04		No	BSL,BBL
Beryllium[4]	1.2	1.2	0.983	170	2000		7.1E-08		6.0E-09	No	BSL
Cadmium	0.91	5.4	4.568	65	620	1.4E-02		1.5E-03		No	BSL,BBL
Chromium	19	29	29	250	3100	7.6E-02		6.1E-03		No	BSL,BBL
Cobalt	5.9	6.4	6.24	25	310	2.4E-01		1.9E-02		No	BSL,BBL
Copper	17	30	29.6	3300	40900	5.2E-03		1.2E-05		No	BSL,BBL
Iron	51000	25000	22500	58100	715000	8.8E-01		3.6E-02		No	BSL
Lead	44	36	28.85	400	800					No	BSL
Manganese	550	860	770	2000	24500	2.8E-01		2.2E-02		No	BSL,BBL
Mercury	0.033U	0.06	0.0601	25	310	4.4E-04		5.3E-05		No	BSL,BBL
Molybdenum	4.6	10	11.47	410	5100	1.1E-02		9.0E-04		No	BSL,BBL
Nickel	13	21	21	1700	20400	7.6E-03		6.4E-04		No	BSL,BBL
Selenium	1	3.2	2.759	410	5100	2.4E-03		2.0E-04		No	BSL,BBL
Silver	1 U	0.055	(4)	410	5100	1.2E-03		9.8E-05		No	BSL, ND
Thallium	0.085	0.2	0.2	6.6	82	1.3E-02		1.0E-03		No	BSL, BBL
Vanadium	31	43	43	580	7200	5.3E-02		4.3E-03		No	BSL, BBL
Zinc	67	110	110	24900	307000	2.7E-03		2.2E-04		No	BSL,BBL
Uranium	390	19	18	250	3100	1.6E+00		1.3E-01		No	BSL
					TOTAL	**3.4E+00**	**1.3E-04**	**2.3E-01**	**3.1E-05**		

(1) All concentrations are mg/kg. Site and background samples are from the PA/SI (KSI, 2004) and Tetra Tech 2009 sampling
(2) ADEC Table B1 values and as calculated by ADEC Method 3 calculator for Al, Co, Fe, Mn, Mo, and U
(3) ADEC Method 3 calculator (occupational exposure) at risk = 1E-5 and HI = 1.0
(4) Revised for direct contact pathways excluding inhalation; inhalation is not a complete exposure pathway for marine sediment
Residential screening presented per ADEC guidance but not used to select COPCs
ASL = Above Screening Level, BSL = Below Screening Level, ABL = Above Background Level, BBL = Below or Equivalent to Background Level

Table 26. Marine Sediment Data for Radionuclides Compared to Human Health-Based Benchmarks[1]

Analyte	Maximum of Site Samples	Maximum Background	Back-Ground UPL	EPA Rad-PRG Residential[2]	EPA Rad PRG Outdoor Worker[3]	Residential Risk	Outdoor Worker Risk	COPC?	COPC Rationale
The Decay Chain									
Th-232	117	5.15	5.105	3.07E+00	1.89E+01	3.8E-05	6.2E-06	**Yes**	ASL
Ra-228	45.4	3.96	3.534	2.69E-01	8.40E+00	1.7E-04	5.4E-06	**Yes**	ASL
Th-228	123	5.18	4.535	2.34E+01	1.21E+02	5.3E-06	1.0E-06	No	BSL
Pb-212	48.3	5.1	4.68	3.55E+03	5.92E+03	1.4E-08	8.2E-09	No	BSL
Bi-212	46.3	5.4	4.307	2.05E+04	3.33E+04	2.3E-09	1.4E-09	No	BSL
U-235 Decay Chain									
U-235	8.7	0.44	0.302	1.92E-01	4.17E-01	4.5E-05	2.1E-05	**Yes**	ASL
Th-227	4.6	--	--	1.05E+02	1.78E+02	4.4E-08	2.6E-08	No	BSL
U-238 Decay Chain									
U-238	137	7.8	7.8	4.48E+00	3.67E+01	3.1E-05	3.7E-06	**Yes**	ASL
Th-234	121	9.5	7.064	1.27E+03	3.05E+03	9.5E-08	4.0E-08	No	BSL
U-234	132	7.9	7.9	4.02E+00	3.23E+01	3.3E-05	4.1E-06	**Yes**	ASL
Th-230	222	9.3	8.85	3.46E+00	2.00E+01	6.4E-05	1.1E-05	**Yes**	ASL
Ra-226	64	7.32	6.225	1.99E-01	3.64E+00	3.2E-04	1.8E-05	**Yes**	ASL
Pb-214	82	6.43	5.425	4.48E+04	7.25E+04	1.8E-09	1.1E-09	No	BSL
Bi-214	75.2	5.18	4.49	7.95E+03	1.29E+04	9.5E-09	5.8E-09	No	BSL
Pb-210	15.2	9.3	8.535	3.35E-01	4.18E+00	4.5E-05	3.6E-06	**Yes**	ASL
Po-210	41.6	13	12.4	3.82E+01	2.73E+02	1.1E-06	1.5E-07	No	BSL
Tl-208	4.56	1.57	1.348	2.31E+04	3.73E+04	2.0E-10	1.2E-10	No	BSL
					TOTAL	**7.5E-04**	**7.4E-05**		

(1) All Concentrations are in pCi/g. Site and background samples are from the PA/SI (KSI, 2004) and Tetra Tech 2009 sampling
(2) EPA Radiological PRGs 2010a residential exposure assumptions, risk set to 1.0E-6
(3) EPA Radiological PRGs 2010Outdoor Worker assumptions, risk set to 1.0E-6
Residential screening presented per ADEC guidance but not used to select COPCs
ASL = Above Screening Level, BSL = Below Screening Level, ABL = Above Background Level, BBL = Below or Equivalent to Background Level

Table 27. Maximum Measured Rn Concentrations and Maximum Gamma Dose Rate

Location	Maximum Rn Concentration (pCi/L)	Average Gamma Exposure Rate (uR/hr)	Calculated Gamma Dose Rate (urem/hr)
Ore Stockpile Area	92.9	401	182
300-Foot Level	136.1	120	52
700-Foot Level	40.1	306	137
900-Foot Level (includes open pit)	372.8	287	128

3.7.1 Radon Screening Level Assessment

Radon gas is present at the Site due to the decay of natural uranium and thorium. Radon-222 is a decay product of uranium. Rn-220 is a decay product of thorium. Radon itself is an inert gas that is not generally absorbed in the body, and thus produces only a small portion of its radiation dose from inhalation. It is the inhaled short-lived Rn-222 decay products, principally polonium-218 (Po-218), lead-214 (Pb-214), bismuth-214 (Bi-214) and polonium-214 (Po-214), if deposited in the lung where they subsequently decay and release energy in the form of alpha radiation, that produce the principal dose. The short-lived decay products of Rn-220 include Po-216, Pb-212, Bi-212, Po-208, and Th-208. Radon is released from soil or rock as a gas. In a closed system the Rn-222 decay products build into equilibrium with the parent at a rate that is dependent on the half-lives of the decay products, which range from 164 microseconds to 28.6 minutes. In general, the decay products build into full equilibrium, i.e. activity equal to the activity of the parent Rn-222, in approximately four hours. The equilibrium fraction, thus the relative concentration of the decay products, is a complex function of the "age" of the air. For the Site, the fractions of equilibrium at various times after emanation from rock or soil were assumed to be less than 0.10 based on the wind speed and distance from the source to the point of interest. The equilibrium fraction would be lower close to the source and higher at the perimeter of the impacted area.

The maximum equilibrium fraction was estimated from a curve of equilibrium fraction versus age of air presented in Radiation Data and Reports (Schiager, 1974). The age of the air was calculated using the annual average wind speed at the Site based on data from the Annette Island meteorological station, and the longest distance across the impacted 700-Foot/900-Foot Level area of the Site determined from the gamma exposure rate maps (Tetra Tech, 2010a).

Annual average wind speed = 6 m s^{-1}
Distance across the 700-Foot/900-Foot Level area = 2300 ft (700 m)
Annual average age of the air passing across the 700/900-Foot Level area = 2 minutes

The equilibrium fraction for 2 minute radon decay product buildup time is approximately 0.05 (Schiager, 1974). However, for the purpose of this screening level risk assessment, in order to be conservative and take into account the contribution from sub-surface sources of radon gas, e.g., exhalation from portals and force flow through cracks in the bedrock, the upper limit of the equilibrium fraction for radon emanating from the Site was assumed to be 0.1.

The appropriate radiation protection guidance for outdoor exposure to radon and its decay products for members of the public is given in 10 CFR 20, the Nuclear Regulatory Commission regulations for licensed sites. The 10 CFR 20, Appendix B effluent concentration limit for members of the public is 0.1 pCi L^{-1} Rn-222 in full equilibrium with its decay products, or 10 pCi

L^{-1} with no decay products present. The allowable Rn-222 concentration is adjusted to account for the degree of equilibrium. For example, at an equilibrium fraction of 0.1, the allowable Rn-222 concentration would be as follows:

$$\text{Concentration} = 0.1 \text{ pCi } L^{-1}/0.10 = 1 \text{ pCi } L^{-1}$$

The U.S. Environmental Protection Agency recommends remediation of residences at indoor radon concentrations 4 pCi L^{-1} or greater (EPA, 2009c). However, this guideline is not risk-based but takes into account the levels that are reasonably achievable through remediation. The EPA encourages efforts to reduce Rn-222 concentrations to levels below the 4 pCi L^{-1} guideline.

Radon-220, the gaseous decay product of Th-232, is released from the Site along with the Rn-222. The alpha track radon measurement device deployed at Site, does not distinguish between Rn-220 and Rn-222. However, the assumption that all of the measured radon is Rn-222 is conservative since the risk from inhalation of Rn-220 decay products is significantly lower than the risk from Rn-222 decay products at equivalent radon gas concentrations. Due to the very short half-life of the Rn-220 (55 s), its longer-lived immediate decay products do not reach equilibrium.

The upper limit of background was subtracted from the maximum measured radon concentrations at the monitoring locations around the Site as shown in the Final Site Characterization Report (Tetra Tech, 2010a). The maximum measured radon concentration was used in the screening level assessment because there were too few valid measurements at each location to calculate the 95 percent upper confidence limit on the mean (95 UCLM).

Since the screening level based on the 10 CFR 20 effluent limit is equal to 1 pCi L^{-1}, the net radon concentration is numerically equal to the screening level ratio. The 10CFR20, Appendix B effluent limit is the average annual concentration in air that will result in a dose to an average member of the public equal to 50 mrem per year. The effluent limit for radon is dependent on the equilibrium fraction.

- Background radon concentration ranges up to 5.8 pCi L^{-1}
- Radon monitoring locations where concentrations exceeded 5.8 pCi L^{-1} + 1 pCi L^{-1}
  - OSA-RAD-1: (92.9 pCi L^{-1}–6.8 pCi L^{-1})/1 pCi L^{-1}= 86.1
  - 700L-RAD-14: (40.1 pCi L^{-1} – 6.8 pCi L^{-1})/1 pCi L^{-1} = 33.3
  - 900L-RAD-23: (372.8 pCi L^{-1} – 6.8 pCi L^{-1}/1 pCi L^{-1}= 366
  - 300L-RAD-29: (136.1 pCi L^{-1} – 6.8 pCi L^{-1})/1 pCi L^{-1} = 130

Based on the screening level calculations, radon is a constituent of concern. Therefore, potential radiation dose and risk due to inhalation of radon decay products is evaluated further in the site-specific risk assessment. The 95 UCLM for the Site average was used in the site-specific dose and risk calculations.

3.7.2 Direct Gamma Dose Rate Screening Level Risk Assessment

The EPA has established a dose limit for cleanup of radiologically contaminated CERCLA sites of 15 mrem per year (Luftig, 1997). The EPA notes that 15 mrem per year equates to a lifetime risk of approximately 3 x 10^{-4}. If gamma exposure were the only pathway present, the maximum allowable hourly dose rate would be approximately 3 urem/hr above background assuming 75 percent of time is spent at a site. The measured gamma background level for non-mineralized

areas of the Site is estimated to be approximately 15 uR/hr or 6 urem/hr. The average gamma dose rate for all locations at the Site exceeds 9 urem/hr; therefore, direct gamma radiation dose and risk are carried over to the site-specific risk assessment. The average gamma dose rate was used in the analysis since it would be nearly identical to the 95 UCLM given the very large number of observations, i.e., greater than 20,000 for each area.

3.8 Conclusion

Based on the screening level risk evaluation, the following substances were selected as COPCs and retained for the detailed SSRA site-specific risk assessment, including subsistence exposure pathways:

- Soil: Arsenic, Uranium, Th-232, Ra-228, Th-228, U-235, U-238, U-234, Th-230, Ra-226, Pb-210, Po-210
- Surface Water: Manganese, Uranium; Gross alpha, Gross beta, Ra-228, Ra-226, Th-228, Th-230, Po-210, U-234, U-235, U-238, Pb-210
- Stream Sediment: Th-232, Ra-228, U-234, U-235, U-238, Th-230, Ra-226, Pb-210
- Marine Sediment: Arsenic; Th-232, Ra-228, U-235, U-238, U-234, Th-230, Ra-226, Pb-210
- Radon in Air
- Direct Gamma Radiation Exposure

4.0 THE SITE-SPECIFIC HUMAN HEALTH RISK ASSESSMENT

4.1 Introduction

Using the COPCs selected in the screening level evaluation, a site-specific risk assessment (SSRA) was conducted. This site-specific HHRA evaluated subsistence activities, as well as direct contact pathways, using exposure parameters more specific to the Site. Data were aggregated for soil COPCs, gamma radiation and radon to calculate an exposure point concentration while the maximum detected value was retained as the exposure point concentration for all other media. Site-specific workers, area visitors and subsistence food pathways are evaluated in the SSRA. Statistical estimates were computed using ProUCL software (EPA, 2007).

To assess subsistence food pathways, the COPCs from the screening evaluation were further evaluated for the likely sources of locally-obtained-food ingestion (harvested deer, seasonal berries, sea weed, fish, and sea cucumber). Given no local full-time population, assumptions concerning the harvested amount for these foods included in the SSRA calculations are from Hydaburg and Craig.

Exposure parameters for the SSRA were selected to more accurately reflect current and future Site use. In particular, exposure frequencies and durations more indicative of potential Site receptors were used. Additionally, a more reasonable estimate of direct contact with sediment was used for the site-specific occupational and area visitor receptors in the SSRA, and time-apportioned exposure was utilize in assessing gamma radiation dose and risk.

The following subsections further describe the receptors and exposure parameters used to assess risks at the Site, followed by the results of the radon assessment, gamma assessment, and the assessment of risks and hazards from contact with soil, surface water, and sediments.

4.2 Site-specific Receptors and Exposure Parameters

The revised CSM, presented in Figure 9, identifies the receptors evaluated in the SSRA. The current and future uses of the Site, consistent with the Tongass National Forest Master Plan, determined the potential receptors for the Ross-Adams area. The four scenarios evaluated are:

1. a site-specific mineral exploration worker
2. a site-specific USFS worker
3. an area visitor
4. subsistence food pathways

Exposure parameters used to assess each receptor are presented in Tables 28 through 31. Tables 33 and 34 present the chemical and radionuclide-specific toxicity values and uptake factors. The following subsections describe the exposure parameters used to evaluate the four receptors.

4.2.1 Site-Specific Mineral Exploration Worker

Table 28 presents the exposure parameters used to evaluate Site exposure for a mineral exploration worker.

Table 28. Exposure Parameters for Mineral Exploration Worker

Exposure Parameter	Value	Source
Soil Ingestion Rate	100 mg/day	ADEC 2010
Inhalation Rate	30 m^3/day	Receptor-specific
Exposure Frequency	120 days/year	Receptor-specific
Exposure Time	12 hours/day	Receptor-specific
Sediment Contact Time	1 hour per 24 hour day	Professional judgment
Sediment Ingestion Rate	10 mg/day	10% of soil ingestion rate
Dermal Contact	3,300 cm^2/event	ADEC 2010
Dermal Adherence Factor	0.07	ADEC 2010
Exposure Duration	3 years	Receptor-specific
Particulate Emission Factor	1.18E9	ORNL 2011 (Seattle area value)
Area Correction Factor	0.9	ORNL 2011
Gamma Shielding Factor	0.4	ORNL 2011

The site-specific mineral exploration worker reasonable maximum exposure was set to 120 days per year based on:

1. remoteness of the Site; and
2. known mineral exploration work occurring in the Bokan Mountain Area that indicates work is generally performed from August to mid-November, weather permitting (approximately 110 days) (Landmark Alaska, 2009).

The worker was assumed to be on-site for 12 hours per day, with the balance of the day spent off-site (off-shore). Dermal exposure was evaluated using a surface area of 3,300 cm^2 (ADEC, 2010) with a dermal adherence factor of 0.07, and the inhalation rate was assumed to be 30 m^3/day over the 12 hour exposure period. The soil ingestion rate was set to 100 mg/day, the ADEC default for an outdoor worker. The sediment ingestion rate was set to 10 percent of the soil ingestion rate. Sediment ingestion is not likely to occur as frequently or to the extent that soil ingestion may occur, and 10 mg/day was considered an upper-bound estimate of direct contact with sediment. Sediment exposure was also assumed to occur for only one hour per day, which is likely a high contact rate.

Potential exposure to airborne dust was estimated using a particulate emission factor (PEF) that relates the concentration of soil COPCs to the concentration of respirable particles in air. The PEF is an annual average emission rate based on wind erosion/suspension. The PEF methodology utilized is found in Section 3.3.2 of Risk Assessment Guidance for Superfund, Part B (EPA, 1991). The PEF methodology assumes an "unlimited reservoir" model, developed to estimate PM10 emissions of respirable particulate matter (defined as being less than 10 micrometers in diameter) (Cowherd et al., 1985). The PEF was based on climatic data for Seattle, Washington, which was the most similar climatic region available for the PEF calculation.

Estimating dose from radionuclides includes an assessment of dose from external exposure (instead of dermal contact). Assessment of external dose utilizes the unitless factors of area correction and gamma shielding. The area correction factor of 0.9 is appropriate for source areas of up to 2,000 m^2 (about 0.5 acres), consistent with the PEF assumptions (EPA, 2000). The value is representative of contact with impacted soils across the Site. The gamma shielding factor of 0.4 assumes a low level of shielding (EPA, 2000) and is the default value used by RAIS (ORNL, 2011).

4.2.2 USFS Worker

As shown in Table 29, the site-specific USFS worker reasonable maximum exposure was set to ten days per year, based on typical lengths of time needed for biota and wildlife surveys, or for USFS workers to evaluate land use for consistency with the Master Plan. Exposure duration equal to the occupational tenure of 25 years was used; it is the upper-bound estimate of employment tenure and likely an overestimate of an individual's frequency of visiting the Site.

Table 29. Exposure Parameters for USFS Worker

Exposure Parameter	Value	Source
Soil Ingestion Rate	100 mg/day	ADEC 2010
Sediment Ingestion Rate	10 mg/day	10% of soil ingestion rate; professional judgment
Sediment Contact Time	1 hour per 24 hour day	Professional judgment
Inhalation Rate	20 m^3/day	ADEC 2010
Exposure Frequency	10 days/year	Receptor-specific
Exposure Time	12 hours/day	Receptor-specific
Dermal Contact	33,00 cm^2/event	ADEC 2010
Dermal Adherence Factor	0.07	ADEC 2010
Exposure Duration	25 years	ADEC 2010
Particulate Emission Factor	1.18E9	ORNL 2011 (Seattle area value)
Area Correction Factor	0.9	ORNL 2011
Gamma Shielding Factor	0.4	ORNL 2011

Dermal exposure was evaluated using a surface area of 3,300 cm^2 with a dermal adherence factor of 0.07 (ADEC, 2010) and the inhalation rate was assumed to be 20 m^3/day over the 12 hour exposure period. The soil ingestion rate was set to 100 mg/day, the ADEC default for an outdoor worker. The sediment ingestion rate was set to 10 percent of the soil ingestion rate. Sediment ingestion is not likely to occur as frequently or to the extent that soil ingestion may occur, and 10 mg/day was considered an upper-bound estimate of direct contact with sediment. Sediment exposure was also assumed to occur for only 1 hour per day, which is likely a high contact rate.

Potential exposure to airborne dust was estimated using a particulate emission factor (PEF) that relates the concentration of soil COPCs to the concentration of respirable particles in air. The PEF is an annual average emission rate based on wind erosion/suspension. The PEF methodology utilized is found in Section 3.3.2 of Risk Assessment Guidance for Superfund, Part B (EPA, 1991). The PEF methodology assumes an "unlimited reservoir" model, developed to estimate PM10 emissions of respirable particulate matter (defined as being less than ten micrometers in diameter) (Cowherd et al., 1985). The PEF was based on climatic data for Seattle, Washington, which was the most similar climatic region available for the PEF calculation.

Estimating dose from radionuclides includes an assessment of dose from external exposure (instead of dermal contact). Assessment of external dose utilizes the unitless factors of area correction and gamma shielding. The area correction factor of 0.9 is appropriate for source areas of up to 2,000 m^2 (about 0.5 acres), consistent with the PEF assumptions (EPA 2000). The value is representative of contact with impacted soils across the Site. The gamma shielding factor of 0.4 assumes a low level of shielding (EPA, 2000) and is the default value used by RAIS (ORNL, 2011). The shielding factors assume the source is an "infinite slab" of gamma radiation.

4.2.3 Area Visitor

Given the potential recreational uses of the Site as part of the Tongass National Forest, an area visitor exposure scenario was developed and assessed. Using an exposure frequency of 14 days per year for 30 years, this receptor was conservatively assessed using both adult and child exposure parameters (Table 30). Surface water ingestion was included in this assessment. The exposure frequency is based on Tongass National Forest limits for maintained campgrounds. Because the Site is not a maintained campground, this exposure frequency is conservative, given the remoteness of the Site, lack of facilities, and lack of nearby communities. While it is also unlikely that the same individual would visit the Site every year for 30 years, the exposure duration of 30 years was used to be consistent with ADEC recommendations for residential exposure duration and subsistence receptor exposure durations.

Table 30. Exposure Parameters for Area Visitor

Exposure Parameter	Value	Source
Soil Ingestion Rate	100 mg/day (adult) 200 mg/day (child)	ADEC 2010
Sediment Ingestion Rate	10 mg/day 20 mg/day (child)	10% of soil ingestion rate; professional judgment
Sediment Contact Time	1 hour per 24 hour day	Professional judgment
Inhalation Rate	20 m^3/day (adult) 10 m^3/day (child)	ADEC 2010
Exposure Frequency	14 days/year	Receptor-specific
Exposure Time	24 hours/day	Receptor-specific
Water Ingestion	2 L/day (adult)	ADEC 2010
Dermal Contact	5700 cm^2/event (adult) 2800 cm^2/event (child)	ADEC 2010
Dermal Adherence Factor (metals only)	0.07 (adult) 0.2 (child)	ADEC 2010
Exposure Duration	30 years	ADEC 2010
Particulate Emission Factor	1.18E9	ORNL 2011 (Seattle area value)
Shielding Factor (radionuclides only)	0.4	ORNL 2011
Area Correction Factor	0.9	ORNL 2011
Gamma Shielding Factor	0.4	ORNL 2011

It was assumed that the child area visitor would have a soil ingestion rate of 200 mg/day, and inhalation rate of 10 m^3/day. The adult area visitor was assumed to have a soil ingestion rate of 100 mg/day inhalation rate of 20 m^3/day and water ingestion rate of 2 L/day. Again, the incidental sediment ingestion rate was assume to be 10 percent of the soil ingestion rate and occur for one hour per day, and the particulate emission factor, gamma shielding factor, and area correction factor were the same as the occupational receptors. The dermal adherence factor for adults was 0.07 and for children was 0.2 (ADEC, 2010).

Potential exposure to airborne dust was estimated using a particulate emission factor (PEF) that relates the concentration of soil COPCs to the concentration of respirable particles in air. The PEF is an annual average emission rate based on wind erosion/suspension. The PEF methodology utilized is found in Section 3.3.2 of Risk Assessment Guidance for Superfund, Part B (EPA, 1991). The PEF methodology assumes an “unlimited reservoir” model, developed to estimate PM10 emissions of respirable particulate matter (defined as being less than ten micrometers in diameter) (Cowherd et al., 1985). The PEF was based on climatic data for Seattle, Washington, which was the most similar climatic region available for the PEF calculation.

Estimating dose from radionuclides includes an assessment of dose from external exposure (instead of dermal contact). Assessment of external dose utilizes the unitless factors of area correction and gamma shielding. The area correction factor of 0.9 is appropriate for source areas of up to 2,000 m^2 (about 0.5 acres), consistent with the PEF assumptions (EPA, 2000). The value is representative of contact with impacted soils across the Site. The gamma shielding factor of 0.4 assumes a low level of shielding (EPA, 2000) and is the default value used by RAIS (ORNL, 2011). The shielding factors assume the source is an "infinite slab" of gamma radiation.

4.2.4 Subsistence Food Pathways

Due to the location of the Site within the Tongass National Forest, and the reliance on subsistence hunting, gathering, and fishing by communities in the region, subsistence activities were considered for this Site. Subsistence ingestion pathways are based on information from the Community Subsistence Information System maintained by the Alaska Department of Fish and Game (ADFG) Subsistence Division (Table 31). Hydaburg, located approximately 33 miles northwest of the Site, was selected as a representative community based on proximity to the Site The proportion of Native Alaskans in the population of Hydaburg is 89.5 percent, per Okleasik (2005). Information gathered at a community meeting in Hydaburg in December 2010 indicates that Bokan Mountain is not frequented as hunting or fishing areas, as traditional customs do not favor the area and because there are many closer areas that provide the same hunting and fishing opportunities (Hydaburg Community Meeting, 2010). If information on a particular subsistence food was not available in the ADFG database, information from the community of Craig was used.

Table 31. Exposure Parameters for Subsistence Food Pathways

Exposure Parameter	Value	Source
Ingestion rate, deer	43.06 g/day	ADFG 2009a
Ingestion rate, berries	14.2 g/day	ADFG 2009a
Ingestion Rate, Sea Cucumbers	8.8 g/day	ADFG 2009a
Ingestion Rate, Flounder	0.075 g/day	ADFG 2009a
Ingestion Rate, Seaweed	6.75 g/day	ADFG 2009a
Areal Fractionation, deer	0.085	17.4 impacted acres divided by 200 acre grazing range
Deer soil ingestion rate	2%	DOE 1994
Areal Fractionation for berries	0.009	17.4 impacted acres of the 1900 acres available for harvesting
Areal Fractionation of marine life	0.0042	1.9 acres impacted zone relative to 448 acres of West Arm of Kendrick Bay
Kd	Chemical specific	See Table 34; used to estimate solubilized portion of marine sediment concentrations
Bioaccumulation Factors	Chemical- and Biota-specific	See Tables 33 and 24

Subsistence food pathways have been evaluated separately from direct contact pathways, to allow risks and hazard indices to be added to those calculated for other receptors, if desired. Subsistence food pathways were evaluated for deer and local berries in the terrestrial subsistence scenario; and for sea weed, sea cucumbers and flounder in the marine environment. Deer and berries were selected for assessment due to their relative abundance in both the Site and their substantial inclusion in the diet of Native populations. Sea cucumbers and flounder were selected as representative of sediment dwelling marine invertebrates and fin fish. Seaweed also comprises a portion of the subsistence diet per the ADFG, and is present in the intertidal and subtidal zones at the Site.

Although commercial fishing can occur in Kendrick Bay, the subsistence fisher as assessed here would have greater exposure to the food resources than would a commercial fisherman utilizing the entire Bay. The subsistence fisher is assumed to harvest sea cucumber, flounder, and sea weed annually from the west Arm of Kendrick Bay whereas commercial sea cucumber harvesting is rotated on a 3-year basis, and commercial fishers would sell all or part of their harvest, diluting exposure of any single individual. Therefore, while commercial fishing may occur in the west Arm of Kendrick Bay, the subsistence fisherman is considered to be the maximum exposed individual in this category. It is known that commercial salmon rearing and fishing occur in other parts of Kendrick Bay, but the distance to those areas would minimize related potential Site-linked exposures.

Further, it has been reported that the headwaters of the west Arm of Kendrick Bay are relatively unproductive because of restricted circulation (KSI, 2004). Other areas of the west Arm or Kendrick Bay as whole might be more attractive to commercial and subsistence fishers.

As shown in Table 31, the annual ingestion rate of each harvested food was used as the ingestion rate of the subsistence food gatherer. Bioconcentration factors are used in the assessment of subsistence foods and are presented in Table 33 and 34 for each analyte and biota category. Data from Hydaburg indicates an annual per capita harvest of 34.65 pounds or deer; 11.45 pounds of berries; 7.08 pounds of sea cucumber, and 5.43 pounds of seaweed (ADFG, 2009). Flounder was selected for evaluation in the subsistence food evaluation because it is present at the Site and, unlike salmon, has extensive contact with the sediment and does not migrate. The data available from ADFG for Hydaburg did not include an intake of flounder; therefore, the per capita harvest value from Craig of 0.06 pounds per year was used.

For deer, the estimated concentration in the harvested meat was fractionated based on the typical grazing range of a Sitka deer, and the typical sol ingestion rate of a deer. This more accurately characterizes the impacted of the affected areas on the concentration of COPCs in deer meat, as the 17.4 potentially impacted acres of the Site would not support a deer population; grazing areas are as large as 1,000 acres (ADFG, 2008) and the impacted Site areas do not contain sufficient foraging vegetation for deer. Similarly, berry harvesting was fractionated for the amount of land readily accessible from the shoreline of the Site (approximately 1900 acres), as compared to the impacted acres (17.4 acres). Again, the impacted acres of the Site do not support much vegetation and berry harvesting, if it occurred, would likely be focused in a location with more vegetation.

Subsistence food resources in the dock area include seaweed, sea cucumbers, and fin fish. The available resources are similar to those available at any shoreline location within the west Arm of Kendrick Bay. The impacted area of the Site is approximately 1.9 acres; relative to the 448 acres of the west Arm, a fractionation value of 0.0042 was used to assess the portion of a subsistence harvest that could have been collected from the impacted area around the dock.

4.3 Exposure Point Concentrations

To estimate a reasonable maximum exposure concentration for soil COPCs, data for each COPC were aggregated to calculate an upper confidence limit of the mean concentration (UCL) using EPA's ProUCL software. The exposure point concentrations were used to evaluate direct Site exposure, as well as estimating exposure via the terrestrial food ingestion pathways. All soil samples were included in calculating the exposure point concentration for soil. Although the maximum detected concentrations by mine level were utilized for the SLRA, long-term exposure to a single sampled point's results is overly conservative when considering more realistic

exposures over larger portions of the Site involving ranges of concentrations. Therefore, all data from Tetra Tech 2009 sampling efforts and the KSI (2004) data were used to determine the 95 percent upper confidence limit (UCL95) for each COPC in soil in the SSRA. This approach, still conservative, better represents site-specific exposures for the site-specific HHRA. The upper confidence limits were calculated using EPA's ProUCL software (EPA, 2007) and the soil data included in the calculations were both Site and background data. Table 32 presents the exposure point concentrations and data summary for each soil COPC. In some cases, ProUCl recommended an exposure point concentration other than the 95UCL (97.5 UCL or 99 UCL). In these cases, the recommendations of ProUCL were taken and the higher exposure point concentration was used, as shown in Table 32. The new version of ProUCL (2010) may have recommended lower exposure point concentrations than used herein, which would have resulted in lower risk estimates for soil.

Tables 13, 14, and 15 summarized the surface water, stream sediment, and marine sediment Site data, respectively. The maximum values for COPCs were again used for these media to assess site-specific risks. Due to the smaller data sets, surface water, stream sediment and marine sediment could not be aggregated in the same manner as soil and therefore, maximum concentrations of COPCs for these three media were again used in the SSRA.

Table 32. Exposure Point Concentrations for Site-Specific Human Health Risk Assessment Soil

Chemical/Isotope	Maximum Concentration	Frequency of Detection	Data Distribution	Exposure Point Concentration	Description (1)
Arsenic (mg/kg)	33	81/82	Lognormal	4.6	95UCL
Uranium (mg/kg)	2,600	82/82	not discernable	719.7	99UCL
Radionuclides (pCi/g)					
Th-232	307	82/82	not discernable	86.9	97.5UCL
Ra-228	272	80/82	not discernable	79.4	97.5UCL
Th-228	359	82/82	Lognormal	106.1	95UCL
U-235	50	25/82	Gamma	5.3	95UCL
U-238	700	25/25	not discernable	515.9	99UCL
U-234	730	25/25	not discernable	526.4	99UCL
Th-230	680	82/82	not discernable	171.5	97.5UCL
Ra-226	631	82/82	not discernable	172.2	97.5UCL
Pb-210	510	76/76	not discernable	118.1	97.5UCL
Po-210	527	61/61	Gamma	81.16	95UCL

(1) As recommended by ProUCL for this analyte (EPA, 2007).

4.4 Toxicity Values

Toxicity values used in the SSRA for direct contact and food ingestion pathways are presented in Tables 33 and 34. Sources for toxicity values included ADEC and EPA for nonradionuclides, and EPA for radionuclides. General information on the use of toxicity values in risk assessments was provided in Section 2.5.

Table 33. Chemical Specific Values Used in the SSRA

Chemical	Cancer Slope Factor Oral (mg/kg-day) [1]	Cancer Slope Factor Inhalation (mg/kg-day) [1]	Reference Dose Oral (mg/kg-day)	Reference Concentration (mg/m3)	Dermal Absorption from Soil/Sediment	Sediment BAF[(1)]	Water BAF (Fish) (L/kg)[(2)]	Soil BAF (Plants)[(3)]	Soil BAF (Deer) (day/kg)[(2)]
Metals									
Arsenic[(4)]	1.5	15	3.00E-04	ND	0.03	0.127	3.00E+02	0.03752	4.0E-05
Manganese	ND	ND	0.024	NA	NA	NA	NA	NA	NA
Uranium	ND	ND	3.00E-03	3E-04	NA	NA	NA	0.023	6E-06

Sources: AK, EPA Integrated Risk Information System (EPA, 2009a) EPA Radionuclide PRG Table (EPA, 2007a)
NA - Not Applicable to this assessment
ND = Not Determined
mg/Kg = milligrams per kilogram
BAF = Bioaccumulation Factor
(1) Bechtel and Jacobs 1998; unitless
(2) Risk Assessment Information System; includes soil ingestion by animal
(3) Eco SSL Attachment 4-1. ORNL 2005 (arsenic); IAEA 1994 (uranium)
(4) Kd value of 6.7 is used for arsenic in modeling exposure to sea cucumbers. This value is from Baes and Sharp 1983 as cited by EPA 2004.

Table 34. Radioisotope Specific Values Used in the SSRA

Radioisotopes	Water Ingestion CSF(risk/pCi)	Food Ingestion CSF (risk/pCi)	Adult Soil Ingestion CSF (occupational receptors) (risk/pCi)	Soil Ingestion CSF (recreational receptor) (risk/pCi)	Inhalation CSF (risk/pCi)	External Exposure CSF (risk/pCi)	BIV Aquatic	Kd Value (marine) (mg/L) (1)	BIV Plants	BIV Terrestrial Soil
	Th-232 Decay Chain									
Th-232	1.01E-10	1.33E-10	8.47E-11	2.31E-10	4.33E-08	3.42E-10	80	1700	1.02E-03	1.60E-03
Ra-228	1.04E-09	1.43E-09	6.70E-10	2.28E-09	5.18E-09	0	3200	500	1.09E-01	6.00E-02
Th-228	1.07E-10	1.48E-10	6.40E-11	2.89E-10	1.32E-07	5.59E-06	80	1700	1.02E-03	1.91E-03
	U-235 Decay Chain									
U-235	6.96E-11	9.44E-11	4.92E-11	1.57E-10	1.01E-08	5.19E-07	29.5	63	3.78E-03	3.70E-03
	U-238 Decay Chain									
U-238	6.40E-11	8.66E-11	4.99E-11	1.43E-10	9.32E-09	4.99E-11	29.5	63	3.78E-03	3.73E-03
Th-234	2.31E-11	3.40E-11	9.51E-12	6.70E-11	3.07E-11	1.64E-08	80	1700	1.02E-03	1.12E-04
U-234	7.07E-11	9.55E-11	5.11E-11	1.58E-10	1.14E-08	2.52E-10	1000	63	3.78E-03	3.80E-03
Th-230	9.10E-11	1.19E-10	7.73E-11	2.02E-10	2.85E-08	8.19E-10	80	1700	1.02E-03	1.91E-03
Ra-226	3.85E-10	5.14E-10	2.95E-10	7.29E-10	1.15E-08	2.29E-08	3200	500	1.09E-01	6.00E-02
Po-210	3.77E-10	2.25E-09	2.96E-10	7.96E-10	1.08E-08	3.95E-11	500	400	1.00E-03	4.22E-03
Pb-210	8.81E-10	1.18E-09	5.99E-10	1.84E-09	2.77E-09	1.41E-09	300	4000	1.00E-02	9.02E-03

pCi = pico Curies
NA = Not Available in RESRAD
BIV = Bioconcentration factor as found in RESRAD BIOTA (ANL, 2009)
(1) Kd values selected from lower end of ranges for each radioisotope from the following sources:
Uranium, Lead and Thorium: EPA 1999; Radium – EPA 2004; Polonium – PNNL 2007

4.5 Dose and Risks from Inhalation of Radon and its Decay Products

Inhalation of Rn-222 decay products represents the most significant component of radiation exposure, excluding medical procedures, received by all members of the public regardless of where they reside (NCRP, 2009). Based on a very conservative calculation, as provided below, inhalation of the decay products of Rn-222 constitutes the greatest single contributor to the total risk to a Site visitor or worker on the Ross-Adams Mine Site. The land use scenarios described in Section 4.2 and summarized in Table 35 below, were applied to the risk from inhalation of radon decay products.

Table 35. Exposure Parameter Values for Radon and Gamma Exposure Assessment

	Frequency (days/year)	Hours per day	Duration (years)	Breathing rate (m^3/day)
Site Visitor	14	24	30	20
Forest Service Worker	10	12	25	20
Minerals Exploration Worker	120	12	3	30

The workers and Site visitors are assumed to spend all of their time on the Site. This is a very conservative assumption. It is not likely that any individual would actually receive the doses or incur the lifetime risks calculated in this risk assessment. In contrast to the other constituents of concern at the Site, the Rn-222 concentration cannot be directly compared to an accepted slope factor (risk coefficient) since the measured quantity, Rn-222 concentration, is not the risk driver (See Section 3.7). Therefore, the radon risk assessment is carried out in a different context from that for other constituents.

Radon concentrations across the Site are extremely variable, ranging from measured values at background (less than 5.8 pCi L^{-1}) to concentration at the 300-Foot Level mine portal that exceeded the capacity of the detection system (greater than 1215 pCi L^{-1}). Given the size of the Site and the average wind speed, the average equilibrium fraction for radon would be less than 0.1 (as described in Section 3.7).

The measured ambient radon concentrations from the 2009 field study, excluding the concentrations measured at the portals, are summarized in Table 36. Pro UCL was used to determine the 95 percent Upper Confidence Limit on the Mean (95 UCLM) (EPA, 2007). The Pro UCL code recommended a "gamma" distribution with a 95 UCLM of 92.6 pCi/L. This likely represents an overestimate of the average radon concentration to which an individual might be exposed since the radon measurement locations were targeted for the purpose of characterizing the Site rather than randomly or systematically spaced as would be required to obtain a true average radon concentration for the Site.

Table 36. Summary of Ross Adams Mine Site Radon Concentrations

Statistic	Value
Number of Valid Samples (excluding portal measurements)	24
Minimum value	1.2 pCi/L
Maximum value	372.8 pCi/L
Median	16.1 pCi/L
Average	52.4 pCi/L
95 UCLM	92.6

The EPA slope factor, that is the risk of cancer per pCi Rn-222 plus decay products, inhaled, is 1.8×10^{-11} pCi^{-1}. This slope factor assumes an equilibrium fraction of 0.4, the average for indoor radon exposure (EPA, 2001). (The equilibrium fraction is defined in Section 3.7.) The slope factor, for Rn-222 is directly proportional to the equilibrium fraction. Therefore, the slope factor

normalized to 100 percent of equilibrium would be 1.8 x 10^{-11} pCi^{-1} divided by 0.4 or 4.5 x 10^{-11} pCi^{-1}. For the purpose of the risk assessment, the maximum measured background concentration was subtracted from the 95 UCLM.

The site-specific occupancy parameters for potential receptors defined in Section 4.2 and summarized in Table 35, were used to determine the lifetime risks to the potentially exposed site-specific workers and Site visitors. For the purpose of calculating dose from inhalation of radon and its decay products, the subsistence receptor was assumed to be the same as the Site visitor.

The risk from inhalation of radon decay products was calculated using the following equation:

$$Risk = (C_{Rn} - C_{Rn\ bkg})(F_{eq})(IR)(EF)(ED)(SF)(CF)$$

Where: C_{Rn} = 95 UCLM radon concentration (includes Rn-222 and Rn-220) = 92.6 pCi L^{-1}
$C_{Rn\ bkg}$ = 5.8 pCi L^{-1}
F_{eq} = equilibrium fraction = 0.1
IR = intake rate (cubic meters of air per day)
EF = exposure frequency (days per year)
ED = exposure duration (years of exposure)
SF = slope factor at an equilibrium fraction of 1.0 = 4.5 x 10^{-11} pCi^{-1}
CF = unit conversion factor (Liters per cubic meter) = 1 x 10^{3}

A mineral exploration workers was assumed to spend 120 days on the Site at 12 hours per day for 3 years resulting in a potential lifetime risk as follows:

Risk = (92.6 pCi L^{-1}- 5 .8 pCi L^{-1})(0.1)(30 m^3 d^{-1})(120 d y^{-1})(3 y)(4.5 x 10^{-11} pCi^{-1})(10^3 L m^{-3}) = 4.2 x 10^{-3}

The potential lifetime risk to a forest service worker was calculated in the same way.

IR = 20 m^3 d^{-1}
EF = exposure frequency = 10 d y^{-1}
ED = exposure duration = 25 y

Risk = (92.6 pCi L^{-1}- 5 .8 pCi L^{-1})(0.1)(20 m^3 d^{-1})(10 d y^{-1})(25 y)(4.5 x 10^{-11} pCi^{-1})(10^3 L m^{-3}) = 2.0 x 10^{-3}

The potential lifetime risk to a Site visitor or subsistence receptor spending 14, 24-hour days on the Site for 30 years would be as follows:

IR = 20 m^3 d^{-1}
EF = exposure frequency = 14 d y^{-1}
ED = exposure duration = 30 y

Risk = (92.6 pCi L^{-1}- 5 .8 pCi L^{-1})(0.1)(20 m^3 d^{-1})(14 d y^{-1})(30 y)(4.5 x 10^{-11} pCi^{-1})(10^3 L m^{-3}) = 3.3 x 10^{-3}

These calculations represent *worst-case* conditions since they assume the occupationally-exposed individuals and the Site visitor spend their entire time in the area on the impacted portions of the Site.

While a visitor might choose to camp in the upper areas of the Site in proximity to the mine workings, it is more likely that the individual would camp in the area by the bay. The maximum measured radon concentration in the Ore Storage Area (OSA) was 92 pCi/L, approximately the same as the 95 UCLM used in the risk calculation. It should be noted that the area is posted with warning signs, further reducing the probability that an individual would camp in that location. Because of the limited dimensions of the impacted area, based on the map of gamma exposure rate measurements (Tetra Tech, 2010a), the age of the air passing across the OSA and thus the equilibrium fraction would be less than 0.1. The maximum dimension of the impacted area of the OSA is estimated to be 300 ft. The equilibrium fraction would be less than 0.05 assuming an average wind speed of 6 m/s. Therefore, the risk would be less than half the nominal risk calculated for the Site in general.

The potential annual dose to a Site visitor and Site workers was calculating using the net 95 UCLM radon concentration applied to the lifetime risk calculations, 86.8 pCi/L. As noted above, the dose from radon derives from inhalation of the short-lived decay products (Po-218, Pb-214, Bi-214 and Po-214). The concentration of radon decay products in air is expressed in a unit called the Working Level (WL). One WL is equal to the concentration of radon decay products in air in equilibrium with an Rn-222 concentration of 100 pCi/L. The equilibrium factor estimated for the Ross Adams Site is 0.1. Therefore, a radon concentration of 86.8 pCi/L would represent a radon decay product concentration of 0.086 WL.

Exposure to radon decay products is expressed in Working Level Months (WLM). One WLM is equal to exposure to a radon decay product concentration of 1 WL for 170 hours (approximately equivalent to the hours in one working month.). The effective radiation dose resulting from an exposure of 1 WLM is 1000 mrem (NCRP, 2009). The annual estimated doses for a worker or Site visitor were calculated as follows:

Site visitor: Exposure = (0.086 WL)(14 d/y)(24 h/d)/170 h/M = 0.17 WLM/y
Dose = (0.17 WLM/y)(1000 mrem/WLM) = 170 mrem/y

Mineral Exploration Worker: Exposure = (0.086 WL)(120 d/y)(12 h/d)/170 h/M = 0.73 WLM/y
Dose = (0.73 WLM/y)(1000 mrem/WLM) = 730 mrem/y

Forest Service Worker: Exposure = (0.086 WL)(10 d/y)(12 h/d)/170 h/M) = 0.06 WLM/y
Dose = (0.06 WLM/y)(1000 mrem/WLM) = 60 mrem/y

4.6 Annual Dose and Risk from Exposure to Direct Gamma Radiation

The potential annual radiation doses from direct gamma radiation exposure were calculated using the dose rate and annual frequency of exposure as described in Section 4.2. The annual dose for external gamma exposure was multiplied by a dose conversion factor to obtain the annual effective dose (UNSCEAR, 2000). The lifetime risks under the defined exposure scenarios were estimated using the International Commission on Radiological Protection (ICRP) detriment-adjusted risk coefficient (ICRP, 2007). The external and dermal risks for contact with soils with elevated radionuclide concentrations were estimated using a risk calculator as described in the site-specific risk assessment. The measured direct gamma exposure rates are summarized in Table 37. The annual dose and lifetime risk due to direct gamma radiation were calculated using the average measured gamma exposure rates for the mine levels. The average is effectively equal to the 95 UCLM due to the large number of gamma exposure rate measurements. The background dose rate in non-mineralized areas was assumed to be 6 µrem/hr, as discussed in the SCR (Tetra Tech, 2010a).

The pre-mining gamma radiation levels in the Ross Adams Mine area were not measured. The I&L Zone is a potential surrogate for pre-mining conditions in the 700- and 900-Foot Levels as it has been explored for its uranium potential but has not been mined. The I&L Zone is located in the same area but sufficiently distant as to be unaffected by gamma radiation from the exposed mine rock at the Ross Adams Mine.

The annual radiation dose rates to the three receptors with exposure factors defined in Table 35 were calculated assuming the individuals divide their time on the Site as shown in Table 38. The Site visitor was assumed to camp on the OSA, thus spending a larger fraction of his or her time in that area. The workers were assumed to be daily visitors to the Site, thus spending a larger fraction of their time in the mined areas rather than the OSA. The fractional distribution is arbitrary but different assumptions regarding the fraction of time spent on the OSA would not change the annual dose by more than a factor of two.

The dose rate for the adult visitor and workers was multiplied by a factor of 0.7 to obtain the effective dose (UNSCEAR, 2000). The dose rate for a child visitor was multiplied by a factor of 0.8. The effective dose takes into account self-shielding of sensitive organs by the body.

Table 37. Summary of Measured Gamma Exposure and Dose Rates

	OSA	300-Foot Level	700-Foot Level	900-Foot Level	I&L Zone (pre-mining surrogate)
Number of Measurements	20899	21205	28849	54204	3449
Minimum (uR/hr)	6.1	6.8	22.7	17.5	24.0
Maximum (uR/hr)	4103	2460	4207	3354	2124
Average (uR/hr)	401	120	306	287	270
Median (uR/hr)	81	47	118	88	94
90th Percentile (uR/hr)	1326	301	804	864	741
95th Percentile (uR/hr)	1967	464	1045	1204	1165
Calculated average gamma dose rate (urem/hr)	182	52	137	128	120
Net dose rate (urem/hr)	176	46	131	122	114

Table 38. Estimated Exposure Fraction in Specific Areas

	OSA (F_{osa})	300 Level (F_{300})	700 Level (F_{700})	900 Level (F_{900})
Site Visitor	0.4	0.2	0.2	0.2
Mineral Exploration worker	0.1	0.3	0.3	0.3
Forest Service Worker	0.1	0.3	0.3	0.3

The annual effective dose (H) to an adult worker or Site visitor was calculated as follows:

$H = [(\ h/d)(d/y)(0.7)(0.001\ mrem/urem)][(F_{osa}x176 + F_{300}x46 + F_{700}x131+F_{900}x122)urem/h]$

The annual effective dose to a child was calculated in the same manner except with an effective dose factor of 0.8. The lifetime cancer risk was calculated by multiplying the annual dose by the years of exposure and the International Commission on Radiological Protection (ICRP) cancer risk coefficients: 5.5×10^{-7} per mrem for the general population and 4.1×10^{-7} per mrem for adult workers (ICRP, 2007).

The calculated annual effective doses and lifetime risks are given in Table 39.

Table 39. Calculated Annual Effective Dose and Lifetime Risk from Gamma Radiation Exposure

	Annual Effective Dose (mrem/y)	Lifetime Risk
Site Visitor – Adult	31	5.1×10^{-4}
Site Visitor – Child	35	5.3×10^{-4}
Mineral Exploration Worker	108	1.3×10^{-4}
Forest Service Worker	9	9.2×10^{-5}

4.7 Summary of Radiation Doses and Risks

The estimated radiation doses and risks are summarized in Tables 40 and 41. Approximately 90 to 95 percent of the radiation risk is from inhalation of radon decay products.

Table 40. Summary of Estimated Lifetime Radiation Risks

Lifetime Radiation Risk Estimates	Site Visitor	Mineral Exploration Worker	Forest Service Worker
Radon Decay Product Inhalation	3.3×10^{-3}	4.2×10^{-3}	2.0×10^{-3}
Direct Gamma Exposure	5.1×10^{-4}	1.3×10^{-4}	9.2×10^{-5}
Total Risk	3.8×10^{-3}	4.3×10^{-3}	2.1×10^{-3}

Table 41. Summary of Estimated Annual Radiation Dose

Annual Dose Estimates	Site Visitor (mrem/y)	Mineral Exploration Worker (mrem/y)	Forest Service Worker (mrem/y)
Radon Decay Product Inhalation	170	730	60
Direct Gamma Exposure	31 (35)	108	9
Total Annual Dose	201 (205)	838	69

4.8 Estimated Radon and Direct Gamma Radiation Pre-mining Dose

The dose and risk calculations for gamma radiation exposure assume that the pre-mining exposure rates were similar to the background in the non-mineralized area. However, the data from the I&L Zone, shown in Table 42 provide a reasonable surrogate for pre-mining conditions in the mineralized 700- and 900-Foot Levels of the Ross Adams Mine. The distribution of measured radiation exposure rates in the 700-Foot Level, 900-Foot Level, and I&L Zones are similar, indicating the pre-mining gamma exposure rates may have been nearly the same as the exposure rates measured in 2009. The pre-mining gamma exposure rates at the 300-Foot Level and OSA areas may have been similar to the estimated background rate for non-mineralized areas.

The potential background risk from inhalation of radon decay products was calculated based on the maximum measured background concentration assuming a background equilibrium factor of 0.5. While no pre-mining Site background gamma exposure rate data are available for the Ross Adams Mine Site, the data obtained for the I&L Zone during the 2009 Site characterization surveys

is assumed to be reasonably representative of pre-mining conditions in the mineralized areas for this background analysis. The occupancy factors used in the analysis for the Ross Adams Mine Site were adapted for the background assessment. That is, the Site visitor was assumed to spend 40 percent of his or her time in the mineralized area (I&L Zone); the worker, 60 percent in the I&L Zone. The remainder of the time for both workers and visitors was assumed to have been spent in areas at the non-mineralized background gamma exposure rate. The radon background was assumed to be the same in the mineralized and non-mineralized areas. The calculated doses and risks are given in Tables 42 and 43, respectively. The dose and risk calculations are described in detail in Appendix C.

Table 42. Estimated Annual Dose Due to Background

Pathway	Estimated Annual Dose		
	Site Visitor (mrem/y) (child dose)	Forest Service Employee (mrem/y)	Mineral Exploration Employee (mrem/y)
Direct Gamma	11 (13)	6	73
Inhalation of Radon Decay Products	27	15	177
Particulate Inhalation and Inadvertent Soil Ingestion	<1	<1	4
Total Annual Dose	38 (40)	21	254

Table 43. Estimated Lifetime Risk Due to Background Radiation

Pathway	Estimated Lifetime Risk		
	Site Visitor	Forest Service Employee	Mineral Exploration Employee
Direct Gamma	1.9×10^{-4}	6.6×10^{-5}	9.2×10^{-5}
Inhalation of Radon Decay Products	4.0×10^{-3}	1.9×10^{-4}	2.6×10^{-4}
Particulate Inhalation and Inadvertent Soil Ingestion	5.8×10^{-6}	2.6×10^{-6}	4.6×10^{-6}
Total Lifetime Risk	6.0×10^{-4}	2.6×10^{-4}	3.6×10^{-4}

Approximately 30 percent of the total projected background dose is due to direct gamma exposure with inhalation of radon decay products accounting for nearly all of the remainder of the dose. Inhalation of radionuclides in airborne particulate matter and inadvertent soil ingestion contribute a small fraction of the total dose, less than two percent in all cases.

4.9 Risk Characterization for Metals and Radionuclides

Toxicity values presented in Tables 33 and 34 were used with the parameters presented in Tables 28 through 31 to quantify risks associated with metals and radionuclides in soil, surface water, and sediment for each receptor using the appropriate COPC exposure point concentrations. Results of the risk characterization for each of the Site receptors are described below and presented in Tables 44 through 47. Risks for soil, water and sediment were calculated using the ORNL's risk assessment tools (available at rais.ornl.gov) and output from the risk assessment tools is presented in Appendix B. It should be noted that the software required Ra-226 to be evaluated as Ra-226+D for the particulate inhalation pathway, and therefore, the output displays two results for Ra-226 for soil exposure assessments.

4.9.1 Site-specific Mineral Exploration Worker

Table 44 presents the risk summary for the mineral exploration worker from exposure to soil, stream sediment and marine sediment. The total risk from arsenic and radioisotopes in soil, stream sediment, and marine sediment was 1.16E-5. In soil, most risk came from soil ingestion and external exposure to gamma radiation. Soil ingestion risks from Ra-226 and Pb-210 exceeded 1.0E-06. External exposure risk from soil totaled 3.2E-6. Ra-226 and U-235 were the only isotopes posing an individual risk over 1E-06 for this pathway (1.74E-06 and 1.22E-06, respectively); all other radionuclides posed external risks below 1.0E-07. Overall, arsenic posed a risk of 1.7 E-07 through the soil exposure pathways. Arsenic is not a major contributor to soil contact-related risk for the site-specific worker. The noncarcinogenic hazard index (HI) associated with uranium was 0.11 from soil exposure pathways. Noncarcinogenic effects from uranium at this Site are very unlikely.

Stream sediment posed a risk of 1.97E-07 through external exposure to radionuclides and 2.65E-07 through ingestion of sediments. While it is possible that an on-site worker could have some incidental contact with sediment, it is unlikely that such exposure would occur on a daily basis. Further, the stream water would provide additional shielding from stream sediment, attenuating exposures more than is reflected in the risk estimate. Exposure to stream sediment was calculated using the maximum detected concentrations for each isotope, all of which were located at the 300-Foot Level portal. Lower concentrations, as found in the other sediment sample locations, would be associated with a lower risk. Again, however, the risk associated with all exposure pathways to the site-specific worker totaled 4.6E-07, which is not significant.

Direct contact with marine sediment posed a total risk of 7.5E-07 through external exposure (dermal contact) with radionuclides, dermal contact with arsenic in marine sediment and ingestion of sediments. Again, ingestion of and contact with sediment is unlikely to occur on a daily basis, and the risk estimates were based on the maximum detected value. The risk is therefore a conservative estimate. No individual isotope or arsenic posed a risk above 1E-6; contact with marine sediment does not pose a significant risk.

4.9.2 USFS Worker

Table 45 presents the risk summary for soil, stream sediment and marine sediment. The total risk from arsenic and radioisotopes in soil, stream sediment, and marine sediment was 8.05E-06. In soil, most risk came from soil ingestion and external exposure to gamma radiation (soil pathways posed a total risk of 7.1E-6. Soil ingestion risks from Ra-226 and Pb-210 exceeded 1.0E-06. External exposure risk from soil totaled 2.23E-6 due to U-235 (8.48E-07) and Ra-226 (1.21E-06). Overall, arsenic posed a risk of 1.2 E-07 through the soil exposure pathways and is not a significant contributor to risk.

Similarly, the noncarcinogenic hazard index (HI) associated with uranium was 0.009 from soil exposure pathways. Noncarcinogenic effects from uranium at this Site are very unlikely.

Stream sediment posed a risk of 1.22E-07 through external exposure to radionuclides and 1.84E-07 through ingestion of sediments. While it is possible that an on-site worker could have some incidental contact with sediment, it is unlikely that such exposure would occur on a daily basis. Further, the stream water would provide additional shielding from stream sediment, further attenuating exposures. Exposure to stream sediment was calculated using the maximum detected concentrations for each isotope, all of which were located at the 300-Foot Level portal. Lower concentrations, as found in the other sediment sample locations, would be associated with a lower risk. Again, however, the risk associated with all exposure pathways to the site-specific worker totaled 3.1E-07, which is not significant.

Direct contact with marine sediment posed a total risk of 5.24E-07 through external exposure (dermal contact) with radionuclides, dermal contact with arsenic in marine sediment and ingestion of sediments. Again, ingestion of and contact with sediment is unlikely to occur on a daily basis, and the risk estimates were based on the maximum detected value. The risk is therefore a conservative estimate. Arsenic posed a total risk of 1.7E-7 from exposure to marine sediment, but if risks had been calculated using the next highest concentration of 11 mg/kg would decrease risks by approximately 77 percent, to about 3.7E-08. Arsenic is not a major contributor to risk from marine sediment.

Overall, the radioisotopes Ra-226, Pb-210, and U-235 posed the most risk and in soil, the risks exceeded 1E-06. However, no risks exceeded 1E-05.

Table 44. Risk Summary - Site –Specific Mineral Exploration Worker

Chemical/ Isotope	Soil Ingestion	Soil-Dermal Contact or External	Particulate Inhalation	Stream Sediment Ingestion	Stream Sediment - Dermal Contact or External	Marine Sediment Ingestion	Marine Sediment - Dermal Contact or External	Total Risk
Arsenic	1.39E-07	2.75E-08	1.03E-10	--	--	1.48E-07	1.03E-07	4.18E-07
Th-232	2.65E-07	1.32E-08	3.43E-08	1.01E-08	4.23E-10	3.57E-08	1.49E-09	3.60E-07
Ra-228	6.04E-07	0	1.18E-09	3.62E-08	0.00E+00	3.46E-08	0.00E+00	6.76E-07
Th-228	2.70E-08	2.91E-08	1.41E-08	--	--	--	--	7.02E-08
U-235	9.39E-09	1.22E-06	4.88E-10	6.73E-10	7.35E-08	1.54E-09	1.68E-07	1.47E-06
U-238	8.65E-07	1.14E-08	4.38E-08	1.02E-08	2.30E-08	2.30E-08	9.33E-10	9.77E-07
U-234	9.68E-07	5.89E-08	5.47E-08	1.04E-08	5.34E-10	2.43E-08	1.24E-09	1.12E-06
Th-230	4.77E-07	6.23E-08	4.46E-08	1.95E-08	2.14E-09	6.18E-08	6.78E-09	6.74E-07
Ra-226	1.82E-06	1.74E-06	1.81E-08	1.20E-07	9.68E-08	6.76E-08	5.43E-08	3.92E-06
Pb-210	1.77E-06	5.14E-08	2.07E-09	5.77E-08	1.41E-09	2.28E-08	5.56E-10	1.91E-06
Po-210	1.89E-08	3.11E-11	1.75E-10	--	--	--	--	1.91E-08
SUM	**6.96E-06**	**3.21E-06**	**2.14E-07**	**2.65E-07**	**1.98E-07**	**4.19E-07**	**3.36E-07**	**1.16E-05**
Chemical	**Soil Ingestion HQ**	**Soil-Dermal Contact HQ**	**Particulate Inhalation HQ**	**Stream Sediment Ingestion HQ**	**Stream Sediment-Dermal Contact HQ**	**Marine Sediment Ingestion HQ**	**Marine Sediment-Dermal Contact HQ**	**Total HI**
Uranium	0.113	0.00029	0.00033	--	--	--	--	0.11
SUM	0.113	0.00029	0.00033	--	--	--	--	0.11

Notes:
-- Not a COPC for this medium
HQ = Hazard Quotient
HI = Hazard Index

Table 45. Risk Summary - Site-Specific USFS Worker

Chemical/ Isotope	Soil Ingestion	Soil- Dermal Contact or External	Particulate Inhalation	Stream Sediment Ingestion	Stream Sediment - Dermal Contact or External	Marine Sediment Ingestion	Marine Sediment - Dermal Contact or External	Total Risk
Arsenic	9.64E-08	1.91E-08	8.17E-11	--	--	1.03E-07	7.12E-08	2.90E-07
Th-232	1.84E-07	9.16E-09	2.38E-08	7.03E-09	2.94E-10	2.48E-08	1.04E-09	2.50E-07
Ra-228	4.20E-07	0	8.22E-10	2.52E-08	0.00E+00	2.40E-08	0.00E+00	4.70E-07
Th-228	1.87E-08	2.02E-08	9.79E-09	--	--	--	--	4.87E-08
U-235	6.52E-09	8.48E-07	3.39E-10	4.67E-10	5.11E-08	1.07E-09	1.17E-07	1.02E-06
U-238	6.01E-07	7.93E-09	3.04E-08	7.08E-09	7.85E-11	1.60E-08	1.77E-10	6.63E-07
U-234	6.72E-07	4.09E-08	3.80E-08	7.26E-09	3.71E-10	1.69E-08	8.61E-10	7.76E-07
Th-230	3.31E-07	4.33E-08	3.09E-08	1.35E-08	1.48E-09	4.29E-08	4.71E-09	4.68E-07
Ra-226	1.26E-06	1.21E-06	1.26E-08	8.36E-08	6.72E-08	4.69E-08	3.77E-08	2.72E-06
Pb-210	1.23E-06	3.57E-08	1.44E-09	4.01E-08	9.77E-10	1.58E-08	3.86E-10	1.32E-06
Po-210	1.31E-08	2.16E-11	1.21E-10	--	--	--	--	1.32E-08
SUM	4.83E-06	2.23E-06	1.48E-07	1.84E-07	1.22E-07	2.91E-07	2.33E-07	8.05E-06
Chemical	**Soil Ingestion HQ**	**Soil-Dermal Contact HQ**	**Particulate Inhalation HQ**	**Stream Sediment Ingestion HQ**	**Stream Sediment-Dermal Contact HQ**	**Marine Sediment Ingestion HQ**	**Marine Sediment-Dermal Contact HQ**	**Total HI**
Uranium	9.39E-03	--	2.77E-05	--	--	--	--	9.42E-03
Sum	9.39E-03	--	2.77E-05	--	--	--	--	9.42E-03

-- Not a COPC for this medium

Table 46. Risk Summary - Area Visitor

Chemical/ Isotope	Soil Ingestion	Soil - Dermal Contact or External Exposure	Particulate Inhalation	Surface Water Ingestion	Stream Sediment Ingestion	Stream Sediment Dermal Contact or External	Marine Sediment Ingestion	Marine Sediment - Dermal Contact or External Exposure	Total Risk
Arsenic	4.31E-07	4.09E-08	2.75E-10	--	--	--	4.60E-07	4.36E-07	1.37E-06
Th-232	1.01E-06	1.28E-09	1.00E-09	--	3.87E-08	4.90E-10	1.36E-07	1.73E-09	1.19E-06
Ra-228	2.46E-06	0	2.94E-11	6.29E-06	1.47E-07	0.00E+00	1.40E-07	0.00E+00	9.04E-06
Th-228	1.42E-07	2.35E-09	3.43E-10	9.35E-08	--	0.00E+00	--	-	2.38E-07
U-235	4.19E-08	1.19E-07	1.42E-11	2.00E-07	3.01E-09	8.51E-08	6.88E-09	1.95E-07	6.51E-07
U-238	3.72E-06	1.11E-09	1.28E-09	4.25E-06	4.38E-08	1.31E-10	9.87E-08	2.95E-10	8.11E-06
U-234	4.19E-06	5.72E-09	1.60E-09	5.70E-06	4.52E-08	6.18E-10	1.05E-07	1.44E-09	1.01E-05
Th-230	1.75E-06	6.06E-09	1.30E-09	7.26E-08	7.13E-08	2.47E-09	2.26E-07	7.84E-09	2.14E-06
Ra-226	6.29E-06	1.69E-07	1.27E-08	2.52E-06	4.16E-07	1.12E-07	2.34E-07	6.28E-08	9.82E-06
Pb-210	7.12E-06	4.67E-09	5.66E-11	4.0E-06	2.32E-07	1.52E-09	9.17E-08	6.01E-10	1.15E-05
Po-210	5.94E-08	2.52E-12	4.25E-12	4.15E-07	--	--	--	0.00E+00	4.74E-07
SUM	2.72E-05	3.50E-07	1.86E-08	2.35E-05	9.97E-07	2.02E-07	1.50E-06	7.06E-07	5.45E-05

Chemical	Soil Ingestion – HQ	Soil- Dermal Contact - HQ	Particulate Inhalation – HQ	Surface Water Ingestion – HQ	Stream Sediment Ingestion - HQ	Stream Sediment Dermal Contact - HQ	Marine Sediment Ingestion – HQ	Marine Sediment Dermal Contact –HQ	Total HI
Uranium	1.2E-01	0.0E+00	7.8E-05	4.1E-01	--	--	--	--	5.3E-01
Mn	--	--	--	2.0E-02	--	--	--	--	2.0E-02
SUM	1.2E-01	0.0E+00	7.8E-05	4.3E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.5E-01

-- not a COPC for this medium

Table 47. Risk Summary - Subsistence Ingestion

Chemical/Isotope	Deer	Berries	Seaweed	Sea Cucumbers	Flounder	Total Risk
Arsenic	6.43E-09	2.06E-07	NQA	3.18E-07	2.71E-09	5.33E-07
Th-232	1.52E-11	1.67E-11	NQA	2.99E-10	2.55E-12	3.33E-10
Ra-228	5.59E-09	1.75E-08	NQA	1.70E-07	1.45E-09	1.95E-07
Th-228	2.46E-11	2.26E-11	NQA			4.72E-11
U-235	1.52E-12	2.76E-12	NQA	5.33E-09	4.54E-11	5.38E-09
U-238	1.37E-10	2.39E-10	NQA	7.70E-08	6.56E-10	7.80E-08
U-234	1.57E-10	2.69E-10	NQA	8.18E-08	6.97E-10	8.29E-08
Th-230	3.20E-11	2.94E-11	NQA	5.08E-10	4.33E-12	5.74E-10
Ra-226	4.37E-09	1.37E-08	NQA	8.62E-08	7.35E-10	1.05E-07
Pb-210	1.03E-09	1.97E-09	NQA	5.50E-10	4.69E-12	3.55E-09
Po-210	6.33E-10	2.58E-10	NQA			8.91E-10
SUM	1.84E-08	2.40E-07	0.00E+00	7.40E-07	6.30E-09	1.00E-06
Chemical	**Deer – HQ**	**Berries - HQ**	**Seaweed- HQ**	**Sea Cucumbers – HQ**	**Flounder - HQ**	**Total HI**
Uranium	3.30E-05	4.39E-03	--	--	--	4.72E-04
SUM	3.3E-05	4.39E-03	--	--	--	4.72E-04

NQA – Not Quantitatively Assessed due to lack of bioaccumulation factors

-- Not a COPC for this medium

4.9.3 Area Visitor

The area visitor was evaluated for direct contact with soil, stream sediment, marine sediment, and surface water ingestion, based on a 14 day per year exposure for 30 years. Soil and sediment exposure parameters were adjusted to account for child and adult exposures, resulting in more conservative risk estimates than evaluating adults only. Risks are presented in Table 46. The soil ingestion exposure pathway posed a total risk of 2.72E-05. The risk was due to radionuclides and was highest for Ra-226 and Pb-210, although no isotope posed an individual risk in excess of 1.0E-5 through soil contact pathways. The risks are higher than those for occupational receptors because of the increased soil ingestion rate of children and higher toxicity values for assessing soil ingestion in children. External exposure posed a risk of 3.5E-07 in total, below levels of concern. Arsenic in soil was associated with a risk of 4.7E-07 and uranium posed a noncarcinogenic HI of 0.12, both of which are not significant.

Direct contact with and ingestion of stream sediment posed a total risk of 1.2E-06. Direct contact with marine sediments posed an ingestion risk of 1.50E-06 and total dermal/external risk of 7.06E-7. These risks are likely overestimated, as sediment contact is not likely to occur on a daily basis, and exposure to the maximum concentration on a daily basis is also unlikely. It was assumed that 1 hour per day was spent in contact with sediment.

The screening level assessment concludes that manganese and uranium were the only inorganic COPCs for surface water. The screening level of 50 µg/L for manganese is based on fish and water ingestion, while the uranium screening level of 30 µg/L is based on drinking water use (Alaska Water Quality Tables). Manganese concentrations in all surface water samples ranged from 4.1 µg/L to 100 µg/L. All concentrations were below 50 µg/L except for two samples collected from the 300-Foot Level portal, where concentrations were 71 µg/L and 100 µg/L in the two sampling events in 2009. Assuming that water from this location is consumed for 14 days per year for 30 years, the hazard index associated with manganese is 0.02. This is not a significant HI and likely an overestimate due to the use of the maximum concentration, from a location not likely to be a continuous source of drinking water for an area visitor.

Similarly, uranium in surface water was detected above 30 µg/L (the water quality standard) in two samples from the 300-Foot Level portal at concentrations of 240 and 160 µg/L. The maximum detected concentration of 240 µg/L poses a hazard index of 0.41 if ingested for 14 days per year.

Radionuclides were also assessed for surface water ingestion exposure and posed a total risk of 2.35E-05, due primarily to Ra-226, Ra-228, Pb-210, U-238, and U-234. Again, these maximum concentrations were found in sample 300L/SW/01/E, collected at the 300-Foot Level portal and are unlikely sources of drinking water. The risks are likely overestimates of actual exposure.

Total risk to the hypothetical area visitor totaled 5.45E-05 from all pathways and chemicals for existing Site conditions and the above discussed exposure assumptions. However, the pathways most likely to be complete are soil contact pathways with risks totaling 2.8E-05. These risks would be lower if lower soil exposure point concentrations had been used, which may be recommended in newer versions of ProUCL.

4.9.4 Subsistence Receptor

The subsistence receptor was evaluated for ingestion of deer, berries, sea weed, sea cucumbers and flounder collected from the Site area. Each endpoint is discussed below. Risks are presented in Table 47, and totaled 1.0E-06 for all food ingestion pathways. No individual analyte posed a risk above 1.0E-06.

4.9.4.1 Deer

Per the Community Subsistence Information System (ADFG, 2009a), the most recent data collected for Hydaburg indicate an annual *per capita* deer harvest of 35 pounds. This equates to 43 grams per day per person, which was the ingestion rate used for the subsistence receptor for this resource.

To estimate the concentration of COPCs in deer tissue, the bioaccumulation factor for each chemical was used in conjunction with the deer soil ingestion rate of 2 percent of diet. In addition, the average grazing range of the Sitka Black-tailed deer of 200 acres (ADFG, 2008) was used to adjust intakes to reflect exposure to the 17.4 site-influenced acres as a fraction of the overall grazing range for a deer. The result is a risk estimate of 1.22E-08 from arsenic and radionuclides, through the ingestion of deer pathway which is not a significant risk. The noncarcinogenic hazard index associated with ingestion of deer is 0.000033, far below levels of concern.

4.9.4.2 Berries

Locally-harvested berry ingestion was assessed for the Site, using the reported per capita harvest of 11.45 pounds per year (14.2 grams per day) for Hydaburg from the CSIS. The entire Site was assumed to be used for berry collecting, while only 17.4 acres is impacted by Site contaminants. Therefore, intake was adjusted for the proportion of impacted areas relative to the entire Site (1,900 acres). The results, shown in Table 38, indicate a total risk of 2.4E-07 from ingestion of berries collected at the Site during a 30 year exposure period, below levels of concern. The hazard index associated with berry ingestion was 0.0044, also below levels of concern.

4.9.4.3 Seaweed

Seaweed also comprises a portion of the subsistence diet and was observed to be present in the west Arm of Kendrick Bay. While ingestion rates of sea weed are available from the CSIS (5.43 pounds per year, or 6.7 grams per day), there is no bioaccumulation factor information for the sediment-to-marine plant pathway, preventing an accurate assessment of uptake to the plant. This pathway is likely to pose low risk; however, as the bioaccumulation would be no more than that of the terrestrial plants, and the continuous effect of tide on the sediment would act to mix the dock area sediments with sediment from unimpacted areas, resulting in lower concentrations available for uptake. Further, the areal fractionation of marine subsistence food gathering would decrease exposure potential. It is likely that this pathway would contribute insignificantly to overall risk from subsistence foods. The quantitative evaluation provided for berries is assumed to be a bounding estimate for ingestion of all plants at this site.

4.9.4.4 Sea Cucumbers

Sea cucumbers were observed to exist in the west Arm of Kendrick Bay and represent a subsistence harvest, as well as a potential commercial harvest on a less frequent basis. Assuming that a receptor's annual harvest of sea cucumbers (7.1 pound per year) came from the west Arm of Kendrick Bay (areal fraction of 0.004), the total risk was 7.40E-07, with the majority of the risk due to arsenic (3.18E-07) and Ra-228 (1.70E-07).

4.9.4.5 Flounder

Flounder were selected as the representative fin fish because they were observed to dwell in the sediment at the Site and would spend more time in the west Arm than salmon. Salmon pass through the Bay during migration, but would not feed during the spawning runs, and therefore would have little contact with the sediment. The ingestion rate of flounder by a subsistence fisher was determined to be 0.074 g/day (0.06 pounds per year) based on CSIS data for Craig

(ADFG, 2009b) as Hydaburg reported no ingestion of flounder for the most recent available year. The areal fractionation for the west Arm of Kendrick Bay is 0.004. Based on the intake rate and portion of the west Arm of Kendrick Bay that is impacted (i.e., the dock area), the total risk from ingestion of flounder was 6.30E-09.

4.10 Summary of Risks from Direct Contact Pathways and Subsistence Food Ingestion

The SSRA estimates show that the pathways contributing the most to overall risk are soil ingestion and external exposure to direct gamma radiation and inhalation of radon decay products. Nonradionuclides in soil do not pose a risk above 1E-6 or HI above 1.0 by any pathway. For the area visitor, radionuclide exposure through soil ingestion presents the largest risk from direct contact pathways (2.7E-05), because the soil ingestion rate for children is twice as high as that for adults. The short amount of time that an area visitor spends at the Site causes the external exposure risk from radionuclides in soil to be below 1E-6, while for the mineral exploration worker it is 3.1E-06 and for the USFS worker it is 2.2E-06. With the exception of soil ingestion by the area visitor receptor, all soil-related risks are below 1E-05 and are acceptable per ADEC guidance (ADEC, 2010). Soil ingestion and external exposure risks to the area visitor were attributable mainly to U-238, U-234, Th-230, Ra-226, and Pb-210.

Surface water ingestion was evaluated only for the area visitor, as occupational receptors would have their own water supply. The surface water risks totaled 1.95E-05, which is likely an overestimate because it was conservatively estimated using the maximum detected concentration of each radionuclide COPC. It is unlikely that any receptor would consistently be exposed to the maximum detected concentrations of COPC in surface water, which for radionuclides all occurred in runoff at the 300-Foot Level portal.

Exposure to marine sediments posed a total risk of 2.2E-06 for the area visitor; risks to the occupational receptors were below 1E-06. These risks are also likely to be an overestimate-, as they are based on daily exposure to the maximum detected concentration in marine sediment. Most visitors would not contact marine sediment for 14 days, and the presence of water would act to further shield from external exposures.

For the subsistence resource user, the total risk from all subsistence foods was 9.97E-07. This is below levels of concern, and not likely to be achieved as there is no indication that the Site or the dock area are a subsistence hunting or gathering area.

Although presented here, the external radiation risks calculated using the RAIS risk calculator are not relevant to this assessment since actual data on radiation exposure levels are available and are the preferred basis for calculating radiation risks. The “external exposure” risks calculated for the individual radionuclides by the RAIS risk calculator have been treated as being equivalent to the dermal exposure pathway of nonradionuclides. However, because of the manner in which the RAIS risk calculator treats external radiation doses from naturally occurring terrestrial radionuclides, the external exposure risks are not a complete assessment of gamma exposure to the site. The external radiation risk was calculated using direct gamma radiation measurements that reflect the actual radiation exposure from soil as well as waste rock and outcroppings of the underlying rock formation. The external radiation risks for the individual radionuclides for which measured concentrations were available have been presented for completeness of the risk assessment, but are not relevant since direct gamma measurements are available for the estimation of dose and risk. Therefore, while the “external exposure” risk calculations help describe the risk associated with the individual radionuclides, the risks and doses associated with

the direct gamma measurements (Section 4.6) are relevant and should drive risk management decisions.

Figure 11 summarizes the results of the SSRA, providing a tabulated view of COPCs assessed, pathways assessed, and a list of the COPCs that posed risks in excess of 1E-6 by media and pathway after evaluation in the SSRA.

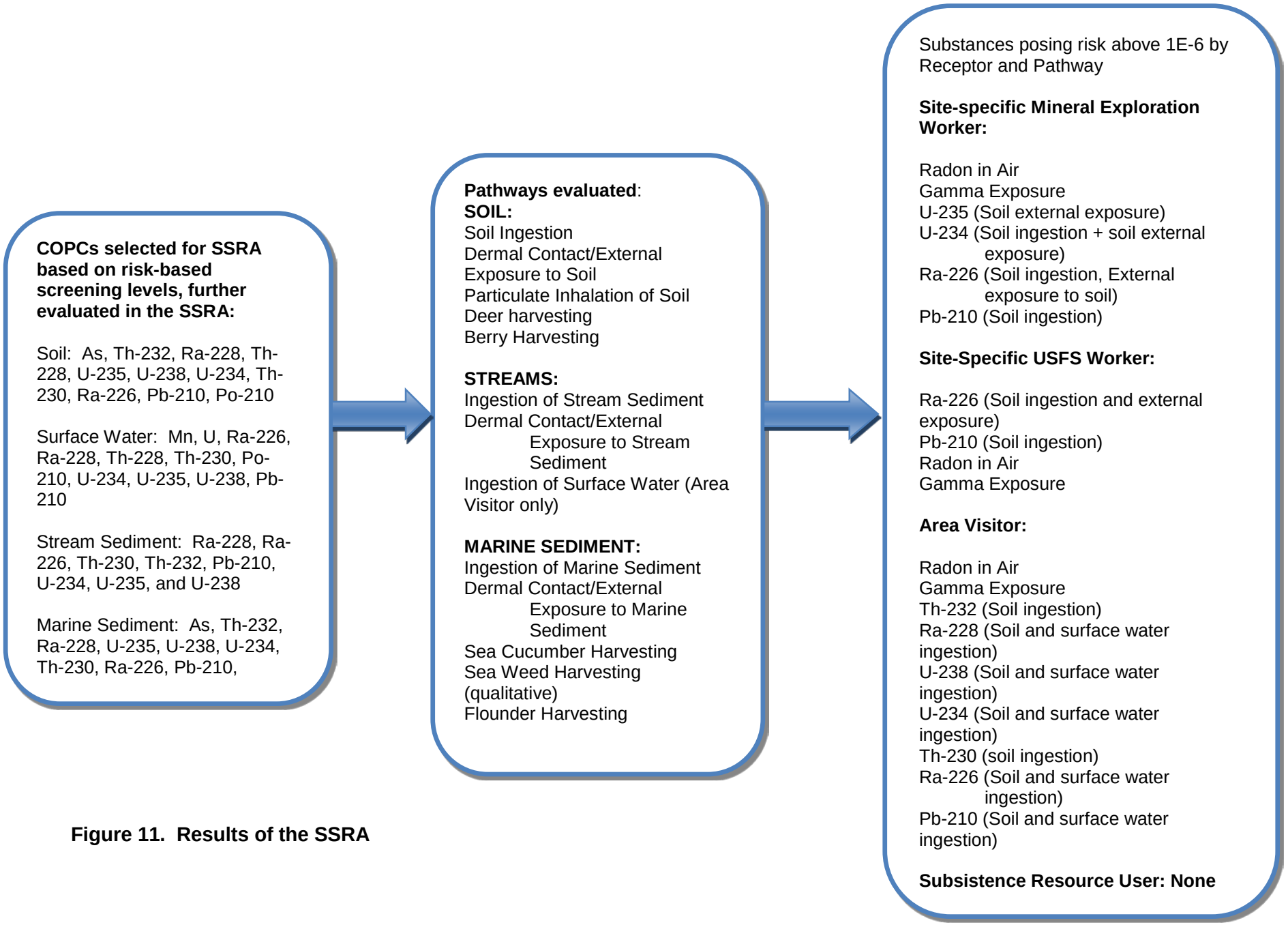

Figure 11. Results of the SSRA

5.0 DISCUSSION OF UNCERTAINTIES

Risk assessments are a management tool for developing conservative estimates of health hazards, and are therefore unlikely to underestimate the true risk for potentially exposed populations. In all risk assessments, both variability (normal variation in data or exposure) and uncertainty (lack of data) are inherent in exposure parameters, toxicity values, and chemical concentrations. While uncertainty may be decreased with collection of additional data, variability cannot be changed.

As a result, the risks estimated in a human health risk assessment have associated uncertainties reflecting the limitations in available knowledge about Site concentrations, variability in exposure assumptions (e.g., chronic exposure concentrations, intake rates, amount of time spent at the Site), and chemical toxicity. Conservative assumptions are used to overcome the uncertainty inherent in risk calculations, as all inputs to the exposure equations are impacted by variability and uncertainty.

The risk estimates presented in the screening evaluation were based on an occupational exposure of up to 250 days per year for 25 years, and using the maximum detected concentrations from each mine level, surface water, stream sediment, and marine sediment as the exposure point concentrations. This is a conservative approach since a more realistic scenario involves less frequent Site use for recreational purposes or mineral exploration and exposure concentrations averaged over the Site. Therefore, the site-specific risk assessment estimated potential risks under more realistic, non-default assumptions, including subsistence food gathering and recreational Site use, and an occupational exposure frequency of up to 120 days per year.

The conservative exposure point concentrations also affected the results of the SSRA. First, data for all media at the Site are based on sampling that was not random but purposefully collected. The sampling data were collected from locations that had visible mine rock or high gamma readings and were suspected of being impacted by Site activities. Most site assessments rely on purposefully collected data but when used in the risk assessment, it usually results in an overestimate of exposure concentration and therefore risk. In the SSRA, soil data were aggregated and an upper confidence limit of the mean concentration was calculated to better represent typical exposure that could be expected at the Site. Samples labeled as background data from Tetra Tech were included in the calculation of the soil UCL because there was no reason to exclude them, based on location, from being part of the exposure unit for visitors or workers. Use of this data provided a larger and more representative data set for the calculation of the UCLs, after COPC selection had occurred in the SLRA. Use of this data, therefore, results in less likelihood of an overestimate of risks from soil exposure even though the soil data were purposefully collected and there were more Site data than background data in the aggregated soil data set.

For other media, the maximum detected concentration was used in the SSRA, which likely results in an overestimate of risk. Again, data were purposefully collected, and the maximum detected concentration would not likely be representative of exposures over time, which would include exposure to much lower concentrations and unimpacted locations. However, the data sets were not large enough or did not contain sufficient number of detected results to allow for a reliable calculation of exposure point concentrations based on averaging for marine sediment, stream sediment, and surface water. Nonetheless, the risks based on maximum values for stream and marine sediment exposure were not above 1E-5 in total for any receptor, indicating that the media do not pose an unacceptable risk.

Surface water was associated with a risk of almost 2.0E-05 based on the maximum detected values in the 300-Foot Level portal area for Ra-228, U-238, U-234 and Ra-226. Lower concentrations that still exceeded background concentrations of these isotopes also occurred in the surface water sample from the north end of the 900-Foot Level open pit, and in the 700-Foot Level sample "700-SW-01-B". It is unlikely, though, that a person would collect 14 days' worth of water from any one of these locations. Cabin Creek, which is not impacted by Site activities, is closer to the shoreline and would be a more likely source of water for an area visitor.

Receptors evaluated in the SSRA were consistent with current and expected future uses of the Site, as defined by the Tongass National Forest Master Plan. These receptors included a mineral exploration worker, an USFS worker, an area visitor, and subsistence food pathways. Other land uses that may be associated with potential future mining are uncertain. On-site housing for mine workers and more frequent recreational use in the vicinity of the Kendrick Bay onshore area in the non-mineralized area would increase exposure and possibly risk estimates for existing conditions depending on the extent of Site use relative to the exposures used in the risk assessment presented.

Exposure parameters used to estimate dose for each receptor are also a source of uncertainty. Parameters were selected that would best represent the site-specific receptors exposure to the Site, but all were selected to be at the upper-end of potential exposure frequency and duration. For example, the USFS Worker receptor was estimated to visit the Site 10 days per year for 25 years. While it is possible that one USFS worker could be at the Site each year, it is an upper-bound assumption that it would be the same individual for 25 years, and that the individual would spend 10 days per year at each Site visit. The mineral exploration worker, similarly, was assumed to return to the Site for 3 consecutive years for 120 days each time. This is an upper-bound estimate because the same individual would not likely make the same trip for all 3 years, and 3 years is an upper-bound estimate of the length of time a mineral company would explore a site before deciding whether mining is a viable option. An area visitor was assumed to return to the Site every year for 30 years, for 14 days at a time, which is also an upper-bound estimate given the Site's remote location and lack of facilities. Subsistence food gathering was assumed to occur annually for 30 years as well, even though the Site is not a favored hunting or gathering area by the Haida tribe and is remote for population centers.

In estimating exposures via the subsistence food pathways, the soil/sediment to water distribution coefficient (Kd) values were selected from the literature in the absence of site-specific values for the assessment of exposure through sea cucumber and flounder ingestion. The Kd value approximates the amount of analyte in water from the sediment source so that the bioconcentration in biota can be estimated. Kd values are highly variable, and an effort was made to locate reasonably conservative values from literature sources that often provided values that varied in range by over an order of magnitude. The lower values selected for Kds result in higher estimated concentrations available to the organism for accumulation. This is a reasonably conservative approach which is more likely to result in an overestimate of exposure than an underestimate. The bioconcentration factors used, however, are not specific to sea cucumbers or flounder in arctic waters, and could result in an over- or underestimate of risk.

Areal fractionation was used in the subsistence food pathway estimates to more accurately reflect gathering areas and for deer, grazing areas relative to the impacted areas of the Site. For deer, the impacted areas of the Site (approximately 17.4 acres) are insufficient to support foraging and are not densely vegetated, if at all. The typical grazing range of a Sitka black-tailed deer ranges from 100 to 1,000 acres (ADFG, 2000). A grazing range of 200 acres was selected as a conservative estimate for the impact of grazing range on the potential bioaccumulation of analytes

in deer. The ratio of the impacted areas to the grazing range (17.4 acres/200 acres, or 0.09) was incorporated into the estimate of dose to humans. Similarly, the ratio of impacted acres to acreage available for berry harvesting was used to more accurately assess the amount of berries potentially harvested from impacted areas, which again are mostly barren and do not support abundant plant life. The areal fractionation value for the marine sediment represents the ratio of the impacted dock area to the acreage of the west Arm of Kendrick Bay that could be harvested. This value better reflects harvesting opportunities that could be realized on an annual basis by an individual.

Although presented with the risk assessment, the external radiation risks calculated using the RAIS risk calculator are not relevant to this assessment since actual data on radiation exposure levels are available and are the preferred basis for calculating radiation risks. The "external exposure" risks calculated for the individual radionuclides by the RAIS risk calculator have been treated as being equivalent to the dermal exposure pathway of nonradionuclides. However, because of the manner in which the RAIS risk calculator treats external radiation doses from naturally occurring terrestrial radionuclides, the external exposure risks are not a complete assessment of gamma exposure to the site. The external radiation risk was calculated using direct gamma radiation measurements that reflect the actual radiation exposure from soil as well as waste rock and outcroppings of the underlying rock formation. The external radiation risks for the individual radionuclides for which measured concentrations were available have been presented for completeness of the risk assessment, but are not relevant since direct gamma measurements are available for the estimation of dose and risk. Therefore, while the "external exposure" risk calculations help describe the risk associated with the individual radionuclides, the risks and doses associated with the direct gamma measurements (Section 4.6) are relevant and should drive risk management decisions.

6.0 CONCLUSIONS

Radon and direct gamma radiation contribute the major portion of the estimated hypothetical risk to occupational and recreational users of the Site, with inhalation of radon decay products accounting for approximately 80 to 90 percent of the radiation risk. The estimated hypothetical lifetime risks ranged from 2E-3 to 4E-3. While no pre-mining radiation measurements are available for the Ross Adams Mine Site, the background gamma doses were estimated using the unmined I&L Zone gamma radiation measurements as a surrogate. The distribution of gamma exposure rate measurements for the mineralized areas of the Site is similar to the distribution of measurements in the unmined I&L zone. No radon data were available for the unmined area so pre-mining radon risk was estimated based on the maximum background measurement. All estimated radiation risks are very conservative in that they assume the individuals spend all of their time in the area in the 17.4 acre mining affected area.

Soil at the Site, under current conditions, could hypothetically pose risks above 1E-5 for area visitors, but risks are below 1E-5 for the more likely occupational receptors. In general, the risks are associated with soil ingestion and external exposure to radionuclides in soil. Surface water is also associated with a hypothetical risk above 1E-5 for area visitors if it is used as a drinking water supply from the most impacted surface water bodies on-Site. Given that unimpacted surface water bodies (Cabin Creek) and the lower part of Kendrick Creek which meets drinking water standards are close to the shoreline and more accessible, it is not likely that drainage from the 300-Foot Level portal would be used as a drinking water supply at all. Again, the risks from surface water ingestion are due to the presence of radionuclides.

Risks to the subsistence receptor assume that the entire annual intake of each food substance was harvested from the Site, fractionated for areal extent of impacted areas relative to the entire area available for subsistence activities around the Site. The total hypothetical risk for all food substances totaled 9.97E-7. The risk is likely an overestimate, as this Site is far from populated areas and accessible on a limited basis, primarily by boat or plane. Subsistence harvesting is more likely to occur in areas closer to population centers, due to accessibility and ease in transporting the harvest. As such, it is not likely that a significant annual harvest of food substances occurs at this Site. Further, the risk was due mostly to ingestion of sea cucumbers, a pathway with uncertainty associated with it as bioavailability factors for the radionuclides of interest are lacking in published literature, as are bioavailability factors specific to sea cucumbers.

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APPENDIX A
CALCULATIONS FOR THE SCREENING LEVEL RISK ASSESSMENT

A.1 Occupational Soil Screening Levels for Radionuclides

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Ac-223	-	-	1.55E-08	-	-	1.36E+09	1.66E+05	9.86E-01	-	-	5.27E+07	5.27E+07	1.38E-07
Ac-223+D	-	-	2.34E-07	-	-	1.36E+09	1.66E+05	9.07E-01	-	-	3.80E+06	3.80E+06	9.92E-09
Ac-224	S	4.07E-10	6.06E-07	2.77E-12	-	1.36E+09	2.09E+03	1.00E+00	3.36E+07	1.55E+09	1.68E+04	1.68E+04	3.49E-09
Ac-225	S	2.86E-08	4.50E-08	9.03E-11	-	1.36E+09	2.53E+01	9.78E-01	1.24E+04	2.67E+05	2.80E+03	2.26E+03	3.91E-08
Ac-225+D	S	-	9.36E-07	-	-	1.36E+09	2.53E+01	9.63E-01	-	-	1.37E+02	1.37E+02	2.36E-09
Ac-226	S	4.33E-09	4.46E-07	2.84E-11	-	1.36E+09	2.09E+02	1.00E+00	3.28E+05	1.46E+07	2.28E+03	2.27E+03	4.75E-09
Ac-227	S	1.49E-07	3.48E-10	2.01E-10	-	1.36E+09	3.18E-02	1.00E+00	1.28E+01	1.18E+02	8.11E+02	1.14E+01	1.58E-07
Ac-228	S	4.92E-11	4.53E-06	9.10E-13	-	1.36E+09	9.90E+02	9.69E-01	4.84E+07	6.08E+09	1.10E+03	1.10E+03	4.90E-10
Ag-102	M	2.56E-14	1.60E-05	5.74E-14	-	1.36E+09	2.82E+04	8.33E-01	2.19E+10	3.33E+14	1.03E+04	1.03E+04	7.23E-11
Ag-103	M	6.07E-14	3.33E-06	7.22E-14	-	1.36E+09	5.54E+03	9.38E-01	3.41E+09	2.76E+13	8.64E+03	8.64E+03	3.11E-10
Ag-104	M	6.25E-14	1.25E-05	1.10E-13	-	1.36E+09	5.26E+03	8.67E-01	2.13E+09	2.54E+13	2.36E+03	2.36E+03	9.06E-11
Ag-104m	M	4.92E-14	5.50E-06	8.29E-14	-	1.36E+09	1.09E+04	8.56E-01	5.83E+09	6.68E+13	1.12E+04	1.12E+04	2.09E-10
Ag-105	M	2.83E-12	2.15E-06	9.77E-13	-	1.36E+09	6.17E+00	9.05E-01	2.81E+05	6.59E+08	1.54E+01	1.54E+01	5.10E-10
Ag-106	M	2.72E-14	3.08E-06	4.44E-14	-	1.36E+09	1.52E+04	9.16E-01	1.52E+10	1.69E+14	2.62E+04	2.62E+04	3.55E-10
Ag-106m	M	3.54E-12	1.31E-05	2.82E-12	-	1.36E+09	3.01E+01	8.81E-01	4.74E+05	2.57E+09	1.27E+01	1.27E+01	8.67E-11
Ag-108	-	-	8.56E-08	-	-	1.36E+09	1.54E+05	8.78E-01	-	-	9.95E+06	9.95E+06	1.36E-08
Ag-108m	M	2.67E-11	7.18E-06	5.07E-12	-	1.36E+09	5.46E-03	8.80E-01	3.75E+02	4.84E+05	3.30E-02	3.30E-02	1.27E-09
Ag-109m	-	-	7.66E-09	-	-	1.36E+09	5.52E+05	9.95E-01	-	-	3.52E+08	3.52E+08	1.35E-07
Ag-110	-	-	1.69E-07	-	-	1.36E+09	8.88E+05	8.70E-01	-	-	2.94E+07	2.94E+07	7.06E-09
Ag-110m	M	2.83E-11	1.30E-05	5.96E-12	-	1.36E+09	1.01E+00	9.18E-01	7.55E+03	1.08E+07	4.13E-01	4.13E-01	8.70E-11
Ag-111	M	6.66E-12	1.09E-07	3.36E-12	-	1.36E+09	3.40E+01	9.02E-01	4.49E+05	1.54E+09	1.68E+03	1.67E+03	1.06E-08
Ag-112	M	7.25E-13	3.24E-06	9.10E-13	-	1.36E+09	1.95E+03	8.71E-01	9.50E+07	8.11E+11	3.36E+03	3.36E+03	3.75E-10
Ag-115	M	6.81E-14	3.45E-06	8.92E-14	-	1.36E+09	1.82E+04	8.78E-01	9.07E+09	8.08E+13	2.93E+04	2.93E+04	3.59E-10
Al-26	M	6.92E-11	1.33E-05	8.18E-12	-	1.36E+09	9.68E-07	8.45E-01	2.17E+02	1.75E+05	1.73E-02	1.73E-02	9.03E-07
Al-28	-	-	9.32E-06	-	-	1.36E+09	1.63E+05	8.14E-01	-	-	1.04E+05	1.04E+05	3.49E-11
Am-237	M	5.77E-14	1.35E-06	3.12E-14	-	1.36E+09	4.99E+03	9.45E-01	7.11E+09	2.61E+13	1.90E+04	1.90E+04	1.75E-09
Am-238	M	9.51E-14	4.02E-06	5.96E-14	-	1.36E+09	3.72E+03	9.50E-01	2.77E+09	1.18E+13	4.74E+03	4.74E+03	5.89E-10
Am-239	M	8.40E-13	6.91E-07	5.99E-13	-	1.36E+09	5.10E+02	9.99E-01	3.79E+07	1.83E+11	3.60E+03	3.60E+03	3.27E-09
Am-240	M	1.41E-12	4.70E-06	1.27E-12	-	1.36E+09	1.20E+02	9.66E-01	4.18E+06	2.56E+10	1.28E+02	1.28E+02	4.99E-10
Am-241	M	2.81E-08	2.76E-08	9.10E-11	-	1.36E+09	1.60E-03	9.65E-01	1.99E+01	4.39E+02	7.46E+00	5.36E+00	1.56E-06
Am-242	M	5.03E-11	3.48E-08	7.51E-13	-	1.36E+09	3.79E+02	9.98E-01	2.24E+07	2.28E+09	5.31E+04	5.30E+04	6.56E-08
Am-242m	M	1.56E-08	1.05E-09	7.33E-11	-	1.36E+09	4.56E-03	9.99E-01	2.57E+01	8.20E+02	1.96E+02	2.21E+01	2.11E-06
Am-242m+D	M	2.81E-08	4.82E-08	8.95E-11	-	1.36E+09	4.56E-03	9.98E-01	2.10E+01	4.55E+02	4.28E+00	3.53E+00	3.37E-07
Am-243	M	2.70E-08	9.47E-08	9.03E-11	-	1.36E+09	9.39E-05	9.54E-01	1.97E+01	4.48E+02	2.16E+00	1.94E+00	9.72E-06
Am-243+D	M	2.70E-08	6.36E-07	2.15E-12	-	1.36E+09	9.39E-05	9.58E-01	8.28E+02	4.48E+02	3.20E-01	3.20E-01	1.60E-06
Am-244	M	3.09E-12	3.59E-06	1.12E-12	-	1.36E+09	6.01E+02	8.77E-01	2.39E+07	5.88E+10	9.29E+02	9.29E+02	7.32E-10
Am-244m	M	1.02E-13	5.09E-09	3.81E-14	-	1.36E+09	1.40E+04	9.99E-01	1.63E+10	4.15E+13	1.34E+07	1.34E+07	4.53E-07
Am-245	M	1.56E-13	1.04E-07	1.10E-13	-	1.36E+09	2.96E+03	9.26E-01	1.20E+09	5.73E+12	1.50E+05	1.50E+05	2.40E-08
Am-246	M	1.31E-13	2.93E-06	8.47E-14	-	1.36E+09	9.34E+03	9.33E-01	4.90E+09	2.15E+13	1.66E+04	1.66E+04	8.50E-10
Am-246m	M	3.96E-14	4.84E-06	4.96E-14	-	1.36E+09	1.46E+04	9.79E-01	1.31E+10	1.11E+14	1.50E+04	1.50E+04	4.90E-10
Ar-37	-	-	0.00E+00	-	-	1.36E+09	7.22E+00	0.00E+00	-	-	-	-	-
Ar-39	-	-	5.95E-10	-	-	1.36E+09	2.58E-03	9.27E-01	-	-	3.64E+02	3.64E+02	1.07E-05
Ar-41	-	-	6.39E-06	-	-	1.36E+09	3.32E+03	8.33E-01	-	-	3.04E+03	3.04E+03	7.27E-11
As-69	M	4.29E-14	4.43E-06	7.70E-14	-	1.36E+09	2.40E+04	8.83E-01	1.38E+10	1.69E+14	2.98E+04	2.98E+04	1.67E-10
As-69+D	M	-	8.44E-06	-	-	1.36E+09	2.40E+04	9.25E-01	-	-	1.49E+04	1.49E+04	8.35E-11
As-70	M	1.37E-13	1.96E-05	2.16E-13	-	1.36E+09	6.92E+03	8.70E-01	1.42E+09	1.53E+13	1.98E+03	1.98E+03	3.88E-11
As-71	M	1.52E-12	2.37E-06	1.09E-12	-	1.36E+09	9.37E+01	8.84E-01	3.82E+06	1.86E+10	2.18E+02	2.18E+02	3.20E-10
As-72	M	4.29E-12	8.21E-06	4.55E-12	-	1.36E+09	2.33E+02	8.63E-01	2.28E+06	1.64E+10	1.60E+02	1.60E+02	9.60E-11
As-73	M	3.88E-12	5.78E-09	6.85E-13	-	1.36E+09	3.15E+00	9.94E-01	2.04E+05	2.45E+08	2.67E+03	2.63E+03	1.18E-07
As-74	M	8.44E-12	3.35E-06	3.17E-12	-	1.36E+09	1.42E+01	8.77E-01	2.00E+05	5.10E+08	2.36E+01	2.36E+01	2.38E-10

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
As-76	M	4.14E-12	2.01E-06	4.14E-12	-	1.36E+09	2.31E+02	8.75E-01	2.48E+06	1.68E+10	6.38E+02	6.38E+02	4.08E-10
As-77	M	1.76E-12	3.59E-08	1.06E-12	-	1.36E+09	1.56E+02	9.00E-01	6.56E+06	2.69E+10	2.36E+04	2.35E+04	2.24E-08
As-78	M	2.69E-13	6.11E-06	3.59E-13	-	1.36E+09	4.02E+03	8.58E-01	4.97E+08	4.51E+12	3.73E+03	3.73E+03	1.41E-10
At-207	M	7.77E-12	6.11E-06	4.77E-13	-	1.36E+09	3.37E+03	9.34E-01	3.14E+08	1.31E+11	2.88E+03	2.88E+03	3.43E-10
At-211	M	3.58E-10	7.94E-08	2.23E-11	-	1.36E+09	8.42E+02	1.00E+00	1.68E+06	7.10E+08	5.16E+04	5.00E+04	2.43E-08
At-211+D	M	-	1.00E-07	-	-	1.36E+09	8.42E+02	9.85E-01	-	-	4.16E+04	4.16E+04	2.02E-08
At-215	-	-	8.09E-10	-	-	1.36E+09	2.19E+11	8.94E-01	-	-	1.47E+15	1.47E+15	2.81E-06
At-216	-	-	3.08E-09	-	-	1.36E+09	7.28E+10	9.54E-01	-	-	1.21E+14	1.21E+14	6.94E-07
At-217	-	-	1.32E-09	-	-	1.36E+09	6.77E+08	8.89E-01	-	-	2.81E+12	2.81E+12	1.75E-06
At-218	-	-	3.57E-09	-	-	1.36E+09	1.09E+07	9.95E-01	-	-	1.50E+10	1.50E+10	5.80E-07
Au-193	S	4.55E-13	4.30E-07	3.26E-13	-	1.36E+09	3.44E+02	9.50E-01	4.69E+07	2.28E+11	4.10E+03	4.10E+03	4.46E-09
Au-194	S	7.92E-13	4.93E-06	8.70E-13	-	1.36E+09	1.54E+02	9.55E-01	7.85E+06	5.86E+10	1.59E+02	1.59E+02	3.89E-10
Au-195	S	6.48E-12	1.38E-07	6.48E-13	-	1.36E+09	1.38E+00	9.60E-01	9.48E+04	6.44E+07	5.08E+01	5.07E+01	1.39E-08
Au-195m	-	-	7.37E-07	-	-	1.36E+09	7.17E+05	9.17E-01	-	-	5.16E+06	5.16E+06	2.72E-09
Au-198	S	4.00E-12	1.71E-06	2.66E-12	-	1.36E+09	9.38E+01	8.92E-01	1.57E+06	7.09E+09	2.99E+02	2.99E+02	1.23E-09
Au-198m	S	7.77E-12	1.89E-06	3.20E-12	-	1.36E+09	1.10E+02	9.22E-01	1.53E+06	4.28E+09	3.07E+02	3.07E+02	1.07E-09
Au-199	S	3.12E-12	2.79E-07	1.16E-12	-	1.36E+09	8.06E+01	9.30E-01	3.09E+06	7.80E+09	1.51E+03	1.51E+03	7.24E-09
Au-200	S	8.55E-14	1.30E-06	9.92E-14	-	1.36E+09	7.53E+03	8.97E-01	3.37E+09	2.66E+13	3.14E+04	3.14E+04	1.62E-09
Au-200m	S	2.81E-12	9.04E-06	2.50E-12	-	1.36E+09	3.25E+02	9.78E-01	5.77E+06	3.49E+10	1.79E+02	1.79E+02	2.14E-10
Au-201	S	3.30E-14	2.29E-07	3.19E-14	-	1.36E+09	1.38E+04	9.02E-01	1.92E+10	1.26E+14	3.25E+05	3.25E+05	9.19E-09
Ba-126	M	3.49E-13	5.83E-07	4.66E-13	-	1.36E+09	3.77E+03	9.40E-01	3.60E+08	3.27E+12	3.35E+04	3.35E+04	2.17E-09
Ba-128	M	7.22E-12	2.10E-07	6.92E-12	-	1.36E+09	1.04E+02	9.66E-01	6.69E+05	4.35E+09	2.50E+03	2.49E+03	5.94E-09
Ba-131	M	2.91E-12	1.78E-06	1.02E-12	-	1.36E+09	2.14E+01	9.05E-01	9.34E+05	2.23E+09	6.48E+01	6.48E+01	7.68E-10
Ba-131m	M	1.69E-14	1.67E-07	6.88E-15	-	1.36E+09	2.49E+04	9.54E-01	1.61E+11	4.46E+14	7.62E+05	7.62E+05	7.76E-09
Ba-133	M	1.16E-11	1.44E-06	4.37E-12	-	1.36E+09	6.45E-02	9.12E-01	8.20E+02	2.10E+06	2.99E-01	2.99E-01	1.19E-09
Ba-133m	M	2.04E-12	1.96E-07	1.42E-12	-	1.36E+09	1.56E+02	9.62E-01	4.88E+06	2.31E+10	4.03E+03	4.02E+03	6.66E-09
Ba-135m	M	1.61E-12	1.71E-07	1.14E-12	-	1.36E+09	2.12E+02	9.61E-01	8.25E+06	3.97E+10	6.26E+03	6.26E+03	7.75E-09
Ba-137m	-	-	2.69E-06	-	-	1.36E+09	1.43E+05	8.77E-01	-	-	2.94E+05	2.94E+05	5.48E-10
Ba-139	M	1.79E-13	1.65E-07	2.06E-13	-	1.36E+09	4.40E+03	9.09E-01	9.50E+08	7.43E+12	1.43E+05	1.43E+05	8.75E-09
Ba-140	M	2.03E-11	7.62E-07	6.77E-12	-	1.36E+09	1.99E+01	8.88E-01	1.30E+05	2.95E+08	1.43E+02	1.43E+02	1.95E-09
Ba-141	M	9.69E-14	3.80E-06	1.22E-13	-	1.36E+09	1.99E+04	8.94E-01	7.26E+09	6.21E+13	2.86E+04	2.86E+04	3.92E-10
Ba-142	M	4.55E-14	4.85E-06	5.88E-14	-	1.36E+09	3.44E+04	9.05E-01	2.60E+10	2.28E+14	3.81E+04	3.81E+04	3.06E-10
Be-10	S	9.40E-11	7.43E-10	2.96E-12	-	1.36E+09	4.33E-07	9.27E-01	6.01E+02	1.29E+05	2.83E+02	1.92E+02	8.60E-03
Be-7	S	2.13E-13	2.13E-07	5.03E-14	-	1.36E+09	4.75E+00	8.86E-01	4.19E+06	6.73E+09	1.22E+02	1.22E+02	3.50E-10
Bi-200	M	7.55E-14	1.06E-05	9.36E-14	-	1.36E+09	1.00E+04	9.24E-01	4.75E+09	4.00E+13	4.97E+03	4.97E+03	1.93E-10
Bi-201	M	1.90E-13	6.05E-06	2.26E-13	-	1.36E+09	3.37E+03	8.67E-01	6.63E+08	5.36E+12	3.13E+03	3.13E+03	3.62E-10
Bi-202	M	1.12E-13	1.24E-05	1.66E-13	-	1.36E+09	3.64E+03	9.51E-01	9.73E+08	9.80E+12	1.50E+03	1.50E+03	1.62E-10
Bi-203	M	8.21E-13	1.16E-05	1.01E-12	-	1.36E+09	5.16E+02	9.51E-01	2.27E+07	1.90E+11	2.28E+02	2.28E+02	1.74E-10
Bi-205	M	3.24E-12	8.19E-06	1.79E-12	-	1.36E+09	1.65E+01	9.62E-01	4.10E+05	1.54E+09	1.02E+01	1.02E+01	2.46E-10
Bi-206	M	5.85E-12	1.52E-05	4.00E-12	-	1.36E+09	4.05E+01	9.40E-01	4.50E+05	2.09E+09	1.38E+01	1.38E+01	1.36E-10
Bi-207	M	2.10E-11	7.08E-06	2.77E-12	-	1.36E+09	1.82E-02	8.65E-01	7.99E+02	7.16E+05	3.96E-02	3.96E-02	8.72E-10
Bi-210	M	3.17E-10	2.76E-09	3.74E-12	-	1.36E+09	5.05E+01	9.27E-01	6.00E+05	4.81E+07	9.60E+04	8.26E+04	6.67E-07
Bi-210m	M	1.17E-08	1.01E-06	2.92E-11	-	1.36E+09	2.31E-07	9.06E-01	6.09E+01	1.03E+03	2.13E-01	2.12E-01	3.74E-04
Bi-211	M	-	1.88E-07	-	-	1.36E+09	1.70E+05	9.03E-01	-	-	4.88E+06	4.88E+06	1.17E-08
Bi-212	M	7.77E-11	8.88E-07	4.40E-13	-	1.36E+09	6.02E+03	9.91E-01	6.08E+08	2.34E+10	3.33E+04	3.33E+04	2.27E-09
Bi-212+D	M	-	7.22E-06	-	-	1.36E+09	6.02E+03	8.96E-01	-	-	4.53E+03	4.53E+03	3.09E-10
Bi-213	M	6.85E-11	5.65E-07	3.17E-13	-	1.36E+09	7.98E+03	1.00E+00	1.12E+09	3.52E+10	6.87E+04	6.87E+04	3.56E-09
Bi-213+D	M	-	7.78E-07	-	-	1.36E+09	7.98E+03	9.68E-01	-	-	5.16E+04	5.16E+04	2.67E-09
Bi-214	M	2.90E-11	7.49E-06	1.47E-13	-	1.36E+09	1.83E+04	9.25E-01	5.53E+09	1.91E+11	1.29E+04	1.29E+04	2.92E-10

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Bk-245	M	7.22E-12	7.09E-07	1.45E-12	-	1.36E+09	5.12E+01	9.98E-01	1.57E+06	2.14E+09	3.52E+02	3.52E+02	3.27E-09
Bk-246	M	9.25E-13	4.25E-06	9.99E-13	-	1.36E+09	1.38E+02	8.80E-01	6.15E+06	4.51E+10	1.80E+02	1.80E+02	6.21E-10
Bk-247	M	3.26E-08	3.10E-07	1.12E-10	-	1.36E+09	5.02E-04	9.28E-01	1.60E+01	3.73E+02	6.81E-01	6.52E-01	6.22E-07
Bk-249	M	5.14E-11	2.63E-12	5.99E-13	-	1.36E+09	7.90E-01	9.11E-01	5.86E+04	4.65E+06	1.61E+06	5.59E+04	3.42E-05
Bk-250	M	1.03E-12	4.23E-06	2.77E-13	-	1.36E+09	1.88E+03	8.51E-01	3.02E+08	5.53E+11	2.55E+03	2.55E+03	6.56E-10
Br-74	M	6.44E-14	2.32E-05	1.22E-13	-	1.36E+09	1.44E+04	8.48E-01	5.24E+09	6.75E+13	3.56E+03	3.56E+03	3.55E-11
Br-74m	M	1.15E-13	2.00E-05	1.98E-13	-	1.36E+09	8.78E+03	8.67E-01	1.97E+09	2.31E+13	2.46E+03	2.46E+03	4.03E-11
Br-75	M	1.13E-13	5.21E-06	1.22E-13	-	1.36E+09	3.72E+03	8.84E-01	1.35E+09	9.94E+12	3.93E+03	3.93E+03	1.54E-10
Br-76	M	1.10E-12	1.30E-05	9.99E-13	-	1.36E+09	3.75E+02	8.84E-01	1.67E+07	1.03E+11	1.59E+02	1.59E+02	6.25E-11
Br-77	M	2.06E-13	1.34E-06	2.20E-13	-	1.36E+09	1.08E+02	9.22E-01	2.19E+07	1.59E+11	4.27E+02	4.27E+02	5.89E-10
Br-80	M	1.80E-14	3.55E-07	3.85E-14	-	1.36E+09	2.09E+04	8.88E-01	2.42E+10	3.51E+14	3.23E+05	3.23E+05	2.40E-09
Br-80m	M	2.43E-13	5.96E-09	1.97E-13	-	1.36E+09	1.37E+03	9.95E-01	3.10E+08	1.71E+12	1.13E+06	1.12E+06	1.27E-07
Br-82	M	1.66E-12	1.24E-05	1.24E-12	-	1.36E+09	1.72E+02	8.65E-01	6.16E+06	3.13E+10	7.80E+01	7.80E+01	7.22E-11
Br-83	M	1.21E-13	3.46E-08	6.33E-14	-	1.36E+09	2.54E+03	8.81E-01	1.78E+09	6.34E+12	4.06E+05	4.05E+05	2.57E-08
Br-84	M	7.18E-14	9.36E-06	1.19E-13	-	1.36E+09	1.15E+04	8.49E-01	4.28E+09	4.82E+13	7.01E+03	7.01E+03	9.98E-11
C-11	M	2.78E-14	4.45E-06	3.32E-14	-	1.36E+09	1.79E+04	8.83E-01	2.39E+10	1.94E+14	2.21E+04	2.21E+04	2.64E-11
C-14	M	7.07E-12	7.84E-12	1.38E-12	-	1.36E+09	1.21E-04	9.27E-01	1.29E+03	1.71E+06	2.68E+04	1.23E+03	2.76E-04
Ca-41	M	2.09E-13	0.00E+00	3.24E-13	-	1.36E+09	4.95E-06	0.00E+00	5.49E+03	5.78E+07	-	5.49E+03	8.82E-02
Ca-45	M	9.40E-12	3.96E-11	1.52E-12	-	1.36E+09	1.55E+00	1.00E+00	4.54E+04	4.99E+07	1.91E+05	3.66E+04	2.06E-06
Ca-47	M	7.88E-12	5.24E-06	3.85E-12	-	1.36E+09	5.58E+01	8.36E-01	6.45E+05	2.14E+09	6.20E+01	6.20E+01	1.01E-10
Ca-49	M	-	1.75E-05	-	-	1.36E+09	4.18E+04	7.78E-01	-	-	1.49E+04	1.49E+04	3.40E-11
Cd-104	S	7.66E-14	9.71E-07	1.02E-13	-	1.36E+09	6.31E+03	9.32E-01	2.75E+09	2.49E+13	3.39E+04	3.39E+04	1.09E-09
Cd-107	S	3.10E-13	3.48E-08	1.49E-13	-	1.36E+09	9.35E+02	9.75E-01	2.79E+08	9.11E+11	1.34E+05	1.34E+05	2.98E-08
Cd-109	S	2.19E-11	8.74E-09	3.36E-12	-	1.36E+09	5.45E-01	9.96E-01	7.21E+03	7.52E+06	3.05E+02	2.92E+02	1.13E-07
Cd-113	F	1.12E-10	7.36E-11	2.18E-11	-	1.36E+09	7.45E-17	9.27E-01	8.05E+01	1.06E+05	2.82E+03	7.82E+01	2.30E+08
Cd-113m	F	1.30E-10	4.45E-10	2.63E-11	-	1.36E+09	5.10E-02	9.27E-01	1.20E+02	1.64E+05	8.35E+02	1.05E+02	4.50E-07
Cd-115	S	5.14E-12	1.01E-06	3.60E-12	-	1.36E+09	1.14E+02	8.86E-01	1.40E+06	6.67E+09	6.18E+02	6.17E+02	1.21E-09
Cd-115m	S	2.92E-11	1.13E-07	7.70E-12	-	1.36E+09	5.67E+00	8.43E-01	3.27E+04	5.87E+07	2.90E+02	2.87E+02	1.13E-08
Cd-117	S	6.51E-13	5.23E-06	6.22E-13	-	1.36E+09	2.44E+03	9.02E-01	1.74E+08	1.13E+12	2.52E+03	2.52E+03	2.34E-10
Cd-117m	S	6.55E-13	1.03E-05	6.03E-13	-	1.36E+09	1.81E+03	8.79E-01	1.33E+08	8.33E+11	9.71E+02	9.71E+02	1.22E-10
Ce-134	M	6.96E-12	8.25E-09	6.62E-12	-	1.36E+09	8.43E+01	9.76E-01	5.66E+05	3.66E+09	5.10E+04	4.68E+04	1.44E-07
Ce-135	M	1.75E-12	7.74E-06	1.78E-12	-	1.36E+09	3.45E+02	9.10E-01	8.61E+06	5.95E+10	2.38E+02	2.38E+02	1.81E-10
Ce-137	M	4.11E-14	4.46E-08	5.85E-14	-	1.36E+09	6.75E+02	9.70E-01	5.12E+08	4.96E+12	7.59E+04	7.59E+04	2.99E-08
Ce-137m	M	1.94E-12	1.38E-07	1.42E-12	-	1.36E+09	1.76E+02	9.44E-01	5.52E+06	2.75E+10	6.59E+03	6.58E+03	9.92E-09
Ce-139	M	5.66E-12	4.54E-07	6.07E-13	-	1.36E+09	1.84E+00	9.49E-01	1.35E+05	9.81E+07	2.08E+01	2.08E+01	3.05E-09
Ce-141	M	1.14E-11	2.27E-07	1.89E-12	-	1.36E+09	7.78E+00	9.38E-01	1.83E+05	2.06E+08	1.78E+02	1.78E+02	6.25E-09
Ce-143	M	3.74E-12	1.09E-06	2.93E-12	-	1.36E+09	1.84E+02	9.04E-01	2.79E+06	1.49E+10	9.09E+02	9.08E+02	1.37E-09
Ce-144	M	1.10E-10	5.02E-08	1.42E-11	-	1.36E+09	8.90E-01	9.35E-01	2.78E+03	2.44E+06	9.22E+01	8.93E+01	2.80E-08
Ce-144+D	M	1.10E-10	2.44E-07	1.02E-10	-	1.36E+09	8.90E-01	8.81E-01	3.88E+02	2.44E+06	2.01E+01	1.91E+01	6.01E-09
Cf-244	M	2.96E-11	6.83E-11	9.03E-14	-	1.36E+09	1.88E+04	9.99E-01	9.24E+09	1.92E+11	1.34E+09	1.16E+09	2.93E-05
Cf-246	M	1.47E-09	9.25E-11	8.58E-12	-	1.36E+09	1.70E+02	9.98E-01	8.81E+05	3.49E+07	8.96E+06	7.84E+05	2.20E-06
Cf-248	M	1.81E-08	4.73E-11	2.42E-11	-	1.36E+09	7.58E-01	9.99E-01	1.39E+03	1.27E+04	7.81E+04	1.24E+03	7.84E-07
Cf-249	M	3.40E-08	1.37E-06	1.14E-10	-	1.36E+09	1.98E-03	9.62E-01	1.60E+01	3.64E+02	1.51E-01	1.50E-01	3.66E-08
Cf-250	M	2.66E-08	4.49E-11	7.10E-11	-	1.36E+09	5.30E-02	9.99E-01	4.52E+01	8.20E+02	7.83E+03	4.26E+01	3.90E-07
Cf-251	M	3.40E-08	3.76E-07	1.17E-10	-	1.36E+09	7.72E-04	9.55E-01	1.53E+01	3.59E+02	5.47E-01	5.28E-01	3.33E-07
Cf-252	-	1.89E-08	2.37E-06	-	-	1.36E+09	2.63E-01	1.69E+00	-	4.20E+03	3.20E-01	3.20E-01	5.95E-10
Cf-253	M	4.22E-09	4.86E-11	1.96E-12	-	1.36E+09	1.42E+01	9.98E-01	3.22E+05	1.02E+06	1.43E+06	2.09E+05	7.22E-06
Cf-254	M	1.21E-07	8.69E-05	-	-	1.36E+09	4.18E+00	1.68E+00	-	1.04E+04	1.39E-01	1.39E-01	1.64E-11
Cl-36	M	2.50E-11	1.74E-09	2.29E-12	-	1.36E+09	2.30E-06	8.83E-01	7.76E+02	4.83E+05	1.27E+02	1.09E+02	3.30E-03

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Cl-38	M	9.40E-14	7.93E-06	1.55E-13	-	1.36E+09	9.79E+03	8.07E-01	2.81E+09	3.15E+13	7.44E+03	7.44E+03	5.61E-11
Cl-39	M	9.36E-14	7.09E-06	1.21E-13	-	1.36E+09	6.55E+03	8.34E-01	2.41E+09	2.11E+13	5.39E+03	5.39E+03	6.23E-11
Cm-238	M	1.35E-11	1.90E-07	1.65E-13	-	1.36E+09	2.53E+03	9.58E-01	6.81E+08	5.66E+10	6.76E+04	6.76E+04	1.23E-08
Cm-240	M	9.51E-09	6.19E-11	1.53E-11	-	1.36E+09	9.37E+00	9.99E-01	2.72E+04	2.98E+05	7.37E+05	2.41E+04	1.20E-06
Cm-241	M	1.01E-10	1.94E-06	2.15E-12	-	1.36E+09	7.71E+00	9.99E-01	1.59E+05	2.31E+07	1.94E+01	1.94E+01	1.17E-09
Cm-242	M	1.51E-08	7.73E-11	1.87E-11	-	1.36E+09	1.55E+00	9.99E-01	3.69E+03	3.11E+04	9.79E+04	3.19E+03	9.65E-07
Cm-243	M	2.69E-08	4.19E-07	7.84E-11	-	1.36E+09	2.43E-02	9.49E-01	3.03E+01	5.99E+02	6.53E-01	6.39E-01	1.24E-08
Cm-244	M	2.53E-08	4.85E-11	6.88E-11	-	1.36E+09	3.83E-02	9.99E-01	4.01E+01	7.42E+02	6.24E+03	3.78E+01	4.68E-07
Cm-245	M	2.77E-08	2.38E-07	9.14E-11	-	1.36E+09	8.15E-05	9.52E-01	1.95E+01	4.37E+02	8.60E-01	8.22E-01	4.79E-06
Cm-246	M	2.77E-08	4.57E-11	9.03E-11	-	1.36E+09	1.47E-04	9.99E-01	1.97E+01	4.37E+02	4.27E+03	1.88E+01	6.12E-05
Cm-247	M	2.50E-08	1.31E-06	8.58E-11	-	1.36E+09	4.44E-08	9.25E-01	2.07E+01	4.83E+02	1.61E-01	1.59E-01	1.72E-03
Cm-248	-	9.58E-08	6.81E-06	-	-	1.36E+09	1.99E-06	1.68E+00	-	1.26E+02	1.70E-02	1.70E-02	4.11E-06
Cm-249	M	7.25E-14	8.51E-08	4.92E-14	-	1.36E+09	5.68E+03	9.09E-01	5.13E+09	2.37E+13	3.57E+05	3.57E+05	3.04E-08
Cm-250	M	4.37E-07	5.03E-05	-	-	1.36E+09	7.14E-05	1.68E+00	-	2.77E+01	2.31E-03	2.31E-03	1.57E-08
Cm-250+D	M	-	1.31E-06	-	-	1.36E+09	7.14E-05	1.68E+00	-	-	8.85E-02	8.85E-02	6.01E-07
Co-55	M	2.07E-12	9.22E-06	2.38E-12	-	1.36E+09	3.46E+02	8.48E-01	6.46E+06	5.05E+10	2.15E+02	2.15E+02	6.64E-11
Co-56	M	1.85E-11	1.80E-05	5.29E-12	-	1.36E+09	3.21E+00	8.23E-01	2.70E+04	5.24E+07	1.06E+00	1.06E+00	3.57E-11
Co-57	M	2.09E-12	3.55E-07	4.85E-13	-	1.36E+09	9.34E-01	9.71E-01	8.56E+04	1.35E+08	1.32E+01	1.32E+01	1.56E-09
Co-58	M	5.99E-12	4.49E-06	1.57E-12	-	1.36E+09	3.57E+00	8.63E-01	1.01E+05	1.80E+08	4.49E+00	4.49E+00	1.41E-10
Co-58m	M	6.88E-14	1.00E-12	5.99E-14	-	1.36E+09	6.63E+02	9.94E-01	4.92E+08	2.91E+12	3.25E+09	4.27E+08	7.25E-05
Co-60	M	3.58E-11	1.24E-05	7.33E-12	-	1.36E+09	1.31E-01	8.34E-01	8.28E+02	1.15E+06	6.43E-02	6.43E-02	5.69E-11
Co-60m	M	3.96E-15	1.86E-08	2.12E-15	-	1.36E+09	3.48E+04	9.25E-01	7.29E+11	2.65E+15	9.84E+06	9.84E+06	3.29E-08
Co-61	M	1.43E-13	2.48E-07	1.32E-13	-	1.36E+09	3.68E+03	9.38E-01	1.24E+09	7.77E+12	7.70E+04	7.70E+04	2.48E-09
Co-62m	M	3.17E-14	1.35E-05	6.55E-14	-	1.36E+09	2.62E+04	8.28E-01	1.78E+10	2.50E+14	1.14E+04	1.14E+04	5.24E-11
Cr-48	S	7.51E-13	1.62E-06	4.07E-13	-	1.36E+09	2.64E+02	9.13E-01	2.89E+07	1.06E+11	8.70E+02	8.70E+02	3.06E-10
Cr-49	S	7.36E-14	4.43E-06	9.10E-14	-	1.36E+09	8.65E+03	8.92E-01	4.23E+09	3.55E+13	1.07E+04	1.07E+04	1.17E-10
Cr-51	S	1.67E-13	1.27E-07	8.88E-14	-	1.36E+09	9.13E+00	9.03E-01	4.57E+06	1.65E+10	3.87E+02	3.87E+02	4.20E-09
Cs-125	F	1.64E-14	2.92E-06	4.77E-14	-	1.36E+09	8.09E+03	8.78E-01	7.54E+09	1.49E+14	1.54E+04	1.54E+04	4.60E-10
Cs-126	-	-	4.74E-06	-	-	1.36E+09	2.22E+05	8.87E-01	-	-	2.57E+05	2.57E+05	2.83E-10
Cs-127	F	2.47E-14	1.68E-06	5.00E-14	-	1.36E+09	9.71E+02	8.98E-01	8.63E+08	1.19E+13	3.13E+03	3.13E+03	7.95E-10
Cs-128	F	-	3.92E-06	-	-	1.36E+09	9.34E+04	8.85E-01	-	-	1.31E+05	1.31E+05	3.48E-10
Cs-129	F	7.44E-14	1.05E-06	1.38E-13	-	1.36E+09	1.89E+02	8.98E-01	6.10E+07	7.69E+11	9.77E+02	9.77E+02	1.29E-09
Cs-130	F	1.24E-14	2.22E-06	3.85E-14	-	1.36E+09	1.22E+04	8.90E-01	1.41E+10	2.97E+14	3.00E+04	3.00E+04	6.21E-10
Cs-131	F	7.51E-14	4.91E-09	1.37E-13	-	1.36E+09	2.61E+01	9.83E-01	8.47E+06	1.05E+11	2.63E+04	2.62E+04	2.56E-07
Cs-132	F	5.92E-13	3.11E-06	1.18E-12	-	1.36E+09	3.91E+01	8.71E-01	1.47E+06	1.99E+10	7.02E+01	7.02E+01	4.60E-10
Cs-134	F	1.65E-11	7.10E-06	4.48E-11	-	1.36E+09	3.36E-01	8.65E-01	3.33E+02	6.15E+06	2.66E-01	2.66E-01	2.06E-10
Cs-134m	F	1.99E-14	5.02E-08	3.28E-14	-	1.36E+09	2.09E+03	9.71E-01	2.84E+09	3.18E+13	2.09E+05	2.09E+05	2.60E-08
Cs-135	F	1.86E-12	2.36E-11	4.70E-12	-	1.36E+09	3.01E-07	9.27E-01	3.78E+02	6.50E+06	8.90E+03	3.63E+02	3.15E-01
Cs-135m	F	1.32E-14	7.37E-06	3.66E-14	-	1.36E+09	6.87E+03	8.61E-01	8.35E+09	1.57E+14	5.27E+03	5.27E+03	2.01E-10
Cs-136	F	3.49E-12	1.00E-05	7.22E-12	-	1.36E+09	1.93E+01	8.56E-01	1.19E+05	1.67E+09	1.10E+01	1.10E+01	1.50E-10
Cs-137	F	1.19E-11	5.33E-10	3.17E-11	-	1.36E+09	2.31E-02	9.27E-01	7.38E+01	1.34E+06	5.19E+02	6.46E+01	7.44E-07
Cs-137+D	F	1.19E-11	2.54E-06	3.17E-11	-	1.36E+09	2.31E-02	8.77E-01	7.38E+01	1.34E+06	1.15E-01	1.15E-01	1.32E-09
Cs-138	F	4.00E-14	1.19E-05	1.27E-13	-	1.36E+09	1.13E+04	8.85E-01	3.96E+09	8.54E+13	5.23E+03	5.23E+03	1.24E-10
Cu-60	S	5.77E-14	1.93E-05	1.04E-13	-	1.36E+09	1.57E+04	8.32E-01	6.71E+09	8.22E+13	4.76E+03	4.76E+03	3.53E-11
Cu-61	S	2.41E-13	3.63E-06	2.39E-13	-	1.36E+09	1.78E+03	8.51E-01	3.31E+08	2.23E+12	2.81E+03	2.81E+03	1.86E-10
Cu-62	-	-	4.43E-06	-	-	1.36E+09	3.74E+04	8.82E-01	-	-	4.66E+04	4.66E+04	1.50E-10
Cu-64	S	4.33E-13	8.30E-07	2.93E-13	-	1.36E+09	4.78E+02	8.82E-01	7.25E+07	3.33E+11	3.18E+03	3.18E+03	8.26E-10
Cu-66	-	-	4.32E-07	-	-	1.36E+09	7.14E+04	8.46E-01	-	-	9.51E+05	9.51E+05	1.71E-09
Cu-67	S	2.35E-12	3.83E-07	8.88E-13	-	1.36E+09	9.81E+01	9.24E-01	4.91E+06	1.26E+10	1.35E+03	1.35E+03	1.79E-09

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Dy-155	M	2.45E-13	2.44E-06	2.68E-13	-	1.36E+09	6.07E+02	9.16E-01	1.01E+08	7.48E+11	1.32E+03	1.32E+03	6.55E-10
Dy-157	M	8.33E-14	1.32E-06	1.21E-13	-	1.36E+09	7.49E+02	9.04E-01	2.75E+08	2.72E+12	3.06E+03	3.06E+03	1.24E-09
Dy-159	M	1.28E-12	3.19E-08	2.37E-13	-	1.36E+09	1.75E+00	9.60E-01	3.28E+05	4.13E+08	2.78E+02	2.78E+02	4.90E-08
Dy-165	M	2.10E-13	9.50E-08	1.95E-13	-	1.36E+09	2.60E+03	9.40E-01	5.93E+08	3.74E+12	1.42E+05	1.42E+05	1.74E-08
Dy-166	M	8.36E-12	6.03E-08	4.48E-12	-	1.36E+09	7.44E+01	9.44E-01	7.38E+05	2.69E+09	6.36E+03	6.31E+03	2.73E-08
Er-161	M	1.34E-13	4.09E-06	1.65E-13	-	1.36E+09	1.87E+03	9.42E-01	5.05E+08	4.22E+12	2.37E+03	2.37E+03	3.95E-10
Er-165	M	3.13E-14	3.05E-08	4.18E-14	-	1.36E+09	5.86E+02	9.57E-01	6.23E+08	5.66E+12	9.77E+04	9.77E+04	5.34E-08
Er-169	M	3.85E-12	9.10E-11	1.02E-12	-	1.36E+09	2.72E+01	9.27E-01	1.19E+06	2.13E+09	1.57E+06	6.75E+05	8.14E-06
Er-171	M	9.40E-13	1.42E-06	8.70E-13	-	1.36E+09	8.07E+02	9.05E-01	4.12E+07	2.59E+11	3.06E+03	3.06E+03	1.26E-09
Er-172	M	4.74E-12	2.20E-06	2.55E-12	-	1.36E+09	1.23E+02	9.28E-01	2.15E+06	7.85E+09	2.94E+02	2.93E+02	7.95E-10
Es-250	M	5.07E-13	1.69E-06	3.55E-14	-	1.36E+09	2.89E+03	8.88E-01	3.62E+09	1.72E+12	9.37E+03	9.37E+03	1.57E-09
Es-251	M	6.40E-12	2.55E-07	4.33E-13	-	1.36E+09	1.84E+02	9.48E-01	1.89E+07	8.68E+09	3.70E+03	3.70E+03	9.80E-09
Es-253	M	8.84E-09	1.25E-09	1.44E-11	-	1.36E+09	1.24E+01	9.95E-01	3.81E+04	4.22E+05	4.84E+04	2.03E+04	8.06E-07
Es-254	M	1.85E-08	8.55E-09	2.82E-11	-	1.36E+09	9.17E-01	9.95E-01	1.45E+03	1.50E+04	5.25E+02	3.75E+02	2.02E-07
Es-254+D	M	-	4.24E-06	-	-	1.36E+09	9.17E-01	8.53E-01	-	-	1.23E+00	1.23E+00	6.63E-10
Es-254m	M	1.53E-09	2.10E-06	1.11E-11	-	1.36E+09	1.54E+02	9.95E-01	6.18E+05	3.05E+07	3.60E+02	3.60E+02	1.15E-09
Eu-145	M	1.81E-12	6.95E-06	1.46E-12	-	1.36E+09	4.26E+01	8.75E-01	1.30E+06	7.11E+09	3.41E+01	3.41E+01	2.25E-10
Eu-146	M	2.59E-12	1.16E-05	2.45E-12	-	1.36E+09	5.49E+01	8.71E-01	9.95E+05	6.40E+09	2.64E+01	2.64E+01	1.36E-10
Eu-147	M	3.85E-12	2.04E-06	9.69E-13	-	1.36E+09	1.05E+01	8.66E-01	4.83E+05	8.27E+08	2.90E+01	2.90E+01	7.86E-10
Eu-148	M	9.92E-12	9.85E-06	2.38E-12	-	1.36E+09	4.64E+00	9.14E-01	8.67E+04	1.41E+08	2.51E+00	2.51E+00	1.55E-10
Eu-149	M	1.07E-12	1.42E-07	2.34E-13	-	1.36E+09	2.72E+00	9.24E-01	5.16E+05	7.67E+08	1.01E+02	1.01E+02	1.07E-08
Eu-150	M	1.12E-10	6.49E-06	2.43E-12	-	1.36E+09	2.03E-02	9.01E-01	9.32E+02	1.38E+05	4.24E-02	4.24E-02	6.09E-10
Eu-150m	M	1.03E-12	1.95E-07	9.81E-13	-	1.36E+09	4.81E+02	8.56E-01	2.18E+07	1.41E+11	1.40E+04	1.40E+04	8.48E-09
Eu-152	M	9.10E-11	5.30E-06	2.96E-12	-	1.36E+09	5.20E-02	9.19E-01	1.07E+03	2.37E+05	7.14E-02	7.14E-02	4.05E-10
Eu-152m	M	1.12E-12	1.33E-06	1.25E-12	-	1.36E+09	6.51E+02	9.10E-01	2.32E+07	1.76E+11	2.62E+03	2.62E+03	1.19E-09
Eu-154	M	1.15E-10	5.83E-06	4.74E-12	-	1.36E+09	7.88E-02	9.35E-01	8.58E+02	2.40E+05	8.17E-02	8.17E-02	3.10E-10
Eu-155	M	1.48E-11	1.24E-07	8.07E-13	-	1.36E+09	1.40E-01	9.41E-01	7.94E+03	2.94E+06	6.01E+00	6.01E+00	1.29E-08
Eu-156	M	1.37E-11	6.62E-06	5.44E-12	-	1.36E+09	1.67E+01	8.97E-01	1.36E+05	3.67E+08	1.36E+01	1.36E+01	2.48E-10
Eu-157	M	1.57E-12	9.60E-07	1.54E-12	-	1.36E+09	4.01E+02	8.95E-01	1.16E+07	7.71E+10	2.27E+03	2.27E+03	1.73E-09
Eu-158	M	1.10E-13	5.06E-06	1.39E-13	-	1.36E+09	7.94E+03	8.56E-01	2.54E+09	2.18E+13	8.92E+03	8.92E+03	3.44E-10
F-18	M	1.21E-13	4.45E-06	7.88E-14	-	1.36E+09	3.32E+03	8.83E-01	1.87E+09	8.28E+12	4.11E+03	4.11E+03	4.33E-11
Fe-52	M	2.73E-12	3.07E-06	3.29E-12	-	1.36E+09	7.34E+02	8.96E-01	9.91E+06	8.12E+10	1.30E+03	1.30E+03	1.78E-10
Fe-55	M	7.99E-13	0.00E+00	5.18E-13	-	1.36E+09	2.57E-01	0.00E+00	2.21E+04	9.72E+07	-	2.21E+04	9.17E-06
Fe-59	M	1.33E-11	5.83E-06	4.07E-12	-	1.36E+09	5.68E+00	8.39E-01	6.20E+04	1.29E+08	5.65E+00	5.65E+00	1.14E-10
Fe-60	M	1.84E-10	6.38E-12	1.28E-10	-	1.36E+09	6.93E-06	9.27E-01	1.39E+01	6.57E+04	3.29E+04	1.39E+01	2.33E-04
Fe-60+D	M	-	1.86E-08	-	-	1.36E+09	6.93E-06	9.25E-01	-	-	1.13E+01	1.13E+01	1.90E-04
Fm-252	M	1.03E-09	5.09E-11	6.92E-12	-	1.36E+09	2.67E+02	9.98E-01	1.72E+06	7.84E+07	2.56E+07	1.58E+06	2.88E-06
Fm-253	M	1.28E-09	2.24E-07	2.13E-12	-	1.36E+09	8.43E+01	9.96E-01	1.76E+06	1.99E+07	1.84E+03	1.84E+03	1.07E-08
Fm-254	M	1.98E-10	1.23E-10	9.58E-13	-	1.36E+09	1.87E+03	9.97E-01	8.69E+07	2.86E+09	7.44E+07	3.95E+07	1.04E-05
Fm-255	M	8.84E-10	3.85E-09	6.73E-12	-	1.36E+09	3.02E+02	9.91E-01	2.00E+06	1.03E+08	3.86E+05	3.22E+05	5.27E-07
Fm-257	M	2.04E-08	3.06E-07	2.05E-11	-	1.36E+09	2.52E+00	9.39E-01	5.46E+03	3.73E+04	4.26E+01	4.23E+01	8.37E-09
Fr-219	-	-	1.44E-08	-	-	1.36E+09	1.04E+09	8.97E-01	-	-	3.92E+11	3.92E+11	1.60E-07
Fr-220	-	-	3.25E-08	-	-	1.36E+09	7.98E+05	9.68E-01	-	-	1.23E+08	1.23E+08	6.60E-08
Fr-220+D	-	-	7.26E-06	-	-	1.36E+09	7.98E+05	8.96E-01	-	-	5.97E+05	5.97E+05	3.19E-10
Fr-221	-	-	1.11E-07	-	-	1.36E+09	7.59E+04	9.19E-01	-	-	3.62E+06	3.62E+06	2.05E-08
Fr-221+D	-	-	8.91E-07	-	-	1.36E+09	7.59E+04	9.72E-01	-	-	4.26E+05	4.26E+05	2.41E-09
Fr-222	F	2.42E-11	1.14E-08	1.07E-12	-	1.36E+09	2.53E+04	9.27E-01	1.05E+09	3.16E+11	1.16E+07	1.15E+07	1.96E-07
Fr-223	F	3.06E-12	1.40E-07	4.85E-12	-	1.36E+09	1.67E+04	9.61E-01	1.53E+08	1.65E+12	6.04E+05	6.02E+05	1.56E-08
Ga-65	M	2.84E-14	5.05E-06	4.96E-14	-	1.36E+09	2.40E+04	8.65E-01	2.15E+10	2.55E+14	2.67E+04	2.67E+04	1.41E-10

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Ga-66	M	2.18E-12	1.26E-05	2.81E-12	-	1.36E+09	6.46E+02	8.43E-01	1.02E+07	8.95E+10	2.96E+02	2.96E+02	5.87E-11
Ga-67	M	9.55E-13	5.36E-07	4.59E-13	-	1.36E+09	7.76E+01	9.15E-01	7.51E+06	2.45E+10	7.70E+02	7.70E+02	1.29E-09
Ga-68	M	1.28E-13	4.17E-06	1.66E-13	-	1.36E+09	5.36E+03	8.80E-01	1.43E+09	1.26E+13	7.10E+03	7.10E+03	1.75E-10
Ga-70	M	2.92E-14	4.39E-08	3.96E-14	-	1.36E+09	1.72E+04	8.64E-01	1.93E+10	1.78E+14	2.21E+06	2.21E+06	1.74E-08
Ga-72	M	2.17E-12	1.37E-05	2.54E-12	-	1.36E+09	4.31E+02	8.71E-01	7.53E+06	5.99E+10	1.76E+02	1.76E+02	5.70E-11
Ga-73	M	6.14E-13	1.25E-06	6.07E-13	-	1.36E+09	1.24E+03	9.29E-01	9.05E+07	6.08E+11	5.18E+03	5.18E+03	5.94E-10
Gd-145	M	3.63E-14	1.13E-05	6.59E-14	-	1.36E+09	1.59E+04	8.14E-01	1.07E+10	1.32E+14	8.42E+03	8.42E+03	1.49E-10
Gd-146	M	2.27E-11	5.56E-07	2.26E-12	-	1.36E+09	5.24E+00	9.43E-01	1.03E+05	6.97E+07	4.86E+01	4.86E+01	2.63E-09
Gd-147	M	1.34E-12	5.88E-06	1.25E-12	-	1.36E+09	1.59E+02	9.11E-01	5.67E+06	3.59E+10	1.45E+02	1.45E+02	2.59E-10
Gd-148	F	1.26E-08	0.00E+00	3.37E-11	-	1.36E+09	7.45E-03	0.00E+00	5.78E+01	1.05E+03	-	5.48E+01	2.11E-06
Gd-149	M	2.76E-12	1.59E-06	1.02E-12	-	1.36E+09	2.69E+01	8.92E-01	1.17E+06	2.95E+09	9.23E+01	9.23E+01	9.92E-10
Gd-151	M	2.92E-12	1.20E-07	4.85E-13	-	1.36E+09	2.11E+00	9.30E-01	1.93E+05	2.18E+08	9.19E+01	9.19E+01	1.28E-08
Gd-152	F	9.10E-09	0.00E+00	2.40E-11	-	1.36E+09	6.42E-15	0.00E+00	7.41E+01	1.33E+03	-	7.02E+01	3.22E+06
Gd-153	M	6.55E-12	1.62E-07	6.66E-13	-	1.36E+09	1.05E+00	9.45E-01	6.98E+04	4.82E+07	3.32E+01	3.32E+01	9.43E-09
Gd-159	M	1.46E-12	1.74E-07	1.31E-12	-	1.36E+09	3.27E+02	9.00E-01	1.11E+07	6.77E+10	1.02E+04	1.02E+04	9.58E-09
Ge-66	M	2.50E-13	2.86E-06	2.58E-13	-	1.36E+09	2.67E+03	9.15E-01	4.61E+08	3.23E+12	4.97E+03	4.97E+03	2.38E-10
Ge-67	M	4.59E-14	6.24E-06	8.62E-14	-	1.36E+09	1.95E+04	8.43E-01	1.00E+10	1.28E+14	1.80E+04	1.80E+04	1.20E-10
Ge-68	M	4.88E-11	4.70E-13	3.48E-12	-	1.36E+09	8.78E-01	1.00E+00	1.12E+04	5.44E+06	9.09E+06	1.12E+04	1.68E-06
Ge-68+D	M	-	4.17E-06	-	-	1.36E+09	8.78E-01	8.80E-01	-	-	1.16E+00	1.16E+00	1.75E-10
Ge-69	M	8.81E-13	4.02E-06	5.99E-13	-	1.36E+09	1.55E+02	8.46E-01	1.15E+07	5.33E+10	2.22E+02	2.22E+02	1.92E-10
Ge-71	M	5.18E-14	4.74E-13	3.19E-14	-	1.36E+09	2.14E+01	1.00E+00	2.99E+07	1.25E+11	2.20E+08	2.63E+07	1.69E-04
Ge-75	M	8.44E-14	1.38E-07	6.92E-14	-	1.36E+09	4.40E+03	9.09E-01	2.83E+09	1.57E+13	1.71E+05	1.71E+05	5.65E-09
Ge-77	M	1.15E-12	4.82E-06	7.92E-13	-	1.36E+09	5.37E+02	8.98E-01	3.01E+07	1.41E+11	6.04E+02	6.04E+02	1.68E-10
Ge-78	M	2.48E-13	1.10E-06	2.43E-13	-	1.36E+09	4.19E+03	9.09E-01	7.66E+08	5.10E+12	2.04E+04	2.04E+04	7.37E-10
H-3	M	1.99E-13	0.00E+00	2.20E-13	-	1.70E+01	5.61E-02	0.00E+00	1.50E+04	1.41E+00	-	1.41E+00	1.47E-10
Hf-170	M	1.20E-12	2.04E-06	1.05E-12	-	1.36E+09	3.79E+02	9.49E-01	1.60E+07	9.54E+10	9.53E+02	9.53E+02	8.29E-10
Hf-172	F	6.92E-11	1.62E-07	2.35E-12	-	1.36E+09	3.71E-01	9.47E-01	7.01E+03	1.62E+06	1.18E+01	1.17E+01	1.06E-08
Hf-173	M	5.92E-13	1.34E-06	5.00E-13	-	1.36E+09	2.53E+02	9.13E-01	2.25E+07	1.29E+11	1.01E+03	1.01E+03	1.34E-09
Hf-175	M	4.29E-12	1.35E-06	9.21E-13	-	1.36E+09	3.61E+00	9.03E-01	1.74E+05	2.54E+08	1.44E+01	1.44E+01	1.36E-09
Hf-177m	M	1.81E-13	8.58E-06	1.33E-13	-	1.36E+09	7.09E+03	9.20E-01	2.37E+09	1.18E+13	4.37E+03	4.37E+03	2.12E-10
Hf-178m	F	3.70E-10	9.58E-06	8.40E-12	-	1.36E+09	2.24E-02	8.88E-01	2.76E+02	4.26E+04	2.99E-02	2.99E-02	4.61E-10
Hf-179m	M	1.38E-11	3.42E-06	2.94E-12	-	1.36E+09	1.01E+01	8.96E-01	1.52E+05	2.21E+08	1.60E+01	1.60E+01	5.52E-10
Hf-180m	M	4.14E-13	3.94E-06	3.56E-13	-	1.36E+09	1.10E+03	9.02E-01	1.38E+08	8.05E+11	1.51E+03	1.51E+03	4.78E-10
Hf-181	M	1.76E-11	2.24E-06	2.75E-12	-	1.36E+09	5.97E+00	8.93E-01	9.64E+04	1.02E+08	1.45E+01	1.45E+01	8.54E-10
Hf-182	F	3.41E-10	9.10E-07	3.74E-12	-	1.36E+09	7.70E-08	9.11E-01	4.75E+02	3.54E+04	2.35E-01	2.35E-01	1.08E-03
Hf-182+D	F	-	6.95E-06	-	-	1.36E+09	7.70E-08	9.11E-01	-	-	3.07E-02	3.07E-02	1.41E-04
Hf-182m	M	1.04E-13	3.83E-06	6.99E-14	-	1.36E+09	5.92E+03	9.42E-01	3.77E+09	1.72E+13	7.99E+03	7.99E+03	4.76E-10
Hf-183	M	1.65E-13	3.31E-06	1.31E-13	-	1.36E+09	5.69E+03	8.66E-01	1.93E+09	1.04E+13	9.66E+03	9.66E+03	6.03E-10
Hf-184	M	1.38E-12	8.64E-07	1.26E-12	-	1.36E+09	1.47E+03	9.17E-01	5.20E+07	3.23E+11	9.05E+03	9.05E+03	2.19E-09
Hg-193	M	2.53E-13	5.55E-07	1.87E-13	-	1.36E+09	1.73E+03	9.38E-01	4.12E+08	2.07E+12	1.62E+04	1.62E+04	3.50E-09
Hg-193m	M	9.40E-13	4.54E-06	9.10E-13	-	1.36E+09	5.47E+02	9.65E-01	2.67E+07	1.76E+11	6.08E+02	6.08E+02	4.16E-10
Hg-194	M	2.88E-11	5.05E-12	2.00E-12	-	1.36E+09	2.67E-03	1.00E+00	9.19E+02	4.34E+05	3.98E+04	8.96E+02	1.27E-04
Hg-194+D	M	-	4.93E-06	-	-	1.36E+09	2.67E-03	9.55E-01	-	-	4.27E-02	4.27E-02	6.04E-09
Hg-195	M	2.84E-13	7.35E-07	2.27E-13	-	1.36E+09	6.13E+02	9.51E-01	1.20E+08	6.52E+11	4.27E+03	4.27E+03	2.63E-09
Hg-195m	M	2.33E-12	7.69E-07	1.42E-12	-	1.36E+09	1.46E+02	9.98E-01	4.57E+06	1.89E+10	9.25E+02	9.25E+02	2.40E-09
Hg-197	M	1.25E-12	1.14E-07	5.99E-13	-	1.36E+09	9.47E+01	9.65E-01	7.03E+06	2.29E+10	4.19E+03	4.19E+03	1.69E-08
Hg-197m	M	2.28E-12	2.50E-07	1.24E-12	-	1.36E+09	2.55E+02	9.69E-01	9.14E+06	3.38E+10	5.12E+03	5.12E+03	7.68E-09
Hg-199m	M	6.33E-14	5.77E-07	4.44E-14	-	1.36E+09	8.55E+03	9.32E-01	8.56E+09	4.08E+13	7.74E+04	7.74E+04	3.49E-09
Hg-203	M	8.95E-12	9.22E-07	1.35E-12	-	1.36E+09	5.43E+00	9.11E-01	1.79E+05	1.83E+08	3.15E+01	3.14E+01	2.28E-09

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Ho-155	M	5.29E-14	1.52E-06	6.25E-14	-	1.36E+09	7.59E+03	9.26E-01	5.40E+09	4.33E+13	2.62E+04	2.62E+04	1.04E-09
Ho-157	M	7.36E-15	1.85E-06	1.07E-14	-	1.36E+09	2.89E+04	9.23E-01	1.20E+11	1.19E+15	8.24E+04	8.24E+04	8.68E-10
Ho-159	M	1.22E-14	1.16E-06	1.28E-14	-	1.36E+09	1.10E+04	9.27E-01	3.83E+10	2.73E+14	5.00E+04	5.00E+04	1.40E-09
Ho-161	M	1.98E-14	5.52E-08	2.48E-14	-	1.36E+09	2.43E+03	9.57E-01	4.35E+09	3.70E+13	2.24E+05	2.24E+05	2.88E-08
Ho-162	M	5.40E-15	6.03E-07	4.66E-15	-	1.36E+09	2.43E+04	8.79E-01	2.32E+11	1.36E+15	2.23E+05	2.23E+05	2.89E-09
Ho-162m	M	5.18E-14	2.46E-06	4.55E-14	-	1.36E+09	5.36E+03	9.24E-01	5.23E+09	3.12E+13	1.15E+04	1.15E+04	6.73E-10
Ho-164	M	1.65E-14	2.78E-08	1.26E-14	-	1.36E+09	1.26E+04	9.50E-01	4.43E+10	2.30E+14	2.31E+06	2.31E+06	5.86E-08
Ho-164m	M	3.48E-14	3.63E-08	2.50E-14	-	1.36E+09	9.71E+03	9.57E-01	1.73E+10	8.43E+13	1.36E+06	1.36E+06	4.46E-08
Ho-166	M	3.85E-12	1.18E-07	3.74E-12	-	1.36E+09	2.27E+02	8.97E-01	2.69E+06	1.78E+10	1.04E+04	1.04E+04	1.48E-08
Ho-166m	M	3.09E-10	7.70E-06	4.29E-12	-	1.36E+09	5.78E-04	9.03E-01	4.17E+02	3.94E+04	2.82E-02	2.82E-02	1.57E-08
Ho-167	M	2.25E-13	1.45E-06	1.73E-13	-	1.36E+09	1.96E+03	9.00E-01	5.03E+08	2.63E+12	7.30E+03	7.30E+03	1.21E-09
I-120	F	3.89E-13	1.33E-05	5.66E-13	-	1.36E+09	4.50E+03	8.78E-01	3.53E+08	3.49E+12	1.87E+03	1.87E+03	9.70E-11
I-120m	F	1.98E-13	2.55E-05	3.53E-13	-	1.36E+09	6.87E+03	8.57E-01	8.65E+08	1.05E+13	1.53E+03	1.53E+03	5.19E-11
I-121	F	9.81E-14	1.64E-06	1.44E-13	-	1.36E+09	2.86E+03	8.92E-01	8.84E+08	8.82E+12	9.53E+03	9.53E+03	7.81E-10
I-122	-	-	4.17E-06	-	-	1.36E+09	1.01E+05	8.75E-01	-	-	1.34E+05	1.34E+05	3.16E-10
I-123	F	3.03E-13	5.10E-07	3.77E-13	-	1.36E+09	4.60E+02	9.56E-01	5.42E+07	4.58E+11	4.59E+03	4.59E+03	2.38E-09
I-124	F	1.76E-11	5.10E-06	2.18E-11	-	1.36E+09	6.05E+01	8.75E-01	1.23E+05	1.04E+09	6.60E+01	6.60E+01	2.62E-10
I-125	F	1.06E-11	7.24E-09	1.70E-11	-	1.36E+09	4.21E+00	9.86E-01	1.10E+04	1.20E+08	2.87E+03	2.27E+03	1.31E-07
I-126	F	3.70E-11	1.96E-06	3.24E-11	-	1.36E+09	1.94E+01	8.81E-01	2.66E+04	1.59E+08	5.48E+01	5.46E+01	6.88E-10
I-128	F	3.04E-14	3.74E-07	6.14E-14	-	1.36E+09	1.46E+04	8.90E-01	1.06E+10	1.45E+14	2.13E+05	2.13E+05	3.63E-09
I-129	F	6.07E-11	6.10E-09	1.14E-10	-	1.36E+09	4.41E-08	9.80E-01	1.56E+01	1.99E+05	3.26E+01	1.05E+01	5.98E-02
I-130	F	2.76E-12	9.67E-06	3.41E-12	-	1.36E+09	4.91E+02	8.72E-01	6.40E+06	5.38E+10	2.83E+02	2.83E+02	1.46E-10
I-131	F	1.95E-11	1.59E-06	2.43E-11	-	1.36E+09	3.15E+01	8.91E-01	5.75E+04	4.87E+08	1.08E+02	1.08E+02	8.72E-10
I-132	F	3.74E-13	1.06E-05	5.07E-13	-	1.36E+09	2.64E+03	8.92E-01	2.31E+08	2.13E+12	1.36E+03	1.36E+03	1.32E-10
I-132m	F	2.70E-13	1.40E-06	3.40E-13	-	1.36E+09	4.36E+03	8.74E-01	5.70E+08	4.87E+12	1.73E+04	1.73E+04	1.02E-09
I-133	F	6.25E-12	2.72E-06	7.25E-12	-	1.36E+09	2.92E+02	8.81E-01	1.79E+06	1.41E+10	5.93E+02	5.93E+02	5.24E-10
I-134	F	1.02E-13	1.24E-05	1.76E-13	-	1.36E+09	6.92E+03	8.79E-01	1.75E+09	2.05E+13	3.09E+03	3.09E+03	1.16E-10
I-135	F	1.34E-12	7.84E-06	1.64E-12	-	1.36E+09	9.18E+02	9.00E-01	2.49E+07	2.07E+11	6.33E+02	6.33E+02	1.81E-10
In-109	M	1.11E-13	2.90E-06	1.32E-13	-	1.36E+09	1.45E+03	8.99E-01	4.87E+08	3.93E+12	2.70E+03	2.70E+03	3.95E-10
In-110	M	2.65E-13	1.41E-05	4.51E-13	-	1.36E+09	1.24E+03	8.71E-01	1.22E+08	1.41E+12	4.91E+02	4.91E+02	8.46E-11
In-110m	M	1.17E-13	7.14E-06	1.68E-13	-	1.36E+09	5.27E+03	8.74E-01	1.39E+09	1.36E+13	4.11E+03	4.11E+03	1.66E-10
In-111	M	8.03E-13	1.42E-06	6.25E-13	-	1.36E+09	8.94E+01	9.52E-01	6.36E+06	3.36E+10	3.22E+02	3.22E+02	7.75E-10
In-112	M	1.10E-14	1.15E-06	1.33E-14	-	1.36E+09	2.53E+04	9.31E-01	8.45E+10	6.95E+14	1.15E+05	1.15E+05	9.88E-10
In-113m	M	5.18E-14	1.05E-06	5.11E-14	-	1.36E+09	3.66E+03	9.32E-01	3.18E+09	2.14E+13	1.82E+04	1.82E+04	1.09E-09
In-114	-	-	1.35E-08	-	-	1.36E+09	3.04E+05	8.69E-01	-	-	1.26E+08	1.26E+08	9.18E-08
In-114m	M	3.00E-11	3.57E-07	1.07E-11	-	1.36E+09	5.11E+00	9.46E-01	2.12E+04	5.14E+07	7.36E+01	7.34E+01	3.18E-09
In-115	F	4.03E-10	2.70E-10	3.19E-11	-	1.36E+09	1.36E-16	9.27E-01	5.50E+01	2.96E+04	7.68E+02	5.12E+01	8.41E+07
In-115m	M	2.15E-13	6.27E-07	1.96E-13	-	1.36E+09	1.35E+03	9.17E-01	3.07E+08	1.90E+12	1.15E+04	1.15E+04	1.89E-09
In-116m	M	8.77E-14	1.23E-05	1.07E-13	-	1.36E+09	6.73E+03	8.92E-01	2.79E+09	2.32E+13	2.98E+03	2.98E+03	9.98E-11
In-117	M	5.59E-14	2.90E-06	4.74E-14	-	1.36E+09	8.32E+03	8.97E-01	7.80E+09	4.49E+13	1.56E+04	1.56E+04	4.25E-10
In-117m	M	2.33E-13	3.35E-07	2.17E-13	-	1.36E+09	3.13E+03	9.23E-01	6.40E+08	4.05E+12	4.92E+04	4.92E+04	3.57E-09
In-119	-	-	3.54E-06	-	-	1.36E+09	1.52E+05	8.71E-01	-	-	2.40E+05	2.40E+05	3.64E-10
In-119m	M	3.34E-14	5.63E-08	5.85E-14	-	1.36E+09	2.02E+04	9.30E-01	1.54E+10	1.83E+14	1.88E+06	1.88E+06	2.15E-08
Ir-182	S	5.03E-14	5.85E-06	6.92E-14	-	1.36E+09	2.43E+04	9.28E-01	1.56E+10	1.46E+14	2.18E+04	2.18E+04	3.17E-10
Ir-184	S	3.30E-13	8.67E-06	3.38E-13	-	1.36E+09	2.01E+03	9.44E-01	2.64E+08	1.84E+12	1.20E+03	1.20E+03	2.12E-10
Ir-185	S	7.25E-13	2.69E-06	6.03E-13	-	1.36E+09	4.34E+02	9.53E-01	3.20E+07	1.81E+11	8.23E+02	8.23E+02	6.81E-10
Ir-186	S	1.06E-12	7.41E-06	1.04E-12	-	1.36E+09	3.84E+02	9.42E-01	1.64E+07	1.09E+11	2.68E+02	2.68E+02	2.52E-10
Ir-186m	S	1.11E-13	4.22E-06	1.12E-13	-	1.36E+09	3.47E+03	8.78E-01	1.38E+09	9.44E+12	4.56E+03	4.56E+03	4.74E-10
Ir-187	S	2.87E-13	1.42E-06	2.71E-13	-	1.36E+09	5.78E+02	9.58E-01	9.48E+07	6.09E+11	2.07E+03	2.07E+03	1.30E-09

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Ir-188	S	1.38E-12	7.69E-06	1.30E-12	-	1.36E+09	1.46E+02	9.08E-01	5.00E+06	3.20E+10	1.02E+02	1.02E+02	2.54E-10
Ir-189	S	2.33E-12	1.69E-07	6.44E-13	-	1.36E+09	1.90E+01	9.54E-01	1.31E+06	2.47E+09	5.74E+02	5.74E+02	1.11E-08
Ir-190	S	8.81E-12	5.99E-06	2.72E-12	-	1.36E+09	2.09E+01	9.28E-01	3.42E+05	7.17E+08	1.83E+01	1.83E+01	3.23E-10
Ir-190m	S	3.89E-14	8.69E-13	1.59E-14	-	1.36E+09	5.06E+03	1.00E+00	1.41E+10	3.93E+13	2.83E+10	9.43E+09	6.87E-04
Ir-190n	S	2.14E-13	6.48E-06	2.33E-13	-	1.36E+09	1.96E+03	9.55E-01	3.74E+08	2.76E+12	1.54E+03	1.54E+03	2.90E-10
Ir-191m	-	-	1.58E-07	-	-	1.36E+09	4.42E+06	9.45E-01	-	-	1.44E+08	1.44E+08	1.21E-08
Ir-192	S	2.41E-11	3.40E-06	3.30E-12	-	1.36E+09	3.42E+00	9.57E-01	4.60E+04	4.28E+07	5.11E+00	5.11E+00	5.57E-10
Ir-192m	S	1.02E-10	5.40E-07	6.77E-13	-	1.36E+09	2.88E-03	9.25E-01	2.72E+03	1.23E+05	4.04E-01	4.04E-01	5.23E-08
Ir-194	S	3.40E-12	4.09E-07	3.52E-12	-	1.36E+09	3.17E+02	9.02E-01	4.00E+06	2.82E+10	4.18E+03	4.18E+03	4.96E-09
Ir-194m	S	4.59E-11	1.01E-05	4.55E-12	-	1.36E+09	1.48E+00	8.81E-01	1.44E+04	9.73E+06	8.09E-01	8.09E-01	2.06E-10
Ir-195	S	2.39E-13	1.12E-07	1.85E-13	-	1.36E+09	2.43E+03	9.54E-01	5.83E+08	3.07E+12	1.11E+05	1.11E+05	1.72E-08
Ir-195m	S	5.96E-13	1.58E-06	4.63E-13	-	1.36E+09	1.60E+03	9.98E-01	1.53E+08	8.10E+11	4.93E+03	4.93E+03	1.17E-09
K-38	-	-	1.61E-05	-	-	1.36E+09	4.77E+04	8.44E-01	-	-	1.71E+04	1.71E+04	2.64E-11
K-40	F	1.03E-11	7.98E-07	1.51E-11	-	1.36E+09	5.41E-10	8.26E-01	1.18E+02	1.17E+06	2.95E-01	2.95E-01	4.22E-02
K-42	F	4.33E-13	1.46E-06	8.40E-13	-	1.36E+09	4.91E+02	8.23E-01	2.60E+07	3.43E+11	1.99E+03	1.99E+03	3.30E-10
K-43	F	3.09E-13	4.23E-06	5.48E-13	-	1.36E+09	2.69E+02	8.78E-01	2.18E+07	2.63E+11	3.52E+02	3.52E+02	1.09E-10
K-44	F	3.39E-14	1.19E-05	1.13E-13	-	1.36E+09	1.65E+04	7.99E-01	6.47E+09	1.47E+14	8.42E+03	8.42E+03	4.37E-11
K-45	F	2.33E-14	9.53E-06	7.29E-14	-	1.36E+09	1.82E+04	8.33E-01	1.11E+10	2.36E+14	1.12E+04	1.12E+04	5.35E-11
Kr-74	-	-	4.91E-06	-	-	1.36E+09	3.17E+04	9.23E-01	-	-	3.40E+04	3.40E+04	1.54E-10
Kr-76	-	-	1.73E-06	-	-	1.36E+09	4.10E+02	9.71E-01	-	-	1.19E+03	1.19E+03	4.27E-10
Kr-77	-	-	4.22E-06	-	-	1.36E+09	4.88E+03	8.94E-01	-	-	6.29E+03	6.29E+03	1.93E-10
Kr-79	-	-	1.08E-06	-	-	1.36E+09	1.73E+02	8.93E-01	-	-	8.74E+02	8.74E+02	7.74E-10
Kr-81	-	-	2.18E-08	-	-	1.36E+09	3.30E-06	9.99E-01	-	-	8.94E+00	8.94E+00	4.26E-04
Kr-81m	-	-	4.60E-07	-	-	1.36E+09	1.68E+06	9.68E-01	-	-	1.84E+07	1.84E+07	1.72E-09
Kr-83m	-	-	1.34E-11	-	-	1.36E+09	3.32E+03	1.00E+00	-	-	1.20E+09	1.20E+09	5.85E-05
Kr-85	-	-	1.05E-08	-	-	1.36E+09	6.46E-02	8.84E-01	-	-	4.23E+01	4.23E+01	1.08E-07
Kr-85m	-	-	5.47E-07	-	-	1.36E+09	1.36E+03	9.28E-01	-	-	1.30E+04	1.30E+04	1.58E-09
Kr-87	-	-	4.01E-06	-	-	1.36E+09	4.77E+03	8.49E-01	-	-	6.82E+03	6.82E+03	2.41E-10
Kr-88	-	-	1.02E-05	-	-	1.36E+09	2.14E+03	9.16E-01	-	-	1.11E+03	1.11E+03	8.89E-11
La-131	M	5.48E-14	2.76E-06	5.74E-14	-	1.36E+09	6.17E+03	8.96E-01	4.78E+09	3.40E+13	1.21E+04	1.21E+04	5.00E-10
La-132	M	6.25E-13	9.52E-06	8.44E-13	-	1.36E+09	1.26E+03	8.79E-01	6.66E+07	6.11E+11	7.36E+02	7.36E+02	1.49E-10
La-134	-	-	3.05E-06	-	-	1.36E+09	5.46E+04	8.90E-01	-	-	9.79E+04	9.79E+04	4.66E-10
La-135	M	5.03E-14	5.21E-08	6.70E-14	-	1.36E+09	3.11E+02	9.43E-01	2.07E+08	1.87E+12	3.08E+04	3.08E+04	2.59E-08
La-137	F	1.39E-11	6.75E-09	1.67E-13	-	1.36E+09	1.16E-05	9.78E-01	1.06E+04	8.69E+05	2.95E+01	2.94E+01	6.77E-04
La-138	F	3.05E-10	6.07E-06	2.03E-12	-	1.36E+09	5.13E-12	8.42E-01	8.76E+02	3.96E+04	3.81E-02	3.81E-02	1.99E+00
La-140	M	4.77E-12	1.15E-05	4.85E-12	-	1.36E+09	1.51E+02	8.68E-01	1.38E+06	9.55E+09	7.35E+01	7.35E+01	1.32E-10
La-141	M	7.44E-13	2.37E-07	8.18E-13	-	1.36E+09	1.54E+03	8.29E-01	8.39E+07	6.27E+11	3.83E+04	3.82E+04	6.77E-09
La-142	M	2.42E-13	1.44E-05	3.23E-13	-	1.36E+09	3.94E+03	8.80E-01	5.42E+08	4.92E+12	1.51E+03	1.51E+03	1.06E-10
La-143	M	5.66E-14	5.12E-07	8.03E-14	-	1.36E+09	2.56E+04	8.53E-01	1.42E+10	1.37E+14	2.85E+05	2.85E+05	3.09E-09
Lu-169	S	1.33E-12	4.73E-06	9.69E-13	-	1.36E+09	1.78E+02	9.22E-01	8.17E+06	4.05E+10	1.99E+02	1.99E+02	3.66E-10
Lu-170	S	2.25E-12	1.26E-05	2.11E-12	-	1.36E+09	1.26E+02	9.41E-01	2.66E+06	1.70E+10	5.19E+01	5.19E+01	1.35E-10
Lu-171	S	3.50E-12	2.90E-06	1.52E-12	-	1.36E+09	3.08E+01	9.41E-01	9.00E+05	2.66E+09	5.49E+01	5.49E+01	5.92E-10
Lu-172	S	6.03E-12	8.70E-06	2.75E-12	-	1.36E+09	3.78E+01	9.20E-01	6.10E+05	1.89E+09	2.30E+01	2.30E+01	2.03E-10
Lu-173	S	8.70E-12	2.92E-07	6.03E-13	-	1.36E+09	5.06E-01	9.07E-01	3.73E+04	1.76E+07	9.30E+00	9.29E+00	6.17E-09
Lu-174	S	1.42E-11	4.26E-07	6.44E-13	-	1.36E+09	2.09E-01	9.17E-01	1.45E+04	4.48E+06	2.62E+00	2.62E+00	4.23E-09
Lu-174m	S	1.51E-11	9.88E-08	1.39E-12	-	1.36E+09	1.78E+00	9.48E-01	5.70E+04	3.56E+07	9.26E+01	9.24E+01	1.75E-08
Lu-176	S	1.41E-10	1.83E-06	4.11E-12	-	1.36E+09	1.93E-11	9.12E-01	4.33E+02	8.57E+04	1.17E-01	1.17E-01	2.07E+00
Lu-176m	S	4.55E-13	2.78E-08	3.74E-13	-	1.36E+09	1.65E+03	9.47E-01	1.96E+08	1.10E+12	3.05E+05	3.04E+05	6.30E-08
Lu-177	S	4.66E-12	1.14E-07	1.43E-12	-	1.36E+09	3.77E+01	9.23E-01	1.17E+06	2.44E+09	1.74E+03	1.74E+03	1.59E-08

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Lu-177m	S	5.70E-11	3.63E-06	4.14E-12	-	1.36E+09	1.57E+00	9.41E-01	1.69E+04	8.33E+06	2.24E+00	2.24E+00	4.89E-10
Lu-178	S	5.29E-14	6.76E-07	6.25E-14	-	1.36E+09	1.28E+04	8.36E-01	9.12E+09	7.32E+13	1.10E+05	1.10E+05	2.97E-09
Lu-178m	S	5.85E-14	4.26E-06	5.37E-14	-	1.36E+09	1.60E+04	9.04E-01	1.33E+10	8.29E+13	2.03E+04	2.03E+04	4.36E-10
Lu-179	S	5.14E-13	1.19E-07	4.81E-13	-	1.36E+09	1.32E+03	9.05E-01	1.22E+08	7.77E+11	5.98E+04	5.97E+04	1.57E-08
Md-257	M	7.70E-11	3.62E-07	2.59E-13	-	1.36E+09	1.17E+03	9.95E-01	2.00E+08	4.58E+09	1.58E+04	1.58E+04	6.74E-09
Md-258	M	1.68E-08	1.31E-09	1.95E-11	-	1.36E+09	4.60E+00	9.96E-01	1.05E+04	8.27E+04	1.72E+04	6.03E+03	6.57E-07
Mg-28	M	5.14E-12	6.56E-06	5.22E-12	-	1.36E+09	2.90E+02	8.72E-01	2.47E+06	1.71E+10	2.47E+02	2.47E+02	4.62E-11
Mn-51	M	9.55E-14	4.37E-06	1.37E-13	-	1.36E+09	7.88E+03	8.82E-01	2.56E+09	2.49E+13	9.95E+03	9.95E+03	1.25E-10
Mn-52	M	4.40E-12	1.67E-05	3.60E-12	-	1.36E+09	4.52E+01	8.36E-01	5.59E+05	3.11E+09	1.58E+01	1.58E+01	3.52E-11
Mn-52m	M	5.07E-14	1.15E-05	9.66E-14	-	1.36E+09	1.73E+04	8.48E-01	7.94E+09	1.03E+14	8.61E+03	8.61E+03	5.04E-11
Mn-53	M	2.17E-13	0.00E+00	6.99E-14	-	1.36E+09	1.87E-07	0.00E+00	2.54E+04	5.57E+07	-	2.54E+04	1.40E+01
Mn-54	M	5.88E-12	3.89E-06	1.48E-12	-	1.36E+09	8.09E-01	8.58E-01	2.43E+04	4.16E+07	1.18E+00	1.18E+00	1.53E-10
Mn-56	M	4.14E-13	8.44E-06	5.11E-13	-	1.36E+09	2.35E+03	8.27E-01	2.05E+08	1.72E+12	1.64E+03	1.64E+03	7.58E-11
Mo-101	M	4.33E-14	6.62E-06	5.59E-14	-	1.36E+09	2.49E+04	9.17E-01	1.98E+10	1.74E+14	2.00E+04	2.00E+04	1.57E-10
Mo-90	M	1.24E-12	3.41E-06	5.03E-13	-	1.36E+09	1.07E+03	8.84E-01	9.46E+07	2.61E+11	1.73E+03	1.73E+03	2.82E-10
Mo-93	M	1.27E-12	2.17E-10	3.38E-12	-	1.36E+09	1.98E-04	1.00E+00	5.27E+02	9.54E+06	8.99E+02	3.32E+02	3.03E-04
Mo-93m	M	4.33E-13	1.09E-05	2.51E-13	-	1.36E+09	8.86E+02	8.61E-01	1.57E+08	6.18E+11	4.60E+02	4.60E+02	9.36E-11
Mo-99	M	4.29E-12	6.65E-07	1.18E-12	-	1.36E+09	9.20E+01	9.29E-01	3.46E+06	6.48E+09	7.25E+02	7.24E+02	1.51E-09
N-13	-	-	4.45E-06	-	-	1.36E+09	3.66E+04	8.83E-01	-	-	4.53E+04	4.53E+04	3.12E-11
Na-22	F	3.89E-12	1.03E-05	7.47E-12	-	1.36E+09	2.66E-01	8.61E-01	1.59E+03	2.07E+07	1.46E-01	1.46E-01	2.35E-11
Na-24	F	4.74E-13	2.20E-05	9.29E-13	-	1.36E+09	4.05E+02	8.06E-01	1.94E+07	2.58E+11	1.11E+02	1.11E+02	1.28E-11
Nb-88	M	4.51E-14	1.89E-05	8.92E-14	-	1.36E+09	2.55E+04	8.71E-01	1.27E+10	1.71E+14	7.53E+03	7.53E+03	5.05E-11
Nb-89	M	4.07E-13	6.65E-06	5.22E-13	-	1.36E+09	2.99E+03	8.85E-01	2.54E+08	2.22E+12	2.47E+03	2.47E+03	1.43E-10
Nb-89m	M	1.74E-13	8.48E-06	2.35E-13	-	1.36E+09	5.52E+03	8.90E-01	1.04E+09	9.58E+12	3.56E+03	3.56E+03	1.11E-10
Nb-90	M	2.27E-12	2.13E-05	2.75E-12	-	1.36E+09	4.16E+02	8.51E-01	6.72E+06	5.53E+10	1.12E+02	1.12E+02	4.69E-11
Nb-93m	M	1.90E-12	3.83E-11	3.32E-13	-	1.36E+09	5.10E-02	1.00E+00	9.47E+03	1.12E+07	8.99E+03	4.61E+03	1.63E-05
Nb-94	M	3.77E-11	7.29E-06	3.89E-12	-	1.36E+09	3.41E-05	8.61E-01	4.57E+02	3.21E+05	3.10E-02	3.10E-02	1.66E-07
Nb-95	M	5.44E-12	3.53E-06	1.23E-12	-	1.36E+09	7.20E+00	8.63E-01	2.60E+05	4.00E+08	1.15E+01	1.15E+01	2.94E-10
Nb-95m	M	3.27E-12	2.32E-07	1.50E-12	-	1.36E+09	7.01E+01	9.88E-01	2.08E+06	6.48E+09	1.49E+03	1.49E+03	3.91E-09
Nb-96	M	2.28E-12	1.15E-05	2.41E-12	-	1.36E+09	2.60E+02	8.66E-01	4.79E+06	3.44E+10	1.27E+02	1.27E+02	9.10E-11
Nb-97	M	1.07E-13	2.97E-06	1.14E-13	-	1.36E+09	5.05E+03	8.70E-01	1.97E+09	1.43E+13	9.52E+03	9.51E+03	3.55E-10
Nb-97m	-	-	3.34E-06	-	-	1.36E+09	3.64E+05	8.70E-01	-	-	6.10E+05	6.10E+05	3.15E-10
Nb-98	M	1.23E-13	1.16E-05	1.81E-13	-	1.36E+09	7.07E+03	8.40E-01	1.74E+09	1.74E+13	3.53E+03	3.53E+03	9.50E-11
Nd-136	S	1.34E-13	1.01E-06	1.64E-13	-	1.36E+09	7.19E+03	8.84E-01	1.95E+09	1.62E+13	3.92E+04	3.92E+04	1.44E-09
Nd-138	S	1.24E-12	6.73E-08	1.49E-12	-	1.36E+09	1.20E+03	9.45E-01	3.59E+07	2.93E+11	9.22E+04	9.19E+04	2.04E-08
Nd-139	S	2.37E-14	1.72E-06	3.11E-14	-	1.36E+09	1.23E+04	8.70E-01	1.75E+10	1.56E+14	3.99E+04	3.99E+04	8.77E-10
Nd-139m	S	4.96E-13	7.14E-06	5.37E-13	-	1.36E+09	1.10E+03	8.98E-01	9.14E+07	6.72E+11	8.38E+02	8.38E+02	2.05E-10
Nd-141	S	1.34E-14	2.28E-07	1.61E-14	-	1.36E+09	2.44E+03	9.42E-01	6.73E+09	5.50E+13	5.52E+04	5.52E+04	6.20E-09
Nd-141m	-	-	3.48E-06	-	-	1.36E+09	3.50E+05	8.65E-01	-	-	5.66E+05	5.66E+05	4.42E-10
Nd-147	S	9.36E-12	4.87E-07	2.86E-12	-	1.36E+09	2.30E+01	8.90E-01	3.58E+05	7.43E+08	2.59E+02	2.58E+02	3.20E-09
Nd-149	S	3.19E-13	1.50E-06	2.58E-13	-	1.36E+09	3.51E+03	9.27E-01	6.04E+08	3.32E+12	1.23E+04	1.23E+04	1.01E-09
Nd-151	S	3.92E-14	4.10E-06	4.63E-14	-	1.36E+09	2.93E+04	9.28E-01	2.81E+10	2.26E+14	3.75E+04	3.75E+04	3.75E-10
Ne-19	-	-	4.47E-06	-	-	1.36E+09	1.27E+06	8.83E-01	-	-	1.56E+06	1.56E+06	4.55E-11
Ni-56	M	2.88E-12	7.74E-06	1.64E-12	-	1.36E+09	4.15E+01	8.69E-01	1.12E+06	4.35E+09	3.00E+01	3.00E+01	7.86E-11
Ni-57	M	1.78E-12	9.44E-06	1.89E-12	-	1.36E+09	1.68E+02	8.29E-01	3.96E+06	2.86E+10	1.05E+02	1.05E+02	6.88E-11
Ni-59	M	4.66E-13	0.00E+00	1.44E-13	-	1.36E+09	9.24E-06	0.00E+00	1.23E+04	2.59E+07	-	1.23E+04	1.53E-01
Ni-63	M	1.64E-12	0.00E+00	3.50E-13	-	1.36E+09	7.22E-03	0.00E+00	5.55E+03	8.05E+06	-	5.55E+03	9.39E-05
Ni-65	M	3.03E-13	2.74E-06	3.34E-13	-	1.36E+09	2.41E+03	8.31E-01	3.21E+08	2.40E+12	5.15E+03	5.15E+03	2.70E-10
Ni-66	M	8.99E-12	2.67E-11	8.18E-12	-	1.36E+09	1.11E+02	9.27E-01	6.04E+05	3.74E+09	2.19E+07	5.88E+05	6.77E-07

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Np-232	M	3.17E-14	5.26E-06	1.57E-14	-	1.36E+09	2.48E+04	9.16E-01	7.01E+10	2.36E+14	2.50E+04	2.50E+04	4.55E-10
Np-233	M	2.49E-15	2.29E-07	3.58E-15	-	1.36E+09	1.01E+04	9.51E-01	1.25E+11	1.22E+15	2.25E+05	2.25E+05	1.01E-08
Np-234	M	1.86E-12	7.07E-06	1.72E-12	-	1.36E+09	5.75E+01	9.66E-01	1.49E+06	9.34E+09	4.10E+01	4.10E+01	3.24E-10
Np-235	M	1.15E-12	2.13E-09	1.42E-13	-	1.36E+09	6.39E-01	1.00E+00	2.00E+05	1.68E+08	1.46E+03	1.45E+03	1.03E-06
Np-236	M	9.77E-10	3.25E-07	7.18E-12	-	1.36E+09	6.03E-06	9.99E-01	2.48E+02	1.24E+04	6.00E-01	5.98E-01	4.55E-05
Np-236m	M	8.07E-12	1.34E-07	4.74E-13	-	1.36E+09	2.70E+02	9.99E-01	2.53E+07	1.01E+10	9.81E+03	9.80E+03	1.66E-08
Np-237	M	1.77E-08	5.36E-08	4.70E-11	-	1.36E+09	3.24E-07	9.73E-01	3.78E+01	6.83E+02	3.73E+00	3.38E+00	4.80E-03
Np-237+D	M	1.77E-08	7.96E-07	4.92E-11	-	1.36E+09	3.24E-07	9.73E-01	3.61E+01	6.83E+02	2.51E-01	2.50E-01	3.54E-04
Np-238	M	4.18E-12	2.62E-06	2.33E-12	-	1.36E+09	1.19E+02	9.95E-01	2.28E+06	8.63E+09	2.23E+02	2.23E+02	8.62E-10
Np-239	M	4.00E-12	5.41E-07	2.15E-12	-	1.36E+09	1.07E+02	9.45E-01	2.22E+06	8.11E+09	1.02E+03	1.02E+03	4.41E-09
Np-240	M	1.95E-13	5.80E-06	1.37E-13	-	1.36E+09	5.60E+03	9.54E-01	1.82E+09	8.68E+12	4.93E+03	4.93E+03	4.10E-10
Np-240m	-	-	1.51E-06	-	-	1.36E+09	4.92E+04	9.70E-01	-	-	1.64E+05	1.64E+05	1.55E-09
O-15	-	-	4.46E-06	-	-	1.36E+09	1.79E+05	8.83E-01	-	-	2.21E+05	2.21E+05	3.60E-11
Os-180	M	2.62E-14	1.08E-07	2.72E-14	-	1.36E+09	1.66E+04	9.70E-01	2.71E+10	1.91E+14	7.69E+05	7.69E+05	1.62E-08
Os-181	M	1.95E-13	5.41E-06	1.83E-13	-	1.36E+09	3.47E+03	9.18E-01	8.42E+08	5.37E+12	3.40E+03	3.40E+03	3.44E-10
Os-182	M	1.45E-12	1.64E-06	1.23E-12	-	1.36E+09	2.76E+02	9.50E-01	9.97E+06	5.75E+10	8.62E+02	8.62E+02	1.10E-09
Os-185	M	6.14E-12	3.11E-06	1.04E-12	-	1.36E+09	2.69E+00	8.71E-01	1.15E+05	1.32E+08	4.83E+00	4.83E+00	6.45E-10
Os-189m	M	3.44E-14	7.21E-13	4.29E-14	-	1.36E+09	1.01E+03	1.00E+00	1.05E+09	8.88E+12	6.83E+09	9.09E+08	3.29E-04
Os-190m	M	-	6.76E-06	-	-	1.36E+09	3.68E+04	8.87E-01	-	-	2.99E+04	2.99E+04	2.99E-10
Os-191	M	7.10E-12	1.66E-07	1.50E-12	-	1.36E+09	1.64E+01	9.45E-01	4.87E+05	6.99E+08	5.10E+02	5.09E+02	1.15E-08
Os-191m	M	6.36E-13	1.05E-08	2.51E-13	-	1.36E+09	4.66E+02	9.80E-01	8.25E+07	2.21E+11	2.20E+05	2.20E+05	1.75E-07
Os-193	M	2.71E-12	2.69E-07	2.16E-12	-	1.36E+09	2.02E+02	9.39E-01	4.16E+06	2.26E+10	3.90E+03	3.90E+03	7.21E-09
Os-194	M	2.55E-10	6.58E-10	6.55E-12	-	1.36E+09	1.16E-01	9.94E-01	8.30E+02	1.45E+05	9.10E+02	4.33E+02	1.41E-06
Os-194+D	M	-	4.09E-07	-	-	1.36E+09	1.16E-01	9.03E-01	-	-	1.61E+00	1.61E+00	5.25E-09
P-30	-	-	4.50E-06	-	-	1.36E+09	1.46E+05	8.83E-01	-	-	1.79E+05	1.79E+05	7.13E-11
P-32	M	1.22E-11	9.41E-09	5.37E-12	-	1.36E+09	1.77E+01	9.27E-01	1.46E+05	4.38E+08	9.88E+03	9.25E+03	3.25E-08
P-33	M	5.11E-12	3.73E-11	5.62E-13	-	1.36E+09	9.96E+00	9.27E-01	7.88E+05	5.89E+08	1.40E+06	5.04E+05	3.24E-06
Pa-227	S	2.12E-10	4.37E-08	6.48E-13	-	1.36E+09	9.51E+03	1.00E+00	6.52E+08	1.36E+10	1.06E+06	1.06E+06	4.90E-08
Pa-228	S	2.33E-10	5.10E-06	1.68E-12	-	1.36E+09	2.76E+02	1.00E+00	7.30E+06	3.58E+08	2.63E+02	2.63E+02	4.22E-10
Pa-230	S	2.58E-09	2.86E-06	1.80E-12	-	1.36E+09	1.45E+01	1.00E+00	3.59E+05	1.70E+06	2.47E+01	2.47E+01	7.59E-10
Pa-231	S	4.55E-08	1.39E-07	1.54E-10	-	1.36E+09	2.12E-05	9.94E-01	1.15E+01	2.66E+02	1.41E+00	1.25E+00	2.65E-05
Pa-232	S	6.81E-12	4.29E-06	1.59E-12	-	1.36E+09	1.93E+02	9.52E-01	5.40E+06	8.56E+09	2.30E+02	2.30E+02	5.36E-10
Pa-233	S	1.42E-11	7.43E-07	2.34E-12	-	1.36E+09	9.37E+00	9.51E-01	1.78E+05	1.99E+08	6.45E+01	6.45E+01	3.11E-09
Pa-234	S	1.46E-12	8.71E-06	1.20E-12	-	1.36E+09	9.06E+02	9.57E-01	3.36E+07	1.87E+11	5.29E+02	5.29E+02	2.65E-10
Pa-234m	-	-	6.87E-08	-	-	1.36E+09	3.11E+05	9.99E-01	-	-	2.21E+07	2.21E+07	3.22E-08
Pb-195m	M	4.37E-14	6.90E-06	4.18E-14	-	1.36E+09	2.31E+04	9.02E-01	2.45E+10	1.59E+14	1.80E+04	1.80E+04	2.96E-10
Pb-198	M	1.43E-13	1.62E-06	1.62E-13	-	1.36E+09	2.53E+03	9.36E-01	6.94E+08	5.34E+12	8.12E+03	8.12E+03	1.23E-09
Pb-199	M	7.44E-14	6.87E-06	9.29E-14	-	1.36E+09	4.05E+03	9.58E-01	1.94E+09	1.64E+13	2.99E+03	2.99E+03	2.86E-10
Pb-200	M	1.16E-12	5.97E-07	8.70E-13	-	1.36E+09	2.82E+02	9.39E-01	1.44E+07	7.35E+10	2.45E+03	2.45E+03	3.37E-09
Pb-201	M	3.50E-13	3.18E-06	3.41E-13	-	1.36E+09	6.46E+02	9.60E-01	8.42E+07	5.57E+11	1.03E+03	1.03E+03	6.22E-10
Pb-202	M	1.43E-11	3.10E-12	1.74E-11	-	1.36E+09	2.31E-06	1.00E+00	1.02E+02	8.45E+05	6.28E+04	1.02E+02	1.73E-02
Pb-202+D	M	-	1.83E-06	-	-	1.36E+09	2.31E-06	9.06E-01	-	-	1.17E-01	1.17E-01	1.99E-05
Pb-202m	M	2.25E-13	9.32E-06	2.65E-13	-	1.36E+09	1.68E+03	9.94E-01	2.81E+08	2.25E+12	8.81E+02	8.81E+02	2.06E-10
Pb-203	M	7.55E-13	1.09E-06	5.59E-13	-	1.36E+09	1.17E+02	9.21E-01	9.27E+06	4.67E+10	5.65E+02	5.65E+02	1.91E-09
Pb-205	M	6.44E-13	3.50E-12	4.92E-13	-	1.36E+09	4.85E-08	1.00E+00	3.61E+03	1.88E+07	5.56E+04	3.39E+03	2.78E+01
Pb-209	M	1.90E-13	5.37E-10	1.22E-13	-	1.36E+09	1.87E+03	9.27E-01	6.80E+08	2.97E+12	1.82E+07	1.78E+07	3.86E-06
Pb-210	M	2.77E-09	1.41E-09	5.99E-10	-	1.36E+09	3.11E-02	9.96E-01	4.27E+00	6.27E+03	1.99E+02	4.18E+00	5.48E-08
Pb-211	M	3.70E-11	2.29E-07	2.63E-13	-	1.36E+09	1.01E+04	8.94E-01	1.71E+09	8.24E+10	2.40E+05	2.40E+05	9.73E-09
Pb-212	M	5.77E-10	5.09E-07	1.31E-11	-	1.36E+09	5.71E+02	9.19E-01	1.94E+06	2.99E+08	5.94E+03	5.92E+03	4.27E-09

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Pb-214	M	3.63E-11	9.82E-07	2.21E-13	-	1.36E+09	1.36E+04	9.29E-01	2.73E+09	1.13E+11	7.25E+04	7.25E+04	2.22E-09
Pd-100	S	3.10E-12	2.22E-07	1.99E-12	-	1.36E+09	6.97E+01	9.73E-01	1.56E+06	6.79E+09	1.57E+03	1.57E+03	4.37E-09
Pd-101	S	1.97E-13	1.38E-06	2.03E-13	-	1.36E+09	7.34E+02	8.93E-01	1.61E+08	1.13E+12	2.90E+03	2.90E+03	7.74E-10
Pd-103	S	1.77E-12	1.15E-09	5.07E-13	-	1.36E+09	1.49E+01	9.98E-01	1.31E+06	2.55E+09	6.32E+04	6.03E+04	8.08E-07
Pd-107	S	1.69E-12	0.00E+00	1.01E-13	-	1.36E+09	1.07E-07	0.00E+00	1.76E+04	7.15E+06	-	1.76E+04	3.42E+01
Pd-109	S	1.85E-12	1.27E-08	1.43E-12	-	1.36E+09	4.52E+02	9.92E-01	1.41E+07	7.38E+10	1.75E+05	1.73E+05	8.07E-08
Pm-141	S	2.85E-14	3.33E-06	4.96E-14	-	1.36E+09	1.74E+04	8.77E-01	1.56E+10	1.85E+14	2.90E+04	2.90E+04	4.56E-10
Pm-142	-	-	3.87E-06	-	-	1.36E+09	5.40E+05	8.80E-01	-	-	7.71E+05	7.71E+05	3.94E-10
Pm-143	S	5.37E-12	1.33E-06	4.59E-13	-	1.36E+09	9.55E-01	9.18E-01	9.24E+04	5.37E+07	3.80E+00	3.80E+00	1.11E-09
Pm-144	S	2.76E-11	6.90E-06	1.86E-12	-	1.36E+09	6.97E-01	8.75E-01	1.67E+04	7.63E+06	5.62E-01	5.62E-01	2.25E-10
Pm-145	S	6.59E-12	1.61E-08	2.54E-13	-	1.36E+09	3.92E-02	9.68E-01	1.10E+04	2.87E+06	1.96E+01	1.96E+01	1.40E-07
Pm-146	S	5.40E-11	3.29E-06	2.00E-12	-	1.36E+09	1.25E-01	8.73E-01	2.91E+03	7.32E+05	2.22E-01	2.22E-01	5.02E-10
Pm-147	S	1.61E-11	3.21E-11	6.92E-13	-	1.36E+09	2.64E-01	9.42E-01	1.70E+04	4.96E+06	4.26E+04	1.21E+04	1.31E-05
Pm-148	S	1.05E-11	2.80E-06	7.07E-12	-	1.36E+09	4.71E+01	8.45E-01	2.96E+05	1.36E+09	9.69E+01	9.69E+01	5.91E-10
Pm-148m	S	2.12E-11	8.98E-06	3.85E-12	-	1.36E+09	6.12E+00	8.75E-01	7.07E+04	8.73E+07	3.79E+00	3.79E+00	1.78E-10
Pm-149	S	3.66E-12	4.60E-08	2.69E-12	-	1.36E+09	1.14E+02	8.98E-01	1.89E+06	9.44E+09	1.35E+04	1.34E+04	3.38E-08
Pm-150	S	4.63E-13	6.87E-06	5.25E-13	-	1.36E+09	2.27E+03	8.99E-01	1.92E+08	1.48E+12	1.78E+03	1.78E+03	2.29E-10
Pm-151	S	2.36E-12	1.27E-06	1.88E-12	-	1.36E+09	2.14E+02	9.39E-01	5.05E+06	2.74E+10	8.72E+02	8.72E+02	1.20E-09
Po-203	M	7.73E-14	7.65E-06	9.77E-14	-	1.36E+09	9.92E+03	9.35E-01	4.51E+09	3.88E+13	6.75E+03	6.75E+03	2.68E-10
Po-205	M	1.72E-13	7.36E-06	1.12E-13	-	1.36E+09	3.37E+03	9.55E-01	1.34E+09	5.92E+12	2.34E+03	2.34E+03	2.75E-10
Po-207	M	1.99E-13	6.09E-06	2.86E-13	-	1.36E+09	1.04E+03	9.55E-01	1.62E+08	1.58E+12	8.71E+02	8.71E+02	3.36E-10
Po-210	M	1.08E-08	3.95E-11	2.96E-10	-	1.36E+09	1.83E+00	8.60E-01	2.74E+02	5.11E+04	2.62E+05	2.73E+02	6.08E-08
Po-211	-	-	3.59E-08	-	-	1.36E+09	4.24E+07	8.65E-01	-	-	6.64E+09	6.64E+09	6.42E-08
Po-212	-	-	0.00E+00	-	-	1.36E+09	7.17E+13	0.00E+00	-	-	-	-	-
Po-213	-	-	0.00E+00	-	-	1.36E+09	5.20E+12	0.00E+00	-	-	-	-	-
Po-214	-	-	3.87E-10	-	-	1.36E+09	1.33E+11	8.61E-01	-	-	1.94E+15	1.94E+15	6.06E-06
Po-215	-	-	7.49E-10	-	-	1.36E+09	1.23E+10	8.90E-01	-	-	8.96E+13	8.96E+13	3.05E-06
Po-216	-	-	7.87E-11	-	-	1.36E+09	1.46E+08	8.60E-01	-	-	1.05E+13	1.05E+13	3.01E-05
Po-218	-	-	4.26E-11	-	-	1.36E+09	1.19E+05	8.58E-01	-	-	1.59E+10	1.59E+10	5.63E-05
Pr-136	S	2.15E-14	9.74E-06	4.66E-14	-	1.36E+09	2.78E+04	8.55E-01	2.65E+10	3.91E+14	1.62E+04	1.62E+04	1.54E-10
Pr-137	S	5.55E-14	2.14E-06	6.99E-14	-	1.36E+09	4.76E+03	8.85E-01	3.02E+09	2.59E+13	1.22E+04	1.22E+04	6.83E-10
Pr-138	-	-	3.57E-06	-	-	1.36E+09	2.51E+05	8.79E-01	-	-	3.90E+05	3.90E+05	4.15E-10
Pr-138m	S	1.76E-13	1.14E-05	2.41E-13	-	1.36E+09	2.89E+03	8.68E-01	5.33E+08	4.96E+12	1.42E+03	1.42E+03	1.32E-10
Pr-139	S	6.96E-14	4.42E-07	6.85E-14	-	1.36E+09	1.35E+03	9.37E-01	8.73E+08	5.84E+12	1.58E+04	1.58E+04	3.17E-09
Pr-142	S	3.38E-12	3.14E-07	3.50E-12	-	1.36E+09	3.17E+02	8.21E-01	4.03E+06	2.84E+10	5.99E+03	5.98E+03	5.19E-09
Pr-142m	S	4.33E-14	0.00E+00	4.48E-14	-	1.36E+09	2.49E+04	0.00E+00	2.48E+10	1.74E+14	-	2.47E+10	2.73E-04
Pr-143	S	9.73E-12	1.64E-09	3.19E-12	-	1.36E+09	1.87E+01	8.64E-01	2.60E+05	5.79E+08	6.41E+04	5.14E+04	7.64E-07
Pr-144	S	3.58E-14	1.94E-07	6.33E-14	-	1.36E+09	2.11E+04	8.21E-01	1.48E+10	1.78E+14	6.44E+05	6.44E+05	8.54E-09
Pr-144m	-	-	8.74E-09	-	-	1.36E+09	5.06E+04	9.64E-01	-	-	2.92E+07	2.92E+07	1.61E-07
Pr-145	S	9.25E-13	6.95E-08	9.66E-13	-	1.36E+09	1.02E+03	8.60E-01	4.67E+07	3.32E+11	8.27E+04	8.25E+04	2.29E-08
Pr-147	S	3.59E-14	3.78E-06	4.40E-14	-	1.36E+09	2.68E+04	8.96E-01	2.71E+10	2.25E+14	3.85E+04	3.85E+04	4.10E-10
Pt-186	F	8.25E-14	3.20E-06	1.97E-13	-	1.36E+09	3.04E+03	8.87E-01	6.85E+08	1.11E+13	5.20E+03	5.20E+03	6.19E-10
Pt-188	F	1.88E-12	6.03E-07	1.74E-12	-	1.36E+09	2.48E+01	9.28E-01	6.33E+05	3.98E+09	2.16E+02	2.16E+02	3.17E-09
Pt-189	F	1.32E-13	1.17E-06	2.76E-13	-	1.36E+09	5.58E+02	9.47E-01	8.99E+07	1.28E+12	2.45E+03	2.45E+03	1.61E-09
Pt-191	F	4.63E-13	9.79E-07	7.88E-13	-	1.36E+09	9.03E+01	9.45E-01	5.10E+06	5.89E+10	4.75E+02	4.75E+02	1.95E-09
Pt-193	F	1.11E-13	2.78E-12	8.51E-14	-	1.36E+09	1.39E-02	1.00E+00	2.47E+04	1.29E+08	8.29E+04	1.90E+04	5.14E-04
Pt-193m	F	7.73E-13	1.68E-08	1.23E-12	-	1.36E+09	5.84E+01	9.76E-01	2.11E+06	2.28E+10	1.73E+04	1.72E+04	1.10E-07
Pt-195m	F	1.05E-12	1.26E-07	1.69E-12	-	1.36E+09	6.29E+01	9.55E-01	1.65E+06	1.81E+10	2.54E+03	2.54E+03	1.53E-08
Pt-197	F	5.22E-13	5.63E-08	1.07E-12	-	1.36E+09	3.32E+02	9.61E-01	1.38E+07	1.92E+11	2.98E+04	2.98E+04	3.43E-08

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Pt-197m	F	8.66E-14	2.38E-07	1.81E-13	-	1.36E+09	3.86E+03	9.59E-01	9.47E+08	1.35E+13	8.23E+04	8.23E+04	8.15E-09
Pt-199	F	2.48E-14	8.69E-07	5.66E-14	-	1.36E+09	1.18E+04	9.27E-01	9.29E+09	1.44E+14	7.14E+04	7.14E+04	2.33E-09
Pt-200	F	1.48E-12	1.58E-07	3.16E-12	-	1.36E+09	4.86E+02	9.50E-01	6.83E+06	9.91E+10	1.57E+04	1.57E+04	1.26E-08
Pu-234	M	6.85E-11	1.61E-07	3.85E-13	-	1.36E+09	6.90E+02	9.99E-01	7.96E+07	3.04E+09	2.09E+04	2.09E+04	1.37E-08
Pu-235	M	2.39E-15	2.37E-07	3.24E-15	-	1.36E+09	1.44E+04	9.55E-01	1.97E+11	1.82E+15	3.10E+05	3.10E+05	9.80E-09
Pu-236	M	2.28E-08	1.19E-10	5.55E-11	-	1.36E+09	2.43E-01	9.99E-01	1.95E+02	3.23E+03	9.97E+03	1.81E+02	3.40E-07
Pu-237	M	1.27E-12	1.12E-07	2.53E-13	-	1.36E+09	5.58E+00	9.99E-01	9.81E+05	1.33E+09	2.43E+02	2.43E+02	2.00E-08
Pu-238	M	3.36E-08	7.22E-11	1.17E-10	-	1.36E+09	7.90E-03	9.99E-01	1.67E+01	3.96E+02	2.97E+03	1.60E+01	9.34E-07
Pu-239	M	3.33E-08	2.00E-10	1.21E-10	-	1.36E+09	2.88E-05	9.99E-01	1.47E+01	3.63E+02	9.75E+02	1.39E+01	2.24E-04
Pu-240	M	3.33E-08	6.98E-11	1.21E-10	-	1.36E+09	1.06E-04	9.99E-01	1.47E+01	3.63E+02	2.80E+03	1.41E+01	6.18E-05
Pu-241	M	3.34E-10	4.11E-12	1.73E-12	-	1.36E+09	4.81E-02	9.74E-01	1.77E+03	6.22E+04	8.36E+04	1.68E+03	1.64E-05
Pu-242	M	3.13E-08	6.25E-11	1.15E-10	-	1.36E+09	1.84E-06	9.99E-01	1.55E+01	3.86E+02	3.12E+03	1.48E+01	3.77E-03
Pu-243	M	2.94E-13	5.50E-08	2.06E-13	-	1.36E+09	1.22E+03	9.52E-01	2.64E+08	1.26E+12	1.14E+05	1.14E+05	4.38E-08
Pu-244	M	3.04E-08	1.11E-07	1.15E-10	-	1.36E+09	8.66E-09	1.78E+00	1.55E+01	3.97E+02	9.85E-01	9.24E-01	5.05E-02
Pu-244+D	M	2.93E-08	1.51E-06	3.14E-10	-	1.36E+09	8.66E-09	9.73E-01	5.66E+00	4.12E+02	1.32E-01	1.29E-01	7.07E-03
Pu-245	M	2.07E-12	1.78E-06	1.89E-12	-	1.36E+09	5.78E+02	9.50E-01	1.36E+07	8.44E+10	1.66E+03	1.66E+03	1.37E-09
Pu-246	M	1.73E-11	4.04E-07	7.40E-12	-	1.36E+09	2.33E+01	9.55E-01	1.40E+05	4.07E+08	2.94E+02	2.93E+02	6.01E-09
Ra-222	-	-	3.71E-08	-	-	1.36E+09	5.75E+05	9.03E-01	-	-	8.35E+07	8.35E+07	6.26E-08
Ra-223	M	2.50E-08	4.34E-07	1.23E-10	-	1.36E+09	2.21E+01	9.58E-01	7.99E+03	2.67E+05	2.59E+02	2.51E+02	4.90E-09
Ra-223+D	M	-	1.09E-06	-	-	1.36E+09	2.21E+01	9.45E-01	-	-	1.05E+02	1.05E+02	2.04E-09
Ra-224	M	9.99E-09	3.73E-08	8.44E-11	-	1.36E+09	6.91E+01	9.16E-01	3.64E+04	2.09E+06	9.84E+03	7.72E+03	4.85E-08
Ra-224+D	M	-	7.77E-06	-	-	1.36E+09	6.91E+01	8.98E-01	-	-	4.82E+01	4.82E+01	3.03E-10
Ra-225	M	2.10E-08	5.91E-09	7.44E-11	-	1.36E+09	1.71E+01	9.77E-01	1.02E+04	2.46E+05	1.44E+04	5.83E+03	1.49E-07
Ra-225+D	M	-	9.42E-07	-	-	1.36E+09	1.71E+01	9.64E-01	-	-	9.16E+01	9.16E+01	2.34E-09
Ra-226	M	1.15E-08	2.29E-08	2.95E-10	-	1.36E+09	4.33E-04	9.28E-01	6.06E+00	1.06E+03	9.21E+00	3.64E+00	3.69E-06
Ra-226+D	M	1.16E-08	8.49E-06	2.95E-10	-	1.36E+09	4.33E-04	9.26E-01	6.06E+00	1.05E+03	2.49E-02	2.48E-02	2.51E-08
Ra-227	M	3.13E-13	6.23E-07	7.44E-14	-	1.36E+09	8.63E+03	9.79E-01	5.16E+09	8.33E+12	6.89E+04	6.89E+04	3.51E-09
Ra-227+D	M	-	2.09E-06	-	-	1.36E+09	8.63E+03	9.79E-01	-	-	2.05E+04	2.05E+04	1.05E-09
Ra-228	M	5.18E-09	0.00E+00	6.70E-10	-	1.36E+09	1.21E-01	0.00E+00	8.41E+00	7.39E+03	-	8.40E+00	3.08E-08
Ra-228+D	M	5.23E-09	1.23E-05	6.70E-10	-	1.36E+09	1.21E-01	9.26E-01	8.41E+00	7.32E+03	5.42E-02	5.38E-02	1.98E-10
Rb-79	F	2.37E-14	5.85E-06	6.77E-14	-	1.36E+09	1.59E+04	9.14E-01	1.04E+10	2.03E+14	1.45E+04	1.45E+04	1.40E-10
Rb-80	-	-	5.56E-06	-	-	1.36E+09	6.43E+05	8.83E-01	-	-	6.37E+05	6.37E+05	1.54E-10
Rb-81	F	4.63E-14	2.59E-06	9.69E-14	-	1.36E+09	1.33E+03	9.02E-01	6.08E+08	8.65E+12	2.76E+03	2.76E+03	3.27E-10
Rb-81m	F	1.10E-14	9.09E-09	1.57E-14	-	1.36E+09	1.14E+04	9.99E-01	3.22E+10	3.13E+14	6.10E+06	6.10E+06	8.42E-08
Rb-82	-	-	4.85E-06	-	-	1.36E+09	2.80E+05	8.83E-01	-	-	3.18E+05	3.18E+05	1.81E-10
Rb-82m	F	1.35E-13	1.35E-05	2.75E-13	-	1.36E+09	9.79E+02	8.62E-01	1.58E+08	2.19E+12	4.09E+02	4.09E+02	6.65E-11
Rb-83	F	2.32E-12	2.18E-06	4.40E-12	-	1.36E+09	2.93E+00	9.44E-01	2.96E+04	3.82E+08	6.94E+00	6.94E+00	3.81E-10
Rb-84	F	3.59E-12	4.22E-06	6.55E-12	-	1.36E+09	7.72E+00	9.40E-01	5.24E+04	6.49E+08	9.47E+00	9.47E+00	2.00E-10
Rb-86	F	4.00E-12	4.67E-07	6.59E-12	-	1.36E+09	1.36E+01	8.44E-01	9.14E+04	1.02E+09	1.67E+02	1.67E+02	2.06E-09
Rb-87	F	2.14E-12	9.11E-11	3.43E-12	-	1.36E+09	1.47E-11	9.27E-01	5.18E+02	5.65E+06	2.31E+03	4.23E+02	4.84E+03
Rb-88	F	3.17E-14	3.36E-06	1.14E-13	-	1.36E+09	2.05E+04	8.09E-01	7.98E+09	1.95E+14	3.66E+04	3.66E+04	3.06E-10
Rb-89	F	2.09E-14	1.05E-05	6.40E-14	-	1.36E+09	2.40E+04	8.47E-01	1.66E+10	3.46E+14	1.31E+04	1.31E+04	9.45E-11
Re-177	M	2.97E-14	2.62E-06	3.28E-14	-	1.36E+09	2.60E+04	8.90E-01	3.53E+10	2.65E+14	5.43E+04	5.43E+04	7.17E-10
Re-178	M	2.33E-14	5.65E-06	3.37E-14	-	1.36E+09	2.76E+04	8.73E-01	3.64E+10	3.58E+14	2.72E+04	2.72E+04	3.41E-10
Re-180	-	-	5.29E-06	-	-	1.36E+09	1.50E+05	8.59E-01	-	-	1.61E+05	1.61E+05	3.74E-10
Re-181	M	7.96E-13	3.18E-06	7.96E-13	-	1.36E+09	3.04E+02	9.45E-01	1.69E+07	1.15E+11	4.92E+02	4.92E+02	5.69E-10
Re-182	M	4.44E-12	8.22E-06	2.86E-12	-	1.36E+09	9.49E+01	9.40E-01	1.47E+06	6.45E+09	5.97E+01	5.97E+01	2.22E-10
Re-182m	M	5.51E-13	5.37E-06	5.22E-13	-	1.36E+09	4.78E+02	9.26E-01	4.07E+07	2.62E+11	4.68E+02	4.68E+02	3.46E-10
Re-184	M	6.73E-12	3.94E-06	1.94E-12	-	1.36E+09	6.66E+00	8.97E-01	1.52E+05	2.99E+08	9.17E+00	9.17E+00	4.92E-10

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Re-184m	M	2.26E-11	1.52E-06	2.78E-12	-	1.36E+09	1.53E+00	9.52E-01	2.45E+04	2.05E+07	5.16E+00	5.15E+00	1.20E-09
Re-186	M	4.26E-12	5.49E-08	2.84E-12	-	1.36E+09	6.70E+01	9.54E-01	1.05E+06	4.75E+09	6.22E+03	6.19E+03	3.33E-08
Re-186m	M	4.18E-11	1.75E-08	4.03E-12	-	1.36E+09	3.47E-06	9.85E-01	4.41E+02	2.89E+05	1.13E+01	1.10E+01	1.15E-03
Re-186m+D	M	-	7.24E-08	-	-	1.36E+09	3.47E-06	9.73E-01	-	-	2.76E+00	2.76E+00	2.88E-04
Re-187	M	2.51E-14	0.00E+00	9.47E-15	-	1.36E+09	1.39E-11	0.00E+00	1.88E+05	4.81E+08	-	1.88E+05	4.91E+06
Re-188	M	2.22E-12	2.38E-07	2.52E-12	-	1.36E+09	3.58E+02	9.03E-01	6.31E+06	4.86E+10	8.10E+03	8.09E+03	8.25E-09
Re-188m	M	5.07E-14	1.28E-07	5.29E-14	-	1.36E+09	1.96E+04	9.53E-01	1.65E+10	1.17E+14	7.81E+05	7.81E+05	1.46E-08
Re-189	M	1.73E-12	2.42E-07	1.47E-12	-	1.36E+09	2.50E+02	9.21E-01	7.55E+06	4.36E+10	5.45E+03	5.45E+03	8.00E-09
Rh-100	S	1.04E-12	1.38E-05	1.42E-12	-	1.36E+09	2.92E+02	8.86E-01	9.13E+06	8.48E+10	1.16E+02	1.16E+02	7.72E-11
Rh-101	S	1.81E-11	8.84E-07	1.22E-12	-	1.36E+09	2.17E-01	9.31E-01	7.92E+03	3.63E+06	1.29E+00	1.29E+00	1.16E-09
Rh-101m	S	7.14E-13	1.19E-06	4.63E-13	-	1.36E+09	5.83E+01	9.07E-01	5.59E+06	2.47E+10	2.63E+02	2.63E+02	8.84E-10
Rh-102	S	5.99E-11	9.73E-06	5.22E-12	-	1.36E+09	2.39E-01	8.61E-01	2.04E+03	1.21E+06	1.39E-01	1.39E-01	1.15E-10
Rh-102m	S	2.56E-11	2.11E-06	2.85E-12	-	1.36E+09	1.22E+00	9.87E-01	1.91E+04	1.44E+07	2.86E+00	2.86E+00	4.62E-10
Rh-103m	S	9.14E-15	9.31E-11	5.66E-15	-	1.36E+09	6.49E+03	9.98E-01	5.10E+10	2.14E+14	3.40E+08	3.38E+08	1.04E-05
Rh-105	S	1.59E-12	3.15E-07	9.66E-13	-	1.36E+09	1.72E+02	9.05E-01	7.90E+06	3.26E+10	2.93E+03	2.93E+03	3.48E-09
Rh-106	-	-	9.66E-07	-	-	1.36E+09	7.31E+05	8.83E-01	-	-	4.17E+06	4.17E+06	1.17E-09
Rh-106m	S	2.71E-13	1.37E-05	3.09E-13	-	1.36E+09	2.76E+03	8.70E-01	3.97E+08	3.08E+12	1.13E+03	1.13E+03	8.40E-11
Rh-107	S	2.88E-14	1.28E-06	3.19E-14	-	1.36E+09	1.68E+04	9.00E-01	2.34E+10	1.76E+14	7.09E+04	7.09E+04	8.77E-10
Rh-99	S	3.33E-12	2.50E-06	1.10E-12	-	1.36E+09	1.58E+01	8.91E-01	6.39E+05	1.43E+09	3.45E+01	3.45E+01	4.20E-10
Rh-99m	S	9.99E-14	3.03E-06	1.32E-13	-	1.36E+09	1.29E+03	8.59E-01	4.35E+08	3.91E+12	2.42E+03	2.42E+03	3.59E-10
Rn-218	-	-	3.39E-09	-	-	1.36E+09	6.24E+08	8.75E-01	-	-	1.02E+12	1.02E+12	6.94E-07
Rn-219	-	-	2.25E-07	-	-	1.36E+09	5.52E+06	9.11E-01	-	-	1.31E+08	1.31E+08	1.01E-08
Rn-219+D	-	-	6.58E-07	-	-	1.36E+09	5.52E+06	9.31E-01	-	-	4.38E+07	4.38E+07	3.38E-09
Rn-220	-	-	1.71E-09	-	-	1.36E+09	3.93E+05	8.80E-01	-	-	1.27E+09	1.27E+09	1.38E-06
Rn-222	-	-	1.74E-09	-	-	1.36E+09	6.62E+01	8.83E-01	-	-	2.10E+05	2.10E+05	1.36E-06
Rn-222+D	-	1.80E-11	8.48E-06	-	-	1.36E+09	6.62E+01	9.26E-01	-	1.11E+09	4.10E+01	4.10E+01	2.67E-10
Ru-103	M	8.92E-12	2.04E-06	1.76E-12	-	1.36E+09	6.44E+00	8.82E-01	1.63E+05	2.18E+08	1.74E+01	1.74E+01	5.41E-10
Ru-105	M	6.48E-13	3.52E-06	6.07E-13	-	1.36E+09	1.37E+03	8.98E-01	1.00E+08	6.37E+11	2.11E+03	2.11E+03	3.14E-10
Ru-106	M	1.02E-10	0.00E+00	1.84E-11	-	1.36E+09	6.87E-01	0.00E+00	1.66E+03	2.03E+06	-	1.66E+03	4.96E-07
Ru-106+D	M	1.02E-10	9.66E-07	1.19E-10	-	1.36E+09	6.87E-01	8.83E-01	2.57E+02	2.03E+06	3.92E+00	3.86E+00	1.16E-09
Ru-94	M	1.23E-13	2.31E-06	1.61E-13	-	1.36E+09	7.03E+03	9.51E-01	1.94E+09	1.73E+13	1.56E+04	1.56E+04	4.04E-10
Ru-97	M	3.36E-13	8.63E-07	3.15E-13	-	1.36E+09	8.72E+01	9.49E-01	1.23E+07	7.84E+10	5.18E+02	5.18E+02	1.12E-09
S-35	M	5.03E-12	8.77E-12	3.27E-13	-	1.36E+09	2.89E+00	9.27E-01	3.93E+05	1.74E+08	1.73E+06	3.20E+05	7.51E-06
Sb-115	M	2.33E-14	3.92E-06	3.70E-14	-	1.36E+09	1.15E+04	8.91E-01	1.38E+10	1.48E+14	1.60E+04	1.60E+04	3.11E-10
Sb-116	M	1.88E-14	1.05E-05	3.89E-14	-	1.36E+09	2.31E+04	8.67E-01	2.63E+10	3.70E+14	1.23E+04	1.23E+04	1.20E-10
Sb-116m	M	8.81E-14	1.47E-05	1.18E-13	-	1.36E+09	6.04E+03	8.56E-01	2.28E+09	2.07E+13	2.34E+03	2.34E+03	8.71E-11
Sb-117	M	4.07E-14	5.78E-07	3.50E-14	-	1.36E+09	2.17E+03	9.62E-01	2.75E+09	1.61E+13	1.90E+04	1.90E+04	1.99E-09
Sb-118m	M	2.64E-13	1.21E-05	4.07E-13	-	1.36E+09	1.21E+03	8.70E-01	1.33E+08	1.39E+12	5.61E+02	5.61E+02	1.06E-10
Sb-119	M	1.74E-13	2.58E-09	2.01E-13	-	1.36E+09	1.59E+02	9.92E-01	3.52E+07	2.77E+11	3.03E+05	3.00E+05	4.35E-07
Sb-120	M	1.12E-14	1.94E-06	1.94E-14	-	1.36E+09	2.29E+04	9.27E-01	5.25E+10	6.18E+14	6.20E+04	6.20E+04	6.30E-10
Sb-120m	M	3.30E-12	1.15E-05	2.45E-12	-	1.36E+09	4.39E+01	8.80E-01	7.97E+05	4.02E+09	2.11E+01	2.11E+01	1.12E-10
Sb-122	M	5.48E-12	1.97E-06	4.44E-12	-	1.36E+09	9.37E+01	8.75E-01	9.38E+05	5.16E+09	2.64E+02	2.64E+02	6.68E-10
Sb-124	M	2.43E-11	8.89E-06	6.03E-12	-	1.36E+09	4.20E+00	8.71E-01	3.10E+04	5.22E+07	2.64E+00	2.64E+00	1.51E-10
Sb-124m	M	-	1.57E-06	-	-	1.36E+09	2.35E+05	8.75E-01	-	-	8.32E+05	8.32E+05	8.52E-10
Sb-124n	M	1.15E-14	7.77E-12	1.20E-14	-	1.36E+09	1.80E+04	9.93E-01	6.68E+10	4.74E+14	1.14E+10	9.72E+09	1.30E-04
Sb-125	M	1.66E-11	1.81E-06	2.38E-12	-	1.36E+09	2.50E-01	8.81E-01	4.68E+03	4.56E+06	7.65E-01	7.65E-01	7.42E-10
Sb-126	M	1.15E-11	1.28E-05	5.40E-12	-	1.36E+09	2.04E+01	8.66E-01	1.68E+05	5.36E+08	8.96E+00	8.96E+00	1.07E-10
Sb-126m	M	3.16E-14	6.94E-06	5.11E-14	-	1.36E+09	1.92E+04	8.72E-01	1.67E+10	1.83E+14	1.54E+04	1.54E+04	1.97E-10
Sb-127	M	7.51E-12	3.07E-06	4.29E-12	-	1.36E+09	6.57E+01	8.83E-01	6.81E+05	2.64E+09	1.18E+02	1.18E+02	4.42E-10

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Sb-128	M	1.44E-12	1.40E-05	1.67E-12	-	1.36E+09	6.74E+02	8.85E-01	1.79E+07	1.41E+11	2.65E+02	2.65E+02	9.76E-11
Sb-128m	M	2.12E-14	9.03E-06	4.44E-14	-	1.36E+09	3.50E+04	8.63E-01	3.51E+10	4.99E+14	2.19E+04	2.19E+04	1.55E-10
Sb-129	M	9.62E-13	6.86E-06	9.81E-13	-	1.36E+09	1.41E+03	8.75E-01	6.37E+07	4.41E+11	1.14E+03	1.14E+03	2.03E-10
Sb-130	M	9.73E-14	1.51E-05	1.44E-13	-	1.36E+09	9.11E+03	8.63E-01	2.81E+09	2.83E+13	3.40E+03	3.40E+03	9.42E-11
Sb-131	M	9.73E-14	9.09E-06	1.59E-13	-	1.36E+09	1.58E+04	8.58E-01	4.43E+09	4.92E+13	9.88E+03	9.88E+03	1.59E-10
Sc-43	S	3.81E-13	4.73E-06	3.96E-13	-	1.36E+09	1.56E+03	8.86E-01	1.75E+08	1.24E+12	1.81E+03	1.81E+03	9.69E-11
Sc-44	S	6.44E-13	9.95E-06	7.51E-13	-	1.36E+09	1.55E+03	8.63E-01	9.15E+07	7.25E+11	8.76E+02	8.76E+02	4.84E-11
Sc-44m	S	6.96E-12	1.15E-06	6.03E-12	-	1.36E+09	1.04E+02	9.02E-01	7.64E+05	4.50E+09	4.86E+02	4.86E+02	4.00E-10
Sc-46	S	2.47E-11	9.64E-06	3.07E-12	-	1.36E+09	3.02E+00	8.47E-01	4.37E+04	3.69E+07	1.80E+00	1.80E+00	5.32E-11
Sc-47	S	3.05E-12	3.62E-07	1.44E-12	-	1.36E+09	7.55E+01	9.26E-01	2.33E+06	7.48E+09	1.10E+03	1.10E+03	1.32E-09
Sc-48	S	3.96E-12	1.62E-05	3.59E-12	-	1.36E+09	1.39E+02	8.40E-01	1.72E+06	1.06E+10	4.97E+01	4.97E+01	3.33E-11
Sc-49	S	1.07E-13	1.90E-08	1.22E-13	-	1.36E+09	6.35E+03	8.15E-01	2.31E+09	1.79E+13	1.99E+06	1.99E+06	2.99E-08
Se-70	F	7.36E-14	4.22E-06	1.95E-13	-	1.36E+09	8.88E+03	9.36E-01	2.02E+09	3.65E+13	1.09E+04	1.09E+04	1.67E-10
Se-73	F	1.99E-13	4.52E-06	4.48E-13	-	1.36E+09	8.49E+02	9.05E-01	8.42E+07	1.29E+12	1.01E+03	1.01E+03	1.69E-10
Se-73m	F	2.06E-14	1.06E-06	5.07E-14	-	1.36E+09	9.34E+03	9.41E-01	8.19E+09	1.37E+14	4.56E+04	4.56E+04	6.91E-10
Se-75	F	3.77E-12	1.45E-06	6.25E-12	-	1.36E+09	2.11E+00	9.18E-01	1.50E+04	1.69E+08	7.72E+00	7.72E+00	5.32E-10
Se-77m	-	-	2.85E-07	-	-	1.36E+09	1.25E+06	9.80E-01	-	-	2.18E+07	2.18E+07	2.60E-09
Se-79	F	3.33E-12	1.10E-11	5.29E-12	-	1.36E+09	1.07E-05	9.27E-01	3.36E+02	3.63E+06	1.91E+04	3.30E+02	4.75E-03
Se-81	F	1.27E-14	4.68E-08	3.36E-14	-	1.36E+09	1.97E+04	8.78E-01	2.60E+10	4.68E+14	2.33E+06	2.33E+06	1.86E-08
Se-81m	F	3.54E-14	3.56E-08	8.07E-14	-	1.36E+09	6.36E+03	9.87E-01	3.50E+09	5.43E+13	8.81E+05	8.81E+05	2.18E-08
Se-83	F	2.72E-14	1.16E-05	7.33E-14	-	1.36E+09	1.62E+04	8.81E-01	9.82E+09	1.80E+14	7.71E+03	7.71E+03	7.67E-11
Si-31	S	3.05E-13	1.11E-08	2.97E-13	-	1.36E+09	2.32E+03	8.34E-01	3.47E+08	2.29E+12	1.22E+06	1.21E+06	3.15E-08
Si-32	S	2.93E-10	2.18E-11	1.50E-12	-	1.36E+09	1.54E-03	9.27E-01	1.21E+03	4.20E+04	9.82E+03	1.05E+03	4.23E-05
Si-32+D	S	-	9.44E-09	-	-	1.36E+09	1.54E-03	9.28E-01	-	-	2.27E+01	2.27E+01	9.13E-07
Sm-141	M	2.79E-14	6.39E-06	5.37E-14	-	1.36E+09	3.57E+04	8.51E-01	2.96E+10	3.87E+14	3.20E+04	3.20E+04	2.45E-10
Sm-141m	M	6.29E-14	9.04E-06	9.81E-14	-	1.36E+09	1.61E+04	8.90E-01	7.30E+09	7.74E+13	9.75E+03	9.75E+03	1.65E-10
Sm-142	M	2.13E-13	2.99E-07	3.05E-13	-	1.36E+09	5.02E+03	9.44E-01	7.32E+08	7.13E+12	8.66E+04	8.66E+04	4.75E-09
Sm-145	M	4.51E-12	3.83E-08	5.11E-13	-	1.36E+09	7.44E-01	9.65E-01	6.47E+04	4.98E+07	9.80E+01	9.78E+01	3.70E-08
Sm-146	M	7.88E-09	0.00E+00	3.49E-11	-	1.36E+09	6.73E-09	0.00E+00	5.09E+01	1.53E+03	-	4.93E+01	2.08E+00
Sm-147	M	6.88E-09	0.00E+00	3.17E-11	-	1.36E+09	6.54E-12	0.00E+00	5.61E+01	1.76E+03	-	5.43E+01	2.37E+03
Sm-151	M	4.88E-12	3.60E-13	2.35E-13	-	1.36E+09	7.70E-03	9.98E-01	8.32E+03	2.72E+06	5.96E+05	8.18E+03	3.11E-04
Sm-153	M	2.95E-12	1.06E-07	1.97E-12	-	1.36E+09	1.30E+02	9.40E-01	2.93E+06	1.33E+10	6.35E+03	6.34E+03	1.45E-08
Sm-155	M	3.15E-14	2.81E-07	3.74E-14	-	1.36E+09	1.65E+04	9.25E-01	1.96E+10	1.58E+14	3.09E+05	3.09E+05	5.63E-09
Sm-156	M	9.69E-13	3.80E-07	6.29E-13	-	1.36E+09	6.46E+02	9.24E-01	4.56E+07	2.01E+11	8.95E+03	8.95E+03	4.19E-09
Sn-110	M	6.70E-13	1.13E-06	8.36E-13	-	1.36E+09	1.52E+03	9.56E-01	8.07E+07	6.84E+11	6.84E+03	6.84E+03	9.61E-10
Sn-111	M	2.83E-14	2.29E-06	3.61E-14	-	1.36E+09	1.03E+04	8.71E-01	1.27E+10	1.10E+14	2.52E+04	2.52E+04	5.26E-10
Sn-113	M	1.00E-11	2.02E-08	1.86E-12	-	1.36E+09	2.20E+00	9.92E-01	5.25E+04	6.64E+07	5.34E+02	5.28E+02	5.27E-08
Sn-117m	M	8.84E-12	4.70E-07	1.83E-12	-	1.36E+09	1.86E+01	9.61E-01	4.51E+05	6.35E+08	2.00E+02	2.00E+02	2.45E-09
Sn-119m	M	7.81E-12	1.20E-09	9.14E-13	-	1.36E+09	8.63E-01	9.92E-01	4.20E+04	3.34E+07	3.53E+03	3.26E+03	8.71E-07
Sn-121	M	1.02E-12	1.30E-10	6.11E-13	-	1.36E+09	2.24E+02	9.27E-01	1.63E+07	6.64E+10	9.06E+06	5.83E+06	6.10E-06
Sn-121m	M	1.54E-11	8.85E-10	9.99E-13	-	1.36E+09	1.26E-02	9.86E-01	2.07E+03	9.15E+05	2.60E+02	2.31E+02	4.31E-06
Sn-121m+D	M	-	9.86E-10	-	-	1.36E+09	1.26E-02	9.86E-01	-	-	2.33E+02	2.33E+02	4.35E-06
Sn-123	M	3.03E-11	3.88E-08	5.70E-12	-	1.36E+09	1.96E+00	8.43E-01	1.53E+04	1.95E+07	2.91E+02	2.86E+02	3.48E-08
Sn-123m	M	5.62E-14	4.63E-07	5.33E-14	-	1.36E+09	9.09E+03	9.36E-01	7.58E+09	4.88E+13	1.02E+05	1.02E+05	2.68E-09
Sn-125	M	1.41E-11	1.53E-06	8.25E-12	-	1.36E+09	2.62E+01	8.57E-01	1.41E+05	5.62E+08	9.74E+01	9.73E+01	9.00E-10
Sn-126	M	9.95E-11	9.96E-08	1.17E-11	-	1.36E+09	6.93E-06	9.57E-01	1.52E+02	1.21E+05	2.04E+00	2.02E+00	7.11E-05
Sn-126+D	M	-	8.84E-06	-	-	1.36E+09	6.93E-06	8.74E-01	-	-	2.52E-02	2.52E-02	8.89E-07
Sn-127	M	4.40E-13	9.25E-06	4.11E-13	-	1.36E+09	2.89E+03	9.28E-01	3.13E+08	1.98E+12	1.64E+03	1.64E+03	1.40E-10
Sn-128	M	2.29E-13	2.62E-06	2.57E-13	-	1.36E+09	6.16E+03	9.04E-01	1.07E+09	8.13E+12	1.27E+04	1.27E+04	5.10E-10

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Sr-80	M	4.51E-13	5.08E-11	6.11E-13	-	1.36E+09	3.64E+03	1.00E+00	2.65E+08	2.44E+12	3.49E+08	1.51E+08	6.42E-06
Sr-81	M	8.07E-14	5.97E-06	1.17E-13	-	1.36E+09	1.43E+04	8.95E-01	5.43E+09	5.35E+13	1.30E+04	1.30E+04	1.43E-10
Sr-82	M	3.69E-11	5.00E-11	1.57E-11	-	1.36E+09	1.01E+01	1.00E+00	2.86E+04	8.28E+07	9.85E+05	2.78E+04	4.38E-07
Sr-82+D	M	-	4.85E-06	-	-	1.36E+09	1.01E+01	8.83E-01	-	-	1.15E+01	1.15E+01	1.81E-10
Sr-83	M	1.26E-12	3.60E-06	1.14E-12	-	1.36E+09	1.87E+02	9.06E-01	7.30E+06	4.49E+10	2.80E+02	2.80E+02	2.40E-10
Sr-85	M	2.56E-12	2.20E-06	1.42E-12	-	1.36E+09	3.90E+00	9.68E-01	1.22E+05	4.60E+08	8.91E+00	8.91E+00	3.77E-10
Sr-85m	M	8.32E-15	8.21E-07	1.14E-14	-	1.36E+09	5.24E+03	9.21E-01	2.04E+10	1.90E+14	3.37E+04	3.37E+04	1.06E-09
Sr-87m	M	5.62E-14	1.33E-06	6.03E-14	-	1.36E+09	2.16E+03	9.17E-01	1.60E+09	1.16E+13	8.64E+03	8.64E+03	6.74E-10
Sr-89	M	2.34E-11	7.19E-09	6.48E-12	-	1.36E+09	5.01E+00	8.56E-01	3.44E+04	6.47E+07	3.96E+03	3.55E+03	1.22E-07
Sr-90	M	1.05E-10	4.82E-10	5.18E-11	-	1.36E+09	2.38E-02	9.27E-01	4.55E+01	1.53E+05	5.78E+02	4.22E+01	3.10E-07
Sr-90+D	M	1.13E-10	1.96E-08	5.92E-11	-	1.36E+09	2.38E-02	1.00E+00	3.98E+01	1.42E+05	1.32E+01	9.90E+00	7.27E-08
Sr-91	M	1.70E-12	3.31E-06	1.57E-12	-	1.36E+09	6.39E+02	8.62E-01	1.81E+07	1.14E+11	1.09E+03	1.09E+03	3.01E-10
Sr-92	M	1.03E-12	6.69E-06	1.07E-12	-	1.36E+09	2.24E+03	8.31E-01	9.30E+07	6.57E+11	1.96E+03	1.96E+03	1.56E-10
Ta-172	S	7.22E-14	7.04E-06	7.96E-14	-	1.36E+09	9.90E+03	9.13E-01	5.53E+09	4.14E+13	7.49E+03	7.49E+03	2.53E-10
Ta-173	S	4.44E-13	2.38E-06	4.22E-13	-	1.36E+09	1.66E+03	9.30E-01	1.75E+08	1.13E+12	3.66E+03	3.66E+03	7.38E-10
Ta-174	S	1.11E-13	2.55E-06	9.47E-14	-	1.36E+09	5.06E+03	8.65E-01	2.37E+09	1.38E+13	1.12E+04	1.12E+04	7.45E-10
Ta-175	S	4.37E-13	4.16E-06	4.37E-13	-	1.36E+09	5.78E+02	9.34E-01	5.88E+07	4.00E+11	7.24E+02	7.24E+02	4.25E-10
Ta-176	S	5.96E-13	1.06E-05	6.55E-13	-	1.36E+09	7.51E+02	9.41E-01	5.10E+07	3.81E+11	3.67E+02	3.67E+02	1.67E-10
Ta-177	S	4.44E-13	1.20E-07	2.58E-13	-	1.36E+09	1.07E+02	9.41E-01	1.85E+07	7.30E+10	4.62E+03	4.62E+03	1.48E-08
Ta-178	-	-	3.29E-07	-	-	1.36E+09	3.91E+04	9.05E-01	-	-	6.39E+05	6.39E+05	5.65E-09
Ta-178m	S	1.79E-13	3.78E-06	1.38E-13	-	1.36E+09	2.76E+03	9.06E-01	8.89E+08	4.66E+12	3.92E+03	3.92E+03	4.91E-10
Ta-179	S	2.05E-12	3.62E-08	1.54E-13	-	1.36E+09	3.80E-01	9.59E-01	1.10E+05	5.61E+07	5.33E+01	5.33E+01	4.87E-08
Ta-180	S	7.25E-11	2.03E-06	1.99E-12	-	1.36E+09	6.93E-14	9.12E-01	8.93E+02	1.67E+05	1.05E-01	1.05E-01	5.30E+02
Ta-180m	S	1.86E-13	6.13E-08	1.31E-13	-	1.36E+09	7.49E+02	9.46E-01	2.54E+08	1.22E+12	6.29E+04	6.29E+04	2.93E-08
Ta-182	S	3.74E-11	6.04E-06	3.59E-12	-	1.36E+09	2.20E+00	9.25E-01	2.72E+04	1.78E+07	1.92E+00	1.92E+00	3.08E-10
Ta-182m	S	3.41E-14	7.38E-07	1.54E-14	-	1.36E+09	2.30E+04	9.28E-01	6.64E+10	2.04E+14	1.63E+05	1.63E+05	2.51E-09
Ta-183	S	8.81E-12	9.40E-07	3.44E-12	-	1.36E+09	4.96E+01	9.32E-01	6.41E+05	1.70E+09	2.76E+02	2.75E+02	1.97E-09
Ta-184	S	1.73E-12	7.02E-06	1.58E-12	-	1.36E+09	6.98E+02	9.14E-01	1.96E+07	1.22E+11	5.29E+02	5.29E+02	2.71E-10
Ta-185	S	1.18E-13	6.24E-07	9.88E-14	-	1.36E+09	7.43E+03	9.23E-01	3.34E+09	1.90E+13	6.28E+04	6.28E+04	3.03E-09
Ta-186	S	2.69E-14	6.69E-06	4.44E-14	-	1.36E+09	3.47E+04	9.13E-01	3.47E+10	3.90E+14	2.76E+04	2.76E+04	2.88E-10
Tb-147	M	2.26E-13	7.30E-06	2.88E-13	-	1.36E+09	3.68E+03	8.59E-01	5.68E+08	4.92E+12	2.86E+03	2.86E+03	2.21E-10
Tb-149	M	1.65E-11	7.60E-06	5.25E-13	-	1.36E+09	1.46E+03	8.63E-01	1.24E+08	2.68E+10	1.09E+03	1.09E+03	2.15E-10
Tb-150	M	3.88E-13	7.79E-06	5.25E-13	-	1.36E+09	1.86E+03	8.68E-01	1.57E+08	1.45E+12	1.34E+03	1.34E+03	2.09E-10
Tb-151	M	7.73E-13	3.66E-06	7.25E-13	-	1.36E+09	3.45E+02	8.92E-01	2.11E+07	1.35E+11	5.14E+02	5.14E+02	4.37E-10
Tb-153	M	8.18E-13	7.24E-07	5.77E-13	-	1.36E+09	1.08E+02	9.31E-01	8.33E+06	3.99E+10	7.80E+02	7.80E+02	2.14E-09
Tb-154	M	1.14E-12	1.18E-05	1.34E-12	-	1.36E+09	2.84E+02	8.89E-01	9.41E+06	7.52E+10	1.32E+02	1.32E+02	1.39E-10
Tb-155	M	8.99E-13	3.26E-07	4.81E-13	-	1.36E+09	4.75E+01	9.37E-01	4.39E+06	1.60E+10	7.58E+02	7.57E+02	4.79E-09
Tb-156	M	4.22E-12	8.37E-06	2.46E-12	-	1.36E+09	4.74E+01	8.83E-01	8.56E+05	3.39E+09	3.12E+01	3.12E+01	1.99E-10
Tb-156m	M	8.47E-13	2.16E-08	3.92E-13	-	1.36E+09	2.49E+02	9.57E-01	2.82E+07	8.87E+10	5.86E+04	5.85E+04	7.11E-08
Tb-156n	M	3.77E-13	4.06E-09	1.82E-13	-	1.36E+09	1.21E+03	9.55E-01	2.96E+08	9.73E+11	1.52E+06	1.52E+06	3.78E-07
Tb-157	M	1.46E-12	1.64E-09	7.99E-14	-	1.36E+09	4.62E-03	9.62E-01	2.36E+04	8.76E+06	1.31E+02	1.30E+02	8.57E-06
Tb-158	M	8.29E-11	3.57E-06	2.38E-12	-	1.36E+09	4.62E-03	8.54E-01	7.91E+02	1.54E+05	6.76E-02	6.76E-02	4.49E-09
Tb-160	M	2.45E-11	5.23E-06	3.85E-12	-	1.36E+09	3.50E+00	8.61E-01	4.04E+04	4.31E+07	3.78E+00	3.78E+00	3.36E-10
Tb-161	M	5.03E-12	3.45E-08	1.95E-12	-	1.36E+09	3.66E+01	9.54E-01	8.34E+05	2.20E+09	5.41E+03	5.38E+03	4.59E-08
Tc-101	M	1.85E-14	1.37E-06	2.42E-14	-	1.36E+09	2.57E+04	8.94E-01	4.71E+10	4.19E+14	1.02E+05	1.02E+05	7.79E-10
Tc-104	M	5.33E-14	9.75E-06	1.07E-13	-	1.36E+09	2.00E+04	8.98E-01	8.31E+09	1.13E+14	1.11E+04	1.11E+04	1.12E-10
Tc-93	M	6.36E-14	7.31E-06	1.04E-13	-	1.36E+09	2.21E+03	8.91E-01	9.43E+08	1.05E+13	1.65E+03	1.65E+03	1.35E-10
Tc-93m	M	3.17E-14	3.62E-06	4.51E-14	-	1.36E+09	8.37E+03	8.98E-01	8.25E+09	7.98E+13	1.25E+04	1.25E+04	2.70E-10
Tc-94	M	2.80E-13	1.24E-05	3.92E-13	-	1.36E+09	1.24E+03	8.70E-01	1.41E+08	1.34E+12	5.61E+02	5.61E+02	8.23E-11

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Tc-94m	M	1.03E-13	8.70E-06	1.55E-13	-	1.36E+09	7.00E+03	8.59E-01	2.01E+09	2.05E+13	4.56E+03	4.56E+03	1.19E-10
Tc-95	M	2.63E-13	3.63E-06	3.50E-13	-	1.36E+09	3.04E+02	8.77E-01	3.85E+07	3.49E+11	4.64E+02	4.64E+02	2.82E-10
Tc-95m	M	3.40E-12	2.93E-06	1.10E-12	-	1.36E+09	4.15E+00	8.73E-01	1.68E+05	3.68E+08	7.89E+00	7.89E+00	3.51E-10
Tc-96	M	2.00E-12	1.16E-05	2.15E-12	-	1.36E+09	5.91E+01	8.60E-01	1.22E+06	8.93E+09	2.88E+01	2.88E+01	9.09E-11
Tc-96m	M	2.05E-14	2.13E-07	2.27E-14	-	1.36E+09	7.07E+03	9.38E-01	1.38E+10	1.04E+14	1.72E+05	1.72E+05	4.54E-09
Tc-97	M	8.51E-13	2.94E-10	1.34E-13	-	1.36E+09	2.67E-07	1.00E+00	1.33E+04	1.42E+07	6.62E+02	6.31E+02	4.45E-01
Tc-97m	M	1.12E-11	1.04E-09	1.14E-12	-	1.36E+09	2.91E+00	9.99E-01	1.13E+05	7.84E+07	1.36E+04	1.22E+04	7.87E-07
Tc-98	M	3.01E-11	6.45E-06	3.92E-12	-	1.36E+09	1.65E-07	8.67E-01	4.54E+02	4.01E+05	3.48E-02	3.48E-02	4.01E-05
Tc-99	M	1.41E-11	8.14E-11	1.32E-12	-	1.36E+09	3.25E-06	9.27E-01	1.35E+03	8.57E+05	2.58E+03	8.84E+02	5.22E-02
Tc-99m	M	5.70E-14	3.94E-07	4.37E-14	-	1.36E+09	1.01E+03	9.46E-01	1.03E+09	5.34E+12	1.32E+04	1.32E+04	2.51E-09
Te-116	M	3.20E-13	1.34E-07	3.48E-13	-	1.36E+09	2.44E+03	9.80E-01	3.11E+08	2.30E+12	9.04E+04	9.03E+04	8.34E-09
Te-121	M	1.30E-12	2.46E-06	9.07E-13	-	1.36E+09	1.49E+01	9.02E-01	7.29E+05	3.46E+09	3.26E+01	3.26E+01	5.15E-10
Te-121m	M	1.44E-11	7.84E-07	4.51E-12	-	1.36E+09	1.64E+00	9.17E-01	1.62E+04	3.45E+07	1.11E+01	1.11E+01	1.59E-09
Te-123	M	2.50E-12	2.73E-09	4.07E-12	-	1.36E+09	6.93E-14	9.89E-01	4.37E+02	4.83E+06	7.21E+01	6.19E+01	2.13E+05
Te-123m	M	1.36E-11	4.49E-07	2.46E-12	-	1.36E+09	2.11E+00	9.51E-01	3.82E+04	4.69E+07	2.41E+01	2.41E+01	2.72E-09
Te-125m	M	1.17E-11	6.95E-09	1.70E-12	-	1.36E+09	4.36E+00	9.86E-01	1.14E+05	1.13E+08	3.10E+03	3.02E+03	1.68E-07
Te-127	M	6.11E-13	2.10E-08	4.22E-13	-	1.36E+09	6.49E+02	8.94E-01	6.84E+07	3.21E+11	1.68E+05	1.68E+05	6.37E-08
Te-127m	M	2.58E-11	2.73E-09	4.77E-12	-	1.36E+09	2.32E+00	9.83E-01	2.16E+04	2.72E+07	4.21E+03	3.52E+03	3.74E-07
Te-129	M	9.95E-14	2.45E-07	9.88E-14	-	1.36E+09	5.23E+03	8.89E-01	2.35E+09	1.59E+13	1.17E+05	1.17E+05	5.59E-09
Te-129m	M	2.49E-11	1.38E-07	7.18E-12	-	1.36E+09	7.53E+00	9.85E-01	4.66E+04	9.13E+07	2.70E+02	2.68E+02	8.91E-09
Te-131	M	6.40E-14	1.79E-06	1.31E-13	-	1.36E+09	1.46E+04	9.17E-01	4.94E+09	6.88E+13	4.32E+04	4.32E+04	7.54E-10
Te-131m	M	4.22E-12	6.61E-06	4.00E-12	-	1.36E+09	2.02E+02	9.49E-01	2.25E+06	1.45E+10	1.57E+02	1.57E+02	1.97E-10
Te-132	M	9.32E-12	7.84E-07	8.25E-12	-	1.36E+09	7.76E+01	9.36E-01	4.18E+05	2.52E+09	5.15E+02	5.14E+02	1.70E-09
Te-133	M	4.92E-14	4.29E-06	1.11E-13	-	1.36E+09	2.93E+04	8.42E-01	1.17E+10	1.80E+14	3.94E+04	3.94E+04	3.48E-10
Te-133m	M	2.64E-13	1.09E-05	4.74E-13	-	1.36E+09	6.57E+03	9.27E-01	6.16E+08	7.52E+12	3.17E+03	3.17E+03	1.24E-10
Te-134	M	1.60E-13	3.78E-06	1.89E-13	-	1.36E+09	8.71E+03	8.72E-01	2.05E+09	1.65E+13	1.29E+04	1.29E+04	3.84E-10
Th-226	S	1.56E-10	2.36E-08	4.77E-13	-	1.36E+09	1.18E+04	9.47E-01	1.10E+09	2.28E+10	2.57E+06	2.56E+06	9.53E-08
Th-227	S	3.51E-08	3.78E-07	2.03E-11	-	1.36E+09	1.35E+01	9.71E-01	2.96E+04	1.16E+05	1.79E+02	1.78E+02	5.80E-09
Th-228	S	1.32E-07	5.59E-09	6.40E-11	-	1.36E+09	3.62E-01	9.80E-01	2.52E+02	8.29E+02	3.22E+02	1.21E+02	1.47E-07
Th-229	S	1.75E-07	2.25E-07	1.97E-10	-	1.36E+09	9.44E-05	9.59E-01	9.03E+00	6.91E+01	9.03E-01	8.12E-01	3.82E-06
Th-229+D	S	2.25E-07	1.17E-06	3.63E-10	-	1.36E+09	9.44E-05	9.72E-01	4.90E+00	5.38E+01	1.71E-01	1.65E-01	7.77E-07
Th-230	S	2.85E-08	8.19E-10	7.73E-11	-	1.36E+09	9.00E-06	9.97E-01	2.30E+01	4.24E+02	2.38E+02	2.00E+01	9.91E-04
Th-231	S	1.52E-12	2.45E-08	9.14E-13	-	1.36E+09	2.38E+02	9.85E-01	1.16E+07	4.73E+10	4.80E+04	4.78E+04	9.00E-08
Th-232	S	4.33E-08	3.42E-10	8.47E-11	-	1.36E+09	4.93E-11	9.98E-01	2.10E+01	2.79E+02	5.70E+02	1.89E+01	1.72E+02
Th-234	S	3.07E-11	1.64E-08	9.51E-12	-	1.36E+09	1.05E+01	9.57E-01	4.91E+04	1.03E+08	3.25E+03	3.05E+03	1.32E-07
Th-234+D	S	-	1.14E-07	-	-	1.36E+09	1.05E+01	9.91E-01	-	-	4.52E+02	4.52E+02	1.96E-08
Ti-44	S	3.41E-10	2.39E-07	1.34E-11	-	1.36E+09	1.47E-02	9.45E-01	1.58E+02	4.23E+04	1.03E+00	1.02E+00	5.96E-09
Ti-44+D	S	-	1.02E-05	-	-	1.36E+09	1.47E-02	8.71E-01	-	-	2.62E-02	2.62E-02	1.52E-10
Ti-45	S	3.09E-13	3.80E-06	3.12E-13	-	1.36E+09	1.97E+03	8.82E-01	2.81E+08	1.93E+12	2.86E+03	2.86E+03	1.27E-10
Tl-194	F	5.11E-15	3.25E-06	1.48E-14	-	1.36E+09	1.10E+04	8.86E-01	3.31E+10	6.52E+14	1.87E+04	1.87E+04	6.36E-10
Tl-194m	F	2.50E-14	1.01E-05	6.36E-14	-	1.36E+09	1.11E+04	9.27E-01	7.76E+09	1.34E+14	5.77E+03	5.77E+03	1.96E-10
Tl-195	F	2.08E-14	6.03E-06	5.00E-14	-	1.36E+09	5.23E+03	9.44E-01	4.65E+09	7.60E+13	4.47E+03	4.47E+03	3.23E-10
Tl-197	F	2.39E-14	1.65E-06	4.51E-14	-	1.36E+09	2.14E+03	9.34E-01	2.11E+09	2.70E+13	6.75E+03	6.75E+03	1.21E-09
Tl-198	F	7.92E-14	9.67E-06	1.61E-13	-	1.36E+09	1.15E+03	9.48E-01	3.16E+08	4.37E+12	6.08E+02	6.08E+02	2.04E-10
Tl-198m	F	4.92E-14	5.05E-06	1.01E-13	-	1.36E+09	3.25E+03	9.81E-01	1.43E+09	1.99E+13	3.19E+03	3.19E+03	3.77E-10
Tl-199	F	2.89E-14	8.56E-07	5.33E-14	-	1.36E+09	8.18E+02	9.31E-01	6.82E+08	8.55E+12	5.00E+03	5.00E+03	2.36E-09
Tl-200	F	2.52E-13	5.93E-06	4.55E-13	-	1.36E+09	2.33E+02	9.52E-01	2.27E+07	2.79E+11	2.01E+02	2.01E+02	3.35E-10
Tl-201	F	1.49E-13	1.88E-07	2.23E-13	-	1.36E+09	8.31E+01	9.44E-01	1.66E+07	1.68E+11	2.28E+03	2.28E+03	1.07E-08
Tl-202	F	6.14E-13	1.83E-06	1.05E-12	-	1.36E+09	2.07E+01	9.06E-01	8.75E+05	1.02E+10	6.07E+01	6.07E+01	1.15E-09

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Tl-204	F	2.45E-12	2.76E-09	3.16E-12	-	1.36E+09	1.83E-01	9.63E-01	2.61E+03	2.28E+07	3.39E+02	3.00E+02	6.48E-07
Tl-206	-	-	6.05E-09	-	-	1.36E+09	8.67E+04	9.34E-01	-	-	7.47E+07	7.47E+07	3.44E-07
Tl-207	-	-	1.52E-08	-	-	1.36E+09	7.64E+04	8.55E-01	-	-	2.86E+07	2.86E+07	1.50E-07
Tl-208	-	-	1.76E-05	-	-	1.36E+09	1.19E+05	8.79E-01	-	-	3.73E+04	3.73E+04	1.27E-10
Tl-209	-	-	9.83E-06	-	-	1.36E+09	1.66E+05	8.65E-01	-	-	9.48E+04	9.48E+04	2.32E-10
Tm-162	M	2.72E-14	8.69E-06	4.29E-14	-	1.36E+09	1.68E+04	8.83E-01	1.74E+10	1.86E+14	1.06E+04	1.06E+04	1.99E-10
Tm-166	M	5.14E-13	8.98E-06	5.85E-13	-	1.36E+09	7.88E+02	9.12E-01	5.99E+07	4.63E+11	4.68E+02	4.68E+02	1.91E-10
Tm-167	M	4.37E-12	3.97E-07	1.44E-12	-	1.36E+09	2.74E+01	9.28E-01	8.45E+05	1.89E+09	3.62E+02	3.61E+02	4.28E-09
Tm-170	M	2.43E-11	1.01E-08	3.61E-12	-	1.36E+09	1.97E+00	9.44E-01	2.42E+04	2.45E+07	1.00E+03	9.64E+02	1.62E-07
Tm-171	M	3.33E-12	6.97E-10	2.85E-13	-	1.36E+09	3.61E-01	9.53E-01	5.63E+04	3.27E+07	2.64E+03	2.53E+03	2.32E-06
Tm-172	M	5.62E-12	2.35E-06	4.44E-12	-	1.36E+09	9.55E+01	8.98E-01	9.55E+05	5.13E+09	2.20E+02	2.20E+02	7.69E-10
Tm-173	M	7.73E-13	1.62E-06	7.44E-13	-	1.36E+09	7.37E+02	8.95E-01	4.40E+07	2.88E+11	2.47E+03	2.47E+03	1.13E-09
Tm-175	M	3.26E-14	4.78E-06	3.85E-14	-	1.36E+09	2.40E+04	8.92E-01	2.77E+10	2.22E+14	2.74E+04	2.74E+04	3.88E-10
U-230	M	4.55E-08	3.07E-09	1.04E-10	-	1.36E+09	1.22E+01	9.87E-01	5.20E+03	8.07E+04	1.95E+04	3.91E+03	1.43E-07
U-231	M	1.80E-12	1.60E-07	7.40E-13	-	1.36E+09	6.02E+01	9.61E-01	3.62E+06	1.01E+10	1.91E+03	1.91E+03	1.42E-08
U-232	M	1.95E-08	5.98E-10	2.45E-10	-	1.36E+09	9.63E-03	9.97E-01	8.16E+00	6.97E+02	3.67E+02	7.90E+00	3.69E-07
U-233	M	1.16E-08	9.82E-10	5.22E-11	-	1.36E+09	4.37E-06	9.98E-01	3.41E+01	1.04E+03	1.99E+02	2.83E+01	2.92E-03
U-234	M	1.14E-08	2.52E-10	5.11E-11	-	1.36E+09	2.83E-06	9.98E-01	3.48E+01	1.06E+03	7.74E+02	3.23E+01	5.17E-03
U-235	M	1.01E-08	5.19E-07	4.92E-11	-	1.36E+09	9.85E-10	9.60E-01	3.61E+01	1.20E+03	3.91E-01	3.86E-01	1.79E-01
U-235+D	M	1.01E-08	-	5.03E-11	-	1.36E+09	9.85E-10	9.60E-01	3.53E+01	1.20E+03	-	3.43E+01	1.59E+01
U-236	M	1.05E-08	1.25E-10	4.85E-11	-	1.36E+09	2.96E-08	9.99E-01	3.67E+01	1.15E+03	1.56E+03	3.47E+01	5.37E-01
U-237	M	6.44E-12	3.76E-07	2.05E-12	-	1.36E+09	3.75E+01	9.53E-01	8.12E+05	1.76E+09	5.09E+02	5.09E+02	6.24E-09
U-238	M	9.32E-09	4.99E-11	4.66E-11	-	1.36E+09	1.55E-10	1.00E+00	3.81E+01	1.30E+03	3.90E+03	3.67E+01	1.09E+02
U-238+D	M	9.35E-09	1.14E-07	5.62E-11	-	1.36E+09	1.55E-10	9.79E-01	3.16E+01	1.29E+03	1.74E+00	1.65E+00	4.92E+00
U-239	M	5.70E-14	1.21E-07	4.40E-14	-	1.36E+09	1.55E+04	9.58E-01	1.56E+10	8.20E+13	6.50E+05	6.50E+05	1.95E-08
U-240	M	2.96E-12	7.34E-10	2.96E-12	-	1.36E+09	4.31E+02	9.98E-01	6.46E+06	4.39E+10	2.86E+06	1.98E+06	2.14E-06
V-47	M	5.96E-14	4.36E-06	8.88E-14	-	1.36E+09	1.12E+04	8.82E-01	5.59E+09	5.66E+13	1.41E+04	1.41E+04	1.15E-10
V-48	M	9.29E-12	1.40E-05	4.11E-12	-	1.36E+09	1.56E+01	8.44E-01	1.68E+05	5.06E+08	6.42E+00	6.42E+00	3.84E-11
V-49	M	1.47E-13	0.00E+00	5.00E-14	-	1.36E+09	7.67E-01	0.00E+00	6.81E+05	1.58E+09	-	6.81E+05	8.45E-05
W-176	F	1.24E-13	3.20E-07	2.13E-13	-	1.36E+09	2.64E+03	9.42E-01	5.51E+08	6.43E+12	4.26E+04	4.26E+04	5.51E-09
W-177	F	5.99E-14	3.63E-06	1.13E-13	-	1.36E+09	2.70E+03	9.27E-01	1.06E+09	1.36E+13	3.90E+03	3.90E+03	4.97E-10
W-178	F	3.85E-13	1.59E-08	5.37E-13	-	1.36E+09	1.17E+01	9.71E-01	9.65E+05	9.15E+09	3.67E+03	3.66E+03	1.08E-07
W-178+D	F	-	3.45E-07	-	-	1.36E+09	1.17E+01	9.15E-01	-	-	1.80E+02	1.80E+02	5.32E-09
W-179	F	1.83E-15	6.02E-08	5.00E-15	-	1.36E+09	9.71E+03	9.67E-01	8.63E+10	1.60E+15	8.12E+05	8.12E+05	2.90E-08
W-181	F	1.35E-13	4.86E-08	1.83E-13	-	1.36E+09	2.09E+00	9.56E-01	5.07E+05	4.67E+09	2.19E+02	2.19E+02	3.68E-08
W-185	F	9.36E-13	2.92E-10	1.21E-12	-	1.36E+09	3.37E+00	9.45E-01	1.24E+05	1.09E+09	5.94E+04	4.01E+04	4.28E-06
W-187	F	1.11E-12	2.04E-06	1.59E-12	-	1.36E+09	2.54E+02	9.40E-01	7.10E+06	6.91E+10	6.45E+02	6.45E+02	9.21E-10
W-188	F	4.63E-12	7.02E-09	5.77E-12	-	1.36E+09	3.64E+00	9.11E-01	2.81E+04	2.38E+08	2.77E+03	2.52E+03	2.53E-07
Xe-120	-	-	1.71E-06	-	-	1.36E+09	9.11E+03	9.51E-01	-	-	2.73E+04	2.73E+04	6.97E-10
Xe-121	-	-	8.74E-06	-	-	1.36E+09	9.08E+03	9.02E-01	-	-	5.61E+03	5.61E+03	1.45E-10
Xe-122	-	-	1.83E-07	-	-	1.36E+09	3.02E+02	9.06E-01	-	-	8.87E+03	8.87E+03	6.95E-09
Xe-123	-	-	2.72E-06	-	-	1.36E+09	2.92E+03	9.03E-01	-	-	5.78E+03	5.78E+03	4.73E-10
Xe-125	-	-	9.38E-07	-	-	1.36E+09	3.57E+02	9.06E-01	-	-	2.04E+03	2.04E+03	1.39E-09
Xe-127	-	-	9.52E-07	-	-	1.36E+09	6.95E+00	9.33E-01	-	-	3.81E+01	3.81E+01	1.35E-09
Xe-129m	-	-	4.25E-08	-	-	1.36E+09	3.16E+01	9.79E-01	-	-	3.70E+03	3.70E+03	2.93E-08
Xe-131m	-	-	1.41E-08	-	-	1.36E+09	2.13E+01	9.81E-01	-	-	7.48E+03	7.48E+03	8.94E-08
Xe-133	-	-	6.62E-08	-	-	1.36E+09	4.82E+01	9.64E-01	-	-	3.68E+03	3.68E+03	1.97E-08
Xe-133m	-	-	9.25E-08	-	-	1.36E+09	1.16E+02	9.73E-01	-	-	6.25E+03	6.25E+03	1.40E-08
Xe-135	-	-	9.71E-07	-	-	1.36E+09	6.68E+02	9.07E-01	-	-	3.69E+03	3.69E+03	1.45E-09

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Xe-135m	-	-	1.86E-06	-	-	1.36E+09	2.38E+04	8.84E-01	-	-	7.05E+04	7.05E+04	7.75E-10
Xe-138	-	-	5.62E-06	-	-	1.36E+09	2.57E+04	8.93E-01	-	-	2.49E+04	2.49E+04	2.60E-10
Y-86	S	1.58E-12	1.73E-05	2.03E-12	-	1.36E+09	4.12E+02	8.98E-01	9.02E+06	7.87E+10	1.29E+02	1.29E+02	5.23E-11
Y-86m	S	9.29E-14	8.35E-07	1.18E-13	-	1.36E+09	7.59E+03	9.19E-01	2.86E+09	2.47E+13	4.81E+04	4.81E+04	1.06E-09
Y-87	S	1.49E-12	1.94E-06	1.21E-12	-	1.36E+09	7.56E+01	9.69E-01	2.78E+06	1.53E+10	1.96E+02	1.96E+02	4.37E-10
Y-88	S	1.70E-11	1.37E-05	2.40E-12	-	1.36E+09	2.37E+00	8.81E-01	4.39E+04	4.21E+07	9.56E-01	9.56E-01	6.88E-11
Y-90	S	8.40E-12	1.92E-08	7.29E-12	-	1.36E+09	9.49E+01	1.00E+00	5.78E+05	3.41E+09	2.40E+04	2.31E+04	4.25E-08
Y-90m	S	4.81E-13	2.58E-06	4.40E-13	-	1.36E+09	1.90E+03	9.12E-01	1.92E+08	1.20E+12	3.94E+03	3.94E+03	3.61E-10
Y-91	S	3.36E-11	2.51E-08	6.48E-12	-	1.36E+09	4.32E+00	8.37E-01	2.97E+04	3.89E+07	1.00E+03	9.69E+02	3.96E-08
Y-91m	S	3.01E-14	2.34E-06	2.15E-14	-	1.36E+09	7.33E+03	8.92E-01	1.51E+10	7.35E+13	1.71E+04	1.71E+04	4.12E-10
Y-92	S	9.32E-13	1.26E-06	1.10E-12	-	1.36E+09	1.71E+03	8.43E-01	6.93E+07	5.56E+11	7.86E+03	7.86E+03	8.18E-10
Y-93	S	2.64E-12	4.60E-07	2.96E-12	-	1.36E+09	6.01E+02	8.14E-01	9.02E+06	6.88E+10	7.81E+03	7.81E+03	2.34E-09
Y-94	S	5.51E-14	5.45E-06	1.06E-13	-	1.36E+09	1.91E+04	8.30E-01	8.00E+09	1.05E+14	2.05E+04	2.05E+04	1.96E-10
Y-95	S	2.92E-14	4.80E-06	5.85E-14	-	1.36E+09	3.40E+04	8.29E-01	2.59E+10	3.52E+14	4.16E+04	4.16E+04	2.25E-10
Yb-162	S	3.00E-14	3.26E-07	3.62E-14	-	1.36E+09	1.93E+04	9.37E-01	2.37E+10	1.94E+14	3.07E+05	3.07E+05	5.01E-09
Yb-166	S	2.89E-12	9.46E-08	2.08E-12	-	1.36E+09	1.07E+02	9.52E-01	2.29E+06	1.12E+10	5.79E+03	5.77E+03	1.74E-08
Yb-167	S	1.71E-14	6.21E-07	1.04E-14	-	1.36E+09	2.08E+04	9.28E-01	8.89E+10	3.68E+14	1.76E+05	1.76E+05	2.74E-09
Yb-169	S	1.08E-11	7.76E-07	1.73E-12	-	1.36E+09	7.90E+00	9.21E-01	2.03E+05	2.21E+08	5.38E+01	5.38E+01	2.23E-09
Yb-175	S	2.95E-12	1.54E-07	1.17E-12	-	1.36E+09	6.04E+01	9.01E-01	2.29E+06	6.18E+09	2.12E+03	2.12E+03	1.19E-08
Yb-177	S	2.29E-13	8.35E-07	1.69E-13	-	1.36E+09	3.20E+03	8.82E-01	8.40E+08	4.21E+12	2.11E+04	2.11E+04	2.27E-09
Yb-178	S	2.38E-13	1.44E-07	1.92E-13	-	1.36E+09	4.92E+03	8.98E-01	1.14E+09	6.25E+12	1.85E+05	1.85E+05	1.30E-08
Zn-62	M	2.65E-12	1.87E-06	2.25E-12	-	1.36E+09	6.56E+02	8.79E-01	1.29E+07	7.47E+10	1.94E+03	1.94E+03	3.56E-10
Zn-63	M	7.55E-14	4.87E-06	1.13E-13	-	1.36E+09	9.56E+03	8.62E-01	3.76E+09	3.82E+13	1.11E+04	1.11E+04	1.42E-10
Zn-65	M	5.81E-12	2.81E-06	8.95E-12	-	1.36E+09	1.04E+00	8.43E-01	5.15E+03	5.39E+07	2.13E+00	2.13E+00	2.59E-10
Zn-69	M	6.11E-14	1.67E-09	4.51E-14	-	1.36E+09	6.39E+03	8.92E-01	6.30E+09	3.16E+13	2.09E+07	2.08E+07	4.36E-07
Zn-69m	M	1.28E-12	1.78E-06	8.33E-13	-	1.36E+09	4.41E+02	8.89E-01	2.35E+07	1.04E+11	1.36E+03	1.36E+03	4.12E-10
Zn-71m	M	5.33E-13	6.84E-06	4.92E-13	-	1.36E+09	1.55E+03	8.68E-01	1.40E+08	8.78E+11	1.27E+03	1.27E+03	1.13E-10
Zn-72	M	5.48E-12	4.68E-07	3.34E-12	-	1.36E+09	1.31E+02	9.43E-01	1.74E+06	7.20E+09	1.44E+03	1.44E+03	1.54E-09
Zr-86	M	1.56E-12	1.04E-06	1.86E-12	-	1.36E+09	3.68E+02	9.82E-01	8.79E+06	7.12E+10	1.75E+03	1.75E+03	7.95E-10
Zr-88	M	8.95E-12	1.65E-06	9.36E-13	-	1.36E+09	3.03E+00	9.70E-01	1.44E+05	1.02E+08	9.22E+00	9.22E+00	5.19E-10
Zr-89	M	1.92E-12	5.38E-06	1.72E-12	-	1.36E+09	7.74E+01	9.32E-01	2.00E+06	1.22E+10	7.51E+01	7.51E+01	1.68E-10
Zr-93	M	7.29E-12	0.00E+00	9.81E-13	-	1.36E+09	4.53E-07	0.00E+00	1.81E+03	1.66E+06	-	1.81E+03	7.21E-01
Zr-95	M	1.65E-11	3.40E-06	2.16E-12	-	1.36E+09	3.95E+00	8.65E-01	8.13E+04	7.24E+07	6.54E+00	6.54E+00	3.05E-10
Zr-97	M	4.81E-12	8.62E-07	5.25E-12	-	1.36E+09	3.59E+02	8.63E-01	3.04E+06	2.26E+10	2.35E+03	2.35E+03	1.23E-09

A.2 Residential Soil Screening Levels for Radionuclides

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Wet Soil-to-plant transfer factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Produce Ingestion PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Ac-223	-	-	1.55E-08	-	-	-	1.36E+09	1.66E+05	9.86E-01	2.50E-03	-	-	3.26E+07	-	3.26E+07	8.52E-08
Ac-223+D	-	-	2.34E-07	-	-	-	1.36E+09	1.66E+05	9.07E-01	2.50E-03	-	-	2.35E+06	-	2.35E+06	6.13E-09
Ac-224	S	4.07E-10	6.06E-07	8.03E-12	1.53E-11	-	1.36E+09	2.09E+03	1.00E+00	2.50E-03	3.26E+06	1.11E+09	1.04E+04	1.64E+07	1.04E+04	2.15E-09
Ac-225	S	2.86E-08	4.50E-08	2.71E-10	5.18E-10	-	1.36E+09	2.53E+01	9.78E-01	2.50E-03	1.16E+03	1.91E+05	1.73E+03	5.86E+03	6.20E+02	1.07E-08
Ac-225+D	S	-	9.36E-07	-	-	-	1.36E+09	2.53E+01	9.63E-01	2.50E-03	-	-	8.44E+01	-	8.44E+01	1.46E-09
Ac-226	S	4.33E-09	4.46E-07	1.01E-10	2.00E-10	-	1.36E+09	2.09E+02	1.00E+00	2.50E-03	2.49E+04	1.04E+07	1.41E+03	1.30E+05	1.32E+03	2.77E-09
Ac-227	S	1.49E-07	3.48E-10	2.45E-10	3.81E-10	-	1.36E+09	3.18E-02	1.00E+00	2.50E-03	3.23E+00	7.49E+01	4.47E+02	1.33E+01	2.50E+00	3.46E-08
Ac-228	S	4.92E-11	4.53E-06	2.89E-12	5.55E-12	-	1.36E+09	9.90E+02	9.69E-01	2.50E-03	4.25E+06	4.34E+09	6.79E+02	2.15E+07	6.79E+02	3.03E-10
Ag-102	M	2.56E-14	1.60E-05	9.95E-14	1.56E-13	-	1.36E+09	2.82E+04	8.33E-01	1.50E-01	4.31E+09	2.38E+14	6.37E+03	2.97E+08	6.37E+03	4.47E-11
Ag-103	M	6.07E-14	3.33E-06	1.69E-13	2.96E-13	-	1.36E+09	5.54E+03	9.38E-01	1.50E-01	4.46E+08	1.97E+13	5.34E+03	3.43E+07	5.34E+03	1.92E-10
Ag-104	M	6.25E-14	1.25E-05	2.29E-13	3.77E-13	-	1.36E+09	5.26E+03	8.67E-01	1.50E-01	3.32E+08	1.82E+13	1.46E+03	2.41E+07	1.46E+03	5.60E-11
Ag-104m	M	4.92E-14	5.50E-06	1.68E-13	2.81E-13	-	1.36E+09	1.09E+04	8.56E-01	1.50E-01	9.21E+08	4.77E+13	6.95E+03	6.78E+07	6.95E+03	1.29E-10
Ag-105	M	2.83E-12	2.15E-06	2.49E-12	4.40E-12	-	1.36E+09	6.17E+00	9.05E-01	1.50E-01	3.34E+04	4.70E+08	9.54E+00	2.59E+03	9.50E+00	3.14E-10
Ag-106	M	2.72E-14	3.08E-06	8.21E-14	1.34E-13	-	1.36E+09	1.52E+04	9.16E-01	1.50E-01	2.70E+09	1.21E+14	1.62E+04	1.94E+08	1.62E+04	2.19E-10
Ag-106m	M	3.54E-12	1.31E-05	6.73E-12	1.14E-11	-	1.36E+09	3.01E+01	8.81E-01	1.50E-01	6.28E+04	1.83E+09	7.84E+00	4.68E+03	7.83E+00	5.35E-11
Ag-108	-	-	8.56E-08	-	-	-	1.36E+09	1.54E+05	8.78E-01	1.50E-01	-	-	6.15E+06	-	6.15E+06	8.39E-09
Ag-108m	M	2.67E-11	7.18E-06	1.12E-11	1.92E-11	-	1.36E+09	5.46E-03	8.80E-01	1.50E-01	4.48E+01	2.92E+05	1.72E-02	3.38E+00	1.71E-02	6.57E-10
Ag-109m	-	-	7.66E-09	-	-	-	1.36E+09	5.52E+05	9.95E-01	1.50E-01	-	-	2.18E+08	-	2.18E+08	8.35E-08
Ag-110	-	-	1.69E-07	-	-	-	1.36E+09	8.88E+05	8.70E-01	1.50E-01	-	-	1.82E+07	-	1.82E+07	4.37E-09
Ag-110m	M	2.83E-11	1.30E-05	1.37E-11	2.37E-11	-	1.36E+09	1.01E+00	9.18E-01	1.50E-01	1.02E+03	7.72E+06	2.55E-01	7.74E+01	2.54E-01	5.36E-11
Ag-111	M	6.66E-12	1.09E-07	1.21E-11	2.37E-11	-	1.36E+09	3.40E+01	9.02E-01	1.50E-01	3.41E+04	1.10E+09	1.04E+03	2.94E+03	7.51E+02	4.76E-09
Ag-112	M	7.25E-13	3.24E-06	2.90E-12	5.59E-12	-	1.36E+09	1.95E+03	8.71E-01	1.50E-01	8.29E+06	5.79E+11	2.07E+03	7.03E+05	2.07E+03	2.31E-10
Ag-115	M	6.81E-14	3.45E-06	1.98E-13	3.46E-13	-	1.36E+09	1.82E+04	8.78E-01	1.50E-01	1.25E+09	5.77E+13	1.81E+04	9.63E+07	1.81E+04	2.22E-10
Al-26	M	6.92E-11	1.33E-05	2.49E-11	4.70E-11	-	1.36E+09	9.68E-07	8.45E-01	4.00E-03	1.69E+01	1.04E+05	8.92E-03	5.26E+01	8.92E-03	4.65E-07
Al-28	-	-	9.32E-06	-	-	-	1.36E+09	1.63E+05	8.14E-01	4.00E-03	-	-	6.45E+04	-	6.45E+04	2.15E-11
Am-237	M	5.77E-14	1.35E-06	7.18E-14	1.24E-13	-	1.36E+09	4.99E+03	9.45E-01	1.00E-03	9.58E+08	1.87E+13	1.18E+04	1.09E+10	1.18E+04	1.08E-09
Am-238	M	9.51E-14	4.02E-06	1.35E-13	2.28E-13	-	1.36E+09	3.72E+03	9.50E-01	1.00E-03	3.88E+08	8.43E+12	2.93E+03	4.32E+09	2.93E+03	3.64E-10
Am-239	M	8.40E-13	6.91E-07	2.01E-12	3.89E-12	-	1.36E+09	5.10E+02	9.99E-01	1.00E-03	3.12E+06	1.31E+11	2.22E+03	3.99E+07	2.22E+03	2.02E-09
Am-240	M	1.41E-12	4.70E-06	3.70E-12	6.81E-12	-	1.36E+09	1.20E+02	9.66E-01	1.00E-03	4.18E+05	1.83E+10	7.92E+01	5.07E+06	7.92E+01	3.09E-10
Am-241	M	2.81E-08	2.76E-08	1.34E-10	2.17E-10	-	1.36E+09	1.60E-03	9.65E-01	1.00E-03	3.75E+00	2.62E+02	3.86E+00	4.00E+01	1.80E+00	5.25E-07
Am-242	M	5.03E-11	3.48E-08	2.62E-12	5.14E-12	-	1.36E+09	3.79E+02	9.98E-01	1.00E-03	1.76E+06	1.63E+09	3.28E+04	2.27E+07	3.22E+04	3.99E-08
Am-242m	M	1.56E-08	1.05E-09	8.77E-11	1.29E-10	-	1.36E+09	4.56E-03	9.99E-01	1.00E-03	6.58E+00	4.93E+02	1.02E+02	6.39E+01	5.57E+00	5.33E-07
Am-242m+D	M	2.81E-08	4.82E-08	1.36E-10	2.21E-10	-	1.36E+09	4.56E-03	9.98E-01	1.00E-03	3.84E+00	2.74E+02	2.23E+00	4.12E+01	1.36E+00	1.30E-07
Am-243	M	2.70E-08	9.47E-08	1.34E-10	2.17E-10	-	1.36E+09	9.39E-05	9.54E-01	1.00E-03	3.66E+00	2.67E+02	1.11E+00	3.91E+01	8.32E-01	4.18E-06
Am-243+D	M	2.70E-08	6.36E-07	1.42E-10	2.32E-10	-	1.36E+09	9.39E-05	9.58E-01	1.00E-03	3.43E+00	2.67E+02	1.65E-01	3.69E+01	1.57E-01	7.86E-07
Am-244	M	3.09E-12	3.59E-06	3.66E-12	7.03E-12	-	1.36E+09	6.01E+02	8.77E-01	1.00E-03	2.04E+06	4.20E+10	5.74E+02	2.58E+07	5.74E+02	4.52E-10
Am-244m	M	1.02E-13	5.09E-09	7.10E-14	1.18E-13	-	1.36E+09	1.40E+04	9.99E-01	1.00E-03	2.83E+09	2.96E+13	8.29E+06	3.10E+10	8.26E+06	2.79E-07
Am-245	M	1.56E-13	1.04E-07	3.22E-13	6.11E-13	-	1.36E+09	2.96E+03	9.26E-01	1.00E-03	1.15E+08	4.10E+12	9.25E+04	1.44E+09	9.24E+04	1.48E-08
Am-246	M	1.31E-13	2.93E-06	1.73E-13	2.93E-13	-	1.36E+09	9.34E+03	9.33E-01	1.00E-03	7.59E+08	1.54E+13	1.03E+04	8.48E+09	1.03E+04	5.25E-10
Am-246m	M	3.96E-14	4.84E-06	9.10E-14	1.48E-13	-	1.36E+09	1.46E+04	9.79E-01	1.00E-03	2.34E+09	7.94E+13	9.25E+03	2.51E+10	9.25E+03	3.03E-10
Ar-37	-	-	0.00E+00	-	-	-	1.36E+09	7.22E+00	0.00E+00	0.00E+00	-	-	-	-	-	-
Ar-39	-	-	5.95E-10	-	-	-	1.36E+09	2.58E-03	9.27E-01	0.00E+00	-	-	1.89E+02	-	1.89E+02	5.55E-06
Ar-41	-	-	6.39E-06	-	-	-	1.36E+09	3.32E+03	8.33E-01	0.00E+00	-	-	1.88E+03	-	1.88E+03	4.50E-11
As-69	M	4.29E-14	4.43E-06	1.46E-13	2.39E-13	-	1.36E+09	2.40E+04	8.83E-01	8.00E-02	2.39E+09	1.21E+14	1.84E+04	3.22E+08	1.84E+04	1.03E-10
As-69+D	M	-	8.44E-06	-	-	-	1.36E+09	2.40E+04	9.25E-01	8.00E-02	-	-	9.24E+03	-	9.24E+03	5.16E-11
As-70	M	1.37E-13	1.96E-05	4.48E-13	7.40E-13	-	1.36E+09	6.92E+03	8.70E-01	8.00E-02	2.23E+08	1.09E+13	1.22E+03	3.03E+07	1.22E+03	2.40E-11
As-71	M	1.52E-12	2.37E-06	3.29E-12	6.07E-12	-	1.36E+09	9.37E+01	8.84E-01	8.00E-02	3.67E+05	1.33E+10	1.35E+02	5.59E+04	1.34E+02	1.97E-10
As-72	M	4.29E-12	8.21E-06	1.48E-11	2.79E-11	-	1.36E+09	2.33E+02	8.63E-01	8.00E-02	1.99E+05	1.17E+10	9.92E+01	3.10E+04	9.88E+01	5.91E-11
As-73	M	3.88E-12	5.78E-09	2.28E-12	4.40E-12	-	1.36E+09	3.15E+00	9.94E-01	8.00E-02	1.70E+04	1.75E+08	1.65E+03	2.71E+03	9.68E+02	4.35E-08
As-74	M	8.44E-12	3.35E-06	9.69E-12	1.82E-11	-	1.36E+09	1.42E+01	8.77E-01	8.00E-02	1.86E+04	3.64E+08	1.46E+01	2.89E+03	1.45E+01	1.46E-10
As-76	M	4.14E-12	2.01E-06	1.42E-11	2.70E-11	-	1.36E+09	2.31E+02	8.75E-01	8.00E-02	2.03E+05	1.20E+10	3.95E+02	3.19E+04	3.89E+02	2.49E-10
As-77	M	1.76E-12	3.59E-08	3.67E-12	7.03E-12	-	1.36E+09	1.56E+02	9.00E-01	8.00E-02	5.30E+05	1.92E+10	1.46E+04	8.37E+04	1.21E+04	1.16E-08
As-78	M	2.69E-13	6.11E-06	9.03E-13	1.61E-12	-	1.36E+09	4.02E+03	8.58E-01	8.00E-02	5.94E+07	3.22E+12	2.30E+03	8.73E+06	2.30E+03	8.68E-11
At-207	M	7.77E-12	6.11E-06	9.51E-13	1.66E-12	-	1.36E+09	3.37E+03	9.34E-01	-	4.84E+07	9.37E+10	1.78E+03	-	1.78E+03	2.12E-10
At-211	M	3.58E-10	7.94E-08	4.63E-11	8.21E-11	-	1.36E+09	8.42E+02	1.00E+00	-	2.44E+05	5.07E+08	3.19E+04	-	2.82E+04	1.37E-08
At-211+D	M	-	1.00E-07	-	-	-	1.36E+09	8.42E+02	9.85E-01	-	-	-	2.57E+04	-	2.57E+04	1.25E-08
At-215	-	-	8.09E-10	-	-	-	1.36E+09	2.19E+11	8.94E-01	-	-	-	9.09E+14	-	9.09E+14	1.74E-06
At-216	-	-	3.08E-09	-	-	-	1.36E+09	7.28E+10	9.54E-01	-	-	-	7.46E+13	-	7.46E+13	4.29E-07
At-217	-	-	1.32E-09	-	-	-	1.36E+09	6.77E+08	8.89E-01	-	-	-	1.73E+12	-	1.73E+12	1.08E-06
At-218	-	-	3.57E-09	-	-	-	1.36E+09	1.09E+07	9.95E-01	-	-	-	9.26E+09	-	9.26E+09	3.58E-07

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Wet Soil-to-plant transfer factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Produce Ingestion PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Au-193	S	4.55E-13	4.30E-07	1.07E-12	2.05E-12	-	1.36E+09	3.44E+02	9.50E-01	1.00E-01	3.99E+06	1.63E+11	2.53E+03	5.05E+05	2.52E+03	2.74E-09
Au-194	S	7.92E-13	4.93E-06	2.36E-12	4.22E-12	-	1.36E+09	1.54E+02	9.55E-01	1.00E-01	8.67E+05	4.19E+10	9.82E+01	1.02E+05	9.81E+01	2.40E-10
Au-195	S	6.48E-12	1.38E-07	2.19E-12	4.22E-12	-	1.36E+09	1.38E+00	9.60E-01	1.00E-01	7.80E+03	4.60E+07	3.14E+01	9.91E+02	3.03E+01	8.30E-09
Au-195m	-	-	7.37E-07	-	-	-	1.36E+09	7.17E+05	9.17E-01	1.00E-01	-	-	3.19E+06	-	3.19E+06	1.68E-09
Au-198	S	4.00E-12	1.71E-06	9.18E-12	1.78E-11	-	1.36E+09	9.38E+01	8.92E-01	1.00E-01	1.25E+05	5.06E+09	1.85E+02	1.61E+04	1.83E+02	7.48E-10
Au-198m	S	7.77E-12	1.89E-06	1.08E-11	2.09E-11	-	1.36E+09	1.10E+02	9.22E-01	1.00E-01	1.25E+05	3.05E+09	1.90E+02	1.60E+04	1.87E+02	6.55E-10
Au-199	S	3.12E-12	2.79E-07	4.07E-12	7.92E-12	-	1.36E+09	8.06E+01	9.30E-01	1.00E-01	2.42E+05	5.57E+09	9.34E+02	3.11E+04	9.04E+02	4.33E-09
Au-200	S	8.55E-14	1.30E-06	2.20E-13	3.85E-13	-	1.36E+09	7.53E+03	8.97E-01	1.00E-01	4.65E+08	1.90E+13	1.94E+04	5.37E+07	1.94E+04	1.00E-09
Au-200m	S	2.81E-12	9.04E-06	7.88E-12	1.48E-11	-	1.36E+09	3.25E+02	9.78E-01	1.00E-01	5.22E+05	2.49E+10	1.10E+02	6.47E+04	1.10E+02	1.32E-10
Au-201	S	3.30E-14	2.29E-07	6.03E-14	1.01E-13	-	1.36E+09	1.38E+04	9.02E-01	1.00E-01	3.25E+09	9.02E+13	2.01E+05	3.59E+08	2.01E+05	5.68E-09
Ba-126	M	3.49E-13	5.83E-07	1.22E-12	2.24E-12	-	1.36E+09	3.77E+03	9.40E-01	5.00E-03	4.01E+07	2.33E+12	2.07E+04	9.72E+07	2.07E+04	1.34E-09
Ba-128	M	7.22E-12	2.10E-07	2.23E-11	4.33E-11	-	1.36E+09	1.04E+02	9.66E-01	5.00E-03	5.72E+04	3.11E+09	1.54E+03	1.47E+05	1.49E+03	3.55E-09
Ba-131	M	2.91E-12	1.78E-06	2.87E-12	5.25E-12	-	1.36E+09	2.14E+01	9.05E-01	5.00E-03	9.72E+04	1.59E+09	4.00E+01	2.35E+05	4.00E+01	4.75E-10
Ba-131m	M	1.69E-14	1.67E-07	1.29E-14	2.11E-14	-	1.36E+09	2.49E+04	9.54E-01	5.00E-03	2.82E+10	3.19E+14	4.71E+05	6.07E+10	4.71E+05	4.80E-09
Ba-133	M	1.16E-11	1.44E-06	9.44E-12	1.39E-11	-	1.36E+09	6.45E-02	9.12E-01	5.00E-03	1.29E+02	1.40E+06	1.73E-01	2.51E+02	1.72E-01	6.90E-10
Ba-133m	M	2.04E-12	1.96E-07	4.66E-12	9.07E-12	-	1.36E+09	1.56E+02	9.62E-01	5.00E-03	4.10E+05	1.65E+10	2.49E+03	1.05E+06	2.47E+03	4.08E-09
Ba-135m	M	1.61E-12	1.71E-07	3.74E-12	7.29E-12	-	1.36E+09	2.12E+02	9.61E-01	5.00E-03	6.91E+05	2.83E+10	3.87E+03	1.78E+06	3.84E+03	4.76E-09
Ba-137m	-	-	2.69E-06	-	-	-	1.36E+09	1.43E+05	8.77E-01	5.00E-03	-	-	1.82E+05	-	1.82E+05	3.39E-10
Ba-139	M	1.79E-13	1.65E-07	5.33E-13	9.73E-13	-	1.36E+09	4.40E+03	9.09E-01	5.00E-03	1.08E+08	5.31E+12	8.84E+04	2.60E+08	8.83E+04	5.40E-09
Ba-140	M	2.03E-11	7.62E-07	2.17E-11	4.18E-11	-	1.36E+09	1.99E+01	8.88E-01	5.00E-03	1.13E+04	2.11E+08	8.83E+01	2.87E+04	8.73E+01	1.19E-09
Ba-141	M	9.69E-14	3.80E-06	3.07E-13	5.59E-13	-	1.36E+09	1.99E+04	8.94E-01	5.00E-03	8.49E+08	4.44E+13	1.77E+04	2.04E+09	1.77E+04	2.42E-10
Ba-142	M	4.55E-14	4.85E-06	1.31E-13	2.27E-13	-	1.36E+09	3.44E+04	9.05E-01	5.00E-03	3.60E+09	1.63E+14	2.36E+04	8.24E+09	2.36E+04	1.89E-10
Be-10	S	9.40E-11	7.43E-10	1.02E-11	2.02E-11	-	1.36E+09	4.33E-07	9.27E-01	4.00E-03	3.93E+01	7.65E+04	1.46E+02	1.28E+02	2.49E+01	1.12E-03
Be-7	S	2.13E-13	2.13E-07	1.20E-13	2.02E-13	-	1.36E+09	4.75E+00	8.86E-01	4.00E-03	5.59E+05	4.81E+09	7.57E+01	1.55E+06	7.56E+01	2.17E-10
Bi-200	M	7.55E-14	1.06E-05	2.13E-13	3.65E-13	-	1.36E+09	1.00E+04	9.24E-01	1.00E-01	6.53E+08	2.86E+13	3.07E+03	7.38E+07	3.07E+03	1.19E-10
Bi-201	M	1.90E-13	6.05E-06	6.03E-13	1.09E-12	-	1.36E+09	3.37E+03	8.67E-01	1.00E-01	7.37E+07	3.83E+12	1.93E+03	8.78E+06	1.93E+03	2.24E-10
Bi-202	M	1.12E-13	1.24E-05	3.69E-13	6.18E-13	-	1.36E+09	3.64E+03	9.51E-01	1.00E-01	1.40E+08	7.00E+12	9.28E+02	1.55E+07	9.27E+02	1.00E-10
Bi-203	M	8.21E-13	1.16E-05	2.73E-12	4.85E-12	-	1.36E+09	5.16E+02	9.51E-01	1.00E-01	2.53E+06	1.36E+11	1.41E+02	2.97E+05	1.41E+02	1.07E-10
Bi-205	M	3.24E-12	8.19E-06	4.66E-12	8.18E-12	-	1.36E+09	1.65E+01	9.62E-01	1.00E-01	4.81E+04	1.10E+09	6.31E+00	5.57E+03	6.30E+00	1.52E-10
Bi-206	M	5.85E-12	1.52E-05	1.10E-11	1.98E-11	-	1.36E+09	4.05E+01	9.40E-01	1.00E-01	4.87E+04	1.49E+09	8.53E+00	5.78E+03	8.52E+00	8.40E-11
Bi-207	M	2.10E-11	7.08E-06	8.14E-12	1.49E-11	-	1.36E+09	1.82E-02	8.65E-01	1.00E-01	6.92E+01	4.45E+05	2.13E-02	8.35E+00	2.12E-02	4.67E-10
Bi-210	M	3.17E-10	2.76E-09	1.30E-11	2.55E-11	-	1.36E+09	5.05E+01	9.27E-01	1.00E-01	4.71E+04	3.44E+07	5.94E+04	6.10E+03	4.95E+03	3.99E-08
Bi-210m	M	1.17E-08	1.01E-06	7.77E-11	1.45E-10	-	1.36E+09	2.31E-07	9.06E-01	1.00E-01	5.47E+00	6.15E+02	1.10E-01	6.74E-01	9.27E-02	1.63E-04
Bi-211	M	-	1.88E-07	-	-	-	1.36E+09	1.70E+05	9.03E-01	1.00E-01	-	-	3.02E+06	-	3.02E+06	7.26E-09
Bi-212	M	7.77E-11	8.88E-07	9.99E-13	1.78E-12	-	1.36E+09	6.02E+03	9.91E-01	1.00E-01	8.05E+07	1.67E+10	2.06E+04	9.46E+06	2.05E+04	1.40E-09
Bi-212+D	M	-	7.22E-06	-	-	-	1.36E+09	6.02E+03	8.96E-01	1.00E-01	-	-	2.80E+03	-	2.80E+03	1.91E-10
Bi-213	M	6.85E-11	5.65E-07	7.18E-13	1.28E-12	-	1.36E+09	7.98E+03	1.00E+00	1.00E-01	1.48E+08	2.51E+10	4.25E+04	1.75E+07	4.24E+04	2.20E-09
Bi-213+D	M	-	7.78E-07	-	-	-	1.36E+09	7.98E+03	9.68E-01	1.00E-01	-	-	3.19E+04	-	3.19E+04	1.65E-09
Bi-214	M	2.90E-11	7.49E-06	2.65E-13	4.33E-13	-	1.36E+09	1.83E+04	9.25E-01	1.00E-01	1.01E+09	1.36E+11	7.95E+03	1.08E+08	7.95E+03	1.80E-10
Bk-245	M	7.22E-12	7.09E-07	5.00E-12	9.73E-12	-	1.36E+09	5.12E+01	9.98E-01	-	1.25E+05	1.53E+09	2.18E+02	-	2.17E+02	2.02E-09
Bk-246	M	9.25E-13	4.25E-06	2.88E-12	5.25E-12	-	1.36E+09	1.38E+02	8.80E-01	-	6.27E+05	3.22E+10	1.11E+02	-	1.11E+02	3.84E-10
Bk-247	M	3.26E-08	3.10E-07	1.60E-10	2.49E-10	-	1.36E+09	5.02E-04	9.28E-01	-	3.21E+00	2.22E+02	3.51E-01	-	3.16E-01	3.02E-07
Bk-249	M	5.14E-11	2.63E-12	1.57E-12	2.95E-12	-	1.36E+09	7.90E-01	9.11E-01	-	6.38E+03	3.32E+06	9.93E+05	-	6.33E+03	3.87E-06
Bk-250	M	1.03E-12	4.23E-06	8.18E-13	1.54E-12	-	1.36E+09	1.88E+03	8.51E-01	-	2.91E+07	3.95E+11	1.57E+03	-	1.57E+03	4.05E-10
Br-74	M	6.44E-14	2.32E-05	2.05E-13	3.19E-13	-	1.36E+09	1.44E+04	8.48E-01	7.60E-01	1.07E+09	4.82E+13	2.20E+03	1.45E+07	2.20E+03	2.20E-11
Br-74m	M	1.15E-13	2.00E-05	3.36E-13	5.29E-13	-	1.36E+09	8.78E+03	8.67E-01	7.60E-01	3.95E+08	1.65E+13	1.52E+03	5.40E+06	1.52E+03	2.49E-11
Br-75	M	1.13E-13	5.21E-06	2.13E-13	3.42E-13	-	1.36E+09	3.72E+03	8.84E-01	7.60E-01	2.59E+08	7.10E+12	2.43E+03	3.61E+06	2.43E+03	9.50E-11
Br-76	M	1.10E-12	1.30E-05	1.97E-12	3.34E-12	-	1.36E+09	3.75E+02	8.84E-01	7.60E-01	2.67E+06	7.35E+10	9.81E+01	3.93E+04	9.79E+01	3.85E-11
Br-77	M	2.06E-13	1.34E-06	4.03E-13	6.51E-13	-	1.36E+09	1.08E+02	9.22E-01	7.60E-01	3.96E+06	1.14E+11	2.64E+02	5.56E+04	2.63E+02	3.62E-10
Br-80	M	1.80E-14	3.55E-07	6.48E-14	1.03E-13	-	1.36E+09	2.09E+04	8.88E-01	7.60E-01	4.84E+09	2.51E+14	2.00E+05	6.68E+07	1.99E+05	1.48E-09
Br-80m	M	2.43E-13	5.96E-09	3.89E-13	6.70E-13	-	1.36E+09	1.37E+03	9.95E-01	7.60E-01	4.88E+07	1.22E+12	6.97E+05	7.30E+05	3.54E+05	4.00E-08
Br-82	M	1.66E-12	1.24E-05	2.30E-12	3.70E-12	-	1.36E+09	1.72E+02	8.65E-01	7.60E-01	1.11E+06	2.24E+10	4.82E+01	1.55E+04	4.81E+01	4.45E-11
Br-83	M	1.21E-13	3.46E-08	1.16E-13	1.94E-13	-	1.36E+09	2.54E+03	8.81E-01	7.60E-01	3.12E+08	4.53E+12	2.51E+05	4.53E+06	2.37E+05	1.51E-08
Br-84	M	7.18E-14	9.36E-06	2.02E-13	3.21E-13	-	1.36E+09	1.15E+04	8.49E-01	7.60E-01	8.50E+08	3.44E+13	4.34E+03	1.17E+07	4.34E+03	6.17E-11
C-11	M	2.78E-14	4.45E-06	5.59E-14	8.70E-14	-	1.36E+09	1.79E+04	8.83E-01	5.50E+00	4.89E+09	1.39E+14	1.37E+04	9.13E+06	1.37E+04	1.63E-11
C-14	M	7.07E-12	7.84E-12	2.00E-12	2.79E-12	-	1.36E+09	1.21E-04	9.27E-01	5.50E+00	2.85E+02	1.02E+06	1.38E+04	4.77E-01	4.76E-01	1.07E-07
Ca-41	M	2.09E-13	0.00E+00	4.37E-13	5.74E-13	-	1.36E+09	4.95E-06	0.00E+00	5.00E-01	1.38E+03	3.44E+07	-	2.40E+01	2.36E+01	3.79E-04
Ca-45	M	9.40E-12	3.96E-11	3.37E-12	6.07E-12	-	1.36E+09	1.55E+00	1.00E+00	5.00E-01	6.09E+03	3.56E+07	1.18E+05	1.45E+02	1.41E+02	7.94E-09
Ca-47	M	7.88E-12	5.24E-06	1.08E-11	2.02E-11	-	1.36E+09	5.58E+01	8.36E-01	5.00E-01	6.58E+04	1.53E+09	3.84E+01	1.62E+03	3.74E+01	6.12E-11
Ca-49	M	-	1.75E-05	-	-	-	1.36E+09	4.18E+04	7.78E-01	5.00E-01	-	-	9.24E+03	-	9.24E+03	2.10E-11

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Wet Soil-to-plant transfer factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Produce Ingestion PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Cd-104	S	7.66E-14	9.71E-07	2.41E-13	4.14E-13	-	1.36E+09	6.31E+03	9.32E-01	3.00E-01	3.63E+08	1.78E+13	2.10E+04	1.37E+07	2.10E+04	6.70E-10
Cd-107	S	3.10E-13	3.48E-08	5.11E-13	9.99E-13	-	1.36E+09	9.35E+02	9.75E-01	3.00E-01	2.23E+07	6.51E+11	8.29E+04	9.58E+05	7.61E+04	1.69E-08
Cd-109	S	2.19E-11	8.74E-09	6.70E-12	1.14E-11	-	1.36E+09	5.45E-01	9.96E-01	3.00E-01	1.14E+03	5.37E+06	1.88E+02	4.26E+01	3.37E+01	1.31E-08
Cd-113	F	1.12E-10	7.36E-11	2.90E-11	3.85E-11	-	1.36E+09	7.45E-17	9.27E-01	3.00E-01	2.08E+01	6.46E+04	1.48E+03	6.06E-01	5.88E-01	1.73E+06
Cd-113m	F	1.30E-10	4.45E-10	3.64E-11	5.11E-11	-	1.36E+09	5.10E-02	9.27E-01	3.00E-01	3.03E+01	1.08E+05	4.75E+02	9.36E-01	9.06E-01	3.90E-09
Cd-115	S	5.14E-12	1.01E-06	1.27E-11	2.47E-11	-	1.36E+09	1.14E+02	8.86E-01	3.00E-01	1.09E+05	4.77E+09	3.82E+02	4.68E+03	3.52E+02	6.91E-10
Cd-115m	S	2.92E-11	1.13E-07	2.46E-11	4.74E-11	-	1.36E+09	5.67E+00	8.43E-01	3.00E-01	2.85E+03	4.19E+07	1.79E+02	1.21E+02	7.03E+01	2.77E-09
Cd-117	S	6.51E-13	5.23E-06	1.99E-12	3.81E-12	-	1.36E+09	2.44E+03	9.02E-01	3.00E-01	1.52E+07	8.08E+11	1.55E+03	6.41E+05	1.55E+03	1.44E-10
Cd-117m	S	6.55E-13	1.03E-05	1.76E-12	3.26E-12	-	1.36E+09	1.81E+03	8.79E-01	3.00E-01	1.32E+07	5.95E+11	6.00E+02	5.37E+05	6.00E+02	7.54E-11
Ce-134	M	6.96E-12	8.25E-09	2.33E-11	4.59E-11	-	1.36E+09	8.43E+01	9.76E-01	2.00E-03	4.37E+04	2.61E+09	3.15E+04	2.84E+05	1.72E+04	5.31E-08
Ce-135	M	1.75E-12	7.74E-06	5.48E-12	1.02E-11	-	1.36E+09	3.45E+02	9.10E-01	2.00E-03	8.05E+05	4.25E+10	1.47E+02	4.94E+06	1.47E+02	1.12E-10
Ce-137	M	4.11E-14	4.46E-08	1.91E-13	3.64E-13	-	1.36E+09	6.75E+02	9.70E-01	2.00E-03	4.41E+07	3.54E+12	4.69E+04	2.77E+08	4.69E+04	1.85E-08
Ce-137m	M	1.94E-12	1.38E-07	5.07E-12	9.99E-12	-	1.36E+09	1.76E+02	9.44E-01	2.00E-03	4.21E+05	1.96E+10	4.08E+03	2.73E+06	4.03E+03	6.07E-09
Ce-139	M	5.66E-12	4.54E-07	1.95E-12	3.70E-12	-	1.36E+09	1.84E+00	9.49E-01	2.00E-03	1.18E+04	7.00E+07	1.28E+01	7.40E+04	1.28E+01	1.88E-09
Ce-141	M	1.14E-11	2.27E-07	6.77E-12	1.34E-11	-	1.36E+09	7.78E+00	9.38E-01	2.00E-03	1.38E+04	1.47E+08	1.10E+02	9.03E+04	1.09E+02	3.83E-09
Ce-143	M	3.74E-12	1.09E-06	1.04E-11	2.04E-11	-	1.36E+09	1.84E+02	9.04E-01	2.00E-03	2.15E+05	1.06E+10	5.62E+02	1.39E+06	5.60E+02	8.45E-10
Ce-144	M	1.10E-10	5.02E-08	5.18E-11	1.02E-10	-	1.36E+09	8.90E-01	9.35E-01	2.00E-03	2.08E+02	1.75E+06	5.70E+01	1.35E+03	4.33E+01	1.36E-08
Ce-144+D	M	1.10E-10	2.44E-07	5.19E-11	1.02E-10	-	1.36E+09	8.90E-01	8.81E-01	2.00E-03	2.08E+02	1.75E+06	1.25E+01	1.35E+03	1.16E+01	3.66E-09
Cf-244	M	2.96E-11	6.83E-11	1.74E-13	2.93E-13	-	1.36E+09	1.88E+04	9.99E-01	1.00E-03	1.53E+09	1.37E+11	8.28E+08	1.69E+10	5.18E+08	1.31E-05
Cf-246	M	1.47E-09	9.25E-11	3.09E-11	6.11E-11	-	1.36E+09	1.70E+02	9.98E-01	1.00E-03	6.63E+04	2.50E+07	5.54E+06	8.64E+05	6.07E+04	1.70E-07
Cf-248	M	1.81E-08	4.73E-11	6.22E-11	1.18E-10	-	1.36E+09	7.58E-01	9.99E-01	1.00E-03	1.53E+02	9.04E+03	4.83E+04	1.92E+03	1.39E+02	8.83E-08
Cf-249	M	3.40E-08	1.37E-06	1.63E-10	2.54E-10	-	1.36E+09	1.98E-03	9.62E-01	1.00E-03	3.22E+00	2.18E+02	7.84E-02	3.31E+01	7.63E-02	1.87E-08
Cf-250	M	2.66E-08	4.49E-11	1.12E-10	1.85E-10	-	1.36E+09	5.30E-02	9.99E-01	1.00E-03	8.57E+00	5.40E+02	4.46E+03	9.33E+01	7.72E+00	7.07E-08
Cf-251	M	3.40E-08	3.76E-07	1.70E-10	2.67E-10	-	1.36E+09	7.72E-04	9.55E-01	1.00E-03	3.01E+00	2.14E+02	2.83E-01	3.12E+01	2.56E-01	1.61E-07
Cf-252	-	1.89E-08	2.37E-06	1.84E-10	-	-	1.36E+09	2.63E-01	1.69E+00	1.00E-03	-	3.00E+03	1.97E-01	2.24E+02	1.97E-01	3.67E-10
Cf-253	M	4.22E-09	4.86E-11	6.11E-12	1.20E-11	-	1.36E+09	1.42E+01	9.98E-01	1.00E-03	2.82E+04	7.26E+05	8.81E+05	3.65E+05	2.45E+04	8.48E-07
Cf-254	M	1.21E-07	8.69E-05	3.08E-09	-	-	1.36E+09	4.18E+00	1.68E+00	1.00E-03	-	7.46E+03	8.62E-02	2.13E+02	8.61E-02	1.02E-11
Cl-36	M	2.50E-11	1.74E-09	4.44E-12	7.66E-12	-	1.36E+09	2.30E-06	8.83E-01	2.00E+01	1.04E+02	2.88E+05	6.53E+01	5.90E-02	5.89E-02	1.79E-06
Cl-38	M	9.40E-14	7.93E-06	2.64E-13	4.22E-13	-	1.36E+09	9.79E+03	8.07E-01	2.00E+01	5.52E+08	2.25E+13	4.60E+03	2.91E+05	4.53E+03	3.41E-11
Cl-39	M	9.36E-14	7.09E-06	2.08E-13	3.31E-13	-	1.36E+09	6.55E+03	8.34E-01	2.00E+01	4.71E+08	1.51E+13	3.33E+03	2.47E+05	3.29E+03	3.80E-11
Cm-238	M	1.35E-11	1.90E-07	4.70E-13	8.70E-13	-	1.36E+09	2.53E+03	9.58E-01	1.00E-03	6.92E+07	4.04E+10	4.18E+04	8.45E+08	4.18E+04	7.63E-09
Cm-240	M	9.51E-09	6.19E-11	5.07E-11	9.88E-11	-	1.36E+09	9.37E+00	9.99E-01	1.00E-03	2.26E+03	2.13E+05	4.56E+05	2.90E+04	2.06E+03	1.03E-07
Cm-241	M	1.01E-10	1.94E-06	7.03E-12	1.35E-11	-	1.36E+09	7.71E+00	9.99E-01	1.00E-03	1.36E+04	1.65E+07	1.20E+01	1.72E+05	1.20E+01	7.25E-10
Cm-242	M	1.51E-08	7.73E-11	5.48E-11	1.05E-10	-	1.36E+09	1.55E+00	9.99E-01	1.00E-03	3.52E+02	2.22E+04	6.05E+04	4.45E+03	3.20E+02	9.67E-08
Cm-243	M	2.69E-08	4.19E-07	1.23E-10	2.05E-10	-	1.36E+09	2.43E-02	9.49E-01	1.00E-03	5.45E+00	3.77E+02	3.55E-01	6.00E+01	3.31E-01	6.43E-09
Cm-244	M	2.53E-08	4.85E-11	1.08E-10	1.81E-10	-	1.36E+09	3.83E-02	9.99E-01	1.00E-03	7.37E+00	4.78E+02	3.48E+03	8.15E+01	6.65E+00	8.23E-08
Cm-245	M	2.77E-08	2.38E-07	1.35E-10	2.18E-10	-	1.36E+09	8.15E-05	9.52E-01	1.00E-03	3.65E+00	2.60E+02	4.43E-01	3.88E+01	3.91E-01	2.28E-06
Cm-246	M	2.77E-08	4.57E-11	1.31E-10	2.12E-10	-	1.36E+09	1.47E-04	9.99E-01	1.00E-03	3.75E+00	2.60E+02	2.20E+03	4.01E+01	3.38E+00	1.10E-05
Cm-247	M	2.50E-08	1.31E-06	1.30E-10	2.11E-10	-	1.36E+09	4.44E-08	9.25E-01	1.00E-03	3.76E+00	2.88E+02	8.28E-02	4.03E+01	8.08E-02	8.72E-04
Cm-248	-	9.58E-08	6.81E-06	6.11E-10	-	-	1.36E+09	1.99E-06	1.68E+00	1.00E-03	-	7.51E+01	8.77E-03	8.57E+00	8.76E-03	2.12E-06
Cm-249	M	7.25E-14	8.51E-08	1.20E-13	2.18E-13	-	1.36E+09	5.68E+03	9.09E-01	1.00E-03	6.20E+08	1.69E+13	2.21E+05	7.43E+09	2.21E+05	1.88E-08
Cm-250	M	4.37E-07	5.03E-05	4.51E-09	-	-	1.36E+09	7.14E-05	1.68E+00	1.00E-03	-	1.65E+01	1.19E-03	1.16E+00	1.19E-03	8.06E-09
Cm-250+D	M	-	1.31E-06	-	-	-	1.36E+09	7.14E-05	1.68E+00	1.00E-03	-	-	4.56E-02	-	4.56E-02	3.10E-07
Co-55	M	2.07E-12	9.22E-06	6.70E-12	1.23E-11	-	1.36E+09	3.46E+02	8.48E-01	8.00E-02	6.70E+05	3.61E+10	1.33E+02	1.01E+05	1.33E+02	4.10E-11
Co-56	M	1.85E-11	1.80E-05	1.43E-11	2.56E-11	-	1.36E+09	3.21E+00	8.23E-01	8.00E-02	2.99E+03	3.75E+07	6.52E-01	4.41E+02	6.51E-01	2.20E-11
Co-57	M	2.09E-12	3.55E-07	1.49E-12	2.78E-12	-	1.36E+09	9.34E-01	9.71E-01	8.00E-02	8.00E+03	9.64E+07	8.15E+00	1.23E+03	8.09E+00	9.58E-10
Co-58	M	5.99E-12	4.49E-06	4.18E-12	7.44E-12	-	1.36E+09	3.57E+00	8.63E-01	8.00E-02	1.14E+04	1.29E+08	2.77E+00	1.68E+03	2.77E+00	8.72E-11
Co-58m	M	6.88E-14	1.00E-12	1.83E-13	3.47E-13	-	1.36E+09	6.63E+02	9.94E-01	8.00E-02	4.55E+07	2.08E+12	2.01E+09	7.12E+06	6.14E+06	1.04E-06
Co-60	M	3.58E-11	1.24E-05	2.23E-11	4.03E-11	-	1.36E+09	1.31E-01	8.34E-01	8.00E-02	7.92E+01	8.08E+05	3.90E-02	1.18E+01	3.89E-02	3.44E-11
Co-60m	M	3.96E-15	1.86E-08	3.66E-15	5.88E-15	-	1.36E+09	3.48E+04	9.25E-01	8.00E-02	1.41E+11	1.90E+15	6.08E+06	1.87E+10	6.08E+06	2.04E-08
Co-61	M	1.43E-13	2.48E-07	3.49E-13	6.40E-13	-	1.36E+09	3.68E+03	9.38E-01	8.00E-02	1.37E+08	5.55E+12	4.76E+04	2.07E+07	4.75E+04	1.53E-09
Co-62m	M	3.17E-14	1.35E-05	1.13E-13	1.79E-13	-	1.36E+09	2.62E+04	8.28E-01	8.00E-02	3.48E+09	1.78E+14	7.05E+03	4.55E+08	7.05E+03	3.24E-11
Cr-48	S	7.51E-13	1.62E-06	1.05E-12	1.84E-12	-	1.36E+09	2.64E+02	9.13E-01	0.00E+00	3.42E+06	7.60E+10	5.38E+02	-	5.38E+02	1.89E-10
Cr-49	S	7.36E-14	4.43E-06	1.89E-13	3.20E-13	-	1.36E+09	8.65E+03	8.92E-01	0.00E+00	6.44E+08	2.54E+13	6.59E+03	-	6.59E+03	7.24E-11
Cr-51	S	1.67E-13	1.27E-07	2.66E-13	4.96E-13	-	1.36E+09	9.13E+00	9.03E-01	0.00E+00	4.38E+05	1.18E+10	2.40E+02	-	2.39E+02	2.59E-09
Cs-125	F	1.64E-14	2.92E-06	8.18E-14	1.29E-13	-	1.36E+09	8.09E+03	8.78E-01	4.00E-02	1.49E+09	1.06E+14	9.50E+03	3.89E+08	9.50E+03	2.85E-10
Cs-126	-	-	4.74E-06	-	-	-	1.36E+09	2.22E+05	8.87E-01	4.00E-02	-	-	1.59E+05	-	1.59E+05	1.75E-10
Cs-127	F	2.47E-14	1.68E-06	8.73E-14	1.38E-13	-	1.36E+09	9.71E+02	8.98E-01	4.00E-02	1.68E+08	8.48E+12	1.94E+03	4.37E+07	1.94E+03	4.91E-10
Cs-128	F	-	3.92E-06	-	-	-	1.36E+09	9.34E+04	8.85E-01	4.00E-02	-	-	8.10E+04	-	8.10E+04	2.15E-10
Cs-129	F	7.44E-14	1.05E-06	2.48E-13	4.00E-13	-	1.36E+09	1.89E+02	8.98E-01	4.00E-02	1.13E+07	5.49E+11	6.04E+02	3.00E+06	6.04E+02	7.99E-10

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Wet Soil-to-plant transfer factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Produce Ingestion PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Cs-130	F	1.24E-14	2.22E-06	6.48E-14	1.02E-13	-	1.36E+09	1.22E+04	8.90E-01	4.00E-02	2.84E+09	2.12E+14	1.86E+04	7.38E+08	1.86E+04	3.84E-10
Cs-131	F	7.51E-14	4.91E-09	2.49E-13	4.11E-13	-	1.36E+09	2.61E+01	9.83E-01	4.00E-02	1.51E+06	7.50E+10	1.63E+04	4.12E+05	1.55E+04	1.51E-07
Cs-132	F	5.92E-13	3.11E-06	1.91E-12	2.89E-12	-	1.36E+09	3.91E+01	8.71E-01	4.00E-02	3.22E+05	1.42E+10	4.34E+01	8.03E+04	4.34E+01	2.84E-10
Cs-134	F	1.65E-11	7.10E-06	5.14E-11	5.81E-11	-	1.36E+09	3.36E-01	8.65E-01	4.00E-02	1.38E+02	4.39E+06	1.65E-01	2.57E+01	1.63E-01	1.26E-10
Cs-134m	F	1.99E-14	5.02E-08	5.55E-14	8.84E-14	-	1.36E+09	2.09E+03	9.71E-01	4.00E-02	5.64E+08	2.27E+13	1.29E+05	1.48E+08	1.29E+05	1.60E-08
Cs-135	F	1.86E-12	2.36E-11	5.88E-12	7.18E-12	-	1.36E+09	3.01E-07	9.27E-01	4.00E-02	1.11E+02	3.87E+06	4.58E+03	2.23E+01	1.85E+01	1.60E-02
Cs-135m	F	1.32E-14	7.37E-06	6.07E-14	9.10E-14	-	1.36E+09	6.87E+03	8.61E-01	4.00E-02	1.80E+09	1.12E+14	3.26E+03	4.45E+08	3.26E+03	1.24E-10
Cs-136	F	3.49E-12	1.00E-05	1.12E-11	1.65E-11	-	1.36E+09	1.93E+01	8.56E-01	4.00E-02	2.79E+04	1.19E+09	6.79E+00	6.77E+03	6.78E+00	9.26E-11
Cs-137	F	1.19E-11	5.33E-10	3.74E-11	4.33E-11	-	1.36E+09	2.31E-02	9.27E-01	4.00E-02	2.54E+01	8.38E+05	2.81E+02	4.85E+00	4.02E+00	4.62E-08
Cs-137+D	F	1.19E-11	2.54E-06	3.74E-11	4.33E-11	-	1.36E+09	2.31E-02	8.77E-01	4.00E-02	2.54E+01	8.38E+05	6.24E-02	4.85E+00	6.15E-02	7.07E-10
Cs-138	F	4.00E-14	1.19E-05	2.16E-13	3.40E-13	-	1.36E+09	1.13E+04	8.85E-01	4.00E-02	7.92E+08	6.10E+13	3.23E+03	2.06E+08	3.23E+03	7.65E-11
Cu-60	S	5.77E-14	1.93E-05	1.89E-13	3.00E-13	-	1.36E+09	1.57E+04	8.32E-01	1.30E-01	1.25E+09	5.87E+13	2.94E+03	1.00E+08	2.94E+03	2.18E-11
Cu-61	S	2.41E-13	3.63E-06	6.70E-13	1.20E-12	-	1.36E+09	1.78E+03	8.51E-01	1.30E-01	3.53E+07	1.59E+12	1.73E+03	3.21E+06	1.73E+03	1.15E-10
Cu-62	-	-	4.43E-06	-	-	-	1.36E+09	3.74E+04	8.82E-01	1.30E-01	-	-	2.88E+04	-	2.88E+04	9.26E-11
Cu-64	S	4.33E-13	8.30E-07	9.32E-13	1.72E-12	-	1.36E+09	4.78E+02	8.82E-01	1.30E-01	6.62E+06	2.38E+11	1.96E+03	6.20E+05	1.96E+03	5.09E-10
Cu-66	-	-	4.32E-07	-	-	-	1.36E+09	7.14E+04	8.46E-01	1.30E-01	-	-	5.88E+05	-	5.88E+05	1.05E-09
Cu-67	S	2.35E-12	3.83E-07	2.83E-12	5.29E-12	-	1.36E+09	9.81E+01	9.24E-01	1.30E-01	4.42E+05	9.01E+09	8.34E+02	4.19E+04	8.17E+02	1.08E-09
Dy-155	M	2.45E-13	2.44E-06	7.47E-13	1.35E-12	-	1.36E+09	6.07E+02	9.16E-01	-	1.07E+07	5.35E+11	8.17E+02	-	8.17E+02	4.05E-10
Dy-157	M	8.33E-14	1.32E-06	3.20E-13	5.62E-13	-	1.36E+09	7.49E+02	9.04E-01	-	3.18E+07	1.94E+12	1.89E+03	-	1.89E+03	7.68E-10
Dy-159	M	1.28E-12	3.19E-08	7.70E-13	1.47E-12	-	1.36E+09	1.75E+00	9.60E-01	-	2.84E+04	2.95E+08	1.72E+02	-	1.71E+02	3.01E-08
Dy-165	M	2.10E-13	9.50E-08	6.03E-13	1.15E-12	-	1.36E+09	2.60E+03	9.40E-01	-	5.39E+07	2.67E+12	8.76E+04	-	8.75E+04	1.08E-08
Dy-166	M	8.36E-12	6.03E-08	1.63E-11	3.22E-11	-	1.36E+09	7.44E+01	9.44E-01	-	5.50E+04	1.92E+09	3.93E+03	-	3.67E+03	1.59E-08
Er-161	M	1.34E-13	4.09E-06	4.51E-13	8.10E-13	-	1.36E+09	1.87E+03	9.42E-01	-	5.51E+07	3.02E+12	1.46E+03	-	1.46E+03	2.44E-10
Er-165	M	3.13E-14	3.05E-08	1.30E-13	2.42E-13	-	1.36E+09	5.86E+02	9.57E-01	-	5.77E+07	4.04E+12	6.04E+04	-	6.03E+04	3.30E-08
Er-169	M	3.85E-12	9.10E-11	3.70E-12	7.36E-12	-	1.36E+09	2.72E+01	9.27E-01	-	8.80E+04	1.52E+09	9.70E+05	-	8.07E+04	9.73E-07
Er-171	M	9.40E-13	1.42E-06	2.96E-12	5.74E-12	-	1.36E+09	8.07E+02	9.05E-01	-	3.35E+06	1.85E+11	1.89E+03	-	1.89E+03	7.76E-10
Er-172	M	4.74E-12	2.20E-06	8.77E-12	1.70E-11	-	1.36E+09	1.23E+02	9.28E-01	-	1.72E+05	5.61E+09	1.81E+02	-	1.81E+02	4.91E-10
Es-250	M	5.07E-13	1.69E-06	8.36E-14	1.44E-13	-	1.36E+09	2.89E+03	8.88E-01	-	4.78E+08	1.23E+12	5.80E+03	-	5.80E+03	9.73E-10
Es-251	M	6.40E-12	2.55E-07	1.49E-12	2.89E-12	-	1.36E+09	1.84E+02	9.48E-01	-	1.52E+06	6.20E+09	2.29E+03	-	2.29E+03	6.05E-09
Es-253	M	8.84E-09	1.25E-09	5.11E-11	1.01E-10	-	1.36E+09	1.24E+01	9.95E-01	-	2.91E+03	3.02E+05	2.99E+04	-	2.63E+03	1.05E-07
Es-254	M	1.85E-08	8.55E-09	7.81E-11	1.50E-10	-	1.36E+09	9.17E-01	9.95E-01	-	1.46E+02	1.07E+04	3.24E+02	-	9.96E+01	5.35E-08
Es-254+D	M	-	4.24E-06	-	-	-	1.36E+09	9.17E-01	8.53E-01	-	-	-	7.63E-01	-	7.63E-01	4.10E-10
Es-254m	M	1.53E-09	2.10E-06	4.00E-11	7.88E-11	-	1.36E+09	1.54E+02	9.95E-01	-	4.67E+04	2.18E+07	2.22E+02	-	2.21E+02	7.06E-10
Eu-145	M	1.81E-12	6.95E-06	3.85E-12	6.77E-12	-	1.36E+09	4.26E+01	8.75E-01	2.50E-03	1.50E+05	5.08E+09	2.11E+01	6.95E+05	2.11E+01	1.39E-10
Eu-146	M	2.59E-12	1.16E-05	6.40E-12	1.12E-11	-	1.36E+09	5.49E+01	8.71E-01	2.50E-03	1.17E+05	4.57E+09	1.63E+01	5.39E+05	1.63E+01	8.44E-11
Eu-147	M	3.85E-12	2.04E-06	2.90E-12	5.37E-12	-	1.36E+09	1.05E+01	8.66E-01	2.50E-03	4.67E+04	5.91E+08	1.79E+01	2.28E+05	1.79E+01	4.86E-10
Eu-148	M	9.92E-12	9.85E-06	6.03E-12	1.04E-11	-	1.36E+09	4.64E+00	9.14E-01	2.50E-03	1.06E+04	1.01E+08	1.55E+00	4.84E+04	1.55E+00	9.60E-11
Eu-149	M	1.07E-12	1.42E-07	7.40E-13	1.40E-12	-	1.36E+09	2.72E+00	9.24E-01	2.50E-03	4.62E+04	5.48E+08	6.23E+01	2.31E+05	6.22E+01	6.62E-09
Eu-150	M	1.12E-10	6.49E-06	6.07E-12	1.08E-11	-	1.36E+09	2.03E-02	9.01E-01	2.50E-03	9.81E+01	8.57E+04	2.29E-02	4.60E+02	2.29E-02	3.29E-10
Eu-150m	M	1.03E-12	1.95E-07	3.50E-12	6.88E-12	-	1.36E+09	4.81E+02	8.56E-01	2.50E-03	1.66E+06	1.01E+11	8.67E+03	8.63E+06	8.62E+03	5.21E-09
Eu-152	M	9.10E-11	5.30E-06	8.70E-12	1.62E-11	-	1.36E+09	5.20E-02	9.19E-01	2.50E-03	9.67E+01	1.56E+05	4.07E-02	4.75E+02	4.06E-02	2.31E-10
Eu-152m	M	1.12E-12	1.33E-06	4.37E-12	8.51E-12	-	1.36E+09	6.51E+02	9.10E-01	2.50E-03	1.82E+06	1.25E+11	1.62E+03	9.36E+06	1.62E+03	7.32E-10
Eu-154	M	1.15E-10	5.83E-06	1.49E-11	2.85E-11	-	1.36E+09	7.88E-02	9.35E-01	2.50E-03	7.26E+01	1.63E+05	4.80E-02	3.67E+02	4.79E-02	1.82E-10
Eu-155	M	1.48E-11	1.24E-07	2.77E-12	5.40E-12	-	1.36E+09	1.40E-01	9.41E-01	2.50E-03	6.25E+02	2.07E+06	3.66E+00	3.22E+03	3.63E+00	7.82E-09
Eu-156	M	1.37E-11	6.62E-06	1.84E-11	3.56E-11	-	1.36E+09	1.67E+01	8.97E-01	2.50E-03	1.11E+04	2.62E+08	8.44E+00	5.69E+04	8.43E+00	1.53E-10
Eu-157	M	1.57E-12	9.60E-07	5.40E-12	1.06E-11	-	1.36E+09	4.01E+02	8.95E-01	2.50E-03	9.00E+05	5.51E+10	1.40E+03	4.66E+06	1.40E+03	1.06E-09
Eu-158	M	1.10E-13	5.06E-06	3.01E-13	5.22E-13	-	1.36E+09	7.94E+03	8.56E-01	2.50E-03	3.62E+08	1.56E+13	5.51E+03	1.66E+09	5.51E+03	2.13E-10
F-18	M	1.21E-13	4.45E-06	1.30E-13	2.00E-13	-	1.36E+09	3.32E+03	8.83E-01	2.00E-02	3.95E+08	5.92E+12	2.54E+03	2.00E+08	2.54E+03	2.67E-11
Fe-52	M	2.73E-12	3.07E-06	1.03E-11	1.94E-11	-	1.36E+09	7.34E+02	8.96E-01	1.00E-03	9.00E+05	5.80E+10	8.02E+02	1.12E+07	8.02E+02	1.10E-10
Fe-55	M	7.99E-13	0.00E+00	1.16E-12	2.09E-12	-	1.36E+09	2.57E-01	0.00E+00	1.00E-03	2.93E+03	6.93E+07	-	3.48E+04	2.70E+03	1.12E-06
Fe-59	M	1.33E-11	5.83E-06	1.11E-11	2.07E-11	-	1.36E+09	5.68E+00	8.39E-01	1.00E-03	6.53E+03	9.22E+07	3.49E+00	8.04E+04	3.49E+00	7.04E-11
Fe-60	M	1.84E-10	6.38E-12	2.39E-10	3.53E-10	-	1.36E+09	6.93E-06	9.27E-01	1.00E-03	2.25E+00	3.91E+04	1.70E+04	2.19E+01	2.04E+00	3.43E-05
Fe-60+D	M	-	1.86E-08	-	-	-	1.36E+09	6.93E-06	9.25E-01	1.00E-03	-	-	5.83E+00	-	5.83E+00	9.79E-05
Fm-252	M	1.03E-09	5.09E-11	2.48E-11	4.92E-11	-	1.36E+09	2.67E+02	9.98E-01	-	1.29E+05	5.60E+07	1.58E+07	-	1.28E+05	2.34E-07
Fm-253	M	1.28E-09	2.24E-07	7.51E-12	1.48E-11	-	1.36E+09	8.43E+01	9.96E-01	-	1.36E+05	1.42E+07	1.14E+03	-	1.13E+03	6.57E-09
Fm-254	M	1.98E-10	1.23E-10	3.13E-12	6.07E-12	-	1.36E+09	1.87E+03	9.97E-01	-	7.35E+06	2.04E+09	4.60E+07	-	6.32E+06	1.66E-06
Fm-255	M	8.84E-10	3.85E-09	2.42E-11	4.77E-11	-	1.36E+09	3.02E+02	9.91E-01	-	1.51E+05	7.38E+07	2.39E+05	-	9.23E+04	1.51E-07
Fm-257	M	2.04E-08	3.06E-07	6.29E-11	1.23E-10	-	1.36E+09	2.52E+00	9.39E-01	-	4.87E+02	2.66E+04	2.64E+01	-	2.50E+01	4.95E-09
Fr-219	-	-	1.44E-08	-	-	-	1.36E+09	1.04E+09	8.97E-01	-	-	-	2.42E+11	-	2.42E+11	9.90E-08
Fr-220	-	-	3.25E-08	-	-	-	1.36E+09	7.98E+05	9.68E-01	-	-	-	7.63E+07	-	7.63E+07	4.08E-08

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Wet Soil-to-plant transfer factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Produce Ingestion PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Fr-220+D	-	-	7.26E-06	-	-	-	1.36E+09	7.98E+05	8.96E-01	-	-	-	3.69E+05	-	3.69E+05	1.97E-10
Fr-221	-	-	1.11E-07	-	-	-	1.36E+09	7.59E+04	9.19E-01	-	-	-	2.24E+06	-	2.24E+06	1.26E-08
Fr-221+D	-	-	8.91E-07	-	-	-	1.36E+09	7.59E+04	9.72E-01	-	-	-	2.64E+05	-	2.64E+05	1.49E-09
Fr-222	F	2.42E-11	1.14E-08	2.02E-12	3.43E-12	-	1.36E+09	2.53E+04	9.27E-01	-	1.76E+08	2.26E+11	7.20E+06	-	6.92E+06	1.18E-07
Fr-223	F	3.06E-12	1.40E-07	1.00E-11	1.78E-11	-	1.36E+09	1.67E+04	9.61E-01	-	2.23E+07	1.18E+12	3.74E+05	-	3.68E+05	9.52E-09
Ga-65	M	2.84E-14	5.05E-06	8.73E-14	1.39E-13	-	1.36E+09	2.40E+04	8.65E-01	-	4.10E+09	1.82E+14	1.65E+04	-	1.65E+04	8.69E-11
Ga-66	M	2.18E-12	1.26E-05	9.32E-12	1.80E-11	-	1.36E+09	6.46E+02	8.43E-01	-	8.54E+05	6.39E+10	1.83E+02	-	1.83E+02	3.63E-11
Ga-67	M	9.55E-13	5.36E-07	1.51E-12	2.89E-12	-	1.36E+09	7.76E+01	9.15E-01	-	6.39E+05	1.75E+10	4.76E+02	-	4.76E+02	7.97E-10
Ga-68	M	1.28E-13	4.17E-06	4.03E-13	7.18E-13	-	1.36E+09	5.36E+03	8.80E-01	-	1.78E+08	9.03E+12	4.39E+03	-	4.39E+03	1.08E-10
Ga-70	M	2.92E-14	4.39E-08	7.22E-14	1.19E-13	-	1.36E+09	1.72E+04	8.64E-01	-	3.45E+09	1.27E+14	1.37E+06	-	1.37E+06	1.08E-08
Ga-72	M	2.17E-12	1.37E-05	8.07E-12	1.53E-11	-	1.36E+09	4.31E+02	8.71E-01	-	6.70E+05	4.28E+10	1.09E+02	-	1.09E+02	3.52E-11
Ga-73	M	6.14E-13	1.25E-06	2.03E-12	3.92E-12	-	1.36E+09	1.24E+03	9.29E-01	-	7.51E+06	4.34E+11	3.20E+03	-	3.20E+03	3.67E-10
Gd-145	M	3.63E-14	1.13E-05	1.23E-13	1.99E-13	-	1.36E+09	1.59E+04	8.14E-01	2.50E-03	1.90E+09	9.45E+13	5.20E+03	8.12E+09	5.20E+03	9.20E-11
Gd-146	M	2.27E-11	5.56E-07	7.29E-12	1.39E-11	-	1.36E+09	5.24E+00	9.43E-01	2.50E-03	8.97E+03	4.98E+07	3.01E+01	4.51E+04	2.99E+01	1.62E-09
Gd-147	M	1.34E-12	5.88E-06	3.50E-12	6.33E-12	-	1.36E+09	1.59E+02	9.11E-01	2.50E-03	5.99E+05	2.57E+10	8.95E+01	2.86E+06	8.95E+01	1.60E-10
Gd-148	F	1.26E-08	0.00E+00	5.51E-11	9.07E-11	-	1.36E+09	7.45E-03	0.00E+00	2.50E-03	9.76E+00	6.37E+02	-	4.24E+01	7.84E+00	3.02E-07
Gd-149	M	2.76E-12	1.59E-06	3.22E-12	6.03E-12	-	1.36E+09	2.69E+01	8.92E-01	2.50E-03	1.06E+05	2.10E+09	5.71E+01	5.25E+05	5.70E+01	6.13E-10
Gd-151	M	2.92E-12	1.20E-07	1.65E-12	3.20E-12	-	1.36E+09	2.11E+00	9.30E-01	2.50E-03	1.57E+04	1.56E+08	5.68E+01	8.03E+04	5.66E+01	7.87E-09
Gd-152	F	9.10E-09	0.00E+00	3.85E-11	6.29E-11	-	1.36E+09	6.42E-15	0.00E+00	2.50E-03	1.26E+01	7.90E+02	-	5.44E+01	1.01E+01	4.65E+05
Gd-153	M	6.55E-12	1.62E-07	2.22E-12	4.26E-12	-	1.36E+09	1.05E+00	9.45E-01	2.50E-03	5.84E+03	3.44E+07	2.05E+01	2.96E+04	2.05E+01	5.81E-09
Gd-159	M	1.46E-12	1.74E-07	4.66E-12	9.21E-12	-	1.36E+09	3.27E+02	9.00E-01	2.50E-03	8.46E+05	4.83E+10	6.28E+03	4.41E+06	6.23E+03	5.88E-09
Ge-66	M	2.50E-13	2.86E-06	4.88E-13	7.99E-13	-	1.36E+09	2.67E+03	9.15E-01	4.00E-01	7.97E+07	2.31E+12	3.07E+03	2.15E+06	3.07E+03	1.47E-10
Ge-67	M	4.59E-14	6.24E-06	1.45E-13	2.28E-13	-	1.36E+09	1.95E+04	8.43E-01	4.00E-01	2.03E+09	9.16E+13	1.11E+04	5.27E+07	1.11E+04	7.43E-11
Ge-68	M	4.88E-11	4.70E-13	9.88E-12	1.85E-11	-	1.36E+09	8.78E-01	1.00E+00	4.00E-01	1.13E+03	3.88E+06	5.62E+06	3.49E+01	3.39E+01	5.09E-09
Ge-68+D	M	-	4.17E-06	-	-	-	1.36E+09	8.78E-01	8.80E-01	4.00E-01	-	-	7.20E-01	-	7.20E-01	1.08E-10
Ge-69	M	8.81E-13	4.02E-06	1.35E-12	2.35E-12	-	1.36E+09	1.55E+02	8.46E-01	4.00E-01	1.58E+06	3.81E+10	1.38E+02	4.52E+04	1.37E+02	1.18E-10
Ge-71	M	5.18E-14	4.74E-13	9.18E-14	1.73E-13	-	1.36E+09	2.14E+01	1.00E+00	4.00E-01	2.95E+06	8.93E+10	1.36E+08	9.17E+04	8.89E+04	5.71E-07
Ge-75	M	8.44E-14	1.38E-07	1.17E-13	1.85E-13	-	1.36E+09	4.40E+03	9.09E-01	4.00E-01	5.66E+08	1.12E+13	1.06E+05	1.48E+07	1.05E+05	3.47E-09
Ge-77	M	1.15E-12	4.82E-06	1.65E-12	2.81E-12	-	1.36E+09	5.37E+02	8.98E-01	4.00E-01	4.55E+06	1.01E+11	3.73E+02	1.28E+05	3.72E+02	1.04E-10
Ge-78	M	2.48E-13	1.10E-06	4.03E-13	6.22E-13	-	1.36E+09	4.19E+03	9.09E-01	4.00E-01	1.60E+08	3.64E+12	1.26E+04	4.08E+06	1.26E+04	4.54E-10
H-3	M	1.99E-13	0.00E+00	1.44E-13	2.20E-13	-	1.70E+01	5.61E-02	0.00E+00	4.80E+00	7.46E+03	9.34E-01	-	1.57E+01	8.82E-01	9.15E-11
Hf-170	M	1.20E-12	2.04E-06	3.14E-12	5.81E-12	-	1.36E+09	3.79E+02	9.49E-01	-	1.55E+06	6.82E+10	5.89E+02	-	5.89E+02	5.12E-10
Hf-172	F	6.92E-11	1.62E-07	7.14E-12	1.37E-11	-	1.36E+09	3.71E-01	9.47E-01	-	6.44E+02	1.16E+06	7.27E+00	-	7.19E+00	6.47E-09
Hf-173	M	5.92E-13	1.34E-06	1.52E-12	2.85E-12	-	1.36E+09	2.53E+02	9.13E-01	-	2.11E+06	9.22E+10	6.22E+02	-	6.22E+02	8.25E-10
Hf-175	M	4.29E-12	1.35E-06	2.83E-12	5.29E-12	-	1.36E+09	3.61E+00	9.03E-01	-	1.63E+04	1.82E+08	8.92E+00	-	8.91E+00	8.38E-10
Hf-177m	M	1.81E-13	8.58E-06	2.81E-13	4.74E-13	-	1.36E+09	7.09E+03	9.20E-01	-	3.56E+08	8.45E+12	2.70E+03	-	2.70E+03	1.31E-10
Hf-178m	F	3.70E-10	9.58E-06	2.13E-11	3.89E-11	-	1.36E+09	2.24E-02	8.88E-01	-	2.80E+01	2.67E+04	1.62E-02	-	1.62E-02	2.50E-10
Hf-179m	M	1.38E-11	3.42E-06	9.51E-12	1.81E-11	-	1.36E+09	1.01E+01	8.96E-01	-	1.33E+04	1.58E+08	9.89E+00	-	9.89E+00	3.41E-10
Hf-180m	M	4.14E-13	3.94E-06	1.03E-12	1.89E-12	-	1.36E+09	1.10E+03	9.02E-01	-	1.39E+07	5.75E+11	9.34E+02	-	9.34E+02	2.96E-10
Hf-181	M	1.76E-11	2.24E-06	9.25E-12	1.79E-11	-	1.36E+09	5.97E+00	8.93E-01	-	7.94E+03	7.31E+07	8.97E+00	-	8.96E+00	5.28E-10
Hf-182	F	3.41E-10	9.10E-07	7.25E-12	1.27E-11	-	1.36E+09	7.70E-08	9.11E-01	-	6.25E+01	2.11E+04	1.21E-01	-	1.21E-01	5.54E-04
Hf-182+D	F	-	6.95E-06	-	-	-	1.36E+09	7.70E-08	9.11E-01	-	-	-	1.58E-02	-	1.58E-02	7.27E-05
Hf-182m	M	1.04E-13	3.83E-06	1.57E-13	2.70E-13	-	1.36E+09	5.92E+03	9.42E-01	-	5.22E+08	1.23E+13	4.94E+03	-	4.94E+03	2.95E-10
Hf-183	M	1.65E-13	3.31E-06	3.42E-13	6.25E-13	-	1.36E+09	5.69E+03	8.66E-01	-	2.17E+08	7.44E+12	5.97E+03	-	5.97E+03	3.73E-10
Hf-184	M	1.38E-12	8.64E-07	4.26E-12	8.18E-12	-	1.36E+09	1.47E+03	9.17E-01	-	4.29E+06	2.30E+11	5.60E+03	-	5.59E+03	1.35E-09
Hg-193	M	2.53E-13	5.55E-07	5.99E-13	1.14E-12	-	1.36E+09	1.73E+03	9.38E-01	3.80E-01	3.62E+07	1.48E+12	1.00E+04	1.20E+06	9.94E+03	2.15E-09
Hg-193m	M	9.40E-13	4.54E-06	2.84E-12	5.37E-12	-	1.36E+09	5.47E+02	9.65E-01	3.80E-01	2.42E+06	1.26E+11	3.76E+02	7.96E+04	3.74E+02	2.56E-10
Hg-194	M	2.88E-11	5.05E-12	1.06E-10	1.55E-10	-	1.36E+09	2.67E-03	1.00E+00	3.80E-01	5.33E+00	2.60E+05	2.07E+04	1.35E-01	1.32E-01	1.86E-08
Hg-194+D	M	-	4.93E-06	-	-	-	1.36E+09	2.67E-03	9.55E-01	3.80E-01	-	-	2.22E-02	-	2.22E-02	3.13E-09
Hg-195	M	2.84E-13	7.35E-07	7.36E-13	1.41E-12	-	1.36E+09	6.13E+02	9.51E-01	3.80E-01	1.04E+07	4.66E+11	2.64E+03	3.44E+05	2.62E+03	1.62E-09
Hg-195m	M	2.33E-12	7.69E-07	4.92E-12	9.55E-12	-	1.36E+09	1.46E+02	9.98E-01	3.80E-01	3.64E+05	1.35E+10	5.72E+02	1.23E+04	5.46E+02	1.42E-09
Hg-197	M	1.25E-12	1.14E-07	2.09E-12	4.07E-12	-	1.36E+09	9.47E+01	9.65E-01	3.80E-01	5.54E+05	1.63E+10	2.59E+03	1.87E+04	2.27E+03	9.15E-09
Hg-197m	M	2.28E-12	2.50E-07	4.40E-12	8.62E-12	-	1.36E+09	2.55E+02	9.69E-01	3.80E-01	7.05E+05	2.41E+10	3.17E+03	2.40E+04	2.79E+03	4.18E-09
Hg-199m	M	6.33E-14	5.77E-07	9.44E-14	1.63E-13	-	1.36E+09	8.55E+03	9.32E-01	3.80E-01	1.25E+09	2.91E+13	4.78E+04	3.74E+07	4.78E+04	2.16E-09
Hg-203	M	8.95E-12	9.22E-07	7.62E-12	1.27E-11	-	1.36E+09	5.43E+00	9.11E-01	3.80E-01	1.02E+04	1.31E+08	1.94E+01	2.94E+02	1.82E+01	1.32E-09
Ho-155	M	5.29E-14	1.52E-06	1.49E-13	2.63E-13	-	1.36E+09	7.59E+03	9.26E-01	2.60E-03	6.87E+08	3.10E+13	1.62E+04	3.08E+09	1.62E+04	6.43E-10
Ho-157	M	7.36E-15	1.85E-06	2.13E-14	3.49E-14	-	1.36E+09	2.89E+04	9.23E-01	2.60E-03	1.97E+10	8.47E+14	5.09E+04	8.20E+10	5.09E+04	5.37E-10
Ho-159	M	1.22E-14	1.16E-06	2.46E-14	3.96E-14	-	1.36E+09	1.10E+04	9.27E-01	2.60E-03	6.64E+09	1.95E+14	3.09E+04	2.71E+10	3.09E+04	8.63E-10
Ho-161	M	1.98E-14	5.52E-08	7.14E-14	1.33E-13	-	1.36E+09	2.43E+03	9.57E-01	2.60E-03	4.35E+08	2.65E+13	1.38E+05	2.05E+09	1.38E+05	1.78E-08
Ho-162	M	5.40E-15	6.03E-07	8.18E-15	1.29E-14	-	1.36E+09	2.43E+04	8.79E-01	2.60E-03	4.48E+10	9.70E+14	1.38E+05	1.79E+11	1.38E+05	1.78E-09

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Wet Soil-to-plant transfer factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Produce Ingestion PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Ho-162m	M	5.18E-14	2.46E-06	1.05E-13	1.81E-13	-	1.36E+09	5.36E+03	9.24E-01	2.60E-03	7.05E+08	2.23E+13	7.09E+03	3.08E+09	7.09E+03	4.16E-10
Ho-164	M	1.65E-14	2.78E-08	2.45E-14	4.11E-14	-	1.36E+09	1.26E+04	9.50E-01	2.60E-03	7.28E+09	1.64E+14	1.43E+06	3.10E+10	1.43E+06	3.62E-08
Ho-164m	M	3.48E-14	3.63E-08	5.88E-14	1.05E-13	-	1.36E+09	9.71E+03	9.57E-01	2.60E-03	2.20E+09	6.02E+13	8.41E+05	9.98E+09	8.41E+05	2.75E-08
Ho-166	M	3.85E-12	1.18E-07	1.35E-11	2.67E-11	-	1.36E+09	2.27E+02	8.97E-01	2.60E-03	2.02E+05	1.27E+10	6.44E+03	1.01E+06	6.20E+03	8.82E-09
Ho-166m	M	3.09E-10	7.70E-06	1.14E-11	2.10E-11	-	1.36E+09	5.78E-04	9.03E-01	2.60E-03	3.81E+01	2.35E+04	1.45E-02	1.78E+02	1.45E-02	8.11E-09
Ho-167	M	2.25E-13	1.45E-06	5.25E-13	9.95E-13	-	1.36E+09	1.96E+03	9.00E-01	2.60E-03	4.69E+07	1.88E+12	4.52E+03	2.25E+08	4.51E+03	7.47E-10
I-120	F	3.89E-13	1.33E-05	2.46E-12	2.33E-12	-	1.36E+09	4.50E+03	8.78E-01	2.00E-02	4.60E+07	2.49E+12	1.16E+03	1.44E+07	1.16E+03	6.00E-11
I-120m	F	1.98E-13	2.55E-05	1.30E-12	1.20E-12	-	1.36E+09	6.87E+03	8.57E-01	2.00E-02	1.36E+08	7.49E+12	9.46E+02	4.15E+07	9.46E+02	3.21E-11
I-121	F	9.81E-14	1.64E-06	6.03E-13	5.59E-13	-	1.36E+09	2.86E+03	8.92E-01	2.00E-02	1.22E+08	6.30E+12	5.89E+03	3.73E+07	5.89E+03	4.83E-10
I-122	-	-	4.17E-06	-	-	-	1.36E+09	1.01E+05	8.75E-01	2.00E-02	-	-	8.30E+04	-	8.30E+04	1.95E-10
I-123	F	3.03E-13	5.10E-07	2.05E-12	1.96E-12	-	1.36E+09	4.60E+02	9.56E-01	2.00E-02	5.59E+06	3.27E+11	2.84E+03	1.76E+06	2.83E+03	1.47E-09
I-124	F	1.76E-11	5.10E-06	1.22E-10	1.16E-10	-	1.36E+09	6.05E+01	8.75E-01	2.00E-02	1.24E+04	7.42E+08	4.08E+01	3.90E+03	4.02E+01	1.60E-10
I-125	F	1.06E-11	7.24E-09	6.29E-11	5.55E-11	-	1.36E+09	4.21E+00	9.86E-01	2.00E-02	1.80E+03	8.56E+07	1.77E+03	5.25E+02	3.31E+02	1.91E-08
I-126	F	3.70E-11	1.96E-06	2.48E-10	2.31E-10	-	1.36E+09	1.94E+01	8.81E-01	2.00E-02	2.00E+03	1.13E+08	3.39E+01	6.15E+02	3.16E+01	3.97E-10
I-128	F	3.04E-14	3.74E-07	2.06E-13	1.89E-13	-	1.36E+09	1.46E+04	8.90E-01	2.00E-02	1.84E+09	1.03E+14	1.32E+05	5.56E+08	1.32E+05	2.24E-09
I-129	F	6.07E-11	6.10E-09	3.22E-10	2.71E-10	-	1.36E+09	4.41E-08	9.80E-01	2.00E-02	2.93E+00	1.18E+05	1.68E+01	8.13E-01	6.13E-01	3.48E-03
I-130	F	2.76E-12	9.67E-06	1.88E-11	1.80E-11	-	1.36E+09	4.91E+02	8.72E-01	2.00E-02	6.50E+05	3.84E+10	1.75E+02	2.05E+05	1.75E+02	8.99E-11
I-131	F	1.95E-11	1.59E-06	1.34E-10	1.26E-10	-	1.36E+09	3.15E+01	8.91E-01	2.00E-02	5.94E+03	3.48E+08	6.68E+01	1.84E+03	6.38E+01	5.15E-10
I-132	F	3.74E-13	1.06E-05	2.34E-12	2.22E-12	-	1.36E+09	2.64E+03	8.92E-01	2.00E-02	2.83E+07	1.52E+12	8.40E+02	8.86E+06	8.40E+02	8.15E-11
I-132m	F	2.70E-13	1.40E-06	1.78E-12	1.70E-12	-	1.36E+09	4.36E+03	8.74E-01	2.00E-02	6.10E+07	3.48E+12	1.07E+04	1.92E+07	1.07E+04	6.29E-10
I-133	F	6.25E-12	2.72E-06	4.40E-11	4.26E-11	-	1.36E+09	2.92E+02	8.81E-01	2.00E-02	1.63E+05	1.01E+10	3.66E+02	5.21E+04	3.63E+02	3.21E-10
I-134	F	1.02E-13	1.24E-05	6.44E-13	5.96E-13	-	1.36E+09	6.92E+03	8.79E-01	2.00E-02	2.77E+08	1.46E+13	1.91E+03	8.44E+07	1.91E+03	7.18E-11
I-135	F	1.34E-12	7.84E-06	8.99E-12	8.62E-12	-	1.36E+09	9.18E+02	9.00E-01	2.00E-02	2.54E+06	1.48E+11	3.92E+02	8.02E+05	3.91E+02	1.12E-10
In-109	M	1.11E-13	2.90E-06	3.50E-13	6.25E-13	-	1.36E+09	1.45E+03	8.99E-01	3.00E-03	5.51E+07	2.81E+12	1.67E+03	2.16E+08	1.67E+03	2.44E-10
In-110	M	2.65E-13	1.41E-05	1.05E-12	1.77E-12	-	1.36E+09	1.24E+03	8.71E-01	3.00E-03	1.67E+07	1.01E+12	3.04E+02	6.18E+07	3.04E+02	5.23E-11
In-110m	M	1.17E-13	7.14E-06	4.00E-13	7.03E-13	-	1.36E+09	5.27E+03	8.74E-01	3.00E-03	1.79E+08	9.72E+12	2.54E+03	6.90E+08	2.54E+03	1.03E-10
In-111	M	8.03E-13	1.42E-06	1.85E-12	3.40E-12	-	1.36E+09	8.94E+01	9.52E-01	3.00E-03	6.26E+05	2.40E+10	1.99E+02	2.53E+06	1.99E+02	4.79E-10
In-112	M	1.10E-14	1.15E-06	2.32E-14	3.70E-14	-	1.36E+09	2.53E+04	9.31E-01	3.00E-03	1.63E+10	4.96E+14	7.11E+04	5.71E+10	7.11E+04	6.11E-10
In-113m	M	5.18E-14	1.05E-06	1.35E-13	2.47E-13	-	1.36E+09	3.66E+03	9.32E-01	3.00E-03	3.53E+08	1.53E+13	1.13E+04	1.42E+09	1.13E+04	6.74E-10
In-114	-	-	1.35E-08	-	-	-	1.36E+09	3.04E+05	8.69E-01	3.00E-03	-	-	7.80E+07	-	7.80E+07	5.67E-08
In-114m	M	3.00E-11	3.57E-07	3.60E-11	7.03E-11	-	1.36E+09	5.11E+00	9.46E-01	3.00E-03	1.73E+03	3.67E+07	4.55E+01	7.43E+03	4.41E+01	1.91E-09
In-115	F	4.03E-10	2.70E-10	4.33E-11	5.85E-11	-	1.36E+09	1.36E-16	9.27E-01	3.00E-03	1.35E+01	1.77E+04	3.98E+02	4.00E+01	9.82E+00	1.61E+07
In-115m	M	2.15E-13	6.27E-07	6.40E-13	1.24E-12	-	1.36E+09	1.35E+03	9.17E-01	3.00E-03	2.60E+07	1.36E+12	7.08E+03	1.11E+08	7.08E+03	1.17E-09
In-116m	M	8.77E-14	1.23E-05	2.26E-13	3.77E-13	-	1.36E+09	6.73E+03	8.92E-01	3.00E-03	4.25E+08	1.65E+13	1.84E+03	1.56E+09	1.84E+03	6.17E-11
In-117	M	5.59E-14	2.90E-06	9.84E-14	1.67E-13	-	1.36E+09	8.32E+03	8.97E-01	3.00E-03	1.19E+09	3.21E+13	9.62E+03	4.42E+09	9.62E+03	2.63E-10
In-117m	M	2.33E-13	3.35E-07	6.44E-13	1.22E-12	-	1.36E+09	3.13E+03	9.23E-01	3.00E-03	6.10E+07	2.90E+12	3.04E+04	2.54E+08	3.04E+04	2.21E-09
In-119	-	-	3.54E-06	-	-	-	1.36E+09	1.52E+05	8.71E-01	3.00E-03	-	-	1.48E+05	-	1.48E+05	2.25E-10
In-119m	M	3.34E-14	5.63E-08	1.04E-13	1.70E-13	-	1.36E+09	2.02E+04	9.30E-01	3.00E-03	2.83E+09	1.31E+14	1.16E+06	1.02E+10	1.16E+06	1.33E-08
Ir-182	S	5.03E-14	5.85E-06	1.39E-13	2.33E-13	-	1.36E+09	2.43E+04	9.28E-01	3.00E-02	2.48E+09	1.04E+14	1.35E+04	9.15E+08	1.35E+04	1.96E-10
Ir-184	S	3.30E-13	8.67E-06	9.21E-13	1.67E-12	-	1.36E+09	2.01E+03	9.44E-01	3.00E-02	2.87E+07	1.31E+12	7.39E+02	1.14E+07	7.39E+02	1.31E-10
Ir-185	S	7.25E-13	2.69E-06	1.91E-12	3.61E-12	-	1.36E+09	4.34E+02	9.53E-01	3.00E-02	2.86E+06	1.29E+11	5.09E+02	1.19E+06	5.09E+02	4.21E-10
Ir-186	S	1.06E-12	7.41E-06	2.98E-12	5.44E-12	-	1.36E+09	3.84E+02	9.42E-01	3.00E-02	1.68E+06	7.82E+10	1.66E+02	6.75E+05	1.66E+02	1.56E-10
Ir-186m	S	1.11E-13	4.22E-06	2.84E-13	5.07E-13	-	1.36E+09	3.47E+03	8.78E-01	3.00E-02	1.63E+08	6.74E+12	2.82E+03	6.39E+07	2.82E+03	2.93E-10
Ir-187	S	2.87E-13	1.42E-06	8.33E-13	1.57E-12	-	1.36E+09	5.78E+02	9.58E-01	3.00E-02	8.77E+06	4.35E+11	1.28E+03	3.63E+06	1.28E+03	8.02E-10
Ir-188	S	1.38E-12	7.69E-06	3.58E-12	6.40E-12	-	1.36E+09	1.46E+02	9.08E-01	3.00E-02	5.44E+05	2.29E+10	6.30E+01	2.14E+05	6.30E+01	1.57E-10
Ir-189	S	2.33E-12	1.69E-07	2.21E-12	4.29E-12	-	1.36E+09	1.90E+01	9.54E-01	3.00E-02	1.06E+05	1.76E+09	3.55E+02	4.51E+04	3.51E+02	6.77E-09
Ir-190	S	8.81E-12	5.99E-06	8.10E-12	1.50E-11	-	1.36E+09	2.09E+01	9.28E-01	3.00E-02	3.32E+04	5.12E+08	1.13E+01	1.35E+04	1.13E+01	1.99E-10
Ir-190m	S	3.89E-14	8.69E-13	4.55E-14	8.44E-14	-	1.36E+09	5.06E+03	1.00E+00	3.00E-02	1.43E+09	2.81E+13	1.75E+10	5.82E+08	4.04E+08	2.94E-05
Ir-190n	S	2.14E-13	6.48E-06	6.03E-13	1.07E-12	-	1.36E+09	1.96E+03	9.55E-01	3.00E-02	4.36E+07	1.97E+12	9.52E+02	1.70E+07	9.52E+02	1.79E-10
Ir-191m	-	-	1.58E-07	-	-	-	1.36E+09	4.42E+06	9.45E-01	3.00E-02	-	-	8.91E+07	-	8.91E+07	7.47E-09
Ir-192	S	2.41E-11	3.40E-06	1.07E-11	2.04E-11	-	1.36E+09	3.42E+00	9.57E-01	3.00E-02	3.99E+03	3.06E+07	3.16E+00	1.67E+03	3.15E+00	3.44E-10
Ir-192m	S	1.02E-10	5.40E-07	1.32E-12	2.16E-12	-	1.36E+09	2.88E-03	9.25E-01	3.00E-02	3.84E+02	7.36E+04	2.10E-01	1.38E+02	2.09E-01	2.71E-08
Ir-194	S	3.40E-12	4.09E-07	1.26E-11	2.49E-11	-	1.36E+09	3.17E+02	9.02E-01	3.00E-02	3.03E+05	2.01E+10	2.59E+03	1.32E+05	2.51E+03	2.99E-09
Ir-194m	S	4.59E-11	1.01E-05	1.26E-11	2.29E-11	-	1.36E+09	1.48E+00	8.81E-01	3.00E-02	1.54E+03	6.95E+06	5.00E-01	6.15E+02	5.00E-01	1.27E-10
Ir-195	S	2.39E-13	1.12E-07	5.77E-13	1.10E-12	-	1.36E+09	2.43E+03	9.54E-01	3.00E-02	5.26E+07	2.19E+12	6.84E+04	2.20E+07	6.81E+04	1.06E-08
Ir-195m	S	5.96E-13	1.58E-06	1.50E-12	2.89E-12	-	1.36E+09	1.60E+03	9.98E-01	3.00E-02	1.32E+07	5.78E+11	3.05E+03	5.58E+06	3.05E+03	7.21E-10
K-38	-	-	1.61E-05	-	-	-	1.36E+09	4.77E+04	8.44E-01	3.00E-01	-	-	1.06E+04	-	1.06E+04	1.63E-11
K-40	F	1.03E-11	7.98E-07	3.43E-11	6.18E-11	-	1.36E+09	5.41E-10	8.26E-01	3.00E-01	1.28E+01	6.98E+05	1.52E-01	5.09E-01	1.16E-01	1.66E-02
K-42	F	4.33E-13	1.46E-06	1.74E-12	3.06E-12	-	1.36E+09	4.91E+02	8.23E-01	3.00E-01	3.82E+06	2.45E+11	1.23E+03	1.48E+05	1.22E+03	2.02E-10
K-43	F	3.09E-13	4.23E-06	1.07E-12	1.81E-12	-	1.36E+09	2.69E+02	8.78E-01	3.00E-01	3.53E+06	1.88E+11	2.18E+02	1.31E+05	2.17E+02	6.75E-11

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Wet Soil-to-plant transfer factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Produce Ingestion PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
K-44	F	3.39E-14	1.19E-05	1.91E-13	3.00E-13	-	1.36E+09	1.65E+04	7.99E-01	3.00E-01	1.31E+09	1.05E+14	5.21E+03	4.51E+07	5.21E+03	2.70E-11
K-45	F	2.33E-14	9.53E-06	1.22E-13	1.93E-13	-	1.36E+09	1.82E+04	8.33E-01	3.00E-01	2.25E+09	1.69E+14	6.90E+03	7.82E+07	6.90E+03	3.31E-11
Kr-74	-	-	4.91E-06	-	-	-	1.36E+09	3.17E+04	9.23E-01	0.00E+00	-	-	2.10E+04	-	2.10E+04	9.53E-11
Kr-76	-	-	1.73E-06	-	-	-	1.36E+09	4.10E+02	9.71E-01	0.00E+00	-	-	7.35E+02	-	7.35E+02	2.64E-10
Kr-77	-	-	4.22E-06	-	-	-	1.36E+09	4.88E+03	8.94E-01	0.00E+00	-	-	3.89E+03	-	3.89E+03	1.19E-10
Kr-79	-	-	1.08E-06	-	-	-	1.36E+09	1.73E+02	8.93E-01	0.00E+00	-	-	5.40E+02	-	5.40E+02	4.78E-10
Kr-81	-	-	2.18E-08	-	-	-	1.36E+09	3.30E-06	9.99E-01	0.00E+00	-	-	4.61E+00	-	4.61E+00	2.19E-04
Kr-81m	-	-	4.60E-07	-	-	-	1.36E+09	1.68E+06	9.68E-01	0.00E+00	-	-	1.14E+07	-	1.14E+07	1.06E-09
Kr-83m	-	-	1.34E-11	-	-	-	1.36E+09	3.32E+03	1.00E+00	0.00E+00	-	-	7.45E+08	-	7.45E+08	3.62E-05
Kr-85	-	-	1.05E-08	-	-	-	1.36E+09	6.46E-02	8.84E-01	0.00E+00	-	-	2.45E+01	-	2.45E+01	6.24E-08
Kr-85m	-	-	5.47E-07	-	-	-	1.36E+09	1.36E+03	9.28E-01	0.00E+00	-	-	8.03E+03	-	8.03E+03	9.78E-10
Kr-87	-	-	4.01E-06	-	-	-	1.36E+09	4.77E+03	8.49E-01	0.00E+00	-	-	4.22E+03	-	4.22E+03	1.49E-10
Kr-88	-	-	1.02E-05	-	-	-	1.36E+09	2.14E+03	9.16E-01	0.00E+00	-	-	6.88E+02	-	6.88E+02	5.50E-11
La-131	M	5.48E-14	2.76E-06	1.31E-13	2.28E-13	-	1.36E+09	6.17E+03	8.96E-01	2.50E-03	6.45E+08	2.43E+13	7.51E+03	2.96E+09	7.51E+03	3.09E-10
La-132	M	6.25E-13	9.52E-06	2.58E-12	4.85E-12	-	1.36E+09	1.26E+03	8.79E-01	2.50E-03	6.21E+06	4.37E+11	4.55E+02	3.08E+07	4.55E+02	9.21E-11
La-134	-	-	3.05E-06	-	-	-	1.36E+09	5.46E+04	8.90E-01	2.50E-03	-	-	6.05E+04	-	6.05E+04	2.88E-10
La-135	M	5.03E-14	5.21E-08	2.11E-13	3.96E-13	-	1.36E+09	3.11E+02	9.43E-01	2.50E-03	1.87E+07	1.34E+12	1.91E+04	9.27E+07	1.90E+04	1.60E-08
La-137	F	1.39E-11	6.75E-09	5.00E-13	9.44E-13	-	1.36E+09	1.16E-05	9.78E-01	2.50E-03	8.41E+02	5.18E+05	1.52E+01	4.19E+03	1.49E+01	3.42E-04
La-138	F	3.05E-10	6.07E-06	4.96E-12	8.81E-12	-	1.36E+09	5.13E-12	8.42E-01	2.50E-03	9.01E+01	2.36E+04	1.96E-02	4.22E+02	1.96E-02	1.02E+00
La-140	M	4.77E-12	1.15E-05	1.59E-11	3.05E-11	-	1.36E+09	1.51E+02	8.68E-01	2.50E-03	1.18E+05	6.82E+09	4.54E+01	5.96E+05	4.54E+01	8.18E-11
La-141	M	7.44E-13	2.37E-07	2.74E-12	5.37E-12	-	1.36E+09	1.54E+03	8.29E-01	2.50E-03	6.85E+06	4.48E+11	2.37E+04	3.54E+07	2.36E+04	4.17E-09
La-142	M	2.42E-13	1.44E-05	8.21E-13	1.48E-12	-	1.36E+09	3.94E+03	8.80E-01	2.50E-03	6.33E+07	3.51E+12	9.35E+02	3.01E+08	9.35E+02	6.54E-11
La-143	M	5.66E-14	5.12E-07	1.78E-13	3.14E-13	-	1.36E+09	2.56E+04	8.53E-01	2.50E-03	1.94E+09	9.76E+13	1.76E+05	9.03E+09	1.76E+05	1.91E-09
Lu-169	S	1.33E-12	4.73E-06	2.77E-12	5.03E-12	-	1.36E+09	1.78E+02	9.22E-01	-	8.44E+05	2.89E+10	1.23E+02	-	1.23E+02	2.26E-10
Lu-170	S	2.25E-12	1.26E-05	5.88E-12	1.06E-11	-	1.36E+09	1.26E+02	9.41E-01	-	2.84E+05	1.21E+10	3.21E+01	-	3.21E+01	8.37E-11
Lu-171	S	3.50E-12	2.90E-06	4.70E-12	8.84E-12	-	1.36E+09	3.08E+01	9.41E-01	-	8.29E+04	1.90E+09	3.39E+01	-	3.39E+01	3.66E-10
Lu-172	S	6.03E-12	8.70E-06	8.03E-12	1.47E-11	-	1.36E+09	3.78E+01	9.20E-01	-	6.11E+04	1.35E+09	1.42E+01	-	1.42E+01	1.25E-10
Lu-173	S	8.70E-12	2.92E-07	1.96E-12	3.74E-12	-	1.36E+09	5.06E-01	9.07E-01	-	3.22E+03	1.25E+07	5.75E+00	-	5.74E+00	3.81E-09
Lu-174	S	1.42E-11	4.26E-07	2.12E-12	4.11E-12	-	1.36E+09	2.09E-01	9.17E-01	-	1.22E+03	3.19E+06	1.62E+00	-	1.61E+00	2.60E-09
Lu-174m	S	1.51E-11	9.88E-08	4.96E-12	9.73E-12	-	1.36E+09	1.78E+00	9.48E-01	-	4.36E+03	2.55E+07	5.72E+01	-	5.65E+01	1.07E-08
Lu-176	S	1.41E-10	1.83E-06	1.35E-11	2.60E-11	-	1.36E+09	1.93E-11	9.12E-01	-	3.05E+01	5.10E+04	6.01E-02	-	6.00E-02	1.06E+00
Lu-176m	S	4.55E-13	2.78E-08	1.25E-12	2.43E-12	-	1.36E+09	1.65E+03	9.47E-01	-	1.62E+07	7.82E+11	1.89E+05	-	1.86E+05	3.86E-08
Lu-177	S	4.66E-12	1.14E-07	5.18E-12	1.02E-11	-	1.36E+09	3.77E+01	9.23E-01	-	8.80E+04	1.75E+09	1.08E+03	-	1.06E+03	9.70E-09
Lu-177m	S	5.70E-11	3.63E-06	1.36E-11	2.60E-11	-	1.36E+09	1.57E+00	9.41E-01	-	1.44E+03	5.95E+06	1.38E+00	-	1.38E+00	3.02E-10
Lu-178	S	5.29E-14	6.76E-07	1.20E-13	2.02E-13	-	1.36E+09	1.28E+04	8.36E-01	-	1.51E+09	5.23E+13	6.83E+04	-	6.83E+04	1.84E-09
Lu-178m	S	5.85E-14	4.26E-06	9.84E-14	1.59E-13	-	1.36E+09	1.60E+04	9.04E-01	-	2.40E+09	5.92E+13	1.25E+04	-	1.25E+04	2.70E-10
Lu-179	S	5.14E-13	1.19E-07	1.64E-12	3.21E-12	-	1.36E+09	1.32E+03	9.05E-01	-	9.81E+06	5.55E+11	3.70E+04	-	3.68E+04	9.67E-09
Md-257	M	7.70E-11	3.62E-07	8.58E-13	1.67E-12	-	1.36E+09	1.17E+03	9.95E-01	-	1.66E+07	3.27E+09	9.75E+03	-	9.75E+03	4.16E-09
Md-258	M	1.68E-08	1.31E-09	6.25E-11	1.23E-10	-	1.36E+09	4.60E+00	9.96E-01	-	8.90E+02	5.91E+04	1.06E+04	-	8.10E+02	8.82E-08
Mg-28	M	5.14E-12	6.56E-06	1.65E-11	3.06E-11	-	1.36E+09	2.90E+02	8.72E-01	-	2.26E+05	1.22E+10	1.53E+02	-	1.53E+02	2.86E-11
Mn-51	M	9.55E-14	4.37E-06	2.95E-13	5.11E-13	-	1.36E+09	7.88E+03	8.82E-01	3.00E-01	3.67E+08	1.78E+13	6.15E+03	1.40E+07	6.15E+03	7.72E-11
Mn-52	M	4.40E-12	1.67E-05	9.07E-12	1.58E-11	-	1.36E+09	4.52E+01	8.36E-01	3.00E-01	6.82E+04	2.22E+09	9.75E+00	2.61E+03	9.71E+00	2.17E-11
Mn-52m	M	5.07E-14	1.15E-05	1.75E-13	2.82E-13	-	1.36E+09	1.73E+04	8.48E-01	3.00E-01	1.46E+09	7.35E+13	5.33E+03	5.16E+07	5.33E+03	3.11E-11
Mn-53	M	2.17E-13	0.00E+00	2.25E-13	4.37E-13	-	1.36E+09	1.87E-07	0.00E+00	3.00E-01	1.82E+03	3.31E+07	-	7.76E+01	7.44E+01	4.08E-02
Mn-54	M	5.88E-12	3.89E-06	3.11E-12	5.14E-12	-	1.36E+09	8.09E-01	8.58E-01	3.00E-01	3.75E+03	2.97E+07	7.30E-01	1.36E+02	7.26E-01	9.39E-11
Mn-56	M	4.14E-13	8.44E-06	1.48E-12	2.78E-12	-	1.36E+09	2.35E+03	8.27E-01	3.00E-01	2.02E+07	1.23E+12	1.01E+03	8.33E+05	1.01E+03	4.68E-11
Mo-101	M	4.33E-14	6.62E-06	9.44E-14	1.48E-13	-	1.36E+09	2.49E+04	9.17E-01	1.30E-01	4.01E+09	1.24E+14	1.23E+04	3.19E+08	1.23E+04	9.71E-11
Mo-90	M	1.24E-12	3.41E-06	8.73E-13	1.39E-12	-	1.36E+09	1.07E+03	8.84E-01	1.30E-01	1.83E+07	1.86E+11	1.07E+03	1.48E+06	1.07E+03	1.74E-10
Mo-93	M	1.27E-12	2.17E-10	4.18E-12	5.29E-12	-	1.36E+09	1.98E-04	1.00E+00	1.30E-01	1.50E+02	5.68E+06	4.64E+02	9.66E+00	8.91E+00	8.12E-06
Mo-93m	M	4.33E-13	1.09E-05	4.26E-13	6.62E-13	-	1.36E+09	8.86E+02	8.61E-01	1.30E-01	3.19E+07	4.42E+11	2.84E+02	2.51E+06	2.84E+02	5.78E-11
Mo-99	M	4.29E-12	6.65E-07	2.11E-12	3.50E-12	-	1.36E+09	9.20E+01	9.29E-01	1.30E-01	6.26E+05	4.63E+09	4.48E+02	5.27E+04	4.44E+02	9.27E-10
N-13	-	-	4.45E-06	-	-	-	1.36E+09	3.66E+04	8.83E-01	7.50E+00	-	-	2.80E+04	-	2.80E+04	1.93E-11
Na-22	F	3.89E-12	1.03E-05	1.26E-11	1.97E-11	-	1.36E+09	2.66E-01	8.61E-01	5.00E-02	3.22E+02	1.48E+07	9.04E-02	6.64E+01	9.02E-02	1.45E-11
Na-24	F	4.74E-13	2.20E-05	1.65E-12	2.64E-12	-	1.36E+09	4.05E+02	8.06E-01	5.00E-02	3.65E+06	1.84E+11	6.87E+01	7.70E+05	6.87E+01	7.90E-12
Nb-88	M	4.51E-14	1.89E-05	1.55E-13	2.45E-13	-	1.36E+09	2.55E+04	8.71E-01	1.00E-02	2.48E+09	1.22E+14	4.66E+03	2.58E+09	4.66E+03	3.12E-11
Nb-89	M	4.07E-13	6.65E-06	1.51E-12	2.82E-12	-	1.36E+09	2.99E+03	8.85E-01	1.00E-02	2.52E+07	1.58E+12	1.53E+03	3.11E+07	1.53E+03	8.83E-11
Nb-89m	M	1.74E-13	8.48E-06	5.66E-13	1.01E-12	-	1.36E+09	5.52E+03	8.90E-01	1.00E-02	1.30E+08	6.84E+12	2.20E+03	1.53E+08	2.20E+03	6.88E-11
Nb-90	M	2.27E-12	2.13E-05	8.21E-12	1.52E-11	-	1.36E+09	4.16E+02	8.51E-01	1.00E-02	6.51E+05	3.95E+10	6.90E+01	7.95E+05	6.90E+01	2.90E-11
Nb-93m	M	1.90E-12	3.83E-11	1.17E-12	2.31E-12	-	1.36E+09	5.10E-02	1.00E+00	1.00E-02	6.71E+02	7.39E+06	5.11E+03	8.73E+02	3.53E+02	1.25E-06
Nb-94	M	3.77E-11	7.29E-06	1.11E-11	2.05E-11	-	1.36E+09	3.41E-05	8.61E-01	1.00E-02	3.87E+01	1.91E+05	1.60E-02	4.72E+01	1.60E-02	8.54E-08

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Wet Soil-to-plant transfer factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Produce Ingestion PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Nb-95	M	5.44E-12	3.53E-06	3.50E-12	6.36E-12	-	1.36E+09	7.20E+00	8.63E-01	1.00E-02	2.69E+04	2.85E+08	7.11E+00	3.23E+04	7.10E+00	1.82E-10
Nb-95m	M	3.27E-12	2.32E-07	5.37E-12	1.05E-11	-	1.36E+09	7.01E+01	9.88E-01	1.00E-02	1.59E+05	4.63E+09	9.20E+02	2.05E+05	9.11E+02	2.40E-09
Nb-96	M	2.28E-12	1.15E-05	7.25E-12	1.35E-11	-	1.36E+09	2.60E+02	8.66E-01	1.00E-02	4.59E+05	2.46E+10	7.85E+01	5.63E+05	7.85E+01	5.63E-11
Nb-97	M	1.07E-13	2.97E-06	2.79E-13	5.00E-13	-	1.36E+09	5.05E+03	8.70E-01	1.00E-02	2.41E+08	1.02E+13	5.88E+03	2.84E+08	5.88E+03	2.19E-10
Nb-97m	-	-	3.34E-06	-	-	-	1.36E+09	3.64E+05	8.70E-01	1.00E-02	-	-	3.77E+05	-	3.77E+05	1.95E-10
Nb-98	M	1.23E-13	1.16E-05	3.92E-13	6.73E-13	-	1.36E+09	7.07E+03	8.40E-01	1.00E-02	2.50E+08	1.24E+13	2.18E+03	2.83E+08	2.18E+03	5.87E-11
Nd-136	S	1.34E-13	1.01E-06	3.81E-13	6.70E-13	-	1.36E+09	7.19E+03	8.84E-01	2.40E-03	2.56E+08	1.16E+13	2.42E+04	1.24E+09	2.42E+04	8.89E-10
Nd-138	S	1.24E-12	6.73E-08	5.00E-12	9.69E-12	-	1.36E+09	1.20E+03	9.45E-01	2.40E-03	2.96E+06	2.10E+11	5.70E+04	1.58E+07	5.57E+04	1.24E-08
Nd-139	S	2.37E-14	1.72E-06	6.96E-14	1.21E-13	-	1.36E+09	1.23E+04	8.70E-01	2.40E-03	2.41E+09	1.12E+14	2.47E+04	1.15E+10	2.47E+04	5.42E-10
Nd-139m	S	4.96E-13	7.14E-06	1.56E-12	2.86E-12	-	1.36E+09	1.10E+03	8.98E-01	2.40E-03	9.19E+06	4.80E+11	5.18E+02	4.63E+07	5.18E+02	1.27E-10
Nd-141	S	1.34E-14	2.28E-07	4.40E-14	8.07E-14	-	1.36E+09	2.44E+03	9.42E-01	2.40E-03	7.19E+08	3.93E+13	3.42E+04	3.63E+09	3.42E+04	3.83E-09
Nd-141m	-	-	3.48E-06	-	-	-	1.36E+09	3.50E+05	8.65E-01	2.40E-03	-	-	3.50E+05	-	3.50E+05	2.73E-10
Nd-147	S	9.36E-12	4.87E-07	1.02E-11	2.01E-11	-	1.36E+09	2.30E+01	8.90E-01	2.40E-03	2.73E+04	5.31E+08	1.60E+02	1.48E+05	1.59E+02	1.97E-09
Nd-149	S	3.19E-13	1.50E-06	7.92E-13	1.51E-12	-	1.36E+09	3.51E+03	9.27E-01	2.40E-03	5.53E+07	2.37E+12	7.59E+03	2.90E+08	7.59E+03	6.26E-10
Nd-151	S	3.92E-14	4.10E-06	1.04E-13	1.83E-13	-	1.36E+09	2.93E+04	9.28E-01	2.40E-03	3.81E+09	1.61E+14	2.32E+04	1.84E+10	2.32E+04	2.32E-10
Ne-19	-	-	4.47E-06	-	-	-	1.36E+09	1.27E+06	8.83E-01	-	-	-	9.67E+05	-	9.67E+05	2.81E-11
Ni-56	M	2.88E-12	7.74E-06	3.96E-12	6.70E-12	-	1.36E+09	4.15E+01	8.69E-01	5.00E-02	1.47E+05	3.11E+09	1.85E+01	3.29E+04	1.85E+01	4.86E-11
Ni-57	M	1.78E-12	9.44E-06	5.55E-12	1.02E-11	-	1.36E+09	1.68E+02	8.29E-01	5.00E-02	3.93E+05	2.04E+10	6.47E+01	9.52E+04	6.46E+01	4.25E-11
Ni-59	M	4.66E-13	0.00E+00	3.89E-13	7.33E-13	-	1.36E+09	9.24E-06	0.00E+00	5.00E-02	1.08E+03	1.54E+07	-	2.69E+02	2.16E+02	2.67E-03
Ni-63	M	1.64E-12	0.00E+00	9.51E-13	1.79E-12	-	1.36E+09	7.22E-03	0.00E+00	5.00E-02	4.93E+02	4.88E+06	-	1.22E+02	9.81E+01	1.66E-06
Ni-65	M	3.03E-13	2.74E-06	1.01E-12	1.92E-12	-	1.36E+09	2.41E+03	8.31E-01	5.00E-02	2.99E+07	1.72E+12	3.18E+03	7.49E+06	3.18E+03	1.67E-10
Ni-66	M	8.99E-12	2.67E-11	2.94E-11	5.77E-11	-	1.36E+09	1.11E+02	9.27E-01	5.00E-02	4.59E+04	2.67E+09	1.35E+07	1.19E+04	9.43E+03	1.09E-08
Np-232	M	3.17E-14	5.26E-06	2.70E-14	4.14E-14	-	1.36E+09	2.48E+04	9.16E-01	2.00E-02	1.43E+10	1.69E+14	1.55E+04	7.21E+09	1.55E+04	2.81E-10
Np-233	M	2.49E-15	2.29E-07	6.99E-15	1.14E-14	-	1.36E+09	1.01E+04	9.51E-01	2.00E-02	2.10E+10	8.72E+14	1.39E+05	1.13E+10	1.39E+05	6.25E-09
Np-234	M	1.86E-12	7.07E-06	4.85E-12	8.77E-12	-	1.36E+09	5.75E+01	9.66E-01	2.00E-02	1.56E+05	6.67E+09	2.53E+01	9.31E+04	2.53E+01	2.00E-10
Np-235	M	1.15E-12	2.13E-09	5.07E-13	9.99E-13	-	1.36E+09	6.39E-01	1.00E+00	2.00E-02	1.52E+04	1.20E+08	9.02E+02	9.89E+03	7.84E+02	5.60E-07
Np-236	M	9.77E-10	3.25E-07	1.44E-11	2.56E-11	-	1.36E+09	6.03E-06	9.99E-01	2.00E-02	3.10E+01	7.36E+03	3.09E-01	1.82E+01	3.01E-01	2.29E-05
Np-236m	M	8.07E-12	1.34E-07	1.63E-12	3.19E-12	-	1.36E+09	2.70E+02	9.99E-01	2.00E-02	2.01E+06	7.21E+09	6.06E+03	1.30E+06	6.02E+03	1.02E-08
Np-237	M	1.77E-08	5.36E-08	8.29E-11	1.46E-10	-	1.36E+09	3.24E-07	9.73E-01	2.00E-02	5.44E+00	4.06E+02	1.92E+00	3.16E+00	9.77E-01	1.39E-03
Np-237+D	M	1.77E-08	7.96E-07	9.10E-11	1.62E-10	-	1.36E+09	3.24E-07	9.73E-01	2.00E-02	4.90E+00	4.06E+02	1.29E-01	2.88E+00	1.21E-01	1.72E-04
Np-238	M	4.18E-12	2.62E-06	7.88E-12	1.52E-11	-	1.36E+09	1.19E+02	9.95E-01	2.00E-02	1.87E+05	6.17E+09	1.38E+02	1.19E+05	1.38E+02	5.32E-10
Np-239	M	4.00E-12	5.41E-07	7.51E-12	1.47E-11	-	1.36E+09	1.07E+02	9.45E-01	2.00E-02	1.74E+05	5.79E+09	6.32E+02	1.12E+05	6.26E+02	2.70E-09
Np-240	M	1.95E-13	5.80E-06	3.16E-13	5.55E-13	-	1.36E+09	5.60E+03	9.54E-01	2.00E-02	2.40E+08	6.20E+12	3.05E+03	1.39E+08	3.05E+03	2.53E-10
Np-240m	-	-	1.51E-06	-	-	-	1.36E+09	4.92E+04	9.70E-01	2.00E-02	-	-	1.01E+05	-	1.01E+05	9.57E-10
O-15	-	-	4.46E-06	-	-	-	1.36E+09	1.79E+05	8.83E-01	-	-	-	1.37E+05	-	1.37E+05	2.22E-11
Os-180	M	2.62E-14	1.08E-07	5.00E-14	7.92E-14	-	1.36E+09	1.66E+04	9.70E-01	-	4.98E+09	1.36E+14	4.76E+05	-	4.75E+05	1.00E-08
Os-181	M	1.95E-13	5.41E-06	5.07E-13	9.21E-13	-	1.36E+09	3.47E+03	9.18E-01	-	8.97E+07	3.84E+12	2.10E+03	-	2.10E+03	2.13E-10
Os-182	M	1.45E-12	1.64E-06	3.74E-12	6.92E-12	-	1.36E+09	2.76E+02	9.50E-01	-	9.49E+05	4.11E+10	5.33E+02	-	5.33E+02	6.82E-10
Os-185	M	6.14E-12	3.11E-06	2.70E-12	4.77E-12	-	1.36E+09	2.69E+00	8.71E-01	-	1.34E+04	9.46E+07	2.99E+00	-	2.99E+00	3.99E-10
Os-189m	M	3.44E-14	7.21E-13	1.50E-13	2.94E-13	-	1.36E+09	1.01E+03	1.00E+00	-	8.19E+07	6.35E+12	4.22E+09	-	8.04E+07	2.91E-05
Os-190m	M	-	6.76E-06	-	-	-	1.36E+09	3.68E+04	8.87E-01	-	-	-	1.85E+04	-	1.85E+04	1.85E-10
Os-191	M	7.10E-12	1.66E-07	5.33E-12	1.05E-11	-	1.36E+09	1.64E+01	9.45E-01	-	3.72E+04	4.99E+08	3.15E+02	-	3.12E+02	7.05E-09
Os-191m	M	6.36E-13	1.05E-08	8.95E-13	1.76E-12	-	1.36E+09	4.66E+02	9.80E-01	-	6.30E+06	1.58E+11	1.36E+05	-	1.33E+05	1.06E-07
Os-193	M	2.71E-12	2.69E-07	7.77E-12	1.53E-11	-	1.36E+09	2.02E+02	9.39E-01	-	3.15E+05	1.61E+10	2.41E+03	-	2.39E+03	4.43E-09
Os-194	M	2.55E-10	6.58E-10	2.23E-11	4.37E-11	-	1.36E+09	1.16E-01	9.94E-01	-	6.50E+01	1.01E+05	5.48E+02	-	5.80E+01	1.89E-07
Os-194+D	M	-	4.09E-07	-	-	-	1.36E+09	1.16E-01	9.03E-01	-	-	-	9.71E-01	-	9.71E-01	3.17E-09
P-30	-	-	4.50E-06	-	-	-	1.36E+09	1.46E+05	8.83E-01	1.00E+00	-	-	1.10E+05	-	1.10E+05	4.41E-11
P-32	M	1.22E-11	9.41E-09	1.23E-11	2.21E-11	-	1.36E+09	1.77E+01	9.27E-01	1.00E+00	1.91E+04	3.13E+08	6.11E+03	2.26E+02	2.15E+02	7.56E-10
P-33	M	5.11E-12	3.73E-11	1.36E-12	2.47E-12	-	1.36E+09	9.96E+00	9.27E-01	1.00E+00	9.60E+04	4.20E+08	8.67E+05	1.15E+03	1.13E+03	7.30E-09
Pa-227	S	2.12E-10	4.37E-08	1.37E-12	2.38E-12	-	1.36E+09	9.51E+03	1.00E+00	1.00E-02	9.51E+07	9.68E+09	6.55E+05	1.09E+08	6.46E+05	2.99E-08
Pa-228	S	2.33E-10	5.10E-06	5.18E-12	9.84E-12	-	1.36E+09	2.76E+02	1.00E+00	1.00E-02	6.68E+05	2.56E+08	1.63E+02	8.37E+05	1.63E+02	2.61E-10
Pa-230	S	2.58E-09	2.86E-06	5.40E-12	1.02E-11	-	1.36E+09	1.45E+01	1.00E+00	1.00E-02	3.39E+04	1.22E+06	1.53E+01	4.23E+04	1.53E+01	4.69E-10
Pa-231	S	4.55E-08	1.39E-07	2.26E-10	3.74E-10	-	1.36E+09	2.12E-05	9.94E-01	1.00E-02	2.12E+00	1.58E+02	7.26E-01	2.32E+00	4.37E-01	9.27E-06
Pa-232	S	6.81E-12	4.29E-06	5.03E-12	9.55E-12	-	1.36E+09	1.93E+02	9.52E-01	1.00E-02	4.81E+05	6.12E+09	1.42E+02	6.03E+05	1.42E+02	3.31E-10
Pa-233	S	1.42E-11	7.43E-07	8.14E-12	1.59E-11	-	1.36E+09	9.37E+00	9.51E-01	1.00E-02	1.40E+04	1.42E+08	3.99E+01	1.81E+04	3.97E+01	1.92E-09
Pa-234	S	1.46E-12	8.71E-06	3.70E-12	7.03E-12	-	1.36E+09	9.06E+02	9.57E-01	1.00E-02	3.07E+06	1.34E+11	3.27E+02	3.85E+06	3.27E+02	1.64E-10
Pa-234m	-	-	6.87E-08	-	-	-	1.36E+09	3.11E+05	9.99E-01	1.00E-02	-	-	1.36E+07	-	1.36E+07	1.99E-08
Pb-195m	M	4.37E-14	6.90E-06	7.55E-14	1.20E-13	-	1.36E+09	2.31E+04	9.02E-01	1.00E-02	4.57E+09	1.14E+14	1.11E+04	4.80E+09	1.11E+04	1.83E-10
Pb-198	M	1.43E-13	1.62E-06	3.63E-13	6.18E-13	-	1.36E+09	2.53E+03	9.36E-01	1.00E-02	9.75E+07	3.82E+12	5.02E+03	1.09E+08	5.02E+03	7.62E-10
Pb-199	M	7.44E-14	6.87E-06	1.97E-13	3.28E-13	-	1.36E+09	4.05E+03	9.58E-01	1.00E-02	2.94E+08	1.17E+13	1.85E+03	3.23E+08	1.85E+03	1.77E-10

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Wet Soil-to-plant transfer factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Produce Ingestion PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Pb-200	M	1.16E-12	5.97E-07	2.24E-12	4.03E-12	-	1.36E+09	2.82E+02	9.39E-01	1.00E-02	1.67E+06	5.25E+10	1.52E+03	1.98E+06	1.51E+03	2.08E-09
Pb-201	M	3.50E-13	3.18E-06	8.36E-13	1.47E-12	-	1.36E+09	6.46E+02	9.60E-01	1.00E-02	1.05E+07	3.98E+11	6.37E+02	1.21E+07	6.36E+02	3.84E-10
Pb-202	M	1.43E-11	3.10E-12	2.93E-11	3.74E-11	-	1.36E+09	2.31E-06	1.00E+00	1.00E-02	2.12E+01	5.03E+05	3.24E+04	1.79E+01	9.70E+00	1.65E-03
Pb-202+D	M	-	1.83E-06	-	-	-	1.36E+09	2.31E-06	9.06E-01	1.00E-02	-	-	6.05E-02	-	6.05E-02	1.03E-05
Pb-202m	M	2.25E-13	9.32E-06	5.85E-13	9.84E-13	-	1.36E+09	1.68E+03	9.94E-01	1.00E-02	4.06E+07	1.61E+12	5.45E+02	4.50E+07	5.45E+02	1.27E-10
Pb-203	M	7.55E-13	1.09E-06	1.46E-12	2.65E-12	-	1.36E+09	1.17E+02	9.21E-01	1.00E-02	1.05E+06	3.33E+10	3.50E+02	1.25E+06	3.49E+02	1.18E-09
Pb-205	M	6.44E-13	3.50E-12	8.25E-13	1.26E-12	-	1.36E+09	4.85E-08	1.00E+00	1.00E-02	6.30E+02	1.12E+07	2.87E+04	6.35E+02	3.13E+02	2.57E+00
Pb-209	M	1.90E-13	5.37E-10	3.49E-13	6.55E-13	-	1.36E+09	1.87E+03	9.27E-01	1.00E-02	6.78E+07	2.12E+12	1.13E+07	8.40E+07	8.67E+06	1.88E-06
Pb-210	M	2.77E-09	1.41E-09	1.18E-09	1.84E-09	-	1.36E+09	3.11E-02	9.96E-01	1.00E-02	6.63E-01	3.99E+03	1.10E+02	6.82E-01	3.35E-01	4.40E-09
Pb-211	M	3.70E-11	2.29E-07	5.81E-13	1.04E-12	-	1.36E+09	1.01E+04	8.94E-01	1.00E-02	2.31E+08	5.88E+10	1.48E+05	2.73E+08	1.48E+05	6.01E-09
Pb-212	M	5.77E-10	5.09E-07	3.54E-11	6.70E-11	-	1.36E+09	5.71E+02	9.19E-01	1.00E-02	2.03E+05	2.13E+08	3.67E+03	2.53E+05	3.55E+03	2.56E-09
Pb-214	M	3.63E-11	9.82E-07	4.85E-13	8.51E-13	-	1.36E+09	1.36E+04	9.29E-01	1.00E-02	3.80E+08	8.08E+10	4.48E+04	4.40E+08	4.48E+04	1.37E-09
Pd-100	S	3.10E-12	2.22E-07	5.77E-12	1.05E-11	-	1.36E+09	6.97E+01	9.73E-01	1.00E-01	1.58E+05	4.85E+09	9.71E+02	1.90E+04	9.18E+02	2.56E-09
Pd-101	S	1.97E-13	1.38E-06	6.07E-13	1.12E-12	-	1.36E+09	7.34E+02	8.93E-01	1.00E-01	1.56E+07	8.04E+11	1.79E+03	1.90E+06	1.79E+03	4.78E-10
Pd-103	S	1.77E-12	1.15E-09	1.84E-12	3.61E-12	-	1.36E+09	1.49E+01	9.98E-01	1.00E-01	9.84E+04	1.82E+09	3.91E+04	1.27E+04	8.75E+03	1.17E-07
Pd-107	S	1.69E-12	0.00E+00	3.67E-13	7.25E-13	-	1.36E+09	1.07E-07	0.00E+00	1.00E-01	1.09E+03	4.26E+06	-	1.43E+02	1.26E+02	2.46E-01
Pd-109	S	1.85E-12	1.27E-08	5.14E-12	1.01E-11	-	1.36E+09	4.52E+02	9.92E-01	1.00E-01	1.07E+06	5.27E+10	1.08E+05	1.38E+05	5.73E+04	2.68E-08
Pm-141	S	2.85E-14	3.33E-06	9.25E-14	1.52E-13	-	1.36E+09	1.74E+04	8.77E-01	2.50E-03	2.73E+09	1.32E+14	1.80E+04	1.18E+10	1.80E+04	2.82E-10
Pm-142	-	-	3.87E-06	-	-	-	1.36E+09	5.40E+05	8.80E-01	2.50E-03	-	-	4.77E+05	-	4.77E+05	2.43E-10
Pm-143	S	5.37E-12	1.33E-06	1.24E-12	2.20E-12	-	1.36E+09	9.55E-01	9.18E-01	2.50E-03	1.03E+04	3.84E+07	2.35E+00	4.84E+04	2.35E+00	6.84E-10
Pm-144	S	2.76E-11	6.90E-06	4.66E-12	8.10E-12	-	1.36E+09	6.97E-01	8.75E-01	2.50E-03	2.05E+03	5.45E+06	3.47E-01	9.39E+03	3.47E-01	1.39E-10
Pm-145	S	6.59E-12	1.61E-08	8.07E-13	1.54E-12	-	1.36E+09	3.92E-02	9.68E-01	2.50E-03	8.76E+02	1.85E+06	1.09E+01	4.41E+03	1.08E+01	7.74E-08
Pm-146	S	5.40E-11	3.29E-06	5.99E-12	1.12E-11	-	1.36E+09	1.25E-01	8.73E-01	2.50E-03	2.73E+02	5.12E+05	1.34E-01	1.34E+03	1.34E-01	3.04E-10
Pm-147	S	1.61E-11	3.21E-11	2.48E-12	4.88E-12	-	1.36E+09	2.64E-01	9.42E-01	2.50E-03	1.29E+03	3.54E+06	2.63E+04	6.69E+03	1.04E+03	1.12E-06
Pm-148	S	1.05E-11	2.80E-06	2.52E-11	4.96E-11	-	1.36E+09	4.71E+01	8.45E-01	2.50E-03	2.26E+04	9.68E+08	5.99E+01	1.17E+05	5.97E+01	3.64E-10
Pm-148m	S	2.12E-11	8.98E-06	1.15E-11	2.13E-11	-	1.36E+09	6.12E+00	8.75E-01	2.50E-03	6.85E+03	6.23E+07	2.35E+00	3.35E+04	2.34E+00	1.10E-10
Pm-149	S	3.66E-12	4.60E-08	9.77E-12	1.93E-11	-	1.36E+09	1.14E+02	8.98E-01	2.50E-03	1.41E+05	6.74E+09	8.33E+03	7.35E+05	7.78E+03	1.97E-08
Pm-150	S	4.63E-13	6.87E-06	1.56E-12	2.94E-12	-	1.36E+09	2.27E+03	8.99E-01	2.50E-03	1.83E+07	1.06E+12	1.10E+03	9.12E+07	1.10E+03	1.42E-10
Pm-151	S	2.36E-12	1.27E-06	6.59E-12	1.28E-11	-	1.36E+09	2.14E+02	9.39E-01	2.50E-03	3.98E+05	1.95E+10	5.39E+02	2.04E+06	5.38E+02	7.38E-10
Po-203	M	7.73E-14	7.65E-06	1.88E-13	3.92E-13	-	1.36E+09	9.92E+03	9.35E-01	1.00E-03	6.03E+08	2.77E+13	4.17E+03	8.29E+09	4.17E+03	1.66E-10
Po-205	M	1.72E-13	7.36E-06	2.41E-13	4.26E-13	-	1.36E+09	3.37E+03	9.55E-01	1.00E-03	1.88E+08	4.23E+12	1.44E+03	2.20E+09	1.44E+03	1.70E-10
Po-207	M	1.99E-13	6.09E-06	5.55E-13	1.28E-12	-	1.36E+09	1.04E+03	9.55E-01	1.00E-03	1.94E+07	1.13E+12	5.38E+02	2.94E+08	5.38E+02	2.08E-10
Po-210	M	1.08E-08	3.95E-11	2.25E-09	7.96E-10	-	1.36E+09	1.83E+00	8.60E-01	1.00E-03	5.47E+01	3.65E+04	1.62E+05	1.28E+02	3.82E+01	8.52E-09
Po-211	-	-	3.59E-08	-	-	-	1.36E+09	4.24E+07	8.65E-01	1.00E-03	-	-	4.10E+09	-	4.10E+09	3.97E-08
Po-212	-	-	0.00E+00	-	-	-	1.36E+09	7.17E+13	0.00E+00	1.00E-03	-	-	-	-	-	-
Po-213	-	-	0.00E+00	-	-	-	1.36E+09	5.20E+12	0.00E+00	1.00E-03	-	-	-	-	-	-
Po-214	-	-	3.87E-10	-	-	-	1.36E+09	1.33E+11	8.61E-01	1.00E-03	-	-	1.20E+15	-	1.20E+15	3.75E-06
Po-215	-	-	7.49E-10	-	-	-	1.36E+09	1.23E+10	8.90E-01	1.00E-03	-	-	5.54E+13	-	5.54E+13	1.88E-06
Po-216	-	-	7.87E-11	-	-	-	1.36E+09	1.46E+08	8.60E-01	1.00E-03	-	-	6.48E+12	-	6.48E+12	1.86E-05
Po-218	-	-	4.26E-11	-	-	-	1.36E+09	1.19E+05	8.58E-01	1.00E-03	-	-	9.83E+09	-	9.83E+09	3.48E-05
Pr-136	S	2.15E-14	9.74E-06	8.07E-14	1.27E-13	-	1.36E+09	2.78E+04	8.55E-01	2.50E-03	5.21E+09	2.79E+14	1.00E+04	2.16E+10	1.00E+04	9.53E-11
Pr-137	S	5.55E-14	2.14E-06	1.78E-13	3.22E-13	-	1.36E+09	4.76E+03	8.85E-01	2.50E-03	3.52E+08	1.85E+13	7.55E+03	1.68E+09	7.55E+03	4.22E-10
Pr-138	-	-	3.57E-06	-	-	-	1.36E+09	2.51E+05	8.79E-01	2.50E-03	-	-	2.41E+05	-	2.41E+05	2.57E-10
Pr-138m	S	1.76E-13	1.14E-05	5.92E-13	1.03E-12	-	1.36E+09	2.89E+03	8.68E-01	2.50E-03	6.68E+07	3.54E+12	8.79E+02	3.07E+08	8.79E+02	8.14E-11
Pr-139	S	6.96E-14	4.42E-07	2.12E-13	4.03E-13	-	1.36E+09	1.35E+03	9.37E-01	2.50E-03	7.95E+07	4.17E+12	9.78E+03	3.99E+08	9.78E+03	1.96E-09
Pr-142	S	3.38E-12	3.14E-07	1.26E-11	2.49E-11	-	1.36E+09	3.17E+02	8.21E-01	2.50E-03	3.03E+05	2.03E+10	3.70E+03	1.58E+06	3.65E+03	3.17E-09
Pr-142m	S	4.33E-14	0.00E+00	1.62E-13	3.20E-13	-	1.36E+09	2.49E+04	0.00E+00	2.50E-03	1.86E+09	1.24E+14	-	9.67E+09	1.56E+09	1.72E-05
Pr-143	S	9.73E-12	1.64E-09	1.16E-11	2.29E-11	-	1.36E+09	1.87E+01	8.64E-01	2.50E-03	1.94E+04	4.14E+08	3.96E+04	1.01E+05	1.15E+04	1.72E-07
Pr-144	S	3.58E-14	1.94E-07	1.12E-13	1.82E-13	-	1.36E+09	2.11E+04	8.21E-01	2.50E-03	2.76E+09	1.27E+14	3.98E+05	1.18E+10	3.98E+05	5.28E-09
Pr-144m	-	-	8.74E-09	-	-	-	1.36E+09	5.06E+04	9.64E-01	2.50E-03	-	-	1.81E+07	-	1.81E+07	9.98E-08
Pr-145	S	9.25E-13	6.95E-08	3.36E-12	6.59E-12	-	1.36E+09	1.02E+03	8.60E-01	2.50E-03	3.67E+06	2.37E+11	5.11E+04	1.90E+07	5.03E+04	1.39E-08
Pr-147	S	3.59E-14	3.78E-06	8.10E-14	1.32E-13	-	1.36E+09	2.68E+04	8.96E-01	2.50E-03	4.83E+09	1.61E+14	2.38E+04	2.08E+10	2.38E+04	2.53E-10
Pt-186	F	8.25E-14	3.20E-06	5.62E-13	1.03E-12	-	1.36E+09	3.04E+03	8.87E-01	-	7.02E+07	7.94E+12	3.22E+03	-	3.22E+03	3.83E-10
Pt-188	F	1.88E-12	6.03E-07	5.44E-12	1.03E-11	-	1.36E+09	2.48E+01	9.28E-01	-	5.73E+04	2.85E+09	1.33E+02	-	1.33E+02	1.96E-09
Pt-189	F	1.32E-13	1.17E-06	8.55E-13	1.61E-12	-	1.36E+09	5.58E+02	9.47E-01	-	8.26E+06	9.13E+11	1.52E+03	-	1.52E+03	9.96E-10
Pt-191	F	4.63E-13	9.79E-07	2.55E-12	4.85E-12	-	1.36E+09	9.03E+01	9.45E-01	-	4.43E+05	4.21E+10	2.94E+02	-	2.94E+02	1.20E-09
Pt-193	F	1.11E-13	2.78E-12	3.09E-13	6.14E-13	-	1.36E+09	1.39E-02	1.00E+00	-	1.58E+03	7.92E+07	4.41E+04	-	1.53E+03	4.12E-05
Pt-193m	F	7.73E-13	1.68E-08	4.44E-12	8.81E-12	-	1.36E+09	5.84E+01	9.76E-01	-	1.58E+05	1.63E+10	1.07E+04	-	1.00E+04	6.44E-08
Pt-195m	F	1.05E-12	1.26E-07	6.03E-12	1.19E-11	-	1.36E+09	6.29E+01	9.55E-01	-	1.26E+05	1.29E+10	1.57E+03	-	1.55E+03	9.34E-09
Pt-197	F	5.22E-13	5.63E-08	3.85E-12	7.59E-12	-	1.36E+09	3.32E+02	9.61E-01	-	1.04E+06	1.37E+11	1.84E+04	-	1.81E+04	2.09E-08

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Wet Soil-to-plant transfer factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Produce Ingestion PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Pt-197m	F	8.66E-14	2.38E-07	5.81E-13	1.12E-12	-	1.36E+09	3.86E+03	9.59E-01	-	8.20E+07	9.61E+12	5.09E+04	-	5.08E+04	5.04E-09
Pt-199	F	2.48E-14	8.69E-07	1.25E-13	2.18E-13	-	1.36E+09	1.18E+04	9.27E-01	-	1.29E+09	1.03E+14	4.42E+04	-	4.42E+04	1.44E-09
Pt-200	F	1.48E-12	1.58E-07	1.13E-11	2.23E-11	-	1.36E+09	4.86E+02	9.50E-01	-	5.19E+05	7.08E+10	9.74E+03	-	9.56E+03	7.64E-09
Pu-234	M	6.85E-11	1.61E-07	1.25E-12	2.39E-12	-	1.36E+09	6.90E+02	9.99E-01	1.00E-03	6.87E+06	2.17E+09	1.29E+04	8.67E+07	1.29E+04	8.48E-09
Pu-235	M	2.39E-15	2.37E-07	6.03E-15	9.73E-15	-	1.36E+09	1.44E+04	9.55E-01	1.00E-03	3.52E+10	1.30E+15	1.91E+05	3.75E+11	1.91E+05	6.06E-09
Pu-236	M	2.28E-08	1.19E-10	9.92E-11	1.74E-10	-	1.36E+09	2.43E-01	9.99E-01	1.00E-03	3.33E+01	2.30E+03	6.16E+03	3.85E+02	3.01E+01	5.67E-08
Pu-237	M	1.27E-12	1.12E-07	8.40E-13	1.62E-12	-	1.36E+09	5.58E+00	9.99E-01	1.00E-03	8.21E+04	9.49E+08	1.50E+02	1.04E+06	1.50E+02	1.23E-08
Pu-238	M	3.36E-08	7.22E-11	1.69E-10	2.72E-10	-	1.36E+09	7.90E-03	9.99E-01	1.00E-03	3.28E+00	2.40E+02	1.56E+03	3.48E+01	2.95E+00	1.73E-07
Pu-239	M	3.33E-08	2.00E-10	1.74E-10	2.76E-10	-	1.36E+09	2.88E-05	9.99E-01	1.00E-03	2.88E+00	2.16E+02	5.02E+02	3.01E+01	2.58E+00	4.16E-05
Pu-240	M	3.33E-08	6.98E-11	1.74E-10	2.77E-10	-	1.36E+09	1.06E-04	9.99E-01	1.00E-03	2.87E+00	2.16E+02	1.44E+03	3.01E+01	2.58E+00	1.14E-05
Pu-241	M	3.34E-10	4.11E-12	2.28E-12	3.29E-12	-	1.36E+09	4.81E-02	9.74E-01	1.00E-03	4.56E+02	4.07E+04	4.73E+04	4.34E+03	4.05E+02	3.93E-06
Pu-242	M	3.13E-08	6.25E-11	1.65E-10	2.63E-10	-	1.36E+09	1.84E-06	9.99E-01	1.00E-03	3.02E+00	2.30E+02	1.61E+03	3.17E+01	2.72E+00	6.93E-04
Pu-243	M	2.94E-13	5.50E-08	6.92E-13	1.34E-12	-	1.36E+09	1.22E+03	9.52E-01	1.00E-03	2.18E+07	8.99E+11	7.04E+04	2.78E+08	7.01E+04	2.70E-08
Pu-244	M	3.04E-08	1.11E-07	1.88E-10	3.14E-10	-	1.36E+09	8.66E-09	1.78E+00	1.00E-03	2.53E+00	2.37E+02	5.08E-01	2.78E+01	4.16E-01	2.27E-02
Pu-244+D	M	2.93E-08	1.51E-06	1.90E-10	3.14E-10	-	1.36E+09	8.66E-09	9.73E-01	1.00E-03	2.53E+00	2.45E+02	6.83E-02	2.76E+01	6.63E-02	3.62E-03
Pu-245	M	2.07E-12	1.78E-06	6.55E-12	1.28E-11	-	1.36E+09	5.78E+02	9.50E-01	1.00E-03	1.08E+06	6.03E+10	1.03E+03	1.39E+07	1.03E+03	8.45E-10
Pu-246	M	1.73E-11	4.04E-07	2.53E-11	4.92E-11	-	1.36E+09	2.33E+01	9.55E-01	1.00E-03	1.13E+04	2.91E+08	1.82E+02	1.45E+05	1.79E+02	3.66E-09
Ra-222	-	-	3.71E-08	-	-	-	1.36E+09	5.75E+05	9.03E-01	4.00E-02	-	-	5.17E+07	-	5.17E+07	3.87E-08
Ra-223	M	2.50E-08	4.34E-07	3.39E-10	6.44E-10	-	1.36E+09	2.21E+01	9.58E-01	4.00E-02	8.18E+02	1.91E+05	1.60E+02	2.56E+02	8.79E+01	1.72E-09
Ra-223+D	M	-	1.09E-06	-	-	-	1.36E+09	2.21E+01	9.45E-01	4.00E-02	-	-	6.46E+01	-	6.46E+01	1.26E-09
Ra-224	M	9.99E-09	3.73E-08	2.38E-10	4.51E-10	-	1.36E+09	6.91E+01	9.16E-01	4.00E-02	3.65E+03	1.49E+06	6.09E+03	1.14E+03	7.60E+02	4.78E-09
Ra-224+D	M	-	7.77E-06	-	-	-	1.36E+09	6.91E+01	8.98E-01	4.00E-02	-	-	2.98E+01	-	2.98E+01	1.87E-10
Ra-225	M	2.10E-08	5.91E-09	1.54E-10	2.72E-10	-	1.36E+09	1.71E+01	9.77E-01	4.00E-02	1.50E+03	1.76E+05	8.91E+03	4.36E+02	3.25E+02	8.29E-09
Ra-225+D	M	-	9.42E-07	-	-	-	1.36E+09	1.71E+01	9.64E-01	4.00E-02	-	-	5.66E+01	-	5.66E+01	1.45E-09
Ra-226	M	1.15E-08	2.29E-08	5.14E-10	7.29E-10	-	1.36E+09	4.33E-04	9.28E-01	4.00E-02	1.10E+00	6.29E+02	4.75E+00	2.56E-01	1.99E-01	2.01E-07
Ra-226+D	M	1.16E-08	8.49E-06	5.15E-10	7.30E-10	-	1.36E+09	4.33E-04	9.26E-01	4.00E-02	1.09E+00	6.24E+02	1.28E-02	2.56E-01	1.21E-02	1.22E-08
Ra-227	M	3.13E-13	6.23E-07	1.46E-13	2.48E-13	-	1.36E+09	8.63E+03	9.79E-01	4.00E-02	8.29E+08	5.95E+12	4.26E+04	2.32E+08	4.26E+04	2.17E-09
Ra-227+D	M	-	2.09E-06	-	-	-	1.36E+09	8.63E+03	9.79E-01	4.00E-02	-	-	1.27E+04	-	1.27E+04	6.48E-10
Ra-228	M	5.18E-09	0.00E+00	1.43E-09	2.28E-09	-	1.36E+09	1.21E-01	0.00E+00	4.00E-02	1.29E+00	5.16E+03	-	3.40E-01	2.69E-01	9.88E-10
Ra-228+D	M	5.23E-09	1.23E-05	1.43E-09	2.29E-09	-	1.36E+09	1.21E-01	9.26E-01	4.00E-02	1.29E+00	5.11E+03	3.27E-02	3.40E-01	2.92E-02	1.07E-10
Rb-79	F	2.37E-14	5.85E-06	1.14E-13	1.79E-13	-	1.36E+09	1.59E+04	9.14E-01	1.30E-01	2.12E+09	1.45E+14	8.95E+03	1.69E+08	8.95E+03	8.63E-11
Rb-80	-	-	5.56E-06	-	-	-	1.36E+09	6.43E+05	8.83E-01	1.30E-01	-	-	3.94E+05	-	3.94E+05	9.51E-11
Rb-81	F	4.63E-14	2.59E-06	1.74E-13	2.83E-13	-	1.36E+09	1.33E+03	9.02E-01	1.30E-01	1.12E+08	6.18E+12	1.71E+03	9.20E+06	1.71E+03	2.02E-10
Rb-81m	F	1.10E-14	9.09E-09	2.80E-14	4.55E-14	-	1.36E+09	1.14E+04	9.99E-01	1.30E-01	5.96E+09	2.23E+14	3.77E+06	4.91E+08	3.74E+06	5.16E-08
Rb-82	-	-	4.85E-06	-	-	-	1.36E+09	2.80E+05	8.83E-01	1.30E-01	-	-	1.97E+05	-	1.97E+05	1.12E-10
Rb-82m	F	1.35E-13	1.35E-05	4.70E-13	7.25E-13	-	1.36E+09	9.79E+02	8.62E-01	1.30E-01	3.22E+07	1.56E+12	2.53E+02	2.52E+06	2.53E+02	4.11E-11
Rb-83	F	2.32E-12	2.18E-06	7.51E-12	1.18E-11	-	1.36E+09	2.93E+00	9.44E-01	1.30E-01	5.92E+03	2.73E+08	4.29E+00	4.72E+02	4.25E+00	2.33E-10
Rb-84	F	3.59E-12	4.22E-06	1.17E-11	1.91E-11	-	1.36E+09	7.72E+00	9.40E-01	1.30E-01	9.62E+03	4.64E+08	5.85E+00	7.97E+02	5.81E+00	1.23E-10
Rb-86	F	4.00E-12	4.67E-07	1.34E-11	2.37E-11	-	1.36E+09	1.36E+01	8.44E-01	1.30E-01	1.36E+04	7.31E+08	1.03E+02	1.22E+03	9.47E+01	1.17E-09
Rb-87	F	2.14E-12	9.11E-11	7.07E-12	1.25E-11	-	1.36E+09	1.47E-11	9.27E-01	1.30E-01	6.35E+01	3.36E+06	1.19E+03	5.70E+00	5.20E+00	5.96E+01
Rb-88	F	3.17E-14	3.36E-06	1.92E-13	3.06E-13	-	1.36E+09	2.05E+04	8.09E-01	1.30E-01	1.59E+09	1.39E+14	2.27E+04	1.29E+08	2.26E+04	1.89E-10
Rb-89	F	2.09E-14	1.05E-05	1.08E-13	1.70E-13	-	1.36E+09	2.40E+04	8.47E-01	1.30E-01	3.36E+09	2.47E+14	8.11E+03	2.68E+08	8.11E+03	5.84E-11
Re-177	M	2.97E-14	2.62E-06	6.33E-14	1.05E-13	-	1.36E+09	2.60E+04	8.90E-01	-	5.90E+09	1.89E+14	3.36E+04	-	3.36E+04	4.43E-10
Re-178	M	2.33E-14	5.65E-06	5.85E-14	9.32E-14	-	1.36E+09	2.76E+04	8.73E-01	-	7.05E+09	2.56E+14	1.68E+04	-	1.68E+04	2.11E-10
Re-180	-	-	5.29E-06	-	-	-	1.36E+09	1.50E+05	8.59E-01	-	-	-	9.92E+04	-	9.92E+04	2.31E-10
Re-181	M	7.96E-13	3.18E-06	2.00E-12	3.64E-12	-	1.36E+09	3.04E+02	9.45E-01	-	1.99E+06	8.23E+10	3.04E+02	-	3.04E+02	3.52E-10
Re-182	M	4.44E-12	8.22E-06	6.99E-12	1.26E-11	-	1.36E+09	9.49E+01	9.40E-01	-	1.79E+05	4.61E+09	3.69E+01	-	3.69E+01	1.37E-10
Re-182m	M	5.51E-13	5.37E-06	1.22E-12	2.16E-12	-	1.36E+09	4.78E+02	9.26E-01	-	5.27E+06	1.87E+11	2.89E+02	-	2.89E+02	2.14E-10
Re-184	M	6.73E-12	3.94E-06	4.40E-12	7.66E-12	-	1.36E+09	6.66E+00	8.97E-01	-	2.07E+04	2.13E+08	5.67E+00	-	5.67E+00	3.04E-10
Re-184m	M	2.26E-11	1.52E-06	6.96E-12	1.27E-11	-	1.36E+09	1.53E+00	9.52E-01	-	2.87E+03	1.46E+07	3.19E+00	-	3.18E+00	7.42E-10
Re-186	M	4.26E-12	5.49E-08	8.03E-12	1.53E-11	-	1.36E+09	6.70E+01	9.54E-01	-	1.04E+05	3.39E+09	3.85E+03	-	3.71E+03	2.00E-08
Re-186m	M	4.18E-11	1.75E-08	1.05E-11	1.95E-11	-	1.36E+09	3.47E-06	9.85E-01	-	4.07E+01	1.72E+05	5.82E+00	-	5.09E+00	5.30E-04
Re-186m+D	M	-	7.24E-08	-	-	-	1.36E+09	3.47E-06	9.73E-01	-	-	-	1.42E+00	-	1.42E+00	1.48E-04
Re-187	M	2.51E-14	0.00E+00	2.56E-14	4.81E-14	-	1.36E+09	1.39E-11	0.00E+00	-	1.65E+04	2.87E+08	-	-	1.65E+04	4.32E+05
Re-188	M	2.22E-12	2.38E-07	7.07E-12	1.35E-11	-	1.36E+09	3.58E+02	9.03E-01	-	6.31E+05	3.47E+10	5.01E+03	-	4.97E+03	5.07E-09
Re-188m	M	5.07E-14	1.28E-07	1.42E-13	2.69E-13	-	1.36E+09	1.96E+04	9.53E-01	-	1.73E+09	8.33E+13	4.83E+05	-	4.83E+05	9.00E-09
Re-189	M	1.73E-12	2.42E-07	4.11E-12	7.84E-12	-	1.36E+09	2.50E+02	9.21E-01	-	7.59E+05	3.12E+10	3.37E+03	-	3.36E+03	4.93E-09
Rh-100	S	1.04E-12	1.38E-05	3.74E-12	6.62E-12	-	1.36E+09	2.92E+02	8.86E-01	1.30E-01	1.05E+06	6.05E+10	7.18E+01	9.43E+04	7.18E+01	4.77E-11
Rh-101	S	1.81E-11	8.84E-07	3.01E-12	5.37E-12	-	1.36E+09	2.17E-01	9.31E-01	1.30E-01	9.62E+02	2.59E+06	7.93E-01	8.71E+01	7.85E-01	7.11E-10
Rh-101m	S	7.14E-13	1.19E-06	1.34E-12	2.46E-12	-	1.36E+09	5.83E+01	9.07E-01	1.30E-01	5.64E+05	1.76E+10	1.62E+02	5.25E+04	1.62E+02	5.44E-10

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Wet Soil-to-plant transfer factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Produce Ingestion PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Rh-102	S	5.99E-11	9.73E-06	1.04E-11	1.71E-11	-	1.36E+09	2.39E-01	8.61E-01	1.30E-01	3.33E+02	8.61E+05	8.59E-02	2.78E+01	8.56E-02	7.09E-11
Rh-102m	S	2.56E-11	2.11E-06	8.73E-12	1.66E-11	-	1.36E+09	1.22E+00	9.87E-01	1.30E-01	1.75E+03	1.03E+07	1.77E+00	1.69E+02	1.75E+00	2.83E-10
Rh-103m	S	9.14E-15	9.31E-11	1.34E-14	2.40E-14	-	1.36E+09	6.49E+03	9.98E-01	1.30E-01	6.44E+09	1.53E+14	2.10E+08	5.85E+08	1.51E+08	4.65E-06
Rh-105	S	1.59E-12	3.15E-07	3.43E-12	6.73E-12	-	1.36E+09	1.72E+02	9.05E-01	1.30E-01	6.07E+05	2.33E+10	1.81E+03	6.05E+04	1.75E+03	2.08E-09
Rh-106	-	-	9.66E-07	-	-	-	1.36E+09	7.31E+05	8.83E-01	1.30E-01	-	-	2.58E+06	-	2.58E+06	7.26E-10
Rh-106m	S	2.71E-13	1.37E-05	7.73E-13	1.37E-12	-	1.36E+09	2.76E+03	8.70E-01	1.30E-01	4.80E+07	2.20E+12	6.97E+02	4.31E+06	6.96E+02	5.19E-11
Rh-107	S	2.88E-14	1.28E-06	5.81E-14	9.51E-14	-	1.36E+09	1.68E+04	9.00E-01	1.30E-01	4.20E+09	1.26E+14	4.38E+04	3.49E+08	4.38E+04	5.42E-10
Rh-99	S	3.33E-12	2.50E-06	3.15E-12	5.77E-12	-	1.36E+09	1.58E+01	8.91E-01	1.30E-01	6.52E+04	1.02E+09	2.14E+01	6.06E+03	2.13E+01	2.58E-10
Rh-99m	S	9.99E-14	3.03E-06	3.42E-13	6.03E-13	-	1.36E+09	1.29E+03	8.59E-01	1.30E-01	5.10E+07	2.79E+12	1.49E+03	4.56E+06	1.49E+03	2.22E-10
Rn-218	-	-	3.39E-09	-	-	-	1.36E+09	6.24E+08	8.75E-01	0.00E+00	-	-	6.33E+11	-	6.33E+11	4.29E-07
Rn-219	-	-	2.25E-07	-	-	-	1.36E+09	5.52E+06	9.11E-01	0.00E+00	-	-	8.10E+07	-	8.10E+07	6.24E-09
Rn-219+D	-	-	6.58E-07	-	-	-	1.36E+09	5.52E+06	9.31E-01	0.00E+00	-	-	2.71E+07	-	2.71E+07	2.09E-09
Rn-220	-	-	1.71E-09	-	-	-	1.36E+09	3.93E+05	8.80E-01	0.00E+00	-	-	7.86E+08	-	7.86E+08	8.54E-07
Rn-222	-	-	1.74E-09	-	-	-	1.36E+09	6.62E+01	8.83E-01	0.00E+00	-	-	1.30E+05	-	1.30E+05	8.44E-07
Rn-222+D	-	1.80E-11	8.48E-06	-	-	-	1.36E+09	6.62E+01	9.26E-01	0.00E+00	-	7.93E+08	2.53E+01	-	2.53E+01	1.65E-10
Ru-103	M	8.92E-12	2.04E-06	5.55E-12	1.05E-11	-	1.36E+09	6.44E+00	8.82E-01	3.00E-02	1.46E+04	1.56E+08	1.08E+01	6.07E+03	1.07E+01	3.33E-10
Ru-105	M	6.48E-13	3.52E-06	1.96E-12	3.77E-12	-	1.36E+09	1.37E+03	8.98E-01	3.00E-02	8.64E+06	4.55E+11	1.30E+03	3.65E+06	1.30E+03	1.94E-10
Ru-106	M	1.02E-10	0.00E+00	6.11E-11	1.19E-10	-	1.36E+09	6.87E-01	0.00E+00	3.00E-02	1.37E+02	1.45E+06	-	5.89E+01	4.12E+01	1.23E-08
Ru-106+D	M	1.02E-10	9.66E-07	6.11E-11	1.19E-10	-	1.36E+09	6.87E-01	8.83E-01	3.00E-02	1.37E+02	1.45E+06	2.42E+00	5.89E+01	2.29E+00	6.85E-10
Ru-94	M	1.23E-13	2.31E-06	4.37E-13	8.03E-13	-	1.36E+09	7.03E+03	9.51E-01	3.00E-02	2.08E+08	1.23E+13	9.63E+03	8.42E+07	9.63E+03	2.50E-10
Ru-97	M	3.36E-13	8.63E-07	9.07E-13	1.65E-12	-	1.36E+09	8.72E+01	9.49E-01	3.00E-02	1.26E+06	5.60E+10	3.20E+02	5.03E+05	3.20E+02	6.91E-10
S-35	M	5.03E-12	8.77E-12	3.70E-12	1.24E-12	-	1.36E+09	2.89E+00	9.27E-01	6.00E-01	5.55E+04	1.24E+08	1.07E+06	2.05E+02	2.04E+02	4.79E-09
Sb-115	M	2.33E-14	3.92E-06	7.10E-14	1.16E-13	-	1.36E+09	1.15E+04	8.91E-01	1.00E-02	2.35E+09	1.06E+14	9.87E+03	2.53E+09	9.87E+03	1.92E-10
Sb-116	M	1.88E-14	1.05E-05	6.81E-14	1.07E-13	-	1.36E+09	2.31E+04	8.67E-01	1.00E-02	5.13E+09	2.65E+14	7.62E+03	5.32E+09	7.62E+03	7.44E-11
Sb-116m	M	8.81E-14	1.47E-05	2.45E-13	4.00E-13	-	1.36E+09	6.04E+03	8.56E-01	1.00E-02	3.60E+08	1.48E+13	1.44E+03	3.87E+08	1.44E+03	5.38E-11
Sb-117	M	4.07E-14	5.78E-07	9.44E-14	1.70E-13	-	1.36E+09	2.17E+03	9.62E-01	1.00E-02	3.04E+08	1.15E+13	1.17E+04	3.61E+08	1.17E+04	1.23E-09
Sb-118m	M	2.64E-13	1.21E-05	9.81E-13	1.67E-12	-	1.36E+09	1.21E+03	8.70E-01	1.00E-02	1.73E+07	9.92E+11	3.47E+02	1.94E+07	3.47E+02	6.54E-11
Sb-119	M	1.74E-13	2.58E-09	6.96E-13	1.35E-12	-	1.36E+09	1.59E+02	9.92E-01	1.00E-02	2.81E+06	1.98E+11	1.87E+05	3.60E+06	1.67E+05	2.43E-07
Sb-120	M	1.12E-14	1.94E-06	3.42E-14	5.44E-14	-	1.36E+09	2.29E+04	9.27E-01	1.00E-02	1.00E+10	4.42E+14	3.84E+04	1.05E+10	3.84E+04	3.90E-10
Sb-120m	M	3.30E-12	1.15E-05	6.22E-12	1.08E-11	-	1.36E+09	4.39E+01	8.80E-01	1.00E-02	9.68E+04	2.87E+09	1.31E+01	1.11E+05	1.31E+01	6.92E-11
Sb-122	M	5.48E-12	1.97E-06	1.55E-11	3.03E-11	-	1.36E+09	9.37E+01	8.75E-01	1.00E-02	7.36E+04	3.69E+09	1.64E+02	9.49E+04	1.63E+02	4.12E-10
Sb-124	M	2.43E-11	8.89E-06	1.85E-11	3.50E-11	-	1.36E+09	4.20E+00	8.71E-01	1.00E-02	2.86E+03	3.73E+07	1.63E+00	3.57E+03	1.63E+00	9.34E-11
Sb-124m	M	-	1.57E-06	-	-	-	1.36E+09	2.35E+05	8.75E-01	1.00E-02	-	-	5.15E+05	-	5.15E+05	5.27E-10
Sb-124n	M	1.15E-14	7.77E-12	2.32E-14	3.81E-14	-	1.36E+09	1.80E+04	9.93E-01	1.00E-02	1.13E+10	3.38E+14	7.03E+09	1.22E+10	3.20E+09	4.26E-05
Sb-125	M	1.66E-11	1.81E-06	6.14E-12	1.12E-11	-	1.36E+09	2.50E-01	8.81E-01	1.00E-02	5.32E+02	3.25E+06	4.72E-01	6.40E+02	4.72E-01	4.57E-10
Sb-126	M	1.15E-11	1.28E-05	1.59E-11	2.93E-11	-	1.36E+09	2.04E+01	8.66E-01	1.00E-02	1.66E+04	3.83E+08	5.54E+00	2.01E+04	5.53E+00	6.63E-11
Sb-126m	M	3.16E-14	6.94E-06	9.21E-14	1.48E-13	-	1.36E+09	1.92E+04	8.72E-01	1.00E-02	3.08E+09	1.31E+14	9.53E+03	3.27E+09	9.53E+03	1.22E-10
Sb-127	M	7.51E-12	3.07E-06	1.47E-11	2.85E-11	-	1.36E+09	6.57E+01	8.83E-01	1.00E-02	5.49E+04	1.89E+09	7.29E+01	7.02E+04	7.28E+01	2.73E-10
Sb-128	M	1.44E-12	1.40E-05	4.96E-12	9.21E-12	-	1.36E+09	6.74E+02	8.85E-01	1.00E-02	1.74E+06	1.01E+11	1.64E+02	2.13E+06	1.64E+02	6.03E-11
Sb-128m	M	2.12E-14	9.03E-06	7.55E-14	1.19E-13	-	1.36E+09	3.50E+04	8.63E-01	1.00E-02	7.01E+09	3.56E+14	1.35E+04	7.29E+09	1.35E+04	9.59E-11
Sb-129	M	9.62E-13	6.86E-06	3.19E-12	6.11E-12	-	1.36E+09	1.41E+03	8.75E-01	1.00E-02	5.48E+06	3.15E+11	7.04E+02	6.92E+06	7.04E+02	1.25E-10
Sb-130	M	9.73E-14	1.51E-05	2.88E-13	4.77E-13	-	1.36E+09	9.11E+03	8.63E-01	1.00E-02	4.55E+08	2.02E+13	2.10E+03	4.97E+08	2.10E+03	5.82E-11
Sb-131	M	9.73E-14	9.09E-06	3.59E-13	6.48E-13	-	1.36E+09	1.58E+04	8.58E-01	1.00E-02	5.82E+08	3.51E+13	6.11E+03	6.93E+08	6.11E+03	9.81E-11
Sc-43	S	3.81E-13	4.73E-06	1.18E-12	2.21E-12	-	1.36E+09	1.56E+03	8.86E-01	2.00E-03	1.68E+07	8.84E+11	1.12E+03	1.04E+08	1.12E+03	5.99E-11
Sc-44	S	6.44E-13	9.95E-06	2.25E-12	4.22E-12	-	1.36E+09	1.55E+03	8.63E-01	2.00E-03	8.72E+06	5.18E+11	5.42E+02	5.40E+07	5.42E+02	2.99E-11
Sc-44m	S	6.96E-12	1.15E-06	2.01E-11	3.89E-11	-	1.36E+09	1.04E+02	9.02E-01	2.00E-03	6.34E+04	3.21E+09	3.00E+02	4.05E+05	2.99E+02	2.46E-10
Sc-46	S	2.47E-11	9.64E-06	8.88E-12	1.62E-11	-	1.36E+09	3.02E+00	8.47E-01	2.00E-03	4.43E+03	2.64E+07	1.11E+00	2.67E+04	1.11E+00	3.29E-11
Sc-47	S	3.05E-12	3.62E-07	5.11E-12	1.00E-11	-	1.36E+09	7.55E+01	9.26E-01	2.00E-03	1.80E+05	5.34E+09	6.78E+02	1.16E+06	6.75E+02	8.15E-10
Sc-48	S	3.96E-12	1.62E-05	1.05E-11	1.93E-11	-	1.36E+09	1.39E+02	8.40E-01	2.00E-03	1.71E+05	7.57E+09	3.07E+01	1.04E+06	3.07E+01	2.06E-11
Sc-49	S	1.07E-13	1.90E-08	2.92E-13	5.25E-13	-	1.36E+09	6.35E+03	8.15E-01	2.00E-03	2.88E+08	1.28E+13	1.23E+06	1.71E+09	1.23E+06	1.84E-08
Se-70	F	7.36E-14	4.22E-06	4.11E-13	6.92E-13	-	1.36E+09	8.88E+03	9.36E-01	1.00E-01	3.06E+08	2.60E+13	6.77E+03	3.39E+07	6.77E+03	1.03E-10
Se-73	F	1.99E-13	4.52E-06	1.13E-12	1.99E-12	-	1.36E+09	8.49E+02	9.05E-01	1.00E-01	1.02E+07	9.21E+11	6.25E+02	1.18E+06	6.24E+02	1.04E-10
Se-73m	F	2.06E-14	1.06E-06	1.17E-13	2.02E-13	-	1.36E+09	9.34E+03	9.41E-01	1.00E-01	1.10E+09	9.78E+13	2.82E+04	1.25E+08	2.82E+04	4.27E-10
Se-75	F	3.77E-12	1.45E-06	1.08E-11	1.67E-11	-	1.36E+09	2.11E+00	9.18E-01	1.00E-01	3.01E+03	1.21E+08	4.77E+00	3.07E+02	4.69E+00	3.23E-10
Se-77m	-	-	2.85E-07	-	-	-	1.36E+09	1.25E+06	9.80E-01	1.00E-01	-	-	1.35E+07	-	1.35E+07	1.61E-09
Se-79	F	3.33E-12	1.10E-11	9.69E-12	1.60E-11	-	1.36E+09	1.07E-05	9.27E-01	1.00E-01	4.96E+01	2.16E+06	9.84E+03	5.40E+00	4.87E+00	7.00E-05
Se-81	F	1.27E-14	4.68E-08	5.92E-14	9.58E-14	-	1.36E+09	1.97E+04	8.78E-01	1.00E-01	4.89E+09	3.34E+14	1.44E+06	5.22E+08	1.44E+06	1.15E-08
Se-81m	F	3.54E-14	3.56E-08	1.85E-13	3.24E-13	-	1.36E+09	6.36E+03	9.87E-01	1.00E-01	4.68E+08	3.88E+13	5.45E+05	5.40E+07	5.39E+05	1.33E-08
Se-83	F	2.72E-14	1.16E-05	1.43E-13	2.33E-13	-	1.36E+09	1.62E+04	8.81E-01	1.00E-01	1.65E+09	1.28E+14	4.77E+03	1.78E+08	4.77E+03	4.74E-11
Si-31	S	3.05E-13	1.11E-08	9.40E-13	1.81E-12	-	1.36E+09	2.32E+03	8.34E-01	-	3.05E+07	1.64E+12	7.53E+05	-	7.34E+05	1.91E-08

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Wet Soil-to-plant transfer factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Produce Ingestion PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Si-32	S	2.93E-10	2.18E-11	5.00E-12	9.81E-12	-	1.36E+09	1.54E-03	9.27E-01	-	8.28E+01	2.51E+04	5.08E+03	-	8.12E+01	3.27E-06
Si-32+D	S	-	9.44E-09	-	-	-	1.36E+09	1.54E-03	9.28E-01	-	-	-	1.17E+01	-	1.17E+01	4.72E-07
Sm-141	M	2.79E-14	6.39E-06	9.81E-14	1.59E-13	-	1.36E+09	3.57E+04	8.51E-01	2.50E-03	5.35E+09	2.76E+14	1.98E+04	2.29E+10	1.98E+04	1.51E-10
Sm-141m	M	6.29E-14	9.04E-06	1.95E-13	3.26E-13	-	1.36E+09	1.61E+04	8.90E-01	2.50E-03	1.18E+09	5.53E+13	6.03E+03	5.19E+09	6.03E+03	1.02E-10
Sm-142	M	2.13E-13	2.99E-07	7.70E-13	1.40E-12	-	1.36E+09	5.02E+03	9.44E-01	2.50E-03	8.55E+07	5.09E+12	5.36E+04	4.10E+08	5.35E+04	2.93E-09
Sm-145	M	4.51E-12	3.83E-08	1.70E-12	3.27E-12	-	1.36E+09	7.44E-01	9.65E-01	2.50E-03	5.42E+03	3.56E+07	6.06E+01	2.75E+04	5.98E+01	2.26E-08
Sm-146	M	7.88E-09	0.00E+00	5.25E-11	8.36E-11	-	1.36E+09	6.73E-09	0.00E+00	2.50E-03	9.49E+00	9.13E+02	-	3.99E+01	7.60E+00	3.20E-01
Sm-147	M	6.88E-09	0.00E+00	4.77E-11	7.59E-11	-	1.36E+09	6.54E-12	0.00E+00	2.50E-03	1.05E+01	1.05E+03	-	4.39E+01	8.38E+00	3.66E+02
Sm-151	M	4.88E-12	3.60E-13	8.07E-13	1.59E-12	-	1.36E+09	7.70E-03	9.98E-01	2.50E-03	5.59E+02	1.65E+06	3.13E+05	2.91E+03	4.68E+02	1.78E-05
Sm-153	M	2.95E-12	1.06E-07	7.10E-12	1.40E-11	-	1.36E+09	1.30E+02	9.40E-01	2.50E-03	2.21E+05	9.51E+09	3.93E+03	1.15E+06	3.84E+03	8.78E-09
Sm-155	M	3.15E-14	2.81E-07	6.88E-14	1.13E-13	-	1.36E+09	1.65E+04	9.25E-01	2.50E-03	3.47E+09	1.13E+14	1.91E+05	1.50E+10	1.91E+05	3.48E-09
Sm-156	M	9.69E-13	3.80E-07	2.18E-12	4.26E-12	-	1.36E+09	6.46E+02	9.24E-01	2.50E-03	3.61E+06	1.44E+11	5.53E+03	1.86E+07	5.52E+03	2.59E-09
Sn-110	M	6.70E-13	1.13E-06	2.71E-12	5.18E-12	-	1.36E+09	1.52E+03	9.56E-01	2.50E-03	6.98E+06	4.89E+11	4.23E+03	3.52E+07	4.22E+03	5.94E-10
Sn-111	M	2.83E-14	2.29E-06	7.70E-14	1.32E-13	-	1.36E+09	1.03E+04	8.71E-01	2.50E-03	1.86E+09	7.87E+13	1.56E+04	8.42E+09	1.56E+04	3.25E-10
Sn-113	M	1.00E-11	2.02E-08	6.33E-12	1.22E-11	-	1.36E+09	2.20E+00	9.92E-01	2.50E-03	4.29E+03	4.74E+07	3.30E+02	2.18E+04	3.02E+02	3.01E-08
Sn-117m	M	8.84E-12	4.70E-07	6.40E-12	1.25E-11	-	1.36E+09	1.86E+01	9.61E-01	2.50E-03	3.54E+04	4.54E+08	1.24E+02	1.82E+05	1.23E+02	1.51E-09
Sn-119m	M	7.81E-12	1.20E-09	3.24E-12	6.36E-12	-	1.36E+09	8.63E-01	9.92E-01	2.50E-03	3.23E+03	2.38E+07	2.18E+03	1.67E+04	1.21E+03	3.23E-07
Sn-121	M	1.02E-12	1.30E-10	2.20E-12	4.33E-12	-	1.36E+09	2.24E+02	9.27E-01	2.50E-03	1.23E+06	4.75E+10	5.60E+06	6.41E+06	8.73E+05	9.14E-07
Sn-121m	M	1.54E-11	8.85E-10	3.41E-12	6.66E-12	-	1.36E+09	1.26E-02	9.86E-01	2.50E-03	1.43E+02	5.61E+05	1.38E+02	7.37E+02	6.41E+01	1.20E-06
Sn-121m+D	M	-	9.86E-10	-	-	-	1.36E+09	1.26E-02	9.86E-01	2.50E-03	-	-	1.24E+02	-	1.24E+02	2.31E-06
Sn-123	M	3.03E-11	3.88E-08	2.05E-11	4.03E-11	-	1.36E+09	1.96E+00	8.43E-01	2.50E-03	1.16E+03	1.39E+07	1.80E+02	6.00E+03	1.52E+02	1.85E-08
Sn-123m	M	5.62E-14	4.63E-07	1.12E-13	1.94E-13	-	1.36E+09	9.09E+03	9.36E-01	2.50E-03	1.12E+09	3.49E+13	6.31E+04	5.10E+09	6.31E+04	1.66E-09
Sn-125	M	1.41E-11	1.53E-06	2.95E-11	5.81E-11	-	1.36E+09	2.62E+01	8.57E-01	2.50E-03	1.08E+04	4.02E+08	6.02E+01	5.59E+04	5.98E+01	5.53E-10
Sn-126	M	9.95E-11	9.96E-08	3.69E-11	7.07E-11	-	1.36E+09	6.93E-06	9.57E-01	2.50E-03	1.12E+01	7.23E+04	1.05E+00	5.68E+01	9.46E-01	3.34E-05
Sn-126+D	M	-	8.84E-06	-	-	-	1.36E+09	6.93E-06	8.74E-01	2.50E-03	-	-	1.30E-02	-	1.30E-02	4.58E-07
Sn-127	M	4.40E-13	9.25E-06	1.19E-12	2.22E-12	-	1.36E+09	2.89E+03	9.28E-01	2.50E-03	3.10E+07	1.42E+12	1.01E+03	1.53E+08	1.01E+03	8.64E-11
Sn-128	M	2.29E-13	2.62E-06	6.14E-13	1.09E-12	-	1.36E+09	6.16E+03	9.04E-01	2.50E-03	1.35E+08	5.81E+12	7.83E+03	6.31E+08	7.83E+03	3.15E-10
Sr-80	M	4.51E-13	5.08E-11	1.55E-12	2.83E-12	-	1.36E+09	3.64E+03	1.00E+00	3.00E-01	3.06E+07	1.74E+12	2.16E+08	1.23E+06	1.18E+06	5.01E-08
Sr-81	M	8.07E-14	5.97E-06	2.39E-13	4.03E-13	-	1.36E+09	1.43E+04	8.95E-01	3.00E-01	8.44E+08	3.82E+13	8.04E+03	3.13E+07	8.04E+03	8.85E-11
Sr-82	M	3.69E-11	5.00E-11	4.48E-11	8.47E-11	-	1.36E+09	1.01E+01	1.00E+00	3.00E-01	2.84E+03	5.92E+07	6.09E+05	1.18E+02	1.13E+02	1.78E-09
Sr-82+D	M	-	4.85E-06	-	-	-	1.36E+09	1.01E+01	8.83E-01	3.00E-01	-	-	7.11E+00	-	7.11E+00	1.12E-10
Sr-83	M	1.26E-12	3.60E-06	3.17E-12	5.85E-12	-	1.36E+09	1.87E+02	9.06E-01	3.00E-01	7.63E+05	3.21E+10	1.73E+02	3.09E+04	1.72E+02	1.48E-10
Sr-85	M	2.56E-12	2.20E-06	3.11E-12	5.03E-12	-	1.36E+09	3.90E+00	9.68E-01	3.00E-01	1.85E+04	3.29E+08	5.51E+00	6.57E+02	5.46E+00	2.31E-10
Sr-85m	M	8.32E-15	8.21E-07	2.31E-14	3.74E-14	-	1.36E+09	5.24E+03	9.21E-01	3.00E-01	3.34E+09	1.36E+14	2.09E+04	1.19E+08	2.09E+04	6.56E-10
Sr-87m	M	5.62E-14	1.33E-06	1.51E-13	2.69E-13	-	1.36E+09	2.16E+03	9.17E-01	3.00E-01	1.92E+08	8.31E+12	5.34E+03	7.50E+06	5.34E+03	4.16E-10
Sr-89	M	2.34E-11	7.19E-09	1.84E-11	3.47E-11	-	1.36E+09	5.01E+00	8.56E-01	3.00E-01	3.44E+03	4.62E+07	2.45E+03	1.43E+02	1.30E+02	4.47E-09
Sr-90	M	1.05E-10	4.82E-10	6.88E-11	9.18E-11	-	1.36E+09	2.38E-02	9.27E-01	3.00E-01	1.21E+01	9.58E+04	3.14E+02	3.55E-01	3.44E-01	2.53E-09
Sr-90+D	M	1.13E-10	1.96E-08	9.53E-11	1.44E-10	-	1.36E+09	2.38E-02	1.00E+00	3.00E-01	7.71E+00	8.90E+04	7.16E+00	2.56E-01	2.40E-01	1.76E-09
Sr-91	M	1.70E-12	3.31E-06	4.66E-12	8.81E-12	-	1.36E+09	6.39E+02	8.62E-01	3.00E-01	1.73E+06	8.11E+10	6.74E+02	7.18E+04	6.67E+02	1.84E-10
Sr-92	M	1.03E-12	6.69E-06	3.26E-12	6.18E-12	-	1.36E+09	2.24E+03	8.31E-01	3.00E-01	8.63E+06	4.69E+11	1.21E+03	3.60E+05	1.21E+03	9.63E-11
Ta-172	S	7.22E-14	7.04E-06	1.59E-13	2.64E-13	-	1.36E+09	9.90E+03	9.13E-01	2.00E-02	8.93E+08	2.96E+13	4.63E+03	4.89E+08	4.63E+03	1.56E-10
Ta-173	S	4.44E-13	2.38E-06	1.31E-12	2.49E-12	-	1.36E+09	1.66E+03	9.30E-01	2.00E-02	1.59E+07	8.08E+11	2.26E+03	9.97E+06	2.26E+03	4.56E-10
Ta-174	S	1.11E-13	2.55E-06	2.30E-13	4.11E-13	-	1.36E+09	5.06E+03	8.65E-01	2.00E-02	2.93E+08	9.83E+12	6.90E+03	1.73E+08	6.90E+03	4.61E-10
Ta-175	S	4.37E-13	4.16E-06	1.24E-12	2.25E-12	-	1.36E+09	5.78E+02	9.34E-01	2.00E-02	6.12E+06	2.85E+11	4.48E+02	3.66E+06	4.48E+02	2.63E-10
Ta-176	S	5.96E-13	1.06E-05	1.78E-12	3.18E-12	-	1.36E+09	7.51E+02	9.41E-01	2.00E-02	5.63E+06	2.72E+11	2.27E+02	3.31E+06	2.27E+02	1.03E-10
Ta-177	S	4.44E-13	1.20E-07	8.58E-13	1.65E-12	-	1.36E+09	1.07E+02	9.41E-01	2.00E-02	1.55E+06	5.21E+10	2.86E+03	9.82E+05	2.84E+03	9.11E-09
Ta-178	-	-	3.29E-07	-	-	-	1.36E+09	3.91E+04	9.05E-01	2.00E-02	-	-	3.95E+05	-	3.95E+05	3.49E-09
Ta-178m	S	1.79E-13	3.78E-06	3.53E-13	6.29E-13	-	1.36E+09	2.76E+03	9.06E-01	2.00E-02	1.04E+08	3.33E+12	2.42E+03	6.14E+07	2.42E+03	3.03E-10
Ta-179	S	2.05E-12	3.62E-08	5.00E-13	9.51E-13	-	1.36E+09	3.80E-01	9.59E-01	2.00E-02	9.52E+03	4.00E+07	3.30E+01	5.97E+03	3.27E+01	2.98E-08
Ta-180	S	7.25E-11	2.03E-06	6.44E-12	1.23E-11	-	1.36E+09	6.93E-14	9.12E-01	2.00E-02	6.45E+01	9.92E+04	5.42E-02	4.06E+01	5.41E-02	2.72E+02
Ta-180m	S	1.86E-13	6.13E-08	4.40E-13	8.58E-13	-	1.36E+09	7.49E+02	9.46E-01	2.00E-02	2.08E+07	8.69E+11	3.89E+04	1.34E+07	3.87E+04	1.80E-08
Ta-182	S	3.74E-11	6.04E-06	1.15E-11	2.19E-11	-	1.36E+09	2.20E+00	9.25E-01	2.00E-02	2.39E+03	1.27E+07	1.18E+00	1.50E+03	1.18E+00	1.90E-10
Ta-182m	S	3.41E-14	7.38E-07	2.76E-14	4.44E-14	-	1.36E+09	2.30E+04	9.28E-01	2.00E-02	1.23E+10	1.45E+14	1.01E+05	6.54E+09	1.01E+05	1.55E-09
Ta-183	S	8.81E-12	9.40E-07	1.22E-11	2.38E-11	-	1.36E+09	4.96E+01	9.32E-01	2.00E-02	4.96E+04	1.21E+09	1.70E+02	3.19E+04	1.69E+02	1.21E-09
Ta-184	S	1.73E-12	7.02E-06	5.11E-12	9.81E-12	-	1.36E+09	6.98E+02	9.14E-01	2.00E-02	1.69E+06	8.70E+10	3.27E+02	1.07E+06	3.27E+02	1.67E-10
Ta-185	S	1.18E-13	6.24E-07	2.22E-13	3.92E-13	-	1.36E+09	7.43E+03	9.23E-01	2.00E-02	4.51E+08	1.36E+13	3.88E+04	2.63E+08	3.88E+04	1.87E-09
Ta-186	S	2.69E-14	6.69E-06	7.55E-14	1.19E-13	-	1.36E+09	3.47E+04	9.13E-01	2.00E-02	6.94E+09	2.78E+14	1.71E+04	3.61E+09	1.71E+04	1.78E-10
Tb-147	M	2.26E-13	7.30E-06	7.59E-13	1.37E-12	-	1.36E+09	3.68E+03	8.59E-01	2.60E-03	6.39E+07	3.51E+12	1.77E+03	2.93E+08	1.77E+03	1.37E-10
Tb-149	M	1.65E-11	7.60E-06	1.56E-12	2.90E-12	-	1.36E+09	1.46E+03	8.63E-01	2.60E-03	1.20E+07	1.91E+10	6.71E+02	5.66E+07	6.71E+02	1.33E-10
Tb-150	M	3.88E-13	7.79E-06	1.56E-12	2.92E-12	-	1.36E+09	1.86E+03	8.68E-01	2.60E-03	1.51E+07	1.03E+12	8.26E+02	7.19E+07	8.26E+02	1.30E-10

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Wet Soil-to-plant transfer factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Produce Ingestion PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Tb-151	M	7.73E-13	3.66E-06	2.13E-12	3.92E-12	-	1.36E+09	3.45E+02	8.92E-01	2.60E-03	2.10E+06	9.63E+10	3.18E+02	9.78E+06	3.18E+02	2.70E-10
Tb-153	M	8.18E-13	7.24E-07	1.86E-12	3.54E-12	-	1.36E+09	1.08E+02	9.31E-01	2.60E-03	7.27E+05	2.85E+10	4.83E+02	3.51E+06	4.82E+02	1.32E-09
Tb-154	M	1.14E-12	1.18E-05	3.64E-12	6.51E-12	-	1.36E+09	2.84E+02	8.89E-01	2.60E-03	1.04E+06	5.37E+10	8.14E+01	4.71E+06	8.14E+01	8.57E-11
Tb-155	M	8.99E-13	3.26E-07	1.56E-12	2.97E-12	-	1.36E+09	4.75E+01	9.37E-01	2.60E-03	3.81E+05	1.14E+10	4.68E+02	1.84E+06	4.68E+02	2.96E-09
Tb-156	M	4.22E-12	8.37E-06	7.10E-12	1.30E-11	-	1.36E+09	4.74E+01	8.83E-01	2.60E-03	8.68E+04	2.42E+09	1.93E+01	4.03E+05	1.93E+01	1.23E-10
Tb-156m	M	8.47E-13	2.16E-08	1.22E-12	2.29E-12	-	1.36E+09	2.49E+02	9.57E-01	2.60E-03	2.59E+06	6.34E+10	3.62E+04	1.23E+07	3.56E+04	4.33E-08
Tb-156n	M	3.77E-13	4.06E-09	5.85E-13	1.11E-12	-	1.36E+09	1.21E+03	9.55E-01	2.60E-03	2.60E+07	6.95E+11	9.42E+05	1.25E+08	9.03E+05	2.25E-07
Tb-157	M	1.46E-12	1.64E-09	2.70E-13	5.29E-13	-	1.36E+09	4.62E-03	9.62E-01	2.60E-03	1.61E+03	5.28E+06	6.81E+01	7.99E+03	6.48E+01	4.27E-06
Tb-158	M	8.29E-11	3.57E-06	6.99E-12	1.32E-11	-	1.36E+09	4.62E-03	8.54E-01	2.60E-03	6.44E+01	9.29E+04	3.52E-02	3.08E+02	3.52E-02	2.34E-09
Tb-160	M	2.45E-11	5.23E-06	1.27E-11	2.42E-11	-	1.36E+09	3.50E+00	8.61E-01	2.60E-03	3.44E+03	3.08E+07	2.34E+00	1.66E+04	2.34E+00	2.07E-10
Tb-161	M	5.03E-12	3.45E-08	7.03E-12	1.38E-11	-	1.36E+09	3.66E+01	9.54E-01	2.60E-03	6.32E+04	1.57E+09	3.35E+03	3.15E+05	3.15E+03	2.69E-08
Tc-101	M	1.85E-14	1.37E-06	4.22E-14	6.81E-14	-	1.36E+09	2.57E+04	8.94E-01	5.00E+00	8.97E+09	2.99E+14	6.30E+04	1.91E+07	6.28E+04	4.80E-10
Tc-104	M	5.33E-14	9.75E-06	1.90E-13	3.09E-13	-	1.36E+09	2.00E+04	8.98E-01	5.00E+00	1.54E+09	8.10E+13	6.88E+03	3.31E+06	6.86E+03	6.92E-11
Tc-93	M	6.36E-14	7.31E-06	2.20E-13	3.55E-13	-	1.36E+09	2.21E+03	8.91E-01	5.00E+00	1.48E+08	7.49E+12	1.02E+03	3.15E+05	1.02E+03	8.31E-11
Tc-93m	M	3.17E-14	3.62E-06	9.44E-14	1.55E-13	-	1.36E+09	8.37E+03	8.98E-01	5.00E+00	1.29E+09	5.70E+13	7.75E+03	2.79E+06	7.73E+03	1.67E-10
Tc-94	M	2.80E-13	1.24E-05	8.88E-13	1.48E-12	-	1.36E+09	1.24E+03	8.70E-01	5.00E+00	2.00E+07	9.58E+11	3.47E+02	4.40E+04	3.44E+02	5.05E-11
Tc-94m	M	1.03E-13	8.70E-06	3.32E-13	5.74E-13	-	1.36E+09	7.00E+03	8.59E-01	5.00E+00	2.91E+08	1.47E+13	2.82E+03	6.63E+05	2.81E+03	7.31E-11
Tc-95	M	2.63E-13	3.63E-06	8.03E-13	1.35E-12	-	1.36E+09	3.04E+02	8.77E-01	5.00E+00	5.35E+06	2.49E+11	2.87E+02	1.19E+04	2.80E+02	1.70E-10
Tc-95m	M	3.40E-12	2.93E-06	2.51E-12	4.29E-12	-	1.36E+09	4.15E+00	8.73E-01	5.00E+00	2.30E+04	2.63E+08	4.88E+00	5.19E+01	4.46E+00	1.98E-10
Tc-96	M	2.00E-12	1.16E-05	4.74E-12	7.81E-12	-	1.36E+09	5.91E+01	8.60E-01	5.00E+00	1.80E+05	6.38E+09	1.78E+01	3.92E+02	1.70E+01	5.37E-11
Tc-96m	M	2.05E-14	2.13E-07	5.00E-14	8.36E-14	-	1.36E+09	7.07E+03	9.38E-01	5.00E+00	2.01E+09	7.44E+13	1.07E+05	4.44E+06	1.04E+05	2.74E-09
Tc-97	M	8.51E-13	2.94E-10	3.89E-13	7.40E-13	-	1.36E+09	2.67E-07	1.00E+00	5.00E+00	1.07E+03	8.45E+06	3.41E+02	2.69E+00	2.66E+00	1.88E-03
Tc-97m	M	1.12E-11	1.04E-09	3.44E-12	6.62E-12	-	1.36E+09	2.91E+00	9.99E-01	5.00E+00	1.05E+04	5.60E+07	8.42E+03	2.65E+01	2.64E+01	1.71E-09
Tc-98	M	3.01E-11	6.45E-06	1.01E-11	1.83E-11	-	1.36E+09	1.65E-07	8.67E-01	5.00E+00	4.34E+01	2.39E+05	1.79E-02	1.04E-01	1.53E-02	1.76E-05
Tc-99	M	1.41E-11	8.14E-11	4.00E-12	7.66E-12	-	1.36E+09	3.25E-06	9.27E-01	5.00E+00	1.04E+02	5.10E+05	1.33E+03	2.62E-01	2.61E-01	1.54E-05
Tc-99m	M	5.70E-14	3.94E-07	1.14E-13	2.03E-13	-	1.36E+09	1.01E+03	9.46E-01	5.00E+00	1.18E+08	3.82E+12	8.14E+03	2.78E+05	7.91E+03	1.51E-09
Te-116	M	3.20E-13	1.34E-07	9.62E-13	1.75E-12	-	1.36E+09	2.44E+03	9.80E-01	6.00E-01	3.32E+07	1.64E+12	5.59E+04	6.63E+05	5.14E+04	4.75E-09
Te-121	M	1.30E-12	2.46E-06	2.01E-12	3.40E-12	-	1.36E+09	1.49E+01	9.02E-01	6.00E-01	1.04E+05	2.47E+09	2.02E+01	1.94E+03	2.00E+01	3.15E-10
Te-121m	M	1.44E-11	7.84E-07	8.51E-12	1.42E-11	-	1.36E+09	1.64E+00	9.17E-01	6.00E-01	2.75E+03	2.46E+07	6.87E+00	5.05E+01	6.04E+00	8.63E-10
Te-123	M	2.50E-12	2.73E-09	5.11E-12	6.77E-12	-	1.36E+09	6.93E-14	9.89E-01	6.00E-01	1.17E+02	2.88E+06	3.71E+01	1.71E+00	1.61E+00	5.54E+03
Te-123m	M	1.36E-11	4.49E-07	5.66E-12	1.02E-11	-	1.36E+09	2.11E+00	9.51E-01	6.00E-01	4.93E+03	3.35E+07	1.49E+01	9.77E+01	1.29E+01	1.46E-09
Te-125m	M	1.17E-11	6.95E-09	4.70E-12	8.92E-12	-	1.36E+09	4.36E+00	9.86E-01	6.00E-01	1.16E+04	8.04E+07	1.91E+03	2.43E+02	2.12E+02	1.18E-08
Te-127	M	6.11E-13	2.10E-08	1.48E-12	2.87E-12	-	1.36E+09	6.49E+02	8.94E-01	6.00E-01	5.39E+06	2.29E+11	1.04E+05	1.15E+05	5.40E+04	2.05E-08
Te-127m	M	2.58E-11	2.73E-09	1.20E-11	2.25E-11	-	1.36E+09	2.32E+00	9.83E-01	6.00E-01	2.46E+03	1.94E+07	2.60E+03	5.06E+01	4.87E+01	5.17E-09
Te-129	M	9.95E-14	2.45E-07	2.44E-13	4.40E-13	-	1.36E+09	5.23E+03	8.89E-01	6.00E-01	2.83E+08	1.13E+13	7.23E+04	5.61E+06	7.14E+04	3.41E-09
Te-129m	M	2.49E-11	1.38E-07	2.20E-11	4.26E-11	-	1.36E+09	7.53E+00	9.85E-01	6.00E-01	4.21E+03	6.52E+07	1.67E+02	8.96E+01	5.75E+01	1.91E-09
Te-131	M	6.40E-14	1.79E-06	3.05E-13	5.62E-13	-	1.36E+09	1.46E+04	9.17E-01	6.00E-01	6.17E+08	4.91E+13	2.67E+04	1.25E+07	2.66E+04	4.65E-10
Te-131m	M	4.22E-12	6.61E-06	1.19E-11	2.28E-11	-	1.36E+09	2.02E+02	9.49E-01	6.00E-01	2.11E+05	1.03E+10	9.71E+01	4.45E+03	9.49E+01	1.19E-10
Te-132	M	9.32E-12	7.84E-07	2.44E-11	4.77E-11	-	1.36E+09	7.76E+01	9.36E-01	6.00E-01	3.87E+04	1.80E+09	3.18E+02	8.33E+02	2.29E+02	7.55E-10
Te-133	M	4.92E-14	4.29E-06	2.73E-13	5.29E-13	-	1.36E+09	2.93E+04	8.42E-01	6.00E-01	1.32E+09	1.28E+14	2.44E+04	2.81E+07	2.43E+04	2.15E-10
Te-133m	M	2.64E-13	1.09E-05	1.24E-12	2.42E-12	-	1.36E+09	6.57E+03	9.27E-01	6.00E-01	6.47E+07	5.37E+12	1.96E+03	1.39E+06	1.95E+03	7.67E-11
Te-134	M	1.60E-13	3.78E-06	4.18E-13	7.51E-13	-	1.36E+09	8.71E+03	8.72E-01	6.00E-01	2.76E+08	1.18E+13	7.95E+03	5.46E+06	7.94E+03	2.37E-10
Th-226	S	1.56E-10	2.36E-08	9.32E-13	1.58E-12	-	1.36E+09	1.18E+04	9.47E-01	1.00E-03	1.78E+08	1.63E+10	1.59E+06	1.99E+09	1.57E+06	5.85E-08
Th-227	S	3.51E-08	3.78E-07	6.92E-11	1.37E-10	-	1.36E+09	1.35E+01	9.71E-01	1.00E-03	2.35E+03	8.31E+04	1.11E+02	3.07E+04	1.05E+02	3.43E-09
Th-228	S	1.32E-07	5.59E-09	1.48E-10	2.89E-10	-	1.36E+09	3.62E-01	9.80E-01	1.00E-03	2.98E+01	5.92E+02	1.99E+02	3.84E+02	2.34E+01	2.85E-08
Th-229	S	1.75E-07	2.25E-07	2.90E-10	4.96E-10	-	1.36E+09	9.44E-05	9.59E-01	1.00E-03	1.60E+00	4.12E+01	4.65E-01	1.81E+01	3.51E-01	1.65E-06
Th-229+D	S	2.25E-07	1.17E-06	7.16E-10	1.29E-09	-	1.36E+09	9.44E-05	9.72E-01	1.00E-03	6.16E-01	3.20E+01	8.83E-02	7.32E+00	7.63E-02	3.59E-07
Th-230	S	2.85E-08	8.19E-10	1.19E-10	2.02E-10	-	1.36E+09	9.00E-06	9.97E-01	1.00E-03	3.93E+00	2.52E+02	1.23E+02	4.40E+01	3.46E+00	1.71E-04
Th-231	S	1.52E-12	2.45E-08	3.24E-12	6.36E-12	-	1.36E+09	2.38E+02	9.85E-01	1.00E-03	8.91E+05	3.38E+10	2.97E+04	1.15E+07	2.86E+04	5.39E-08
Th-232	S	4.33E-08	3.42E-10	1.33E-10	2.31E-10	-	1.36E+09	4.93E-11	9.98E-01	1.00E-03	3.44E+00	1.66E+02	2.94E+02	3.94E+01	3.07E+00	2.80E+01
Th-234	S	3.07E-11	1.64E-08	3.40E-11	6.70E-11	-	1.36E+09	1.05E+01	9.57E-01	1.00E-03	3.73E+03	7.38E+07	2.01E+03	4.85E+04	1.27E+03	5.51E-08
Th-234+D	S	-	1.14E-07	-	-	-	1.36E+09	1.05E+01	9.91E-01	1.00E-03	-	-	2.80E+02	-	2.80E+02	1.21E-08
Ti-44	S	3.41E-10	2.39E-07	3.64E-11	6.73E-11	-	1.36E+09	1.47E-02	9.45E-01	-	1.46E+01	2.61E+04	5.49E-01	-	5.29E-01	3.08E-09
Ti-44+D	S	-	1.02E-05	-	-	-	1.36E+09	1.47E-02	8.71E-01	-	-	-	1.40E-02	-	1.40E-02	8.13E-11
Ti-45	S	3.09E-13	3.80E-06	9.32E-13	1.75E-12	-	1.36E+09	1.97E+03	8.82E-01	-	2.68E+07	1.38E+12	1.77E+03	-	1.77E+03	7.84E-11
Tl-194	F	5.11E-15	3.25E-06	2.45E-14	3.68E-14	-	1.36E+09	1.10E+04	8.86E-01	2.00E-01	7.14E+09	4.66E+14	1.15E+04	3.54E+08	1.15E+04	3.93E-10
Tl-194m	F	2.50E-14	1.01E-05	1.06E-13	1.63E-13	-	1.36E+09	1.11E+04	9.27E-01	2.00E-01	1.62E+09	9.58E+13	3.57E+03	8.23E+07	3.57E+03	1.21E-10
Tl-195	F	2.08E-14	6.03E-06	8.70E-14	1.36E-13	-	1.36E+09	5.23E+03	9.44E-01	2.00E-01	9.16E+08	5.43E+13	2.77E+03	4.72E+07	2.77E+03	2.00E-10
Tl-197	F	2.39E-14	1.65E-06	8.55E-14	1.41E-13	-	1.36E+09	2.14E+03	9.34E-01	2.00E-01	3.61E+08	1.93E+13	4.17E+03	1.96E+07	4.17E+03	7.46E-10
Tl-198	F	7.92E-14	9.67E-06	2.75E-13	4.26E-13	-	1.36E+09	1.15E+03	9.48E-01	2.00E-01	6.40E+07	3.12E+12	3.76E+02	3.27E+06	3.76E+02	1.26E-10

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Wet Soil-to-plant transfer factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Produce Ingestion PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Tl-198m	F	4.92E-14	5.05E-06	1.75E-13	2.76E-13	-	1.36E+09	3.25E+03	9.81E-01	2.00E-01	2.80E+08	1.42E+13	1.97E+03	1.46E+07	1.97E+03	2.33E-10
Tl-199	F	2.89E-14	8.56E-07	9.99E-14	1.64E-13	-	1.36E+09	8.18E+02	9.31E-01	2.00E-01	1.19E+08	6.11E+12	3.09E+03	6.43E+06	3.09E+03	1.46E-09
Tl-200	F	2.52E-13	5.93E-06	8.21E-13	1.31E-12	-	1.36E+09	2.33E+02	9.52E-01	2.00E-01	4.23E+06	1.99E+11	1.24E+02	2.22E+05	1.24E+02	2.07E-10
Tl-201	F	1.49E-13	1.88E-07	5.00E-13	8.81E-13	-	1.36E+09	8.31E+01	9.44E-01	2.00E-01	2.25E+06	1.20E+11	1.41E+03	1.31E+05	1.39E+03	6.54E-09
Tl-202	F	6.14E-13	1.83E-06	2.01E-12	3.28E-12	-	1.36E+09	2.07E+01	9.06E-01	2.00E-01	1.50E+05	7.27E+09	3.75E+01	8.08E+03	3.74E+01	7.08E-10
Tl-204	F	2.45E-12	2.76E-09	8.25E-12	1.54E-11	-	1.36E+09	1.83E-01	9.63E-01	2.00E-01	2.85E+02	1.62E+07	2.08E+02	1.75E+01	1.53E+01	3.30E-08
Tl-206	-	-	6.05E-09	-	-	-	1.36E+09	8.67E+04	9.34E-01	2.00E-01	-	-	4.62E+07	-	4.62E+07	2.13E-07
Tl-207	-	-	1.52E-08	-	-	-	1.36E+09	7.64E+04	8.55E-01	2.00E-01	-	-	1.77E+07	-	1.77E+07	9.30E-08
Tl-208	-	-	1.76E-05	-	-	-	1.36E+09	1.19E+05	8.79E-01	2.00E-01	-	-	2.31E+04	-	2.31E+04	7.85E-11
Tl-209	-	-	9.83E-06	-	-	-	1.36E+09	1.66E+05	8.65E-01	2.00E-01	-	-	5.86E+04	-	5.86E+04	1.44E-10
Tm-162	M	2.72E-14	8.69E-06	7.77E-14	1.24E-13	-	1.36E+09	1.68E+04	8.83E-01	-	3.22E+09	1.33E+14	6.58E+03	-	6.58E+03	1.23E-10
Tm-166	M	5.14E-13	8.98E-06	1.59E-12	2.86E-12	-	1.36E+09	7.88E+02	9.12E-01	-	6.56E+06	3.31E+11	2.90E+02	-	2.90E+02	1.18E-10
Tm-167	M	4.37E-12	3.97E-07	5.07E-12	9.88E-12	-	1.36E+09	2.74E+01	9.28E-01	-	6.60E+04	1.35E+09	2.24E+02	-	2.23E+02	2.64E-09
Tm-170	M	2.43E-11	1.01E-08	1.31E-11	2.59E-11	-	1.36E+09	1.97E+00	9.44E-01	-	1.81E+03	1.75E+07	6.21E+02	-	4.62E+02	7.75E-08
Tm-171	M	3.33E-12	6.97E-10	1.02E-12	2.02E-12	-	1.36E+09	3.61E-01	9.53E-01	-	4.25E+03	2.34E+07	1.63E+03	-	1.18E+03	1.09E-06
Tm-172	M	5.62E-12	2.35E-06	1.57E-11	3.09E-11	-	1.36E+09	9.55E+01	8.98E-01	-	7.35E+04	3.66E+09	1.36E+02	-	1.36E+02	4.75E-10
Tm-173	M	7.73E-13	1.62E-06	2.52E-12	4.88E-12	-	1.36E+09	7.37E+02	8.95E-01	-	3.59E+06	2.06E+11	1.53E+03	-	1.53E+03	6.96E-10
Tm-175	M	3.26E-14	4.78E-06	7.25E-14	1.19E-13	-	1.36E+09	2.40E+04	8.92E-01	-	4.79E+09	1.59E+14	1.69E+04	-	1.69E+04	2.40E-10
U-230	M	4.55E-08	3.07E-09	2.98E-10	5.66E-10	-	1.36E+09	1.22E+01	9.87E-01	2.50E-03	5.12E+02	5.77E+04	1.21E+04	2.56E+03	4.09E+02	1.50E-08
U-231	M	1.80E-12	1.60E-07	2.56E-12	5.00E-12	-	1.36E+09	6.02E+01	9.61E-01	2.50E-03	2.87E+05	7.22E+09	1.18E+03	1.48E+06	1.17E+03	8.73E-09
U-232	M	1.95E-08	5.98E-10	3.85E-10	5.74E-10	-	1.36E+09	9.63E-03	9.97E-01	2.50E-03	1.59E+00	4.25E+02	1.94E+02	6.26E+00	1.26E+00	5.88E-08
U-233	M	1.16E-08	9.82E-10	9.69E-11	1.60E-10	-	1.36E+09	4.37E-06	9.98E-01	2.50E-03	4.96E+00	6.20E+02	1.02E+02	2.16E+01	3.86E+00	3.99E-04
U-234	M	1.14E-08	2.52E-10	9.55E-11	1.58E-10	-	1.36E+09	2.83E-06	9.98E-01	2.50E-03	5.02E+00	6.31E+02	3.99E+02	2.19E+01	4.02E+00	6.44E-04
U-235	M	1.01E-08	5.19E-07	9.44E-11	1.57E-10	-	1.36E+09	9.85E-10	9.60E-01	2.50E-03	5.06E+00	7.12E+02	2.01E-01	2.22E+01	1.92E-01	8.89E-02
U-235+D	M	1.01E-08	-	9.76E-11	1.63E-10	-	1.36E+09	9.85E-10	9.60E-01	2.50E-03	4.87E+00	7.12E+02	-	2.15E+01	3.95E+00	1.83E+00
U-236	M	1.05E-08	1.25E-10	9.03E-11	1.49E-10	-	1.36E+09	2.96E-08	9.99E-01	2.50E-03	5.33E+00	6.85E+02	8.03E+02	2.32E+01	4.28E+00	6.62E-02
U-237	M	6.44E-12	3.76E-07	7.14E-12	1.39E-11	-	1.36E+09	3.75E+01	9.53E-01	2.50E-03	6.42E+04	1.26E+09	3.15E+02	3.30E+05	3.13E+02	3.84E-09
U-238	M	9.32E-09	4.99E-11	8.66E-11	1.43E-10	-	1.36E+09	1.55E-10	1.00E+00	2.50E-03	5.55E+00	7.72E+02	2.01E+03	2.42E+01	4.48E+00	1.33E+01
U-238+D	M	9.35E-09	1.14E-07	1.21E-10	2.10E-10	-	1.36E+09	1.55E-10	9.79E-01	2.50E-03	3.78E+00	7.69E+02	8.99E-01	1.73E+01	6.96E-01	2.07E+00
U-239	M	5.70E-14	1.21E-07	1.06E-13	1.90E-13	-	1.36E+09	1.55E+04	9.58E-01	2.50E-03	1.94E+09	5.86E+13	4.02E+05	9.17E+09	4.02E+05	1.20E-08
U-240	M	2.96E-12	7.34E-10	1.03E-11	2.02E-11	-	1.36E+09	4.31E+02	9.98E-01	2.50E-03	5.07E+05	3.14E+10	1.77E+06	2.63E+06	3.43E+05	3.71E-07
V-47	M	5.96E-14	4.36E-06	1.74E-13	2.92E-13	-	1.36E+09	1.12E+04	8.82E-01	-	9.11E+08	4.04E+13	8.74E+03	-	8.74E+03	7.14E-11
V-48	M	9.29E-12	1.40E-05	1.17E-11	2.13E-11	-	1.36E+09	1.56E+01	8.44E-01	-	1.74E+04	3.62E+08	3.97E+00	-	3.97E+00	2.37E-11
V-49	M	1.47E-13	0.00E+00	1.79E-13	3.53E-13	-	1.36E+09	7.67E-01	0.00E+00	-	5.17E+04	1.13E+09	-	-	5.17E+04	6.41E-06
W-176	F	1.24E-13	3.20E-07	5.88E-13	1.05E-12	-	1.36E+09	2.64E+03	9.42E-01	1.80E-02	5.99E+07	4.59E+12	2.63E+04	3.92E+07	2.63E+04	3.40E-09
W-177	F	5.99E-14	3.63E-06	2.84E-13	5.00E-13	-	1.36E+09	2.70E+03	9.27E-01	1.80E-02	1.28E+08	9.72E+12	2.41E+03	8.29E+07	2.41E+03	3.07E-10
W-178	F	3.85E-13	1.59E-08	1.75E-12	3.33E-12	-	1.36E+09	1.17E+01	9.71E-01	1.80E-02	8.33E+04	6.53E+09	2.27E+03	5.81E+04	2.13E+03	6.31E-08
W-178+D	F	-	3.45E-07	-	-	-	1.36E+09	1.17E+01	9.15E-01	1.80E-02	-	-	1.11E+02	-	1.11E+02	3.29E-09
W-179	F	1.83E-15	6.02E-08	1.01E-14	1.68E-14	-	1.36E+09	9.71E+03	9.67E-01	1.80E-02	1.38E+10	1.15E+15	5.02E+05	8.39E+09	5.02E+05	1.80E-08
W-181	F	1.35E-13	4.86E-08	5.70E-13	1.07E-12	-	1.36E+09	2.09E+00	9.56E-01	1.80E-02	4.64E+04	3.34E+09	1.35E+02	3.19E+04	1.34E+02	2.26E-08
W-185	F	9.36E-13	2.92E-10	4.29E-12	8.36E-12	-	1.36E+09	3.37E+00	9.45E-01	1.80E-02	9.59E+03	7.76E+08	3.67E+04	6.85E+03	3.60E+03	3.84E-07
W-187	F	1.11E-12	2.04E-06	5.37E-12	1.03E-11	-	1.36E+09	2.54E+02	9.40E-01	1.80E-02	5.87E+05	4.94E+10	3.99E+02	4.13E+05	3.98E+02	5.68E-10
W-188	F	4.63E-12	7.02E-09	2.05E-11	4.00E-11	-	1.36E+09	3.64E+00	9.11E-01	1.80E-02	2.17E+03	1.70E+08	1.71E+03	1.55E+03	5.92E+02	5.93E-08
Xe-120	-	-	1.71E-06	-	-	-	1.36E+09	9.11E+03	9.51E-01	0.00E+00	-	-	1.68E+04	-	1.68E+04	4.31E-10
Xe-121	-	-	8.74E-06	-	-	-	1.36E+09	9.08E+03	9.02E-01	0.00E+00	-	-	3.47E+03	-	3.47E+03	8.96E-11
Xe-122	-	-	1.83E-07	-	-	-	1.36E+09	3.02E+02	9.06E-01	0.00E+00	-	-	5.48E+03	-	5.48E+03	4.30E-09
Xe-123	-	-	2.72E-06	-	-	-	1.36E+09	2.92E+03	9.03E-01	0.00E+00	-	-	3.58E+03	-	3.58E+03	2.92E-10
Xe-125	-	-	9.38E-07	-	-	-	1.36E+09	3.57E+02	9.06E-01	0.00E+00	-	-	1.26E+03	-	1.26E+03	8.59E-10
Xe-127	-	-	9.52E-07	-	-	-	1.36E+09	6.95E+00	9.33E-01	0.00E+00	-	-	2.35E+01	-	2.35E+01	8.35E-10
Xe-129m	-	-	4.25E-08	-	-	-	1.36E+09	3.16E+01	9.79E-01	0.00E+00	-	-	2.29E+03	-	2.29E+03	1.81E-08
Xe-131m	-	-	1.41E-08	-	-	-	1.36E+09	2.13E+01	9.81E-01	0.00E+00	-	-	4.62E+03	-	4.62E+03	5.53E-08
Xe-133	-	-	6.62E-08	-	-	-	1.36E+09	4.82E+01	9.64E-01	0.00E+00	-	-	2.27E+03	-	2.27E+03	1.22E-08
Xe-133m	-	-	9.25E-08	-	-	-	1.36E+09	1.16E+02	9.73E-01	0.00E+00	-	-	3.86E+03	-	3.86E+03	8.63E-09
Xe-135	-	-	9.71E-07	-	-	-	1.36E+09	6.68E+02	9.07E-01	0.00E+00	-	-	2.28E+03	-	2.28E+03	8.95E-10
Xe-135m	-	-	1.86E-06	-	-	-	1.36E+09	2.38E+04	8.84E-01	0.00E+00	-	-	4.36E+04	-	4.36E+04	4.79E-10
Xe-138	-	-	5.62E-06	-	-	-	1.36E+09	2.57E+04	8.93E-01	0.00E+00	-	-	1.54E+04	-	1.54E+04	1.61E-10
Y-86	S	1.58E-12	1.73E-05	5.81E-12	1.05E-11	-	1.36E+09	4.12E+02	8.98E-01	2.50E-03	9.34E+05	5.62E+10	7.98E+01	4.45E+06	7.98E+01	3.23E-11
Y-86m	S	9.29E-14	8.35E-07	3.35E-13	6.11E-13	-	1.36E+09	7.59E+03	9.19E-01	2.50E-03	2.96E+08	1.76E+13	2.98E+04	1.42E+09	2.98E+04	6.54E-10
Y-87	S	1.49E-12	1.94E-06	3.70E-12	6.92E-12	-	1.36E+09	7.56E+01	9.69E-01	2.50E-03	2.60E+05	1.09E+10	1.21E+02	1.28E+06	1.21E+02	2.70E-10
Y-88	S	1.70E-11	1.37E-05	5.85E-12	9.92E-12	-	1.36E+09	2.37E+00	8.81E-01	2.50E-03	5.69E+03	3.01E+07	5.91E-01	2.55E+04	5.91E-01	4.26E-11

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Area Correction Factor	Wet Soil-to-plant transfer factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Produce Ingestion PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Y-90	S	8.40E-12	1.92E-08	2.65E-11	5.25E-11	-	1.36E+09	9.49E+01	1.00E+00	2.50E-03	4.30E+04	2.44E+09	1.49E+04	2.25E+05	1.05E+04	1.94E-08
Y-90m	S	4.81E-13	2.58E-06	1.51E-12	2.95E-12	-	1.36E+09	1.90E+03	9.12E-01	2.50E-03	1.54E+07	8.54E+11	2.43E+03	7.92E+07	2.43E+03	2.23E-10
Y-91	S	3.36E-11	2.51E-08	2.35E-11	4.66E-11	-	1.36E+09	4.32E+00	8.37E-01	2.50E-03	2.21E+03	2.78E+07	6.19E+02	1.16E+04	4.64E+02	1.90E-08
Y-91m	S	3.01E-14	2.34E-06	4.96E-14	8.51E-14	-	1.36E+09	7.33E+03	8.92E-01	2.50E-03	2.05E+09	5.25E+13	1.06E+04	9.28E+09	1.06E+04	2.55E-10
Y-92	S	9.32E-13	1.26E-06	3.61E-12	7.03E-12	-	1.36E+09	1.71E+03	8.43E-01	2.50E-03	5.81E+06	3.97E+11	4.86E+03	2.98E+07	4.85E+03	5.05E-10
Y-93	S	2.64E-12	4.60E-07	1.05E-11	2.08E-11	-	1.36E+09	6.01E+02	8.14E-01	2.50E-03	6.88E+05	4.91E+10	4.83E+03	3.60E+06	4.79E+03	1.44E-09
Y-94	S	5.51E-14	5.45E-06	1.90E-13	3.08E-13	-	1.36E+09	1.91E+04	8.30E-01	2.50E-03	1.47E+09	7.47E+13	1.27E+04	6.31E+09	1.27E+04	1.21E-10
Y-95	S	2.92E-14	4.80E-06	9.99E-14	1.59E-13	-	1.36E+09	3.40E+04	8.29E-01	2.50E-03	5.10E+09	2.52E+14	2.57E+04	2.14E+10	2.57E+04	1.39E-10
Yb-162	S	3.00E-14	3.26E-07	7.29E-14	1.21E-13	-	1.36E+09	1.93E+04	9.37E-01	-	3.79E+09	1.39E+14	1.90E+05	-	1.90E+05	3.10E-09
Yb-166	S	2.89E-12	9.46E-08	6.29E-12	1.17E-11	-	1.36E+09	1.07E+02	9.52E-01	-	2.18E+05	7.99E+09	3.58E+03	-	3.52E+03	1.06E-08
Yb-167	S	1.71E-14	6.21E-07	2.18E-14	3.70E-14	-	1.36E+09	2.08E+04	9.28E-01	-	1.34E+10	2.63E+14	1.09E+05	-	1.09E+05	1.69E-09
Yb-169	S	1.08E-11	7.76E-07	5.85E-12	1.12E-11	-	1.36E+09	7.90E+00	9.21E-01	-	1.68E+04	1.58E+08	3.33E+01	-	3.32E+01	1.38E-09
Yb-175	S	2.95E-12	1.54E-07	4.22E-12	8.29E-12	-	1.36E+09	6.04E+01	9.01E-01	-	1.73E+05	4.42E+09	1.31E+03	-	1.30E+03	7.31E-09
Yb-177	S	2.29E-13	8.35E-07	5.03E-13	9.51E-13	-	1.36E+09	3.20E+03	8.82E-01	-	8.00E+07	3.01E+12	1.31E+04	-	1.31E+04	1.40E-09
Yb-178	S	2.38E-13	1.44E-07	5.59E-13	1.06E-12	-	1.36E+09	4.92E+03	8.98E-01	-	1.11E+08	4.46E+12	1.15E+05	-	1.14E+05	8.03E-09
Zn-62	M	2.65E-12	1.87E-06	7.25E-12	1.34E-11	-	1.36E+09	6.56E+02	8.79E-01	4.00E-01	1.16E+06	5.34E+10	1.20E+03	3.55E+04	1.16E+03	2.13E-10
Zn-63	M	7.55E-14	4.87E-06	2.26E-13	3.77E-13	-	1.36E+09	9.56E+03	8.62E-01	4.00E-01	6.04E+08	2.73E+13	6.85E+03	1.66E+07	6.85E+03	8.76E-11
Zn-65	M	5.81E-12	2.81E-06	1.54E-11	2.45E-11	-	1.36E+09	1.04E+00	8.43E-01	4.00E-01	1.01E+03	3.85E+07	1.32E+00	2.64E+01	1.25E+00	1.52E-10
Zn-69	M	6.11E-14	1.67E-09	1.03E-13	1.79E-13	-	1.36E+09	6.39E+03	8.92E-01	4.00E-01	8.50E+08	2.26E+13	1.29E+07	2.44E+07	8.35E+06	1.75E-07
Zn-69m	M	1.28E-12	1.78E-06	2.73E-12	5.07E-12	-	1.36E+09	4.41E+02	8.89E-01	4.00E-01	2.07E+06	7.44E+10	8.39E+02	6.35E+04	8.28E+02	2.51E-10
Zn-71m	M	5.33E-13	6.84E-06	1.39E-12	2.50E-12	-	1.36E+09	1.55E+03	8.68E-01	4.00E-01	1.47E+07	6.27E+11	7.85E+02	4.37E+05	7.83E+02	6.97E-11
Zn-72	M	5.48E-12	4.68E-07	9.44E-12	1.71E-11	-	1.36E+09	1.31E+02	9.43E-01	4.00E-01	1.82E+05	5.14E+09	8.90E+02	5.43E+03	7.62E+02	8.15E-10
Zr-86	M	1.56E-12	1.04E-06	5.55E-12	1.02E-11	-	1.36E+09	3.68E+02	9.82E-01	1.00E-03	8.59E+05	5.09E+10	1.08E+03	1.04E+07	1.08E+03	4.91E-10
Zr-88	M	8.95E-12	1.65E-06	2.18E-12	3.74E-12	-	1.36E+09	3.03E+00	9.70E-01	1.00E-03	1.93E+04	7.31E+07	5.70E+00	2.19E+05	5.70E+00	3.21E-10
Zr-89	M	1.92E-12	5.38E-06	5.18E-12	9.58E-12	-	1.36E+09	7.74E+01	9.32E-01	1.00E-03	1.92E+05	8.70E+09	4.64E+01	2.35E+06	4.64E+01	1.04E-10
Zr-93	M	7.29E-12	0.00E+00	1.44E-12	2.12E-12	-	1.36E+09	4.53E-07	0.00E+00	1.00E-03	3.74E+02	9.87E+05	-	3.64E+03	3.39E+02	1.35E-01
Zr-95	M	1.65E-11	3.40E-06	6.59E-12	1.23E-11	-	1.36E+09	3.95E+00	8.65E-01	1.00E-03	7.65E+03	5.17E+07	4.04E+00	9.42E+04	4.04E+00	1.88E-10
Zr-97	M	4.81E-12	8.62E-07	1.83E-11	3.57E-11	-	1.36E+09	3.59E+02	8.63E-01	1.00E-03	2.40E+05	1.61E+10	1.45E+03	3.08E+06	1.44E+03	7.56E-10

A.3 Residential Tap Water Screening Levels for Radionuclides

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Ac-223	-	-	-	-	-	-	-
Ac-223+D	-	-	-	-	-	-	-
Ac-224	S	5.59E-12	4.07E-10	9.47E+00	-	9.47E+00	1.97E-15
Ac-225	S	1.89E-10	2.86E-08	2.80E-01	-	2.80E-01	4.83E-15
Ac-225+D	S	-	-	-	-	-	-
Ac-226	S	6.92E-11	4.33E-09	7.65E-01	-	7.65E-01	1.60E-15
Ac-227	S	2.01E-10	1.49E-07	2.63E-01	-	2.63E-01	3.64E-12
Ac-228	S	1.99E-12	4.92E-11	2.66E+01	-	2.66E+01	1.19E-14
Ag-102	M	7.25E-14	2.56E-14	7.30E+02	-	7.30E+02	5.12E-15
Ag-103	M	1.20E-13	6.07E-14	4.41E+02	-	4.41E+02	1.59E-14
Ag-104	M	1.65E-13	6.25E-14	3.21E+02	-	3.21E+02	1.23E-14
Ag-104m	M	1.21E-13	4.92E-14	4.37E+02	-	4.37E+02	8.12E-15
Ag-105	M	1.77E-12	2.83E-12	2.99E+01	-	2.99E+01	9.87E-13
Ag-106	M	5.92E-14	2.72E-14	8.94E+02	-	8.94E+02	1.21E-14
Ag-106m	M	4.81E-12	3.54E-12	1.10E+01	-	1.10E+01	7.52E-14
Ag-108	-	-	-	-	-	-	-
Ag-108m	M	8.14E-12	2.67E-11	6.50E+00	-	6.50E+00	2.50E-10
Ag-109m	-	-	-	-	-	-	-
Ag-110	-	-	-	-	-	-	-
Ag-110m	M	9.88E-12	2.83E-11	5.36E+00	-	5.36E+00	1.13E-12
Ag-111	M	8.21E-12	6.66E-12	6.44E+00	-	6.44E+00	4.09E-14
Ag-112	M	1.99E-12	7.25E-13	2.66E+01	-	2.66E+01	2.97E-15
Ag-115	M	1.40E-13	6.81E-14	3.78E+02	-	3.78E+02	4.63E-15
Al-26	M	1.73E-11	6.92E-11	3.06E+00	-	3.06E+00	1.59E-07
Al-28	-	-	-	-	-	-	-
Am-237	M	5.07E-14	5.77E-14	1.04E+03	-	1.04E+03	9.62E-14
Am-238	M	9.62E-14	9.51E-14	5.50E+02	-	5.50E+02	6.83E-14
Am-239	M	1.38E-12	8.40E-13	3.83E+01	-	3.83E+01	3.49E-14
Am-240	M	2.59E-12	1.41E-12	2.04E+01	-	2.04E+01	7.96E-14
Am-241	M	1.04E-10	2.81E-08	5.09E-01	-	5.09E-01	1.48E-10
Am-242	M	1.79E-12	5.03E-11	2.96E+01	-	2.96E+01	3.66E-14
Am-242m	M	7.07E-11	1.56E-08	7.48E-01	-	7.48E-01	7.15E-11
Am-242m+D	M	1.04E-10	2.81E-08	5.09E-01	-	5.09E-01	4.86E-11
Am-243	M	1.03E-10	2.70E-08	5.14E-01	-	5.14E-01	2.58E-09
Am-243+D	M	1.08E-10	2.70E-08	4.90E-01	-	4.90E-01	2.46E-09
Am-244	M	2.52E-12	3.09E-12	2.10E+01	-	2.10E+01	1.65E-14

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Am-244m	M	5.11E-14	1.02E-13	1.04E+03	-	1.04E+03	3.50E-14
Am-245	M	2.22E-13	1.56E-13	2.38E+02	-	2.38E+02	3.83E-14
Am-246	M	1.23E-13	1.31E-13	4.30E+02	-	4.30E+02	2.20E-14
Am-246m	M	6.59E-14	3.96E-14	8.03E+02	-	8.03E+02	2.63E-14
Ar-37	-	-	-	-	-	-	-
Ar-39	-	-	-	-	-	-	-
Ar-41	-	-	-	-	-	-	-
As-69	M	1.05E-13	4.29E-14	5.04E+02	-	5.04E+02	2.82E-15
As-69+D	M	-	-	-	-	-	-
As-70	M	3.20E-13	1.37E-13	1.65E+02	-	1.65E+02	3.24E-15
As-71	M	2.28E-12	1.52E-12	2.32E+01	-	2.32E+01	3.41E-14
As-72	M	1.02E-11	4.29E-12	5.19E+00	-	5.19E+00	3.10E-15
As-73	M	1.56E-12	3.88E-12	3.39E+01	-	3.39E+01	1.53E-12
As-74	M	6.70E-12	8.44E-12	7.90E+00	-	7.90E+00	7.96E-14
As-76	M	9.66E-12	4.14E-12	5.48E+00	-	5.48E+00	3.50E-15
As-77	M	2.50E-12	1.76E-12	2.12E+01	-	2.12E+01	2.02E-14
As-78	M	6.33E-13	2.69E-13	8.36E+01	-	8.36E+01	3.15E-15
At-207	M	6.96E-13	7.77E-12	7.60E+01	-	7.60E+01	9.05E-15
At-211	M	3.37E-11	3.58E-10	1.57E+00	-	1.57E+00	7.64E-16
At-211+D	M	-	-	-	-	-	-
At-215	-	-	-	-	-	-	-
At-216	-	-	-	-	-	-	-
At-217	-	-	-	-	-	-	-
At-218	-	-	-	-	-	-	-
Au-193	S	7.36E-13	4.55E-13	7.19E+01	-	7.19E+01	7.83E-14
Au-194	S	1.66E-12	7.92E-13	3.19E+01	-	3.19E+01	7.81E-14
Au-195	S	1.50E-12	6.48E-12	3.53E+01	-	3.53E+01	9.66E-12
Au-195m	-	-	-	-	-	-	-
Au-198	S	6.29E-12	4.00E-12	8.41E+00	-	8.41E+00	3.44E-14
Au-198m	S	7.44E-12	7.77E-12	7.11E+00	-	7.11E+00	2.48E-14
Au-199	S	2.78E-12	3.12E-12	1.90E+01	-	1.90E+01	9.12E-14
Au-200	S	1.55E-13	8.55E-14	3.41E+02	-	3.41E+02	1.76E-14
Au-200m	S	5.44E-12	2.81E-12	9.73E+00	-	9.73E+00	1.16E-14
Au-201	S	4.33E-14	3.30E-14	1.22E+03	-	1.22E+03	3.45E-14
Ba-126	M	8.51E-13	3.49E-13	6.22E+01	-	6.22E+01	4.03E-15
Ba-128	M	1.52E-11	7.22E-12	3.48E+00	-	3.48E+00	8.31E-15

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Ba-131	M	2.00E-12	2.91E-12	2.65E+01	-	2.65E+01	3.14E-13
Ba-131m	M	9.25E-15	1.69E-14	5.72E+03	-	5.72E+03	5.83E-14
Ba-133	M	6.81E-12	1.16E-11	7.77E+00	-	7.77E+00	3.11E-11
Ba-133m	M	3.19E-12	2.04E-12	1.66E+01	-	1.66E+01	2.74E-14
Ba-135m	M	2.56E-12	1.61E-12	2.07E+01	-	2.07E+01	2.56E-14
Ba-137m	-	-	-	-	-	-	-
Ba-139	M	3.70E-13	1.79E-13	1.43E+02	-	1.43E+02	8.76E-15
Ba-140	M	1.49E-11	2.03E-11	3.55E+00	-	3.55E+00	4.86E-14
Ba-141	M	2.14E-13	9.69E-14	2.47E+02	-	2.47E+02	3.39E-15
Ba-142	M	9.29E-14	4.55E-14	5.70E+02	-	5.70E+02	4.57E-15
Be-10	S	7.03E-12	9.40E-11	7.53E+00	-	7.53E+00	3.37E-07
Be-7	S	8.66E-14	2.13E-13	6.11E+02	-	6.11E+02	1.75E-12
Bi-200	M	1.52E-13	7.55E-14	3.48E+02	-	3.48E+02	1.35E-14
Bi-201	M	4.22E-13	1.90E-13	1.25E+02	-	1.25E+02	1.45E-14
Bi-202	M	2.65E-13	1.12E-13	2.00E+02	-	2.00E+02	2.15E-14
Bi-203	M	1.92E-12	8.21E-13	2.76E+01	-	2.76E+01	2.10E-14
Bi-205	M	3.32E-12	3.24E-12	1.59E+01	-	1.59E+01	3.84E-13
Bi-206	M	7.73E-12	5.85E-12	6.84E+00	-	6.84E+00	6.75E-14
Bi-207	M	5.66E-12	2.10E-11	9.35E+00	-	9.35E+00	2.06E-10
Bi-210	M	8.92E-12	3.17E-10	5.93E+00	-	5.93E+00	4.79E-14
Bi-210m	M	5.51E-11	1.17E-08	9.60E-01	-	9.60E-01	1.69E-06
Bi-211	M	-	-	-	-	-	-
Bi-212	M	7.10E-13	7.77E-11	7.45E+01	-	7.45E+01	5.10E-15
Bi-212+D	M	-	-	-	-	-	-
Bi-213	M	5.11E-13	6.85E-11	1.04E+02	-	1.04E+02	5.36E-15
Bi-213+D	M	-	-	-	-	-	-
Bi-214	M	1.92E-13	2.90E-11	2.76E+02	-	2.76E+02	6.25E-15
Bk-245	M	3.43E-12	7.22E-12	1.54E+01	-	1.54E+01	1.43E-13
Bk-246	M	2.01E-12	9.25E-13	2.63E+01	-	2.63E+01	9.09E-14
Bk-247	M	1.24E-10	3.26E-08	4.27E-01	-	4.27E-01	4.07E-10
Bk-249	M	1.11E-12	5.14E-11	4.77E+01	-	4.77E+01	2.91E-11
Bk-250	M	5.66E-13	1.03E-12	9.35E+01	-	9.35E+01	2.41E-14
Br-74	M	1.50E-13	6.44E-14	3.53E+02	-	3.53E+02	3.52E-15
Br-74m	M	2.46E-13	1.15E-13	2.15E+02	-	2.15E+02	3.52E-15
Br-75	M	1.57E-13	1.13E-13	3.37E+02	-	3.37E+02	1.32E-14
Br-76	M	1.45E-12	1.10E-12	3.65E+01	-	3.65E+01	1.44E-14

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Br-77	M	3.01E-13	2.06E-13	1.76E+02	-	1.76E+02	2.42E-13
Br-80	M	4.70E-14	1.80E-14	1.13E+03	-	1.13E+03	8.35E-15
Br-80m	M	2.82E-13	2.43E-13	1.88E+02	-	1.88E+02	2.12E-14
Br-82	M	1.71E-12	1.66E-12	3.09E+01	-	3.09E+01	2.86E-14
Br-83	M	8.44E-14	1.21E-13	6.27E+02	-	6.27E+02	3.97E-14
Br-84	M	1.48E-13	7.18E-14	3.58E+02	-	3.58E+02	5.09E-15
C-11	M	4.07E-14	2.78E-14	1.30E+03	-	1.30E+03	1.55E-15
C-14	M	1.55E-12	7.07E-12	3.41E+01	1.50E+00	1.43E+00	3.22E-10
Ca-41	M	3.53E-13	2.09E-13	1.50E+02	-	1.50E+02	2.41E-06
Ca-45	M	2.47E-12	9.40E-12	2.14E+01	-	2.14E+01	1.21E-12
Ca-47	M	7.55E-12	7.88E-12	7.01E+00	-	7.01E+00	1.14E-14
Ca-49	M	-	-	-	-	-	-
Cd-104	S	1.72E-13	7.66E-14	3.08E+02	-	3.08E+02	9.83E-15
Cd-107	S	3.50E-13	3.10E-13	1.51E+02	-	1.51E+02	3.36E-14
Cd-109	S	5.00E-12	2.19E-11	1.06E+01	-	1.06E+01	4.11E-12
Cd-113	F	2.28E-11	1.12E-10	2.32E+00	-	2.32E+00	6.83E+03
Cd-113m	F	2.87E-11	1.30E-10	1.84E+00	-	1.84E+00	7.93E-12
Cd-115	S	8.66E-12	5.14E-12	6.11E+00	-	6.11E+00	1.20E-14
Cd-115m	S	1.70E-11	2.92E-11	3.11E+00	-	3.11E+00	1.22E-13
Cd-117	S	1.37E-12	6.51E-13	3.86E+01	-	3.86E+01	3.60E-15
Cd-117m	S	1.22E-12	6.55E-13	4.34E+01	-	4.34E+01	5.45E-15
Ce-134	M	1.59E-11	6.96E-12	3.33E+00	-	3.33E+00	1.03E-14
Ce-135	M	3.81E-12	1.75E-12	1.39E+01	-	1.39E+01	1.05E-14
Ce-137	M	1.31E-13	4.11E-14	4.04E+02	-	4.04E+02	1.59E-13
Ce-137m	M	3.47E-12	1.94E-12	1.52E+01	-	1.52E+01	2.30E-14
Ce-139	M	1.35E-12	5.66E-12	3.92E+01	-	3.92E+01	5.75E-12
Ce-141	M	4.63E-12	1.14E-11	1.14E+01	-	1.14E+01	4.02E-13
Ce-143	M	7.10E-12	3.74E-12	7.45E+00	-	7.45E+00	1.12E-14
Ce-144	M	3.52E-11	1.10E-10	1.50E+00	-	1.50E+00	4.72E-13
Ce-144+D	M	3.53E-11	1.10E-10	1.50E+00	-	1.50E+00	4.71E-13
Cf-244	M	1.25E-13	2.96E-11	4.23E+02	-	4.23E+02	1.07E-14
Cf-246	M	2.11E-11	1.47E-09	2.51E+00	-	2.51E+00	7.04E-15
Cf-248	M	4.44E-11	1.81E-08	1.19E+00	-	1.19E+00	7.56E-13
Cf-249	M	1.27E-10	3.40E-08	4.17E-01	-	4.17E-01	1.02E-10
Cf-250	M	8.62E-11	2.66E-08	6.14E-01	-	6.14E-01	5.62E-12
Cf-251	M	1.32E-10	3.40E-08	4.01E-01	-	4.01E-01	2.53E-10

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Cf-252	-	1.34E-10	1.89E-08	3.95E-01	-	3.95E-01	7.35E-13
Cf-253	M	4.26E-12	4.22E-09	1.24E+01	-	1.24E+01	4.29E-13
Cf-254	M	2.14E-09	1.21E-07	2.47E-02	-	2.47E-02	2.91E-15
Cl-36	M	3.30E-12	2.50E-11	1.60E+01	-	1.60E+01	4.86E-07
Cl-38	M	1.93E-13	9.40E-14	2.74E+02	-	2.74E+02	2.07E-15
Cl-39	M	1.52E-13	9.36E-14	3.48E+02	-	3.48E+02	4.02E-15
Cm-238	M	3.28E-13	1.35E-11	1.61E+02	-	1.61E+02	2.95E-14
Cm-240	M	3.49E-11	9.51E-09	1.52E+00	-	1.52E+00	7.54E-14
Cm-241	M	4.85E-12	1.01E-10	1.09E+01	-	1.09E+01	6.62E-13
Cm-242	M	3.85E-11	1.51E-08	1.37E+00	-	1.37E+00	4.15E-13
Cm-243	M	9.47E-11	2.69E-08	5.59E-01	-	5.59E-01	1.08E-11
Cm-244	M	8.36E-11	2.53E-08	6.33E-01	-	6.33E-01	7.83E-12
Cm-245	M	1.04E-10	2.77E-08	5.09E-01	-	5.09E-01	2.97E-09
Cm-246	M	1.02E-10	2.77E-08	5.19E-01	-	5.19E-01	1.69E-09
Cm-247	M	9.95E-11	2.50E-08	5.32E-01	-	5.32E-01	5.74E-06
Cm-248	-	4.66E-10	9.58E-08	1.14E-01	-	1.14E-01	2.74E-08
Cm-249	M	8.40E-14	7.25E-14	6.30E+02	-	6.30E+02	5.36E-14
Cm-250	M	3.43E-09	4.37E-07	1.54E-02	-	1.54E-02	1.05E-10
Cm-250+D	M	-	-	-	-	-	-
Co-55	M	4.63E-12	2.07E-12	1.14E+01	-	1.14E+01	3.52E-15
Co-56	M	1.01E-11	1.85E-11	5.24E+00	-	5.24E+00	1.77E-13
Co-57	M	1.04E-12	2.09E-12	5.09E+01	-	5.09E+01	6.03E-12
Co-58	M	2.95E-12	5.99E-12	1.79E+01	-	1.79E+01	5.65E-13
Co-58m	M	1.26E-13	6.88E-14	4.20E+02	-	4.20E+02	7.12E-14
Co-60	M	1.57E-11	3.58E-11	3.37E+00	-	3.37E+00	2.98E-12
Co-60m	M	2.66E-15	3.96E-15	1.99E+04	-	1.99E+04	6.66E-14
Co-61	M	2.43E-13	1.43E-13	2.18E+02	-	2.18E+02	7.00E-15
Co-62m	M	8.25E-14	3.17E-14	6.41E+02	-	6.41E+02	2.95E-15
Cr-48	S	7.44E-13	7.51E-13	7.11E+01	-	7.11E+01	2.51E-14
Cr-49	S	1.35E-13	7.36E-14	3.92E+02	-	3.92E+02	4.31E-15
Cr-51	S	1.85E-13	1.67E-13	2.86E+02	-	2.86E+02	3.10E-12
Cs-125	F	5.96E-14	1.64E-14	8.88E+02	-	8.88E+02	2.66E-14
Cs-126	-	-	-	-	-	-	-
Cs-127	F	6.51E-14	2.47E-14	8.13E+02	-	8.13E+02	2.06E-13
Cs-128	F	-	-	-	-	-	-
Cs-129	F	1.85E-13	7.44E-14	2.86E+02	-	2.86E+02	3.78E-13

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Cs-130	F	4.74E-14	1.24E-14	1.12E+03	-	1.12E+03	2.31E-14
Cs-131	F	1.86E-13	7.51E-14	2.84E+02	-	2.84E+02	2.77E-12
Cs-132	F	1.46E-12	5.92E-13	3.62E+01	-	3.62E+01	2.38E-13
Cs-134	F	4.22E-11	1.65E-11	1.25E+00	-	1.25E+00	9.70E-13
Cs-134m	F	4.14E-14	1.99E-14	1.28E+03	-	1.28E+03	1.59E-13
Cs-135	F	4.74E-12	1.86E-12	1.12E+01	-	1.12E+01	9.70E-06
Cs-135m	F	4.51E-14	1.32E-14	1.17E+03	-	1.17E+03	4.47E-14
Cs-136	F	8.66E-12	3.49E-12	6.11E+00	-	6.11E+00	8.35E-14
Cs-137	F	3.04E-11	1.19E-11	1.74E+00	-	1.74E+00	2.00E-11
Cs-137+D	F	3.04E-11	1.19E-11	1.74E+00	-	1.74E+00	2.00E-11
Cs-138	F	1.58E-13	4.00E-14	3.35E+02	-	3.35E+02	7.93E-15
Cu-60	S	1.37E-13	5.77E-14	3.86E+02	-	3.86E+02	2.86E-15
Cu-61	S	4.63E-13	2.41E-13	1.14E+02	-	1.14E+02	7.59E-15
Cu-62	-	-	-	-	-	-	-
Cu-64	S	6.40E-13	4.33E-13	8.27E+01	-	8.27E+01	2.15E-14
Cu-66	-	-	-	-	-	-	-
Cu-67	S	1.94E-12	2.35E-12	2.73E+01	-	2.73E+01	3.61E-14
Dy-155	M	5.25E-13	2.45E-13	1.01E+02	-	1.01E+02	4.99E-14
Dy-157	M	2.26E-13	8.33E-14	2.34E+02	-	2.34E+02	9.52E-14
Dy-159	M	5.29E-13	1.28E-12	1.00E+02	-	1.00E+02	1.76E-11
Dy-165	M	4.14E-13	2.10E-13	1.28E+02	-	1.28E+02	1.57E-14
Dy-166	M	1.11E-11	8.36E-12	4.77E+00	-	4.77E+00	2.06E-14
Er-161	M	3.15E-13	1.34E-13	1.68E+02	-	1.68E+02	2.80E-14
Er-165	M	8.95E-14	3.13E-14	5.91E+02	-	5.91E+02	3.23E-13
Er-169	M	2.53E-12	3.85E-12	2.09E+01	-	2.09E+01	2.52E-13
Er-171	M	2.02E-12	9.40E-13	2.62E+01	-	2.62E+01	1.08E-14
Er-172	M	5.99E-12	4.74E-12	8.83E+00	-	8.83E+00	2.39E-14
Es-250	M	5.96E-14	5.07E-13	8.88E+02	-	8.88E+02	1.49E-13
Es-251	M	1.02E-12	6.40E-12	5.19E+01	-	5.19E+01	1.37E-13
Es-253	M	3.49E-11	8.84E-09	1.52E+00	-	1.52E+00	6.02E-14
Es-254	M	5.51E-11	1.85E-08	9.60E-01	-	9.60E-01	5.16E-13
Es-254+D	M	-	-	-	-	-	-
Es-254m	M	2.73E-11	1.53E-09	1.94E+00	-	1.94E+00	6.18E-15
Eu-145	M	2.73E-12	1.81E-12	1.94E+01	-	1.94E+01	1.28E-13
Eu-146	M	4.55E-12	2.59E-12	1.16E+01	-	1.16E+01	6.00E-14
Eu-147	M	2.02E-12	3.85E-12	2.62E+01	-	2.62E+01	7.09E-13

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Eu-148	M	4.29E-12	9.92E-12	1.23E+01	-	1.23E+01	7.63E-13
Eu-149	M	5.14E-13	1.07E-12	1.03E+02	-	1.03E+02	1.10E-11
Eu-150	M	4.33E-12	1.12E-10	1.22E+01	-	1.22E+01	1.76E-10
Eu-150m	M	2.38E-12	1.03E-12	2.22E+01	-	2.22E+01	1.35E-14
Eu-152	M	6.07E-12	9.10E-11	8.72E+00	-	8.72E+00	4.95E-11
Eu-152m	M	2.98E-12	1.12E-12	1.78E+01	-	1.78E+01	8.04E-15
Eu-154	M	1.03E-11	1.15E-10	5.14E+00	-	5.14E+00	1.95E-11
Eu-155	M	1.90E-12	1.48E-11	2.78E+01	-	2.78E+01	5.99E-11
Eu-156	M	1.27E-11	1.37E-11	4.17E+00	-	4.17E+00	7.57E-14
Eu-157	M	3.70E-12	1.57E-12	1.43E+01	-	1.43E+01	1.09E-14
Eu-158	M	2.14E-13	1.10E-13	2.47E+02	-	2.47E+02	9.55E-15
F-18	M	9.73E-14	1.21E-13	5.44E+02	-	5.44E+02	5.72E-15
Fe-52	M	7.07E-12	2.73E-12	7.48E+00	-	7.48E+00	1.03E-15
Fe-55	M	8.62E-13	7.99E-13	6.14E+01	-	6.14E+01	2.55E-11
Fe-59	M	7.88E-12	1.33E-11	6.71E+00	-	6.71E+00	1.35E-13
Fe-60	M	1.80E-10	1.84E-10	2.94E-01	-	2.94E-01	4.94E-09
Fe-60+D	M	-	-	-	-	-	-
Fm-252	M	1.69E-11	1.03E-09	3.13E+00	-	3.13E+00	5.72E-15
Fm-253	M	5.14E-12	1.28E-09	1.03E+01	-	1.03E+01	5.99E-14
Fm-254	M	2.15E-12	1.98E-10	2.46E+01	-	2.46E+01	6.47E-15
Fm-255	M	1.65E-11	8.84E-10	3.21E+00	-	3.21E+00	5.25E-15
Fm-257	M	4.40E-11	2.04E-08	1.20E+00	-	1.20E+00	2.38E-13
Fr-219	-	-	-	-	-	-	-
Fr-220	-	-	-	-	-	-	-
Fr-220+D	-	-	-	-	-	-	-
Fr-221	-	-	-	-	-	-	-
Fr-221+D	-	-	-	-	-	-	-
Fr-222	F	1.48E-12	2.42E-11	3.58E+01	-	3.58E+01	6.09E-16
Fr-223	F	7.29E-12	3.06E-12	7.26E+00	-	7.26E+00	1.88E-16
Ga-65	M	6.33E-14	2.84E-14	8.36E+02	-	8.36E+02	4.40E-15
Ga-66	M	6.40E-12	2.18E-12	8.27E+00	-	8.27E+00	1.64E-15
Ga-67	M	1.04E-12	9.55E-13	5.09E+01	-	5.09E+01	8.53E-14
Ga-68	M	2.83E-13	1.28E-13	1.87E+02	-	1.87E+02	4.61E-15
Ga-70	M	5.22E-14	2.92E-14	1.01E+03	-	1.01E+03	7.99E-15
Ga-72	M	5.59E-12	2.17E-12	9.47E+00	-	9.47E+00	3.07E-15
Ga-73	M	1.39E-12	6.14E-13	3.81E+01	-	3.81E+01	4.36E-15

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Gd-145	M	8.92E-14	3.63E-14	5.93E+02	-	5.93E+02	1.05E-14
Gd-146	M	5.03E-12	2.27E-11	1.05E+01	-	1.05E+01	5.69E-13
Gd-147	M	2.46E-12	1.34E-12	2.15E+01	-	2.15E+01	3.85E-14
Gd-148	F	4.22E-11	1.26E-08	1.25E+00	-	1.25E+00	4.83E-11
Gd-149	M	2.23E-12	2.76E-12	2.37E+01	-	2.37E+01	2.55E-13
Gd-151	M	1.14E-12	2.92E-12	4.64E+01	-	4.64E+01	6.45E-12
Gd-152	F	2.97E-11	9.10E-09	1.78E+00	-	1.78E+00	8.19E+01
Gd-153	M	1.52E-12	6.55E-12	3.48E+01	-	3.48E+01	9.89E-12
Gd-159	M	3.19E-12	1.46E-12	1.66E+01	-	1.66E+01	1.56E-14
Ge-66	M	3.70E-13	2.50E-13	1.43E+02	-	1.43E+02	6.85E-15
Ge-67	M	1.06E-13	4.59E-14	4.99E+02	-	4.99E+02	3.33E-15
Ge-68	M	6.96E-12	4.88E-11	7.60E+00	-	7.60E+00	1.14E-12
Ge-68+D	M	-	-	-	-	-	-
Ge-69	M	9.84E-13	8.81E-13	5.38E+01	-	5.38E+01	4.63E-14
Ge-71	M	6.48E-14	5.18E-14	8.17E+02	-	8.17E+02	5.25E-12
Ge-75	M	8.66E-14	8.44E-14	6.11E+02	-	6.11E+02	2.02E-14
Ge-77	M	1.22E-12	1.15E-12	4.34E+01	-	4.34E+01	1.21E-14
Ge-78	M	3.09E-13	2.48E-13	1.71E+02	-	1.71E+02	6.19E-15
H-3	V	5.07E-14	5.62E-14	1.04E+03	1.88E+02	1.60E+02	1.65E-11
Hf-170	M	2.19E-12	1.20E-12	2.42E+01	-	2.42E+01	2.10E-14
Hf-172	F	4.96E-12	6.92E-11	1.07E+01	-	1.07E+01	9.61E-12
Hf-173	M	1.06E-12	5.92E-13	4.99E+01	-	4.99E+01	6.62E-14
Hf-175	M	1.96E-12	4.29E-12	2.70E+01	-	2.70E+01	2.54E-12
Hf-177m	M	2.01E-13	1.81E-13	2.63E+02	-	2.63E+02	1.28E-14
Hf-178m	F	1.51E-11	3.70E-10	3.50E+00	-	3.50E+00	5.41E-11
Hf-179m	M	6.55E-12	1.38E-11	8.08E+00	-	8.08E+00	2.78E-13
Hf-180m	M	7.18E-13	4.14E-13	7.37E+01	-	7.37E+01	2.33E-14
Hf-181	M	6.36E-12	1.76E-11	8.32E+00	-	8.32E+00	4.90E-13
Hf-182	F	5.37E-12	3.41E-10	9.85E+00	-	9.85E+00	4.52E-05
Hf-182+D	F	-	-	-	-	-	-
Hf-182m	M	1.11E-13	1.04E-13	4.77E+02	-	4.77E+02	2.84E-14
Hf-183	M	2.39E-13	1.65E-13	2.21E+02	-	2.21E+02	1.38E-14
Hf-184	M	2.91E-12	1.38E-12	1.82E+01	-	1.82E+01	4.41E-15
Hg-193	M	4.11E-13	2.53E-13	1.29E+02	-	1.29E+02	2.78E-14
Hg-193m	M	1.97E-12	9.40E-13	2.69E+01	-	2.69E+01	1.84E-14
Hg-194	M	8.07E-11	2.88E-11	6.56E-01	-	6.56E-01	9.26E-11

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Hg-194+D	M	-	-	-	-	-	-
Hg-195	M	5.07E-13	2.84E-13	1.04E+02	-	1.04E+02	6.44E-14
Hg-195m	M	3.36E-12	2.33E-12	1.57E+01	-	1.57E+01	4.08E-14
Hg-197	M	1.43E-12	1.25E-12	3.70E+01	-	3.70E+01	1.49E-13
Hg-197m	M	3.00E-12	2.28E-12	1.76E+01	-	1.76E+01	2.64E-14
Hg-199m	M	6.70E-14	6.33E-14	7.90E+02	-	7.90E+02	3.57E-14
Hg-203	M	5.70E-12	8.95E-12	9.28E+00	-	9.28E+00	6.74E-13
Ho-155	M	1.05E-13	5.29E-14	5.04E+02	-	5.04E+02	2.00E-14
Ho-157	M	1.54E-14	7.36E-15	3.44E+03	-	3.44E+03	3.62E-14
Ho-159	M	1.78E-14	1.22E-14	2.97E+03	-	2.97E+03	8.31E-14
Ho-161	M	4.96E-14	1.98E-14	1.07E+03	-	1.07E+03	1.37E-13
Ho-162	M	5.96E-15	5.40E-15	8.88E+03	-	8.88E+03	1.15E-13
Ho-162m	M	7.47E-14	5.18E-14	7.08E+02	-	7.08E+02	4.16E-14
Ho-164	M	1.75E-14	1.65E-14	3.02E+03	-	3.02E+03	7.66E-14
Ho-164m	M	4.14E-14	3.48E-14	1.28E+03	-	1.28E+03	4.19E-14
Ho-166	M	9.21E-12	3.85E-12	5.74E+00	-	5.74E+00	8.17E-15
Ho-166m	M	8.03E-12	3.09E-10	6.59E+00	-	6.59E+00	3.68E-09
Ho-167	M	3.64E-13	2.25E-13	1.45E+02	-	1.45E+02	2.41E-14
I-120	F	9.03E-13	3.89E-13	5.86E+01	-	5.86E+01	3.03E-15
I-120m	F	5.03E-13	1.98E-13	1.05E+02	-	1.05E+02	3.56E-15
I-121	F	2.27E-13	9.81E-14	2.33E+02	-	2.33E+02	1.91E-14
I-122	-	-	-	-	-	-	-
I-123	F	6.96E-13	3.03E-13	7.60E+01	-	7.60E+01	3.95E-14
I-124	F	4.14E-11	1.76E-11	1.28E+00	-	1.28E+00	5.08E-15
I-125	F	2.54E-11	1.06E-11	2.08E+00	-	2.08E+00	1.20E-13
I-126	F	8.73E-11	3.70E-11	6.06E-01	-	6.06E-01	7.63E-15
I-128	F	8.14E-14	3.04E-14	6.50E+02	-	6.50E+02	1.11E-14
I-129	F	1.48E-10	6.07E-11	3.58E-01	-	3.58E-01	2.03E-06
I-130	F	6.36E-12	2.76E-12	8.32E+00	-	8.32E+00	4.27E-15
I-131	F	4.55E-11	1.95E-11	1.16E+00	-	1.16E+00	9.40E-15
I-132	F	8.44E-13	3.74E-13	6.27E+01	-	6.27E+01	6.08E-15
I-132m	F	6.11E-13	2.70E-13	8.66E+01	-	8.66E+01	5.09E-15
I-133	F	1.44E-11	6.25E-12	3.67E+00	-	3.67E+00	3.25E-15
I-134	F	2.50E-13	1.02E-13	2.12E+02	-	2.12E+02	7.95E-15
I-135	F	3.05E-12	1.34E-12	1.73E+01	-	1.73E+01	4.95E-15
In-109	M	2.46E-13	1.11E-13	2.15E+02	-	2.15E+02	3.15E-14

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
In-110	M	7.59E-13	2.65E-13	6.97E+01	-	6.97E+01	1.20E-14
In-110m	M	2.81E-13	1.17E-13	1.88E+02	-	1.88E+02	7.62E-15
In-111	M	1.29E-12	8.03E-13	4.10E+01	-	4.10E+01	9.88E-14
In-112	M	1.68E-14	1.10E-14	3.15E+03	-	3.15E+03	2.71E-14
In-113m	M	9.47E-14	5.18E-14	5.59E+02	-	5.59E+02	3.35E-14
In-114	-	-	-	-	-	-	-
In-114m	M	2.48E-11	3.00E-11	2.13E+00	-	2.13E+00	9.24E-14
In-115	F	3.38E-11	4.03E-10	1.57E+00	-	1.57E+00	2.57E+03
In-115m	M	4.40E-13	2.15E-13	1.20E+02	-	1.20E+02	1.98E-14
In-116m	M	1.62E-13	8.77E-14	3.27E+02	-	3.27E+02	1.09E-14
In-117	M	7.03E-14	5.59E-14	7.53E+02	-	7.53E+02	2.05E-14
In-117m	M	4.44E-13	2.33E-13	1.19E+02	-	1.19E+02	8.65E-15
In-119	-	-	-	-	-	-	-
In-119m	M	7.55E-14	3.34E-14	7.01E+02	-	7.01E+02	8.00E-15
Ir-182	S	9.95E-14	5.03E-14	5.32E+02	-	5.32E+02	7.73E-15
Ir-184	S	6.44E-13	3.30E-13	8.22E+01	-	8.22E+01	1.46E-14
Ir-185	S	1.32E-12	7.25E-13	4.01E+01	-	4.01E+01	3.32E-14
Ir-186	S	2.08E-12	1.06E-12	2.54E+01	-	2.54E+01	2.39E-14
Ir-186m	S	2.00E-13	1.11E-13	2.65E+02	-	2.65E+02	2.75E-14
Ir-187	S	5.77E-13	2.87E-13	9.17E+01	-	9.17E+01	5.76E-14
Ir-188	S	2.52E-12	1.38E-12	2.10E+01	-	2.10E+01	5.24E-14
Ir-189	S	1.51E-12	2.33E-12	3.50E+01	-	3.50E+01	6.76E-13
Ir-190	S	5.66E-12	8.81E-12	9.35E+00	-	9.35E+00	1.65E-13
Ir-190m	S	3.17E-14	3.89E-14	1.67E+03	-	1.67E+03	1.22E-13
Ir-190n	S	4.26E-13	2.14E-13	1.24E+02	-	1.24E+02	2.34E-14
Ir-191m	-	-	-	-	-	-	-
Ir-192	S	7.36E-12	2.41E-11	7.19E+00	-	7.19E+00	7.84E-13
Ir-192m	S	9.81E-13	1.02E-10	5.39E+01	-	5.39E+01	6.99E-09
Ir-194	S	8.62E-12	3.40E-12	6.14E+00	-	6.14E+00	7.29E-15
Ir-194m	S	8.88E-12	4.59E-11	5.96E+00	-	5.96E+00	1.52E-12
Ir-195	S	3.96E-13	2.39E-13	1.34E+02	-	1.34E+02	2.08E-14
Ir-195m	S	1.03E-12	5.96E-13	5.14E+01	-	5.14E+01	1.22E-14
K-38	-	-	-	-	-	-	-
K-40	F	2.47E-11	1.03E-11	2.14E+00	-	2.14E+00	3.07E-04
K-42	F	1.26E-12	4.33E-13	4.20E+01	-	4.20E+01	6.97E-15
K-43	F	7.88E-13	3.09E-13	6.71E+01	-	6.71E+01	2.09E-14

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
K-44	F	1.39E-13	3.39E-14	3.81E+02	-	3.81E+02	1.97E-15
K-45	F	8.95E-14	2.33E-14	5.91E+02	-	5.91E+02	2.83E-15
Kr-74	-	-	-	-	-	-	-
Kr-76	-	-	-	-	-	-	-
Kr-77	-	-	-	-	-	-	-
Kr-79	-	-	-	-	-	-	-
Kr-81	-	-	-	-	-	-	-
Kr-81m	-	-	-	-	-	-	-
Kr-83m	-	-	-	-	-	-	-
Kr-85	-	-	-	-	-	-	-
Kr-85m	-	-	-	-	-	-	-
Kr-87	-	-	-	-	-	-	-
Kr-88	-	-	-	-	-	-	-
La-131	M	9.32E-14	5.48E-14	5.68E+02	-	5.68E+02	2.34E-14
La-132	M	1.78E-12	6.25E-13	2.97E+01	-	2.97E+01	6.02E-15
La-134	-	-	-	-	-	-	-
La-135	M	1.46E-13	5.03E-14	3.62E+02	-	3.62E+02	3.05E-13
La-137	F	3.48E-13	1.39E-11	1.52E+02	-	1.52E+02	3.50E-06
La-138	F	3.53E-12	3.05E-10	1.50E+01	-	1.50E+01	7.82E-01
La-140	M	1.10E-11	4.77E-12	4.81E+00	-	4.81E+00	8.67E-15
La-141	M	1.88E-12	7.44E-13	2.81E+01	-	2.81E+01	4.98E-15
La-142	M	5.77E-13	2.42E-13	9.17E+01	-	9.17E+01	6.42E-15
La-143	M	1.26E-13	5.66E-14	4.20E+02	-	4.20E+02	4.55E-15
Lu-169	S	1.94E-12	1.33E-12	2.73E+01	-	2.73E+01	5.02E-14
Lu-170	S	4.14E-12	2.25E-12	1.28E+01	-	1.28E+01	3.33E-14
Lu-171	S	3.27E-12	3.50E-12	1.62E+01	-	1.62E+01	1.74E-13
Lu-172	S	5.59E-12	6.03E-12	9.47E+00	-	9.47E+00	8.37E-14
Lu-173	S	1.35E-12	8.70E-12	3.92E+01	-	3.92E+01	2.60E-11
Lu-174	S	1.46E-12	1.42E-11	3.62E+01	-	3.62E+01	5.84E-11
Lu-174m	S	3.38E-12	1.51E-11	1.57E+01	-	1.57E+01	2.97E-12
Lu-176	S	9.29E-12	1.41E-10	5.70E+00	-	5.70E+00	1.01E-01
Lu-176m	S	8.55E-13	4.55E-13	6.19E+01	-	6.19E+01	1.28E-14
Lu-177	S	3.53E-12	4.66E-12	1.50E+01	-	1.50E+01	1.37E-13
Lu-177m	S	9.36E-12	5.70E-11	5.65E+00	-	5.65E+00	1.23E-12
Lu-178	S	8.62E-14	5.29E-14	6.14E+02	-	6.14E+02	1.65E-14
Lu-178m	S	7.10E-14	5.85E-14	7.45E+02	-	7.45E+02	1.60E-14

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Lu-179	S	1.12E-12	5.14E-13	4.72E+01	-	4.72E+01	1.24E-14
Md-257	M	5.88E-13	7.70E-11	9.00E+01	-	9.00E+01	3.84E-14
Md-258	M	4.33E-11	1.68E-08	1.22E+00	-	1.22E+00	1.33E-13
Mg-28	M	1.14E-11	5.14E-12	4.64E+00	-	4.64E+00	8.69E-16
Mn-51	M	2.09E-13	9.55E-14	2.53E+02	-	2.53E+02	3.18E-15
Mn-52	M	6.44E-12	4.40E-12	8.22E+00	-	8.22E+00	1.83E-14
Mn-52m	M	1.27E-13	5.07E-14	4.17E+02	-	4.17E+02	2.44E-15
Mn-53	M	1.56E-13	2.17E-13	3.39E+02	-	3.39E+02	1.86E-04
Mn-54	M	2.28E-12	5.88E-12	2.32E+01	-	2.32E+01	3.00E-12
Mn-56	M	1.03E-12	4.14E-13	5.14E+01	-	5.14E+01	2.37E-15
Mo-101	M	6.88E-14	4.33E-14	7.69E+02	-	7.69E+02	6.05E-15
Mo-90	M	6.59E-13	1.24E-12	8.03E+01	-	8.03E+01	1.31E-14
Mo-93	M	3.35E-12	1.27E-12	1.58E+01	-	1.58E+01	1.44E-08
Mo-93m	M	3.20E-13	4.33E-13	1.65E+02	-	1.65E+02	3.37E-14
Mo-99	M	1.60E-12	4.29E-12	3.31E+01	-	3.31E+01	6.91E-14
N-13	-	-	-	-	-	-	-
Na-22	F	9.62E-12	3.89E-12	5.50E+00	-	5.50E+00	8.82E-13
Na-24	F	1.23E-12	4.74E-13	4.30E+01	-	4.30E+01	4.95E-15
Nb-88	M	1.13E-13	4.51E-14	4.68E+02	-	4.68E+02	3.14E-15
Nb-89	M	1.04E-12	4.07E-13	5.09E+01	-	5.09E+01	2.94E-15
Nb-89m	M	4.00E-13	1.74E-13	1.32E+02	-	1.32E+02	4.14E-15
Nb-90	M	5.70E-12	2.27E-12	9.28E+00	-	9.28E+00	3.90E-15
Nb-93m	M	8.03E-13	1.90E-12	6.59E+01	-	6.59E+01	2.33E-10
Nb-94	M	7.77E-12	3.77E-11	6.81E+00	-	6.81E+00	3.64E-08
Nb-95	M	2.45E-12	5.44E-12	2.16E+01	-	2.16E+01	5.53E-13
Nb-95m	M	3.66E-12	3.27E-12	1.45E+01	-	1.45E+01	3.80E-14
Nb-96	M	5.03E-12	2.28E-12	1.05E+01	-	1.05E+01	7.54E-15
Nb-97	M	1.96E-13	1.07E-13	2.70E+02	-	2.70E+02	1.01E-14
Nb-97m	-	-	-	-	-	-	-
Nb-98	M	2.80E-13	1.23E-13	1.89E+02	-	1.89E+02	5.08E-15
Nd-136	S	2.70E-13	1.34E-13	1.96E+02	-	1.96E+02	7.19E-15
Nd-138	S	3.42E-12	1.24E-12	1.55E+01	-	1.55E+01	3.44E-15
Nd-139	S	4.96E-14	2.37E-14	1.07E+03	-	1.07E+03	2.35E-14
Nd-139m	S	1.08E-12	4.96E-13	4.90E+01	-	4.90E+01	1.20E-14
Nd-141	S	3.09E-14	1.34E-14	1.71E+03	-	1.71E+03	1.92E-13
Nd-141m	-	-	-	-	-	-	-

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Nd-147	S	6.96E-12	9.36E-12	7.60E+00	-	7.60E+00	9.41E-14
Nd-149	S	5.44E-13	3.19E-13	9.73E+01	-	9.73E+01	8.01E-15
Nd-151	S	7.36E-14	3.92E-14	7.19E+02	-	7.19E+02	7.19E-15
Ne-19	-	-	-	-	-	-	-
Ni-56	M	2.83E-12	2.88E-12	1.87E+01	-	1.87E+01	4.90E-14
Ni-57	M	3.89E-12	1.78E-12	1.36E+01	-	1.36E+01	8.94E-15
Ni-59	M	2.74E-13	4.66E-13	1.93E+02	-	1.93E+02	2.39E-06
Ni-63	M	6.70E-13	1.64E-12	7.90E+01	-	7.90E+01	1.34E-09
Ni-65	M	6.96E-13	3.03E-13	7.60E+01	-	7.60E+01	3.98E-15
Ni-66	M	2.00E-11	8.99E-12	2.65E+00	-	2.65E+00	3.05E-15
Np-232	M	1.97E-14	3.17E-14	2.69E+03	-	2.69E+03	4.88E-14
Np-233	M	5.03E-15	2.49E-15	1.05E+04	-	1.05E+04	4.73E-13
Np-234	M	3.40E-12	1.86E-12	1.56E+01	-	1.56E+01	1.23E-13
Np-235	M	3.46E-13	1.15E-12	1.53E+02	-	1.53E+02	1.09E-10
Np-236	M	1.05E-11	9.77E-10	5.04E+00	-	5.04E+00	3.83E-07
Np-236m	M	1.11E-12	8.07E-12	4.77E+01	-	4.77E+01	8.09E-14
Np-237	M	6.18E-11	1.77E-08	8.56E-01	-	8.56E-01	1.22E-06
Np-237+D	M	6.74E-11	1.77E-08	7.85E-01	-	7.85E-01	1.11E-06
Np-238	M	5.40E-12	4.18E-12	9.80E+00	-	9.80E+00	3.79E-14
Np-239	M	5.14E-12	4.00E-12	1.03E+01	-	1.03E+01	4.44E-14
Np-240	M	2.23E-13	1.95E-13	2.37E+02	-	2.37E+02	1.97E-14
Np-240m	-	-	-	-	-	-	-
O-15	-	-	-	-	-	-	-
Os-180	M	3.63E-14	2.62E-14	1.46E+03	-	1.46E+03	3.07E-14
Os-181	M	3.54E-13	1.95E-13	1.49E+02	-	1.49E+02	1.51E-14
Os-182	M	2.59E-12	1.45E-12	2.04E+01	-	2.04E+01	2.61E-14
Os-185	M	1.92E-12	6.14E-12	2.76E+01	-	2.76E+01	3.68E-12
Os-189m	M	1.02E-13	3.44E-14	5.19E+02	-	5.19E+02	1.88E-13
Os-190m	M	-	-	-	-	-	-
Os-191	M	3.64E-12	7.10E-12	1.45E+01	-	1.45E+01	3.28E-13
Os-191m	M	6.11E-13	6.36E-13	8.66E+01	-	8.66E+01	6.89E-14
Os-193	M	5.29E-12	2.71E-12	1.00E+01	-	1.00E+01	1.85E-14
Os-194	M	1.53E-11	2.55E-10	3.46E+00	-	3.46E+00	1.13E-11
Os-194+D	M	-	-	-	-	-	-
P-30	-	-	-	-	-	-	-
P-32	M	8.95E-12	1.22E-11	5.91E+00	-	5.91E+00	2.07E-14

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
P-33	M	9.81E-13	5.11E-12	5.39E+01	-	5.39E+01	3.47E-13
Pa-227	S	9.69E-13	2.12E-10	5.46E+01	-	5.46E+01	2.53E-15
Pa-228	S	3.60E-12	2.33E-10	1.47E+01	-	1.47E+01	2.36E-14
Pa-230	S	3.77E-12	2.58E-09	1.40E+01	-	1.40E+01	4.31E-13
Pa-231	S	1.73E-10	4.55E-08	3.06E-01	-	3.06E-01	6.48E-09
Pa-232	S	3.48E-12	6.81E-12	1.52E+01	-	1.52E+01	3.54E-14
Pa-233	S	5.55E-12	1.42E-11	9.53E+00	-	9.53E+00	4.60E-13
Pa-234	S	2.56E-12	1.46E-12	2.07E+01	-	2.07E+01	1.04E-14
Pa-234m	-	-	-	-	-	-	-
Pb-195m	M	5.48E-14	4.37E-14	9.66E+02	-	9.66E+02	1.58E-14
Pb-198	M	2.60E-13	1.43E-13	2.04E+02	-	2.04E+02	3.09E-14
Pb-199	M	1.42E-13	7.44E-14	3.73E+02	-	3.73E+02	3.56E-14
Pb-200	M	1.58E-12	1.16E-12	3.35E+01	-	3.35E+01	4.60E-14
Pb-201	M	5.92E-13	3.50E-13	8.94E+01	-	8.94E+01	5.40E-14
Pb-202	M	2.22E-11	1.43E-11	2.38E+00	-	2.38E+00	4.04E-07
Pb-202+D	M	-	-	-	-	-	-
Pb-202m	M	4.18E-13	2.25E-13	1.27E+02	-	1.27E+02	2.96E-14
Pb-203	M	1.02E-12	7.55E-13	5.19E+01	-	5.19E+01	1.75E-13
Pb-205	M	6.33E-13	6.44E-13	8.36E+01	-	8.36E+01	6.86E-04
Pb-209	M	2.41E-13	1.90E-13	2.20E+02	-	2.20E+02	4.77E-14
Pb-210	M	8.81E-10	2.77E-09	6.01E-02	-	6.01E-02	7.87E-13
Pb-211	M	4.11E-13	3.70E-11	1.29E+02	-	1.29E+02	5.22E-15
Pb-212	M	2.50E-11	5.77E-10	2.12E+00	-	2.12E+00	1.53E-15
Pb-214	M	3.44E-13	3.63E-11	1.54E+02	-	1.54E+02	4.70E-15
Pd-100	S	4.03E-12	3.10E-12	1.31E+01	-	1.31E+01	3.66E-14
Pd-101	S	4.22E-13	1.97E-13	1.25E+02	-	1.25E+02	3.35E-14
Pd-103	S	1.25E-12	1.77E-12	4.23E+01	-	4.23E+01	5.67E-13
Pd-107	S	2.50E-13	1.69E-12	2.12E+02	-	2.12E+02	4.12E-04
Pd-109	S	3.50E-12	1.85E-12	1.51E+01	-	1.51E+01	7.07E-15
Pm-141	S	6.66E-14	2.85E-14	7.94E+02	-	7.94E+02	1.25E-14
Pm-142	-	-	-	-	-	-	-
Pm-143	S	8.73E-13	5.37E-12	6.06E+01	-	6.06E+01	1.76E-11
Pm-144	S	3.34E-12	2.76E-11	1.58E+01	-	1.58E+01	6.35E-12
Pm-145	S	5.59E-13	6.59E-12	9.47E+01	-	9.47E+01	6.80E-10
Pm-146	S	4.18E-12	5.40E-11	1.27E+01	-	1.27E+01	2.86E-11
Pm-147	S	1.69E-12	1.61E-11	3.13E+01	-	3.13E+01	3.38E-11

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Pm-148	S	1.72E-11	1.05E-11	3.08E+00	-	3.08E+00	1.88E-14
Pm-148m	S	7.99E-12	2.12E-11	6.62E+00	-	6.62E+00	3.11E-13
Pm-149	S	6.66E-12	3.66E-12	7.94E+00	-	7.94E+00	2.01E-14
Pm-150	S	1.08E-12	4.63E-13	4.90E+01	-	4.90E+01	6.29E-15
Pm-151	S	4.51E-12	2.36E-12	1.17E+01	-	1.17E+01	1.61E-14
Po-203	M	1.63E-13	7.73E-14	3.25E+02	-	3.25E+02	1.29E-14
Po-205	M	1.81E-13	1.72E-13	2.92E+02	-	2.92E+02	3.45E-14
Po-207	M	5.18E-13	1.99E-13	1.02E+02	-	1.02E+02	3.94E-14
Po-210	M	3.77E-10	1.08E-08	1.40E-01	-	1.40E-01	3.13E-14
Po-211	-	-	-	-	-	-	-
Po-212	-	-	-	-	-	-	-
Po-213	-	-	-	-	-	-	-
Po-214	-	-	-	-	-	-	-
Po-215	-	-	-	-	-	-	-
Po-216	-	-	-	-	-	-	-
Po-218	-	-	-	-	-	-	-
Pr-136	S	5.88E-14	2.15E-14	9.00E+02	-	9.00E+02	8.54E-15
Pr-137	S	1.25E-13	5.55E-14	4.23E+02	-	4.23E+02	2.37E-14
Pr-138	-	-	-	-	-	-	-
Pr-138m	S	4.18E-13	1.76E-13	1.27E+02	-	1.27E+02	1.17E-14
Pr-139	S	1.47E-13	6.96E-14	3.60E+02	-	3.60E+02	7.21E-14
Pr-142	S	8.58E-12	3.38E-12	6.17E+00	-	6.17E+00	5.35E-15
Pr-142m	S	1.10E-13	4.33E-14	4.81E+02	-	4.81E+02	5.31E-15
Pr-143	S	7.92E-12	9.73E-12	6.68E+00	-	6.68E+00	9.94E-14
Pr-144	S	8.10E-14	3.58E-14	6.53E+02	-	6.53E+02	8.66E-15
Pr-144m	-	-	-	-	-	-	-
Pr-145	S	2.29E-12	9.25E-13	2.31E+01	-	2.31E+01	6.40E-15
Pr-147	S	5.85E-14	3.59E-14	9.04E+02	-	9.04E+02	9.63E-15
Pt-186	F	3.92E-13	8.25E-14	1.35E+02	-	1.35E+02	1.60E-14
Pt-188	F	3.77E-12	1.88E-12	1.40E+01	-	1.40E+01	2.06E-13
Pt-189	F	5.92E-13	1.32E-13	8.94E+01	-	8.94E+01	5.87E-14
Pt-191	F	1.76E-12	4.63E-13	3.01E+01	-	3.01E+01	1.23E-13
Pt-193	F	2.11E-13	1.11E-13	2.51E+02	-	2.51E+02	6.78E-09
Pt-193m	F	3.03E-12	7.73E-13	1.75E+01	-	1.75E+01	1.12E-13
Pt-195m	F	4.11E-12	1.05E-12	1.29E+01	-	1.29E+01	7.74E-14
Pt-197	F	2.62E-12	5.22E-13	2.02E+01	-	2.02E+01	2.33E-14

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Pt-197m	F	4.00E-13	8.66E-14	1.32E+02	-	1.32E+02	1.31E-14
Pt-199	F	8.84E-14	2.48E-14	5.99E+02	-	5.99E+02	1.95E-14
Pt-200	F	7.73E-12	1.48E-12	6.84E+00	-	6.84E+00	5.47E-15
Pu-234	M	8.58E-13	6.85E-11	6.17E+01	-	6.17E+01	4.06E-14
Pu-235	M	4.37E-15	2.39E-15	1.21E+04	-	1.21E+04	3.83E-13
Pu-236	M	7.47E-11	2.28E-08	7.08E-01	-	7.08E-01	1.33E-12
Pu-237	M	5.77E-13	1.27E-12	9.17E+01	-	9.17E+01	7.55E-12
Pu-238	M	1.31E-10	3.36E-08	4.04E-01	-	4.04E-01	2.36E-11
Pu-239	M	1.35E-10	3.33E-08	3.92E-01	-	3.92E-01	6.31E-09
Pu-240	M	1.35E-10	3.33E-08	3.92E-01	-	3.92E-01	1.72E-09
Pu-241	M	1.76E-12	3.34E-10	3.01E+01	-	3.01E+01	2.92E-10
Pu-242	M	1.28E-10	3.13E-08	4.13E-01	-	4.13E-01	1.05E-07
Pu-243	M	4.74E-13	2.94E-13	1.12E+02	-	1.12E+02	4.30E-14
Pu-244	M	1.44E-10	3.04E-08	3.67E-01	-	3.67E-01	2.01E-05
Pu-244+D	M	1.44E-10	2.93E-08	3.67E-01	-	3.67E-01	2.01E-05
Pu-245	M	4.48E-12	2.07E-12	1.18E+01	-	1.18E+01	9.71E-15
Pu-246	M	1.73E-11	1.73E-11	3.06E+00	-	3.06E+00	6.26E-14
Ra-222	-	-	-	-	-	-	-
Ra-223	M	2.38E-10	2.50E-08	2.22E-01	-	2.22E-01	4.35E-15
Ra-223+D	M	-	-	-	-	-	-
Ra-224	M	1.67E-10	9.99E-09	3.17E-01	1.06E-03	1.06E-03	6.64E-18
Ra-224+D	M	-	-	-	-	-	-
Ra-225	M	1.14E-10	2.10E-08	4.64E-01	-	4.64E-01	1.19E-14
Ra-225+D	M	-	-	-	-	-	-
Ra-226	M	3.85E-10	1.15E-08	1.37E-01	9.20E-04	9.14E-04	9.25E-13
Ra-226+D	M	3.86E-10	1.16E-08	1.37E-01	9.12E-04	9.06E-04	9.18E-13
Ra-227	M	1.05E-13	3.13E-13	5.04E+02	-	5.04E+02	2.57E-14
Ra-227+D	M	-	-	-	-	-	-
Ra-228	M	1.04E-09	5.18E-09	5.09E-02	-	5.09E-02	1.87E-13
Ra-228+D	M	1.04E-09	5.23E-09	5.09E-02	-	5.09E-02	1.87E-13
Rb-79	F	8.36E-14	2.37E-14	6.33E+02	-	6.33E+02	6.10E-15
Rb-80	-	-	-	-	-	-	-
Rb-81	F	1.28E-13	4.63E-14	4.13E+02	-	4.13E+02	4.90E-14
Rb-81m	F	2.05E-14	1.10E-14	2.58E+03	-	2.58E+03	3.56E-14
Rb-82	-	-	-	-	-	-	-
Rb-82m	F	3.51E-13	1.35E-13	1.51E+02	-	1.51E+02	2.45E-14

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Rb-83	F	5.70E-12	2.32E-12	9.28E+00	-	9.28E+00	5.09E-13
Rb-84	F	8.81E-12	3.59E-12	6.01E+00	-	6.01E+00	1.27E-13
Rb-86	F	9.88E-12	4.00E-12	5.36E+00	-	5.36E+00	6.59E-14
Rb-87	F	5.22E-12	2.14E-12	1.01E+01	-	1.01E+01	1.16E-01
Rb-88	F	1.40E-13	3.17E-14	3.78E+02	-	3.78E+02	3.15E-15
Rb-89	F	7.88E-14	2.09E-14	6.71E+02	-	6.71E+02	4.84E-15
Re-177	M	4.55E-14	2.97E-14	1.16E+03	-	1.16E+03	1.54E-14
Re-178	M	4.26E-14	2.33E-14	1.24E+03	-	1.24E+03	1.55E-14
Re-180	-	-	-	-	-	-	-
Re-181	M	1.41E-12	7.96E-13	3.75E+01	-	3.75E+01	4.34E-14
Re-182	M	4.96E-12	4.44E-12	1.07E+01	-	1.07E+01	3.97E-14
Re-182m	M	8.70E-13	5.51E-13	6.08E+01	-	6.08E+01	4.49E-14
Re-184	M	3.16E-12	6.73E-12	1.67E+01	-	1.67E+01	8.98E-13
Re-184m	M	4.88E-12	2.26E-11	1.08E+01	-	1.08E+01	2.53E-12
Re-186	M	5.59E-12	4.26E-12	9.47E+00	-	9.47E+00	5.10E-14
Re-186m	M	7.33E-12	4.18E-11	7.22E+00	-	7.22E+00	7.52E-07
Re-186m+D	M	-	-	-	-	-	-
Re-187	M	1.79E-14	2.51E-14	2.96E+03	-	2.96E+03	7.74E+01
Re-188	M	4.88E-12	2.22E-12	1.08E+01	-	1.08E+01	1.11E-14
Re-188m	M	9.92E-14	5.07E-14	5.33E+02	-	5.33E+02	9.94E-15
Re-189	M	2.86E-12	1.73E-12	1.85E+01	-	1.85E+01	2.72E-14
Rh-100	S	2.65E-12	1.04E-12	2.00E+01	-	2.00E+01	1.33E-14
Rh-101	S	2.15E-12	1.81E-11	2.46E+01	-	2.46E+01	2.23E-11
Rh-101m	S	9.40E-13	7.14E-13	5.63E+01	-	5.63E+01	1.89E-13
Rh-102	S	7.70E-12	5.99E-11	6.87E+00	-	6.87E+00	5.69E-12
Rh-102m	S	6.07E-12	2.56E-11	8.72E+00	-	8.72E+00	1.41E-12
Rh-103m	S	9.40E-15	9.14E-15	5.63E+03	-	5.63E+03	1.73E-13
Rh-105	S	2.34E-12	1.59E-12	2.26E+01	-	2.26E+01	2.68E-14
Rh-106	-	-	-	-	-	-	-
Rh-106m	S	5.48E-13	2.71E-13	9.66E+01	-	9.66E+01	7.20E-15
Rh-107	S	4.18E-14	2.88E-14	1.27E+03	-	1.27E+03	1.57E-14
Rh-99	S	2.21E-12	3.33E-12	2.39E+01	-	2.39E+01	2.91E-13
Rh-99m	S	2.42E-13	9.99E-14	2.19E+02	-	2.19E+02	3.25E-14
Rn-218	-	-	-	-	-	-	-
Rn-219	-	-	-	-	-	-	-
Rn-219+D	-	-	-	-	-	-	-

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Rn-220	-	-	-	-	-	-	-
Rn-222	-	-	-	-	-	-	-
Rn-222+D	-	-	1.80E-11	-	5.88E-01	5.88E-01	3.83E-15
Ru-103	M	3.85E-12	8.92E-12	1.37E+01	-	1.37E+01	4.27E-13
Ru-105	M	1.35E-12	6.48E-13	3.92E+01	-	3.92E+01	5.84E-15
Ru-106	M	4.22E-11	1.02E-10	1.25E+00	-	1.25E+00	3.75E-13
Ru-106+D	M	4.22E-11	1.02E-10	1.25E+00	-	1.25E+00	3.75E-13
Ru-94	M	3.06E-13	1.23E-13	1.73E+02	-	1.73E+02	4.49E-15
Ru-97	M	6.36E-13	3.36E-13	8.32E+01	-	8.32E+01	1.80E-13
S-35	M	5.14E-13	5.03E-12	1.03E+02	-	1.03E+02	2.42E-12
Sb-115	M	5.14E-14	2.33E-14	1.03E+03	-	1.03E+03	2.01E-14
Sb-116	M	4.96E-14	1.88E-14	1.07E+03	-	1.07E+03	1.04E-14
Sb-116m	M	1.76E-13	8.81E-14	3.01E+02	-	3.01E+02	1.12E-14
Sb-117	M	6.59E-14	4.07E-14	8.03E+02	-	8.03E+02	8.41E-14
Sb-118m	M	6.99E-13	2.64E-13	7.57E+01	-	7.57E+01	1.43E-14
Sb-119	M	4.77E-13	1.74E-13	1.11E+02	-	1.11E+02	1.61E-13
Sb-120	M	2.48E-14	1.12E-14	2.13E+03	-	2.13E+03	2.17E-14
Sb-120m	M	4.44E-12	3.30E-12	1.19E+01	-	1.19E+01	6.32E-14
Sb-122	M	1.06E-11	5.48E-12	4.99E+00	-	4.99E+00	1.26E-14
Sb-124	M	1.29E-11	2.43E-11	4.10E+00	-	4.10E+00	2.35E-13
Sb-124m	M	-	-	-	-	-	-
Sb-124n	M	1.67E-14	1.15E-14	3.17E+03	-	3.17E+03	4.23E-14
Sb-125	M	4.37E-12	1.66E-11	1.21E+01	-	1.21E+01	1.17E-11
Sb-126	M	1.11E-11	1.15E-11	4.77E+00	-	4.77E+00	5.71E-14
Sb-126m	M	6.66E-14	3.16E-14	7.94E+02	-	7.94E+02	1.01E-14
Sb-127	M	1.01E-11	7.51E-12	5.24E+00	-	5.24E+00	1.96E-14
Sb-128	M	3.45E-12	1.44E-12	1.53E+01	-	1.53E+01	5.65E-15
Sb-128m	M	5.51E-14	2.12E-14	9.60E+02	-	9.60E+02	6.81E-15
Sb-129	M	2.19E-12	9.62E-13	2.42E+01	-	2.42E+01	4.30E-15
Sb-130	M	2.07E-13	9.73E-14	2.56E+02	-	2.56E+02	7.08E-15
Sb-131	M	2.56E-13	9.73E-14	2.07E+02	-	2.07E+02	3.32E-15
Sc-43	S	8.18E-13	3.81E-13	6.47E+01	-	6.47E+01	3.46E-15
Sc-44	S	1.56E-12	6.44E-13	3.39E+01	-	3.39E+01	1.87E-15
Sc-44m	S	1.38E-11	6.96E-12	3.83E+00	-	3.83E+00	3.16E-15
Sc-46	S	6.22E-12	2.47E-11	8.51E+00	-	8.51E+00	2.52E-13
Sc-47	S	3.49E-12	3.05E-12	1.52E+01	-	1.52E+01	1.83E-14

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Sc-48	S	7.33E-12	3.96E-12	7.22E+00	-	7.22E+00	4.84E-15
Sc-49	S	2.05E-13	1.07E-13	2.58E+02	-	2.58E+02	3.87E-15
Se-70	F	2.95E-13	7.36E-14	1.79E+02	-	1.79E+02	2.74E-15
Se-73	F	7.96E-13	1.99E-13	6.65E+01	-	6.65E+01	1.11E-14
Se-73m	F	8.29E-14	2.06E-14	6.38E+02	-	6.38E+02	9.68E-15
Se-75	F	8.14E-12	3.77E-12	6.50E+00	-	6.50E+00	4.48E-13
Se-77m	-	-	-	-	-	-	-
Se-79	F	7.29E-12	3.33E-12	7.26E+00	-	7.26E+00	1.04E-07
Se-81	F	4.29E-14	1.27E-14	1.23E+03	-	1.23E+03	9.85E-15
Se-81m	F	1.30E-13	3.54E-14	4.07E+02	-	4.07E+02	1.01E-14
Se-83	F	1.02E-13	2.72E-14	5.19E+02	-	5.19E+02	5.16E-15
Si-31	S	6.48E-13	3.05E-13	8.17E+01	-	8.17E+01	2.12E-15
Si-32	S	3.44E-12	2.93E-10	1.54E+01	-	1.54E+01	6.20E-10
Si-32+D	S	-	-	-	-	-	-
Sm-141	M	7.10E-14	2.79E-14	7.45E+02	-	7.45E+02	5.71E-15
Sm-141m	M	1.40E-13	6.29E-14	3.78E+02	-	3.78E+02	6.42E-15
Sm-142	M	5.37E-13	2.13E-13	9.85E+01	-	9.85E+01	5.40E-15
Sm-145	M	1.17E-12	4.51E-12	4.52E+01	-	4.52E+01	1.71E-11
Sm-146	M	4.11E-11	7.88E-09	1.29E+00	-	1.29E+00	5.42E-05
Sm-147	M	3.74E-11	6.88E-09	1.41E+00	-	1.41E+00	6.17E-02
Sm-151	M	5.55E-13	4.88E-12	9.53E+01	-	9.53E+01	3.63E-09
Sm-153	M	4.85E-12	2.95E-12	1.09E+01	-	1.09E+01	2.49E-14
Sm-155	M	4.96E-14	3.15E-14	1.07E+03	-	1.07E+03	1.95E-14
Sm-156	M	1.49E-12	9.69E-13	3.55E+01	-	3.55E+01	1.66E-14
Sn-110	M	1.87E-12	6.70E-13	2.83E+01	-	2.83E+01	3.98E-15
Sn-111	M	5.51E-14	2.83E-14	9.60E+02	-	9.60E+02	2.00E-14
Sn-113	M	4.33E-12	1.00E-11	1.22E+01	-	1.22E+01	1.22E-12
Sn-117m	M	4.37E-12	8.84E-12	1.21E+01	-	1.21E+01	1.48E-13
Sn-119m	M	2.21E-12	7.81E-12	2.39E+01	-	2.39E+01	6.40E-12
Sn-121	M	1.50E-12	1.02E-12	3.53E+01	-	3.53E+01	3.69E-14
Sn-121m	M	2.34E-12	1.54E-11	2.26E+01	-	2.26E+01	4.21E-10
Sn-121m+D	M	-	-	-	-	-	-
Sn-123	M	1.40E-11	3.03E-11	3.78E+00	-	3.78E+00	4.61E-13
Sn-123m	M	7.96E-14	5.62E-14	6.65E+02	-	6.65E+02	1.75E-14
Sn-125	M	2.01E-11	1.41E-11	2.63E+00	-	2.63E+00	2.43E-14
Sn-126	M	2.56E-11	9.95E-11	2.07E+00	-	2.07E+00	7.29E-08

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Sn-126+D	M	-	-	-	-	-	-
Sn-127	M	8.25E-13	4.40E-13	6.41E+01	-	6.41E+01	5.47E-15
Sn-128	M	4.33E-13	2.29E-13	1.22E+02	-	1.22E+02	4.92E-15
Sr-80	M	1.09E-12	4.51E-13	4.85E+01	-	4.85E+01	2.07E-15
Sr-81	M	1.71E-13	8.07E-14	3.09E+02	-	3.09E+02	3.40E-15
Sr-82	M	3.13E-11	3.69E-11	1.69E+00	-	1.69E+00	2.66E-14
Sr-82+D	M	-	-	-	-	-	-
Sr-83	M	2.21E-12	1.26E-12	2.39E+01	-	2.39E+01	2.06E-14
Sr-85	M	2.26E-12	2.56E-12	2.34E+01	-	2.34E+01	9.90E-13
Sr-85m	M	1.67E-14	8.32E-15	3.17E+03	-	3.17E+03	9.97E-14
Sr-87m	M	1.07E-13	5.62E-14	4.94E+02	-	4.94E+02	3.86E-14
Sr-89	M	1.28E-11	2.34E-11	4.13E+00	-	4.13E+00	1.43E-13
Sr-90	M	5.59E-11	1.05E-10	9.47E-01	-	9.47E-01	6.95E-12
Sr-90+D	M	7.40E-11	1.13E-10	7.15E-01	-	7.15E-01	5.25E-12
Sr-91	M	3.22E-12	1.70E-12	1.64E+01	-	1.64E+01	4.54E-15
Sr-92	M	2.25E-12	1.03E-12	2.35E+01	-	2.35E+01	1.87E-15
Ta-172	S	1.14E-13	7.22E-14	4.64E+02	-	4.64E+02	1.56E-14
Ta-173	S	9.03E-13	4.44E-13	5.86E+01	-	5.86E+01	1.18E-14
Ta-174	S	1.62E-13	1.11E-13	3.27E+02	-	3.27E+02	2.18E-14
Ta-175	S	8.70E-13	4.37E-13	6.08E+01	-	6.08E+01	3.57E-14
Ta-176	S	1.25E-12	5.96E-13	4.23E+01	-	4.23E+01	1.92E-14
Ta-177	S	5.88E-13	4.44E-13	9.00E+01	-	9.00E+01	2.88E-13
Ta-178	-	-	-	-	-	-	-
Ta-178m	S	2.49E-13	1.79E-13	2.12E+02	-	2.12E+02	2.66E-14
Ta-179	S	3.44E-13	2.05E-12	1.54E+02	-	1.54E+02	1.40E-10
Ta-180	S	4.44E-12	7.25E-11	1.19E+01	-	1.19E+01	6.01E+01
Ta-180m	S	3.03E-13	1.86E-13	1.75E+02	-	1.75E+02	8.14E-14
Ta-182	S	7.96E-12	3.74E-11	6.65E+00	-	6.65E+00	1.07E-12
Ta-182m	S	1.99E-14	3.41E-14	2.66E+03	-	2.66E+03	4.08E-14
Ta-183	S	8.33E-12	8.81E-12	6.35E+00	-	6.35E+00	4.55E-14
Ta-184	S	3.53E-12	1.73E-12	1.50E+01	-	1.50E+01	7.67E-15
Ta-185	S	1.57E-13	1.18E-13	3.37E+02	-	3.37E+02	1.63E-14
Ta-186	S	5.51E-14	2.69E-14	9.60E+02	-	9.60E+02	9.99E-15
Tb-147	M	5.33E-13	2.26E-13	9.93E+01	-	9.93E+01	7.70E-15
Tb-149	M	1.08E-12	1.65E-11	4.90E+01	-	4.90E+01	9.68E-15
Tb-150	M	1.08E-12	3.88E-13	4.90E+01	-	4.90E+01	7.68E-15

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Tb-151	M	1.49E-12	7.73E-13	3.55E+01	-	3.55E+01	3.02E-14
Tb-153	M	1.28E-12	8.18E-13	4.13E+01	-	4.13E+01	1.14E-13
Tb-154	M	2.57E-12	1.14E-12	2.06E+01	-	2.06E+01	2.17E-14
Tb-155	M	1.08E-12	8.99E-13	4.90E+01	-	4.90E+01	3.10E-13
Tb-156	M	4.96E-12	4.22E-12	1.07E+01	-	1.07E+01	6.82E-14
Tb-156m	M	8.44E-13	8.47E-13	6.27E+01	-	6.27E+01	7.63E-14
Tb-156n	M	4.03E-13	3.77E-13	1.31E+02	-	1.31E+02	3.27E-14
Tb-157	M	1.86E-13	1.46E-12	2.84E+02	-	2.84E+02	1.88E-08
Tb-158	M	4.88E-12	8.29E-11	1.08E+01	-	1.08E+01	7.19E-10
Tb-160	M	8.70E-12	2.45E-11	6.08E+00	-	6.08E+00	5.40E-13
Tb-161	M	4.77E-12	5.03E-12	1.11E+01	-	1.11E+01	9.47E-14
Tc-101	M	3.06E-14	1.85E-14	1.73E+03	-	1.73E+03	1.32E-14
Tc-104	M	1.38E-13	5.33E-14	3.83E+02	-	3.83E+02	3.87E-15
Tc-93	M	1.59E-13	6.36E-14	3.33E+02	-	3.33E+02	2.72E-14
Tc-93m	M	6.81E-14	3.17E-14	7.77E+02	-	7.77E+02	1.67E-14
Tc-94	M	6.36E-13	2.80E-13	8.32E+01	-	8.32E+01	1.22E-14
Tc-94m	M	2.36E-13	1.03E-13	2.24E+02	-	2.24E+02	5.84E-15
Tc-95	M	5.77E-13	2.63E-13	9.17E+01	-	9.17E+01	5.57E-14
Tc-95m	M	1.80E-12	3.40E-12	2.94E+01	-	2.94E+01	1.31E-12
Tc-96	M	3.42E-12	2.00E-12	1.55E+01	-	1.55E+01	4.88E-14
Tc-96m	M	3.59E-14	2.05E-14	1.47E+03	-	1.47E+03	3.88E-14
Tc-97	M	2.70E-13	8.51E-13	1.96E+02	-	1.96E+02	1.38E-04
Tc-97m	M	2.38E-12	1.12E-11	2.22E+01	-	2.22E+01	1.44E-12
Tc-98	M	7.10E-12	3.01E-11	7.45E+00	-	7.45E+00	8.59E-06
Tc-99	M	2.75E-12	1.41E-11	1.92E+01	-	1.92E+01	1.14E-06
Tc-99m	M	7.96E-14	5.70E-14	6.65E+02	-	6.65E+02	1.27E-13
Te-116	M	6.73E-13	3.20E-13	7.86E+01	-	7.86E+01	7.26E-15
Te-121	M	1.46E-12	1.30E-12	3.62E+01	-	3.62E+01	5.72E-13
Te-121m	M	6.40E-12	1.44E-11	8.27E+00	-	8.27E+00	1.18E-12
Te-123	M	4.11E-12	2.50E-12	1.29E+01	-	1.29E+01	4.43E+01
Te-123m	M	4.14E-12	1.36E-11	1.28E+01	-	1.28E+01	1.44E-12
Te-125m	M	3.33E-12	1.17E-11	1.59E+01	-	1.59E+01	8.84E-13
Te-127	M	1.00E-12	6.11E-13	5.29E+01	-	5.29E+01	2.01E-14
Te-127m	M	8.62E-12	2.58E-11	6.14E+00	-	6.14E+00	6.52E-13
Te-129	M	1.71E-13	9.95E-14	3.09E+02	-	3.09E+02	1.48E-14
Te-129m	M	1.53E-11	2.49E-11	3.46E+00	-	3.46E+00	1.15E-13

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Te-131	M	2.17E-13	6.40E-14	2.44E+02	-	2.44E+02	4.25E-15
Te-131m	M	8.25E-12	4.22E-12	6.41E+00	-	6.41E+00	8.06E-15
Te-132	M	1.70E-11	9.32E-12	3.11E+00	-	3.11E+00	1.03E-14
Te-133	M	1.92E-13	4.92E-14	2.76E+02	-	2.76E+02	2.43E-15
Te-133m	M	8.73E-13	2.64E-13	6.06E+01	-	6.06E+01	2.38E-15
Te-134	M	3.01E-13	1.60E-13	1.76E+02	-	1.76E+02	5.25E-15
Th-226	S	6.66E-13	1.56E-10	7.94E+01	-	7.94E+01	2.96E-15
Th-227	S	4.74E-11	3.51E-08	1.12E+00	-	1.12E+00	3.64E-14
Th-228	S	1.07E-10	1.32E-07	4.94E-01	-	4.94E-01	6.04E-13
Th-229	S	2.24E-10	1.75E-07	2.36E-01	-	2.36E-01	1.11E-09
Th-229+D	S	5.28E-10	2.25E-07	1.00E-01	-	1.00E-01	4.72E-10
Th-230	S	9.10E-11	2.85E-08	5.81E-01	-	5.81E-01	2.88E-08
Th-231	S	2.21E-12	1.52E-12	2.39E+01	-	2.39E+01	4.51E-14
Th-232	S	1.01E-10	4.33E-08	5.24E-01	-	5.24E-01	4.78E-03
Th-234	S	2.31E-11	3.07E-11	2.29E+00	-	2.29E+00	9.91E-14
Th-234+D	S	-	-	-	-	-	-
Ti-44	S	2.56E-11	3.41E-10	2.07E+00	-	2.07E+00	1.20E-11
Ti-44+D	S	-	-	-	-	-	-
Ti-45	S	6.44E-13	3.09E-13	8.22E+01	-	8.22E+01	3.64E-15
Tl-194	F	1.81E-14	5.11E-15	2.92E+03	-	2.92E+03	9.97E-14
Tl-194m	F	7.81E-14	2.50E-14	6.77E+02	-	6.77E+02	2.30E-14
Tl-195	F	6.40E-14	2.08E-14	8.27E+02	-	8.27E+02	5.98E-14
Tl-197	F	6.25E-14	2.39E-14	8.47E+02	-	8.47E+02	1.51E-13
Tl-198	F	2.06E-13	7.92E-14	2.57E+02	-	2.57E+02	8.62E-14
Tl-198m	F	1.30E-13	4.92E-14	4.07E+02	-	4.07E+02	4.82E-14
Tl-199	F	7.36E-14	2.89E-14	7.19E+02	-	7.19E+02	3.39E-13
Tl-200	F	6.14E-13	2.52E-13	8.62E+01	-	8.62E+01	1.44E-13
Tl-201	F	3.61E-13	1.49E-13	1.47E+02	-	1.47E+02	6.88E-13
Tl-202	F	1.49E-12	6.14E-13	3.55E+01	-	3.55E+01	6.73E-13
Tl-204	F	5.85E-12	2.45E-12	9.04E+00	-	9.04E+00	1.95E-11
Tl-206	-	-	-	-	-	-	-
Tl-207	-	-	-	-	-	-	-
Tl-208	-	-	-	-	-	-	-
Tl-209	-	-	-	-	-	-	-
Tm-162	M	5.66E-14	2.72E-14	9.35E+02	-	9.35E+02	1.75E-14
Tm-166	M	1.12E-12	5.14E-13	4.72E+01	-	4.72E+01	1.93E-14

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Tm-167	M	3.46E-12	4.37E-12	1.53E+01	-	1.53E+01	1.81E-13
Tm-170	M	8.92E-12	2.43E-11	5.93E+00	-	5.93E+00	9.95E-13
Tm-171	M	6.99E-13	3.33E-12	7.57E+01	-	7.57E+01	6.96E-11
Tm-172	M	1.08E-11	5.62E-12	4.90E+00	-	4.90E+00	1.71E-14
Tm-173	M	1.72E-12	7.73E-13	3.08E+01	-	3.08E+01	1.40E-14
Tm-175	M	5.22E-14	3.26E-14	1.01E+03	-	1.01E+03	1.44E-14
U-230	M	2.09E-10	4.55E-08	2.53E-01	-	2.53E-01	9.29E-15
U-231	M	1.75E-12	1.80E-12	3.02E+01	-	3.02E+01	2.25E-13
U-232	M	2.92E-10	1.95E-08	1.81E-01	-	1.81E-01	8.47E-12
U-233	M	7.18E-11	1.16E-08	7.37E-01	-	7.37E-01	7.62E-08
U-234	M	7.07E-11	1.14E-08	7.48E-01	-	7.48E-01	1.20E-07
U-235	M	6.96E-11	1.01E-08	7.60E-01	-	7.60E-01	3.52E-04
U-235+D	M	7.18E-11	1.01E-08	7.37E-01	-	7.37E-01	3.41E-04
U-236	M	6.70E-11	1.05E-08	7.90E-01	-	7.90E-01	1.22E-05
U-237	M	4.88E-12	6.44E-12	1.08E+01	-	1.08E+01	1.33E-13
U-238	M	6.40E-11	9.32E-09	8.27E-01	-	8.27E-01	2.46E-03
U-238+D	M	8.71E-11	9.35E-09	6.07E-01	-	6.07E-01	1.81E-03
U-239	M	7.40E-14	5.70E-14	7.15E+02	-	7.15E+02	2.14E-14
U-240	M	7.03E-12	2.96E-12	7.53E+00	-	7.53E+00	8.14E-15
V-47	M	1.25E-13	5.96E-14	4.23E+02	-	4.23E+02	3.45E-15
V-48	M	8.21E-12	9.29E-12	6.44E+00	-	6.44E+00	3.85E-14
V-49	M	1.22E-13	1.47E-13	4.34E+02	-	4.34E+02	5.38E-11
W-176	F	4.11E-13	1.24E-13	1.29E+02	-	1.29E+02	1.67E-14
W-177	F	2.01E-13	5.99E-14	2.63E+02	-	2.63E+02	3.35E-14
W-178	F	1.21E-12	3.85E-13	4.37E+01	-	4.37E+01	1.30E-12
W-178+D	F	-	-	-	-	-	-
W-179	F	7.22E-15	1.83E-15	7.33E+03	-	7.33E+03	2.62E-13
W-181	F	3.96E-13	1.35E-13	1.34E+02	-	1.34E+02	2.25E-11
W-185	F	2.93E-12	9.36E-13	1.81E+01	-	1.81E+01	1.92E-12
W-187	F	3.67E-12	1.11E-12	1.44E+01	-	1.44E+01	2.06E-14
W-188	F	1.40E-11	4.63E-12	3.78E+00	-	3.78E+00	3.78E-13
Xe-120	-	-	-	-	-	-	-
Xe-121	-	-	-	-	-	-	-
Xe-122	-	-	-	-	-	-	-
Xe-123	-	-	-	-	-	-	-
Xe-125	-	-	-	-	-	-	-

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Xe-127	-	-	-	-	-	-	-
Xe-129m	-	-	-	-	-	-	-
Xe-131m	-	-	-	-	-	-	-
Xe-133	-	-	-	-	-	-	-
Xe-133m	-	-	-	-	-	-	-
Xe-135	-	-	-	-	-	-	-
Xe-135m	-	-	-	-	-	-	-
Xe-138	-	-	-	-	-	-	-
Y-86	S	4.07E-12	1.58E-12	1.30E+01	-	1.30E+01	5.27E-15
Y-86m	S	2.35E-13	9.29E-14	2.25E+02	-	2.25E+02	4.95E-15
Y-87	S	2.58E-12	1.49E-12	2.05E+01	-	2.05E+01	4.58E-14
Y-88	S	4.18E-12	1.70E-11	1.27E+01	-	1.27E+01	9.11E-13
Y-90	S	1.81E-11	8.40E-12	2.92E+00	-	2.92E+00	5.38E-15
Y-90m	S	1.04E-12	4.81E-13	5.09E+01	-	5.09E+01	4.67E-15
Y-91	S	1.60E-11	3.36E-11	3.31E+00	-	3.31E+00	1.35E-13
Y-91m	S	3.52E-14	3.01E-14	1.50E+03	-	1.50E+03	3.62E-14
Y-92	S	2.48E-12	9.32E-13	2.13E+01	-	2.13E+01	2.22E-15
Y-93	S	7.18E-12	2.64E-12	7.37E+00	-	7.37E+00	2.21E-15
Y-94	S	1.37E-13	5.51E-14	3.86E+02	-	3.86E+02	3.69E-15
Y-95	S	7.25E-14	2.92E-14	7.30E+02	-	7.30E+02	3.95E-15
Yb-162	S	5.22E-14	3.00E-14	1.01E+03	-	1.01E+03	1.65E-14
Yb-166	S	4.37E-12	2.89E-12	1.21E+01	-	1.21E+01	3.64E-14
Yb-167	S	1.56E-14	1.71E-14	3.39E+03	-	3.39E+03	5.28E-14
Yb-169	S	4.00E-12	1.08E-11	1.32E+01	-	1.32E+01	5.49E-13
Yb-175	S	2.87E-12	2.95E-12	1.84E+01	-	1.84E+01	1.04E-13
Yb-177	S	3.46E-13	2.29E-13	1.53E+02	-	1.53E+02	1.64E-14
Yb-178	S	3.89E-13	2.38E-13	1.36E+02	-	1.36E+02	9.54E-15
Zn-62	M	4.96E-12	2.65E-12	1.07E+01	-	1.07E+01	1.96E-15
Zn-63	M	1.61E-13	7.55E-14	3.29E+02	-	3.29E+02	4.20E-15
Zn-65	M	1.17E-11	5.81E-12	4.52E+00	-	4.52E+00	5.50E-13
Zn-69	M	7.22E-14	6.11E-14	7.33E+02	-	7.33E+02	1.54E-14
Zn-69m	M	1.86E-12	1.28E-12	2.84E+01	-	2.84E+01	8.63E-15
Zn-71m	M	9.66E-13	5.33E-13	5.48E+01	-	5.48E+01	4.87E-15
Zn-72	M	6.59E-12	5.48E-12	8.03E+00	-	8.03E+00	8.59E-15
Zr-86	M	3.85E-12	1.56E-12	1.37E+01	-	1.37E+01	6.23E-15
Zr-88	M	1.58E-12	8.95E-12	3.35E+01	-	3.35E+01	1.89E-12

Isotope	ICRP Lung Absorption Type	Water Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	Ingestion PRG (pCi/L)	Inhalation PRG (pCi/L)	Total PRG (pCi/L)	Total PRG (mg/L)
Zr-89	M	3.60E-12	1.92E-12	1.47E+01	-	1.47E+01	3.28E-14
Zr-93	M	1.11E-12	7.29E-12	4.77E+01	-	4.77E+01	1.90E-05
Zr-95	M	4.59E-12	1.65E-11	1.15E+01	-	1.15E+01	5.37E-13
Zr-97	M	1.25E-11	4.81E-12	4.23E+00	-	4.23E+00	2.22E-15

A.4 Method Three Calculator Output – Occupational Soil Screening Levels

Site zone and exposure scenario: Over 40-inch Zone - Commercial/Industrial Exposures

1/20/2011 Cleanup Level Calculations

Chemical	CAS	Type	Calculations		
Aluminum **User-Added**		Inorganic Non-Carcinogenic	Direct Contact Indoor Worker:	> 10^6	mg/kg
			Direct Contact Outdoor Worker:	> 10^6	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	37	mg/L
			Migration to Groundwater:		
Cobalt **User-Added**		Organic Non-Carcinogenic Solid	Direct Contact Indoor Worker:	610	mg/kg
			Direct Contact Outdoor Worker:	310	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.011	mg/L
			Migration to Groundwater:		
Iron **User-Added**		Inorganic Non-Carcinogenic	Direct Contact Indoor Worker:	> 10^6	mg/kg
			Direct Contact Outdoor Worker:	715000	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	26	mg/L
			Migration to Groundwater:		
Manganese **User-Added**		Inorganic Non-Carcinogenic	Direct Contact Indoor Worker:	49100	mg/kg
			Direct Contact Outdoor Worker:	24500	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.88	mg/L
			Migration to Groundwater:		
Molybdenum **User-Added**		Inorganic Non-Carcinogenic	Direct Contact Indoor Worker:	10200	mg/kg
			Direct Contact Outdoor Worker:	5100	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.18	mg/L
			Migration to Groundwater:		
Uranium **User-Added**		Inorganic Non-Carcinogenic	Direct Contact Indoor Worker:	6100	mg/kg
			Direct Contact Outdoor Worker:	3100	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.11	mg/L
			Migration to Groundwater:		
Antimony	7440-	Inorganic	Direct Contact Indoor Worker:	820	mg/kg

	36-0	Non-Carcinogenic Solid	Direct Contact Outdoor Worker:	410	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.006	mg/L
			Migration to Groundwater:	3.6	mg/kg
Arsenic	7440-38-2	Inorganic Carcinogenic Solid	Direct Contact Indoor Worker:	28	mg/kg
			Direct Contact Outdoor Worker:	16	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.01	mg/L
			Migration to Groundwater:	3.9	mg/kg
Barium	7440-39-3	Inorganic Non-Carcinogenic Solid	Direct Contact Indoor Worker:	409000	mg/kg
			Direct Contact Outdoor Worker:	204000	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	2	mg/L
			Migration to Groundwater:	1100	mg/kg
Beryllium	7440-41-7	Inorganic Carcinogenic Solid	Direct Contact Indoor Worker:	4100	mg/kg
			Direct Contact Outdoor Worker:	2000	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.004	mg/L
			Migration to Groundwater:	42	mg/kg
Cadmium	7440-43-9	Inorganic Carcinogenic Solid	Direct Contact Indoor Worker:	880	mg/kg
			Direct Contact Outdoor Worker:	620	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.005	mg/L
			Migration to Groundwater:	5	mg/kg
Chromium (Total)	7440-47-3	Inorganic Non-Carcinogenic Solid	Direct Contact Indoor Worker:	6100	mg/kg
			Direct Contact Outdoor Worker:	3100	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.1	mg/L
			Migration to Groundwater:	25	mg/kg
Copper	7440-50-8	Inorganic Non-Carcinogenic Solid	Direct Contact Indoor Worker:	81800	mg/kg
			Direct Contact Outdoor Worker:	40900	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	1	mg/L
			Migration to Groundwater:	460	mg/kg

Lead	7439-92-1	Inorganic Carcinogenic Solid	Direct Contact Indoor Worker:	800	mg/kg
			Direct Contact Outdoor Worker:	800	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.015	mg/L
			Migration to Groundwater:		
Mercury	7439-97-6	Inorganic Non-Carcinogenic	Direct Contact Indoor Worker:	610	mg/kg
			Direct Contact Outdoor Worker:	310	mg/kg
			Inhalation Cleanup Level:	17	mg/kg
			Groundwater Cleanup Level:	0.002	mg/L
			Migration to Groundwater:	1.4	mg/kg
Nickel	7440-02-0	Inorganic Non-Carcinogenic Solid	Direct Contact Indoor Worker:	40900	mg/kg
			Direct Contact Outdoor Worker:	20400	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.1	mg/L
			Migration to Groundwater:	86	mg/kg
Selenium	7782-49-2	Inorganic Non-Carcinogenic Solid	Direct Contact Indoor Worker:	10200	mg/kg
			Direct Contact Outdoor Worker:	5100	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.05	mg/L
			Migration to Groundwater:	3.4	mg/kg
Silver	7440-22-4	Inorganic Non-Carcinogenic Solid	Direct Contact Indoor Worker:	10200	mg/kg
			Direct Contact Outdoor Worker:	5100	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.1	mg/L
			Migration to Groundwater:	11	mg/kg
Thallium	7440-28-0	Inorganic Non-Carcinogenic Solid	Direct Contact Indoor Worker:	160	mg/kg
			Direct Contact Outdoor Worker:	82	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.002	mg/L
			Migration to Groundwater:	1.9	mg/kg
Vanadium	7440-62-2	Inorganic Non-Carcinogenic Solid	Direct Contact Indoor Worker:	14300	mg/kg
			Direct Contact Outdoor Worker:	7200	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.26	mg/L

			Migration to Groundwater:	3400	mg/kg
Zinc	7440-66-6	Inorganic Non-Carcinogenic Solid	Direct Contact Indoor Worker:	613000	mg/kg
			Direct Contact Outdoor Worker:	307000	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	5	mg/L
			Migration to Groundwater:	4100	mg/kg

Please Note

Chemical	Notes
Lead	A Method Four risk assessment is required for the determination of an alternative cleanup level.

A.5 Method Three Calculator Output – Residential Soil Screening Levels

Site zone and exposure scenario: Over 40-inch Zone - Residential Exposures

1/20/2011 Cleanup Level Calculations

Chemical	CAS	Type	Calculations		
Aluminum **User-Added**		Inorganic Non-Carcinogenic	Direct Contact Cleanup Level:	83000	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	37	mg/L
			Migration to Groundwater:		
Cobalt **User-Added**		Inorganic Non-Carcinogenic	Direct Contact Cleanup Level:	25	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.011	mg/L
			Migration to Groundwater:		
Iron **User-Added**		Inorganic Non-Carcinogenic	Direct Contact Cleanup Level:	58100	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	26	mg/L
			Migration to Groundwater:		
Manganese **User-Added**		Inorganic Non-Carcinogenic	Direct Contact Cleanup Level:	2000	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.88	mg/L
			Migration to Groundwater:		
Molybdenum **User-Added**		Inorganic Non-Carcinogenic	Direct Contact Cleanup Level:	410	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.18	mg/L
			Migration to Groundwater:		
Uranium **User-Added**		Inorganic Non-Carcinogenic	Direct Contact Cleanup Level:	250	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.11	mg/L
			Migration to Groundwater:		
Antimony	7440-36-0	Inorganic Non-Carcinogenic Solid	Direct Contact Cleanup Level:	33	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.006	mg/L
			Migration to Groundwater:	3.6	mg/kg
Arsenic	7440-38-2	Inorganic Carcinogenic Solid	Direct Contact Cleanup Level:	3.7	mg/kg
			Inhalation Cleanup Level:		

			Groundwater Cleanup Level:	0.01	mg/L
			Migration to Groundwater:	3.9	mg/kg
Barium	7440-39-3	Inorganic Non-Carcinogenic Solid	Direct Contact Cleanup Level:	16600	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	2	mg/L
			Migration to Groundwater:	1100	mg/kg
Beryllium	7440-41-7	Inorganic Carcinogenic Solid	Direct Contact Cleanup Level:	170	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.004	mg/L
			Migration to Groundwater:	42	mg/kg
Cadmium	7440-43-9	Inorganic Carcinogenic Solid	Direct Contact Cleanup Level:	65	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.005	mg/L
			Migration to Groundwater:	5	mg/kg
Chromium (Total)	7440-47-3	Inorganic Non-Carcinogenic Solid	Direct Contact Cleanup Level:	250	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.1	mg/L
			Migration to Groundwater:	25	mg/kg
Copper	7440-50-8	Inorganic Non-Carcinogenic Solid	Direct Contact Cleanup Level:	3300	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	1	mg/L
			Migration to Groundwater:	460	mg/kg
Lead	7439-92-1	Inorganic Carcinogenic Solid	Direct Contact Cleanup Level:	400	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.015	mg/L
			Migration to Groundwater:		
Mercury	7439-97-6	Inorganic Non-Carcinogenic	Direct Contact Cleanup Level:	25	mg/kg
			Inhalation Cleanup Level:	13	mg/kg
			Groundwater Cleanup Level:	0.002	mg/L
			Migration to Groundwater:	1.4	mg/kg
Nickel	7440-02-0	Inorganic Non-Carcinogenic Solid	Direct Contact Cleanup Level:	1700	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.1	mg/L

			Migration to Groundwater:	86	mg/kg
Selenium	7782-49-2	Inorganic Non-Carcinogenic Solid	Direct Contact Cleanup Level:	410	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.05	mg/L
			Migration to Groundwater:	3.4	mg/kg
Silver	7440-22-4	Inorganic Non-Carcinogenic Solid	Direct Contact Cleanup Level:	410	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.1	mg/L
			Migration to Groundwater:	11	mg/kg
Thallium	7440-28-0	Inorganic Non-Carcinogenic Solid	Direct Contact Cleanup Level:	6.6	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.002	mg/L
			Migration to Groundwater:	1.9	mg/kg
Vanadium	7440-62-2	Inorganic Non-Carcinogenic Solid	Direct Contact Cleanup Level:	580	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	0.26	mg/L
			Migration to Groundwater:	3400	mg/kg
Zinc	7440-66-6	Inorganic Non-Carcinogenic Solid	Direct Contact Cleanup Level:	24900	mg/kg
			Inhalation Cleanup Level:		
			Groundwater Cleanup Level:	5	mg/L
			Migration to Groundwater:	4100	mg/kg

Please Note

Chemical	Notes
Lead	A Method Four risk assessment is required for the determination of an alternative cleanup level.

APPENDIX B
CALCULATIONS FOR THE SITE-SPECIFIC RISK ASSESSMENT

B.1 RAIS Output – Risk Estimates for Mineral Exploration Worker (Soil and Sediment)

Mineral Explorer Worker Equation Inputs for Marine Sediment

Variable	Value
EF_{ow} (exposure frequency - outdoor worker) day/yr	120
ED_{ow} (exposure duration - outdoor worker) yr	3
LT (lifetime) yr	70
BW_{ow} (body weight - outdoor worker)	70
IR_{ow} (soil ingestion rate - outdoor worker) mg/day	10
SA_{ow} (surface area - outdoor worker) cm^2/day	3300
AF_{ow} (skin adherence factor - outdoor worker) mg/cm^2	0.07

Output generated 23JAN2011:18:22:12

Mineral Explorer Worker RISK for Marine Sediment

Chemical	Concentration (mg/kg)	Ingestion HQ	Inhalation Particulates and Volatiles HQ	Dermal HQ	Total HI	Ingestion Risk	Inhalation Particulates and Volatiles Risk	Dermal Risk	Total Risk
Arsenic, Inorganic	4.90E+01	7.67E-03	0.00E+00	5.32E-03	1.30E-02	1.48E-07	0.00E+00	1.03E-07	2.51E-07
*Total Risk/HI	-	*7.67E-03*	*0.00E+00*	*5.32E-03*	*1.30E-02*	*1.48E-07*	*0.00E+00*	*1.03E-07*	*2.51E-07*

Output generated 23JAN2011:18:22:12

Worker Equation Inputs for Ambient Air

Variable	Value
EF_{ow} (exposure frequency - outdoor worker) day/yr	225
ED_{ow} (exposure duration - outdoor worker) yr	25
LT (lifetime) yr	70
ET_{ow} (exposure time - outdoor worker) hr	8

Output generated 23JAN2011:18:22:12

Worker RISK for Ambient Air

Chemical	Concentration ($\mu g/m^3$)	Inhalation Ambient Air HQ	Inhalation Ambient Air Risk
Arsenic, Inorganic	-	-	-
*Total Risk/HI	-	-	-

Output generated 23JAN2011:18:22:12

Mineral Explorer Worker Equation Inputs for Soil/Sediment

Variable	Value
EF_{ow} (exposure frequency - outdoor worker) day/yr	120
ED_{ow} (exposure duration - outdoor worker) yr	3
LT (lifetime) yr	70
BW_{ow} (body weight - outdoor worker)	70
IR_{ow} (soil ingestion rate - outdoor worker) mg/day	100
SA_{ow} (surface area - outdoor worker) cm^2/day	3300
AF_{ow} (skin adherence factor - outdoor worker) mg/cm^2	0.2

Output generated 21JAN2011:15:10:16

Mineral Explorer Worker RISK for Soil/Sediment

Chemical	Concentration (mg/kg)	Ingestion HQ	Inhalation Particulates and Volatiles HQ	Dermal HQ	Total HI	Ingestion Risk	Inhalation Particulates and Volatiles Risk	Dermal Risk	Total Risk
Arsenic, Inorganic	4.6	0.0072	0.0000371	0.00143	0.00866	1.39E-07	1.03E-10	2.75E-08	1.66E-07
Uranium (Soluble Salts)	719.7	0.113	0.00029	-	0.113	-	-	-	-
*Total Risk/HI	-	*0.12*	*0.000327*	*0.00143*	*0.122*	*1.39E-07*	*1.03E-10*	*2.75E-08*	*1.66E-07*

Output generated 21JAN2011:15:10:16

Worker Equation Inputs for Ambient Air

Variable	Value
EF_{ow} (exposure frequency - outdoor worker) day/yr	120
ED_{ow} (exposure duration - outdoor worker) yr	3
LT (lifetime) yr	70
ET_{ow} (exposure time - outdoor worker) hr	12

Output generated 21JAN2011:15:10:16

Worker RISK for Ambient Air

Chemical	Concentration ($\mu g/m^3$)	Inhalation Ambient Air HQ	Inhalation Ambient Air Risk
Arsenic, Inorganic	-	-	-
Uranium (Soluble Salts)	-	-	-
*Total Risk/HI	-	-	-

Output generated 21JAN2011:15:10:16

Mineral Explorer Worker Equation Inputs for Soil/Sediment

Variable	Value
EF_{ow} (exposure frequency - outdoor worker) day/yr	120
ED_{ow} (exposure duration - outdoor worker) yr	3
t_{ow} (time - outdoor worker) yr	25
ACF (area correction factor) unitless	0.9
GSF (gamma shielding factor) unitless	0.4
ET_{owo} (outdoor exposure time - outdoor worker) hr/hr	0.5
ET_{owi} (indoor exposure time - outdoor worker) hr/hr	0
DF_i (dilution Factor - indoor) unitless	0.4
IRA_{ow} (inhalation rate - outdoor worker) m^3/day	60

Output generated 21JAN2011:15:07:38

Mineral Explorer Worker RISK for Soil/Sediment

Isotope	ICRP Lung Absorption Type	Concentration (pCi/g)	Ingestion Risk	Inhalation Particulates and Volatiles Risk	External Exposure Risk	Total Risk
Pb-210	M	118.1	1.77E-06	2.07E-09	5.14E-08	1.82E-06
Po-210	M	81.16	1.89E-08	1.75E-10	3.11E-11	1.91E-08
Ra-226	M	172.2	1.82E-06		1.74E-06	3.58E-06
Ra-226+D	M	172.2		1.81E-08		
Ra-228	M	79.4	6.04E-07	1.18E-09	0.00E+00	6.06E-07
Th-228	S	106.1	2.70E-08	1.41E-08	2.91E-08	7.02E-08
Th-230	S	171.5	4.77E-07	4.46E-08	6.23E-08	5.84E-07
Th-232	S	86.9	2.65E-07	3.43E-08	1.32E-08	3.12E-07
U-234	M	526.4	9.68E-07	5.47E-08	5.89E-08	1.08E-06
U-235	M	5.3	9.39E-09	4.88E-10	1.22E-06	1.23E-06
U-238	M	515.9	8.65E-07	4.38E-08	1.14E-08	9.21E-07
*Total Risk/HI		-	6.82E-06	2.14E-07	3.19E-06	1.02E-05

Output generated 21JAN2011:15:07:38

Air

Variable	Value
ED_{ow} (exposure duration - outdoor worker) yr	3
ET_{ow} (exposure time - outdoor worker) hr	12
EF_{ow} (exposure frequency - outdoor worker) day/yr	120
IRA_{ow} (inhalation rate - outdoor worker) m^3/day	60

Output generated 21JAN2011:15:07:38

Worker RISK for Ambient Air

Isotope	ICRP Lung Absorption Type	Concentration (pCi/m^3)	Inhalation Ambient Air Risk
Pb-210	M	-	-
Po-210	M	-	-
Ra-226	M	-	-
Ra-226+D	M	-	-
Ra-228	M	-	-
Th-228	S	-	-
Th-230	S	-	-
Th-232	S	-	-
U-234	M	-	-
U-235	M	-	-
U-238	M	-	-
*Total Risk/HI		-	-

Output generated 21JAN2011:15:07:38

Min Exp Worker Equation Inputs for Marine Sediment

Variable	Value
EF_{ow} (exposure frequency - outdoor worker) day/yr	120
ED_{ow} (exposure duration - outdoor worker) yr	3
t_{ow} (time - outdoor worker) yr	25
ACF (area correction factor) unitless	0.9
GSF (gamma shielding factor) unitless	0.4
ET_{owo} (outdoor exposure time - outdoor worker) hr/hr	0.042
ET_{owi} (indoor exposure time - outdoor worker) hr/hr	0
DF_i (dilution Factor - indoor) unitless	0.4
IRA_{ow} (inhalation rate - outdoor worker) m^3/day	60

Output generated 23JAN2011:18:11:07

Mineral Explorer Worker RISK for Marine Sediment

Isotope	ICRP Lung Absorption Type	Concentration (pCi/g)	Ingestion Risk	Inhalation Particulates and Volatiles Risk	External Exposure Risk	Total Risk
Pb-210	M	15.2	2.28E-08	0	5.56E-10	2.34E-08
Ra-226	M	64	6.76E-08	0	5.43E-08	1.22E-07
Ra-228	M	45.4	3.46E-08	0	0	3.46E-08
Th-230	S	222	6.18E-08	0	6.78E-09	6.86E-08
Th-232	S	117	3.57E-08	0	1.49E-09	3.72E-08
U-234	M	132	2.43E-08	0	1.24E-09	2.55E-08
U-235	M	8.7	1.54E-09	0	0.000000168	1.70E-07
U-238	M	137	2.30E-08	0	2.55E-10	2.33E-08
*Total Risk/HI		-	*2.71E-07*	-	*2.33E-07*	*5.04E-07*

Output generated 23JAN2011:18:11:07

Air

Variable	Value
ED_{ow} (exposure duration - outdoor worker) yr	25
ET_{ow} (exposure time - outdoor worker) hr	8
EF_{ow} (exposure frequency - outdoor worker) day/yr	225
IRA_{ow} (inhalation rate - outdoor worker) m^3/day	60

Output generated 23JAN2011:18:11:07

Worker RISK for Ambient Air

Isotope	ICRP Lung Absorption Type	Concentration (pCi/m^3)	Inhalation Ambient Air Risk
Pb-210	M	-	-
Ra-226	M	-	-
Ra-228	M	-	-
Th-230	S	-	-
Th-232	S	-	-
U-234	M	-	-
U-235	M	-	-
U-238	M	-	-
*Total Risk/HI		-	-

Output generated 23JAN2011:18:11:07

Mineral Explorer Worker Equation Inputs for Soil/Sediment

Variable	Value
EF_{ow} (exposure frequency - outdoor worker) day/yr	120
ED_{ow} (exposure duration - outdoor worker) yr	3
t_{ow} (time - outdoor worker) yr	25
ACF (area correction factor) unitless	0.9
GSF (gamma shielding factor) unitless	0.4
ET_{owo} (outdoor exposure time - outdoor worker) hr/hr	0.042
ET_{owi} (indoor exposure time - outdoor worker) hr/hr	0
DF_i (dilution Factor - indoor) unitless	0.4
IRA_{ow} (inhalation rate - outdoor worker) m^3/day	60

Output generated 23JAN2011:17:11:09

Mineral Explorer Worker RISK for Stream Sediment

Isotope	ICRP Lung Absorption Type	Concentration (pCi/g)	Ingestion Risk	Inhalation Particulates and Volatiles Risk	External Exposure Risk	Total Risk
Pb-210	M	38.5	5.77E-08	0	1.41E-09	5.92E-08
Ra-226	M	114	1.20E-07	0	9.68E-08	2.168E-07
Ra-228	M	47.6	3.62E-08	0	0	3.63E-08
Th-230	S	70	1.95E-08	0	2.14E-09	2.29E-08
Th-232	S	33.2	1.01E-08	0	4.23E-10	1.15E-08
U-234	M	56.8	1.04E-08	0	5.34E-10	1.14E-08
U-235	M	3.8	6.73E-10	0	7.35E-08	7.42E-08
U-238	M	60.8	1.02E-08	0	1.13E-10	1.07E-08
*Total Risk/HI		-	*2.65E-07*	*0.00E+00*	*1.75E-07*	*4.43E-07*

Output generated 23JAN2011:17:11:09

Worker Equation Inputs for Ambient Air

Variable	Value
ED_{ow} (exposure duration - outdoor worker) yr	3
ET_{ow} (exposure time - outdoor worker) hr	12
EF_{ow} (exposure frequency - outdoor worker) day/yr	120
IRA_{ow} (inhalation rate - outdoor worker) m^3/day	60

Output generated 23JAN2011:17:11:09

Worker RISK for Ambient Air

Isotope	ICRP Lung Absorption Type	Concentration (pCi/m^3)	Inhalation Ambient Air Risk
Pb-210	M	-	-
Ra-226	M	-	-
Ra-228	M	-	-
Th-230	S	-	-
Th-232	S	-	-
U-234	M	-	-
U-235	M	-	-
U-238	M	-	-
*Total Risk/HI		-	-

Output generated 23JAN2011:17:11:09

B.2 RAIS Output – Risk Estimates for USFS Worker (Soil and Sediment)

USFS Worker Equation Inputs for Soil

Variable	Value
EF_{ow} (exposure frequency - outdoor worker) day/yr	10
ED_{ow} (exposure duration - outdoor worker) yr	25
LT (lifetime) yr	70
BW_{ow} (body weight - outdoor worker)	70
IR_{ow} (soil ingestion rate - outdoor worker) mg/day	100
SA_{ow} (surface area - outdoor worker) cm^2/day	3300
AF_{ow} (skin adherence factor - outdoor worker) mg/cm^2	0.2

Output generated 21JAN2011:14:40:56

USFS Worker RISK for Soil

Chemical	Concentration (mg/kg)	Ingestion HQ	Inhalation Particulates and Volatiles HQ	Dermal HQ	Total HI	Ingestion Risk	Inhalation Particulates and Volatiles Risk	Dermal Risk	Total Risk
Arsenic, Inorganic	4.6	6.00E-04	3.55E-06	1.19E-04	7.23E-04	9.64E-08	8.17E-11	1.91E-08	1.16E-07
Uranium (Soluble Salts)	719.7	9.39E-03	2.77E-05	-	9.42E-03	-	-	-	-
*Total Risk/HI	-	*9.99E-03*	*3.13E-05*	*1.19E-04*	*1.01E-02*	*9.64E-08*	*8.17E-11*	*1.91E-08*	*1.16E-07*

Output generated 21JAN2011:14:40:56

Worker Equation Inputs for Ambient Air

Variable	Value
EF_{ow} (exposure frequency - outdoor worker) day/yr	10
ED_{ow} (exposure duration - outdoor worker) yr	25
LT (lifetime) yr	70
ET_{ow} (exposure time - outdoor worker) hr	12

Output generated 21JAN2011:14:40:56

Worker RISK for Ambient Air

Chemical	Concentration ($\mu g/m^3$)	Inhalation Ambient Air HQ	Inhalation Ambient Air Risk
Arsenic, Inorganic	-	-	-
Uranium (Soluble Salts)	-	-	-
*Total Risk/HI	-	-	-

Output generated 21JAN2011:14:40:56

USFS Worker Equation Inputs for Soil

Variable	Value
EF_{ow} (exposure frequency - outdoor worker) day/yr	10
ED_{ow} (exposure duration - outdoor worker) yr	25
t_{ow} (time - outdoor worker) yr	25
ACF (area correction factor) unitless	0.9
GSF (gamma shielding factor) unitless	0.4
ET_{owo} (outdoor exposure time - outdoor worker) hr/hr	0.5
ET_{owi} (indoor exposure time - outdoor worker) hr/hr	0
DF_i (dilution Factor - indoor) unitless	0.4
IRA_{ow} (inhalation rate - outdoor worker) m^3/day	60

Output generated 21JAN2011:14:53:16

USFS Worker RISK for Soil

Isotope	ICRP Lung Absorption Type	Concentration (pCi/g)	Ingestion Risk	Inhalation Particulates and Volatiles Risk	External Exposure Risk	Total Risk
Pb-210	M	118.1	1.23E-06	1.44E-09	3.57E-08	1.27E-06
Po-210	M	81.16	1.31E-08	1.21E-10	2.16E-11	1.33E-08
Ra-226	M	172.2	1.26E-06		1.21E-06	2.48E-06
Ra-226+D	M	172.2		1.26E-08		
Ra-228	M	79.4	4.20E-07	8.22E-10	0.00E+00	4.21E-07
Th-228	S	106.1	1.87E-08	9.79E-09	2.02E-08	4.87E-08
Th-230	S	171.5	3.31E-07	3.09E-08	4.33E-08	4.06E-07
Th-232	S	86.9	1.84E-07	2.38E-08	9.16E-09	2.17E-07
U-234	M	526.4	6.72E-07	3.80E-08	4.09E-08	7.51E-07
U-235	M	5.3	6.52E-09	3.39E-10	8.48E-07	8.55E-07
U-238	M	515.9	6.01E-07	3.04E-08	7.93E-09	6.39E-07
*Total Risk/HI		-	*4.74E-06*	*1.48E-07*	*2.22E-06*	*7.10E-06*

Output generated 21JAN2011:14:53:16

Worker Equation Inputs for Ambient Air

Variable	Value
ED_{ow} (exposure duration - outdoor worker) yr	25
ET_{ow} (exposure time - outdoor worker) hr	12
EF_{ow} (exposure frequency - outdoor worker) day/yr	10
IRA_{ow} (inhalation rate - outdoor worker) m^3/day	60

Output generated 21JAN2011:14:53:16

Worker RISK for Ambient Air

Isotope	ICRP Lung Absorption Type	Concentration (pCi/m^3)	Inhalation Ambient Air Risk
Pb-210	M	-	-
Po-210	M	-	-
Ra-226	M	-	-
Ra-226+D	M	-	-
Ra-228	M	-	-
Th-228	S	-	-
Th-230	S	-	-
Th-232	S	-	-
U-234	M	-	-
U-235	M	-	-
U-238	M	-	-
*Total Risk/HI		-	-

Output generated 21JAN2011:14:53:16

USFS Worker Equation Inputs for Marine Sediment

Variable	Value
EF_{ow} (exposure frequency - outdoor worker) day/yr	10
ED_{ow} (exposure duration - outdoor worker) yr	25
LT (lifetime) yr	70
BW_{ow} (body weight - outdoor worker)	70
IR_{ow} (soil ingestion rate - outdoor worker) mg/day	10
SA_{ow} (surface area - outdoor worker) cm^2/day	3300
AF_{ow} (skin adherence factor - outdoor worker) mg/cm^2	0.07

Output generated 23JAN2011:18:35:00

USFS Worker RISK for Marine Sediment

Chemical	Concentration (mg/kg)	Ingestion HQ	Inhalation Particulates and Volatiles HQ	Dermal HQ	Total HI	Ingestion Risk	Inhalation Particulates and Volatiles Risk	Dermal Risk	Total Risk
Arsenic, Inorganic	49	6.39E-04	0.00E+00	4.43E-04	1.08E-03	1.03E-07	0.00E+00	7.12E-08	1.74E-07
*Total Risk/HI	-	*6.39E-04*	*0.00E+00*	*4.43E-04*	*1.08E-03*	*1.03E-07*	*0.00E+00*	*7.12E-08*	*1.74E-07*

Output generated 23JAN2011:18:35:00

Worker Equation Inputs for Ambient Air

Variable	Value
EF_{ow} (exposure frequency - outdoor worker) day/yr	225
ED_{ow} (exposure duration - outdoor worker) yr	25
LT (lifetime) yr	70
ET_{ow} (exposure time - outdoor worker) hr	8

Output generated 23JAN2011:18:35:00

Worker RISK for Ambient Air

Chemical	Concentration ($\mu g/m^3$)	Inhalation Ambient Air HQ	Inhalation Ambient Air Risk
Arsenic, Inorganic	-	-	-
*Total Risk/HI	-	-	-

Output generated 23JAN2011:18:35:00

USFS Worker Equation Inputs for Marine Sediment

Variable	Value
EF_{ow} (exposure frequency - outdoor worker) day/yr	10
ED_{ow} (exposure duration - outdoor worker) yr	25
t_{ow} (time - outdoor worker) yr	25
ACF (area correction factor) unitless	0.9
GSF (gamma shielding factor) unitless	0.4
ET_{owo} (outdoor exposure time - outdoor worker) hr/hr	0.042
ET_{owi} (indoor exposure time - outdoor worker) hr/hr	0
DF_i (dilution Factor - indoor) unitless	0.4
IRA_{ow} (inhalation rate - outdoor worker) m^3/day	60

Output generated 23JAN2011:18:10:09

USFS Worker RISK for Marine Sediment

Isotope	ICRP Lung Absorption Type	Concentration (pCi/g)	Ingestion Risk	Inhalation Particulates and Volatiles Risk	External Exposure Risk	Total Risk
Pb-210	M	15.2	1.58E-08	0.00E+00	3.86E-10	1.62E-08
Ra-226	M	64	4.69E-08	0.00E+00	3.77E-08	8.46E-08
Ra-228	M	45.4	2.40E-08	0.00E+00	0.00E+00	2.40E-08
Th-230	S	222	4.29E-08	0.00E+00	4.71E-09	4.76E-08
Th-232	S	117	2.48E-08	0.00E+00	1.04E-09	2.58E-08
U-234	M	132	1.69E-08	0.00E+00	8.61E-10	1.78E-08
U-235	M	8.7	1.07E-09	0.00E+00	1.17E-07	1.18E-07
U-238	M	137	1.60E-08	0.00E+00	1.77E-10	1.62E-08
*Total Risk/HI		-	*1.88E-07*	*0.00E+00*	*1.62E-07*	*3.50E-07*

Output generated 23JAN2011:18:10:09

Ambient Air

Variable	Value
ED_{ow} (exposure duration - outdoor worker) yr	25
ET_{ow} (exposure time - outdoor worker) hr	8
EF_{ow} (exposure frequency - outdoor worker) day/yr	225
IRA_{ow} (inhalation rate - outdoor worker) m^3/day	60

Output generated 23JAN2011:18:10:09

Worker RISK for Ambient Air

Isotope	ICRP Lung Absorption Type	Concentration (pCi/m^3)	Inhalation Ambient Air Risk
Pb-210	M	-	-
Ra-226	M	-	-
Ra-228	M	-	-
Th-230	S	-	-
Th-232	S	-	-
U-234	M	-	-
U-235	M	-	-
U-238	M	-	-
*Total Risk/HI		-	-

Output generated 23JAN2011:18:10:09

USFS Worker Equation Inputs for Stream Sediment

Variable	Value
EF_{ow} (exposure frequency - outdoor worker) day/yr	10
ED_{ow} (exposure duration - outdoor worker) yr	25
t_{ow} (time - outdoor worker) yr	25
ACF (area correction factor) unitless	0.9
GSF (gamma shielding factor) unitless	0.4
ET_{owo} (outdoor exposure time - outdoor worker) hr/hr	0.042
ET_{owi} (indoor exposure time - outdoor worker) hr/hr	0
DF_i (dilution Factor - indoor) unitless	0.4
IRA_{ow} (inhalation rate - outdoor worker) m^3/day	60

Output generated 23JAN2011:17:09:07

USFS Worker RISK for Stream Sediment

Isotope	ICRP Lung Absorption Type	Concentration (pCi/g)	Ingestion Risk	Inhalation Particulates and Volatiles Risk	External Exposure Risk	Total Risk
Pb-210	M	38.5	4.01E-08	0.00E+00	9.77E-10	4.11E-08
Ra-226	M	114	8.36E-08	0.00E+00	6.72E-08	1.51E-07
Ra-228	M	47.6	2.52E-08	0.00E+00	0.00E+00	2.52E-08
Th-230	S	70	1.35E-08	0.00E+00	1.48E-09	1.50E-08
Th-232	S	33.2	7.03E-09	0.00E+00	2.94E-10	7.32E-09
U-234	M	56.8	7.26E-09	0.00E+00	3.71E-10	7.63E-09
U-235	M	3.8	4.67E-10	0.00E+00	5.11E-08	5.16E-08
U-238	M	60.8	7.08E-09	0.00E+00	7.85E-11	7.16E-09
*Total Risk/HI		-	*1.84E-07*	*0.00E+00*	*1.22E-07*	*3.06E-07*

Output generated 23JAN2011:17:09:07

Worker Equation Inputs for Ambient Air

Variable	Value
ED_{ow} (exposure duration - outdoor worker) yr	25
ET_{ow} (exposure time - outdoor worker) hr	12
EF_{ow} (exposure frequency - outdoor worker) day/yr	10
IRA_{ow} (inhalation rate - outdoor worker) m^3/day	60

Output generated 23JAN2011:17:09:07

Worker RISK for Ambient Air

Isotope	ICRP Lung Absorption Type	Concentration (pCi/m^3)	Inhalation Ambient Air Risk
Pb-210	M	-	-
Ra-226	M	-	-
Ra-228	M	-	-
Th-230	S	-	-
Th-232	S	-	-
U-234	M	-	-
U-235	M	-	-
U-238	M	-	-
*Total Risk/HI		-	-

Output generated 23JAN2011:17:09:07

B.3 RAIS Output – Risk Estimates for Area Visitor (Soil, Sediment, and Water)

Recreator Equation Inputs for Soil

Variable	Value
EF_r (exposure frequency) d/yr	14
ED_r (exposure duration - recreator) years	30
ED_{0-2} (exposure duration first phase) years	2
ED_{2-6} (exposure duration second phase) years	4
ED_{6-16} (exposure duration third phase) years	10
ED_{16-30} (exposure duration fourth phase) years	14
LT (lifetime - recreator) yr	70
ET_r (exposure time - recreator) hours	24
BW_a (body weight - adult) kg	70
BW_c (body weight - child) kg	15
ED_c (exposure duration - child) years	6
IRS_a (soil intake rate - adult) mg/day	100
IRS_c (soil intake rate - child) mg/day	200
SA_a (skin surface area - adult) cm^2/day	5700
SA_c (skin surface area - child) cm^2/day	2800
AF_a (skin adherence factor - adult) mg/cm^2	0.07
AF_c (skin adherence factor - child) mg/cm^2	0.2
IFS_{adi} (age-adjusted soil ingestion factor) mg-yr/kg-day	114
DFS_{adi} (age-adjusted soil dermal factor) mg-yr/kg-day	361
yr/kg-day	489.5
yr/kg-day	1445

Output generated 23JAN2011:21:40:54

Recreator RISK for Soil

Chemical	Concentration (mg/kg)	Ingestion HQ	Inhalation Particulates and Volatiles HQ	Dermal HQ	Total HI	Ingestion Risk	Inhalation Particulates and Volatiles Risk	Dermal Risk	Total Risk
Arsenic, Inorganic	4.6	7.84E-03	9.93E-06	6.59E-04	8.51E-03	4.31E-07	2.75E-10	4.09E-08	4.72E-07
Uranium (Soluble Salts)	719.7	1.23E-01	7.77E-05	-	1.23E-01	-	-	-	-
*Total Risk/HI	-	*1.31E-01*	*8.76E-05*	*6.59E-04*	*1.31E-01*	*4.31E-07*	*2.75E-10*	*4.09E-08*	*4.72E-07*

Output generated 23JAN2011:21:40:54

Recreator Equation Inputs for Soil

Variable	Value
EF_{rec} (exposure frequency - recreator) day/yr	14
ED_{rec} (exposure duration - recreator) yr	30
t_{rec} (time - recreator) yr	30
ACF (area correction factor) unitless	0.9
ED_c (exposure duration - child) yr	6
IRA_a (inhalation rate - adult) m^3/day	20
IRA_c (inhalation rate - child) m^3/day	10
IFS_{adj} (age-adjusted soil ingestion factor) mg-yr/kg-day	120
IFA_{adj} (age-adjusted soil inhalation factor) m^3/day	18

Output generated 23JAN2011:17:41:45

Recreator RISK for Soil

Isotope	ICRP Lung Absorption Type	Concentration (pCi/g)	Ingestion Risk	Inhalation Particulates and Volatiles Risk	External Exposure Risk	Total Risk
Pb-210	M	118.1	7.12E-06	5.66E-11	4.67E-09	7.13E-06
Po-210	M	81.16	5.94E-08	4.25E-12	2.52E-12	5.94E-08
Ra-226 (1)	M	172.2	6.29E-06	1.27E-08	1.69E-07	6.47E-06
Ra-228	M	79.4	2.46E-06	2.94E-11	0.00E+00	2.46E-06
Th-228	S	106.1	1.42E-07	3.43E-10	2.35E-09	1.45E-07
Th-230	S	171.5	1.75E-06	1.30E-09	6.06E-09	1.75E-06
Th-232	S	86.9	1.01E-06	1.00E-09	1.28E-09	1.01E-06
U-234	M	526.4	4.19E-06	1.60E-09	5.72E-09	4.20E-06
U-235	M	5.3	4.19E-08	1.42E-11	1.19E-07	1.61E-07
U-238	M	515.9	3.72E-06	1.28E-09	1.11E-09	3.72E-06
*Total Risk/HI		-	*2.68E-05*	*1.83E-08*	*3.09E-07*	*2.71E-05*

Output generated 23JAN2011:17:41:45

(1) Inhalation risk based on Ra-226+D calculation

Recreator Equation Inputs for Marine Sediment

Variable	Value
EF_r (exposure frequency) d/yr	14
ED_r (exposure duration - recreator) years	30
ED_{0-2} (exposure duration first phase) years	2
ED_{2-6} (exposure duration second phase) years	4
ED_{6-16} (exposure duration third phase) years	10
ED_{16-30} (exposure duration fourth phase) years	14
LT (lifetime - recreator) yr	70
ET_r (exposure time - recreator) hours	1
BW_a (body weight - adult) kg	70
BW_c (body weight - child) kg	15
ED_c (exposure duration - child) years	6
IRS_a (soil intake rate - adult) mg/day	10
IRS_c (soil intake rate - child) mg/day	20
SA_a (skin surface area - adult) cm^2/day	5700
SA_c (skin surface area - child) cm^2/day	2800
AF_a (skin adherence factor - adult) mg/cm^2	0.07
AF_c (skin adherence factor - child) mg/cm^2	0.2
IFS_{adi} (age-adjusted soil ingestion factor) mg-yr/kg-day	11.42857143
DFS_{adi} (age-adjusted soil dermal factor) mg-yr/kg-day	361
yr/kg-day	489.5
yr/kg-day	1445

Output generated 23JAN2011:18:24:44

Recreator RISK for Marine Sediment

Chemical	Concentration (mg/kg)	Ingestion HQ	Inhalation Particulates and Volatiles HQ	Dermal HQ	Total HI	Ingestion Risk	Inhalation Particulates and Volatiles Risk	Dermal Risk	Total Risk
Arsenic, Inorganic	49	8.35E-03	0.00E+00	7.02E-03	1.54E-02	4.60E-07	0.00E+00	4.36E-07	8.96E-07
*Total Risk/HI	-	*8.35E-03*	*0.00E+00*	*7.02E-03*	*1.54E-02*	*4.60E-07*	*0.00E+00*	*4.36E-07*	*8.96E-07*

Output generated 23JAN2011:18:24:44

Water

Variable	Value
EF_{rec-w} (exposure frequency) d/yr	14
ED_{rec} (exposure duration - recreator) years	30
LT (lifetime - recreator) yr	70
ET_{rec} (exposure time) hours/day	1
BW_{a} (body weight - adult) kg	70
IRW_{rec} (water intake rate - adult) L/day	0.05
SA_{rec} (skin surface area - adult) cm^2	18000

Output generated 23JAN2011:18:24:44

Recreator RISK for Surface Water

Chemical	Concentration (ug/L)	Ingestion HQ	Dermal HQ	Total HI	Ingestion Risk	Dermal Risk
Arsenic, Inorganic	-	-	-	-	-	-
*Total Risk/HI	-	-	-	-	-	-

Output generated 23JAN2011:18:24:44

Recreator Equation Inputs for Marine Sediment

Variable	Value
EF_{rec} (exposure frequency - recreator) day/yr	14
ED_{rec} (exposure duration - recreator) yr	30
t_{rec} (time - recreator) yr	30
ACF (area correction factor) unitless	0.9
ED_c (exposure duration - child) yr	6
IRA_a (inhalation rate - adult) m^3/day	20
IRA_c (inhalation rate - child) m^3/day	10
IFS_{adj} (age-adjusted soil ingestion factor) mg-yr/kg-day	12
IFA_{adj} (age-adjusted soil inhalation factor) m^3/day	18

Output generated 23JAN2011:22:49:57

Recreator RISK for Marine Sediment

Isotope	ICRP Lung Absorption Type	Concentration (pCi/g)	Ingestion Risk	Inhalation Particulates and Volatiles Risk	External Exposure Risk	Total Risk
Pb-210	M	15.2	9.17E-08	0	6.01E-10	9.23E-08
Ra-226	M	64	2.34E-07	0	6.28E-08	2.97E-07
Ra-228	M	45.4	1.40E-07	0	0.00E+00	1.40E-07
Th-230	S	222	2.26E-07	0	7.84E-09	2.34E-07
Th-232	S	117	1.36E-07	0	1.73E-09	1.38E-07
U-234	M	132	1.05E-07	0	1.44E-09	1.06E-07
U-235	M	8.7	6.88E-09	0	1.95E-07	2.02E-07
U-238	M	137	9.87E-08	0	2.95E-10	9.90E-08
*Total Risk/HI		-	*1.04E-06*	*0.00E+00*	*2.70E-07*	*1.31E-06*

Output generated 23JAN2011:22:49:57

Recreator Equation Inputs for Surface Water and Stream Sediment

Variable	Value
EF_{rec} (exposure frequency - recreator) day/yr	14
ED_{rec} (exposure duration - recreator) yr	30
t_{rec} (time - recreator) yr	30
ACF (area correction factor) unitless	0.9
ED_c (exposure duration - child) yr	6
IRA_a (inhalation rate - adult) m^3/day	20
IRA_c (inhalation rate - child) m^3/day	10
IFS_{adj} (age-adjusted soil ingestion factor) mg-yr/kg-day	12
IFA_{adj} (age-adjusted soil inhalation factor) m^3/day	18

Output generated 23JAN2011:17:34:56

Recreator RISK for Stream Sediment

Isotope	ICRP Lung Absorption Type	Concentration (pCi/g)	Ingestion Risk	Inhalation Particulates and Volatiles Risk	External Exposure Risk	Total Risk
Pb-210	M	38.5	2.32E-07	0	1.52E-09	2.34E-07
Po-210	M	-	-	-	-	-
Ra-226	M	114	4.16E-07	0	1.12E-07	5.28E-07
Ra-228	M	47.6	1.47E-07	0	0	1.47E-07
Th-228	S	-	-	0	-	-
Th-230	S	70	7.13E-08	0	2.47E-09	7.38E-08
Th-232	S	33.2	3.87E-08	0	4.9E-10	3.92E-08
U-234	M	56.8	4.52E-08	0	6.18E-10	4.58E-08
U-235	M	3.8	3.01E-09	0	8.51E-08	8.81E-08
U-238	M	60.8	4.38E-08	0	1.31E-10	4.39E-08
*Total Risk/HI		-	9.98E-07		0.000000202	0.05

Output generated 23JAN2011:17:34:56

Recreator Equation Inputs for Surface Water

Variable	Value
EF_r (exposure frequency - recreator) day/yr	14
ED_r (exposure duration - recreator) yr	30
ET_{rc} (exposure time - recreator) hr	1
IRW_a (water intake rate - adult) L/day	2

Output generated 23JAN2011:17:34:56

Recreator RISK for Surface Water

Isotope	ICRP Lung Absorption Type	Concentration (pCi/L)	Ingestion Risk
Pb-210	M	-	-
Po-210	M	1.31	4.15E-07
Ra-226	M	7.8	2.52E-06
Ra-228	M	7.2	6.29E-06
Th-228	S	1.04	9.35E-08
Th-230	S	0.95	7.26E-08
Th-232	S	-	-
U-234	M	96	5.70E-06
U-235	M	3.42	2.00E-07
U-238	M	79	4.25E-06
*Total Risk/HI		-	*1.95E-05*

Output generated 23JAN2011:17:34:56

B.4 Calculation of Subsistence Food Pathway Risks

Food Ingestion Pathways

METALS

SOIL - GAME Concentration Adjusted for 200 acre grazing range with 17.4 acre site, or 0.087

	AS - adjusted Soil Conc	BAF*Deer IR	IR	EF	ED	CF	AT	BW	Tox Factor	RISK/HI
AS	0.4002	1.39E-06	43.1	365	30	1.00E-03	25550	70	1.5	**2.21E-10**
U	62.6139	6.00E-06	43.1	365	30	1.00E-03	25550	70	0.003	**3.30E-05**

SOIL -PLANTS Concentration Adjusted for gathering range of 1900 acres with 17.4 impacted acres, or 0.009158

	AS Soil	Plant BAF	IR	EF	ED	CF	AT	BW	Tox Factor	RISK
As	0.0421268	3.75E-02	14.2	365	30	1.00E-03	25550	70	1.5	2.06E-07
U	6.5910126	2.30E-02	14.2	365	30	1.00E-03	25550	70	0.003	4.39E-03

RADIONUCLIDES

SOIL - GAME Adjusted for 200 acre grazing range (17.4 acres affected, 200 total = 0.087

	Adjusted Soil Conc pCi/g	BAF	IR	EF	ED	CF	Soil ingestior BW deer	CSF	RISK
Th 232	7.5603	1.60E-03	43.1	365	30	1.00E-03	0.02	1.33E-10	1.52E-11
Ra 228	6.9078	6.00E-02	43.1	365	30	1.00E-03	0.02	1.43E-09	5.59E-09
Th-228	9.2307	1.91E-03	43.1	365	30	1.00E-03	0.02	1.48E-10	2.46E-11
U-235	0.4611	3.70E-03	43.1	365	30	1.00E-03	0.02	9.44E-11	1.52E-12
U-238	44.8833	3.73E-03	43.1	365	30	1.00E-03	0.02	8.66E-11	1.37E-10
U-234	45.7968	3.80E-03	43.1	365	30	1.00E-03	0.02	9.55E-11	1.57E-10
Th-230	14.9205	1.91E-03	43.1	365	30	1.00E-03	0.02	1.19E-10	3.20E-11
Ra-226	14.9814	6.00E-02	43.1	365	30	1.00E-03	0.02	5.15E-10	4.37E-09
Pb-210	10.2747	9.02E-03	43.1	365	30	1.00E-03	0.02	1.18E-09	1.03E-09
Po-210	7.06092	4.22E-03	43.1	365	30	1.00E-03	0.02	2.25E-09	6.33E-10
								TOTAL	1.20E-08

SOIL-PLANT Adjusted for gathering range of 1900 acres with 17.4 impacted acres 0.009158

	Soil Conc	BAF	IR	EF	ED	CF	AT	Area	CSF	RISK
Th 232	86.9	1.02E-03	14.1	365	30	1.00E-03		0.009158	1.33E-10	1.67E-11
Ra 228	79.4	1.09E-01	14.1	365	30	1.00E-03		0.009158	1.43E-09	1.75E-08
Th-228	106.1	1.02E-03	14.1	365	30	1.00E-03		0.009158	1.48E-10	2.26E-11
U-235	5.3	3.78E-03	14.1	365	30	1.00E-03		0.009158	9.44E-11	2.67E-12
								0.009158		0.00E+00
U-238	515.9	3.78E-03	14.1	365	30	1.00E-03		0.009158	8.66E-11	2.39E-10
								0.009158		0.00E+00
U-234	526.4	3.78E-03	14.1	365	30	1.00E-03		0.009158	9.55E-11	2.69E-10
Th-230	171.5	1.02E-03	14.1	365	30	1.00E-03		0.009158	1.19E-10	2.94E-11
Ra-226	172.2	1.09E-01	14.1	365	30	1.00E-03		0.009158	5.15E-10	1.37E-08
Pb-210	118.1	1.00E-02	14.1	365	30	1.00E-03		0.009158	1.18E-09	1.97E-09
Po-210	81.2	1.00E-03	14.1	365	30	1.00E-03		0.009158	2.25E-09	2.58E-10
									TOTAL	3.40E-08
									with AS	2.40E-07

Radioisotopes		BIV - Plants	BIV Terrestrial
			soil
Th-232 Decay Chain			
Th-232		1.02E-03	1.60E-03
Ra-228		1.09E-01	6.00E-02
Th-228		1.02E-03	1.91E-03
Pb-212		NA	NA
Bi-212		NA	NA
U-235 Decay Chain			
U-235		3.78E-03	3.70E-03
Pa-231		2.00E-02	8.00E-05
Ac-227		NA	NA
Th-227		NA	NA
U-238 Decay Chain			
U-238		3.78E-03	3.73E-03
Th-234		1.02E-03	1.12E-04
U-234		3.78E-03	3.80E-03
Th-230		1.02E-03	1.91E-03
Ra-226		1.09E-01	6.00E-02
Pb-214		NA	NA
Bi-214		NA	NA
Po-210		1.00E-03	4.22E-03
Pb-210		1.00E-02	9.02E-03
Tl-208		NA	NA

METALS

	UCL Sed Conc	BAF	Kd	Sea Cucumber IR	EF	ED	CF	Fractionati	AT	BW	CSF	RISK
As	49	1.27E-01	6.70E+00	8.8	365	30	1.00E-03	0.004241	25550	70	1.5	3.18E-07

	UCL Sed Conc	BAF		Flounder IR	EF	ED	CF		AT	BW	CSF	RISK
As	49	1.27E-01	6.70E+00	0.075	365	30	1.00E-03	0.004241	25550	70	1.5	2.71E-09

Radionculides - adjusted for Kd

	Est Marine Sed Conc	BAF	Sea Cucumber IR	EF	ED	CF	Fractionati	ml/g Kd	CSF	RISK
Th 232	117	80	8.8	365	30	1.00E-03	0.004241	1700	1.33E-10	2.99E-10
Ra 228	45.4	3200	8.8	365	30	1.00E-03	0.004241	500	1.43E-09	1.70E-07
Th-228	0	80	8.8	365	30	1.00E-03	0.004241	1700	1.48E-10	0.00E+00
U-235	8.7	1000	8.8	365	30	1.00E-03	0.004241	63	9.44E-11	5.33E-09
U-238	137	1000	8.8	365	30	1.00E-03	0.004241	63	8.66E-11	7.70E-08
U-234	132	1000	8.8	365	30	1.00E-03	0.004241	63	9.55E-11	8.18E-08
Th-230	222	80	8.8	365	30	1.00E-03	0.004241	1700	1.19E-10	5.08E-10
Ra-226	64	3200	8.8	365	30	1.00E-03	0.004241	500	5.15E-10	8.62E-08
Po-210	0	500	8.8	365	30	1.00E-03	0.004241	400	2.25E-09	0.00E+00
Pb-210	15.2	300	8.8	365	30	1.00E-03	0.004241	4000	1.18E-09	5.50E-10
									TOTAL	4.21E-07

									with As	7.40E-07

Radionculides

	Est Marine Sed Conc	BAF	Flounder IR	EF	ED	CF	Fractionati	ml/g Kd	CSF	RISK
Th 232	117	80	0.075	365	30	1.00E-03	0.004241	1700	1.33E-10	2.55E-12
Ra 228	45.4	3200	0.075	365	30	1.00E-03	0.004241	500	1.43E-09	1.45E-09
Th-228	0	80	0.075	365	30	1.00E-03	0.004241	1700	1.48E-10	0.00E+00
U-235	8.7	1000	0.075	365	30	1.00E-03	0.004241	63	9.44E-11	4.54E-11
U-238	137	1000	0.075	365	30	1.00E-03	0.004241	63	8.66E-11	6.56E-10
U-234	132	1000	0.075	365	30	1.00E-03	0.004241	63	9.55E-11	6.97E-10
Th-230	222	80	0.075	365	30	1.00E-03	0.004241	1700	1.19E-10	4.33E-12
Ra-226	64	3200	0.075	365	30	1.00E-03	0.004241	500	5.15E-10	7.35E-10
Po-210	0	500	0.075	365	30	1.00E-03	0.004241	400	2.25E-09	0.00E+00
Pb-210	15.2	300	0.075	365	30	1.00E-03	0.004241	4000	1.18E-09	4.69E-12
									TOTAL	3.59E-09
									with As	6.30E-09

Ingestion rates

Berries - 1	11.45	lbs per year
	5193.606	grams per year
	14.22906	grams per day
Deer	34.65	lbs per year
	15716.89	grams per year
	43.05998	grams per day
Sea Cuke	7.08	lbs per year
	3211.417	grams per year
	8.798403	grams per day
Flounder	0.06	lbs per year
	27.2154	grams per year
	0.074563	grams per day
Seaweed	5.43	lbs per year
	2462.994	grams per year
	6.747928	grams per day

APPENDIX C
TECHNICAL MEMORANDUM: PROJECTED RADIATION DOSE FROM PRE-MINING CONDITIONS AT ROSS ADAMS MINE SITE

Technical Memorandum

PROJECTED RADIATION DOSE FROM PRE-MINING CONDITIONS AT ROSS ADAMS MINE SITE

J. A. Johnson
Tetra Tech

The baseline (background) radiological conditions at the Ross Adams Mine Site, location of a formerly operated uranium mine, were not quantified prior to the start of mining operations. Therefore, in order to put the current site conditions into perspective the pre-mining radiological conditions were projected based on measured radiological parameters at a similar nearby undeveloped area, the I&L Zone.

The Ross Adams Mine Site is located in the Tongass National Forest on Bokan Mountain, approximately 38 air miles southwest of Ketchikan, Alaska. The uranium ore deposit outcropped at an elevation of approximately 970 feet on the southeastern flank of Bokan Mountain. Uranium mining operations commenced in 1957 with removal of ore from an open pit mine. Underground mining began at the site in 1971.

The I&L Zone is a nearby, smaller and lower grade deposit immediately to the northwest of the Ross Adams Mine Site. It has been explored but not developed. Therefore it is a reasonable analogue for pre-mining conditions in the mined areas of the Ross Adams Mine Site.

I&L Radiological Data

Several radiological investigations have been conducted at the Ross Adams Mine Site since mining operations ceased. An expanded site characterization was conducted in the summer and fall of 2009. A gamma exposure rate scan of the I&L Zone was conducted using a GPS- based system with a NaI gamma exposure rate detector. The data are included in the Site Characterization Report (Tetra Tech, 2010a). The gamma radiation survey partially defined the radiological characteristics of the I&L Zone.

Two soil samples were collected in the I&L Zone to further assess the radiological characteristics of surface materials. The samples were analyzed for metals and radiological parameters. The data were reported in the Site Characterization Report (Tetra Tech, 2010a). The I&L Zone gamma scan data and the soil radionuclide concentration data were used to estimate radiological parameter values for the Ross Adams Mine Site under pre-mining conditions.

Estimated Annual Dose and Lifetime Risk Assessment Under Pre-Mining Conditions

The annual radiation dose and lifetime risk to members of the public who might access the Ross Adams Mine Site under existing radiological conditions are assessed the Human Health Risk Assessment (HHRA). In order to put calculated doses and risks under current conditions in perspective, the same exposure parameters were used to calculate the potential doses and risks to the site users under pre-mining conditions as represented by the I&L Zone.

Exposure Scenarios

Three exposure scenarios have been postulated for the Ross Adams Mine Site:
Camper/Site Visitor
Minerals Exploration Worker

The applicable exposure parameter values are given in Table 1:

Table 1: Exposure Parameter Values Used in the Risk Assessment

Exposure Variable	Exposure Scenario		
	Camper//Site Visitor	Forest Service Worker	Minerals Exploration Worker
Frequency	14 days/year	10 days/year	120 days/year
Hours	24 hours/day	12 hours/day	12 hours/day
Duration	30 years	25 years	3 years
Inhalation Rate	20 m^3/day	20 m^3/day	30 m^3/day
Fraction in mineralized area	0.4	0.6	0.6

The potential exposure pathways include the following:

- Direct gamma radiation exposure
- Inhalation of radon decay products
- Inhalation of radionuclides in airborne particulate matter
- Incidental ingestion of soil

Ingestion of vegetation and wild game from the site were not considered significant pathways of exposure based on the size of the site, sparse vegetation, and the nature of site usage.

In order to be consistent with the HHRA, the site visitor was assumed to spend 40% of his/her time in a mineralized area (I&L Zone) and the remainder in non-mineralized areas similar to the Ore Storage Area (OSA) and the 300 Level of the Ross Adams Mine Site.. The forest service and minerals exploration workers were assumed to spend 60% of their time in the mineralized area and 40% in non-mineralized areas.

Direct Gamma Exposure

The gamma exposure rate measurements taken in the I&L Zone are assumed to represent the minimum for pre-mining background in the mineralized area at the Ross Adams Mine Site. The I&L Zone has been prospected for uranium, but never mined, therefore may be assumed to be of lower grade and less mineralized than the Ross-Adams deposit. Thus pre-mining gamma exposure rates at the Ross-Adams Mine Site were likely higher. The I&L Zone is sufficiently remote from the mined area as to be unaffected by shine from the mined area and is a reasonable surrogate for evaluating pre-mining background in the mineralized area.

The method of isolating the I&L Zone gamma exposure data is described in the Site Characterization Report (Tetra Tech, 2010a). The I&L Zone data were plotted as a cumulative distribution; that is, the cumulative frequency of the observations was plotted against the measured gamma exposure rate. The exposure rate measurements ranged from 24 microroentgen per hour (μR/hr) to 2124 μR/hr. The average gamma exposure rate for the I&L Zone was 270 uR/hr.

The measured exposure rate in uR/hr overestimates the true exposure rate due to the energy dependence of the NaI detector system used in the gamma scan. The NaI detector response is energy-dependent over the range of gamma photon energies associated with the uranium and thorium decay chains. In order to adjust the measured values for energy dependence, the NaI detector was cross-calibrated in the field against a microrem meter that records true dose rate in microrem per hour (urem/hr). The average dose rate in urem/hr was calculated from the average measured exposure rate in uR/hr using the regression equation developed based on the correlation data (Tetra Tech 2010a):

$D = 7 \times 10^{-5} X^2 + 0.4253X - 0.1324$

Where: D = dose rate (urem/hr)
X = measured exposure rate (uR/hr)

$D = 7 \times 10^{-5} (270)^2 + 0.4253(270) - 0.1324 = 120$ urem/hr

The annual dose and lifetime risk were calculated for each exposure scenario assuming the exposure factors given in Table 1. The average dose rate was multiplied by a factor to account for the conversion from measured dose rate to effective dose for the uranium decay series; approximately a factor of 0.7 for adults and 0.8 for children (UNSCEAR, 2000) and the number of hours per year of exposure.

The estimated annual direct gamma radiation doses were calculated as follows:

Site visitor (adult) = 120 uR/hr x 0.001mR/uR x 0.7 mrem/mR x 14 d/y x 24 h/d x 0.4
= 11 mrem/y
Site visitor (child) = 120 uR/hr x 0.001 mR/uR x 0.8 mrem/mR x 14 d/y x 24 h/d x 0.4
= 13 mrem/y

Forest service worker = 120 uR/hr x 0.001mR/uR x 0.7 mrem/mR x 10 d/y x 12 h/d x 0.6
= 6 mrem/y

Mineral exploration worker=120 uR/hr x 0.001 mR/uR x 0.7 mrem/mR x 120 d/y x 12 h/d x 0.6
= 73 mrem/y

The estimated lifetime risk was calculated by multiplying the annual dose by the duration of the exposure and the nominal risk coefficient for direct gamma radiation; 5.5×10^{-7}/mrem for members of the public and 4.1×10^{-7}/mrem for workers (ICRP, 2007). The camper dose conversion was a weighted average of the child and adult dose conversion factors with 12 years credited to exposure as a child and 18 years as an adult. The adjusted dose conversion factor is 0.74.

The estimated lifetime risks are as follows:

Camper = 11 mrem/y x (0.74/0.7) x 30 y x 5.5 x 10^{-7}/mrem = 1.9 x 10^{-4}

Forest Service Worker =62 mrem/y x 25 y x 5 x 10^{-7}/mrem = 6.6 x 10^{-5}

Mineral Exploration Worker = 75 mrem/y x 3 y x 4.1 x 10^{-7}/mrem = 9.2 x 10^{-5}

Inhalation of Radon Decay Products

Radon is a decay product in the ^{238}U and ^{232}Th decay chains and is a major source of radiation dose and risk from naturally occurring radionuclides. There are no data on existing radon concentrations in the I&L Zone. Therefore, two methods were used to estimate the pre-mining radon concentrations on the Ross Adams Mine Site. The radon and radon decay product concentrations were calculated using the RESRAD Computer Code (Yu, 2001) and estimated ^{226}Ra and ^{228}Ra concentrations in surface soil. The RESRAD Code was developed by the Department of Energy to evaluate radiation doses from residual radioactivity in soil. The Code calculates the radon and radon decay product concentrations in air in order to determine the dose from inhalation. The pre-mining radon decay product doses were also calculated based on the measured maximum background radon concentration for the Ross Adams Mine Site, 5.8 pCi/L.

The decay products of ^{238}U and ^{232}Th emit gamma radiation that is reflected in the adjusted exposure rate for the I&L Zone. Therefore, it is possible to estimate the ^{226}Ra and ^{228}Ra concentrations from the gamma exposure rate if the ratio of the ^{238}U decay series concentrations to the ^{232}Th decay series concentrations is known. The gamma exposure rate must be apportioned between the two decay series radionuclides. For the purpose of this calculation, the decay products are assumed to be in equilibrium with the parent ^{238}U and ^{232}Th.

The data on the I&L Zone soil samples presented in the Site Characterization Report indicates that the ratio of the ^{238}U decay series activity to the ^{232}Th decay series activity is approximately 1.3. The average dose rate was apportioned between the two series using the literature value for the exposure rate per pCi/g for each of the decay series: 1.9 uR/hr per pCi/g for ^{238}U and 2.82 uR/hr per pCi/g for ^{232}Th (NRC, 1995). (For the purpose of this analysis, the calculated average dose rate in urem per hour was assumed to be equal to the average true exposure rate in uR/hr.)
The adjusted exposure rate attributable to uranium and thorium in surface materials was apportioned as follows:

X – C uR/hr = 1.9 a + 2.82 b

Where: X = true average exposure rate = 120 uR/hr
C = the estimated contribution from cosmic radiation and ^{40}K = 7 uR/hr
a = the activity concentration of ^{226}Ra in surface soil
b = the activity concentration of ^{228}Ra in surface soil
a = 1.3 b

120 uR/hr – 7 uR/hr = 1.9 a + 2.82 a/1.3

a (^{226}Ra) = 28 pCi/g
b (^{228}Ra) = 21 pCi/g

The RESRAD Code was run using the calculated average activity concentrations for ^{226}Ra and ^{228}Ra assuming all ^{238}U and ^{232}Th decay products are in equilibrium. The RESRAD-calculated radon concentrations depend on parameter values associated with the surface material and the site conditions (i.e., affected area, porosity, contaminated zone thickness, wind speed, etc.). The RESRAD analysis assumed total porosity = 0.5; emanation fractions = 0.1 for ^{222}Rn and 0.05 for ^{220}Rn; impacted source area = 10,000 m^2 ; depth of the impacted layer = 10 m; wind speed = 2 m/s)

In order to calculate the dose and risk, the total outdoor radon decay product concentration in Working Level (WL)[1] was taken from the RESRAD detailed printout. The dose and risk from radon decay products is a function of the concentration and the exposure time. The radon decay product exposure in WL was multiplied by the annual exposure time in hours, based on the specific exposure scenario, and divided by 170 hours per month to obtain the annual exposure in working level months (WLM)[2]. The annual exposure in WLM was multiplied by a dose coefficient of 1000 mrem/WLM (NCRP, 2009) to derive an annual dose. The lifetime risk was calculated by multiplying the annual exposure in WLM by the duration of exposure in years. The total life-time exposure in WLM was multiplied by the risk coefficient for radon decay products of 5×10^{-4} per WLM (ICRP, 2009). The estimated doses and lifetime risks based on the concentrations derived from the RESRAD analysis are given in Table 2.

Ambient radon concentration is dependent on both surface emanation rate and force flow through fissures and cracks in bedrock. Therefore the radon concentration calculated based solely on surface soil concentrations is most likely a significant underestimate of the actual concentration in ambient air. Measured background concentrations in excess of the calculated values demonstrate that radon concentrations cannot be attributed solely to surface ^{226}Ra and ^{228}Ra concentrations: radon flow from sub-surface sources must, therefore, be a significant contributor to the release of radon to ambient air in background locations.

The radon concentrations in the I&L Zone were not measured during the 2009 field investigations. Therefore, the highest measured background radon concentration for the non-mineralized area was used in the background risk analysis with the understanding that the actual radon concentration in the I&L Zone may be significantly higher. The maximum measured background radon concentration, 5.8 pCi/L, was multiplied by the average outdoor equilibrium factor of 0.6 (NCRP, 2009) and divided by 100 to obtain an average radon decay product concentration of 0.035 WL. The exposure per hour in WLM was calculated by dividing the concentration in WL by 170 hours/month. The annual dose and lifetime risk were calculated as described above. The results are summarized in Table 2.

Inhalation of Radionuclides in Airborne Particulate Matter and Inadvertent Soil Ingestion

The annual doses from inhalation of radionuclides in airborne particulate matter and inadvertent ingestion of soil were calculated using the RESRAD Code and the estimated average radionuclide

[1] The term Working Level is a special unit for radon decay product concentrations used in estimating dose and assessing regulatory compliance. It is equal to the concentration of radon decay products in one liter of air that will result in a total emission of 130,000 million electron volts (MeV) of alpha energy or the concentration of radon decay products in air equal to the concentration of 100 pCi/L ^{222}Rn gas in equilibrium with its short-lived decay products.

[2] One Working Level Month (WLM) is equal to the exposure to radon decay products that an individual would incur during one working month (170 hours) at a radon decay product concentration of 1.0 WL.

concentrations for the I&L Zone. As was the case for the radon calculations, all of the ^{238}U and ^{232}Th decay products were assumed to be in equilibrium.

The occupancy factors given in Table 1 were used in the analysis. The lifetime risks were calculated assuming a nominal risk coefficient of 5.5×10^{-7} per mrem for the general public and 4.1 per mrem for occupational exposure (ICRP, 2007). The calculated doses from inhalation of radionuclides in airborne particulate matter and inadvertent soil ingestion are given in Table 3.

Table 2: Estimated Annual Dose and Lifetime Risk Due to Radon Decay Product Inhalation

Parameter	Camper	Forest Service Worker	Mineral Exploration Worker
Days per year	14	10	120
Hours per day	24	12	12
Duration in years	30	25	3
Fraction on min. area	0.4	0.6	0.6
Dose and Risk Based on Calculated Radon Decay Product Concentration			
Radon Concentration $^{220}Rn + ^{222}Rn$ (pCi/L) [RESRAD]	2.6	2.6	2.6
Working Level [RESRAD]	7.9×10^{-5}	7.9×10^{-5}	7.9×10^{-5}
WLM/h exposure [RESRAD]	4.6×10^{-7}	4.6×10^{-7}	4.6×10^{-7}
Annual dose (mrem)	*0.06*	*0.03*	*0.39*
Lifetime Risk	*9.3×10^{76}*	*4.1×10^{-7}*	*6.0×10^{7}*
Dose and Risk Based on Measured Background Radon Concentration			
WLM/h exposure based on 5.8 pCi/L background	2.05×10^{-4}	2.05×10^{-4}	2.05×10^{-4}
Annual dose (mrem)	*27*	*15*	*177*
Lifetime Risk	*4.0×10^{-4}*	*1.9×10^{-4}*	*2.6×10^{-4}*

Table 3: Calculated Annual Doses from Inhalation of Particulates and Ingestion of Soil

Pathway	Camper	Forest Service Worker	Mineral Exploration Worker
Particulate inhalation (mrem/y)	0.13	0.13	2.3
Soil ingestion (mrem/y)	0.22	0.12	1.4
Total Dose (mrem/y)	0.35	0.25	3.7
Lifetime risk	5.8×10^{-6}	2.6×10^{-6}	4.6×10^{-6}

Summary of Estimated Background Doses

The total estimated annual doses are summarized in Table 4 by pathway and exposure scenario; estimated lifetime risks are summarized in Table 5.

Table 4: Estimated Annual Dose Due to Background

Pathway	Estimated Annual Dose		
	Camper (mrem/y) (child dose)	Forest Service Employee (mrem/y)	Mineral Exploration Employee (mrem/y)
Direct Gamma	11 (13)	6	73
Inhalation of Radon Decay Products	27	15	177
Particulate Inhalation and Inadvertent Soil Ingestion	0.35	0.25	3.7
Total Annual Dose	38 (40)	21	254

Table 5: Estimated Lifetime Risk Due to Background Radiation

Pathway	Estimated Lifetime Risk		
	Camper	Forest Service Employee	Mineral Exploration Employee
Direct Gamma	1.9×10^{-4}	6.6×10^{-5}	9.2×10^{-5}
Inhalation of Radon Decay Products	4.0×10^{-4}	1.9×10^{-4}	2.6×10^{-4}
Particulate Inhalation and Inadvertent Soil Ingestion	5.8×10^{-6}	2.6×10^{-6}	4.6×10^{-6}
Total Lifetime Risk	6.0×10^{-4}	2.6×10^{-4}	3.6×10^{-4}

The risk from inhalation of radon decay products based on measured background concentration was assumed for the site. While no pre-mining site radiological data are available for the Ross Adams Mine Site, the data obtained for the I&L Zone during the 2009 site characterization surveys is assumed to be reasonably representative of pre-mining conditions in the mineralized areas.

The estimated annual doses range from 21 mrem per year for the Forest Service employee to 254 mrem per year for a mineral exploration worker. The estimated lifetime risks ranged from 2.6×10^{-4} for the Forest Service worker to 6.0×10^{-4} for the camper/recreational site user. The Environmental Protection Agency's acceptable lifetime risk range for members of the public is 1×10^{-6} to 1×10^{-4} excluding contributions from background levels. The Alaska Department of Environmental Conservation acceptable lifetime risk for members of the public is 1×10^{-5}. Approximately 30 percent of the total dose and risk is due to direct gamma exposure with inhalation of radon decay products accounting for nearly all of the remainder. Particulate inhalation and inadvertent soil ingestion contribute a small fraction of the total dose, less than two percent in all cases.

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