Rio Algom Mining LLC

May 1, 2025

Thomas Lancaster
United States Nuclear Regulatory Commission (NRC)
Mail Stop T5-A10
Washington, DC 20555-0001

Subject: **2024 ALARA Report**
Rio Algom Mining LLC – Ambrosia Lake West Mill
License SUA-1473, Docket No. 40-8905

Dear Mr. Lancaster,

Rio Algom Mining LLC (RAML) respectfully submits the *Calendar Year 2024 ALARA Report* (Attachment 1) for your records. The submittal of this report is not required by license condition but was verbally committed to by RAML during the NRC inspection conducted in September 2018.

If you have any questions or need additional information, please call me at (713) 584-4943.

Sincerely,
Rio Algom Mining LLC

Ryan Schietinger

Ryan Schietinger
Superintendent New Mexico & Utah Sites

cc: Document Control
Attachment: Calendar Year 2024 ALARA Report

CALENDAR YEAR 2024 ALARA REPORT

RIO ALGOM MINING LLC – AMBROSIA LAKE WEST MILL

McKinley County, New Mexico

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April 30, 2025

Table of Contents

List of Figures

List of Tables

Acronyms and Definitions

Term	Definition
ALARA	as low as is reasonably achievable
ALI	Annual limit on intake
ALW	Ambrosia Lake West
byproduct material	tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes. Underground ore bodies depleted by such solution extraction operations do not constitute "byproduct material" within this definition.
BZ	breathing zone
CDE	committed dose equivalent
CEDE	committed effective dose equivalent
CFR	Code of Federal Regulations
Ci	curies
DAC	derived air concentration
DDE	deep dose equivalent
LDE	lens dose equivalent
license	NRC license SUA-1473 for RAML's ALW mill
licensed material	radioactive and non-radioactive material that is regulated pursuant to the license
$\mu Ci\ ml^{-1}$	microcuries per milliliter
mrem	millirem
$mrem\ y^{-1}$	millirem per year
N	north
NRC	US Nuclear Regulatory Commission
OSL	optically stimulated luminescent dosimeter
$pCi\ L^{-1}$	picocuries per liter
POE	point of exposure
RAML	Rio Algom Mining LLC
RPEM	radiation protection and environmental monitoring
RSO	radiation safety officer
RWP	radiation work permit
SDE	shallow dose equivalent
SOP	standard operating procedure
SUA-1473	NRC license SUA-1473 for RAML's ALW mill
TEDE	total effective dose equivalent
visitor	any individual who is onsite at the facility who is not classified as a worker
worker	an employee or contractor who is completing work for RAML onsite at the facility for 5 or more days per year

1 Activities

This report summarizes calendar year 2024 activities, occupational radiation dose monitoring results, and public dose evaluations at Rio Algom Mining LLC's (RAML's) Ambrosia Lake West (ALW) former uranium mill, which is currently being decommissioned.

The ALW mill is regulated by the US Nuclear Regulatory Commission (NRC) via radioactive materials license SUA-1473 (NRC 2023), which requires that RAML implement a radiation protection and environmental monitoring (RPEM) program as described in RAML's *Radiation Protection and Environmental Monitoring Program Manual* (RAML 2022). Among other items, the Radiation Prevention & Environmental Monitoring (RPEM) program manual requires RAML to maintain worker and public exposure to licensed material at levels that are as low as is reasonably achievable (ALARA), perform an annual audit of the RPEM program content and implementation, and prepare this annual report summarizing the RPEM program activities and data for each calendar year.

Much of the licensed material at the ALW mill has been consolidated in engineered repositories that were closed following NRC-approved plans. Activities involving licensed material at the ALW mill in 2024 are summarized for each quarter in the following subsections.

1.1 First Quarter

Activities involving licensed material in January-March 2024 consisted of:

- Routine environmental monitoring required by SUA-1473 consisting of 1) groundwater sampling in and around the ALW mill; and 2) passive track-etch monitoring for radon-222 in ambient air at the seven locations shown on Figure 1.
- As described in the radiation work permits (RWPs), see Table 2, operation of a geotechnical soil laboratory that processed soil samples collected for the *Byproduct Material-Affected Soils Investigation* according to the work plan (Stantec 2023) .

1.2 Second Quarter

Activities involving licensed material in April-June 2024 consisted of:

- Routine environmental monitoring as described in the first quarter.
- Completion of geotechnical soil laboratory processing operations. Trailer and equipment scanned and released for unrestricted use consistent with RAML standard operating procedures (SOPs). The former geotechnical soil laboratory trailer was repurposed as the site operations trailer.
- Radon flux measurements collected on the covers of Cell 1, 2, and 3. RWP was deemed unnecessary as there was no contact made with licensed material during work.
- Geophysics measurements collected south of Cell 1 and in section 4. RWP was deemed unnecessary as measurements were surface-only and any contact with licensed material would not result in the potential for significant exposure to workers.

1.3 Third Quarter

Activities involving licensed material in July-September 2024 consisted of:

- Routine environmental monitoring as described in the first quarter.
- Additional radon flux measurements on the covers of Cell 1, 2, and 3. RWP was deemed unnecessary as there was no contact made with solid licensed material during work.
- Herbicide treatment was conducted on Cells1 and 2. An RWP was deemed unnecessary as there was no contact made with licensed material during work.

1.4 Fourth Quarter

Activities involving licensed material in October-December 2024 consisted of:

- Routine environmental monitoring as described in the first quarter.
- The following tasks were performed as part of the *Supplemental Soil Characterization* work performed in accordance with a work plan (H3 2024) and described in RWPs, see Table 2: 1) advancement of direct push borings 2) grab soil sampling by hand auguring and 3) onsite preliminary processing consistent with RAML standard operating procedures (SOPs).
- Related the field work described above; soil excavation was conducted using a backhoe to retrieve a lost core barrel incidental to direct push drilling operation for the *Supplemental Soil Characterization*. The work is described in its corresponding RWP, see Table 2.

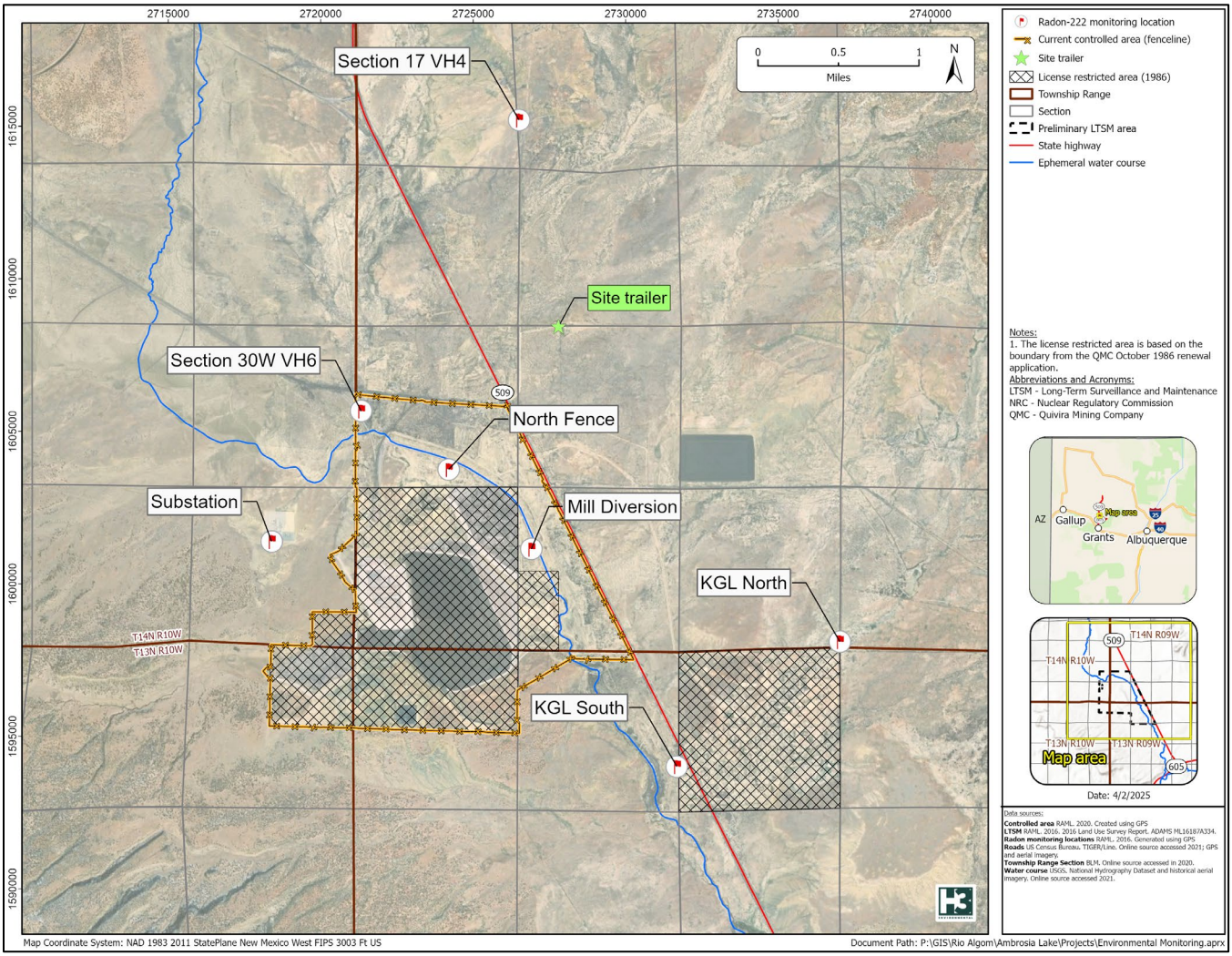

Figure 1. Radon-222 track-etch monitoring locations and site trailer at the Ambrosia Lake West mill.

2 Occupational Radiation Protection Program

External doses from ionizing radiation were monitored for personnel working with and around licensed materials. The monitoring methods are identified in the RPEM program manual and associated SOPs. RAML's dose calculations are performed consistent with NRC guidance in NRC Regulatory Guide 8.34 *Monitoring Criteria and Methods to Calculate Occupational Radiation Doses* (NRC 1992). All applicable regulatory limits for occupational radiation doses are contained in Title 10 *Code of Federal Regulations* (CFR) Part 20 (10 CFR 20.1201).

2.1 External Dosimetry Program

Landauer's Luxel® optically stimulated luminescent dosimeters (OSLs) are used to monitor occupational dose from external sources of ionizing radiation at the ALW mill. OSLs allow determination of deep dose equivalent (DDE), eye lens dose equivalent (LDE), and shallow dose equivalent (SDE). OSLs (including control dosimeters) are exchanged quarterly and stored in a background location (the site trailer, see Figure 1) when personnel are not onsite. Landauer reports background-corrected external dose quarterly to a sensitivity of 1 millirem (mrem). RAML conservatively assumes that all reported dose is the result of exposure to licensed material.

In 2024, 74 workers were assigned OSLs to be worn while onsite. Results are tabulated in Table 1 and indicate that external doses are consistently less than ten percent of regulatory limits. Since 2019, between 22 and 74 individuals have been monitored each year at the ALW mill. Maximum recorded external DDE, LDE, and SDE doses have been consistently low and non-varying (6 mrem y^{-1}, 9 mrem y^{-1}, and 8 mrem y^{-1}, respectively) over the past five years. Therefore monitoring is not required per 10 CFR 20.1502; a determination of prior occupational dose in 10 CFR 20.2104 is also not applicable. However, RAML has opted to continue monitoring worker external doses as an ALARA practice.

2.1.1 Deep Dose Equivalent

In 2024, eight individuals had a DDE exceeding the 1 mrem sensitivity of OSL. The highest DDE was 3 mrem y^{-1}. The 2024 DDE results are below RAML's administrative action level of 500 mrem y^{-1} and are less than 1% of the regulatory occupational standard of 5,000 mrem y^{-1}.

2.1.2 Lens Dose Equivalent

In 2024, eight individuals had an LDE exceeding the 1 mrem sensitivity of the OSL, with a maximum LDE of 3 mrem y^{-1}. The 2024 LDE results are below RAML's administrative action level of 1500 mrem y^{-1} and are less than 1% of the regulatory occupational standard of 15,000 mrem y^{-1}.

2.1.3 Shallow Dose Equivalent

In 2024, six individuals had an SDE exceeding the 1 mrem sensitivity of the OSL, with a maximum LDE of 4 mrem y^{-1}. The 2024 LDE results are below RAML's administrative action level of 5000 mrem y^{-1} and are less than 1% of the regulatory occupational standard of 50,000 mrem y^{-1}.

Table 1. Ambrosia Lake West mill external dosimetry (2024).

Individuals Monitored	Individuals with Dose [a] ≥ 1 mrem y^{-1}			Max Annual Dose [a] (mrem)		
	DDE	LDE	SDE	DDE	LDE	SDE
74	8	8	6	3	3	4

[a] External dosimetry results are corrected for background doses measured by control dosimeters located at the site trailer.
DDE – deep dose equivalent
LDE – lens dose equivalent
mrem - millirem
SDE – shallow dose equivalent
y^{-1} – per year

2.2 Internal Dosimetry Program

RAML did not estimate internal doses from ionizing radiation in 2024 because previous monitoring has demonstrated that potential internal doses resulting from the types of activities conducted at the ALW mill in 2024 are below the monitoring thresholds in 10 CFR 20.1502(b) (i.e., potential intakes less than ten percent of the applicable annual limit on intake in 10 CFR 20 Appendix B Table 1). Radio-particulate sampling of worker breathing zones (BZs) was performed in 2024 as required by specific RWPs (see Section 2.4); results are presented in Table 2.

Routine bioassay was discontinued in 2017. Future bioassay monitoring will be driven by the requirements of RWPs issued for a specific task. In 2024, there were no RWPs that required bioassay sampling and as such, no internal dose was estimated or assigned to workers.

2.3 Total Effective Dose Equivalent

The total effective dose equivalent (TEDE) is the sum of the internal dose component [committed effective dose equivalent (CEDE)] and the external dose component (DDE). Since RAML did not estimate internal doses (CEDE) in 2024, TEDE estimates are equivalent to the DDEs reported in Table 1. Worker TEDEs in 2024 were less than 10% of any applicable limit.

2.4 Radiation Work Permit Program

Consistent with RAML's RPEM program manual, RAML uses RWPs to control dose to workers from ionizing radiation for non-routine work activities if there is potential for significant dose from licensed material. RAML describes most non-routine work in work plans. These plans are reviewed by the radiation safety officer or the radiation safety officer's designee to evaluate the radiation hazard for each proposed job task and if an RWP is required to control the proposed work. In 2024, RWPs were issued for the activities described in Table 2. All RWPs included confirmatory BZ sampling; a summary of confirmatory BZ sampling is included on Figure 2.

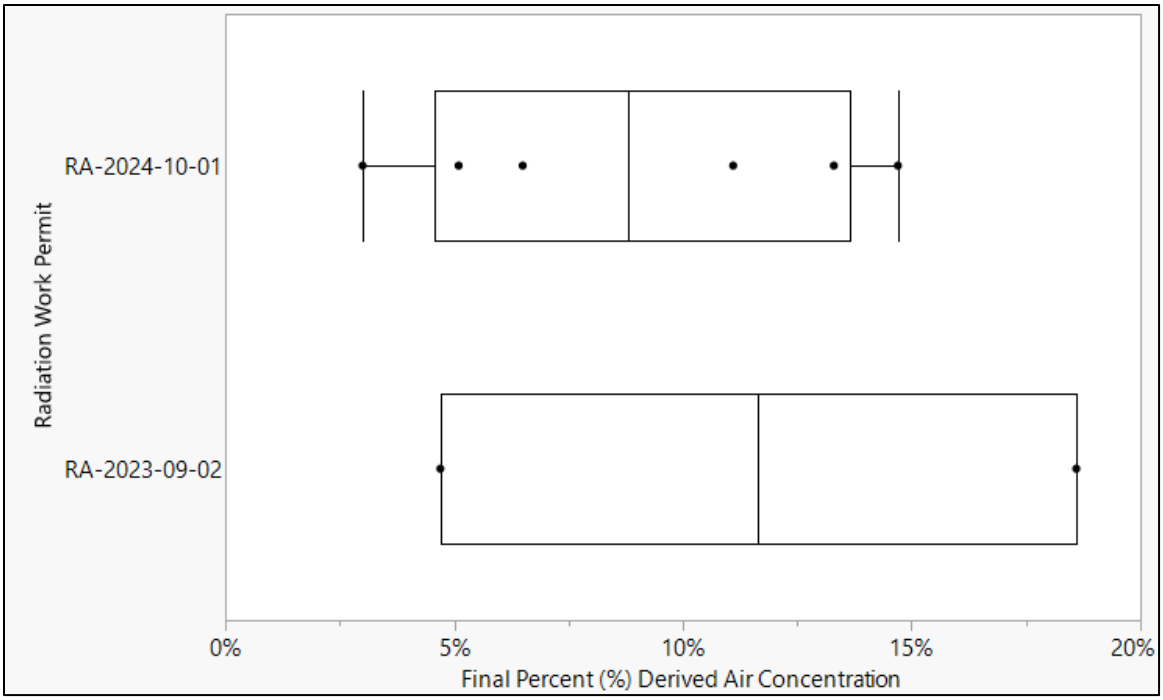

Figure 2. Box plot of breathing zone (BZ) sample results as percent of the most restrictive derived air concentration.

Note 1: The most conservative DAC from 10 CFR 20 Appendix B, Table 1 applicable to ALW mill operations is 3E-12 microcuries per milliliter for thorium-230, class W. BZ samples exceeding 0.3 DAC on an initial count were recounted to correct for decay of short-lived decay products of radon-222; the final count for each sample is included in the above figure.

Table 2. Ambrosia Lake West mill radiation work permits (2024).

RWP Number	Scope / Description	Open Date	Close Date	Working Days	BZ Samples Collected	Measured %DAC [c] Max (Average)	Hypothetical Intake %ALI [d]
RA-2023-09-02 [a]	On-site geotechnical testing of soil samples for a suite of geotechnical parameters at the Geotechnical Lab located adjacent to the site trailer and shop. Some samples potentially contained licensed material.	Sep 13 2023	Feb 2 2024	30[e]	2[f]	18.6% (11.7%)	1.40%[f]
RA-2024-10-01 [b]	Sampling of approximately one hundred boreholes using direct push and hand auguring methods in and near former ALW mill areas.	Oct 30 2024	Nov 14 2024	6[g]	6	14.7% (9.0%)	0.21%
RA-2024-10-02 [b]	Recovery of dislodged core barrel from direct push rig within study area using backhoe. Recovery of core barrel entailed excavation of trench around the core barrel to allow for extraction using backhoe bucket.	Nov 4 2024	Nov 4 2024	1	NA[h]	NA[h]	NA[h]

[a] Work supported the *Byproduct Material-Affected Soils Investigation* work plan (Stantec 2023).
[b] Work supported the *Supplemental Soil Characterization work plan (*H3 2024*).*
[c] The most conservative DAC from 10 CFR 20 Appendix B, Table 1 applicable to ALW mill operations is 3E-12 microcuries per milliliter for thorium-230, class W. BZ samples exceeding 0.3 DAC on an initial count were recounted to correct for decay of short-lived decay products of radon-222; the maximum of the final counts for each RWP is reported. Results with negative activity (sample count rate less than background count rate) were recorded as 0% DAC.
[d] Hypothetical intakes from inhalation conservatively assume one worker worked 8 hour days for the entire project duration at the average recorded %DAC, Hypothetical %ALI was calculated as: $\frac{\#\ working\ days \times Average\ DAC}{250\ \text{working days}}$. The most conservative ALI from 10 CFR 20 Appendix B Table 1 applicable to site operations is 6E-3 microcuries for thorium-230, class W inhalation.
[e] Working days in 2024 only; estimated by assuming five working days were represented by each collected BZ sample.
[f] No sample was collected for the week of January 22, 2024. This represents a deviation from the sampling schedule set forth in RWP RA-2023-09-02. However, consistently low measured concentrations for this RWP indicate worker doses were within acceptable limits. For comparison, a hypothetical intake based on the maximum %DAC observed in January 2024 (18.6 %DAC) would have resulted in 1.82% of the ALI, which is marginally above the calculated hypothetical 1.40 %ALI for the average observed %DAC.
[g] BZ sampling was conducted each day that direct push drilling occurred. BZ pump was deployed with drill operators prior to drilling operations and collected at the end of workday.
[h] Per RWP, BZ monitoring was deemed unnecessary as backhoe operator would remain in enclosed cabin and ground personnel would remain clear of excavation area.

ALI – annual limit on intake
ALW – Ambrosia Lake West
BZ – breathing zone
DAC – derived air concentration
mrem – millirem
NRC – United States Nuclear Regulatory Commission
RAML – Rio Algom Mining LLC
RWP – radiation work permit

2.5 Contamination Control Program

Control of potential contamination from licensed material at the ALW mill consisted of facility, equipment, and personnel surveys. Surveys for total and removable alpha/beta contamination were completed on equipment prior to unrestricted release per RAML SOPs. Equipment was released as consistent with release limits specified in SUA-1473 condition 10D or moved to onsite storage if above release limits.

Personnel contamination surveys were completed in accordance with SOPs with an ALARA action level of "above background." In one instance, personnel had elevated activity on clothing that was slightly above background but was released with RSO consultation. All other personnel surveys (3 instances) that were above background were remedied by hand washing using either wet wipes or soap and water. In all cases, personnel surveys were below site release limits specified in the RPEM program manual.

2.6 Audits and Inspections

An internal audit of the RPEM program was conducted during the preparation of this report. No deviations from the RPEM program manual or SUA-1473 were identified, and proper radiation practices were being implemented at the ALW mill. Periodic inspections of the facility by the RSO were conducted in accordance with RAML SOPs, and the ALW mill was found to be secure and properly posted unless otherwise noted in Table 3.

NRC performed a scheduled inspection consisting of a site visit, interviews, and document review September 24-25, 2024 (NRC 2024). No violations were identified during this site visit.

Table 3. Ambrosia Lake West mill radiation safety officer inspections (2024).

Inspection Date	Actions
Jan 29 2024	None
Feb 27 2024	None
May 8 2024	None
Aug 13 2024	RSO observed signage at gate 30 was down. Signage replaced on the same day.
Nov 18 2024	None

RSO – radiation safety officer

2.7 Training Program

Annual radiation safety awareness training was conducted per Section 3.1 of the RPEM program manual for a total of 141 workers, including contractors and employees.

3 Public Dose Evaluation

In addition to the occupational exposures discussed above, RAML annually evaluates radiation doses to the public from its operations. These are prepared per the requirements of 10 CFR 20.1301-1302, the RPEM program manual, and RAML SOPs.

RAML submitted semiannual effluent reports to the NRC of quarterly radon monitoring results from January-June 2024 (RAML 2024b) and July-December 2024 (RAML 2025). Data contained within these reports were used to demonstrate compliance with dose limits to members of the public from licensed sources. The calculated radiation doses to members of the public include only the radon-222 inhalation pathway. Monitoring for and calculation of doses resulting from other pathways, such as external dose, vegetation, and airborne radioactive particulates, was discontinued in 2017 following NRC concurrence (NRC 2017).

Monitoring locations are shown on Figure 1. The Substation location is considered background. Table 4 provides annual average radon-222 concentrations measured at each location.

Table 4. Measured radon-222 concentrations near the Ambrosia Lake West mill (2024).

Location	**Average Annual Gross Radon-222 Concentration (pCi L^{-1})**	***Duplicate* Average Annual Gross Radon-222 Concentration (pCi L^{-1})**
Substation	0.5	-
Mill diversion	2.0	-
Section 30W VH6	3.2	3.2
North Fence	2.4	2.5
Section 17 VH4	0.4	-
KGL-north	1.9	1.8
KGL-south	1.7	-

"-" – no duplicate result for this location pCi L^{-1} – picocuries per liter

Radiation dose was calculated to the nearest resident and two hypothetical members of the public consistent with a RAML SOP as follows:

- "Nearest resident[1]" using data from location Section 17 VH4 for the point of exposure (POE) concentration. The dose estimate uses a decay product equilibrium fraction of 0.5 representing an indoor exposure.
- "Delivery driver" using data from location Section 30W VH6 for the POE concentration. The dose estimate uses an occupancy factor of 0.0072 representing a 15 minute per day, 252 day per year exposure and a decay product equilibrium fraction of 0.7 representing an outdoor exposure.
- "Occasional visitor" using an average of all radon-222 monitoring data except the Substation (background) for the POE concentration. The dose estimate uses an occupancy factor of 0.0128 representing an 8 hour per day, 14 day per year exposure and a decay product equilibrium fraction of 0.7 representing an outdoor exposure.

The 2024 results for dose to the nearest resident and hypothetical members of the public are shown in Table 4. The potential dose calculations for members of the public for 2024 were less than 10% of the 10 CFR 20.1301 dose limit[2] of 100 mrem y^{-1}.

[1] The nearest resident is the individual member of the public likely to receive the highest dose from the licensed operation and is identified in RAML's annual land use survey report as the Berryhill Ranch (RAML 2024a).
[2] The ALW mill transitioned to "possession only" status in 2003 (NRC 2003); possession only status does not meet the definition of "uranium fuel cycle" in 40 CFR 190.02. Therefore, the public dose limits in 40 CFR 190.10 do not apply to the ALW mill.

Table 5. Public dose estimate for nearest resident and hypothetical public receptors near the Ambrosia Lake West mill (2024).

Receptor Scenario	Average Net Radon-222 Concentration (pCi L^{-1})	Occupancy Factor	Equilibrium Fraction	Dose Conversion Factor [b] (mrem per pCi L^{-1})	TEDE (mrem)
Nearest resident	0 [a]	1	0.5	500	0
Delivery driver	2.7	0.0072	0.7	500	7
Occasional visitor	1.6	0.0128	0.7	500	7

[a] Net radon concentration for this receptor location was negative and is reported as zero dose.
[b] Dose conversion factor for radon-222 is derived using the effluent concentration limit for radon-222 with all decay products from 10 CFR 20, Appendix B, Table 2.

mrem – millirem
TEDE – total effective dose equivalent
pCi L^{-1} – picocuries per liter

4 References

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