

Calendar Year 2017 ALARA Report for the Ambrosia Lake Facility

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prepared for:

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Section 1.0 Site Activities

This report summarizes calendar year 2017 activities, occupational radiation dose monitoring results and public dose estimates at Rio Algom Mining LLC's (RAML's) Ambrosia Lake site.

In the first quarter of 2016, construction work supporting closure of Tailings Impoundment 2 was completed. As such, much of the licensed material subject to site remediation has been consolidated in an engineered repository that was subsequently closed following Nuclear Regulatory Commission (NRC) approval.

Activities at the Ambrosia Lake site in 2017 consisted mainly of routine environmental monitoring and final status survey sampling of the windblown and alternate release criterion (ARC) areas. The major activities for the year at the Ambrosia Lake site are summarized herein.

1.1 1st Quarter

- Routine environmental monitoring including:
 - Groundwater sampling in and around the Long-Term Surveillance Monitoring (LTSM) area
 - Radon-222 in ambient air at the seven locations shown in Figure 1
 - Radioactive particulates in ambient air at the locations shown in Figure 1
 - External dose measurements at the locations shown in Figure 1

1.2 2nd Quarter

- Routine environmental monitoring as described in 1st quarter.

1.3 3rd Quarter

- Routine environmental monitoring as described in 1st quarter.
- Final status survey sampling of the windblown area was initiated on July 11, 2017 and continued through September 7, 2017. Over 400 surface soil samples (0-15 cm) were collected and submitted to GEL laboratories for analysis of uranium-238, thorium-230, and radium-226. Sample locations, depths and analytical methods were consistent with the requirements outlined within Section 8 of the Soil Decommissioning Plan (SDP) and site procedures.
- Final status survey sampling of ARC areas was initiated on August 28, 2017 and continued through September 12, 2017. Over 180 soil samples were collected and submitted to GEL laboratories for analysis of uranium-238, thorium-230, and radium-226. Sample locations, depths and analytical methods were consistent with the Soil Decommissioning Plan (SDP) and site procedures.

1.4 4th Quarter

- Routine environmental monitoring as described in 1st quarter.

Section 2.0 Occupational Exposures to Ionizing Radiation – Summary

External doses from ionizing radiation were monitored for personnel working with and around licensed radioactive materials. The monitoring methods are identified in the site's *Radiation Protection and Environmental Program Manual*. The methods of dose determination herein are consistent with Nuclear Regulatory Commission (NRC) guidance described in USNRC Regulatory Guide 8.34, *Monitoring Criteria and Methods to Calculate Occupational Radiation Doses*. Internal doses from ionizing radiation were not evaluated since previous data have demonstrated internal doses from ionizing radiation are much lower than ten percent of applicable regulatory limit of a Committed Effective Dose Equivalent (CEDE) of 5 rem per year and the largest sources of internal exposure have been mitigated.

2.1 External Exposure to Ionizing Radiation

Optically stimulated luminescent dosimeters (OSLs) are used to monitor occupational exposure to ionizing radiation from external sources at the Ambrosia Lake site. All site personnel and contractors have assigned dosimeters and are required to wear the dosimeter while on site. The dosimeters allow determination of deep dose equivalent (DDE), eye lens dose equivalent (LDE), and shallow dose equivalent (SDE). Dosimeters (including control dosimeters) are stored in a background location (the site trailer) while personnel are not on site. As a result, the measured external dose is from potential exposure to licensed radioactive material. Landauer's Luxel[®] OSLs were used to monitor external dose parameters for the monitoring period. This dosimeter has a reported sensitivity of 1 mrem. All reported external doses are well below regulatory limits. Historically, the external doses at the Ambrosia Lake site have been low (typically less than 10 percent of regulatory limits). The data for the external doses are tabulated in Tables 2.1 through 2.3.

2.1.1 Deep Dose Equivalent

The annual DDE values for Rio Algom Mining LLC (RAML) and contracted personnel were below the 1 mrem sensitivity limit for all monitored individuals. The descriptive statistics in Table 2.1 are based on personnel monitoring results. The 2017 DDE results are well below regulatory standard of 5 rem per year and should continue to be minimal as additional sources of licensed material at Ambrosia Lake are abated.

Table 2.1 2017 Summary of Deep Dose Equivalent

Monitored Group	Number of Employees Monitored	Number of Employees with Measurable Dose	Mean Dose (mrem)	% of group with measurable dose
RAML	4	0	<1	0
Contractor	19	0	<1	0
Total	23	0	<1	0

2.1.2 Shallow Dose Equivalent

The annual SDE values for Rio Algom Mining LLC (RAML) and contracted personnel were below the 1 mrem sensitivity limit for all monitored individuals. The descriptive statistics in Table 2.2 are based on personnel monitoring results. The 2017 SDE results are well below regulatory standard of 50 rem per year and should continue to be minimal as additional sources of licensed material at Ambrosia Lake are abated.

Table 2.2 2017 Summary of Annual Shallow Dose Equivalent

Monitored Group	Number of Employees Monitored	Number of Employees with Measurable Dose	Mean Dose (mrem)	% of group with dose
RAML	4	0	<1	0
Contractors	19	0	<1	0
Total	23	0	<1	0

2.1.3 Lens Dose Equivalent

The annual LDE values for Rio Algom Mining LLC (RAML) and contracted personnel were below the 1 mrem sensitivity limit for all monitored individuals. The descriptive statistics in Table 2.2 are based on personnel monitoring results. The 2017 LDE results are well below regulatory standard of 15 rem per year and should continue to be minimal as additional sources of licensed material at Ambrosia Lake are abated.

Table 2.3 2017 Summary of Lens Dose Equivalent

Monitored Group	Number of Employees Monitored	Number of Employees with Measurable Dose	Mean Dose (mrem)	% of group with dose
RAML	4	0	<1	0
Contractors	19	0	<1	0
Total	23	0	<1	0

2.1.4 Summary of External Exposure to Ionizing Radiation

External doses to ionizing radiation were very low compared to the regulatory limit. For all groups, no measurable dose equivalent was detected. However, annual external doses are dependent on

the type of work scheduled for a given year. This makes comparing external dosimetry from year to year less informative when evaluating trends.

2.2 Long-lived Radionuclide Intake Analysis

Since the work at the site in 2017 was limited to management, supervision, and environmental monitoring, all tasks with a low potential for airborne radionuclide exposure, no breathing zone samples from employees or contractors were collected. Data from the decommissioning contractors in 2015 and 2016, a task with much higher potential for intakes of radionuclides from inhalation, showed internal doses from long-lived radionuclides were very low (less than 10 percent of regulatory limits) and therefore such doses do not require monitoring. Should future activities at the site require breathing zone or a similar type of monitoring, the associated Radiation Work Permit (RWP) will identify this requirement, and the results of such monitoring will be reported in the ALARA Report.

2.2.1 Committed Dose Equivalent (CDE) to the highest exposed organ.

No estimate of CDE was made since no occupational long-lived air samples were collected. As discussed above, data from the monitoring of decommissioning contractors in 2015 and 2016, tasks with much higher potential for intakes of radionuclides, showed that internal doses from long-lived radionuclides were very low (less than 10 percent of the regulatory limit), and therefore monitoring is not required.

2.2.2 Committed Effective Dose Equivalent (CEDE) Summary.

No estimate of CEDE were made since no occupational long-lived air samples were collected. As discussed above, data from the monitoring of decommissioning contractors in 2015 and 2016, tasks with much higher potential for intakes of radionuclides, showed that internal doses from long-lived radionuclides were very low (less than 10 percent of the regulatory limit), and therefore monitoring is not required.

2.3 Total Effective Dose Equivalent (TEDE) Summary

The TEDE is the sum of the internal dose component (CEDE) and the external dose component (DDE). All TEDE estimates for 2017 based on personnel monitoring data are less than 1 mrem, which is the detection limit of dosimeters assigned to RAML and contracted personnel.

2.4 Bioassay Summary

Uranium bioassay in urine was discontinued in 2017 since any sources of soluble uranium at the site have been mitigated. Future bioassay monitoring will be driven by requirements with an RWP issued for the specific work being performed.

2.5 Radiation Work Permit Summary

No RWPs were issued for activities as required by SUA-1473 in CY 2017.

2.6 Contamination Surveys-Personnel and Equipment

Personnel who access the LTSM or perform other activities that may result in contamination perform self scanning before leaving the site. Scanning techniques are reviewed and demonstrated in annual radiation safety training. No personnel surveys exceeding the action level of 100 counts per minute above background were reported.

Periodic equipment surveys for unconditional radiological release are performed for equipment that has potentially been exposed to licensed material. These surveys are documented with records maintained in the RAML Grants office or the site trailer. Most of the equipment released was associated with the final status survey activities occurring in the 3rd quarter of 2017.

2.7 Safety and Training Activities

Annual radiation safety training, as outlined in Section 3.1 of the *2017 Radiation Protection and Environmental Program Manual*, was completed for all employees and contractors and included the topics as outlined therein.

Safety meetings, conducted throughout the year, reviewed various topics pertaining to general safe work practices and included radiation safety.

2.8 Audits and Inspections

An annual audit of the radiation protection program was conducted in June 2017 prior to implementation of the final status surveys and the NRC inspection in September of 2017. No deficiencies were identified. All procedures were reviewed and updated. In addition, a third-party audit of site procedures, the site Soil Decommissioning Plan, and the site Quality Assurance Project Plan was conducted during final status survey.

Monthly inspections of the facility to ensure that radiation protection practices are being properly practiced and that the site fences and gates are secure and properly posted are being conducted by the RSO or the RSO designee.

Section 3.0 Public Dose Evaluation

In addition to the occupational exposures discussed above, RAML prepares an annual evaluation of radiation doses to members of the public. These are prepared per the requirements of 10 CFR 20.1301-1302 and 40 CFR 190.10.

RAML submits semi-annual Effluent Monitoring Reports to the NRC. The first semi-annual report for 2017 was submitted on August 28, 2017 and supplemented with a submittal on October 6, 2017 (NRC accession number ML1728A188). The second report was submitted on March 1, 2018. Data contained within these reports were used to evaluate doses to members of the public.

Radiation dose is calculated to three hypothetical members of the public: the nearest resident (data from location Section 17 VH4 were used), a typical delivery driver (data from location Section 30 West VH6 were used), and the occasional visitor that might spend some time near the boundary of the site property, such as a hunter or rancher (an average of all site monitoring data, except Substation was used). The Substation location is considered background. These monitoring locations are shown in Figure 1.

Dose conversion factors in 10 CFR 20, appendix B, Table 2 were used to estimate public dose. Occupancy factors of 0.75, 0.0071, and 0.0128 were used for the nearest resident, delivery driver, and visitor respectively. A radon-222 decay product equilibrium fraction of 0.2 was assumed to calculate the dose from radon-222 and its decay products.

The 2017 results for dose to member of the public are shown in Table 3.1.

Table 3.1 2017 public dose estimate (mrem) for hypothetical public receptors near the Ambrosia Lake site.

Dose Source	Nearest Resident	Delivery Person	Visitor
Radon-222	0.0	1.8	1.7
Direct Gamma	3.2	0.4	0.1
Particulates	0.0	0.0	0.0
Total	3.2	2.2	1.8

The table shows that the potential dose calculations for members of the public for 2017 were well below the 10 CFR 20.1301 dose limit of 100 mrem per year, as well as the limits in 40 CFR 190.10 of 25 mrem per year to the whole body, 75 mrem per year to the thyroid, and 25 mrem per year to any other organ. Radon-222 and its progeny are excluded from dose limits in 40 CFR 190.10

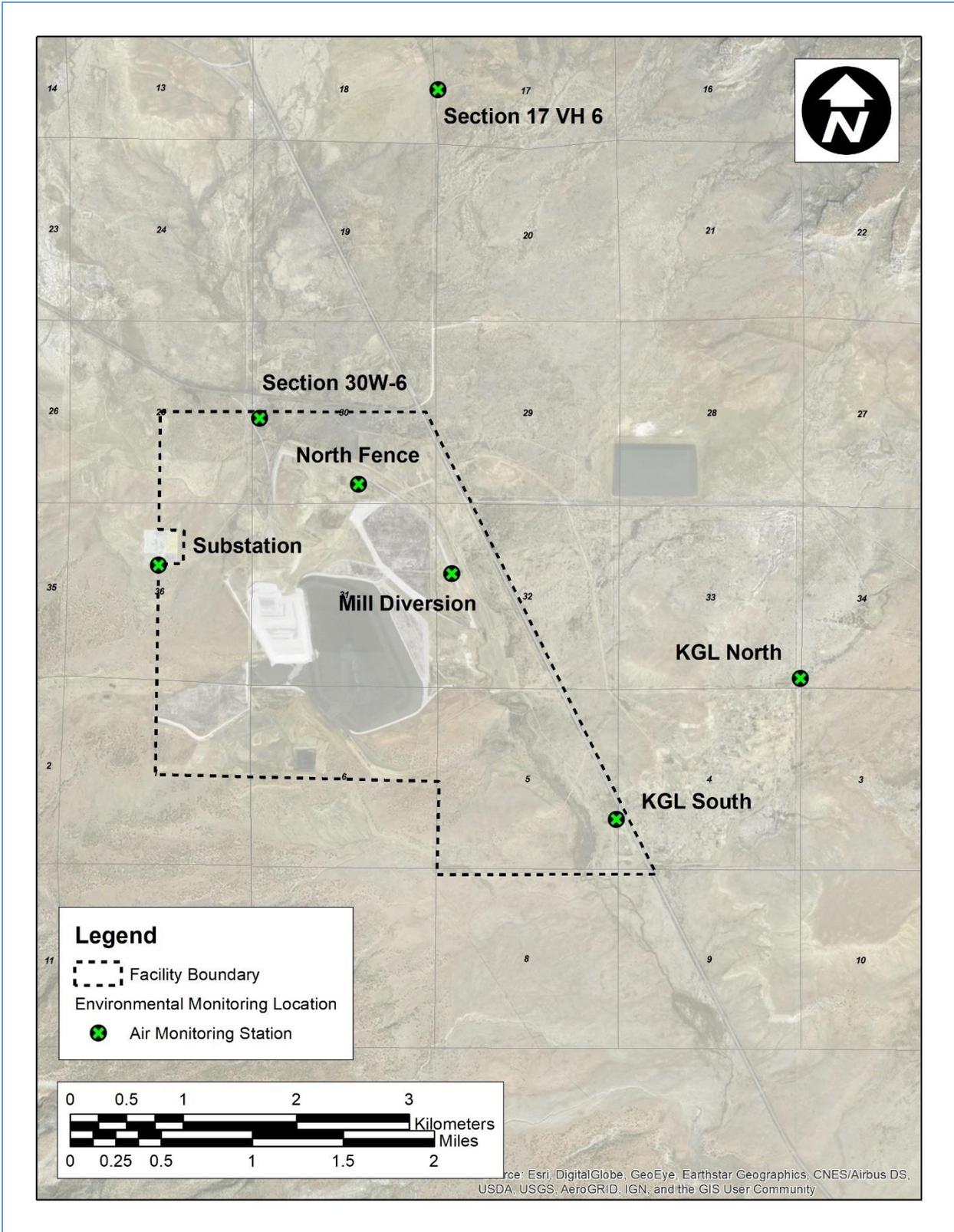


Figure 1. Location of environmental monitoring sites for the Ambrosia Lake facility.