Kiggavik Project

Final Environmental Impact Statement

Tier 3 Technical Appendix 4C
Air Quality Monitoring and Mitigation Plan

September 2014

History of Revisions

Revision Number	Date	Details of Revisions
01	December 2011	First Issue with Draft Environmental Impact Statement
02	September 2014	Issued for Final Environmental Impact Statement – No updates

A management plan is a living document which is continually reviewed and revised throughout the life of the Project to ensure it meets health, safety, and environmental performance standards. This process of adaptive management and continual improvement (Tier 2, Volume 2, Section 17) is consistent with the Inuit Qaujimajatuqangit (IQ) principles of Qanuqtuurunnarniq *being resourceful and flexible to solve problems* and Pilimmaksarniq *maintaining and improving skills through experience and practice.*

Table of Contents

List of Tables

List of Figures

1 Introduction

This Draft Kiggavik Project Air Quality Monitoring and Mitigation Plan (the Plan) has been prepared by AREVA Resources Canada Inc. (AREVA) for the Kiggavik Project (Project) to ensure compliance with relevant environmental regulations during construction, operation, closure and post-closure of the Project. The Plan has been prepared in concert with the Air Quality and Climate Change Assessment (Tier 2, Volume 4) and the Air Dispersion Assessment (Tier 3, Technical Appendix 4B) of the Kiggavik Project Environmental Impact Statement (EIS). Where applicable, the Plan has considered the requirements of CSA Standards N288.4-10, *Environmental monitoring programs at Class I nuclear facilities and uranium mines mills* (CSA 2010), N288.5-11, *Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills*, (CSA 2011) and N288.6-12 *Environmental risk assessments at Class I nuclear facilities and uranium mines and mills*, (CSA 2012) as well as the monitoring requirements outlined in the *Saskatchewan Air Monitoring Guideline* (SkMOE 2012). The plan will be in effect for the duration of the Project and will also undergo review and be subject to update as outlined in CSA Standards, N288.4, N288.5, N288.6, and as outlined in Tier 3, Technical Appendix 2T Environmental Management Plan.

1.1 Purpose and Objectives

The purpose of the Draft Air Quality Monitoring and Mitigation Plan (the Plan) is to provide an outline for monitoring and mitigating the potential effects from the Project identified within the Air Quality and Climate Change Assessment (Tier 2, Volume 4). The Plan provides guidance on the management of air quality effects from the Project as they relate to human health, the terrestrial environment, and aquatic/marine environments as expressed through ambient air quality criteria, standards or objectives (referred to herein as Air Quality Indicator Thresholds). Specifically, the Plan includes actions to prevent, control or mitigate as well as monitor for those Constituents of Potential Concern (COPCs) imposing a potential effect to the atmospheric, terrestrial, aquatic and human environments.

The objectives of the Air Monitoring and Mitigation Plan are as follows:

1. To monitor emissions and/or ambient air concentrations with a focus on those COPCs predicted to have potential air quality effects during the construction, operation, closure and post-closure phases of the Project;
2. To demonstrate compliance with applicable Air Quality Indicator Thresholds or emissions standards;

3. To use monitoring data validate/verify the Air Dispersion Assessment (Tier 3, Technical Appendix 4B) model predictions and confirm that unexpected effects are not occurring as a result of the Project;
4. To prevent, control or mitigate air emissions that could lead to a potential effect on the environment;
5. To use monitoring data to determine the effectiveness of mitigation measures, environmental protection measures and to identify areas for continual improvement, as well as support the development and implementation of adaptive management measures should they be required.

1.2 Scope of the Plan

Concerns over airborne dust, uranium and radioactive materials have been expressed during the course of a number of stakeholder engagement activities associated with the Kiggavik Project. Some examples include:

- *Concern about the emission and dispersion of airborne contaminants from Project*[1][2]
- *Questions about how dust, particularly dust from roads, will affect the environment*[3][4]
- *Concern about the safety of milling*[5]
- *Questions about how dust will be controlled from activities like blasting*[6] *and unpaved roads*[3] [7]*.*
- *Concern about the effects of dust on human health and wildlife*[8][9]*.*

[1] IQ-RIHT 2009: *The potential effects of the Project on Rankin Inlet through airborne contaminants were expressed during the HTO focus group, Elders focus group and the women's focus groups. Hunters explained that the wind travels from Baker Lake towards Rankin Inlet, and that any airborne contaminants, such as dust, would find their way to Rankin Inlet*.

[2] EN-CI OH Nov 2013: *What about the dust? Lots of wind and can carry dust. The dust will be an issues because there is constant wind what will lift the dust and keep it suspended.*

[3] EN-RI KWB Oct 2009: *How is contaminant dust controlled? Will there be dust control on the road? How does dust affect the environment?*

[4] EN-BL EL Oct 2012:*There would be changes near the project site in the spring and summer. Near my house there is lots of dust on the plants from traffic on the roads.*

[5] EN-RB OH Nov 2012: *When milling, is dust safe for people?*

[6] EN-AR AC Nov 2010: *When doing open pit mining, how do you control dust (blasting)?*

[7] IQ-BLHT 2011: *be aware that the road to Meadowbank produces a lot of dust in the summertime. Caribou feed on grass close to the road; this grass is full of dust. If you are going to build a road, try to minimize dust.*

[8] EN-RB NIRB Apr 2010): *Concerned with air pollutants travelling by way of dust particles. Dangers associated with the dust to human health and wildlife*.

The Plan addresses the most common COPCs of concern from mines including dust (i.e., particulate matter) and metals or constituents in dust, as well as uranium, radon and other radionuclides. Other COPCs included in the Plan are nitrogen oxides (NO_x) and sulphur dioxide (SO_2). In addition, the Plan addresses specific stationary emission sources of concern from the Project such as the mill, acid plant and waste incinerator stacks.

The Project Footprint consists of three components: the Kiggavik and Sissons Mine Sites including the Kiggavik-Sissons haul road, the Baker Lake-Kiggavik access road, and the Baker Lake dock and storage facility. All three components are addressed in the Plan. The Plan will be in effect during construction, operations, closure and post-closure phases of the Project.

Note that this Plan is considered draft; details of the Plan will be finalized during the permitting and CNSC licensing stage of the Project. Prior to implementation, the proposed Plan will be presented to regulatory agencies as appropriate. At that time, specifics such as monitoring locations, sampling methodologies and instruments types, will be finalized.

The Plan will also undergo regular review and be updated as outlined in CSA Standards, N288.4, N288.5, N288.6, and as outlined in Tier 3, Technical Appendix 2T Environmental Management Plan.
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[9] EN-BL EL Oct 2012: *I am pretty sure there will be dust that will spread everywhere. There will be lots of dust and animals like rabbits and wolves will be affected*

2 Emission Sources and Mitigation

Implementing air emissions mitigation measures is derived from the assessment of key emission sources of COPCs in relation to applicable best practices or standards of practice. The following sections provide a summary of the key sources of air emissions, as well as air emissions mitigation measures that were included in the Air Dispersion Assessment. The investigation of alternative road dust mitigation measures is provided in Tier 3 Technical Appendix 2M Road Management Plan.

2.1 Key Emission Sources of COPCs

During each Project phase (construction, operation, final closure and post-closure), activities will occur which have the potential to emit and increase ambient air concentrations of Constituents of Potential Concern (COPCs) within the Local Assessment Area (LAA) and Regional Assessment Area (RAA), including: dust (i.e., particulate matter); metals; gaseous compounds (NO_x and SO_2); uranium; radon and other radionuclides. A summary of the key emissions-generating activities in each Project phase are as follows:

2.1.1 Construction Activities

Land clearing, excavating (i.e., earth moving), vehicle travel, quarrying, material handling and fuel combustion.

2.1.2 Operation Activities

Drilling and blasting, ore and mine rock handling, stockpile and road maintenance, wind erosion of stockpiles, vehicle travel, fuel combustion and milling operations.

2.1.3 Final Closure Activities

Backfilling mine rock into the Tailings Management Facilities (TMFs), closure of TMFs and fuel combustion.

2.1.4 Post-Closure Activities

Passive radon emissions from permanent clean rock stockpiles and closed TMFs.

2.2 Mitigation Measures

Design aspects, operational measures and other mitigation measures have been incorporated into the Air Dispersion Assessment (Tier 3, Technical Appendix 4B) which will minimize Project-related emissions and/or the potential effect of Project-related emissions (i.e., increased ambient concentrations of COPCs). Mitigation measures that will be applied to reduce changes to ambient air quality are divided into two categories: Mitigation by Design and Mitigation by Management. Mitigation by Management is further detailed in terms of Activity-Specific Mitigation by Management. Each category is outlined below.

2.2.1 Mitigation by Design

Several focused air dispersion modelling studies were conducted during the Project design phase to examine the potential effects related to air concentrations of COPCs resulting from alternate locations of the following facilities located within the Project Footprint:

- Acid Plant
- Kiggavik Power Plant
- Waste Rock Stockpiles
- Accommodation Complex

The locations of the above facilities utilized in the Environmental Impact Statement (EIS) reflect the results of these individual studies in order to minimize the potential effects to the atmospheric, terrestrial, aquatic and human environments.

2.2.2 Mitigation by Management

- Employ the use of standard operating procedures for use of equipment and machinery to ensure that they are operated appropriately to minimize their exhaust emissions.
- Perform regular maintenance of equipment and machinery in accordance with good engineering practices or as recommended by equipment suppliers such that the equipment is kept in good operating condition in order to promote efficient fuel combustion.
- Develop community complaint/response procedure(s) (see Tier 3, Technical Appendix 3C, Community Involvement Plan) to effectively address issues as they occur.
- Adhere to all permits, authorizations and, approvals.

2.2.3 Activity-Specific Mitigation by Management

- Heavy Equipment and Machinery Operation, Vehicles and Marine Vessels:
    - Where available, use diesel-powered heavy equipment equipped with appropriate exhaust emissions controls including catalytic converters to reduce NOx emissions and use diesel particulate filters to reduce fine particulate matter and other COPCs associated with particulate emissions.
    - Optimize the number of heavy equipment movements and minimize travel distances, where possible.
    - Minimize the number of barge shipments and container off-loading activities.
    - Use diesel fuel that meets the Canada-wide Diesel Sulphur Content standard of 15 ppm for off-road engines. Marine vessels will meet the Canada-Wide sulphur fuel content of 1000 ppm. This will reduce SO2 and particulate matter emissions.
- Unpaved Road Transportation:
    - Minimize or reduce vehicle speeds on unpaved mine site roads (including pit ramps) and along the Kiggavik-Sissons haul road and enforce speed limits, where possible.
    - Apply water or another approved dust suppressant, such as non-toxic, resin-based binder products (see Tier 3, Technical Appendix 2M, Attachment A) to the surfaces of unpaved mine site roads (including pit ramps) and to the Kiggavik-Sissons haul road, when required.
    - Maintain all unpaved road surfaces via grading or other maintenance practices to minimize the amount of silt (i.e., fine particles) present in the roadbed material.
- Blasting:
    - Minimize the number of charges per day to reduce NOx and particulate matter emissions.
    - Optimize/minimize the use of emulsion/ANFO to reduce emissions of NOx.
- Milling and Tailings Management:
    - Tailings will be released to the Tailings Management Facilities (TMFs) as slurry below a water surface. This will eliminate radionuclide and non-radionuclide dust emissions from the tailings.
    - Closed TMFs will be covered by a layer of clean waste rock and overburden/topsoil to minimize the release of radon. See Tier 2, Volume 2, Project Description, Section 8, Tailings Management, for more detail.
- Ore and Waste Rock Stockpiles:
    - During operations, mine ore and waste rock stockpiles will be constructed to minimize the release of radiological and non-radiological dust emissions. For example, the stockpiles will be constructed using a layered approach to increase stability while minimizing permeability to air (i.e., wind erosion) (Tier 2, Volume 2, Project Description, Section 6.6).
    - During closure/post-closure the permanent Type 1 and 2 mine rock stockpiles will be revegetated to suppress emissions of dust. Type 3 mine rock material will be

removed from the surface and backfilled into open pits to eliminate emissions of dust and minimize emissions of radon.

- Waste Management:
    - o As outlined in the Waste Management Plan (Tier 3, Technical Appendix 2S), the waste incinerator(s) will comply with the emission limits set out in the Canada-Wide Standards for mercury and dioxin and furans.
    - o Through proper waste segregation, materials containing chlorinated compounds will not be placed in the incinerator (Tier 3, Technical Appendix 2S Waste Management Plan). Therefore, emissions of hydrogen chloride (HCl) will be prevented.

At the time the Air Dispersion Assessment was prepared, information for the mill complex and acid plant was limited and data available from AREVA's McClean Lake Operation was used to estimate the release of COPCs (see Tier 3, Technical Appendix 4B). At present, AREVA has committed to installing emission controls in the mill and acid plant that will achieve emissions which are lower than what was modelled in the Air Dispersion Assessment. As a result, the emission rates used in the Air Dispersion Assessment for the mill and acid plant are considered conservative (i.e., tend to be overestimated) and actual emissions are expected to be less. Air pollution controls that will be installed on the exhaust stacks of the mill complex and acid plant as described in Tier 2, Volume 2 Project Description, include the following:

- A scrubber will be installed in the crushing and grinding circuit of the Mill Complex to control dust emissions.
- A scrubber and HEPA filter will be installed in the yellowcake drying circuit of the Mill Complex to control dust emissions.
- A scrubber will be installed on the Acid Plant to remove acid mist and excess SO_2.

AREVA has investigated alternative road dust control measures in the event that water spray is ineffective (see Technical Appendix 2M Road Management Plan, Attachment A).

3 Summary of Predicted Residual Effects

The need for monitoring a specific COPC in a specific Project phase is indicated by the prediction of potential residual effects to air quality (i.e., effects after mitigation) and potential residual cumulative effects. For the purpose of the air quality effects assessment, a residual effect was defined as an exceedance of an Air Quality (AQ) Indicator Threshold beyond the Project Footprint. A summary of residual Project effects and residual cumulative effects, as discussed under separate cover (Tier 2, Volume 4), is provided below.

3.1 Construction

The emissions from construction activities within the Project Footprint were shown to be lower than those of the operations phases (Tier 2, Volume 4). As such, construction emissions were not specifically modelled. However, these activities have the potential to generate substantial quantities of dust, albeit short-lived relative to the Project lifetime. This Plan therefore outlines monitoring during construction to verify that mitigation and best management practices are being implemented effectively.

3.2 Operations

During the operations phase of the Project, the AQ Indicator Thresholds were predicted to be exceeded for some COPCs at limited distances beyond the Project Footprint. This includes the following:

3.2.1 Predicted residual effect

Exceedances of maximum 24-hour AQ Indicator Thresholds for all three size fractions of dust (TSP, PM10 and PM2.5) beyond the Project Footprint, into a limited area of the LAA.

3.2.2 Predicted residual effect

The maximum predicted 24-hour uranium concentration is marginally above the AQ Indicator Threshold beyond the Project Footprint, into the LAA. The concentrations of all other metals and radionuclides are predicted to be below their respective AQ Indicator Thresholds.

3.2.3 Predicted residual effect

The maximum predicted 1- and 24-hour NO2 concentrations exceed their AQ Indicator Thresholds both within the Project Footprint, extending into the LAA.

3.2.4 Predicted residual effect and predicted residual cumulative effect

At the Baker Lake Dock and Storage Facility:

- Maximum predicted 1- and 24-hour concentrations of NO_2 exceeded AQ Indicator Thresholds, extending to a distance of about 1 km southwest of the dock site.

3.3 Final Closure/Post-Closure

No residual effects to air quality were predicted for the Final Closure or Post-Closure phases of the Project. However, monitoring will be undertaken to confirm/verify these predictions.

4 Draft Air Quality Monitoring Plan

Air quality monitoring is a useful tool to validate and verify the results of EIS predictions and to provide feedback on the efficacy of mitigation measures. Two types of monitoring are considered in the air quality monitoring plan: ambient air quality monitoring and stationary source (i.e., stack) monitoring. These are discussed separately in the following sections.

For both types of monitoring, a draft plan is outlined which identifies the following:

- parameters or COPCs to be measured;
- suggested monitoring methods to be used;
- general locations of monitoring;
- number of samples and sampling frequency; and,
- quality assurance and quality control (QA/QC) procedures.

4.1 Ambient Air Quality Monitoring

An ambient air quality monitoring program will be implemented to demonstrate that the environmental effects are equivalent to or lower than those predicted. The proposed ambient air quality monitoring plan consists of the following components:

- Meteorological monitoring
- Ambient air quality monitoring, including:
    - High-Volume Air Sampling (HVAS) of particulate matter
    - Continuous and passive air monitoring of Sulphur Dioxide (SO2) and Nitrogen oxides (NOx)
    - Dustfall monitoring
    - Radon monitoring
- Berries, Lichen, caribou fecal pellet and soil monitoring
- Snow chemistry monitoring

The proposed ambient air monitoring plan applies to the construction, operation, closure and post-closure phases of the Project to verify atmospheric dispersion predictions and compliance with air quality objectives.

Monitoring requirements will also consider input from the complaints response procedure outlined in the Community Involvement Plan (see Tier 3, Technical Appendix 3C Community Involvement Plan).

4.1.1 Ambient Air Quality Monitoring Plan Study Design

Based on the results of the Air Dispersion Assessment (Tier 3, Technical Appendix 4B), a hybrid study design which combines a before-after control impact (BACI) study design, and a gradient study design has been adopted for the primary components of the Air Quality Monitoring Plan. Figure 4.1-1 provides an outline of the proposed monitoring areas relative to the total annual dust deposition predicted in the Maximum Operations Assessment.

As illustrated, the air quality sampling areas are placed along the predicted dust deposition gradient from each of the Kiggavik and Sissons mine sites. Each sampling area is 250 m off each of the respective Kiggavik and Sissons mine site access corridors to Judge Sissons Lake. This will provide the availability of a power source to operate the TSP High-Volume air sampler located at each of the air quality sampling areas. For the vegetation, caribou fecal pellet and soil monitoring components of the Plan, the study design consists of five (5) randomly allocated sampling locations within each area; within each location three (3) randomly allocated sub-sample sites will be selected, from which co-incident crowberry (*Empetrum nigrum*), lichen (*Cetraria* sp. or *Cladina* sp.), caribou fecal pellet and soil samples will be collected. These sub-samples will be pooled to ensure sufficient mass for laboratory analysis of COPCs. The winter snow core sample component of the Plan will also utilize this study design. Also, within each of the air quality sampling areas, duplicate dustfall samplers, Track-Etch cups for monitoring radon, and passive SO_2 and NO_2 monitors will also be deployed.

The study design also includes a reference area near the outlet of Judge Sissons Lake (Figure 4.1-1); as electricity will not be available at this location, a TSP High-Volume air sampler is not be included for this area in the study design.

Passive and continuous, automated ambient SO_2 and NO_x samplers will also be co-located near the Project boundary (Figure 4.1-1). A $PM_{2.5}$ High-Volume air sampler will also be located at the Accommodation Complex.

The Air Quality Monitoring Plan also includes a road dust monitoring component. The study design for the Kiggavik-Sissons haul road consists of two dust monitoring areas with duplicate dustfall samplers located along the predicted dust gradient at 50 m, 100 m, 200 m, and 300 m from the road centerline (Figure 4.1-1). This study design will also be adopted for the all-season road option, should it be implemented.

Based on the study design for the vegetation, caribou fecal pellet and soils monitoring component outlined above, a quantitative baseline will be collected prior to the commencement of construction activities at each of the Kiggavik and Sissons mine sites. Similarly, the co-incident duplicate dustfall, Track-Etch cup, and passive SO_2 and NO_2 monitoring components will be initiated prior to construction activities at each of the mine sites. The TSP High-Volume air sampling component of the study design will be implemented at each of the Kiggavik and Sissons mine sites as each of the respective access corridors to Judge Sissons Lake are developed and electrical power becomes available.

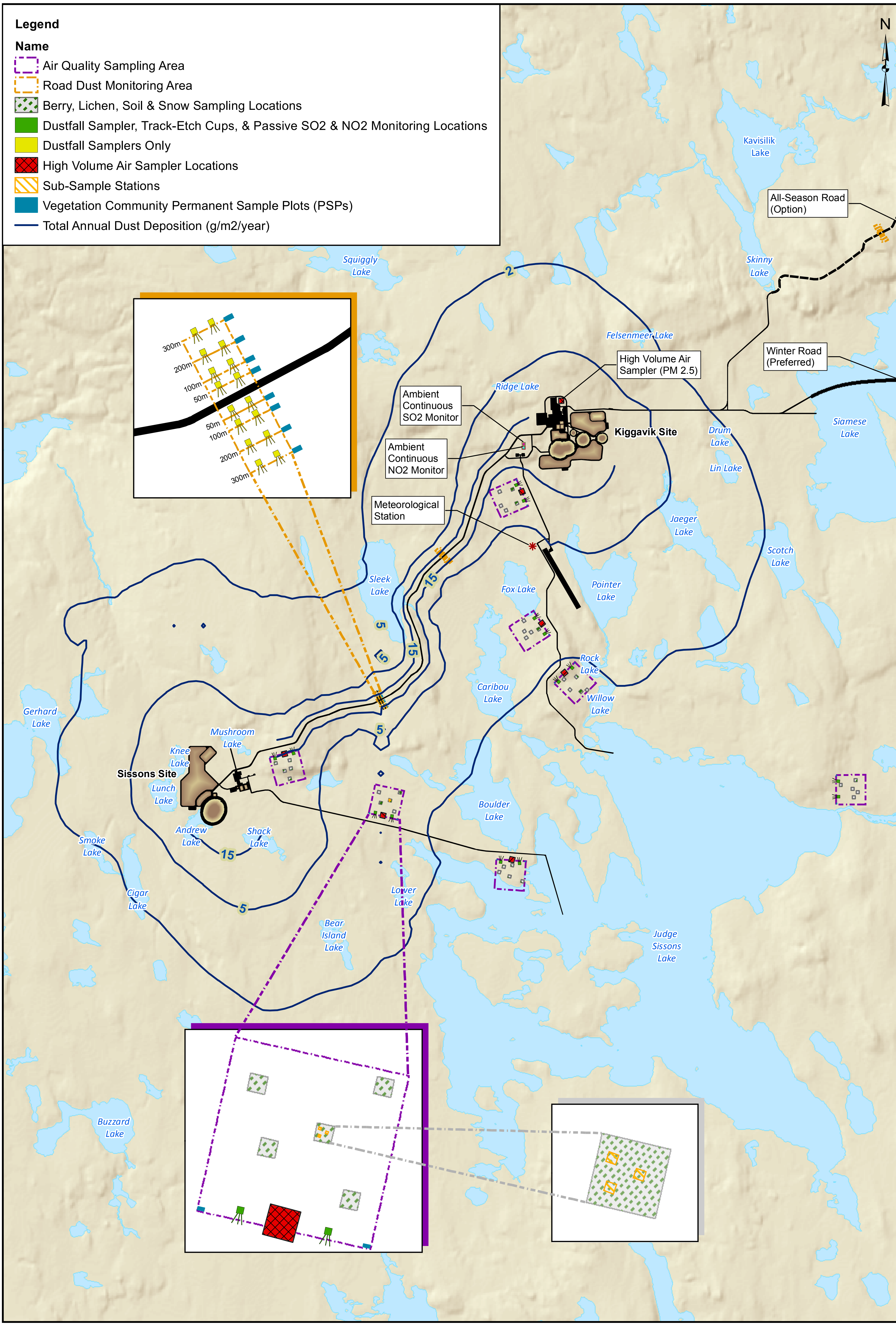
Vegetation community monitoring Permanent Sampling Plots (PSPs) will also be established to assess potential changes in vegetation community structure over time. The requirement for vegetation community monitoring (e.g. abundance and diversity) was described in Tier 2, Volume 6, Sections 9.2.7 and 9.7.1. Vegetation PSPs will be located as illustrated in Figure 4.1-1. Each PSP will be approximately 40 m x 20 m in size. In each PSP, 45 sampling points (1 m^2 quadrats) will be surveyed and the occurrence of each plant, bryophyte, and lichen species will be recorded. In a subset (~13) of pre-assigned quadrats per PSP, the percent cover of each plant, bryophyte, and lichen species present will be recorded. By surveying the same PSPs every three years, changes in vegetation community composition over time will be examined.

In addition, short-term local monitoring will be undertaken at Baker Lake for NO_x during one shipping season during the construction phase of the mine. Sampling will be carried out during the shipping season during the initial construction phase of the Kiggavik mine site. The instrument will be placed in a shelter located within the Community of Baker Lake with data collected continuously throughout the shipping season, in addition to one month before and after the season opens to be able to assess the existing local baseline NO_x concentrations.

For the vegetation and soil chemistry sampling component of the air quality monitoring plan, within the statistical design, the adoption of alpha (α) = 0.10 and five (5) replicate locations within areas, the ability to detect between-area differences of two (2) standard deviations will have a power (beta; β) = 0.90.

A meteorological station will also be installed near the Pointer Lake Airstrip (Figure 4.1-1). The meteorological station will be equipped to measure wind speed, wind direction, temperature, precipitation and incoming solar radiation. The station will also have the capability to either telemeter the data to a central location or store the measurements for a minimum of two months to ensure no data is lost prior to manual download. The accumulation of meteorological data will improve the understanding of local climatic conditions, and over time, will facilitate refinement of dispersion modeling of atmospheric emissions for the Project.

The co-incident sampling of many of the components within the Air Quality Monitoring Plan also provides the opportunity to evaluate a variety of relationships amongst the various components within the Plan. As summary of the sample methods, frequencies, and analytes of the ambient air quality monitoring plan are provided in Table 4-1.



Projection: NAD 1983 UTM Zone 14N
Compiled: TL Drawn: TL
Date: 9/3/2014 Scale: 1:120,000
Data Sources: *Natural Resources Canada, Geobase®, Nation Topographic Database, AREVA Resources Canada Inc.*

FIGURE 4.1-1
AMBIENT AIR QUALITY MONITORING PLAN STUDY DESIGN

ENVIRONMENTAL IMPACT STATEMENT
VOLUME 4 - ATMOSPHERIC ENVIRONMENT
Technical Appendix 4C - Air Quality Monitoring Plan

2.5 0 2.5
Kilometers

KIGGAVIK PROJECT

AREVA

File: Q:\SHEQ\GIS\KIGGAVIK\2014\EIS\Volume 4 - Atmospheric Environment\Maps\Volume 4 - Tier 3\Appendix 4C - Air Quality Monitoring Plan\Maps\MXD\Figure 4.1-1 Ambient Air Quality Monitoring Plan Study Design.mxd

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Table 4-1 Summary of Proposed Ambient Air Quality Monitoring Plan for the Kiggavik Project

Type / COPC	Location	Method	Frequency	Analysis
Meteorological Data	Pointer Lake airstrip	Meteorological station with 10 m tower	Continuously	Wind speed, wind direction, temperature, precipitation (rain and snow gauge), and incoming solar radiation
Dustfall	• Kiggavik Site, Sissons Site: o Three (3) areas along predicted gradient at each site (with duplicates)	Dustfall jars	Monthly (30 days), year round	Total Dustfall ($g/m^2/30d$) Inorganic & organic Dustfall ($g/m^2/30d$) Dustfall composition: Uranium, ICP/MS metals, Ra-226, Po-210, Pb-210, Th-230
	• Unpaved roads: o Two (2) locations along Kiggavik-Sissons Haul Road o One (1) location along All-Season Road (if implemented) ▪ At four (4) intervals (50, 100, 200 & 300 m) on either side of the right-of-way (plus duplicates)		Monthly (30 days), from June to September	Total Dustfall ($g/m^2/30d$) Inorganic & organic Dustfall ($g/m^2/30d$) Dustfall composition: Uranium, ICP/MS metals, Ra-226, Po-210, Pb-210, Th-230
Airborne Dust (TSP and PM_{10} or $PM_{2.5}$)	• Kiggavik and Sissons Sites: o Three (3) areas located along predicted gradient at each site (TSP) (when power is available) o One (1) PM2.5 sampler at Accommodation Complex	High-Volume Air Samplers (HVAS)	24-hours at 6 day or weekly intervals, year round	Total TSP, plus quarterly composites of samples for metals and uranium, Ra-226, Po-210, Pb-210, Th-230 $PM_{2.5}$
Ambient SO_2	• Kiggavik Site: o vicinity of the acid plant stack	Continuous, automated SO_2 analyzer	Continuous	SO_2

Table 4-1 Summary of Proposed Ambient Air Quality Monitoring Plan for the Kiggavik Project

Type / COPC	Location	Method	Frequency	Analysis
	• Kiggavik and Sissons Site: o One (1) unit co-located with continuous monitor o Three (3) areas located along predicted gradient (with duplicates) for each Site o Includes reference area	Passive Air Sampling System	Monthly (30 days) from June to September	SO_2
Ambient NO_x	• Kiggavik Site: o Co-located with ambient SO2 monitor	Continuous, automated sampler	Continuous	NO, NO_2 and Total NO_x
	• Kiggavik and Sissons Site: o One (1) unit co-located with continuous monitor o Three (3) areas located along predicted gradient (with duplicates) for each Site o Includes reference area	Passive Air Sampling System	Monthly (30 days) from June to September	NO_2
	• Baker Lake Community	Continuous, automated sampler	Continuous over one shipping season	NO, NO_2 and Total NO_x
Radon	• Kiggavik and Sissons Sites: o Three areas (3) located along predicted gradient (with duplicates) for each Site o Includes reference area	Track-Etch cups	Semi-annual	Radon
Berry, Lichen, caribou fecal pellet and Soil sampling	• Kiggavik and Sissons Sites: o Three (3) areas located along predicted gradient for each Site o Includes reference area o Five (5) locations within each area; three (3) sub-samples within each location	Collection of crowberry (*Empetrum nigrum*), lichen (*Cetraria* sp. or *Cladina* sp.), and soil samples	Every 3 years	Plants expressed on a dry weight basis: species, % ash, metals, uranium, Pb-210, Po-210, Ra-226, Th-230

4.1.2 Quality Assurance/Quality Control

AREVA will ensure that all ambient air quality monitoring is conducted in accordance with the sampling reference methodologies outlined in the *Saskatchewan Air Monitoring Guideline* (SMoE 2012). This will include following all QA/QC requirements for instrument calibration, equipment/sampler maintenance, regular station visits as well as documentation. In addition, the following QA/QC procedures for the ambient air quality monitoring program will include:

- An accredited laboratory will be used for pre-sample preparation as well as detailed lab analysis;
- Samples will be collected, stored and handled by qualified, trained personnel and consistent with standard operating procedures;
- Data from automated samplers will be downloaded, analyzed and interpreted by qualified, trained personnel consistent with standard operating procedures;
- Detailed sampling logs, including field records, calibration records, laboratory chain of custody forms, and laboratory certificates of analyses will be maintained by qualified personnel; and,
- Laboratory results will be analyzed and interpreted by qualified, trained personnel.

Prior to implementing the sampling program, a detailed QA/QC protocol will be developed.

4.2 Source Monitoring

Direct measurement of stationary source emission rates is often used in addition to ambient air monitoring programs to verify that the emission rates and hence model predictions used in the environmental effects assessment were conservative, and that expected effects will be less than originally predicted.

The key stack/process sources at the Project site are the Acid Plant and the Mill Complex. Several sources at the Mill Complex will undergo periodic source testing to measure and verify the emission rates of key COPCs, and to demonstrate that the mill is operated in a manner such that the emission rates have not increased over time.

The stationary sources for which source emission testing is proposed are as follows:

- Acid plant stack (SO_2)
    - Source emission monitoring at the acid plant stack using a continuous emission monitor (CEM).
    - In addition to continuous monitoring, periodic independent source testing (once per year) using Environment Canada or US EPA reference methods will be conducted.
- Mill Complex - Yellowcake Plant (particulate, uranium, metals, radionuclides)
    - Proposed source emission monitoring at the Mill Complex entails periodic source testing (once per year) for particulates (TSP, PM10 and PM2.5), metals, uranium and radionuclides.

- o Grab samples will also be collected by AREVA personnel four times per year, using a portable C5000 sampling probe. These samples will also be analyzed for metals, uranium and radionuclides.

In addition to the mill and acid plant, the incinerator(s) will also be tested as follows:

- Periodic testing of the incinerator(s) will occur once per year to ensure that it complies with the Canadian Council of Ministers of Environment and Canada-Wide Standards for mercury and dioxins and furan emissions.

It is anticipated that the data from the source monitoring program will be used to update the air quality assessment, if required, in order to provide a more refined assessment using actual emission rates rather than the conservative emissions scenarios developed and used in the Air Dispersion Assessment (Tier 3, Technical Appendix 4B). A summary of the proposed stationary source monitoring program is provided in Table 4-2.

4.2.1 Quality Assurance/Quality Control

AREVA will ensure that all stationary source testing is conducted in accordance with the sampling reference methodologies. Where sample collection is performed by AREVA personnel, all QA/QC requirements for instrument calibration, equipment/sampler maintenance, regular equipment inspections as well as documentation will be followed. In addition, the following QA/QC procedures for source testing will include:

- Samples will be collected by qualified, trained personnel and consistent with standard operating procedures;
- An accredited laboratory will be used for sample analysis;
- Data from automated systems will be downloaded, analyzed and intrepreted by qualified, trained personnel consistent with standard operating procedures;
- Detailed sampling logs, including calibration records, laboratory chain of custody forms, and laboratory certificates of analyses will be maintained by qualified personnel; and,
- Laboratory results will be analyzed and interpreted by qualified, trained personnel.

Prior to implementing the sampling program, a detailed QA/QC protocol will be developed.

Table 4-2 Proposed Stationary Source Monitoring Program for the Kiggavik Project

Type / COPC	Location	Method	Frequency	Analysis
Source Monitoring	Yellowcake Stacks	Stack Testing	Every year, with quarterly grabs each year	Particulate, uranium, ICP/MS metals, Ra-226, Po-210, Pb-210, Th-230
	Acid Plant Stack	Continuous emission monitor	Continuous	SO_2, daily and hourly emissions
		Stack Testing	Once every year	SO_2, SO_3, NO_x, CO
	Incinerator	Stack Testing	Once every year	Hg, dioxins and furans

5 Conclusions

This Air Quality Monitoring and Mitigation Plan (the Plan) outlines mitigation and monitoring measures that will be implemented by AREVA as a means to prevent or reduce emissions of Constituents of Potential Concern (COPCs) identified as having potential effects to air quality in Tier 2, Volume 4, Atmospheric Environment. It is expected that monitoring will verify the conservatism of the atmospheric dispersion model predictions. If observed monitoring results are higher than those predicted (i.e., more frequent exceedances of the AQ Indicator Thresholds), enhanced dust controls or increased implementation of the existing controls will be considered.

The Plan will be in effect for the duration of the Project and will undergo periodic review as outlined in CSA Standards, N288.4, N288.5, N288.6, and as outlined in Tier 3, Technical Appendix 2T Environmental Management Plan. The Plan is considered draft, and details of the Plan will be finalized during the permitting or licensing stage of the Project.

6 References

BLHT (Baker Lake Hunters and Trappers). 2011. Summary of community review meeting conducted by Mitchell Goodjohn with eight representatives of the Baker Lake Hunters and Trappers Organisation. February 16, 2011; in Appendix 3B: Inuit Qaujimajatuqangit Documentation, Attachment B.

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