

Sierra Club Canada's Submissions to CNSC

Cameco's proposed expansion of the world's largest Uranium mines and mills in Northern Saskatchewan

September 4, 2013



www.sierraclub.ca

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Foreword



"We shouldn't be exporting uranium because you're exporting cancer."

- Helen Caldicott,

doctor, educator, anti-nuclear activist, mother, grandmother, and lover of life

Sydney Morning Herald, July 2006

By Dr. Helen Caldicott, MD

Few, if any, estimates of the costs of nuclear energy take into account the health costs to the human race. Even when nuclear power plants are operating normally, these costs are not insignificant. Miners, workers, and residents in the vicinity of the mining and milling functions are at risk for exposure to unhealthy amounts of radiation and have increased incidences of cancer and related diseases as a result. Routine and accidental radioactive releases at nuclear power plants as well as the inevitable leakage of radioactive waste will contaminate water and food chains and expose humans and animals now and for generations to come. Understanding the biological effects of radiation is critical to understanding the health impacts of nuclear energy.

The Sierra Club Canada report on Northern Saskatchewan uranium mining shines a very bright light on an industry with a history ignoring even inadequate regulations and exceeding the limits on the release of radioactive substances into the environment.

Those responsible for regulating the nuclear industry in Canada must urgently put a stop to these irresponsible industry practices for uranium mining is, in fact, an issue of global public health. It is therefore time to stop expanding an extremely dangerous industry that puts all human beings at risk.

***Dr. Helen Caldicott** is a Nobel Peace Prize nominee and the recipient of the 2003 Lannan Prize for Cultural Freedom. A bestselling author, Caldicott is the co-founder of Physicians for Social Responsibility and president of the Nuclear Policy Research Institute.*

Summary

Having reviewed in detail Cameco's applications to expand three mines in Northern Saskatchewan and the federal and provincial regulatory framework for uranium mining, we are of the view that the applications should **not** be approved. Until there is an environmental impact assessment that is based on enforced regulatory limits for heavy metals and radioactive to the environment releases, that takes into account impacts to the Arctic environment and peoples, the CNSC may be acting contrary to its statutory mandate should it approve the expansion of the world's already largest uranium mines.

We show that Cameco's operations already release an extraordinary and increasing amount of air and water releases that are a major source and pathway for pollution both south and north. These pollutants are often not regulated at all. Yet the negative consequences to people and the environment are well known. We provide updates from both the Arctic Monitoring and Assessment Program (AMAP) and UNEP. The conclusion is inescapable, Cameco has been allowed by to operate in an environmental and regulatory vacuum, that needs to be addressed now.

Sierra Club Canada is calling upon the Arctic Council to request that Canada, as the founding and current Chair, undertake a responsible approach to resource development that prioritizes public health, environmental protection, the precautionary principle, transparency, the duty to regulate and govern in the public interest and compliance with international agreements. Indeed the Canadian government and CNSC may, at present, be out of compliance with a number of international agreements to give notice, to conduct environmental impact assessments (EIA), to reduce and where possible eliminate and mitigate likely transboundary pollution. We rely on the 1991 *Arctic Council Declaration* including the 1997 *Arctic Guidelines for EIA*. These *Guidelines* established by the AMAP of the Arctic Council led to the 2003 *Heavy Metal's Protocol* to the 1979 *UNECE Convention on Long-Range Transboundary Pollution*. As we review, that Protocol together with the 1991 *Espoo Convention* establish international obligations on the Canadian government in this regard. The Northern Circumpolar is particularly affected by long-range sources of pollution and the Canadian government knows this fact.

As the federal uranium regulator, we call upon CNSC to require Cameco to conduct a public and comprehensive environmental impact assessment of the three applications based on protective limits to heavy metals and radiation in air, water and wild foods that considers both the Saskatchewan and the Arctic environments. It is incumbent upon the Saskatchewan government to fill in the gaps in provincial air and water standards. Given what is well known

about the links between uranium mining and severe pollution, any effort less than this cannot be said to strike the right balance between development and sustainability.

Introduction

The Canadian Nuclear Safety Commission (CNSC) is holding public hearings on the applications by Cameco Corporation (Cameco) to renew its uranium mine and mill licences for the Key Lake, McArthur River and Rabbit Lake operations located in Northern Saskatchewan. Cameco has requested 10-year licence terms and an increase of more than a 30 percent production increase at each site.

Only Key Lake was subject to any environmental screening, the scope of which was decided by the CNSC without a public hearing, see CNSC Notice of Hearing August 12, 2011. At the time of writing, Cameco has still not released its assessment. Despite proposals to expand the capacity of McArthur River and Rabbit Lake in an already compromised environment, the Canadian Minister of Environment did not see it fit to require an impact assessment.

HIGHLIGHTS

- Having reviewed in detail Cameco's applications to expand three mines in Northern Saskatchewan by more than a 30 percent production increase each, and the federal and provincial regulatory framework for uranium mining, **we are of the view that the applications should not be approved.**
- We show that Cameco's operations already emit an extraordinary and increasing amount of air and water releases that are a major source and pathway for pollution both south and north. **These pollutants are often not regulated at all.**
- Before the CNSC can approve these applications it must ensure Cameco has made adequate provision for environmental protection and the health and safety of persons and measures required to implement **international obligations to which Canada has agreed.**
- The Canadian government **may be out of compliance with international agreements to give notice**, to conduct environmental impact assessments(EIA), to reduce and where possible eliminate and mitigate likely transboundary pollution: the 1991 Arctic Council Declaration including the 1997 Arctic Guidelines for EIA; with the 1991 Espoo Convention and the 2003 Heavy Metal's Protocol to the 1979 UNECE Convention on Long-Range Transboundary Pollution. The Northern Circumpolar is particularly affected

by long-range sources of pollution especially mercury, cadmium, lead and radioactivity and the Canadian government knows it.

- The only public radiation protection level provided in regulations is a generally described effective dose rate of 1 mSv per year, which standard is **not an appropriate proxy for coherent and protective regulatory limits to environmental releases.**
- Even where there are standards, Cameco is not required to report airborne mercury emissions and waterborne mercury, uranium and cadmium release are merely identified as an “effluent characterization” not subject to specific limits. **There is no limit for uranium in groundwater.** Despite limits were they exist, Cameco is allowed to wildly exceed them without consequence.
- We calculate that should CNSC approve the **Key Lake** expansion application, we can expect an increase of almost 400 percent in the airborne release of uranium and radioactive lead 210 from the Yellowcake drying equipment alone! We are unable to calculate for mercury or cadmium as those air emissions were **not reported.**
- **Despite failed reverse osmosis treatment and on-going sloughing failures** at the tailings ponds containing uranium, lead, arsenic and polonium 210 from the mill effluent, the Saskatchewan Ministry of Environment permits Cameco to release water from the Gaetner and Deilmann tail ponds directly into the environment at Horsefly Lake. This lake drains into the Wheeler River to Wollaston Lake where is drains both to Hudson Bay and through the effects of McArthur River mine, through the Mackenzie River to the Beaufort Sea.
- As of 2010, water releases from Deilmann Tailings in cadmium **exceed the Saskatchewan standard by an extraordinary 5,782 percent.** Uranium concentrations were above the standard on average 1,323 percent and at the high level value by **10,153 percent!** Radium 226 and lead 210 concentrations on average exceed the standard by 1,481 and 140 percent respectively.
- While there is no Canadian groundwater standard for uranium, Cameco reports concentrations at the Deilmann waste pile **1,190 times greater** than the comparable Arizona standard.
- At the **McArthur River** site, concentrations of arsenic, selenium, and uranium in water effluent have exceeded the standards by 54 percent for arsenic, 700 percent for selenium and an astronomical 1,230 percent for uranium. There is no reporting done on mercury. **Blueberries and fish are contaminated with uranium.**

- The Saskatchewan government permits Cameco to directly discharge water from Shaft 3 into the environment despite exceedences in both mercury and cadmium releases.
- There is an **increasing trend** in radiation air concentrations of lead 210 and polonium 210.
- As the longest operating uranium mine in Saskatchewan, the **Rabbit Lake** Mine and Mill shows an extraordinary increase in uranium contamination of Hidden Bay's sediment at Wollaston Lake of **9,233 percent** between 1992 and 2007.
- There has been an extreme increase in **uranium concentrations in lichen** near the D-Zone pond, one of the three flooded open pits at the site, by 2,167 percent and of radiation by 3,400 percent respectively also between 1992 and 2007.
- Cameco **does not report** on mercury, cadmium, lead and radiation, including polonium and cesium-137, air releases from the Yellowcake drying equipment on site. Cameco also does not report on groundwater quality "as it is also not an SMOE requirement".
- The fish around the B Zone pit lake are contaminated with **polonium-210 and radium-226**.
- Yet **Cameco's position is that no further environmental assessment is required** of the expected air emissions to the atmosphere, deposition to the surface waters and/or to sediment quality or aquatic biota in order for CNSC to approve the 33 percent increase in production sought.
- It is **both inadequate and a clear conflict of interest** to rely on Cameco to establish its action levels and hence the limits to the release of radiation and heavy metals into the environment. It is a failure of regulation and inconsistent with the government of Canada's domestic and international obligations to not pay particular attention to establish enforced regulatory limits for the uranium sector to air and waterborne releases mercury, cadmium, lead and radiation.
- Given what is well known about the links between uranium mining and severe pollution, any effort less than **comprehensive impact assessment** cannot be said to strike the right balance between development and sustainability.
- Based on our findings, it is the position of Sierra Club Canada that an **impartial and comprehensive environmental and social impact assessment** will indicate levels of impact beyond which resource development cannot be sustained.

- In addition to requiring a transboundary EIA of Cameco's applications, we call on the Arctic Council to approve a project following up on the 1997 Guidelines for Arctic Impact Assessment, as part of the Arctic Environmental Protection Strategy, to compile a public inventory of all proposed licensing applications for new, extended and decommissioned uranium mining facilities that may impact the Arctic. This inventory should be **maintained on a public registry** as currently it is not possible to conduct comparative, cumulative impact and risk assessment of the sources and negative effects of the most harmful heavy metals and radioactivity released both near and far as a result of this growing and largely unregulated industry.

1. Background to Proceeding

Before approving the applications, as the federal regulator the CNSC has a number of legal obligations. At the most fundamental, the Commission must uphold the purpose of its constituting legislation, the *Nuclear Safety and Control Act* (NSCA).

The purpose of the Act is to provide for the limitation, to a reasonable level **and in a manner consistent with Canada's international obligations**, of the risks to the health and safety and the environment that are associated with the development of nuclear energy and the use of nuclear substances and prescribed equipment (NSCA s. 3(a)).

Consequently, in approving any application, the Commission must also ensure that:

- the applicant has made adequate provision for environmental protection and the health and safety of persons and measures required to implement international obligations to which Canada has agreed (NSCA, s.24 (4)(b));
- the applicant provides information on the origin and volume of any radioactive waste or hazardous waste that may result from the activity (*General Nuclear Safety and Control Regulations*, s. 3(1)(j)); and
- the applicant has a radiation protection program that sets out administrative levels, if exceeded, triggers action for the following: gamma radiation dose rates and radon progeny, radon gas and long lived radioactive dust concentrations (*Uranium Mines and Mills Regulation*, s.4 and *Radiation Protection Regulations*, s.4).

Note that this radiation protection program is limited to worker protection and does not extend to general environmental protection from radioactive releases.

Trouble in the Air

Indeed the only general public protection level provided in regulations under the NSCA is a generally described effective dose rate of 1 mSv per year, see *Radiation Protection Regulation*, s. 13. We argue that this standard is not an appropriate proxy for coherent and protective regulatory limits to environmental releases.

The 2009 AMAP in its assessment of radioactivity in the Arctic paraphrased the original International Commission on Radiological Protection axiom, of which CNSC is a member, “if man is protected then the environment is protected” (Smith, 2004). Although a framework for protection of the environment from radiation has been long overdue for various reasons, including the requirement to fill a conceptual void and to place environmental assessment on a firm regulatory footing, the AMAP adds remarks concerning the need for a simple and cost-effective regulatory approach are highly pertinent, see p. 62, AMAP 2009 AMAP below at p. 55.

Given the high levels of protection ensured by other jurisdictions and the on-going scientific work, we argue that the 1 mSv per year limit is two to three times less protective than it should be, see **Pickering Nuclear: A Cracking Bad Idea**, Sierra Club Canada, pgs.29-32:

www.sierraclub.ca/sites/sierraclub.ca/files/scc-pickering-submission-final-rv.pdf

Other than this general effective dose, and despite an extensive search, we are unable to find any other federal or provincial regulatory limits to radiation releases to air for the uranium sector. There are some comparative provincial airborne limits for heavy metals, see Table 1 Air-related Standards for the Uranium Sector, 2013. We also made an attempt to do a comparative review of water standards, see Table 2 Water-related Standards for the Uranium Sector.

2. Provincial Regulation or the Lack thereof

In Saskatchewan, while there may be limits for hazardous substances such as mercury, cadmium, lead, and arsenic, these limits do not apply to substances that are regulated pursuant to the (then) *Atomic Energy Control Act*, see Hazardous Substances and Waste Dangerous Good Regulation, Ch E-10-2, Reg 3, s.5(1) General Exemptions. Each jurisdiction thinks the other is regulating.

According to Saskatchewan Ministry of Environment (SMOE) their role for air quality of metals, is “ basically a comparison to previous year’s data, comparison between reference and exposure sites, and to guide numbers that may be available. The proponent is allowed to select guide numbers that are appropriate for the parameters and conditions and the use of Ontario or CCME guide numbers for comparisons where justified. Saskatchewan does not have its own set of guideline values for metals in air samples”.

Despite an extensive review, **Ontario also does not have air emission limits for radiation.**

And while there may be relevant Ontario air emission limits for certain heavy metals such as mercury, cadmium, arsenic, and lead (pb, not Lead 210) under the *Local Air Quality Regulations*, 419/05, Cameco is not required to track, let alone limit, its air emissions of mercury from any of its many stacks at any of the three sites in this proceeding. That is because at least according to SMOE, mercury isn't really an issue there, see Background to Applications below.

This is the situation despite Cameco's legal duty to ensure measures to protect the environment – such a limits of mercury, cadmium and lead- as required ensuring environmental protection for Canadians and to implement international obligations to which Canada has agreed, seeing NSCA, s. 24 above.

3. Federal Guidelines

The negative effects from exposure to gamma radiation, radon progeny, radon gas and long lived radioactive dust concentrations was recognized in the *Uranium and Radiation Protection Regulations*, above.

As explained in a CNSC Regulatory Guide on Measuring Airborne Radon Progeny at Uranium Mines and Mills, June 2003, there are also four solid, short lived radionuclides - polonium 218, lead 214, bismuth 214 and polonium 214. These four products are the radon progeny. Alpha, beta and gamma radiation are emitted during the decay of radon gas to create lead 210. Of these forms of radiation, alpha particles typically pose the most significant radiation hazard to workers because, over time, the inhalation of air containing elevated concentrations of alpha emitting radon progeny may **increase the incidence of lung cancers in humans.**

The Guide describes out how to measure this radiation, it does not set out limits. But it assures that radon and radon progeny concentrations are kept at safe levels by adequate workplace ventilation and “exhausting air that contains significantly elevated concentrations of radon and its progeny”, see p.1.

In the most recent report by CNSC on the performance of uranium mines in Canada, staff was prepared to say that at five uranium mines and mills in Canada, none had exceedences of Ontario's air release limits for uranium. We show otherwise. It is important to note that staff could not say there were not exceedences for mercury, cadmium, lead, or arsenic, or for radiation, see 2011CNSC Staff Report on the Performance of Canadian Uranium Fuel Cycle and Processing Facilities, p. 63-64.

In short, there appears to be a failure to regulate key contaminants released to the air and to enforce the few that exist. The only CNSC radiation standard is a poor substitute for real environmental regulation of radiological air substances.

Trouble in the Water

In addition to the regulations under the NSCA, Cameco is also obliged to comply with the Canadian *Metal Mining Effluent Regulations*. These Regulations are enforced by Environment Canada pursuant to the current *Fisheries Act*. Despite sweeping changes to key parts of the *Fisheries Act* in the 2012 omnibus budget Bill 38, Section 36 of these regulations, which deals with the release of “deleterious” substances, remains intact. That means the *Metal Mining Effluent Regulations* (MMER) which fall under Section 36 have also remained as they were – at least for now

According to the 2011 Staff report, the MMER specifies the maximum concentration limits in effluent for seven contaminants (arsenic, copper, lead, nickel, zinc, radium-226 and total suspended solids) and an allowable pH range. Effluents must be non-toxic and pass the trout acute-lethality test.

But uranium, mercury and cadmium are described as “effluent characterization” and are **not** subject to specific limits or targets. According to the *2001 GUIDANCE DOCUMENT FOR THE SAMPLING AND ANALYSIS OF METAL MINING EFFLUENTS*, Environment Canada confirms that: “Analysis methods must be implemented by the regulated industry and their laboratories to provide data to comply with the proposed MMER. Some chemical parameters are regulated, with concentration limits specified in the proposed MMER, while others are characterization parameters. The latter do not have regulatory limits” .¹ See Table 2 Water-Quality Standards.

The MMER regulations do, however, require Effluent and Water Quality monitoring studies on effluent characterizations, see Part 1, section 3 and 4. Commissioners may want to check that this is being done.

¹ GUIDANCE DOCUMENT FOR THE SAMPLING AND ANALYSIS OF METAL MINING EFFLUENTS FINAL REPORT Canada, EPS 2/MM/5 – April 2001, Environment Canada, Target Data Quality Objectives for analysis are listed in Table 1., p.1 Arsenic(1) 0.01 mg/L Method Detection Limit, Lead(1) 0.03 mg/L, Radium 226 (total)(1) 0.01 Bq/L, Cadmium 0.002 mg/L, Mercury 0.0001 mg/L. Note 1 says (1) Prescribed deleterious substance under the proposed MMER; other parameters for characterization only. Thus, only arsenic, lead and Radium 226 are prescribed; Cadmium and mercury are not prescribed.

4. The Failure to Regulate

As a general observation, compiling an overview of current air and water regulatory limits at both the federal and provincial levels of government is a difficult exercise, impeded by a lack of transparency. The lack of common identities of contaminants and measurement unit conversions are barriers to a coherent approach. Such things lend themselves to gaps in regulations and a patchwork approach. Commissioners are urged to request a comprehensive review of the state of environmental regulation in the uranium sector.

To summarize other than an inexact and unprotective general radiation standard for the public, there are no environmental standards to limit exposure to radiation from the uranium sector both at the federal and provincial levels of government. Where there are standards, we show Cameco is not required to report about them all, including those for uranium, mercury, cadmium and lead in particular. And where there is reporting and despite crazy numbers above the limits, regulators turn a blind eye. This is a story about the failure to regulate despite the Canadian public interest and international commitments otherwise.

The current federal and provincial regulatory gap in environmental protection from both water and air releases of the uranium sector is unacceptable. CNSC would fail in its regulatory oversight of the uranium industry if it approves the current applications without ensuring effective domestic standards with limits and reporting, to at least mercury and cadmium pollution, let alone uranium and radioactivity, see discussion on Arctic Council instruments and the UN *LRTAP, Heavy Metals Protocol and the Espoo Conventions* below at p. 49.

Figure 1: Air-related standards for uranium sector, 2013

Substance	SK std	Cdn std	other	comments
metals				
Arsenic	0	0	0.3 ug/m 24 hour 0.09 ug/m annual, Ontario Ambient Air Quality Criteria 2008	½ hour Guideline 1 ug/m3, OAAQC. Ont Reg 419 Air Pollution Local Air Quality
Cadmium	0	0	0.025 ug/m3 24 hour, OAAQC, Sch 3, 2012	
Lead- CASRN 7439-92-1	0	0	1.5 ug/m3 ½ hour averaging time, 0.5 ug/m3 24 hours,	Cameco relies on SAAAs for 5 ug/m3

Substance	SK std	Cdn std	other	comments
			OAAQC, 2012,	Ont Reg 419, Sch 6, Upper Risk Threshold ½ hour 6 ug/m3.
Mercury, Hg	0	0	5 ug/m3 ½ hour averaging time, OAAQC Sch 2, 2012; 2 ug/m3 24 hour, Sch 3	
TSP	120 ug/m 24 hour 70 ug/m annual Ambient Air Quality Standards Sk Clean Air Act Reg, 1989, says Cameco	0	0	
radiation				Cdn Radiation Protection Reg has a general radiation effective dose limit of 1 mSv annual for general public
Lead 210, pd 210	0	0	0	
Polonium , Po210	0	0	0	
Radon 222, Ra 222	0	0	US 10 mrem/y effective dose (40 CFR 61.22, National Emission Standards for Hazardous Air Pollutants)	Conversion is 0.1 mSv/annual, same as NSCA. Also see 30 CFR Part 57 for limits specific to uranium mines.
Radon 222 release rates from tailings	0	0	US EPA Std 0.74 Bq/m2s, (40 CFR 192)	See Note 1.
Radon in homes		200 Bq/m3	US EPA 4 pCi/l (143 Bq/m3)	WHO 100 Bq/m3, see Note 2.

Substance	SK std	Cdn std	other	comments
Radon 226, Ra 226	0	0	0	
Thorium, alpha-emitter, breaks down to radium and radon gas, migrates into the ecosystem for 75,000 years, Th 230	0	0	0	
Uranium	0	0	1.8 ug/m 24 hour 0.56 annual Ont AAQC	As of July 2016 0.45 ug/m3 (U in PM10) ½ hour averaging time, Sch 2; 0.03 ug/m3 U in pm10 annual; 4.5 ug/m3 URT, 1.5 ug/m3 24 hour URT see Note 3.

Note 1. Radon releases are a major hazard that continues after uranium mines are shut down. The U.S. Environmental Protection Agency (EPA) estimates the lifetime excess lung cancer risk of residents living nearby a bare tailings pile of 80 hectares at two cases per hundred. See US regulations above and the Nuclear Regulatory Commission (NRC: 10 CFR 40). These regulations not only define maximum contaminant concentrations for soils and admissible contaminant releases (in particular for radon), but also the period of time, in which the reclamation measures taken must be effective: 200 - 1000 years.

Note 2. The [World Health Organization, Handbook on Indoor Radon](#) proposes a reference levels of 100 Bq/m3 to minimize health hazards.

Note 3. See Section 19, *Ontario Local Air Quality Regulations, 419/05* for uranium and compounds in particulate matter less than 10 um in diameter, to take effect July 1, 2016, with annual averaging periods. See also Summary of Standards and Guidelines to support OR 419/05, OMOE April 2012.

Figure 2: Water – related standards for Uranium Sector

Substance	SK SSWQO and MIEPR, Note 1.	CDA	MMER, Note 2.	Other	Comments
Polonium 210		0.1 Bq/L			CDWG, Radiological Parameters, Appendix A, Health Canada
Radium 226 in drinking water		0.5 Bq/L		US EPA (40 CFR 141.25) 5 pCi/l (0.185 Bq/l)	
Radium 226, Ra 226 Surface water	0.11 Bq/L				
Ra 226 Bq/L Dewatering discharge	0.11 SK Dewatering Water Quality Objectives				
Ra 226 Liquid Effluent	0.37 Bq/L		0.01 Bq/L MDL		
Lead 210, pb210 Drinking water Bq/L		0.1			Note CDWG says 0.2 Bq/L but SMOE otherwise
Lead 210, Liquid Effluent			0.92 Bq/L		

Substance	SK SSWQO and MIEPR, Note 1.	CDA	MMER, Note 2.	Other	Comments
Thorium 230 Drinking water Bq/L		0.4			Note CDWG App A says 0.6
Thorium 230 Liquid Effluent	1.85 Bq/L				
Arsenic As (mg/L) Drinking water	0.005	0.010			
Arsenic As(ug/L) surface quality	5				0.005 mg/L SSWQO
As in Liquid Effluent	0.05 mg/L		0.010 mg/L		
As dewatering	0.05				
Cadmium drinking water (mg/L)	0.005	0.005			
Cadmium Cd (mg/L) Surface quality	0.000017 to 0.00010, depending on hardness				0.1 ug/L
Mercury Hg (mg/L) Drinking water	0.000026	0.001 (total Hg)			
Mercury Hg (ug/L) Water quality	0.026				

Substance	SK SSWQO and MIEPR, Note 1.	CDA	MMER, Note 2.	Other	Comments
Lead pb Drinking water	0.01 mg/L	0.01 Mg/L			
Lead (mg/L) Water quality	0.0001 to 0.007 depending on hardness				
Lead pd mg/L Dewatering	0.05				
Lead in Liquid Effluent	0.02 mg/L		0.20 mg/L		
Lead in surface water				EPA 2.5 ug/L	
Uranium in drinking water	0.015 mg/L	0.2 mg/L CDWG (20 ug per litre); 1999 Fed-prov subcmte proposed 10 ug per litre		California Public Health Goal 0.05 ug/L(2004) German drinking water standard 10 ug/L	Office of Environmental Health Hazard Assessment, 2001. www.atsdr.cdc.gov/interaction_profiles/ip09.html WHO 0.015 mg/L USEPA 0.03 mg/L(30 ug/L)
Uranium, U (ug/L) water quality	15				
U_dewatering	0.08 mg/L				
U in groundwater					Arizona 0.21 mg/L
U Liquid Effluent	2.5 mg/L		0.02 mg/L		
U surface water	0.015 mg/L (15 ug/L)				

Note 1: See Saskatchewan *Mineral Industry Environmental Protection Regulations*, 1996, CHAPTER E-10.2 REG 7 *The Environmental Management and Protection Act*, Appendix, Section 30, Authorized Concentration of Pollutants in Liquid Effluent, Maximum Monthly Concentration Arithmetic Mean.

Note 2: The Canadian Metal Mining Effluent Regulations, PART 2, CONDITIONS GOVERNING AUTHORITY TO DEPOSIT, Schedule 5.

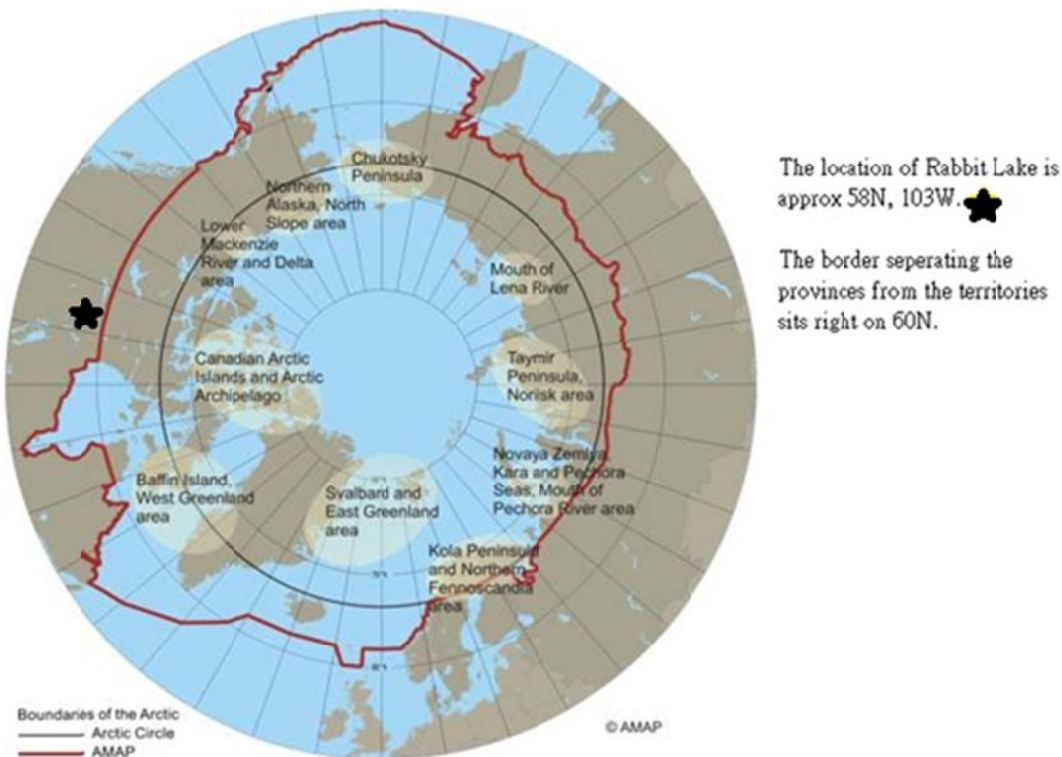
5. Background to Applications

Before reviewing the details of Cameco's applications it is important to situate the location of the uranium mines and mills in their geographic and human populations context.

5.1 Geographical Location at 58 degrees latitude

At approximately 58 degrees latitude, the three sites are just south of the start of the Canadian Arctic and the Arctic Monitoring and Assessment Program at 60 degrees. The map below shows the location relative to the Arctic. For example Rabbit Lake is a mere 360 km from the southernmost part of the Arctic, being Duck Lake Post, Manitoba. Despite this relatively short distance, the pollution caused by Cameco's current and expected operations pass through many air zones and watersheds.

Figure 3: Location of Rabbit Lake



Sierra Club Canada Submission to the CNSC
Cameco's proposed expansion of the world's largest Uranium mines and mills in Northern Saskatchewan
September 4, 2013

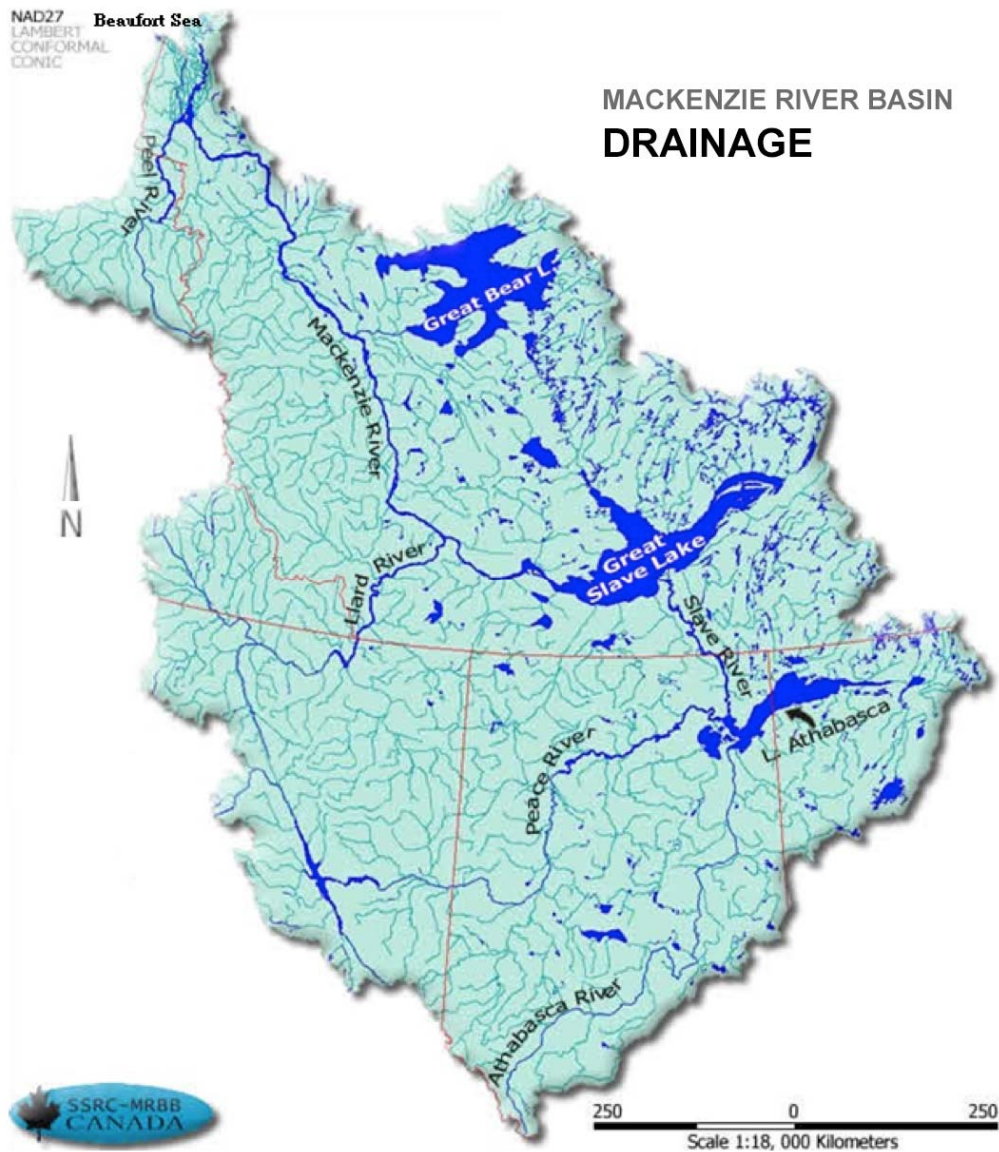
Figure 3: Examples of Exceedences

	Uranium	Arsenic	Cadmium	Radium 226	Polonium	Lead 210	Comment
Key Lake							
yellowcake	In 2010 3 times above average. As of 2011 - 421% higher on average since 2010			One times above average		As of 2011 – 394% higher on average since 2010	No testing for Mercury or Cadmium, see p. 30
Calciner Stack Air emissions							
Deillmann Tailings	As of 2010, on average 1,323% above SSWQO standard and at high value 10,153%	As of 2010, on average	As of 2010 on average 5,782% above SSWQO standard		As of 2010 on average 4,250% above drinking water standard	As of 2010 on average 1,710% above drinking water standard	No other standard to compare Polonium and Lead 210 than drinking water, see p. 34
Water releases		1, 320% above SSWQO standard					
Raise Water at DRWP	As of 2010, on average 3,560% above SSWQO	As of 2011, on average 45,500% above SSWQO standard		As of 2011, on average 1,481% above SSWQO		As of 2011, on average 140% above SSWQO	Mercury not reported and no number for cadmium See p.34
Deilmann dewatering wells	As of 2011, on average between 166 and 258% above SSWQO			As of 2011, on average more than two times higher than SSWQO			See p. 35
Deilmann waste pile	As of 2011, average 1,190 greater than Arizona standard						There is no Cdn or SK ground water standard see p. 36
In ground water							
McArthur							
Mine water effluent	As of 2007, on average 1,230 % above SSWQO	As of 2007 on average 54% above SSWQO					No reporting on mercury despite SSWQO standard, see p. 41, Selenium 700%% above SSWQO
Rabbit Lake							
Sediment at Hidden Bay	As of 2009, a 9,233% increase since 2000.						No disclosure on stack air emissions see p. 48.
D-Zone Pond Lichen	As of 2007, 2,167% increase since 1992			As of 2007, 3,400% increase since 1992			As of 2007 1,233% increase since 1992 of Thorium -
Collins Creek	As of 2010, more than ten times above SSWQO						See p 51
Link Lake Pow Bay	As of 2010 347-767% more than SSWQO						Arsenic, lead 210 & radium 226 also above SSWQO, see p.52

This next map shows the Arctic's Beaufort Sea at the end of the Mackenzie River and their relationship to Lake Athabasca in Alberta and Saskatchewan. Lake Athabasca spans 7,935 square km making it the third largest lake in the Mackenzie River Basin.

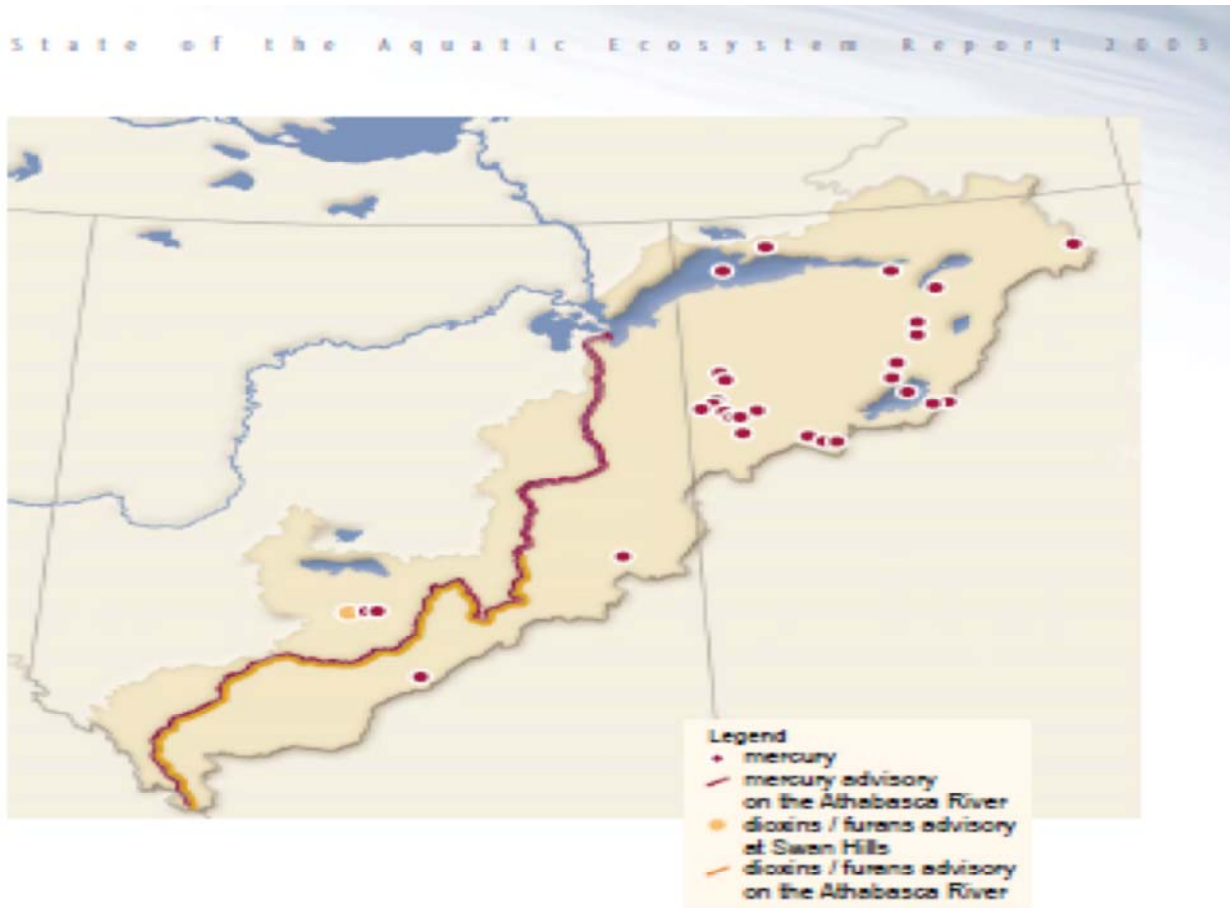
Although the flow of water out of Lake Athabasca is variable and can change direction under certain conditions, water typically flows north through the Riviera des Rochers and joins the Peace River to form the Slave River. Most of the water flow in Slave River diverts west towards Great Slave Lake, then flowing into the Mackenzie River, ultimately onto the Beaufort Sea, and the Arctic Ocean. Map Source Mackenzie River Basin Board, State of Aquatic Ecosystem Report, 2003.

Figure 4: Mackenzie River Basin Drainage



Despite the assurance by the Saskatchewan’s Ministry of the Environment, Uranium and Northern Operations Branch, that air testing for mercury is not required by Cameco “because mercury is really not a problem”, the Figure below shows the locations around the Athabasca sub-basin where mercury related fish consumption advisories have been issued. Data Source for Figure: Alberta Sustainable Resource Development; Saskatchewan Environment and Resource Management, 2003 MRB State of the Environment Report.

Figure 5: Mercury related fish consumption advisories



In 2003, there were twenty-five water bodies in the Saskatchewan portion of the Athabasca sub-basin with fish consumption advisories for mercury, p. 79. State of the Environment Reports from the MacKenzie River Basin Board no longer report on the general human and environmental health of the Athabasca Sub-basin, but rather focus on particular issues, such as Oil/Tar Sands development. An update of public reporting of this analysis is urged.

Finally, this map shows the connection between Lake Athabasca and the three uranium sites that are the subject of Cameco’s current applications. Lake Athabasca is a bifurcting lake, that means it drains both north to the MacKensive River and south to the Churchill River that provides the drinking water for almost a million people in southern Saskatchewan.

Figure 6: Map of Saskatchewan



DWG. No. C000-F-096
DEC, 2000

5.2 Athabaskan Human Populations and threats to Food Security

The Athabasca sub-basin includes lands covered by Treaties 6, 8 and 10, and there are fifteen First Nations with over forty reserves. According to information gathered by the Mackenzie River Basin Board in 1995 and in consultation with First Nation groups, they “would be very supportive of a move to eliminate discharges of wastewater into the aquatic ecosystems of the Athabasca sub-basin” (p. 59).

Traditional Knowledge of In-Stream Water Uses indicates people have decreased their consumption of fish because of concerns about fish health. Elders indicated that fish did not taste as good as in the past, and that people were having difficulty drying fish because the flesh was often soft and watery. Some people are eating less fish than they used to because of concerns about the quality and health of this resource, p. 69. In addition to declining quality, traditional knowledge has also identified a decline in fish populations, p. 71.

At some locations, various anatomical and physiological changes were also noted in some of the fish: external warts, unusually blue veins, abnormally yellow livers, internal white markings, and soft watery flesh, p. 73. The Board identified that threats to healthy, abundant and diverse aquatic species includes environmental contamination, p. 74 and referred to Thorpe and Godwin. 1999. SRC Publication No. 11158-1C99. Saskatchewan Research Council, Saskatoon.

The overall assessment of Traditional Knowledge of Human Health and Safety was unfavourable, p. 77. When thinking about the Athabasca River and the several lakes within its watershed that have fish consumption advisories based on elevated concentrations of mercury, it is important to recall that Cameco’s uranium mines in this current proceeding are just south of Lake Athabasca.

5.3 First Nations and Métis Communities at Cameco’s sites

According to Cameco, the Northern Village of Pine house and the Northern Hamlet of Patuanak / English River Denesuline First Nation (ERFN) are the primary impact communities for the Key Lake operation, while pick-up points are located in Pinehouse, Patuanak, Beauval, Ile-a-la-Crosse, Buffalo Narrows, La Loche, La Ronge, Cumberland House, and Flin Flon (which is located in Manitoba but also serves the community of Creighton, Saskatchewan)p 3.13, Project Description. The Key Lake operation has been mapped as a part of the traditional territory of the Lac La Ronge Indian Band, as well as the ERFN, p. 3-16

Commercial fishing also takes place in the Wheeler River, Russell Lake, and Yalowega Lake. One commercial fishing lodge is located downstream of the Key Lake operation on Russell Lake. p 3;16

Regional organizations include: Prince Albert Grand Council (PAGC), Métis Nation of Saskatchewan (MNS), Meadow Lake Tribal Council (MLTC), Athabasca Work Group (AWG), p. 5-4, Project Description.

See p. 41 for a discussion on the Crown’s Duty to Consult and Accommodate.

6. Key Lake Application

Cameco's Application seeks a ten year additional operating licence, based on a 1979 Environmental Impact Statement (EIS). It wishes to increase the capacity of the Deilmann Tailings Pit (DTMF) to store tailings to a consolidated elevation of 505.0 masl and expand production capacity from 7.2M Kg/yr Uranium to 9.6M Kg/yr Uranium. This would be a 33 percentage increase in production. The intention is to become a regional mill for ore from the McArthur as well as Millennium mines.

There is no doubt that the expansion of the McArthur mine site, Key Lake mill and Deilmann tailings disposal pit will contaminate the already stressed environment. The McArthur River ores in particular contain high-grade uranium but are also rich in other radionuclides and heavy metals, reviewed in detail at p. 32. If approved by both CNSC and Saskatchewan Ministry of Environment pursuant to s. 15 of the *Saskatchewan Environmental Assessment Act*, Cameco hopes to continue milling at Key Lake until 2040 or longer.

6.1 Trouble in the Air

Yet already the Key Lake mine and mills exhausts extraordinary amounts of heavy metals and radioactive dust and radon progeny bearing air to the atmosphere. We calculate that should CNSC approve this expansion application, we can expect an increase of almost 400 percent in the release of uranium and lead 210 from the Yellowcake drying equipment alone!

A 1997 review of Cameco's application to convert the Deilmann pit to an in-pit tailings management facility concluded uranium, radium-226, lead-210 and polonium-210, all dangerous to the biosphere, were present in plants, soil, animals in amounts well above permissible limits for humans. The highest amounts were for polonium-210 a breakdown product of the gas radon that enters the atmosphere from uranium mines and mills and can spread around the globe, see Thomas, P.A. The ecological distribution and bioavailability of uranium-series radionuclides in terrestrial food chains: Key Lake Uranium operations, Northern Saskatchewan. Dec.1997, p. 139 plus appendix, for Environment Canada. Despite the Deilmann Tailing Management Facility having a 5 m water cover, radiation and gamma releases to the atmosphere continue.

Uranium mining operations affect air quality through particulate and gaseous emissions during milling, especially during uranium ore crushing and yellowcake drying operations, and through radon emissions from waste rock and tailings. The Key Lake disposal operations will have the largest radon emissions of all of the uranium projects in northern Saskatchewan, over two times higher than either Rabbit or McClean Lake. But there are no Canadian Radon emissions limit standards.

The situation has not improved and will become worse with an increase of 33 percent in production.

6.2 Trouble in the Water

The uranium ores contain large amounts of radium-226, among other pollutants, which will be concentrated throughout milling and disposal operations and will ultimately be sent to the Deilmann pit. Since radium-226 is especially mobile in surface water and ground water, the migration of radium-226

away from the tailings pit is of particular concern. Contamination from the tailings pit will eventually escape and enter the local ground water and an already compromised regional drainage system.

Tailing storage in the Deilmann open pit already suffers from periodic sloughing of the sidewalls, undermining the impermeable performance of it in the short and long term.

Radiologically contaminated materials are taken to the contaminated landfill at the Above Ground Pit (AGTMF). Liquid effluent is released into the shallow Horsefly and Wolf Lakes that now contain mainly effluent, affecting the entire aquatic food chain. Despite a bentonite liner and drainage collection system, the Above Ground Tailings Management Facility still leaks.

Despite failed reverse osmosis to treat uranium, lead, arsenic and polonium 210 in mill effluent at Wolf Lake and on-going sloughing failures at the tailings ponds, the Saskatchewan Ministry of Environment permits Cameco to release water from the Gaetner and Deilmann tail ponds directly into the environment at Horsefly Lake. This lake drains into the Wheeler River to Wollaston Lake where it drains both to Hudson Bay and through the effects of McArthur River mine, towards the Beaufort Sea., see Cameco's Key Lake Project Description, 2010, p. 3.1, Figure A-3 Mill Process Flow Sheet and drainage map below at p. 26.

We show that as of 2010 water releases from Deilmann Tailings in cadmium exceed the standard by an outrageous 5,782 percent. Uranium concentrations were above the SSWQO standard of 15 ug/L on average 1,323 percent and at the high level value by 10,153 percent!

As in the case of air, there is a huge regulatory gap in waterborne limits to major heavy metals and radiological materials. Where there are standards, regulators tolerate systemic and astronomical noncompliance. No wonder there are serious food security issues.

6.3 Trouble in the Food

The uptake of radionuclides in the terrestrial environment of the Key Lake operation was investigated in 1997 and more recently in 2009. Animal tissue activity levels and associated internal doses were higher than any previously reported for Saskatchewan prairie animals. The highest activity levels and internal dose were associated with the AGTMF. The major dose contributor at the control site was polonium-210, while radium-226 was the main dose contributor at the AGTMF and Gerald Lake sites (Ecometrix 2005b) and see more recently, Minnow 2009, p. 3-12, Project Description. Cameco admits that bog cranberries show elevated levels of uranium. We also have the regional evidence provided by AMAP and UNEP, see p. 49 below.

6.4 CNSC Concerns re Aging Management

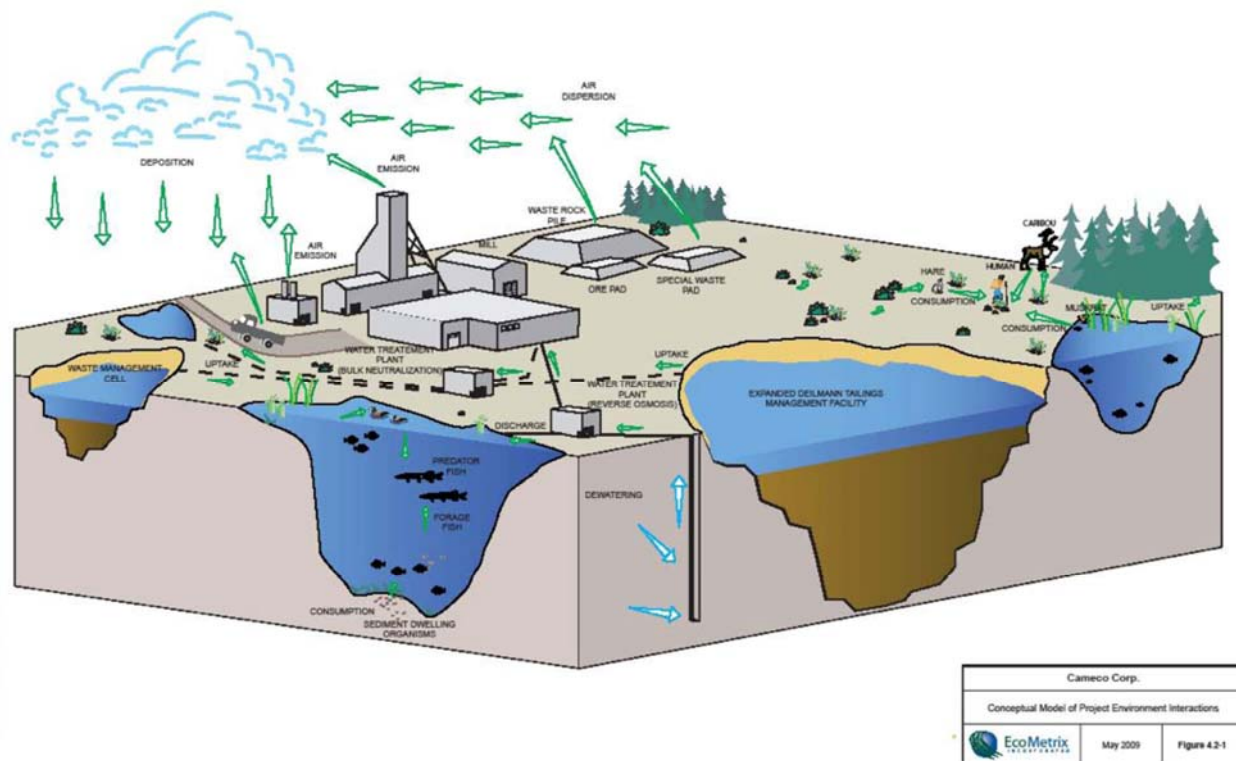
Even Commission staff has concerns and has sought more information on Cameco's approach to aging management, referring specifically to containment issues that Cameco has faced recently at several of its licensed facilities.

CNSC staff added that most of these spills were related to an aging groundwater dewatering pipeline infrastructure and that sloughing concerns have been on-going and that insufficient progress has been made to date to address this issue in the long term. The Commission expressed its concern that the lack of a remediation plan would affect the viability of the facility by compromising the capacity to safely store the tailings at the site, see para. 57, CNSC Decision.

6.5 What does Cameco Say?

We focus on three main operations at Key Lake: the milling of the uranium ore, the drying of the processed slurry into Yellowcake, and waste management, all of which entail significant air and water releases. In short high grade uranium ore from the McArthur site is pumped into one of four large air agitated slurry storage Pachuca tanks, ground and blended with lower grade ore, treated with the solvent sulphuric acid to extract the ore, resulting in left over waste rock, tailings and water. The blended uranium slurry is then dried in the Calciner furnace and packaged for shipment far and wide, including to India and perhaps China in the near future.

Figure 7: The following illustration provides a conceptual model of the operations environmental interactions.



Source: Cameco, Figure 4-2-1, Project Description.

Despite ample evidence to the contrary, Cameco maintains that there are “no project-related impacts anticipated to the atmospheric pathway” related to this application, see p. 4.4, Project Description.

Release of air emissions, including radon gas and dust as well as metals, occur at many points in the operation. The sources include the grinding and processing of ores, the mill ventilation systems, the storage of waste materials and importantly, at the fuel burning reclaiming equipment where the chemical slurry is dried at temperatures above 800 degrees C into uranium in the form of Yellowcake.

Each area of the Mill has its own ventilation system. According to Cameco the purpose of which is to supply fresh air and to exhaust radon progeny bearing air, see. P.3.5, Mining Facility Licensing Manual, Dec. 2012. Air emissions are also intentionally released at the bulk neutralization area where four air agitating reactors are used before atmospheric release, see p. 3-7.

Despite these significant sources of contaminated air emissions, the scope for potential atmospheric effects of this application was limited by CNSC to a mere 10km radius circle around the Key Lake site, see p.4-2, Project Description.

General air quality in the vicinity of the Key Lake Operation is monitored for total suspended particulate (TSP), SO₂ and radon. At the boundary locations, outside of the immediate area of the Key Lake Operation, the air quality is only monitored for radon and SO₂, see section 9.8.10.

What do the numbers show?

The following information is taken from Cameco's Key Lake 2010 Project Description, Cameco's 2011 Annual Report and NPRI data.

6.6 Air Emissions

Analysis was completed on a quarterly composite of the Total Suspended Particulate (TSP) matter for radionuclide and heavy metal concentrations. We note below the concern that relying on TSP is questionable because the general nature of this indicator is not sufficient to identify and measure particular pollutants, see AMAP Assessment of Heavy Metals 2002, below at p. 55.

Cameco's Key Lake Operation's 2011 Annual Report shows the results of the 2011 atmospheric particulate measurements in Table 9.34. In 2011 the daily ambient air quality standard of 120 µg/m³ was not exceeded during the year. The mean annual ambient air quality standard of 70 µg/m³ was also not exceeded in 2011. Given what we found below, it is remarkable that Cameco's is in compliance with these standards, suggesting the standards are either ineffective and/or unprotective.

Radionuclide and heavy metal concentrations associated with the suspended particulate are shown in Table 9.36. The 2011 annual mean parameter concentrations are within the long-term historical averages, with the exception of uranium at Station 10.1, which was higher than the long term average, P. 128 2011 Annual Report. Also Note that mercury, cadmium and lead (Pb) were not sampled.

6.6.1 Sampling of Yellowcake Calciner Stack

The Calciner is a multi-hearth furnace, a type of fuel burning equipment where the chemical slurry is dried at temperatures at 840 degrees C into uranium in the form of Yellowcake, See Cameco, MacArthur Technical Report, p. 134-135. The Calciner's scrubber was installed in 2000. The results of the stack testing were presented to the agencies in a report entitled Source Testing of Cameco Corporation Key Lake Operation Yellowcake Calciner Scrubber Stack (SRC 2011).p. 130, 2011 Annual Report, also see Table 9.43 that presents a current list of industrial fuel burning equipment and incinerators as defined by the Saskatchewan Clean Air Act.

The results of the September 2011 testing indicated higher emissions and concentrations of arsenic, lead, uranium, the radioactive form of lead, lead 210 (Pb 210) and radium (Ra 226) when compared to 2010 results, p. 1. It is important to note that testing was not done for mercury and cadmium. Uranium and Ra 226 concentrations in particular were greater than three and one standard deviations above the mean, respectively. Particulate matter was approximately 8 percent higher than that of the prior fifteen test average.

SCR suggests that since the average mill production rate of yellowcake, U3O8 (1802 kg/h) during the test was 1.84 times that of the June 2010 testing (987 kg/h) this points to some rationale for the higher uranium and Pb 210 concentrations. When we calculate the 33 percent increase in production requested by Cameco, we can expect a 321 percentage increase in uranium and 294 percent increase in Lead 210 from the Calciner Stack alone. These are astronomical increases!

Figure 8: Emissions of Uranium and Lead – Comparison between June 2010 and September 2011

	June 2010		Sept 2011		
Ur	3.1663mg/drm3	15.8343g/h	13.3204mg/drm3	70.0188g/h	+421%, +442%
Pb 210	0.0016	0.0080	0.0063	0.0328	+394%, +410%

Emission samples indicate that uranium concentrations were the highest in the fifteen test periods, beginning in 2000; lead the fourth, lead 210 the third and thorium the second highest level in the fifteen test periods since 2000, see Figures 2-11, SRC 2011. Total particulates and radium 226 were also higher than the fifteen year average. No analysis is provided for either mercury or cadmium.

6.6.2 Radon Measurements

Note that the radon measured at the surface Tailing Management Facility failed to report concentrations at the TMF East station because that station is damaged. This critical monitoring equipment should be repaired, see Figure 9-2. 2011 Annual Report.

In short the current and expected air emissions from the Key Lake Operation is severe. We are unable to report on mercury or cadmium emissions as those expected regulatory requirements are not reported or monitored despite Canadian obligations otherwise, see above Failure to Regulate.

a. Radiation Deposition to plants

Despite the weight of evidence to the contrary, the scope for the potential terrestrial effects from atmospheric deposition related to this application, including on traditional uses of the land and on traditional foods, was limited by CNSC to a mere 1km around the Key Lake site, see p.4-2, Project Description.

Cameco admits that atmospheric deposition from this operation includes emissions from facility air exhaust systems, waste piles and residual emissions from process equipment dust scrubbing systems. Monitoring has identified elevated radon, total suspended particulate, and metals and radionuclides in lichen sampled close to the mine site, see p. E-3, Project Description

Cameco says the concentrations of metals and other elements are not high enough to be considered a risk to the plants or to local terrestrial wildlife through food chain exposure (Ecometrix 2005b), p. 3.2.2 Project Description.

Despite the conclusion of CanNorth, a Cameco and Aboriginal partnership that no cumulative effects from the Key Lake operation were occurring (CanNorth 2007).p. 3.19 Project Description, bog cranberry results in 2005 showed the uranium level (0.87 µg/g) was elevated in bog cranberries from Wollaston Lake, see p.. 3-18, Project Description.

b. Uptake by animals

The uptake of radionuclides in the terrestrial environment of the Key Lake operation was investigated in 1997 and more recently in 2009. Animal tissue activity levels and associated internal doses were higher than any previously reported for Saskatchewan prairie animals. The highest activity levels and internal dose were associated with the AGTMF, especially respecting polonium- 210 and radium-226 , see Ecometrix 2005b and see more recently, Minnow 2009, p. 3-12, Project Description.

6.7 Water Releases

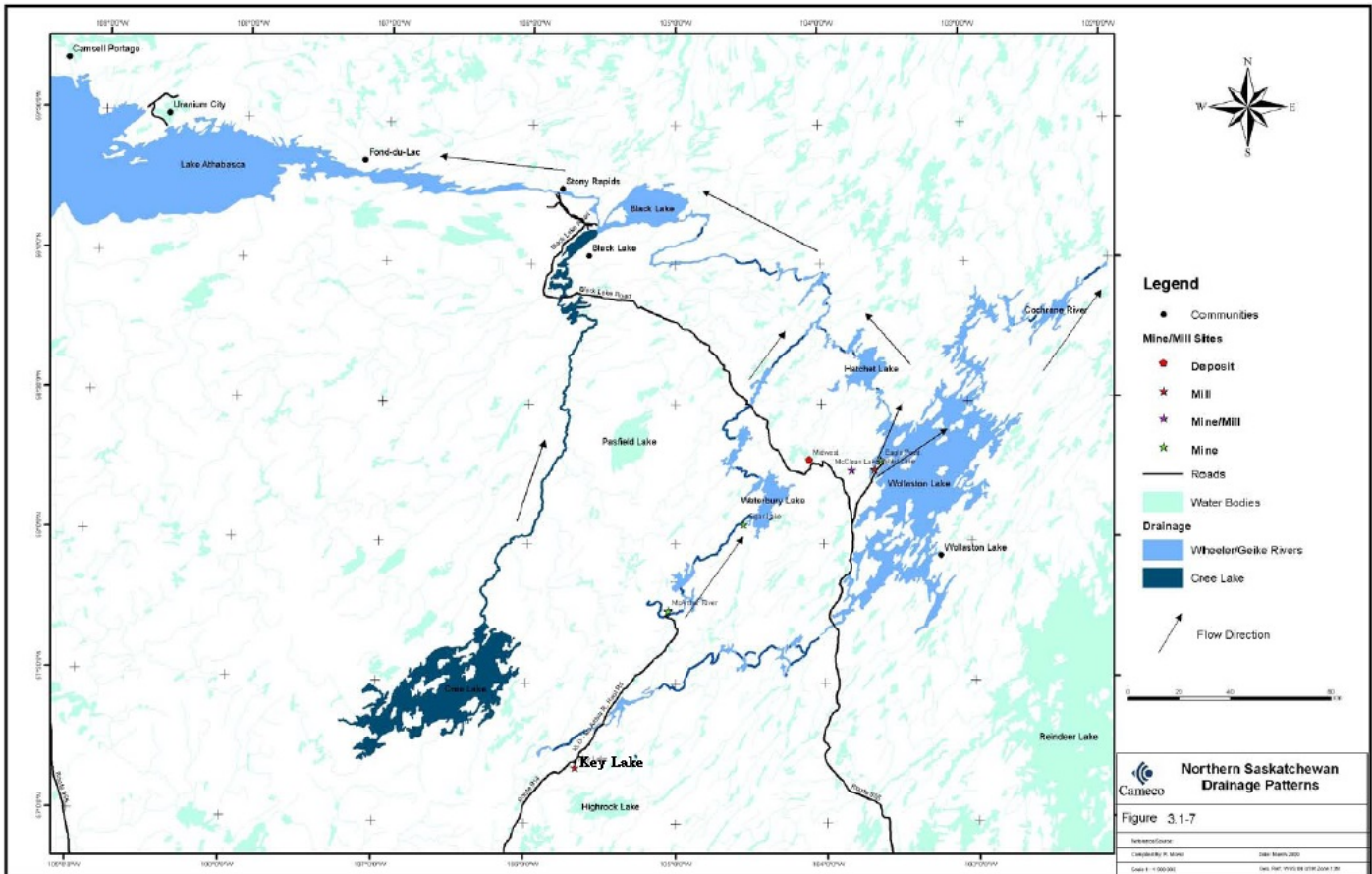
The scope for potential environmental impacts of this application to regional water drainage systems was defined by CNSC as the land area which encompasses the McArthur and Key Lake operations as well as the potentially affected drainages up to and including Lake Athabasca, see p.4.2, Project Description.

6.7.1 Regional Drainage Areas

Surface water from the Key Lake site is drained into two sub basins – David Creek and Outlet Creek – to the Wheeler River, which drains into Wollaston Lake. Recall that Wollaston Lake is bifurcated, flowing both south to the Churchill River basin and north to the Athabasca drainage system to the Arctic.

Below is a map showing the Key Lake drainage system through Wheeler River to Wollaston Lake, Source: Cameco Figure 3.16 and 3.17 respectively, Project Description

Figure 9: Key Lake drainage system through Wheeler River to Wollaston Lake



6.7.2 Liquid Effluent to David Creek

The waste solution from the extraction process is pumped to the bulk neutralization plant and then released as mill effluent to David Creek, which flows to Wolf Lake and then the Wheeler River to Wollaston Lake. According to Cameco, the waste solution containing, for example, radium-226 is treated with lime prior to release.

Arsenic as well as uranium are elevated within the sediments of David Creek. The sedimentation rates and sediment layer represents sediment deposition since mining began at the Key Lake operation in 1982. Molybdenum and selenium concentrations continue to exceed the water quality guideline limits upstream of Delta Lake, p. 3-6, Project Description.

6.7.3 Mill Effluent Quality at Wolf Lake

According to Cameco, the total volume of treated mill effluent (Stn. 1.4) released to Wolf Lake in 2011 was 1,239,619 m³. The monthly mean water quality effluent released to Wolf Lake, Stn 1.4, is presented in Table 3.7 of Cameco's 2011 Annual Report.

It shows that even after bulk neutralization and reverse osmosis treatment, there were a number of molybdenum exceedences, with increases of polonium 210 and lead.

According to Table 9.31, 2011 Annual Report, the Wolf Culvert (Station 3.5) parameter concentrations show a trend of increasing arsenic concentrations over the past five years.

6.7.4 Dewatering to Horsefly Lake

The dewatering from the waste rock and tailings pits and ponds effluent and seepage is released to Outlet and McDonald Creeks, to Horsefly Lake, to the Wheeler River and then Wollaston Lake. Despite reverse osmosis treatments at the Gaertner pit before dewatering into Horsefly Lake, we know from the experience at Wolf Lake that reverse osmosis is an unreliable treatment.

Waste rock contains uranium, and elevated sulphides and arsenide materials, Project Description, p. 2-9. The Key Lake site has several waste rock piles. These piles generate acidic seepage releasing elevated concentrations of metals. According to Cameco, this seepage is collected in the dewatering system to the reverse osmosis plant prior to being released into Horsefly Lake.

6.7.5 Deilmann Tailings Releases

According to Cameco, as of October 2008 the DTMF contained about 6.3 million m³ of placed tailings and about 2.3 million m³ of material that has sloughed into the facility from the surrounding sand slopes. Small sloughing type failures of the sand slopes began in 2001 during re-flooding of the DTMF when the water elevation reached the sand/sandstone contact along the west wall of the facility. After three significant events between 2003 and 2005, re-flooding of the facility was halted to prevent further failure of the sand slopes, see Project Description p. 2.8-9. Aging management is recognized by CNSC to be an on-going issue.

Sediment quality at McDonald Creek from the DTMF show arsenic, nickel, uranium and zinc are elevated, with arsenic exceeding guideline levels, p. 3.8, Project Description.

And Cameco admits that with an expanded DTMF an increase in the seepage of radionuclides (e.g. radium – 226) can be expected, p.4.9, Project Description.

According to 2010 data, presented in Table 3.5 of Cameco's Key Lake Operations 2011 Annual Report, the average annual tailings showed:

- a mean annual radium-226 concentration of 148 Bq/L, with a range from 102 to 308 Bq/L for the monthly composites, shockingly above the Saskatchewan Surface Water standard of 0.11Bq/L;

- a mean annual 210Po and 210Pb, the radioactive substance of polonium, concentrations within the historical range of 4.35Bq/L vs. 1.83-6.46, 1.81 vs. 1.31-2.81 respectively, and exceeds the only available standard to compare, drinking water standards, by a ridiculous 4250% and 1710%;
- a mean annual concentration of thorium - Th230, showed an increasing trend established over the last four years;
- mean annual concentrations of arsenic was 71 ug/L and cadmium was 0.001 which are higher than the standard of 5 ug/L and 0.00010 by 1,320 percent and by 5,782 percent respectively; and
- a mean annual uranium concentration of 213.4 µg/L, with a high value of 1,538 µg/L in April, 2010, outrageously above the SSWQO of 15 ug/L; and a mean annual Uranium - U, concentration of 213.4 µg/L, with a high value of 1,538 µg/L in April, 2010.

Note this and the next indicator are the only two samples and records provided by Cameco on cadmium releases, both of which showed exceedences, with cadmium levels in the tailings at 5,782 percent above the standard!

As of 2010, uranium concentrations were above the SSWQO standard of 15 ug/L on average by 1,323 percent and at the high level value by a crazy 10, 153 percent.

6.7.5.1 Raise Water

The Raise Water Quality at the Deilmann RWP pond is also a concern. According to Cameco at Table 3.27:

- average Uranium concentration in 2011 (549 µg/L) was elevated compared to previous years (2006 to 2010), when the average varied between 382 µg/L and 448 µg/L, well above the Canadian Water Quality standard of 15 ug/L, an average that exceeds standard by 3560%;
- mean concentrations of 226Ra, 210Po and 210Pb in RWP water were 1.74 Bq/L, 0.07 Bq/L, and 0.24 Bq/L, respectively in 2011, compared to 1.72 Bq/L, 0.06 Bq/L, and 0.3 Bq/L in 2010, well above the SSWQO of 0.11 Bq/L;
- mean annual Arsenic – As, concentration in 2011 was 2.28 mg/L, slightly lower than the value of 2.43 mg/L in 2010.p. 28, also well above the SSWQO of 0.005 mg/L;
- mean concentration of cadmium was also well above the SSWQO of 0.000017 TO 0.00010 depending on water hardness; and
- Mercury was not sampled or reported.

Note that as of 2011 radiation standards were very significantly exceeded In 2011, with Ra226 exceeded by 1481% and Pb210 exceeded by 140%. The mean annual arsenic concentration in well above the SSWQO of 0.005 mg/L. and exceeded the SSWQQ (drinking water standard) by 45,500%.

6.7.5.2 Deilmann Dewatering Wells

According to Cameco at Tables 3.29 to 3.32, 2011 Annual Report, the monitoring results for the 35 dewatering wells shows:

- mean As concentration at two stations ranged from 27 to 28 µg/L in 2011 versus a range of 18 to 22 µg/L in 2010, exceeds SSWQO of 0.005 and Canadian standard of 0.010mg/L if compared as Drinking Water;
- mean 226Ra concentrations ranged from 23 to 28 Bq/L, with an overall mean of 25.4 Bq/L., more that two times higher than the dewatering SSWQO of 0.11Bq/L;
- mean uranium concentrations ranged from 213 to 287 µg/L in 2011 well above the Uranium SSWQO dewatering standard of 0.08 mg/L, exceeds the Objectives by 166-258%.

6.7.6 Above Ground Tailings Management Facility

According to Tables 3.33, the average annual concentrations of 226Ra and 210Pb were 2.74 Bq/L, which are very high when compared to radium in drinking water standards of 0.5 be/L and 0.17 Bq/L, respectively, in 2011 in the supernatant, the water floating on the surface. The average annual 226Ra concentration has shown a steady increase from 0.58 Bq/L in 2001 to 2.74 Bq/L in 2011.

The 2011 average annual concentrations of Mo (7.729 mg/L) and U (713.6 µg/L) were higher compared to those measured in 2010, and both Mo and U have shown a generally increasing trend in average annual concentrations over the past several years, p. 31, 2011 Annual Report. Cd was 0.002 mg/L. As for the seepage from the AGTMF, Radionuclides 226Ra and 210Pb (1.956 Bq/L and 0.13 Bq/L) were higher than those measured in 2010, with average annual 226Ra concentrations showing an overall increasing trend since 2003.

The average annual As concentrations in 2011 (1,704 µg/L) is lower than that determined for 2010. Average annual As concentrations have been highly variable over the period of record (1983 to present), with more values suggesting an overall stable to slightly increasing trend.

6.7.7 Gaertner Pit Water Quality

According to Table 4.4 and 4.5, the average levels of 226Ra, 210Po, 210Pb and U were higher in the Gaertner pit than in previous years, p. 43, 2011 Annual Report.

6.7.8 Waste Rock Management

Seepage from the Gaertner special waste pile shows annual As concentrations increased in 2011, relative to 2010, which was already high compared to other years, see Table 5.5, 2011 Annual Report, 2007-2011, 320.5ug/L, 83.7, 123.5, 7.3, 40.8 respectively.

Table 5-18 shows the water quality of seepage from this pit troubling. 226Ra has increased in more recent years (2.788 Bq/L average for 2011, compared to range of averages of 1.498 Bq/L to 2.594 Bq/L from 2007 to 2010), 2011 Annual Report.

6.7.9 Groundwater Monitoring Results

The average annual uranium concentration in groundwater at the Deilmann Waste Pile was 250 mg/L in 2011, see p. 61, 2011 Annual Report. While is no Canadian standard for uranium in groundwater, this level is 1190 times greater than what is allowed in Arizona with a groundwater standard of 0.21 mg/L.

6.7.10 Cumulative Impacts and Standard Setting

There is little discussion of cumulative impacts in any of the materials presented by either Cameco or CNSC staff. Cameco did undertake to conduct a regional impact assessment of water releases to the Wheeler River and Delta Lake sub basin, including the establishment of comprehensive baselines, see Project Specific Guidelines Scoping Documents, Cameco, Draft February, 2011, p. 21

Comprehensive cumulative impact assessment would account for the increasing exceedences above what regulatory limits exist and risk of accidents as the proposed overall level of mining activity increases. An adequate EIA would be truly based on the possible 'worst-case' local and transboundary releases from the current six Northern Saskatchewan uranium sites with detailed contingency plans and cost estimates. There is a concern that contingency plans may be abandoned if costs are high.

But frankly it is not enough to require Cameco to estimate its contamination levels and measure its performance or potential liability by determining if it meet its own estimate or was at least not releasing relatively more pollution than years before. This is especially true when Cameco seeks an expansion of production of some 33 percent. As we have shown Cameco is already severely out of compliance with both air and water related release limits, where they exist.

In other words, it is obviously inadequate to rely on Cameco to establish its action levels and hence the limits to the release of radiation and heavy metals into the environment. With respect, it is a failure of regulation to not establish in advance absolute, science-based limits to the environmental burden of at least mercury, cadmium, lead and radiation exposure. The Canadian government has specific international and regional obligations in this regard. It is also inadequate to rely on the general and the already unprotective public health limit of 1 mSv per year as a proxy for real environmental, including Arctic-related, regulatory constraints for the uranium industry.

The situation at the McArthur River and Rabbit Lake Mine is no less astonishing.

7. McArthur River Application

McArthur River is an underground uranium mine located in northern Saskatchewan. It contains the world's largest known high grade uranium deposit and as at August 31, 2012 has produced approximately 225 Mlbs U3O8 since the start of production in 1999. Cameco seeks a ten year extension of its licence based on the 1995 EIS. Over the ten year term of the licence application, Cameco intends to pursue the following activities

- expand nominal production capacity from 7.2 million kg/yr uranium to 9.6 million kg/yr uranium, resulting in a 33.33 percentage increase,
- construction of a fourth air shaft and/or ventilation raise located to the north of the Pollock (#1) Shaft, and
- installation of a new water treatment plant to assure capacity for future effluent treatment requirements.

Given the failure to designate this project, no new environmental impact assessment was required in this proceeding. On July 6, 2012, the new *Canadian Environmental Assessment Act, 2012* came into effect, changing the requirements for "low-risk" environmental assessments. As a result, the assessment of an increase in the McArthur River uranium mine production capacity was cancelled, see CNSC Revised Notice of Public Hearing, Aug. 21, 2012.

This was the decision despite a history of sloughing troubles at this mine. In 2003 and 2008 significant ground failures occurred resulting in a massive inflow of contaminated water into the mine. We also show an increasing trend in radiation and metals of uranium, lead, lead 210 and polonium 210 in Total Suspended Particulate air concentrations. Blueberries are contaminated with uranium.

Concentrations of arsenic, selenium, and uranium in water effluent have exceeded Saskatchewan Water Quality Objectives by 54 percent for arsenic, 700 percent for selenium and an astronomical 1, 230 percent for uranium. There is no reporting done on mercury.

The McArthur River mine site is located near Toby Lake in northern Saskatchewan, approximately 620 km north of Saskatoon, at approximate latitude 57° 46' north and longitude 105° 03' west, and about 40 km inside the eastern margin of the Athabasca Basin Region. Toby Lake is a small lake which is close to the mine site. Read Lake and Yalowega Lake are nearby lakes, see Map below at p. 35.

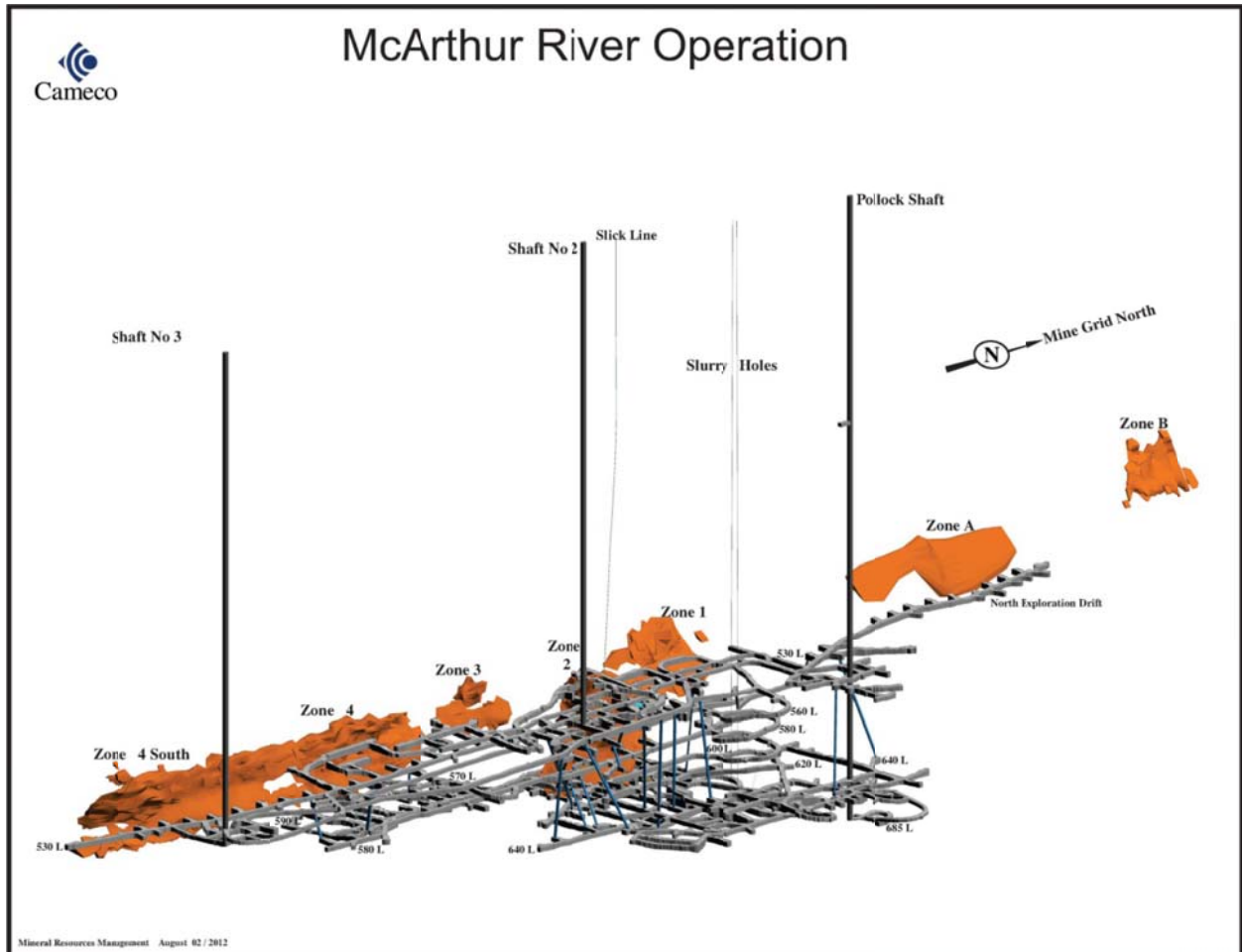
7.1 Mining Method

The deposit is located about 550 meters below ground and cannot be mined by conventional mining techniques. Therefore, the boxhole boring technique is used. The ore is crushed and ground underground and then hydraulically pumped to the surface for further treatment. The ore is trucked over a distance of 80 km and milled at the existing Key Lake mill.

Gamma, radon, radon progeny and long-lived radioactive dust hazards are all present at the McArthur River site. Typical controls used at the McArthur River Operation feature the low cost approach of direct

exhaust ventilation in the many dust and radon source areas, see p.8-9 Technical Report. The Figure below shows the current mine layout, see Figure18-1, Technical Report.

Figure 10: Processing of McArthur mineral reserves



The processing of McArthur mineral reserves is intended to supply the Key Lake Mill for the next thirty years, p. 11, Cameco McArthur Technical Report, 2012.

7.2 Trouble in the Air

Given the high uranium, radiation and metals content of the ore at McArthur, it is remarkable that Cameco may have its application approved to increase production and to construct a fourth air shaft and to the north of the Pollock (#1) Shaft without the need to conduct an environmental impact assessment, see Mining Facility Licensing Manual, Dec 2012, , p. 2-5. There is absolutely no information on anticipated air emissions from this additional air shaft to the local, let alone the regional and transboundary environments.

Currently two ventilation systems are used to ventilate the underground environment. The primary ventilation system is driven by surface exhaust fans that draw fresh air down through the shafts, through the main workings underground, and then up the shafts to be exhausted to the surface environment.

As we show, even at current production, radiation and metals levels and concentrations significantly increased in 2009 compared to previous years.

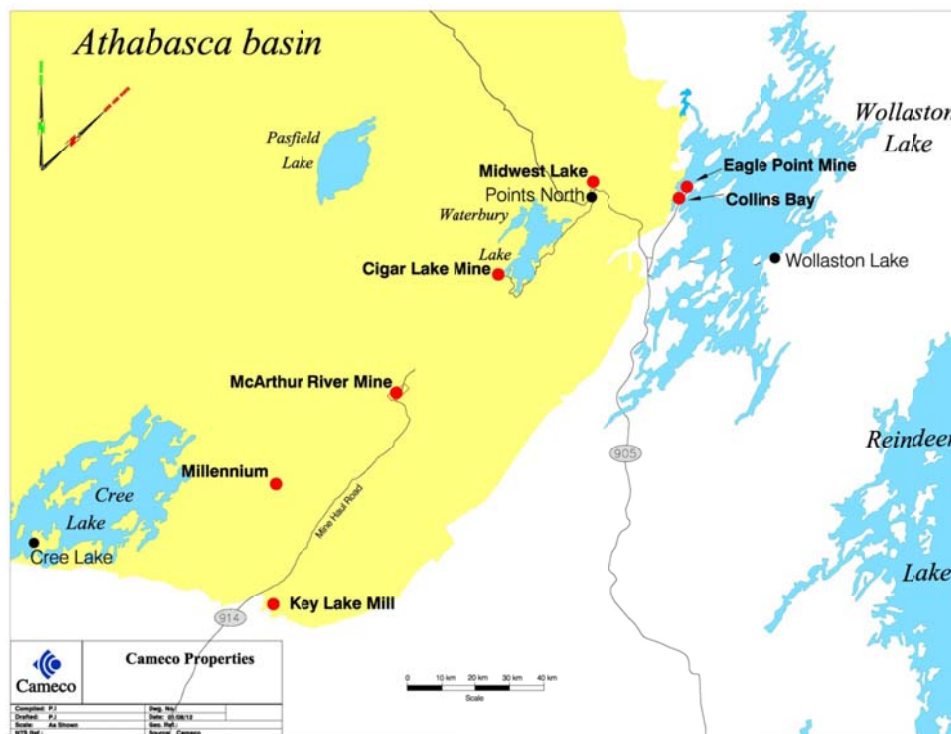
7.3 Trouble in the Water

Release of McArthur River effluent to Read Creek and Beyond

The ore that is mined at McArthur River, besides being extremely rich in uranium, is high in nickel and arsenic. McArthur River mine water is sent to a surge pond, treated and finally discharged to Boomerang Lake, about 1.5 km from the mine site. From there flow continues to Lucy Lake, Read Creek, May Creek, Little Yellowlegs Lake, and Yallowega Lake. It eventually reaches Waterbury Lake, Waterfound Bay, Black Lake, Fond du Lac, Lake Athabasca and the Beaufort Sea, see Map p. 34.

So called clean water from Shaft #3 was approved in 2003 for direct discharge to the environment, p. 3.2, Licensing Manual. As we show, this source has a significant negative influence on surface water quality, with exceedences in both mercury and cadmium releases.

Figure 11: McArthur River Site



Source: Figure 5-2 McArthur River Site – Regional Location, Technical Report

7.4 Trouble in the Food

Fish chemistry monitoring during 2005 and 2009 identified elevated levels of molybdenum, selenium, and uranium in the near-field exposure area as compared to the reference area.

Increased mining activity in and around the waste rock piles is a source of increased uranium observed in blueberry tissues near the McArthur River site due to air emissions .

7.5 What does Cameco Say?

The following review is taken from the McArthur River Operation: Status of the Environment Report 2005 to 2009, prepared by ECOMETRIX INCORPORATED on December 2010 (State of Environment Report, Set) and Cameco's McArthur River Operations Technical Report dated August 31, 2012(Technical Report). NPRI data was also obtained.

a. Air Quality

Potential atmospheric emissions from the mine include radon and dust released during operations. These emissions are derived primarily from the venting of the mine shaft and from temporary mine rock storage activities, p 3-3, SOE.

The 2010 State of Environment Report concluded that Radon levels (annual average) at stations in close proximity to the mine were in the range of 0.3 to 40.7 Bq/m³ and were on average 15.9 Bq/m³, see p. 3-5. It is important to note that the monitoring stations only considered the air quality at close proximity to the mine. There is no environmental air quality standard for radon, see Table 1.

TSP concentrations (annual average) over the current reporting period (2005 to 2009) in the vicinity of the mine were in the range of 11 to 28 µg/m³. The radiation and metals associated with TSP showed increasing levels of lead, Pb- 210 and Po-210 at these two stations and higher concentrations of lead, zinc and uranium at both stations were observed in 2009 as compared to previous years, p. 3.5, SOE.

It is troubling that the technical report provided by Cameco does not describe the thermal process related to the so called removal of molybdenum and selenium. Is this thermal process an incinerator? A type of fuel burning equipment? Cameco says the removal of these metals is thermodynamically controlled, and as such, the annual loading of these elements to the environment is independent of production rates within the mill, p. 133, Technical Report. More transparency on this significant process is urged. Commissioners may want to see that stack results of this thermal process, especially given Canadian obligations under the *Persistent Organic Pollutant's Protocol to LRTAP*, see p. 53 below.

b. Water Releases

According to the Status of the Environment Report, the most significant influence on surface water quality in the McArthur River Operation area is the release of "clean" untreated groundwater from Shaft #3 to dewater the mine directly into the environment and the treated mine waters that are also released directly into the environment at Boomerang Lake, see p. 3-12, SOE.

I. Mine Water Effluent

Metals

According to the Status of Environment Report that reviewed data from 2005 to 2009, Arsenic, selenium, and uranium have exceeded water quality guidelines, with molybdenum consistently being exceeded, see iv. The increase in arsenic and molybdenum is related to both increases in concentration and treated mine water discharge volumes, see p. 3.19, SOE.

Fish chemistry monitoring during this SOE period also identified elevated levels of molybdenum, selenium, and uranium in the near-field exposure area as compared to the reference area, p.v, SOE.

Concentrations of arsenic, selenium, and uranium in Station 2.3 have exceeded the SSWQOs as shown on TABLE 3-4-2, on occasion. In 2007, the maximum for arsenic (0.0077 mg/L) exceeds the Objective (0.005 mg/L) by 54 percent; the maximum for selenium (0.008 mg/L) exceeds the Objective (0.001 mg/L) by 700 percent; and the maximum for uranium (0.2 mg/L) exceeds the Objective (0.015 mg/L) by an astronomical 1,230 percent.

Note that despite a Saskatchewan Water Quality Objective for mercury in water quality of 0.026 ug/L, Cameco has not reported on this critical contaminate, nor apparently has SMOE or CNSC required it to, see Table 3-4-2, SOE and Table 2.

Radiation

At Stations 2.3 and 3.2 the mean radium- 226 levels during this SOE period were 0.04 Bq/L and 0.009 Bq/L, respectively. Background levels upstream of the mine are about 0.006 Bq/L., see p. 3.24 During 2005 to 2009, radium-226 levels remained relatively constant at around 0.06 Bq/L, except in 2008 where levels increased to 0.09 Bq/L, p. 3.18, SOE.

Levels of lead-210, polonium-210, and thorium-230 have generally been similar prior to and during production, although there was a temporary upwards excursion of each in 2002. During this SOE period (2005-2009) the levels of lead-210, polonium-210, and thorium-230 have remained at similar levels and have stayed constant over the past five years. Uranium was observed at 0.007 mg/L in 2009.

Lead 210 in effluent release was observed at concentrations above the predicted values, but no number is given, see p. 3.31, SOE. This matter should be clarified.

ii. Sediment Quality

Sediment samples from 2005 to 2009 for the lakes that received treated mine water show arsenic, molybdenum, selenium, and uranium exceeded the assessed benchmarks., see p.1v. Indeed concentrations for arsenic and selenium in East Boomerang Lake have doubled and tripled respectively since 2004, see p 3.34 and Figure 3.5-1, SOE.

Uranium and radium-226 were found to be increasing in sediments in the near-field in the previous SOE.

The uranium concentration in the sediment has continued to increase in all exposure lakes sampled, although more significantly in the exposure lakes (East Boomerang Lake, Unknown Lake, and Little Yalowega Lake). Uranium has dramatically increased in East Boomerang Lake from 100 mg/kg to 350 mg/kg and in Unknown Lake from 65 mg/kg to 150 mg/kg.

Radium-226 values in sediments in East Boomerang Lake were higher during this period than in previous periods; radium-226 levels increased from 0.04 Bq/g in 2004 to 0.1 Bq/g in 2007. In other lakes, the radium-226 levels have remained about the same compared to previous years.

Uranium and radium-226 concentrations in the sediments of East Boomerang, Unknown and Little Yalowega Lakes are above the reference lake values for the 2007 sampling period – 347 mg/kg, 140 mg/kg and 10.6 mg/kg respectively for uranium as compared to 8.3 mg/kg at Lower Read Lake, and 0.1 mg/kg, 0.1 mg/kg and 0.05 mg/kg respectively for radium-226 as compared to 0.01 mg/kg. p. 3.35, SOE.

iii. Terrestrial Ecology - Trouble in the Food

Blueberry plants in the vicinity of the McArthur River mine accumulated uranium in stems and twigs above background levels. Uranium concentrations have shown variability over time in response to levels of surface activity at the McArthur River site. Blueberry uranium concentrations were greater at locations in close proximity to the waste rock piles. Uranium accumulation in blueberry twigs and stems was attributed to uptake from soil and the subsequent translocation from the root system.

The results provided a clear indication that increased activity in and around the waste rock piles can be a source of increased uranium observed in blueberry tissues near the McArthur River site due to emissions of TSP, see p. vi, SOE.

iv. Waste Management

Non-contaminated domestic and industrial materials are either disposed of in a landfill where waste management practices are applied or the material is incinerated. Despite best efforts we have not been able to find out any details of incineration at this or the Key Lake facility. Commissioners would benefit from full disclosure on the impact of this equipment, especially given Canadian commitments under the *POPs Convention*, see p. 53.

Radioactively contaminated materials may be shipped to the Above Ground Tailings Management Facility at the already overburdened Key Lake operation, see Key Lake Application above.

In summary, even at current production and waste capacity we have shown an increasing trend in radiation and metals of uranium, lead, lead 210 and polonium 210 in air concentrations. Blueberry plants are contaminated with uranium, a tradition use and food of First Nations. Concentrations of arsenic, selenium, and uranium in water effluent already exceed the Saskatchewan Water Quality Objectives, with uranium at 1,230 percent above! There is no reporting done on mercury. Yet Cameco seeks to increase production by 33 percent and install yet another air shaft?

Without environmental standards, verified reporting and assessment especially for mercury, cadmium, lead and uranium releases to the air, water and land, CNSC may be out of compliance with the Canadian *Nuclear Safety and Control Act* should it approve this application, see above Failure to Regulate.

8. Rabbit Lake Application

Rabbit Lake is the longest operating uranium mining and milling facility in Saskatchewan. Cameco's application seeks to extend the operation an additional ten years, requiring the expansion of current tailings capacity from 9 cubic meters (Mm³) to 12 Mm³, significant 33.33% increase. The current licence authorizes Cameco to operate an active underground uranium mine (Eagle Point Mine), three inactive and flooded open-pit mines, a mill and various mine and mill waste management systems. The last EIA was done in 1992.

In 2009 CNSC approval was given to expand the pit crest to accommodate mining at Cigar Lake and at Eagle Point within the Rabbit Lake site. In 2011 processing for Cigar Lake was transferred to the McLean Lake mill. Production of Eagle Point continues and remains the primary source for the Rabbit Lake mill. Given the cancellation of ore from Cigar Lake for processing at Rabbit Lake, as well as the already overburdened environment at Rabbit Lake, there is every reason to deny the application and to proceed with the early and orderly decommissioning of the Rabbit Lake mill and mine.

Despite a dam between the site and Collins Bay that drains into Wollaston Lake, in 1989 2 million litres of radioactive water spilled into Wollaston Lake. The Inter Church Uranium Committee was unsuccessful on appeal in opposing Cameco's proposal to flood the Rabbit Lake open pit mine by opening that dam that separated it from Wollaston Lake. CNSC approved the tear down of the dam permitting radioactive and heavy metal contaminated water and particles to move into the Lake (Radio Canada Aug. 11, 2003).

Cameco admits that the mean concentrations in surface water of arsenic, copper, lead and uranium and radium-226 during 2000-2005 were above applicable water quality criteria (SSWQO) at Link Lakes.

The uranium concentrations in the release of mine and mill effluent, including from the AGTME, measured at 160 ug/L and is extremely high when compared with the limit to protect aquatic life at 15 ug/L, more than ten times greater in concentration.

We also show there has been a sharp increase of uranium loads in Wollaston Lake's Hidden Bay sediments near the Rabbit Lake mine. Using Cameco's own data we show as of 2007, there has been an outrageous increase in uranium contamination of Hidden Bay's sediment at Wollaston Lake of 9,233 percent since 1992.

Again according to Cameco's own data, there has been an extreme increase in uranium concentrations in lichen near the D-Zone pond, one of the three flooded open pits at the site, by 2,167 percent and of radiation by 3,400 percent respectively between 1992 and 2007.

In addition to not reporting on at least the mercury, cadmium, lead and radiation, including polonium and cesium-137, air releases from the Yellowcake drying equipment, Cameco does not report on groundwater quality as it is also not an SOE requirement, see p. 1-2, SOE.

The numbers show huge air emission increases for radiation, including thorium 230 and radium 226, as well as uranium. It is no surprise that Cameco did not, nor was it required to, report on the stack emissions from its Yellowcake dryer equipment for at least mercury, cadmium and polonium air releases.

In this application CNSC did not hold public hearings to consider the proposed Guidelines Scoping Document in preparation of an Environmental Impact Statement . Cameco intends to continue the life of the Rabbit Lake Operation to 2028 or longer by extending the tailings storage capacity at the Rabbit Lake Tailings Management Facility (RLTMF), see CNSC Notice of Hearing, May 24, 2012.

The federal environmental assessment was cancelled for Rabbit Lake Tailings North Pit Expansion Project as a result of change in legislation. On July 6, 2012, the new *Canadian Environmental Assessment Act*, 2012 came into effect, changing the requirements for "low-risk" environmental assessments. As a result, the EAs underway of these projects are no longer required under the former CEA Act; the assessment of the Rabbit Lake Tailings North Pit Expansion Project was cancelled.

8.1 Geographic Context

Regionally, the Rabbit Lake Operation is situated on a major continental drainage divide which includes the Mackenzie River drainage system to the north and the Churchill River drainage system to the south.

Local streams from both drainage systems discharge to Wollaston Lake, which drains naturally in two directions. The Fond du Lac River flows northwest from the northwest corner of Wollaston Lake into Lake Athabasca and the Mackenzie River system. The Cochrane River initially flows northeast from the northeast end of Wollaston Lake, but eventually courses south, to Reindeer Lake, which in turn drains to the Churchill River and ultimately to Hudson Bay. About 85 to 90% of the water from Wollaston Lake is discharged through the Cochrane River and the remainder through the Fond du Lac River, see p. 3-5 Project Description, citing Environment Canada 1970; Mackenzie River Basin Committee 1981, see map above at p. 18.

In terms of site drainage, Horseshoe Creek drains south and eventually discharges into Hidden Bay on Wollaston Lake. Contaminated and process water generated at the Rabbit Lake Operation (i.e. drainage

from waste rock piles, mineralized waste and ore stockpiles, mine water from Eagle Point, raise water from the existing RLTMF, surface runoff and some seepage flows from the AGTMF, mill process water) is directed to the effluent treatment system and discharged to the headwaters of Horseshoe Creek. Station 2.3.3 has been designated as the final point of operational control for the treated effluent before flowing through Links Lakes, near Collins Bay, to Wollaston Lake, p. 3-6 and Figure 3.3.3.-1, Cameco Rabbit Lake Project Description, 2011.

8.2 Human Populations

In determining which First Nations and Métis Locals ought to be engaged on applicable projects at the Rabbit Lake Operation generally, Cameco assesses whether or not and to what degree, applicable northern First Nations and Métis Locals could be adversely impacted by projects and activities pertaining to the Rabbit Lake Operation in relation to any impact of the following categories (as a minimum): Trapping, hunting and fishing activities; Food/medicine gathering activities; Sacred cultural sites; Any applicable watershed; Any applicable airshed; Commercial fishing activities; Commercial trapping activities; and Outfitting, tourism, or lodge-related interests.

Historically and based on known information at the time of writing, the following First Nations are the ones that Cameco has and continues to focus on primarily in relation to its public participation programming for the Rabbit Lake Operation: Black Lake Denesuline First Nation; Fond du Lac Denesuline First Nation; and Hatchet Lake Denesuline First Nation.

In addition to these three Athabasca Basin-based First Nations, there are others who over the years have both expressed some interest in and who have received project-specific information regarding the Rabbit Lake site from Cameco including English River Denesuline First Nation, Lac La Ronge Cree Indian Band, and the First Nation Community of Southend (which community is a semi-autonomous sub-community of the Peter Ballantyne Cree Nation), p. 5-3, Project Description.

To ensure applicable Métis rights and interests are identified in relation to Cameco projects and activities, Cameco has engaged the applicable Métis Regions in addition to Métis Locals, each generally organized under the governance structure of the Métis Nation of Saskatchewan (MNS). In 2010, Cameco entered into a Memorandum of Understanding with four Saskatchewan Métis Regions: MNS Northern Region I; MNS Northern Region II; MNS Northern Region III; and MNS Eastern Region I.

Cameco makes these remarks on the Crown's Duty to Consult. The goal of any constitutional Crown consultation process in the Aboriginal context is a reasonable determination of whether or not and to what degree, a proposed project may adversely impact the exercise of any applicable Aboriginal or Treaty rights and, if it may, the development of a reasonable accommodation strategy that seeks to avoid, minimize or mitigate any such impact, p. 5-7, Project Description.

8.3 Potential for Novel Adverse Impact to Rights

When it comes to proposed projects in relation to an existing operation like the Rabbit Lake Operation, Crown consultation and/or accommodation obligations are triggered if it can be demonstrably

established that such projects have the potential to cause novel or new adverse impact to the exercise of Treaty or Aboriginal rights. Cameco says it will assist the Crown by assessing throughout this entire EA process whether or not there is any potential for the Project to adversely impact the exercise of Treaty or Aboriginal rights.

In its “First Nation and Métis Consultation Policy Framework” (June 2010), the Saskatchewan government mandates the consideration of three substantive tests to gauge the potential for any proposed project to adversely impact Treaty and/or Aboriginal rights: (1) whether or not the proposed project may result in an applicable land disturbance (short-term or long-term); (2) whether or not the proposed project may result in a change in applicable resource availability (i.e. the exercise of certain Treaty or Aboriginal rights will be adversely impacted if resources such as animals, fish, herbs or berries are impacted or diminished in number); and (3) whether or not the proposed project requires a new uptake in land (i.e. land that may be previously have been unoccupied). If adverse impact to rights is anticipated in accordance with any of these three metrics, then the next step is to assess the magnitude or extent of any such impact.

The facts underlying the public health and environmental crisis we reveal at the three sites of Cameco’s applications, and as supported by AMAP and UNEP data, would seem to support a novel right or interest in air and water sheds, as well as traditional uses such as hunting, fishing and berry gathering.

8.4 Public Health

No information is currently provided in the materials respecting Community Health and facility services but is promised to be made available in a regional study area assessment, see p. 3-17, Project Description.

Cameco does admit, however, that the extended operation of the mill may result in public exposure to emissions of radon-222, to radon decay products -lead-210 and polonium-210 - and associated metals, and to radon gas from both the surface layer of tailings slurry and during degassing of raise water of tailings from the North Pit Expansion, see p. 4-64, Project Description.

8.5 What does Cameco say?

8.5.1 Mining and Milling Method

Mining at the Rabbit Lake Operation has included both open pit and underground mining. Of the five deposits mined to date, four were open pit operations. Mining at all four open pits has been completed (i.e. the Rabbit Lake, B Zone, D Zone and A Zone pits). Only the Eagle Point underground is currently active. Ore extracted during mining at Eagle Point is moved to an ore storage pad at the mill or to the B Zone ore stockpile pad. “Special waste” (i.e. radioactive mine rock that has non-economic uranium content) is also transported from Eagle Point to the ore pad at B Zone.

Waste rock that cannot be used readily underground for backfill purposes is moved to the surface and placed on the waste rock storage pad at Eagle Point. Mineralized rock, that is rock still containing

uranium and arsenic is moved to B Zone ore pad, already approved for storage of hazardous waste, p. 2-15, Project Description.

8.5.2 Air Releases

Atmospheric sources of emissions at the Rabbit Lake Operation include at the Eagle Point mine, the existing RLTMF, where the tailings slurry and raised water contains radon gas and gamma radiation, and the Rabbit Lake mill complex, including the acid plant. Other sources include the waste rock piles, ore storage pads, and the AGTMF.

According to Cameco, at Eagle Point, total suspended particulate (TSP) and radon-222 are the main air quality issues of concern, the main source of which is the mine ventilation exhaust. Monitoring of TSP and radon-222 is carried out at Eagle Point to measure the effects of the exhaust on local air quality, p. 2-11. Note no consideration is given to regional air sheds or zones.

At the existing RLTMF, fresh tailings are placed by subaerial discharge, subaqueous discharge or injection. Cameco maintains that all three methods essentially “eliminate TSP emissions and reduce radon gas emissions”. Raise water drawn from the bottom of the partially filled pit is pumped to a valve chamber where radon gas is also released to the atmosphere prior to pumping the water to the mill for use in processing ore.

Emissions from the Rabbit Lake mill complex and associated out-buildings are mainly controlled with exhaust fans and ventilation to the atmosphere. Radon-222 and its progeny within the mill complex and again according to Cameco, provides an effective mechanism to capture radon gas and allow it to be released to the atmosphere in a controlled fashion, see p.2-10, Project Description.

The 2010 State of the Environment Report prepared by SENES and referred to below, finds radon 222 levels at the AGTMF are high. Yet Cameco was permitted to discontinue the air quality monitoring program there claiming the radon-222 levels were low and that further monitoring was not warranted, see p. 3-2, Project description. The CNSC is urged to review that decision.

In the yellowcake drying and processing area, exhaust air is passed through venture scrubbers to minimize emission of uranium bearing particulate. Air is drawn from the loading and the lid stations, keeping the packaging stations and dryer area at a negative pressure, p. 2-11.

The Mill’s air emissions from the various exhaust stacks were sampled by the Saskatchewan Research Council in 2007. The three stacks sampled included the dryer scrubber, dust collector in the dryer area and the yellowcake packaging scrubber. The monitoring requirements included analysis of arsenic, copper, lead, molybdenum, nickel, uranium, zinc, lead-210, radium-226 and thorium-230, see p. 3-3, Project Description.

Note the failure to include an assessment of mercury, cadmium and polonium releases. At the time of writing we have not been provided with a copy of this report and a more current 2010 report may exist. Moreover the scope of Cameco’s limited study area of concern is a mere 10 km radius around the Rabbit Lake mine, see p. 4-2, Project Description. Commissioners are urged to review the latest SRC reports.

8.6 What do the numbers show?

The following information is taken from RABBIT LAKE OPERATION INTEGRATED ENVIRONMENTAL RISK ASSESSMENT AND STATE OF THE ENVIRONMENT REPORT 2005-2009, SENES Consultants Limited, Dec 2010, SOE Report. NPRI data was also obtained and reviewed. The Report notes that an assessment was not done for groundwater quality as it is not an SMOE requirement, see p. 1-2, SOE.

Details of the air quality monitoring program at Rabbit Lake are shown in Table 3.1.1-1, which summarize what Cameco believes is its regulatory limits to air releases, also see Table 1.

8.6.1 Source Sampling

Relative to mean particulate concentrations that were emitted from each air emission stack in 2004 (1.8 mg/drm³ from the dryer scrubber; 0.8 mg/drm³ from the dust collector; and, 0.8 mg/drm³ from the yellowcake packaging scrubber), particulate concentrations measured in November 2007 were higher. Radium -226 ranged from 0.013 to 0.057 Bq/drm³, with a range up to 334 Bq/h. The mean uranium emission from all three stacks at the site was also higher in November 2007(0.269 g/h) relative to the 2004 value of 0.050 g/h, see p. 4-11 and Table 4.3.3-3., above and SOE Report.

In general the SOE report found that by comparing the isopleths to a baseline radon-222 level of 15 to 20 Bq/m³, it is evident that the incremental effects of the sources of radon -222 from all facilities it would be indistinguishable from the baseline conditions beyond a few kilometres of the sources, p. 4-3 and see Figure 4.2.1-1.

With respect, the fact that the incremental loading from this project may be indistinguishable from the background does not address the fact that the historic loadings may be too high to begin with, and the standards are too low in any event, with both local and global impacts.

Again we have not received disclosure of the more current SRC stack air emissions studies.

We show there has been a sharp increase of uranium loads in Wollaston Lake's Hidden Bay sediments near the Rabbit Lake mine. While natural uranium levels in the lake sediment are below 3 µg/g, levels in Hidden Bay reached approximately 25 µg/g in 2000, and have more than doubled each year since, see Wollaston Lake, Athabasca Working Group Environmental Monitoring Program 2003. 2004 and 2005 sampling showed uranium levels in the Lake sediment of approx. 90 µg/g, approximately 30 times background and in 2008, the level reached a severe load of approximately 280 µg/g, see Wollaston Lake, Athabasca Working Group Environmental Monitoring Program 2005 and 2009. Note that this is an increase of 2,900% from 2000 to 2005 and an unbelievable 9, 233% increase from 2000 to 2009.

Overall, in 2007, the highest concentrations of all metal and radionuclide constituents in lichen were measured at a location near the D-Zone pond and adjacent to the haul road leading to the Eagle Point mine. The concentration of most constituents (i.e., nickel, uranium, radium-226 and thorium-230) was elevated relative to regional baseline values. p. ES-7 and 8-13, Figure 3.1.1-2, SOE.

The Table below shows the percentage increase of the concentrations of metal and radionuclide in lichen constituents versus regional baselines near the D-Zone pond, one of the three flooded open pits at the site.

Figure 12: Percentage increase of the concentrations of metal and radionuclide in lichen constituents versus regional baselines near the D-Zone pond

Element	Measurements in 2007 including notable exceptions (SOE, 2010)	Regional baseline (Cameco, 1992)	Percentage Increase
Ni	1.3-1.5ug/g	0.5-0.6ug/g	Up to 200%
U	0.95-6.8ug/g	0.3-0.7ug/g	Up to 2167%
Ra226	14-140Bq/m3	4-8Bq/m3	Up to 3400%
Th230	2-8mBq/g	0.6Bq/m3	Up to 1233%

According to Cameco’s own data, there has been an extraordinary increase in uranium concentrations in lichen near the D-Zone pond by 2,167 percent and of radiation Ra 226 by 3,400 percent and thorium -230 by 1,233 percent respectively between 1992 and 2007.

These are indeed troubling numbers showing sometimes crisis level increases in air emissions radiation, including thorium 230 and radium 226, as well as uranium. Imagine a 33 percentage increase if the expansion application is approved?

Despite its own admission that the extended operation of the mill and of the tailings system will result in incremental and residual increases in radon, TSP and uranium, see p. 4-19, Cameco’s position is that no further environmental assessment is required of the expected air emissions to the atmosphere, deposition to the surface waters and/or to sediment quality or aquatic biota (p. 4-41) from the Rabbit Lake Operation, see Table 4.3.2-1, p. 4-36. Unless the Commissioners decide otherwise, the atmospheric aspects will not be addressed by the company in the EIS because, ‘the effects are expected to be low in magnitude, local in geographic extent, medium term in duration and reversible’.

8.6.2 Water Releases

Mine water from the underground Eagle Point mine is pumped to a sedimentation pond on the surface prior to being pumped, along with contaminated water from the existing RLTMF raise water, mill process effluent and site drainage and seepage from the AGTMF, to the Rabbit Lake mill for treatment, see p. 3-8 Project Description. After neutralization with lime, the final liquid effluent is released to Horseshoe Creek, Station 2.3.3 through Weir #3 which is the final control point and the effluent compliance monitoring point, see p.2-10 and p.3-8, Project Description. Cameco has obtained approval to develop a second discharge point at Eagle Point, see Rabbit Lake Tailings N Pit Expansion Project, Project Description, Cameco, June 2011, p. 2-3 Project Description. We have no information on the assessed impacts of this new discharge point.

Presently, there are two tailings management facilities at the Rabbit Lake Operation: the Above Ground Tailings Management Facility , AGTMF that contains tailings and is also designated as a waste disposal area for contaminated solid waste; and, the existing RLTMF.

8.7 What does Cameco say?

Cameco admits that the mean concentrations in surface water of arsenic, copper, lead and uranium and radium-226 during 2000-2005 were above applicable water quality criteria (SSWQO) at Link Lakes, Station 1.2.5. Yet it maintains there will be no significant effect on water quality from the expansion of Rabbit Lakes' production and tailings capacity, see p. 3-8 Project Description.

8.8 CanNorth

In 2010, an aquatic investigation (including sediment quality and benthic invertebrate and fish community surveys) was completed by CanNorth (2011) to establish baseline conditions in the Four Bear Pond study area. Sampling of Four Bear Pond yielded no fish despite multiple sampling methods. According to Cameco, this finding indicates that Four Bear Pond is not a fish bearing water body, p. 3-10. With respect, it could also indicate that the habitat for fish has been destroyed and/or that the scientific credibility of CanNorth is suspect. CanNorth also completed an aerial survey for ungulates finding both moose and caribou.

CanNorth is part of the Athabasca Working Group program that monitors locally important receptors in regards to air quality, water quality, sediment quality, vegetation, fish and wildlife at six study areas located in close proximity to the participating communities (Wollaston Lake, Hatchet Lake Denesuline First Nation, Black Lake Denesuline First Nation, Stony Rapids, Fond-du-Lac Denesuline First Nation, Uranium City and Camsell Portage). Monitoring is carried out by, or with the help of, members of these communities. Cameco Corporation and AREVA Resources Canada Inc. provide funding support for the program, but overall management of the program is undertaken by Canada North Environmental Services Limited Partnership (CanNorth), a First Nation-owned environmental services company, see p.3-19, Project Description.

It is in Cameco's interest to discount the ecological value of the Four Bear Pond. According to Cameco, the construction phase activities of this application, the collection of raise water during operating and decommissioning phases will change local surface water flow patterns in the Links Lake watershed; surface runoff in the area of the North Pit Expansion will be reduced as a result of drawdown of the groundwater table and interception of direct precipitation (i.e. until pumping and treatment of raise water is no longer required). Cameco says a drawdown will likely lower the water level of Four Bear Pond see p. 4-24, Project Description.

It is noted by Cameco that CanNorth found there are no fish present in Four Bear Pond and that it is not hydraulically connected to any other water body; hence, any potential effect on the water level in the pond would have minor consequences.

CanNorth has also found no impacts from Cameco's Rabbit Lake operation to environmental, public health or traditional uses of the land, including the important nutritional practice of the hunting of wildlife and the gathering of blueberries and bog cranberries.

While data collected over the 2000 to 2007 period showed differences between monitoring locations, CanNorth (2008) concluded there are no obvious environmental or human health concerns. Data collected on wildlife samples (caribou and moose) were found to be characteristic of pollution levels in species collected elsewhere. Likewise, concentrations of the key constituents in vegetation samples (blueberries, Labrador tea and bog cranberries) were found to be fairly consistent over time and to be similar to levels measured in plants collected near other northern communities. Finally, radon levels measured at two locations near the Wollaston Lake communities allegedly remained low but varied naturally from season-to-season. The data collected in each of these programs is promised to be discussed in greater depth in Cameco's EIS, p. 3-20. Project Description.

But as we review below, the State of Environment report found mean polonium-210 and radium-226 concentrations were higher in both flesh and bone tissue samples in fish from the BZone pit lake than from Collins Bay. Specifically, polonium-210 and radium-226 on average were twenty-four and thirty-four times higher in flesh tissue and sixteen and fifty-seven times higher in bone tissue, respectively. Despite CanNorth's assurances otherwise our conclusions about impacts are significantly less optimistic. We also recall the CNSC approved the removal of the dam separating the site from Collins Bay.

8.9 What the numbers show

8.9.1 Water Quality

Collins Creek and Collins Bay – Release from site to Wollaston Lake

Recall also that the State of Environment Report found mean polonium-210 and radium-226 concentrations were higher in both flesh and bone tissue samples in fish from the BZone pit lake than from Collins Bay, see ES-7, SOE, 2010.

Horseshoe Creek and Hidden Bay – Release of mine and mill effluent, including the AGTMF

The influence of the treated effluent was apparent in Horseshoe Creek especially at Station 3.1 (Horseshoe Pond), which is located approximately 2 km downstream of the discharge point. Constituents of particular concern in Horseshoe Creek were molybdenum, selenium, and uranium, which remained above surface water quality criteria at both Horseshoe Creek monitoring stations (Stations 3.1 and 3.2). Radium-226 concentrations increased significantly at Station 3.2.2 at Hidden Bay, p. 5-15, SOE.

The uranium concentrations at Station 3.2.2 at 160 ug/L are extremely high where the limit to protect aquatic life is 15 ug/L, more than ten times greater in concentration, see Table 5.2.2-8 and p. 5-88.

Link Lake and Pow Bay – Mill and In Pit Tailings Management Facility (RLITMF)

Uranium concentrations remain above the surface water quality standard of 15 µg/L throughout the system ranging from 67 to 130 µg/L, 4 to 8 times greater in concentration than permitted by law. While exceedances of available water quality criteria were not noted for radionuclides other than lead-210 at any of the stations, radionuclide concentrations (including radium-226) were relatively high throughout the Link Lake system, especially when compared to concentrations measured in the Collins Creek and Horseshoe Creek watersheds, p. ES-3

As can be seen from Table 5.2.3-1, exceedances of water quality criteria were noted for several metals, radionuclides and pH. In particular, the mean concentrations of arsenic (12 µg/L), copper (0.0038 mg/L), uranium (80 µg/L) and lead-210 (0.16 Bq/L) measured over the SOE period exceeded respective water quality criteria, while radium-226 and thorium-230 each exceeded the criterion on one occasion. The mean concentration for lead (0.0013 mg/L) exceeded the criterion as well, but many of the lead exceedances were due to the MDL value being higher than the criterion prior to 2007.p 5-17.

While water quality criteria for protection of aquatic life are not available for most radionuclides other than lead-210, radionuclide concentrations (including radium-226) were relatively high throughout the system, especially when compared to concentrations measured in the Collins Creek and Horseshoe Creek watersheds p 8-4

Parks Lake Watershed – Release of effluent from the AGTMF

Mean concentrations of copper, selenium and particularly uranium and general water chemistry constituents (un-ionized ammonia, hardness, and sulphate) exceeded respective water quality criteria in RLAGTMF seepage at the north dam (Station 2.5.1).

Despite this known source of radiation and heavy metals contamination that exceed what standards exist, the State of Environment report recommended that stations five stations - EM-3, EM-5, EM-7, EM-9, and EM-25 - be dropped from the Wollaston Lake radon-222 monitoring program, and that three stations - EM-7, EM-9, and EM-25- be dropped from the lichen monitoring program, see 8-13. The lichen monitoring program is critical to assessing atmospheric deposition of radiation and heavy metals. The CNSC is urged to reject these recommendations to discontinue key aspects of the radon 222 monitoring program.

8.10 Cumulative Effects

There has been scant attention paid to the cumulative effects on public health and the environment related to this application. This observation is particularly germane given that the same corporation is the primary owner and operator the current Northern Saskatchewan uranium mines.

Cumulative effects are defined as effects that are likely to result from a project in combination with other current or planned projects or activities. Cameco does admit that certain residual effects of the Rabbit Lake North Pit Expansion have the potential to contribute to cumulative effects through interaction with other existing developments in the region—the nearest being the McClean Lake mine

which is approximately 23 km from the Rabbit Lake Operation. Both operations are situated near Wollaston Lake. The Key Lake operation is also located within the watershed boundaries of Wollaston Lake, approximately 165 km from the Rabbit Lake Operation. Potential sources of effects which may contribute to cumulative effects include air emissions, water releases, and disturbances to wildlife, see Table 4.3-1 and p. 4-80, Project Description. But the company assures the current application, if approved, would not measurably contribute to cumulate effects, p. 4-81, Project Description.

Cameco fails, however, to consider the incremental cumulative as well as bioaccumulative and transgenerational effects of its uranium projects on human health and the environment discussed below.

In summary, given the currently extreme exceedences in air and water releases to an already overburdened environment, and the cancellation of ore from Cigar Lake for processing at Rabbit Lake, there is every reason to deny the application and to proceed with the early and orderly decommissioning of the Rabbit Lake mill and mine.

9. Arctic Impacts and Obligations

The Canadian government's failure to effectively regulate the uranium sector has consequences not only locally in Saskatchewan but also regionally in the Arctic and beyond. We outlined the facts that support a call for the Arctic Council to urge the Canadian government and the CNSC to show leadership and require Cameco conduct to comprehensive environmental impacts assessment of the three applications. Our focus here is on the current and expected increases of air and waterborne releases of mercury, cadmium, lead and uranium and radiation.

The reason for this focus is that the government of Canada has legal obligations to the regional and global community to give notice, assess, reduce and where possible eliminate and mitigate the negative effects of likely transboundary pollution, and these contaminates in particular.

Indeed and according to the Arctic Monitoring and Assessment Program (AMAP), the metals in the Arctic biosphere of greatest toxicological concern for individual animals and humans continue to be mercury (Hg), cadmium (Cd), lead, selenium and arsenic, AMPA 2003 Chapter 7 p.128 and AMAP 2011.

Yet Cameco is not required to report mercury emissions to the atmosphere, the general radiation standard is a poor and unprotective proxy and mercury, uranium and cadmium are merely identified as an "effluent characterization" not subject to specific limits or targets. There is no limit for uranium in groundwater. Even where there are limits, Cameco is allowed to wildly exceed them without consequence.

9.1 The Fragile Arctic Environment - Atmospheric transport of pollutants

To many Canadians, the Arctic represents a pristine environment. But this is not the case. Air and water currents carry pollutants from all parts of the Earth to the Arctic. The fragile ecosystem of the Arctic and

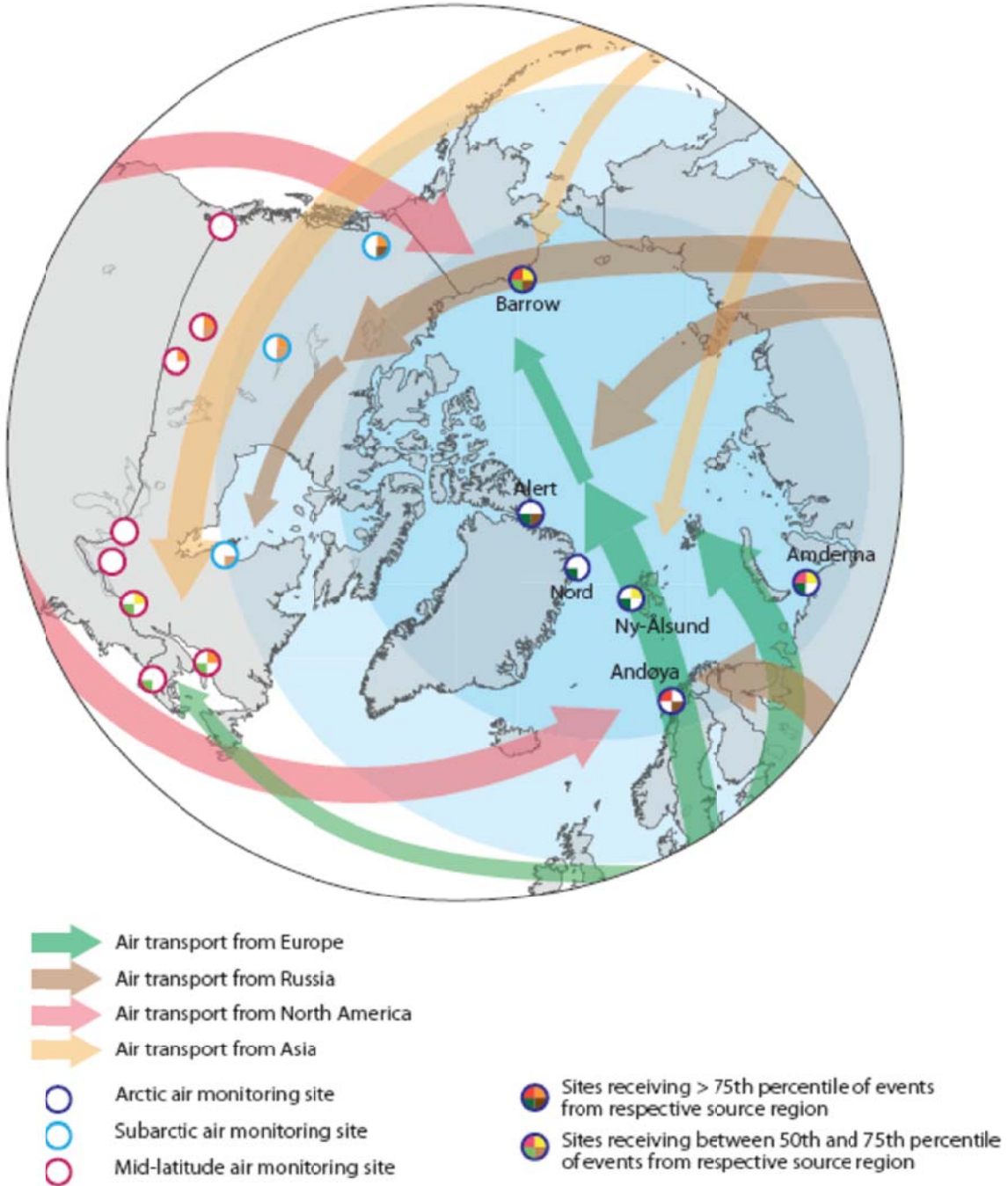
its peoples are directly affected by the actions and inactions of nations, industries and other people both near and far.

Geographical Coverage

There exist many different definitions of 'the Arctic'. In order to establish a geographical context for its assessments AMAP has defined a regional extent based on a compromise among various definitions. The 'AMAP area' essentially includes the terrestrial and marine areas north of the Arctic Circle (66°32'N), and north of 62°N in Asia and 60°N in North America, modified to include the marine areas north of the Aleutian chain, Hudson Bay, and parts of the North Atlantic Ocean including the Labrador Sea. Cameco's Rabbit Lake Mine and Mill is at 58 degrees latitude, clearly within the sub circumpolar region.

Since the first AMAP Assessments in 1997, the concern about heavy metals and radioactivity has been central theme. Major heavy metals of concern to AMAP are mercury, cadmium, and lead. All three can be toxic at levels that are only moderately above background levels. The Arctic region is a particular recipient of heavy metals generated in other regions because they are carried on particles that stay suspended in the cold polar air. The map below shows how atmospheric transport of pollutants effect the Arctic. Source: AMAP 2002.

Figure 13: Atmospheric transport of pollutants in the Arctic



Source: Figure 2.20. Dominant air transport pathways for mercury into the Arctic from major source regions, with an indication of the contribution from these source regions at specific monitoring locations. Source: after Durnford et al. (2010).

We review below the major instruments and scientific assessments that are relevant to Cameco's current applications before the CNSC.

9.2 1991 Declaration on the Protection of the Arctic Environment and Creation of the Arctic Council.

In 1991, the eight circumpolar nations endorsed a Ministerial *Declaration on the Protection of the Arctic Environment* and an Arctic Environmental Protection Strategy. The Strategy focused on four program areas: monitoring and assessment of pollutants; conservation of plants and wildlife; protection of the marine environment; and emergency prevention, preparedness and response.

The eight circumpolar nations that endorsed the Arctic Environmental Protection Strategy formalized their collaboration with the creation of the Arctic Council in 1996; Canada served as its first Chair and is now the current Chair as of May, 2013 for a two year term. For a general history of Arctic governance, Linda Nowlan, Arctic Legal Regime for Environmental Protection, IUCN Environmental Policy and Law Paper No. 44, 2001.

Under the *Declaration*, Canada and the other circumpolar nations committed to implementing the components of the Arctic Environmental Protection Strategy, including the Arctic Monitoring and Assessment Programme (AMAP). Under this program, the circumpolar nations have undertaken to "monitor the levels of, and assess the effects of, anthropogenic [human-made] pollutants in all components of the Arctic environment". We rely on the Declaration in this proceeding.

As one of the Strategy's key components, the AMAP studies and documents the nature and extent of pollutants in the North as well as their transboundary sources and pathways into the Arctic. This research provided most of the scientific justification of the need for international controls on sources of Arctic pollution such as international protocols on heavy metals and persistent organic pollutants under the United Nations Economic Commission for Europe *Convention on Long-Range Transboundary Air Pollution* (LRTAP).

9.3 1991 Convention on Environmental Impact Assessment in a Transboundary Context (Espoo, 1991)

Environmental threats do not respect national borders. Governments have realized that to avert this danger they must notify and consult each other on planned activities likely to have significant adverse environmental impact across borders. Canada ratified the *Espoo Convention* in 1991 and the Convention entered into force in 1997. We also rely upon this Convention in this proceeding.

According to the general provisions of the Convention "The Party of origin shall ensure that in accordance with the provisions of this Convention an environmental impact assessment is undertaken prior to a decision to authorize or undertake a proposed activity listed in Appendix I that is likely to cause a significant adverse transboundary impact" (Article 2.3).

Appendix I of the Convention includes a list of activities that automatically require an application of the Convention if significant impacts may extend across the border.

The list of activities (Appendix I) includes for example "3. Installations solely designed for the production or enrichment of nuclear fuels, for the reprocessing of irradiated nuclear fuels or for the storage, disposal and processing of radioactive waste." as well as "14. Major mining, on-site extraction and processing of metal ores or coal." (emphasis added). See Convention text and Guidance on the Practical Application of the Espoo Convention: <http://www.unece.org/env/eia/guidance/welcome.html>.

9.4 1997 Arctic Guidelines for Environmental Impact Assessment

We rely in particular on these Guidelines. The Guidelines were completed as part of the Arctic Environmental Protection Strategy. The Arctic Council undertook to develop an electronic data base to share circumpolar information on environmental impact assessment.

We go further and call upon the AMAP to compile a public inventory of environmental regulations and all proposed licensing applications for new, extended and decommissioned uranium mining facilities as part of the growing Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM) sector impacting on the Arctic region, discussed below. This list should be maintained and updated on a public registry because currently it is not possible to conduct comparative, cumulative impact and risk assessments.

These Guidelines aim at giving practical guidance for environmental assessments to all parties involved in development activities in the northern circumpolar areas, but especially to local authorities, developers and local people. They are not intended to replace existing procedures adopted by international, national or provincial laws, land claim agreements, regulations or guidelines. They aim to enhance the quality of EIAs and the harmonization of EIA in different parts of the Arctic, see <http://ceq.hss.doe.gov/nepa/eiaguide.pdf>.

In the Arctic, cumulative impacts are of special concern. Baseline data are scarce and there are gaps in the understanding of the important ecological functions in the Arctic systems. The precautionary approach should therefore be encouraged.

In terms of spatial scope, it is important to note that the Guidelines state that impact assessment, including cumulative impacts, must consider all activities that affect components, even those components that lie outside the immediate area affected by the project. Because of the natural conditions in the Arctic, the affected area often is larger than in temperate areas.

In the Arctic, the development of oil and gas resources, large-scale hydroelectric projects, and extensive mining and smelter works are activities that have already led to transboundary impacts. For these activities the scale of operation is often so large that transboundary impacts can occur even though the border is far away.

The temporal scope of impact assessment, particularly of cumulative impacts, may also be because most physical, chemical and ecological processes are slower, more non-linear and potentially irreversible than

in more temperate regions. Assessments should take into account the impacts of past, existing and planned activities as well as those activities associated with the present project.

People who will be affected by an activity have a stake in identifying the important issues or concerns and alternatives to be analyzed, and in setting the temporal boundaries of the EIA.

We say an adequate impact assessment that considers the particulars of the Arctic environment and the concerns of Arctic peoples may indicate levels of impact beyond which resource development cannot be sustained.

9.5 1998 Heavy Metals Protocol to LRTAP

We also rely on this global Protocol. The objective of the *1998 Aarhus Protocol on Heavy Metals* (Heavy Metals Protocol) to the LRTAP is to control emissions of heavy metals caused by anthropogenic activities that are subject to long-range transboundary atmospheric transport and are likely to have significant adverse effects on human health or the environment. The Protocol covers cadmium, lead and mercury. According to one of the basic obligations, Parties have to reduce their emissions for these three metals below their levels in 1990. Canada ratified it in 1998 and it came into effect in 2003, see http://www.unece.org/env/lrtap/hm_h1.html.

The Protocol aims to cut emissions from industrial sources (iron and steel industry, non-ferrous metal industry), combustion processes (power generation, road transport) and waste incineration. Obligations for emissions control focus on the application of best available techniques (BAT) and emission limit values to reduce atmospheric releases. It is mentioned in Annex III, that precautions should be taken to avoid that the implementation of atmospheric pollution control techniques do not result in increased water pollution, or other releases from handling of residues from the pollution control activities.

The Heavy Metal Protocol is part of the 1979 the *Convention Long-range Transboundary Air Pollution* (LRTAP). That Convention has been extended by eight protocols that identify specific measures to be taken by Parties to cut their emissions of air pollutants, including the 2001 *Persistent Organic Pollutants Convention*, <http://chm.pops.int>. The definition of transboundary air pollution in article 1 of the LRTAP Convention is: "means air pollution whose physical origin is situated wholly or in part within the area under the national jurisdiction of one State and which has adverse effects in the area under the jurisdiction of another State at such a distance that it is not generally possible to distinguish the contribution of individual emission sources or groups of sources."

9.6 2000 AMAP Assessment

Canada contributed to the 2000 AMAP Assessment by conducting studies on four species of Arctic marine mammals (bowhead whales, beluga whales, ringed seals, and polar bears) sampled on the basis of their importance to Native subsistence users and value as indicators of Arctic contamination (Woshner 2000). In particular, there exists a need to identify techniques for studying higher order effects (neurotoxicology, immunosuppression) of methyl-mercury.

The 2000 Assessment considered Uranium mining and Northern Canada.

Northern Canada is rich in mineral resources, including uranium. The uranium industry, which includes mining, milling and transport, has been the greatest single contributor to local levels of TENORM in the Canadian Arctic environment, see Section 3.3.2.

There are several abandoned and decommissioned uranium mines in the Northwest Territories. In addition, a number of shipping points along the Northern Transportation Route were contaminated with low levels of natural radionuclides from the loading and unloading of uranium ores. In Canada today, active uranium mining continues only in the northern part of Saskatchewan. However, with the worldwide resurgence of nuclear power and the increasing demand for uranium, the 2000 Assessment noted it is likely that uranium mining activities will be revived in the far north of Canada. It should be noted that the government of Nunavut requires a positive public referendum before any uranium mines are approved, see Pembina Institute, Life Cycle Study of Nuclear Power, Fact Sheet No. 2 Uranium, 2007.

9.7 2001 Arctic Council adopts Mercury Reduction program

Mercury is a heavy metal of special concern. . A major part of the emission occurs in the form of gaseous Hg, which passes control equipment and enters the atmosphere. It is toxic to human and other living organisms and bioaccumulates in the Arctic marine food chain to reach levels that are a cause for concern especially for that part of the population of Canada and Greenland whose traditional diets include fish and marine mammals, p. v, AMAP 2011 Arctic Pollution.

In response to the 1997 AMAP findings, the Arctic Council decided in 2001 to implement a number of projects; among these is a project on 'Reduction of Atmospheric Mercury Emissions from Arctic States' as part of the 'Arctic Council Action Plan to Eliminate Pollution of the Arctic'. Mercury, together with arsenic, cadmium, lead and selenium have been identified as elements of toxicological concern.

9.8 AMAP Assessment 2002: Heavy Metals in the Arctic

Once they enter the atmosphere, heavy metals are capable of being transported for distances of up to a few thousand kilometers, depending on particle size and metal solubility. Heavy metals on larger particulates deposit closer to their source and have more local and close regional impacts .p. 9, 2002 AMAP Assessment.

In addition to atmospheric transport, heavy metals are also transported to the Arctic Ocean by rivers including the Mackenzie (Canada) and Yukon (United States) rivers, p.31.

According to the Arctic Mercury Releases Inventory, non-ferrous metal production, including uranium mining, is the second largest mercury source category in the Arctic countries. Nonferrous metal production contributed with 15%, or about 23 metric tons per year, of the total reported annual atmospheric mercury releases across the eight Arctic countries (157 metric tons per year), p.13. Emissions during production in this sector account for the largest source of atmospheric arsenic (As; 69%) and cadmium (Cd; 73%).

The reduction of lead (Pb) emissions through the decreased use of leaded gasoline around the globe is among the more successful regulatory actions in recent times. As a result, Pb deposition has decreased,

although Pb levels in Arctic biota do not yet reflect this change, p. 134. Riverine transport of Pb to the Arctic Basin is comparable to the amount transported by the atmosphere.

Riverine transport of Cadmium (Cd) to the Arctic Basin is comparable to the amount transported by the atmosphere. The highest concentrations of Cd in ringed seals, beluga whales and polar bears are reported from the eastern Canadian Arctic and northwest Greenland. Cadmium levels in some reindeer/caribou, moose (*Alces alces*), and ptarmigan (*Lagopus mutus*) from the Yukon Territory (Canada) as well as those in seabirds and marine mammals from northwest Greenland and the Faroe Islands may be high enough to cause kidney damage to humans, p. 135.

It was beyond the frames of this study to investigate if the prescribed emission limits for particulate matter ensure adequate mercury retention. But particulate matter controls have varying, and for this sector often moderate, efficiency for mercury retention (based on Environment Canada, 2002; European Commission, 2001; ACAP, 2004), and the effectiveness of particulate matter limits on the reduction of mercury emissions may perhaps be questionable, p.15, 2002 AMAP Assessment. We agree that Total Suspended Particle (TSP) standards are too general to identify particular contaminants and thus, ineffective to reduce emissions.

9.9 2003 AMAP Assessment Health Effects of Contaminates

During its second assessment period (1998-2002), AMAP continued to document evidence of the existence of subtle health effects, related to contaminant exposure, including effects both in the Inuit and the Faroese populations. Traditional marine food is the main source of human exposure in the Arctic to environmental contaminants such as the chlorinated organic compounds and methyl mercury (AMAP 1998, AMAP 2003). Although the measured exposure levels are unlikely to lead to overt diseases, they indicate that the presence of contaminants may initiate processes with a potential for transgenerational adverse health effects. With the exception of certain populations, such as the Inuit consuming large quantities of marine mammals, even if the general levels of contaminant exposure in the Arctic are currently below guidelines for safe exposure, a question remains as to whether these relatively low exposures can still have an influence on metabolic disorders and transgenerational effects, p. 80.

The 2003 AMAP assessment report concluded: “At actual levels of exposure observed in some Arctic populations there are negative health effects related to the contaminant exposure; for this reason there is an urgent need to lower the level of exposure in some populations, through both national and international efforts”, AMAP Assessment 2003: Human Health in the Arctic

9.10 AMAP Assessment 2009: Radioactivity in the Arctic

Because of the particular challenges of radiation and the Arctic, specific assessments by AMAP are regularly conducted. The focus has been on the TENORM sector. Technologically enhanced naturally occurring radioactive material (TENORM) can become a radiation risk in the context of mining of uranium and other minerals, oil- and gas extraction, coal mining and the use of geothermal energy. Several of these activities are likely to increase in the Arctic and more knowledge about waste streams and releases are needed in order to assess human and environmental risks.

In contrast to the situation for industries involved in the nuclear fuel cycle, where the material is used because of its fissile or radioactive properties, the radioactivity of the materials processed in the TENORM sector is not of primary interest and is, almost without exception, undesired, and the awareness of potential problems concerning natural radioactivity may be low.

Because some of these industries have the potential to give rise to doses of the same order of magnitude as industries involved in the nuclear fuel cycle (which are under more strict regulatory control, and where the potential hazard is of course much greater), increasing attention has been paid to this subject in recent years.

Actions to be taken by regulators include to ensure that: 1) relevant norms and standards exist, which take account of the vulnerability of the Arctic ecosystem, for application to the sites and facilities of interest; 2) decommissioning projects and the corresponding risk management measures are implemented in an appropriate way; 3) licence conditions are complied with; and 4) environmental monitoring is in place to demonstrate that the planned and implemented measures are working as intended. The previous AMAP assessment concluded that the particular vulnerability of the Arctic to radioactivity related primarily to the scope for bio-accumulation of radionuclides within components of the ecosystems with which humans interact. It was subsequently recommended that AMAP extends its consideration of these issues with respect to environmental protection, p. 79, 2009 AMAP Radioactive Assessment.

9.11 Ecological pathways in the Arctic environment and Human Health

The highest levels of cesium-137 and strontium-90 in the Arctic environment appear in terrestrial animals that graze on long-lived plants. The prime example is reindeer/caribou feeding on lichen. In forests, bogs, and mountain pastures, root uptake may be very important for radioactive contamination of berries and indirectly of animals through fodder. Mushrooms often have relatively high uptake of radiocesium through their root systems, p. 120. Polonium from caribou/reindeer dominates the natural radiation dose, whereas cesium-137 from an array of terrestrial food sources is the most important anthropogenic radionuclide.

Efficient transport of radionuclides from fallout to lichen to reindeer/caribou, along with uptake in other natural food products such as mushrooms, freshwater fish, and berries, leads to Arctic people receiving higher doses of cesium-137 from fallout than people almost anywhere else in the world. The doses from naturally-occurring radionuclides are also higher for people who rely heavily on caribou or reindeer in their diet.

People with a diet high in terrestrial and freshwater foodstuffs receive the highest radiation exposures, from both natural and anthropogenic radionuclides. These foodstuffs include caribou/reindeer, freshwater fish, goat cheese, berries, mushrooms, and lamb. People who eat mostly marine foodstuffs have the lowest doses.

The highest average exposures to individuals in indigenous Arctic populations are in Canada and the lowest in Greenland. Consumers of large amounts of caribou/reindeer can have radiation exposures 50

times higher than the average members of their national population.p.127, 2009 AMAP Radioactivity Assessment.

9.12 AMAP Assessment 2011 Arctic Pollution

The most recent State of the Environment Report on Mercury from AMAP finds that the risk of mercury contamination to Arctic wildlife and human populations remains. Indeed, Mercury levels in some species continue to rise in large areas of the Arctic.

9.13 UNEP Updates

As part of the UN Environmental Program's Hazardous Substances project, it recently released updated assessments for mercury, cadmium and lead. The Global Mercury Inventory shows that the emissions from the Non-ferrous metals sector have risen from 169 tonnes in 2005 to 200 tonnes in 2010, the most current data, see Table 2.9. UNEP cautions that the numbers maybe under reported: "Industry reporting to national government may be limited to sources with emissions above a certain threshold level so that emissions from smaller sources, below are not reported. Where smaller sources make up a significant part of the source category, reported inventories may therefore significantly underestimate total Hg emissions, see p. 23, UNEP Technical Background Report, Global Mercury Assessment 2013.

Despite being in the sector that is the second largest contributor to increasing global mercury emissions and evidence of mercury hot spots in Northern Saskatchewan along the McKenzie River basin, the Canadian government in general and the CNSC in particular are failing to regulate, see Map at p. 17.

Respecting the Non-ferrous metals sector, that includes the uranium industry, UNEP confirms that contamination occurs due to the use of thermal methods during processing of these ores that can contain significant amounts of Hg. These locations are known sources of Hg (e.g., Li et al., 2008), but are extremely poorly documented, especially in terms of their surrounding aquatic systems. P. 78. Recall that Cameco dries the uranium slurry into Yellowcake using high temperature burning equipment that exhausts into the atmosphere.

It is not an answer to say any mercury present in the ore is at low levels or that it is just naturally present. UPEP finds that, on average, 92% (range 74–94%) of the present-day Hg in Arctic marine wildlife is likely to be of anthropogenic origin. A similar finding (96% anthropogenic) was reported by a more recent study using polar bear hair from northwest Greenland (Dietz et al., 2011), p. 94.

Because historical Hg emissions continue to circulate in the world's oceans, further increases in atmospheric emissions in future will have long-term consequences for Hg levels, including methylmercury, in the world's commercial fisheries, and for Hg exposure among indigenous, subsistence and recreational consumers of marine and freshwater foods.

9.14 Cadmium and Lead

The Long-range transport pathways of cadmium and lead in the environment beyond the local scale are atmospheric transport, ocean transport, river transport and transport in large, transboundary lakes. Some long-range transport of cadmium may also take place with migrating fauna.

Due to anthropogenic emissions of cadmium (Cd) to the atmosphere Cd mass concentrations measured in atmospheric aerosol in various locations were much higher (up to 1000 times) than its natural content in soil and soil derived aerosols, see para. 383, Final review of scientific information on cadmium <http://www.unep.org/hazardoussubstances/LeadCadmium/ScientificReviews/CadmiumCd/tabid/29844/Default.aspx>.

With respect to Arctic pollution in particular, UNEP observed: The Arctic is a remote region with vulnerable ecosystems which has virtually no significant emission sources on its territory. That is why the transport of pollutants like cadmium from adjacent industrial areas (e.g. Kola Peninsula, Norilsk region, etc.) or from other continents of the Northern Hemisphere may be of importance for contamination of the Arctic region, para. 404.

The Arctic is particularly vulnerable to Cd transport as it appears to deposit more readily in the Arctic than other particulate elements (AMAP, 2005). This is related to the anthropogenic releases and characteristics of air mass movement to the Arctic, para 409.

The higher temperature of the release can also increase the height of the emission plume in the atmosphere and lead to greater transport distance, para. 412. Recall that Cameco dries the Yellowcake at Key Lake at least at 800 c plus degrees, see p. 24 and that the cadmium levels in tailings water at Key Lake was 5,782 percent above the SSWQO, see p. 29.

With respect to lead, UNEP observed: The evidence for intercontinental atmospheric transport of lead is limited. Due to the relatively short residence time of lead in the atmosphere (days or weeks; Alcamo et al., 1992), the airborne dispersion of this pollutant has a pronounced local or regional character. However, data from ice core measurements in Greenland and the Antarctic indicate that lead can be transported over distances of up to thousands of kilometres (Boutron, 1995; Vallalunga et al., 2002). Analysis of lead in aerosols in a number of regions further illustrates long-range transport. Some small portion of anthropogenic lead from North America has been noted in the Russian Arctic (Shevchenko et al., 2003). Further, measurements at the Canadian Alert station show that a portion of airborne lead reaching the Canadian Arctic comes from industrial sources in Europe (Mercier et al., 1999),p. 451, UNEP Final review of scientific information on lead –Version of December 2010 http://www.unep.org/hazardoussubstances/Portals/9/Lead_Cadmium/docs/Interim_reviews/UNEP_GC26_INF_11_Add_1_Final_UNEP_Lead_review_and_appendix_Dec_2010.pdf.

The weight of evidence is that the failure of the Canadian government to regulate mercury, cadmium and lead as well as radioactive emissions such as cesium 137 to the atmosphere from the uranium sector is contributing to the intercontinental transport of hazardous substances. Long-term chronic exposure to lead has more of an effect on human health than episodic peaks, p. 455.

9.15 Arctic Council Governance

The Ottawa Declaration of 1996 formally established the Arctic Council. It is a high level intergovernmental forum to provide a means for promoting cooperation, coordination and interaction among the Arctic States, with the involvement of the Arctic Indigenous communities and other Arctic inhabitants on common Arctic issues, in particular issues of sustainable development and environmental protection in the Arctic.

Arctic Council Member States are Canada, Denmark (including Greenland and the Faroe Islands), Finland, Iceland, Norway, Russian Federation, Sweden, and the United States of America. The Arctic Council Secretariat at the Fram Centre in Tromsø supports the Chair of the Arctic Council.

In addition to the Member States, the Arctic Council has the category of Permanent Participants. Six international organisations representing Arctic Indigenous Peoples have permanent participant status . The following organizations are Permanent Participants of the Arctic Council: Arctic Athabaskan Council, Aleut International Association, Gwich'in Council International, Inuit Circumpolar Council, Russian Association of Indigenous Peoples of the North, and Saami Council.

The Arctic Athabaskan Council is an international treaty organization established to defend the rights and further the interests internationally of American and Canadian Athabaskan member First Nation governments, see <http://www.arcticathabaskancouncil.com/aac>. At approximately 3 million square kilometers, this vast region has been continuously occupied by Athabaskan peoples for at least 10,000 years and includes three of North America's largest river systems (Mackenzie, Yukon and Churchill Rivers). The staples of Athabaskan life are caribou, moose, beaver, rabbits and fish.

The Permanent Participants have full consultation rights in connection with the Council's negotiations and decisions. The Permanent Participants are supported by the: Indigenous Peoples Secretariat, see www.arcticpeoples.org.

Observer Status

Nine Intergovernmental and Inter-Parliamentary Organizations have been given observer status, including the International Union for the Conservation of Nature, of which Sierra Club is a member. While the primary role of observers is to observe the work of the Arctic Council, observers continue to make relevant contributions through their engagement in the Arctic Council primarily at the level of Working Groups and may propose projects through an Arctic State or a Permanent Participant. Observers may make statements at the discretion of the Chair and submit relevant documents to the meetings, see Section 38, Rules of Procedure.

9.15.1 Proposal for Cooperative Activities

According to the 1998 Rules of Procedure, section 26: An Arctic State or Permanent Participant may make proposals for cooperative activities. All proposed programs and projects for which there is no existing Ministerial mandate shall be subject to a decision of the Council at an Arctic Council meeting. Proposals for cooperative activities should be received 90 days prior to any Senior Arctic Officials

meeting or meeting of a subsidiary body at which they are to be considered. SAOs shall review and make recommendations to the Arctic Council on proposals by Arctic States and Permanent Participants to be submitted to a Ministerial meeting with respect to proposed cooperative activities, section 24.

9.15.2 Arctic Council Meeting of Senior Arctic Officials

The first Senior Arctic Officials meeting under the 2013-15 Canadian Chairmanship of the Arctic Council, preceded by a closed meeting of heads of delegations, will take place in Canada on 21 October, 2013. The Arctic Council meets in May 2015 in Canada.

In addition to requiring a comprehensive transboundary EIA of Cameco's applications, Sierra Club Canada calls on Arctic Council members, Permanent Representatives and Observers to propose a cooperation project. This project follows up on the 1997 Guidelines for Arctic Impact Assessment, completed as part of the Arctic Environmental Protection Strategy and the Arctic Council undertaking to develop an electronic data base to share circumpolar information on environmental impact assessment.

We urge the AMAP to compile a public inventory of all proposed licensing applications for new, extended and decommissioned uranium mining facilities as part of the growing Technologically Enhanced Naturally Occurring Radioactive Materials sector in the Arctic region. This list should be maintained and updated on a public registry because currently it is not possible to effectively conduct comparative, cumulative impact and risk assessment of the sources and negative effects of most harmful heavy metals and radioactivity, both near and far as a result of this growing and largely unregulated activity.

10. Conclusion

Should CNSC approve Cameco's plan to further expand already the world's largest uranium mines, without notice, impact assessment, avoidance and mitigation that considers the likely and cumulative effects to the local and Arctic environment and peoples, the Commission may be out of compliance with the purpose of the *Nuclear Safety and Control Act* to act in a manner that is consistent with Canada's domestic and international obligations, see p.6.

We say an adequate impact assessment that considers the particulars of the environment and the concerns of the peoples may indicate levels of impact beyond which resource development cannot be sustained.

In order to act consistently with the government of Canada's domestic and international obligations, particular attention is required to establish regulatory limits for the uranium development sector to air and waterborne mercury, cadmium, lead and radioactivity.

The maintenance of Canadian regulatory, scientific and monitoring interest, capability and credibility over the short and longer term is recognized as essential. Attention is required to determine the effectiveness of provincial, national as well as international pollution controls and to identify and assess any new areas of concern such as climate change impacts to Northern Canada and the Arctic, already overburdened jurisdictions.