

Orano Canada Inc.

Cluff Lake Project

End State Report for Provincial Institutional Control

September 2022

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Acronyms and Abbreviations

Term	Definition
AECB	Atomic Energy Control Board
ALARA	As Low As Reasonably Achievable
CCME	Canadian Council of Ministers of the Environment
CEAA	Canadian Environmental Assessment Act
CNSC	Canadian Nuclear Safety Commission
COPCs	Constituents of Potential Concern
CSD	Comprehensive Study for Decommissioning
CSR	Comprehensive Study Report
CWRP	Claude Waste Rock Pile
DDP	Detailed Decommissioning Plan
DPDP	Detailed Post-Decommissioning Plan
CWRP	Claude Waste Rock Pile
DSWQO	Decommissioning Surface Water Quality Objectives
EA	Environmental Assessment
EMLS	Environmental Monitoring Location Schedule
EQC	Environmental Quality Committees
FUP	Follow-up Program
IAEA	International Atomic Energy Association
ICP	Institutional Control Program
IMS	Integrated Management System
LLRD	Long lived radioactive dust
LTMP	Long-Term Monitoring Plan
MHI	Saskatchewan Ministry of Highways and Infrastructure
MMER	Metal Mining Effluent Regulations
NSCA	Nuclear Safety and Control Act
Orano	Orano Canada Inc.
PIP	Public Information Document
SMOE	Saskatchewan Ministry of Environment
SSWQO	Saskatchewan Surface Water Quality Objective
TID	Technical Information Document
TMA	Tailings Management Area
TRU	Traditional Resource User

Table of Contents

1	Introduction.....	1-1
1.1	Purpose	1-1
1.2	Project Overview	1-1
1.3	Regulatory	1-6
1.3.1	Licensee	1-6
1.4	Provincial Institutional Control Program	1-6
2	Project Status	2-1
2.1	Decommissioning Environmental Assessment and Objectives	2-1
2.1.1	Post-Decommissioning Surface Water Quality.....	2-2
2.1.2	Post-Decommissioning Radiological Objectives	2-4
2.1.3	Post-Decommissioning Landscape	2-5
2.1.4	Engineered Soil Covers	2-7
2.1.5	Post-Decommissioning Aesthetics and Absence of Unreasonable Risk	2-8
2.2	Decommissioning	2-9
2.3	Decommissioning Reports	2-9
2.4	Planning Envelopes.....	2-10
2.4.1	D Mining Area	2-12
2.4.1.1	D Pit	2-12
2.4.1.1	D-Waste Rock Pile.....	2-12
2.4.2	Claude Mining Area	2-13
2.4.2.1	Claude Pit	2-13
2.4.2.1	Claude Waste Rock Pile	2-14
2.4.2.2	Buildings and Infrastructure	2-14
2.4.3	DJ Mining Area	2-14
2.4.3.1	DJN/DJX Pit	2-14
2.4.3.2	DJN Waste Rock Pile.....	2-15
2.4.3.3	DJ Underground.....	2-15
2.4.3.1	DJX Overburden Pile	2-15
2.4.4	OP/DP Mining Area	2-16
2.4.4.1	OP/DP Underground.....	2-16
2.4.4.2	Buildings and Infrastructure	2-16
2.4.5	Mill Complex and Supporting Facilities.....	2-16
2.4.6	Tailings Management Area.....	2-17
2.4.6.1	TMA Cover and Main Dam	2-17
2.4.7	Ancillary Buildings and Services.....	2-18
2.4.7.1	Germaine Camp Area	2-18
2.4.7.1	Cluff Center	2-18
2.4.7.1	Southgate Entrance	2-19
2.4.7.2	Batch Plant.....	2-19

2.4.7.3	Cluff Lake Pumphouse.....	2-19
2.4.8	Airstrip.....	2-19
2.4.9	Site Roads	2-20
2.4.10	Highway 955	2-21
2.4.11	Fuel Storage Facilities	2-22
3	Waste Quantities and Disposition.....	3-1
3.1	Remaining Nuclear Waste.....	3-1
3.2	Waste Management	3-3
4	Abnormal Incidents or Occurrences.....	4-1
4.1	Island Lake Fish Kill.....	4-1
4.2	TMA Cover – ponding	4-1
4.3	D-pit – elevated COPC	4-2
5	Institutional Controls	5-1
6	Lessons Learned	6-1
7	Institutional Control Program.....	7-1
7.1	Long-Term Monitoring and Maintenance	7-1
7.1.1	Monitoring	7-1
7.1.2	Maintenance	7-1
7.2	Funds and Assurance	7-2
7.3	Schedule to IC Program	7-2
8	Traditional Land Use	8-1
9	References	9-1

Appendices

Appendix A: Concordance Tables

Appendix B: Operational and Decommissioning History

Tables

Table 2.1: Summary of Post-Decommissioning Surface Water Quality Objectives

Figures

Figure 1.1: Location of Cluff Lake Project
Figure 1.2: General Site Layout
Figure 1.3: Orano Management for the Cluff Lake Project
Figure 2.1: Aerial Photos of D Mining Area
Figure 2.2: Aerial Photos of Claude Mining Area
Figure 2.3: Aerial Photos of DJ Mining Area
Figure 2.4: Aerial Photos of Mill Complex Area
Figure 2.5: Aerial Photos of Tailings Management Area (TMA)
Figure 2.6: Aerial Photos of Germaine Camp Area
Figure 4.1: Cluff Lake Decommissioned Nuclear Facility – Decommissioned Nuclear Facilities with Radioactive Inventory $>10^{15}$ Bq
Figure 9-1: Land Use Near the Decommissioned Cluff Lake Project

1 Introduction

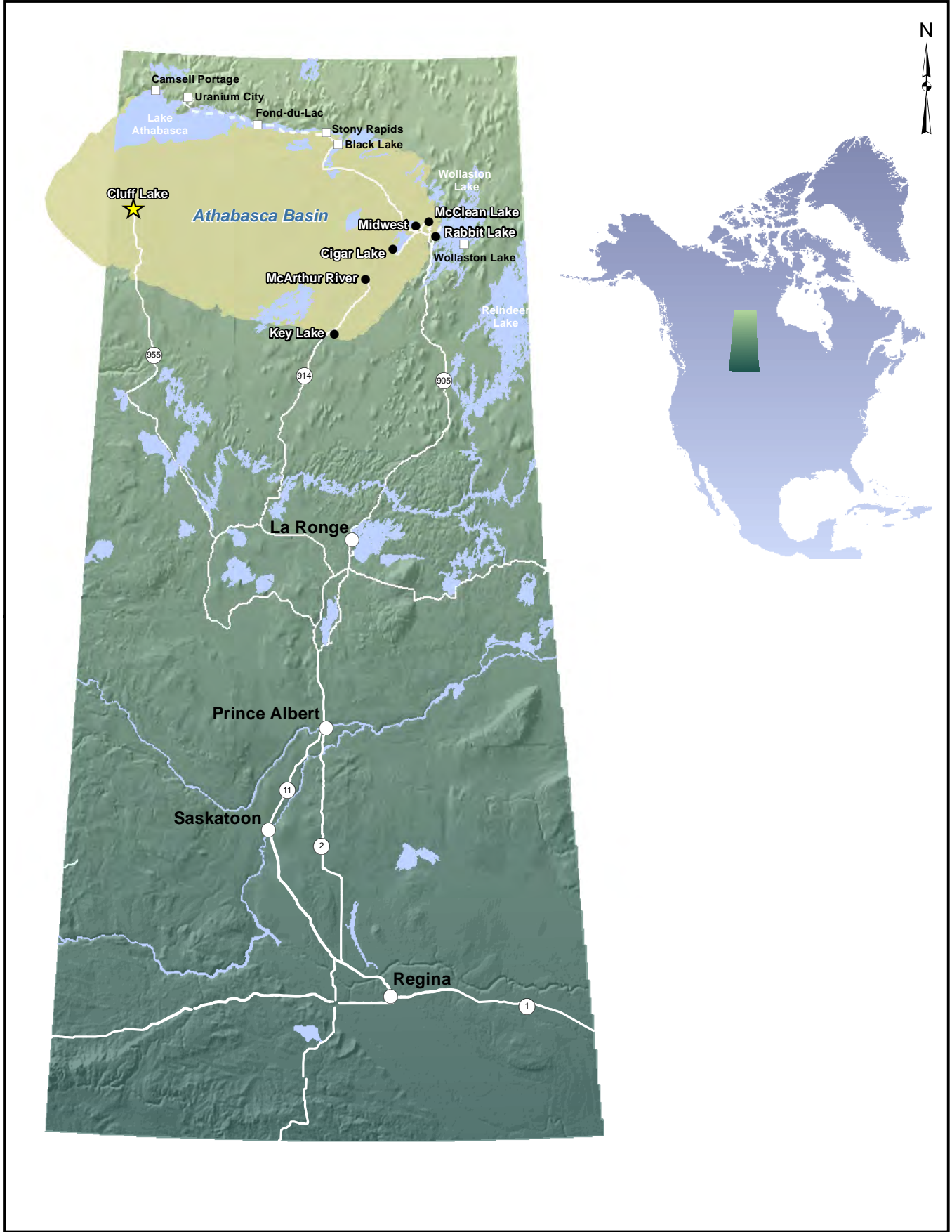
1.1 Purpose

In 2019, Orano demonstrated to the satisfaction of provincial and federal regulators that the Cluff Lake Project decommissioning objectives have been met and will continue to be met in the very long term. The Cluff Lake Project Technical Information Documents (AREVA 2015a, AREVA 2015b, and AREVA 2015c, Orano 2019b, Orano 2019c, Orano 2022) and the Follow-up Program Report (AREVA 2015d) document the successful completion of the decommissioning.

This End-State Report had been prepared to describe the final status of the Cluff Lake Project as responsibility for the site is turned over to the Province of Saskatchewan under their institutional control program. The End-state Report is intended to satisfy the requirements of CNSC REGDOC 2.11.2.

1.2 Project Overview

The Cluff Lake Project is a former uranium mine and mill site located in the Athabasca Basin of northern Saskatchewan. The mine site is located approximately 900 km north of Saskatoon, Saskatchewan, and approximately 75 km south of Lake Athabasca (Figure 1.1).



Projection: NAD 1983 UTM Zone 13N
 Compiled: T.Lohman Drawn: T.Lohman
 Date: 2022-04-21 Scale: 1:6,000,000
 Data Sources: Natural Resources Canada, Geobase®, Nation
 Topographic Database, ORANO Canada Inc.

CLUFF LAKE PROJECT

FIGURE 1.1
 LOCATION OF THE CLUFF LAKE PROJECT



The Cluff Lake Project commenced mining and milling operations in 1980. Over the 22-year operating life of the mine, five ore bodies were extracted using either underground or open pit techniques. The Cluff Lake Project produced 28 million kilograms of uranium concentrate (U_3O_8) over its operational period and produced its final barrel of yellowcake in December 2002. Operational facilities at the Cluff Lake Project included open pit and underground mines, a mill, a tailings management area (TMA) with a two-stage liquid effluent treatment system, a residential camp area, and various other support and site infrastructure facilities.

Over its operating life, the Cluff Lake Project was the largest industrial employer on the west side of northern Saskatchewan providing a stable base of employment for over 20 years generating about 4,000 person years of company staff employment. Employees averaged around 200 at a given time and with on-site contractors, indirect, and induced employment this number is estimated to have been as high as 958 individuals employed in 1996. Approximately 52% of company staff were northern and approximately 80% of northerners were from the west side of the province. The company was recognized for advancing residents of northern Saskatchewan into management and supervisory positions. The training and experience gained by individuals throughout the project life provided transferable skills for subsequent employment. As well, nearby lands continued to be used for traditional purposes that included the safe consumption of country food.

Mining operations include decommissioning as a phase in the overall project life. The Cluff Lake Project may be considered the first decommissioned uranium mine site of its era in Saskatchewan. With the end of successful operations in 2002, the decommissioning of the site underwent a decommissioning environmental assessment (Comprehensive Study for Decommissioning (CSD), COGEMA 2000a and Comprehensive Study Report (CSR), CNSC 2003). The general decommissioning objectives and appropriate locations and timeframes for accomplishing the objectives were established in consultation with federal and provincial authorities and through the public engagement process.

Subsequent to receiving federal and provincial environmental assessment and licensing and permitting approvals, decommissioning of the Cluff Lake Project commenced in 2004. The majority of physical decommissioning was completed by 2006 including demolition of the mill complex buildings, covering the TMA and Claude Waste Rock Pile, moving the DJN waste rock to the Claude Pit, complete backfilling of the Claude Pit, flooding the contiguous DJN and DJX pits (referred to collectively as the DJX Pit post-decommissioning), grading, and revegetation. Underground mine raises and declines were decommissioned earlier at the cessation of underground mining. Minor physical undertakings were completed in 2013 to mark the end of an on-site presence, included the demolition of a small residential camp which included potable and sewage treatment plants, two steel outbuildings, and the Secondary Treatment System. The Cluff Lake site has been in post-decommissioning monitoring since 2006 with a transition to campaign monitoring in 2013. With final minor physical works completed in 2017 and 2018, the site was readied for transfer back to the province through the Institutional Control Program (ICP).

With the establishment of the Institutional Control (IC) Program under the Saskatchewan *Reclaimed Industrial Sites Act*, parcels of land that, in consequence of development and use, require long-term monitoring and, in certain circumstances, maintenance, can be transferred to the Government of

Saskatchewan if the site achieves an end state of long-term safety and stability and the proponent provides funds necessary for the government administration of the decommissioned site.

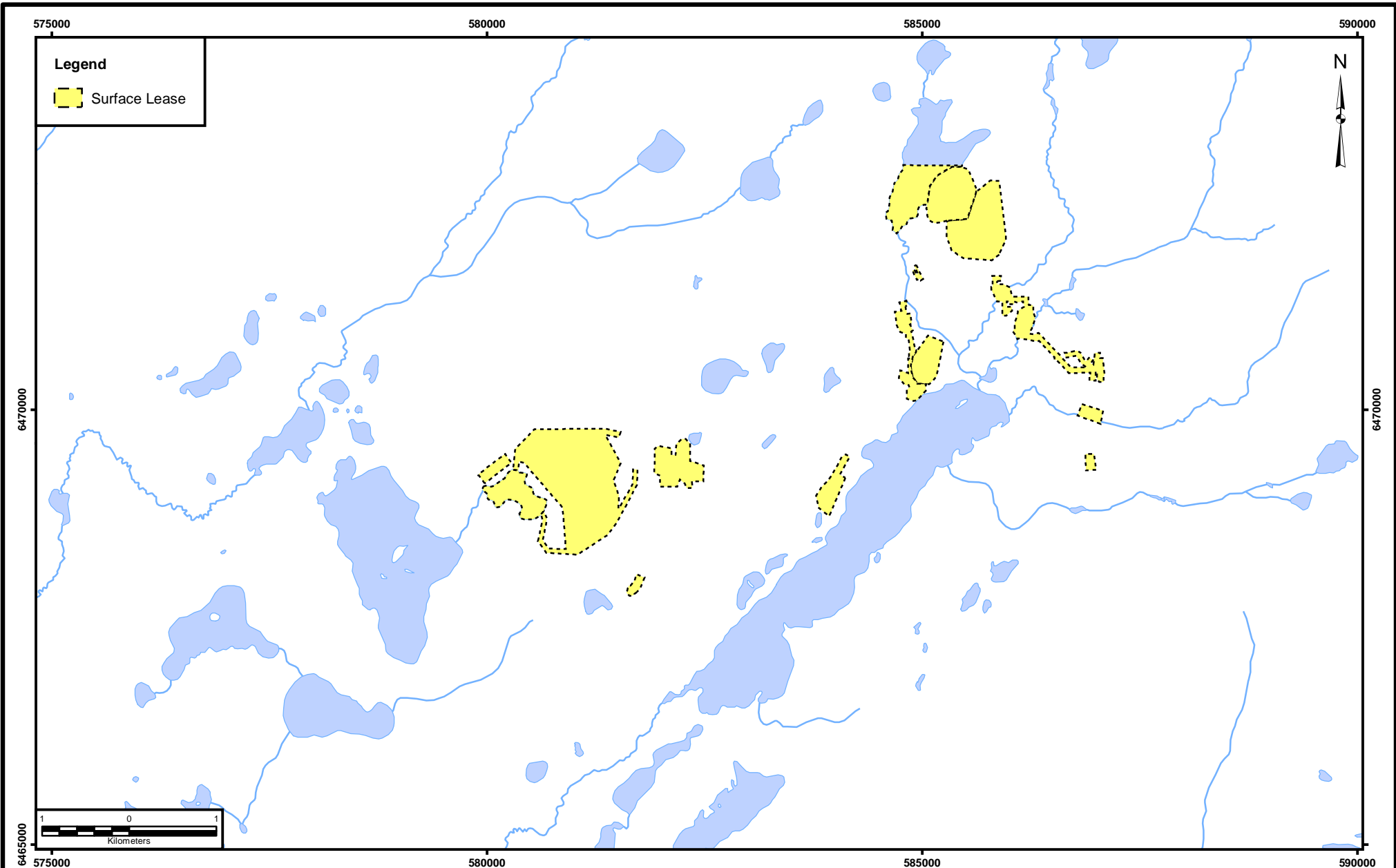
In 2019, regulators acknowledged that decommissioning objectives had been met and a portion of the Cluff Lake surface lease was surrendered, releasing the following parcels that would not require restrictions:

- Undeveloped/undisturbed areas – 508.11 hectares
- Surface water bodies (Cluff Lake and Island Lake as they do not require long-term controls or maintenance) – 527.21 hectares
- Remediated areas of previous surface disturbance – 260.76 hectares

Parcels that require long-term administrative controls, and in certain circumstances, maintenance remained in the Cluff Lake surface lease. The following areas will be transferred to the provincial IC Program :

- D Mining Area: D-pit
- Claude Mining Area: Claude pit, Claude waste rock pile, Claude peat trenches
- DJ Mining Area: DJN/DJX pit, DJ underground mine
- OP-DP Mining Area: OP/DP underground mine
- Mill Complex Area
- Tailings Management Area
- Landfills: domestic, industrial, Secondary Treatment System Ponds, mill landfill and Cluff centre landfill
- Lakes: Snake Lake and the portion of Claude Lake that is within the surface lease boundaries.

With buffers for underground mine workings and pits (25 meters) and other parcels (10 meters), as recommended by the Saskatchewan Ministry of Energy and Resources, the total leased area, to be transferred into the provincial IC Program is 336.39 hectares (Figure 1.2).



Projection: NAD 1983 UTM Zone 12N
 Compiled: T.Lohman Drawn: T.Lohman
 Date: 1/3/2022 Scale: 1:60,000
 Data Sources: Natural Resources Canada, Geobase®, Nation
 Topographic Database, ORANO Canada Inc.

CLUFF LAKE PROJECT

FIGURE 1.2
 CLUFF LAKE - CURRENT SURFACE LEASE



1.3 Regulatory

1.3.1 Licensee

Orano Canada Inc., with headquarters in Saskatoon, is the sole owner and operator of the Cluff Lake Project. Orano Canada Inc. is a wholly owned subsidiary of Orano Group, a world leader in nuclear energy and components.

The business address is:

Orano Canada Inc.
100-833 45th Street West
Saskatoon, SK S7L 5X2

1.4 Provincial Institutional Control Program

In 2005, Saskatchewan initiated the formal development of an institutional control framework for the long-term management of decommissioned mine and mill sites on provincial Crown lands. This work resulted in the establishment of the Institutional Control (IC) Program in 2007. The IC Program's purpose is to: support the safe, environmentally sound decommissioning of mining and mill sites; ensure the on-going monitoring and maintenance of reclaimed sites; provide a funding mechanism to cover costs associated with long-term monitoring and maintenance of reclaimed sites; and ensure that records and information on the reclaimed sites are preserved through the establishment of a registry.

The amount deposited into the funds by the former owner of each site accepted into the IC Program is determined by the Ministry of Energy and Resources based on a site-specific risk assessment detailed by a long-term monitoring and maintenance schedule.

The legislated funds are managed by the Government of Saskatchewan and independent from provincial revenue.

Orano's objective is for the Cluff Lake property to successfully transfer into the IC Program.

Orano has demonstrated that the Cluff Lake site is well understood and remaining residual risks can be adequately and confidently addressed under the provincial IC Program. The purposes of the IC Program, as outlined in the Section 3(2) of the Saskatchewan *Reclaimed Industrial Sites Regulations* are:

“(a) to set out the conditions by which the Government of Saskatchewan will accept responsibility for land that, in consequence of development and use, requires long-term monitoring and, in certain circumstances, maintenance;

(b) to ensure that the required monitoring and maintenance are carried out on that land;

(c) to provide a funding mechanism to cover costs associated with the monitoring and maintenance on that land; and

(d) to ensure that certain records and information are preserved with respect to that land.”

Ecological risk assessments provide the basis for the scope and complexity of monitoring programs (CSA N288.4-19 Clause 4.1, CSA 2019). Decommissioning monitoring started with the 2003 Comprehensive Study Report (CSR) where potential project-environment interactions were identified, and potential effects defined.

EP TID Volume 2 (Orano 2019c) and associated GW TID (Orano 2019b) provide the basis for the scope and complexity of the proposed Long-Term Monitoring and Maintenance Plan (LTMMMP) to be administered under the IC Program by the Province of Saskatchewan. The LTMMMP is proposed to continue for decades, at a sample frequency focused on confirming the site’s environmental performance against predicted performance and relative to decommissioning objectives.

2 Project Status

2.1 Decommissioning Environmental Assessment and Objectives

The original environmental assessment for the Cluff Lake Project was completed in 1978 and the environmental assessment for decommissioning was completed in 2003, referred to as the Comprehensive Study Report (CSR) (CNSC 2003). The CSR was accepted in 2004, followed by the subsequent issuance of required federal and provincial authorizations to proceed with decommissioning activities.

As described in the CSR, the effects of decommissioning are largely positive. Decommissioning involves the removal or stabilization of constructed structures and the reclamation of disturbed areas. Orano's key objective was to remove, minimize, or control potential contaminant sources and thereby minimize the potential for adverse environmental effects associated with the decommissioned property. Decommissioning was designed to minimize the need for care and maintenance activities and long-term active institutional controls (i.e., prioritize passive care) taking into consideration socio-economic factors.

The decommissioning was designed to achieve an end-state where the:

- environment was safe for use by human and non-human biota;
- reclaimed landscape is chemically and physically stable;
- self-sustaining landscape allows utilization for traditional purposes; and
- potential constraints on future land use are minimized

To evaluate the success of the decommissioning program for the Cluff Lake Project, site-specific objectives (referred to as abandonment criteria in section 5.2 of the CSD and decommissioning objectives in section 7 of the CSR) were established which, when achieved, indicate the site has been successfully decommissioned. The decommissioning objectives, and associated locations and timeframes for accomplishing the objectives, were established in consultation with federal and provincial authorities and with public engagement through the CSR process.

The following criteria are indicators of decommissioning success:

- achieving Decommissioning Surface Water Quality Objectives (DSWQO) and other accepted decommissioning objectives at surface water and flooded pit locations;
- levels of gamma, radon, and long-lived radioactive dust which pose no unacceptable risk to traditional land use, and which are consistent with application of the As Low As Reasonably Achievable social and economic factors considered (ALARA) principle;
- a stable, self-sustaining landscape;

- reduction of infiltration rates around the TMA and the Claude waste rock pile to levels that adequately restrict contaminant movement in groundwater and are suitably protective of downstream surface water receptors; and
- return of the site to an aesthetically acceptable state, similar in appearance and land capability as that which existed prior to mining activities, and that poses no unreasonable risk to humans or the environment.

The CSR outlined decommissioning objectives for surface water quality, radiological clearance, a stable, self-sustaining state with minimal requirements for monitoring, maintenance, or institutional controls, and safe, casual traditional land use. Sediment quality guidelines are noted in both the CSD and CSR as benchmarks, i.e., values are not considered to be formal decommissioning criteria. Sediment quality is considered in the ecological risk assessment (see section 2.1.5) but not as a specific decommissioning endpoint.

Over a decade of post-decommissioning monitoring (2006 to 2021) has provided the environmental data for comparison to water quality, radiological objectives, or key model inputs used to forecast long-term surface water quality (e.g., infiltration rates through soil covers and source terms). The decommissioning groundwater and ecological risk models are validated, and long-term predictions remain within decommissioning objectives (AREVA 2015a, AREVA 2015b, and AREVA 2015c, Orano 2019b, Orano 2019c, Orano 2022).

2.1.1 Post-Decommissioning Surface Water Quality

Objective: Achieving Decommissioning Surface Water Quality Objectives (DSWQO) and other accepted decommissioning objectives at surface water and flooded pit locations.

Decommissioning Surface Water Quality Objectives (DSWQO) were based on the 1997 Saskatchewan Surface Water Quality Objectives (SSWQO) and site-specific surface water quality objectives developed by Orano in the absence of provincial surface water quality objectives (i.e., uranium, molybdenum, and cobalt) or specific natural conditions prevailing in the area (i.e., iron). These decommissioning objectives were described in the original Comprehensive Study Report for Decommissioning (COGEMA 2000a).

Locations chosen to meet the DSWQOs for key surface waterbodies were identified by consideration of the locations and the distances of potential constituents of potential concern (COPC) sources in relation to potentially impacted natural surface waterbodies, and in consultation with federal and provincial authorities. As presented in the CSR (CNSC 2003), selected locations and DSWQOs are listed in Table 2.1.

Table 2.1: Summary of Post-Decommissioning Surface Water Quality Objectives

Parameter	Unit	Snake Lake	Island Lake	Claude Lake	Claude Creek	Peter River	Earl Creek	Cluff Lake	Flooded Pits ⁽¹⁾
As	µg/L	50	50	50	50	50	50	50	50
Ba	mg/L	1	1	1	1	1	1	1	1
Cd	µg/L	1	1	1	1	1	1	1	1
Cr	µg/L	20	20	20	20	20	20	20	20
Cu	µg/L	10	10	10	10	10	10	10	10
Fe ⁽²⁾	mg/L	3.2	1	7.3	7.3	1	5.2	1	7.3
Pb	µg/L	20	20	20	20	20	20	20	20
Hg	µg/L	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Ni ⁽³⁾	µg/L	-	-	-	-	-	-	-	-
Se	µg/L	10	10	10	10	10	10	10	10
Ag	µg/L	10	10	10	10	10	10	10	10
Zn	µg/L	50	50	50	50	50	50	50	50
Ra ²²⁶	Bq/L	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
U ⁽⁴⁾	mg/L	-	-	-	-	-	-	-	-
Mo ⁽²⁾	µg/L	73	500	73	73	73	73	73	500
Co ⁽⁵⁾	µg/L	20	20	20	20	20	20	20	20

(1) Flooded Pits – Objectives apply to upper 50% of the water column only

(2) Fe and Mo are waterbody specific objectives

(3) Nickel values are hardness related; values range from 25 µg/L when [Hardness] <100 mg/L and 100 µg/L when [Hardness] >100 mg/L at the site in question

(4) Uranium DSWQO was calculated as 0.002 [Hardness in mg/L] at the site in question. The current CCME surface water quality guideline for uranium is 0.015 mg/L. The CCME guideline is used as a screening tool for the environmental risk assessment.

(5) Cobalt objective was set as a site specific decommissioning objective

Status: Surface water quality objectives have been achieved and are predicted to be achieved in the long-term. Surface water quality at key waterbodies will continue to be monitored by Orano and following successful transfer of the property into Provincial Institutional Control the long-term monitoring of surface water quality will be administered by the Province of Saskatchewan.

Orano has used the CCME surface water quality guideline for uranium of 0.015 mg/L, as a screening tool in environmental risk assessments (AREVA 2015c, Orano 2019c). The uranium guideline was exceeded at Island Lake, D-Pit and DJX-Pit and site-specific risk assessment characterized localized risks from uranium (AREVA 2015c, Orano 2019c). The conservative assessment concluded that uranium exposure should not result in unacceptable risk to individual species or populations.

Key reference(s) that provide evidence or document achievement of objective:

- Annual Reports, e.g., Cluff Lake Project 2017 Annual Report Section 5.4 (Orano, March 2018b)
- Environmental Performance Technical Information Documents Volume 1 Section 4.2 (AREVA, 2015b)
- Environmental Performance Technical Information Documents Volume 2 Section 6 (AREVA 2015c, Orano 2019c)
 - Site-specific risk assessments for pit lakes, i.e., D-Pit, and DJX-Pit, are presented in Appendix K (AREVA 2015c)

2.1.2 Post-Decommissioning Radiological Objectives

Objective: Levels of gamma, radon (RnP), and long-lived radioactive dust (LLRD) which pose no unacceptable risk to traditional land use, and which are consistent with application of the ALARA principle.

The decommissioning radiological objectives are based on a need to keep radiation doses to the general public below the regulatory limits and “as low as reasonably achievable” (ALARA; social and economic factors considered) through the final decommissioning and post-decommissioning phases.

The limit on annual effective dose to a member of the public under the CNSC’s Radiation Protection Regulations (RPR) is 1 mSv per year above natural background levels. The regulations specify that the proposed limit includes contributions from external sources, inhalation of radon progeny, and ingestion and inhalation of radioactivity according to the sum rule provided [subsection 13(2) of the RPR].

RnP and LLRD levels were reduced through removal of source material or by covering with clean soil material. Sufficient cover materials were applied to eliminate LLRD, and to reduce radon progeny levels to near background conditions, where source terms existed. Post-decommissioning LLRD and RnP levels are near background and did not require specific decommissioning objectives. The potential exposure to gamma radiation is the primary exposure pathway and this potential pathway was addressed through surface gamma clearance surveys and associated remediation as necessary. Exposure to ambient gamma radiation is included in a comprehensive human health risk assessment (AREVA 2015c, Orano 2019c).

Status: Levels of gamma, radon, and long-lived radioactive dust pose no unacceptable risk to traditional land use and are consistent with application of the ALARA principle. Radiological levels achieved protect public health by maintaining doses to future users that are well within regulatory limits for members of the public. Having confidently achieved this decommissioning objective, radon monitoring was removed from the environmental monitoring program in late 2017 with regulatory approval. **Radiological objectives have been achieved.**

Key reference(s) that provide evidence or document achievement of objective:

- Annual Reports, e.g., Cluff Lake Project 2017 Annual Report Section 4 (Orano, March 2018b)
- Environmental Performance Technical Information Documents Volume 1 Section 3.2.3.1 (AREVA, 2015b)
- Environmental Performance Technical Information Documents Volume 2 Section 8.1 (AREVA, 2015c, Orano 2019c)
- Environmental Monitoring Locations and Schedule Optimization Report Section 5 (AREVA, 2017)
- Gamma Radiation Clearance Reports:
 - Submission for Gamma Radiation Clearance – Cluff Lake Project, November 2007 (AREVA 2007a)
 - Review of Surface Gamma Radiation Survey of Disturbed Areas at Cluff Lake Site and validated by a third-party survey (SENES 2009)
 - Addendum to Submission for Gamma Radiation Clearance – Cluff Lake Project, titled Submission for Gamma Clearance of the Germaine Camp Area, December 2009 (AREVA 2009)
 - 2014 Surface Gamma Clearance Report - Cluff Lake Project, October 2014 (AREVA 2014a)
 - Cluff Lake Project – Surface Gamma Clearance Report, October 2018 (Orano, 2018e)

2.1.3 Post-Decommissioning Landscape

Objective: a stable, self-sustaining reclaimed landscape

Decommissioning of the site included works to stabilize the landscape and minimize public safety hazards, e.g., backfilling or flooding mined out pits. Of particular note is the decommissioning of underground mine workings and the TMA dam rehabilitation, as summarized below. A detailed progression of physical works is documented in the evolution and closure of the Cluff Lake Project DDP.

- DJ Underground: mined using undercut and fill mining method; DJU raises entirely backfilled from bottom of the raise to the raise collar elevation in 2002; DJU decline backfilled from about 181m down the ramp to the portal opening; reinforced concrete caps placed over all backfilled raises and a concrete plug poured over the former DJU portal opening; single instance of surface subsidence related to mining activities at the DJ underground mine – the only area of the DJ mine that sub-outcropped to surface and was vulnerable to crown pillar failure – was stabilized and the area eliminated from further ground fall considerations.
- OP/DP Underground: mined using undercut and fill mining method; raises partially backfilled in 2000 with final backfilling completed in 2002; OP/DP decline was backfilled from about 176m down the ramp to the portal opening; reinforced concrete caps placed above backfilled raises and a concrete plug was poured over the former OP/DP portal opening; no instance of surface subsidence associated with the OP/DP mining activities and works are not vulnerable to crown pillar failure.
- TMA dam rehabilitation: construction of storm water management structures and design including engineered cover, spillway established to passively release water, grading for positive drainage

towards spillway, installation of toe drain in 1999, construction of the south division ditch and north diversion ditches in 1999 and 2000, respectively; buttressing the main dam with a downstream slope of 4H:1V; potentially erodible slopes vegetated; achievement of a passive state that does not require regular surveillance; considered physically, chemically, ecologically, and socially stable (i.e. a landform).

The revegetation approach for the Cluff Lake Project included two different strategies: seeding soil covers with grasses and forbs (addressed in following section on waste covers); and planting trees in other disturbed areas. Tree seedlings were propagated from local seed and cutting sources including a mixture of six native woody species: green alder, balsam poplar, white birch, trembling aspen, willow, and jack pine. Over 600,000 seedlings were planted across 129 ha from 2005 to 2007. In general, good survival and density of trees has been observed. Some small, low risk disturbed areas were not seeded but rather regraded to allow indigenous vegetation to establish naturally.

The Cluff Lake Project is located in the northern boreal ecosystem where natural revegetation commonly begins with early successional species including various types of forbs (e.g., fireweed) and a selection of native grasses (e.g., northern reedgrass). Deciduous shrubs and trees (e.g., alder, willow, balsam poplar, trembling aspen, and birch) tend to establish next as soil conditions improve. Climax species in the Cluff Lake Project area are generally conifers, such as black spruce and jack pine, which take advantage of early life cover and enriched soil conditions largely attributable to the earlier deciduous successional stage.

Status: the former mine site is stable, self-sustaining, and largely reclaimed; further minor works are appropriately captured under long-term maintenance. **Decommissioning works are complete.**

Key reference(s) that provide evidence or document achievement of objective:

- Cluff Lake Detailed Decommissioning Plan (COGEMA 2003, COGEMA 2004, AREVA 2009, AREVA 2014, this document)
- Environmental Performance Technical Information Documents Volume 1 Section 5.2.3 and 5.3.1 (AREVA 2015b)
- Status of Vegetation Recovery in the Cluff Lake Project Reclaimed Areas 2008-2014 (HAB-TECH Environmental, 2014)
- TMA Water Management and 2013 Remedial Works Closure Report (SRK 2018)
- Third-Party Geotechnical Inspection Reports, e.g., 2016 Biennial Geotechnical Inspection Final Report – Cluff Lake Saskatchewan (SRK 2017)
- Vegetation Recovery at the Cluff Lake Mine Site 2008 to 2020. December 2020.
- Third-Party Geotechnical Inspection Reports, e.g., 2020 Biennial Geotechnical Inspection Final Report – Cluff Lake Saskatchewan (SRK 2021)

2.1.4 Engineered Soil Covers

Objective: Reduction of infiltration rates around the TMA and the Claude Waste Rock Pile to levels that adequately restrict contaminant movement to groundwater and are suitably protective of downstream surface water receptors

The purpose of soil covers for the Claude Waste Rock Pile (CWRP) and the Tailings Management Area (TMA) are to promote surface runoff, minimize infiltration, and thus minimize the release of contaminants to groundwater. Between 2001 and 2006, a minimum 1 m thick glacial till cover was placed on the TMA. The CWRP was overlain with a 1 m thick till cover in 2005/06. A soil cover monitoring program was implemented following final grading of these areas in 2006. Monitoring stations were installed at select locations to monitor soil and weather conditions to gauge the success of the cover systems and results are presented in the Cluff Lake Project Annual Reports and more comprehensively in the Follow-up Program Report (AREVA 2015d).

Transformations of the TMA and CWRP covers into evaporative covers were initiated in 2006 by hydroseeding the areas with shallow-rooting grasses and forbs. These types of vegetative covers tend to resist and slow the rate of natural invasion onto the site and ensure the integrity of the covers for an extended duration. As native vegetation progressively invades, the soil binding capabilities of the grass/forb understory persists and is supplemented by the rooting systems of the native varieties. The vegetation community has shifted over time with both the TMA and CWRP on a natural revegetation trajectory (Hab-tech, 2014; CanNorth 2020).

Status: The cover systems have been performing for a number of years and are on a stable trajectory; they are expected to continue to be stable. The covers are self-sustaining and effective in controlling erosion. Long-term monitoring for erosion and potential minor repair to covers is appropriate under the institutional control program. **Engineered soil cover objectives have been achieved.**

Key reference(s) that provide evidence or document achievement of objective:

- Follow-up Program Version 03 Sections 3.1.2 and 3.2.1 and Appendix B (AREVA, 2015d)
- Hydrogeology and Groundwater Modelling Technical Information Document Section 2.1.2.3 and 2.2.2.6 (AREVA, 2015a)
- Environmental Performance Technical Information Document Volume 2 Section 6 (AREVA, 2015c)
- Status of Vegetation Recovery in the Cluff Lake Project Reclaimed Areas 2008-2014 (HAB-TECH Environmental, 2014)
- Risk Assessment of the Presence of Ponded Water on the Decommissioned TMA (Orano 2018f)
- Hydrogeology and Groundwater Modelling Technical Information Document, Version 02. October 2019. (Orano 2019b)

- Environmental Performance Technical Information Document, Volume 2, Version 02. October 2019. (Orano 2019c)
- Vegetation Recovery at Cluff Lake (CanNorth 2020)

2.1.5 Post-Decommissioning Aesthetics and Absence of Unreasonable Risk

Objective: Return of the site to an aesthetically acceptable state, similar in appearance and land capability as that which existed prior to mining activities, and that poses no unreasonable risk to humans or the environment

Re-vegetation efforts (as summarized in section 2.1.3 above) focused on the re-establishment of native species of grasses, forbs, and woody species to accelerate the process of natural ecological succession and result in a forested environment similar to that which existed prior to mining. With forest establishment comparable to pre-mining and sound decommissioning, wildlife species can reclaim the mine footprint. The site is safe, reclaimed, and allows for hunting and trapping land uses that existed prior to site development.

A comprehensive ecological and human health risk assessment for the Island Creek and Cluff Creek watersheds was submitted in 2015 and again in 2019 (AREVA 2015c, Orano 2019c). The assessments were completed to comply with applicable components of the N288.6 Standard for Environmental Risk Assessments at Class I Nuclear Facilities and Uranium Mines and Mills. Potential risk was characterized both temporally and spatially within an integrated probabilistic framework to address uncertainties in the assessment of effects.

A weight-of-evidence approach was used combining the results of the predictions and risk evaluations with biological monitoring carried out at the Cluff Lake Project. The weight-of-evidence suggests that I) there are elevated levels of some COPCs in the Island Creek Watershed but the aquatic system is recovering and will continue to improve in the future and there is some potential risk to local populations including mink, muskrat, otter, yellowlegs, and the nighthawk with no further terrestrial species concern downstream at Island Creek at the Dolomites II) conditions in the Cluff Creek Watershed will not significantly affect the health of the aquatic communities present and there are no predicted effects on terrestrial species. The results are comparable to those predicted in the CSR (CNSC, 2003) stating recovery of the Island Creek watershed over time and potential effects on biota considered not significant as effects are restricted locally with full recovery expected.

The results of the human health assessment indicated that a casual visitor to the site who hunts, fishes, and traps over a lifetime as well as his/her family who would consume the food over a six-month period at the Cluff Lake Project will not experience adverse effects from exposure to radionuclides or non-radionuclides.

Status: There is an absence of unreasonable risk. The site has unrestricted access and public health and safety does not rely on controlling human behaviours (e.g. fences, signs, fish advisories). Ecological integrity is maintained. Aquatic and terrestrial systems are recovering, and they are expected to continue to do so in the future. **Aesthetic and risk objectives have been achieved.**

Key reference(s) that provide evidence or document achievement of objective:

- Environmental Performance Technical Information Document Volume 2 (AREVA 2015c; Orano 2019c)

2.2 Decommissioning

The majority of physical decommissioning of mine and mill facilities was completed by 2006. Certain infrastructure remained from 2006 until 2013 in order to support the post-closure monitoring phase and to control site access during the initial monitoring period. In 2013, remaining structures and facilities were decommissioned. Final minor decommissioning works took place in 2017, 2018 and 2021. A history of decommissioning is provided as Appendix C3.

Within this report section, key decommissioning documents detailing decommissioning activities are listed and completion of final works from the approved 2014 DDP, the 2018 DPDP to the final closure state described in this end-state report.

2.3 Decommissioning Reports

Detailed information on the decommissioning work completed can be found in the following reports:

- Decommissioning of the D Pit Area, November 1995 (COGEMA 1995)
- Cluff Lake Interim Construction As-Built Report, February 1998 (COGEMA 1998a)
- TMA Interim Construction Activities, February 1998 (COGEMA 1998b)
- Cessation of Mining at Dominique-Peter Mine, September 1999 (COGEMA 1999d)
- Site Cleanup and Reclamation Activities for 1999 (COGEMA 1999b), 2000 (COGEMA 2000c), 2001 (COGEMA 2001), and 2002 (COGEMA 2002e)
- Construction of the TMA Surface Diversion Works – South Ditch. April 20, 1999. (COGEMA 1999a)
- Construction of the TMA Surface Diversion Works – North Ditch. April 20, 2000. (COGEMA 2000b)
- Cessation of Mining in DJ Mine and Additional Reclamation Activities at DP Mine. April 5, 2002 (COGEMA 2002a)
- Cessation of Mining Activities at the Cluff Lake Project. May 22, 2002. (COGEMA 2002b)
- Interim As-Builts for Closure of Underground Mines. July 1, 2002. (COGEMA 2002c)
- Sealing of Underground Mine Openings. July 24, 2002. (COGEMA 2002d)
- TMA Lower Solids Levelling Course. October 1, 2002. (COGEMA 2002f)
- As-Built Report – Permeable Reactive Barrier (Peat Trench) Adjacent to Claude Creek (AREVA 2006)

- Germaine Camp – 2006 Demolition Report, September 2006 (Denison 2006)
- Submission for Gamma Radiation Clearance (AREVA 2007a)
- As-Built - Claude Mining Area Decommissioning (AREVA 2007b)
- As-Built - Dominique Janine Area Decommissioning (AREVA 2007c)
- As-Built - Mill Demolition (AREVA 2007d)
- As-Built - Tailings Management Area Decommissioning (AREVA 2007e)
- As Built Report – Second Permeable Reactive Barrier (Peat Trench) Adjacent to Claude Creek (AREVA 2007f)
- Submission for Gamma Clearance of the Germaine Camp Area (AREVA 2009a)
- Construction Completion Report – 2013 Miscellaneous Earthworks and Site Cleanup (Denison 2013)
- 2014 Submission for Gamma Radiation Clearance (AREVA 2014a)
- 2017 Minor Earthworks and Activity Report (AREVA 2018)
- TMA Water Management and 2013 Remedial Works Closure Report, Final Report – Cluff Lake Saskatchewan (SRK 2018)
- Cluff Lake Project – Claude Pit Horizontal Drain Closure Report (Orano 2018d)
- Cluff Lake Project – Surface Gamma Clearance Report, October 2018 (Orano 2018e)
- Claude Pit Horizontal Drain Closure Report (Orano 2018g)
- 2018 Minor Earthworks and Activity Report (Orano 2019a)
- 2020 Minor Earthworks and Groundwater Well Decommissioning Report (Orano 2021)

2.4 Planning Envelopes

The 2004 DDP (AREVA 2004) included decommissioning plans for key areas described as planning envelopes. The following table and section provide the status and summary of each of these parcels.

The majority of physical decommissioning of site facilities was completed between 2004 and 2006, from 2006 to 2021 reclamation activities focused on revegetation efforts, environmental monitoring, and landform maintenance.

In 2019, provincial and federal regulators acknowledged that decommissioning objectives had been met, the site entered post-decommissioning phase, parcels of the surface lease that would not require future oversight were released without restrictions, maintaining parcels that would be transferred into the provincial IC program.

Planning Envelope	Parcel	Current Status
D-Mining Area	D-Pit	Decommissioning complete To Transfer to IC Program
	D-Waste Rock Pile	Decommissioning complete
Claude Mining Area	Claude Pit	Decommissioning complete To Transfer to IC Program
	Claude Waste Rock Pile	Decommissioning complete To Transfer to IC Program
DJ Mining Area	DJN/DJX Pit	Decommissioning complete To Transfer to IC Program
	DJN Waste Rock Pile Area	Decommissioning complete Released
	DJ Underground	Decommissioning complete To Transfer to IC Program
	DJX Overburden Pile	Decommissioning complete Released
OP/DP Mining Area	OP/DP Underground	Decommissioning complete To Transfer to IC Program
Mill Complex Area	Mill Complex Area	Decommissioning complete To Transfer to IC Program
Tailings Management Area	Cover and Main Dam	Decommissioning is complete To Transfer to IC Program
Landfills	domestic, industrial, Secondary Treatment System Ponds, mill landfill and Cluff centre landfill	Decommissioning is complete To Transfer to IC Program
Ancillary Buildings and Services	Germaine Camp	Decommissioning complete Released
	Cluff Center	Decommissioning complete Released
	Southgate Entrance	Decommissioning complete Released
	Airstrip	Decommissioning is complete Released
	Site Roads	Decommissioning is complete Released
	Highway 955	Decommissioning is complete. Released. Responsibility of three crossing locations on the portion of road between the end of highway 955 and the airstrip are currently held by Orano under a provincial land use permit. These areas <u>will be</u> transferred to the Province or local lodge owner (permit pending)

2.4.1 D Mining Area

2.4.1.1 D Pit

D Pit was the first ore body mined at the Cluff Lake Project, beginning in 1979 and completed in 1981. The pit, with a maximum depth of 28 m, became flooded in 1983 when ice formation during the spring thaw caused Boulder Creek to overflow its banks. The pit has remained flooded since that time. There is no surficial outflow from the pit; water either discharges as groundwater or is lost to evaporation.

Routine monitoring on 5 m intervals throughout the water column has been conducted since 1987. The water column is stable, has an established chemocline with very little seasonal depth fluctuation. All decommissioning surface water quality objectives for flooded pits are met in the upper 50% of the water column (Orano 2022b). The shoreline has naturally revegetated with native emergent and submergent aquatic macrophytes

Decommissioning complete.

Transfer to IC Program

2.4.1.1 D-Waste Rock Pile

The D waste rock pile is small (2.3 ha) with a volume of less than 150,000 m³. The pile is entirely D Pit waste and is located immediately adjacent to the pit. The pile was resloped and revegetated shortly after pit flooding. A self-sustaining vegetative cover has been established, initially from seeding of agronomic species, and more recently by native colonization. Infiltration from the waste rock pile reports to the flooded D Pit.

Extensive cleanup, grading, and revegetation have been undertaken at the D Mining Area. A final radiological survey was conducted on the D Waste Rock Pile as part of the Surface Gamma Radiation Clearance. Initial radiological surveys identified areas of elevated gamma radiation primarily on the D waste rock cover that required further remediation. Remediation was carried out in strategic areas to reduce individual readings to below 2.5 µSv/hr and to meet ALARA objectives, although the large area average ALARA objective is not met. To remediate the D Mining Area to meet the large area average objective would require an extra layer of till which would destroy a substantial amount of vegetation in an advanced stage of growth that had already occurred. The affected area is small in comparison to the entire Cluff Lake Project site and is unlikely to contribute significantly to the annual effective dose for traditional land users. The area was determined to be ALARA, social and economic factors considered.

Decommissioning complete.

Released in 2019.

2.4.2 Claude Mining Area

2.4.2.1 Claude Pit

Claude open pit is the largest pit at the Cluff Lake Project and was mined from 1982 through to 1989. The pit has been used as a repository for waste rock, scrap steel, contaminated materials and demolition wastes.

To facilitate the backfilling of Claude Pit, dewatering of the Claude Pit started in 2003 and was completed by September 2005. Backfilling involved the placement of waste rock from DJX Pit and the DJN Waste Rock Pile into Claude Pit, disposal of demolition waste from the Mill complex and other site buildings and the application of a final cover. After final capping and grading, the remaining till cover was revegetated with tree seedlings.

In the fall of 2009, some surface seepage was observed on the Claude Pit till cover and investigation revealed the water was elevated in dissolved metals and had a low pH. Mitigative measures were implemented to prevent the surface seepage from directly entering Claude Lake. In 2010, piezometers were installed at varying depths in Claude Pit and hydraulic head and water chemistry data was collected from 2010 to 2013. In 2013, regulatory approval was received to install three horizontal finger drains across the ring-dyke road west of Claude Pit. The purpose of the drains is to breach the barrier to groundwater movement created by the ring-dyke, thereby reducing the groundwater elevation in the area and the possibility of groundwater expression to surface during periods of high precipitation. The drains were installed in 2013 and semi-annual inspections of the area are conducted during monitoring campaigns.

Summarized below is the Cluff Lake Project – Claude Pit Horizontal Drain Closure Report provided to regulators in August 2018.

Three horizontal drains were installed in 2013 to reduce the frequency, duration, and extent of groundwater expression to surface on the Claude Pit cover. Five years of monitoring and two targeted field studies in the fall of 2017 and the spring of 2018 support that the 2013 performance optimization was achieved: I) localized groundwater levels at the edge of the former Claude Pit have been lowered by about 0.5 m and II) the incremental contaminant loading remains bounded by the flow through the drains, i.e., <10% of total flow/contaminant loading from the Claude Pit flowpath. No further mitigation is recommended.

***Decommissioning complete.
Transfer to IC Program***

2.4.2.1 Claude Waste Rock Pile

The CWRP was constructed between 1982 and 1989 and contains all waste rock from Claude pit. The pile contains roughly 5.2 million cubic meters of waste, is approximately 30 m high and covers an area of approximately 29.5 hectares to the south of Claude pit. The pile was developed by end dumping and contains well-developed traffic surfaces between the lifts of dumped material. The pile was recontoured in 1993 to reduce side slopes to 2H:1V or less. In 2001 and 2002, resloping and compaction tests were conducted on the CWRP to evaluate constructability and performance issues in support of the final cover design.

In 2005 and 2006, the CWRP was recontoured, compacted, covered with 1 m thick glacial till cover and revegetated with grasses and forbes.

Decommissioning complete.

Transfer to IC Program

2.4.2.2 Buildings and Infrastructure

Claude Shop, formerly used for heavy equipment storage and maintenance was removed in 2006. The surrounding area was covered with clean glacial till and graded for aesthetic reasons. Subsequently, the Claude Shop yard area was cleared for surface gamma radiation and revegetated with tree seedlings.

Decommissioning is complete.

Released in 2019

2.4.3 DJ Mining Area

Decommissioning the DJ mining area involved:

- the entire DJN Waste Rock Pile and part of the DJX waste rock moved to Claude pit
- decommissioning of remaining DJ area buildings and surface infrastructure

2.4.3.1 DJN/DJX Pit

The DJX and DJN open pits are located south of the Claude deposit and adjacent to the north end of Cluff Lake. The DJN pit came into production in 1989 and continued through to 1991. Mining of the DJX pit occurred from 1994 through to 1997.

The DJN pit was allowed to fill with water prior to mining of the DJX ore body. The DJN pit was drained and later filled with clean waste rock from the DJX pit.

Decommissioning the DJN/DJX Pit complex involved relocating a portion of the existing waste rock in DJN Pit, flooding of the pits, regrading the area, stormwater management, and revegetation.

Decommissioning complete.
Transfer to IC Program

2.4.3.2 DJN Waste Rock Pile

The DJN waste rock pile was constructed between 1989 and 1991 during the development of the DJN open pit. The pile contained approximately 1.4 million cubic meters of waste rock, was up to 16 m high and covered an area of approximately 14 ha. The entire pile was relocated to Claude Pit in 2004 and 2005 and the area regraded and revegetated.

Decommissioning is complete.
Released in 2019

2.4.3.3 DJ Underground

The DJ underground (DJU) mine was developed in 1994 and operated until mine closure in 2002.

During site cleanup operations in 2002, DJU raises and the DJU decline were backfilled with till material. DJU raises were entirely backfilled from the bottom of the raise to the raise collar elevation. The DJU decline was backfilled from approximately 181 m down the ramp to the portal opening. Reinforced concrete caps were placed above all backfilled raises and a concrete plug was poured at the DJU portal opening. The mine was partially flooded in 2002 using minewater from the adjacent DJX pit. The mine continues to flood under natural water flow conditions.

Decommissioning complete.
Transfer to IC Program

2.4.3.1 DJX Overburden Pile

The DJX Overburden Pile consists of till material removed from the DJX Pit prior to mining. This material was used as cover material in the cover construction of the CWRP. Once the till haulage was completed, the area was graded and revegetated with tree seedlings.

***Decommissioning is complete.
Released in 2019***

2.4.4 OP/DP Mining Area

Decommissioning the OP/DP mining area involved:

- Decommissioning of the OP/DP underground mine
- Decommissioning of DP area buildings and surface infrastructure

2.4.4.1 OP/DP Underground

Stripping and construction of ramps for the OP/DP mine began in 1983 and production commenced in 1985. Mining was discontinued in 1999, and the OP/DP mine was allowed to flood under natural conditions. Complete flooding of the workings was achieved in August 2002.

The OP/DP raises were partially backfilled in 2000 with final backfilling completed during site cleanup operations in 2002. The OP/DP decline was backfilled from approximately 176 m down the ramp to the portal opening. Reinforced concrete caps were placed above all backfilled raises and a concrete plug was poured at the OP/DP portal opening. Site grading and radiological clearance was completed in 2004.

***Decommissioning complete.
Transfer to IC Program***

2.4.4.2 Buildings and Infrastructure

All buildings and surface infrastructure in this area have been decommissioned, the area has been regraded and revegetated with seedlings.

Decommissioning is complete.

2.4.5 Mill Complex and Supporting Facilities

Decommissioning the mill area was completed in two phases. Phase 1 was carried out from August to November 2004. Phase 2 was carried out from August to December 2005. Demolition material was disposed of in the Claude Pit during backfilling. Following demolition, the former Mill area was covered with clean glacial till, graded, cleared for surface gamma radiation, and then revegetated with tree seedlings.

To provide adequate facilities to support post-decommissioning environmental monitoring, the mill warehouse and services fuel farm were maintained until 2013. In August 2013, demolition occurred, and non-salvageable material was disposed of in the landfill.

Decommissioning complete.

Transfer to IC Program

2.4.6 Tailings Management Area

The TMA was the disposal location for all tailings produced during the operating life of the Cluff Lake Project. The TMA is an aboveground facility located in a topographic low with tailings solids (and liquids previously) retained behind a clay-core dam. The TMA has also been used as a receptor for contaminated mine water and site runoff requiring treatment.

The South Diversion Ditch and North Diversion Ditch were constructed in 1999 and 2000, respectively, to divert uncontaminated water (from the drainage basin surrounding the TMA) to Snake Lake. These ditches minimize run-on of clean water into the TMA and ensure that area runoff from a major precipitation event, including a Probable Maximum Precipitation event, can be safely diverted around the TMA.

Decommissioning the TMA area involved the following primary work items:

- Covering all tailings materials with a minimum 1m glacial till cover
- Backfilling the Liquids Pond
- Buttressing the main dam
- Construction of stormwater management structures
- Removal of buildings and surface infrastructure, and
- Revegetation

2.4.6.1 TMA Cover and Main Dam

Two reports were submitted to regulators in August 2018 in support of closing the 2014 DDP: TMA Water Management Report and 2013 Remedial Works Closure Report, Final Report – Cluff Lake Saskatchewan (SRK 2018) and Risk Assessment of the Presence of Poned Water on the Decommissioned Tailings Management Area (CanNorth 2018).

The TMA engineered cover was designed to minimize surface ponding but not necessarily eliminate the presence of ephemeral ponds. Ephemeral ponds are observed primarily on the former liquids pond where the thickest amount of till was placed during decommissioning (up to 5 m) and adjacent to the internal TMA berm at the boundary of the lower solids areas where about 2 m of till was placed. The presence of ponded

water does not undermine design. Positive drainage is maintained across the TMA towards the spillway contributing to the overall capacity to route higher precipitation events, including a PMP.

No further mitigation is recommended.

A risk assessment of TMA ponded water was completed to evaluate potential impacts and to alleviate community concern. Ponded water, sediment, and vegetation samples were collected on the TMA and the associated ecological risk was evaluated using a consistent approach and assumptions as presented in Environmental Performance Technical Information Document Volume 2 (AREVA 2015c, Orano 2019c). From an ecological perspective, should ephemeral ponds on the TMA persist, I) no adverse effects are expected for terrestrial wildlife or species-at-risk that may use the TMA and II) other than a small potential for nickel concentrations to be an issue for individual toads, no adverse effects are expected from an aquatic perspective.

Decommissioning complete.
Transfer to IC Program

2.4.7 Ancillary Buildings and Services

2.4.7.1 Germaine Camp Area

A permanent camp for the Cluff Lake operations is located adjacent to Germaine Lake near the southwest end of Cluff Lake. With reduced site personnel following decommissioning of the major mining areas, a portion of the camp was decommissioned in 2006. The remaining camp facilities supported both the staff providing monitoring and minor maintenance for the Cluff Lake Project and exploration staff working at the Shea Creek site located to the south of the Cluff Lake site and were decommissioned in August 2013, along with the sewage treatment plant and freshwater supply plant.

The area underwent gamma surveys and was regraded and revegetated.

Decommissioning is complete.
Released in 2019

2.4.7.1 Cluff Center

A portion of the Cluff Centre area is used for core storage. The fenced core storage area provides a specific storage area for mineralized core and other sections for non-mineralized core pursuant to The Mineral Disposition Regulations. The core storage area continues to be used by Orano's Exploration Department.

The unfenced portions of area referred to as Cluff Centre have been regraded and revegetated. The area was cleared for surface gamma radiation.

Decommissioning is complete.
Release in 2019

2.4.7.1 Southgate Entrance

The Southgate Entrance was a security gate located at the south end of the site on the main access road at the end of Highway 955 and was the primary location for controlling site access until 2013. In August 2013, upon completion of decommissioning and cleanup activities, the south gate was removed, and the site remains open for unrestricted access to the general public.

Decommissioning is complete.
Released in 2019

2.4.7.2 Batch Plant

The batch plant was sold and removed in 2003. Decommissioning activities were completed with final regarding and revegetation.

Decommissioning is complete.
Release in 2019

2.4.7.3 Cluff Lake Pumphouse

The Cluff Lake pumphouse, and associated pipeline to the mill, were demolished with the Mill complex. Demolition materials that were not salvageable were disposed of in the Claude Pit during backfilling and the area has been regraded and revegetated.

Decommissioning is complete.
Released in 2019

2.4.8 Airstrip

The airstrip was closed in 2013 and is listed as abandoned on air navigation charts and in the Canada Flight Supplement. As detailed in the 2017 Minor Earthworks and Activity Report (AREVA 2018) and the 2018 Notification of Activities (Huffman to Merkowsky and Glover dated August 10, 2018), the airstrip will be left in its current condition and will remain listed as abandoned. Abandoned airstrips serve as important, potential landing strips for aircraft and the west side of Saskatchewan has limited alternate landing locations.

The Cluff Lake airstrip is well positioned as an emergency landing strip - the closest active aerodrome is Fort Chipewyan, 100 km to the northwest. There is another abandoned aerodrome, Keane Tower, about 45 km west of Cluff Lake and located in Alberta. The closest active aerodromes in Saskatchewan are the

private strip with no winter maintenance at Axe Lake, 126 km to the south and Camsel Portage and Uranium City at 137 and 139 km to the north. There are other examples of abandoned airstrips in Saskatchewan and across Canada located on active mineral claims including Hidden Bay and Otter Lake abandoned airstrips.

Decommissioning is complete.

Released in 2019

2.4.9 Site Roads

These include several on-site roads used during the mining and milling operations.

Since cessation of a full-time site presence, cleanup activities in 2013 included removing culverts at 7 locations and replacing them with drive-through cross ditches:

- Boulder Creek (1)
- Earl Creek (3)
- Peter River (1)
- Claude Creek (1)
- Lost Knife Creek (1)

Streambank restoration at these sites involved recontouring and flattening of approach slopes, riprap armouring of the streambed and partial slope and erosion control matting installed at the Claude Creek location.

As detailed in correspondence titled Cluff Lake Project 2018 Notification of Activities (August 10, 2018 from Huffman to Merkowsky and Glover), the Cluff Creek culverts and Germaine Camp culverts were removed in the fall of 2018 (2018 Final Earthworks Report to be submitted).

On-site roads are determined to be sufficiently de-activated and decommissioned and obligations under the previous DDP are closed.

The Cluff Lake site has about 28 km of onsite roads and an additional 22 km of trails. Traffic on roadways at Cluff Lake reduced considerably in 2002 at the end of operations, again in 2006 following the end of the main decommissioning and reduced further when continuous on-site presence ended in 2013. Current traffic on Cluff Lake roads includes a small crew of about four workers travelling the site for about two weeks at a time for annual campaign monitoring, exploration, and occasional travel by traditional land users - mainly by members of the Flett family to visit their cabin on Cluff Lake.

Scarification of roads would unnecessarily delay final, natural reclamation of the site. The roadways at the Cluff Lake site are in various stages of natural revegetation that began when grading and regular use of the

roads stopped. Berms have been placed across the entrances to the mill landfill and half berms placed before stream crossings to slow potential traffic. Beaver dam activity to the north of Cluff Lake is resulting in some water flowing over that site road. Overtime, the improved access resulting from mining activity will fade into wilderness travel.

***Decommissioning is complete.
Released in 2019***

2.4.10 Highway 955

Prior to mining at the Cluff Lake Project, highway 955 transitioned into an ice road servicing Uranium City. Over time with the increased traffic due to mining activities, the road was upgraded including installation of culverts. Highway 955 largely bypasses the decommissioned mine site and provides continued public access north to Carswell Lake where there is an established business. Culverts are located at the Beaver, Boulder, and Earl Creek crossings on the portion of Highway 955 overlapping with the current Cluff Lake Project provincial surface lease.

The Earl Creek culverts were removed in 2013 and the streambed rehabilitated. In 2016, members of the public improperly installed a single undersized culvert at the Earl Creek crossing potentially impeding fish passage. The crossing was partially washed out in the spring of 2017 and again in 2018 with attempted repairs both years, again by members of the public, with placed cobble and gravel. The final state of the Beaver, Boulder, and Earl Creek crossings was re-evaluated given:

- I. the known and documented public use of this route prior to, during, and post mining operations,
- II. the demonstrated public interest in maintaining the road,
- III. stated concerns from the Carswell Lake business owner that culvert crossings are required for reliable truck and trailer access to the business,
- IV. with the understanding that removal of the Beaver and Boulder Creek crossings would materially affect public access north to Carswell Lake and also to established Traditional Resource User (TRU) parcels (including cabins) on Cluff and Sandy lakes,
- V. the high potential for improper installation of culverts in the future where adequate culverts are currently in place, and
- VI. interest in decommissioning that minimizes adverse effects and also considers benefits.

Orano will maintain responsibility for the three culvert crossings until they are successfully transferred to the Ministry of Highways (public) or potentially to the TRU holders and/or Carswell Lake business owner (private). Should the culverts be successfully transferred to a private owner, the infrastructure will be permitted under a provincial Miscellaneous Use Permit.

The Cluff Lake site can remain recognized as decommissioned with a provincially or privately maintained road bypassing the site.

Decommissioning is complete.

2.4.11 Fuel Storage Facilities

Decommissioning of the fuel storage farm in 2013 was carried out in accordance with the Saskatchewan Hazardous Substances and Waste Dangerous Goods Regulations. The diesel tanks were drained of their contents and ventilated prior to crushing and disposal of the tanks in the landfill. Approximately 0.5 m of underlying substrate soil beneath the fuel farm was excavated and transported to the hydrocarbon landfarm.

Aerial photographs of key areas which show operational, decommissioned, and recent conditions are presented in Figures 2.1 to 2.6.



1999



2008



2014



2019

Projection:
Compiled: T.Lohman
Date: 2022-04-28
Data Sources: ORANO Canada Inc.

Drawn: T.Lohman
Scale:

FIGURE 2.1
AERIAL PHOTOGRAPHS OF D MINING AREA

CLUFF LAKE PROJECT





2004



2008



2014



2019

Projection:
 Compiled: T.Lohman
 Date: 2022-04-28
 Data Sources: ORANO Canada Inc.

Drawn: T.Lohman
 Scale:

FIGURE 2.2
 AERIAL PHOTOGRAPHS OF CLAUDE MINING AREA

CLUFF LAKE PROJECT





Projection:
Compiled: T.Lohman
Date: 2022-04-28
Data Sources: ORANO Canada Inc.

Drawn: T.Lohman
Scale:

FIGURE 2.3
AERIAL PHOTOGRAPHS OF DJ MINING AREA

CLUFF LAKE PROJECT





Projection:
Compiled: T.Lohman
Date: 2022-04-28
Data Sources: ORANO Canada Inc.

Drawn: T.Lohman
Scale:

FIGURE 2.4
AERIAL PHOTOGRAPHS OF MILL COMPLEX AREA

CLUFF LAKE PROJECT





Projection:
 Compiled: T.Lohman
 Date: 2022-04-28
 Data Sources: ORANO Canada Inc.

Drawn: T.Lohman
 Scale:

FIGURE 2.5
 AERIAL PHOTOGRAPHS OF TAILINGS MANAGEMENT AREA (TMA)

CLUFF LAKE PROJECT





2004



2008



2014

Projection:
Compiled: T.Lohman
Date: 2022-04-21
Data Sources: ORANO Canada Inc.

Drawn: T.Lohman
Scale:

CLUFF LAKE PROJECT

FIGURE 2.6
AERIAL PHOTOGRAPHS OF GERMAINE CAMP AREA



3 Waste Quantities and Disposition

3.1 Remaining Nuclear Waste

In 2019, the Surface Lease was amended to reflect the parcels that will have land-use controls under the IC Program.

These parcels include subsets of land parcels that may be defined as decommissioned nuclear facilities containing mine and mill wastes (i.e., disposed nuclear substances; decommissioned waste rock and tailings) with a radioactive inventory of 10^{15} Bq or more (*NSCA* S.2 and *NSCR* S.19(a)). In 2019, the Cluff Lake Licence was reduced to include parcels of land to be included for future transfer into the provincial IC Program, the parcels identified included land where the licenced activity of 'possess, manage, store' a nuclear substance is conducted, or parcels of land with a radioactivity inventory of 10^{15} Bq or more (identified above and in Figure 4-1). These parcels are listed below, and the status described in Section 2.4.

- Claude Waste Rock Pile
- Claude Pit
- DJX Pit
- Tailings Management Area

As activities licensed under the Cluff Lake licence, these land parcels which 'possess, manage, store' a nuclear substance will be included in the return of property to the Government of Saskatchewan. The transfer will occur in accordance with Subsection 24(4) of the *NSCA* and Section 13 of the *GNSCR* given the acceptance of the Cluff Lake Property by the Saskatchewan Ministry of Energy and Resources according to Section 5 of the *Reclaimed Industrial Sites Act*. The Province of Saskatchewan is qualified to possess, manage, store radioactive waste and, in doing so, will make adequate provision for the protection of the environment, health and safety of persons, maintenance of national and international obligations.

Following the transfer, a licence exemption should be granted to the Province for the activity of possess, manage, store radioactive waste on the Cluff Lake property according to Section 7 of the *NSCA* and Section 11 of the *GNSCR*. The radioactive waste will not be abandoned; the responsibility is being transferred from one responsible authority to another.

3.2 Waste Management

The Cluff Lake Project was subject to a robust waste management plan, directing waste generated during operation and decommissioning to designated areas (i.e., landfills, TMA, Claude Pit), hazardous waste was shipped off site for recycling/disposal. Volumes were diligently inventoried for reporting in annual reports and post minor work reports provided to the regulators.

4 Abnormal Incidents or Occurrences

4.1 Island Lake Fish Kill

In the spring of 2002 and 2003 increased fish mortality was observed in the lower reaches of Snake Creek and the inlet of Island Lake, attributed to a reversion to the natural state that existed prior to operations. Over 20 years of effluent release through the winters provided enough dissolved oxygen in the lake waters under the ice cover to support artificial enlargements of the White Sucker population.

With the shutdown of the effluent treatment system and the lack of effluent releases, the Island Lake system reverted to its predevelopment condition, of limited dissolved oxygen content in the winters.

Island Lake is an isolated system and ecological effects assessments indicated that fish populations are recovering.

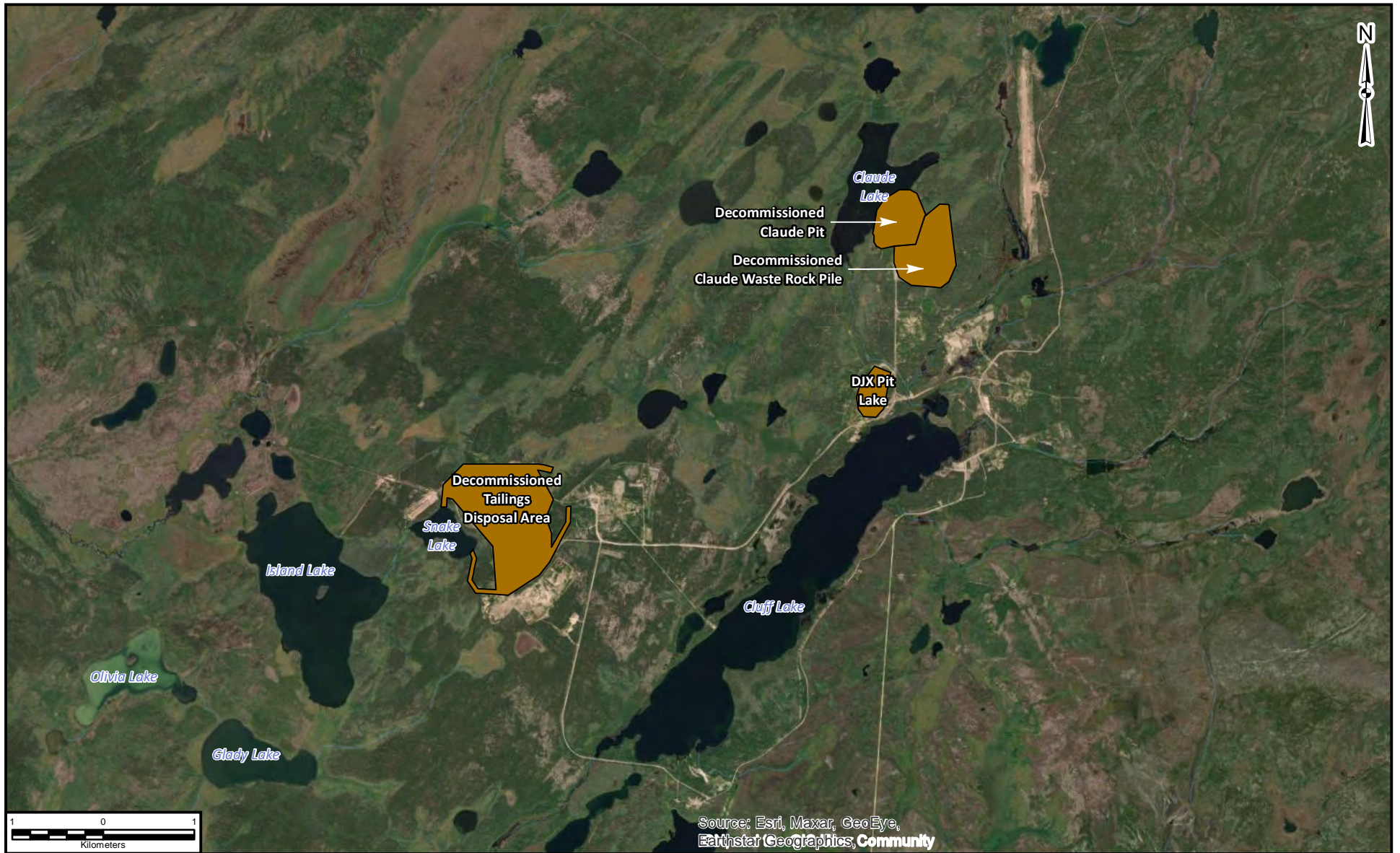
4.2 TMA Cover – ponding

Decommissioning of the TMA involved placement of an engineered cover (minimum 1 m glacial till) over tailings that would promote surface runoff, minimize infiltration, and provide a medium for revegetation. With backfilling and covering the area to an elevation above the anticipated post-closure phreatic surface and grading, ponding of water and/or groundwater seepage was intended to be minimal with positive drainage towards the spillway maintained. Ephemeral ponded water and areas with wetland features have been observed on the TMA. Monitoring results of generally low concentrations of COPC indicates that the majority of ponding is due to localized depressions holding fresh surface water but there is a possibility of intermittent groundwater daylighting on the TMA cover driven by seasonal and climatic influences on the water table despite overall net percolation.

Animals are expected to use, and have been observed on, the TMA. Orano undertook to evaluate and better quantify the associated potential risks to wildlife. The report providing an ecological risk assessment of the ponded areas was provided in August 2018 (CanNorth 2018).

The VECs selected for the TMA assessment included aquatic plants, phytoplankton, zooplankton, aquatic invertebrates, leopard frog, hare, muskrat, fox, moose, mallard, and nighthawk.

From an aquatic perspective, the ponded water on the TMA is not considered to be high quality habitat and does not support fish due to their shallow nature. The aquatic assessment demonstrated while there may be a potential for nickel concentrations to be an issue for toads, the limited habitat and spatial extent of the areas of shallow ponded water on the TMA are not expected to result in population-level effects.



Projection: NAD 1983 UTM Zone 12N
 Compiled: T.Lohman Drawn: T.Lohman
 Date: 2022-04-28 Scale: 1:60,000
 Data Sources: Natural Resources Canada, Geobase®, Nation
 Topographic Database, ORANO Canada Inc.

CLUFF LAKE PROJECT

FIGURE 4.1
 CLUFF LAKE DECOMMISSIONED NUCLEAR FACILITY
 DECOMMISSIONED NUCLEAR FACILITIES WITH
 RADIOACTIVE INVENTORY >10¹⁵ Bq



The terrestrial assessment demonstrated that no adverse effects are expected for terrestrial VECs (wildlife) that use the TMA. In addition, there is no potential for risk for molybdenosis in moose. An assessment of potential effects on species at risk using the nighthawk as a reference species demonstrated that individuals will not experience adverse effects.

In conclusion, from an ecological perspective, it is not expected that ponded water on the TMA would result in population-level effects in ecological receptors that use the area and there will not be effects in species at risk.

4.3 D-pit – elevated COPC

Concentrations of several COPCs showed increases in the 2020 surface water sample results including sulphate, molybdenum, selenium, nickel, and uranium (which exceeded DSWQO). These increases carried over into the 2021 sampling although decreases in surface water concentrations were noted for most affected COPCs. Orano associates these increases with a large precipitation event in August 2020, which is suspected to have washed a higher-than-normal loading of COPCs from the adjacent D-pit waste rock pile into the D-pit. The decrease in most COPC concentrations in the 2021 surface water samples is in line with the expected performance of the D-Pit after such an inflow event.

Elevated concentrations of COPCs which initially report to the surface layer of the pit will gradually decline as COPCs fall out through the water column to be sequestered below the chemocline. This movement of COPCs deeper in the pit is most noted in uranium values which have decreased slightly in 2021 surface water quality values and increased in the 10 m interval sampling as predicted. It is expected that surface water quality and 10 m depth interval values of uranium in the D-Pit will gradually decrease to again achieve DSWQO objectives. The chemocline remains stable in D-Pit which restricts the interaction of the deep pit water with the surface. In general, for D-Pit surface water samples molybdenum concentrations remained well below available provincial guidelines for the protection of freshwater aquatic life while, uranium concentrations continued to exceed the available provincial guideline of 15 µg/L for the duration of the decommissioning and monitoring period.

5 Institutional Controls

The Cluff Lake site decommissioning has been designed such that no active maintenance is expected. An evaluation of permanent occupancy indicates low risks. The Cluff Lake property has a very low reliance on institutional controls for the protection of people or the environment.

Decommissioning involved the removal or stabilization of constructed structures and the reclamation of disturbed areas. Orano's key objective was to remove, minimize, or control potential contaminant sources and thereby minimize the potential for adverse environmental effects associated with the decommissioned property. Decommissioning was designed to minimize the need for care and maintenance activities and long-term institutional controls taking into consideration socio-economic factors. The objectives for decommissioning have been achieved.

Long-term monitoring requirements are expected to be infrequent and minimal as the site will be stable and self-sustaining upon transfer to the provincial IC Program.

The provincial IC Program will protect areas of land to make sure they are only used for appropriate uses in the future so that the decommissioned sites are not disturbed by other developments.

Administrative responsibility for the Cluff Lake site will be with the Province of Saskatchewan following successful transfer into the IC Program. Under the IC Program, acceptable land uses are defined, and administrative controls put into place. Sections 10 and 17 and of the *Reclaimed Industrial Sites Act* describes the ability of the Province to restrict or control access as follows:

Controlling access to closed sites

10(1) The minister may restrict or prohibit access to a closed site that has been accepted into the Institutional Control Program if the minister considers it to be in the public interest to do so.

(2) No person who has knowledge of a restriction or prohibition imposed by the minister pursuant to subsection (1) shall fail to comply with that restriction or prohibition.

Offence and penalties

17(1) No person shall fail to comply with subsection 10(2).

(2) Every person who contravenes subsection 10(2) is guilty of an offence and liable on summary conviction to a fine not exceeding \$50,000.

(3) Every director, officer or agent of a corporation who directed, authorized, assented to, acquiesced in or participated in an act or omission of the corporation that would constitute an offence by the corporation is guilty of that offence and is liable on summary conviction to the penalties provided for the offence whether or not the corporation has been prosecuted or convicted.

Additionally, proposed Crown land use (e.g., quarrying, exploration) requires application and approval for the applicable lease, permit, easement, or licence to allow authorized use. The Ministry of Environment reviews applications to ensure that environmental and resource impacts are considered (including proximity to other land users, buffers from sensitive area(s), and designations that prohibit certain types of development) before issuing a decision.

In consideration of administrative controls, Orano recommends that:

- The decommissioned mine footprint has industrial and commercial uses and disturbances restricted. Some industrial and commercial uses such as exploration and quarrying may be compatible with the long-term decommissioning stability of the Cluff Lake site, depending on location. No exploration or quarry activities on the decommissioned mine footprint should take place without the Ministry outlining potential risks and consequences and, pending Ministry approval, having that land user accept liability. The CWRP, Claude pit, and TMA should have no approved industrial or commercial uses or disturbances.
- There should be no draining and/or dredging of Claude or Snake lakes.
- There should be no installation and use of wells to access groundwater for drinking water.

6 Lessons Learned

Key lessons learned from the decommissioning of the Cluff Lake Project, include:

- Mining is a temporary use of the land. Beginning a mining project with the end-state in mind leads to successful decommissioning.
- End-state expectations need to be developed in partnership with regulators and local stakeholders early in the project.
- Continual engagement with local stakeholders, especially land-users, throughout the development, operating, and decommissioning period ensures needs are met post-closure.
- Environmental assessment is a valuable planning tool.
- Having an actionable decommissioning plan during the operating period enables progressive decommissioning.
- Working in a jurisdiction with an institutional control framework (i.e. Saskatchewan) in place is enviable in the global mining industry.
- Implement systems to collect and maintain corporate knowledge and history.

7 Institutional Control Program

7.1 Long-Term Monitoring and Maintenance

7.1.1 Monitoring

With decommissioning objectives sustainably achieved and long-term stability of the site projected, monitoring requirements have been appropriately reduced. Environmental and ecological risk assessments provide the basis for the scope and complexity of monitoring programs and as such, the Cluff Lake Long-Term Monitoring and Maintenance Program (LTMMP) was proposed in the 2019 EP TID and subsequently removed to form its own independent document.

A LTMMP will continue, into the far future, at a reduced sample frequency focused on confirming and demonstrating the site's environmental performance against predicted performance and relative to decommissioning objectives. Notwithstanding major changes in the understanding of ecological and human health risk, if monitored surface water quality remains comparable to predicted surface water quality over time it can be reasonably assumed that the assessed risks (or absence of risk) remain valid. In this way, monitoring at a selection of key surface water quality locations can confidently validate the continued achievement of the following decommissioning objectives: I) achieving DSQWO and II) a site that poses no unreasonable risk to humans or the environment. The predicted rate of change in surface water quality should inform and influence the sampling frequency.

For the purpose of estimating the financial assurance, 16 key surface water quality sampling locations are assumed; a one-time fish, sediment, benthic and vegetation survey and the associated program cost estimates for planning, travel, accommodations, equipment rental, sample analysis, report writing, and modest on-going public engagement/communication. It is expected that the frequency of site monitoring would diminish with time.

7.1.2 Maintenance

The need for long-term care and maintenance has been minimized through decommissioning design and completed reclamation. Long-term maintenance requirements are expected to be infrequent and minimal as the site is stable, self-sustaining, and under passive care. The LTMMP is assumed to comprise of periodic geotechnical inspections to monitor the stability of engineered structures, water management, and potential erosion and it is through this monitoring that potential maintenance would be identified.

For the purposes of estimating the financial assurance, a geotechnical inspection and associated site maintenance value is included in each monitoring year. The most probable future maintenance is expected with either I) potential settling in the landfills or in the TMA that would require localized work to fill holes or

maintain overall surface grading, respectively or II) potential erosion on the TMA or CWRP covers that would require localized works.

7.2 Funds and Assurance

With reclamation and decommissioning work completed, the ongoing cost of post-closure management includes monitoring and maintenance of the Cluff Lake property. The decommissioned end-state objective was to achieve a stable and self-sustaining site with perpetual passive care. Engineered structures including the CWRP and the TMA dam have been designed to require no routine on-going maintenance. Underground mine workings were backfilled as part of routine operations, vent raises were backfilled completely before capping, and declines were substantially backfilled before closure. Replacement of decommissioned features is not anticipated at the Cluff Lake property, e.g., there are no shaft caps to replace. Monitoring of the site will include geotechnical monitoring to ensure landforms are stable, and water quality monitoring to ensure continuous achievement of decommissioning objectives.

LTMP funds have been estimated according to guidance provided in the provincial IC Program document (SMER 2009). Future costs are based on escalation of present costs using a 10-year average Bank of Canada inflation rate. The calculation of the net present value of an annuity that would support future site expenses assumes a conservative rate of return of 3.65%, i.e., inflation plus 2%. The present value of a cash payment sufficient to support monitoring and maintenance in perpetuity has been proposed to the Government of Saskatchewan.

The Province of Saskatchewan's *Reclaimed Industrial Sites Act* and its regulations require provision of a fund sufficient to pay for the perpetual monitoring and maintenance of the site, and an additional contribution of 20% of the monitoring and maintenance amount to an unforeseen events fund. Until such time as the provincial unforeseen events fund is self-sufficient, new entries into the IC Program are requested to provide an additional financial assurance for repair of a potential low-probability, worst-case failure event.

7.3 Schedule to IC Program

Briefly, some of the major decommissioning milestones for the Cluff Lake Project include:

- 2000 - Comprehensive Study for Decommissioning (CSD; AREVA)
- 2003 - Comprehensive Study Report (CSR; CNSC)
- 2004 – CNSC decommissioning approval
- 2004 to 2006 – primary decommissioning
- 2004 - partial surrender of provincial surface lease
- 2009 – revised Detailed Decommissioning Plan

- 2013 – physical decommissioning of remaining surface infrastructure, minor earthworks, continuous site presence discontinued
- 2013 – unrestricted access to site
- 2014 – environmental monitoring transitioned to campaigns 4X/year
- 2014 – revised Detailed Decommissioning Plan
- 2015 – reclassification of entire provincial surface lease to ‘undeveloped’
- 2015 – submission of the Cluff Lake Technical Information Documents demonstrating current and long-term achievement of decommissioning objectives
- 2015 – completion of Follow-Up Program (updates in 2004 and 2009)
- 2017 to current – environmental monitoring transitioned to 1X/year
- 2018 – completion of activities under DDP
- 2018/2019 – transition of DDP to Detailed Post Decommissioning Plan
- 2019 – submission of the Cluff Lake Technical Information Documents demonstrating current and long-term achievement of decommissioning objectives
- 2019 – CNSC license renewal and amendments
- 2019+ - development and review of Long Term Monitoring and Maintenance Plan and associated Funds with regulators and stakeholders
- 2020 – surface lease reduction to 336.39 hectares
- 2021 – conduct minor works and decommission groundwater wells
- 2022 – optimization of 2022 environmental monitoring program, generally reduced to sampling required in LTMMMP

8 Traditional Land Use

Traditionally, the site was seasonally accessed by an aboriginal trapper who maintained a commercial trap line in the local study area. The trapper also hunted and fished for personal consumption. There is no evidence of other site activities by aboriginal or non-aboriginal peoples prior to site development. Throughout the Cluff Lake Project history, this same trapper continued to trap within the Cluff Lake area. The trapper-maintained cabins at both Cluff Lake and Sandy Lake. In addition, an outfitter also established a fishing/hunting lodge on the shore of Carswell Lake, approximately 20 km north of the site. While some fishing has occurred on Cluff Lake, most fishing is concentrated on the nearby Sandy and Carswell Lakes. Gathering and consumption of locally available low bush cranberries, blueberries, and mushrooms has also been conducted throughout the Project history.

Orano acknowledges and appreciates land use information shared from the representatives from the from the Environmental Quality Committee (EQC) and west side EQC representatives in particular, the Athabasca Chipewyan First Nation (ACFN), the Clearwater River Dene Nation (CRDN), registered trappers in the N22 Fur Block, outfitters, interested interveners in regulatory proceedings, and west side community members.

On February 21 and 22, 2005, Orano held a workshop on the decommissioning of the Cluff Lake Project with members of the west side EQC and the ACFN to gain insights into the historic, current, and expected future traditional use of the land. The participants included a trapper from the ACFN, and members of his family, who have seasonally accessed the Cluff Lake area and maintained a trap line in the local study area prior to mine construction and throughout operations. Members of the extended family have maintained cabins on both Cluff Lake and Sandy Lake.

During the workshop, attendees were asked to envision having a cabin on Cluff Lake available for year-round use when advising of land use activities, locations, and time frames. Expected and potential land use was identified as, but not limited to fishing, hunting, berry picking, firewood collection, trapping, wild rice production, herbs and medicine harvesting, gardening, tourism, hiking, swimming, and camping. Attendees then described the amount of time they would spend conducting these activities throughout the year and identified the probable locations for the various activities. The participants agreed that under a scenario with year-round cabin availability at Cluff Lake, approximately 91 days would be spent in the Cluff Lake area, with 25% of the time spent in the immediate Cluff Lake area (~23 days) and 75% of the time would be spent at other lakes including Sandy, Carswell, and Two-Mile lakes.

This advice is supported by known local land use as presented on Figure 9-1. The family of owners of the traditional resource use cabin on Cluff Lake also own a near-by cabin on Sandy Lake and spend time in northern Alberta and the Northwest Territories. ACFN has identified land use throughout the area. The Cluff Lake area is part of the south-north corridor identified by the CRDN consistent with Orano's understanding of the area as part of a travel route. CRDN has identified areas of cultural significance. Orano is aware of

hunters throughout the region that travel Highway 955 north towards, to, and past the Cluff Lake site. The two closest outfitters are located on Sandy and Carswell lakes.

The following are major outcomes of the discussion:

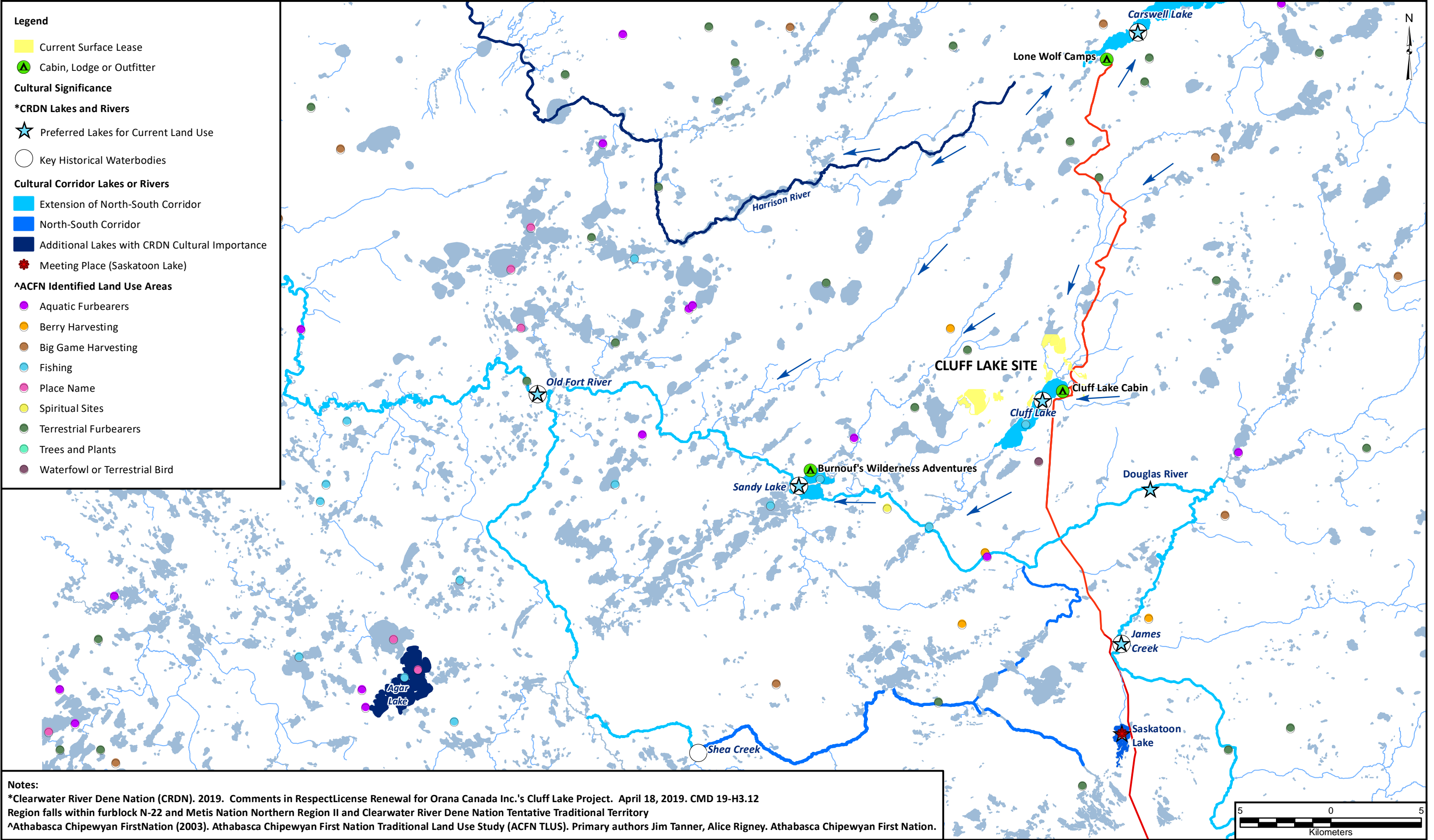
- Traditional land use, while sometimes utilizing land and resources in a small and preferred area, generally involves travelling over a wide area. The decommissioned Cluff Lake footprint is generally considered small relative to areas used for traditional purposes.
- Traditional land users would be unlikely to set up a cabin at Cluff Lake given that there are better fishing lakes in the region. The location could and would more likely be used as a base with most activities conducted away from this area. Fishing on Cluff Lake would be expected but limited as the lake is not preferred.
- The mining areas were viewed as unattractive areas for most activities, with the exception of gathering blueberries. With the exception of berry picking, activities were unlikely to be conducted in the small, localized areas affected by mining.
- The vicinity of pit lakes was viewed as unlikely areas for setting up camp. The pits are isolated from the aquatic system and, although remediated for aesthetics and safe surface water quality, traditional users are unlikely to drink water from, or fish on, pit lakes because they are obviously human-made lakes in a region of abundant and known good fishing.
- It is unlikely that a cabin in the area, away from home communities, would be occupied year-round. This feedback is consistent with current cabin use by the family owning a traditional resource user cabin on the shore of Cluff Lake who use the cabin periodically.

The participants agreed upon a base case scenario to assess potential risk in the Human Health Risk Assessments (HHRA) conducted by Orano: under a scenario with year-round cabin availability at Cluff Lake, approximately 91 days would be spent in the Cluff Lake area, with 25% of the time spent in the immediate Cluff Lake area (~23 days) and 75% of the time would be spent at other lakes including Sandy, Carswell, and Two-Mile lakes.

Additionally – full time residency was considered in the HHRA - The full-time receptor is assumed to obtain 70% of drinking water from Cluff Lake and 30% from a background lake, such as Carswell Lake, which is a known popular fishing lake.

Results were comparable to the casual traditional land use receptor, with both scenarios indicating:

- decommissioned Cluff Lake site is safe for people who may hunt, fish, drink water and gather from the site and that the food from and near the site is safe to share with extended families, including children



Notes:
 *Clearwater River Dene Nation (CRDN). 2019. Comments in Respect License Renewal for Orana Canada Inc.'s Cluff Lake Project. April 18, 2019. CMD 19-H3.12
 Region falls within furblock N-22 and Metis Nation Northern Region II and Clearwater River Dene Nation Tentative Traditional Territory
 ^Athabasca Chipewyan First Nation (2003). Athabasca Chipewyan First Nation Traditional Land Use Study (ACFN TLUS). Primary authors Jim Tanner, Alice Rigney. Athabasca Chipewyan First Nation.

FIGURE 9.1
 LAND USE NEAR THE DECOMMISSIONED CLUFF LAKE PROJECT

Projection: NAD 1983 UTM Zone 12N
 Compiled: T.Lohman Drawn: T.Lohman
 Date: 2022-05-03 Scale: 1:200,000
 Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

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9 References

- AREVA Resources Canada Inc. (AREVA). 2006. As Built Report – Permeable Reactive Barrier (Peat Trench) Adjacent to Claude Creek, April 2006.
- AREVA Resources Canada Inc. (AREVA). 2007a. Submission for Gamma Radiation Clearance – Cluff Lake Project. November 2007.
- AREVA Resources Canada Inc. (AREVA). 2007b. As-Built – Claude Mining Area Decommissioning. March 2007.
- AREVA Resources Canada Inc. (AREVA). 2007c. As-Built – DJ Mining Area Decommissioning. March 2007.
- AREVA Resources Canada Inc. (AREVA). 2007d. As-Built – Mill Demolition. March 2007.
- AREVA Resources Canada Inc. (AREVA). 2007e. As-Built – Tailings Management Area Decommissioning. March 2007.
- AREVA Resources Canada Inc. (AREVA). 2007f. As Built Report – Second Permeable Reactive Barrier (Peat Trench) Adjacent to Claude Creek, June 2007.
- AREVA Resources Canada Inc. (AREVA). 2009a, Submission for Gamma Clearance of the Germaine Camp Area: Addendum to Section 3 of the Submission for Gamma Radiation Clearance Report. November 2007 – December 2009
- AREVA Resources Canada Inc. (AREVA). 2009b. Cluff Lake Project - Detailed Decommissioning Plan, Version 2. February 2009.
- AREVA Resources Canada Inc. (AREVA). 2014a, 2014 Surface Gamma Clearance Report, October 2014
- AREVA Resources Canada Inc. (AREVA). 2014b. Cluff Lake Project - Detailed Decommissioning Plan, Version 3. December 2014.
- AREVA Resources Canada Inc. (AREVA). 2015a. Hydrogeology and Groundwater Modelling Technical Information Document. June 2015.
- AREVA Resources Canada Inc. (AREVA). 2015b. Environmental Performance Technical Information Document. Volume 1. August 2015

- AREVA Resources Canada Inc. (AREVA). 2015c. Environmental Performance Technical Information Document. Volume 2. September 2015
- AREVA Resources Canada Inc. (AREVA). 2015d. Follow-up Program Report. September 2015.
- AREVA Resources Canada Inc. (AREVA). 2016. Cluff Lake Project Integrated Management System Manual, Version 12, Revision 0. February 2016.
- AREVA Resources Canada Inc. (AREVA). 2017. Cluff Lake Project – Optimization of Environmental Monitoring Locations and Schedule. September 2017.
- AREVA Resources Canada Inc. (AREVA). 2018. Cluff Lake Project – 2017 Minor Earthworks and Activity Report. January 2018.
- Canada North Environmental Services Limited Partnership (CanNorth). 2018. Cluff Lake Project – Risk Assessment of the Presence of Poned Water on the Decommissioned Tailings Management Area. August 2018.
- Canada North Environmental Services Limited Partnership (CanNorth). 2020. Vegetation Recovery at the Cluff Lake Mine Site 2008 to 2020. December 2020.
- Canadian Council of Ministers of the Environment (CCME). 2007. Canadian Environmental Quality Guidelines. Ottawa, ON.
- Canadian Nuclear Safety Commission (CNSC). 1997. *Nuclear Safety and Control Act*. Ottawa, ON.
- Canadian Nuclear Safety Commission (CNSC). 2000a. *General Nuclear Safety and Control Regulations*. Ottawa, ON.
- Canadian Nuclear Safety Commission (CNSC). 2000b. *Uranium Mines and Mills Regulations*. Ottawa, ON.
- Canadian Nuclear Safety Commission (CNSC). 2000c. Regulatory Guide G-206, Financial Guarantees for the Decommissioning of Licensed Activities. June. Ottawa, ON.
- Canadian Nuclear Safety Commission (CNSC). 2000d. Regulatory Guide G-219, Decommissioning Planning for Licensed Activities. June. Ottawa, ON.
- Canadian Nuclear Safety Commission (CNSC). 2001. Regulatory Policy P-223, Protection of the Environment. February. Ottawa, ON.
- Canadian Nuclear Safety Commission (CNSC). 2003. Comprehensive Study Report – Cluff Lake Decommissioning Project. December 2003.

- Canadian Nuclear Safety Commission (CNSC). 2004. Regulatory Policy P-290, Managing Radioactive Wastes. July. Ottawa, ON.
- Canadian Nuclear Safety Commission (CNSC). 2006. Regulatory Guide G-320, Assessing the Long Term Safety of Radioactive Waste Management. December. Ottawa, ON.
- Canadian Nuclear Safety Commission (CNSC). 2012. Regulatory Document RD/GD-370, Management of Uranium Mine Waste Rock and Mill Tailings. March. Ottawa, ON.
- Canadian Nuclear Safety Commission (CNSC). 2017. REGDOC 2.9.1 Environmental Protection – Environmental Principles, Assessments and Protection Measures. Version 1.1. April 2017.
- Canadian Nuclear Safety Commission (CNSC). 2018a. REGDOC 2.11 Framework for Radioactive Waste Management and Decommissioning in Canada,
- Canadian Nuclear Safety Commission (CNSC). 2018b. REGDOC 2.11.1 Waste Management – Volume I Management of Radioactive Waste. Ottawa 2018
- Canadian Nuclear Safety Commission (CNSC). 2018c. REGDOC 2.11.1 Waste Management – Volume II Management of Uranium Mine Waste Rock and Mill Tailings. November 2018
- Canadian Nuclear Safety Commission (CNSC). 2018d. REGDOC 2.11.1 Waste Management – Volume III Assessing the Long-Term Safety of Radioactive Waste Management. May 2018
- Canadian Nuclear Safety Commission (CNSC). 2018e. REGDOC 2.11.2 Decommissioning
- Canadian Nuclear Safety Commission (CNSC). 2018f. REGDOC 3.2.1 Public Information and Disclosure
- Canadian Standards Association, (CSA). 2009. Decommissioning of Facilities Containing Nuclear Substances. N294-09.
- Canadian Standards Association, (CSA). 2019. Environmental Risk Assessments at Class I Nuclear Facilities and Uranium Mines and Mills. N288.4-19 Clause 4.1
- COGEMA Resources Inc., (COGEMA). 1995. Cluff Lake Project – Decommissioning of the D Pit Area. November 1995.
- COGEMA Resources Inc., (COGEMA). 1998a. Cluff Lake Project - Cluff Lake Interim Construction As-Built Report, February 1998.
- COGEMA Resources Inc., (COGEMA). 1998b. Cluff Lake Project - TMA Interim Construction Activities, February 1998

- COGEMA Resources Inc., (COGEMA). 1999a. Cluff Lake Project – Construction of the TMA Surface Diversion Works – South Ditch. April 20, 1999.
- COGEMA Resources Inc., (COGEMA). 1999b. Site Cleanup and Reclamation Activities for 1999. April 1999.
- COGEMA Resources Inc., (COGEMA). 1999c. Cluff Lake Project – Detailed Decommissioning Plan. June 30, 1999.
- COGEMA Resources Inc., (COGEMA). 1999d. Cluff Lake Project - Cessation of Mining at Dominique-Peter Mine, September 1999
- COGEMA Resources Inc., (COGEMA). 2000a. Cluff Lake Project Comprehensive Study For Decommissioning, Comprehensive Study Report, Version 1. December 2000; Response to Regulatory Comments November 2001.
- COGEMA Resources Inc., (COGEMA). 2000b. Cluff Lake Project – Construction of the TMA Surface Diversion Works – North Ditch. April 20, 2000.
- COGEMA Resources Inc., (COGEMA). 2000c. Cluff Lake Project - Site Cleanup and Reclamation Activities for 2000. February 2000.
- COGEMA Resources Inc., (COGEMA). 2001. Cluff Lake Project - Site Cleanup and Reclamation Activities for 2001. April 19, 2001.
- COGEMA Resources Inc., (COGEMA). 2002a. Cluff Lake Project – Cessation of Mining in DJ Mine and Additional Reclamation Activities at DP Mine. April 5, 2002.
- COGEMA Resources Inc., (COGEMA). 2002b. Cluff Lake Project – Cessation of Mining Activities at the Cluff Lake Project. May 22, 2002.
- COGEMA Resources Inc., (COGEMA). 2002c. Cluff Lake Project – Interim As-Builts for Closure of Underground Mines. July 1, 2002.
- COGEMA Resources Inc., (COGEMA). 2002d. Cluff Lake Project – Sealing of Underground Mine Openings. July 24, 2002.
- COGEMA Resources Inc., (COGEMA). 2002e. Cluff Lake Project - Site Cleanup and Reclamation Activities for 2002. April 21, 2002.
- COGEMA Resources Inc., (COGEMA). 2002f. Cluff Lake Project – TMA Lower Solids Levelling Course. October 1, 2002.

- COGEMA Resources Inc., (COGEMA). 2003. Cluff Lake Project – Detailed Decommissioning Plan Version 0. October 2003.
- COGEMA Resources Inc., (COGEMA). 2004. Cluff Lake Project – Detailed Decommissioning Plan Version 1. May 2004.
- COGEMA Resources Inc., (COGEMA). 2005. Cluff Lake Project – Surface Gamma Clearance Procedure, July 15, 2005.
- Denison Environmental Services. 2006. Cluff Lake Mine Site, Germaine Camp - 2006 Demolition Report, September 2006.
- Denison Environmental Services. 2013. Construction Completion Report – 2013 Miscellaneous Earthworks and Site Cleanup, Cluff Lake Mine Site, SK. November 26, 2013.
- HAB-TECH Environmental, (HAB-TECH). 2014. Status of Vegetation Recovery in the Cluff Lake Project Reclaimed Areas 2008 to 2014.
- International Atomic Energy Agency, (IAEA). 2011. Specific Safety Requirements No. SSR-5, Disposal of Radioactive Waste
- International Atomic Energy Agency, (IAEA). 2012. Specific Safety Requirements No. SSG-23, The Safety Case and Safety Assessment for the Disposal of Radioactive Waste
- Orano Canada Inc., (Orano). 2018a. Environmental Monitoring Locations and Schedule, CLP-150 Version 07. March 2018. (only the AREVA 2017 EMLS is mentioned in the text)
- Orano Canada Inc., (Orano). 2018b. Cluff Lake Project – 2017 Annual Report. March 2018.
- Orano Canada Inc., (Orano). 2018c. Cluff Lake Project - Public Information Program, Version 3. March 2018
- Orano Canada Inc., (Orano). 2018d. Cluff Lake Project – Claude Pit Horizontal Drain Closure Report. August 2018.
- Orano Canada Inc., (Orano). 2018e. 2018 Surface Gamma Clearance Report, October 2018
- Orano Canada Inc., (Orano). 2018f. Risk Assessment of the Presence of Poned Water on the Decommissioned TMA, August 2018.
- Orano Canada Inc., (Orano). 2018g. Claude Pit Horizontal Drain Closure Report. August 2018.
- Orano Canada Inc., (Orano). 2019a. 2018 Minor Earthworks and Activity Report. June 2019.

- Orano Canada Inc., (Orano). 2019b. Hydrogeology and Groundwater Modelling Technical Information Document, Version 02. October 2019.
- Orano Canada Inc., (Orano). 2019c. Environmental Performance Technical Information Document, Volume 2, Version 02. October 2019
- Orano Canada Inc., (Orano). 2021. 2020 Minor Earthworks and Groundwater Well Decommissioning Report. November 2021.
- Orano Canada Inc., (Orano). 2022. Environmental Performance Technical Information Document, Volume 1, Version 02. March 2022.
- Orano Canada Inc., (Orano). 2022b. Cluff Lake Project Annual Report. March 2022
- Saskatchewan Ministry of Energy and Resources (SMER). 2009. Institutional Control Program. Post Closure Management of Decommissioned Mine/Mill Properties Located on Crown Land in Saskatchewan. December. Regina, SK.
- Saskatchewan Ministry of Environment (SMOE). 1978. The Provincial Lands Act.
- Saskatchewan Ministry of Environment (SMOE). 1995. Draft Guidelines for Decommissioning, Cleanup and Reclamation of Northern Mine Sites. March 20, 1995. Regina, SK.
- Saskatchewan Ministry of Environment (SMOE). 1996. Draft Manual on Financial Assurances for Reclamation and Decommissioning of Saskatchewan Mines. Regina, Saskatchewan.
- Saskatchewan Ministry of Environment (SMOE). 1998. Draft Guideline for the Closure and Reclamation of Municipal Waste Disposal Grounds, October 1998. October. Regina, SK.
- Saskatchewan Ministry of Environment (SMOE). 2004. The Crown Resource Land Regulations. Regina, SK.
- Saskatchewan Ministry of Environment (SMOE). 2006. EPB 356, Surface Water Quality Objectives, Interim Edition. July. Regina, Saskatchewan.
- Saskatchewan Ministry of Environment (SMOE). 2008a. EPB 381, Guidelines for Northern Mine Decommissioning and Reclamation, November. Regina, SK.
- Saskatchewan Ministry of Environment (SMOE). 2010a. The Environmental Management and Protection Act, 2010. Regina, SK.
- Saskatchewan Ministry of Environment (SMOE). 2010b. The Reclaimed Industrial Sites Regulations. Regina, SK.

SENES Consultants Limited 2009 (SENES 2009), SENES Consultants Limited, Review of AREVA Surface Gamma Radiation Survey of Disturbed Areas at Cluff Lake Site, February 2009.

SRK Consulting Canada Inc. 2017. 2016 Biennial Geotechnical Inspection, Final Report – Cluff Lake, Saskatchewan. March 2017.

SRK Consulting Canada Inc. 2018. TMA Water Management and 2013 Remedial Works Closure Report – Final Report. August 2018.

SRK Consulting Canada Inc. 2021. 2020 Biennial Geotechnical Inspection Final Report – Cluff Lake Saskatchewan (SRK 2021)

Water Security Agency (WSA). 2015. Saskatchewan Surface Water Quality Objectives, Interim Edition

Appendix A – Concordance Tables

Table A.1: Ministry Energy and Resources IC Program Process for application

Step/Requirement	Status
Decommissioning and Reclamation	Completed
Operator Applies for Release <ul style="list-style-type: none"> - Release from decommissioning and reclamation to SMOE - Release from licence to CNSC 	Initially submitted in February 2020 <ul style="list-style-type: none"> - Provincial commitments are pending
SMOE issue release	Pending
CNSC issue exemption	Public hearing required
Operator applies for and is issued a release from Surface Lease Agreement	Submitted in February 2020
Operator applies for entry into IC Program	Submitted in February 2020
Items established required for IC Program entry <ul style="list-style-type: none"> - LTMMP and funds - Unforeseen Events Funds - Financial Assurance = to failure event - Registration fee = \$500 	LTMMP and funds under review between Orano, MOE and the ER Registration fee to be paid to Ministry of Finance

Table A.2 REGDOC 2.11.2 Decommissioning; Section 9 Completion of Decommissioning – End State Report requirements

	End State Report	Other Reference/Comment
Documentation that end-state has been met (with survey results)	Section 2.1	
Proposed further licence requirements/institutional controls	Section 6 and 8	
Release Criteria	Section 2.1	
Decommissioning works, noting deviations	Section 3.2, Appendix B3	
Remaining SSCs	NA	
Final physical and radiological status	Section 3.2	<p>Gamma Radiation Clearance Reports:</p> <ul style="list-style-type: none"> • Submission for Gamma Radiation Clearance – Cluff Lake Project, November 2007 (AREVA 2007a) • Review of Surface Gamma Radiation Survey of Disturbed Areas at Cluff Lake Site and validated by a third party survey (SENEC 2009) • Addendum to Submission for Gamma Radiation Clearance – Cluff Lake Project, titled Submission for Gamma Clearance of the Germaine Camp Area, December 2009 (AREVA 2009) • 2014 Surface Gamma Clearance Report - Cluff Lake Project, October 2014 (AREVA 2014a) • Cluff Lake Project – Surface Gamma Clearance Report, October 2018 (Orano, 2018e)
List of SSCs designated for restricted use	Section 6	
Summary of remaining waste	Section 4	
Waste quantities and disposition	Section 4	
Summary of radiological doses received by workers during decommissioning	Appendix B4	
Summary of abnormal occurrences of incidents that occurred during decommissioning	Section 5	
Lessons learned	Section 7	
Reference to decommissioning records	Appendix B3	
Future use, or restrictions	Section 6	

Appendix B – Cluff Lake Operations and Decommissioning History

B1 Cluff Lake Environmental Assessment History

Initial exploration activities in the Cluff Lake area date back to the 1960's. Subsequent to the delineation of the "D" ore body, the proponent (Amok Ltd.), at the request of the Department of Environment Saskatchewan, submitted the initial Environmental Assessment and Safety Report (1976) for the development of a uranium mine and mill (Phase I). At the time of that request, there were provisions in the law for a proposed mine operator to provide certain information regarding the intended operations of a uranium mine and mill and the physical environment liable to be affected by it (AECB 1974).

The Minister of Environment asked the Lieutenant-Governor-in-Council for a public inquiry to review the Environmental Assessment and Safety Report, and to "contemporaneously study what have been termed the "broader implications" and "global implications" of expanding the uranium mining industry in Saskatchewan" (Bayda 1978). The Board of Inquiry, commonly referred to as the Bayda Commission, reviewed the expansion to uranium mining in northern Saskatchewan. The Atomic Energy Control Board (AECB, the precursor federal nuclear regulatory agency to the Canadian Nuclear Safety Commission (CNSC), and other federal regulatory agencies participated in the Board of Inquiry.

Subsequent to review of the EA, written briefs and public and formal hearings, the Board of Inquiry recommended that development of the Cluff Lake Project proposed mill and mine proceed, and that the uranium industry be allowed to expand in northern Saskatchewan (Bayda 1978). The AECB also used the findings and recommendations of the Board of Inquiry to proceed through the AECB licensing process.

Phase II of the Cluff Lake site development (Cluff Mining 1982) was the subject of a provincial environmental assessment under the Saskatchewan Environmental Assessment Policy (1978). The Phase II assessment encompassed uranium reserves identified as the Claude, N, N40, OP, and Dominique-Peter (DP) ore bodies (Cluff Mining 1982). Once again, the province and AECB, reviewed the EA. A Ministerial Approval was issued in June of 1983, to allow development of the abovementioned mining operations.

In 1985, Amok Ltd. advised the regulatory agencies that it had discovered a new ore body, the Dominique-Janine (DJ) ore body that was more appropriate for development than the N ore bodies. In late 1986, the regulatory agencies agreed that Amok Ltd. could proceed with the development of the DJ ore body. In 1989, the Saskatchewan government issued a Ministerial Approval that effectively added the DJ mining operations to the existing operating licence. Further investigations to delineate the DJ ore body indicated uranium mineralization extended continuously southward toward the edge of Cluff Lake (Amok Ltd. 1992).

The proposed extension of the DJ mining operation to encompass the reserves identified south of the existing mine development occurred at the same time that several other uranium mining projects were also

being proposed in northern Saskatchewan. These projects included the development of the Midwest, McArthur River and Cigar Lake projects along with AREVA's (then COGEMA) McClean Lake Operation. In response to these development proposals, the governments of Canada and Saskatchewan under their respective legislation, the federal Environmental Assessment Review Process Guidelines Order (EARPGO 1984) and the provincial Environmental Assessment Policy (EAP 1978), appointed a Joint Federal-Provincial Environmental Assessment Review Panel (Joint Panel) to study uranium mine developments in northern Saskatchewan. The mandate of the Joint Panel, as outlined in its terms of reference, was to review the environmental, health, safety, and socioeconomic impacts, including the benefits afforded by the proposals, and assess their acceptability. These projects became the subject of an environmental assessment by the Joint Federal-Provincial Panel on Uranium Mining Developments in northern Saskatchewan.

Ultimately, the Joint Panel, based on its terms of reference to review the environmental, health, safety, and socio-economic impacts including the benefits of the proposals, recommended to the governments of Saskatchewan and Canada that these projects should be allowed to proceed (Joint Panel 1993 and 1997). The Joint Panel also recommended a wide range of conditions that the federal and provincial governments should consider when allowing the proposals to be implemented (Government of Saskatchewan 1993, Government of Canada 1993). The Joint Panel recommendations and the provincial and federal government responses resulted in the establishment of a variety of mechanisms to minimize environmental impacts and maximize the economic benefits to northern Saskatchewan. Many of the recommendations facilitated opportunities for northern persons and businesses to benefit from the development of the uranium mining industry in northern Saskatchewan. Other recommendations were implemented as federal and provincial license conditions, which imposed constraints on the construction and operation of the proposed facilities.

In parallel with the Joint Panel review from 1992 to 1997 under EARPGO, the federal government moved to strengthen the environmental assessment process in Canada, replacing the federal EARPGO with the Canadian Environmental Assessment Act (CEAA 1992). The CEAA, which came into force in 1995, contains provisions to maintain valid environmental assessments conducted under EARPGO. With the promulgation of CEAA, new uranium mining activities, facilities, and substantive changes to existing uranium mining operations were subject to the requirements outlined in the Act.

Upon completion of the Joint Panel EARPGO environmental assessment, the licensing of activities at the Cluff Lake site were subject to the CNSC staged licensing process which authorizes the development and operation of a uranium production facility. The preliminary decommissioning plans arising from the DJX EA, and subsequent licensing requirements formed the basis of what would become the detailed decommissioning plan for the Cluff Lake Project.

In April 1999, COGEMA submitted a Project Description for the proposed Cluff Lake Decommissioning Project to regulators. In May 1999, the CNSC advised COGEMA that they had determined a Comprehensive Study level environmental assessment (EA) was required under CEAA, 1992, with the CNSC as the Responsible Authority¹. The CNSC further established, in consultation with SMOE, that an EA of the decommissioning project was not required by the Saskatchewan Environmental Assessment Act. However, SMOE agreed to participate as technical reviewers in the assessment process and were required under the provincial process to approve the decommissioning plan prior to its implementation.

Guidelines for the scope of the project and the scope of the assessment were provided by the CNSC to COGEMA in October 1999. Pursuant to Section 17 of CEAA, 1992 the CNSC delegated COGEMA the responsibilities for public consultation and the preparation of technical EA studies and documentation

A detailed decommissioning plan and environmental assessment was developed. The Cluff Lake Project Comprehensive Study for Decommissioning (CSD, COGEMA 2000) was prepared to meet the requirements of the Canadian Environmental Assessment Act (CEAA 1992). The CSD (COGEMA 2000) was submitted to regulatory agencies, including the CNSC, Environment Canada, Health Canada, Natural Resources, SMOE and Saskatchewan Labour in 2000. Combined with subsequent technical reviews and responses (COGEMA 2001, COGEMA 2002), the CSD provided much of the basis of the CNSC Comprehensive Study Report (CSR; CNSC 2003). The CNSC CSR for decommissioning was submitted to the federal Minister of Environment and Canadian Environmental Assessment Agency in January 2004. The CNSC was the Responsible Authority under the CEAA for environmental assessment of the decommissioning plan developed by AREVA. The Minister of Environment issued its decision on the EA on April 15, 2004, determining that the project is not likely to cause significant adverse environmental effects. Subsequent to federal and provincial ministerial approval of the decommissioning environmental assessment, a decommissioning license was granted in 2004 from the CNSC, and an Approval to Operate Pollutant Control Facilities was granted from the SMOE. Approvals for decommissioning have been maintained over time.

B2 Cluff Lake Project Operations Summary

During its 22 years of operation, the Cluff Lake Project produced 62 million pounds of U₃O₈. The sequence of activities at the Cluff Lake Project is presented in the following sections. Project milestones are summarized as follows:

¹ Under the Nuclear Safety and Control Act (1997) and associated regulations, a uranium mining facility may only be decommissioned in accordance with a CNSC licence. The issuing of a decommissioning licence by the CNSC represented the exercise, by a federal authority, of a regulatory duty covered under the Law List Regulations of the CEAA, and thus triggered the application of the CEAA. A comprehensive study was required for the project pursuant to the Comprehensive Study List Regulations (CEAA 1992; section 19(b)).

Table B1.1 Cluff Lake Operational Milestones

Year	Milestone
Mid-1960s	Exploration
1978	Bayda Commission approves mine and mill operation at the Cluff Lake site
1979-81	D-Open pit mining (Phase I)
1982-89	Claude Pit mining (Phase II)
1983	D-Pit area decommissioned
1983-84	Re-milling of Phase I D ore gravimetric tailings
1983-99	OP/DP underground mining (Phase II)
1987-89	Gold extraction circuit added to the mill to recover gold from the Phase I tailings
1989-91	DJN Pit mining
1994-97	DJX Pit mining
1994	DJ underground mining
2002	After 22 years, mining (May) and milling (December) operations cease with a total production of 62 million pounds

The Cluff Lake ore bodies were first discovered in the mid-1960s. Mining activity commenced at the Cluff Lake Project in 1979 and ceased in 2002. Six different ore bodies were approved for extraction (D, Claude, OP, DP, N and DJ ore bodies) using a combination of open pit, underground, and surface-to-underground extraction methods. At the conclusion of the project, five ore bodies were extracted using either underground or open pit techniques. Mining of the N ore body was deferred in favour of the Dominique-Janine (DJ) ore body. The delineation of extent of the DJ ore body was completed in 1989. The surface-to-underground extraction method approved for the DJ ore pods proved to be uneconomical and did not proceed beyond the test phase. During operations, facilities included four mined-out open pits, two underground mines, a mill, a tailings management area with a two-stage liquid effluent treatment system, a residential camp area, and various other support and site infrastructure facilities.

The Cluff Lake Project was initiated in 1977 with the formation of the Board of Inquiry known as the Bayda Commission (Bayda 1978). The final report made by this Board in June 1978 stated that the proposed mining and milling operations at Cluff Lake should be allowed to proceed and that the expansion beyond the initial proposal should also be allowed, recognizing potential future development.

Construction of the Cluff Lake Project was completed in 1979 with operations commencing in early 1980. Phase I operations consisted of the mining and milling of ore from the D ore body. Ore from the D-Pit was milled in stages; first, using conventional milling methods, and second (phase I extension), by re-milling uranium-bearing gravimetric tailings that were generated from the first stage of milling.

To accommodate the additional tailings that would be generated during Phase II mining and milling, the TMA was sequentially expanded. Two additional dams were built in 1982 and a dike was constructed to divide the tailings ponds into a solids pond and a liquids pond area in 1984. In 1986, a berm was

constructed across the solids area to segregate the Phase I tailings. To optimize the TMA area, additional internal berms were constructed in the 1990s to further segregate tailings and improve existing storage capacities.

Post-mining clean-up and reclamation activities of the D-Pit and associated D waste rock pile included the removal of surface facilities, breaching of the Boulder Creek diversion dam, and removal of the half culvert diversion flume which had diverted Boulder Creek past the open pit. The Boulder Creek stream channel was re-established adjacent to the D-Pit in 1983. During the 1983 spring thaw, an ice dam formed in Boulder Creek, causing the creek to overflow and flood D-Pit. In response, a dyke was constructed between Boulder Creek and the open pit. D-Pit has remained flooded and isolated from Boulder Creek over the intervening years with no surficial outflow.

Subsequent to the removal of the D mining area surface facilities, the D waste rock pile and surrounding area disturbed during development was resloped and revegetated between 1983 and 1985.

In June 1983, ministerial approval was issued for Phase II operations, which allowed for the development of the Claude open pit, the N open pit and N40 underground (not developed), and the OP and Dominique Peter (DP) underground. Ore from the Claude open pit and from the OP underground mine supplied the initial mill feed for Phase II operations. At the completion of the underground mining of the OP ore body, the Company began extracting ore from the DP ore body, also using the underground mining method. In September 1986, the Dominique Janine (DJ) ore body (subsequently referred to as Dominique-Janine North (DJN)) was added to the existing license, which allowed for development of the DJN open pit.

The open pit mining of the Claude ore body ended in mid-1989. In order to prepare for continuing operations at the Cluff Lake Project, Amok Ltd., in April 1988, submitted to the various regulatory agencies, both federal and provincial, an application for approval to proceed with the open pit mining of the northern part of the DJ ore body. In 1993, subsequent to the Joint Panel environmental assessment review, regulatory approval was granted for the Dominique Janine extension (DJX) which consisted of the development of the DJX open pit, which was adjacent to and contiguous with the existing DJN open pit, and the development of the DJ underground.

To facilitate milling of lower grade ores generated from Phase II activities, the mill underwent modification/expansion in 1993-1994.

The scope of the Dominique-Janine Extension (DJX) Project was modified as described in the COGEMA Resources Inc. March 1994 proposal, to include the following components:

- Part 1 of the DJX pit;
- Placement of waste rock into the mined out Claude and DJ North pits only (i.e. none into Cluff Lake);
- No dam or dewatering wells within Cluff Lake, to significantly reduce the amount of liquid effluent;
- Creation of an underground mine using the cut and fill method; and

- Tests of jet boring and/or blind boring methods to mine the DJ ore pods (at the shoreline of Cluff Lake).

These approved modifications addressed four (4) recommendations of the 1993 Joint Federal-Provincial Report and provided enhancements to environmental protection. The DJX pit was mined out in August 1997. After testing in 1995-1996, the DJ Pods area proved to be an uneconomical deposit. The test site was closed down in 1996 and reclaimed in 1999-2000.

In 1997, approval was received to haul the OP/DP waste rock pile to Claude pit. Haulage was completed in 2000. In the fall of 1999, the DP underground mine was shut down due to depleted ore reserves. Permanent closure was completed in 2000 with the backfilling and capping of the raises and decline completed in 2002. Natural flooding of the DP underground working was complete in August 2002.

The company announced in August 1998 that it would indefinitely suspend operations at the Cluff Lake Project as of December 31, 2000, due to depletion of economically viable ore reserves and the volume of tailings approaching the authorized capacity of the existing TMA. Additional ore reserves in the DJ underground mine, with a higher grade than the historical average, made it economically feasible to extend the operation into 2002. The raises and declines were backfilled and capped in the summer and fall of 2002. Flooding of the mine was assisted using water from the adjacent DJX Pit. The higher grade also reduced the rate at which tailings are generated; thereby extending the period until the TMA reached its authorized capacity. Mining operations extended through May of 2002, while milling, to process all of the remaining ore, was completed in December of 2002. The mill was subsequently put into care and maintenance in preparation for decommissioning.

History of Incidents and Accidents

Throughout the twenty-two-year operational life of the project, there were a number of minor spills and incidents. These events have been described in detail in Section 2.4.3.2 of COGEMA, 2000.

There was also one incidence of surface-expressed subsidence of an underground mine working which occurred on February 28, 1999. A complete account of this incident can be found in Section 5.5.6 of COGEMA, 2000.

B3 Cluff Lake Project Decommissioning Summary

The Cluff Lake Project site was largely decommissioned in 2004 and 2005 with minimal infrastructure left to support ongoing reclamation activities and environmental monitoring. In 2013, decommissioning of remaining structures was completed and permanent site occupancy was discontinued. In 2017 and 2018, the final minor works at the Cluff lake site were completed and the activities listed under the Detailed Decommissioning Plan completed.

Table B1.1 Cluff Lake Decommissioning Milestones

Year	Milestone
2002	After 22 years, mining (May) and milling (December) operations cease with a total production of 62 million pounds
2003	CNSC Comprehensive Study Report (CSR) for Decommissioning submitted to the Minister of Environment and Canadian Environmental Assessment Agency
2004	Decommissioning licence granted by CNSC and physical decommissioning work begins
2004	ISO 14001 certification for environmental management system-the first North American uranium mine in the process of being decommissioned
2006	Physical decommissioning substantially complete; Cluff Lake Project officially recognized as a Closed Mine under the Metal Mining Effluent Regulations (EC 2002)
2009	CNSC 10-year decommissioning licence obtained
2013	Final physical decommissioning of the Cluff Lake site completed – end of continuous site occupancy
2018 and 2020	Minor works
2019	CNSC licence amendment/renewal issued for 5 years Reduced surface lease; releasing parcels that would not be transferred into IC Program
2013-2022	Campaign environmental monitoring

Following shut down, the Cluff Lake Project was in a state of care and maintenance until July 2004 when decommissioning approval was received. From 1999 until the summer of 2004, a number of miscellaneous clean up and reclamation activities were carried out to reduce risks to health, safety and the environment.

In 1999, as part of ongoing operations and in an effort to reduce potential environmental impacts or eliminate radiological or safety hazards, COGEMA initiated several site cleanup and reclamation activities. Reclamation activities were focused on the DJ pods area, the B1-B2 ponds at the outlet of the Secondary Treatment System, the Claude pit area and a fuel storage area north of the mill complex. Also in 1999, a south diversion ditch was constructed at the TMA to divert surface water runoff around the Southeast portion of the TMA.

In 2000, site cleanup and reclamation efforts were concentrated on the ore storage bins, gold plant and mine water holding ponds at the mill complex. A second diversion ditch, which diverts flow around the Northwest portion of the TMA, was constructed in the fall of 2000.

In 2001, a number of redundant surface facilities at the DP, DJ and Claude mines and Germaine Camp were removed. A nominal 1 m leveling course was placed on the Upper Solids of the TMA to reduce gamma fields, LLRD and RnP levels to near background levels. Resloping and compaction tests were conducted on the Claude Waste Rock pile. The environmental monitoring program underwent an initial review, which led to the installation of additional piezometers around waste rock piles and landfill sites.

In 2002, most of the remaining surface facilities and contaminated surface materials at the DP and DJ mines were removed and hauled to Claude pit for disposal. All DJ underground (DJU) raises and the DJU decline were backfilled with till material in 2002. The DJU decline was backfilled from approximately 181 m down the ramp to the portal opening. Reinforced concrete caps were placed above all backfilled raises and a

concrete plug was poured at the DJU portal opening. The mine was flooded in 2002 using minewater from the adjacent DJX pit.

The Claude Waste Rock Pile (CWRP) was recontoured in 1993 to reduce side slopes to 2H:1V or less. In 2001 and 2002, resloping and compaction tests were conducted on the CWRP to evaluate constructability and potential performance limitations in support of the final cover design.

In 2003, the leveling course initiated in 2001 was extended to cover all remaining exposed tailings in the TMA. Mill mothballing was completed. The batch plant was sold and removed in 2003. Decommissioning activities were completed with final regrading and revegetation of the area.

In 2004, approvals from the CNSC and SMOE were received for demolition of the mill, backfilling of the Claude Pit, and covering of the TMA. Mill demolition was completed in December of 2005 with demolition materials backfilled into the Claude Pit. At the TMA, backfilling of the liquids pond and placement and grading of glacial till material for the cover commenced.

In 2005, work at the former DJ mining area included radiological cleanup, removal of the DJ fuel tank, and backfilling of the DJN sump. Flooding of DJX Pit with water from Cluff Lake commenced in May 2005. Waste rock excavation from DJN Pit (initiated in 2004) was completed and all waste was disposed of in Claude Pit. Claude mining area activities included completion of the Claude Pit dewatering, excavation, and relocation of waste rock from the CWRP, regrading and compaction of the CWRP, initiation of cover placement, removal of the Claude pit dykes, reclamation of the ore pad area. Where final grading was complete, tree seedlings were planted as part of the revegetation project.

In 2006, final landscaping of the DJ yard and pit areas was completed. Flooding of DJX Pit was completed in January. TMA activities included completion of the Grading Course, completion of the Liquids Pond backfilling, buttressing of the Main Dam, and construction of the storm water/runoff management structures. Claude mining area activities included completion of the covers for Claude Pit and the waste rock pile and removal of the Claude Shop. The Claude Yard was covered with glacial till and graded to match the surrounding contours. To address a contaminated groundwater plume originating from the waste rock pile, a permeable reactive barrier (peat trench) was constructed southwest of the pile to intercept the plume. Revegetation activities included planting tree seedlings where final grading was completed, as well as seeding the TMA and Claude Waste Rock Pile with a blend of grasses and legumes.

In 2007, reclamation work was essentially limited to continued revegetation of the major decommissioned areas and removal of power poles and power lines that were no longer needed. Some erosion gullies were observed along the TMA Main Dam and along the slopes of the Claude Waste Rock Pile. These gullies were repaired and revegetated. A second permeable reactive barrier was constructed next to the first barrier.

In 2008, reclamation activities included fertilizing the TMA and Claude Waste Rock Pile grass/legume covers. Hydro seeding was completed on areas of the TMA and Claude pile that showed poor germination. Some minor erosion gullies were repaired at the TMA Main Dam and some restructuring and relining of the runoff channel at the Claude Waste Rock Pile.

From 2009 to 2012, activities at the Cluff Lake Project mainly related to environmental monitoring, monitoring under the Follow-Up Program, and monitoring and maintenance of the physical performance of the completed decommissioning projects. During this time, minimal infrastructure remained to support activities. Remaining facilities included the Secondary Treatment System (STS) water treatment plant and settling ponds, heated shop and warehouse storage buildings, fuel farm, sewage and potable water treatment plants, five dormitory structures, kitchen facility, main office building, and power generators.

Site cleanup and decommissioning of remaining infrastructure took place from April to September 2013. Earthwork was completed to improve drainage in the TMA area and the STS was demolished. Horizontal drains were installed in the Claude Pit area to improve groundwater movement and lower groundwater elevation. The warehouse, fuel farm, water treatment plants, and camp facilities were demolished and disposed of in the landfill. Some culverts were removed, and streambanks reconstructed.

In 2017, 2018 and 2020 final minor works on site were completed. Reports on the 2017 and 2018 were submitted in support of closing the Cluff Lake DDP submitted for regulatory review.

In 2019, regulators acknowledged that decommissioning objectives had been met and a portion of the Cluff Lake surface lease was surrendered, releasing the following parcels without restrictions:

- Undeveloped/undisturbed areas – 508.11 hectares
- Surface water bodies (Cluff Lake and Island Lake as they do not require long-term controls or maintenance) – 527.21 hectares
- Remediated areas of previous surface disturbance – 260.76 hectares

References

Amok Ltd. (AMOK), 1976. Environmental Assessment and Safety Report.

Amok Ltd. (AMOK). 1992. Environmental Impact Statement Dominique-Janine Extension. February.

Atomic Energy Control Board (AECB). 1974. Regulation of Uranium Mining and Milling in Canada

Bayda, E.D., McCallum, K.J. and Groome, A.J. (Bayda). 1978. The Cluff Lake Board of Inquiry Final Report. May 1978.

Canadian Environmental Assessment Agency (CEAA). 1992. Canadian Environmental Assessment Act. S.C. 1992, c.37.

Canadian Environmental Assessment Agency (CEAA). 2012. Canadian Environmental Assessment Act, 2012.

Cluff Mining. (Cluff Mining). 1982. Cluff Lake Development Phase II Environmental Impact Assessment. SRC Publication, November, 1982.

Environmental Assessment Policy (EAP). 1978. Government of Saskatchewan.

Environmental Assessment and Review Process Guidelines Order. (EARPGO). 1984.

Government of Canada. 1999 "Scope of the Project and Assessment for the Preparation of a CEAA Comprehensive Study Cluff Lake Decommissioning Project, Saskatchewan". October, 1999.

Government of Saskatchewan. 1993. The Government's Position on the Proposed Uranium Mining Developments in Northern Saskatchewan. Midwest Joint Venture, Dominique-Janine Extension and McClean Lake Projects. December 1993.

Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan (Joint Panel). 1993. Dominique-Janine Extension, McClean Lake Project, and Midwest Joint Venture. Report of the Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan. October, 1993.

Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan (Joint Panel). 1997. Report of the Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan (Cumulative Observations). November, 1997.

B4 Cluff Lake Project Decommissioning – Worker Doses Received during Decommissioning

Year	Total Collective Dose mSv	Average Dose mSv	Maximum Dose mSv
2004 ¹	26.8	0.15	1.91
2005	16.7	0.10	1.20
2006	1.28	0.02	0.27
2007	0.41	0.03	0.08
2008	0.04	0.003	0.02
2009	0.06	0.005	0.03
2010	0.02	0.002	0.01
2011	0.05	0.005	0.05
2012	0.03	0.005	0.03
2013 ²	0	0	0
2014+ ³	-	-	-

¹decommissioning occurred primarily during the final 5 months of the year – the presented results for the whole year

² In 2013 all workers received doses below the OLD detection limit of 0.01 mSv. Workers received no incremental dose while working on site.

³ the level of dosimetry issued to workers is based on risk exposure. Worker exposure had been at background levels for several years before routine monitoring worker radiation ceased in 2013