Chalk River Laboratories Overview Decommissioning and Cleanup Plan REV 2

225-508300-PLA-001

Prepared by	Title	Date
Renee Silke	Environmental Evaluation Specialist	2023/05/10
Scott Clemow	Environmental Remediation Specialist	2023/05/10
Luc Robitaille	Environmental Remediation Specialist	2023/05/10

Reviewed by	Title	Date
Samantha Scott	Manager, Cleanup Function	2023/05/10

Approved by	Title	Date
Grace Snell	Acting Director, Integrated Functional Support Services	2023/05/10

Accepted by	Title	Date
Andrew Tisler	VP, Central Technical Authority	2023/05/11

Effective Date: 2023/06/23

This page is for Content Controls that apply to this document. If no Content Controls apply, none will be listed.

Intellectual Property

Revision History

Rev. No.	Date	Details of Rev.	Authored By	Reviewed By	Approved By
R2	2023/05/08	Issued as "Approved For Use". Major Changes: Revised to incorporate dispositions to CNSC comments: -Executive Summary and Section 14.1 to include Total Present Value Cost of Cleanup at CRL. - Executive Summary, 3.3, 4.3.2, 4.4 (Table 1), 9.1.2 (Table 5), 9.2, 9.7.2 (Table 6), 9.7.3, 10 (Table 7), 10.2, 10.8, 10.11, Table A-3, Table A-6, Table B-2, to disposition minor comments. Once CNSC Accepts, this document replaces the *Comprehensive Preliminary Decommissioning Plan*, CPDP-508300-PDP-001 Revision 4, 2018 March, 40526618.	L. Robitaille R. Silke S. Clemow	S. Scott	G. Snell **Accepted By** A. Tisler
R1.1	2023/01/16	Issued as "Approved For Use" for CNSC acceptance Once CNSC Accepts, this document replaces the *Comprehensive Preliminary Decommissioning Plan*, CPDP-508300-PDP-001 Revision 4, 2018 March, 40526618.	L. Robitaille R. Silke S. Clemow	S. Scott	G. Snell **Accepted By** A. Tisler
R1.1D1	2023/01/12	Issued for formal "Review & Comment". Minor Revisions: Incorporated opportunities for improvement as per SRC Memo: SRC-514416-021-000, WMDS-22-022, 2022 Dec 12.	L. Robitaille R. Silke S. Clemow	S. Scott	

Rev. No.	Date	Details of Rev.	Authored By	Reviewed By	Approved By
		Revised Section 14.1 as per recommendation from G. Snell			
R1	2022/12/12	Issued to SRC for acceptance	L. Robitaille R. Silke S. Clemow	S. Scott	G. Snell
R1D1	2022/11/10	Issued for formal "Review & Comment". Revisions: Added current status of projects and company plans; Replaced "Area of Concern" with "Area of Potential Environmental Concern"; Updated section 6 with most recent engagement activities and feedback; Updated lists for building/structure decommissioning status in Appendix A.	L. Robitaille R. Silke S. Clemow	J. McCafferty (AECL) R. Chennette C. De Waele J. Faught C. Gallagher G. Hamilton C. Igwe L. Jones M. MacKay P. Neal P. Pottelberg M. Scheer S. Scott L. Theil	
0	2022/07/26	Issued as "Approved For Use" for CNSC review; revised to address comments on D4	L. Robitaille R. Silke S. Clemow	S. Scott	
D4	2022/04/07	Issued for formal "Review & Comment" to AECL and CRL Safety Review Committee; revised to address comments on D3 from internal consultations with SMEs	L. Robitaille R. Silke S. Clemow	J. McCafferty P. McClelland J. McKenna A. Fournier J. Carver U. Senaratne	
D3	2022/01/17	Issued for formal "Review & Comment" internally and 3rd party (Golder); revised to address comments on D2; moved detailed Management Unit content from the body of the document into Appendices, reorganized sections for readability, added in updated content from internal consultations with SMEs	L. Robitaille R. Silke S. Clemow	M. Mackay P. Pottelberg N. MacDonald G. Hamilton K. Lariviere R. Chennette G. Al Haddad J. DeWilde (Golder) P. Hurst (Golder) F. Trzebiatowski T. Hennessy P. Pentney D. Campbell C. Trudeau S. Melnyk V. Lim S. Scott S. Gamley J. Byrne D. Yuke P. Aikens M. Klukas A. Morin B. Janke S. Mistry G. Snell B. Moric L. Jones M. Scheer R. Dufour	

Rev. No.	Date	Details of Rev.	Authored By	Reviewed By	Approved By
D2	2021/03/31	Issued for "Information" to AECL to provide support for Milestone completion; revised to address comments on D1	L. Robitaille R. Silke S. Clemow	G. Snell	
D1	2021/02/18	Issued for informal "Review & Comment". This plan was originally registered under CPDP-01600-PDP-002 and subsequently CPDP-508300-PDP-001 and underwent review and comment under those document numbers.	L. Robitaille R. Silke S. Clemow	D. Priyanto C. Gallagher T. Gorman P. Pottelberg M. Labriola A. Blanchard R. Chennette M. MacKay B. Swarbrick H. Athauda-Arachige G. Snell S. Brewer B. Janke J. Faught L. Jones G. Hamilton M. Scheer	

Executive Summary

This Overview Decommissioning and Cleanup Plan (ODCP) provides a general summary of the proposed approach to decommissioning and environmental remediation for the Chalk River Laboratories (CRL) site. The ODCP expands upon and supersedes the previous "Comprehensive Preliminary Decommissioning Plan" (CPDP) for the site. The ODCP fulfills the requirement that the licensee shall submit an overarching Preliminary Decommissioning Plan for sites with more than one facility as stated in Canadian Nuclear Safety Commission's Regulatory Document (REGDOC) 2.11.2.

Canadian Nuclear Laboratories respectfully acknowledges that the CRL site is located on the unceded and unsurrendered territory of the Algonquin Anishnaabe Nation. CNL recognizes and appreciates their historic connection to this land, and their role as customary keepers and defenders of the Ottawa River and its tributaries. CNL recognizes the contributions that all First Nations, Métis and Inuit peoples have made, and continue to make, in shaping this land we now know as Canada. CNL management and staff acknowledge, respect and seek to better understand unique Indigenous history, rights and title on the lands where we work.

In accordance with its Public Information Program requirements as outlined in the CRL Nuclear Research and Test Establishment Operating Licence, CNL employs a variety of methods to inform, educate, and discuss the project with stakeholders and to enable the public to provide valuable feedback. The ODCP is a forward-looking document, intended to support stakeholder, Indigenous and community engagement to gather input and incorporate public and Indigenous needs and concerns into CNL's cleanup plans. To support this journey, CNL has recently formed a Community Advisory Panel comprised of members of the public who will provide ongoing input into key elements of the cleanup of the CRL site and other broader topics, as part of their mandate. In addition, an ongoing dialogue continues with local Indigenous communities and organizations regarding various issues related to the cleanup of the CRL site.

The CRL site is owned by Atomic Energy of Canada Limited (AECL), a federal Crown corporation. AECL has contracted CNL to manage and operate its sites, including the CRL site. CNL is Canada's premier nuclear science organization, and a world leader in developing technology for peaceful and innovative applications. This work has included the production of medical isotopes for the diagnosis and treatment of over one billion patients worldwide, as well as developments in clean energy that reduce greenhouse gas emissions. The revitalization of the CRL campus, which is currently underway, will allow that innovative science to continue into the future.

AECL and CNL are also committed to reporting publicly on performance against the cleanup outcomes identified in this ODCP, in support of their respective sustainability efforts.

The ODCP provides a holistic and strategic approach to cleanup in support of revitalization efforts underway at CRL which are leading to the creation of a modern campus environment dedicated to world-class research and development in nuclear science and technology. The plan gives an overview of future redevelopment opportunities created by decommissioning and removing obsolete buildings and infrastructure within the built up area of the site (i.e., the Campus Precinct area). It highlights the framework for several new facilities that will be

required as part of CNL's commitment to growing the research conducted at CRL and outlines the environmental remediation efforts underway to reduce and effectively manage Canada's nuclear liabilities.

Canadian Nuclear Laboratories is committed to the revitalization of the site and advancement of the decommissioning, environmental remediation and waste management missions. Several elements of this revitalization effort and cleanup plan rest on the pending regulatory approval of an on-site low-level radioactive waste (LLW) disposal facility; the proposed Near Surface Disposal Facility (NSDF). In particular, the Integrated Waste Strategy, a CNL-wide guiding document about waste management across all sites, includes a contingency plan that ensures storage space for LLW at CRL until at least 2030.

Also, to mitigate the need for additional storage capability, the timing of some of the cleanup activities at CRL, including any large-scale environmental remediation efforts, may be deferred to align with the availability of LLW disposal capability at CRL, limiting risks, and costs associated with interim storage and subsequent re-handling of waste. The environmental remediation of land areas impacted by previous operations must be undertaken to allow for new development.

The ODCP highlights several additional essential enabling facilities, capabilities and factors that are required for effective cleanup of the CRL site.

The CRL site end-state has yet to be determined. CNL will take into account the most appropriate next land use for each area, recognizing that that there is no planned end date for the science and technology mission at CRL. Final end-state conditions must be approved by AECL (as the site and land owner) and the Canadian Nuclear Safety Commission (as the regulator).

Detailed decommissioning plans and remedial action plans will be developed based upon the most likely future land uses at each location, whether proposed for an industrial, parkland, or alternative land use, giving consideration to the future needs of the surrounding communities, the general site conditions and long-term site needs. Industrial, parkland, and unrestricted land use scenarios have been used in the development of CRL-specific soil screening criteria to determine the extent of soil remediation required to protect human and ecological health.

The ODCP presents an overview of decommissioning strategy and a summary of environmental conditions across the site detailed by Management Unit (MU). The MUs consist of groupings of historical waste management areas, support facilities, and experimental research installations. For each MU a description is provided which includes the following:

- Revitalization projects and proposed enabling facilities;
- Status of existing buildings/structures;
- Affected lands and brownfield areas of potential environmental concern; and,
- Where available, volume estimates of waste materials and environmental media that may require remediation, updated based on comparison of environmental characterization data with risk-based soil screening criteria.

The overall costs to clean up the CRL site are based on the initial estimates developed in 2013 as part of the Government of Canada's former Nuclear Legacy Liabilities Program (NLLP). Since then, the cost estimates that support AECL's decommissioning, remediation and waste management liabilities are actively updated and managed and the work is outlined in the latest 10 Year Plan and Annual Program of Work and Budget, which are updated on a 3-year and annual basis, respectively. Additional remaining future work will be planned in detail as decommissioning and environmental remediation progresses. As of 2023 March, AECL's liabilities totaled $6.7 billion (net present value) for the decommissioning and remediation associated with the CRL site. This estimate includes the cost required to decontaminate and remediate areas of the CRL site and dispose of waste to an acceptable standard. As noted above, AECL has tasked CNL to manage its liabilities on its behalf and to propose projects and undertake the necessary activities to address and reduce those liabilities.

This plan is a living document and will be updated as decommissioning and remediation work proceeds and new information and strategies develop. While this plan reflects the conditions and data available at the time of its publication, CNL is required to revise the ODCP every five years, at a minimum.

Table of Contents

Figures

Tables

1. Overview Decommissioning and Cleanup Plan

1.1 Introduction

The Chalk River Laboratories (CRL) site is undergoing major revitalization efforts to enable Canadian Nuclear Laboratories' (CNL) mission to advance nuclear science and technology and develop peaceful and innovative applications through its world class expertise in advanced reactors, safety & security, isotopes, radiobiology, the environment, hydrogen and tritium technologies and reactor fleet sustainability.

CNL is committed to ensuring that Canadians and people around the world are confident that they are safely and securely receiving energy, health, and environmental benefits from nuclear science and technology. CNL works to safely deliver all work activities and to provide the highest level of performance in meeting the commitments expected of them by regulators, customers, stakeholders, and the public.

To support its mission, CNL is in the process of creating a modernized research campus by first decommissioning and removing old, obsolete buildings and infrastructure, mostly within the built-up area. Once environmental remediation is undertaken to clean up the contamination associated with any impacted areas, reusable land will be available for new facilities to support innovative research and development in nuclear science and technology.

These revitalization efforts support the effective management and reduction of Canada's nuclear liabilities through environmental remediation towards a sustainable and healthy environment. A strategic approach is integrated to make land use decisions that will reduce long-term operational costs, effectively manage the site footprint, protect the surrounding natural environment, and bring impacted areas of the site to the desired final end state.

This Overview Decommissioning and Cleanup Plan (ODCP) is the next iteration of the *Comprehensive Preliminary Decommissioning Plan* (CPDP) [1]. The ODCP highlights a consolidated review of near-term needs, plans and priorities, while also integrating the input from current operations, future Science and Technology development projects, waste management capabilities, remediation and site constraints. CNL has renamed the document to better reflect the content of the document which provides a holistic view of cleanup, i.e., an overview of planned decommissioning as well as environmental remediation activities. The ODCP addresses all the requirements of a Preliminary Decommissioning Plan (PDP) as listed in the CSA standard N294-19 [2] and CNSC REGDOC-2.11.2 [3].

The input of public stakeholders and of Indigenous communities and organizations is integral in developing a sustainable and responsible plan that has long-term positive impacts on the natural environment and the socio-economic potential of the area, while ensuring the safety of its neighbours. A Community Advisory Panel, has been formed to provide input into the cleanup plans for the CRL site as part of their mandate. Regular meetings began with local Indigenous communities and organizations to discuss the site cleanup in 2022. This ODCP reflects CNL's holistic and flexible approach to effectively manage CRL's environmental legacy, reduce the

footprint of its operations, return land safely for beneficial reuse and reduce and mitigate long-term risks while considering the needs of local and Indigenous communities.

The ODCP is a living document and will be updated periodically, as decommissioning and remediation work proceeds, as new data is collected and as new research and development opportunities develop. While this plan reflects the conditions and data available at the time of its publication, CNL is required, under REGDOC-2.11.2, Section 6.1 [3], to revise the ODCP every five years, at a minimum.

1.2 Purpose

The purpose of the ODCP is to meet the requirements specified in the Canadian Nuclear Safety Commission (CNSC) document, *Decommissioning*, REGDOC-2.11.2 [3], and of Canadian Standards Association (CSA) standard, *Decommissioning of Facilities Containing Nuclear Substances*, N294-19 [2] [1]. REGDOC 2.11.2, Section 6.1 states that a "licensee shall prepare a PDP [Preliminary Decommissioning Plan] and submit it to the CNSC for acceptance with an application for a licence in respect of a nuclear facility or the conduct of a licensed activity in accordance with the conditions of its licence". For sites with more than one facility, as is the case at CRL, the licensee is required to submit an overarching PDP to ensure that interdependencies between planning envelopes or facilities are taken into account [4].

In accordance with the *CRL Nuclear Research and Test Establishment Operating Licence* [4] associated *Licence Conditions Handbook* [5], and REGDOC-2.11.2 [3], the site-wide PDP is to be reviewed and revised at such times as CNSC staff may require, no later than five years from the previous revision. The ODCP is the fifth revision of the site-wide, overview Preliminary Decommissioning Plan for CRL and builds on the information provided in the four previous revisions of the CPDP [1]. This revision includes information about the CRL site, in its configuration as of 2022 December, and the contents are supportive of the *CRL Nuclear Research and Test Establishment Operating Licence* [4] and associated *Licence Conditions Handbook* [5] issued by the CNSC.

The ODCP documents CNL's strategic cleanup approach to decommissioning and remediating the CRL site's buildings, infrastructure, and contaminated lands at a Management Unit (MU) level. The ODCP will allow CNL to integrate its overall cleanup plans with its operational needs and revitalization efforts.

The ODCP summarizes the current level of information available for the areas of the CRL site that require decommissioning and remediation, highlighting recommendations to rectify any

[1] It is significant to note that in the preamble to the May, 30th 2019 CNSC Staff review of the 2018 CPDP for the Chalk River Laboratories site [7], CNSC states the following: "Although there are no specific timelines for the revision of the CRL CPDP in the current Licence and the associated LCH, CNL is advised that the new draft CNSC regulatory document REGDOC-2.11.2 on decommissioning and the CSA N294 new revision (2019) would include a requirement to update the decommissioning plans every five years at the latest." Both these documents have since been published and were consequently used as references in the development of the present ODCP as they were specifically mentioned in the CNSC's CPDP review letter and represent the most current requirements associated with decommissioning nuclear facilities in Canada.

knowledge gaps. Key elements of the CNL *Integrated Waste Strategy* [6]were considered in developing the cleanup plan, including the availability and limitations associated with waste management, such as storage, disposal pathways and the need for enabling facilities required for the safe processing, treatment, storage and disposal of Low-Level radioactive Waste (LLW), Intermediate-Level radioactive Waste (ILW) and High-Level radioactive Waste (HLW).

The ODCP describes future cleanup efforts and will be informed by engagement and consultation with the public and Indigenous communities. CNL will incorporate their respective feedback and concerns and document how CNL has addressed such feedback into CRL's ODCP ahead of the next review of the CRL Site Licence in 2023, and beyond.

1.3 Scope

While CNL is responsible for managing and operating all of AECL's sites, this ODCP is exclusively applicable to the CRL site.

1.4 Abbreviations and Terminology

This document relies primarily on word meaning as found in common dictionaries. The current CNSC REGDOC-3.6 *Glossary of CNSC Terminology* [8] contains specific meanings for those words that require further clarification.

Four terms are used extensively throughout this document and are defined as follows:

Area of Potential Environmental Concern: is a portion of a site where contamination is suspected or confirmed [9].

Cleanup: Technical actions taken to retire a facility permanently from service or to rehabilitate an affected land area and restore it to a predetermined end-state condition. In this document, cleanup includes decommissioning and environmental remediation, as defined below.

Decommissioning: Planned action, procedures, processes and work activities taken to retire a facility with due regards for the health and safety of people or the environment. Activities may include decontamination, dismantling, demolition, storage with surveillance and disposal of legacy structures or facilities toward achieving the desired end-state goals.

Remediation: Environmental remediation is the removal, reduction or control of contaminants in soil, groundwater, surface water and/or sediment in order to protect human health and the environment. Remediation in this document refers to environmental remediation except where indicated.

ACS	Acid-Chemical-Solvent
AECL	Atomic Energy of Canada Ltd.
AHJ	Authority Having Jurisdiction
ALARA	As Low As Reasonably Achievable
AOPFN	Algonquins of Pikwakanagan First Nation

APEC	Area of Potential Environmental Concern
ANMRC	Advanced Nuclear Materials Research Centre
BRP	Building Removal Plan
CA	Controlled Area
CANDU®	CANada Deuterium Uranium
CAP	Community Advisory Panel
CCME	Canadian Council of Ministers of the Environment
CNL	Canadian Nuclear Laboratories
CNSC	Canadian Nuclear Safety Commission
CPDP	Comprehensive Preliminary Decommissioning Plan
CRL	Chalk River Laboratories
CSA	Canadian Standards Association
D&D	Decommissioning and Demolition
DDP	Detailed Decommissioning Plan
DGR	Deep Geological Repository
ECM	Engineered Containment Mound
EDMS	Environmental Data Management System
EIS	Environmental Impact Statement
EMP	Environmental Monitoring Program
ENVP	Environmental Protection
ERA	Environmental Risk Assessment
ESC	Environmental Stewardship Council
EVMP	Effluent Verification Monitoring Program
GWMP	Groundwater Monitoring Program
HEU	Highly-Enriched Uranium
HLW	High-Level Waste
IAA	Impact Assessment Act
ILW	Intermediate-Level Waste
IWS	Integrated Waste Strategy
LDA	Liquid Dispersal Area

LLW	Low-Level Waste
MU	Management Unit
NCCA	Nuclear Criticality Controlled Area
NPD	Nuclear Power Demonstration
NRC	National Research Council
NRU	National Research Universal
NRX	National Research Experimental
NSDF	Near Surface Disposal Facility
NWMO	Nuclear Waste Management Organization
OA	Outer Area
ODCP	Overview Decommissioning and Cleanup Plan
PDP	Preliminary Decommissioning Plan
PNERP	Provincial Nuclear Emergency Response Plan
PRB	Permeable Reactive Barrier
RACER	Remedial Action Cost Engineering Requirements
RAP	Remedial Action Plan
REGDOC	Regulatory Document
RESRAD	RESidual RADioactive (family of dose assessment codes)
RP1	Reactor Pit 1
RP2	Reactor Pit 2
S&T	Science and Technology
SA	Supervised Area
SMP	Site Master Plan
SMAGS	Shielded Modular Above Ground Storage
SWS	Storage with Surveillance
TRC	Truth and Reconciliation Commission
VC	Valued Component
WAF	Waste Analysis Facility
WMA	Waste Management Area

Radioisotopes of the following elements are presented within this document: Aluminum (Al),

Barium (Ba), Carbon (C), Cerium (Ce), Chlorine (Cl), Cobalt (Co), Chromium (Cr), Cesium (Cs), Iron (Fe), Tritium (H3), Iodine (I), Molybdenum (Mo), Niobium (Nb), Nickel (Ni), Plutonium (Pu), Radium (Ra), Ruthenium (Ru), Strontium (Sr), Technetium (Tc), Thorium (Th), Uranium (U), Yttrium (Y), Zinc (Zn), Zirconium (Zr).

2. Changes since Last Revision of the Comprehensive Preliminary Decommissioning Plan

This document supersedes and expands on the previous *Comprehensive Preliminary Decommissioning Plan* (CPDP), issued in 2018 [1], and addresses gaps highlighted by the CNSC during their last CPDP review [7]. The new name for this document, the Overview Decommissioning and Cleanup Plan (ODCP) is a better reflection of the Plan's purpose as it covers both decommissioning and environmental remediation activities.

A description of the changes since the last CPDP is summarized in this Section.

Planning Updates:

- Expansion into a more holistic plan inclusive of environmental remediation aspects
- New Land Use Program launched and managed by the Cleanup Function
- Expansion of future land use scenarios to include a parkland land use category in addition to industrial and unrestricted land uses
- Introduction of CRL-specific risk-based screening criteria for radionuclides in unsaturated soils
- An overview of the Management Units (MU) of the CRL site; the revitalization plans, decommissioning and demolition status of buildings (as applicable), and the Area of Potential Environmental Concern (APEC) status within each MU
- Changes to the MU delineations include the following:
  - Expansion of MU 2 to include the increased footprint of Waste Management Area (WMA) H;
  - Expansion of MU 7 to include the full length of the National Research Experimental (NRX) Emergency Pipeline route and associated soil contamination;
  - Expansion of MU 8 to include the full footprint of WMA J; and
  - Expansion of MU 6 to include Perch Lake (previously included in MU 4).

Progress in Decommissioning and Remediation:

- The proposed Near Surface Disposal Facility (NSDF) project Environmental Impact Statement (EIS) and licence amendment application was accepted by the CNSC [10], and Public Commission hearings occurred in 2022. A licensing decision is pending.[2]
- Risk-based soil screening criteria were developed for unsaturated soils and have been applied to provide preliminary evaluation of APECs
- The upgraded New Spring B Groundwater Treatment Facility (MU 3) was commissioned

[2] Current regulatory review status is available at: https://www.cnsc-ccsn.gc.ca/eng/reactors/research-reactors/nuclear-facilities/chalk-river/near-surface-disposal-facility-regulatory-review.cfm

- Progress was made on the Stored Liquid Waste Project with some liquid waste material being transferred to the Waste Treatment Centre facilities to be processed. CNL is actively planning upcoming field schedules
- The National Research Universal (NRU) reactor was permanently shut down and defueled. The heavy water was drained from the system. Work continues to progress the NRU reactor to a Storage With Surveillance state
- As of 2022 December, 114 buildings and structures have been decommissioned and removed since September 2015, resulting in a reduction of 26,301 square meters in floor space (mainly in MU 1 and MU 7)
- As part of decommissioning activities underway since September 2015, 20,248,793 kg of clean waste including 251,779 kg of asbestos waste have been removed and disposed. In addition, more than 3,113,349 kg of low-level radioactive waste and 46,747 kg of intermediate-level radioactive waste have been safely stored in CRL's waste management areas
- Decommissioning work is underway in several buildings in the inner Controlled Area, including Building [redacted] and select buildings in the [redacted] series, along with associated soil characterization resulting in significant hazard reduction
- Progress on the non-nuclear decommissioning and hazard reduction of the NRX Stage 1, a Class 1 nuclear facility
- Repatriation of unused Highly-Enriched Uranium (HEU), Target Residue Materials from the Mo-99 Production Facility and NRU/NRX HEU fuel rods from WMA B was completed
- Initial environmental characterization of Acid-Chemical-Solvent (ACS) Pits, Thorium Pit and Nitrate Plant (MU 11) was completed
- The wash pad at WMA F (MU 10) was partially remediated
- The majority of the Liquid Dispersal Area (LDA) pipeline in MU 7 was removed and environmentally remediated
- The environmental characterization of WMA A and LDA (MU 6) has advanced
- A site-specific prioritization tool was developed to help in cleanup planning
- Fuel associated with the Fuel Packaging and Storage Facility project was successfully transferred to the facility, dried, and placed in long-term indoor storage
- The new Sort and Segregation Pilot Facility and Waste Sort and Segregation Facility for LLW processing have reached operational status

Progress in Site Revitalization:

- The Harriet Brooks Building, a logistics warehouse facility (the Minwamon building) and the Support Facility have been constructed and are occupied
- Construction of the new Science Collaboration Centre is in progress with a target completion date in 2023
- Portions of the Site Utilities Revitalization Plan were completed in November 2021 to facilitate new construction. This scope included the relocation of infrastructure within the Advanced Nuclear Materials Research Centre (ANMRC) footprint, utility upgrades to

Foundation Road along the river, and the utility corridor behind the Harriet Brooks Building

- CNL broke ground on the new ANMRC, a state-of-the-art nuclear research complex, in 2022
- As a result of the COVID-19 pandemic, CNL transitioned over half of its staff to a remote workforce. Building on the successes of that effort, a Digital Workplace program was created to support the continuation of a remote work arrangement for about one-third of the CRL site-based staff post-pandemic.

3. Site Location and Physical Setting

The CRL site is located on the unceded and unsurrendered territory of the Algonquin Anishnaabe Nation, in Renfrew County in the Province of Ontario, on the shore of the Ottawa River, approximately 200 km northwest of Ottawa as illustrated in Figure 1. The CRL site occupies an area of approximately 40 km^2 and extends approximately 6.5 km inland from the Ottawa River.

CRL operations have been concentrated, for more than 70 years, over an area representing only approximately 6% of the entire site footprint, mostly along both sides of Plant Road and nearest the Ottawa River. Other than a few small farms which were present prior to the development of CRL, the vast majority of the site has been left undisturbed and remains in a natural state.

The CRL site is within the boundaries of the Corporation of the Town of Deep River. The Federal Department of National Defence Garrison Petawawa borders the CRL site to the southeast, and the Village of Chalk River in the Municipality of Laurentian Hills is to the southwest. The Ottawa River forms the northeastern boundary of the CRL site. The natural features of the site are typical of the surrounding land–forested, uneven terrain interspersed with small lakes, wetlands and rock outcrops.

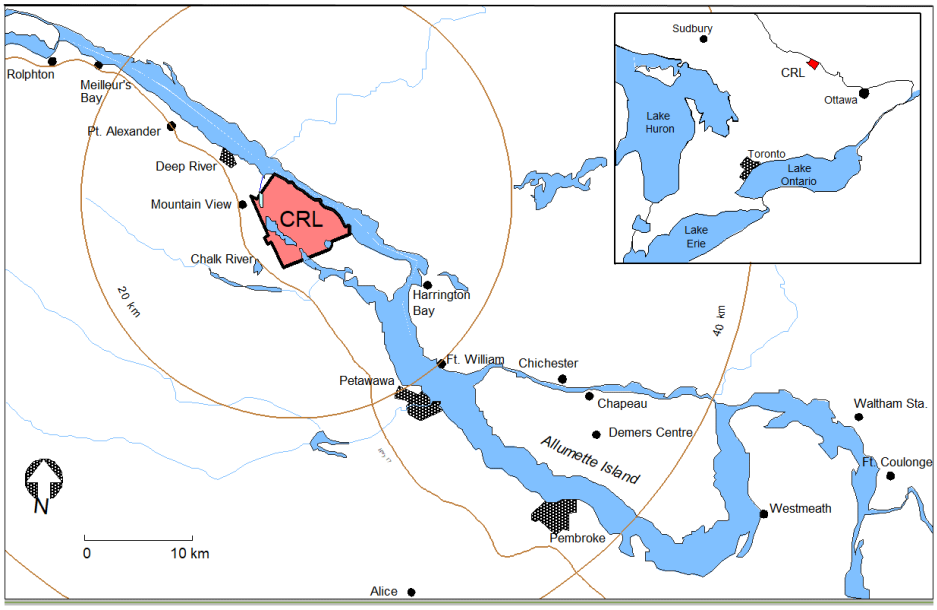

Figure 1: Location of the Chalk River Laboratories

The following Sections summarize additional information describing the CRL site. For more details, see Section 2 of the 2018 *Environmental Risk Assessment of Chalk River Laboratories*, [11].

3.1 Surrounding Communities

The population surrounding CRL in Renfrew County, Ontario, is relatively stable at approximately 106,365 residents (2021 Census) with an overall population density of approximately 14.5 persons/km^2. Most of the closest local residents live in and surrounding the Town of Deep River and the Village of Chalk River. Deep River is 10 km upstream from CRL. Chalk River is located at the western border of the site, about 3 km away from the nearest WMA. Surrounding these two population centres are the townships of Rolph, Buchanan, Wylie and McKay, which, with Chalk River, form the Town of Laurentian Hills.

According to the 2021 Census of Population, Deep River has 4,175 residents and Laurentian Hills has a combined population of 2,885. The Town of Petawawa, including Garrison Petawawa, has approximately 18,160 residents, and is located 20 km downstream from CRL. Other large population centres are the City of Pembroke with approximately 14,364 residents, 35 km downstream from CRL, and the Township of Laurentian Valley which surrounds Pembroke, with 9,450 residents.

North Bay and Ottawa are approximately 140 km up and 180 km down river, respectively.

The portion of Pontiac Regional County Municipality in the Province of Quebec, immediately north and east of the river and opposite the CRL site, is primarily inhabited only seasonally during the summer months when a few cottage dwellers may be present. The closest permanent residents in the Pontiac Regional County Municipality are located 3 km southeast of the CRL site, in the Harrington Bay area. The next closest permanent residents are 11 km downriver, in the Downey Bay area. The closest populated area on the Québec side is the Municipality of Sheenboro including Fort William, approximately 16 km down river, with a population of approximately 150 residents.

The closest First Nations community to the CRL site is the Algonquins of Pikwakanagan First Nation (AOPFN), located on the southeast shore of Golden Lake where it flows in to the Bonnechere River, in Renfrew County, Ontario and covers an area of 688.8 hectares. The AOPFN are part of the Algonquins of Ontario organization, which has reached an Agreement-In-Principle with the Governments of Ontario and Canada regarding a land claim for their traditional homelands in the Ottawa Valley which includes the National Capital Region, all of Renfrew County, and most of Algonquin Park, including the CRL site [12]. In addition, the CRL property also overlaps the Mattawa/Lake Nipissing Traditional Harvesting Territory for the Métis Nation of Ontario [13]. Discussions with Williams Treaties First Nation communities and Algonquin Anishinabeg Nation Tribal Council member's communities (Kebaowek First Nation and Kitigan Zibi Anishinabeg First Nation) have also indicated that traditional harvest occurs in the general area surrounding the Chalk River Laboratories site [14].

A proposed list of the Indigenous communities and organizations identified by CNL in the vicinity of the CRL site (specifically, the NSDF Project) is found in Section 3, Table 3-1 of the NSDF Indigenous Engagement Report [14].

Access to the CRL site is restricted and has not been used for traditional purposes by Indigenous Peoples since the formation of the site.

Canadian Nuclear Laboratories is one of the two major employers in Renfrew County and the nearby communities of Pembroke, Petawawa, Deep River and Laurentian Hills. Garrison Petawawa is the main employer with 7,000 military and civilian personnel. CNL employs about 2,900 highly trained staff at CRL, including scientists, engineers, technicians, trades, and administrative staff.

The campus revitalization efforts at CRL will provide, for decades to come, numerous opportunities for new R&D research and development projects and supporting installations, in particular around nuclear applications of Science and Technology (S&T). In addition, environmental remediation efforts will also progress over a number of years at CRL.

A public attitude survey conducted in 2022 April [15] and *The County of Renfrew Social, Economic and Environmental Impact Analysis of CNL/CRL* [16] conducted in 2021 April, showed high levels of awareness of and support for CRL within the community, including:

- Acknowledging the positive impacts of the laboratories on local employment and business growth
- Appreciating the importance of CRL in generating employment, talent attraction/retention and business activity
- Recognizing the strict environmental standards that CRL adheres to

Decommissioning and remediation work requires skills in the following disciplines: radiation protection, radiochemistry, nuclear and environmental engineering, hydrogeology, skilled trades, safety case development, criticality assessment, nuclear safety, licensing, control and instrumentation, waste management, mathematical modelling, facility management, maintenance, engineering and project management. Training and employment of highly qualified people will therefore be required for many decades.

The CRL Implementing Plan [17] of the Provincial Nuclear Emergency Response Plan (PNERP) Master Plan [18] provides estimates of the Primary Zone population figures. The Primary Zone is the zone around a nuclear installation within which planning and preparedness is carried out for measures against exposure to a radioactive plume. A revised assessment is currently underway to evaluate the significant reduction in risk to the surrounding off-site populations resulting from the shutdown of the NRU reactor in 2018 March. Discussions proposing that CRL be removed from the PNERP are underway with the CNSC (on behalf of the Province on Ontario) and the Province of Quebec.

3.2 Land Use

Atomic Energy Canada Limited is the landowner of the CRL site and remains responsible for the legacy liabilities at the site.

The 2018 CPDP [1] assumed that all current land use at CRL was classified as industrial due to the operations and activities undertaken by CNL, restrictions on public access and prohibition of third-party land uses. Large portions of the site are, however, covered by natural forests, wetlands and surface water bodies. For future cleanup planning purposes it has therefore been proposed that in addition to industrial land use, where appropriate, targeted next land uses will also include unrestricted as well as parkland (see Section 9.1.2).

Land use in the region consists primarily of forestry, recreation and tourism, with limited agriculture, trapping and mining. Upstream of CRL, except for the Municipality of Rapides Des Joachims in Quebec, the majority of settlement and development is located on the Ontario side of the Ottawa River. Very little development has taken place on the Quebec side of the river, northwest of Allumette Lake. A wide range of types and scales of farming exist in the upper Ottawa Valley, from small scale mixed (hobby) farming to commercial-scale beef farming and dairy farming with associated forage crops. Most large-scale farming activities occur over 20 km from CRL in the Petawawa-Pembroke region (and further southeast). There are a few smaller farms in the Chalk/Deep River area, including an alpaca farm. The nearest area of significant agriculture is approximately 35 km downstream on the Ontario side of the river and further downstream on the Quebec side. No harvesting (hunting, trapping, fishing, or gathering) is permitted on the CRL site.

The Ottawa River, referred to in the Algonquin language as “Kichi-Sìbì” or Big River, is of significant heritage, cultural and spiritual value to Indigenous communities due to its use as a traditional travel route [19]. In 2016, the Ottawa River was designated to the Canadian Heritage Rivers System for its cultural value. Sport fishing is carried out in lakes outside of the CRL property boundary, as well as in the Ottawa River. There is no commercial fishing in the area. Only fishing for environmental monitoring purposes is permitted on the CRL property. Fish found in local waters within and surrounding the CRL property include pike, bass, walleye, pickerel, muskellunge and sturgeon.

One of the largest military bases in Canada is in Renfrew County, adjacent to the CNL property at Garrison Petawawa. Because of its irregular boundaries, the eastern edge of Algonquin Park (Provincial) ranges from 8 to 15 km west of Highway 17. Most of the remaining land in the region is undeveloped.

3.3 Topography and Hydrology

One of the dominant topographic features of the CRL property is the ridge that separates the Maskinonge-Chalk Lake valley from the Ottawa River. Many of the site’s topographic features are bedrock-controlled and where exposed, the bedrock surface is frequently knobby, with highs and lows on a scale of several hundred meters laterally and tens of meters vertically.

The Ottawa River is the dominant drainage feature in the area. The CRL property is located in the Allumette Lake and Lac Coulonge reach of the Ottawa River, which extends approximately 90 kilometers between La Passe and the Des Joachims Dam.

The site contains several small drainage basins that discharge either directly to the Ottawa River or to smaller lakes and streams, which in turn, drain to the Ottawa River. Direct drainage to the river occurs from the Ottawa River Direct basin which covers 12% of the site area, including the built-up area. The Perch Lake basin drains 15% of CRL property. Maskinonge Lake is the largest surface water body entirely within the CRL site boundary and its catchment (drainage basin) accounts for almost 40% of the site's area. Drainage from the Maskinonge Lake basin is into Sturgeon Lake and then into the Ottawa River. Chalk Lake East and West water basins, located in the southwest corner of the site also drain into Sturgeon Lake (also known as Chalk Lake).

Ottawa River flows are controlled and measured at various locations upstream. The Des Joachims Generating Station, operated by Ontario Power Generation is located approximately 35 km upstream of CRL near Rolphton and is the nearest control point.

3.4 Wildlife and Habitats

The CRL site is characterized by a forest cover consisting of white, red and jack pine; white and yellow birch; hemlock; white, red and black spruce; beech, sugar and red maple; red oak and poplar. The pine species are the most significant from a commercial viewpoint.

The area supports a wide range of wildlife species, including moose, deer, black bear, ruffed grouse, hare, turtles and waterfowl. The area also supports many fur bearing animals such as beaver, mink, fisher, marten, otter, muskrat, fox and raccoon. The surrounding area is not situated within a major waterfowl flyway; however, numerous wetlands provide a suitable nesting habitat for waterfowl.

Several wildlife species observed at the CRL site are listed as species at risk (see Section 7.2.1).

CNL recognizes that there are valued components in the aquatic, terrestrial and cultural environments reflecting Indigenous interests within the CRL site and the adjacent Ottawa River [14], [19]. A summarized list of the wide range of valued components reflecting environmental effects and Indigenous interests selected for the proposed NSDF project is presented in Table 5-2 of the NSDF *Indigenous Engagement Report* [14], and will be considered as cleanup planning progresses.

3.5 Geology

The CRL Site is typical of its immediate surroundings-a mixture of exposed bedrock, glacial till, fluvial sand, Aeolian sand dunes and organic materials mostly found in small lakes and marshes. Ground surface elevations vary from the level of the Ottawa River which is approximately 111 to 200 metres (m) above mean sea level.

The bedrock in the CRL site consists principally of deformed metamorphic gneiss rock formations. A major fault is observed along the Ottawa River, and a branch from this fault extends through the CRL site.

The earliest unconsolidated sedimentary material in the CRL area dates to near the end of the last ice age and consist of fluvial sand and interbedded silt. These materials have been locally reworked by the wind to form large, fine sand dunes, where several of the CRL site's waste management areas have been located. Underlying these sandy deposits, relatively thin deposits of very boulder like glacial till are found on much of the CRL property. However, at certain locations at the CRL site, thickness of the till has been found to vary from less than 0.3 m to 30 m thick. The till contains a wide range of grain size, from automobile size blocks of rock to clay size particles.

3.6 Climate

The climate of the area is classified as humid continental, with warm summers, cold winters, and no distinct dry season. According to meteorological data from Environment Canada, the average daily temperature in Renfrew County is 4.9°C, with a high daily average temperature for the month of July of 26.6°C and a low daily average temperature for the month of January of -17.6°C. Annual average precipitation of 811.5 millimetres (mm) equivalent is observed for the region, with the highest precipitation typically occurring in the summer and an average annual snowfall of 195.5 centimetres (cm). The extreme daily precipitation (most rain or snow in one day) of 110 mm of rain was recorded in September 1989 and 39 cm of snow in February 1984.

4. Site Missions and Background for Cleanup Planning

4.1 Chalk River Laboratories' Strategic Priorities

The CRL site holds unique expertise and specialized facilities that support research in advanced nuclear technology and innovation in safety, security, health, environmental and clean energy technologies. CRL was instrumental in the development of the CANada Deuterium Uranium (CANDU®) reactor technology. Until the shutdown of the National Research Universal reactor in 2018, CRL produced a large share of the world's supply of medical radioisotopes.

Significant industrial/commercial activities are still generated at CRL, including research and development of innovative applications for nuclear technology and the design and engineering of specialized technology, waste management, decommissioning and environmental remediation. CNL is committed to ensuring that Canadians and people around the world are confident that they are safely and securely receiving energy, health, and environmental benefits from nuclear science and technology. See Figure 2 for CNL's strategic priorities. CNL works to safely deliver all work activities and to provide the highest level of performance in meeting the commitments expected of them by regulators, customers, stakeholders, the public and Indigenous peoples.

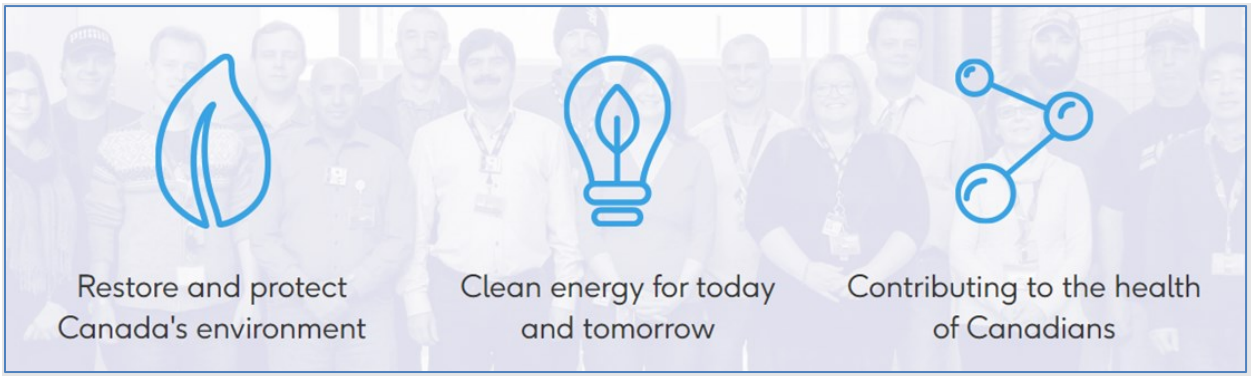

Figure 2: CNL's Strategic Priorities

Canadian Nuclear Laboratories strives to advance nuclear S&T for a clean and secure world and to undertake the following missions at the CRL site:

- We will restore and protect Canada's environment by reducing and effectively managing nuclear liabilities
- We will provide the world with sustainable energy solutions including the extension of reactor operating lifetimes, hydrogen energy technologies, and fuel development for the reactor designs of tomorrow
- Together, with partners, we will demonstrate the commercial viability of advanced reactor designs including Small Modular Reactor (SMR)
- We will work collaboratively with medical/educational institutions and pharmaceutical companies to pioneer new alpha therapies for cancer treatments that save countless lives
- We will leverage all of our capabilities for commercial success in Canadian and international markets

Advancing nuclear S&T for a clean and secure world is CNL's purpose. New infrastructure and refurbishment of existing infrastructure to support this S&T mission will be extensive. Cleanup planning will support these missions at CRL by providing a safe and effective framework to reduce the environmental liabilities through decommissioning and remediation allowing for the development of the new, revitalized S&T campus.

4.2 CRL Operating History

The construction of CRL began in August 1944. Nuclear research at the Chalk River site began in 1945 under the administration of the National Research Council (NRC) with the completion of the Zero Energy Experimental Pile (ZEEP) reactor which was designed to provide basic information on the physics of neutrons in a natural uranium/heavy water environment and to optimize the design of the planned National Research Experimental (NRX) reactor. In 1946, the Atomic Energy Control Act established the Atomic Energy Control Board (AECB), and the AECB asked the NRC to continue to operate CRL on their behalf.

The NRX reactor and its associated facilities began operating in 1947 and continued to operate until 1993. The focus of the early NRX operation was the production and recovery of Plutonium

and Uranium-233, and the building complex included facilities for processing irradiated uranium and thorium and packaging the recovered products. Government approval to proceed with the National Research Universal (NRU) reactor was received in 1950. The NRU reactor operated as a multi-purpose research science facility until 2018. It also generated radionuclides used to annually diagnose and treat over 20 million people in 80 countries. The NRU was the neutron source for the NRC Canadian Neutron Beam Centre and it was the first test bed for the CANDU® reactor.

In 1952, the Canadian government formed Atomic Energy of Canada Ltd (AECL), a Crown corporation with the mandate to develop peaceful uses of nuclear technology, to take over operation of the Chalk River site from the NRC. That same year, NRX suffered an accident that resulted in extensive fuel failure, severe damage to the reactor core and release of radioactive material. Solid and liquid wastes from the NRX accident, including reactor components, were taken to dedicated Waste Management Areas, in particular WMA A and WMA B.

Six such WMAs (WMA A, WMA B, WMA C, WMA D, WMA E, and WMA F) were developed during the 1950s and 1960s to manage low-level radioactive wastes and other CRL wastes. Three of these WMAs (i.e., WMA A, WMA E, WMA F) stopped accepting waste between the 1960s and the early 1980s, once their respective design capacities were reached.

Three of these WMAs are still in operation (WMA B, WMA C, WMA D) while two additional WMAs (WMA G and WMA H) were added between 1988 and 2002 and are also still in operation. An area was assigned as WMA I, but the facility was never constructed. WMA J is the most recent addition. It was constructed in 2011 to accept dewatered sewage sludge from the wastewater treatment system and is still in operation today.

Environmental characterization and monitoring of groundwater and surface quality has been ongoing at each of these WMAs since the start of their operations and continues to this day. The legacy waste management areas at the CRL site were designed and built prior to development of modern standards thus, do not meet all aspects of modern design requirements. Specifically, the legacy waste management areas lack robust containment, which has affected the surrounding environment. These areas will require further analysis and environmental remediation options analysis, as is discussed further in this plan.

Several of these WMAs have been the source of radioactive contaminant plumes, some of which have been mitigated using active or passive treatment systems. Radionuclide concentrations in soil and water have been decreasing at most locations due to natural attenuation and radioactive decay.

In 1954, a revision of the Atomic Energy Control Act changed the relationship between the AECB and AECL, with AECL reporting directly to the designated Minister. The research focus shifted in 1954 from plutonium production to the application of nuclear technology for electrical power generation based on the natural uranium fuelled, heavy water moderated concept, subsequently dubbed CANDU® (CANada Deuterium Uranium). Nuclear facilities were installed to support this research program, (e.g. for development, fabrication, testing and post-irradiation examination of fuels and reactor components). Engineering programs were initiated to support development of the prototypes for the CANDU® nuclear power reactor and

advanced reactor concepts. Support facilities and services such as machine and instrument shops, analytical laboratories, engineering, computation, stores, radiation protection, environmental and biological research, nuclear materials and waste management, administration, cafeteria, and other support facilities were constructed, as required. The larger NRU reactor and its associated facilities began operation in 1957 and ceased operating in March 2018. ZED-2 is currently the only remaining reactor operating on the CRL site.

In 2015, following a restructuring process led by the Government of Canada, AECL moved from a Government-owned, Government-operated model to a Government-owned, Contractor-operated (GoCo) model. Through this model, AECL contracts the management and operation of its sites to CNL, which is a private-sector company responsible for the day-to-day management and operation of all AECL's sites, facilities and assets, including CRL. AECL remains the owner of all land, assets, properties, and liabilities. CNL is licensed by the CNSC to operate AECL's sites.

In the past five years, several new facilities and projects have been completed and since September 2015, 114 buildings and structures have been safely decommissioned and demolished. The NRU reactor remains under an operating licence in a permanent safe shutdown state (defueled and dewatered). Work continues to progress the NRU reactor to a Storage with Surveillance state which will be followed by the initiation of decommissioning execution in 2029. Buildings [redacted] (storage tanks) and [redacted] (Chemical Laboratories) have also been shut down and have been recently characterized as part of decommissioning. The Harriet Brooks Building ([redacted]), the Minwamon Building, i.e., the new Logistics Warehouse facility ([redacted]) and the Support Facility ([redacted]) opened in 2018, 2020, and 2021 respectively. More details on recent infrastructure projects are presented in Section 4.3.5.

4.3 Site Layout

The CRL land boundaries are shown in Figure 3. The CRL site includes a wide variety of buildings, WMAs and structures used directly or in support of nuclear S&T and industrial activities. The Campus Precinct area of the CRL site, as of 2022 December, is shown in Figure 4. To assist in site cleanup planning, the CRL site has been divided into 11 Management Units (MUs), as shown in Figure 5. An MU is an area with potential or known environmental impact associated with historic or ongoing site operations within a defined boundary. Further description of the MUs is provided in Section 4.3.4.

Over the next 10 years, from 2023 to 2032, CNL will continue to transform the CRL site through the revitalization of essential infrastructure, decommissioning of aging buildings, and investments into new facilities. Re-use of already disturbed lands (brownfield areas) is a priority over developing undisturbed green field areas. The total built footprint of the site will be reduced with development consolidated on a smaller area of land. Development blocks have been identified to control the extent of the built environment and optimize servicing (e.g., roads, utilities, emergency response, etc.) during redevelopment.

For development planning purposes, the site has been divided into three areas - the Entry Precinct, the Outer Precinct and the Campus Precinct:

- The Entry Precinct is located immediately next to the Village of Chalk River and is the first point of arrival to the site. No significant decommissioning or environmental remediation activities are foreseen in the Entry Precinct over the near term.
- The Outer Precinct covers the majority of the site and is largely in a natural state except for the Plant Road corridor where the WMAs are located and where development blocks have been identified. The site of the proposed NSDF is located in the Outer Precinct.
- The Campus Precinct includes the main built-up area of the site (Figure 4), including the inner Supervised and Controlled areas which consist of approximately 48 hectares next to the Ottawa River. The Campus Precinct is the focus of the transformation of the CRL site for new world-class nuclear S&T facilities. The goal is that site cleanup will contribute to a significantly reduced built footprint.

4.3.1 Controlled, Supervised, and Outer Areas

The CRL site consists of three types of designated areas under progressive degrees of access and radiation protection controls, as follows:

- Controlled Area (CA): CRL site areas within which normal working conditions, including unplanned events, require all personnel to follow well-established radiation protection procedures and practices. The predominant hazard may be either external radiation or contamination. Controlled Areas have access restrictions and most have perimeter fencing. The north section of the Campus Precinct is often referred to as the 'inner area', which is currently a [redacted] section. There are also CAs located in the Outer Precinct consisting of the Waste Management Areas, most of which are fenced. The ones without fencing still require authorization before gaining access. There are also CA 'islands' (active areas in 4 buildings) in the Supervised Areas.
- Supervised Area (SA): CRL site areas in which working conditions are to be kept under review, but special radiation protection procedures are not normally needed. Work with radiation sources and the storage of radioactive materials is not permitted without authorization. SAs include the southern [redacted] section of the Campus Precinct, referred to as the inner SA, as well as operational and affected areas in the 'Outer Area'.
- Outer Area (OA): The area within the site boundaries is known as the 'Outer Area'. The Outer Precinct is predominantly made up of the 'Outer Area'. The 'Outer Area' is accessed from Highway 17 in the Village of Chalk River. Access to the interior of the site by authorized personnel is by road through a security checkpoint.

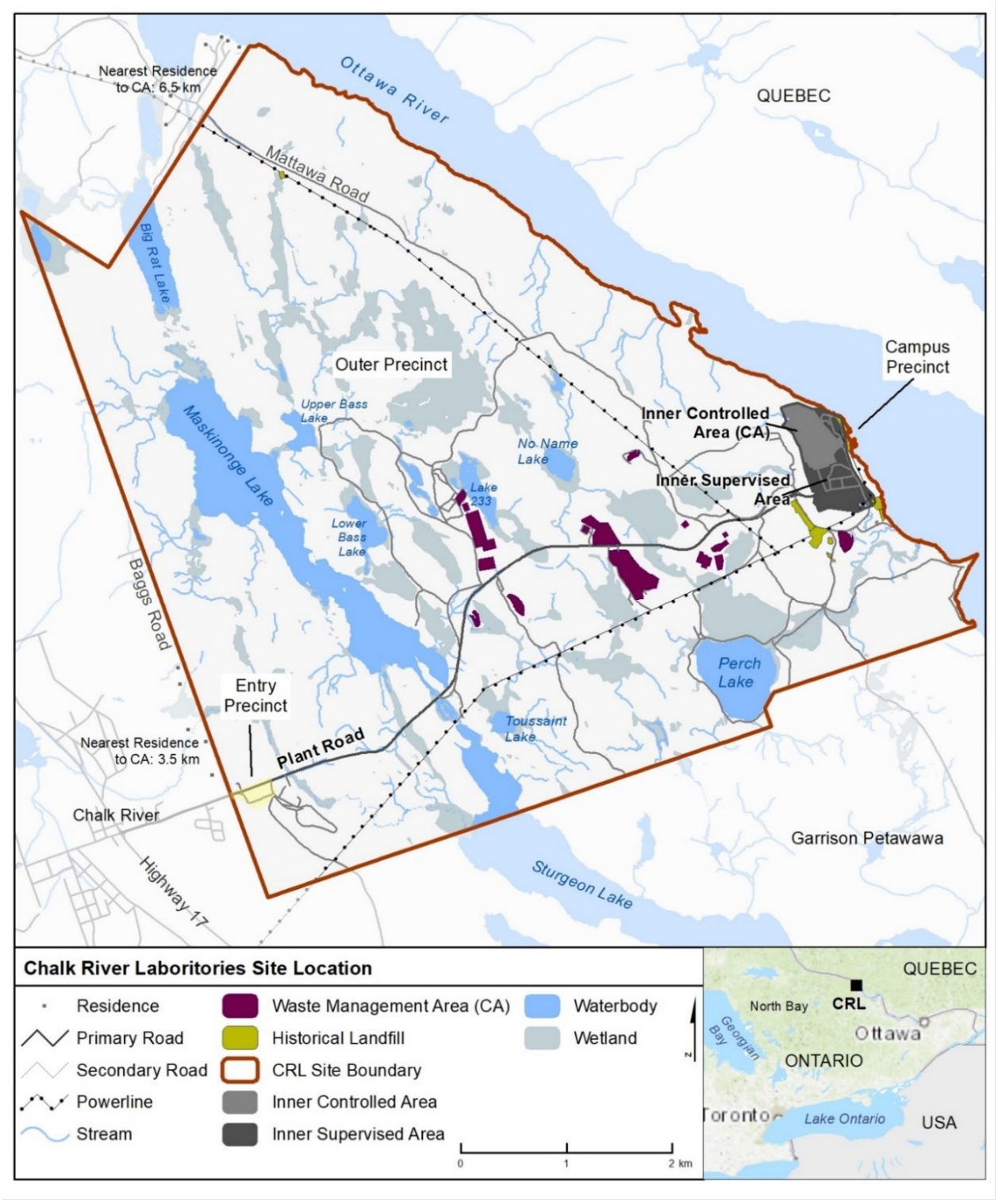

Figure 3 Map of Chalk River Laboratories Site Layout

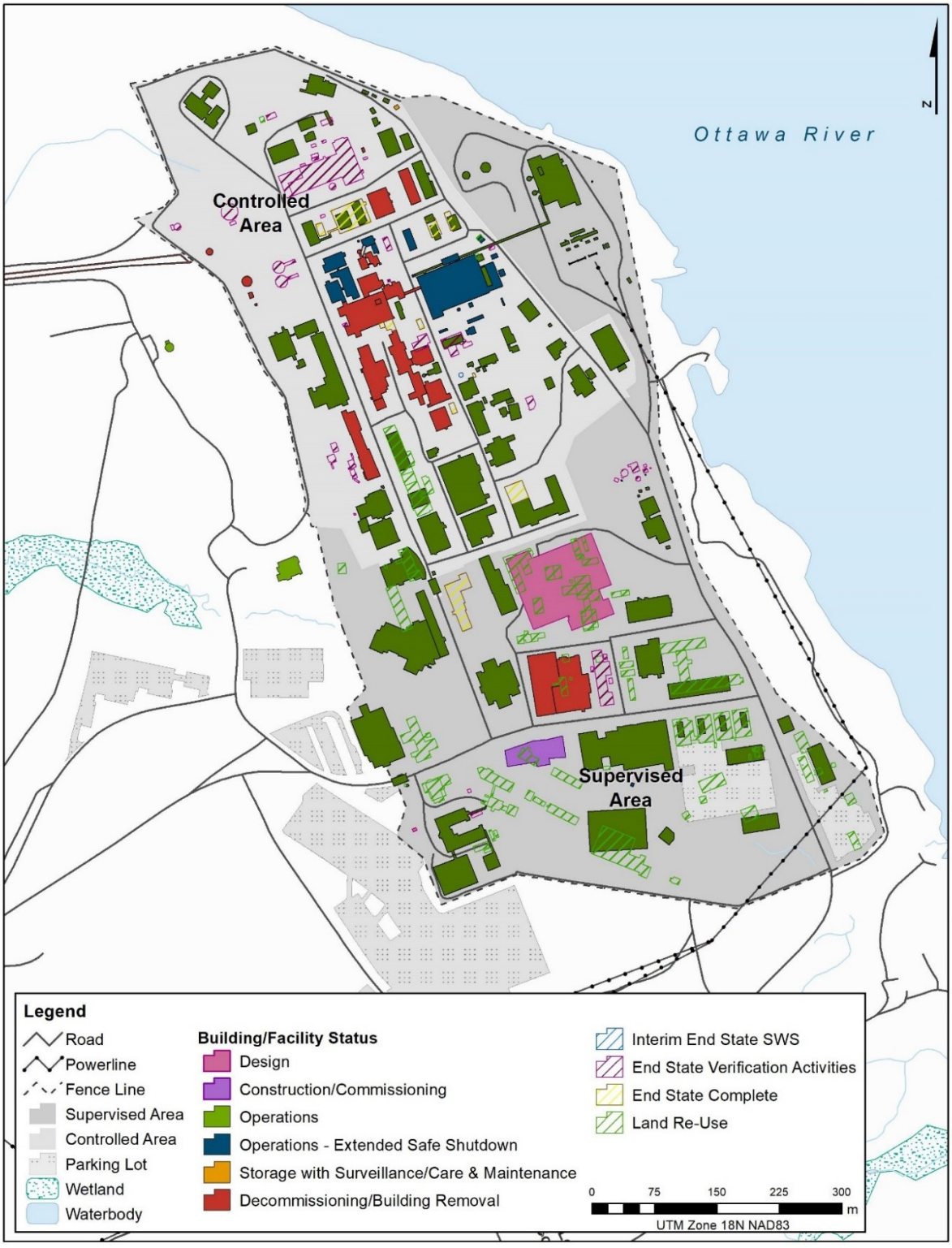

Figure 4: Map of the Campus Precinct of Chalk River Laboratories

(See Appendix A for descriptions of the Building/Facility Status Categories)

4.3.2 Buildings, Facilities, and Support Functions (Active/Operational)

The Campus Precinct, which includes the Inner CA and the Inner SA, represents the highest concentration of development and decommissioning activities planned for the 2023-2027 period and beyond.

Green space and landscaping is presently limited to a small area between the Entrance Building ([redacted]) and the Cafeteria ([redacted]) and to the north and south of the cafeteria. The Campus Precinct contains many end-of-life buildings scheduled for removal. The list of buildings to be demolished and those that will remain in the Campus Precinct are included in Appendix A.

Ultimately, a large portion of the Campus Precinct is planned to be converted to green space. The cleanup activities will also provide opportunities for reutilization of brownfield lands which will be dependent on the results of subsurface characterization, remediation effort and the need for footprint for new development.

Buildings in the SA are used for applications such as scientific laboratories, research not involving significant amounts of radioactive materials, workshops, administration, and other services, such as the new logistics warehouse facility (the Minwamon building), the Waste Analysis Facility (WAF), and the low background counting building. There are a few minor exceptions, such as the use of radioisotopes in the Biological Research Facility and the Harriet Brooks Building which are located in the inner SA.

Most buildings located outside of the CA can generally be considered uncontaminated. Nonetheless, precautions are in place to reduce the risk of inadvertent transfer of minor contamination; any transfer of equipment or waste materials that can involve radiation or radiological contamination is subject to Radiation Protection Program requirements [20]. The Campus Precinct section of the SA is approximately 28 hectares (approximately 600 m in the north-south direction by 700 m in the east-west direction) and currently includes approximately 16 permanent buildings, excluding sheds and trailers. The primary access to this area is from the main gate on the west side.

Since September 2015 through 2022 December, 114 structures have been decommissioned and demolished at CRL totalling over 26,301 square meters of building floor space (not building footprint area). These decommissioning efforts have been focused in the inner Controlled and inner Supervised Area. This has created space for several larger new build projects to enable transformation of the Chalk River site into a modern and vibrant campus. The inner CA, is a [redacted] area of approximately 20 hectares (approximately 700 m in the north-south direction by 400 m in the east-west direction), as shown in Figure 4. At the exit of the inner CA, as well as at WMA B, sensitive monitoring portals are installed to eliminate the risk of transporting radioactive contamination outside of the CA.

The inner CA currently consists of 44 permanent buildings and facilities, excluding sheds, trailers, towers and tanks. The buildings in the CA accommodate and support nuclear facilities such as reactors, hot cells, radioisotope laboratories, nuclear materials storage, etc. The more significant of these facilities are listed in the CRL Site *Licence Conditions Handbook* [5] and are operated in accordance with formal documentation, including a Safety Analysis Report, Facility

Authorization and Conduct of Operations Program. Many of the facilities in this area have been turned over to the Decommissioning Program and are governed by Building Removal Plans (BRP), Preliminary or Detailed Decommissioning Plans (PDP or DDP) and Storage with Surveillance (SWS) Plans.

Many rooms in the buildings in the Campus Precinct are reserved for non-nuclear uses, such as offices, conference rooms, corridors, and storage, and are not expected to exhibit evidence of radiological contamination. Transfers of equipment and waste materials from the CA to the SA are, however, subject to Radiation Protection Program requirements [20]. The focus of decommissioning efforts for 2023 to 2027 is shifting to the disused/vacant facilities in the Controlled Area of the Campus Precinct. These decommissioning activities will significantly reduce health, safety, and environmental risks by removing high-hazard liabilities and will reduce the costs associated with maintaining redundant buildings.

To aid in decommissioning efforts and to provide a modern, right-sized, efficient campus environment, both security and radiation protection programs are shifting away from large area controls. The goal is for central monitoring and fencing to be removed from many areas that do not require these controls in order to blend the 'Inner CA' and 'Inner SA'.

The following new buildings and facilities have been commissioned since the last revision of the CPDP [1]:

- 2018 -Harriet Brooks Building ([redacted])[3]
- 2019 -Hazardous Waste Process and Radioactive Waste Characterization Facility ([redacted])
- 2019 -New Sanitary Sewage Treatment Facility ([redacted])
- 2020 -New Spring B Pump and Treat Facility ([redacted])
- 2020 -Sort and Segregation Facility Pilot (Repurposing of [redacted])
- 2021 -Minwamon Building: Logistics warehouse facility and site entrance building ([redacted])
- 2021 -Support Facility (Maintenance) ([redacted])
- 2021 -WMA-G Service Building ([redacted])
- 2022 -Waste Sort and Segregation Facility ([redacted])
- 2022 -WMA G expanded to add new concrete canisters for the storage of used fuel from other CNL sites (e.g., Whiteshell Laboratories and Gentilly-1)

The description and operational status of buildings, structures, WMA's and services on the CRL site, as of 2022 December, are listed by MU in Appendix A.

4.3.3 Waste Management Areas and Affected Lands

Most of the WMAs at CRL have access controls in place, such as fencing, and require pre-approval to access. The majority of lands within the WMAs are considered as having been affected by previous operational activities. Outside of the Campus Precinct the majority of the lands at CRL are unaffected with the exception of the WMAs and associated plumes, the

[3] The office portion of this building was commissioned in 2016; the remainder was commissioned in 2018.

landfills located in MU 7, and isolated areas where historical research has occurred. These areas are generally referred to as affected lands.

Responsible waste management includes full life cycle management from generation to disposal. As such, AECL, as the waste owner, has tasked CNL to identify solutions for waste management of the entire life cycle of all radioactive waste classifications including LLW, ILW, HLW, hazardous waste, as well as clean (non-radiological) waste which are covered in the CNL Integrated Waste Strategy [6].

The legacy waste management areas at the CRL site were designed and built prior to development of modern standards and thus do not meet all aspects of modern design requirements. Specifically, the legacy waste management areas lack robust containment, which has affected the surrounding environment. Waste storage within the WMAs has resulted in contamination plumes that extend beyond the defined boundaries of some of the WMAs. Some smaller areas have been identified as being affected-environmentally or radiologically–as a result of operations or accidental spills. Additionally, sediments in the Ottawa River adjacent to the site have also been affected by past CRL operations.

4.3.4 Management Units

As shown in Figure 5, the entire CRL site is divided into specific MUs. Assignment of land to a specific MU is based on a combination of criteria including spatial relationships to other units, contribution to the same groundwater plumes, physical characteristics of the area, access considerations, anticipation of similar remedial action strategy (economy of scale), and reasonable number of total units to effectively manage. The division into MUs enables a coordinated approach to the planning of decommissioning and remedial investigations (modeling and characterization), remedial actions and strategies, and the development of interim and long-term management solutions. The MUs currently define the CRL site's "Decision Units" as recommended in CSA N294-19 [2]. Appendix A discusses the MUs, and the WMAs and other Areas of Potential Environmental Concern (APEC) within each, in more detail.

Management Units 1 and 7 comprise the Campus Precinct of the CRL site where most of the redevelopment potential exists and where building decommissioning activities are currently focused. To date, 114 structures across the site have been decommissioned and demolished since September 2015 with several more scheduled for decommissioning in the next 5 years as shown in Appendix A.

While generally less contaminated than the higher priority areas, cleanup may be prioritized in MUs 1 and 7 where new builds are being considered as part of site revitalization efforts. In some cases, this will require more detailed soil and groundwater characterization. This type of information is essential in determining the extent of cleanup efforts required or the type of mitigation measures that will be needed to allow safe future land use of contaminated areas.

Much of the needed environmental remediation work on the CRL site will be focused on the WMAs, in particular those that are sources of contaminated groundwater plumes as described in more detail in Table 1, below, and in Section 10 and Appendix A. The five high priority MUs (MU 3, 6, 8, 10 and 11) each contain radioactive and chemical wastes in below grade facilities

that do not meet current waste management standards. MUs 3, 6, 8, and 11 include wetlands which have been impacted by migration of contamination in groundwater from waste management areas. Groundwater treatment systems are in place to limit the migration of contaminants toward downgradient receptors from four groundwater plumes originating from WMAs located in MUs 3, 6 and 11.

There is also an impermeable geomembrane cover capping WMA C (MU 8) and decreasing the contaminant migration from wastes contained in the area. The natural wetland areas downgradient of MUs 3, 6, 8, and 11 have not yet been fully characterized and will be addressed in future years

Environmental remediation may also be required in other MUs where contamination is present but to a lesser extent (i.e., MU 1, 7, and 9) and in some cases may be appropriately managed in situ after mitigation measures are put into place. There is currently no evidence of contaminant transport to soil or groundwater from the facilities within MU 2.

Management Unit 5 consists solely of the area of contaminated sediment off-site in the Ottawa River that has been affected by CRL operations. Following detailed quantitative risk assessments, this area is currently being managed using a Monitored Natural Attenuation approach.

Several research and support activities have taken place in MU 4 (the majority of the Outer Precinct) and in most cases these have resulted in limited or localized contamination which has been remediated, at least partially, but may require confirmatory characterization or where necessary complementary environmental remediation.

Such future remediation is planned to proceed sequentially over each MU to allow for better management of the remediation efforts and to limit the impacts of these activities on surrounding areas. As mentioned previously, this approach may be modified, particularly in MU 1 and MU 7, where revitalization efforts may require cleanup of specific sites on a priority basis to allow for proposed redevelopment.

As new facilities are constructed at the CRL site, for example, the proposed NSDF, consideration will be given to whether a new MU should be created, or an abutting MU should be extended to include the new facility.

Changes to the MU delineations since the last iteration of the CPDP [1] include the following:

- Expansion of MU 2 to include the increased footprint of WMA H;
- Expansion of MU 7 to include the full length of the LDA Pipeline and associated soil contamination and the NRX Emergency pipeline corridor;
- Expansion of MU 8 to include the full footprint of WMA J; and
- Expansion of MU 6 to include Perch Lake due to the presence of a groundwater plume which originates in the LDA and WMA A both also located in MU 6 (previously included in MU 4)

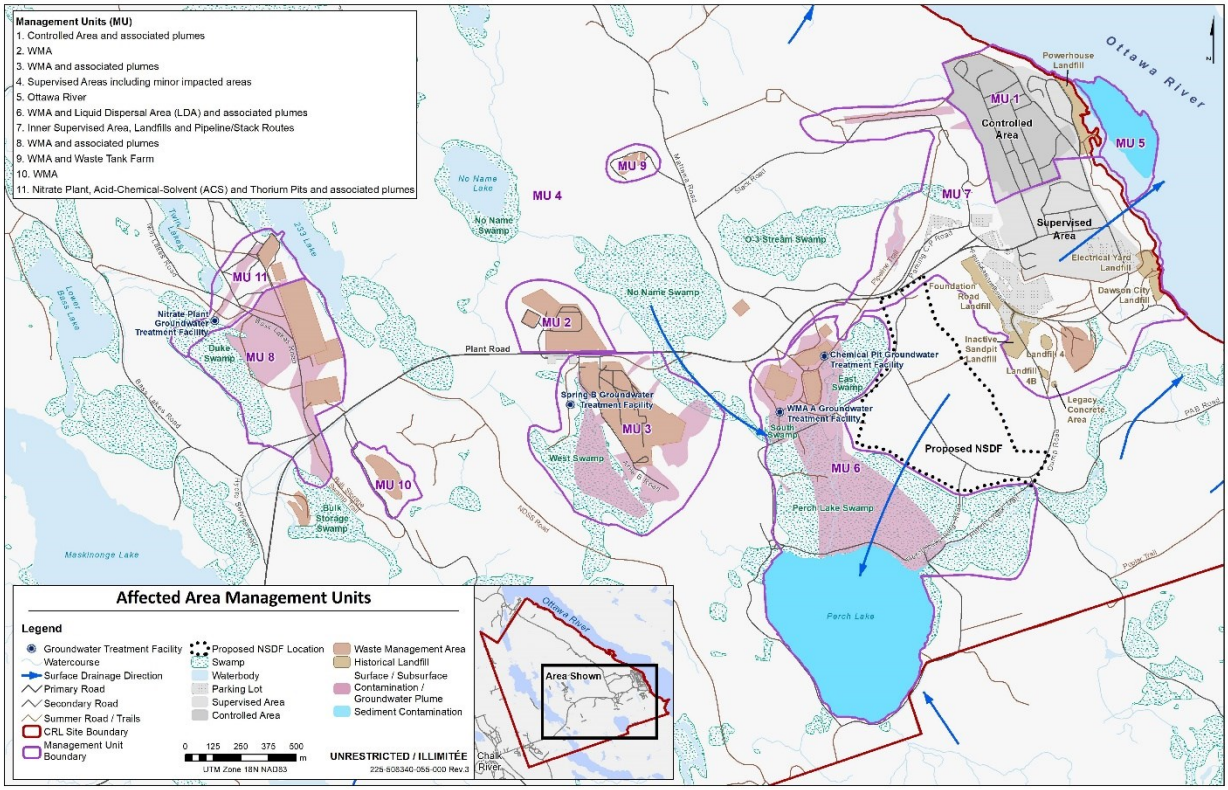

Figure 5: Map of the Management Units on the Chalk River Laboratories Site

4.3.5 Site Master Plan and Future Developments

The purpose of the Site Master Plan (SMP) is to establish a vision for the CRL site and provide an efficient and logical path forward for the redevelopment of CRL that meets business needs, reduces potential land use and infrastructure conflicts, and identifies synergistic opportunities in execution. The SMP envisions the creation of a modern campus environment leveraging its natural setting and will utilize redevelopment opportunities created by decommissioning and removal of old, obsolete infrastructure and cleanup of lands within the built-up area.

The SMP identifies 'Development Blocks' where future development will preferentially take place within the context of a reduced overall site footprint. Proposed projects outside of these identified blocks will require an amendment to the SMP. Preliminary environmental assessments, as well as transportation and utilities planning will be pursued to facilitate the permitting process and provision of site services to projects in these development blocks. Any environmental remediation required to make the development blocks ready for re-use is a key factor in the success of consolidating and shrinking the built footprint.

As planning for decommissioning and remediation at CRL develops it will be important to take into consideration changes to the planned development of the site as documented in the SMP. The maps included in the ODCP outline the areas where wastes or contaminants are known or believed to be present, potentially limiting the redevelopment potential of these areas until remedial activities can occur. For example, the activities associated with cleanup may impose

timeline constraints that do not align with the potential redevelopment project. It is important to also recognize that several of the contaminated areas are located in or near the Campus Precinct and therefore do have strong redevelopment potential. Supporting redevelopment projects is of high priority and consequently may result in changes to cleanup planning sequence or scope. The construction of proposed facilities, such as the ones listed below, may require that the remediation of certain areas be expedited and this, in turn, may have an impact on waste management planning at CRL.

Considering both plans for site revitalization and sustainability principles, redeveloping previously disturbed areas (brownfield development) is preferable to clearing undeveloped, natural areas (greenfield development), especially when brownfield areas are located close to existing services and infrastructure. When evaluating sites for new development in the future, planned interim and final end states will be part of the consideration. Development activities over the next ten years include the construction of several enabling facilities and capabilities, as well as facilities to transform the current built-up area into a modern research campus:

Outer Precinct:

- Various waste management enabling capabilities and facilities are required to manage all classifications of waste. This includes non-radioactive waste, clean waste, hazardous waste, and radioactive waste; LLW, ILW, and HLW (i.e., used fuel). Details of current and future proposed capabilities and facilities are described in Section 9.7.3.

Campus Precinct:

- Advanced Nuclear Materials Research Centre (ANMRC) (construction began in 2022)
- Central Quad (greenspace that will be in the middle of the current Supervised Area) plus overall greening of the Campus Precinct
- Science Collaboration Centre (under construction, planned to be operational in 2023)
- Small Modular Reactor
- Targeted Alpha Therapy Production Facility

In addition, there are enabling facilities and activities needed to support near-term progress in decommissioning and remediation; details are provided in Section 9.

4.3.5.1 Infrastructure and Utility Network

The site infrastructure and utilities network consists of services for the district heating system, electrical distribution, natural gas, sanitary sewer, storm sewer, water supply, telecommunication, and other specialized requirements.

Much of the existing infrastructure and utility network at CRL is beyond its life expectancy. This has resulted in high operation and maintenance costs, and ongoing reliability concerns. Currently, much of the effort is spent on corrective maintenance to existing systems.

Canadian Nuclear Laboratories recognizes that modern site infrastructure and utilities are fundamental for the redevelopment of the Campus Precinct. A comprehensive plan to determine the required service improvements is being developed and will align with the development framework established in the Site Master Plan. It is expected that utility corridors

will be established adjacent to roadways to facilitate more efficient use of real estate and improve ease of maintenance.

Portions of the Site Utilities Revitalization Project were completed in November 2021 to support new construction. This included utility upgrades to Foundation Road along the river, the relocation of infrastructure within the proposed ANMRC footprint and the utility corridor behind the Harriet Brooks Building and the new Science Collaboration Centre. Post-2026 work is related to replacing the CRL Power Distribution System, switchyard and site heating and cooling systems and will focus on looking ahead to future projects and tie-ins to the existing infrastructure.

A traffic study was completed in 2022 to assess the current transportation network, regular operational movement of people and vehicles on-site along with mission requirements for truck and material movement and recommends transportation network improvements for the site.

4.4 Nature and Extent of Contamination

The contaminants identified to date in the areas of concern at CRL primarily originate from reactor operations, fuel development and fabrication, isotope production and other nuclear operations at the site, including research and processing of fissile materials. The suite of fission and activation products produced from the NRX and NRU reactors have been very predictable and define the primary source term for waste streams in the MUs.

Tritium and ^{90}Sr are two radiological contaminants that are mobile and have been migrating with groundwater. Most other radiological contaminants are strongly sorbed to soil and have not migrated from their source areas. Fission products such as ^{137}Cs, ^{90}Sr and the actinides, Pu and Am, are also present in waste streams and soil. In many areas, more detailed characterization of chemical parameters in the environment is still required (Section 4.5 details the radiological and non-radiological contaminants that may be present).

Overall, adequate non-radiological and radiological characterization of each MU is required to support remedial action planning. Table 1 provides an overview of the contaminants identified in each MU to date. Detailed information is provided in Appendix A.

Table 1: Nature and Extent of Known Contamination at CRL by MU

MU	Key Features	Impacted Media	Identified Contaminants [1]
MU 1	Inner Controlled Area (northern part of the Campus Precinct): One operating reactor and four shutdown reactors* as well as facilities such as fuel fabrication and shutdown fuel processing facilities, radioactive research and development laboratories, miscellaneous support structures, [redacted] infiltration pit, and the Power House shoreline landfill. Groundwater tritium and ^{90}Sr plumes emanate from the NRU and NRX reactors. *ZEEP, NRX, NRU and Pool Test Reactor	Groundwater, Sediment	Tritium, ^{90}Sr
		Soil	Mixed fission and activation products
MU 2	WMA D, WMA G, WMA H; located in the Outer Precinct: Operational above-ground radioactive waste storage structures. In 2019, new storage canisters were added to increase the storage capability in WMA G, and WMA H was expanded. WMA H and WMA D now include temporary storage of waste in sealand containers. Minor known subsurface contamination; unconfirmed historical source.	Soil	Localized non-radiological and tritium
MU 3	WMA B, located in the Outer Precinct: Operational; tile holes, cylindrical bunkers; and non-operational facilities, e.g., unlined waste trenches, asphalt lined waste trenches, rectangular concrete bunkers, special burials. Three plumes (tritium, solvent and ^{90}Sr) exist originating from three different waste storage areas within WMA B. West Swamp wetland and streams exist within the footprint of MU 3. A Pump & Treat facility operates to remove ^{90}Sr from a groundwater plume resulting from the unlined waste trenches.	Groundwater, Surface Water, Sediment	Tritium, ^{90}Sr, solvents, mercury
		Soil	Mixed fission and activation products, uranium
MU 4	Outer Area is the majority of the Outer Precinct: includes forests, swamps, streams, lakes. Some areas have minor amounts of contamination (e.g., Bulk Storage Compound, Old Firing Range)	Groundwater, Surface Water, Sediment, Soil	Minor amounts of various contaminants, mainly in localized locations; ^{14}C and ^{3}H from stack effluent atmospheric washout

MU	Key Features	Impacted Media	Identified Contaminants [1]
	MU 4 includes the footprint of the proposed NSDF for low-level waste. A licensing decision for the project is expected in 2023.		exists in the dominant wind sectors (approximately parallel to the river)
MU 5	The Ottawa River is next to the Campus Precinct, but outside the boundaries of the CRL site: Affected area of sediment is approximately 8 to 10 hectares adjacent to Process Outfall at water depths of approximately 8 to 30 m. Contamination consists of dispersed bulk sediment and discrete radioactive particles.	Sediment	^{137}Cs, ^{60}Co, actinides and mercury
MU 6	Located in the Outer Precinct. WMA A: No longer accepting wastes; direct burial of solid and liquid wastes into unlined sand trenches, discrete buried objects and some buried structures. Liquid Dispersal Area: No longer accepting wastes; Chemical Pits, Reactor Pits 1 and 2, Laundry Pit. Liquid wastes from operational activities in the Inner Controlled Area were pumped through the LDA Pipeline to the appropriate pit and dispersed directly into the ground. Some contaminated metal waste exists in Reactor Pit 1. Frog Pond, various wetlands (South Swamp, East Swamp) and streams, and Perch Lake, exist within the footprint of MU 6. A Pump & Treat facility currently removes ^{90}Sr from the groundwater affected by the Chemical Pit and a Permeable Reactive Barrier (PRB) funnel and gate system intercepts ^{90}Sr from groundwater downgradient of WMA A.	Groundwater, Surface Water, Sediment	Mixed fission and activation products, actinides; (including tritium, ^{90}Sr, and mercury and other metals in groundwater and sediments)
		Soil	Mixed fission and activation products, actinides and metals
MU 7	Inner Supervised Area, (southern part of Campus Precinct): Contains a wide variety of infrastructure, including non-radioactive S&T facilities and general support services as well as buried site services. Includes Electrical Yard Landfill, Foundation Road Landfill, Above-ground Reactor Ventilation Duct, Dawson City, Sanitary (Inactive) Landfill, LDA Pipeline, 1953 NRX Emergency Pipeline corridor	Soil	Isolated hot spots containing minor amounts of various non-radiological and radiological contaminants

MU	Key Features	Impacted Media	Identified Contaminants [1]
	and other APECs. These areas were used mainly as construction landfills, for waste burning, equipment lay-down/storage, winter snow dumping, and in one case, sand blasting decontamination.		
MU 8	Located in the Outer Precinct. WMA C: Consists of low-level wastes that were direct buried in unlined waste trenches. An engineered impermeable geomembrane cover prevents significant water infiltration through the waste below grade. A tritium groundwater plume is associated with WMA C. Construction / area modifications began in 2022 to prepare WMA C for operational use as a surface storage area for waste. WMA J (Bulk Materials Landfill): Operational; currently used for the long-term management of dewatered sewage sludge from the CRL Sanitary Sewage Treatment Plant.	Groundwater, Surface Water	Tritium, ^{90}Sr, ^{14}C
		Soil	^{14}C, and other mixed fission and activation products
MU 9	Located in the Outer Precinct. WMA E: Non-operational; Suspect-contaminated bulk soils and building materials. Waste Tank Farm (B538): No longer accepting wastes; seven underground stainless steel tanks store highly contaminated liquid waste solutions and sludge from operations in 1960s. Monitoring and surveillance of these tanks is performed and confirms there have been no leaks to the environment. Ongoing operations to remove the liquid wastes are underway.	Soil	Minor discrete areas of mixed fission and activation products
MU 10	WMA F, located in the Outer precinct: No longer accepting wastes; contaminated soils brought to CRL in the 1970s, including alkaline radium mill tailings from Port Hope, niobium refinery slag containing Naturally Occurring Radioactive Material (NORM) from the Ottawa area, and radium waste from Mono Mills, Ontario.	Soil (waste itself; silty soil with some mixed building debris)	Thorium, arsenic, radium, uranium and other metals

MU	Key Features	Impacted Media	Identified Contaminants [1]
MU 11	Located in the Outer Precinct. Nitrate Plant: Built to decompose ammonium nitrate solutions remaining from spent fuel reprocessing (operated from 1953-1954). Consisted of five structures and an infiltration pit situated adjacent to Lake 233. The buildings were buried in situ. A ^{90}Sr groundwater contamination plume is currently mitigated by the Wall and Curtain PRB system. Thorium Pit, Acids, Chemicals, Solvents Pits: used to dispose of active and/or chemical waste solutions in the ground in 1950s and 1960s. A ^{90}Sr groundwater plume extends from Thorium Pit to Duke Swamp. Duke Swamp wetland and streams exist within the footprint of MU 11.	Groundwater, Soil, Surface Water, Sediment	^{90}Sr, thorium, mixed fission products, transuranic elements
Table Notes: [1] The contaminants identified in this column represent only a list of the primary known contaminants and is not intended to be a complete list of compounds observed to date in each MU			

4.5 Principal Hazardous Conditions

Hazards expected to be present during cleanup will be addressed in documentation prepared prior to physical decommissioning or remediation activities taking place, with the documentation containing detail appropriate for the structure or area, as per the requirements of the Cleanup Function (i.e., the Land Use, Decommissioning and Demolition (D&D) and Environmental Remediation Programs).

This provides a graded approach to decommissioning, safety analysis, and environmental remediation based on the risk of the hazard and in compliance with the CRL Licence and regulatory requirements.

See Section 5.3.1 for details regarding the programs in place to support the safe and effective cleanup of the CRL site.

The following sections provide discussion of the hazards that may be present on the CRL site.

4.5.1 Radiological Hazards

Based on historical and current operational activities at CRL, the typical radioisotopes expected to be encountered during facility decommissioning and/or environmental remediation activities include (but may not be not limited to):

- Those generated during reactor operations, i.e.;
  - Fission products such as ^{137}Cs, ^{90}Sr, ^{99}Tc & ^{129}I;

  - Activation products bound in materials and typically released through corrosion and degradation such as ^{60}Co, ^{36}Cl, ^{93}Zr and radioactive isotopes of Iron, Nickel, Zinc, Chromium and Aluminium. This also includes isotopes of elements found in Steel and Zircalloy as well as other materials subject to neutron flux like ^{14}C in Graphite and notably Tritium in heavy water; and
  - Actinide contamination arising directly from fuel through historical in-core fuel failure and other incidents, typically ^{241}Am and Plutonium and Uranium isotopes
- Fuel fabrication activities, primarily the Uranium isotopes ^{234}U, ^{235}U and ^{238}U in varying proportion due to both natural and enriched Uranium
- Isotope processing and experiments which have a varied list of isotopes of concern - for instance ^{95}Zr, ^{95}Nb, ^{141}Ce, ^{99}Mo which are associated with decay periods of <100 days and therefore, not likely to be encountered during cleanup)-however, as many of these isotopes are obtained from low burn-up, high enriched fuels, the reference hazards will be those associated with actinide and fission product contamination. This is also true of facilities involved with Advanced CANDU® Fuel Development and Research Reactor Fuel where the isotopes will be similar but may exist in variable proportions and exist as different chemical compounds requiring hazard assessment
- A full range of decay products notably ^{90}Y, ^{137}Ba
- Radioisotopes associated with contaminated wastes from off-site, historic industrial operations stored in waste management areas, such as Radium and Thorium

These radioisotopes are present in some of the structures in the CA and can lead to radiation dose rates and residual contamination hazards. The hazards specific to each building, area or system are estimated using input from historical assessments and are quantified using characterization. Mitigating measures are then introduced to prevent exposure to the worker or the environment through the implementation of *Radiation Protection Program Requirements* [20]. The characterization data is also used to ensure correct containment and packaging of waste.

4.5.2 Nuclear Criticality Control

Inventories of fissile material will be removed from the facilities as part of establishment of the respective permanent Safe Shutdown State, early in the decommissioning process or prior to turnover. If fissile material is encountered during cleanup, a criticality safety assessment, and the planned actions involving fissile material shall be included.

The majority of the Waste Management Areas at CRL are subject to the *CNL Nuclear Criticality Safety Program requirements* [21], whether declared a Nuclear Criticality Controlled Area (NCCA), subject to Criticality Safety Documents, or a non-NCCA, requiring maintenance of a fissionable materials ledger and compliance with non-NCCA limits. Examples include the [redacted] – these facilities will remain operational until disposal pathways are available and will continue to be managed under CNL's *Nuclear Criticality Safety Program Requirements* [21].

4.5.3 Industrial Hazards

Decommissioning and environmental remediation will include elements that present potential industrial hazards, additional to those recognized during facility operation. In general, the severity of these hazards will be consistent with those presented by conventional demolition jobs for low-rise structures or large-scale excavation activities. These hazards will be mitigated through key support programs such as Occupational Safety and Health [22], [23] and Fire Protection [24], [25].

Although not a complete list, some of the potential industrial hazards consist of:

- Trips, slips and falls
- Strains, sprains, and pinch points
- Heavy equipment and vehicles
- Power tool injuries
- Cutting–dust, sharp object, fire
- Electrical
- Sloping, shoring/trenching
- Working at heights
- Falling objects
- Buried utility
- Radiation sources (e.g., industrial radiography)
- Asbestos containing materials, such as pipe insulation, building siding, floor tiles, transite, drywall, caulking, etc.
- Crystalline silica
- Wildlife
- Inclement weather, including heat exhaustion
- Confined space
- Hot work
- Mobile equipment/cranes/hoisting and rigging
- Traffic
- Chemicals and compressed gases
- Drilling/blasting
- Concrete works
- Noise
- Mobile elevated work platforms

4.5.4 Chemical Hazards

Operational inventories of chemicals, such as acids, alkalis and solvents will be removed as part of the establishment of the Safe Shutdown State for each building or structure in preparation for the turnover to the decommissioning group. Additionally, chemicals make up a part of the waste inventory of many impacted legacy areas and will need to be managed/accounted for as part of future characterization efforts or remedial actions. These hazards will be mitigated

through key support programs such as Occupational Safety and Health [22], [23] and Fire Protection [24], [25]. Examples of the remaining chemical hazards that may be encountered during decommissioning, although not a complete list, include:

- Residual inventories of industrial chemicals
- Perchlorates
- Mercury switches
- Bio-hazards
- Acids and caustics
- Lead-based paint
- Hydrocarbons, benzene, solvents
- Arsenic
- Cadmium
- Beryllium
- Iso-cyanates
- Nitrates
- Self-igniting chemicals (zirconium)
- Lead bricks and sheets
- Polychlorinated Biphenyls (PCBs) in transformers, fluorescent light fixture ballasts, and to a lesser extent in paint, caulking, mastic and roofing materials, etc. (the bulk of the PCB wastes have been removed and transferred to a national facility for destruction, leaving only isolated small amounts on-site)

All decommissioning work performed on contaminated structures will be conducted in a manner that will minimize the spread of the contamination. When the work is performed, appropriate contamination control techniques will be used in accordance with the OSH Program [22], [23].

4.6 Work Hazard Monitoring and Worker Protection Precautions

The Occupational Safety and Health program [22], [23] and the Integrated Work Control System [26] ensure that the radiological, industrial and chemical hazards are well controlled at all work sites.

Precautions for working in radiation fields, with contaminated equipment and materials and chemical hazards are well understood. CNL's Radiation Protection Program [20] governs the radiological aspect of this work. As part of the Radiation Protection Program, CNL monitors the quantity and concentration of any nuclear substance as a result of the licensed activity and keeps a record of doses of radiation and magnitude of exposure, the effective dose and the equivalent dose received by a person (see Section 8.3.1).

4.7 Design Features to Reduce Contamination and Facilitate Cleanup

Sequencing of work will be considered in order to minimize the movement of wastes and equipment from areas of high levels of contaminants to cleaner areas. Topography and the

presence of surface water, wetlands and significant habitats will also be taken into consideration to limit impacts to surrounding areas.

The confinement system for CRL structures, systems and components include suitably designed building envelopes, filtered ventilation systems and any other systems that are important for the confinement function. The primary barriers will prevent the migration of loose contamination sources within CRL to the environment. The engineered design features will control or limit the spread of airborne contamination within facilities. Contamination control design features also include drainage systems for CRL facilities.

Radioactive waste generated from dismantling and decommissioning activities will be treated where required to reduce worker exposure to meet the requirements of CNL's Transportation of Dangerous Goods [27], [28] and the regulatory requirements for waste transport and disposal. The necessary packages will be identified, designed, tested and procured prior to decommissioning.

LLW and ILW will be segregated, packaged and stored in CRL waste management areas. LLW that meets the proposed NSDF waste acceptance criteria will be disposed of in the proposed NSDF, once available.

Based upon the proposed cleanup strategy, additional facilities may be required to segregate, screen, process wastes and contaminated materials and contaminated soils. In addition, surface water controls and treatment may be required where excavations will extend below the water table. If large volumes of contaminated saturated soil are required for disposal, dewatering solutions may be required to satisfy moisture disposal requirements.

Emergency response equipment will also need to be located in close proximity depending upon the work taking place. Particularly when working in waste areas where liquid wastes or drummed materials could escape or be released from degraded or damaged containers, provisions will be made to temporarily store these materials in leak proof containers to prevent contaminating surrounding areas.

The groundwater and surface monitoring programs are also an essential tool in recognizing and reducing contamination throughout the site. It also helps identify and assess the potential remediation techniques required to clean up the CRL site as well as verifying their effectiveness.

5. Applicable Programs and Standards

5.1 Regulatory Framework

The *Nuclear Safety and Control Act* [29] and its regulations, are the primary legislation for the CRL site. Several regulations fall under the *Nuclear Safety and Control Act*. CNL is the licensee responsible for the *CRL Nuclear Research and Test Establishment Operating Licence* [4] and *Licence Condition Handbook* [5] which includes a list of the publications which form the basis of the CRL licence and includes several CSA standards.

The CNSC issues regulatory guidance documents that present general CNSC requirements and expectations, along with recommended approaches that can be followed to meet them. The regulatory documents applicable to the CRL site are listed in CRL's *Licence Conditions Handbook* [5] (i.e., for which CNSC has a regulatory role).

In addition to the Nuclear Safety and Control Act, the CRL site is also regulated by other legislation, including (but not limited to) the following:

- *Migratory Birds Convention Act*, 1994
- *Species at Risk Act,* 2002
- Polychlorinated Biphenyls Regulations, 2008
- *Fisheries Act,* 1985
- Canada Labour Code and Canada Occupational Health and Safety Regulations

Other Federal and Provincial Acts and associated regulations apply to CNL's operating mandate, and specifically to site cleanup, and are documented in CNL's *Environmental Protection Program Requirements Document* [30].

Although the CRL site falls under federal jurisdiction, CNL will, to the extent practical, and to the extent that requirements do not conflict with applicable federal legislation, strive to conform to environmental legislation and associated requirements of general application in force in the province and/or the municipality in which the site is located. For example, the screening criteria being used for non-radiological compounds, to determine the extent of contamination and the need for environmental remediation, are based in part, on the Ontario Ministry of the Environment Soil, Groundwater and Sediment Standards [31], where appropriate.

5.2 CNL/AECL Policies and Commitments

Canadian Nuclear Laboratories has developed a suite of company policies to define CNL's expectations for behaviours in all aspects of CNL activities from Health, Safety Security and the Environment to the protection of Intellectual and Real Property, the Supply Chain and People, Ethics and the Code of Conduct.

In addition to these policies, the *AECL Environmental, Social and Governance Strategy* [32] and *CNL Sustainability Plan* [33] are also applicable to cleanup planning. The *CRL Carbon Neutral Strategy* [34] will also play a role in cleanup processes and approaches.

5.3 Management System

Chalk River Laboratories maintains a management system comprised of an integrated set of documented policies, expectations, standards, procedures and responsibilities through which CNL is governed and managed, from the setting of direction through to day-to-day operations. CNL's integrated Management System demonstrates and documents the commitment to maintaining a high-level of quality and excellence in the management of all CNL activities within an environment that prioritizes safety and fosters continual improvement. This management system is expected to remain in place until site operations and active decommissioning are completed.

The Management System provides, enables, and defines a detailed framework for full nuclear facility life cycle phases, including construction, commissioning, operations, decommissioning and long-term safety of the nuclear facilities and laboratories at all CNL sites, including the proposed NSDF. The various mature programs and processes already in place will continue to evolve to ensure that all regulatory requirements are achieved.

The management system applies to all CNL management and execution activities. Management activities include setting expectations, enabling, planning and budgeting, and assessing all aspects of business, thereby ensuring delivery against commitments within appropriate accountabilities and controls. Execution activities include the safe, effective and efficient conduct of work across all CNL lines of business, performed by CNL employees as well as third parties engaged through external partnerships, collaboration and CNL's Supply Chain.

The *CNL Management System Manual* (MSM) [35], including subsidiary documents to which it refers, provides the formal reference documentation of CNL's management system. The MSM describes the governance arrangements which enable CNL to operate the assets of AECL and describes and identifies the relevant statutory, regulatory, contractual, and corporate frameworks within which CNL exists and operates. Each Functional Support Area and the associated top tier documents are listed in CRL's *Licence Condition Handbook* under their respective Safety and Control Area and form part of the Compliance Verification Criteria.

5.3.1 Support Programs

Chalk River Laboratories is expected to continue to operate as a Nuclear S&T/industrial site until an undetermined future closure date. During this time, CNL will continue to maintain supporting programs to provide the necessary processes, procedures and guidance in the delivery of safe and effective decommissioning and environmental remediation of the CRL site. These are the key supporting programs:

- Radiation Protection [20], [36]
- Environmental Protection [30], [37]
- Occupational Safety and Health [22], [23]
- Emergency Preparedness [38], [39]
- Fire Protection [24], [25]
- Security [40], [41]

- Quality Assurance [42], [43]
- Performance Assurance [44], [45]
- Nuclear Criticality Safety [21], [46]
- Nuclear Materials and Safeguards Management [47], [48]
- Site Planning
- Waste Management [49], [50]
- Transportation of Dangerous Goods [27], [28]
- Land Use Planning (Cleanup Function) [51]
- Decommissioning Process (Cleanup Function) [52]
- Environmental Remediation Process (Cleanup Function) [53]
- Engineering [54], [55]
- Safety Analysis [56], [57]

5.3.2 Compliance

The Compliance Program provides the regulatory and licensing framework and the process for independent technical reviews to provide a coordinated and consistent approach in how CNL manages relationships with its regulators. The Compliance Program supports the licencing of CNL nuclear facilities and activities to enable the fulfilment of CNL's mandate. This is accomplished through independent, but related processes to ensure the following:

- A coordinated and consistent approach to how CNL deals with the CNSC regarding company-wide regulatory and licensing matters
- A coordinated and consistent approach to how CNL deals with other regulators (e.g., the Technical Standards and Safety Authority, Environment and Climate Change Canada, and Employment and Social Development Canada) regarding company-wide regulatory and licensing matters
- Independent technical reviews of a proposed nuclear facility or licensed activities before submission to the regulator

The Safety Review Committee and the Nuclear Criticality Safety Panel support independent technical reviews of major safety documentation, related to CNL's licensed facilities and activities, before submission to the regulator. These reviews are based on the type of hazards present and conducted for new facilities, major modifications to operating facilities, decommissioning and environmental remediation activities.

Safety analysis documentation is controlled and periodically reviewed and revised throughout the life of a facility or site. Safety analysis is documented in a manner that is permanently retrievable, facilitates independent review by qualified experts, provides traceability, and is reproducible. Projects at CRL will be subject to this process.

As an example, the safety analysis demonstrates that the following requirements under normal operations, anticipated operational occurrences, design basis accidents, and design extension conditions in the proposed NSDF, have been met:

- The safety of the off-site public, and on-site personnel is protected,

- The dose acceptance criteria are met for radiological consequences to the on-site and off-site receptors,
- There are no significant adverse impacts on the environment,
- The design of the proposed NSDF conforms to regulatory requirements and guidance provided by the CNSC, and
- The IAEA waste containment is maintained for the duration of the facility operation under normal operating conditions

6. Consultation and Engagement with First Nations, Metis and the Public

Stakeholder, public and Indigenous engagement on the ODCP will be conducted on an ongoing basis and this section summarizes the engagement that has informed the plan up to the date of publication. This aligns with the requirements of Decommissioning of Facilities Containing Nuclear Substances, CSA N294-19 [2]. Included are specific recommendations for stakeholder engagement aspects:

- Public and Indigenous Communications and Engagement Section 5.3 of N294-19 [2]
- Stakeholder Engagement - Annex F1.2, F1.5, H.2 of N294-19 [2].

Canadian Nuclear Laboratories will meet these expectations by providing opportunities for the public and Indigenous communities to provide input into the ODCP. CNL employs a variety of methods and activities to achieve these objectives. Each method or activity is undertaken to build mutual awareness of plans, activities, interests and concerns; share information and support collaboration with various stakeholders. Public, stakeholder and Indigenous participation in the overall process is vital in developing confidence and trust in the cleanup process. Public input will be integrated into the early development of the ODCP and will continue throughout the entire site cleanup process and during any subsequent institutional control period. CNL recognizes the importance of meaningful engagement to build strong relationships with Indigenous Nations. CNL is seeking to understand and incorporate the perspectives and traditional knowledge of Indigenous Peoples in project planning, documentation and reports.

6.1 Public Information Program

Canadian Nuclear Laboratories Public Information Program is intended to cover public activities that occur at CNL. It has been prepared in accordance with the CNSC Regulatory Document REGDOC-3.2.1 *Public Information and Disclosure*, published in 2018 [58].

As a corporation, CNL makes it a priority to build public awareness, understanding, and a supportive appreciation of CNL's value and relevance to Canadians. In accordance with its *Public Information Program* [59] requirements as outlined in the *CRL Nuclear Research and Test Establishment Operating Licence* [4], CNL will employ a variety of methods to inform, educate, and discuss the project with stakeholders and to enable the public to provide valuable feedback. CNL will employ these methods to meet the engagement objectives outlined in Section 6.2.

6.2 Engagement Objectives

In order to ensure that engagement has informed the ODCP, CNL has developed overarching objectives:

1. Introduce the concepts of the whole-site cleanup plan and ongoing land use to the public, stakeholders and Indigenous communities/organizations
2. Develop meaningful opportunities for the public, stakeholders and Indigenous communities/organizations to provide input and influence CNL's cleanup approach for the CRL site and ongoing opportunities to engage on cleanup activities as they progress
3. Provide greater context to information provided to the public, stakeholders and Indigenous communities/organizations on other CNL projects, for example the proposed NSDF and other enabling facilities
4. Ensure the ODCP, as well as decommissioning and remediation projects, remain reflective of input from the public, stakeholders and Indigenous communities/organizations as it evolves by soliciting and providing their feedback to the CNL project teams
5. Collaborate, understand and incorporate the perspectives and traditional knowledge of Indigenous Peoples in project planning, documentation and reports
6. Meet regulatory requirements related to engagement and provide confidence to the CNSC that mechanisms are in place to ensure that CNL's plans for the CRL site continue to reflect public, stakeholder and Indigenous community feedback

6.3 Engagement with First Nations and Metis Communities

In developing the ODCP, CNL recognizes the importance of meaningful engagement to build strong relationships with Indigenous Nations, communities and organizations. In support, CNL has sought to build meaningful relationships with Indigenous communities and organizations while gaining an understanding of the cultural knowledge of Indigenous Peoples. CNL continues to seek meaningful relationships with Indigenous communities. We acknowledge that Indigenous Peoples have been stewarding and caring for this land since time immemorial, and we remain committed to advancing reconciliation through meaningful actions.

On an ongoing basis, CNL is committed to sharing information and engaging in dialogue and mutual learning opportunities to discuss potential effects of activities at CRL on Indigenous and/or treaty rights, including rights to hunt, trap, fish and conduct cultural ceremonies. CNL will also continue to invite, respond to, and incorporate Indigenous feedback throughout the different phases of the cleanup of the CRL site. It is CNL's ongoing commitment to develop deep, lasting relationships with Indigenous communities and organizations by providing meaningful avenues for participation. This includes CNL's commitment to developing contribution and long-term agreements that include appropriate support to Indigenous Nations, while seeking to understand and incorporate the perspectives and traditional knowledge of Indigenous Peoples in project planning, documentation and reports.

As part of CNL's mission to restore and protect Canada's environment by reducing and effectively managing nuclear liabilities, CNL has embarked on building meaningful, mutually

beneficial relationships with Indigenous communities and organizations in the interest of safeguarding the environment together. CNL does this through:

1. **Recognition of Rights.** CNL recognizes the constitutionally-protected rights of Indigenous peoples in Canada, and the importance of the relationship between Indigenous Peoples and their traditional lands and resources
2. **Capacity Development.** CNL recognizes that Indigenous Nations and communities have unique interests, priorities, needs and perspectives and will be engaged accordingly, with appropriate capacity supports
3. **Meaningful Engagement.** CNL commits to working with Indigenous communities and organizations in a mutually respectful manner that considers Indigenous perspectives, creating meaningful opportunities for dialogue, participation, and learning. CNL recognizes that the inclusion of Indigenous Knowledge into our projects and across all operations at CNL, helps to improve the way CNL does our work, and helps to build trust and understanding between CNL staff and Indigenous Peoples whose traditional territory is in proximity to a CNL-managed site. We also commit to ensuring that our projects are carried out in an environmentally responsible manner. CNL engages in forthright and sincere engagement with Indigenous communities and organizations about CNL projects through processes that are open, transparent, easily accessible, and that seek to achieve trust
4. **Economic Partnerships.** CNL seeks opportunities for mutual economic benefit with Indigenous communities. CNL is developing an *Indigenous Procurement Policy* which continues to evolve. The main objective is to attract more Indigenous businesses to act as contractors or sub-contractors on projects that CNL manages
5. **Journey towards Reconciliation.** CNL is also preparing a *Reconciliation Action Plan*, which is intended as a foundation that guides CNL's decision-making and helps to actively promote the national reconciliation movement through commitments and leadership. Reconciliation is about strengthening the relationships

Canadian Nuclear Laboratories is committed to reconciliation. CNL's commitment is demonstrated by incorporating the principles from the Calls to Action found in the Truth and Reconciliation Commission (TRC) report [60] into our draft *Reconciliation Action Plan*, and thereby, our daily work.

The draft Reconciliation Action Plan undertakes to use the TRC Call to Action #92 [60] to guide its development. Action #92 calls upon the corporate sector in Canada to adopt the principles of the United Nations Declaration on the Rights of Indigenous Peoples and to apply it to our corporate policy and core operational activities involving Indigenous Peoples, their lands, and resources.

Canadian Nuclear Laboratories draft *Reconciliation Action Plan* (in development) acknowledges the United Nations Declaration on the Rights of Indigenous Peoples and its clauses pertaining to Free, Prior and Informed Consent as a framework that recognizes the basic human rights and rights of self-determination of Indigenous people. As a company, CNL commits to meaningful engagement in the spirit of Free, Prior and Informed Consent, long-term sustainable benefits to

Indigenous businesses from economic development, and education and training for staff and management about the history of Indigenous peoples. Canadian Nuclear Laboratories draft *Reconciliation Action Plan* (in preparation) also includes:

- Developing measures to break down barriers to Indigenous access to jobs, training, and education opportunities in the corporate sector, as well as seeking ways to increase opportunities for Indigenous businesses to gain long-term sustainable, economic benefits from projects that CNL manages
- A commitment to ensure that CNL staff and management are provided training on the history of Indigenous peoples. By better understanding each other, we can continue to move toward reconciliation

These efforts are also guided by CNSC REGDOC-3.2.2 *Indigenous Engagement* [61].

6.4 Dissemination of Information to the Public

In accordance with CNL's *Public Information Program* [59], information is disseminated in a number of ways:

- Canadian Nuclear Laboratories corporate website: www.CNL.ca
- Posts with specific environmental information
- Reports on site environmental performance are posted quarterly
- Community Information Bulletins
- Press releases and media releases
- CONTACT newsletter
- Community meetings
- Community events
- Webinars
- Technical discussions
- Presentations and site tours
- Public engagement activities
- Social media (Facebook, Twitter, YouTube, LinkedIn and Instagram)

Canadian Nuclear Laboratories has established a specific webpage for the Cleanup Function: www.cnl.ca/LUP which includes information on the Land Use Program and a specific webpage for the Community Advisory Panel: www.cnl.ca/CAP. Information will be added to both webpages as it becomes available and webpage activity continues to be tracked.

6.5 Chalk River Laboratories' Community Advisory Panel

The objective of the Chalk River Laboratories' Community Advisory Panel (CAP) is to bring new voices from the Renfrew and Pontiac communities into the dialogue with CNL.

Through the CAP, CNL hopes to increase understanding, grow its appreciation of the communities' diverse perspectives, and enable members of the community to access first-hand knowledge about CNL activities.

Discussions between CNL and the CAP focus on the activities that are subject to licensing and environmental regulation as well as activities that may affect the social and economic life of the community. This will include an ongoing focus on the ODCP and environmental remediation projects.

Canadian Nuclear Laboratories has hosted CAP meetings on a quarterly basis since September 2021. The CAP meetings are facilitated by independent third-party facilitators.

6.6 Environmental Stewardship Council at CRL

To provide stakeholders opportunities for dialogue and feedback, CNL established the Environmental Stewardship Council (ESC) in 2006. The ESC is independently facilitated and comprised of members of public interest groups, Indigenous communities and organizations, and members designated by local councils and representatives from CNL.

The council openly discusses a broad range of matters of mutual interest to both CNL and the community, to seek input for solutions to remediate and/or continually improve CNL's environmental performance and provides ongoing and consistent two-way interactions with community stakeholders on CNL's business (not just environmental issues). The ESC meets three times a year.

6.7 Key Public Engagement on CRL Cleanup Planning to Date

Key Engagement that has been held up to December 2022 in the development of the ODCP is shown in Table 2.

Table 2: Summary of Engagement Activities to Date

Activity	Input/Feedback
Environmental Stewardship Council Meeting – 2021 June 24	The ESC was introduced to the CAP plans, including the CAP mandate and meeting schedule. Following the updates, members had the opportunity to seek clarification and ask any questions.
Community Advisory Panel Website Launch - 2021 July 07	CNL launched the CAP website and the application process for interested community members to apply for the CAP. The CAP webpage is updated following each CAP meeting with the meeting agenda and notes. The CRL CAP will meet on a quarterly basis.
Community Advisory Panel (#1) - 2021 September 9	Prior to the meeting, CAP members responded to a survey designed to determine their priorities regarding environmental issues. At the meeting, the CAP was introduced to CNL and the ODCP. During the session members had the opportunity to seek clarification and ask any questions.

Environmental Stewardship Council Meeting – 2021 October 21	The ESC was briefed on the first CAP meeting, including the agenda and key themes from the meeting. Following the updates, members had the opportunity to seek clarification and ask any questions.
CNL Cleanup Function: Land Use Program page Launch on CNL Website- November 2021	CNL launched the Cleanup Function: which manages the Land Use, Decommissioning and Environmental Remediation Programs.
Community Advisory Panel (#2) - 2021 December 2	The CAP was introduced to the basics of radioactivity and the proposed Near Surface Disposal Facility (NSDF) project. Following the presentations, members had the opportunity to seek clarification and ask any questions. The CAP provided input on the ODCP Vision and Mission statements as well as the *Why NSDF?* video.
Community Advisory Panel (#3) **2022 March 10**	The CAP was introduced to waste management practices at CRL and plans for enabling facilities. There was a presentation on environmental characterization and a discussion over potential remedial options that may be used to deal with the presence of contamination at CRL. This was followed by a discussion with the panel on opportunities, risks and challenges associated with these options. The CAP also provided feedback on NSDF hearing communication efforts to date.
Community Advisory Panel (#4) **2022 June 9**	The CAP began with a review of the remediation options from CAP 3. The CAP was introduced to potential next land uses at CRL. There were presentations on the key elements of cleanup planning, cleanup objectives and criteria, and next land uses at CRL by Management Units. The CAP worked through an exercise on the potential land uses at the site and discussed land use considerations.
Community Advisory Panel (#2-1) **2022 September 8**	This CAP meeting was in-person for those who could attend and the others were accommodated virtually. Those present on site were taken on an informative tour of the New Spring B Groundwater Treatment Facility. This was followed by a session with the full CAP where they provided review and feedback on draft Cleanup Function and ODCP communications materials.
Community Open Houses **2022 November 8 – 24**	CNL hosted in-person Public Information Sessions throughout the month of November in the communities surrounding CRL. CNL staff provided the public with information on the plans to restore and protect the environment at the CRL site, answered questions and noted feedback. Each session featured information on CNL's overarching waste strategy program, on plans for the cleanup of the Chalk River site, and on the

	proposed Near Surface Disposal Facility Project and Nuclear Power Demonstration Closure Project.
Community Advisory Panel (#2-2) **2022 December 8**	This CAP meeting was in-person for those who could attend and the others were accommodated virtually. CAP members were given a presentation on the Nuclear Power Demonstration Closure Project. The Actinium-225 Project was introduced and CAP members completed a workshop to assist CNL in developing an engagement plan. This was followed by a session on the ODCP Principles and Goals, to gather input. The feedback provided insight that will be used to further refine the principles in broader communications products. Some suggested modifications to the language of the current principles are reflected in Section 8.4. CAP members agreed that 'Ensure Safety' and 'Protection of Human Health and the Environment' were the two principles of highest importance but that all the principles identified should be considered in cleanup planning.

6.8 Planned Future Public Engagement

Canadian Nuclear Laboratories priority in all engagement activities is the safety of the public and its employees. Thus, CNL will continue to ensure all stakeholder engagement activities are in alignment with applicable public health guidance and corporate policy related to the COVID-19 pandemic. To this end, CNL continued with virtual engagement activities until it was safe to return to in-person engagement in summer/fall of 2022.

Canadian Nuclear Laboratories will continue to engage the public through a variety of mechanisms–demonstrating transparency and access to information. CNL will continue to promote all revitalization and cleanup plans, including decommissioning and remediation milestones and significant events such as the Environmental Assessment milestones.

Through public information sessions, site tours, meetings of the ESC and CAP, engagement with Indigenous communities and organizations, website updates, and social media, CNL will continue to share information about the ODCP and the cleanup mission.

7. Environmental Protection Program

The Environmental Protection (ENVP) Program requirements apply to all operations and activities that may affect the environment in and around CNL sites and utilizes a life-cycle approach. The ENVP Program at CRL covers the Environmental Management System for the operation of nuclear facilities, conducting research and development to support science and technology, waste management and decommissioning activities. The CRL site is registered to the ISO 14001:2015 standard for Environmental Management Systems [62].

The mandate of the program is to ensure staff and contractors practice responsible environmental management, to ensure environmental regulatory compliance of all activities on CNL sites and support the implementation of CNL's *Environment Policy* [63].

Focus areas of the ENVP program that support Decommissioning and Environmental Remediation activities include:

- Environmental reviews of non-routine activities to identify potential impacts, identify mitigation measures and ensure no significant adverse environmental effects occur (Section 7.1)
- Management of the natural environment and protection of species at risk (Section 7.2)
- Ensuring sustainability is considered in the operating of the CRL site (Section 7.3)
- Conduct of Environmental Risk Assessment of the CRL site on a five year cycle to evaluate potential impacts of ongoing operations on the environment (Section 7.4)
- Integrated Environmental Monitoring Program to monitor releases to the environment from CRL operations and contaminant concentrations in environmental media and groundwater (Section 7.5)
- Tracking and reporting environmental incidents (Section 7.6)

7.1 Environmental Reviews

Canadian Nuclear Laboratories conducts environmental reviews of non-routine activities in accordance with the requirements of the *Impact Assessment Act* (IAA) [64], CNL's *Environment Policy* [63] and CNL's Environmental Protection Program [30], [37]. These reviews serve to ensure that activities are considered in a careful and precautionary manner to avoid significant adverse environmental effects.

The category of environmental review will be determined through CNL's classification process in collaboration with AECL and will be commensurate with the level of risk presented by the proposed activities.

If decommissioning and environmental remediation activities on the CRL site are subject to the requirements under s.82 of the IAA, the project will be required to disclose the proposed activities on the IAA Registry, providing opportunity for involvement from interested members of the public and Indigenous groups. After the public comment period is over, AECL posts a determination on whether significant adverse environmental effects will be caused by the proposed project.

7.2 The Natural Environment

Details on the vegetation species (including rare plants), terrestrial wildlife, and fisheries and aquatic habitat at the CRL site are presented in the *CRL Site-wide Environmental Risk Assessment* (ERA) [11], which is updated every 5 years.

The ERA includes a sub-set of environmental values, known as Valued Components (VC), that have been identified as requiring special attention at CRL as CNL carries out its operations. VCs are defined as being "Environmental features that may be affected by a project and that have been identified to be of concern by the proponent, government agencies, Aboriginal peoples or the public. The value of a component not only relates to its role in the ecosystem, but also to the value people place on it. For example, it may have been identified as having scientific, social, cultural, economic, historical, archaeological or aesthetic importance." [65]. Importance may be determined on the basis of cultural values or scientific concern and VCs should be:

- Recognized under International or Federal legislation and afforded protection,
- Recognized as being rare, sensitive or unique,
- Representative of significant food-chain pathways for uptake by biota, and/or
- Recognized by the public as being important

The terms "VCs" and "receptors" are often used interchangeably. All VCs can be receptors, however, not all receptors are VCs. Receptors may be surrogate organisms rather than actual plant or animal species (e.g., a benthic feeding fish species), communities (e.g., a benthic macroinvertebrate community), a specific species (e.g., an endangered species), or a significant ecological feature such as a wetland. Using an ecological receptor to represent the VC allows the potential for adverse effects to be assessed through contaminant pathways. The VCs for the CRL site are listed in the CRL ERA [11].

7.2.1 Species at Risk

Canadian Nuclear Laboratories has developed and maintained a thorough database of plant and animal populations on the CRL site, with a particular focus on species at risk. In 2008, CNL initiated an inventory program for Species at Risk listed under the *Species at Risk Act* [66] and the *Ontario Endangered Species Act* [67] as well as candidate species listed by the *Committee on the Status of Endangered Wildlife in Canada* (COSEWIC) [68]. All of the suitable areas on the CRL site that may have been of importance for candidate species listed under the *Species at Risk Act* have been inventoried and documented.

The following lists several of the relevant studies and initiatives that have been undertaken at the CRL site in order to protect at risk species:

- Over the years, the presence of a number of vulnerable species have been confirmed on the CRL site, including endangered turtle, bat and bird species. CNL has undertaken a number of mitigative measures to help protect and accommodate these animals and their habitat. These include: The construction of larger concrete culverts to allow safe passage of turtles and other small animals beneath Plant Road, the installation of permanent exclusion fencing along the sides of the road to aid in funnelling the turtles through the culverts, and signage to alert drivers to be cautious of turtles crossing
- A research study in collaboration with the University of Ottawa began in May 2022 as follow-up to a study conducted in 2015 that identified the movement pattern of the CRL Blanding's turtle (*Emydoidea blandingii*). With the installation of the new eco-passages, CNL will assess whether the local population of Blanding's turtle is undertaking longer movement facilitated by the new crossing structures and also evaluate if the road mortality has decreased due to the system of fencing and availability of new nest mounds located in key locations
- Speed limits along Plant Road were reduced and the installation of traffic cameras to monitor and enforce compliance to aid in reducing the potential for road mortality of all wildlife species prone to road crossing
- A study with Trent University examined the roosting behaviours of Chimney Swifts (*Chaetura pelagica*) and determined that ventilation stacks have become essential roosting locations for this species. CNL is working to preserve these structures
- The installation of artificial nesting structures for Barn Swallows (*Hirundo rustica*)
- The installation of bat boxes for endangered bat species, including the Little Brown Myotis bat (*Myotis lucifugus*), the Northern Myotis bat (*Myotis septentrionalis*), the Tri-colored bat (*Perimyotis subflavus*) and the Eastern Small-footed Myotis (*Myotis leibii*) bat. CNL has also completed a research project with Trent University to find other maternity roosting sites for these bats to protect their habitat and developed a Habitat Suitability Index for the CRL site identifying high quality habitat for roosting
- Canadian Nuclear Laboratories is also planning to identify and protect Monarch Butterfly (*Danaus plexippus*) habitats, which are essential to the lifecycle of these endangered insects

The potential for impacts to species at risk are considered prior to all activities and projects at CRL via CNL's Environmental Review process. Preventative and mitigative measures are put in place in any case when species at risk or other wildlife may be affected (such as timing restrictions during bird nesting season, requirements for visual species surveys prior to ground works, etc.).

For detailed lists of species at risk that have been confirmed as present or are considered potentially present on the site from species surveys conducted since 2009 see the CRL ERA [11].

7.2.2 Sustainable Forest Management Plan

Canadian Nuclear Laboratories has a strong commitment to preserving the natural areas at CRL and is developing a Sustainable Forest Management Plan for the CRL site. The plan will ensure that the forest composition and age structure present on the CRL site is maintained and continues to provide habitat for a wide range of species and species at risk. The Sustainable Forest Management Plan proposes management of the forest at CRL using several management strategies such as selective cutting, shelter wood and clear-cut systems to mimic the natural disturbances of the Great Lakes St. Lawrence forests to emulate natural succession. CNL is developing the Sustainable Forest Management Plan with input from local Indigenous communities.

7.2.3 Vegetation Control

Vegetation control is an integral part of the institutional controls required for the management of wastes currently stored within WMAs as well as legacy contaminated lands. Inadequate vegetation control can result in contamination spread through leaf litter which will ultimately increase the volume of contaminated media that will require disposal when these areas are eventually remediated.

Canadian Nuclear Laboratories has committed to ongoing effective vegetation management via routine inspection, monitoring and surveillance of waste management facilities and legacy contaminated lands.

7.3 Sustainability Plans and Outcomes

As noted in Section 5.2, sustainability strategies and plans will play a core role in cleanup processes, approaches and plans. The *CNL Sustainability Plan* [33] (which aligns with the *AECL Environmental, Social and Governance Strategy* [32]) objectives and outcomes (in particular, those listed in Table 3) will inform the cleanup strategy.

Table 3: CNL Sustainability Focus Areas and Objectives Applicable to Cleanup Planning

Focus Area	Objective
Greenhouse Gas Emissions	Minimize greenhouse gas emissions at sites
Non-radiological waste management	Prevent and minimize the production of conventional waste, wherever possible, while reusing and recycling waste when it is generated
Radiological waste management	Support the Government of Canada's commitment to a clean and healthy environment for Canadians via the Environmental Remediation Management Mission
Biodiversity	Responsibly manage CNL sites and activities to ensure the protection of local wildlife and the environments that surround them
Climate Resilience	Consider climate resilience in decision making for all major infrastructure and operational decisions

7.4 CRL Site-Wide Environmental Risk Assessment (ERA)

A recent update to the CRL site-wide Environmental Risk Assessment (ERA) was completed in 2018 [11] in accordance with CSA standard, *Environmental risk assessments at Class I nuclear facilities and uranium mines and mills*, N288.6 [69]. The CRL ERA evaluates risks to relevant human and ecological receptors associated with potential exposure to contaminants and stressors as a results of the contamination present on-site, today. It also serves to identify where additional data is required to confirm or reduce uncertainties in the assessment. The ERA primarily assesses the existing data gathered for environmental compliance monitoring and special investigations which is focused on non-operational areas and on groundwater, surface water and atmospheric releases (e.g., soil contamination within WMAs and other areas of potential environmental concern is not evaluated).

The areas of greater concern at CRL for environmental protection are MU 3, 6, 8 and 11, due to the presence of contaminant plumes extending to nearby wetlands and MU 4 due to potential turtle mortality associated with vehicles. MU 1 and 7 exhibit intermediate risk levels while MU 2, 5, 9 and 10 exhibit lower risk levels [11].

7.5 Integrated Environmental Monitoring Program

Chalk River Laboratories *Integrated Environmental Monitoring Program* [70] is part of CNL's Environmental Management System. A summary of the Annual Compliance Monitoring Report on Environmental Monitoring is publicly available on www.cnl.ca. The results of the EMP are considered in developing characterization and environmental remediation plans for the various areas of concern on the CRL site.

The EMP is designed to track radiological and non-radiological contaminants throughout the different compartments of the geosphere, atmosphere, and biosphere and consists of three distinct programs: the Effluent Verification Monitoring Program (EVMP), the Environmental Monitoring Program (EMP) and the Groundwater Monitoring Program (GWMP).

The Effluent Verification Monitoring Program evaluates the quality of both air and liquid discharges to the environment from CRL operations. The Environmental Monitoring Program evaluates the receiving environment, with monitored media ranging from ambient air and surface water, to deposition, fish, and game animals, etc. The Groundwater Monitoring Program evaluates potential impacts on groundwater quality and guides environmental remediation activities. Where there is the potential for environmental impacts remedial measures are undertaken. To date, four groundwater treatment systems have been implemented on the CRL site.

The Groundwater monitoring program includes two types of monitoring activities, operational control monitoring and plume monitoring.

Operational control monitoring is conducted at 32 monitoring sites and includes over 190 monitoring wells. Monitoring sites include nuclear facilities in the developed area, the perimeter of waste management areas and the Ottawa River shoreline. Monitoring serves to identify potential impacts on groundwater quality at these sites. The monitoring is done on an

annual/semi-annual basis with up to 200 different parameters at a location. Over 1900 samples are collected and over 25,000 analyses are performed each year.

Plume monitoring serves to identify potential environmental impacts from past contaminant releases, to determine the extent of the contamination, contaminant inventories and to project future plume migration. Plumes are monitored on a five or ten year cycle.

The Integrated Environmental Monitoring Program is designed and managed according to the following standards; *Environmental monitoring programs at nuclear facilities and uranium mines and mills*, CSA N288.4 [71], *Effluent and emissions monitoring programs nuclear facilities*, CSA N288.5 [72] and *Groundwater protection programs at Class I nuclear facilities and uranium mines and mills*, CSA N288.7 [73]. Annual reports are prepared for each of these programs and monitoring plans have been prepared outlining the required monitoring for each element of the program:

- Effluent Verification Monitoring Program [74], [75]
- Environmental Monitoring Program [76]
- Groundwater Monitoring Program [77]

In effect, the Integrated Environmental Monitoring Program [70] achieves three main tasks:

a. Direct release monitoring (via the EVMP);
b. Contaminant pathways monitoring (via the combination of EVMP, GWMP, and EMP)
c. Biological effects monitoring (via the EMP).

The Integrated Environmental Monitoring Program is dynamic in nature meaning that it is continually evolving based on various sources of information received as well as requests for information required to plan for cleanup at a site. A depiction of this dynamic nature is illustrated in Figure 6 [70].

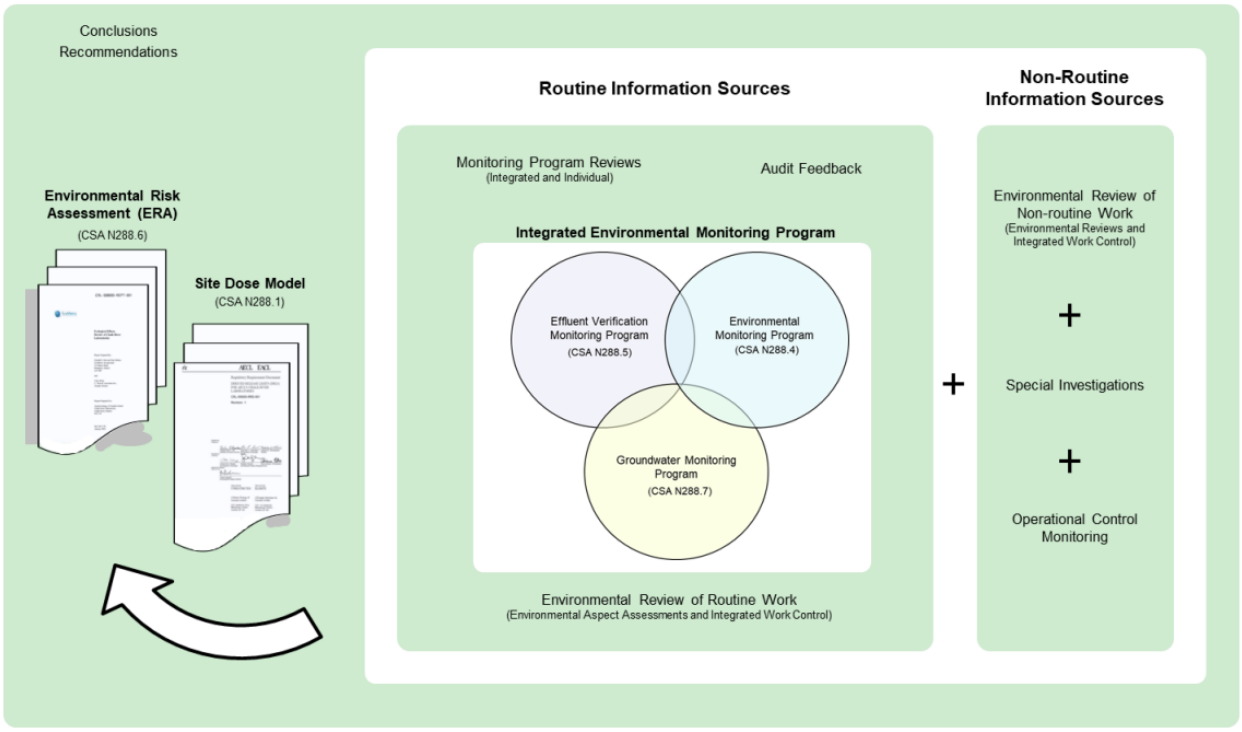

Figure 6: Dynamic Nature of CRL's Integrated Environmental Monitoring Program

Canadian Nuclear Laboratories is committed to maintaining the Integrated Environmental Monitoring Program into the future as part of the verification of progress toward accomplishing the cleanup mission.

7.5.1 Monitoring for Potential Off-site Impacts

Potential off-site impacts are monitored through CRL's Environmental Monitoring Program which includes off-site locations. Monitored media include ambient air, Ottawa River water for the reach of the Ottawa River extending from Rolphton upstream of CRL to Pembroke downstream of CRL, and various foodstuff (e.g., fish, garden produce, large game, and farm animals). Monitoring of beach sand, ground surfaces, local vegetation, small animals and meteorological conditions is also performed.

Historic operations, waste management activities, environmental incidents and process discharges have the potential to impact nearby communities or the surrounding environment. There are currently limited activities which could release significant non-radiological air pollutants, which would include for example greenhouse gases and criteria air contaminants from the Power House and other smaller sources. Discharges to the river from storm sewer outlets and from process water piping are monitored as part of the effluent monitoring program.

Environmental releases from operations and from a number of areas of concern have also occurred. For the most part these are associated with groundwater contaminant plumes and surface water transport. Groundwater plumes on the CRL site have been well delineated and

characterized through CNL's GWMP. To date, based upon the extensive off-site environmental monitoring program, the impacts from these contaminant releases both in groundwater and surface water have not been observed outside of the site boundaries.

More information on the sources of the contaminant plumes as well as the four groundwater treatment facilities in place serving to reduce the downgradient transport of contaminants, are provided in Appendix A.

7.6 Incident Tracking

Incidents or accidents that could affect cleanup, are tracked via CNL's *ImpAct Process* [79], as well as in lessons learned, annual reports, etc. These records are retained and referenced when the area, building or facility is transferred for management under the Decommissioning Process or the Environmental Remediation Process and are documented in project completion reports.

Any environmental incidents are reported according to the Environmental Protection Program requirements and investigated to determine corrective or preventive actions and ensure that environmental incidents are appropriately mitigated. Incident response and mitigation procedures and capabilities are maintained for all facilities, processes and activities with identified environmental aspects.

Response and mitigative actions to anticipated environmental incidents are addressed in the facility/operation/project/building specific emergency procedures. Equipment required for incident response and mitigation within facilities, for operations and for projects is identified and made available in clearly identified designated locations. Any environmental events/incidents that occur are documented and tracked within the CNL's *ImpAct Process* [79].

Canadian Nuclear Laboratories reporting procedure to Regulatory Agencies [80] describes the requirements, processes, and responsibilities for reporting by CNL to the CNSC as required by the *Nuclear Safety and Control Act* [29] and associated regulations as well as other regulatory agencies, as per the applicable legislation. CNL is required to report to CNSC staff on unplanned situations or events, along with providing annual safety and compliance monitoring reports.

8. Cleanup Vision, Mission, Goals, Objectives and Principles

The previous CRL end-state plan, as documented in the 2018 CPDP [1], was for any contaminated or otherwise unacceptable hazardous infrastructure, soil, sediments, surface water and groundwater to meet risk-based cleanup criteria based upon an assumed future industrial land use with some areas qualifying for unrestricted use. The ODCP proposes a revised approach to cleanup planning that uses a scenario approach to enable optimal cleanup of the site. Site revitalization projects will be optimized through the beneficial reuse or redevelopment of environmentally impacted areas of the site taking into account several factors such as redevelopment potential, compatibility with surrounding land uses, ecological value, community needs, nearby infrastructure and services, and environmental mitigation measures, where needed.

Consequently, CNL has adopted screening criteria for radiological and non-radiological compounds according to three potential future land uses at CRL. The land uses under

consideration for CRL include unrestricted use (based on a conservative agricultural land use scenario), parkland use (a casual access recreational scenario), and industrial land use - see Section 9.1.2 for detailed descriptions. An area of the site may be released from regulatory control, if appropriate, once a targeted end-state land use is achieved.

Ultimately next land uses and end-states for each of the MUs, or in some cases portions of a large MU, will be discussed with stakeholders and will be integrated from a site-wide perspective (considering the current and future use of surrounding land) and alignment with the ongoing site revitalization and nuclear S&T mission.

Considerations for the future determination of a site wide end-state for CRL will include:

- End-states of adjacent MUs
- Likelihood of currently unaffected lands to remain unaffected for the duration of the operational phase of the site
- Accessibility to various areas on site
- Location of site infrastructure
- Development potential to support the ongoing mission,
- Proximity to military facilities
- Potential industrial corridors
- Values of the surrounding communities/stakeholders
- Indigenous Peoples traditional land and resource uses (see Section 6)
- Critical habitat for species at risk
- Long-term future beneficial use of the CRL site

8.1 Cleanup Vision and Mission

Canadian Nuclear Laboratories has developed the following vision and mission statements for the cleanup of the CRL site. The vision describes the long-term objective while the mission describes what we are doing today in order to reach that objective.

The Cleanup Vision and Mission Statements were developed with input from the CRL Community Advisory Panel (CAP) to ensure they accurately reflect public concerns and values (see Section 6). Ongoing engagement, including that with Indigenous communities, may lead to further refinement of these statements.

CRL Cleanup Vision

Successful mitigation and remediation of impacts from historical operations at Chalk River Laboratories, while protecting health, safety and the environment during operations now and into the future.

CRL Cleanup Mission

As a world class nuclear research facility, Chalk River Laboratories is committed to the long-term management of waste, the decommissioning of aging facilities, and the environmental remediation of impacts associated with past operations.

All present and future activities will be designed to support day-to-day operational safety and long-term environmental protection of the site and surrounding communities. Science-based solutions along with community, stakeholder and Indigenous values will guide progress towards the desired end-state of the site and the advancement of nuclear science and technology for a clean and secure world.

8.2 Preliminary Site Cleanup Goals

The underpinning requisite for the cleanup of the CRL site is the continued protection of human health and the environment. Environmental protection, human health and safety are CNL's and AECL's highest priorities.

Targeted outcomes applicable to cleanup planning that have been committed to as part of CNL's sustainability focus areas are described in Section 7.3 and Table 3.

Additional SMART—specific, measurable, achievable, realistic, and time-bound – goals for the cleanup of the Chalk River site will be determined as planning progresses. CNL will include engagement with stakeholders and Indigenous communities in the development of the goals and maintain transparency by externally reporting on progress. These goals will be consistent with Canadian regulations and guidance and will be based on the following high-level objectives:

i. Implementing modern solutions to contain and isolate hazards from people and the environment.

ii. Meeting the conditions for interim or end-state land uses that are protective of human health and the environment.

iii. Minimizing the nuclear legacy liability, i.e., risks to human health and the environment, and cleanup costs to today's taxpayer and to future generations.

iv. Making brownfield land available for redevelopment to support the going S&T mission at CRL.

The goal of minimizing the nuclear legacy liability will be achieved by developing and implementing decommissioning and environmental remediation solutions that reduce Monitoring and Surveillance and other landlord costs.

Minimizing liability can be facilitated by early removal or control of sources of contamination, by implementing risk-based solutions or by consolidating contamination sources into a modern engineered and monitored disposal facility to reduce the contamination footprint on the CRL site. These cleanup actions may also address AECL's business needs by making land available for new facilities at CRL. Land remediation may also yield economic benefits when the cleanup results in an opportunity for another activity on-site (e.g., providing contaminated soil for void space management in the proposed NSDF).

Cleanup activities will not result in the elimination of all radiological or non-radiological contamination on the CRL site. Risk assessment will therefore underpin the determination of the short-term and long-term management strategies and any necessary controls to ensure protection of human health and environmental receptors. These controls will be developed from a holistic perspective, ensuring effectiveness over the long term as site cleanup activities progress.

Pollution prevention efforts and waste minimization programs and targets can also be effective tools in achieving site cleanup goals.

8.3 Recommended Dose/Concentration Cleanup Objectives

The following recommended radiological and non-radiological end-state cleanup objectives are protective of both human health and environmental receptors, (i.e., are aligned with the cleanup goals described in Section 8.2).

The radiological objectives for contaminant exposure are based on International best practice, as recommended in Canadian guidance, and are proposed as:

- 0.3 mSv/yr[4] incremental (above background) maximum effective dose for humans [2]
- 400 µGy/h maximum absorbed dose for aquatic biota (protection at the population/community level) [69]
- 100 µGy/h maximum absorbed dose for terrestrial biota (protection at the population/community level) [69]

Exceeding these objectives for biota in a preliminary quantitative assessment would indicate a potential for adverse effects and a need for further (detailed) assessment based on actual effects monitoring or more realistic exposure data monitoring [69].

Proposed objectives for non-radiological contaminants are either i) concentration limits at or below the most appropriate Federal and/or Provincial soil contaminant standards, after background conditions have been considered, or ii) below site-specific, risk-based criteria developed in accordance with Federal and/or Provincial guidance [31], [81].

The benchmarks to be used in risk assessment for non-radiological contaminants are:

[4] 0.3 mSv/yr takes into consideration potential effects from multiple activities (or 'practices', in accordance with N294-19 Section F.2.4 [2]) ongoing at CRL, of which cleanup is one activity, in order to keep the dose to the public constrained to below 1 mSv/yr.

- An Incremental Lifetime Cancer Risk of one in a million or a hazard quotient of less than 1 for humans [69],
- Lowest Observed Adverse Effect Level (LOAEL) for biota, i.e., protection at the population/community level (e.g., EC20 (20% effects concentration)) [69], and
- Species at risk are to be protected at the individual level (e.g., No Observed Adverse Effect Level (NOAEL)) [69]

8.3.1 Radiation Protection

The Radiation Protection Program (noted in Section 5.3, [20], [36]) applies to the operation and activities that affect the safety of staff and equipment in terms of exposure to ionizing radiation at all CNL sites and applies to all employees and other personnel (e.g., visitors and contract staff) conducting work at CNL sites. The Radiation Protection Program applies to all activities conducted where CNL holds a CNSC issued licence in Canada.

The objective of the Radiation Protection Program is to ensure demonstrable compliance with applicable regulatory requirements, such as the Radiation Protection Regulations and acts, and to maintain doses to workers as low as reasonably achievable (ALARA), taking into account social and economic factors. CNL applies the ALARA principle to all activities involving the use of ionizing radiation. All radiation doses to personnel or members of the public are justified, in accordance with the ALARA principle, and maintained below regulatory limits.

Dosimetry is a necessary component of the Program. It provides a quantitative measure of the effectiveness of the Radiation Protection Program, as it applies to both the individual worker and the collective workforce. Dosimetry is a fundamental requirement for the demonstration of compliance with regulatory obligations mandated by the site licence. Dosimetry services for personnel and visitors are provided by CNL and are managed according to the CNL Dosimetry Program. These services include monitoring, assessing, recording, and reporting doses of ionizing radiation received by all individuals while on-site.

8.4 Cleanup Planning Principles

The goals and plans for cleanup at the CRL site will be guided by the application of science-based principles underlying international best management practices on establishing end-states and executing successful decommissioning and environmental remediation. These principles will be further discussed during engagement with public stakeholders, interested members of the public, and Indigenous communities and are outlined in Table 4.

Table 4: Cleanup Planning Principles to be Applied at CRL

Principle Title	Principle Description	Applicable Section(s):
Ensure Safety	CNL will have the capability to secure and maintain the safety to workers and the public of its undertakings. CNL will demonstrate an effective understanding and control of the hazards posed by a site or facility through a comprehensive and systematic process of safety	Sections 4.5 and 4.6

Principle Title	Principle Description	Applicable Section(s):
	assessment. Safety assessments, that are kept up to date as work progresses, will be used to demonstrate the safety of the plans for managing and cleaning up contaminated structures and lands and associated controls.	
Protection of Human Health and the Environment	CNL is committed to managing radiological and non-radiological hazards at all sites to ensure the protection of human health and the environment, now and in the future. CNL adopts the precautionary principle whereby, in the absence of scientific certainty, we apply appropriate mitigating measures to prevent environmental degradation.	Section 7
Robust Characterization in Support of Science-Based Solutions	Contaminated lands and structures will be characterized to adequately understand hazards and provide information to support environmental remediation decisions. Robust characterization will facilitate effective planning to enable safe execution of remediation as well as ensuring the characterization will be done following defensible methods to ensure the integrity of the data.	Sections 9.1.1, 9.2, and 9.3
Effective Record Keeping	CNL is committed to effective record keeping and arrangements will be made, implemented, and managed for recording and preserving the information required for the safe and effective control and stewardship of contaminated land now and in the future.	Section 15
Transparent Reporting	CNL is committed to open and honest communications about our activities and performance. CNL routinely reports the results of monitoring and compliance programs through open and transparent communication with stakeholders and to assure the public that CNL makes every effort to keep the impact of our work to a minimum.	Sections 6, 7.6 and 8.2
Meaningful Consultation and Engagement with First Nations and the Public	CNL is committed to visibility and transparency in cleanup decision making and will engage with the public and Indigenous communities appropriately and early in the determination of next land uses, end-states and proposed remedial actions, including the use of institutional controls where residual contamination will remain.	Section 6
Risk to Workers, the Public and the Environment kept ALARA	A balanced approach is required to ensure that the intended benefits from CNL cleanup actions taken outweigh any potential for undesirable effects. Cleanup actions for radiological compounds at any CNL site are deemed reasonably achievable, when overall benefits of the actions outweigh potential adverse impacts to either economics, human health or environmental factors.	Sections 8.4 and 9

Principle Title	Principle Description	Applicable Section(s):
	Actions taken to reduce risks from one hazard should not result in higher cumulative risks.	
Consolidate Source/Impacted Areas into Modern, Controlled Engineered Facilities	CNL is committed to the minimization and mitigation of environmental impact. Identified contamination sources will be remediated in accordance with the ALARA principle, or identified in an environmental risk assessment, and wastes will be consolidated in designated disposal areas to shrink the contamination footprints within each as well as across all CNL sites.	Sections 1.1, 4.3, and 8.2
Minimize Institutional Controls	Where the risks and impacts to the environment, human health, and the economy are justifiable and feasible, CNL will strive to bring a site to a future condition at which it can meet unrestricted use. Where this condition is deemed achievable, the site should be brought to an interim end-state from which it can eventually be released from radioactive substances regulation, and in a manner which places a progressively reducing reliance on human action to protect people and the environment against radiological and non-radiological hazards.	Sections 9.4 and 12
Reduce Long-term Nuclear Liability	CNL has undertaken the task to responsibly address the legacy waste of the early decades of nuclear research and development in Canada. This work is being delivered with an unwavering commitment to responsible environmental stewardship.	All
Strategic Site Planning/ Integration	CNL teams work to address legacy liabilities and cleanup challenges by planning in collaboration and finding optimal cross-organizational solutions in line with the principles listed in this section. A strategy shall be produced for the control and cleanup of all contaminated land on the site. Next land use will be considered throughout project planning for fiscal responsibility and environmental stewardship.	Sections 4.3.5 and 9.1.2
Sustainability	CNL is committed to sustainable cleanup, which consists of remedial actions that deliver a net benefit and are informed by the short- and long-term impacts on safety and the environment, society and the economy, natural resources and climate change. The *AECL Environmental, Social and Governance Strategy* [32] is applicable to cleanup planning. *CNL's Sustainability Plan* [33] and the *CRL Carbon Neutral Strategy* [34] will also play a role in developing cleanup processes and approaches.	Section 5.2 and 7.3
Support Clean Energy Solutions by Optimizing Land Use	To help the Government of Canada achieve its national target	Sections 4.1, 4.3.5, 8, 9 and 11

Principle Title	Principle Description	Applicable Section(s):
	of net-zero emissions by 2050, CNL is advancing clean energy technologies for today and tomorrow, including small and advanced nuclear reactors, hydrogen and fusion technologies. CNL will endeavour to reuse previously affected areas of sites prior to considering the use of untouched areas for new development. Cleanup of the CRL site will help support these advancements by providing remediated land areas in the right areas of the site for new builds.	
Continual Improvement	CNL will remain focused on continual improvement through assessment of internal and external lessons learned in environmental stewardship, leadership, organisational capability, the management system, safety decision making, and safety performance.	Sections 5.3, 7.5 and 4.3.5
Pollution Prevention and Waste Minimization	CNL is committed to pollution prevention and waste minimization by minimizing the creation of pollutants and implementing the Waste Hierarchy as part of CNL Environment policy to prevent, reduce, decontaminate, segregate, and recycle, with focus on the management of radioactive, non-radioactive, and hazardous wastes.	Section 7.3 and 9.7
Risk-Based Cleanup Criteria	In line with the sustainability principle, screening and risk-based cleanup criteria should be used as preference. The use of risk-based screening criteria will result in CNL site cleanup being performed as efficiently and cost effectively as possible, with key aims of: • minimization of the amount of waste generated by the environmental remediation process; • minimization of disturbance to the environment; • reduction of risk to workers (ALARA) and the public; and • maximizing cost effectiveness.	Section 9.3.1
Flexible Adaptive Phased Approach	CNL will use an adaptive, phased approach to account for changing conditions, priorities, or objectives as cleanup progresses through the phases, and understanding is improved as additional information is obtained. For example, information obtained through additional characterization as a result of remedy implementation, or as verification monitoring results are obtained will be used in planning next remedial efforts. Industry best-practices will also be used.	Sections 8 and 9

9. The Cleanup Strategy

The CRL site is to remain operational for the foreseeable future and CNL's mission is to revitalize the site into a state-of-the-art research campus. To accomplish this goal in a safe, sustainable manner, targeted decommissioning and environmental remediation is required in brownfield areas to support redevelopment. Therefore the current cleanup strategy for the Chalk River site is to target select facilities for prompt decommissioning and specific areas of land for environmental remediation to enable effective site revitalization. This cleanup effort is currently focused in the Campus Precinct (MUs 1 and 7) to enable reuse of areas for new facilities in accordance with the Site Master Plan and revitalization priorities. Targeted focus is required in some areas, particularly the Controlled Area and Waste Management Areas, to provide footprint ready for re-use. Upon availability of an appropriate LLW waste disposal facility the strategy will shift to focus on large-scale cleanup to reduce the legacy liabilities associated with historic site operations. The selected decommissioning strategies for legacy facilities and the strategies related to large-scale environmental remediation will be determined at the DDP and Remedial Action Plan (RAP) stages [52], [51], [53]. The cleanup strategy requires further characterization and environmental risk assessment to support the selection of appropriate decommissioning and environmental remediation strategies.

Several strategic plans and priorities are required to support and implement the cleanup strategies. Key near-term priorities to ensure the safe and effective delivery of cleanup strategy include:

- Application of the Land Use Program, Decommissioning and Demolition Program and Environmental Remediation Program
- Planning and delivering enabling facilities and projects, in particular Waste Management solutions, e.g., the proposed NSDF. See Section 9.7.3.
- Development of saturated soil screening criteria to enable assessment of saturated soil (i.e., in the water table), sediments and contamination within wetlands
- Site wide coordination on contaminated soil excavation and soil management
- Sequencing of cleanup actions to align with proposed NSDF operational needs
- Environmental monitoring and planning to ensure remedial actions are not generating negative impacts
- Advancing characterization and risk assessment to evaluate APECs (where potential adverse effects are present) and remediating/mitigating known adverse effects
- Planning to prioritize the remediation of brownfield areas with the greatest redevelopment potential for new builds
- Radiological Protection to ensure safe, ALARA conditions are maintained throughout all decommissioning and cleanup operations
- Obtaining local soil background concentration data to ensure cleanup criteria are not at or below levels that exist naturally (or from unrelated anthropogenic activity) and to enable demonstration of successful cleanup
- Advancing the accuracy of estimates of the waste volumes that may be generated during cleanup

9.1 Cleanup Function

The Cleanup Function is made up of three programs: the Land Use Program, the Decommissioning and Demolition Program, and the Environmental Remediation Program. The Programs maintain their respective processes and guide these activities across the sites (Figure 7).

The three programs interact throughout the lifecycle of facilities at CNL sites. Records are generated and maintained throughout the lifecycle of a facility in support of the Cleanup Function (Section 15). The function recognizes that design, construction, commissioning, and operations all have requirements for data collection along the way to support the effective and successful cleanup of sites.

The Land Use Program, which defines the *Land Use Process* [51], ensures all CNL sites have a consistent approach to defining next land uses and interim or final end-states and that these are achieved using consistent methods. For planning purposes, the Land Use Process looks at sites as a whole and ensures the whole site is working towards a common goal.

The Decommissioning and Demolition Program guides sites in the *Decommissioning Process* [52] and maintains process documents. The Decommissioning and Demolition Program ensures that each site is decommissioning and demolishing facilities in a consistent and defendable manner that is aligned with site goals in order reach the target next land use and end-state safely and effectively.

A graded approach is used for the decommissioning activities based on the licence or legal requirements, complexity, level of risk and the residual hazards present, and applies to a variety of facilities, including buildings, systems, and engineered structures (infrastructure). The details of the decommissioning process, sub-processes and grading process are described in the *Decommissioning Process* [52].

The Environmental Remediation Program guides sites in the *Environmental Remediation Process* [53] and maintains process documents. The Environmental Remediation Program ensures that the removal, reduction or control of contaminants from environmental media is conducted in a consistent and defendable manner that is aligned with site-wide goals in order to reach the target next land use and end-state safely and effectively.

The *Environmental Remediation Process* [53] is applicable to all CNL sites. CNL sites refers to CNL managed lands associated with a facility or a standalone site that may have been impacted by previous nuclear activities and by its operations.

An important part of the *Environmental Remediation Process* [53] is environmental characterization (see Stage 1 – Environmental Site Assessment, in Figure 7). Environmental characterization is the systematic collection of environmental data in order to provide a sufficient description of the nature, extent, and variability of contamination of the site under investigation. This allows CNL to make informed decisions about what type of remedial actions should be considered to best reach next land uses and end-states.

Figure 7: Cleanup Function Overview

9.1.1 Facilities and Capabilities Required to Enable Cleanup

To enable prompt decommissioning and large scale remediation at the CRL site, construction of various support facilities and the establishment of certain enabling capabilities are required, such as the new Sort and Segregation Facilities, for example. Below is a conceptual list of facilities/capabilities that are being considered to support CRL site cleanup and revitalization:

- **Proposed NSDF and other Waste Management Facilities:** Past waste management practices, which met the standards of the day, are no longer acceptable. Specifically, the legacy waste management areas lack robust containment, which in some instances has led to contamination of the surrounding environment. The availability of an engineered, secure waste facility for LLW at CRL is one of the key enablers for prompt site decommissioning and environmental remediation. In addition, several supporting waste management facilities for LLW, ILW and HLW will be required as decommissioning and environmental remediation are progressing. See Section 9.7.3.
- **Support Space**: Various staff will be required to support cleanup work, including but not limited to managers, administrators, engineers, health physicists, planners, schedulers, technicians, technologists, trades, etc. Professional and technical staff will require office space for the duration of cleanup work; the use of temporary trailers will be minimized taking advantage of existing space instead and consolidating support space needs in centralized permanent buildings.
- **Temporary Laydown Areas:** Over the next decade, decommissioning teams will begin dismantling and demolishing large facilities (>900 square meters). Laydown areas will be planned within project sites or on already disturbed land.
- **Heavy Equipment Storage and Maintenance Facilities:** Heavy equipment such as excavators, remotely operated equipment (Brokks), telehandlers, etc. will require construction of weather-proof facilities for both storage and maintenance.
- **Analytical Labs:** It is expected that there will be high demand to analyze samples from the scoping and characterization of legacy facilities. To meet this demand, on-site lab capabilities may require expansion, either by refurbishing existing spaces, creating interim laboratory capabilities, or constructing new facilities.

9.1.2 Potential Next Land Uses at CRL

The proposed next land uses for areas undergoing cleanup at the CRL site will be a key topic of engagement with Public stakeholders and Indigenous Peoples representatives as cleanup planning advances (see Section 6). To date, the proposed target land uses listed in Table 5 and discussed in each MU section (Sections 10.1 through 10.11), have been discussed with the CRL Community Advisory Panel, AECL, and several internal stakeholders.

Next land uses currently proposed as targets for areas being cleaned up at CRL are aligned with site revitalization needs and the priorities in the Site Master Plan (see Section 4.3.5). The land uses being considered may also change over time as stakeholders and regulators are engaged during development of the long-term CRL site cleanup plans. CRL land to be used for ongoing or new missions will be required to meet applicable cleanup criteria for the duration of those

missions. At a later date, when the mission is complete, other stakeholder considerations may result in a different preferred final land use scenario. Thus, remediating to a particular future land use on an ongoing operational site may carry risks that will have to be managed, conceivably by making conservative assumptions regarding the choice of interim or final end-state land uses. Additionally, AECL may direct that certain land uses are not applicable to the site.

The 2018 CPDP assumed that all land use at CRL would retain an industrial land use with some areas qualifying for unrestricted use [1]. Large portions of the site are, however, covered by natural forests, wetlands and surface water bodies. The ODCP expands the future land use scenarios under consideration to include a parkland land use category in addition to industrial and unrestricted land uses. This scenario emphasizes the protection of wildlife and wildlife habitat during casual human use, primarily involving temporary activities that are recreational in nature (e.g., where people are moving about the property during the course of hiking, hunting, cycling, skiing, or other recreational activity).

The exposure assumptions associated with each of the proposed land use categories being considered for cleanup planning for areas of the site are provided in Table 5. The land use refers to the purpose the land will serve. As per Section 8.3, the dose objectives for the protection of human health and biota remain the same for each land use scenario, however, the receptor(s) and the mechanisms by which the receptor(s) are assumed to be exposed to contamination (i.e., the exposure pathways) differ between the scenarios. For example, the exposure scenarios reflect differences in food and water consumption, time spent on-site, on-site activities and other factors. The assumptions used to determine the exposure scenarios for each land use are consistent with guidance from Health Canada and the Canadian Council for Ministers of the Environment (CCME) and are further detailed in [82], [83], and [84].

This information is used to determine the cleanup criteria necessary to ensure that human health and ecosystem components are protected now and also into the future under the prospective land uses, following the presumed end of nuclear operations at the site.

Table 5: Exposure Assumptions and Receptors Used in Development of Land Use-Based Screening Criteria for the CRL Site

Land Use	Receptor(s)	General Assumptions
Industrial	Adult industrial workers only	• Industrial facility is located on the designated area, • Receptor's drinking water is from an off-site source (i.e., there is no on-site well), • Receptor does not ingest plant or meat from on-site sources, and • Maximum time spent at the designated area is 2,500 hours per year.
Unrestricted	Adult, infant, toddler, child, and teen[1]	Primarily based on a conservative agricultural scenario, as follows: • Farm and residence are located on the designated area, • Receptor is a self-sufficient resident farming family member that derives a significant fraction of food from the designated area, • Drinking water and irrigation water are derived on site from the assumed primary potable water source impacted by leaching from the designated area (with the well location oriented for the highest well water dose/exposure), and • No maximum exposure time limit (i.e., 100% of time spent at the designated area).
Parkland	Adult, infant, toddler, child, and teen[1]	• Casual human use, primarily involving temporary activities that are recreational in nature (e.g., where people are moving about the property during the course of hiking, hunting, cycling, skiing, or other recreational activity), • Receptor drinks on-site surface water in accordance with examples provided in Health Canada's guidance, as well as a realistic worst-case scenario, • Receptor ingests game, plants and fish from the designated area, and • Maximum time spent at the designated area is 200 hours per year.
All (industrial, unrestricted, parkland)	Representative aquatic and terrestrial biota (see [83] and [84] for details)	• Receptors assumed to spend 100% of time exposed to the designated area (i.e. an area use correction factor based on an animal's home range was not applied), • Conservative literature-based concentration ratios were relied upon, more realistic site-representative bioaccumulation

Land Use	Receptor(s)	General Assumptions
		factors or concentration ratios can be developed and used in place of conservative default parameter, • Aerial receptors such as birds and bats, are assumed to spend all their terrestrial time on soil, • Aquatic species have been conservatively assumed to spend all aquatic time in water (as opposed to on water), and • The radiological dose rate benchmarks for biota are intended to provide receptor protection at the population or community level for species other than those that are 'vulnerable, threatened, or endangered'. Consideration of Species at Risk at each particular APEC will require explicit assessment at the individual, not population, level.
Table Notes: [1] The receptor age groups used in the analyses are specified by Health Canada and are, in some instances, mapped to slightly different age groups to align the dose factors with the ICRP receptor age groups [82].		

The land areas will be cleaned up to meet to-be-established cleanup criteria for the designated land use category. Using current assumptions on future land use and interim end-states, it is reasonable to suggest that the campus precinct will remain an industrial land use where research activities will continue to take place. Most of the Outer Precinct area remains unaffected by CRL operations.

9.1.3 Interim End-States and Final End-State Agreement

Industry experience has shown that targets for decommissioning and environmental remediation are best communicated using an end-state and/or interim end-states for each area. Interim end-states will be technically defensible and based on systematic understanding of the contamination issue and impact of proposed solutions. Together they describe the journey from the state of the site today through to where it should be.

In some cases, the end-state will not be achieved for many decades. In these cases, interim end-states help to focus delivery on nearer term goals. They typically mark a stepped reduction in risk or hazard on the way to the site end-state [85]. A crucial aspect when planning an environmental remediation project, is to begin with the end-state in mind. The difference between the end-state and the existing conditions will guide what remedial actions should be taken. As such, it will be essential to determine the preferred end uses or interim land uses of all areas of CRL site early in the planning stages of cleanup.

Not all locations on the CRL site may have clear preferred end or future uses determined in the early stages of planning, however, in these cases an iterative process will be maintained to balance the value of the remediated site options against the emerging technical and financial challenges of achieving them.

For many areas at CRL the end-state is not yet known and the end-state may not need to be achieved for many decades. This does not preclude the cleanup of the CRL, as cleanup targets will be based on next land uses for the continued operation at the site. Land use decisions will inform the end-state for each discrete DDP / RAP developed for cleanup at CRL. As an initial approach, areas in the Outer Precinct surrounded by undisturbed natural forests or wetlands may be preliminarily assessed against parkland land use criteria until a final determination is made as the constraints would be consistent with the surrounding land uses.

Since the clean energy and S&T missions at CRL have been extended indefinitely, it is difficult to determine when an overall end-state will be achieved. As discussed in the previous section, interim end-states for the Campus area will be associated with the operations of a nuclear research facility. The interim end-state for the Outer Precinct will, except in some specific areas such as the centralized Waste Management area or the proposed NSDF, be associated with a return to a more natural setting. These interim end-states may remain in place for decades or longer, in support of the ongoing CRL missions.

9.2 Decommissioning Strategy

Predominantly a prompt decommissioning strategy has been selected for legacy facilities and buildings to enable the revitalization of the Chalk River site. Accelerating CRL's decommissioning to the extent possible will limit Storage with Surveillance costs for the site and provide other benefits. Deferred decommissioning may be considered for certain facilities to allow for decay of relatively short lived nuclides (e.g., half-lives of less than 10 years) or to await the availability of waste disposal facilities. Table 7 in Section 10 provides a summary of the status of the Class 1 and 2 facilities at CRL and the MU sub-sections note priorities related to existing buildings and structures that will be decommissioned in the next 5 years, most of which are in MUs 1 and 7.

The chosen decommissioning strategies are further described in 9.2.2 - 0 for each facility or structure and will be documented in the individual Detailed Decommissioning Plan (DDP) or Building Removal Plan (BRP), as required, prior to dismantling and demolition.

In line with the regulations, CNL applies a graded approach to determine how and to what degree decommissioning strategies and plans will be documented. CNL's graded approach to decommissioning planning can be found within CNL's Standard - *Decommissioning Process* [52], which is based on the requirements in CSA N294-19 [2] and REGDOC-2.11.2 [3].

The facilities within the Management Units are evaluated on a case-by-case basis to ensure consideration is given to each facility's unique characteristics, such as operational history, facility type, scale, complexity, maturity, physical state, radionuclide inventory, uncertainty and reliability of information and risks associated with decommissioning of the facility, location or site.

The current status and any known plans for decommissioning of all buildings, structures and WMAs at CRL is provided for each MU in Appendix A. There is also an ongoing commitment to provide an annual update on the status (also by MU, starting in 2022) to the CNSC.

In addition to buildings, various tanks are located on the CRL site. The wastes stored in these tanks vary in chemical and radiological composition and require retrieval and processing such that the generated product is suitable for interim storage, reuse and/or disposal. The most likely decommissioning strategy for the emptied underground storage tanks involves excavation and packaging followed by emplacement in an appropriate disposal facility. All opportunities for decontamination, re-use, or recycling will be considered once fully characterized.

As per the *Environmental Remediation Process* requirements [53], systematic soil characterization is required to determine if there is residual contamination in the ground associated with buildings or tanks.

9.2.1 Shutdown Process

The Shutdown process for transferring an operating facility to decommissioning is described in CNL's Standard - *Decommissioning Process* [52]. This process is applied on a facility-by-facility basis and in general the process consists of the following steps:

1. Declare the intent to shut down and decommission the facility based on senior management decision and decommissioning planning
2. Perform Permanent Shutdown and Stabilization Activity Planning
3. Confirm and communicate the decommissioning strategy and interim or final end-state based on the Preliminary Plan and any new information
4. Accept care and maintenance or institutional control requirements which will be used after the facility is shut down
5. Execute the Shutdown Plan to remove materials and hazards following work planning, and control procedures
6. Verify Safe Shutdown State achieved

9.2.2 Requirements for Prompt Decommissioning

Once a DDP or BRP is developed for a facility and approved, decommissioning teams will begin characterizing and scoping the facility to develop an inventory of radiological and hazardous materials and address any identified gaps in facility data, although in some cases characterization takes place ahead of the development of the DDP or BRP. Invasive characterization and sampling plans are written and approved following the *Integrated Work Control Process* [26]. The results of characterization work will drive granular work packages and identify materials (radiological, asbestos, PCBs, etc.) requiring removal prior to demolition.

Prior to the execution of all work, work plans are written in accordance with the *Integrated Work Control Process* [26]. This process includes a review by a team of subject matter experts from the applicable groups and support programs, including but not limited to engineering, health physics, radiation protection, occupational health and safety, waste, industrial hygiene, fire, security, etc.

Prior to building demolition, both radiological and non-radiological hazards are identified and removed from facilities in a controlled manner. Hazardous materials, or waste are removed to a level that allows for traditional demolition methods. These methods typically involve

demolition with heavy equipment, or a controlled dismantlement depending on facility location and remaining hazards. Generally speaking, as waste is removed it will be sorted, segregated, size reduced, and packaged within the grounds of the facility. Waste is packaged to a level that meets the Waste Acceptance Criteria of current or future waste disposal facilities or storage or transportation requirements. In situations where challenges exist to remove such hazards to acceptable levels, hazards may be left in place for demolition with the use of engineered controls.

Each facility specific demolition strategy is described in the facility's PDP and, where applicable the BRP. The PDP is periodically reviewed and updated until a DDP is prepared. Both the BRP and DDP are respectively reviewed, and in the case of a DDP formally accepted, by the CNSC prior to execution.

After demolition, the entire facility footprint will be removed, which generally includes clean foundations and underground services within a one meter perimeter of the footprint. If foundations are found to be contaminated, a prompt decommissioning strategy may be replaced with a deferred decommissioning strategy (described in more detail under Section 9.2.3), and contaminated foundations could enter a period of Storage with Surveillance until waste disposal facilities are constructed.

9.2.3 Deferred Decommissioning and Storage with Surveillance

Deferred decommissioning with a period of Storage with Surveillance may be preferred over prompt decommissioning for certain facilities (e.g., the NRU and NRX reactors) to allow for decay of relatively short-lived nuclides (i.e., half-lives of less than 10 years) such as activation products produced in reactor components exposed to high neutron flux. By deferring decommissioning for multiple years the activity of these components can be greatly reduced, therefore decreasing the potential dose to personnel during decommissioning activities. In these facilities it is possible that prompt decommissioning is performed on auxiliary structures and systems during the deferment of the higher activity components. In these cases, multiple DDPs may be produced for the facility to separate the strategies for different areas.

Deferred decommissioning may be required over prompt decommissioning due to the availability of waste disposal facilities (e.g., the proposed NSDF). At CRL, several facilities have been demolished, but for those in the Controlled Area, the foundation and underground services remain in place. These facilities enter a period of Storage with Surveillance until a final waste disposal facility is available for the low-level contaminated concrete and soil which may be produced during final foundation removal and area remediation. For these facilities an Interim Storage with Surveillance plans will be prepared to document the interim end-state and the required monitoring activities during Storage with Surveillance.

9.2.4 In situ Decommissioning

Currently, in situ decommissioning has not been identified as a preferred strategy for any facilities at CRL. If in situ decommissioning is identified as a proposed strategy to be pursued for

one or more facilities at CRL, appropriate stakeholders will be engaged and CNL will meet the requirements outlined in REGDOC-2.11.2 [3] and N294-19 [2], as required.

It is noted that two other CNL-managed sites, Nuclear Power Demonstration (NPD) near Rolphton, ON and the WR-1 reactor in Whiteshell, MB, are pursuing an in situ decommissioning strategy. Therefore, if any of the facilities at CRL pursue such a strategy at a later date, decommissioning teams at CRL can learn from the organizational and process knowledge obtained from these sites. It is important to note that while in situ decommissioning is not currently being considered at CRL, it may be considered for a few waste management areas and several former landfills depending upon the findings of ongoing environmental characterizations and safety assessments.

9.3 Environmental Remediation Strategy

Risk and liabilities associated with the CRL site will be progressively reduced through management, mitigation and environmental remediation of the contaminated sites at Chalk River. Targeted remedial actions have taken place, however, a significant amount of buried waste, soil contamination, and groundwater contamination remains on the site and requires remediation.

Cleanup planning at CRL, with respect to the development of site end-state objectives (Section 8.3) and cleanup criteria, has followed the overarching process outlined in CSA N294-19 [2], as set out within the *Land Use Process* [51]. The *Environmental Remediation Process* is to be followed in any instance where environmental site investigation/assessment or environmental remediation is required [53], including where areas of site are required for reuse for operations.

Additional information that is integral to further progress environmental remediation includes a description of the detailed assumptions applicable to remediation planning (see Section 9.4), as well as the approach used to develop screening/ cleanup criteria (see Section 9.3.1).

Over the next several years, until the proposed NSDF is operational, work will focus on:

- Site Characterization, including:
  - Filling identified gaps in characterization information based on the preliminary assessment of the APECs (see Appendix A)
  - Evaluating new characterization information against site-specific soil screening criteria
- Advancing the cleanup plans for each MU on a priority basis, i.e.
  - Site Assessment (including human health and ecological risk assessments)
  - Remedial Options Evaluation
  - Remedial Planning

9.3.1 Risk-based Soil Screening and Cleanup Criteria

For the purposes of cleaning up the CRL site, risk-based, site-specific radiological and non-radiological cleanup criteria will underpin the cleanup decisions. This method is preferred to the

use of non-risk based or generic criteria, which may result in required remedial work even though the risk already meets acceptable federal/international standards or background concentrations. This approach has been used at similar facilities, for example at the Hanford site in Washington State, a US nuclear site undergoing decommissioning and environmental remediation, as well as at the Deloro site, a former mining and industrial area in the Municipality of Marmora and Lake, east of Peterborough, Ontario.

The use of risk-based criteria will enable optimal cleanup of the CRL site and the specific benefits include:

- Minimization of the amount of waste generated by the remediation process
- Minimization of disturbance to the environment
- Reduction of dose and risk to workers
- Maximization of cost effectiveness

Screening criteria for soils for the land use scenarios under consideration for the CRL site, described in Table 5, have been derived for radiological contaminants of potential concern by using conservative, risk-based assumptions developed to be protective of both human and ecological health. For non-radiological contaminants, risk-based screening criteria developed by federal and provincial agencies for comparable land use scenarios, will be selected.

The screening criteria will be used as an assessment and planning tool to perform a high-level evaluation of the need for remedial actions in an area and to develop priorities for cleanup planning. The application of screening criteria is an intermediate step in the development of final risk-based cleanup criteria; although it may be appropriate to adopt the screening criteria as the cleanup criteria for a targeted area.

These screening and cleanup criteria will be applied to affected soil, sediments, surface water and groundwater that remains at a location at the CRL site after the removal or management of discrete waste material.

A protocol detailing the applicability and requirements for use, including summary tables, of the unsaturated soil screening criteria has been developed [86]. Work is underway to derive similar criteria for saturated soils and sediments. The protocol details i) how the screening criteria are to be used to evaluate the available characterization data for adequacy (to determine characterization gaps for each MU), and ii) screen characterization data to determine whether concentrations within a specific area meet the appropriate land use criteria. If not, they serve to determine the level of effort required, through a site-specific risk assessment or through remedial actions.

In addition to the above described Integrated Environmental Monitoring Program (Section 7.5), CNL is committed to conduct detailed post-operation surveys in support of DDP development for licensed facilities and RAPs for other non-licensed facilities; and to develop plans and protocols necessary to meet regulatory requirements for the detailed planning stage for monitoring.

Although operations at CRL are scheduled to continue indefinitely, modeling in support of environmental remediation planning has assumed that nuclear operations will cease in the year

2100, and the final end-state will be achieved by the year 2400, after approximately 300 years of institutional control.

As noted in Section 9, CNL is currently obtaining local soil background concentration data to ensure screening and cleanup criteria are not below naturally occurring levels at CRL to enable effective and successful cleanup. As new science becomes available, screening and cleanup criteria will be reviewed and adjusted accordingly, as required, to ensure the protection levels afforded through remediation are current.

9.3.2 In Situ Decommissioning

There are currently no licensed radiological waste disposal sites at CRL. Clean wastes and radioactive wastes are stored in waste management areas and conventional landfills located in several Management Units at CRL. Most of these facilities were used or constructed before present safety standards were implemented and may not meet all safety requirements listed in the IAEA's *Specific Safety Requirements (SSR)-5 Disposal of Radioactive Wastes* [87] and the CNSC's REGDOC-2.11.1 *Safety Case for the Disposal of Radioactive Waste* [88].

According to CSA N294-19 (clause 6.1.2.2) [2], in situ decommissioning may be considered a viable solution under exceptional circumstances, such as for legacy sites for which decommissioning was not planned as part of the design and which will remain under institutional control for the foreseeable future. In situ decommissioning should not be considered a reasonable option for situations where removal is possible and practicable. On the other hand, this does not preclude the use of risk-based screening levels to guide remediation efforts.

Where waste management facilities at CRL were not constructed to present safety standards and may not meet current safety criteria, reasonably practicable measures have to be taken to upgrade the safety of the facility to mitigate potential risks. Possible options may include the removal of some or all of the wastes from the facility, making engineering improvements and/or putting in place institutional controls. The evaluation of these options has to include technical and social issues.

Three principles have been adopted by the International Commission on Radiological Protection (ICRP) [89] to guide decisions regarding radioactive waste disposal, including whether to dispose of wastes in situ. These principles are:

- *Intervention* (having to supplement existing safety features at closed disposal facilities),
- *Justification* (the intervention is required to have a net positive cost-benefit), and
- *Optimization* (maximize the margin of safety over potential harm, for example through the use of multi-layer protection) [87].

In support of a licence application for any in situ radioactive waste disposal facility at CRL, it will be necessary to submit a safety case to the CNSC for acceptance which will demonstrate that all safety requirements will be met, assess the safety using a graded approach, and describe all safety aspects of the site such as design, construction and operation [88].

For waste management facilities considered for in situ decommissioning the safety strategy will identify and describe several key elements such as containment and isolation of the waste, multiple safety functions, defence in depth, passive safety features, robustness, demonstrability, feasibility and other elements that contribute to safety.

The environmental viability of in situ decommissioning is largely dependent upon site-specific characteristics feasibility of waste retrieval, dose to workers, and waste transport requirements, and natural site conditions such as hydrogeological conditions.

9.3.3 Monitored Natural Attenuation

Monitored Natural Attenuation relies upon natural attenuation processes to achieve site-specific environmental remediation objectives within a time frame that is reasonable compared to that offered by other more active methods [90]. The natural processes that can attenuate the concentrations of dissolved non-radiological contaminants in groundwater include biological degradation, sorption and dispersion. The main attenuation mechanism for radiological compounds is radiological decay which differs from one radioisotope to another and is represented by the radionuclide's half-life. As the concentration declines over time, it may reach a point when the contaminant level is no longer considered hazardous.

Monitoring, for groundwater and on occasion also for soils/sediments, is required to determine the effectiveness of the technique and determine when monitoring is no longer necessary once levels decrease below the site-specific risk-based screening criteria.

Monitored natural attenuation is generally used where contaminant concentrations are relatively low and where no sensitive receptors would be adversely impacted in or downgradient of the impacted area. Regulatory agencies generally consider three conditions in determining the applicability of Monitored Natural Attenuation:

- Groundwater and soil chemistry data demonstrate a clear and meaningful decreasing trend in concentration over an appropriate time frame
- Hydrogeologic and geochemical data demonstrate that attenuation processes are active at the site at a rate that indicates that contaminant levels will decrease to required levels
- For biological processes, field data demonstrates that conditions are favorable to the development of the active microorganisms involved in biological degradation

9.3.4 Alternative Cleanup Approaches

For complex cleanup projects, it is often advantageous to develop strategies for multiple alternate remediation options to be considered to achieve the desired end land use cleanup criteria. These alternative approaches are then evaluated and refined based on an initial technical feasibility screening. Each alternate strategy is assessed considering its potential value in advancing the site towards achieving its final objectives as well as how it manages residual contamination during that time. Viable strategy alternatives will likely need to be managed and adapted over time as conditions change and as new characterization data becomes available.

Key performance parameters for each of the interim remedial actions within the overarching strategy will be required to ensure the interim actions are performing as predicted.

Optimization of the various strategic alternatives can be evaluated using guidance from the US EPA [90], [91], the UK Nuclear Decommissioning Authority Value Framework [92], and CNL's *Remedial Options Evaluation Guideline* [93] includes criteria that may be used for high-level screening of all alternate strategies and evaluating options that are deemed viable.

9.4 End-State Requirements

When a decommissioning or environmental remediation project has been completed the following activities will be completed as described in CNL's Standard *Closeout Process* [94]:

- Assemble decommissioning records including:
  - Confirmation that all Engineering Change Controls (ECC) have been closed out;
  - Lessons Learned and OPEX;
  - Confirmation that all Work Plans have been closed out;
  - All applicable documents listed in the *D&ER Closeout Checklist* [95]
- Ensure that all verification of end-state steps have been performed:
  - Confirm that final status surveys and verification sampling has been completed and applicable records of end-state verification have been prepared (e.g., verification reports, survey logs, etc.).
  - Ensure Facility status has been updated in the Facility Information System and EDMS.
- Determine End-State (Interim or Final):
  - Determine whether planned end-state objectives have been met by reviewing verification records and comparing them to the planned end-state as stated in the DDP/BRP/RAP.
  - Provide justification if planned end-state has not been achieved.
  - Determine whether a transfer of incomplete scope (to another planning envelope) is required to close out project DDP/BRP/RAP (in such a case the end-state will be interim by default).
- Identification of Land Use Designation, Land Use Restriction and Institutional Controls:
  - Comparison of target land use designation (as determined in this document) with planned land use designation (as outlined in DDP/BRP/RAP) with the land use designation achieved at the end of decommissioning.
  - If the achieved land use designation is not in alignment with the planned land use as stated in the DDP/RAP, then justification must be provided.
  - Any land use restrictions are determined and must be reported in the end-state documentation;
  - Planned institutional controls as determined during decommissioning or environmental remediation planning are reviewed to ensure applicability and updated if required.

Note: There may be requirements for some records to be placed on public record (e.g., land registry records) and for CNL Legal representatives to be involved

- Preparation of (Interim or Final) End-State Documentation:
  - End-state documentation is prepared ensuring the information gathered in the preceding steps are included.
- Acceptance of (Interim or Final) End-State:
  - The end-state documentation is submitted to the Authority Having Jurisdiction (AHJ) for acceptance of the achieved (interim or final) end-state;
  - By accepting the end-state documentation, the AHJ accepts any transfer of incomplete scope and justifications provided for failing to meet planned end-state objectives.
- Licensing Changes:
  - Once the end-state has been accepted, any required licensing changes are requested (if applicable).
- Turnover from Decommissioning / Environmental Remediation
  - A final site inspection is performed and the site condition is confirmed;
  - The Transfer Certificate is finalized and turnover is complete.

  Note: The turnover can be for re-use on Licensed Site or for Institutional Control (long-term monitoring).

A graded approach is applied to the decommissioning and environmental remediation process at CRL and a risk grade (Grade 1 or Grade 2) is determined using the Risk Grading Table in Appendix A of the *Decommissioning Process* [52]. For Grade 1 facilities, which are typically Class I facilities, upon confirmation that an interim or final end-state has been achieved an End-State Report (interim or final) [96] will be written and submitted to the CNSC for acceptance.

A *Decommissioning Project Completion Report* form [97] is completed for Grade 2, non-Class I facilities, and includes most of the information found in an End-State Report but with sections omitted commensurate with the building hazard level.

9.5 Cleanup Planning Assumptions

Assumptions and Risks that will guide the development and implementation of the cleanup plan for the CRL site were first identified as part of the development of the *Framework for CRL Site Cleanup* [98]. These were later reviewed and updated with input from CNL and AECL stakeholders in 2019 July and also in 2021 September at a dedicated workshop involving several Functions and Groups at CNL. In addition, associated risks and risk mitigation measures have been developed in support of these assumptions and will be reviewed periodically.

The principal assumptions cover several aspects of the cleanup such as Cleanup Strategy, Land Use, Affected Lands, End-State, Waste Strategy, Regulatory Constraints, Site Revitalization and Stakeholder Concerns. They include, but are not limited to:

- Operational controls, to ensure the safety of humans and mitigate the potential for ecological risk, will persist throughout the Operation Phase of the site
- Institutional controls, to protect the integrity of the remedy and minimize human exposure, will be incorporated into the environmental remediation process, as required
- Many areas of the site, including many of the affected areas, are wildlands and should be maintained as, or remediated to, parkland use (at a minimum) to protect ecological habitat, except when there is a justifiable near-term operational need (i.e. industrial use) for the land
- Chalk River Laboratories has an enduring operational mission and there is currently no planned closure date for the site (but the date 2100 is assumed for planning purposes)
- Large scale remediation will not occur until on/off-site facilities for the processing and storage or disposal of all retrieved remediation wastes are available, including LLW and ILW, to avoid double-handling of materials or the need for additional temporary storage, where possible
- The on-site interim storage facilities and/or lay down areas for LLW will provide sufficient capacity for currently planned decommissioning and environmental remediation activities until the proposed NSDF is fully operational, based on currently assumed timelines
- Cleanup will occur while CRL is an operating site and will need to accommodate decommissioning and demolition, site infrastructure renewal and normal operating activities occurring alongside environmental remediation activities
- Monitored Natural Attenuation will be the preferred remedial action if predictive modelling can demonstrate that contaminated environmental media is not currently and will not in future pose unacceptable risks and will meet acceptable levels for future land use in the required time frame
- Ongoing and future operational activities will comply with current regulations (those prevailing at the time), including Federal or Provincial soil and groundwater cleanup criteria or guidance levels and seek to minimize environmental impacts on-site and offsite (i.e., the cleanup of the CRL site will be planned based on the current understanding of liabilities)
- The CRL site boundaries and land area will remain constant over time; i.e., there are currently no plans to transfer ownership of any CRL lands to external entities
- The cleanup planning, as detailed in the ODCP is an iterative process, continually being reviewed and improved upon as new information is available to reduce planning uncertainty
- Cleanup will be considered achieved, once the following is verified: Risk-based cleanup criteria for soil are met for the impacted area in accordance with the appropriate land-use category
- Soil will be managed in situ if proven to meet the end-state objectives i.e., risk-based cleanup criteria
- Any waste remaining in situ may trigger additional regulatory and licensing requirements that will be considered

9.6 Prioritization Tool

The CRL site will be cleaned up according to a schedule informed by a prioritization tool based on Health, Safety, Security and Environmental (HSSE) concerns, waste management availability, and business factors (e.g., revitalization needs, stakeholder concerns).

Past efforts have been made to implement a risk-based approach to support the prioritization of decommissioning and environmental remediation projects (formerly listed under the Nuclear Legacy Liabilities Program) at the CRL site. In 2021, these efforts were examined in detail and benchmarked against an additional two dozen site-ranking and prioritization tools in use at nuclear facilities and other industrial and military facilities in North America and Europe. Contrary to site-ranking tools which simply place sites in an order of risk using simple numerical scores, prioritization tools have the ability to determine which actions should take place, to consider costs and incremental risk reduction and to help identify trade-offs across multiple sites and across the multiple, sometimes competing cleanup objectives (e.g. priority based upon risk, complexity, or the need for redevelopment footprint).

A new prioritization tool is under development and proposed for use at CRL. It uses a multi-criteria, non-aggregating approach (i.e., scores for different parameters are not added to derive a global score) to identify which remediation projects can deliver the greatest benefits for risk reduction and future site redevelopment activities. This approach is also more transparent as it provides a clear link to the original data (contaminant levels for example), while seeking to eliminate bias. This allows for better individual and overall parameter optimization and provides more flexibility in comparing different scenarios and trade-offs, removal versus in situ remediation, for example.

The proposed tool, as shown below in Figure 8, also uses a graphical depiction of each scoring parameter for easier comparison between current and post-intervention scenarios or to assess existing conditions in areas being considered for redevelopment. A site-wide risk-ranking model does not allow for such detailed evaluation.

Wherever possible, the risk parameters are to be determined using measurable and verifiable data instead of relying upon qualitative or default values. The proposed tool has been reviewed and pilot tested and is being rolled out more extensively in 2023. The cost parameters are being revised to align with the overall cost estimates for the decommissioning and cleanup of the CRL site.

For illustrative purposes, an example of a preliminary graphical representation of results is shown in Figure 8. The arrows represent the modified assessment results using a before and after scenario reflecting the risk reduction impact of source removal at a specific waste management area. In this case, the preliminary scenario presented is the removal of wastes from WMA A and its disposal in the NSDF.

The colors reflect the six main prioritization categories (Contamination, Impact, Condition, Revitalization, Uncertainty and Costs) and are used for easier visualization especially when comparing several APECs. Scores are a reflection of current conditions and of the impact or risk

level for each parameter. A site with significant radiological contamination would score higher, for example, under the radiological contamination parameter.

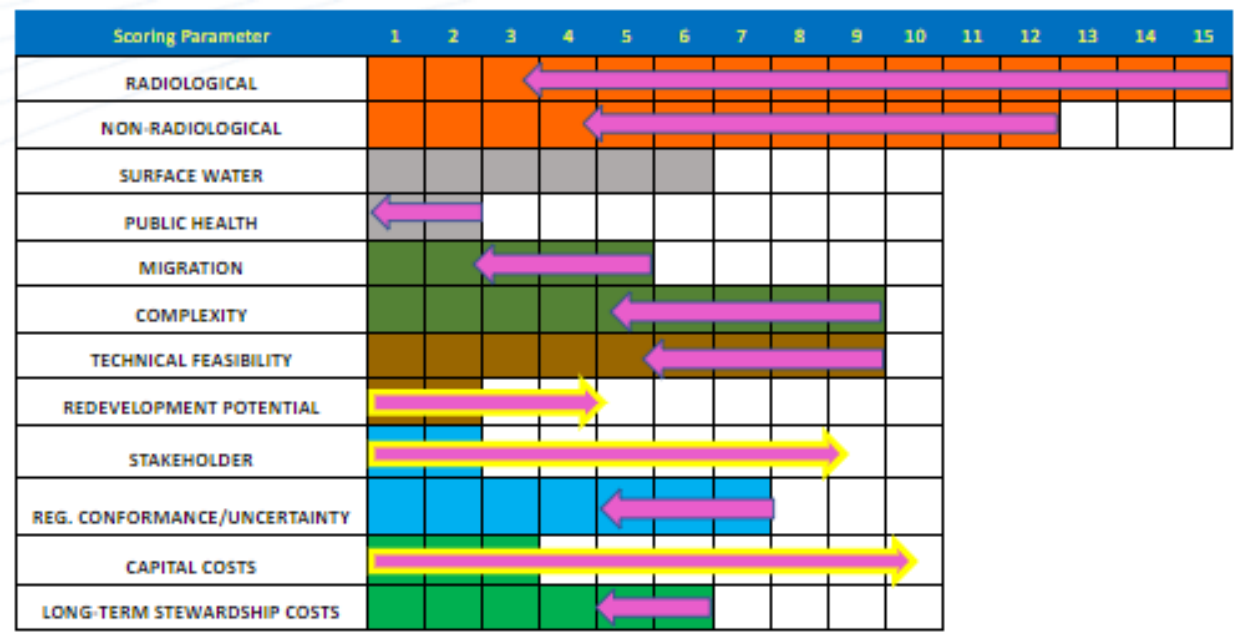

Figure 8: Proposed CRL Cleanup Prioritization tool – Preliminary Graphical Representation

9.7 Waste Management Strategy

A critical factor in dealing with the cleanup of the CRL site is the ability to manage the wastes that will result from the decommissioning and environmental remediation initiatives. CNL has developed an *Integrated Waste Strategy* (IWS) [6] to implement safe, cost-effective lifecycle waste management. The IWS describes CNL's strategic approach to waste management and aims to support integrated management of waste across CNL and ensure alignment with the goals and requirements of CNL's primary business missions [6]. The IWS is currently in the process of being updated and a new revision will be issued in 2023. CNL implements the applicable radioactive waste management regulatory documents and Canadian Standard Association standards, into the Waste Management Program. The *Management System* [35], and *Waste Management Program Requirement Document* [50] identifies and lists all applicable CNL licences and regulatory documents pertinent to the Waste Management Program under applicable Acts, regulations, and standards.

The cleanup plan for the CRL site is based on the assumption that, where appropriate, radioactive waste management capabilities are provided at the CRL site, while other off-site waste service providers are also used as appropriate.

Waste minimization is a key principle applied at CNL (see Table 4). CNL's *Environment Policy* [63] states that waste should be dealt with at the highest practicable level in the waste hierarchy (Figure 9). Effective use of diversion, recycle and reuse routes, including those

currently supplied by off-site service providers, requires options analysis, inventory and characterization information. Examples of each are:

Prevent:

- Waste Planning: CNL applies a rigorous waste planning process to minimize volumes, and prevent waste generation
- New Build Planning: For each new building, CNL incorporates design features that reduce future waste generation at the operational and decommissioning phases

Reduce:

- Sort and Segregation: This occurs at the source of all cleanup projects. CNL has also invested in a new facility to enable sorting and segregation of legacy and decommissioning LLW. This approach enables physical reduction in volume through processing and segregation of contaminated materials from materials that can be cleared for unconditional radiological release
- Proposed Fuel and ILW Stabilization Facility: CNL is committed to making investments into new facilities that offer improved capabilities for fuel and ILW processing. These processing/stabilization facilities will offer new opportunities to reduce the amount of waste requiring future disposal

Reuse:

- Radiological Clearance and Release: CNL implements a comprehensive radiological clearance process, predominately through the operation of the Waste Analysis Facility. This program enables a significant quantity of waste materials to be dispositioned for off-site reuse
- Source Recycling Program: CNL works with supply chain partners to reuse radiological sources that would otherwise be considered as waste

Recycle:

- Heavy Water Detritiation: Through the use of CNL-developed technologies, CNL will apply a detritiation process to separate tritium from heavy water. This will enable approximately 700,000 litres of heavy water to be used for nuclear and non-nuclear applications
- Off-Site Processing (Metal Melt): CNL utilizes commercial processing facilities, such as Metal Melt offered by EnergySolutions, to melt metallic wastes which are then recycled into metal shielding blocks for reuse in the nuclear industry
- Repatriation: Through repatriation initiatives, CNL works with partner nations to return the material to country of origin for processing for future use or disposal
- Radiological Clearance and Release: Similar to reuse (above)

Dispose:

- Near Surface Disposal Facility: The proposed NSDF will provide an option for disposal of LLW that cannot be diverted

CNL will continue to operate with the waste hierarchy in mind and with a focus on prevention and reduction of waste generation. The proposed NSDF, in particular, is considered an asset with a finite capacity, and application of the waste hierarchy is important to ensure other waste options are fully explored prior to utilizing disposal capacity. Disposal is the final option after all other means of prevention, reduction, re-use, and recycling are exhausted.

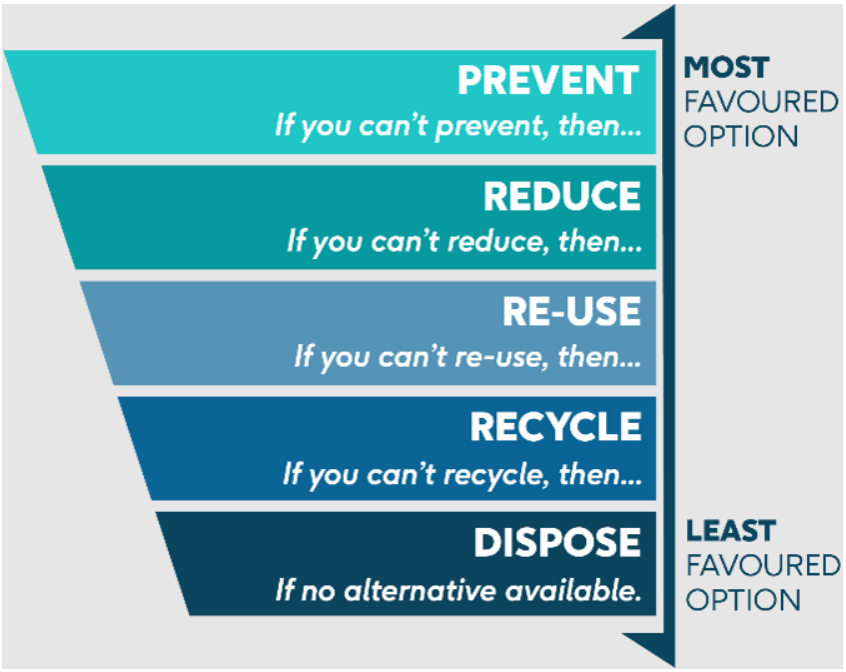

Figure 9: Waste Hierarchy Diagram

9.7.1 Waste Inventory and Waste Forecast

The baseline waste volume forecast until the year 2100 is provided in the Inventory of Radioactive Waste in Canada 2019 [99]. The year 2100 is an assumed end date of nuclear operations at CRL that has been used for planning purposes and in the modeling efforts in support of the development of screening criteria, however it is important to note that the operational mission at the CRL site has been extended indefinitely.

The waste forecast is used to identify gaps and areas of concern regarding waste storage and plan the logistics of waste receipt, processing and disposition. The waste forecast is live and regularly updated to reflect new characterization data and other planning inputs as information becomes available, and the associated strategies and plans evolve.

9.7.2 Waste Strategies by Classification

The Waste Management Program mandate applies to the full life cycle of waste from the point of generation to its final disposition. This includes all operations and activities that results from the planning, generation, transportation, processing, storage, and/or disposal of waste generated by CNL-managed sites or received from external organizations. The Waste Management Program adheres to CNL's *Environment Policy* [63], which states that waste

should be dealt with at the highest practicable level in the hierarchy. Wastes generated at CRL are divided into waste classifications. Table 6 provides examples of the types of waste within each classification and an overview of the strategies for each. Further detail can be found in the IWS [6].

Table 6: CRL Waste Classifications and Baseline Waste Strategies

Waste Classification		Waste Type Examples	Waste Strategy **(in cases where more than one strategy is presented the optimal route for specific waste is selected)**
Non-Radioactive	Clean	Conventional trash, metal, construction, demolition and decommissioning material, ground material and vegetation	• Identify reuse and recycle opportunities • Manage waste through local municipal landfills and processing facilities
	Hazardous	Chemicals, oils, lead, Mercury, hydrocarbon contaminated soil	• Manage as per Hazardous waste regulations through off-site service providers
Radioactive	Low-Level Waste (LLW)	Solid waste: Personal protective equipment & clothing (PPE&C) , metal, rubble, concrete, wood, equipment, soil & vegetation	• Consolidate at CRL in storage until the LLW disposal (proposed NSDF) becomes available • Process LLW where required to manage hazardous constituents and ensure disposal ready • Manage suitable legacy LLW *in situ*, where agreed • Align decommissioning strategy to waste storage and disposal availability • Defer large scale Environmental Remediation to align to proposed NSDF availability • Manage historic waste through Port Hope Area Initiative program

Waste Classification		Waste Type Examples	Waste Strategy **(in cases where more than one strategy is presented the optimal route for specific waste is selected)**
		Liquid Waste	• Process to achieve a liquid effluent suitable for release and/or to create a waste suitable for storage in a passively safe condition
	Intermediate-Level Waste (ILW)	Solid Waste: Reactor parts and components associated with reactor operations, isotope production process and decommissioning and environmental remediation wastes, and Cemented Target Material	• Consolidate at CRL in long term engineered storage until geological disposal becomes available • Process appropriately to enable storage in a passively safe condition • Manage suitable legacy ILW *in situ*, where agreed
		Liquid Waste	• Process to achieve a liquid effluent suitable for release and/or to create a waste suitable for storage in a passively safe condition
	High-Level Waste (HLW)	CANDU type and research reactor used fuels	• Consolidate at CRL in long-term storage, as appropriate, until a national used fuel Deep Geological Repository (DGR) becomes available ○ The consolidation of Douglas Point HLW is dependent on the siting decision of the HLW DGR

9.7.3 Key Enabling Waste Facilities / Capabilities

There are ongoing plans to advance the strategies for new waste facilities and capabilities over the next 5 years.

Current Facilities/Capabilities

To ensure the waste generated is managed effectively, current key facilities/ capabilities at CRL which manage waste at CNL include:

- The Waste Analysis Facility (WAF) which accepts clean solid waste generated or processed at CRL, verifies it is clean, and then sorts and segregates the wastes, as appropriate, prior to routing it through different waste paths for final disposition
- The Waste Characterization Facility which is a centralized facility for characterizing waste
- Concrete crushing capability to enable re-use of concrete material at site
- The Waste Treatment Centre where liquid waste is evaporated and bituminized in drums to produce a stable product [6]
- Above ground storage capability for sealand containers at WMA's D and H in MU 2 (see Section 10.2)
- Storage capability for ILW in various storage structures, including MU 3 below-grade tile holes, concrete bunkers, and the MU 2 Shielded Modular Above Ground Storage (SMAGS) facilities (see Table 1, Sections 10.3 and 10.2)
- Storage capability for HLW storage in below grade tile holes at WMA B (Section 10.3), and above ground storage in canisters at WMA G (Section 10.2) and at the Fuel Packaging and Storage (FPS) facility for storage of selected legacy research reactor fuel rods from tile holes (Section 10.3)
- The Sanitary Landfill accepts clean, solid waste (i.e., non-radioactive and non-hazardous) (see Section 10.7)
- The Sort and Segregation Pilot Facility and the Waste Sort and Segregation Facility began operating in 2020 and 2022, respectively, to address solid LLW that is currently in storage (Section 10.2)
- Planning is underway to repurpose WMA C for the recoverable surface storage of LLW in sealand containers

New Facilities/Capabilities

A number of new key enabling waste facilities and capabilities which are at various stages within the program of work have been identified which will complement the current capabilities at CRL and address processing, storage and disposal requirements as necessary to ensure the waste strategies can be successfully completed. These include:

- The proposed NSDF:

The NSDF Project is a proposed waste disposal facility using an Engineered Containment Mound (ECM) design built at ground surface that will hold up to 1 million cubic metres (m^3) of LLW (planned to be located in MU 4, adjacent to MU 6 – see Figure 5. The facility will feature ten waste disposal cells built in two phases. The ECM includes a multilayer base liner and cover system, where waste will be placed in between. The waste in each cell is covered after the cell is full. It is similar to an engineered municipal landfill but with much more robust engineering features. The proposed facility will be licensed under the Nuclear and Safety Control Act and thus subject to the associated regulations and independent regulatory oversight from the CNSC. The proposed NSDF is to be comprised of the ECM, the Waste Water Treatment Plant and supporting facilities and infrastructures. The ECM will safely dispose of LLW that meets the NSDF Waste Acceptance Criteria [100]. Disposal space inside the proposed NSDF is to be treated as an asset, and all efforts will be made to use the space efficiently for wastes that cannot be cleared for other disposal options. The proposed NSDF will hold only LLW which contains primarily short-lived radionuclides, and limits the amount of long-lived radionuclides. This material will require isolation and containment for up to a few hundred years. The ECM design life of 550 years has been established to meet the required time period to allow for radiologic decay of the waste inventory. The radioactivity concentration in the ECM is estimated to have decreased by approximately 2,000 times in the first 100 years and begins to approach background levels of concentration shortly thereafter. CNL will be required to undertake a Post-closure Safety Assessment which analyzes the long-term implications and demonstrates that the dose to any future generation which may interact with the disposal facility is within the established dose acceptance criteria, consistent with applicable IAEA and CNSC guidance and requirements.

- Optimization of Existing Central Waste Management Areas:

CNL is assessing the current land area available within Waste Management Areas B, D, G and H to optimize the re-use of already disturbed lands for proposed new facilities and capabilities, which include:

  - The Sort and Segregation Facilities, which are already operational.
  - The Cask Facility, a planned new nuclear facility, which will be a centralized facility for transportation cask and transfer flask operations, storage, and maintenance
  - Intermediate-Level Waste and High-Level Waste processing capabilities and facilities. Work is currently underway to determine requirements to meet CNL needs including the stabilization/ processing of WMA B inventory.

- Intermediate-Level Waste and High-Level Waste storage capabilities and facilities, including an ILW storage Facility and expanded storage capacities within WMA G to receive and store used fuel (High-Level Waste) consolidated at CRL until the national used fuel Deep Geological Repository (DGR) is available[5].

The advantages of consolidating facilities/capabilities in one area include:

- Planning the renewal of infrastructure and service requirements specific to the WMA needs (i.e., electrical, fire water, process water, roads, support facilities)
- Supporting planning for enabling facility sequencing in connection with IWS and Cleanup Function
- Minimizing impacts on the environment by optimizing the existing WMA footprint (i.e., manages sprawl)

Additionally, a Heavy Water Detritiation Facility (HWDF) will be designed, licensed, constructed and operated to disposition AECL's inventory of tritiated heavy water. This is part of the Tritiated Heavy Water Management Program of work and converts a complex nuclear liability into two assets (Heavy Water and elemental tritium) that can be re-used for nuclear and non-nuclear applications.

Areas that need further assessment and review of options for managing waste include:

- Radioactive Liquid Waste: Liquid waste processing capability is currently being evaluated to assess the options for the longer-term, to ensure future ILW liquid processing capability is sized appropriately and produces a waste form that will meet geological disposal criteria [6]
- Intermediate-Level Waste Disposal: The national draft Integrated Strategy for Radioactive Waste includes a recommendation for a single DGR for ILW in Canada, including the AECL-owned inventory of ILW. The CNL Integrated Waste Strategy includes an ILW Program of work, which monitors the progress of the national ISRW recommendations, while also evaluating lifecycle management options and opportunities.
- Clean Waste Disposal: The estimated remaining life of the Sanitary Landfill, based upon the landfill profile and annual waste volume, is currently assumed to be approximately 7 to 10 years. It is recognized that the capability will continue to be required beyond this timeframe, therefore it is necessary to identify alternative management options
- Soil Management and Disposal: During environmental remediation large amounts of non-radiological impacted soil will be generated, including some classified as hazardous wastes. Options to address the disposal of this material will need to be identified and assessed

[5] The used fuel DGR is being developed by the Nuclear Waste Management Organization (NWMO) as part of the Adaptive Phased Management plan for long term management of Canada's used nuclear fuel. Site selection is currently underway and after starting with 22 communities that expressed an interest, two sites – the Township of Ignace in northwestern Ontario, and the Municipality of South Bruce in southern Ontario being considered as potential host areas for the project.

Notably, the Federal Government's Integrated Strategy on Radioactive Waste has been drafted by the NWMO and issued for public review. The strategy will not be finalized until after the government's revised Policy for Radioactive Waste Management and Decommissioning is published. The outcome may have impacts on the IWS and cleanup planning.

9.8 Constraints and Limitations

It is also imperative to consider constraints and assumptions within a cleanup options assessment. Constraints act to limit the options that can be implemented. Conversely, assumptions may be required to support the practicality of implementing an option [92]. See Section 9.2.2 and 9.4 for details on the assumptions underpinning cleanup at the CRL Site.

Some examples of the constraints applicable to advancing CRL cleanup planning are:

- The lack of an appropriate LLW disposal facility limits the advancement of the execution of decommissioning and environmental remediation
- Once a LLW disposal facility is available, its capacity will be limited, and therefore will be treated as an asset to be used efficiently for wastes that cannot be cleared for other waste management options
- The continued operations at site limits the areas that can be cleaned up for site revitalization and also adds to the complexity of cleanup, e.g., infrastructure will be re-planned and re-routed, etc.
- The lack of definition on ILW disposal pathways, including the location of a future disposal facility, and the applicable Waste Acceptance Criteria that will need to be satisfied by CRL Waste Generators

Constraints applicable to individual decommissioning and environmental remediation projects will be detailed in individual DDPs and RAPs, respectively.

10. Current Assessment Status by Management Unit

The CRL site is a highly complex facility where nuclear research and development activities have taken place for more than 70 years. To allow for more efficient planning and tracking of decommissioning and environmental remediation activities the site has been divided into 11 Management Units (MUs), which correspond to areas with similar levels of contamination or similar operational history and which are well defined geographically and physically.

The focus for the next five years is planned to continue as it has for the past five years; on decommissioning activities, mostly the dismantling and demolition of structures in the Campus Precinct (MUs 1 and 7), and progressing characterization of the environmental legacy at CRL. The characterization efforts will be accelerating in the next five years to facilitate remediation execution once the proposed NSDF is approved and is ready to receive LLW generated as part of decommissioning and remediation activities.

Cleanup will support revitalization in accordance with CNL's ongoing S&T mission at the CRL site. The areas with the greatest redevelopment potential are principally in MUs 1 and 7; which are both part of the Campus Precinct. Several areas in the Outer and Entry Precincts have also been designated as development blocks where future facilities may be located.

Several Management Units in the Outer Precinct contain long-lived radioactive and chemical wastes stored below-grade in facilities that do not meet current waste management standards. These along with associated contaminant plumes which have impacted soil, groundwater, surface water and sediments will require remediation efforts.

Outside the footprint of specific waste management areas, the Outer and Entry Precincts at CRL are characterized by natural areas with rolling forested landscape and numerous lakes, rivers, and wetlands that provide critical habitat to several species at risk. The vast majority of these natural areas will be preserved and their usage will not change appreciably in the future once they have been remediated and restored where necessary.

See Figure 5 for the overview map of the CRL MUs.

Description of Each MU Sub-Section:

More than 60 sub-areas, defined as APECs have been identified within the 11 MUs. The eleven MUs are presented in numerical order, and this order does not reflect an order of importance related to either environmental risk or development potential. As cleanup planning progresses, the APECs within each MU will be evaluated using a proposed prioritization tool (Section 9.6) to determine which remedial actions may result in the greatest overall risk reduction or achievement of other goal (e.g. clean up of an area needed for new construction).

Each MU sub-section includes:

- An overview description,
- A map of the MU,
- Descriptions of any enabling or site revitalization projects within the MU,
- The current and planned status of any buildings/structures or APECs currently undergoing decommissioning or environmental remediation,
- Where sufficient information is available, refined estimated waste volumes associated with the decommissioning and remediation of the MU based on comparison of recent soil characterization results to risk-based soil screening criteria, and
- Preliminary proposed, target next land uses for each MU.

These land uses are considered 'proposed' as engagement with stakeholders is ongoing, and 'target' because CNL has not yet undertaken the assessments and evaluation required to determine if remediation to these levels is feasible or achievable. It is also possible that the various APECs within an MU will be cleaned up to different land uses depending on operational needs.

A table describing the operational or decommissioning status of all buildings/structures and summary information on each APEC within each MU is found in Appendix A.

Status of Class I and II Facilities:

Table 7 summarizes the current and future status of the Class I and Class II Nuclear Facilities at CRL and has been updated to reflect changes since the last iteration of the overview CPDP [1]. The descriptions of the status categories are provided in Appendix A, Table A-1. The Class I and II Nuclear Facilities listed in Table 7 must have facility specific DDPs developed and accepted, prior to the conduct of any decommissioning work, which describe the decommissioning plans for that facility. See the appropriate MU section where details are provided for each facility that is currently in a state of decommissioning (i.e., not operations).

Table 7: Status of Class I and Class II Nuclear Facilities at CRL

Facility or Equipment	Scope (Building(s) or Area)	Current Facility Status[1] (as of 2022 December)	Plan Forward (expected status[1] in 5 years)	Located in:
CRL Class I Nuclear Facilities				
Recycle Fuel Fabrication Laboratories (RFFL)	[redacted] (part)	Operations	Operations	MU 1
ZED-2 Reactor	[redacted] (part)	Operations	Operations	MU 1
Universal Cells	[redacted]	Operations	Operations	MU 1
Fuels and Materials Cells	[redacted] (part)	Operations	Operations	MU 1
Nuclear Fuel Fabrication Facility (NFFF) – lower level, Fuel Assembly Science & Technology (FAST) – upper level	[redacted]	Operations	Operations	MU 1
^{99}Mo Production Facility	[redacted]	Operations	Operations	MU 1
	[redacted]	Operations	Decommissioning / Building Removal	MU 1
Tritium Laboratory	[redacted] (partial)	Operations	Operations	MU 1
Combined Electrolysis Catalytic and Exchange Upgrade and Detritiation Test Facility	[redacted] (partial)	Operations	Storage With Surveillance (SWS)/ Care & Maintenance (C&M)	MU 1
Waste Treatment Centre and Associated Facilities	[redacted]	Operations	Operations	MU 1
	[redacted]	Operations	SWS/C&M	MU 1
	[redacted]	Operations	SWS/C&M	MU 1
	[redacted] – Emergency Storage Basin	Operations	SWS/C&M	MU 4

Facility or Equipment	Scope (Building(s) or Area)	Current Facility Status[1] (as of 2022 December)	Plan Forward (expected status[1] in 5 years)	Located in:
	[redacted] – Tank Farm	Operations	Operations	MU 9
Waste Management Areas and Associated Buildings and Facilities	WMA A, LDA	Operations (not currently accepting waste)	Operations	MU 6
	WMA B, [redacted]	Operations	Operations	MU 3
	WMA C	Operations (not currently accepting waste)	Operations [2]	MU 8
	WMA J (BML)	Operations	Operations	MU 8
	WMA D, G, H; [redacted] series, [redacted] series	Operations	Operations	MU 2
	WMA E	Operations (not currently accepting waste)	Operations	MU 9
	WMA F	Operations (not currently accepting waste)	Operations	MU 10
	Thorium Nitrate Dispersal, Ammonium Nitrate Plant	Operations (not currently accepting waste)	Operations	MU 11
CRL Class II Nuclear Facilities				
Gamma Beam [redacted] Irradiation Facility	[redacted] (part)	Operations	Operations	MU 7
Gamma Beam Irradiators Model GC60	[redacted] (part)	Operations	Operations	MU 7

Facility or Equipment	Scope (Building(s) or Area)	Current Facility Status[1] (as of 2022 December)	Plan Forward (expected status[1] in 5 years)	Located in:
Van de Graaff Accelerator	[redacted] (part)	Operations	Operations	MU 1
Health Physics Neutron Generator	[redacted] (part)	Operations	Operations	MU 7
CRL Nuclear Facilities in Extended Shutdown State				
MAPLE 1 and 2 Reactors	[redacted]	Operations -Extended Safe Shutdown	Decommissioning / Building Removal	MU 1
New Processing Facility	[redacted]	Operations - Extended Safe Shutdown	Decommissioning / Building Removal	MU 1
CRL Nuclear Facilities Undergoing Decommissioning Activities				
NRX Reactor	[redacted]	Decommissioning / Building Removal	Decommissioning / Building Removal	MU 1
NRX Reactor Ancillary Buildings	[redacted]	End-State Verification Activities	Interim End State - SWS	MU 1
	[redacted]	End-State Verification Activities	Interim End State - SWS	MU 1
	[redacted]	Decommissioning / Building Removal	Decommissioning / Building Removal	MU 1
	[redacted]	End-State Verification Activities	Interim End State - SWS	MU 1
Former Reactor Bay Deionization System	[redacted]	Decommissioning / Building Removal	Decommissioning / Building Removal	MU 1
NRX Fuel Storage and Handling Bays ([redacted])	[redacted]	Decommissioning / Building Removal	Decommissioning / Building Removal	MU 1
Plutonium Recovery Laboratory	[redacted]	Decommissioning / Building Removal	Decommissioning / Building Removal	MU 1
Plutonium Tower	[redacted]	Interim End-State - SWS	Interim End State - SWS	MU 1
Waste Water Evaporator	[redacted]	End-State Verification Activities	Interim End State - SWS	MU 1
Active Waste Disposal ([redacted])	[redacted]	Decommissioning / Building Removal	Decommissioning / Building Removal	MU 1
Building [redacted] including former Tritium Laboratory and Radio Isotope labs	[redacted]	Decommissioning / Building Removal	Decommissioning / Building Removal	MU 1
Nuclear Fuel Fabrication Facility (NFFF) ([redacted])	[redacted]	Decommissioning / Building Removal	Interim End State - SWS	MU 1
Emergency Process Water Cooling - NRU	[redacted]	End-State Verification Activities	Interim End State - SWS	MU 1
	[redacted]	End-State Verification Activities	Interim End State - SWS	MU 1

Facility or Equipment	Scope (Building(s) or Area)	Current Facility Status[1] (as of 2022 December)	Plan Forward (expected status[1] in 5 years)	Located in:
	[redacted]	Decommissioning / Building Removal	End State Complete / Land Re-use	MU 1
	[redacted]	End State Complete	End State Complete / Land Re-use	MU 1
CRL Permanently Shut Down Facilities				
NRU and auxiliary buildings	[redacted]	Operations - Extended Safe Shutdown	SWS/C&M	MU 1
Table Notes: [1] See Appendix A, Table A-1 for descriptions of the Status categories. [2] Work is in progress to return WMA C to service for use as a Recoverable Surface Storage Area.				

10.1 Management Unit 1

Management Unit 1 is part of the Campus Precinct and includes the Controlled Area and the affected shoreline along the Ottawa River which includes the Power House Shoreline Landfill (Figure 10). Operational activities in MU 1 have also left a legacy of hazardous materials both within buildings and in the sub- surface. Contamination sources in MU 1 are the result of spills, leaks and direct emplacements (e.g., landfilling, coal stockpiling). Legacy leaks from both the NRU and NRX reactor fuel storage, or rod, bays have resulted in contamination plumes that extend to the Ottawa River. These plumes are monitored under the CRL GWMP and updates are provided in the Annual Compliance Monitoring Report on Environmental Monitoring.

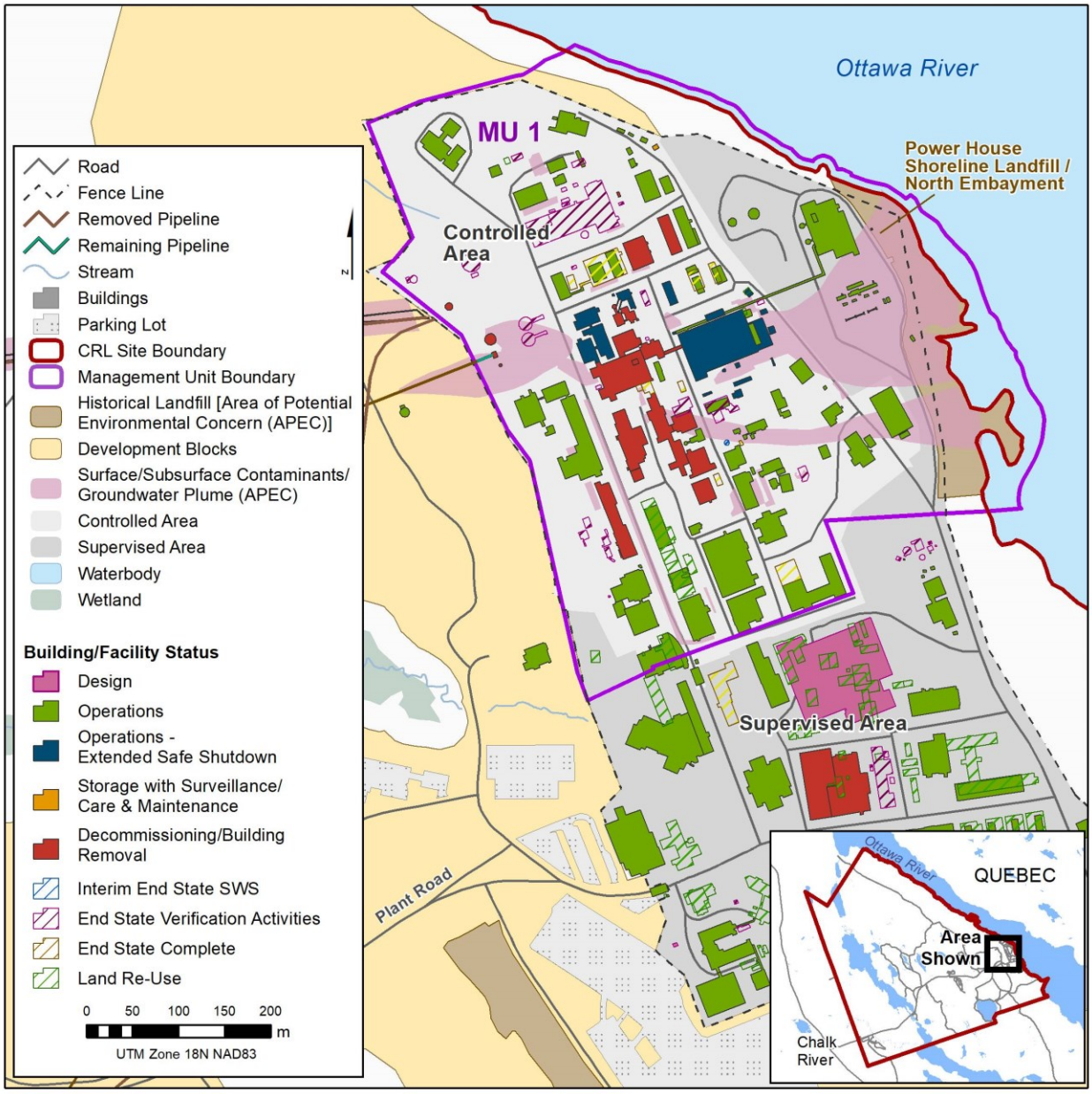

Figure 10: Map of Management Unit 1

No key enabling facilities to support the cleanup mission are currently planned within MU 1, although several development blocks have been identified which are areas that may preferentially be used in support of CNL's missions. Of the development blocks identified for the Campus Precinct in the Site Master Plan, however, approximately half are located in MU 1.

Significant cleanup efforts have been initiated in MU 1 to enable site revitalization and eventual redevelopment of the Campus Precinct. Several of the structures demolished at CRL in recent years were located in MU 1 and the Land Use and Environmental Remediation processes will be executed to deal with remaining contamination and in-ground infrastructure. Since the last iteration of this overview plan a number of major changes within MU 1 include:

- Decommissioning execution is underway in the NRX reactor in accordance with the Detailed Decommissioning Plan (DDP) for Interior Demolition (Stage 1) of Building [redacted], and is forecast for completion in 2031 (see Figure 26). The NRX Reactor will change designation to a Nuclear Facility Undergoing Decommissioning Activities in the next revision of the Site Licences, Certificates, Permits, Building/Facility Contacts, & Licence Representatives document. Routine monitoring, maintenance and surveillance activities have continued on the NRX reactor, building structure and systems consistent with the NRX Reactor Facility Storage with Surveillance Plan as described in Section 4 of the Building [redacted] DDP. A summary of the decommissioning activities undertaken each year is provided in CNL's Annual Compliance Monitoring Report (e.g., [101]).
- The decommissioning of [redacted], the NRX delay tanks, has progressed through demolition and the site has been restored; end-state verification activities are underway.
- The Dedicated Isotope Facilities (DIF), includes the MAPLE 1 and 2 Reactors and the New Processing Facility and remains non-operational, with no fuel in the MAPLE reactor cores. The focus for the DIF has been to monitor and maintain the facilities in Extended Shutdown State, where only systems that are required to preserve assets are operational. DIF is the only nuclear facility on-site in an Extended Shutdown State (ESS). The surveillance and maintenance activities have been continued as outlined in the MAPLE and New Processing Facility (NPF) Operational Limits and Conditions documents. Decommissioning execution is forecast for 2025 - 2031 (see Figure 27). A summary of the decommissioning activities undertaken each year is provided in CNL's Annual Compliance Monitoring Reports (e.g., [101]).
- The permanent shutdown of the NRU Reactor occurred on March 31, 2018. The facility is currently de-fueled and de-watered. Work continues to progress the NRU reactor to a Storage with Surveillance state followed by of the development of the DDP Stage 1 with decommissioning execution planned to begin in 2029 (see Figure 28). A summary of the decommissioning activities undertaken each year is provided in CNL's Annual Compliance Monitoring Report (e.g., [101]).
- The decommissioning of the Active Laundry Facility, [redacted], has been undertaken and the area is undergoing end-state verification activities.
- As part of the Active Liquid Waste Project, all legacy radioactive liquid waste was removed from the storage tanks in Building [redacted] and decommissioning planning has been initiated.
- The decommissioning of the Emergency Process Water Supply, [redacted], and associated structures, has also progressed to the stage of end-state verification.

Over the next five years, significant decommissioning activity within MU 1 will continue to remove legacy buildings to enable eventual progress toward additional redevelopment space for the site revitalization in the Campus Precinct. Some of the major projects planned include:

- Decommissioning and demolition of [redacted] and various others (Appendix A)
- The turnover of approximately 30 NRU-related ancillary buildings to Facilities Decommissioning and their subsequent decommissioning activities

- Environmental remediation activities will be initiated when suitable support facilities are available (i.e., proposed NSDF). In the meantime, environmental site assessments (Phase 1 and 2) will be developed for discrete areas of MU 1 to gain the appropriate knowledge to develop refined waste volumes estimates and remediation plans

The areas within MU 1 will be cleaned up to a proposed target of industrial land use to meet the needs for the revitalization of the campus. Of the development blocks identified for the Campus Precinct in the Site Master Plan, approximately half are located in MU 1.

10.2 Management Unit 2

Management Unit 2 is within the Perch Lake Drainage Basin and includes three active Waste Management Areas located in the Outer Precinct along Plant Road:

- Waste Management Area D, where sealand containers are stored above ground and where mixed wastes are stored and processed in the [redacted] series buildings;
- Waste Management Area G, where used nuclear fuel is stored in above ground concrete canisters; and
- Waste Management Area H, where Sort and Segregation Facilities are located and where LLW is stored in sealand containers or in one of the available storage or processing facilities (Figure 11)

These three facilities are scheduled to continue operating and ongoing operational monitoring will continue to ensure that stored materials are not releasing contamination to the surrounding environment.

The WMA's within MU 2 are currently undergoing capacity expansions and are being considered for the construction of new facilities to support the CNL cleanup mission. The areas will, therefore, not be available for decommissioning and environmental remediation for the foreseeable future. As a result, detailed cleanup planning for MU 2 is not a near term priority. In addition, a secondary plan is being prepared for WMAs D, G and H (as well as WMA B in MU 3, Section 10.3) which will consider holistic needs for new builds, roads and services, as described below.

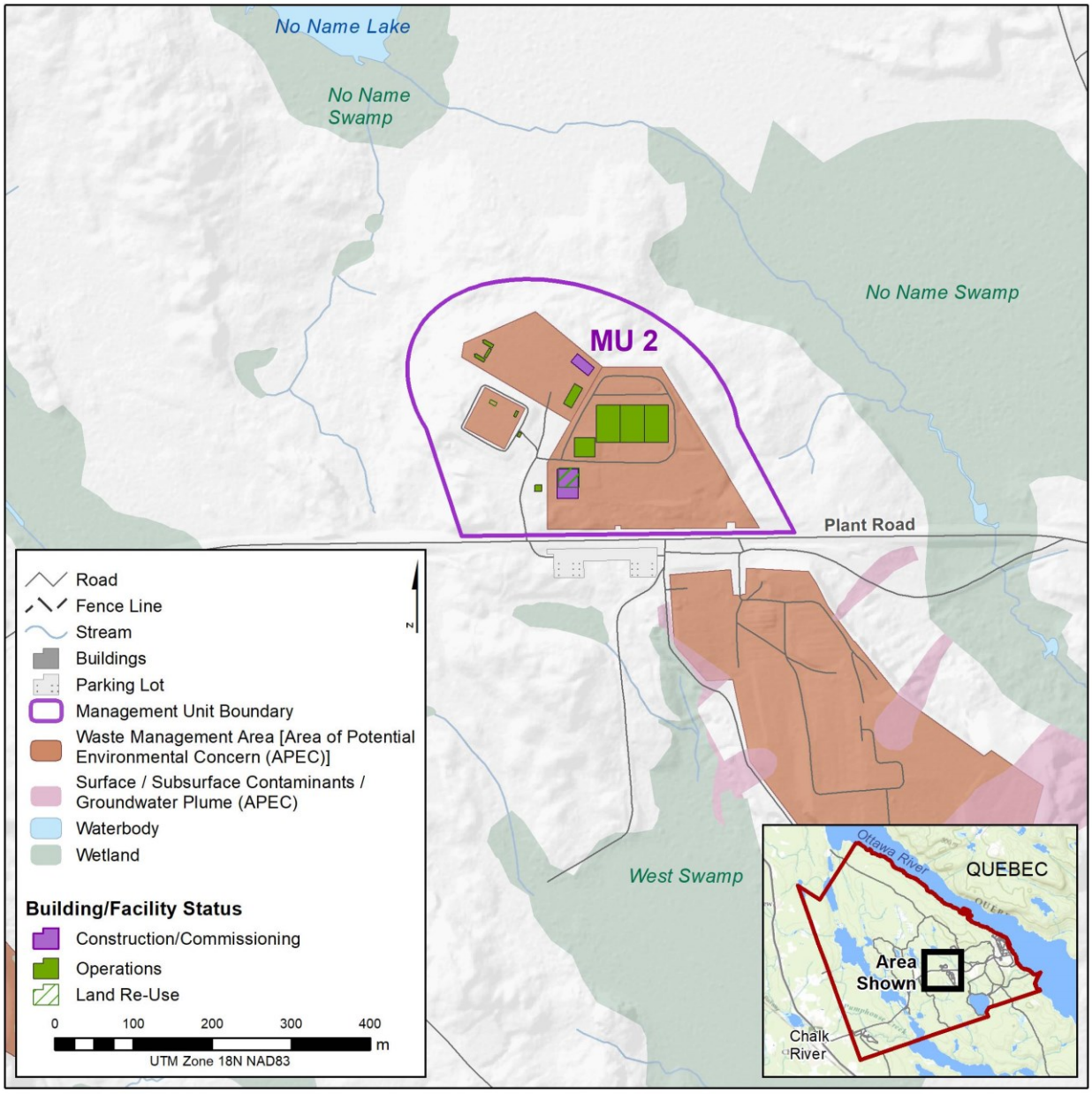

Figure 11: Map of Management Unit 2

To support the long-term Waste Services mission at CRL which parallels ongoing operations of the site, CNL is assessing the current land area available within Waste Management Areas B, D, G and H to optimize the re-use of already disturbed lands for proposed new facilities and capabilities.

In addition to the existing waste management facilities this area would house several enabling waste facilities which are planned to support the ongoing Cleanup Mission. Waste processing facilities, the Cask Facility, ILW and fuel storage facilities, and a stabilization/processing facility for inventory removal at WMA B could be located within MU 2 along with a permanent building for centralized support functions.

There are no facilities slated for decommissioning within MU 2 in the immediate future. The Environmental Remediation process and decommissioning plans will be implemented once these facilities no longer serve a useful purpose and in the interim, the proposed target land use will remain industrial.

There are no downgradient contamination concerns associated with WMA G or WMA H operations, historical or current. There is currently minimal evidence of contamination to soil or groundwater from WMA D operations within MU 2. Tritium and nitrate levels have periodically been observed above surrounding background levels in a few groundwater monitoring wells in MU 2. The source of this contamination is unconfirmed, but it is believed to be related to past operational spills from drums of liquid waste formerly stored at WMA D. The contaminated waste volumes that may require remediation in MU 2 cannot be estimated at this time.

10.3 Management Unit 3

Management Unit 3 is operational and has been used since 1953 for the long-term storage of radioactive waste. It is scheduled to remain operational until disposal facilities become available. The area includes all of WMA B, all structures, facilities, and plumes emanating from the aging waste management facilities within this area and includes West Swamp.

A portion of MU 3, directly southeast of WMA B, has been identified as an area of high development potential in the Outer Precinct (see Development Block identified in Figure 12), this area is one option being considered for a proposed extension to WMA B in an undeveloped natural area for the construction of new large-scale waste management facilities. The boundaries of MU 3 may therefore require adjustment in the future.

To upgrade and replace the original system, the modernized New Spring B Groundwater Treatment Facility pump and treat system ([redacted]) has been constructed and began operating in 2020 to continue to mitigate the ^{90}Sr groundwater plume along the west perimeter of WMA B which discharges in West Swamp. This new facility is designed to treat the entire plume emanating from the Unlined Sand and Asphalt Trenches toward the south-west of WMA B.

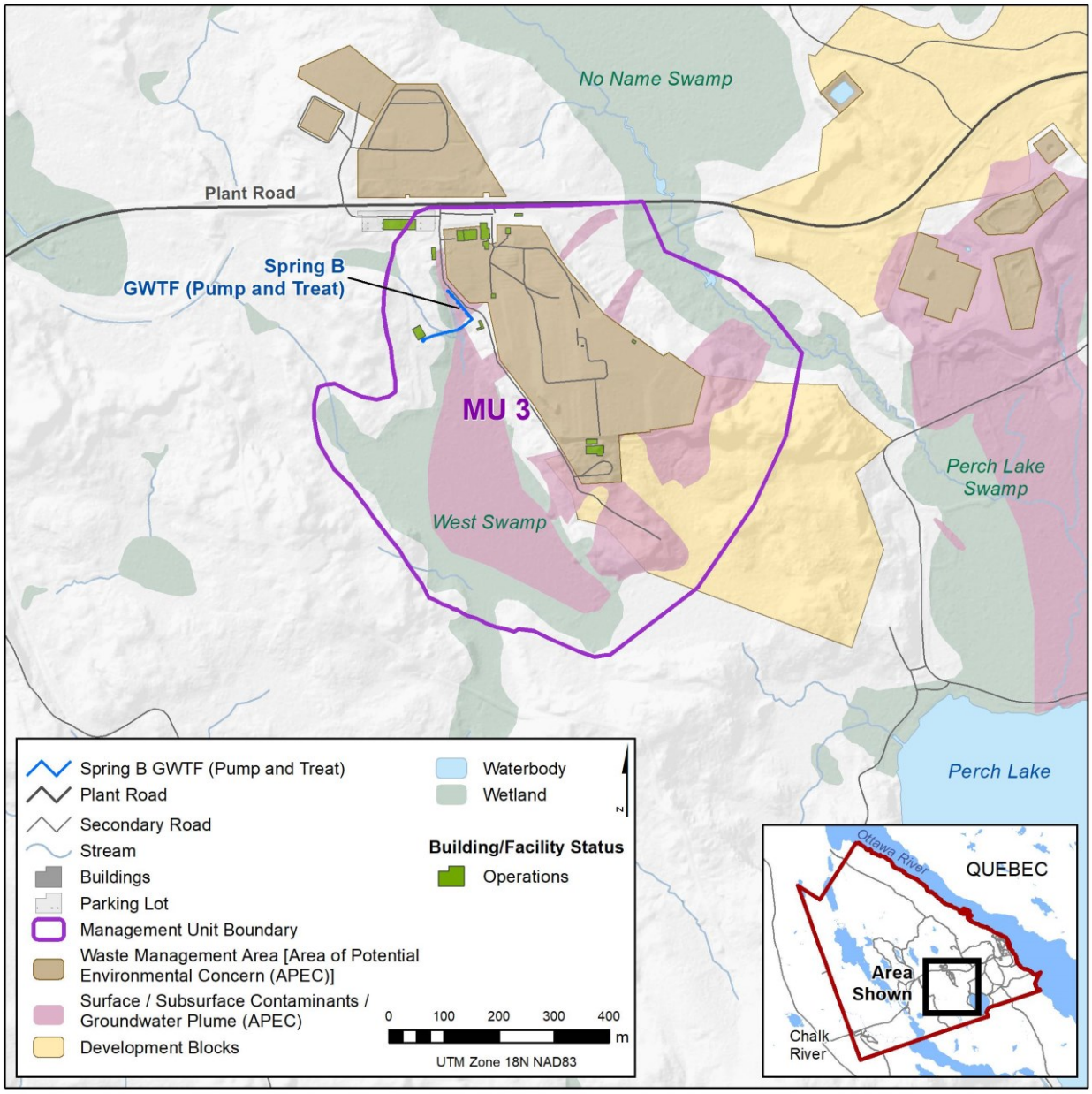

Figure 12: Map of Management Unit 3

Aside from the former change room at WMA B ([redacted]) and the original Spring B groundwater treatment system ([redacted]), no other buildings or structures are slated for decommissioning within MU 3 for the foreseeable future. Some aging waste containment structures are no longer in use while others may need to be replaced. A summary of the WMA and currently operational buildings within MU 3 are provided in Appendix A.

Assessments will be undertaken to ensure cleanup is not required to provide redevelopment space for any expansion. A development block has been identified for an area south of WMA B.

Although WMA B has been safely managing radioactive waste at the CRL site, past waste management practices were not designed and operated in line with modern day containment and confinement for radioactive waste storage. Subsurface contaminant migration at WMA B results from the storage of solid wastes in a variety of waste storage facilities, including unlined sand trenches and specialized engineered structures over the last five decades [78].

The Environmental Remediation process and decommissioning plans will be implemented once these facilities are no longer in service and in the interim, the proposed target land use will remain industrial for the facilities and parkland or unrestricted will be considered for the plumes. The contaminated waste volumes that will need to be managed upon closure of the areas within MU 3 cannot be estimated at this time.

10.4 Management Unit 4

Management Unit 4 covers most of the Outer Precinct except for several Waste Management Areas located within their respective Management Units. The outer areas of the CRL site have been host to a variety of experimental installations and include numerous site support areas such as firing ranges, a fire fighting training facility and snow dumps, as well as areas where waste has been landfilled or stored on surface. Some of these areas have already been remediated but will need to undergo verification to demonstrate that they meet the environmental screening criteria associated with the future land use at each location, once determined. Few facilities in MU 4 are operational but several exhibit evidence of local contamination.

Development blocks have been identified at both extremities of the Plant Road corridor. It is anticipated that outside of the development blocks, most other areas in MU 4 will be preserved as natural areas and will see limited change over the next few decades aside from any remediation required to meet the yet to-be-determined next land use. MU 4 includes several areas that are considered as ecologically sensitive such as wetlands, surface water bodies, and species at risk habitat (e.g., Blanding’s turtle critical habitat).

The proposed NSDF (and its supporting facilities) is the primary enabling facility currently proposed to be located in MU 4 to support the cleanup mission.

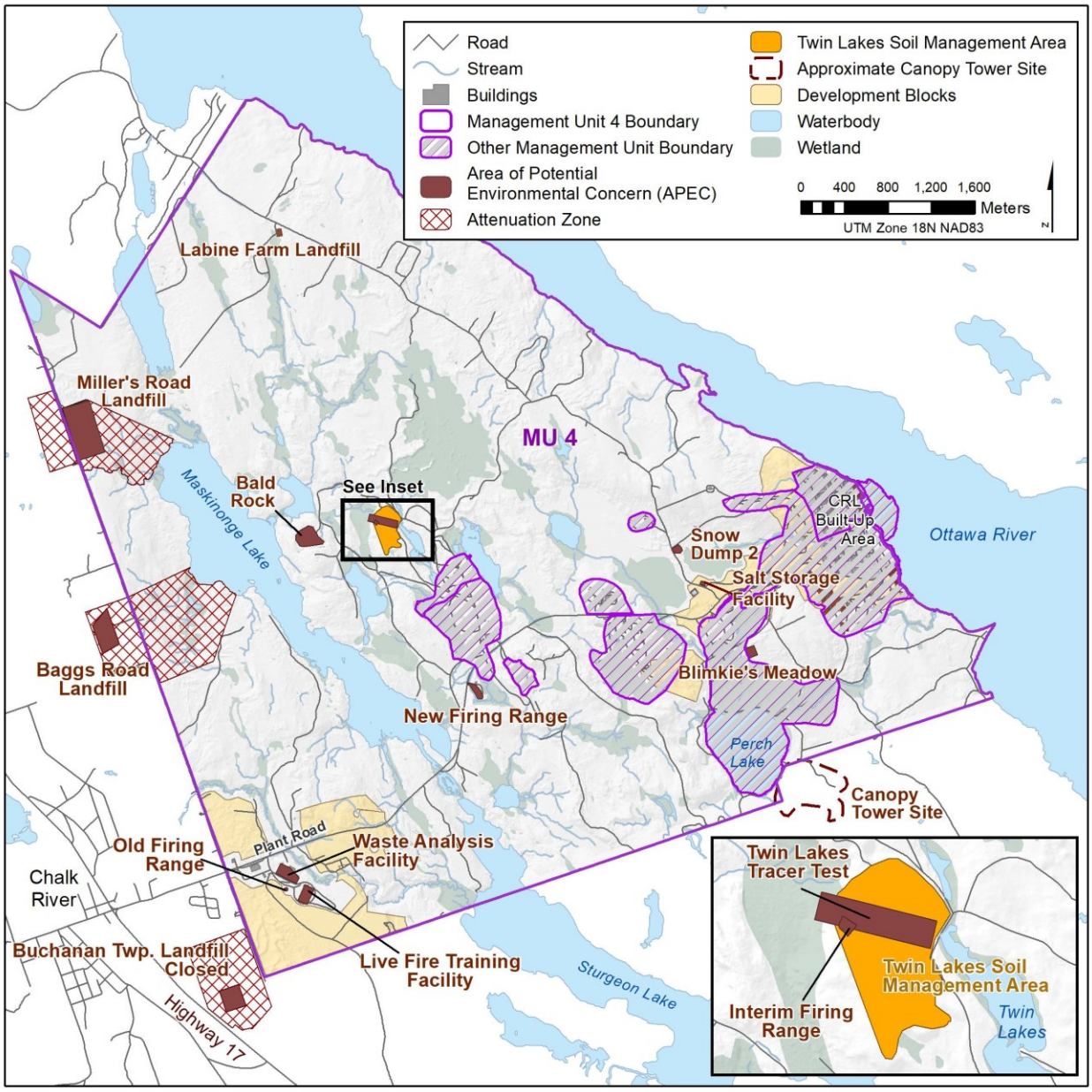

Figure 13: Map of Management Unit 4

Since the past iteration of this overview CPDP, changes have occurred at the Waste Analysis Facility and at the Live Fire Training Facility areas. A concrete and asphalt storage and processing facility became operational in 2021 which will allow for on-site reuse of aggregate material. There is also a facility under construction which will be comprised of a Waste Characterization Services Lab and Fire Training Classrooms.

Other projects completed since 2018 include several buildings such as [redacted] (Emergency Equipment Storage), [redacted] (Document Shack), and [redacted] (Outer Gate House) which have undergone decommissioning within MU 4, have reached end-state and in some cases the area is being reused, e.g., the widening of Plant Road at the site entrance is occupying the former

footprint of [redacted]. The new logistics warehouse facility at the CRL site entrance, the Minwamon building ([redacted]), was commissioned in 2021.

In 2021 and 2022 all 37 of the deep exploratory boreholes were decommissioned. Twin Lakes Soil Management Area was expanded in 2021 to include two formerly affected lands: the Twin Lakes Tracer Test Site and the Interim Firing Range. Supporting documentation for the appropriate management of soil is under development to ensure any soil being stored for reuse is of appropriate environmental and physical quality.

Most of the affected lands in MU 4 exhibit no, or only limited, localized evidence of contamination. Several of these APECs are currently operational or are being redeveloped as part of ongoing operations. Other APECs, located in the Outer Precinct, away from current operations are not currently candidates for redevelopment and may be allowed to return to nature following the necessary confirmatory characterization and closure process.

Contaminated areas within MU 4 will be remediated to the lowest level reasonably achievable and the majority of the final land use following cleanup activities will likely meet a proposed target of unrestricted or parkland land use. Affected areas within MU 4 that are selected for site revitalization purposes may instead be remediated to a proposed, target of industrial land use to support the ongoing CNL missions. A list of the APECs within MU 4 is provided in Appendix A.

10.5 Management Unit 5

Management Unit 5 consists solely of the area of contaminated sediment in the Ottawa River adjacent to the CRL Campus Precinct area that has been affected by CRL operations. The CRL shoreline areas along the built-up area are considered as part of MU 1 (Section 10.1) and MU 7 (Section 10.7).

Human health risk assessment confirms a low risk to the public from the contaminated sediment and that the river in this area remains safe for recreational use. In addition, multiple lines of evidence presented in the Ottawa River sediment Ecological risk assessment showed that there is negligible and declining risk to the Ottawa River biota from this historical sediment contamination [102]. Numerous downstream beach and shoreline surveys on both shores of the Ottawa River have not detected any radioactive particles and comprehensive studies have indicated that even under extreme scenarios, the contamination is highly unlikely to be transported toward beaches and shorelines. A robust effluent monitoring program continues to monitor for changes and indicate that discharges to the Ottawa River meet all regulatory requirements [74], [75].

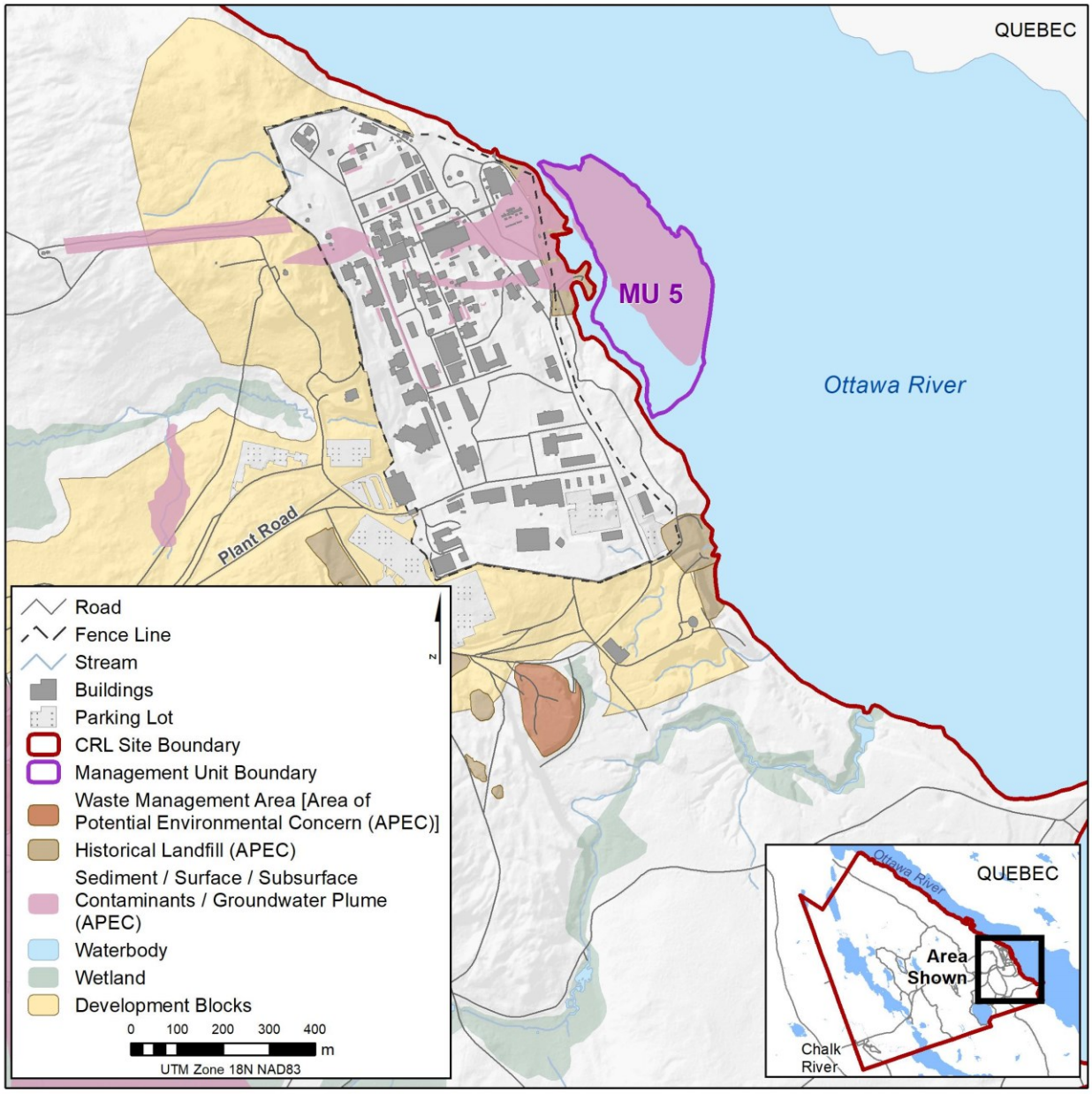

Figure 14: Map of Management Unit 5

A detailed summary of the Ottawa River sediment contamination and the extensive work done to assess the area is provided in Section 4.7 of the 2018 CRL ERA [11], also see Appendix A. The management goal is to maintain low and acceptable risk to human health and the environment under a Monitored Natural Attenuation approach. An ongoing sediment verification monitoring program is being implemented in order to monitor the riverbed and verify that the underlying assumptions and conclusions made with respect to the contamination situation remain valid [103]. The results of the monitoring program to date have shown that the critical assumptions remain valid and river sediment deposition is further burying the contaminated sediments under clean more recent sediments while allowing radiological contaminants to decay [104],

[105]. The Ottawa River Sediment verification monitoring program will continue to assess Monitored Natural Attenuation progress. A forward plan to determine, and work toward, an appropriate end-state for this area requires development.

10.6 Management Unit 6

Management Unit 6 in the Outer Precinct lies within the Perch Lake Basin, which drains to the Ottawa River (Figure 15). MU 6 includes WMA A and the Liquid Dispersal Area (LDA), Reactor Pit 1, Reactor Pit 2, Laundry Pit and Chemical Pit, where radiological wastes have been dispersed and buried and significant contamination has been observed. MU 6 also includes former experimental sites where lower levels of contamination may remain present. Wetlands, generally to the south of WMA A and the LDA toward Perch Lake which drains to Perch Creek, have been impacted by waste disposed in MU 6. Both a Pump and Treat system and a permeable reactive barrier treatment system are used to intercept and remove ^{90}Sr from the groundwater before migration to the East Swamp and South Swamp, respectively.

There are currently no near-term plans for additional enabling facilities to be located in MU 6 to support the cleanup missions. The former disposal area valve house ([redacted]) is currently undergoing decommissioning in MU 6 and will enter an interim end-state. The other buildings in MU 6 house the groundwater treatment facilities which will remain operational (see Appendix A).

Management Unit 6 is a key priority area for cleanup activities due to the potential environmental risk associated with the waste contained in WMA A and the LDAs and because the portion of MU 6 that runs adjacent to Plant Road has been identified as a potential area for redevelopment. Appropriate enabling facilities will be required to support the cleanup of MU 6 due to the large quantities of contaminated waste and soil that will require remediation which most likely will include removal prior to site restoration to meet future land use requirements.

In 2017, an environmental characterization effort was focused on the unsaturated soil across the WMAs within MU 6 to determine if the soil would meet the proposed NSDF waste acceptance criteria. The analytical results from samples in and around the Areas of Potential Environmental Concern within MU 6 suggest that the contaminated soil in the unsaturated zone will meet the proposed NSDF waste acceptance criteria. The buried waste materials will be characterized during environmental remediation.

Over the next five years, additional environmental characterization efforts at the Waste Management Areas within MU 6 will be undertaken to assist in remedial planning and help delineate LLW areas from clean areas to reduce the amount of waste generated. Treatment options will be assessed for any waste that may not be suitable for disposal at the proposed NSDF.

Screening criteria for radionuclides in saturated soil are required to assist in the development of the remediation plan for any contaminated soil below the water table within MU 6. Detailed Decommissioning Plans and Remedial Action Plans will be prepared for the Nuclear Facilities within MU 6 (see Table 7) following the characterization activities.

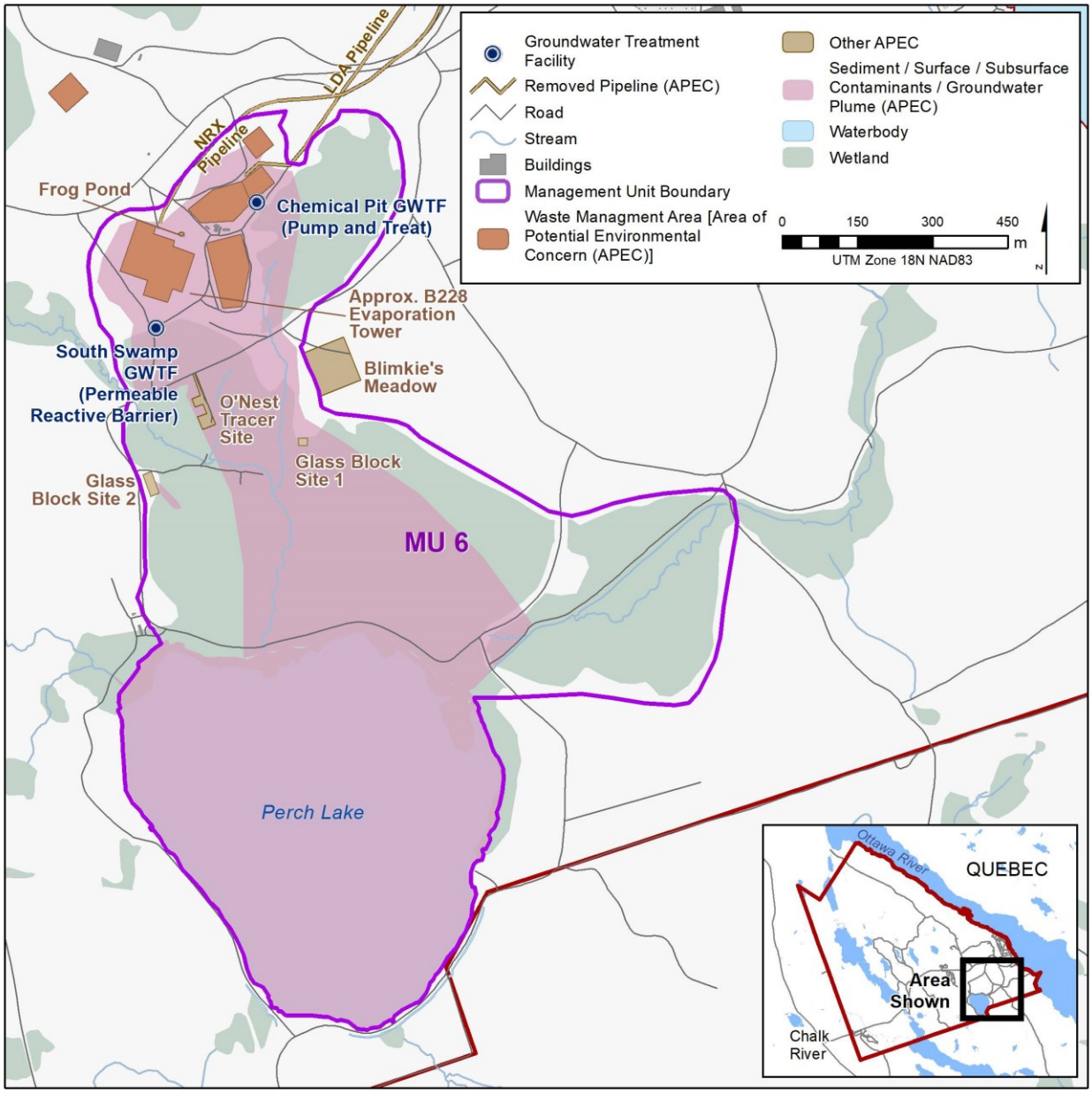

Figure 15: Map of Management Unit 6

The source areas (i.e., WMAs) within MU 6 will be remediated to the lowest level reasonably achievable. For instance based on the current understanding of the spatial and temporal distribution of the contaminants within MU 6, the Laundry Pit will likely meet a proposed target of unrestricted land use following remedial activities, however alternative land use scenarios (e.g., parkland) may be considered for the remaining areas. Areas within MU 6 that are selected to enable the cleanup mission or for site revitalization purposes may be remediated to a proposed target industrial land use. The Remedial Plans will also consider future land use scenarios beyond the period of institutional controls for the site. Wetlands impacted by groundwater plumes attributable to the contamination sources in MU 6 will be evaluated to

assess the effectiveness of natural attenuation as a potential remediation option. A list of affected lands within MU 6 is provided in Appendix A.

Based on comparison of recent soil characterization results to risk-based soil screening criteria, the total waste volume of contaminated material to be remediated from MU 6 is currently estimated to be 144,000 m^3. This volume is considered adequate for preliminary planning purposes, however it does not consider reuse of any soil material. For example, reuse of the clean, unsaturated soil cover over WMA A may be possible and would reduce the amount of soil to be sent for disposal. The disposal estimate also does not include soil within the saturated zone since the screening criteria for saturated soils are yet to be developed. These estimates are based on the most recent characterization results available, additional characterization in MU 6 is currently underway and this will lead to refinements in estimated volumes.

The preliminary estimated breakdown of waste from MU 6 is as follows:

- Approximately 101,326 m^3 of low-level contaminated soil,
- Approximately 19,390 m^3 of aggregate/rock,
- Approximately 3,500 m^3 of vegetation, and
- Approximately 20,000 m^3 of solid waste

For the areas with sufficient characterization data available, figures delineating the preliminary estimated extent of contamination in the unsaturated soil zone were created using the risk-based soil screening criteria (Section 9.3.1). These were developed based on the potential next land uses at CRL (Section 9.1.2) for two specific reference time periods which correspond to today (if the site was reused immediately following remediation) and 400 years from now which is the assumed end of institutional controls used for modelling purposes. The preliminary estimated extent of impact for the Laundry Pit, Chemical Pit and RP 2 are shown in Figure 16, Figure 17, and Figure 18, respectively. The estimated and interpreted extent of impact differ in that the estimated extent of impact is confirmed (i.e., the polygon is closed in) based on the evaluation of sufficient characterization data, whereas the dashed line showing the interpreted extent of impact indicates where CNL requires additional characterization data in order to fully define the boundaries of where the contamination exceeds the soil screening criteria for the particular land use and time period (indicated by a red dot), and where it is below the applicable criteria (indicated by a yellow dot). For example, in Figure 18: Reactor Pit 2 – Preliminary Estimated Extent of Impact, there is sufficient characterization data in order to determine the preliminary estimated extent of impact for both parkland use in 400 years and industrial use today, but additional soil sampling and analysis would need to be completed to fully delineate the extent of impact for unrestricted use today, unrestricted use in 400 years and parkland use today.

These interpretations will be used to determine the estimated contaminated waste volumes within MU 6 and serve as an important tool for the detailed decommissioned and remedial planning. Within MU 6, characterization activities initiated in 2022 and planned within the next 5 years will be used to further refine these volumes.

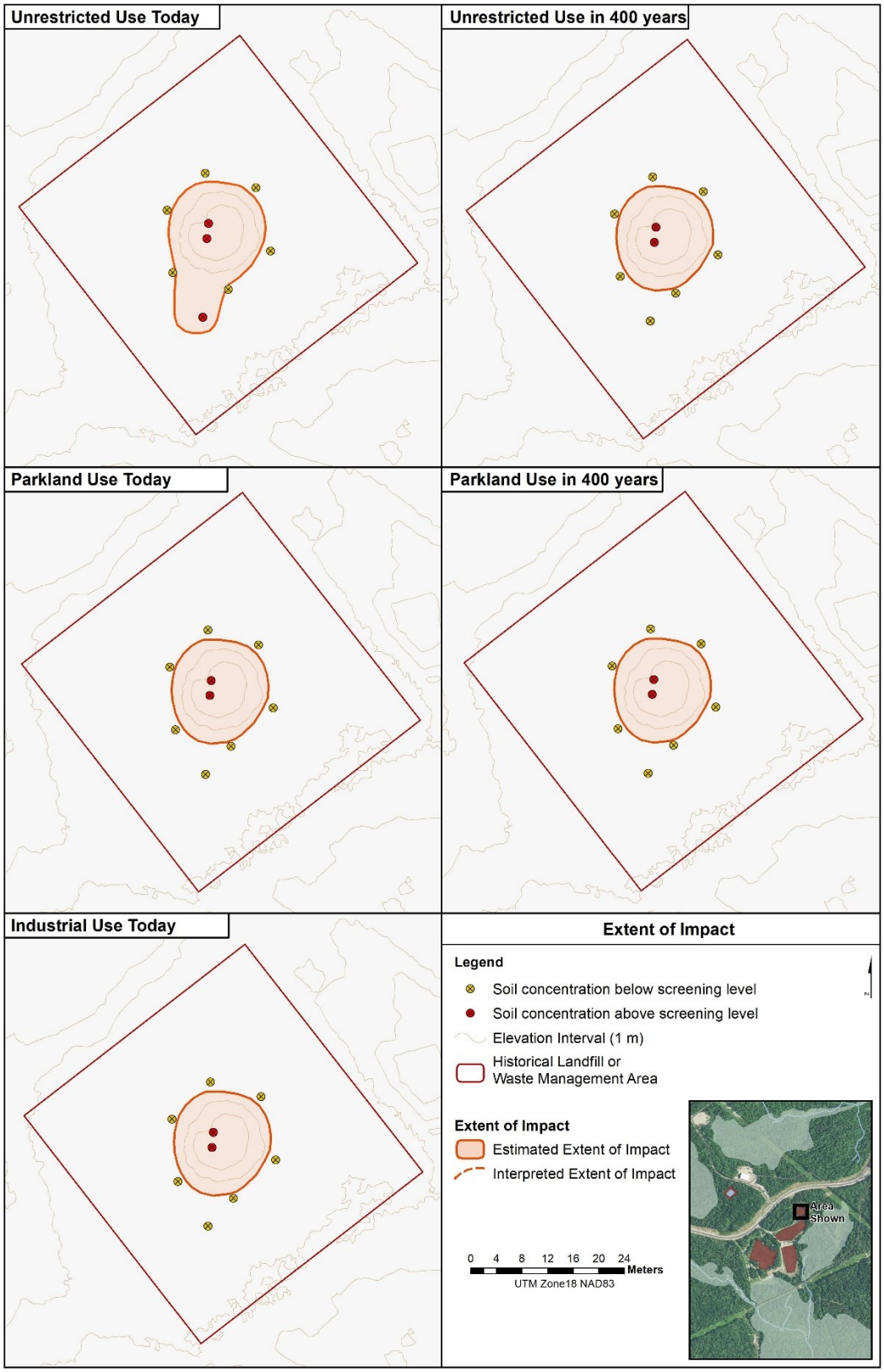

Figure 16: Laundry Pit – Preliminary Estimated Extent of Impact

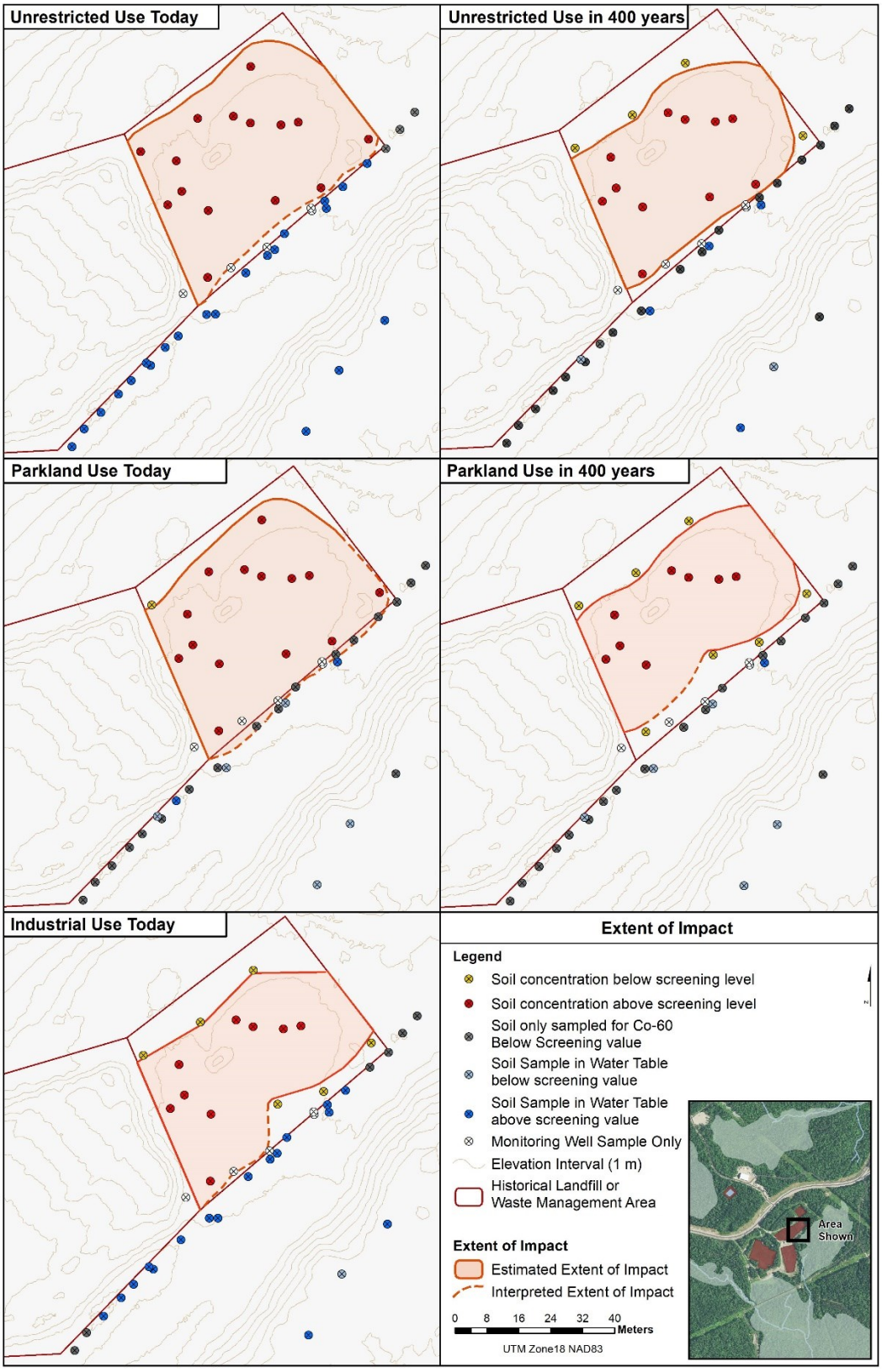

Figure 17: Chemical Pit – Preliminary Estimated Extent of Impact

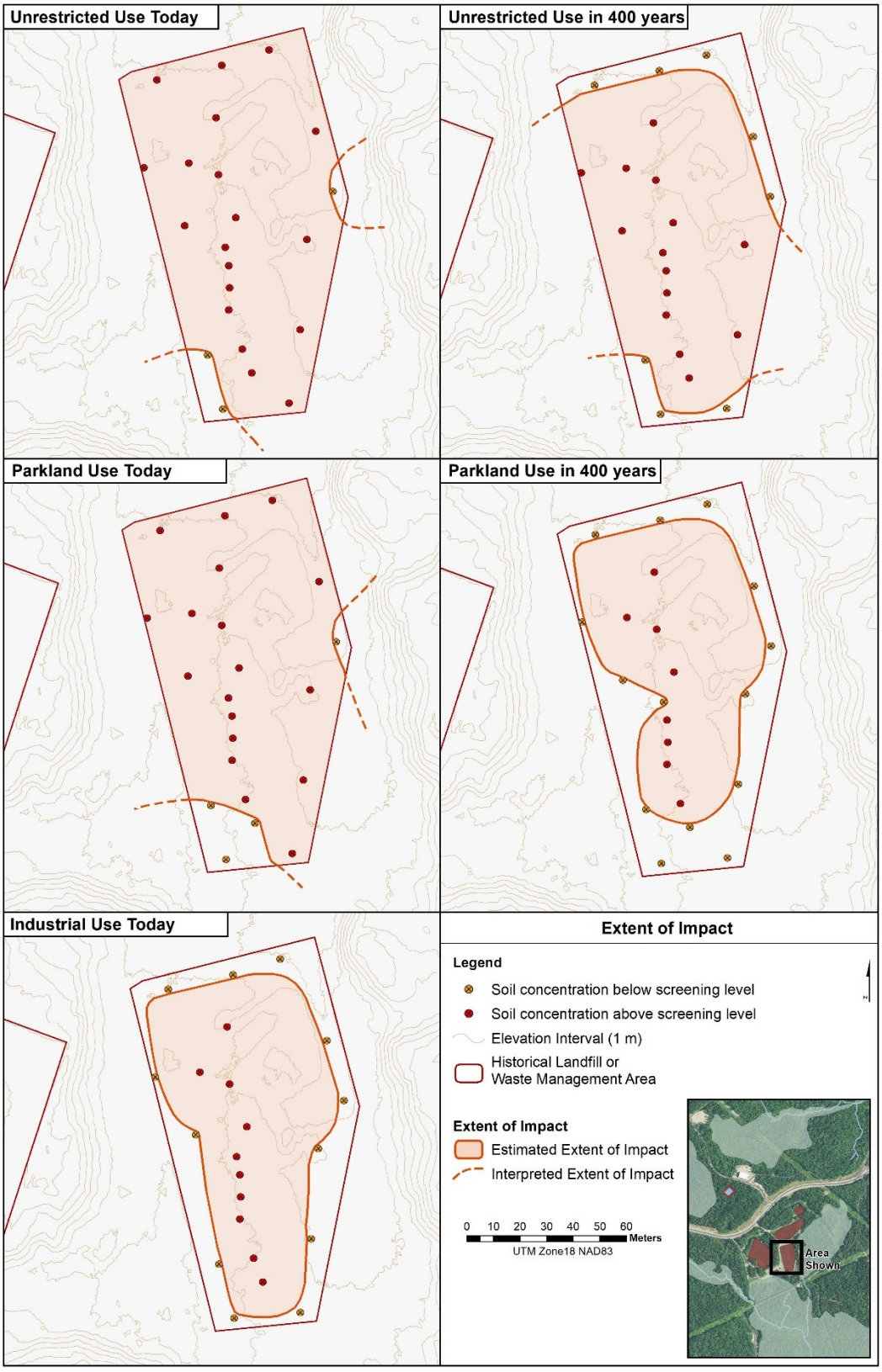

Figure 18: Reactor Pit 2 – Preliminary Estimated Extent of Impact

10.7 Management Unit 7

Management Unit 7 is located in the Ottawa River Direct Basin and includes the southern [redacted] portion of the Campus Precinct, also known as the inner Supervised Area (SA) (Figure 19). The inner SA is undergoing a period of major redevelopment as part of site revitalization. The developed area of the SA is currently and has historically been occupied by predominantly non-nuclear facilities, office buildings, industrial facilities (e.g. water and sewage treatment facilities, machine shops, vehicle maintenance shops, petroleum supplies). There are some Controlled Area islands in buildings inside the SA (e.g. [redacted]). MU 7 also includes the immediately adjacent portions of land within the Outer Precinct to the south and west which are portions of land that were used in various operational capacities during earlier years of site development and operation. The historic uses consisted of landfilling, waste burning, equipment lay-down/storage, and winter snow dumping. This area also contains the operational sanitary landfill. This MU also includes the LDA Pipeline; 1953 NRX Emergency Pipeline and Above Ground Reactor Ventilation Duct Routes. In general, low to moderate levels of radioactive contamination have been observed at these facilities, except in the Foundation Road Landfill and the Electrical Yard Landfill where hazardous and radioactive wastes are known to be present.

Management Unit 7 contains numerous buildings and structures, some of which are undergoing accelerated decommissioning, while others will continue to be operational for many years. MU 7 is a priority area for site redevelopment to support continued operations at the CRL site into the future. Since the last iteration of the CPDP [1], a number of buildings have been decommissioned and demolished in MU 7. A partial list of the more significant buildings decommissioned in MU 7 since 2018 includes:

- The Vehicle Maintenance Shop [redacted]
- The Library [redacted]
- The remaining portion of the Glass Blowing Shop [redacted]
- The Carpentry Shop [redacted]
- The Sanitary Waste Water Plant [redacted]
- The National Research Council Technology Lab [redacted]

Several new builds have been commissioned and are now occupied including the Harriet Brooks Building ([redacted]) and the Support Facility ([redacted]). The Science Collaboration Centre ([redacted]) is under construction. Additional buildings are planned to continue the transformation of the Campus Precinct including a Small Modular Reactor, a Heavy Water Detritiation Facility, and a new switchyard and energy centre. The focal point of the Campus Precinct will be the Central Quad, a large greenspace area which will be framed by the Advanced Nuclear Materials Research Centre (ANMRC) and the Harriet Brooks buildings. The Support Facility is one example of a recent new build in MU 7 (another is the Minwamon Building in MU 4) which is built sustainably to align with the Government of Canada's Federal Sustainable Development Strategy plan to promote clean growth, ensure healthy ecosystems and build safe, secure and sustainable communities.

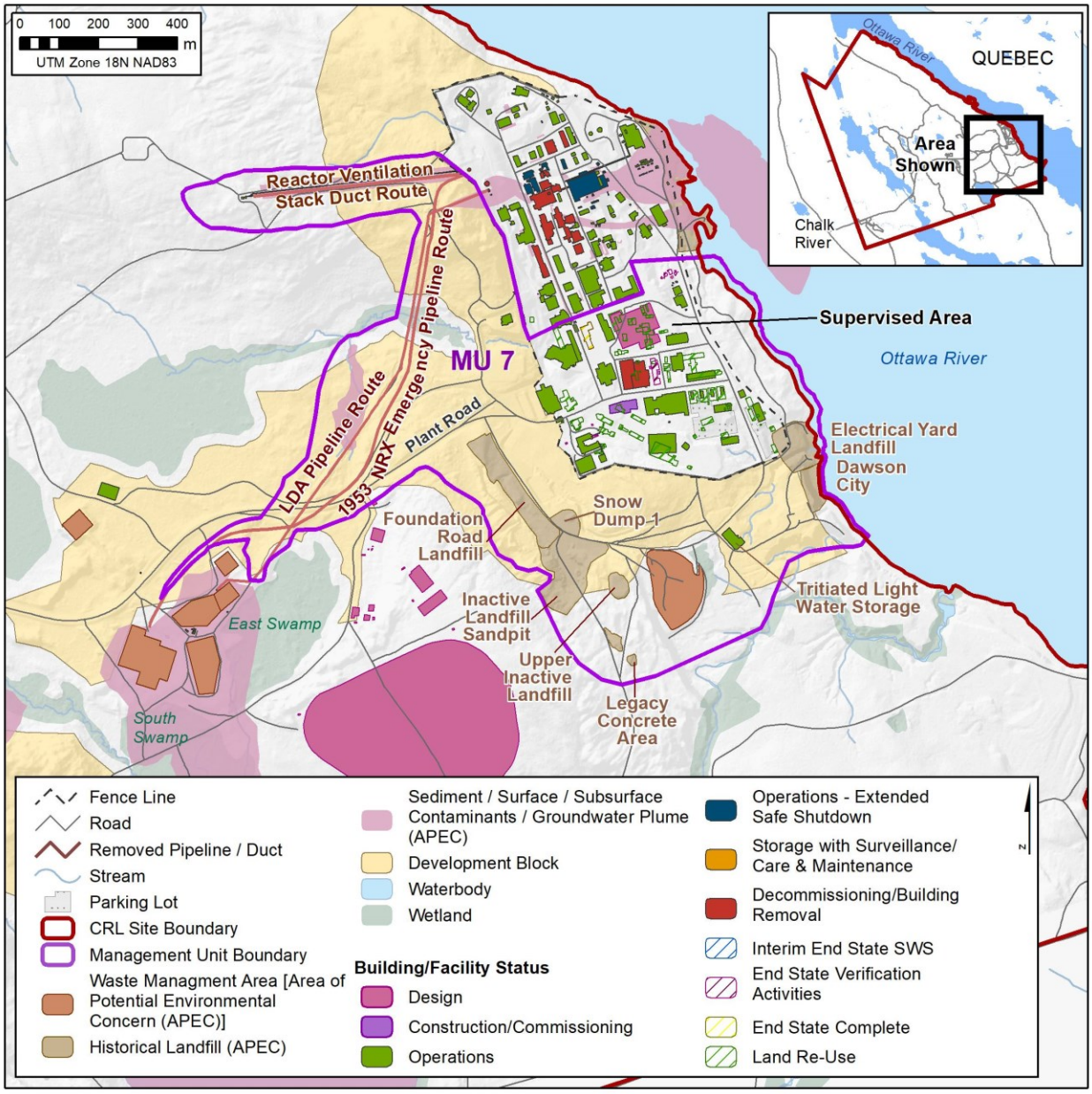

Figure 19: Map of Management Unit 7

The Support Building opened in 2021 to provide a base of operations for approximately 140 people and consolidates roughly 20 different trade shops from the inner SA. The new building also contains storage facilities and offices to streamline maintenance and manufacturing activities. Prior to the development of the Support facility a small remedial project was undertaken to remove hydrocarbon contaminated soil resulting from the vehicle maintenance building ([redacted]), which was located in the footprint used for the new Support building.

Environmental Site Assessments have been conducted to support cleanup efforts at a number of areas within MU 7 in advance of decommissioning, new building developments, utility upgrades, and characterization of some APECs where development projects have been

contemplated (e.g., Dawson City, Electrical Yard Landfill, and the Foundation Road Landfill). Aside from the hydrocarbon contamination identified at the [redacted] (building demolished and area cleaned up), contamination has not been identified in the new build footprints or the utility project corridors in MU 7.

To enable the redevelopment of MU 7, several decommissioning and environmental remediation projects will take place over the next few years. The decommissioning of legacy buildings will include [redacted] to continue to make space for site redevelopment. In addition, MU 7 is the prime candidate area to host the development of the Small Modular Reactor project. Some temporary structures may be removed if the development blocks in which they are located are required for priority new build projects. A summary of the current buildings within MU 7 that are destined to be kept for the long-term and those that are slated for decommissioning is presented in Appendix A.

Much of the area surrounding the SA consists of impacted lands, including several landfills. It is considered prime redevelopment land to support the revitalized research campus. Should new development or revitalization projects require land that has been impacted, the environmental remediation process will be followed to ensure appropriate industrial land use criteria is achieved prior to development. Thus, over the next few years a number of Environmental Site Assessments will be required to help plan and develop remedial action plans to guide the cleanup of these impacted areas to proposed target industrial land use. Other affected areas within MU 7 that may not be suitable or desirable for industrial reuse, may alternatively be cleaned up to proposed target parkland or unrestricted land use.

Upcoming environmental remediation work within MU 7 includes the delineation of contamination along some sections of the LDA pipeline contamination, delineation and project closeout activities, and assessment of legacy sites. The southern portion of the Foundation Road Landfill and the Inactive Sandpit Landfill will be remediated to provide space for a parking lot expansion in support of the Small Modular Reactor project.

The APECs within MU 7 with known or probable contamination are listed in Appendix A. Conditions at most of the APECs in MU 7 are monitored and stable although further environmental characterization is needed at several locations to adequately delineate contaminated areas and establish the most appropriate remedial path.

The estimated waste volumes of the APECs are important for the planning of cleanup activities across the site. Further environmental characterization is required to delineate the full extent of the impacted areas and to refine expected volumes of waste generation for a given land use or end-state.

10.8 Management Unit 8

Management Unit 8 is located within the Outer Precinct, north of Plant Road between Lake 233 and Duke Swamp and south of MU 11. It includes WMA C and WMA J, and two tritium plumes which extend from WMA C westward to Duke Swamp and south to Bulk Storage Swamp. Lake 233 has not been impacted by operations at MU 8, as confirmed as part of the annual compliance monitoring program, as it is located upgradient of the Nitrate Plant, the Thorium Pit

and the ACS Pits. No significant changes are anticipated at WMA J (Bulk Material Landfill), which is planned to remain operational for the long term. The plumes from WMA C, a long-term waste storage facility, are partially mitigated by an impermeable geomembrane cover.

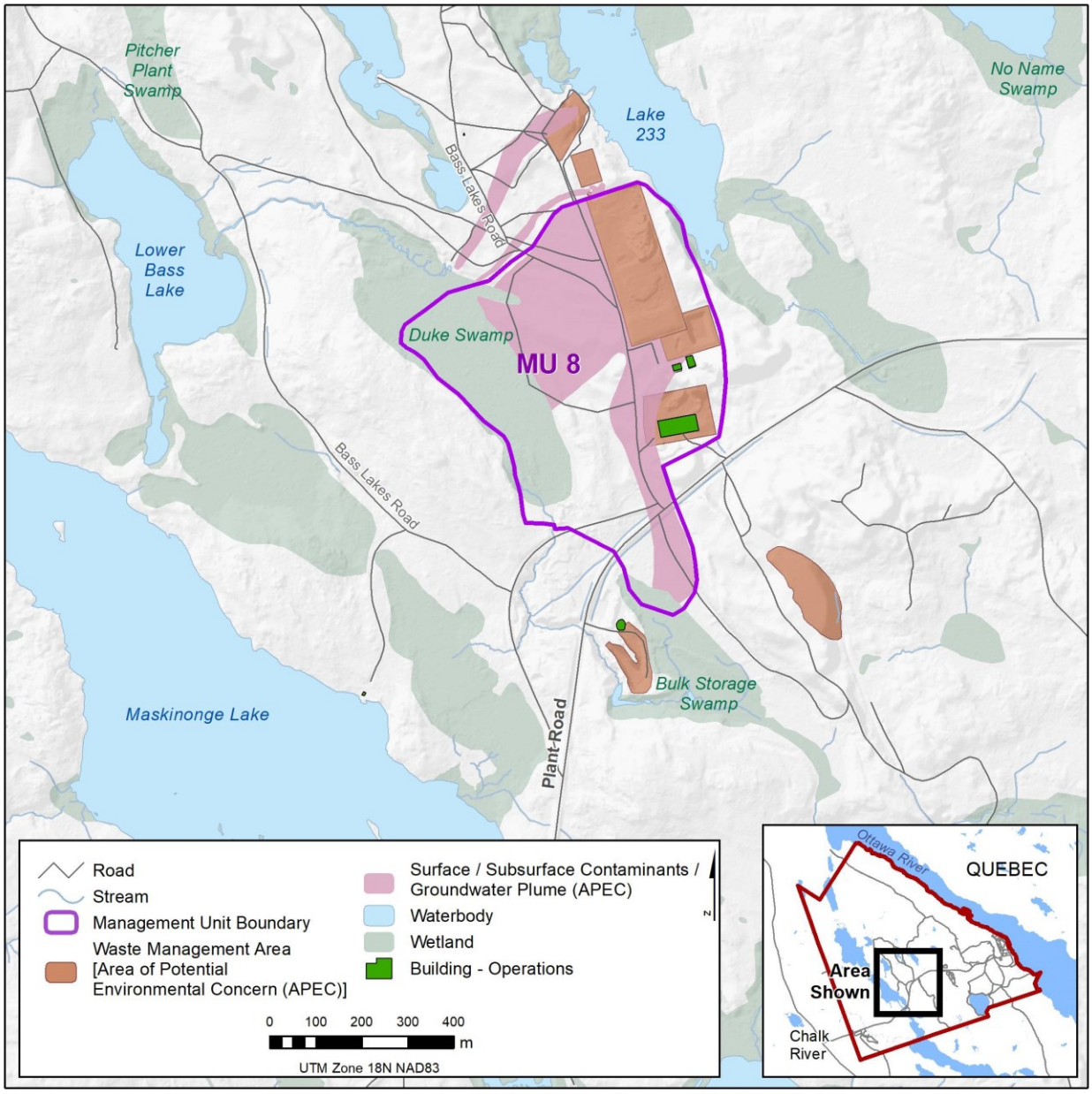

Figure 20: Map of Management Unit 8

There are presently no new development plans within MU 8, however, WMA C is planned to be repurposed for the recoverable surface storage of LLW in sealand containers. As such, WMA C will retain its current function as a waste storage area.

The impermeable geomembrane cover over WMA C (installed in 2013) was designed with a 100-year life expectancy and CNL committed to monitoring of up- and down-gradient

groundwater, annually, as well as plume updates every 10 years. The installation of the impermeable geomembrane cover has been an effective improvement, indicated by decreasing tritium trends in contaminant migration since 2015.

Two storage buildings were recently built outside of the WMA C fence line for the storage of equipment and supplies for environmental monitoring, characterization and remediation work ([redacted]). There are no structures currently slated for decommissioning within MU 8 (Appendix A).

Waste Management Area C has not been characterized, therefore the waste estimates available have not yet been updated based on comparison to risk-based soil screening criteria. The waste inventory estimates for MU 8 range between 113,000 and 119,000 m^3. This volume may be a low estimate as it currently does not consider any contaminated media outside the footprint of WMA C that may require remediation or the impact that the application of saturated soil screening criteria (to be developed), may have on the volume. Characterization in support of an environmental site assessment, risk assessment and a safety case assessment would be required to determine if the wastes at WMA C may be allowed to remain in situ with appropriate institutional controls.

The ER process and facility specific decommissioning plans/remedial plans will be implemented to determine forward plans for once these facilities are no longer in service and in the interim, the proposed target land use will remain industrial for WMA C and J, and likely will be parkland or unrestricted for the plumes.

10.9 Management Unit 9

Management Unit 9 is located in the Outer Precinct and is within the Perch Lake Drainage Basin. It includes WMA E, the Waste Tank Farm, and the former Lysimeter Research Facility.

The Waste Tank Farm is operational but has not accepted waste transfers since 1968. The Waste Tank Farm area within MU 9 is undergoing expansion in order to support enabling facilities to achieve cleanup of the area. The key enabling facilities to support the cleanup of the Waste Tank Farm include a tank farm weather enclosure, a legacy waste processing intermodal container, and a whole body monitoring building. There are currently no future development plans for MU 9.

Waste Management Area E accepted waste until approximately 1984. WMA E has been considered a candidate for in situ disposal in various planning assumptions. The latest characterization was completed in 2018 when monitoring wells were installed and soil and ground samples were collected to provide data for future evaluations. Limited contamination has been observed in MU 9, mostly around small pockets of construction waste. No significant groundwater contamination has been detected in the area.

A summary of the buildings and structures and APECs currently within MU 9 are provided in Appendix A. The total waste volume of MU 9 is not known at this time. There is an estimated 22, 000 to 24,000 m^3 of waste within WMA E. No estimate has been made for potential contamination around the Waste Tank Farm area. Overall waste volumes associated with the eventual cleanup of MU 9 will be further detailed as the ER process and facility specific

decommissioning plans/remedial plans are progressed once these facilities are no longer in service. A safety case assessment would be required to allow in situ disposal of the wastes found at WMA E. Alternatively, cleanup to the proposed target land use of industrial, parkland and/or unrestricted will also be considered under the remediation options evaluation process.

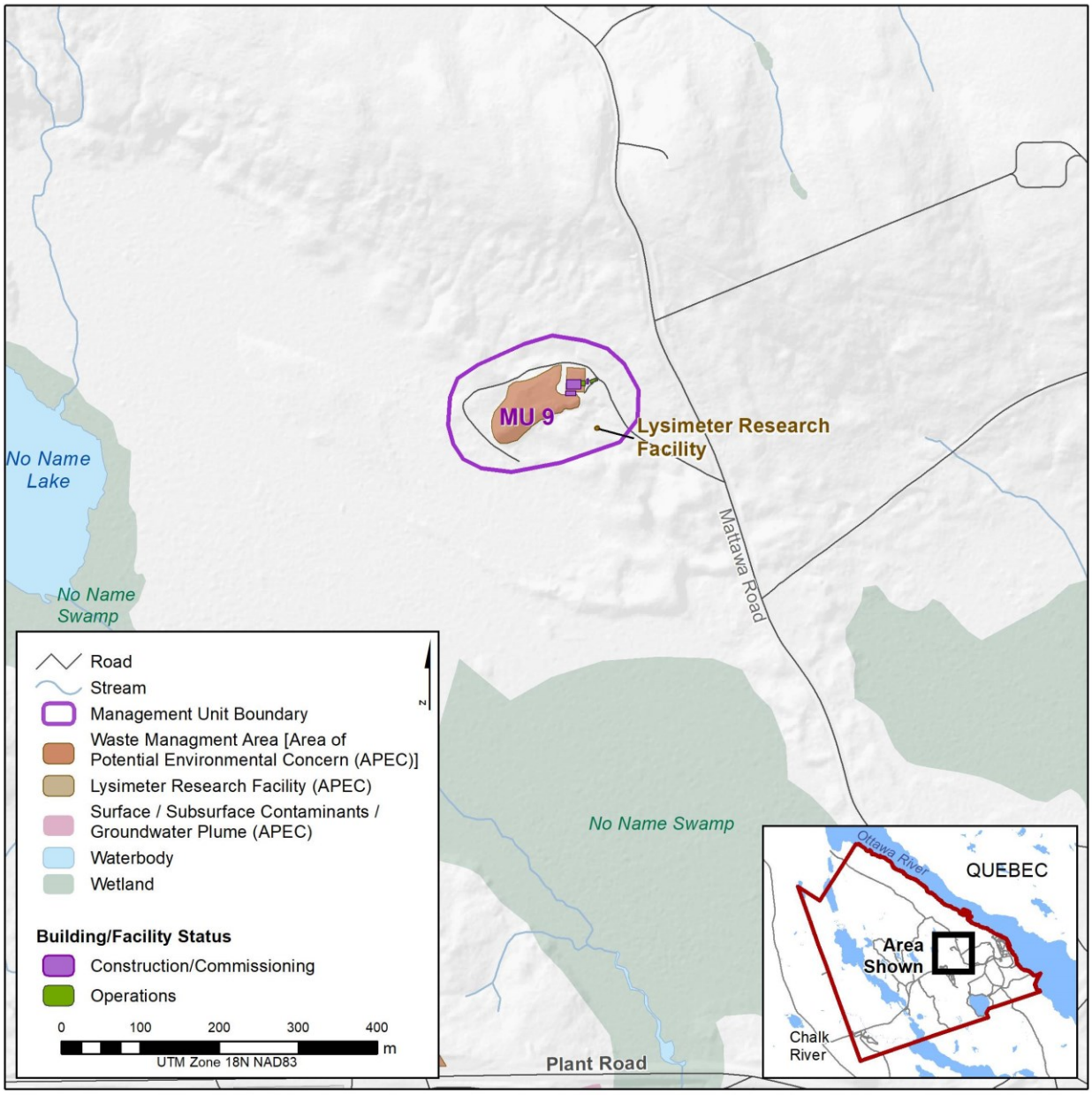

Figure 21: Map of Management Unit 9

10.10 Management Unit 10

Management Unit 10 is located in the Maskinonge Drainage Basin. It includes WMA F where radiologically contaminated soils and wastes were brought from four historic off-site Ontario facilities and buried in the late 1970s. WMA F is monitored annually to assess possible

migration of radioactive and chemical contaminants. All environmental monitoring indicates that the waste is stable and contamination is not migrating from the WMA.

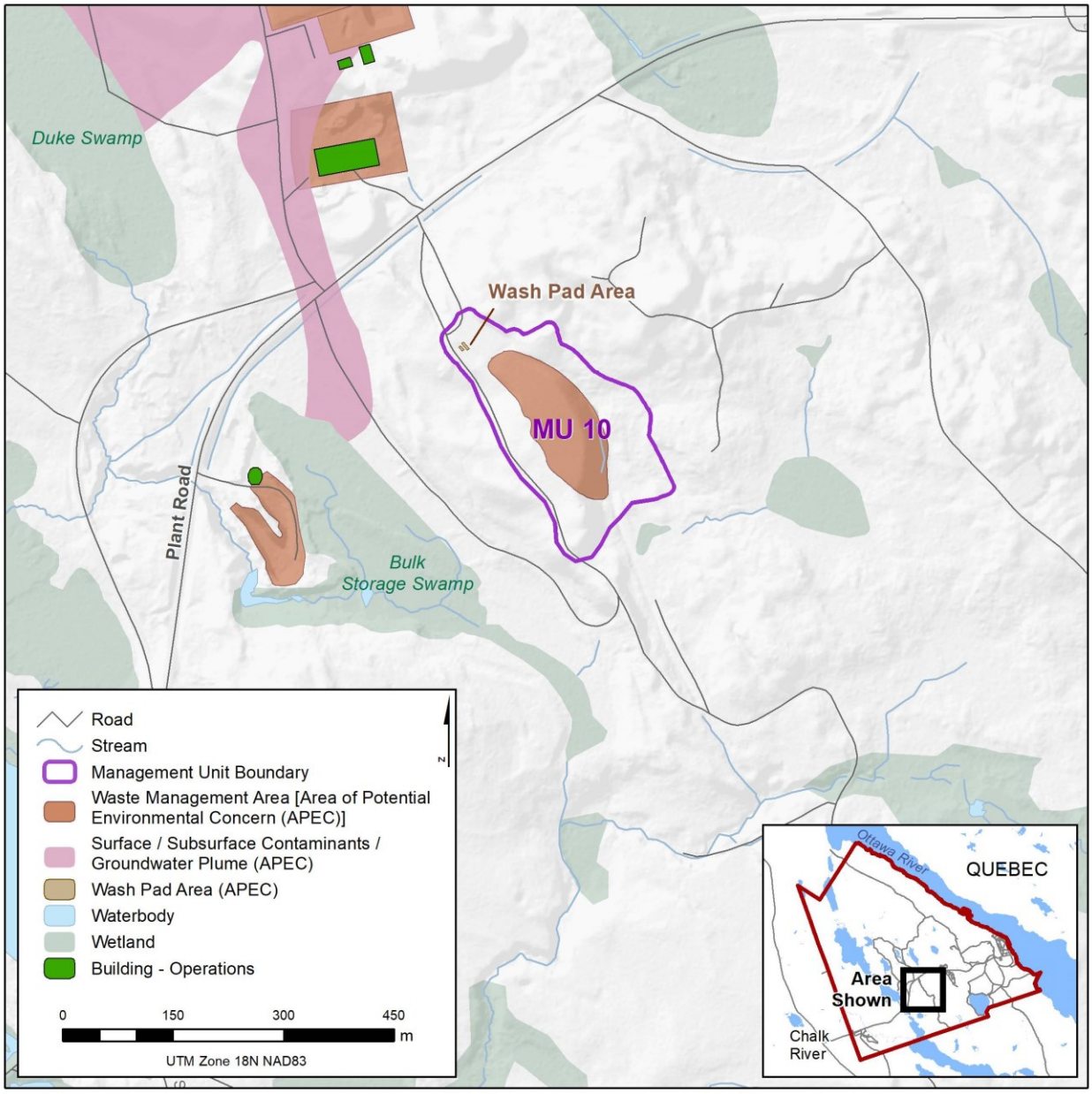

Figure 22: Map of Management Unit 10

Cleanup enabling facilities to support the cleanup mission or site revitalization are not planned for MU 10 and no new facilities have been planned in this area. Since the last iteration of the CPDP [1] the concrete pads for the truck wash bay were decommissioned and verification sampling and limited remediation was undertaken to remove contaminated soil. A detailed environmental characterization is being planned at WMA F to fill key knowledge gaps on missing data for contaminants of potential concern. This data will be used to support the RAP for WMA F. See Appendix A.

The contaminated waste volume associated with MU 10 is estimated to be 60, 500 m^3, based on records of the amount of waste that was emplaced, with an additional 24,900 m^3 of clean cover that will require management. Notably, the waste volumes requiring remediation remain the same regardless of the future land use selected since the contaminants have stayed within the waste mound. Proposed target land use for MU 10 could be either parkland or unrestricted based on location and current assumptions.

10.11 Management Unit 11

Management Unit 11 is located within the Outer Precinct, north of Plant Road between Lake 233 and Duke Swamp and north of MU 8. It includes the Nitrate Plant, Thorium Pit, Acid-Chemical-Solvent (ACS) Pits, and groundwater plumes within the associated footprint. A ^{90}Sr plume originating from the Nitrate Plant infiltration pit is currently treated with a passive permeable reactive barrier near Duke Swamp, referred to as the "Wall and Curtain".

There are no cleanup enabling facilities to support the cleanup mission or new developments for site revitalization planned within MU 11. Since the last iteration of the CPDP [1], initial environmental characterization was completed within each facility in 2019.

There are no buildings remaining to be decommissioned within MU 11 other than a small, dilapidated pump house ([redacted]) associated with the former operations of the Nitrate Plant. All other Nitrate Plant associated buildings and supporting structures have been buried in situ under a large sand mound. Over the next few years, additional environmental characterization activities will be conducted to gain an understanding of the spatial and temporal distribution of the contaminants and to delineate the contamination within MU 11. This information will be used to support cleanup plans including consideration of the appropriate remedial options, development of facility specific DDPs, and to refine anticipated waste volumes.

A brief summary of the areas of concern within MU 11 are provided in Appendix A. The conditions at the WMAs in MU 11 are monitored regularly. Lake 233 has not been impacted by operations at MU 11, as confirmed as part of the annual compliance monitoring program, as it is located upgradient of Waste Management Area C. Based upon surrounding areas, the most likely future proposed target land use would be either parkland or unrestricted as the site has not been identified as an area with significant redevelopment potential.

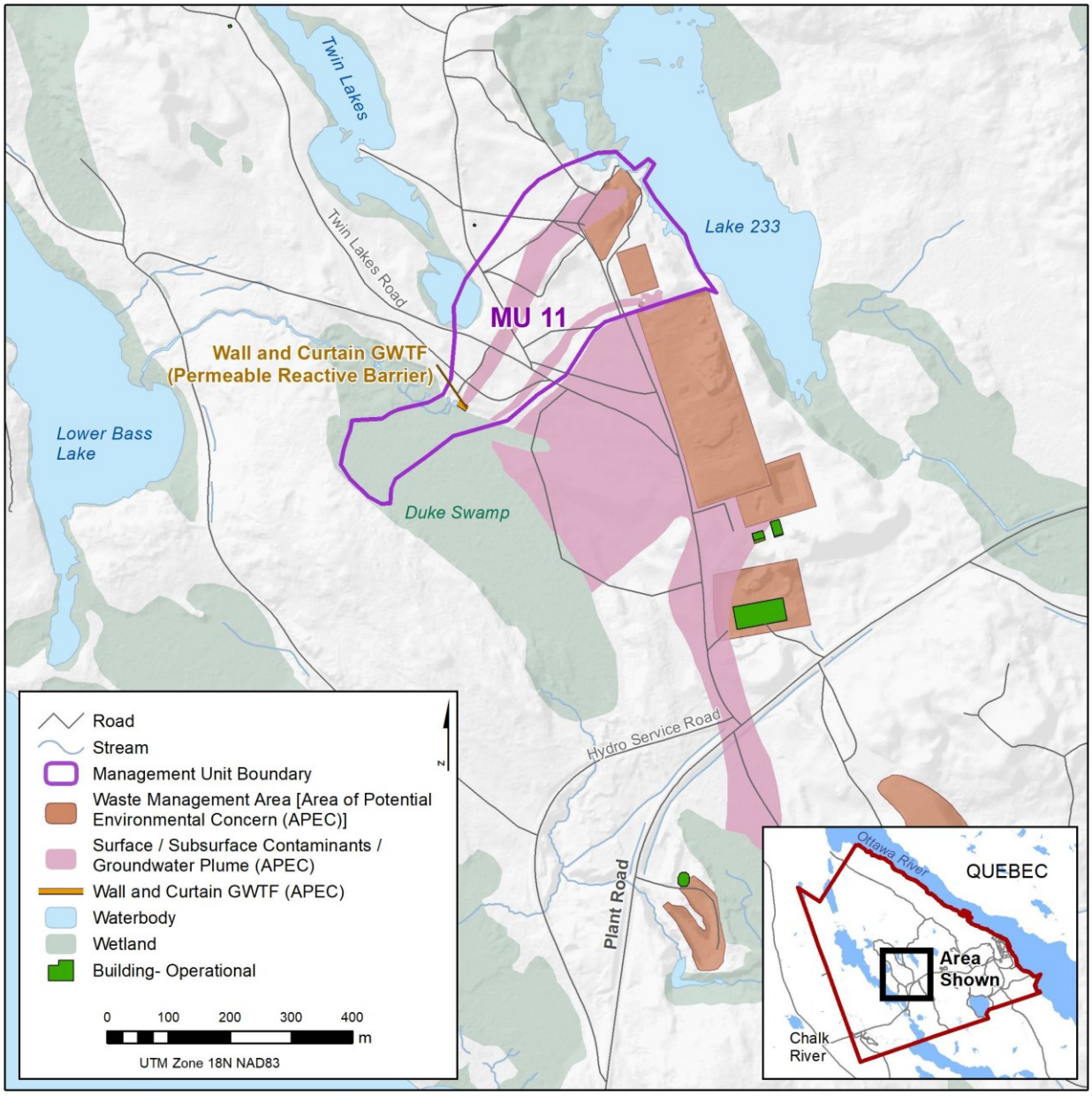

Figure 23: Map of Management Unit 11

10.12 Swamps and Wetlands Affected by Groundwater Plumes

Several historic, non-engineered WMA facilities (within MUs 3, 6, 8 and 11) are the source of radiological and chemical substances releases which have migrated to the surrounding environment, primarily via groundwater transport. This has led to several plumes that are the subject of characterization and monitoring programs, most of which have impacted swamps and wetlands in the outer Supervised Areas. There are also plumes resulting from historic facility operations in the Controlled Area which are migrating toward the Ottawa River (see Section 10.1).

Plume monitoring, conducted as part of CNL's Groundwater Monitoring Program, provides confirmatory data that the plumes are behaving as expected. Plume monitoring will continue for the indefinite future and will guide intervention and environmental remediation programs designed to ensure continued public safety.

These plumes do not represent a potential direct external exposure hazard to operating personnel or the public. The risk to non-human biota and the environment is being managed by CNL. Where risks to non-human biota are identified, mitigative groundwater treatment systems are implemented. Four groundwater treatment systems have been implemented to date.

The annual discharges into the relevant drainage basins have been, and are projected to continue to be, well below annual Derived Release Limits for CRL.

In general, at present, the strategy for the plumes will be continued monitoring, treatment in several cases, and assessment of the need for capture. The purpose of continued monitoring is to confirm whether the plumes are evolving as expected and determine if impacts are acceptable. In order to preserve valuable wetlands that may include species at risk habitat, media impacted by groundwater plumes will be evaluated to assess the effectiveness of natural attenuation as a potential remediation option. Annual updates on plume monitoring results and affected downgradient wetlands are provided in the Annual Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL (e.g., [106]). Screening criteria for radionuclides in saturated soil are required to assist in the development of remediation plans for any contaminated soil within the water table.

The wetland areas affected by contaminant plumes will be characterized in detail and new information will be incorporated into future ODCP revisions.

10.13 Existing Site Infrastructure

The infrastructure listed below are currently operational and are located in various areas of the site, in some cases across several or all MUs (e.g., meteorological stations and roads). Long-term plans (see Section 4.3.5.1) for either ongoing maintenance or removal of this infrastructure from service will be considered in future iterations of the ODCP and the Site Master Plan (e.g., in the case of roads and distributed services), as applicable.

10.13.1 Roads and Parking Lots

The CRL site includes approximately 52 km of roads, approximately 20 km are paved, while 32 km are gravel or dirt paths. There are also several parking lots, with the largest ones located in MU 7 (Figure 24). In terms of area, the roads provide access and therefore impact a significant portion of the CRL site.

Two primary environmental concerns regarding roads and parking lots on the CRL site are the use of road salt (year round access roads and parking lots) and historically, the application of dust suppressant oils (sub fraction of the gravel roads). Several areas near the Plant Road have elevated chloride concentrations resulting directly from winter road salt application. Since 2018 CNL has reduced the amount of road salt being used on CRL roads by incorporating more sand

into the mixture and since that time several locations, particularly in both MU 1 and 6, have observed significantly decreased road salt impacts [78].

Blanding's turtle road mortality is also a concern from the road network. If the road mortality continued at the rate observed in 2015, a Population Viability Analysis concluded that the population would be extinct in less than 60 years. CNL has implemented new measures to protect turtles and other species from vehicles circulating on Plant Road and other roads at CRL (see Section 7.2.1).

Canadian Nuclear Laboratories is currently developing a cohesive strategy for the site's road network. A traffic study was completed in 2022 to assess the current transportation network, regular operational movement of people and vehicles on-site along with mission requirements for truck and material movement in order to recommend transportation network improvements for the site. This may result in the eventual decommissioning or reconfiguration of some existing roads.

Figure 24: Map of the Main Parking Lots at CRL

10.13.2 Aggregate Borrow Pits

Aggregate extraction on the CRL site has taken place from the earliest days of site development (the start of some of these activities pre-date both AECL and the initial development of CRL). This has resulted in the presence of several sand pits on the site. All the pit areas are considered to be in operational use, but the frequency of their use depends largely on their proximity to current operations requiring aggregate. The total land area under use as aggregate borrow pit is less than 19 acres (8 hectares) most of which are located in MU 4.

Although currently considered to be in operational use, as site operations no longer requires them, several steps will be taken to provide for pit reclamation such as; stabilizing slopes, filling in excavations that extend into the water table; re-vegetating areas, as required (e.g., areas larger than 2 acres (0.8 hectares)).

10.13.3 Forest Slash Areas

Several areas on the CRL site have been used to accumulate forest slash, course and fine woody debris, from site and road development activities. These areas continue to be in operational use and there are no plans to cease these operations in the next 25 years. Over time, the accumulated vegetation degrades to a mulch/organic layer. The Forest Management Plan will be implemented to deal with the accumulation of forest debris in managed areas.

10.13.4 Meteorological Stations

The CRL SA is host to several types of meteorological stations. The primary station consists of instrumentation to provide data on several meteorological aspects including wind speed/direction and air temperature. Others provide data on either wind speed/direction, precipitation, temperature maximum/minimum or air quality. There is also a network of 20 ambient radiation measurement installations on the CRL site, although only 5 are currently in use with the non-operational stations planned to be turned over to decommissioning by 2022. The stations require ongoing maintenance and periodic equipment upgrades over the lifetime of the CRL site.

10.13.5 Boreholes

Boreholes are present across the CRL site and are present in several MUs. They can be subdivided into two categories: deep bedrock boreholes and shallow overburden boreholes. The deep boreholes are exploratory/experimental in nature as opposed to the shallow holes, which in many cases, have been installed for monitoring contaminant migration (e.g., in sub-surface soil and groundwater) from a variety of facilities. No radiological or non-radiological contamination issues are known to exist with respect to the boreholes.

Thirty-seven of the approximately 50 deep boreholes at CRL were decommissioned in 2021 and 2022; the remainder will remain operational for the time being (see Appendix A. The closure of these deep boreholes involves sealing of the boreholes to prevent cross-linking of aquifers.

There are approximately 2,000 shallow overburden holes across the CRL site. Closure of the shallow boreholes occurs as required.

In general, all boreholes will be decommissioned following Ontario Regulations and industry standards. Decommissioning will involve the removal of as much equipment as possible (i.e., existing internal monitoring wells and packer systems), filling the annular space with a cementitious grout and casings will be extracted or terminated as close to the surface as practical.

10.13.6 Distributed Services

Table 8 and Table 9 summarize the status, decommissioning and/or upgrade plans for distributed civil and electrical services on the CRL, respectively.

Table 8: Distributed Civil Services on the CRL Site

Service	Description/ Current Status	Plans for the Next 5 Years
Underground Thermal Column Exhaust Duct	1.2 m diameter shielded active duct. In FY 22/23 this system is planned to be permanently shut down and replaced with a reactor ventilation system that is local to NRU. Ducts feed [redacted]. A common exhaust header delivers exhaust to the remote stack.	Permanent shutdown of the NRU reactor ventilation system (does not include physical component removal)
Active Drain System	Active drain replacement project is ongoing. The new Active Drain System consists of the Reactor Drain (100% in service), the Decontamination Centre Drain (100% in service) and the Chemical Active Drain (30% in service) with chemical waste collection via overland transfer. The design of a replacement of a section of the new (chemical) ADS was prepared in 2019.	The design and construction was progressed as far as economically feasible. No work is currently planned over the next 5 years, however a templated design is available should replacement of Active Drain Lines be desired.
Acid Waste	A single 2” (5.1 cm) plastic line running from [redacted].	No plans.
Condensate	A network of lines running from buildings that use plant steam to return condensate to the Power House. A mix of below- and above-ground lines, 2” (5.1 cm) to 6” (15.2 cm) diameter, mostly steel.	No plans.
Disposal Sewer	54” (1.4 m) diameter steel pipe from the Power House to the river.	No plans.
Fire Water	Distributed below-ground throughout the plant site from the Power House. Mostly cast iron, diameters starting at 12” (30.5 cm) and reducing to 4” (10.2 cm) or 6” (15.2 cm) for entry into buildings. A portion of the supervised area underground infrastructure has been updated to new PVCP piping.	No plans.

Service	Description/ Current Status	Plans for the Next 5 Years
Heating Water	Mostly PVC, 12” (30.5 cm) to 3” (7.6 cm) diameter. System is now largely out of service.	To be determined as part of future decommissioning strategy.
Helium	Two lines, 1½” (3.8 cm) stainless steel and 1” (2.5 cm) copper. Serviced several buildings in the CA and is out of service (cut and capped).	To be determined as part of future decommissioning strategy.
Heating Drain	Return lines for old heating water system. 21” (53.3 cm) to 2” (5.1 cm) diameter PVC. Now largely out of service.	To be determined as part of future decommissioning strategy.
Pneumatic	Below-ground system to transfer samples from NRU to [redacted] and the Universal Cells ([redacted]).	No plans.
Process Sewer	10”, 12” and 36” (25.4 cm, 30.5 cm, 91.4 cm) cast iron, vitrified clay and steel lines leading to 48” (1.2 m) pipe to the river. System includes 26 manholes.	No plans.
Process Water	Distributed to NRU and associated buildings from the Power House. Starts off as 48” (1.2 m) diameter steel pipeline and smaller diameter as required for entry into buildings.	No plans.
Raw Water	One 54” (1.4 m) and two 30” (76.2 cm) intakes from river to the Power House plus one 24” intake to [redacted].	No plans.
Refrigeration	Dedicated insulated line serving [redacted].	No plans.
Sanitary Sewer	Mainly vitrified clay, cast iron and Transite, 4” (10.2 cm) to 12” (30.5 cm) diameter, distributed throughout the plant. System includes 80 Manholes, 2 pumping stations & a single sewer system for both Supervised and Controlled Areas.	No plans.
Service Air	Distributed throughout the plant from the Power House. Starts off at 6” (15.2 cm) steel and reduces to as small as ¼” (6.4 mm) for entry into buildings.	No plans.
Potable Water (Service Water)	The entire water system has been split into two subsystems; drinking and non-drinking water systems. It consists of a wide variety of materials (including cast iron, steel and PVC) and diameters from 1” (2.5 cm) to 16” (40.6 cm). System has been extensively modified and updated over the life of the plant site. Many lines replaced and old ones left in place. System includes 165 shutoff valves, 13 hydrants and an underground Backflow Preventing Chamber. CRL’s new drinking water supply line became operational in 2019 and originates from the Town of	An Aeration System will be added in the Water Reservoir.

Service	Description/ Current Status	Plans for the Next 5 Years
	Deep River. A water booster pumping station pumps potable water via a single discharge line or feeder main 300 mm diameter, PVC pipe from the town to a newly constructed 2,000 m^3 capacity Water Reservoir located at a high point. From there, water flows through a pressure reducing valve station, to reduce the water pressure to match the operating conditions required at site, then via gravity through a single supply 300 mm diameter pipe line to the existing distribution system on site.	
Steam	Distributed throughout the plant site from the Power House. Mostly steel, 3" (7.6 cm) to 16" (40.6 cm) diameter and includes approximately 1,220 m of overhead line. Note: Steam/air/condensate system incorporates 40 manholes, 40 steam meters, 215 m of underground steam tunnel & 23 expansion joints.	No plans.
Storm Sewer	Surface drains feed into several below-ground culverts (mostly concrete up to 72" (1.8 m) diameter). The drains discharge to storm-water management ponds with the exception of one line on the south side of site that discharges directly to the river. The system consists of approximately 195 catch basins.	Upgrades ongoing.
Active Exhaust Duct	0.45 m diameter buried stainless steel vent from Building [redacted].	No plans.
Miscellaneous	Assorted lines such as weeping pipes, distilled water, nitrogen, conduit etc.	No plans.
Natural Gas	The CNL site has 6.8 km of 6" steel Natural Gas pipeline running from the main gate down the Plant Road to the CRL Site where a metering and regulating (M&R) station is located near Parking Lot C. From this point it is distributed via 2.1 km of 6" plastic piping throughout the supervised area to select buildings. An additional 1.8 km of 6" steel pipe (not included in the total length) runs from the nearby high-pressure TransCanada Pipeline system, west along Highway 17 to the outer gate.	No plans.

Table 9: Distributed Electrical Services on the CRL Site

Service	
13.8 kV Overhead Cable Run	Fire Signal Cable Run
13.8 kV Underground Cable Run	Telephone Cable Run
Class 4 (Normal) 600V Cable Run	Fibre Optic Cable Run
Class 3 (Emergency) 600V Cable Run	Ethernet Cable Run
Plant Ground Run	Security Cable Run
Common Control Cable Run	

11. Features in The Natural and Social Environment that Could be Affected by Cleanup

Canadian Nuclear Laboratories has identified over 60 operational and non-operational areas of the CRL site where current or past activities impacted the natural environment, including soil, sediments, surface water and groundwater quality which have been summarized in Appendix A. The presence of contaminants in these areas have had an impact, although limited, on vegetation and biota at the site.

A large portion of the CRL site is covered in generally healthy forests, wetlands and water bodies, even in areas that were previously used as part of site operations. Future remedial actions will undoubtedly have an impact on the ecosystem, including locally on some sensitive species or habitats. This would include, for example, impacts associated with clearing vegetation for new development surface water control and impacts from other construction-type activities.

These impacts will be minimized during the planning (PDP, DDP for Class 1 nuclear facilities and BRP, RAP, for non-Class I facilities, as appropriate) and implementation of environmental remediation. This is especially significant where more fragile ecosystems such as wetlands, shoreline habitats, nesting areas and critical habitat for species at risk are present.

Noise, vibration, dust and traffic will lead to local disturbance which will be assessed for potential impact to breeding birds and roosting bats as part of the permit application under the Species at Risk Act and mitigation measures will be implemented as required. Impacts to biodiversity will also be assessed for each project.

It is important consequently to determine where risk-based, less disruptive approaches, such as bioremediation, natural attenuation or radiological decay may be preferred to excavation which has the potential to disturb these ecosystems, at least on a temporary basis.

It will be necessary to establish during the planning stage whether damages caused during remediation would be significant and whether they would be reversible or not as some species are more sensitive to land disturbance and transplantation than others. In rare cases it may be necessary to limit access or even relocate land-based animals or wetlands-based amphibians for the duration of the work. Where this is not possible, compensatory measures may be required.

In addition, projects that enhance biodiversity may be considered based upon an ecosystem needs assessment. Following remediation, this could include, the selective planting of species at risk, the creation of grasslands or other beneficial habitats. Each remedial work package will be reviewed and permit applications will be filed with Environment and Climate Change Canada under Section 73 of the *Species at Risk Act*, as required (see Section 7).

A socio-economic benefit of the cleanup of the CRL site is that it will most certainly result in local employment for a number of years during cleanup and as supported by the Science and Technology research mission at CRL.

In addition, once remediation and site revitalization is completed, it may lead to the release of presently restricted land to other future land uses by providing recreational space or a return to a more natural setting benefiting the local ecosystem.

11.1 Technology Development and Transfer

An important mission for the CRL site is the development and application of new environmental remediation techniques and practices. Technology transfer, under ideal conditions, is a two way relationship. CNL will benefit from the experience of other nuclear facilities which have undertaken similar decommissioning and remediation operations, mostly in Europe and in the United States. CNL has been working with world-class experts in developing its own program, including groundwater modeling associated with radiological compound migration, the development of site-specific, risk-based cleanup criteria (see Section 9.3.1) and safe decommissioning techniques.

Lessons Learned and Operating Experience (OPEX) from CNL's Port Hope and Port Granby Projects are being reviewed and recommendations will be incorporated into the development of cleanup planning for CRL.

A number of basic science experiments have been conducted at CRL to obtain useful site specific data regarding groundwater recharge, movement, evapotranspiration and other physical processes. Also, short-lived radiological tracers have been used effectively at CRL as part of several groundwater characterizations. New remediation techniques are being implemented at the site, in particular, passive radiological contaminant plume control. CNL will continue to share the results of these studies with the nuclear and environmental community.

The retrieval of specific wastes from waste management areas will require the development of new tools and techniques designed to perform the work effectively, safely and in some cases remotely. For example, we will continue to build upon experience with the retrieval of the experimental glass blocks. Many characterization and remediation techniques have already been used at CRL which were not available a few decades ago. It is anticipated that the remediation of the site will allow for the testing and use of new tools and techniques that will be piloted at the site and may benefit the environmental community for decades to come allowing Canadian experts to export this knowledge to other parts of the world.

Canadian Nuclear Laboratories has developed a Systematic Approach to Training that provides a standardized approach to staff training and qualification and ensures that CNL complies with conditions in the applicable licence and may serve as a model for other similar facilities. The

purpose of the Systematic Approach to Training process is to provide a structured, documented, and auditable set of processes that, when implemented, will provide management with the assurance that personnel are trained, competent, and qualified for the assigned work. A graded approach, commensurate with risk, is used in the application of the Systematic Approach to Training.

11.2 Environmental Nuisance Issues

Since the areas that may require remediation are within the controlled and supervised areas, access to these areas will be limited to authorized personnel. For the most part, these areas are also several kilometers from the nearest neighboring residences. It is unlikely that on-site work will have a measurable impact on neighbors with the only exception being the movement of vehicles associated with the cleanup. This additional traffic should be limited as it is anticipated that the majority of the remediated wastes will remain on-site for final waste disposition. Clean material (e.g., soil) may be reused on-site as well.

Environmental nuisance issues, such as noise and dust are not expected to be significant issues to local neighbors at the CRL site as part of the decommissioning and environmental remediation operations due to the distance between the various areas that will be remediated over the years and the buffer offered by the dense forest surrounding the various operations at the site. Visual impacts from the river or the banks of the Ottawa River could also be expected, but should not be significant.

Development planning for new facilities will be required to consider viewscapes, both looking out from the proposed structure and looking towards the proposed structure. Building designers will consider and leverage the natural setting and ensure that spaces are planned to optimize the integration of the nature environment with the work environment. Already, the decommissioning of unused or outdated structures, the construction of visually attractive buildings and the greening of the site with lawns and other green space has gone a long way to improve the visual appearance of the site from the river.

Also the periodic inspection and removal of small volumes of waste materials, mostly demolition wastes, which occasionally wash out from areas bordering the site along the Ottawa River, such as at the Power House Shoreline Landfill or east of Dawson City, will also improve the visual appearance of the site to boaters on the river.

Increased traffic may be an issue as waste and other materials are either imported or exported from the site. The development of the proposed NSDF may significantly increase traffic on site during construction in the short-term, but will greatly reduce the need to transport materials on and off of the site as part of future remedial actions. The traffic study completed in 2022 assessed the current transportation network for continued operations in parallel with planned construction and decommissioning/demolition activities and found the current network to be acceptable with some recommended localized improvements.

12. Long-Term Stewardship

Environmental remediation may result in radiological or non-radiological contamination exceeding the applicable screening criteria while remaining below risk-based objectives. Thus, long-term monitoring programs and institutional controls are used to monitor residual risks at a site after it has been decommissioned or remediated and will allow CNL to identify areas where additional interventions may be required.

The purpose of a Long-Term Stewardship Program is to:

- Support the safe, environmentally-sound decommissioning of facilities and sites;
- Ensure the ongoing monitoring and maintenance of sites;
- Provide a funding mechanism to cover costs associated with long-term monitoring and maintenance of sites; and
- Ensure that records and information on the sites are preserved through the establishment of a registry

Environmental risk assessment will underpin the determination of the short-term and long-term management strategies and any necessary controls to ensure protection of human health and environmental receptors. Criteria and exit strategies will be developed for determining when engineering controls such as groundwater Pump and Treat systems can be terminated or when changes to monitoring may be warranted. The implementation of institutional controls should represent the start of a long-term remedy, not the conclusion of the environmental remediation process.

The CNL Environmental Monitoring Program that is in place during operations (see Section 7) will be reviewed and revised to ensure that the requirements for the remaining stages of the cleanup are covered. During the transition period between shutdown and decommissioning, surveillance, monitoring and maintenance will be conducted to ensure the health and safety of persons and the protection of the environment. When decommissioning of facilities are to take place in discrete phases, the removal of radioactive materials, the dismantling of structures or the remediation of the site, or both can be deferred. A plan for surveillance, monitoring and maintenance of the facilities will be developed and implemented.

Monitoring to confirm cleanup criteria are met will be conducted during the course of or at the conclusion of the decommissioning or any period of storage with surveillance prior to the transfer to institutional control. In some cases, a period of follow-up monitoring might be necessary to validate end-point assumptions to ensure that the final end-state objectives remain satisfied.

The land use designation of waste disposal facilities, including buffer or attenuation zones as applicable, will require controls upon closure to limit land usage. These controls may include fencing, signs, surveillance and legal instruments such as deed restrictions.

13. Conceptual Schedule

Figure 25 shows a short-term timeline of the revitalization, decommissioning and environmental remediation work scheduled at CRL over the next 5 years.

Decommissioning projects have been proceeding with the demolition of 114 structures since September 2015 with the objective to reduce risks, reduce the footprint of the built environment and allow for the development of a modern research campus.

Until the proposed NSDF is accepting waste, projects will be advanced while minimizing the need to temporarily store waste that would require additional handling at some point in the future.

A strategy is being developed in particular for the sequencing of LLW going to the proposed NSDF. Long-term storage and disposal options for ILW are also being investigated.

Various planning and optimization tools are being developed to allow for effective sequencing of decommissioning and environmental remediation activities, such as the prioritization tool (Section 9.6) which may be used in support of such planning efforts. New infrastructure and refurbishment of existing infrastructure to support the ongoing S&T mission will be extensive. Cleanup planning will support these missions at CRL by providing a safe and effective framework to reduce the environmental liabilities through decommissioning and remediation allowing for the development of the new, revitalized S&T campus (Section 4.3.5)).

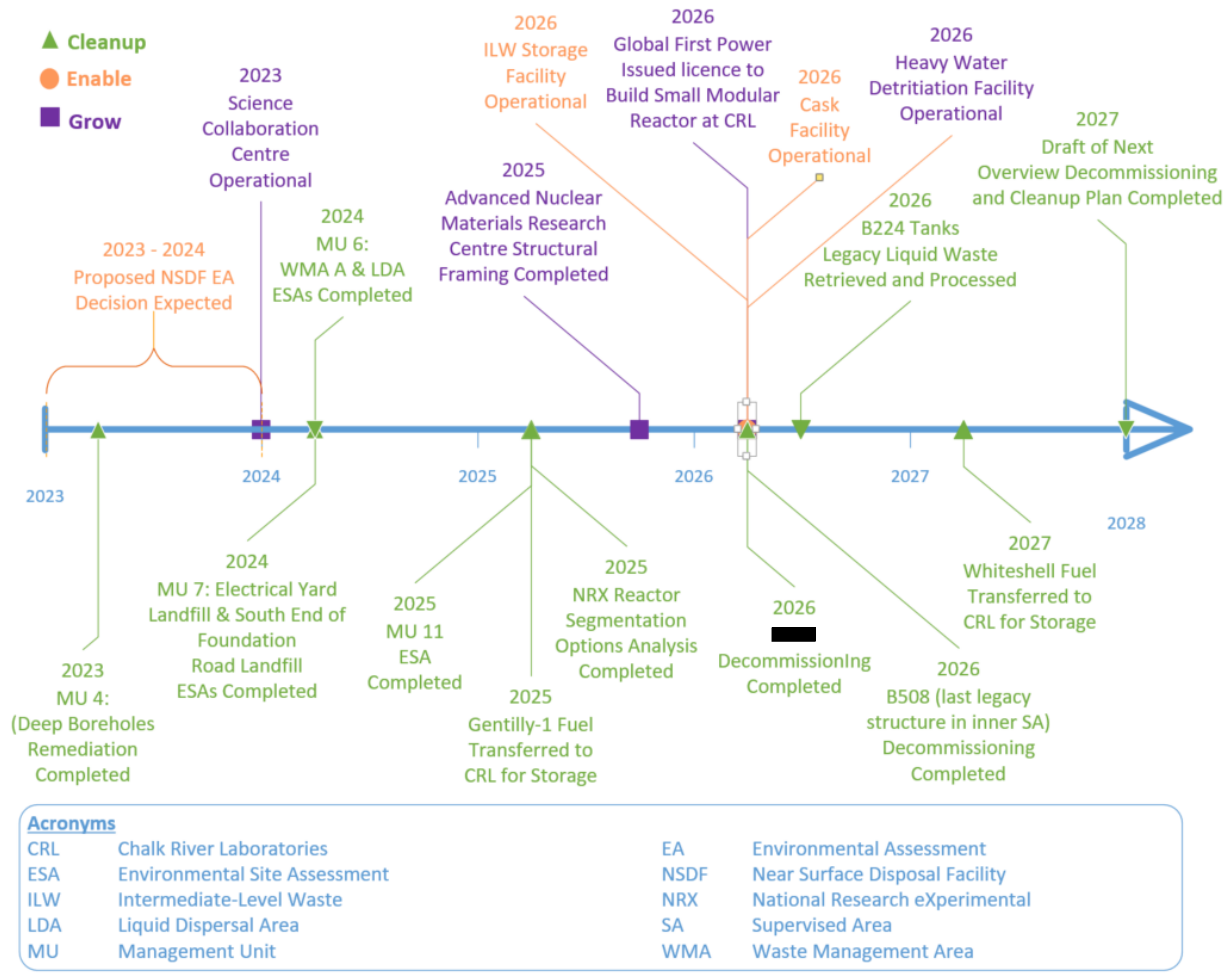

Figure 25: Near-Term Cleanup-Enable-Grow Timeline for 2023 through 2028 (current as of 2022 December)

The preliminary schedules showing forward plans for the NRX, MAPLE I & II and NRU reactors for the next ten years are presented in Figure 26, Figure 27, and Figure 28, respectively. These schedules will be updated in each of their respective DDPs. For more details on the current status of the of the reactor facilities undergoing decommissioning at the CRL site see Section 10.1. Annual updates are provided in CNL's Annual Compliance Monitoring Report (e.g., [101]).

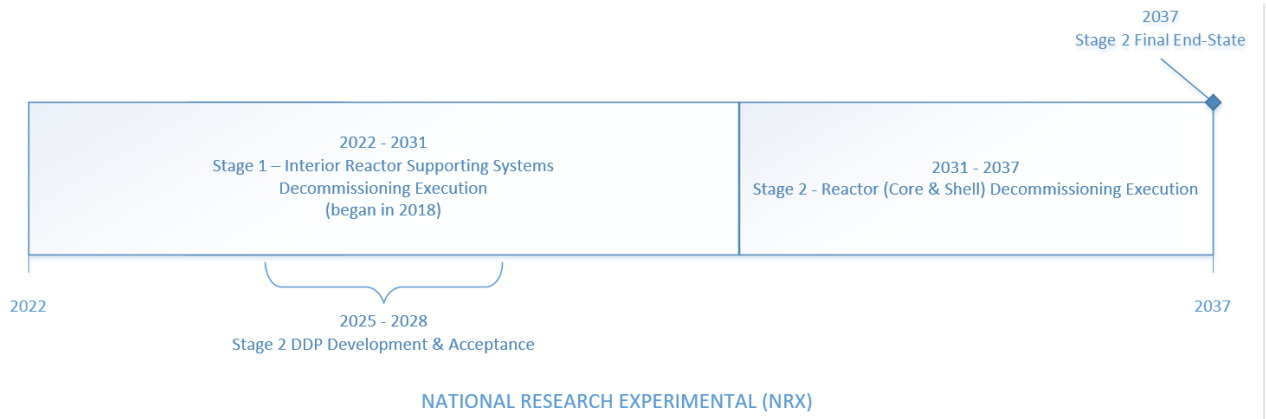

Figure 26: Forward Plans for the Decommissioning of NRX

Figure 27: Forward Plans for the Decommissioning of MAPLE I & II and New Processing Facility

Figure 28: Forward Plans for the Decommissioning of NRU

13.1 Long-Term

The primary long-term decommissioning objectives include; the disposition of redundant facilities, the remediation of environmental contamination to the extent required to meet end-state objectives, or in some cases interim end-states, and the processing and disposal of the wastes are scheduled to take place over the next 50 years. Scheduling is based on priorities determined in part by:

- Health Safety Security & Environment risks;
- Availability of enabling/storage/disposal facilities;
- Advantage of sequencing of similar activities (to allow advantages to be taken of lessons learned);
- Life span and continued use of buildings and other infrastructure;
- Need for land for new development;
- Cost effectiveness of scheduling work to be concurrent with other linked work;
- Stakeholder concerns; and
- AECL/CNL business decisions.

14. Cost Estimates and Funding

Canadian Nuclear Laboratories and the nuclear industry recognize that in the course of operating a nuclear site, contaminated facilities/land and radioactive waste are produced that require long-term management. These facilities, land and waste constitute decommissioning, remediation and waste management liabilities that are acknowledged and owned by AECL. At CNL, the liability is referred to as Environmental Liability.

14.1 Cost Estimate

In 2013, CNL undertook a comprehensive review of the decommissioning, environmental remediation and waste management liability cost estimate. Strategies, technical approaches, assumptions, timelines, risks, cost methodologies and estimates for addressing the liability were carefully examined and confirmed or revised to reflect changes to program policies and base assumptions. This information was presented in the *2013 Basis of Estimate: Chalk River Laboratories Decommissioning Liability* [107].

The information put forward in 2013 remains the basis for the current estimate. Additional factors impacting the total estimate include: i) the re-estimation of near-term work; ii) the re-profiling of future-year scope to align with strategy revisions; and, iii) the retirement of liability through the completion of work. Section 14.1.2 identifies the process for managing change to the liability estimate.

In developing the original cost estimates for cleanup, the CRL site was divided into seven planning envelopes which are listed below. Decommissioning costs are covered by planning envelopes 1 to 5, and environmental remediation by planning envelopes 6 and 7. The planning envelopes categorize the CRL cleanup activities by facility type whereas the MU boundaries include buildings/structures as well as APECs delineated based on the combination of criteria

outlined in Section 4.3.4:

- Planning Envelope 1: Nuclear Facilities
- Planning Envelope 2: Radiochemical laboratories
- Planning Envelope 3: Low hazard contaminated structures
- Planning Envelope 4: Non-contaminated structures
- Planning Envelope 5: Distributed Services
- Planning Envelope 6: Affected Lands
- Planning Envelope 7: Waste Management Areas

As of 2023 March, the cost for decommissioning AECL's liabilities at CRL has a Net Present Value of $6.7 Billion as reported in AECL's Annual Report, which is audited by the Office of the Auditor General of Canada. Cost estimates will undergo future revisions as required by CNL Subject Matter Experts, AECL and CNSC requirements.

14.1.1 Types of Project Estimates

Depending on the timing and the type of work involved, several cost-estimating models or approaches were used in the development of the Basis of Estimate [107]. The estimates have been compared to the determination of "Grade" as defined by the CNSC Regulatory Guide, G-206 Financial Guarantees for the Decommissioning of Licensed Activities [108]. The ongoing revisions of project estimates are undertaken as work packages have matured through rolling-wave processes to attain greater accuracy and reliability.

CNL has completed a gap-analysis and is implementing a plan for achieving compliance to the updated version of G-206 and REGDOC-3.3.1 *Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities* [109]. While the present ODCP has been designed to meet CSA's N294–19 [2] and the associated REGDOC-2.11.2 [3], the current ODCP is compliant with the updated REGDOC-3.3.1, and going forward CNL will ensure cost estimate revisions meet REGDOC-3.3.1 requirements [109].

14.1.2 Change Management

The Project Change Control procedure [110] defines the process by which CNL provides auditable documentation for repairing, reviewing, approving and controlling changes to the environmental liabilities life-cycle cost. All change proposals will clearly identify the impact of the proposed change on the scope, schedule and cost of the environmental liabilities baseline.

The decommissioning and environmental remediation liabilities estimate is reviewed and updated annually [111] to reflect the actual expenditures incurred and the changes in the estimated future costs and timing thereof. The annual review process assists in ensuring that the value of the liabilities is fairly stated in AECL's Annual Report and on the Public Accounts of the Government of Canada.

While detailed cost estimates and schedules are developed to support the planning and execution of individual D&D projects, a generic cost model is used for long-term strategic planning purposes such as the development of cost estimates for the CRL ODCP and supporting documentation.

14.1.3 Cost Model

The Site Structures Decommissioning and Demolition Cost Model was initially designed as a Microsoft Access database known as the CRL Site Cost Model, which was later converted to a Microsoft Excel spreadsheet to facilitate information transfer and ease of use. As described in the Basis of Estimate [107], the cost model was developed using building and room information from two databases available at the time: Space Information Management System database (now the Facility Information System database), and the Ontario Lands Assessment database. Unit-cost and waste-volume estimates for decommissioning and demolition were derived from industrial estimating standards, AECL experience, and judgment factors. This model was used for the majority of the buildings on the CRL site, including the NRX and NRU reactors and was expected to produce a Grade C estimate [107], [108].

The model produced an output that included the following elements of cost [107]:

- Documentation and Planning – This includes all the activities leading to approval to decommission. This includes activities such as planning, engineering, design, safety analysis, environmental reviews and regulatory approvals. It is typically assumed to be performed by CNL personnel;
- Activities to Achieve Storage with Surveillance (SWS) – After a post-operational closure, these are activities such as inspections, maintenance, removal of Health, Safety, Security and Environment (HSSE) hazards such as asbestos and mercury, stabilization of longer-term hazards, electrical isolation, service water closure and fire alarm or ventilation upgrades to meet current building codes,
- Prepare for Demolition – The underlying assumption is that all radiological hazards will be removed so that the structure or systems can be removed using conventional building demolition techniques and companies; and
- Demolition/Final Report – All activities involved with conventional demolition and removal of waste, close-out reports and regulatory submissions

14.1.4 Remedial Action Cost Engineering Requirements (RACER) Model

As described in the Basis of Estimate [107], the RACER model is a tool that was used to estimate costs for all phases of environmental remediation including those specifically chosen for the work to be done at CRL at the time: Remedial Investigation/Feasibility Study, Remedial Design, Remedial Action, Project Closeout and Long-Term Monitoring, and long-term care and maintenance. RACER was developed in 1992 by the U.S. Government (Air Force, Army, Department of Energy and the Environmental Protection Agency), and has been peer reviewed by numerous organizations and industry professionals, validated, verified, and accredited in accordance with the U.S. Department of Defense Instruction 5000.61b [107].

Site specific parameters and location modifiers were used to reflect project specific conditions. These parameters were then translated into specific quantities of work which were then priced using current cost data. Direct costs developed by RACER included all costs that could be directly attributed to a particular work package required to complete a project, including direct labour costs, direct materials costs, direct equipment costs and contractor costs. A contingency

of 17% was added to the direct costs obtained by RACER. Labour classes and hourly rates, available at the time, were provided by AECL for input to the model. The parametric model, using current labour rates and standardized cost elements was expected to be Grade C [107], [108].

14.1.5 External Comparators

External comparators are cost estimates reported or used by other organizations for similar work. The comparators were used in the Basis of Estimate [107] to provide a level of assurance that the estimate from a current cost model or estimating group (internal or third party) had a degree of reasonableness and did not appear to be widely different, given the variables and differences associated with the estimate.

External comparators were identified through on-line sources or obtained through cooperative agreements with other countries and nuclear programs. These estimates were also expected to be at Grade C estimate level [107], [108].

14.2 Funding Source

Canadian Nuclear Laboratories understands the requirement for an acceptable financial guarantee. While ownership of CNL has transferred to the contractor Canadian National Energy Alliance (CNEA) Limited, AECL retains ownership of the lands, assets, and liabilities associated with CNL's licences including CRL.

The liabilities associated with the CRL site are those of AECL. As a federal Crown corporation and an agent of the Government of Canada, AECL's accounts are consolidated with those of the Government of Canada. As such, AECL's liabilities are those of the Government of Canada. Funding to undertake decommissioning activities is provided to CNL by AECL. These liabilities were officially recognized by the Minister of Natural Resources in a letter dated July 31, 2015, as per the CRL Licence Condition 16.3 (Financial Guarantee) and re-affirmed by AECL in 2020 [112].

15. Record Retention

Storing and handling information is a controlled activity at CNL. Information Management develops and maintains processes to ensure the authenticity and integrity of records so that CNL can meet its long-term information requirements. Important information will be retained as a permanent record to be used by future generations.

Canadian Nuclear Laboratories *Information Management Program Description* [113] ensure records are categorized, registered, retrievable, and properly managed in a controlled environment. This process ensures that essential and non-essential records are identified, maintained, stored, retained, and routinely inspected to ensure their preservation and protection from loss, deterioration, or destruction [114]. As well retention periods that meet regulatory requirements, are assigned to each record and these determine whether a record is a permanent or non-permanent record [115].

Site Operational Records, which are maintained in accordance with required standards for decommissioning, environmental, waste and project management and execution, include:

- Operating Records, such as Operating Logs, Fuel Records, Waste Records, Operations Manuals/Procedures/Limits/Conditions, and Maintenance Records;
- Configuration Records, such as Maps, Drawings, Photographs, Engineering Records, Design Records, Technical/Materials Specifications, and Change Control Information; and
- Environmental/Radiological/Incident/Regulatory Records, such as Annual Reports, Unplanned Event Reports, Radiation Zone Surveys, Survey Logs, Hazardous Materials Inventory/Control/Surveys, Licensing Reports, Compliance Reports, and Safety Analysis Reports
- Environmental Remediation Records, such as Historical Site Assessments (Phase I), Environmental Site Assessment or Characterization Reports (Phase 2), Environmental Risk Assessments, Remedial Action Plans, Remedial Verification Reports, and Project Close Out and End-State Reports
- Decommissioning Records, such as Detailed Decommissioning Plans and Storage with Surveillance Plans for Class 1 and Class 2 facilities. In addition, Detailed Work Plans, Building Characterization Reports, Assessment Reports, Project Plans, Schedules, Institutional Controls and End-State Reports; shall continue to be managed throughout the decommissioning process and beyond as required

Records will be managed throughout the land use planning, decommissioning, and remediation processes according to those requirements, to the extent applicable, to ensure consistency and transparency throughout the lifespan of the CRL site. The Information Management processes are outlined in the Program standards [51], [52], and [53] detail which records are important to the success of the Cleanup Function and work closely with interfacing functions.

Environmental data will be managed in the Environmental Data Management System (EDMS) using a Geographical Information System interface. Historical data in the EDMS includes groundwater monitoring data, plume updates, characterization data and other pertinent environmental data. Current and future data will be entered during characterization and final site surveys to demonstrate compliance with site cleanup criteria.

Both the records and records management systems are continually maintained, and will be periodically reviewed to ensure that the records are protected, managed and accessible and to take advantage of any new advances in records storage, practices and technologies. Records management for the CRL site is an ongoing process and as the site is cleaned up, information storage will continue to be protected and may be relocated at the appropriate time as required.

16. References

[1] *Comprehensive Preliminary Decommissioning Plan*, CPDP-508300-PDP-001 Revision 4, 2018 March, 40526618.

[2] *Decommissioning of facilities containing nuclear substances,* CSA N294:19, Canadian Standards Association, 2019.

[3] *Decommissioning,* REGDOC-2.11.2, Canadian Nuclear Safety Commission, 2021 January, https://nuclearsafety.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-11-2/index.cfm

[4] *Nuclear Research and Test Establishment Operating Licence*, *Chalk River Laboratories*, NRTEOL-01.00/2028. Expiry Date: 2028 March 31. https://www.cnl.ca/wp-content/uploads/2020/11/NRTEOL-01.002028.pdf

[5] *Licence Conditions Handbook for Chalk River Laboratories Nuclear Research and Test Establishment Operating Licence*, CRL-508760-HBK-002, Revision 2, 2021 February 28, 47236344.

[6] *Canadian Nuclear Laboratories Integrated Waste Strategy*, CW-508600-PLA-002 Revision 1, 2019 February 28, 47542215.

[7] K. Murthy, *CNSC Staff Review of the Comprehensive Preliminary Decommissioning Plan (CPDP) for the Chalk River Laboratories (CRL) and attachments,* 140-NOCN-19-0001-L, 2019 May 30, 50202198

[8] *Glossary of CNSC Terminology*, REGDOC-3.6, Canadian Nuclear Safety Commission, 2022 February, https://nuclearsafety.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc3-6/index.cfm

[9] Canadian Council of Ministers of the Environment, *Ecological Risk Assessment Guidance Document*, 2020, *https://meia.mb.ca/wp-content/uploads/2020/01/ERA-Guidance-Doc.pdf*

[10] N-O Kwamena, *Outcome of Federal-Provincial Review Team Review of Final Environmental Impact Statement for the Near Surface Disposal Facility Project*, 2021 July 2, https://www.iaac-aeic.gc.ca/050/documents/p80122/139593E.pdf

[11] *Environmental Risk Assessment of Chalk River Laboratories*, ENVP-509220-REPT-003, 2018 December, 42077960

[12] *Environmental Assessment (and/or Environmental Effects Review). Project Description: Near Surface Disposal Facility at Chalk River Laboratories,* 232-509200-ENA-001, Revision 1, 2016 September, 22412735

[13] MNO (Métis Nation of Ontario) & Ontario Ministry of Natural Resources and Forestry, *Framework Agreement on Métis Harvesting*, 2018 April, https://www.metisnation.org/registry/harvesting/

[14] *Indigenous Engagement Report*, 232-513130-REPT-001, Revision 6, 2022 January 21, 56324487

[15] Canadian Nuclear Laboratories & Nanos Research, *2022 Public Attitude Survey of Canadian Nuclear Laboratories' Chalk River Site*, February 2022, https://engagewithcnl.ca/nsdf/wp-content/uploads/2022/04/2022-Public-Attitude-Survey-of-CNL_CRL_FINAL.pdf

[16] County of Renfrew, *Social, Economic and Environmental Impact Analysis of CNL/CRL*, 2021 April

[17] Minister of Community Safety and Correctional Services of Ontario, *PNERP (Provincial Nuclear Emergency Response Plan) Implementing Plan For Chalk River Laboratories*, 2011 May, https://www.ontario.ca/document/pnerp-implementing-plan-chalk-river-laboratories

[18] Ministry of Community Safety and Correctional Services, *Provincial Nuclear Emergency Response Plan (PNERP) Master Plan 2017*, 2017 December 13, https://www.ontario.ca/document/provincial-nuclear-emergency-response-plan-pnerp-master-plan

[19] Algonquins of Pikwakanagan First Nation, *RE: Implications of the Algonquin Knowledge and Land Use Study for the Near Surface Disposal Facility Project*, January 15, 2021

[20] *Radiation Protection*, 900-508740-PRD-001, Revision 4, 2021 March 15, 40766658

[21] *Nuclear Criticality Safety Program Requirements Document*, 900-508550-PRD-001, Revision 3, 2021 October 17, 52931473

[22] *Occupational Safety and Health Program Requirements Document*, 900-510400-PRD-001, Revision 2, 2021 March 15, 12487835

[23] *Occupational Safety and Health Program Description Document*, 900-510400-PDD-001, Revision 3, 2021 October 01, 40761159

[24] *Fire Protection Program Description Document,* 900-508720-PDD-001, Revision 3, 2021 June 29, 40793276

[25] *Fire Protection Program Requirement Document,* 900-508720-PRD-001, Revision 1, 2020 August 11, 12489833

[26] *Integrated Work Control*, 900-514100-STD-002, Revision 4, 2022 July 27, 51505551

[27] *Transportation of Dangerous Goods Program Description Document,* 900508520-PDD-001, Revision 3, 2022 May 20, 50491264

[28] *Transportation of Dangerous Goods Program Requirement Document,* 900508520-PRD-001, Revision 3, 2022 May 09, 50318478

[29] *Nuclear Safety and Control Act*, S.C. 1997, c. 9, https://laws-lois.justice.gc.ca/eng/acts/n-28.3/

[30] *Environmental Protection Program Requirements Document*, 900-509200-PRD-001, Revision 4, 2022 May 16, 40792906

[31] *Soil, ground water and sediment standards for use under Part XV.1 of the Environmental Protection Act*, PIBS#7382e01, Ministry of the Environment - Ontario, 2011 April, https://www.ontario.ca/document/soil-ground-water-and-sediment-standards-use-under-part-xv1-environmental-protection-act

[32] *AECL Environmental, Social and Governance (ESG) Strategy,* CW-514100-041-000, Revision 2, 2022 March 08, 57480224

[33] *CNL Sustainability Plan*, ENVP-509200-PLA-015, 2021 October, Revision 0, 2021 October 06, 55469386

[34] *Chalk River Laboratories' Carbon-Neutral Strategy*, 145-502300-021-001, 2020 March, 52002151

[35] *CNL Management System Manual*, 900-514100-MAN-001, Revision 3, 2022 June 22, 12489834

[36] *Radiation Protection Program Description Document*, 900-208740-PDD-001, Revision 3, 2022 September 6, 12487852

[37] *Environmental Protection Program Description Document,* 900-509200-PDD-001, Revision 4, 2022 September 30, 40788125

[38] *Emergency Preparedness Program Description Document*, 900-508730-PDD-001, Revision 2, 2020 January 06, 50982494

[39] *Emergency Preparedness Program Requirements Document*, 900-508730-PRD-001, Revision 2, 2021 March 31, 50046216

[40] *Security Program Description Document,* 900-508710-PDD-001, Revision 5, 2022 March 01, 50823241

[41] *Security Program Requirement Document,* 900-508710-PRD-001, Revision 4, 2022 April 14, 51689228

[42] *Quality Assurance Program Description Document,* 900-514200-PDD-001, Revision 2, 2022 May 18, 47487865

[43] *Quality Assurance Program Requirement Document,* 900-514200-PRD-001, Revision 3, 2022 May 18, 50321640

[44] *Performance Assurance Program Description Document,* 900-514000-PDD-001, Revision 1, 2020 November 17, 12494609

[45] *Performance Assurance Program Requirements Document,* 900-514000-PRD-001, Revision 2, 2020 November 12, 12489867

[46] *Nuclear Criticality Safety Program Description Document*, 900-508550-PDD-001, Revision 2, 2022 May 20, 42019403

[47] *Nuclear Materials and Safeguards Management Program Description Document*, 900-508510-PDD-001, Revision 4, 2022 October 24, 47487725

[48] *Nuclear Materials and Safeguards Management Program Requirements Document*, 900-508510-PRD-001, Revision 4, 2022 September 30, 47376026

[49] *Waste Management Program Description Document,* 900-508600-PDD-001, Revision 4, 2022 May 20, 51793801

[50] *Waste Management Program Requirement Document,* 900-508600-PRD-001, Revision 3, 2022 May 09, 51423339

[51] *Land Use Process*, 900-508300-STD-002, Revision 0, 2020 December 18, 52034637

[52] *Decommissioning Process*, 900-508300-STD-003, Revision 0, 2021 December 08, 54298095

[53] *Environmental Remediation Process*, 900-508300-STD-001, Revision 1, 2022 April 04, 44164061

[54] *Design Authority and Design Engineering Program Description Document,* 900-508120-PDD-001, Revision 5, 2022 May 20, 52753070

[55] *Design Authority and Design Engineering Program Requirements Document,* 900-508120-PRD-001, Revision 5, 2022 September 30, 52455759

[56] *Safety Analysis Program Description Document,* 900-508770-PDD-001, Revision 5, 2022 October 24, 52705850

[57] *Safety Analysis Program Requirements Document,* 900-508770-PRD-001, Revision 4, 2021 July 27, 52738121

[58] *Public Information and Disclosure,* REGDOC-3.2.1, Canadian Nuclear Safety Commission, 2018 April 27, https://nuclearsafety.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc3-2-1/index.cfm

[59] *Public Information Program for Canadian Nuclear Laboratories (CNL)*, CW-513430-REPT-001, Revision 8, 2021 January 13,53749225

[60] The Truth and Reconciliation Commission of Canada, *Honouring the Truth, Reconciling for the Future Summary of the Final Report of the Truth and Reconciliation Commission of Canada,* 2015, https://ehprnh2mwo3.exactdn.com/wp-content/uploads/2021/01/Executive_Summary_English_Web.pdf

[61] *Indigenous Engagement,* REGDOC-3.2.2 version 1.1, Canadian Nuclear Safety Commission, 2019 August 13,http://www.nuclearsafety.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc3-2-2-ver1.1/index.cfm

[62] *ISO 14001:2015 Environmental management systems – Requirements with guidance for use*, CAN/CSA ISO 14001:16 (R2021)

[63] *Environment*, 900-509200-POL-001, Revision 3, 2022 November 16, 12489856

[64] *Impact Assessment Act* (IAA), S.C. 2019, c. 28, s. 1, https://laws.justice.gc.ca/eng/acts/I-2.75/index.html

[65] *Environmental Protection: Environmental Principles, Assessments and Protection Measures,* REGDOC-2.9.1, Canadian Nuclear Safety Commission, 2016 November 23, http://nuclearsafety.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-9-1-new/index.cfm

[66] *Species at Risk Act*, S.C. 2002, c.29, https://laws-lois.justice.gc.ca/eng/acts/s-15.3/FullText.html

[67] *Species at Risk in Ontario List*, O Reg 230/08, https://www.ontario.ca/laws/regulation/080230

[68] COSEWIC. *Home.* Committee on the Status of Endangered Wildlife in Canada. https://www.cosewic.ca/index.php/en-ca/

[69] *Environmental risk assessments at Class I nuclear facilities and uranium mines and mills*, CSA N288.6:12, Canadian Standards Association, 2012

[70] *Chalk River Laboratories Integrated Environmental Monitoring Framework*, ENVP-509200-STD-020, Revision 0, 2022 October 31, 57922609

[71] *Environmental monitoring programs at nuclear facilities and uranium mines and mills*, CSA N288.4:19, Canadian Standards Association, 2019

[72] *Effluent and emissions monitoring programs nuclear facilities,* CSA N288.5:22, Canadian Standards Association, 2022

[73] *Groundwater protection programs at Class I nuclear facilities and uranium mines and mills*, CSA N288.7:15 (R2020), Canadian Standards Association, 2020

[74] *CRL Radioactive Effluent Verification Monitoring Plan*, CRL-509200-PLA-004, Revision 2, 2022 May 13, 56794487

[75] *CRL Non-Radioactive Effluent Verification Monitoring Plan*, CRL-509200-PLA-003, Revision 2, 2022 May 13, 56792843

[76] *CRL Environmental Monitoring Plan*, CRL-509200-PLA-007, Revision 0, 2022 May 16, 57215785

[77] *Chalk River Laboratories Groundwater Protection and Monitoring Plans, 2020*, CRL-509200-PLA-006, Revision 0, 2020 December 18, 52689706

[78] *CRL Groundwater Monitoring Program Annual Report for 2020,* CRL-509249-ACMR-2020, Revision 0, 2021 November 26, 55179138

[79] *Improvement Action (ImpAct) Corrective Action Program*, 900-514000-MCP-004, Revision 3, 2022 January 12, 40772346

[80] *CNL Reporting to Regulatory Agencies*, 900-514300-MCP-006, Revision 0, 2018 December 31, 41554361

[81] Canadian Council of Ministers of the Environment (CCME), *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health*, https://www.ccme.ca/en/current-activities/canadian-environmental-quality-guidelines

[82] *Analysis Basis and RESRAD-OFFSITE Modeling Results for the Development of Scenario Specific Radiological Soil Screening Criteria for Canadian Nuclear Laboratories Chalk River Laboratories Site*, 225-508350-REPT-006, Revision 0, 2019 September 30, 50595471

[83] *The Development of Biota Benchmark Effects Concentrations for Soil, Surface Water and Sediment*, 225-509250-REPT-001, Revision 0, 2020 October 30, 53236750

[84] *Off-Site Human Game Ingestion Scenario And Biota Exposure Modeling Results For The Development Of Radiological Soil Screening Criteria For Canadian Nuclear Laboratories Chalk River Laboratories Site*, 225-508350-REPT-007, Revision 1, 2020 October 30, 53238466

[85] UK Nuclear Decommissioning Authority, *Nuclear Decommissioning Authority (NDA) Strategy Effective from 2016 April*, 2016 April 01, https://www.gov.uk/government/publications/nda-strategy

[86] *Protocols for the Use of Environmental Remediation Soil Screening Criteria at CRL*, 225-508350-041-000, Revision 1, 2020 October 30, 53242334

[87] Disposal of Radioactive Waste, IAEA Specific Safety Requirements, No. SSR-5, International Atomic Energy Agency, 2007, https://www-pub.iaea.org/MTCD/publications/PDF/Pub1449_web.pdf

[88] *Safety Case for the Disposal of Radioactive Waste*, REGDOC-2.11.1, Waste Management, Volume III, Version 2, Canadian Nuclear Safety Commission, 2021 January, https://www.nuclearsafety.gc.ca/pubs_catalogue/uploads/REGDOC-2-11-1-volume-III-safety-case-for-the-disposal-of-radioactive-waste-version-2.pdf

[89] *Principles for the Disposal of Solid Radioactive Waste*, ICRP Publication 46, International Commission on Radiological Protection, 1985, https://www.icrp.org/publication.asp?id=ICRP%20Publication%2046

[90] *Use of monitored natural attenuation at superfund, RCRA corrective action, and underground storage tank sites*, OSWER Directive No. 9200.4-17P, U.S. Environmental Protection Agency, 1999, https://www.epa.gov/sites/default/files/2014-02/documents/d9200.4-17.pdf

[91] Interstate Technology Regulatory Council, *Remediation Management of Complex Sites*, 2017 October, https://rmcs-1.itrcweb.org/

[92] UK Nuclear Decommissioning Authority, *The NDA Value Framework*, 2021 August, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1022217/The_NDA_Value_Framework_Aug21.pdf

[93] *Remedial Options Evaluation Guideline*, 182-509420-GL-001, Revision 0, 2018 September 25, 41560194

[94] Closeout Process, 900-508300-STD-004, 54621304

[95] *D&ER Closeout Checklist*, 900-508300-FM-000299

[96] *Interim and Final End-State Report Template*, 900-508300-TMP-000310

[97] *Decommissioning Project Completion Report*, 900-508300-FM-002, Revision 0, 51722765

[98] *Framework for CRL Site Cleanup*, 225-508350-REPT-001, Revision 2, 2020 January 31, 51324266

[99] Natural Resources Canada, *Inventory of Radioactive Waste in Canada 2019,* 2019*,* https://www.nrcan.gc.ca/sites/nrcan/files/energy/pdf/uranium-nuclear/17-0467%2520Canada%2520Radioactive%2520Waste%2520Report_access_e.pdf

[100] *Near Surface Disposal Facility Waste Acceptance Criteria*, 232-508600-WAC-003, Revision 4, 2020 November 12, 53310816.

[101] *Annual Compliance Monitoring Report for Canadian Nuclear Laboratories for 2020: Sub-Section: Chalk River Laboratories*, 145-00583-ACMR-2020, Revision 0, 2021 April 28, 54381504

[102] *A Weight-of-Evidence Approach to the Assessment of Ecological Risk from Historical Contamination of Ottawa River Sediments*, Matthew J. Bond, Renee Silke, Marilyne Stuart, Jamie Carr, and David J. Rowan. AECL Nuclear Review. 4(2): 155-170, 2015 December 15, https://doi.org/10.12943/CNR.2015.00048

[103] *Ottawa River Sediment Verification Monitoring Plan,* 175-509247-PLA-001, 22365970

[104] *2016 Ottawa River Sediment Verification Monitoring Report,* 175-509247-REPT-001, Revision 1, 2016 November 10, 22599941

[105] *2021 Ottawa River Sediment Verification Monitoring Report,* 175-509247-REPT-002, Revision 0, 2022 March 25, 56794366

[106] *Environmental Monitoring in 2020 at Chalk River Laboratories*, CRL-509243-ACMR-2020, Revision 0, 2021 June 25, 54768960

[107] *2013 Basis of Cost Estimate: Chalk River Laboratories Decommissioning Liability*, 146-508810-REPT-036, Revision 0, 2014 April 01, 22357550

[108] *Financial Guarantees for the Decommissioning of Licensed Activities*, CNSC Regulatory Guide G-206, 2000 June, https://nuclearsafety.gc.ca/pubs_catalogue/uploads/G206_e.pdf

[109] *Financial guarantees for decommissioning of nuclear facilities and termination of licensed activities,* CNSC REGDOC-3.3.1, 2021 January, https://nuclearsafety.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc3-3-1/index.cfm

[110] *Project Change Control*, 900-502000-MCP-004, Revision 3, 2021 February 16, 40813373

[111] *Annual Update of the Environmental Liabilities Estimate*, 146-512200-PRO-001, Revision 1, 2022 July 11, 42054250

[112] *Submission of Information Regarding Financial Guarantee for all AECL Sites*, 145-CNNO-20-0028-L, 2020 August 25, 52786674

[113] *Information Management Program Description Document,* 900-511300-PDD-001, Revision 4, 2022 June 13, 47088909

[114] *Creation, Capture and Use of Information Assets*, 900-511300-STD-003, Revision 4, 2022 September 19, 50746207

[115] *Retention, Preservation and Disposition of Information Asset*, 900-511300-STD-004, Revision 1, 2019 October 21, 50742658

[116] *Contamination Migration from Waste Management Area C*, *2019*, 153-121265-REPT-008, Revision 0, 2021 January 04, 52927258

[117] *Land Use in the CERCLA Remedy Selection Process*, OSWER Directive No. 9355.7-04, U.S. Environmental Protection Agency, 1995 May, https://www.epa.gov/sites/production/files/documents/landuse.pdf

[118] *Final NSDF Environmental Impact Statement*, 232-509220-021-000, Revision 3, 2021 May 26, 54887298

[119] *Decommissioning of Facilities Using Radioactive Material*, IAEA Safety Standards Series, No. WS-R-5, International Atomic Energy Agency, 2006, https://www.iaea.org/publications/7536/decommissioning-of-facilities-using-radioactive-material

[120] *Decommissioning Strategies for Facilities Using Radioactive Material*, IAEA Safety Reports Series, No. 50, International Atomic Energy Agency, 2007, https://www.iaea.org/publications/7540/decommissioning-strategies-for-facilities-using-radioactive-material

[121] *Selection of Decommissioning Strategies: Issues and Factors*, IAEA TECDOC No. 1478, International Atomic Energy Agency, 2005,

https://www.iaea.org/publications/7393/selection-of-decommissioning-strategies-issues-and-factors

Appendix A Detailed Information on the Status of Buildings Structures, and Areas of Potential Environmental Concern in each Management Unit

Status of Buildings and Structures on the CRL Site

The status of all buildings, structures, WMAs and services on the CRL site (as of 2022 December 31) is summarized in tables within each MU sub-section. The tables present each structure/area's "building" number, name/description, and current and forward looking D&D status.

It is also important to note what types of facilities and buildings are included and purposely excluded from the lists. Portable trailers that are currently on the site are included, while portable trailers that have been removed from the site are excluded or may have a forward looking status indicated as 'to be removed from site' if removal is pending. Waste Management Areas (WMA) associated facilities and buildings are included. Some underground infrastructure, including manholes, ductwork and electrical substations across the CRL site are assigned a building number and are also included in the lists. In some cases infrastructure components, e.g., gas storage tanks, may have a forward looking status indicated as 'to be removed from site'.

The status categories are described in Table A-1, including a reference to CSA N294-19 [2], as appropriate. For non-nuclear buildings and structures, the same general description applies, although the prescriptive requirements for a Nuclear Facility apply using a graded approach, described in CNL's management system [35].

These status categories only apply to the D&D process. The forward plans do not currently include information on the status of environmental remediation which may be required to deal with potential contamination beneath some structures.

Table A-1: D&D Status Categories

D&D Status	Description	CSA N294-19 Phase
Design	A phase intended to include the overall planning and philosophies that go into ensuring that every aspect of the physical design will consider safety, security and safeguards under all scenarios it may encounter during its lifecycle.	Planning for decommissioning (Phase 1)
Construction/ Commissioning	A phase intended to demonstrate that installed structures, systems and components (SSCs) perform in accordance with their specifications before the facility is placed in service or before the SSCs are returned or placed in service.	Planning for decommissioning (Phase 1)
Operations	A phase, in which all activities that are performed to achieve the purpose for which the facility was constructed.	Preparation for decommissioning (Phase 2)
Operations - Extended Safe Shutdown	A phase in which the facility is in an extended safe shutdown state but has not been formally transitioned to decommissioning.	Preparation for decommissioning (Phase 2)
Storage with Surveillance (SWS) / Care & Maintenance (C&M)	Storage with Surveillance consists of a planned phase within the decommissioning program, in which the remaining contaminated materials, equipment and site(s) are placed under controlled surveillance for a specified period of time. Care & Maintenance consists of a phase within the decommissioning program, in which the facility is maintained in a safe state.	Execution of decommissioning (Phase 3)
Decommissioning/ Building Removal	A phase, in which planned actions are executed to retire a facility permanently from service and render it to a predetermined end-state condition.	Execution of decommissioning (Phase 3)
Interim End-State - SWS	This is a planned phase within a decommissioning program, in which there is completion of a defined set of decommissioning activities and re-entry into a Storage with Surveillance phase.	Execution of decommissioning (Phase 3)
End-State – Verification Activities	This phase involves verifying that all decommissioning activities have been completed satisfactorily, the final end-state has been reached, and all documentation has been completed.	Completion of decommissioning (Phase 4)
End-State – Complete	This phase is defined by verification and acknowledgement by the appropriate regulatory authority that the end-state is confirmed to be achieved.	Completion of decommissioning (Phase 4)
Land Re-use	This phase is identified when a defined area of land or building footprint of a previous structure is ready for or has been taken over, fully or partially, by a new building or structure, infrastructure or laydown area.	N/A

Status of the Remediation process at CRL

An Environmental Remediation Process Standard has been introduced by CNL and applies to all sites managed by CNL [53]. The CRL site has been used as the pilot facility where this process is being developed and tested. Each of the Areas of Potential Environmental Concern presented in this Appendix are working through the phases of the process, as required. Many of the Areas of Potential Environmental Concern have progressed to the Environmental Site Assessment stage, either at the Phase 1 or Phase 2 stage. At this stage site characterization is progressing which involves soil, surface water and groundwater sampling and waste characterization.

Where ongoing monitoring has identified the potential for risks to receptors, interim mitigative remedial actions have been taken, more specifically in the installation of passive and active groundwater treatment systems, in MU 3, 6 and 11 and the installation of the impermeable geomembrane cover over WMA C in MU 8.

In the Campus Precinct, especially in MU 1, some buildings and structures are undergoing the decommissioning process and will also be taken through the Environmental Remediation Process, more specifically the Phase 1 historical review and preliminary sampling associated with a Phase 2 characterization. The development of a remedial action plan may be deferred or in some cases, be accelerated, in order to sequence the work to better align with site revitalization efforts and the overall site mission.

Environmental Remediation Status for Areas of Potential Environmental Concern at CRL

More than 60 sub-areas, defined as Areas of Potential Environmental Concern (APECs) have been identified within the 11 MUs at the CRL site. These include seven waste management areas, six solid waste landfills, former supporting infrastructure such as pipelines, snow dumps, security firing ranges, and various other legacy sites. Each MU section includes a brief description of each APEC including summary of known contaminants, wastes present, environmental impacts where known and current and forward looking remediation status. Where sufficient information is available, information regarding estimated waste volumes associated with the environmental remediation of the APECs within each MU. In some cases, it may be noted that an area has no known contamination or may have not been operationally used for its intended purpose. These areas are considered to have been affected by CNL, however, and therefore must be put through the phases of the Environmental Remediation Process in order to verify that they are clean and meet next land use requirements.

Table A-2: Environmental Remediation Status Categories

ER Status	Description	Reference
Operations	A phase, in which all activities performed to achieve the purpose for which the facility was constructed.	CSA N294-19 Phase 2
Area of Potential Environmental Concern (APEC) Identified and Monitored	Land/media is identified as an Area of Potential Environmental Concern (APEC) / Planned for ER (currently or post-Decommissioning Process)	N/A
Environmental Site Assessment	A full characterization of a site; includes soil, groundwater, surface water, soil vapour, air quality, sediment, biology, and background levels. CNL's Environmental Remediation Process recommends using Phase I and II ESAs to fulfill site characterization.	CSA N294-19
Risk Assessment	The systematic process used to identify, quantify, and characterize the risk posed by contaminants and physical stressors in the environment on biological receptors, including the magnitude and extent of the potential effects associated with a facility.	CSA N288.6-12
Remedial Planning	Determining the appropriate remedial solution(s) to remediate or cleanup a site to the degree required to meet the end-state criteria.	CSA N294-19 and REGDOC-2.11.2
Execute Remedial Action	Executing the selected remedial option(s) to cleanup a site to meet the end-state criteria.	CSA N294-19 and REGDOC-2.11.2
Remediation Project Closeout	Completion of the environmental remediation work and verification that the predetermined end-state has been achieved.	CSA N294-19
Land Re-use	This phase is identified when a defined area of land or building footprint of a previous structure is ready for or has been taken over, fully or partially, by a new building or structure, infrastructure or laydown area.	N/A

A.1 Management Unit 1

Table A-3: Status of Buildings/Structures within MU 1

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in 5 years) [3]
[redacted]	NRX Reactor	Decommissioning/ Building Removal	Decommissioning/ Building Removal
[redacted]	NRX Annex – Office Space	Decommissioning/ Building Removal	Decommissioning/ Building Removal
[redacted]	NRX Reactor Effluent Exp. Building	End-State Verification Activities	Interim End State - SWS
[redacted]	NRX Reactor Fan House	Decommissioning/ Building Removal	SWS/C&M
[redacted]	NRX Reactor Exhaust Air System	Decommissioning/ Building Removal	SWS/C&M
[redacted]	Mixed Waste Storage – Former Heavy Water & Drum Cleaning Building/ Former Change House	End-State Verification Activities	SWS/C&M
[redacted]	Delay Tank No.1 For NRX	End-State Verification Activities	Interim End State - SWS
[redacted]	Delay Tank No.2 For NRX	End-State Verification Activities	Interim End State - SWS
[redacted]	Former Phy. & Gen. Chemistry Lab	Land Re-Use (occupied by [redacted])	Land Re-Use
[redacted]	NRU Maintenance Offices	Removed from site; Land Re-use (Available for re-use/vacant)	Land Re-Use
[redacted]	MAPLE-1 Reactor	Operations - Extended Safe Shutdown	Decommissioning/ Building Removal
[redacted]	MAPLE-2 Reactor	Operations - Extended Safe Shutdown	Decommissioning/ Building Removal
[redacted]	Legacy Radiation Protection Offices	Land Re-Use (occupied by [redacted])	Land Re-Use
[redacted]	Legacy Radiation Protection Offices	Land Re-Use (occupied by [redacted])	Land Re-Use
[redacted]	Legacy Radiation Protection Offices	Land Re-Use (occupied by [redacted])	Land Re-Use
[redacted]	Legacy Radiation Protection Offices	Land Re-Use (occupied by [redacted])	Land Re-Use
[redacted]	Reactor Exhaust Stack	Decommissioning/ Building Removal	SWS /C&M

Building #	**Name / Description**	**Current D&D Status (December 2022)**	**Plan Forward (expected status in 5 years) [3]**
[redacted]	Process Water Valve House	End-State Verification Activities	Interim End-State - SWS
[redacted]	Effluent Monitoring Equipment For Loops	End-State Verification Activities	Interim End-State - SWS
[redacted]	Former Emergency Change Room *(Slab Remains)*	End-State Complete	N/A
[redacted]	Class III Emergency Power House	Operations	Operations
[redacted]	Former Beta-Ray Spectrometer Building	Land Re-Use (Available for re-use/vacant)	Land Re-Use
[redacted]	Offices/Change Room For NRX/NRU/MAP	Decommissioning / Building Removal (Above Ground Only)	SWS/C&M
[redacted]	NRU/QA Storage Fab & Pressure Vessel; maintenance shop; storage; pipe rack enclosure	Decommissioning/ Building Removal	SWS/C&M
[redacted]	Former Helium Supply Tank For NRX	End-State Complete	Land Re-Use (Available for re-use/vacant)
[redacted]	Pool Test Reactor	End-State Complete	N/A
[redacted]	Multi-Use Facility: ZED-2 Reactor, Deformation Technology, Facility Operations, Fuel and Fuel Channel Safety, CTL-1 Facility, reactor physics research, machine/electrical shops, Burst Test Facility and offices	Operations	Operations
[redacted]	NRU Reactor	Operations – Extended Safe Shutdown	SWS/C&M
[redacted]	NRU Rod Bay	Operations – Extended Safe Shutdown	SWS/C&M
[redacted]	NRU License Extension Project	Land-Reuse (occupied by [redacted])	N/A
[redacted]	Service Tunnel	Operations	SWS/C&M
[redacted]	54" Intake From River	Operations	SWS/C&M
[redacted]	48" Cooling Water	Operations	SWS/C&M
[redacted]	Pipeline Building, 150	Operations	SWS/C&M
[redacted]	Overhead Passage to NRU	Decommissioning/ Building Removal	SWS/C&M
[redacted]	Passage Duct	Operations – Extended Safe Shutdown	SWS/C&M

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in 5 years) [3]
[redacted]	Steam Trench Tunnel	Operations	Operations
[redacted]	NRU Emergency Filter System and Exhaust Air Filtration System	Operations	SWS/C&M
[redacted]	Steam Trench North From W.End	Operations	SWS/C&M
[redacted]	NRU Exhaust Air Filters	Operations – Extended Safe Shutdown	SWS/C&M
[redacted]	NRX/NRU Booster Fan House	Operations – Extended Safe Shutdown	SWS/C&M
[redacted]	Duct Work	Operations – Extended Safe Shutdown	SWS/C&M
[redacted]	Emergency Ductwork	Operations – Extended Safe Shutdown	SWS/C&M
[redacted]	Sump & Pumping Equip. FOR [redacted]	Operations – Extended Safe Shutdown	SWS/C&M
[redacted]	Waste Disp Sorting/Temp Storage	Land Re-Use (occupied by [redacted])	N/A
[redacted]	NRU 25-Ton C02 Tank	Storage with Surveillance/Care & Maintenance	Removed from site (tank)/ SWS/C&M (pad)
[redacted]	NRU Instrument Maintenance Shop	Operations	SWS/C&M
[redacted]	Decontam Skid Strge For NRU	Storage with Surveillance/Care & Maintenance	Decommissioning/ Building Removal
[redacted]	NRU Misc. Equipment Storage	Operations	SWS/C&M
[redacted]	NRU Oil Products Storage	End-State Verification Activities	Land Re-Use (Available for re-use/vacant)
[redacted]	NRU Carpenter Shop	Land Re-Use (occupied by [redacted])	N/A
[redacted]	NRU Operational Storage	Operations	Operations, new use as waste processing
[redacted]	NRU Hazardous Storage	Operations	SWS/C&M
[redacted]	Carpenter Storage Facility	SWS/C&M	SWS/C&M
[redacted]	NRU Waste Collect & Characterization	Operations	Operations
[redacted]	Steam Generator Cleaning Skid Storage For NRU	Storage with Surveillance/Care & Maintenance	Decommissioning/ Building Removal

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in 5 years) [3]
[redacted]	FORMER REACTOR BAY & CA2 DEIONIZATION	Decommissioning/ Building Removal	SWS/C&M
[redacted]	Former MAPLE & Decommissioning Offices	End-State Verification Activities	Interim End-State - SWS
[redacted]	Former Refr/Air Cond Shop/Filter St	End-State Complete	Land Re-Use
[redacted]	Active Laundry Building	End-State Verification Activities / Land Re-Use (occupied by [redacted])	SWS/ C&M /Land Re-Use (occupied by [redacted])
[redacted]	Chemical Plant Exhaust Stack	Operations	Operations
[redacted]	NRX Rod Handling Bays	Decommissioning/ Building Removal	Decommissioning/ Building Removal
[redacted]	Delay Tanks For Radioactive Liquid	Operations	Decommissioning/ Building Removal
[redacted]	Guard Tank Overflow 68,000 LTR	Operations	Decommissioning/ Building Removal
[redacted]	Filter/Fan House [redacted]	Operations	Operations
[redacted]	Loop Decontam Liquid Waste Storage	Operations	Interim End State -SWS
[redacted]	Former Heavy Water Upgrading Plant (slab remains)	End-State Complete / Land Re-use (occupied by [redacted] and [redacted])	Land Re-use
[redacted]	Underground HW Storage Tanks	End-State Complete	Land Re-use
[redacted]	Former Heavy Water Storage Tanks; TSU Material Storage Area	Operations	Operations
[redacted]	Tritium Facility/ Combined Electrolysis Catalytic and Exchange Upgrade and Detritiation Test Facility	Operations	Operations
[redacted]	Vehicle Search Tent	Operations	Operations
[redacted]	Security Command Post Trailer	Operations	Operations
[redacted]	Active Holding Tank Entry	Operations	Interim End State -SWS
[redacted]	Former Recovery Lab	Decommissioning/ Building Removal	Decommissioning / Building Removal
[redacted]	Annex to Building [redacted]	Decommissioning/ Building Removal	Decommissioning / Building Removal
[redacted]	Decomm. Materials Storage	End-State Complete	Land Re-Use
[redacted]	Concentrated IX Regenerant Liquid	Operations	Operations
[redacted]	FMR Liquid Waste Loading/Unloading	Operations	Operations
[redacted]	FMR IX Regenerant Liquid Waste Evap	Operations	Operations
[redacted]	Former Chemical Tower (no annexes)	Interim End-State - SWS	SWS/C&M
[redacted]	C60 & Loop Decontam Liquid Waste St	Operations	Operations

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in 5 years) [3]
[redacted]	Moly Production Facility/Reac Chem	Operations	Operations
[redacted]	Delay storage pit for [redacted]	Operations	Operations
[redacted]	Efflu Monitor./Filter Test Lab/HVAC	Operations	Interim End State - SWS
[redacted]	NMMT/NFO Offices, Shower/Change Are	Decommissioning/ Building Removal	Land Re-Use
[redacted]	Former Waste Recovery From NRX - structure removed, slab and fenced land only	End-State Verification Activities	Interim End State - SWS
[redacted]	Solution Storage Tank (FISST) for [redacted]	Operations	Decommissioning/ Building Removal
[redacted]	Truck Bay and Pump Annex	Operations	Operations
[redacted]	Storage Building	End-State Complete	Land Re-Use
[redacted]	Universal Hot Cells	Operations	Operations
[redacted]	Pump House	Decommissioning/ Building Removal	SWS/C&M
[redacted]	Reactor Drain Tank; Chemical Active Drain Tank	Decommissioning/ Building Removal	SWS/C&M
[redacted]	Decontam Centre (DC) Active Collection	Operations	Decommissioning / Building Removal
[redacted]	Chem Active Drains (CAD) Collection	Operations	Decommissioning / Building Removal
[redacted]	Chemical Engineering Lab/Offices	Decommissioning/ Building Removal	SWS/C&M / Land Re-Use
[redacted]	Hydrogen Gas Cylinder Storage	Decommissioning/ Building Removal	Removed from site (tank)/ SWS/C&M (pad)
[redacted]	New Processing Facility (NPF)	Operations - Extended Safe Shutdown	Decommissioning / Building Removal
[redacted]	Office Trailer	Operations	Removed from site/ Land Re-Use
[redacted]	Fuel Eng Technical Offices/Labs; Corrosion Tech Offices/Lab; Fuel And Fuel Channel Safety	Decommissioning/ Building Removal	SWS/C&M / Land Re-Use
[redacted]	Garbage Can Storage	Design	Operations
[redacted]	Analytical & Reactor Chemistry Laboratories/Offices	Operations	Operations
[redacted]	Gas Cylinders Storage and Garbage Storage	Operations	Operations
[redacted]	Garbage Can Storage	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in 5 years) [3]
[redacted]	Services for laboratories in Building [redacted]	Operations	Operations
[redacted]	Analytical and Reactor Chemistry laboratories/offices	Operations	Operations
[redacted]	Garbage Storage	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Metallurgy Offices/Labs RFFL FAC.	Operations	Operations
[redacted]	Materials Labs And Offices	Operations	Operations
[redacted]	Nuclear Fuel Fabrication Facility (NFFF)	Operations	Operations
[redacted]	Power House	Operations	Operations
[redacted]	Oil Tank Valve House	Operations	SWS/C&M
[redacted]	Chlorinator Building	Operations	Operations
[redacted]	Chlorine Cylinder Shed	End State Verification Activities	End-State – Complete
[redacted]	Main Electrical Substation	Operations	Operations
[redacted]	Sewage pump building service	Operations	Operations
[redacted]	Gravity Tank For Service Water	Decommissioning/ Building Removal	End-State – Complete
[redacted]	Fabrication Facility (NFFF); Testing And Assembly Area; Casting Area	Decommissioning/ Building Removal	SWS/C&M
[redacted]	Charcoal Filter Testing Labs	End-State Complete	Land Re-Use
[redacted]	Pipe Fab/Motor Wind Shop/NRU QA Storage	Operations	SWS/C&M
[redacted]	Pipe Fab/Motor Wind Shop/QA Storage	Operations	SWS/C&M
[redacted]	Emergency Process Water Cooling NRU	End-State Verification Activities	SWS/C&M / Land Re-Use
[redacted]	Valve House A For NRU	End-State Verification Activities	SWS/C&M
[redacted]	Valve House B For NRU	End-State Verification Activities	SWS/C&M
[redacted]	Valve House C For NRU	Decommissioning/ Building Removal	Decommissioning / Building Removal
[redacted]	Valve House D For NRU	Decommissioning/ Building Removal	Decommissioning / Building Removal
[redacted]	Former Tank Used For CANDU® 9 Rupture Disk	End-State Verification Activities	Land Re-use
[redacted]	Former Filtered Water Storage Reserve	End-State Verification Activities	Decommissioning / Building Removal

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in 5 years) [3]
[redacted]	Radio Communications (New In 1999)	End-State Verification Activities	Land Re-use
[redacted]	Process & Service Water Tower	End-State Verification Activities	Decommissioning / Building Removal
[redacted]	Heavy Water Storage Facility	Decommissioning/ Building Removal	SWS/C&M
[redacted]	Carpenter Shop/Non-Dest. Test Tool	End-State Verification Activities	End-State – Complete
[redacted]	Machine Shop and Thermal Hydraulics Laboratories/Offices	Operations	Operations
[redacted]	Restricted Area Shop	Operations	Operations
[redacted]	Waste Technologies Development/Laboratories And Offices	Operations	End-State – Complete
[redacted]	Waste Proc Tech Dev Labs/Offices	Operations	End-State – Complete
[redacted]	Vehicle/Bulk Decontamination Building	Operations	Operations
[redacted]	Fuel Engineering /Reactor Safety Laboratories And Offices	Operations	Operations
[redacted]	Former Aquatic Storage	End-State Verification Activities	Land Re-use
[redacted]	Decontamination	Operations	Operations
[redacted]	Emergency Equipment Storage	Operations	Land Re-use
[redacted]	Former Liquid Dispersal Area Valve House	End-State Verification Activities	End-State - Complete
[redacted]	High Pressure Mass Transfer Rig	End-State Verification Activities	End-State - Complete
[redacted]	High Pressure Mass Transfer Rig (Tower) (Slab remains)	End-State Verification Activities	End-State - Complete
[redacted]	Burst Test Facility Labs/Offices	Operations	SWS/C&M
[redacted]	Process Sewer Sampling Station	Operations	Operations
[redacted]	Former Oil & Paint Storage	End-State Complete	Land Re-use
[redacted]	Nuclear Materials Storage facility	Operations	Operations
[redacted]	NRU/NRC Storage Equip/Surplus Mat	Operations	Operations
[redacted]	Liquid Nitrogen Tower	Operations	SWS/C&M
[redacted]	NRU/NRC Storage	Operations – Extended Safe Shutdown	SWS/C&M
[redacted]	Decontam Storage Building	End-State Verification Activities	End-State Complete
[redacted]	Flasks/Radioactive-Contam Equipment	Operations	End-State Complete

Building #	**Name / Description**	**Current D&D Status (December 2022)**	**Plan Forward (expected status in 5 years) [3]**
[redacted]	FTIR Lab	End-State Verification Activities	End-State Verification Activities
[redacted]	High Pressure LPCE Test Facility	End-State Verification Activities	SWS/C&M
[redacted]	Hydrogen H_2O Gas Cylinders	End-State Verification Activities	SWS/C&M
[redacted]	Hydrogen/H_2O/Nitrogen Storage	End-State Verification Activities	SWS/C&M
[redacted]	Sandblasting Building	Land Re-Use (Available for re-use/vacant)	N/A
[redacted]	Waste Treatment Centre	Operations	Operations
[redacted]	Shed	Land Re-Use (Available for re-use/vacant)	N/A
[redacted]	Non-radiological emulsified bitumen storage	Operations	Operations
[redacted]	Chemical Storage	Operations	Operations
[redacted]	Hazardous Active and Chemical Storage	Operations	Operations
[redacted]	Temporary Office trailer	Removed from site, End State Complete	Land Re-use (occupied by B716T)
[redacted]	Active Drain System Holding Tank	Operations	Operations
[redacted]	Nuclear Material Storage facility	Operations	Operations
[redacted]	Mixed Waste Storage Shed	End-State Complete	Land Re-use
[redacted]	WTC STORAGE UNIT	Operations	Operations
[redacted]	High Bay Mock-Up And Assembly Labs	Operations	Operations
[redacted]	Machinery And Equipment Storage	Operations	Operations
[redacted]	Controlled Area Main Pedestrian Entrance/Exit, Radiation Protection Offices, Instrument Shop, Security Office And Locker Area	Operations	Operations
[redacted]	Decommissioning Change Facility	Operations	Operations
[redacted]	Waste Treatment Centre Team Trailer	Operations	Removed from site / Land Re-Use
[redacted]	FD Office Trailer ([redacted]) - being installed	Operations	Operations
[redacted]	FD Office Trailer ([redacted]) - being installed	Operations	Operations
[redacted]	FD Office Trailer ([redacted] greenspace) - being installed	Operations	Operations

Building #	**Name / Description**	**Current D&D Status (December 2022)**	**Plan Forward (expected status in 5 years) [3]**
xSheds	Miscellaneous Sheds, Quantity 3 ([redacted] area)	End-State Verification Activities	Land Re-use

Table Notes: [1]These building/structures are also listed as Areas of Potential Environmental Concern in Table A-4: *Areas of Potential Environmental Concern within MU 1*, and are assessed considering Environmental Remediation requirements.
[2]These buildings have entered Decommissioning / Building Removal stage, but will be returning to SWS/ C&M due to delays to the proposed NSDF.
[3]A re-planning exercise is currently underway which may alter the forward plan status.
SWS is Storage with Surveillance.
C&M is Care and Maintenance.

Table A-4: Areas of Potential Environmental Concern within MU 1

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
Inner Controlled Area	Most of CRL's radioactive activities take place in MU 1, home to 5 reactors, one of which is still operating (ZED-2) and to a number of laboratories and support facilities.	APEC Identified and Monitored	APEC Identified and Monitored
Power House Shoreline Landfill	Was used as a construction waste dump in the 1940s and 1950s. Waste consists mainly of buried materials from old demolished buildings. Solid wastes are periodically observed due to local erosion. These wastes have been retrieved and disposed on two occasions.	Environmental Site Assessment	Environmental Site Assessment
NRX Rod Bay Plume toward the Ottawa River	A leak occurred in 1959 as a result of modifications to the NRX Fuel Storage Bays releasing significant quantities of radionuclides to subsurface resulting in a plume of tritium and of ^{90}Sr which continued until 2006 when the rod bay water was removed, leading to a significant reduction in tritium levels. The highest ^{90}Sr concentrations are found in a narrow band 10-to 20-m wide along much of the flow path. The concentrations of ^{90}Sr in the plume have been reasonably constant for the past 15 years, and are expected to gradually decrease in the future. This plume is monitored under the CRL GWMP and updates are provided in the *Annual Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL* (e.g., [106]).	APEC Identified and Monitored	APEC Identified and Monitored
North Embayment (Ottawa River)	Sediment in a small area of the Ottawa River known as the North Embayment has elevated levels of gross beta activity (^{90}Sr and ^{90}Y) as a result of the NRX groundwater plume discharging in this area and a small area of elevated ^{137}Cs concentration in surface sediment.	Risk Assessment	Risk Assessment

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
NRU Plume toward the Ottawa River	An ongoing leak in the NRU spent fuel storage bays is the source of a long-term release of tritium contaminated groundwater that began the early 1980s. With the shutdown of the NRU reactor and the removal of a portion of the bay water in 2018, the tritium concentration in the bay is expected to decrease by approximately 15 to 30% per annum due to radiological decay and water losses due to evaporation and bay leakage. Tritium concentrations in the groundwater downgradient of NRU are remaining stable. This plume is monitored under the CRL GWMP and updates are provided in the *Annual Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL* (e.g., [106]).	APEC Identified and Monitored	APEC Identified and Monitored
Building [redacted] Land	Building [redacted] is located on the side of a hill in the Controlled Area and includes a pump house building, a 300 m^3 cylindrical holding tank ([redacted]) and a smaller 30 m^3 cylindrical tank ([redacted]) both used for radioactive contaminated waste water from buildings [redacted] and [redacted]. Evidence of groundwater contamination resulting from leaks in tank [redacted] was first detected in 1972 and again in 1983. The leak from Tank [redacted] during operations resulted in localized, low-level soil contamination. The extent of contamination has not been fully delineated.	Environmental Site Assessment	Environmental Site Assessment
Building [redacted] Land	Building [redacted] was a facility used to process and treat radioactive waste product from the NRX reactor and reactor fuel reprocessing carried out in buildings [redacted] and [redacted]. The liquid wastes contained concentrations of fission products in nitric acid and ammonium nitrate. A	APEC Identified and Monitored	APEC Identified and Monitored

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
	process piping failure in 1955 led to a leak of 10 to 50 liters of radioactive liquid on the ground outside the building through a crack in the floor. Considerable contamination is believed to remain in the soil but has not been delineated due to its location under the building.		
LDA Pipeline (inner Controlled Area portion)	Remedial actions have taken place to remove the pipeline and associated contaminated soil in MU 7. Several leaks were reported from the LDA pipeline, however, some of which were in MU 1. The contaminant plume has migrated toward the Controlled Area, near building [redacted], in particular. The remaining section of the pipeline within the controlled area, near the [redacted], remains due to access restrictions related to security and awaiting decommissioning activities related to building [redacted].	Environmental Site Assessment	Environmental Site Assessment
Building [redacted] Land	Located in the Metallurgy Building [redacted], the Fuels and Materials Cells facility has been used for experiments with highly radioactive fuels and reactor components. In 1995 contaminated soil was observed under the facility due to leaks from the active drain. The contamination has not been removed and is still present beneath the centre of the building.	APEC Identified and Monitored	APEC Identified and Monitored
Active Drain System	The Active Drain System collects radioactive wastewater from nuclear facilities and radioactive laboratories within MU 1 and low toxicity water-soluble chemicals. Several leaks have occurred and resulted in localized soil and groundwater contamination. Any legacy piping associated with the Active Drain System has been removed during decommissioning activities as required.	Operations	Operations

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
Building [redacted] Infiltration Pit	In 1945, an infiltration pit was installed to allow for disposal of active liquid waste from the north end of building [redacted]. Test wells drilled in 2003 revealed the presence of small amounts of ^{137}Cs at depths corresponding to the location of the infiltration pit. The drain pipe, the infiltration pit and contaminated soils were left in place following decommissioning of building [redacted] due to the infrastructure congestion in the area.	APEC Identified and Monitored	APEC Identified and Monitored
Building [redacted] Land	Low-level radioactive water was observed until the late 1950s in a former small pond located next to building [redacted]. The contaminated materials have not yet been excavated from this area.	APEC Identified and Monitored	APEC Identified and Monitored
Building [redacted] Land	Building [redacted] is a complex used to store radioactive liquid wastes in four separate storage tanks housed in separate concrete vaults. Several leaks and incidents have been reported in and around building [redacted]. ^{137}Cs contamination is believed to remain in the soil at buildings [redacted] and [redacted] and will require further characterization and delineation.	APEC Identified and Monitored	APEC Identified and Monitored
Building [redacted] Land	The building [redacted] reactor exhaust sump has collected up to 20,000 L of water annually. The water is contaminated with tritium and non-tritium alpha and beta activity and represents a potential source of contamination.	APEC Identified and Monitored	APEC Identified and Monitored
Building [redacted] Land	Shallow soil contamination has been observed on the west and north sides of building [redacted] as part of a characterization completed in 2021 ahead of decommissioning execution.	APEC Identified and Monitored	APEC Identified and Monitored
Other contaminant sources in MU 1	Several locations in the CA have been exposed to small spills and leaks affecting the soil in the immediate vicinity of the upset. These spills and leaks have not yet been assessed directly to determine if they may have impacted the	APEC Identified and Monitored	APEC Identified and Monitored

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
	groundwater, surface water, or biota in MU 1. Downgradient locations are, however, monitored under the CRL GWMP and updates are provided in the *Annual Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL* (e.g., [106]).		

A.2 Management Unit 2

Table A-5: Status of Buildings/Structures within MU 2

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in 5 years)
[redacted]	WMA D: Low-level waste storage building	Operations	Operations
[redacted]	WMA G: Service Building (backup power supply and testing equipment storage)	Land Re-Use (occupied by [redacted])	N/A
[redacted]	WMA D: Interim Storage of drums of contaminated mixed-waste liquids	Operations	Operations
[redacted]	WMA D: Interim Storage of drums of contaminated mixed-waste liquids	Operations	Operations
[redacted]	WMA D: sampling and transferring drums of contaminated mix-waste liquids	Operations	Operations
[redacted]	WMA D: Low-Level Radioactive Waste Management Office building	Land Re-Use (occupied by [redacted])	N/A
[redacted]	WMA D: Equipment storage and dedicated low background characterization area	Operations	Operations
[redacted]	WMA H: Electric Service Building For WMA H, D And G	Operations	Operations
[redacted]	WMA H: MAGS I	Land Re-Use (occupied by [redacted])	N/A
[redacted] **(former)**	WMA H: MAGS II	Land Re-Use (occupied by [redacted])	N/A
[redacted]	WMA H: Sort and Segregation Pilot Facility	Operations	Operations
[redacted]	WMA H: SMAGS I	Operations	Operations
[redacted]	WMA H: SMAGS II	Operations	Operations
[redacted]	WMA H: SMAGS III	Operations	Operations
[redacted]	WMA H: Waste Sort and Segregation Facility	Construction/ Commissioning	Operations
[redacted]	WMA G: Service Building	Operations	Operations
[redacted]	WMA G: Entrance Building	Operations	Operations

Table A-6: Areas of Potential Environmental Concern within MU 2

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
WMA D	Operating WMA established in 1976 to store contaminated obsolete or surplus equipment above ground. It currently contains a building used for the secure storage of slightly contaminated material, one building for heated mechanical equipment storage and a low background space in support of waste characterization work, and a facility comprised of three buildings for sampling and bulking liquid mixed wastes. WMA D also contains a Recoverable Surface Storage Area for the above ground storage of low-level waste in sealand containers. There has been downgradient contamination (namely tritium) detected and associated with historical WMA D operations. Ongoing monitoring of operations and downgradient groundwater quality will continue and updates are provided in the *Annual Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL* (e.g., [106]).	Operations	Operations
WMA G	Established in 1988 to securely store the [redacted] from the NPD prototype CANDU® power reactor in aboveground concrete canisters. The facility design includes multiple engineered barriers to ensure that fuel fission products and actinides remain contained and several routine procedures are carried out to monitor the canisters. Additional canisters have recently been constructed in preparation for receiving the [redacted] from WR-1 and G-1.	Operations	Operations

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
	There are no downgradient contamination concerns associated with WMA G operations, historical or current. Ongoing monitoring of operations and downgradient groundwater quality will continue and updates are provided in the *Annual Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL* (e.g., [106]).		
WMA H	Operating WMA established in 2002 that provides waste storage space for low-level solid wastes in a Recoverable Surface Storage Area and low and intermediate level waste in the Shielded Modular Above-Ground Storage (SMAGS) buildings. Recently the original MAGS-I building was demolished and replaced with the new Waste Sort and Segregation Facility. The MAGS-II building has had its waste inventory removed and has been converted to the Sort and Segregation Pilot Facility. There are no downgradient contamination concerns associated with WMA H operations, historical or current. Ongoing monitoring of operations and downgradient groundwater quality will continue and updates are provided in the *Annual Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL* (e.g., [106]).	Operations	Operations

A.3 Management Unit 3

Table A-6: Status of Buildings/Structures within MU 3

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in 5 years)
[redacted]	Equipment Storage Facility	Operations	Operations
[redacted]	Storage Building at WMA B	Operations	Operations
[redacted]	Storage area and change facility for WMA	Operations	Operations
[redacted]	Security monitoring electrical equipment and security systems equipment	Operations	Operations
[redacted]	Tile Array Enclosure for WMA B	Operations	Operations
[redacted]	Trailer for Office and Storage	Removed from Site, Land Re-Use	Land Re-use
[redacted]	Fuel Packaging and Storage (FPS) Facility	Operations	Operations
[redacted]	Annex Building Housing the Rotating Unit for the FPS Transfer Flask	Operations	Operations
[redacted]	Waste Reception Centre in WMA B	Operations	Operations
[redacted]	Waste Handling Building - Super compactor for low-level waste	Operations	Operations
[redacted]	Original Spring B Groundwater Treatment Facility	SWS/ C&M	Land Re-use
[redacted]	Equipment/Chemicals Storage	SWS/ C&M	Land Re-use
[redacted]	WMA B Entrance Building	Operations	Operations
[redacted]	Waste Services Office Trailer Complex	Operations	Operations
[redacted]	WMA Portable Shower/Change Room	Operations	Operations
[redacted]	New Spring B Groundwater Treatment Facility	Operations	Operations

Table A-7: Areas of Potential Environmental Concern within MU 3

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
WMA B	WMA B was established in 1953 to succeed WMA A and is currently in operational use as a location for solid LLW, ILW and HLW waste management. Historical Waste Storage: Until 1963 wastes were placed in capped, unlined trenches and until 1959 in asphalt-lined sand trenches. Rectangular concrete bunkers were then used but in 1977 the design was updated to cylindrical reinforced concrete bunkers, which remain in use today. Several special burials (NRU and NRX calandrias) were also made in concrete containers or directly in the trenches. HLW such as irradiated fuel, hot cell waste, fuel bundles, unusable radioisotopes, spent columns, and filters and fission product wastes from ^{99}Mo production are stored in shielded engineered in-ground storage units known as tile holes. Fuel has been removed from the first-generation tile holes to FPS, however tile hole remediation is still required. Some of the underground waste containers have degraded over the years. Operational Waste Storage: Cylindrical Bunkers containing ILW have been formed with concrete walls and pads and include leak detection. Approximately 6000 modern Tile Holes continue to store high-level waste in WMA B, including: •Irradiated Rod Part (IRP) tile holes •Irradiated Fuel Element (IFE) tile holes •Irradiated Material Disposal (IMD) tile holes •Cell Waste (CW) tile holes •Cell Filter (CF) tile holes	Operations	Operations

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
	•Reverse Osmosis Disposal (ROD) tile holes WMA B is of high concern due to significant contaminant transport via groundwater and due to numerous HLW, ILW burials and historic LLW storage units.		
Fuel Packaging and Storage Facility	The Fuel Packaging and Storage (FPS) Facility, located within WMA B, was designed and built to retrieve, transfer, dry and store research reactor fuel from the tile holes that house used fuel transferred from the NRX and NRU rod bays between 1963 and 1983. The FPS currently operates to store the fuel retrieved and transferred from 96 first generation tile holes between 2015 December and 2018 August.	Operations	Operations
WMA B Eastern Plume toward Main Stream	A contaminated groundwater plume is transporting chlorinated solvents originating from the unlined sand trenches at the north end of WMA B and tritium from the northeast unlined trenches and the cylindrical bunkers in the southern region of WMA A toward Main Stream. This plume is monitored under the CRL GWMP and updates are provided in the *Annual Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL* (e.g., [106]).	APEC Identified and Monitored	APEC Identified and Monitored
WMA B Southern Plume toward Perch Lake	The tritium contaminated solid waste stored in the cylindrical bunkers has also impacted the groundwater leaving WMA B to the South toward Perch Lake. This plume is monitored under the CRL GWMP and updates are provided in the *Annual Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL* (e.g., [106]).	APEC Identified and Monitored	APEC Identified and Monitored
WMA B Western Plume toward Spring B	The groundwater along the west perimeter of WMA B continues to be substantially affected by the waste stored in the western	APEC Identified and Monitored	APEC Identified and Monitored

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
Forest and West Swamp	block of unlined sand trenches, resulting in a contaminant plume comprised primarily of elevated gross beta activity, as well as low concentrations of several organic compounds and elevated concentrations of tritium in the southern third of the perimeter. This plume flows through Spring B forest and toward West Swamp where the groundwater flow path discharges. This plume is monitored under the CRL GWMP, mitigated by the **Spring B Groundwater Treatment Facility (Pump and Treat)** updates are provided in the *Annual Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL* (e.g., [106]).		
Spring B Groundwater Treatment Facility (Pump and Treat) (598)	The WMA B Western groundwater plume has been subject to treatment since 1992 when an experimental treatment system was put into operation. The original Spring B Treatment System has, since then, been treating a significant fraction of migrating radiostrontium, mitigating impacts on the West Swamp where the groundwater flow path discharges. The New Spring B Groundwater Treatment Facility was commissioned in 2020. The original system (594/594A) has now ceased operations and planning for decommissioning was initiated in 2022/23. Performance updates are provided in the *Annual Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL* (e.g., [106]).	Operations	Operations

A.4 Management Unit 4

Table A-8: Status of Buildings/Structures within MU 4

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in 5 years)
[redacted]	Emergency Storage Basin	Operations	SWS/C&M
[redacted]	Emergency Equipment Storage	Land Re-Use (proximal to [redacted])	N/A
[redacted]	Document Shack	End-State Complete	Land Re-Use
[redacted]	Fuse Shack	End-State Complete	Land Re-Use
[redacted]	In Vivo Monitoring, Whole-Body/Lung Counters, Environmental Sample Analyses	Operations	Operations
[redacted]	Low Background Office Trailer	Operations	Removed from site-Land Re-Use
[redacted]	Radiation Portal Monitor	Operations	Operations
[redacted]	Site Evacuation/Monitoring Building	Land Re-Use (proximal to [redacted])	N/A
[redacted]	Vehicle Monitor #1	Land Re-Use (proximal to [redacted])	N/A
[redacted]	Vehicle Monitor #2	Land Re-Use (proximal to [redacted])	N/A
[redacted]	Outer Gate House For Site	Land Re-Use (occupied by Plant Rd)	N/A
[redacted]	Emergency Generator	Land Re-Use (occupied by Plant Rd)	N/A
[redacted]	Guard House	Land Re-Use (occupied by Plant Rd)	N/A
[redacted]	Security Tent	Land Re-Use (occupied by [redacted])	N/A
[redacted]	Contractor Management Trailer (at Twin Lakes Soil Management area)	Operations	Operations
[redacted]	Waste Analysis Facility	Operations	Operations
[redacted]	Waste Characterization Facility	Operations	Operations
[redacted]	Waste Characterization Facility Office Trailer 1	Operations	Operations
[redacted]	Waste Analysis Facility Concrete Segregation Facility	Operations	Operations
[redacted]	Waste Characterization Facility Office Trailer 2	Operations	Operations
[redacted]	Sprung Shelter	Operations	Operations
[redacted]	Security Equipment Storage	Land Re-Use (Available for re-use/vacant)	Land Re-Use
[redacted]	Live Firefighter Training Structure	Operations	Operations

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in 5 years)
[redacted]	Fire Equipment Storage	Operations	Operations
[redacted]	Rehabilitation Area for Firefighting Training Evolutions	Operations	Operations
[redacted]	Underground Waste Water Tank	Operations	Operations
[redacted]	Confined Space Training Container	Operations	Operations
[redacted]	Live Fire Equipment Storage Container	Operations	Operations
[redacted]	Class A Fuel Storage Container	Operations	Operations
[redacted]	Personal Protective Equipment Storage Container	Operations	Operations
[redacted]	Live Fire Training Site Gazebo	Operations	Operations
[redacted]	Waste Characterization Services Lab & Fire Training Trailer	Operations	Operations/Removed from site – Land Re-Use
[redacted]	Firefighting Training Trailer	Land Re-Use (occupied by [redacted])	N/A
[redacted]	Salt Storage Building	Operations	Land Re-Use (for new salt storage building being built in-situ in 2023)
[redacted]	Former Bulk Storage Compound Sprung Tent Structure	Operations	Operations
[redacted]	Minwamon Building: Logistics warehouse facility and site entrance building	Operations	Operations
[redacted]	Vehicle Inspection Station	Operations	Operations
[redacted]	Vehicle Inspection Personnel Booth	Operations	Operations
[redacted]	Roadway Booths	Operations	Operations
[redacted]	CRL Site Entrance Canopy	Operations	Operations
[redacted]	Contractor Management Complex	Operations	Operations
[redacted]	Waste Management and Heavy Equipment Break Room Trailer	End State Verification Activities	N/A

Table A-9: Areas of Potential Environmental Concern within MU 4

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
Bald Rock	Bald Rock is a site where research was initiated in the 1970's and ended in 1985 to investigate the crystalline rock formations at CRL and their potential for deep cavern storage of radioactive waste. No sign of radioactive or non-radioactive contamination or waste was uncovered during decommissioning and removal of the equipment and instruments completed between 2007 and 2010. Decommissioning and environmental remediation of the 6 boreholes (test wells) at Bald Rock is occurring in 2022 (see **Deep Boreholes**, below). Confirmatory characterization will be undertaken prior to closure.	Execute Remedial Action	Environmental Remediation Project Closeout/ Land Re-use
Deep Boreholes	Thirty-seven of the approximately 50 exploratory deep boreholes existing on the CRL site are slated to be decommissioned and remediated by 2022. Several of these are located in the **Bald Rock** area (see above). No radiological or non-radiological contamination issues exist with respect to these boreholes.	Execute Remedial Action	Environmental Remediation Project Closeout / Land Re-use
Blimkie's Meadow	Blimkie's Meadow is a former farm site (pre-dating operations) located next to WMA A which was used by CNL for the storage of discarded equipment. Its history suggests the presence of contamination at Blimkie's Meadow is unlikely. Confirmatory characterization may be required prior to closure.	Environmental Remediation Project Closeout	Land Re-use
Emergency Storage Basin ([redacted])	The Emergency Storage Basin was built in 1960 as a temporary holding facility for any contaminated water that would have been generated in a major reactor	Operations	SWS/C&M

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
	accident. The storage basin has never been used and is considered clean and operational.		
Interim Firing Range	The interim firing range was located near the Twin Lakes sand and gravel aggregate pit. It operated between 2004 and 2019. It is no longer in operation and has been incorporated into the Twin Lakes Soil Management area. The site will require further characterization and possibly cleanup before it is considered as closed.	Land Re-use (as Twin Lakes Soil Management area)	N/A
Old Firing Range	A former sand pit used for shooting practice from 1943 to 2004. The 2,000 m^2 shooting range was located near the Entry Precinct. Approximately 200 m^3 of contaminated soils and 5 m^3 of bullets and shell casings were recovered and sent for off-site disposal in 2010. While most of the impacted soils have been excavated, confirmatory samples and field measurements collected following remediation suggest the presence of lead levels slightly above Ontario guidelines at ground surface remain in a few small areas. Confirmatory characterization will be undertaken prior to closure.	Remediation Project Closeout	Land Re-use
Perch Lake Canopy Tower	The Perch Lake Canopy Tower Site, located on Garrison Petawawa property, was an instrumented experimental site used between the early 1960s and the late 1980s to collect environmental data. All research equipment was removed and no evidence of contamination was identified during cleanup work in 2003.	Land Re-use (area is no longer on the CRL site)	N/A
Snow Dump #2	The gravel-based Snow Dump #2 has been in operation since the early 2000's. Ideally snow disposal sites should have a low permeability base such as pavement to protect groundwater according to the CRL	Operations	Operations

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
	Snow Management Plan. Characterization has not occurred to verify the status, therefore such surficial and groundwater contamination is possible.		
Twin Lakes Tracer Test Site	The Twin Lakes Tracer Site was established in 1982 as a location where studies of the dispersion of contaminants in a groundwater flow system occurred under natural gradient conditions. Radiological contamination was not detected an end-state report was completed suggesting the land was suitable for unrestricted land use.	Land Re-use (as Twin Lakes Soil Management area)	N/A
Twin Lakes Soil Management Area	This area is used as a storage and processing area for materials generated by projects and routine operations on the CRL site. Within the pit material is processed and stockpiled in segregated piles allowing for reuse of the material around the CRL site which reduces the need for sourcing new materials when needed.	Operations	Operations
Bulk Storage Compound	The Bulk Storage Compound (BSC) was used for over 60 years to store redundant equipment, recyclable wastes and eventually contaminated materials. During confirmatory sampling in August 2021, a hot particle and soil elevated in radionuclide levels were removed as waste. This eastern half of the area is slated for reuse and will be re-evaluated at a later date. The western half is being reused as the **New Firing Range**. Any residual contamination on the west portion will be removed as part of the eventual closure of the firing range.	Land Re-use (as New Firing Range)	N/A
New Firing Range	Permanent turtle fencing has been installed surrounding the western arm of the former Bulk Storage Compound and it has been commissioned for use as the New Firing Range as of 2022 May.	Operations	Operations

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
Waste Analysis Facility ([redacted] series)	The Waste Analysis Facility (WAF) accepts clean solid waste generated or processed at CRL, verifies it is clean, and then sorts and segregates the waste prior to routing it through appropriate waste disposal paths. This waste includes trash/ bagged waste, metal for recycling, organics and concrete for re-use on site.	Operations	Operations
Miller's Road Landfill	The Millers Road Waste Disposal Site is presently leased by the Town of Deep River from Atomic Energy of Canada Limited (AECL) and has been the waste disposal site for the Municipality since approximately 1965. The landfilling of domestic waste ceased in July 2002. Since July 2002 areas within the 4.5 hectares landfilling area have received only clean (non-radioactive) construction and demolition waste. The attenuation zone for the landfill is on AECL land. A characterization will be required prior to future landfill closure. Beside the Miller's Road Landfill, an additional Area of Potential Environmental Concern includes an area known as "old dump" from the 1950s and other areas where unregulated dumping of trash may have occurred.	Operations	Operations
Labine Farm Landfill	Labine Farm Landfill was established prior to the Government of Canada expropriating land for CRL in 1944. Four separate investigations, a surface radiological survey, a non-intrusive geophysical study, an archeological study, and an intrusive characterising investigation all determined that, although there were bits of trash at surface, that the area was not used as a landfill.	Environmental Remediation Project Closeout	Land Re-use

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
	Confirmatory characterization may be required prior to closure.		
Salt Storage Facility ([redacted])	The Salt Storage Facility is a 30 m by 50 m enclosed storage building and houses snow removal equipment, sanding vehicles and stockpiles of road salt and gravel. This currently operating facility was commissioned in 2007 and is used to contain road salt prior to use on site roads to prevent the unwanted release of salt to the environment. The area surrounding the 0.8 hectares facility is used to store heavy equipment and serves as a laydown area for soil and gravel; it is surrounded by jersey barriers to prevent turtles from entering. The current facility will be demolished in 2023 and a new facility built on the same footprint.	Operations	Operations
Live Fire Training Facility ([redacted] series)	The live fire training facility was established in 2016 and remains operational. The facility consists of a total area of approximately 1.7 hectares which is graded and compacted with gravel. The graveled area is designed for firefighter training, staging areas for large scale exercises (integrated response) and for future development of training simulators. The installation of a new trailer complex in this area housing waste characterization labs is currently in progress with occupancy expected in 2023.	Operations	Operations

A.5 Management Unit 5

There are no buildings or structures in MU 5

Table A-10: Areas of Potential Environmental Concern within MU 5

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
Ottawa River Sediment	Above-background levels of radiological and non-radiological (primarily mercury) substances have been detected in Ottawa River bottom sediment as a result of historical discharges from the CRL Process Sewer system. The area is approximately 400 m long and 200 m wide in water 8 to 30 m deep, and is contained within the top 15 cm of riverbed sediment. The active particles identified can be linked to the period of operation of the NRX reactor (1947-1992). Risk assessment confirms a low risk to the public and negligible and declining risk to Ottawa River biota from this historical sediment contamination. The management goal is to maintain low and acceptable risk to human health and the environment under a Monitored Natural Attenuation approach. The results of an ongoing sediment verification monitoring program [103], have shown that the critical assumptions remain valid and river sediment deposition is further burying the contaminated sediments under clean more recent sediments while allowing radiological contaminants to decay [104], [105]. This monitoring initiative will continue to be conducted every five years or more frequently should any activities take place that could significantly alter the physical stability of the riverbed or in the case of releases to the river [103].	Execute Remedial Action (Monitored Natural Attenuation)	Execute Remedial Action (Monitored Natural Attenuation)

A.6 Management Unit 6

Table A-11: Status of Buildings/Structures within MU 6

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in five years)
[redacted]	Former Disposal Area Valve House	Decommissioning/ Building Removal	Decommissioning/ Building Removal
[redacted]	Groundwater Chemical Pit Pump house	Operations	Operations
[redacted]	Groundwater Collection/ Treatment Area	Operations	Operations
[redacted]	Storage Of Equipment and Chemicals	Operations	Operations

Table A-12: Areas of Potential Environmental Concern within MU 6

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
WMA A	WMA A, is an in-ground radioactive waste storage facility located directly south of Plant Road. The first emplacement of radioactive waste at CRL took place in 1946 into what is now referred to as WMA A. These emplacements took the form of direct disposal of solids and liquids to excavated trenches into the sand overburden. The scale of operations was modest until 1952 when the cleanup from the NRX accident generated large quantities of radioactive waste that had to be quickly and safely managed. At this time, approximately 4,500 m^3 of aqueous waste containing mixed fission products was poured into excavated trenches. This was followed by smaller dispersals in 1954 and 1955 respectively. Approximately 20,000 m^3 of buried waste, primarily radioactive, known to include contaminated soil, contaminated equipment and parts, fuel rod ends, special burials and general refuse were disposed of at WMA A in trenches excavated in sand or in discrete burials located in the east and north portions of the site. Additional characterization is planned for 2023-24.	Environmental Site Assessment	Environmental Site Assessment

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
WMA A Plume toward South Swamp	Groundwater contamination was detected downgradient from WMA A in South Swamp in 1955. The plume is currently characterized by the presence of ^{90}Sr, ^{90}Y (gross beta) and few incidences of ^{241}Am and ^{137}Cs. The levels observed are significantly above drinking water quality guidelines. This plume is monitored under the CRL GWMP (updates are provided in the *Annual Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL;* e.g., [106]), and is mitigated by the **South Swamp Permeable Reactive Barrier**.	APEC Identified and Monitored	APEC Identified and Monitored
South Swamp Permeable Reactive Barrier	A permeable reactive barrier was installed in 2013 downgradient from WMA A to intercept the ^{90}Sr plume and treat the groundwater to remove contamination as it travels toward South Swamp. Performance updates are provided in the *Annual Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL* (e.g., [106]).	Operations	Operations
Laundry Pit (part of the Liquid Dispersal Area)	The Laundry Pit received liquid wastes with various amounts of radioactivity from the Laundry and Decontamination Centre from 1955 to 1958. Additional characterization was completed in 2021 and using risk-based soil screening criteria, it is estimated that approximately 100-150 m^3 of contaminated soils will require remediation.	Environmental Site Assessment	Environmental Site Assessment
Chemical Pit (part of the Liquid Dispersal Area)	The Chemical Pit was established in 1956 to receive radioactive aqueous wastes from active laboratories (other than the reactors). The excavations in sand were backfilled with cobbles to prevent surface ponding. The liquid wastes (acids, alkalis, etc.) were delivered to the pit through the LDA pipeline receiving on average 18,000 m^3 annually. Much of the remaining inventory of contaminants of	Environmental Site Assessment	Environmental Site Assessment

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
	concern (with the exception of Tritium) remains in or immediately below the Chemical Pit. Additional characterization is planned for 2023-24.		
Chemical Pit Plume toward East Swamp	The Chemical pit is located in sand, and by the design of the time, the wastewaters infiltrated and impacted the underlying aquifer with ^{90}Sr. This plume is monitored under the CRL GWMP (updates are provided in the *Annual Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL* (e.g., [106])), and is mitigated by the **Chemical Pit Pump and Treat System**.	APEC Identified and Monitored	APEC Identified and Monitored
Chemical Pit Pump and Treat System	This pilot-scale groundwater treatment system has been operating since 1993 to intercept and treat the ^{90}Sr plume originating from the Chemical Pit before it reaches East Swamp. Performance updates are provided in the *Annual Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL* (e.g., [106]).	Operations	Operations
Reactor Pit 1 (part of the Liquid Dispersal Area)	Reactor Pit 1 (RP1) was a natural depression used between 1953 and 1958 to receive radioactive wastewater (demineralized and contained only radionuclides) from the NRX rod bays. A 1.8 m thick clean sand layer was placed over RP1's contaminated soils in 1958 but liquid dispersals and solid waste burials continued afterwards. In the mid-1970s RP1 was used for the disposal of contaminated metallic wastes, rock, till and sand from the Controlled Area forming a 2 m high mound above grade. Additional characterization is planned for 2022-23.	Environmental Site Assessment	Environmental Site Assessment
Reactor Pit 1 Plume toward Reactor Pit 2, Frog Pond and	A ^{90}Sr plume is moving downgradient from RP1, south toward RP2 as well as south-west toward Frog Pond and then on to WMA A. The Frog Pond is the only surface water body that	APEC Identified and Monitored	APEC Identified and Monitored

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
WMA A	is exclusively affected by contaminants released from RP1. This plume is monitored under the CRL GWMP and updates are provided in the *Annual Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL* (e.g., [106]).		
Reactor Pit 2 (part of the Liquid Dispersal Area)	Reactor Pit 2 (RP2), located directly south of RP1, was used to receive active liquid wastes from building [redacted]. It operated from 1956 to 1972. Asbestos cement baffles were installed at right angles in the pit to increase the length of time required for the liquids to flow through the cobble fill (and therefore allow for more radioactive decay to occur). Additional characterization is planned for 2023-24.	Environmental Site Assessment	Environmental Site Assessment
Reactor Pit 2 Plume toward Perch Lake Swamp, East Swamp, and South Swamp	A ^{90}Sr and tritium plume is moving downgradient from RP2, south toward Perch Lake Swamp as well as south-east and west toward East Swamp and South Swamp, respectively. This plume is monitored under the CRL GWMP and updates are provided in the *Annual Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL* (e.g., [106]).	APEC Identified and Monitored	APEC Identified and Monitored
Perch Lake and Upper Perch Creek	The Perch Lake Basin, which drains 18% of CRL site, contains many of the CRL's operating WMAs and those with early vintage waste storage practices, including **WMA A** and the **Liquid Dispersal Area**. Surface water passing through Perch Lake and upper Perch Creek is, therefore, affected by radiological and non-radiological contamination due to the groundwater plumes in MU 6. Surface water from Perch Lake and upper Perch Creek is monitored under the CRL Environmental Monitoring Program and updates are provided in the *Annual*	APEC Identified and Monitored	APEC Identified and Monitored

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
	Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL (e.g., [106]).		
Glass Blocks Experimental Sites	Experiments were conducted at two locations near Perch Lake beginning in 1958 to examine leaching rates of two sets of 25 vitrified glass blocks, 12 cm by 10 cm, containing mixed fission products placed below the water table. Groundwater samples were collected to determine how much activity was released from the glass, which species were retained by the soil and how the activity in groundwater changed with time. The blocks were removed in 2006 along with soil within 1 m of the blocks. Residual contamination was observed near the location of the sieve that was used as part of the block removal. Confirmatory characterization will be undertaken prior to closure.	Execute Remedial Action	Environmental Remediation Project Closeout / Land Re-Use
Frog Pond	Frog Pond is a receiving surface water body, 40 m downgradient from Reactor Pit 1.	APEC Identified and Monitored	APEC Identified and Monitored
O'Nest Tracer Site	The O'Nest Tracer Site is located approximately 400-m north of Perch Lake and was used in the 1970s for research on contaminant transport in groundwater using short-lived radionuclides (less than 65 days). The site was abandoned when the ^{90}Sr plume from WMA A reached the site and later decommissioned and remediated. Confirmatory characterization will be undertaken prior to closure.	Environmental Remediation Project Closeout	Land Re-use
Former [redacted] Evaporator Tower	The [redacted] Evaporator Tower was removed from the Controlled Area in 1960. The evaporator was used to concentrate wastes from uranium recovery equipment. The tower was removed in two sections and buried in a trench after it was flattened and covered with sand. Characterization will be completed in	Environmental Site Assessment	Environmental Site Assessment

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
	2022 to determine the precise location of the [redacted] tower as it is not currently known.		

A.7 Management Unit 7

Table A-13: Status of Buildings/Structures within MU 7

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in 5 years)
[redacted]	National Research Universal (NRU) Stack monitoring	Operations	SWS/C&M
[redacted]	Technical and Administrative Offices, Glassblowing Laboratory	Operations	Operations
[redacted]	Legacy Neutron & Solid State Physics	Land Re-Use (Available for re-use/vacant)	Land Re-Use
[redacted]	Multi-Use Facility : Industrial Hygiene Laboratory, Molten Fuel Moderator Test Facility, Large Scale Containment Facility, Emergency Response Central, Hydrogen Isotopes Technology Laboratory	Operations	Operations
[redacted]	Gas Cylinders Storage (near Building [redacted])	Operations	Operations
[redacted]	Pipeline Only	Decommissioning/ Building Removal	Interim End State - SWS
[redacted]	Main Exhaust Stack NRU & NRX	Operations	Interim End State - SWS
[redacted]	NRU 48" Underground Duct	Operations	SWS / C&M
[redacted]	Bay Water Tank Array OR “Tritiated Light Water Storage Facility”	Operations	Operations
[redacted]	Harriet Brooks Building : Laboratories and Offices	Operations	Operations
[redacted]	Advanced Nuclear Material Research Centre (ANMRC)	Design	Construction/Commissioning
[redacted]	Security Monitor/Reception & HR	Land Re-Use (occupied by [redacted])	N/A
[redacted]	Transportation Building	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Commercial Operation	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Animal Building	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Radiation Laboratory	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in 5 years)
[redacted]	Green House	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Environmental Sampling Equipment	End-State Verification Activities	Land Re-Use (Available for re-use/vacant)
[redacted]	Solvent Storage	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Vehicle Maintenance Shop	Land Re-Use (occupied by [redacted])	N/A
[redacted]	Fire Department Services Building	Land Re-Use (occupied by [redacted])	N/A
[redacted]	Fire Truck/Equip Storage	Land Re-Use (Proximal to [redacted])	N/A
[redacted]	Lead Burning Shop	Land Re-Use (Proximal to [redacted])	N/A
[redacted]	Elec/Inst/Pipe Fitting/ AC Shop	Land Re-Use (to be occupied by [redacted])	N/A
[redacted]	Glass Blowing Shop	Land Re-Use (to be occupied by [redacted])	N/A
[redacted]	Operations	Land Re-Use (to be occupied by [redacted])	N/A
[redacted]	Former Miscellaneous Storage	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Mach/Weld/Sheet Metal Shop/Admin	Decommissioning/ Building Removal	Land Re-use (Available for re-use/vacant)
[redacted]	Carpentry And Paint Shop; Sawdust Collection Hopper; Lumber And Wood Waste Storage	End State Verification Activities	Land Re-use (Available for re-use/vacant)
[redacted]	Carpenter Shop Storage	Land Re-Use (Available for re-use/vacant)	Land Re-use (Available for re-use/vacant)
[redacted]	Carpenter Shop Storage	Land Re-Use (Available for re-use/vacant)	Land Re-use (Available for re-use/vacant)
[redacted]	Chemical Storage	Land Re-Use (Available for re-use/vacant)	Land Re-use (Available for re-use/vacant)

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in 5 years)
[redacted]	Surplus Metal/Underground Pipe Storage (Aggregate Storage)	Land Re-Use (occupied by [redacted] – currently under D&D)	Land Re-use (Available for re-use/vacant)
[redacted]	Lubricant/Scaffolding Storage	Land Re-Use (Available for re-use/vacant)	Land Re-use (Available for re-use/vacant)
[redacted]	Pipefitting/Chemical Storage	Land Re-Use (Available for re-use/vacant)	Land Re-use (Available for re-use/vacant)
[redacted]	Sewage Pump House	SWS / C&M	End-State Verification Activities
[redacted]	Library/Central Records/Auditorium	End-State Complete	Land Re-use (Available for re-use/vacant)
[redacted]	Tank For Sewage Treatment Plant	End-State Verification Activities	Land Re-use (Available for re-use/vacant)
[redacted]	Imhoff Tank/Sanitary Waste Water	End-State - Verification Activities	End-State - Verification Activities
[redacted]	Chlorination Building	End-State - Verification Activities	Land Re-use (Available for re-use/vacant)
[redacted]	Manhole 4d-4 For Sewage	End-State - Verification Activities	N/A
[redacted]	Manhole 4d-4/Sanitary Sewage	Operations	Operations
[redacted]	Sewer Sampler Enclosure	End-State - Verification Activities	Land Re-use (Available for re-use/vacant)
[redacted]	Caustic Building/Sewage Treatment	End-State - Verification Activities	Land Re-use (Available for re-use/vacant)
[redacted]	Guard House	Operations	Operations
[redacted]	Vehicle Entrance/Exit	Land Re-Use (occupied by [redacted])	N/A
[redacted]	Vehicle Search Tent	Operations	Operations
[redacted]	Quality Assurance (Org. Development & Training)-South	Land Re-Use (occupied by [redacted])	N/A
[redacted]	Engineering Technical Labs, Machine Shops, Offices	Operations	Operations
[redacted]	Records/ Resource Al. - Central	Land Re-Use (occupied by [redacted])	N/A

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in 5 years)
[redacted]	Procurement Offices/Photography (2nd Floor); Central Store Warehouse/Offices (1st Floor)	Decommissioning/ Building Removal	End-State Complete / - Land Re-Use
[redacted]	National Research Council Tech Lab	Land Re-Use (to be occupied by [redacted])	N/A
[redacted]	Vehicle Entrance/Exit	Operations	Operations
[redacted]	Vehicle Search Tent	Operations	Operations
[redacted]	Former Bioassay Labs And Offices	Land Re-Use (occupied by [redacted])	Land Re-Use (Available for re-use/vacant)
[redacted]	Office Trailer	Removed from site, Land Re-Use	Land Re-Use (Available for re-use/vacant)
[redacted]	Former Salt Storage	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Heavy Equipment Maintenance / Storage	Land Re-Use (occupied by [redacted])	N/A
[redacted]	Storage ZEEP Components / QA / Misc. (Reactor Tooling Storage)	Land Re-Use (occupied by [redacted])	N/A
[redacted]	PCB Storage	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	E-Waste Storage Container	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	MMIR Quonset Storage (Construction Storage)	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	6' Concrete Culvert	Operations	Operations
[redacted]	Site Cafeteria, Occupational Health and Safety, First Aid	Operations	Operations
[redacted]	Metal Finishing Shop	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Comp Labs/Servers/Offices/Printserv	Operations	End-State Complete / Land Re-Use
[redacted]	Fire Protection Head Tank	Operations	Operations
[redacted]	Radiological/Environmental/Dosimetry Laboratories and Offices	Operations	Operations
[redacted]	Irradiation Facility	Operations	Operations

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in 5 years)
[redacted]	Hydrogeological Laboratory	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Hydrogeological Offices	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Environmental Research Office & Library	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Env. Protection Authority (Trailer)	End-State – Complete	Land Re-Use (Available for re-use/vacant)
[redacted]	Biosphere Modelling	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Storage Ultrasonic/Eddy Current Test	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Storage Ultrasonic/Eddy Current Test	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Storage Auxiliary Auto Parts	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Storage – Misc. Bulk	Land Re-Use (occupied by [redacted])	N/A
[redacted]	Biology Research Facility, Animal and Animal Tissue-Based Research Facility	Operations	Operations
[redacted]	Storage Shed For Reinforcing Steel (Fabrication Building)	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Electrical Line Crew Truck/Equip & Welding Shop	Land Re-Use (Site selected for ANMRC facility [redacted])	N/A
[redacted]	Storage Building	Land Re-Use (Site selected for ANMRC facility [redacted])	N/A
[redacted]	Storm Sewer Sampling Station	Operations	Operations
[redacted]	Storage Misc. Bulk Supplies / Gas Cylinders	Land Re-Use (occupied by [redacted])	N/A

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in 5 years)
[redacted]	Environmental Bldg's	End-State Verification Activities	Land Re-Use (Available for re-use/vacant)
[redacted]	Environmental Bldg's	End-State Complete	Land Re-Use (Available for re-use/vacant)
[redacted]	Environmental Bldg's	End-State Complete	Land Re-Use (Available for re-use/vacant)
[redacted]	Practical Training Facility (Former Visitor Information Centre)	Operations	Operations
[redacted]	Liquid Nitrogen Flash Dry Ice Storage	Land Re-Use (Available for re-use/vacant)	N/A
[redacted]	Carport	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Electrical Equipment Storage	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Crane Storage Building	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Drop/Impact Testing Facility	Land Re-Use (occupied by [redacted])	N/A
[redacted]	Fire Test Facility	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Auxiliary Impact / Fire Test Facility	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	DROP/IMPACT TESTING FACILITY Trailer	Land Re-Use (Available for re-use/vacant)	Land Re-Use (Available for re-use/vacant)
[redacted]	Sanitary Waste Water Treatment	End-State Verification Activities	End-State –Complete or Land Re-Use (Available for re-use/vacant)
[redacted]	Change Room Asbestos Shop	Land Re-Use (Site selected for ANMRC facility [redacted])	N/A

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in 5 years)
[redacted]	Flammable Gas Cylinder Storage	Land Re-Use (occupied by [redacted])	N/A
[redacted]	Mixed Waste Process/Handling Area	Land Re-Use (occupied by [redacted])	N/A
[redacted]	Hazardous Waste Storage	Land Re-Use (occupied by [redacted])	N/A
[redacted]	Waste Processing Storage	Land Re-Use (occupied by [redacted])	N/A
[redacted]	Waste Processing Storage	Land Re-Use (occupied by [redacted])	N/A
[redacted]	Offices and Non-Nuclear Laboratories	Operations	Operations
[redacted]	Entrance Building, Offices, Security And Fire	Operations	Operations
[redacted]	Science Collaboration Centre	Construction/ Commissioning	Operations
[redacted]	North Office Trailer	Land Re-Use (site selected for ANMRC facility [redacted])	N/A
[redacted]	South Office Trailer	Land Re-Use (site selected for ANMRC facility [redacted])	N/A
[redacted]	Office Trailer For Facility Decommissioning Field Staff	Operations	Removed from site / Land Re-Use
[redacted]	Office Trailer For Facility Decommissioning Field Staff	Operations	Removed from site / Land Re-Use
[redacted]	Office Trailer For Facility Decommissioning Field Staff	Operations	Removed from site / Land Re-Use
[redacted]	Office Trailer For Facility Decommissioning Field Staff	Operations	Removed from site / Land Re-Use
[redacted]	Facilities Decommissioning Office Trailer	Operations	Removed from site / Land Re-Use
[redacted]	Facilities Decommissioning Office Trailer	Operations	Operations
[redacted]	Operations Office Trailer Complex	Operations	Operations
[redacted]	Facility Decommissioning Office Trailer	Operations	Operations
[redacted]	FD Office Trailer (two storey)	Operations	Removed from site / Land Re-Use
[redacted]	Support Facility	Operations	Operations
[redacted]	Fox Hut (Carpenter Storage)	Land Re-Use (Available for re-use/vacant)	N/A
[redacted]	Above Ground Fueling Station	Operations	Operations
[redacted]	Sanitary Sewage Treatment Facility (SSTF)	Operations	Operations

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in 5 years)
[redacted]	Raw Sewage Pump Station Wet Well (New Sanitary Sewage Treatment Facility	Operations	Operations
[redacted]	Raw Sewage Pump Station Valve Chamber (New Sanitary Sewage Treatment Facility)	Operations	Operations
[redacted]	Hauled Liquid Waste Receiving Tank (New Sanitary Sewage Treatment Facility)	Operations	Operations
[redacted]	Power Generator Station (New Sanitary Sewage Treatment Facility)	Operations	Operations
[redacted]	Fuel Storage Tank (New Sanitary Sewage Treatment Facility)	Operations	Operations

Table A-14: Areas of Potential Environmental Concern within MU 7

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
Inner Supervised Area	The inner SA is occupied by non-nuclear facilities, office buildings, radioisotope laboratories, and industrial facilities. The Site Utility Revitalization Plan has upgraded some site utilities with plans to upgrade those outstanding. Several buildings have been demolished in the SA over the past several years and lands, including utility corridors, were subject to environmental characterization in preparation for reuse. No characterization has taken place so far in MU 7 to evaluate for potential impacts from accelerants of fire-fighting foams (e.g., per- and polyfluoroalkyl substances (PFAS)) that may have historically been used for fire training.	Environmental Site Assessment	Environmental Site Assessment
Dawson City	Dawson City is the original worker camp used during the construction of the CRL site. Built in the early 1940s and operated until 1957. Today, only a few of the old concrete foundations, some underground infrastructure piping, and a small amount of trash remain below grade.	Environmental Site Assessment	Environmental Site Assessment

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
	Environmental characterization activities have identified only minor exceedances of applicable industrial land use screening criteria and did not identify elevated radionuclide activity. Portions of the APEC may be affected by the Operational Sanitary Landfill Groundwater Plume.		
Foundation Road Landfill	Was used as an industrial waste dump that operated from 1946 until 1960. Metallic waste, asbestos containing material, coal ash, demolition debris, and blast rock are present. Characterization efforts have determined that all material in the metal-waste knoll area are potentially radiologically contaminated including sand blasting material used on the thermal shield prior to its burial. Concentrations of PCBs and Dioxin and Furans exceed hazardous waste limits in some samples. Further characterization has taken place in the southern portion of the landfill in 2022 to determine if this area would be suitable for a parking lot extension. The entire Foundation Road Landfill may be broken down into sub-areas to allow for site redevelopment projects.	Environmental Site Assessment	Land Re-use (partial)
Inactive Landfill Sandpit	The Inactive Landfill Sandpit is a flat area previously used as a sand borrow pit that lies below the high-tension power line adjacent to the Foundation Road Landfill and across from Snow Dump #1. The disposal of demolition and construction wastes suggests that asbestos containing materials may be present along with other potential contaminants. Further characterization is currently occurring as part of potential site revitalization projects.	Environmental Site Assessment	Environmental Site Assessment

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
Legacy Concrete Area	Legacy concrete, with an unconfirmed source of origin, is located across from the Upper Inactive Landfill and immediately west of the Sanitary Landfill. About 40% of the exposed concrete pieces at this site showed evidence of fixed beta/gamma contamination; gamma spectrometry on several pieces linked this to ^{137}Cs.	APEC Identified and Monitored	APEC Identified and Monitored
Electrical Yard Landfill	Historically used as a non-radioactive landfill which operated from 1960 to 1972. Characterization has indicated that some of the waste within this landfill is hazardous waste.	Environmental Site Assessment / Risk Assessment	Environmental Site Assessment / Risk Assessment
Upper Inactive Landfill	The materials buried in the Upper Inactive Landfill consists of waste from the Power House Building. It is characterized by very loose black ash, cinders, and clinker, indicating that the bulk of the material is waste from the CRL Power House. Radiological analysis indicated that concentration were not elevated above background.	APEC Identified and Monitored	APEC Identified and Monitored
Snow Dump #1	Snow dump #1 was used for several years until concern was raised about road salt entering the adjacent stream with snow melted runoff. When snow dumping was discontinued, it evolved into an overflow parking area and in 2013 it was formally converted, as well as paved, and is now Parking Lot A. Environmental Characterization for non-radiological contamination has not been conducted at the site. This is included in the area proposed for the siting of a Small Modular Reactor at CRL. Coal ash has been observed in portions of the Parking Lot A extension.	Environmental Site Assessment	Land Re-use

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
LDA Pipeline Route	The LDA Pipeline route is 1.5 km long and was comprised of two buried, separate 4-inch pipes: the Reactor Drain and the Chemical Active Drain. The majority of the LDA pipeline itself has been removed and the majority of the route is now in the post-remedial verification stage. Soil remediation on the hillside near [redacted] and on the south side of Plant Road where the pipeline crossed the road is still required. The **O-3 wetland** was contaminated due to a pipeline leak and will need to be assessed for potential cleanup.	Environmental Site Assessment	Environmental Site Assessment
NRX Emergency Pipeline Route	The 1.8 km above ground pipeline route was constructed in 1952 to disperse a large quantity of contaminated waste water after the NRX accident. The Pipeline was removed in 1961 and obviously contaminated soil was removed. Complete environmental characterization has not been performed across the entire route.	Environmental Site Assessment	Environmental Site Assessment
Ventilation Stack Duct Route	Constructed in 1957 for the ventilation stack for NRX, operations were shut down in 1992 and the stack was removed in 2013. The sub surface structures (footings) remain and will require investigation.	Environmental Site Assessment	Environmental Site Assessment
Sanitary Landfill	The Sanitary Landfill is operational and has been used since 1963 for the disposal of non-radioactive garbage from the cafeteria and offices, nonhazardous solid wastes construction waste, building rubble and uncontaminated soil and rock Based upon current practices, the expected remaining operating life of the sanitary landfill is approximately 7 to 10 years. The only radioactive substance detected above normal background levels near the Sanitary	Operations	Operations

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
	Landfill is tritium, and is below the drinking water screening limit of 7,000 Bq/L. Sampling of groundwater for non-radiological compounds has not been completed. It has not been determined whether elevated electric conductivity readings in groundwater are associated with a plume originating from the Sanitary Landfill or from the use of road salt in the area.		
Tritiated Light Water Storage Facility ([redacted])	This tank farm for the storage of tritiated light water removed from the NRU rod bays was constructed in 2012 the northwest corner of the Dawson City site. The facility consists of seven, horizontal double walled above ground storage tanks each supported on a concrete platform. The concrete pad is bermed and protected with an epoxy liner. The pad is designed to collect any spill or runoff in a catch basin located in the centre of the pad. Six of the tanks are filled with a total volume of 1.07 million litres of water, the remaining tank serves as a spare. Monitoring data indicates that there have been no leaks from these tanks to date.	Operations	Operations

A.8 Management Unit 8

Table A-14: Status of Buildings/Structures within MU 8

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in 5 years)
[redacted]	Bulk Material Landfill Sprung Structure	Operations	Operations
[redacted]	Environmental Storage Building [redacted]	Operations	Operations
[redacted]	Environmental Storage Building [redacted]	Operations	Operations

Table A-15: Areas of Potential Environmental Concern within MU 8

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
WMA C	WMA C is currently a long-term waste storage facility which operated between 1963 and 2006. Unlined trenches and pits were excavated for the disposal of low-level radioactive solid and liquid wastes from CRL and from off-site sources such as labs, universities, and hospitals. An extension to WMA C was added toward the southeast in 1993. No characterization of the wastes has been completed due to the highly heterogeneous nature of the materials. Mixed waste containing both radiological and chemical/biological hazardous materials have been disposed of at WMA C. More than 1,550 m^3 of hazardous wastes were also disposed of in the trenches and in special pits, in particular chlorinated solvents, hazardous metals and waste reactor coolant. An impermeable geomembrane cover was installed over WMA C in 2013 and has been an effective improvement, indicated by decreasing tritium trends in contaminant migration since 2015.	Operations	Operations
WMA C Plume toward Duke Swamp and Bulk Storage Swamp	A tritium plume originating at WMA C divides and extends to the west to Duke Swamp and another to the south to Bulk Storage Swamp. Downgradient tritium levels have decreased significantly following the installation of an impermeable geomembrane cover over the entire WMA C area in 2013. This plume is monitored under the CRL GWMP (updates are provided in the *Annual Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL* (e.g., [106])), and is mitigated by an impermeable geomembrane cover [116].	APEC Identified and Monitored	APEC Identified and Monitored

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
WMA J (Bulk Material Landfill)	WMA J was established south of WMA C in 2010. The Bulk Material Landfill is an operational facility for the long-term management of dewatered sewage sludge from the CRL Sanitary Treatment Plant for the next 100 years. A Sprung structure ([redacted]) is installed over WMA J to reduce the infiltration of precipitation. Leachate collected from the landfill is transported to and treated at the CRL Sanitary Sewage Treatment Facility ([redacted]).	Operations	Operations

A.9 Management Unit 9

Table A-16: Status of Buildings/Structures within MU 9

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in five years)
[redacted]	Monitoring equipment for 7 tanks in Waste Tank Farm	Operations	Operations
[redacted]	Site Office	Operations	Operations
[redacted]	[redacted] Whole Body Monitoring Building	Construction/ Commissioning	Operations
[redacted]	Tank Farm Weather Enclosure	Construction/ Commissioning	Operations
[redacted]	Legacy Waste Processing Intermodal	Construction/ Commissioning	Operations

Table A-17: Areas of Potential Environmental Concern within MU 9

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
WMA E	WMA E received waste from 1976 up to approximately 1984. The buried material includes concrete, asphalt, soil and rock and other construction waste some of which are visible along the side slopes of the waste management area and will need to be removed and properly buried. Several environmental characterizations have been completed at WMA E. There are isolated pockets of radiologically contaminated asphalt, other solid wastes and soil still present at the site. Two soil samples exceeded applicable screening criteria for metals.	Operations/ Environmental Site Assessment	Operations
Waste Tank Farm (B538)	This WMA accepted liquid wastes from 1961 to 1987 and contains seven underground stainless steel storage tanks for radioactive waste solutions and sludge. As part of the Stored Liquid Waste Project waste recovery operations are on-going at the Tank Farm to mitigate the risk of contaminant leakage. All legacy radioactive liquid waste has been removed from the direct-buried single-walled	Operations	Operations

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
	storage tanks at Building [redacted] and has been processed through the Waste Treatment Centre.		
Lysimeter Research Facility	An underground installation used to study the release of radioactivity from waste packages and the movement of radionuclides through different buffer/backfill materials from 1989 to 1995. The area was remediated in 2003. Confirmatory characterization will be undertaken prior to closure.	Execute Remedial Action	Environmental Remediation Project Closeout / Land Re-use

A.10 Management Unit 10

There are no buildings or structures in MU 10

Table A-18: Areas of Potential Environmental Concern within MU 10

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
WMA F	Between 1976 and 1979, WMA F received contaminated soils, rubble and slag from four off-site Ontario facilities. The Port Hope wastes represent up to 80% of the materials at WMA F and consist of excavated soils from residential and commercial properties and low concentration wastes from the Eldorado refinery. Wastes containing niobium from two Ottawa facilities (Albion and Rideau Roads) (approximately 20% of volume) and soils contaminated with radium from Mono Mills (< 1% of volume) have also been buried at WMA F. Significant contaminants known to be in WMA F waste include radionuclides (including long-lived radionuclides); ^{226}Ra, ^{230}Th, ^{232}Th, ^{234}U, ^{235}U, and ^{238}U; arsenic and copper. No groundwater contamination has been detected at WMA F [78].	Remedial Planning	Remedial Planning
Wash Pad Area	This is the area where the trucks were washed after unloading wastes into WMA F. Surface soil (46 m^3), concrete pads and buried pipe were excavated in 2018 but residual contamination is still present.	Remedial Planning	Remedial Planning

A.11 Management Unit 11

Table A-19: Status of Buildings/Structures within MU 11

Building #	Name / Description	Current D&D Status (December 2022)	Plan Forward (expected status in 5 years)
[redacted]	Pump House (from Nitrate Plant operation)	Decommissioning / Building Removal	Decommissioning/ Building Removal

Table A-20: Areas of Potential Environmental Concern within MU 11

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
Nitrate Plant	Operated between 1953 and 1954 to process waste ammonium nitrate solutions. Four buildings were buried in situ when operations ceased. Process condensate and other radioactive liquids were discharged to an infiltration pit excavated next to the buildings. Additional characterization is planned to begin in 2022/23. Rusty and leaky drums containing radium paint wastes were found in a portion of the Nitrate Plant and locally impacted surface soils.	Environmental Site Assessment	Environmental Site Assessment
Nitrate Plant Plume toward Duke Swamp	The disposal of waste liquids in the infiltration pit resulted in the development of a groundwater plume with elevated ^{90}Sr concentrations which has been monitored since 1955. This plume has been migrating through the surficial aquifer toward Duke Swamp southwest of the area. This plume is monitored under the CRL GWMP (updates are provided in the *Annual Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL* (e.g., [106])), and is mitigated by the **Wall and Curtain Permeable Reactive Barrier**.	APEC Identified and Monitored	APEC Identified and Monitored
Wall and Curtain Permeable Reactive Barrier	CNL continues to manage and operate the Wall and Curtain Permeable Reactive Barrier (PRB). The system retains ^{90}Sr that would otherwise discharge into Duke Swamp from the Nitrate Plant groundwater plume. Updates are provided in the *Annual Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL* (e.g., [106]).	Operations	Operations
Thorium Pit	A small dispersal pit used to dispose neutralized waste solutions from thorium fuel cycle experiments between 1955 and the 1960s. The pit was filled with lime and covered with soil. Additional characterization is planned to begin in 2022/23.	Environmental Site Assessment	Environmental Site Assessment

Area of Potential Environmental Concern	Description/Highlights	Current ER Status (December 2022)	Plan Forward (expected status in 5 years)
Thorium Pit Plume toward Duke Swamp	A ^{90}Sr groundwater plume extends to Duke Swamp, while other, less mobile radionuclides have not migrated outside of the immediate area around the pit. ^{90}Sr and ^{241}Am in groundwater exceed the Health Canada Drinking Water Quality Guidelines. Vegetation in Duke Swamp has taken up the ^{90}Sr contamination from Thorium Pit. This plume is monitored under the CRL GWMP and updates are provided in the *Annual Compliance Monitoring Report: Environmental Monitoring in 2020 at CRL* (e.g., [106]).	APEC Identified and Monitored	APEC Identified and Monitored
Acid-Chemical-Solvent (ACS) Pits	Three pits where acids, chemicals and solvents were disposed of from 1982 to 1987, some in packages. A fourth pit for pyrophoric wastes is also believed to be present but no information exists about its operation. Additional characterization is planned to begin in 2023.	Environmental Site Assessment	Environmental Site Assessment

Appendix B Cross-Check with REGDOC-2.11.2 and CSA N294-19 Requirements

Table B-1: Cross-Check of ODCP with REGDOC-2.11.2 and CSA N294-19 Requirements

Sections of Clause 6.1.1 in REGDOC-2.11.2 and Annex A of CSA N294-19 (both nearly the same)	ODCP Section
a) a description of the location of the facility, including	3 Site Location and Physical Setting
a) i) a map of the facility and its specifications;	Figure 1, Figure 3 and Figure 4
a) ii) geographic information;	3 Site Location and Physical Setting
a) iii) details regarding the surrounding environment;	3.3 Topography and Hydrology
a) iv) land uses; and	3.2 Land Use
a) v) illustrations and maps of the facility in relation to the municipality;	Figure 1
b) purpose and description of the facility, including	4.1 Chalk River Laboratories' Strategic Priorities & 4.3 Site Layout
b) i) primary components and systems;	4.3.1 Controlled, Supervised and Outer Areas
b) ii) building type and construction, including location of any hazardous building materials (e.g., asbestos, PCBs);	4.3.2 Buildings, Facilities, and Support Functions (Active/Operational), 4.5 Principal Hazardous Conditions
b) iii) building services (e.g., power, heating, ventilation, sewer, water, fire protection);	10.13 Existing Site Infrastructure
b) iv) laboratories and other hazardous handling areas;	4.4 Nature and Extent of Contamination, 9 The Cleanup Strategy & Appendix A
b) v) type, quantity, and form of radioactive and hazardous materials stored, produced, or used during operation; and	4.5.1 Radiological Hazards and 4.5.4 Chemical Hazards
b) vi) design features used to reduce the spread of contamination and facilitate decontamination and dismantling;	4.7 Design Features to Reduce Contamination and Facilitate Cleanup
c) post-operational conditions, including c) i) a summary of the shutdown process, including planned removal of stored inventories of hazardous or radioactive materials;	8.2 Preliminary Site Cleanup Goals, 9.1.2 Potential Next land Uses 9.2.1 Shutdown Process
c) ii) the predicted nature and extent of contamination remaining in the primary systems and components (in list or table format with reference to applicable illustrations);	These are developed as part of facility specific DDPs and are too detailed to appear in an overview such as the ODCP. For cleanup high-level information is

Sections of Clause 6.1.1 in REGDOC-2.11.2 and Annex A of CSA N294-19 (both nearly the same)	**ODCP Section**
	provided for each Area of Potential Environmental Concern in Appendix A.
c) iii) the predicted nature and extent of contamination on floors, walls, work surfaces, ventilation systems, etc.;	These are developed as part of facility specific DDPs and are too detailed to appear in an overview such as the ODCP.
c) iv) the identification of any separate planning envelopes; and	14.1 Cost Estimate
c) v) an overview of the principal hazardous conditions anticipated to exist;	4.5 Principal Hazardous Conditions
c) d) the decommissioning strategy, including	9.2 Decommissioning Strategy, 9.3 Environmental Remediation Strategy
d) i) the final end-state objective;	9.1.3 & 9.3.1 Interim End-States and Final End-State Agreement, Risk-based Soil Screening and Cleanup Criteria
d) ii) rationale for d) ii) 1) the decommissioning strategy selected;	9.2 Decommissioning Strategy
d) ii)2) interim end-states;	9.1.3 Interim End-States and Final End-State Agreement
d) ii) 3) periods of SWS; and	9.2.3 Deferred Decommissioning and Storage with Surveillance
d) ii) 4) in situ decommissioning concepts;	9.2.4 In situ Decommissioning
d) iii) the requirements for long-term institutional controls; and	12 Long-term Stewardship
d) iv) the assessment of alternative strategies (or a rationale for why alternatives do not exist or do not warrant consideration);	9.3.4 Alternative Cleanup Approaches
e) a plan of the decommissioning work, including	9.1 Cleanup Function, 9.2 Decommissioning Strategy/PDP/DDP
e) i) a work breakdown structure;	9.1 Cleanup Function Strategy, 9.2 Decommissioning Strategy /PDP/DDP
e) ii) a summary of the main steps for decontamination/disassembly/removal of each of the systems (preferably grouped into work packages);	9.1 Cleanup Function and 9.2 Decommissioning Strategy/PDP/DDP

Sections of Clause 6.1.1 in REGDOC-2.11.2 and Annex A of CSA N294-19 (both nearly the same)	**ODCP Section**
e) iii) for each work package, identification of those types of activities that could pose a significant hazard to workers, the public, or the environment;	9.2 Decommissioning Strategy/PDP/DDP
e) iv) the role of existing operational standard procedures for radiation protection, hazardous	9.2 Decommissioning Strategy/PDP/DDP
materials handling, industrial safety, and environmental protection in managing hazards;	9.2 Decommissioning Strategy/PDP/DDP
e) v) specific activities for which additional protection/mitigation procedures will be required at the detailed planning stage;	PDP/DDP
e) vi) a summary of the final dismantlement of the structures; and	10 Current Assessment Status by Management Unit; Appendix A Detailed Informed for each Management Unit on the Status of Buildings Structures, and Areas of Potential Environmental Concern, as applicable
e) vii) a conceptual schedule showing the approximate year of facility shutdown and the approximate sequencing and duration of the decommissioning work packages and, where relevant, storage periods;	13 Conceptual Schedule
f) radiological monitoring and survey commitments, including	8.3.1 Radiation Protection, 7.5 Integrated Environmental Monitoring
f) i) a program for conducting periodic contamination surveys and the recording of contamination events during facility operation;	7.5 Integrated Environmental Monitoring, 7.6 Incident Tracking
f) ii) a commitment to conduct detailed post-operation surveys in support of DDP development; and	9.3.3 Monitored Natural Attenuation
f) iii) a commitment to develop plans and protocols acceptable to the AHJ at the detailed planning stage for monitoring	7.5 Integrated Environmental Monitoring
f) 1) work hazards during decommissioning;	4.5 Principal Hazardous Conditions
f) 2) personnel dosimetry;	4.6 Work Hazard Monitoring and Worker Protection Precautions
f) 3) environmental emissions and effluents; and	7.5.1 Monitoring for Potential Off-site Impacts

Sections of Clause 6.1.1 in REGDOC-2.11.2 and Annex A of CSA N294-19 (both nearly the same)	**ODCP Section**
f) 4) materials, sites, and structures to be cleared from regulatory control;	10 Current Assessment Status by Management Unit; Appendix A Detailed Informed for each Management Unit on the Status of Buildings Structures, and Areas of Potential Environmental Concern, as applicable
g) a waste management strategy specifying	9.7 Waste Management Strategy
g) i) the approximate quantities and characteristics of radioactive and chemically hazardous wastes expected to arise from the decommissioning (tied to specific work packages, if possible);	9.7.1 Waste Inventory and Waste Forecast, Appendix A, for decommissioning refer to specific PDPs/DDPs (not included in ODCP)
g) ii) the anticipated final disposition of radioactive and chemically hazardous materials; and	9.7.2 Waste Strategies by Classification, Table 6: CRL Waste Classifications and Baseline Waste Strategies
g) iii) a commitment to segregate as much material as possible for reuse and recycling;	9.7 Waste Management Strategy
h) a commitment to prepare a DDP for regulatory approval prior to dismantling and demolition;	9.1 Cleanup Function, 9.2 Decommissioning Strategy & Figure 7
h) i) a commitment to periodically review and update the PDP until a DDP is prepared, in accordance with Clause 6.2.2;	9.1 Cleanup Function, 9.2 Decommissioning Strategy & Figure 7
j) the physical state of the facility at j) i) the end of operations; and	10 Current Assessment Status by Management Unit and Appendix A
j) ii) the start of decommissioning;	10 Current Assessment Status by Management Unit and Appendix A
k) the records required for decommissioning, including a description of the facility operational	15 Record Retention
records that will be maintained to periodically update the PDP and prepare the DDP(s);	15 Record Retention
l) a public engagement plan, including a public information program and avenues for public participation;	6 Consultation and Engagement with First Nations, Metis and the Public

Sections of Clause 6.1.1 in REGDOC-2.11.2 and Annex A of CSA N294-19 (both nearly the same)	**ODCP Section**
m) an engagement plan with First Nations as per the requirements and guidance of CNSC REGDOC-3.2.2; and	6.1 Engagement with First Nations and Metis Communities
n) the cost and a financial guarantee, specifying*	14.1 Cost Estimate
n) i) an estimate of the total present-value cost of the decommissioning;	14.1 Cost Estimate
n) ii) a reasonable basis for how cost estimates were derived; and	14.1.2 Change Management & 14.1.4 Remedial Action Cost Engineering Requirements Model
n) iii) a description of how the required funds will be provided;	14.2 Funding Source
Notes: *As per REGDOC-2.11.2, the conservative cost estimate of decommissioning and a financial guarantee, as described in REGDOC-3.3.1 [109].	

Table B-2: Cross-Check between the ODCP and 2018 CPDP with CSA N294-19

Section	**ODCP - Section Title**	**CPDP 2018**	**N294 -19**
	Executive Summary	Executive Summary	
1	Overview Decommissioning and Cleanup Plan		√
1.1	Introduction	1	√
1.2	Purpose		√
1.3	Scope	1	√
1.4	Acronyms and Terminology		
2	Changes Since Last Revision of the Comprehensive Preliminary Decommissioning Plan	2	√
3	Site Location and Physical Setting	4.1.1	√
3.1	Surrounding Communities	4.1.2	√
3.2	Land Use	4.1.3	√
3.3	Topography and Hydrology	4.1.4	√
3.4	Wildlife and Habitats	4.1.5	√
3.5	Geology	4.1.6	√
3.6	Climate	4.1.7	√
4	Site Missions and Background for Cleanup Planning		√
4.1	Chalk River Laboratories' Strategic Priorities	2.1	√
4.2	Operating History	4.2	√

Section	ODCP - Section Title	CPDP 2018	N294 -19
4.3	Site Layout	4.5	√
4.3.1	Controlled, Supervised, and Outer Areas	4.5.1, 4.5.2,4.5.3	√
4.3.2	Buildings, Facilities, and Support Functions (active/operational)	Appendix A / 4.5.3	√
4.3.3	Waste Management Areas and Affected Lands	4.5.4	√
4.3.4	Management Units	7.1.2 Table B-1	√
4.3.5	Site Master Plan and Future Developments		√
4.3.5.1	Infrastructure and Utility Network	4.4.2, Table A-5	√
4.4	Nature and Extent of Contamination	Table B-1	√
4.5	Principal Hazardous Conditions	5	√
4.5.1	Radiological Hazards	5.2	√
4.5.2	Nuclear Criticality Control	5.3	√
4.5.3	Industrial Hazards	5.4	√
4.5.4	Chemical Hazards	5.5	√
4.6	Work Hazard Monitoring and Worker Protection Precautions	5.6	√
4.7	Design Features to Reduce Contamination And Facilitate Cleanup		√
5	Applicable Programs and Standards		
5.1	Regulatory Framework		√
5.2	CNL/AECL Policies and Commitments		√
5.3	Management Systems		√
5.3.1	Support Programs	5.7	√
5.3.2	Compliance		√
6	Consultation and Engagement with First Nations, Metis and the Public		√
6.1	Public Information Program		√
6.2	Engagement Objectives		√
6.3	Engagement with First Nations and Metis Communities		√
6.4	Dissemination of Information to the Public		√
6.5	CRL Community Advisory Panel		√
6.6	Environmental Stewardship Council at CRL		√
6.7	Key Public Engagement on CRL Cleanup Planning to Date		√
6.8	Planned Future Public Engagement		√
7	Environmental Protection Program	6.1	√
7.1	Environmental Reviews	6.1	√
7.2	The Natural Environment	6.1	√

Section	ODCP - Section Title	CPDP 2018	N294 -19
7.2.1	Species at Risk		DDP
7.2.2	Sustainable Forest Management Plan		
7.2.3	Vegetation Control		
7.3	Sustainability Plans and Outcomes		
7.4	CRL Site-Wide Environmental Risk Assessment (ERA)		√
7.5	Integrated Environmental Monitoring Program		√
7.5.1	Monitoring for Potential Off-Site Impacts		√
7.6	Incident Tracking		√
8	Cleanup Vision, Mission, Goals ,Objectives and Principles		√
8.1	Cleanup Vision and Mission		
8.2	Preliminary Site Cleanup Goals		√
8.3	Recommended Dose/Concentration Cleanup Objectives		√
8.3.1	Radiation Protection		
8.4	Cleanup Planning Principles		√
9	The Cleanup Strategy		
9.1	Cleanup Function		
9.1.1	Facilities and Capabilities Required to Enable Cleanup	7.1.1 partial	√
9.1.2	Potential Next Land Uses at CRL		√
9.1.3	Interim End-States and Final End-State Agreement		√
9.2	Decommissioning Strategy	7.1.1	√
9.2.1	Shutdown Process		√
9.2.2	Requirements for Prompt Decommissioning	7.1.1 partial	√
9.2.3	Deferred Decommissioning and Storage with Surveillance	7.1.1	√
9.2.4	In Situ Decommissioning		√
9.3	Environmental Remediation Strategy	7.1.2	√
9.3.1	Risk-based Soil Screening and Cleanup Criteria		√
9.3.2	In Situ Decommissioning		
9.3.3	Monitored Natural Attenuation		√
9.3.4	Alternative Cleanup Approach		√
9.4	End-State Requirements	3	√
9.5	Cleanup Planning Assumptions		
9.6	Prioritization Tool		
9.7	Waste Management Strategy	7.1.3	√

Section	ODCP - Section Title	CPDP 2018	N294 -19
9.7.1	Waste Inventory and Waste Forecast	7.1.4	√
9.7.2	Waste Strategies by Classification	7.1.4	√
9.7.3	Key Enabling Waste Facilities / Capabilities		√
9.8	Constraints and Limitations		√
10	Current Assessment Status by Management Unit	B.6 -description only	*
10.1	Management Unit 1		*
10.2	Management Unit 2		*
10.3	Management Unit 3		*
10.4	Management Unit 4		*
10.5	Management Unit 5		*
10.6	Management Unit 6		*
10.7	Management Unit 7		*
10.8	Management Unit 8		*
10.9	Management Unit 9		*
10.10	Management Unit 10		*
10.11	Management Unit 11		*
10.12	Swamps and Wetlands Affected by Groundwater Plumes	B.4	*
10.13	Existing Site Infrastructure		√
10.13.1	Roads and Parking Lots		
10.13.2	Aggregate Borrow Pits		
10.13.3	Forest Slash Areas		
10.13.4	Meteorological Stations		
10.13.5	Boreholes	Appendix A	
10.13.6	Distributed Services	Appendix A	
11	Features in the Natural and Social Environment that could be affected by Cleanup		√
11.1	Technology Development and Transfer		
11.2	Environmental Nuisance Issues		Regulatory
12	Long-Term Stewardship		√
13	Conceptual Schedule	9	√
13.1	Long-Term	9.2	√
14	Cost Estimates and Funding	8	√
14.1	Cost Estimate	8.2	√
14.1.1	Types of Project Estimates	8.4	√
14.1.2	Change Management	8.3	
14.1.3	Cost Model		

Section	ODCP - Section Title	CPDP 2018	N294 -19
14.1.4	Remedial Action Cost Engineering Requirements (RACER) Model	8.4.2	
14.1.5	External Comparators	8.4.3	
14.2	Funding Source	8.5	√
15	Record Retention	10	√
16	References	11	
Appendix A	Detailed Informed for each Management Unit on the Status of Buildings Structures, and Areas of Potential Environmental Concern, as applicable		
Appendix B	Cross-Check with REGDOC-2.11.2 and CSA N294-19 Requirements	14	
Table Notes: Green box is a section not covered in 2018 CPDP; Check Mark (√) refers to CSA N294-19 requirement; Star (*) refers to sections 1.3 & A2 b) v in CSA N294-19, also a requirement			