Canadian Nuclear Laboratories | Laboratoires Nucléaires Canadiens

Environmental Assessment (and/or Environmental Effects Review)

IN SITU DECOMMISSIONING OF THE WR-1 REACTOR AT THE WHITESHELL LABORATORIES SITE

WLDP-03700-ENA-001

Revision 0

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Environmental Assessment

In Situ Decommissioning of the WR-1 Reactor at the Whiteshell Laboratories Site

Whiteshell Laboratories Decommissioning Project

WLDP-03700-ENA-001
Revision 0

2016 April

UNRESTRICTED

286 Plant Road
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1. INTRODUCTION

This document describes the activities related to the In Situ Decommissioning of the Whiteshell Reactor #1 (WR-1 Reactor) at the Whiteshell Laboratories (WL) site. The purpose of this document is to provide the Canadian Nuclear Safety Commission (CNSC) staff with the information necessary to make a determination of Environmental Assessment requirements for the project under the Canadian Environmental Assessment Act (CEAA), 2012 [1]. The contents of the project description address information requirements identified in Canadian Environmental Assessment Act Regulations 'Prescribed Information for the Description of a Designated Project' [2].

1.1 Acronyms

AECL	Atomic Energy of Canada Limited
ALARA	As Low as Reasonably Achievable
CEAA	Canadian Environmental Assessment Act
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CNSC	Canadian Nuclear Safety Commission
CNL	Canadian Nuclear Laboratories
EA	Environmental Assessment
ha	Hectares
ISD	In Situ Decommissioning
PCB	Polychlorinated Biphenyl
PLC	Public Liaison Committee
RM	Rural Municipality
SARA	Species at Risk Act
WL	Whiteshell Laboratories
WMA	Waste Management Area
WR-1	Whiteshell Reactor-1

2. GENERAL INFORMATION

2.1 Project's Name, Nature and Location

2.1.1 Project's Name and Nature

The Whiteshell Laboratories site was established in the 1960's by Atomic Energy of Canada Limited (AECL) to conduct nuclear research. The Whiteshell Reactor-1 was placed in service in 1965 to demonstrate the organic-cooled reactor concept using heavy water (D_2O) as the moderator. The reactor was permanently shut down in 1985.

In 1998 AECL made a decision to decommission the Whiteshell Laboratories Site. A Comprehensive Study Report under the Canadian Environmental Assessment Act was completed for the decommissioning Project [3]. The Canadian Nuclear Safety Commission and Department of Fisheries and Oceans were the Responsible Authorities. The Environmental Assessment Decision to approve the project was announced by the Minister of the Environment in March 2002 [4].

The Whiteshell Laboratories are currently operated by Canadian Nuclear Laboratories (CNL) on behalf of AECL. The current approved decommissioning approach for WR-1 is described in the Comprehensive Study Report and includes complete removal of the facility. Waste from removal of the facility would be classified, segregated and placed in interim storage on site or disposed at off-site disposal facilities based on contamination levels and hazardous content. The below grade concrete structure would largely remain in place.

A new approach, In Situ Decommissioning (ISD), has been proposed for the decommissioning of the WR-1 Reactor. The below grade reactor systems, components and structure and associated radiological and non-radiological hazards will be permanently encased with grout. The above grade structures will be demolished and removed[1]. An engineered cover will then be constructed over the below grade structure. ISD is a permanent, passive decommissioning end state.

The WR-1 Reactor Building includes the main reactor building extending two levels above and five levels below grade (see Figure 4). The east and south wings house office space and supporting facilities.

The project activities are limited to In Situ Decommissioning of the WR-1 Reactor (see Figure 4). Removal of the east and south wings of the reactor building is covered under the existing Comprehensive Study Report. Activities required to prepare for In Situ Decommissioning such as isolation of the WR-1 Reactor Building and targeted remediation of hazardous materials are also covered under the existing Comprehensive Study.

[1] Above grade contaminated materials would be placed below grade and grouted.

2.1.2 Project Location - Overview

The Whiteshell Laboratories site is approximately 100 km northeast of the city of Winnipeg in the province of Manitoba. The laboratories cover an area of approximately 4,375 ha and are located near the towns of Lac du Bonnet, Seven Sisters and Pinawa (Figure 1).

The WR-1 Reactor is located within the Main Laboratory site shown in Figure 2.

The Winnipeg River is an important feature of the area and passes through the WL site (Figure 2). The Winnipeg River flows from the Lake of the Woods and the English River system in Northwestern Ontario and drains to Lake Winnipeg located northwest of the Whiteshell Site.

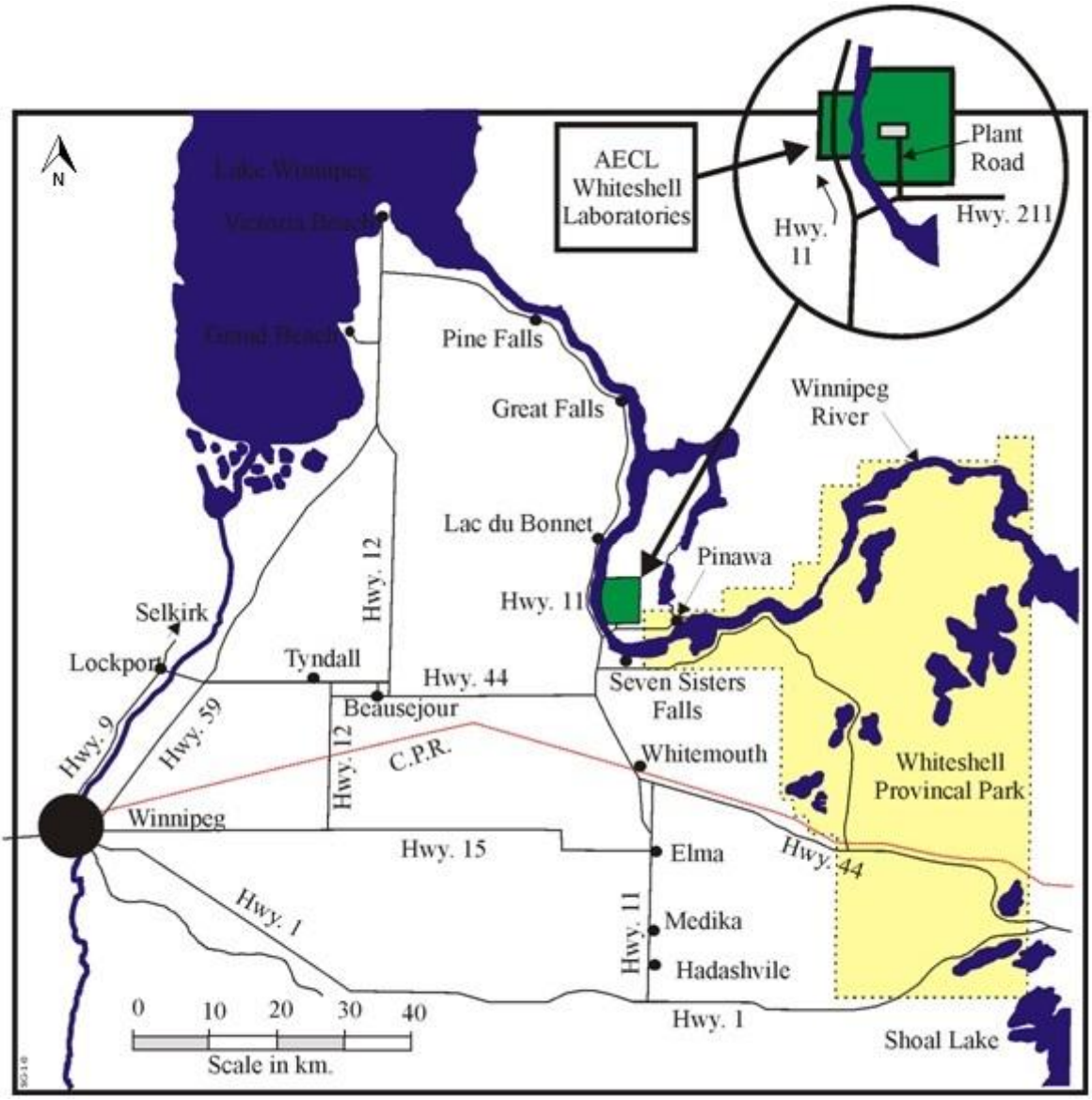

Figure 1 Location of Whiteshell Laboratories

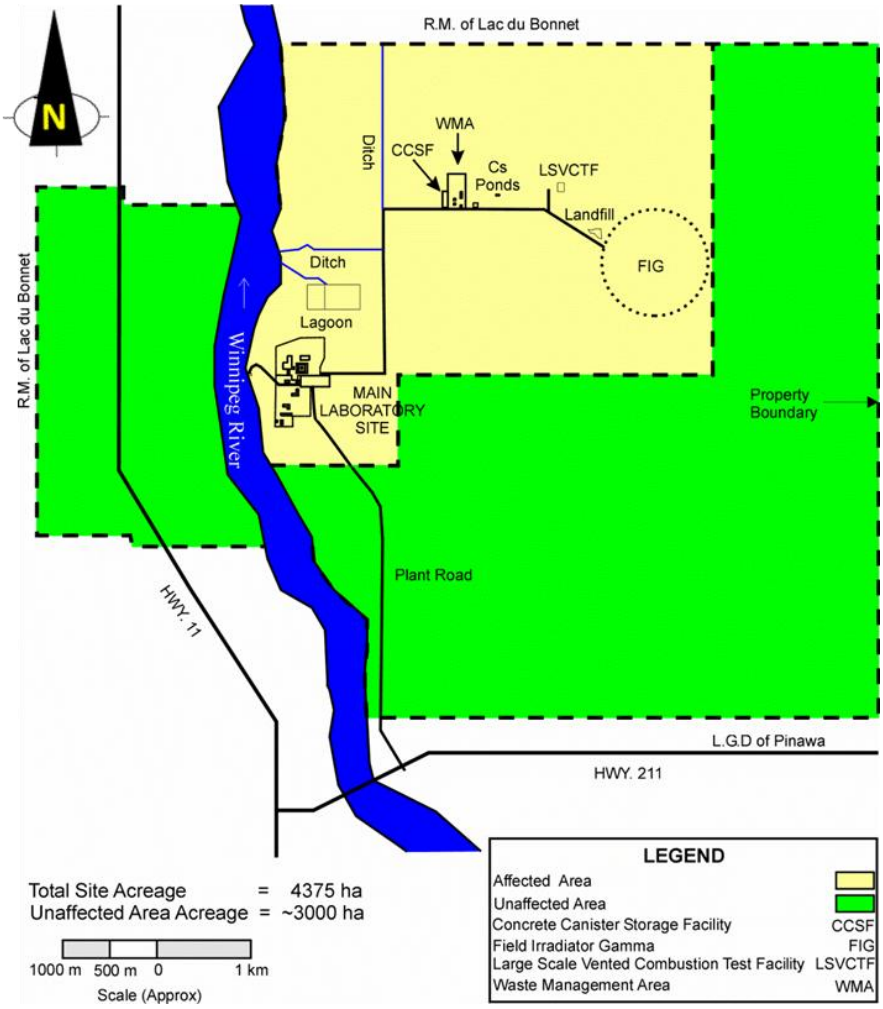

Figure 2 Location of Main Laboratory Site

2.2 Contact Information

Canadian Nuclear Laboratories is the project proponent. The contact information of the primary representative for the project is:

Mr. Pat Quinn
Director, Corporate Communications
Chalk River Laboratories
Chalk River, Ontario, K0J 1J0
Tel. #: 613 584 8811 ext. 43417
Fax #: 613 584 8272
Email: pat.quinn@cnl.ca

2.3 Description of Consultation Activities

CNL provides regular communication updates to public stakeholder groups to enable stakeholder engagement on current and future activities of the Whiteshell Closure Project.

To date, CNL has informed the following stakeholder groups of the proposal for In Situ Decommissioning of the WR-1 Reactor.

- WL Employees (Executive, Management, Unions, Staff).
- Lac Du Bonnet District Officials and Stakeholders (Public meetings held 2015 June and September with elected officials from the Electoral District of Lac du Bonnet, and municipalities).
- Public Liaison Committee (meeting held 2015 December).
- Chief Henderson of the Sagkeeng First Nation (teleconference initiated by the CNSC held 2016 April 1).

The Public Liaison Committee was formed in 2003 with a Terms of Reference for communications and consultation. The committee meets approximately every 6 months and is comprised of community and stakeholder representatives (outlined below), consisting of elected officials and community interest groups. Its mandate is to provide an opportunity for open dialogue between community stakeholders and WL senior management on WL's various environmental and decommissioning projects.

- LDG Pinawa
- R.M. Lac du Bonnet
- Town of Lac du Bonnet
- Town of Beausejour
- R.M. Brokenhead
- R.M. Whitemouth
- Acsion Industries Inc.
- Manitoba Conservation and Water Stewardship
- MLA Electoral District of Lac du Bonnet
- Atomic Energy of Canada Limited

A Communications Protocol between CNL and Sagkeeng First Nation for WL Decommissioning was established in 1999. Meetings have been less frequent than with the PLC.

2.3.1 Future Engagement Activities

CNL recognizes that it must conduct its business in a manner that is both socially and environmentally responsible. CNL's demonstration of this commitment is founded within its public information program. The programs objective is to inform our stakeholders about the activities ongoing at CNL sites, the potential impacts of these activities on the health and safety

of workers, members of the public, and on the environment. The overriding objective of the program is to build public awareness, understanding, and a supportive appreciation of the Laboratories' value and relevance to Canadians. These activities will be undertaken in consultation with the CNSC.

These objectives (among others) form the basis of communication efforts with stakeholders and help to direct the establishment of long-term mutually beneficial working relationships. Engagement will include:

- Formal notification of the project
- Regular and consistent communication on the project (e.g. website, newsletters)
- Targeted community initiatives
- Site visits
- Public project information sessions
- Speaking engagements

Canadian Nuclear Laboratories is currently reviewing the Aboriginal groups to be engaged in dialogue about the project. CNL plans to re-engage with Sagkeeng First Nation and other Aboriginal communities that may have an interest in the project (Section 4.3). Review activities will be aligned with the CNSC's REGDOC-3.2.2 Aboriginal Engagement [5] and will include reporting on the following:

- Aboriginal groups identified for engagement;
- A summary of any Aboriginal engagement activities conducted;
- A description of planned Aboriginal engagement activities; and,
- The proposed schedule for interim reporting to the CNSC.

2.4 Environmental Assessment and Regulatory Requirements of other Jurisdictions

This project is being undertaken on Federal lands and is not subject to provincial environmental assessment requirements.

The project may generate small quantities of hazardous wastes and transport these to registered off-site disposal facilities. Transport of these wastes is subject to the Manitoba *Dangerous Goods Handling and Transportation Act* and the federal *Transportation of Dangerous Goods Act, 1992* which set out requirements for the handling and transportation of dangerous goods and hazardous waste.

3. PROJECT INFORMATION

3.1 Project Context and Objectives

3.1.1 Project Context

The decommissioning approach for the Whiteshell Laboratories site described in the Comprehensive Study Report [3] is to remove facilities entirely from the site with the exception of low level waste trenches in the Waste Management Area (WMA). The trenches are holes of varying lengths and widths, typically 4 m in depth excavated in the WMA until 1985 and used for storage of low-level radioactive waste. In situ disposal of the low level waste trenches was identified as the preferred option as a risk assessment demonstrated that radionuclides present in the waste will decay to negligible levels over a 200 year institutional control period and that there will be no significant radionuclide migration from the trenches.

The Comprehensive Study assessed in situ abandonment of contaminated sediments in the Winnipeg River adjacent to the Whiteshell Laboratories outfall. The sediments are contaminated with low levels of radioactivity from liquid effluent emissions which occurred during operation of the WL site. A risk assessment demonstrated that the contamination does not pose a risk to aquatic biota or human health and that it is safe to leave the sediments in place [3].

Since the EA Decision in 2002, there have been two significant changes to the decommissioning approach for WL. These are:

- In keeping with the evolution of international best practices, the decommissioning timeframe has been accelerated to closure of the WL site by 2024.
- The approach for decommissioning of WR-1 Reactor has been revised. The new approach is In Situ Decommissioning as opposed to complete removal of the facility.

Other decommissioning options have been considered for this project which include:

- Selective remediation of contamination such as the fuel channels[2],
- Dismantling of key contaminated systems such as the Primary Heat Transport system or Moderator system,
- Removal of the reactor vessel, and
- Complete dismantling of WR-1 Reactor.

In Situ Decommissioning has been selected as the preferred approach as it provides the following advantages:

- Reduced risk for radiological and industrial hazards exposures to workers, meeting the As Low As Reasonably Achievable (ALARA) principle;

[2] Fuel channels penetrate through the top and bottom shields of the reactor vessel (Section 3.3.1). They contained the fuel and circulating organic coolant when the reactor was in operation.

- Reduced transport/waste handling risks to workers, the public and the environment;
- Effective reduction of the nuclear liability (e.g., eliminates interim waste storage);
- The majority of the structure is below grade and inside a robust concrete foundation, making it more technically feasible than deactivation, dismantling and demolition of the facility; and
- Significantly lower cost than dismantling, reducing costs for the taxpayer.

Following In-Situ Decommissioning, institutional controls and surveillance activities will be required to monitor environmental performance of the entombed material at the WL site.

3.1.2 Project Objectives

The objective of the project is to safely decommission the WR-1 Reactor ensuring the prompt reduction of Canada's long-term nuclear legacy liabilities.

In Situ Decommissioning of the WR-1 Reactor will meet the following project criterion:

- Isolate and contain contamination inside the reactor vault and limit releases of radiological and other hazardous substances from the facility;
- Ensure that the potential effects on humans and the environment both during and after decommissioning are within acceptable limits.

The In Situ Decommissioning plan is currently under development, but will adhere to several functional requirements. These include:

- Shall be designed so that projections of doses to members of the public are below 0.25 mSv per year from the long term expected evolution of the disposal project (i.e., all processes other than human intrusion) and the design target is set suitably lower to ensure that the safety goal can be demonstrably met. The design target is significantly less than the average Canadian individual background dose rate of 1.8 mSv/a [6].
- Shall be designed so that the dose to the public and to workers will be ALARA.
- Shall demonstrate long-term safety through a combination of site characteristics and engineered design features.

The WR-1 Reactor site will be returned to AECL for Institutional Control. The duration of the Institutional Control period will be determined through the Environmental Assessment.

3.2 Provisions in the Schedule to the Regulations Designating Physical Activities

Under the Canadian Environmental Assessment Act (CEAA) 2012, Environmental Assessments are required for Designated Projects identified in the *Regulations Designating Physical Activities* [2].

The In Situ Decommissioning of WR-1 Reactor may qualify as a Designated Project as per Section 37(b) of these regulations:

37. The construction and operation of a new

(a) facility for the storage of irradiated fuel or nuclear waste, on a site that is not within the licensed perimeter of an existing nuclear facility; or

(b) facility for the long term management or disposal of irradiated fuel or nuclear waste.

The *Regulations Designating Physical Activities* identifies the Canadian Nuclear Safety Commission (CNSC) as the Responsible Authority for projects of this type. The CNSC as the responsible authority is responsible for determining Environmental Assessment requirements for the project and the conduct of the Environmental Assessment.

3.3 Physical Works Related to the Project

3.3.1 WR-1 Reactor

The WR-1 Reactor operated as an organic-cooled, heavy water moderated, vertical pressure tube reactor with a nominal thermal output of 60 MW.

Reactor Building

The general arrangement of the reactor building is shown in Figure 3 and Figure 4, and a cutaway view is shown in Figure 5. The building footprint at ground level measures 63.9 m by 52.7 m and includes the main reactor building and an east and south wing. The east wing is a two story extension that included various systems such as an experimental loop, a mechanical maintenance shop and a chemical laboratory. The south wing is a single story extension that contained offices and the reactor control room. The demolition of the east and south wings will be completed under the existing Comprehensive Study and as such is not included within the scope of the project.

The main reactor building measures 27.4 m by 23.1 m and extends approximately 17.8 m both above and below grade. The building contains the reactor, primary heat-transport circuits, spent fuel storage facilities and experimental loops. All reactor systems are located on 5 levels below grade except the primary coolant pumps and heat exchangers which are contained in a shielded room protruding above the reactor hall floor. The reactor hall is the high bay area above grade where fuel handling and general service operations were carried out.

The Reactor Vessel

The reactor vessel, also known as the calandria, shown in Figure 5, is a cylindrical tank approximately 5 m high and 2.75 m in diameter. The vessel contains 54 calandria tubes. The calandria tubes contain the fuel channels, also known as pressure tubes, which penetrate through the top and bottom shields. The pressure tubes contained the fuel and circulating organic coolant, and are located inside the vessel. The reactor vessel is surrounded by shielding (Figure 5). The fuel and organic coolant have been removed from the reactor (Section 3.3.2).

Primary Heat Transport System

The primary heat-transport (PHT) system shown in Figure 6 was designed to remove the heat

produced in the reactor core. The system was divided into three circuits. The heat removed was dissipated to the Winnipeg River through conventional tube-and-shell heat exchangers using an organic primary coolant and river water for the secondary coolant.

Support Systems

The WR-1 Reactor facility included a number of supporting systems. These included but are not limited to:

- Heavy water moderator and helium balancing systems
- Thermal shield and concrete cooling system
- Spent fuel handling and storage
- Active drainage system
- Ventilation system
- Compressed air systems

3.3.2 Current Status of Reactor

Preliminary decommissioning of the reactor has been completed and the reactor is currently in storage with surveillance. Preliminary decommissioning activities included:

- The reactor was defueled following shutdown in 1985.
- Organic coolant was drained from reactor cooling circuits and transferred to the WL Waste Management Area (WMA) and incinerated or solidified for storage. Residual quantities of organic coolant remain in the cooling circuits.
- Heavy water was removed and transferred to Chalk River Laboratories for storage.
- All irradiated fuel stored in the fuel storage bays were transferred to storage in the WL Concrete Canister Storage Facility.
- All building services are maintained in an operating mode.

3.3.2.1 Radiological Hazards

Reactor Vessel

Over 99% of the remaining radioactivity in WR-1 Reactor is situated in the reactor vessel. The combined material is estimated to contain a total radionuclide content of 1.3×10^{15} Bq, based on 1994 calculations, decay corrected to 2012. The most abundant isotopes are Ni-63 (79% of activity), Co-60 (17% of the activity), Fe-55 (3.6% of the activity) and C-14 (<0.5% of the activity).

Systems and Components

The radiological hazards in the reactor building include potential exposure to radionuclides associated with irradiated reactor fuels, activated reactor components and tritiated heavy water. Corrosion/activation and fission products may also be found in process equipment.

Currently, the predominant contaminants in systems and components such as the primary heat transport system are Cs-137 and Sr-90, with lower amounts of Co-60, Am-241, and H-3 (H-3 restricted to the Helium Heavy Water System), and trace amounts of Ru-106, Cs-134, Co-57, and Ce-144.

3.3.2.2 Non Radiological Hazards

Some hazardous materials remain in WR-1 Reactor. Examples of these are: Asbestos (friable[3] and non-friable asbestos containing materials); residual organic coolant (HB-40 hydrogenated terphenyl used as reactor coolant, also known as OS-84) in the primary heat transport system; lead based paint and lead shielding; Polychlorinated Biphenyls (PCBs) in fluorescent light fixture ballasts; and small quantities of mercury in thermostats and switches.

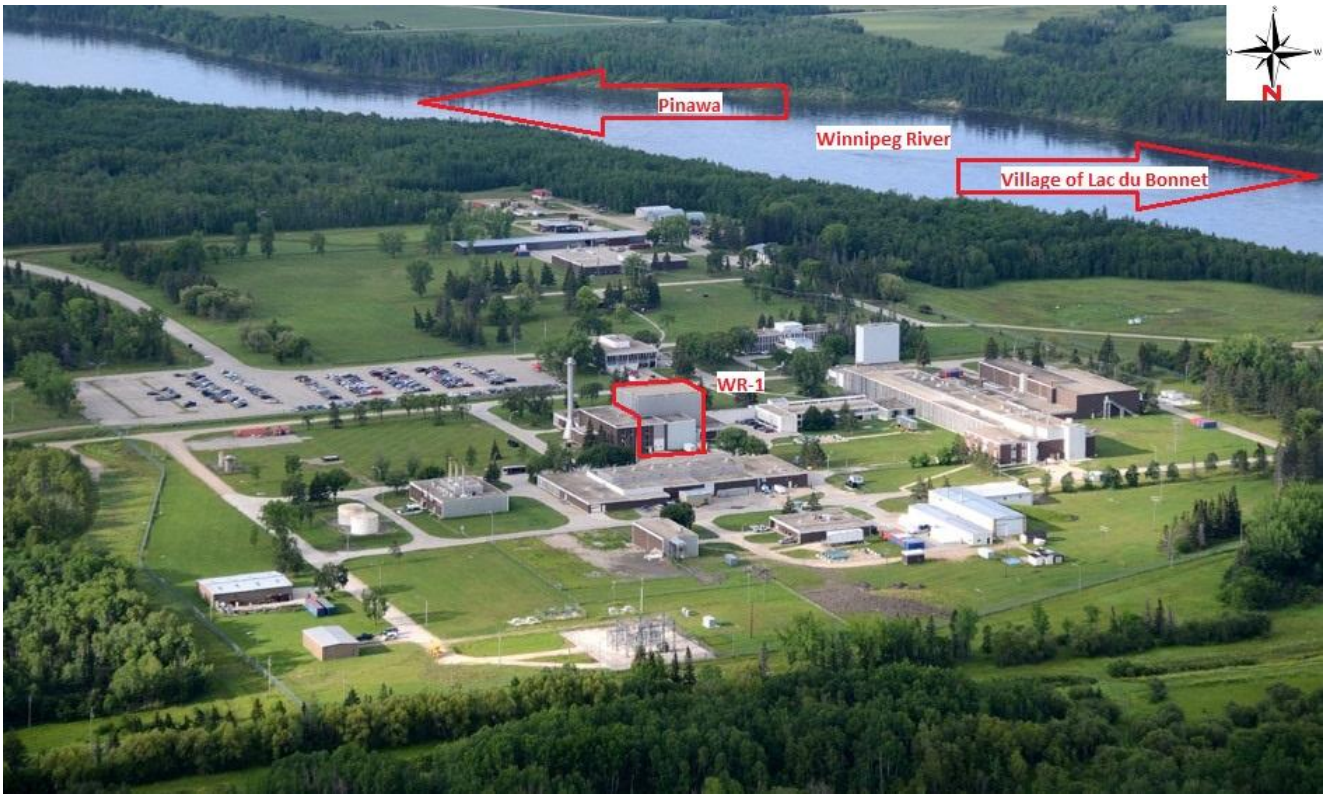

Figure 3 Site Plan showing WR-1 Reactor (Building 100) at Whiteshell Laboratories

[3] The term friable is applied to a material that can be readily reduced to dust or powder by hand or moderate pressure

Figure 4 Location of WR-1 Reactor Building within Building 100

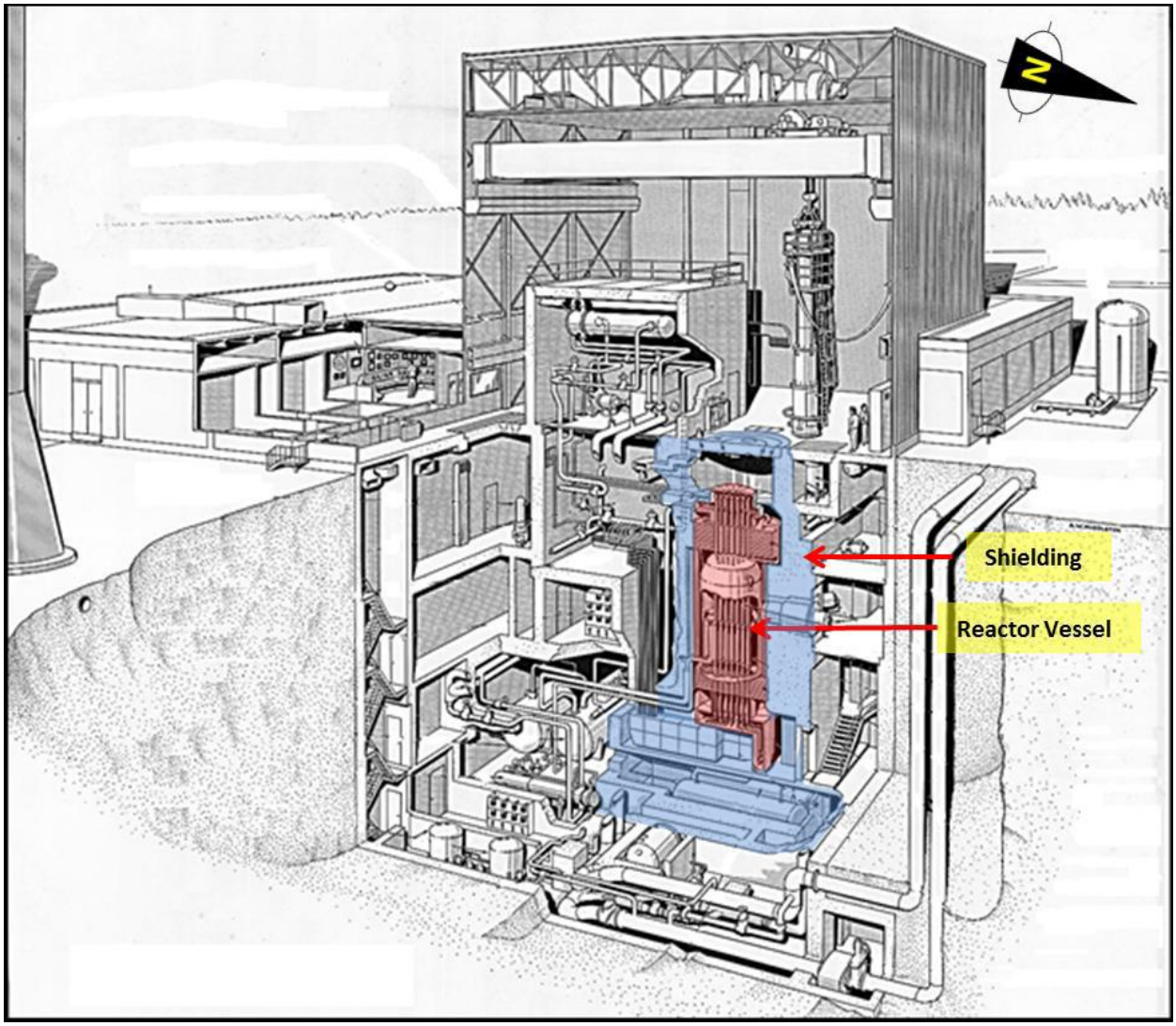

Figure 5 WR-1 Reactor – Reactor Vessel and Shielding

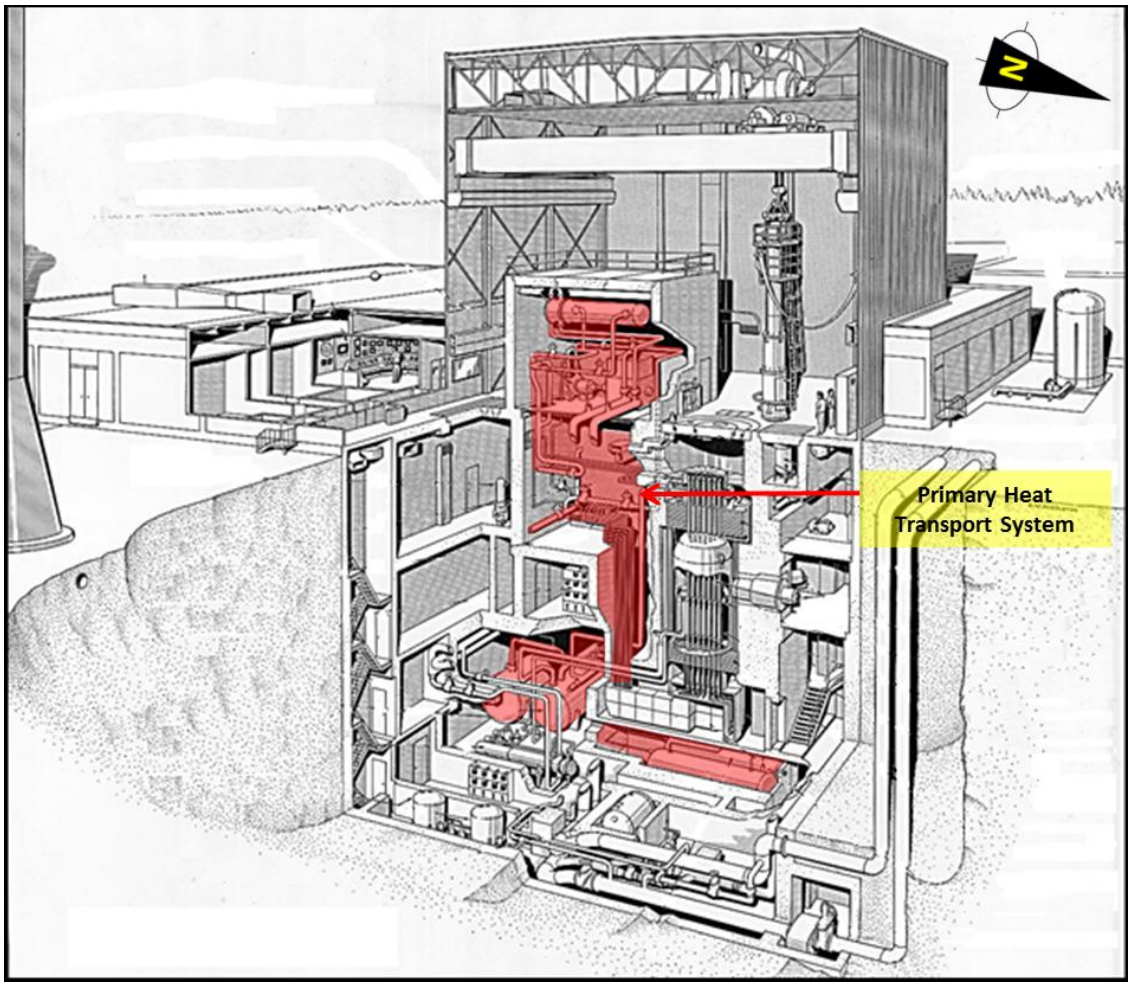

Figure 6 WR-1 Reactor – Primary Heat Transport System

3.4 Supporting Infrastructure

Temporary infrastructure may be required to support the In Situ Decommissioning of the WR-1 Reactor, and may include:

- Batch mixing plant for preparation of grout
- Electrical service and portable lighting
- Heating/Ventilation/Air conditioning
- Domestic water
- Sump water collection, storage and/or treatment
- Construction trailers
- Safety/Security fencing
- Equipment paddock and lay down area

3.5 Project Activities

The general approach to In Situ Decommissioning involves preparing systems and structures for grouting. The below grade sealed structure will encapsulate and contain radiological sources and hazardous materials for a defined period of Institutional Control. The decommissioning activities to be considered as the designated project scope are as follows:

- Preparation for In Situ Decommissioning
- Grouting of below grade structures and systems
- Removal of above grade WR-1 Reactor structures and systems
- Installation of engineered cover over grouted WR-1 Reactor area
- Final site restoration
- Preparation for Institutional Control

Additional detail on each of these project activities is provided below.

3.5.1 Preparation for In Situ Decommissioning

Preparation for decommissioning will require pathways to be created between rooms to minimize void space during grouting and allow for dissipation of heat during the curing of the grout.

Canadian Nuclear Laboratories plans to contract a qualified local grout supplier to prepare and transport the mixed grout to the WR-1 Reactor site. In the event that a qualified local grout supplier is not identified, a temporary batch mixing plant will be assembled on the WL site. This will require shipping by truck and stockpiling aggregate, sand and cement near the batch plant. A water tank, piping, power and settling ponds for equipment wash out will be constructed. A settling pond is an engineered catchment that collects water and allows sediments to collect. Water from the settling pond will be sampled prior to pumping for release or recycled to the batch plant.

3.5.2 Grouting of Below Grade Structures and Systems

All below grade areas are to be filled with grout. This will be done using an engineered fill schedule. Multiple lifts of grouting pours will be executed to systematically fill the reactor systems and the entire below grade structure. The pours will be designed to balance the load forces placed on the below grade structure such that no structural damage can occur as a result of the grouting process. Quality control measures on grouting operations will be implemented.

3.5.3 Removal of Above Grade WR-1 Reactor Structures

The main reactor hall, the above grade portion of the Primary Heat Transport System, the 50T reactor hall bridge crane, and the Ventilation Stack will be demolished. Radiological contaminated equipment from the Primary Heat Transport room will be placed in available below grade facility voids such as the fuel cooling bay and encapsulated along with the below

grade structures. Contaminated materials will be limited to those from decommissioning of the WR-1 Reactor only. Recyclable materials will be separated where practicable and sent for recycling where appropriate. Hazardous substances, with the exception of asbestos, will be removed and managed in accordance with CNL Environmental Protection and Waste Management requirements. Radiological contaminated asbestos if present will be encapsulated with radiological wastes below grade. Clean asbestos will be disposed of in accordance with Environmental Protection requirements at the WL landfill or an off-site landfill.

3.5.4 Installation of Engineered Cover over Grouted WR-1 Reactor Area

After all below grade grouting has been completed, a final engineered cap will be installed over the footprint of the In Situ Decommissioned reactor facility. An engineered barrier is anticipated to be installed over the cap to reduce infiltration. The area will be graded and drainage measures will be installed to manage precipitation.

3.5.5 Final Site Restoration

Upon completion of the engineered cover the remaining WR-1 Reactor grounds that were disturbed during demolition and decommissioning activities will be graded and restored with native vegetation.

3.5.6 Preparation for Institutional Control

The grouted area will be fenced as part of Institutional Controls. Routine surveillance of the site may include inspecting the engineered barrier for subsidence, erosion, and animal or other intrusion. Additional groundwater monitoring wells will be installed, as required, to monitor the performance of the In Situ Decommissioned facility.

3.6 Waste Generation and Management

The project will generate radioactive, hazardous, clean and likely clean wastes[4].

3.6.1 Radioactive Wastes

Radiological wastes will be generated by decommissioning activities. The sources of these wastes are:

- Preparation of reactor systems for In Situ Decommissioning: Personal Protective Equipment, swipe samples and coupons, contaminated tools and equipment.

[4] Clean waste is material that has never been contaminated or radioactive as determined by its history, location and use, or material that has been confirmed to be acceptable for unconditional release by means of suitable radiological monitoring. Likely clean waste is material that is not expected to be contaminated or radioactive but requires suitable radiological clearance monitoring to be declared “clean”.

- Removal of the WR-1 Reactor above grade structure: Contaminated equipment/structures, such as primary heat transport equipment located above grade, active ventilation, and reactor deck plates, etc.
- Fueling and Fuel Channel flasks currently stored in the WR-1 Reactor Hall.
- Contaminated personal protective equipment from grouting activities.

The current plan includes encapsulation of contaminated equipment/structures in the WR-1 Reactor below grade structure prior to grouting. Radioactive wastes such as Personal Protective Equipment that are not encapsulated will be managed in the Whiteshell Laboratories' Waste Management Area (e.g., Shielded Modular Above Ground Storage Facility) or transported off-site (e.g. CNL's Chalk River Laboratories in Ontario).

3.6.2 Hazardous Wastes

Targeted removal of hazardous substances remaining within the WR-1 Reactor will generate small quantities of hazardous wastes.

Hazardous wastes will be managed in accordance with CNL Environmental Protection and Waste Management requirements. The wastes will be shipped off-site to an appropriate hazardous waste facility, or encapsulated in the same manner as radiological wastes where it is demonstrated safe to do so.

3.6.3 Clean Waste and Likely Clean Wastes

Removal of the WR-1 above grade structure and decommissioning of the temporary supporting infrastructure will generate clean and likely clean wastes.

Likely clean wastes will be monitored for radioactivity in accordance with Radiation Protection and Waste Management program requirements to confirm that these are clean. Any wastes not meeting criteria for classification as clean will be managed as radioactive waste.

Disposal methods for clean waste materials will meet all Provincial and Municipal requirements. The disposition options are: reuse or recycle, disposal in an off-site landfill, and disposal in the CNL landfill.

3.7 Project Phases and Schedule

The project phases and their duration is outline below.

Table 1 Project Phases and Schedule

Phase	Duration
1. Preparation for In Situ Decommissioning	2019-2021
2. Grouting of Below Grade Systems and Structures	2021
3. Removal of Above Grade WR-1 Reactor Structures	2021-22
4. Installation of Cap and Environmental Controls	2022-23
5. Final Site Restoration	2023
6. Preparation for Institutional Control	2024
7. Institutional Control	2024-TBD

4. PROJECT LOCATION INFORMATION

4.1 Project Location

The location of the Whiteshell Laboratory site is shown in Figure 1. The centre of the main laboratory site is located at approximately latitude 50°10′ 46″ N and longitude 96°03′ 35″ W.

4.2 Project Proximity to Residences

The permanent residents in closest proximity to the WR-1 Reactor reside to the west of the Winnipeg River along Highway 11. The nearest residents are approximately 2 km from the WR-1 Reactor site and are located along the Winnipeg River northwest of the site.

The nearest population centres are the Village of Lac Du Bonnet, 9 km to the north and the Local Government District of Pinawa, 10 km to the east. Both communities are located on the shore of the Winnipeg River. Lac Du Bonnet has a population of approximately 1100 and Pinawa has a population of approximately 1400. Winnipeg is approximately 100 km to the southeast.

4.3 Project Proximity to Reserves, Traditional Territories and Land/Resources used by Aboriginal Peoples

Three First Nations communities are in proximity to the Whiteshell Laboratories Site. The Ojibway community of Sagkeeng First Nation (also known as Fort Alexander, Manitoba) is located on the shore of the Winnipeg River at Lake Winnipeg approximately 50 km northwest of Whiteshell Laboratories. The Little Black River First Nation is located approximately 60 km northwest of Whiteshell Laboratories, in proximity to Sagkeeng First Nation. The Brokenhead Ojibway Nation (also known as Scanterbury, Manitoba) is located along the shore of the Brokenhead River approximately 50 km west of Whiteshell Laboratories [3].

The Whiteshell Laboratories Site and surrounding region are part of the traditional territories of Sagkeeng First Nation and Treaty 3 First Nations located in Ontario. The Sagkeeng and Little Black River First Nations use the Winnipeg River as its water supply [3].

Canadian Nuclear Laboratories is currently reviewing the Aboriginal groups to be engaged in dialogue about the project. This includes an assessment of the significance of potential adverse impacts and considerations such as asserted rights, historical or traditional practices and land claims. Canadian Nuclear Laboratories' review activities will meet CNSC requirements for Aboriginal engagement [5].

5. FEDERAL INVOLVEMENT

5.1 Federal Financial Support

Funding for the project is provided by Natural Resources Canada (NRCan) and managed by AECL.

5.2 Federal Lands

The WR-1 Reactor In-Situ Decommissioning Project will be undertaken on Federal Lands (The Whiteshell Laboratories site).

5.3 Permits, Licenses or Other Authorizations

Canadian Nuclear Safety Commission regulatory approval is required for the In Situ Decommissioning of WR-1 Reactor to proceed.

A petroleum storage tank permit may be required from Environment Canada, depending on the size of diesel tanks installed on the site to support decommissioning activities (if required).

CNL will have to maintain registration as a waste generator through Manitoba Conservation and Water Stewardship and in compliance with the Hazardous Waste Regulation 195/2015 (created December 2015) that comes into force on May 25, 2016 under the Dangerous Goods Handling and Transportation Act.

6. ENVIRONMENTAL EFFECTS

6.1 Physical and Biological Setting

6.1.1 Geology/Hydrogeology

The regional surficial geology comprises widespread deposits of till and glacio-fluvial and glacio-lacustrine materials. In the immediate vicinity of Whiteshell Laboratories there are approximately 10 to 20 m of surficial overburden soils overlying Precambrian bedrock. Hydrogeological characterization at the WL Main Campus has shown overburden thickness in the area is up to 15 m thick. The stratigraphic units in sequence from bedrock upwards are silty sand till, clayey silt till, silty clay and an upper soil complex comprised of laminated clayey silt with minor interbeds of massive silty clay and up to 0.25 m of surface organics. The foundation of the WR-1 reactor extends into the bedrock. Groundwater flow at WR-1 Reactor is towards the Winnipeg River.

6.1.2 Hydrology

The Winnipeg River is the dominant drainage feature in the area and is classified as a medium-sized lowland river. At the Whiteshell Laboratories site, the river is approximately 0.3 km wide, 7 m deep and flows in a northerly direction at a velocity of approximately 0.3 m/s. Flow rates measured at the nearby Seven Sisters Falls Hydroelectric Generating Station (upstream of WL) vary seasonably between ~600-1800 m^3/s with a record low at ~125m^3/s and as high as ~2,800 m^3/s. Surface water run-off at the Whiteshell Laboratories site drains into the Winnipeg River.

6.1.3 Terrestrial Habitat and Biota

Terrestrial habitat at the Whiteshell Laboratories Site is diverse over short distances. Large tracts of wetland cover the easterly portions of the site, with black spruce common. Further to the west are poorly drained clay plains, some forested with species such as ash and poplar, and some as abandoned farm fields vegetated with grasses and shrubs. Close to the Winnipeg River are gullies and ravines where beaver dams are common.

Over 50 species of mammals can be expected to be found around the Whiteshell Laboratories site. Many of the mammals, such as the snowshoe hare, American red squirrel, meadow vole, red fox and white-tailed deer, are common and widespread. Table 2 lists species that are likely to occur in the vicinity of the WL site and have Species at Risk status, under the federal Species at Risk Act and provincial Endangered Species Act. Likely occurring species for the site were indicated by the Manitoba Conservation Data Centre.

The WR-1 Reactor building does not currently provide habitat for mammals listed as species at risk.

To prepare for decommissioning of buildings on site, a preliminary bat monitoring study was conducted in the summer of 2015 to determine the likelihood of Species at Risk bats roosting in buildings. Based on timing and lack of clustering of echolocation calls, it appears bat species

found on site are not roosting within buildings on the main campus rather are roosting in the forested areas of the site.

6.1.4 Aquatic Habitat and Biota

The primary aquatic habitat in the area is the Winnipeg River, which passes directly through the licensed property area. The river is located approximately 500 m to the west of the WR-1 Reactor site. The river supports a variety of forage fish species such as carp and other minnow species. Predator fish in the area include walleye, northern pike, smallmouth bass, mooneye and lake trout. The carmine shiner, listed as threatened under the Species at Risk Act, is likely to occur in the vicinity of Whiteshell Laboratories according to the Manitoba Conservation Data Centre. Lake Sturgeon, with a status of Endangered under the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), is found in the Winnipeg River. The listed Snapping Turtle is a known species of the site. Aquatic Species at Risk that could be present at Whiteshell are listed in Table 2.

6.2 Changes to the Environment by the Project

This section provides a brief description of changes that may be caused by decommissioning activities and potential long term impacts from the In Situ Decommissioned reactor.

6.2.1 Fish, Fish Habitat and Aquatic Species

No significant impact on fish or fish habitat (as defined in subsection 2(1) of the Fisheries Act) or on aquatic species (as defined in subsection 2(1) of the Species at Risk Act) are expected from In Situ Decommissioning.

There is the potential for radionuclide releases to groundwater from the In Situ Decommissioned reactor and radionuclide migration to the Winnipeg River. The environmental assessment will assess the potential impacts on fish, fish habitat and aquatic species from such releases and ensure these are within acceptable limits.

6.2.2 Migratory birds

No effects on migratory birds are expected. The WR-1 Reactor site is located approximately 500 meters away from the Winnipeg River which is the main corridor for migratory birds.

Swallow species commonly nest on man-made structures. During a nesting count in the summer of 2015, no barn or cliff swallows were noted on the WR-1 Reactor structure. These swallow species are common migratory birds in the area. Chimney shifts are another bird species that commonly choose to nest in chimney's of buildings that are lined with brick, wood or concrete. The WR-1 Reactor ventilation stack, located to the east of the WR-1 building, is made with carbon steel and no interior lining, indicating that it is not a probable location for nesting of this particular species.

Prior to decommissioning, a site walk down will be conducted by environmental protection staff to ensure migratory birds, their nests and eggs are not affected by decommissioning activities as per the Migratory Bird Regulation.

6.2.3 Changes to the Environment on Federal Lands, in a Province other than Manitoba, or outside Canada

Potential effects of the project will be limited to the Whiteshell Laboratories site. No impacts outside of the province of Manitoba are expected.

6.2.4 Effects on Aboriginal People

The project is not expected to affect the health of aboriginal people. The laboratory site is not currently used by aboriginal peoples.

Impacts on items of historical, archaeological, paleontological or architectural significance are not expected. The WR-1 Reactor site was disturbed during construction of the facility in the 1960's. The cultural integrity of the site has been lost.

Table 2 Potential Species at Risk at the WL-Site

Name of species	Latin name of species	taxonomy group (amphibians, birds, fish, mammals, plants, snakes, turtles)	Status		
			COSEWIC	Manitoba	SARA
Bittern, Least	Ixobrychus exilis	bird	Threatened	Endangered	Threatened
Bobolink	Dolichonyx oryzivorus	bird	Threatened	Not Listed	No Status
Flycatcher, Olive-sided	Contopus cooperi	bird	Threatened	Threatened	Threatened
Grebe, Horned	Podiceps auritus	bird	Special Concern	No Status	No Status
Nighthawk, Common	Chordeiles minor	bird	Threatened	Threatened	Threatened
Owl, Short Eared	Asio flammeus	bird	Special Concern	Threatened	Special Concern
Plover, Piping	Charadrius melodus	bird	Endangered	Endangered	Endangered
Rail, Yellow	Coturnicops noveboracensis	bird	Special Concern	No Status	Special Concern
Shrike, Loggerhead	Lanius ludovicianus migrans	bird	Threatened	Endangered	Endangered
Swallow, Barn	Hirundo rustica	bird	Threatened	No Status	No Status
Swan, Trumpeter	Cygnus buccinator	bird	Not at Risk	Endangered	No Status
Swift, Chimney	Chaetura Pelagica	bird	Threatened	Threatened	Threatened
Warber, Golden-winged	Vermivora chrysoptera	bird	Threatened	Threatened	Threatened
Warbler, Canada	Wilsonia Canadensis	bird	Threatened	Threatened	Threatened
Whip-poor-will	Antrostomus vociferus	bird	Threatened	Threatened	Threatened
Eastern Wood pewee	Contopus virens	bird	Special concern	No Status	No Status
Falcon, Peregrine	Falco peregrinus anatum/tundrious	bird	Special Concern	Endangered	Special Concern
Bank swallow	Riparia riparia	bird	Threatened	No Status	No Status
Woodpecker, Red-headed	Melanerpes erythrocephalus	bird	Threatened	Threatened	Threatened
Lamprey, Chestnut	Ichthyomyzon castaneus	fish	Non-Active	No Status	Special Concern (schedule 3)
Shiner, Carmine	Notropis percobromus	fish	Threatened	No Status	Threatened

Name of species	**Latin name of species**	**taxonomy group (amphibians, birds, fish, mammals, plants, snakes, turtles)**	**Status**		
			COSEWIC	**Manitoba**	**SARA**
Sturgeon, Lake	Acipenser fulvescens	fish	Endangered	No Status	No Status
Fox, Grey	Urocyon cinereoargenteus	mammals	Threatened	No Status	Threatened
Little Brown Myotis	Myotis lucifugus	mammals	Endangered	Endangered	Endangered
Northern Myotis	Myotis septentrionalis	mammals	Endangered	Endangered	Endangered
Turtle, Snapping	Chelydra serpentina	reptiles (turtle)	Special Concern	No Status	Special Concern
Monarch	Danaus plexippus	Lepidopterans	Special Concern	No Status	Special Concern
Mottled Duskywing (boreal population)	Erynnis martialis	Lepidopterans	Endangered	No Status	No status
Agalinis, Gattinger's	Agalinis gattingeri	plant	Endangered	Endangered	Endangered
Agalinis, Rough	Agalinis aspera	plant	Endangered	Endangered	Endangered
Aster, Western Silvery	Symphyotrichum sericeum	plant	Threatened	Threatened	Threatened
Ironweed	Vernonia fasciculata	plant	Endangered	Endangered	No Status

7. SUMMARY OF THE PROJECT DESCRIPTION

The Whiteshell Laboratories site was established in the 1960's by AECL to conduct nuclear research. The Whiteshell Reactor-1 was placed in service in 1965 to demonstrate the organic-cooled reactor concept using heavy water (D_2O) as the moderator. The reactor was permanently shut down in 1985.

In 1998, AECL made the decision to decommission the Whiteshell Laboratories Site. An Environmental Assessment Decision for decommissioning of the Whiteshell Laboratories was announced by the Minister of the Environment in March 2002.

Since the EA Decision in 2002, the approach for decommissioning WR-1 Reactor has been revised. The new approach is In Situ Decommissioning as opposed to complete removal of the facility. In Situ Decommissioning results in a concrete monolith which provides a robust and durable containment to allow for continued radioactive decay.

Other decommissioning options have been considered for this project including the removal of all source term for interim storage until final disposal options are available. In Situ Decommissioning has been selected as the preferred approach as it provides the following advantages:

- Reduced risk for radiological and industrial hazards exposures to workers, meeting the ALARA principle;
- Reduced transport/waste handling risks to workers, the public and the environment; and,
- Effective reduction of the nuclear liability (e.g., eliminates interim waste storage)
- The majority of the structure is below grade and inside a robust concrete foundation, making it more technically feasible than deactivation, dismantling and demolition of the facility; and
- Significantly lower cost than dismantling, reducing costs for the taxpayer.

In Situ Decommissioning of the WR-1 Reactor will provide for the safe long term management of nuclear waste and qualifies as a Designated Project as per Section 37(b) of the Regulations Designating Physical Activities under CEAA 2012 [1]. The CNSC is the responsible authority for projects of this type.

The main physical work is the WR-1 Reactor Building and extends five levels above and below grade. The reactor is currently in storage with surveillance. Preliminary decommissioning activities have included defueling the reactor following shutdown in 1985, draining organic coolant and heavy water from the reactor, and isolating all reactor systems. All building services are maintained in an operating mode. The majority of the radiological inventory is associated with the reactor vessel and heat transport system. Hazardous substances still exist in the facility as a result of historical operational uses.

The above grade structure will be removed, and any contaminated material will be placed below grade for encapsulation. The below grade reactor systems, components and structure

will be sealed by capping the service systems and by grouting systems, components and the below grade structure. The sealed structure will be capped with an engineered cover to minimize water ingress and isolate radiological inventory and hazardous substances.

The WR-1 Reactor site will be returned to AECL for Institutional Control.

Canadian Nuclear Laboratories plans to contract a qualified local grout supplier to prepare and transport the mixed grout to the WR-1 Reactor site. In the event that a qualified local grout supplier is not identified, a temporary batch mixing plant will be assembled on the WL site.

The project is scheduled to commence in 2019 and have a duration of approximately five years followed by Institutional Control.

No significant impact on fish or fish habitat (as defined in subsection 2(1) of the Fisheries Act) or on aquatic species (as defined in subsection 2(1) of the SARA) are expected from In Situ Decommissioning.

No effects on migratory birds are expected. The WR-1 Reactor site is located approximately 500 meters away from the Winnipeg River, the main corridor for migratory birds.

The environmental effects of the project are expected to be limited to the WL site. No changes to the environment on federal land, in a province other than Manitoba, or outside Canada are expected.

The WL site is part of the traditional territories of the Sagkeeng First Nation, Treaty 3 First Nations of Ontario and Brokenhead Ojibway Nation. The WL site is not currently used for traditional purposes.

CNL regularly informs Aboriginal groups and local stakeholder groups on the company vision and current and future activities. Local stakeholders have been informed about the project. Communications activities are being planned for the future. CNL is currently reviewing the Aboriginal groups to be engaged in dialogue about the project.

8. REFERENCES

[1] Canadian Environmental Assessment Act, 2012 (S.C. 2012, c. 19, s. 52).

[2] Prescribed Information for the Description of a Designated Project Regulations. SOR/2012-148. Published by the Minister of Justice, http:/laws-lois.justice.gc.ca.

[3] Whiteshell Laboratories Decommissioning Project, Comprehensive Study Report, Volume 1: Main Report, Rev 2, 2001 March.

[4] Canadian Nuclear Safety Commission, *Record of Proceedings, Including Reasons for Decision: Application to Decommission Whiteshell Laboratories*, 2002 December 19.

[5] Canadian Nuclear Safety Commission, *Aboriginal Engagement*. REGDOC-3.2.2, 2016 February.

[6] Grasty, R.L. and J.R. LaMarre. 2004. The Annual Effective Dose from Natural Sources of Ionising Radiation in Canada. Radiation Protection Dosimetry 108, No 3, 215-226.