Near Surface Disposal Facility

Deep River, Renfrew County, Ontario

ENVIRONMENTAL IMPACT STATEMENT

Volume 1: Executive Summary

Canadian Nuclear Laboratories

Laboratoires Nucléaires Canadiens

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Project Number: 1547525

Revision 1; November 13, 2019

EXECUTIVE SUMMARY

Canadian Nuclear Laboratories (CNL) is proposing the construction and operation of a Near Surface Disposal Facility (NSDF) for the disposal of solid, low-level radioactive waste at the Chalk River Laboratories (CRL) site – the NSDF Project. The NSDF Project is based on the mandate of Atomic Energy of Canada Limited (AECL), a federal Crown corporation, to substantially reduce the risks associated with the waste and to create conditions for the revitalization of the CRL site. CNL is a private-sector company that is contractually responsible for the management and operation of nuclear sites, facilities and assets owned by AECL.

For more than 70 years AECL (and now CNL) has been making advances in nuclear science and technology in the interest of Canadians. This includes the production of medical isotopes that have treated over one billion patients worldwide, as well as developments in clean energy which help reduce greenhouse gas emissions. Through investments in the revitalization of the CRL site, that mission and innovative science will continue into the future. However, this proud history has created nuclear liabilities in the form of waste. Furthermore, past waste management practices, which met the standards of the day, are no longer acceptable now. Specifically, the historic waste management areas lack robust containment, which has led to impacts to the surrounding environment.

In accordance with *Canada's Radioactive Waste Policy Framework* the waste producers and owners of radioactive waste are responsible for the funding, organization, management and operation of disposal and other facilities required for their wastes. Responsible nuclear waste management includes full life cycle management from generation to disposal. CNL and AECL are working actively at strategic and operational levels to identify strategies and solutions for waste management of the entire life cycle of all radioactive waste classifications including low-level waste, intermediate level waste and high level waste. CNL's high level waste is in a safe, secure and suitable storage facilities until a national deep geological repository designed for used fuel becomes available. The current strategy for intermediate level waste from all CNL managed sites is safe, secure and suitable storage facilities at CRL until a suitable disposal facility is available. The exceptions to this are the Nuclear Power Demonstration and Whiteshell Reactor 1 facilities which are proposed to be decommissioned in situ.

The purpose of the NSDF Project is to provide the permanent disposal of current and future low-level waste at the CRL site, as well as a small percentage of waste volume from off-site locations, in a manner that is protective of both the public and the environment. The practice of continuing to build additional temporary storage systems at the CRL site for low-level waste is not consistent with modern waste management principles. Further, the NSDF Project would enable the remediation of historically contaminated lands and legacy waste management areas, as well as the decommissioning of outdated infrastructure to facilitate the CRL site revitalization.

The proposed NSDF Project is considered a "designated project" in accordance with paragraph 37(b) of the *Regulations Designating Project Activities*. Under section 15 of the *Canadian Environmental Assessment Act, 2012*, the Canadian Nuclear Safety Commission is the Responsible Authority for this proposed project.

A key element of the regulatory approvals process is the completion of an environmental assessment under the *Canadian Environmental Assessment Act, 2012*, the results of which are documented in this Environmental Impact Statement (EIS). The EIS describes the analysis of alternatives, a process of public and Indigenous engagement, studies of base case conditions, and assessment of project activities during the construction, operation, closure and post-closure phases of the NSDF Project. All these aspects of the EIS are summarized below in this executive summary.

Analysis of Alternatives

A comprehensive analysis of alternatives was undertaken for the location of facility, type of facility, design of facility, and approach for treatment of wastewater to meet the needs of the NSDF Project. Consideration was given to technical, economic and environmental factors. Of the alternatives considered, the construction of a near surface disposal facility for the disposal of low-level waste at the CRL site was the preferred alternative.

Chalk River Laboratories site is the most suitable host site as more than 90% of the waste to be managed by the NSDF Project is already at the CRL site. This location for the facility avoids the time and cost in transporting the waste to another location (an effort which would require approximately 45,000 transport truck trips) and reduce the unnecessary generation of greenhouse gas emissions.

Fifteen potential sites within CRL were initially screened against mandatory criteria such as the minimum space required. Sites that passed this initial screening were further evaluated using several exclusion criteria, such as presence above the floodplain, as well as geotechnical and biodiversity considerations. Based on this review two candidate sites were identified for further evaluation. Both sites were technically feasible, however they differed in relation to the potential for environmental effects.

The preferred site for the NSDF is closest to the CRL main campus and therefore closest to the support services (e.g., electricity, water and heat). The preferred site is located within the Perch Creek and Perch Lake Watershed, which has been impacted by historic waste management practices. Groundwater flow and contaminant migration at CRL site has been studied for over six decades and the Perch Creek and Perch Lake Watershed is well understood, thus better enabling CNL to predict environmental effects as well as mitigate any potential impacts from the NSDF Project.

Protection of the Ottawa River was a key factor in considering the NSDF Project location. The preferred site is located along a bedrock ridge that naturally forces water directly away from the Ottawa River, and it creates a foundation for the engineered containment mound which has been used in the overall design.

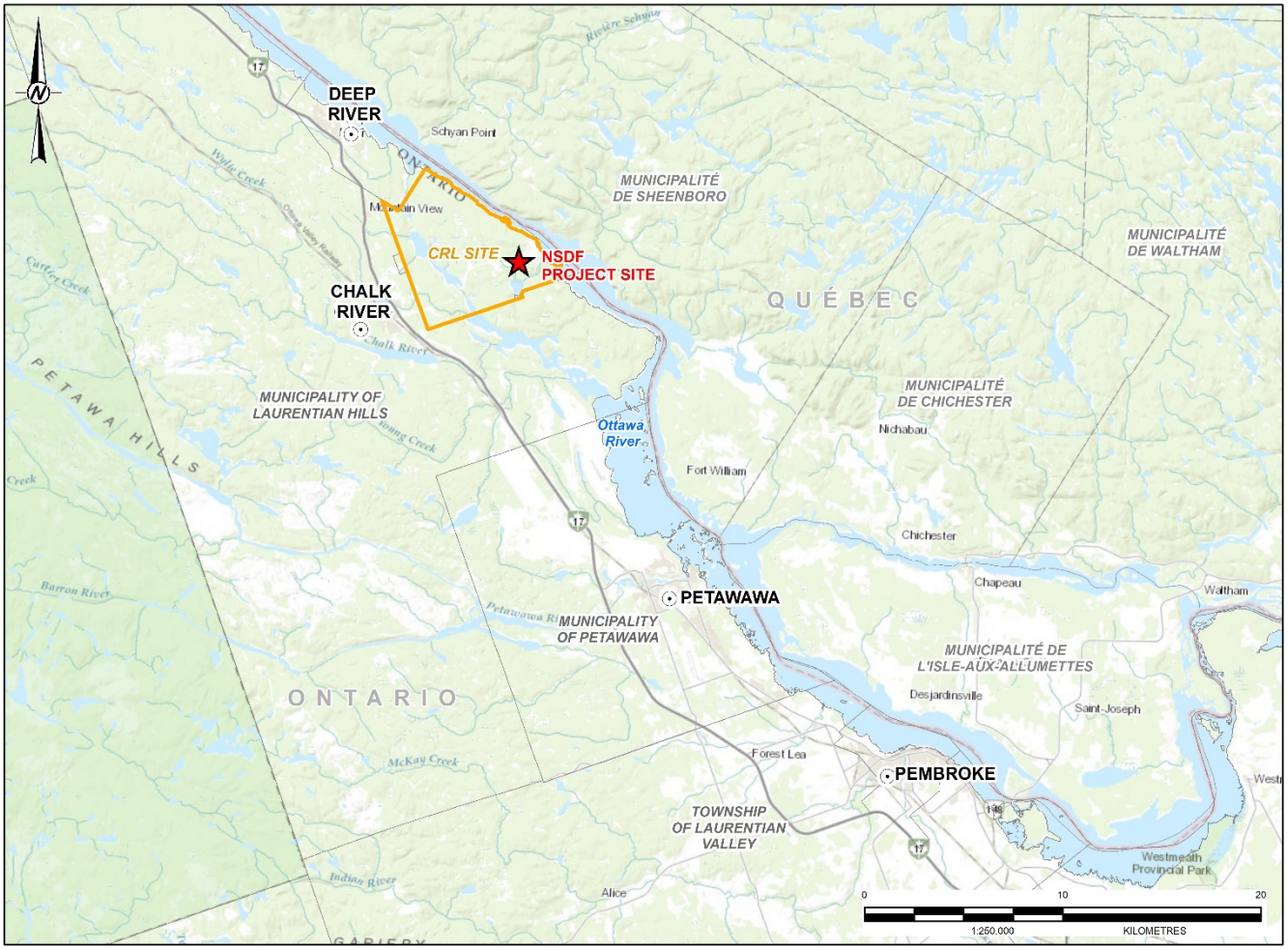
Near surface disposal facilities are suitable for the disposal of low-level waste as noted by international nuclear industry guidance. An engineered containment mound design is a best available technology in consideration of the proposed waste stream, which consists mostly of impacted soils and demolition debris.

Project Description

The NSDF Project is a proposed waste disposal facility using an engineered containment mound design built at ground surface that will hold up to 1,000,000 cubic metres (m^3) of low-level waste. The facility will feature ten waste disposal cells, built in two phases. The engineered containment mound includes a multilayer base liner and cover system, where waste will be placed in between. The waste is covered as each disposal cell is filled. It is similar to a hazardous waste landfill but with more robust engineering features. The proposed facility would be licensed under the *Nuclear and Safety Control Act* thus subject to the associated regulations and independent regulatory oversight from the Canadian Nuclear Safety Commission.

Location

The CRL site is in Renfrew County, Ontario on the shore of the Ottawa River, approximately 200 km northwest of Ottawa. The CRL site contains several nuclear and non-nuclear facilities such as research laboratories and waste management facilities. The CRL site has a total area of approximately 4,000 hectares (ha) and 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 NSDF Project is located entirely within the CRL site and the footprint of the NSDF Project site is approximately 37 ha.



Waste Inventory

The NSDF will contain only low-level waste which contains primarily short-lived radionuclides and restricts the amount of long-lived radionuclides thus requiring isolation and containment for periods of time up to a few hundred years. The engineered containment mound 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 of the inventory will decrease about 2,000 times in the first 100 years, and then begin to approach background concentrations of radioactivity shortly thereafter.

Waste streams destined for the NSDF Project include contaminated soils from remediation activities, demolition debris from decommissioning work and general waste such as used personal protection clothing or equipment. These items are considered low-level waste as they have become contaminated at some point with low levels of radioactivity and can be safely handled with limited precautions.

Wastes to be placed in the NSDF Project will primarily originate from wastes at the CRL site currently in storage, generated from future environmental remediation and decommissioning activities, as well as future waste that is expected to be produced as a result of ongoing nuclear science and technology activities. A small percent of the waste volume to be placed in the NSDF Project will come from other AECL-owned sites (e.g., Whiteshell Laboratories), or from commercial sources such as hospitals and universities.

Facility Design

The NSDF Project has been designed in accordance with regulatory and international design principles for radioactive waste disposal including the incorporation of multiple safety functions, containment and isolation of the radioactive waste as well as incorporation of surveillance and control of the passive safety features. The long-term safety performance of the NSDF Project is not dependent on any single safety feature which includes the following engineered barriers:

- Base liner system, which has a primary and secondary liner to contain the waste and to limit the potential release of contamination to the subsurface and groundwater.
- Final cover system, which will isolate the waste, provides radiation shielding and an intrusion barrier, and prevents precipitation from infiltrating the waste.
- Perimeter berm, which provides structural stability and is designed to withstand natural physical events therefore ensuring containment of the waste.

The base liner and final cover systems are composed of a combination of natural materials (e.g., compact clay liner) and synthetic materials (e.g., high density polyethylene geomembranes) designed to work together to mitigate the release of contaminants into the environment. Long-term performance tests have been conducted to provide confidence that the synthetic high density polyethylene geomembrane component of the liner systems will meet the 550-year design life thus complimenting the natural clay component which will provide a hydraulic barrier for thousands of years. Since the perimeter berm is constructed exclusively from natural materials, it is expected to remain intact and performing its function for thousands of years. Further, the waste material placement and compaction are part of the design basis to ensure structural stability in order to mitigate settling and subsidence. Several human-made mounds have existed for more than 550 years that were built with earthen

materials and limited construction methods or engineering knowledge (e.g., Monks Mound in Illinois, United States of America).

In addition to the engineered barriers, the NSDF Project site is well above the Ottawa River flood levels on a bedrock ridge that naturally forces water to flow in the opposite direction from the river. The NSDF Project design has taken into consideration that the CRL site is in a region of minor to moderate seismic activity and will maintain protection of the environment in such events. The NSDF Project has been sited and designed to provide features that are aimed at the containment and isolation of the radioactive waste from the public and the environment.

Included in the proposed design of the NSDF Project are wastewater collection and treatment systems. The NSDF Project will contain systems within the engineered containment mound to collect and pump leachate as well as other wastewaters to the wastewater treatment plant. The wastewater will be treated through conventional processes to remove radiological and chemical contaminants such that the treated effluent meets discharge targets established to be protective of the environment. After treatment, the effluent will be discharged to ground via an exfiltration gallery to recharge the groundwater. In the event that the exfiltration gallery does not have sufficient capacity to manage the treated effluent (e.g., under spring conditions), a portion of the treated effluent will be conveyed directly to Perch Lake to be released via a transfer line to a submerged diffuser. Only effluent that satisfies the discharge targets will be released. Consistent with CNL practices and regulatory requirements, all discharges will be monitored and reported.

Other supporting infrastructure for the NSDF Project includes support facilities such as a vehicle decontamination facility and administration building, as well as site infrastructure such as surface water management ponds.

Timeline

The NSDF Project is divided into several phases: construction, operations, closure and post-closure.

The construction phase, which includes site preparation, is anticipated to start in 2021 or as soon as the relevant regulatory permits and approvals are in place. This phase will include activities such as site clearing and construction of the engineered containment mound and wastewater treatment plant.

The operations phase is anticipated to begin in 2024 and last approximately 50 years. Activities associated with the operations phase include those activities necessary for placement of wastes, treatment of wastewater, maintenance of facilities and establishment of long-term monitoring.

The closure phase follows cessation of operations and is expected to last 30 years. Activities includes closure of the engineered mound including final cover installation and decommissioning of infrastructure.

The post-closure phase is defined by two distinct periods: institutional control and post-institutional control. For planning purposes, the institutional control period was assumed to last 300 years, however the institutional control period will continue as long as necessary as determined by regulatory agencies. During institutional control, inspection and surveillance activities will verify the integrity of the disposal facility system, while environmental monitoring activities will verify that the performance continues to demonstrate compliance with the environmental assessment predictions. Controls on land usage would include recognition of a waste disposal facility on the property title or deed to ensure the appropriate zoning restrictions, including buffer or attenuation zones, are enforced by the applicable regulatory agency.

Public Engagement Activities

Engagement is a key component of the environmental assessment process. CNL operates an ongoing Public Information Program to inform groups about activities at CNL managed sites and the potential effects of these activities on the public, Indigenous peoples and on the environment. This Public Information Program forms the basis of communication efforts with the public and Indigenous peoples and helps to direct the establishment of long-term, mutually beneficial working relationships with their communities in proximity to CNL sites.

The NSDF Project has provided current project information to communities likely to be most affected or interested in the project, in both the provinces of Ontario and Quebec thus providing information about the project in both of Canada's official languages (French and English). Public engagement activities related to the NSDF Project include:

- presentations, information sessions and site visits;
- distribution of public information (e.g., webpage content, infographics and factsheets, community newsletters, etc.);
- participation in public events and as well as media relations;
- use of social media to advertise events as well as share project information (e.g., Facebook, webinars and YouTube videos).

During regularly scheduled meetings of the Environmental Stewardship Council for the CRL site, members are presented with information about CNL and CNL environmental practices, and these meetings provide opportunities for open dialogue between various stakeholder groups, local communities and CNL. Environmental Stewardship Council members share meeting information with their respective constituents. This open dialog and sharing of information is very important for CNL, ensuring that perspectives from our closest neighbours and non-governmental organizations are heard.

These engagement activities have helped inform stakeholders and have enabled the public to provide valuable feedback into the NSDF Project, which helps CNL understand areas of public concern and improve the NSDF Project design and EIS. Key themes of the feedback received to date for the NSDF Project includes:

- justification for the NSDF Project;
- protection of the Ottawa River;
- waste inventory;
- design/engineering;
- long-term accountability;
- alternative means assessment (including site selection); and
- environmental events (e.g., flooding, earthquakes).

This feedback has been incorporated into the EIS where applicable (e.g. through inclusion of additional analysis or modification of assessment boundaries). A significant change incorporated into the EIS based on feedback was the change in waste inventory to include only low-level waste. In an effort to improve access and transparency CNL continues to post key EIS technical support documents on the NSDF Project's website as they are available.

CNL appreciates all feedback received to date on the project and remains committed to continuing discussions with the public, Indigenous peoples and non-governmental organizations on the NSDF Project. CNL will continue engagements throughout the environmental assessment process but encourages interested members of the public to contact the project directly should they have questions about the project (communications@cnl.ca).

Indigenous Engagement Activities

In consultation with the Canadian Nuclear Safety Commission, and using tools provided through the Aboriginal and Treaty Rights Information System, CNL identified a proposed list of Indigenous peoples with potential interest in the NSDF Project. Engagement with Indigenous peoples started in October 2015 and is ongoing with CNL carrying out information sessions for the NSDF Project within Indigenous communities. Engagement methods have been largely similar to those for public engagement, however, has also included direct communication or contact with each identified Indigenous community or group.

CNL has proactively addressed key issues raised by interested Indigenous peoples, using open and transparent communication to share information in regard to traditional land use, biodiversity and archaeology. In engagements with Indigenous peoples, it is clear that First Nations and Métis peoples do not want to look at the NSDF Project solely in isolation from all other issues and matters pertaining to the AECL properties in the Ottawa Valley. Issues raised by the various Indigenous peoples include issues associated with the historical occupancy of the lands, long-term operations and future operations and scenarios. CNL respects and understands these opinions and has approached its Indigenous engagement in such a way as to answer and address some of these broader questions as well as engaging directly on the NSDF Project.

CNL is working towards developing long-term relationships with Indigenous peoples that occupy and have traditional territories and modern-day interests near its operations. CNL recognizes that such relationships may take a long time to form but believes this is consistent with the Government of Canada's approach to reconciliation with Indigenous peoples.

Environmental Assessment Approach

The environmental assessment approach for the NSDF Project was developed to meet the requirements of *Canadian Environmental Assessment Act, 2012* and the Generic Environmental Impact Statement (EIS) Guidelines developed by the Canadian Nuclear Safety Commission, which provide an outline of the information to be included, along with a high-level description of the methods to be implemented for the environmental assessment.

The assessment started with defining the overall **scope of the assessment** including identifying the **valued components** for each environmental discipline (e.g., atmospheric environment, hydrogeology, terrestrial biodiversity, human health and socio-economic environment). Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, government agencies, Indigenous people, the scientific community or the public. Examples of valued components identified include air quality, groundwater quality, migratory birds and public health.

The next step was to define the spatial boundaries (e.g., geographic extent of the project activities and effects) and temporal boundaries (e.g., timelines for the project phases and effects), and assessment cases to evaluate effects. Three **spatial boundaries** were considered in the assessment: site study area, local study area, regional study area. The site study area includes the area where Project activities would be undertaken (e.g., the NSDF Project's proposed facilities, building and infrastructure). A local study area was selected for each environmental discipline to represent the area that is likely to be directly affected by the NSDF Project. This area most often includes the immediate area surrounding the site study area and portions of the downstream environment (e.g., Perch Lake). The regional study area is the largest extent and is the area where the NSDF Project may interact cumulatively with other existing or reasonably foreseeable developments. For many environmental disciplines, the regional study area extends to the full CRL site boundary.

Temporal boundaries (i.e., project phases) establish the timeframe during which NSDF Project effects were assessed. The assessment phases identified align with the phases of the NSDF Project: construction phase (2021 to 2023), operations phase (approximately 50 years, i.e., 2024 to 2070), closure phase (approximately 2070 through to 2100), and post-closure phase (from 2100 and into the future).

Three discipline-specific **assessment cases** (scenarios) were also identified for the assessment. These consisted of the Base Case, which represents existing conditions (e.g., past and existing disturbances or land uses); the Application Case, which represents the predictions of the effects of the Base Case combined with the effects that may result from the NSDF Project; and the Reasonably Foreseeable Developments Case, which represents predictions of the cumulative effects of the Application Case, plus projects that are currently under application review or that have officially entered a regulatory application process.

The next step was to describe the existing conditions. A **description of the environment** subsection was developed for each discipline and includes a description of the baseline conditions used to prepare a discipline-specific Base Case. Using the Base Case, interactions were then evaluated by conducting a **pathway analysis**. The first part of the analysis was to identify all pathways by which a Project component or activity could cause a potential effect. For an effect to occur, there has to be a Project component or activity that could result in a detectable change to the measurement indicators and a correspondent effect on a valued components.

For primary pathways, an analysis was conducted for each valued component to predict **residual effects** from the NSDF Project. For each assessment, a **prediction of confidence and uncertainty** was evaluated, and the level of certainty that can be placed on predicted residual effects and the methods used to manage uncertainty was described.

The next step was to **classify the predicted residual effects**, including cumulative effects, taking into consideration additional mitigation identified (if applicable) in the residual effects assessment. For valued components without assessment endpoints, the results of the analysis are passed to other disciplines for consideration in their residual effects analysis (e.g., surface water quality is provided to aquatic biodiversity). Residual effects were classified using criteria such as magnitude, geographic extent, duration, reversibility, frequency and likelihood. The results of the classification were used to make **significance determinations** to predict whether the NSDF Project is likely to cause a significant adverse (i.e., negative) effect on the environment or to cause public concern.

Finally, **monitoring programs** were proposed to verify environmental assessment effects predictions, assumptions and mitigation actions. Typically, this included identifying one or more of the following: compliance monitoring (e.g., to confirm the implementation of conditions of approval), environmental monitoring (e.g., monitoring of treated wastewater discharge quality and volumes), and follow-up monitoring (e.g., to test the accuracy of effects predictions or determine the effectiveness of mitigation). Results from these programs can be used to increase the certainty of effect predictions in future environmental assessments.

Atmospheric Assessment Results

The climate in the region surrounding the NSDF Project site is classified as humid continental, with warm summers, cold winters, and no distinct dry season. The average daily temperature is 5.6°C while the daily average temperature in the winter season is -9.3°C and the daily average temperature in the summer season is 19.1°C. Annual precipitation of 859 millimetres equivalent (mm[eq]) is calculated for the region, with the highest precipitation typically occurring in the summer. The wind conditions at the NSDF site are considered to travel predominantly along the Ottawa River. Measured air quality is below the respective provincial and federal criteria, suggesting that the region has generally good air quality.

NSDF Project activities have the potential to release air emissions that could contribute to changes in air quality and incrementally to climate change. During the construction and operations phases, NSDF Project activities will result in emissions, including dust, associated with construction activities such as the operation of vehicles and equipment. Examples of mitigation practices implemented to limit potential effects on air quality and climate change include:

- implementation of the *Dust Management Plan* developed for the NSDF Project, which includes appropriate management techniques to control dust generated by the NSDF Project;
- maintenance of on-site vehicles and equipment engines in good working order; and
- limiting idling of vehicles and equipment on site.

With the implementation of the mitigation identified, the predicted changes to air quality as a result of the NSDF Project during both construction and operations phases are below applicable air quality guidelines and/or standards with one exception (1-hour nitrogen dioxide). However, this exceedance is not likely to occur given the conservative nature of the air quality assessment modelling. For example, in the model, heavy equipment is assumed to run simultaneously and continuously during working hours, which is unlikely to be the case. With the implementation of CNL's robust environmental protection program, including the *Dust Management Plan* for the NSDF Project, **residual effects from the NSDF Project on air quality are not significant**.

A residual effect to greenhouse gas emissions was identified because of the NSDF Project. The change is estimated to be less than a 0.02% increase in total provincial greenhouse gas emissions and a 0.005% increase in total national greenhouse gas emissions. Consequently, the **residual effect from the NSDF Project on greenhouse gases is not significant**.

Monitoring of air quality at the CRL site is conducted under CNL's Effluent Verification Monitoring Program, which is compliant with the CSA Group standard *N288.5-11 Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*. Air quality monitoring for the NSDF Project is intended to verify that mitigation is being implemented effectively and to verify that predictions are within air quality criteria.

Geology and Hydrogeology Assessment Results

The CRL site is located within the Canadian Shield. Bedrock outcrops in several locations in the region, and a widespread but thin deposit of glacial till overlies the bedrock in most areas where overburden is present. Soil substrates generally consist of well-drained sandy soils in the area. Groundwater table depth varies significantly throughout the NSDF Project site and varies seasonally. The average groundwater depths range from approximately 0.06 m in the vicinity of the wetlands to 15.95 m in the northern section of the study area, which corresponds to the thickest overburden. Groundwater flow from the NSDF Project site is to the adjacent wetlands, and ultimately discharges to the Ottawa River via Perch Lake and Perch Creek.

NSDF Project activities have the potential to alter soil quantity, quality, and distribution, as well as geomorphology as a result of construction and closure activities. Blasting activities, site grading, excavating and emissions of air contaminants could change soil quality during construction. The construction of the NSDF Project will physically alter groundwater levels and flows, and surface drainage. During operations, discharge of treated effluent could cause changes to groundwater quality, levels and flows. During the post-closure phase, leakage of leachate could cause changes to groundwater quality. Examples of design features and mitigation implemented to limit these potential effects to geology and hydrogeology include:

- physical changes to the bedrock from blasting will be limited to the local area within the engineered containment mound footprint;
- the base liner design includes both primary and secondary liner systems that are designed to have redundancy in case of premature failure and are designed to be suitable for the disposal of low-level waste; and
- implementation of the *Surface Water Management Plan* developed for the NSDF Project, which includes appropriate management techniques for erosion and sediment control.

The residual effects of the NSDF Project on geology are related to changes in soil quantity and quality and geomorphology as a result of construction of the NSDF Project, and changes to soil quality from blasting activities and air emissions. Mitigation and environmental design features implemented for the NSDF Project are well understood and include existing practices at the CRL site. Consequently, **changes in geology are not expected to result in significant adverse effects to other valued components (e.g., terrestrial environment)**.

The residual effects of the NSDF Project on hydrogeology are related to the alteration of groundwater levels and flows due to the construction of the NSDF Project, and potential changes to groundwater quantity and quality due to leakage from the engineered containment mound post-closure. Residual effects to groundwater from leakage of leachate from the engineered containment mound during the closure and post-closure phases are not anticipated due to the implementation of environmental design features, mitigation and operational monitoring plans. Changes in groundwater quality and quantity were provided to other disciplines for inclusion in their assessment (e.g., human health and ecological health). Overall, **changes in groundwater quality and quantity are not expected to result in significant adverse effects to other valued components (e.g., aquatic environment and human health).**

Operational monitoring will be implemented to verify effects predictions for geology. For example, visual inspections of surface water management systems will be completed to confirm erosion control measures are effective. Groundwater monitoring will be integrated into the overall CNL Groundwater Monitoring Program, and will be compliant with CSA Group standard *N288.7-15 Groundwater Protection Programs at Class I Nuclear Facilities and Uranium Mines and Mills*. Groundwater monitoring is intended to verify that the environmental assessment predictions on groundwater during the operations phase are accurate, and to verify the effectiveness of mitigation. Groundwater monitoring will continue through operations, closure and post-closure phase.

Surface Water Environment Assessment Results

The CRL site is located in the Allumette Lake and Lac Coulonge reach of the Ottawa River. The distance from the centre of the NSDF Project site to the closest point on the Ottawa River shoreline is approximately 1.1 km. The NSDF Project is located entirely within the Perch Creek and Perch Lake Watershed, which drain into the Ottawa River. Surface drainage from approximately 18% of the CRL site flows through Perch Creek and subsequently into the Ottawa River. The drainage basin slopes from a highpoint ridge along the eastern limit of the CRL site, westerly towards Perch Lake and the wetlands located on the western boundary. Surface water monitoring at on-site lakes and streams, off-site streams, and locations in the Ottawa River upstream and downstream of the CRL site is routinely conducted to describe the surface water quality, in accordance with CNL's *Environmental Monitoring Program*.

NSDF Project activities have the potential to change water levels, flows and channel and bank stability due to discharge of treated effluent and non-contact water into adjacent wetlands or downstream locations during operations. Also, the construction and installation of the engineered containment mound will physically alter drainage patterns, and intaking water from the Ottawa River could change its hydrology. Changes to local hydrology, discharge of treated effluent, air and dust emissions, surface water runoff, leakage of leachate or other releases of substances may cause changes to surface water quality at downstream locations.

Examples of mitigation practices implemented to limit predicted effects to surface water include:

- implementation of the *Surface Water Management Plan* developed for the NSDF Project, which includes appropriate management techniques to collect and direct surface drainage, including stormwater management ponds, and erosion and sediment control practices (e.g., silt fences, runoff management) will be used during construction around disturbed areas, where appropriate;
- treated effluent will be sampled to confirm it meets the effluent discharge targets before release; and
- the final cover system will be constructed to promote the shedding of surface water to mitigate infiltration into the mound and minimize leachate generation.

Residual effects to hydrology were identified because the installation of the engineered containment mound will physically alter drainage patterns and may change downstream discharge, water levels in adjacent wetlands, and channel and bank stability. Residual effects to surface water quality were predicted because discharge of treated effluent from the wastewater treatment plant to ground and to Perch Lake could cause changes to downstream surface water quality, and leakage of leachate from the engineered containment mound during the post-closure phase could cause changes to downstream surface water quality. Changes in hydrology and surface water quality were provided to other disciplines for inclusion in their assessment (e.g., aquatic biodiversity). Overall, **changes**

in hydrology and surface water quality are not expected to result in significant adverse effects to other valued components (e.g., aquatic biodiversity and human health).

Monitoring and follow-up programs for surface water hydrology will focus operational performance and environmental monitoring (e.g., monitoring of water levels in the stormwater management ponds to verify they are performing as designed). Stormwater management pond monitoring will be integrated into the NSDF Project *Environmental Protection Plan*, while water-level monitoring of the wetland system will be integrated into the current CNL Environmental Monitoring Program.

Routine surface water quality monitoring for the NSDF Project will be included in CNL's current Environmental Monitoring Program, which is compliant with CSA Group standard *N288.4-10 Environmental Monitoring at Class I Nuclear Facilities and Uranium Mines and Mills*. Effluent water quality from the surface water management ponds and wastewater treatment facility will be monitored in accordance with CNL's Effluent Verification Monitoring Program, which is compliant with the CSA Group standard *N288.5-11 Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*. Together, these programs will be used to verify environmental assessment predictions related to surface water quality, verify the surface water management ponds are performing as designed, and demonstrate compliance with effluent discharge targets developed for the NSDF Project. The water quality monitoring will continue through operations, closure and post-closure (institutional control).

Aquatic Environment Assessment Results

Aquatic habitat in the local study area is found largely in Perch Lake and Perch Creek. Several fish species have been identified in the Perch Creek and Perch Lake Watershed during field programs since the 1980s through 2018. Major changes to fish productivity and community structure over time have not been observed, suggesting that the historical effects of past operations on water quality pose minimal risk to the fish community and populations in Perch Lake. Specifically, Perch Lake continues to support a large-bodied fish community that includes yellow perch, brown bullhead and pumpkinseed. Based on historical reports of fish sampling in the Ottawa River, four fish species of conservation concern occur or have the potential to occur in the river reach adjacent to the CRL site (e.g., Allumette Lake). These species include lake sturgeon, American eel, river redhorse and northern brook lamprey. To the north of Perch Lake are extensive wetlands, notably Perch Lake Swamp, South Swamp and East Swamp. The fish habitat potential of wetlands such as Perch Lake Swamp and East Swamp is predicted to be low.

The potential for effects to aquatic biodiversity are primarily related to changes in groundwater, surface water, and air quality. NSDF Project activities have the potential to affect water levels, flows, water quality and therefore fish habitat quality, and fish survival and reproduction. Activities that could affect fish habitat quality include changes to local hydrology, installation of treated effluent transfer line, discharge of treated effluent, leakage of leachate, release or deposition of harmful substances into downstream waterbodies, and physical changes to fish habitat (e.g., riparian areas). As well, blasting near fish-bearing waterbodies may result in pressure changes, vibrations and affect fish survival and reproduction. Examples of mitigation practices implemented to limit predicted effects to aquatic biodiversity include:

- work will be completed within the in-water work timing window to avoid spawning and egg/larval development periods for spring spawning fish species;
- runoff will be managed to avoid adverse environmental effects in downstream waterbodies; and

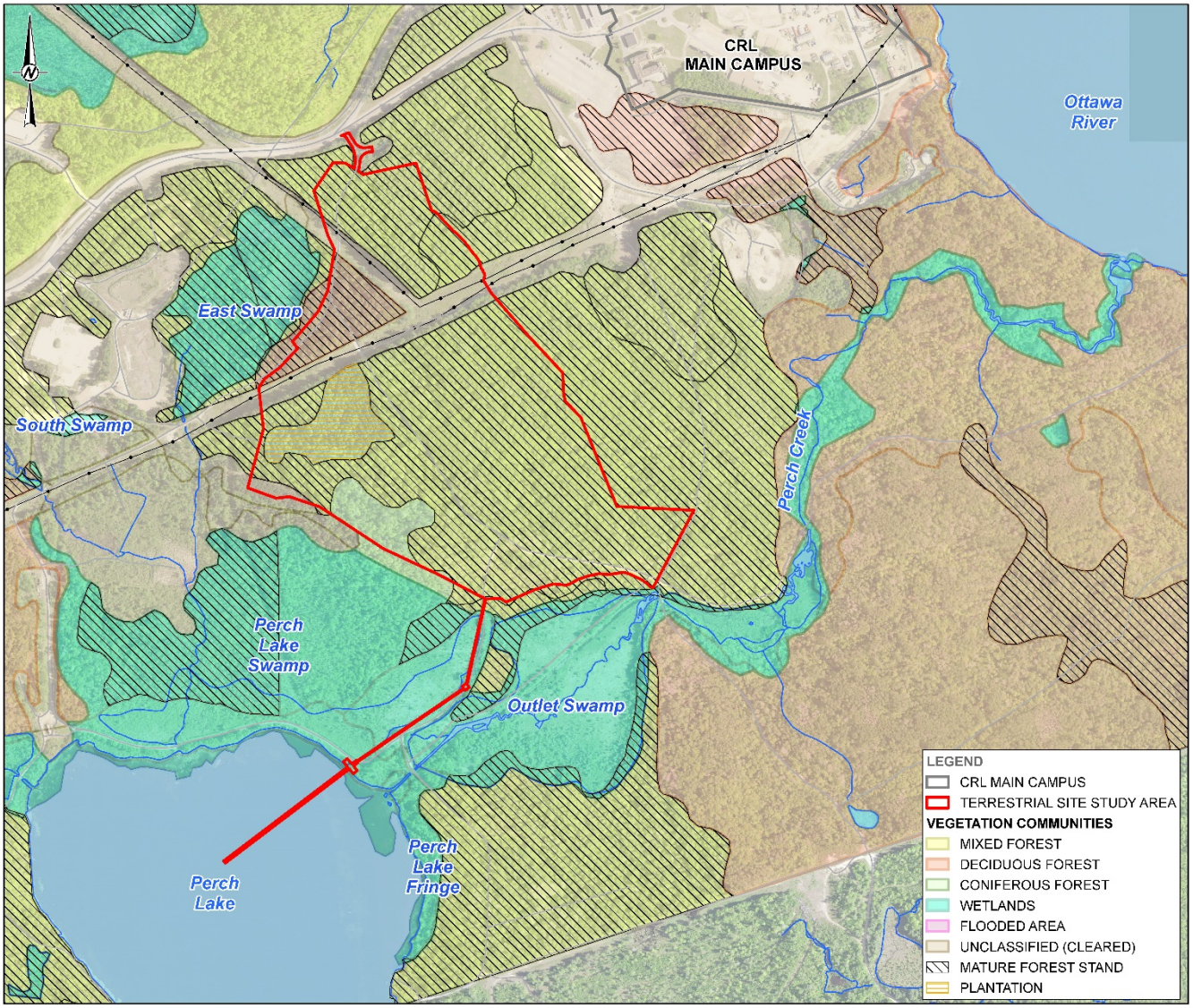
- clearing of any riparian vegetation and organic materials will be minimized. Disturbed riparian areas and shorelines will be re-vegetated and restored to the original stable gradient and contour.

Mitigation and environmental design features implemented for the NSDF Project are well-understood and include existing practices at the CRL site. Therefore **residual effects from the NSDF Project on aquatic biodiversity are not significant.**

As mentioned above for surface water, planned monitoring will include routine monitoring of surface water quality which are protective of aquatic biodiversity. If the environmental monitoring program for surface water quality identifies that adverse environmental effects are greater than predicted, then CNL will evaluate the need for revised mitigation actions and management practices to manage effects related to aquatic biodiversity.

Terrestrial Environment Assessment Results

The CRL site is characterized by deciduous and coniferous forest and the Ottawa River. The NSDF Project is in a primarily undisturbed area adjacent to heavily disturbed areas, including the CRL main campus and various waste management areas. The area is a mix of forested vegetation communities and wetlands (South Swamp, East Swamp, and the marsh wetlands) surrounding Perch Lake and Perch Creek. The area provides suitable habitat for numerous migratory birds, including species at risk such as the Canada warbler, eastern whip-poor-will, eastern wood-pewee, golden-winged warbler and wood thrush. Likewise, the area provides suitable habitat for several wildlife species of mammals, reptiles, amphibians and invertebrates including species at risk such as bats (little brown myotis, northern myotis and tri-colored bat), Blanding's turtle, eastern milksnake, and monarch butterfly.



NSDF Project activities during all phases include activities (e.g., vegetation clearing and grubbing, use of heavy equipment, and discharge of treated effluent) that have the potential to cause losses or alteration of some vegetation and wetland communities and potentially change wildlife habitat availability, use and connectivity, and could influence wildlife abundance and distribution, or survival and reproduction. Activities that cause changes to other valued components, such as surface water quality, soils and vegetation communities (including wetlands), could in turn affect wildlife habitat availability and distribution, and survival and reproduction. Construction activities could also result in injury or mortality to wildlife. These effects may apply to terrestrial species at risk and their habitats as well.

Examples of mitigation practices implemented to limit predicted effects to terrestrial biodiversity include:

- avoiding conducting activities with highest levels of noise and habitat disturbance during most sensitive life history phase (i.e., breeding and nesting for birds) to avoid effects on nesting birds;

- a comprehensive Sustainable Forest Management Plan will be implemented at CRL to ensure the long-term retention of trees serving as maternity roosts for bat species; and
- CNL is currently implementing a detailed Blanding's Turtle Road Mortality Mitigation Plan to eliminate road mortality at CRL and increase connectivity between habitats. This existing plan will continue to be implemented during the NSDF Project.

The assessment predicted residual effects to vegetation communities (including wetlands), Canada warbler, eastern whip-poor-will, eastern wood-pewee, golden-winged warbler, wood thrush, bats, Blanding's turtle, eastern milksnake and monarch butterfly. The residual effects to vegetation are due to loss of forest, change to forest distribution and edge effects. The residual effects to wildlife species primarily result from loss of suitable habitat (e.g., due to clearing), avoidance due to sensory disturbance (e.g., noise), change in movement of wildlife species, risk of injury or mortality (e.g., on roads due to traffic). With the implementation of appropriate mitigation, **residual effects of the NSDF Project on the terrestrial environment (vegetation communities and wildlife species) are not significant.**

Monitoring and follow-up programs are recommended for Canada warbler, eastern whip-poor-will, eastern wood-pewee, golden-winged warbler, wood thrush, bats, Blanding's turtle and eastern milksnake. These will be integrated into CNL's existing *Species at Risk Program* and will be used to confirm the predictions made in the terrestrial biodiversity assessment, including the effectiveness of mitigation. Monitoring will be ongoing during the construction and operations phases, and closure where appropriate.

Ambient Radioactivity and Ecological Health Assessment Results

Background radiation and radioactivity is present in the environment due to natural and anthropogenic (human-made) sources, as well as legacy operations at the CRL site. The main natural sources of radiation are cosmic rays; naturally occurring radionuclides in air, water and food; and naturally occurring radionuclides in the soil, rocks and building materials used in homes. Some radionuclides released from CRL are already present in environmental media due to natural and anthropogenic sources. The CRL *Environmental Monitoring Programs* includes sampling and analysis of surface water, groundwater, sediment, soil, vegetation, ambient air, milk, garden produce, game animals, farm animals and fish at the CRL site boundary and at relevant off-site locations. Environmental concentrations are compared to expected background levels or measurements of samples to distinguish the effect of CRL operations from radiological contamination that is present due to other sources.

NSDF Project activities have the potential to affect ecological health during the operations and closure phases through the release of dust when handling bulk materials, emissions of gases during storage and disposal of radioactive materials, and changes to groundwater quality and downstream surface water quality. As well, effects could result from the release of volatiles or leakage of leachate during the post-closure phase. The robust NSDF design provides containment for hundreds of years allowing for radiologic decay of the waste inventory. Once the NSDF engineered barriers degrade, after 550 years, the levels of radioactivity released to the environment is quite small.

Controls will be in place to minimize the generation of wastewater in the engineered containment mound. For example, waste will be covered as each disposal cell is filled. A wastewater treatment plant has been designed to remove both radiological and chemical contaminants. Through pilot testing CNL has demonstrated that the effluent discharge targets which are protective of the public and the environment can be achieved. Furthermore, the plant

is designed for batch releases, which means all treated effluent must be sampled and proven to meet targets before discharge to the environment.

During the operations and closure phases, airborne emissions are negligible, and waterborne emissions result in environmental concentrations that are below levels that would result in potential adverse effects on aquatic life. During the post-closure phase, airborne and waterborne releases are below the dose benchmark values during the post-closure period. Therefore, **residual effects of the NSDF Project on ambient radioactivity and ecological health are not significant.**

Monitoring air quality (i.e., dust), treated effluent, ambient radioactivity and groundwater for the NSDF Project will be integrated into CNL's existing Environmental Monitoring Program, Groundwater Monitoring Program, and Effluent Verification Monitoring Program, as well as NSDF-specific environmental monitoring activities. For example, the Effluent Verification Monitoring Program includes continuous monitoring of airborne radiological particulates from applicable operational facilities on the CRL site. These programs will verify effects predictions for ecological health and effectiveness of mitigation. Monitoring will be ongoing during operations, closure and during the institutional control period as needed based on annual reviews of monitoring data.

Human Health Assessment Results

Radiation occurs naturally from cosmic and terrestrial sources as well as from anthropogenic materials, independent of CRL operations. Natural background radiation can vary depending on location and within Canada the average dose from natural background radiation is 1.8 mSv in a year (mSv/yr). The Canadian regulations for radiation protection also set limits to the amount of radiation the public or nuclear energy workers may receive from licensed activities to manage nuclear substances. In Canada that public dose limit is 1 mSv/yr and the dose limit for a nuclear energy worker is 50 mSv/yr.

Access to the CRL is restricted however the public may receive a dose as a result of potential waterborne or airborne emissions from the NSDF Project. Dose to the public from waterborne emissions is calculated during the operations phase, as well as during the post-closure phase for the NSDF Project. CNL limits public dose through the establishment of effluent discharge targets, which are protective of the public's drinking water and based on Health Canada Drinking Water guidelines. Airborne releases of dust are controlled during operations thus mitigating airborne releases. The dose consequences to public during the operations phase is expected to be negligible and is almost 50 times lower than the regulatory public dose limit of 1 mSv/yr. Dose to the public during the post-closure phase was calculated by conservatively assuming a resident farmer with a family directly on the engineered containment mound thus interacting with any potential contamination released from the facility. However, the robust NSDF design provides containment for hundreds of years allowing for radiologic decay of the waste inventory. Once the NSDF engineered barriers degrade, after 550 years, the levels of radioactivity released to the environment is quite small. Even during the most disruptive events, such as unintentional intrusion, the radiological dose to a member of the public is more than 60 times lower the current regulatory public dose limit of 1 mSv/yr thus **residual effects from the NSDF Project on the public health are not significant**.

Radiological dose to an on-site worker will mainly occur during the operational phase as the result of carrying out tasks related to the placement of waste and activities within the wastewater treatment plant. Doses to the on-site worker are the result of potential exposure to contamination within the waste and utilizing radiation protection principles are kept as low as reasonably achievable. For the on-site worker, the maximum estimated dose is 5

times lower than the regulatory nuclear energy worker limit of 50 mSv/yr, thus **residual effects from the NSDF Project on worker health are not significant**.

Monitoring of airborne and waterborne emissions at the CRL site is conducted under CNL's Effluent Verification Monitoring Program, which is compliant with the CSA Group standard *N288.5-11 Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*. Air and water quality monitoring for the NSDF Project is intended to verify that mitigation is being implemented effectively and to verify predictions for public health. Radiation dose monitoring for nuclear energy workers will verify predictions for worker health.

Land and Resource Use Assessment Results

The NSDF Project is located entirely within the CRL site, on federal lands. Aside from the operations and activities undertaken by CNL, other land uses of the CRL site are prohibited due to restricted public access. The Project area is bordered by the remaining CRL site to the north, east and west, the Garrison Petawawa (which is another federal land with restricted public access) to the south, and the Ottawa River to the northeast. Therefore, there are limited land and resource uses that have the potential to be disturbed by the NSDF Project. The adjacent Ottawa River is valuable for recreational and tourism-based fishing industries; however, the NSDF Project will have no interaction with recreational activities taking place on the Ottawa River, as the NSDF Project will occur within a restricted area. Potential trapping has been identified as in the southern and western portions of the study area outside the boundary of the CRL site.

An archaeological assessment for the NSDF Project was conducted. The areas of archaeological potential identified have been fully excavated and documented to the extent required under the *Standards and Guidelines for Consultant Archaeologists*. No cultural heritage value or interest remains and the locations have been fully documented; therefore, no further archaeological work is required.

NSDF Project activities have the potential to affect land and resource tenures and other registered interests (i.e., land use designations, mining and aggregates, forestry and agriculture), outdoor tourism and recreation (i.e., parks and protected areas, fishing, hunting, trapping and non-consumptive tourism and recreation), during the construction and operations, closure, post-closure phases as a result of change in access or opportunities for these activities. In addition, there is potential for unanticipated archaeological sites to be affected during construction. Examples of mitigation practices implemented to limit potential effects to land and resource use include:

- CNL will consult with trappers about their use of the surrounding areas for trapping activities and to understand any concerns; and
- implementation of CNL's Cultural Resource Management Program to identify unanticipated archaeological resources and implement adaptive management.

The NSDF Project is not predicted to have any terrestrial effects beyond the CRL site, and results of the aquatic environment assessment identified only negligible residual effects on aquatic biodiversity valued components as a result of the NSDF Project. Access along the Ottawa River will continue to occur and not be restricted because of the NSDF Project. No effect to archaeological resources is identified as most mitigation for archaeological resources are applied and completed in advance of ground disturbance activities. **The assessment concluded that no residual effects on land and resource use are anticipated as a result of the NSDF Project.**

Monitoring and follow-up programs are not specifically identified for land and resource use; however, monitoring for environmental pathways (i.e., for air quality, surface water quality and groundwater quality) will be integrated into CNL's existing Environmental Monitoring Program. The programs will be used to verify effects predictions for land and resource use, and to promote land user comfort with regard to the safety of the surrounding areas for traditional land use, outdoor tourism and recreation, and commercial (i.e., tenured) land use activities. Monitoring will be ongoing during operations, closure and post-closure (institutional control) as needed based on annual reviews of monitoring data.

Socio-economic Environment Assessment Results

The NSDF Project is located on the CRL site in Renfrew County, approximately 12 km southeast of the Town of Deep River, 9 km northwest of the Garrison Petawawa, and 7 km east of the Village of Chalk River. The two largest employers within the vicinity of the NSDF Project are Garrison Petawawa and CNL. As of May 2019, CRL employed approximately 2,850 people. Future economic growth and development opportunities are a key concern for communities in the area. The major arterial Highway that connects the NSDF Project to the local communities and other regions of Ontario is Highway 17, which is the longest highway in Ontario. In 2010, annual average daily traffic counts found that traffic levels between the Village of Chalk River and Deep River ranged from 6,700 and 8,150 vehicles per day. A study of the existing traffic to and from the site indicated that the traffic volumes were between 700 and 800 vehicles during peak hours in the morning and afternoon. The nearest hotel or motel accommodations are available in the Town of Deep River, Petawawa and Pembroke.

NSDF Project activities have the potential to affect employment and income, economic development and government finances through the employment of personnel, procurement of goods and services, and expenditures. Similarly, the NSDF Project may affect housing and accommodation, services and infrastructure, quality of life, and public safety through the employment of personnel, and use of services and infrastructure for NSDF Project. Examples of mitigation practices implemented to limit predicted residual effects to socio-economic valued components include:

- CNL will competitively procure material and services for the NSDF Project;
- continued implementation and maintenance of compliance with all applicable health and safety standards and CNL's existing environmental, safety and security programs; and
- coordinate transportation of construction materials during construction phase to minimize overlap with peak employee traffic times.

Positive residual effects to the socio-economic environment were identified, primarily from activities that occur during the construction phase, because the NSDF Project could provide employment of personnel in the region, provide contracting and supplier opportunities to local and regional businesses, and some use of services such as commercial accommodations. Therefore, **residual effects of the NSDF Project on the labour market, economic development, and housing and accommodation are positive**, and significance is not determined.

On the other hand, the NSDF Project may negatively increase pressure on commercial accommodations, increase public transportation and road degradation, and change demand for community services (health, education, protective and emergency services). For these adverse effects, with the implementation of appropriate mitigation, **residual effects of the NSDF Project on housing and accommodation, and services and infrastructure are not significant.**

Monitoring and follow-up programs are not specifically identified for socio-economics; however, monitoring for environmental pathways (i.e., for air quality, surface water quality and groundwater quality) will be integrated into CNL's existing Environmental Monitoring Program to verify effects predictions. In addition, recognizing people's interest in understanding and participating in decisions that affect them, CNL will proactively seek, engage, and support meaningful discussion on issues and opportunities related to the NSDF Project as part of the Public Information Program. CNL will continually evaluate both the process and the outcome of the ongoing engagement and communication activities to address and manage issues as they arise. This will be ongoing during construction, operations, closure phases, as needed based on annual reviews of monitoring data. The level and nature of engagement with the communities will depend on feedback received.

Indigenous Interests

The closest Indigenous community is the Algonquins of Pikwakanagan, located at Golden Lake, approximately 50 km southeast of the CRL site. The Algonquins of Pikwakanagan First Nation are part of the larger Algonquins of Ontario organization, which has reached an Agreement-In-Principle with the Governments of Ontario and Canada regarding a land claim in the Ottawa Valley, which they consider their traditional homelands. The area that is subject of the Algonquin claim in Ontario includes the National Capital Region, all of Renfrew County and most of Algonquin Park, which is a provincial park. In addition, the CRL site falls within the Métis Nation of Ontario's Ottawa River traditional harvesting territory. As such a separate assessment was completed to determine the potential effects the NSDF Project has on Indigenous traditional land and resource use as well as the Indigenous socio-economic environment and Indigenous health. This assessment was informed by CNL's engagements with Indigenous peoples as well as available Traditional Knowledge and Land Use Studies that have been conducted.

The NSDF Project is located entirely within the CRL site boundary, on federal lands. Therefore, aside from the operations and activities undertaken by CNL, other land uses of the CRL site are prohibited due to restricted public access. The NSDF Project is not predicted to have any terrestrial effects beyond the CRL site, and results of the aquatic environment assessment identify that measurable residual effects on aquatic biodiversity are not predicted as a result of the NSDF Project. Traditional access to the Pointe au Baptême site along the Ottawa River will continue to occur and will not be restricted because of the NSDF Project. There are no effects anticipated to archaeological resources as most mitigation for archaeological resources is applied and completed in advance of ground disturbance activities. Consequently, the **residual effects from the NSDF Project on traditional land and resources use are not significant**.

Indigenous socio-economic valued components were selected based on the potential for the NSDF Project to interact with the features of the Indigenous socio-economic environment, and consist of:

- decision-making;
- population and demographics;
- economy and employment;
- housing and infrastructure; and
- Indigenous resident – use and enjoyment of private property.

The assessment determined there were no direct impacts from the NSDF Project however indirect impacts may be related to employment, contracting and supplier opportunities and potential noise and air quality effects related to construction activities. Consequently, the **residual effects from the NSDF Project on the Indigenous socio-economic environment are not significant**, and in the NSDF Project may result in small positive effects to local Indigenous groups or people through potential contracting or employment opportunities.

Indigenous peoples have expressed a general concern about the potential effect of the NSDF Project on their health. This has partially arisen from the view that they have a greater degree of reliance on foods obtained from traditional land and resource use than the general public. To address potential future safety concerns of Indigenous peoples, the NSDF Project conservatively calculated the dose to self-sufficient Indigenous peoples physically located at the NSDF site and completely reliant on local traditional food. The estimated radiological dose to Indigenous peoples is more than 13 times lower the current regulatory dose limit of 1 mSv/yr thus **residual effects from the NSDF Project on the indigenous health are not significant**.

Monitoring of airborne and waterborne emissions at the CRL site is conducted under CNL's Effluent Verification Monitoring Program, which is compliant with the CSA Group standard *N288.5-11 Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*. Air and water quality monitoring for the NSDF Project is intended to verify that mitigation is being implemented effectively and to verify predictions for traditional land and resource as well as Indigenous health. Additionally, CNL's robust environmental protection program will be used to identify unanticipated archaeological resources and implement adaptive management.

Recognizing Indigenous people's interest in understanding and participating in decisions that affect them, CNL will proactively seek, engage and support meaningful discussion on issues and opportunities related to the NSDF Project through Indigenous engagement activities. CNL will continually evaluate both the process and the outcome of the ongoing engagement and communication activities to address and manage issues as they arise.

Accidents and Malfunctions

To identify potential accident and malfunction events during the construction and operation phases, as well as their potential health and environmental effects that may occur, the NSDF Project used a systematic and comprehensive approach. Credible events were identified through a review of project activities to identify hazards, which were assigned frequency, severity and risk rankings. The bounding or key potential accidents and malfunctions during the operations of NSDF include:

- dropped load during waste placement which could result in the potential spread of contamination;
- dropped load during wastewater treatment operations (i.e. dewatering of filter press) which could result in the potential spread of contamination;
- fire within the engineered containment mound resulting in the ignition of combustible waste which could result in an airborne release;
- fire within the wastewater treatment plant, such as from flammable gas, which could result in an airborne release; and
- spill of contaminated resin during the wastewater treatment operations which could result in the potential spread of contamination.

Each of these accident and malfunction events underwent an analysis to determine the dose estimate for the on-site workers as well as the public. The assessment considered both radiological and non-radiological contaminants. The dose consequences to the on-site workers and the public for all potential accidents and malfunctions meet the respective regulatory limits thus **residual effects from accidents and malfunctions of the NSDF Project are not significant**.

Conventional occupational hazards are anticipated to be typical of major construction project and evaluated to be controlled by human performance, thus provisions including training, procedures and oversight of contractors are in place by CNL to achieve as-low-as-reasonably possible accident and malfunction rates.

If an accident or malfunction situation occurs, CNL has procedures in place that address requirements for immediate response and post-event clean-up or remediation.

Effect of the Environment on the Project Assessment Results

In addition to assessing the effects the NSDF Project potentially has on the environment, the EIS also takes into account how the environment could adversely affect the NSDF Project. This included an evaluation of how climate change, severe weather and other environmental events may interact with and potentially alter the condition and function of the NSDF Project, such that these events result on effects on the environment or public safety. Due to the recognized long timeframe of the NSDF Project as a permanent disposal facility for low-level waste, the magnitude and severity of environmental events were taken into account. For example, natural hazards such as extreme weather caused by climate change, flooding, tornados, forest fires, seismic events and glaciation were all assessed.

To ensure the effects on the environment are minimized, the design basis of the NSDF accounts for the expected environmental conditions of the site. Some of the events considered and the design features which mitigate against their consequences include:

- Extreme rainfall events are considered in the design of the wastewater collection and treatment systems. The storage capacity and maximum flow rate of the wastewater treatment plant was based on two back-to-back 100 year, 24-hour storm events. Within the engineered containment mound stormwater features such as drainage, ditches, culverts and surface water management ponds have been designed appropriately for peak flows that accounted for climate change.
- Flooding of the Ottawa River as well as nearby creeks and wetlands has been taken into consideration in the siting of the NSDF Project. The base of the proposed NSDF is located approximately 163 meters above sea level which is approximately 50 meters above the current water levels of the Ottawa River. Other design features provide additional mitigation to flooding including the topographical slopes of the engineered containment mound.
- Significant seismic events and the potential for damage to the safety features is considered in the design of the engineered containment mound. The design of the engineered containment mound is robust enough to withstand significant seismic events beyond what have been recorded for the Ottawa Valley (i.e. once in 10,000 years). The use of earthen materials and specifications for waste material placement and compaction are part of the design basis of the engineered containment mound that provide the necessary structural stability. The wastewater treatment plant and other infrastructure required only for the operations phase have

followed current national building codes and will withstand typical seismic events for the Ottawa Valley (i.e. once in 2,475 years).

- Tornadoes are recognized as a hazard to the facilities on the CRL site, including the NSDF Project. It is acknowledged the NSDF Project is in a geographical area that could reasonably expect a tornado strike thus the design of the wastewater treatment plant and other infrastructure will be constructed robust to withstand potential tornadoes and high winds. The effects of a tornado or extreme winds on the engineered containment mound are expected to have negligible consequences.

Since the next predicted glaciation event may not occur until 100,000 years into the future, far beyond the hazardous lifetime of the NSDF inventory, an assessment of the consequences as the result of glaciation was not warranted. The NSDF Project incorporates design features to minimize its effect on the environment during facility operation as well as into the post-closure phase thus residual effects from the effects of the environment on the NSDF Project are not significant.

If an extreme environmental event occurs, CNL has procedures in place that address requirements for immediate response and post-event clean-up or remediation.

Monitoring and Follow-up Programs

A conceptual follow-up and monitoring program was developed to verify that mitigations are being implemented effectively and to confirm environmental assessment predictions. This plan provides a preliminary description of the activities and framework for monitoring proposed for the NSDF Project. The details of this program will be further developed into detailed monitoring and follow-up programs as the environmental assessment process continues, with input from the public, Indigenous peoples and regulatory agencies.

If an environmental monitoring and follow-up program identifies that adverse environmental effects are greater than predicted, then CNL will evaluate whether they result in changes to the conclusions in this EIS. If changes are confirmed, then CNL will evaluate the need for revised mitigation actions and management practices to manage effects. CNL's evaluation process for monitoring data include environmental performance criteria that are based on statistical measures and ecological health benchmarks.

Conclusion

This EIS describes the NSDF Project and the existing environmental conditions on the CRL site, and assesses the likely effects of the NSDF Project on the environment. The EIS also includes an assessment of likely cumulative effects of the NSDF Project in combination with other previous, existing or reasonably foreseeable developments, as required. It describes the effects for normal conditions and as a result of accidents and malfunctions. The EIS also describes and assesses the likely effects of the environment on the NSDF Project. Throughout the environmental assessment process, CNL has solicited input from the public and Indigenous peoples and incorporated this feedback into the EIS where appropriate. Examples of this include changes to the waste inventory (i.e., only low-level waste) and expansion of the EIS study areas to include a larger downstream portion of the Ottawa River. Further, CNL is working to develop long-term relationship agreements with Indigenous peoples to work collaboratively to meet the needs of the individual communities in the context of the NSDF Project as well as the broader operations of CRL into the future.

The development of a near surface disposal facility for low-level waste at the CRL site will reduce potential risks associated with AECL's legacy wastes liabilities. The NSDF Project will enable the remediation of historically contaminated lands and legacy waste management areas, as well as decommissioning of outdated infrastructure to facilitate the CRL site revitalization. The current CRL waste management practice is to safely store radioactive waste on-site in individual facilities in accordance with current licence conditions. However, appropriate nuclear waste management includes full life cycle management from generation to disposal. The NSDF Project will accommodate the permanent disposal of current and future low-level waste at the site. The EIS demonstrates that the NSDF Project can be constructed, operated and closed in a manner that is protective of human health and the environment.

Residual adverse effects were identified for air quality, greenhouse gases, hydrogeology, hydrology, surface water quality, terrestrial biodiversity ecological health, human health and socio-economics (housing and accommodations, and services and infrastructure). Beneficial effects were identified for socio-economics (labour market, economic development, Indigenous). CNL has proactively addressed key issues raised by interested Indigenous peoples, using open and transparent communication to share information in regard to traditional land use, biodiversity and archaeology. Overall, it is CNL's conclusion that with the identified mitigation, the implementation of **the NSDF Project is not likely to result in significant residual adverse effects**.

All predicted effects for human health are well below regulatory criteria during the life of the NSDF Project, including post-closure. The maximum estimated dose during the operations period for an on-site worker is 5 times lower than the regulatory limit of 50 mSv/yr and for the public is almost 50 times lower than the regulatory dose limit of 1 mSv/yr. During post-closure, the maximum estimated dose associated with the most likely future state of the facility is more than 60 times lower than the regulatory dose limit of 1 mSv/yr. Residual effects on Ottawa River water quality are determined to be negligible during operations and post-closure phases and may result in a net benefit due to remediation of legacy waste storage areas.

Potential effects of the NSDF Project on the environment are limited because the NSDF Project has been designed in consideration of site-specific characteristics and to be suitable for the proposed inventory, the vast majority of which are comprised of impacted soils and demolition debris. The engineered containment mound is designed to contain and isolate the wastes from the environment for 550 years. Since the NSDF only accepts low-level waste and most of the radioactivity, thus, the hazard, decays in the first 100 years after closure, the design of the NSDF is commensurate with the hazard. The safety of the NSDF during post-closure is provided by means of passive features (e.g., berm, base liner and cover systems) that will end the need for active management, in alignment with regulatory requirements and international nuclear industry guidance.

A conceptual follow-up and monitoring program was developed to verify that mitigation is being implemented effectively and to confirm environmental assessment predictions. The details of this program will be further developed into detailed monitoring and follow-up programs as the environmental assessment process continues, with input from the public, Indigenous peoples and regulatory agencies. The facility will be a licenced nuclear facility under the *Nuclear Safety and Control Act* with regulatory oversight as long as required.

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