August 17, 2017

From: Gavin Battarino (Ontario Ministry of the Environment and Climate Change)

To: Nicole Frigault, Environmental Assessment Specialist
Canadian Nuclear Safety Commission

By email: cnsc.ea-ee.ccsn@canada.ca

Ontario Ministry of the Environment and Climate Change _ Comments on the draft EIS for the Proposed Near Surface Disposal Facility Project

CEAA Reference number: 80122

Ms. Nicole Frigault,

On behalf of the Ontario Ministry of the Environment and Climate Change please find attached a cover letter and appendices summarizing the ministry's review of the draft Environmental Impact Statement for the proposed Near Surface Disposal Facility Project at Chalk River Laboratories site.

Should you have any questions or concerns please let me know

Thank you,

Gavin Battarino, Special Project Officer
Environmental Approvals Branch
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Ministry of the Environment and Climate Change
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August 14, 2017

MEMORANDUM

TO: Ms. Nicole Frigault
Environmental Assessment Specialist
Canadian Nuclear Safety Commission

FROM: Mr. Paul Nieweglowski
Assistant Deputy Minister
Ministry of the Environment and Climate Change

RE: Near Surface Disposal Facility Project – Public Comment Period on Canadian Nuclear Laboratories' Draft Environmental Impact Statement

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On behalf of the Ontario Ministry of the Environment and Climate Change (ministry) I would like to thank you for the opportunity to review the draft Environmental Impact Statement (EIS) for the proposed Near Surface Disposal Facility Project at Chalk River Laboratories site. I am pleased to provide you with the conclusion of this review.

As the proposed project is situated on federal lands there are no provincial environmental approvals or legislative requirements for this project. Although the proposed project is not subject to provincial legislation, the ministry review has identified that the primary contaminant transport mechanism for the proposed project is groundwater discharging to the on-site surface water features. The ministry has therefore focused on a technical review of the draft EIS to assess whether the proposed project may have any potential impacts to local groundwater and surface water quality on neighbouring provincial lands.

Please find attached for your consideration the following Appendices that summarize the ministry's comments pertaining to its review of the draft EIS:

- Appendix A: Eastern Region Technical Support Section Groundwater Comments
- Appendix B: Eastern Region Technical Support Section Surface Water Comments

In moving forward, the ministry recommends that additional information be provided related to the following:

- The stormwater management features of the project site;
- The effluent quality and discharge of the Wastewater Treatment Plant; and,

- The consideration be given to ensuring that the proposed project is assessed against the Province of Ontario's applicable standards and guidelines related to surface water.

I would kindly ask that you please continue to keep this ministry appraised of any developments related to the proposed project. Should you have any questions or concerns please feel free to contact Mr. Peter Taylor, Technical Support Section Manager with the ministry's Eastern Region Office, at 613-540-6884 or by e-mail at peter.g.taylor@ontario.ca.

Yours sincerely,

Signature redacted

Paul Nieweglowski
Assistant Deputy Minister
Ministry of the Environment and Climate Change

Attachment(s)

Ministry of the Environment and Climate Change

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M E M O R A N D U M

July 13, 2017

TO: Peter Taylor
Manager
Technical Support Section
Eastern Region

FROM: Lauren Forrester
Surface Water Specialist
Technical Support Section
Eastern Region

RE: Environmental Impact Statement
Near Surface Disposal Facility, Chalk River Laboratories
Deep River, Renfrew County, Ontario

The subject Environmental Impact Statement (Volumes 1 and 2, Revision 0) was prepared by Golder Associates, dated March 2017, on behalf of Canadian Nuclear Laboratories (CNL) with respect to the proposed construction of a Near Surface Disposal Facility (NSDF) at Chalk River Laboratories (CRL). I offer the following comments, relating to surface water matters only.

I defer to subject matter experts on all matters relating to engineering and radiological assessments (i.e. dose assessments and behaviour of radionuclides in the proposed containment mound and the environment) as these matters are beyond the scope of my expertise.

Background

The purpose of the project is to dispose of up to 1,000,000 cubic metres of solid radioactive waste from legacy waste management areas, current operations, and future environmental remediation and decommissioning projects at CRL, with the overall intent of reducing the risks associated with CNL legacy wastes and liabilities, and to create conditions for revitalization of property. The project is intended to provide for safe, permanent disposal of low level waste (LLW), a small amount of Intermediate Level Waste (ILW) (1% by volume), and mixed wastes. This will permit direct waste disposal, as opposed to the current practice of interim waste storage. Only a small percentage of the waste to be placed on-site is expected to be from off-site sources.

The report outlines the consideration of alternatives with respect to facility type, design of near surface options, facility location, site selection and leachate treatment system.

SUMMARY OF COMMENTS AND RECOMMENDATIONS:

While I agree that, in principle, the NSDF Project should be expected to reduce the potential risks associated with the CNL legacy wastes and liabilities as they relate to surface water, based on my review of the EIS (Rev. 0), I do not feel that the potential impacts to surface water have been adequately assessed. Important information gaps are described below.

- The proposed surface water management system (including non-contact stormwater and surface water runoff) is described as being designed to control runoff rates to pre-construction levels during the post-closure period. The report is silent on anticipated runoff rates during the construction and operational phases. In addition, the modelled runoff rates appear to indicate a marked increase in flow to the East Swamp Wetland from SWMP 1 and a small increase in runoff from the NSDF Project site as a whole.

  There is a need to evaluate runoff rates during construction and operation and confirm that flows will be controlled to pre-development levels through all phases of the proposed project. Additional runoff control measures may be needed to ensure that the project does not result in erosion in the receiving watercourses, specifically the East Swamp Wetland and Stream (known contaminated areas).

- The reviewer encourages consideration of enhanced level treatment (80% TSS removal) for all SWMP to better protect water quality, both in terms of potential sedimentation in receiving watercourse and protection of water quality with respect to contaminants that may be transported with sediments (e.g. metals, nutrients, PCBs), which are known to occur at high concentrations on the CRL property.

- Modelling work undertaken to predict water quality impacts appears to under-represent possible treated effluent concentrations for non-radiological parameters. The model appears to reflect only the effect of high quality effluent (based on predicted removal rates). Treatment Targets identified are notably higher than effluent concentrations input to the model, which reflect concentrations predicted from pilot scale studies. Effluent limits have not been provided for review, nor do model results appear to reflect those limits. The reviewer is not confident that the worst foreseeable effluent quality has been considered in assessing the possible impacts of the proposed discharge.

  The lack of discussion of possible impacts and/or cumulative effects from other potentially toxic or hazardous contaminants that may occur in leachate, but not included in the model, is also a concern.

- Predictions of radiological and non-radiological parameter concentrations in receiving waters in the operational phase appear to rely heavily on average conditions (i.e. average flows in the receiving waterbodies, average effluent volumes, and average precipitation / predicted leachate generation rates), and fail to capture the effect of low flow conditions on assimilative capacity or the effect of higher rates of effluent discharge.

- Background water quality information for some constituents of possible concern is lacking. In addition, summary tables provided in Appendix 5.4-2 (representing background water quality) appear to contain many errors and should be reviewed for completeness and accuracy. Please see discussion below under *Surface Water Quality*. In addition, detection limits for some parameters are either not reported or do not permit comparison of background water quality to comparison to Provincial and Federal guidelines.

- In some cases, proposed Benchmark Values (BV) (which the reviewer understands to represent acceptable water quality for the CRL site) exceed applicable Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQG), Provincial Water Quality Objectives (PWQO) and/or Aquatic Protection Values. This office has not reviewed the documents under which these values were established and I am not a toxicologist, so cannot comment on their derivation but, relative to Provincial and Federal guidelines, I am not confident that all BV are protective of water quality or aquatic life. In addition, there is an apparent unit error also noted in the BV cited for Total Phosphorus (see details provided below).

- In some cases, Treatment Targets for effluent from the wastewater treatment plant exceed the Province's Aquatic Protection Values and may even exceed acute toxicity values (i.e. Cadmium, Treatment Target = 1.5 mg/L). Clarification is needed to confirm that discharge of effluent at concentrations reported as Treatment Targets will not result in adverse effects to the East Swamp Wetland and downstream waterbodies.

Surface Water Regime
The proposed Project Area is approximately 1 km from the Ottawa River (Allumette Lake and Lac Coulonge reach, between La Passe and Des Joachims Dams) and entirely within the lower Perch Lake Basin. Perch Lake drains to Perch Creek, which in turn flows to the Ottawa River, slightly over 2 km downstream. Water levels in the area of the Ottawa River that receives drainage from the site are regulated for hydroelectric power generation.

Both Perch Lake and Perch Creek are considered fish habitat, although features within Perch Creek may limit upstream movement of fish. Golder describes Perch Lake as a shallow, dystrophic-eutrophic lake with a surface area of approximately 45 hectares (ha). Average and maximum depth are 2 metres and 3.5 metres, respectively, with marked water level drop through the dry season (0.25 m). Perch Lake Marsh abuts and extends into the lake as an open marsh. There are also extensive wetlands to the north of Perch Lake (Perch Lake Wetland Complex), in the area of the proposed disposal site. The East Swamp Wetland is to the northwest of the proposed Near Surface Disposal Facility (NSDF) site. The wetland area further to the west is known as the South Swamp. The Perch Lake Swamp is to the south/southwest of the NSDF. The East Swamp Stream flows from the East Swamp and converges with the Main Stream (flow from the South Swamp), and continues south through the Perch Lake Wetland to Perch Lake. Wetlands also line the Perch Creek corridor, to the outfall at the Ottawa River. To the east, the NSDF site boundary follows the natural ridgeline separating the watersheds of Perch Lake and Perch Creek.

Groundwater and surface water flow are reported by Golder to generally follow site topography, towards the adjacent wetlands, ultimately discharging to Perch Lake. Groundwater springs have been observed in the East Swamp Stream and Perch Creek (just beyond the Perch Lake outlet weir).

The Perch Lake Basin houses existing waste management areas and is known to have been impacted by past operations. Existing contaminant migration in that area is reported to be well understood. Golder report that contaminated groundwater is discharged to the Perch Lake Wetland Complex, creating a brownfield. The East Swamp is known to receive groundwater discharge from the Chemical Pit plume and, to a lesser extent, Reactor Pit 2 (groundwater downgradient of the Chemical Pit is known to have high concentrations of lead, uranium, mercury, and PCB, and trace concentrations of dioxins and furans). Radiological parameters are also reportedly high in both groundwater and pore-water from within the East Swamp Wetland.

Proposed Timelines, Preferred Site, and Recommended Alternative
The construction phase of the proposed project is expected to be 2018 to 2020. The operational phase would then be expected to be 2020-2070, with site closure occurring over the time between 2070 and 2100 (active and passive controls, continued groundwater monitoring and groundwater quality management). The post-closure phase is to include an institutional control period (2100 to 2400) and post-institutional control period (2400 and beyond).

The subject property is located in Renfrew County, on the shore of the Ottawa River, approximately 200 km northwest of Ottawa. The property has a total area of 4000 ha and is within the Corporation of the Town of Deep River. The property is bordered to the southeast by Federal Department of National Defence Garrison Petawawa, to the southwest by the Village of Chalk River, and to the northeast by the Ottawa River. Compared to the alternate site, the selected location is closer to the sources of waste (e.g. buildings to be decommissioned, waste management areas, brownfields) and within an existing contaminant plume within the Perch Lake drainage basin, described above.

The recommended alternative is for the construction of a NSDF. The NSDF will be designed as an engineered containment mound with an operational life expectancy of approximately 50 years and design life of 500 years. The proposed development will have a footprint of approximately 34 ha. A minimum setback of 30 metres from wetland areas is described.

Development is proposed to proceed in two stages, with the first stage intended to have design fill capacity 525,000 cubic metres within 6 cells (for remediation of existing contaminated lands and legacy waste management areas). Stage two is to include expansion of the design fill capacity to 1,000,000 cubic metres of waste within an additional 4 cells. The development is intended to include both access road and perimeter road to provide direct access for construction vehicles and maintenance activities.

Leachate from the engineered containment mound will be treated by an on-site wastewater treatment plant (WWTP) and discharged, likely via an exfiltration gallery, to the East Swamp Wetland. The WWTP is also intended to treat wastewater from the Project’s supporting operations, such as vehicle decontamination facility, weighing stations, laydown and stockpiling areas, office and change room facilities, parking and security systems.

Surface water management is also proposed, including three surface water management ponds (SWMP) for non-contact stormwater and runoff, described below. All discharges are proposed to be to the ground surface or exfiltration pits, adjacent to wetland areas.

Potential Surface Water Impacts
Both hydrology and surface water quality are identified as Valued Components within the report. Golder’s assessment includes existing water quality and quantity impacts, effects from the NSDF project (construction, operation, and closure), as well as any reasonably foreseeable effects and effects from future decommissioning and reclamation activities.

Discussion of relevant Provincial policy included below is provided for reference only.

<u>Surface Water Quantity and Hydrology</u>

The hydrology of the Perch Lake watershed is reported to be well understood, having been studied from 1969 through 1988. Section 5.4 of the report outlines anticipated effects pathways as well as management practices and mitigation actions, including surface water management, erosion and sediment control, hydrological impacts of discharge of treated leachate and contact stormwater, and changes in drainage patterns.

Golder concludes that, through implementation of surface water management plans for the NSDF project, changes to downstream discharge, water levels, and channel / bank stability in Perch Creek will be limited, such that residual effects on hydrology will be negligible. Reviewer’s comments are provided below.

Non-Contact Stormwater and Surface Water:
Non-contact runoff from areas within and outside the engineered containment mound is intended to be managed through a combination of collection, conveyance, treatment measures. Treatment includes three SWMP, expected by Golder to manage erosion and sediment control (E&SC) concerns though all phases of the project.

Stormwater will ultimately be discharged from Stormwater Management Ponds (SWMP) to land adjacent to the East Swamp Wetland (SWMP 1) and Perch Lake Wetland (SWMP 2 and SWMP 3) via level spreaders (Figure 3.1.1-1). Golder describes the ponds as being designed in accordance with the MOECC's *Stormwater Management Planning and Design Manual* to provide 'basic' treatment (60% total suspended solids (TSS) removal) and to control post-closure flows to pre-development levels for the 2- through 100-year storms. A three metre depth and one metre free-board is planned to allow for potential climate change-related changes to precipitation, as described in Section 9 of the subject report.

Reviewer comments:

- Anticipated flow during construction and operational periods are not specifically addressed in the report. It is the experience in this region that, during construction that requires the clearing of large areas of land, runoff rates may increase relative to pre-development levels. This increases the risk of sediment laden water overwhelming E&SC measures / SWMP and being released to downstream areas. The resulting increased flow to downstream areas may also result in scouring and/or erosion in the receiving watercourse.

  In the case of SWMP 1, the receiving area is known to be contaminated by other site operations, as described in the report (e.g. Section 5.7, Figure 5.7.4-11). If disturbed as a result of excessive flows, there is potential for contaminated soils and sediments to be mobilized from the East Swamp Wetland and stream corridor, and transported to downstream areas.

  It should be confirmed that flows from each SWMP will be controlled to pre-development levels through all phases of the project.

- Table 5.4.1-10 shows that, while flow from SWMP 2 and 3 does appear to be controlled to below pre-development levels in the post-closure period, modelled flow from SWMP 1 is three to four times pre-development levels under various model scenarios. Total runoff from the site is also increased, driven by the predicted increase in runoff from the catchment of SWMP 1. While Golder reports a 1 ha increase in drainage area for SWPM 1, the relative change in drainage area pre- and post-development is not clear. The apparent discrepancy in the discussion of pre- and post-development flows and reported model results should be addressed.

  It is notable that SWMP 1 includes areas designated for Site and Worker Parking, Vehicle Decontamination Area (fully enclosed), Operations Centre, Admin Building, WWTP and WWTP outfall (Figure 3.7.1-1). These impervious surfaces likely contribute to increased runoff to SWMP 1. Additional measures may be required to control post-development (i.e. operational phase) flows from the catchment area of SWMP 1.

- The MOECC encourages enhanced level treatment for new developments (80% TSS removal). Given the potential for sediment-bound contaminants to be transported off-site with suspended solids (i.e. chlorinated organic compounds (PCBs), metals (iron, arsenic, etc.), and nutrients (total phosphorus)), the reviewer encourages consideration of enhanced level treatment, as opposed to the basic level treatment (60% TSS removal) proposed.

- Should the project proceed, a stormwater management system should be established prior to any substantial clearing of the site. This is to protect against increased runoff and sedimentation during construction.

Leachate and Contact Stormwater:
The expected effluent volume is 6556 m^3 per year. A wastewater treatment plant is proposed for treatment of leachate, contaminated surface water, decontamination wash water, and other wastewater from Project support facilities (i.e. washroom and personal decontamination facilities and other on-site service areas with potential for contaminated flows, but excluding sewage treated by separate system). It is the reviewer's understanding that treated effluent from the WWTP is expected to be discharged to the East Swamp Wetland (likely by way of an exfiltration gallery). An insignificant volume of sanitary sewage will be stored in holding tanks and transferred to the existing CRL Sewage Treatment Plant.

The WWTP is designed to accommodate runoff volumes from back to back 100-year storm events. Discharge from the WWTP is expected to be approximately one cubic metre per hour (0.0003 cubic metres per second) (based on average annual precipitation), which represents only a small proportion of flow to Perch Creek. Golder concludes that the collection and discharge of stormwater and wastewater effluent will have negligible effect on hydrology, with any changes to hydrology expected to be buffered by receiving wetlands.

An inspection and monitoring program is proposed. This is to include continuous water level monitoring (May through November) and water quality testing twice per year during significant rainfall events to monitor for potential leachate contamination and TSS levels in SWMP. Routine inspections and maintenance of SWMP are also described.

Reviewer comments:

- I defer to wastewater engineers on matters relating to design of the WWTP.

- Despite the relatively small volume, the WWTP effluent is also expected to contribute to flows to the East Swamp Wetland. Please see the comments above with respect to potential concerns related to the proposed increased flow to that area.

- The assessment of anticipated effects of effluent discharge on site hydrology appears limited to average annual precipitation levels. Consideration of the range of conditions likely to be encountered would be more informative.

<u>Surface Water Quality</u>

Golder expects that residual effects to surface water quality will be associated primarily with the operation of the WWTP and discharge of effluent. Because the effluent (stormwater and wastewater) is expected to flow to surface water features (Perch Lake via adjacent to wetlands and streams), the discussion below compares expected effluent concentrations, Treatment Targets, and BV to relevant surface water quality guidelines.

Non-Radiological Parameters:
With respect to surface water quality, aluminum, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nitrate phosphorus and zinc were selected of Constituents of Possible Concern (COPC). Golder has selected these parameters based predicted concentrations in leachate and known toxicity to organisms.

It is my understanding that the treatment approach is to define the best demonstrated available technology economically achievable (BDTEA) for parameters predicted to exceed the applicable standards (*CRL Acceptability Criteria for Routine and Non-Routine Discharge of Liquids to Stormwaters*) in untreated leachate. Treatment Targets are listed within Table 3.5.3-2.

Pathway analysis for Surface Water Quality Valued Components is given in Table 5.4.2-5. Only two pathways were determined to have potential for residual effects to water quality: the discharge of treated effluent from the WWTP to the East Swamp and the potential for leakage of leachate from the ECM during the post-institutional control phase (after the year 2400).

Water quality assessments completed by Golder are based on the comparison of existing and predicted water quality to established BV. BV are included as Table 3, Appendix 5.4-2 of the report. BV appear to have been established based on CWQG, PWQO, Ontario Drinking Water Standards, and site-specific Ecological Effects Review and Ecological Risk Assessment under a separate report (CRL-509243-ARS-2015). The report(s) under which these values were established was not reviewed in this office. I cannot comment on the basis of site-specific values; however, observations are provided below.

Background water quality was assessed based on the results of ongoing routine monitoring within the Perch Lake basin and Perch Creek (2010-2015). Data are provided within Tables 4 through 11 of Appendix 5.4-2. Golder report that, in most cases, the concentrations of metals are comparable to reference; however, iron and uranium were sometimes elevated. Available 2015 monitoring data show that iron and copper were consistently above the BV (except for copper at the Main Stream channel, upstream of the East Swamp Wetland), uranium concentration were above benchmark value at PL1, PL2, and MAR (PL1 and PL2 are inflows to Perch Lake, with PL2 capturing flow from the East Swamp Stream and Main Stream channel. MAR is the Main Stream, above Plant Road). High iron and uranium are routinely detected at the East Swamp Weir (East Swamp Stream) and PL2.

Comments based on my review of the summary data provided are provided below.

Reviewer's Comments:

- Possible leakage of leachate during the operational and institutional control phases (up to 2400) was not considered to have potential to affect surface water quality. It is my understanding that this is based on the redundancy incorporated in to the engineering of the containment mound. I am not an engineer so cannot comment on this matter.

- Non-contact surface water is expected to be managed through the surface water management system described above. With respect to stormwater, site runoff from the NSDF site has the potential to transport sediment and contaminants to downstream surface water receivers. Golder proposes a surface water management system, designed to provide 'basic' level treatment (60% TSS removal). As noted above, the provision of higher levels of treatment for TSS may be prudent given the water quality considerations discussed herein (i.e. known elevated concentrations of chlorinated organic compounds (PCBs), metals (iron, arsenic, e.t.c), and nutrients (total phosphorus) on CRL property, which may be transported with sediments).

- Estimated volumes of each type wastewater (contact and non-contact) and their strength with respect to non-radiological parameters have been modelled, calculated and/or estimated based data from comparable sites, pilot studies, and anticipated waste inventories. I defer to the opinion of subject matter experts for comment on these calculations.

- Sampling provisions are expected to be provided at the discharge point. Golder reports that leachate will be sampled to confirm compliance with effluent requirements prior to discharge. It is not clear what contingencies may be implemented in instances where water does not meet effluent requirements.

- The Treatment Target identified for cadmium, copper, lead, and zinc exceed the Province of Ontario's Aquatic Protection Values (APV), sometimes by a significant margin (i.e. the Treatment target given for cadmium is 1.5 mg/L, compared to the APV of 0.00021 mg/L). No treatment target is listed for mercury (as discussed by Golder within the report). The anticipated concentration of mercury in leachate exceeds the APV.

  Ontario's APVs are considered to provide a reasonably conservative level of protection for most aquatic organisms from the migration of contaminated groundwater to surface water resources. Concentrations in excess of APVs may indicate potential for impacts to surface water features and aquatic life. Furthermore, some of these contaminants have the potential to accumulate in sediments through various processes, and/or bio-accumulate in aquatic biota. This is not addressed in the report.

- The Treatment Targets for cadmium, copper, lead, zinc, iron and total phosphorus exceed PWQO and/or CWQG. These are considered conservative values, intended to be protective of the aquatic organisms, through all life phases and with indefinite exposure. In wetland-rich environments, these guidelines should be used with caution.

- Golder makes multiple references to site-specific effluent limits and effluent requirements (as being criteria different from Treatment Targets), but those limits do not appear to be provided within the report. The site-specific effluent limits are reportedly based on the *CRL Acceptability Criteria for Routine and Non-Routine Discharge of Liquids to Stormwaters*, however, that report is not provided and has not been reviewed by this office.

- Benchmark Values, which the reviewer understands to represent acceptable water quality for the CRL site, exceed PWQO and/or CWQG in some cases (e.g. aluminum, lead, mercury, and zinc).

- Some BV have been established through independent study (i.e. Ecological Effect Review and Ecological Risk Assessment). While these values are generally similar to or less than the Province's APV, there are some notable differences (e.g. BV for Boron, Lead, and Polychlorinated Biphenyls (PCB) exceed Ontario's APV). The concern with respect to PCBs is discussed below.

- There appears to be a unit error in the BV listed for total phosphorus. The listed value 4-100 mg/L is cited as being based on the CWQG. The CWQG for total phosphorus is 4-100 µg/L. This apparent error is carried throughout the report, water quality modelling and appendices. This may affect the interpretations provided within the water quality assessment (discussed below).

- The manner in which existing water quality is presented within Appendix 5.4-2 does not permit detailed review (summary data only). It appears that only annual maximum values are presented, as opposed to ranges, means or n^{th} percentile values. These tables also appear to contain multiple unit errors, transcription errors, errors in calculated 5-year average, or in some cases lack of calculated 5-year average, which further complicates any meaningful review.

- Within Tables 4 through 11 of Appendix 5.4-2, where a parameter is below the detection limit, the detection limit is often not indicated. Without knowledge of detection limits it is unknown if "<SRI" indicates good water quality. It is not uncommon for detection limits to exceed relevant water quality guidelines, even within this dataset.

- The parameter list is not consistent between stations (Tables 4 through 11 of Appendix 5.4-2). In most cases, no data are provided for Barium or Manganese. Data are also lacking for Arsenic (at Perch Creek Weir), Uranium (at East Swamp Weir), PCBs (MAR, MSC, Perch Lake Input 4, SSW (South Swamp Weir)). Barium, manganese, and arsenic are considered COPC.

- Golder reports that no background data is available for the body of Perch Lake. The concentration of COPC in Perch Lake has been estimated based on cumulative inputs to the Lake (PL-1 through PL5); however, no data are presented within the appendix for PL-3 or PL-5. Several possible issues with the predicted parameter concentrations in Perch Lake are noted in the discussion below. It is my understanding that the outlet of Perch Lake (PLO) is monitored, but water quality data for this location are also lacking in Appendix 5.4-2.

Water quality results, as they relate to the receiving water assessment are discussed below.

Radiological Parameters:
Available surface water radiological data are summarized in Section 5.7.4.5. Golder reports that Treatment Targets for radiological parameters are based on achieving levels as low as reasonably achievable (ALARA). I defer to subject matter experts on matters relating to the behaviour and decay of radionuclides in the environment and proposed containment mound, and radiological dose assessments. Please note that the PWQO for radionuclides, referenced below, is intended for protection of drinking water sources and not water quality with respect to ecological or recreational endpoints.

Ambient radiation surveys show radiation within the East Swamp Wetland, coinciding with the Chemical Pit groundwater plume. Tritium concentrations in the East Swamp Stream (at ESW) have exceeded the PWQO. Tritium has also been shown to be elevated elsewhere within the Perch Lake basin, occasionally exceeding the PWQO at the outlet of Perch Lake, but not downstream at the Perch Creek Weir (PCW). At the CRL property boundary (in the Ottawa River), the data presented show tritium levels to have been measurable, but low (<64 Bq/L). Gross Beta activity (associated with Strontium-90 and decomposition products) within the East Swamp Wetland has also reported to be high (442 Bq/L, compared to the PWQO of 10 Bq/L), although levels at PCW (Perch Creek, downstream of Perch Lake) are generally below PWQO. Summary data provided within Table 5.7.4-8 and 5.7.4-9. Predicted radionuclide concentrations in effluent and existing concentrations within the East Swamp Stream are summarized in Table 5.7.6-2.

Sediment within Perch Lake has also been tested for tritium oxide and organically bound tritium (HTO), as described in Section 5.7.4.8. Data appear to be limited (2003 and 2013 only). Golder reports that surficial soils in the East Swamp were found to have high levels of Total Beta and Gross Alpha radiation in a 2002 survey (up to 1,845,000 Bq/kg and 8570 Bq/kg, respectively). High levels of Cobalt-60, Cesium 137 were also reported in surficial soils, with highest concentrations in the zone where contaminated groundwater discharges from the Chemical Pit plume.

The potential pathways for radiological impacts, including those to surface water, are summarized in Table 5.7.5-1. As with non-radiological parameters, the discharge of treated effluent to the East Swamp Wetland and leakage of leachate post-closure were considered as primary pathways. In the discharge scenario, effluent concentrations are assumed to be equal to the Treatment Targets (provided in Table 3.5.3-1) (note, treatment is reportedly not feasible for tritium. As such, tritium releases are expected to be managed through provision of additional containment for high tritium wastes, such that tritium concentrations in Perch Creek do not exceed 7000 Bq/L (equal to the PWQO for Tritium)).

Golder concludes that doses to non-human biota during operational and post-institutional control periods are below the dose benchmark values.

Reviewer's comments:

- Estimated wastewater strength with respect to radionuclides was established based extrapolation from reference inventory of wastes and/or modelling. I defer to the opinion of subject matter experts for comment on these calculations, as this is beyond the scope of my expertise.

- As with non-radiological parameters, the potential for leakage of leachate and/or discharge of inadequately treated effluent during operational or institutional control phases are not considered potential effects pathways. It is my understanding that this is based on the redundancy incorporated in to the engineering of the containment mound. I am not an engineer so cannot comment on this matter.

- As noted above, the East Swamp and East Swamp stream corridor are known contaminated areas (depicted in Fig. 5.7.4-11). Erosion or scouring of stream banks and wetland areas, or formation of new channels through the East Swamp associated with discharge from SWMP 1 and the WWTP may have the potential to mobilize contaminated surficial soils, potentially exacerbating the transport of contaminants downstream. Please see comments above.

- Golder has determined the potential concentration of radionuclides in the East Swamp Stream expected as a result from discharge from the WWTP based on predicted effluent volumes (based on average annual precipitation), treatment targets for radionuclides (Table 3.5.3-1) and dilution a dilution factor of 12.5 within the East Swamp Stream (based on flow in the stream of 72000 m^3/year).

  It is not clear if the flow value for the East Swamp Stream represents average annual flow or low flow conditions. Conservative analysis would include consideration of low flow conditions (i.e. $7Q_{20}$ or other suitable low flow statistic) to assess the reasonably foreseeable 'worst case scenario' (i.e. concentrations of radiological parameters which may occur within the swamp under lower flow / lower dilution conditions). Conversely, higher than average precipitation may result in higher than average leachate generation and larger volumes of effluent discharged. Conditions deviating from the average should be considered.

Receiving Water Assessment / Assimilative Capacity

Routine water quality monitoring is undertaken throughout the Perch Creek basin, as discussed above. Golder has undertaken water quality modeling based on a mass-balance approach (using GoldSim modelling package) to predict water quality conditions under four distinct scenarios at six water quality 'nodes'. Scenarios include Operational Phase (Scenarios 1 and 2), Post-Closure Phase (Scenario 3), and Post-Closure with cover failure (Scenario 4). Model inputs and assumptions are outlined within section 5.4.7.2 of the report.

Based on model results, Golder reports that concentrations of some parameters may be higher than BV at the East Swamp Weir, Perch Creek Weir and/or Perch Creek Outlet under various scenarios. The anticipated concentration of aluminum, barium, and mercury met their respective aquatic life guidelines in all model scenarios, while the concentrations of cadmium, copper, iron, manganese were predicted to exceed relevant guidelines during post-closure and post-institutional control phases.

Golder interprets the risk associated with these parameters and project phases to be negligible, with the Ottawa River expected to assimilate any discharge from the watershed such that impacts to aquatic life and drinking water sources will be negligible.

With consideration for the information constraints identified above, under the *Surface Water Quality* discussion, I have reviewed the available data and model results, with particular attention to parameters known to be present at high levels in East Swamp Wetland and COPC identified by Golder. A summary of my observations is provided below.

Reviewer's comments:

- Policy status of receiving waters – Based on the data presented in Appendix 5.4-2, Perch Creek (at the Perch Creek Weir, midway between the outlet of Perch Lake and the Ottawa River) may be considered a Policy 2 receiver for total phosphorus, iron, aluminum and copper (existing water quality may not meet the PWQO / CWQG). Provincial policy would be to prevent further deterioration of water quality with respect to these parameters, except under specific circumstances.

  The existing concentrations of lead, barium and manganese (identified as COPC) are unknown or are not well defined. While there is no APV or PWQO exist for manganese, barium has an APV of 2.3 mg/L. Lead has an interim hardness-dependent PWQO of 1, 3 or 5 µg/L. Based on available hardness data, an Objective of 1 µg/L likely applies. Treatment Targets and BV, as they compare to water quality guidelines, are summarized above.

- Golder report that 'anticipated effluent concentrations' were used to model the expected influence of effluent discharge under scenarios 1 and 2 (as opposed to the higher concentrations listed as Treatment Targets, or effluent limits, which are not provided). Anticipated effluent concentrations are based on treatment system performance on a pilot scale (i.e. high effluent quality under ideal conditions). It is unlikely that the model results reflect the "worst case scenario" for the effects of discharge.

  Modelling of discharge at the full effluent strength being proposed (i.e. effluent limits or Treatment Targets, equivalent to the worst quality that could be expected under conditions that would be considered acceptable based on the proposed project) is not an unreasonable expectation.

- Seasonal / annual variability in flows may not be adequately captured by the model. It is my understanding that modelling work was undertaken using average annual flows (1969-1980) (with the exception of monthly flow data for a limited number of locations). Low flows have the potential to limit the ability of receiving waterbodies to assimilate contaminants by affecting dilution rates.

  Modelling of the effects of effluent discharge under low flow conditions (i.e. lowest annual flow from data record or, preferably, seasonal low flows or 7Q20)) would provide a higher level of confidence with respect to the potential for adverse effects.

In addition, as noted with respect to the radiological assessment, higher than average precipitation may result in increased leachate generation and larger volumes of effluent discharged. Conditions deviating from the average should be considered.

- Given that model results are based on high quality effluent and do not account for variations in flow or effluent volumes, I do not have a high level of confidence that the model represents worst case scenario likely to occur for this project.

- It is my understanding that toxic metals such as beryllium, cobalt, fluorine and thallium were omitted from the study due to lack of projected effluent concentrations. Organic compounds were also excluded on the basis that the model is unable to capture processes of decay and/or bioaccumulation. The possible concentrations of most of these parameters in both effluent and in receiving waters are unknown. This data gap is a concern due to potential toxicity and/or cumulative effects not captured within this impact assessment.

- Under current conditions, the concentration of PCBs in surface water appears to exceed the PWQO and APV at the Perch Creek Weir, as well as at PL2 (inflow to Perch Creek, downstream of proposed discharge), and East Swamp Stream. Data from other monitoring locations are often lacking (Appendix 5.4-2), and may not be available. While PCBs are not identified as a constituent of potential concern by Golder and the Treatment Target for PCBs is equal to the PWQO (0.001 µg/L) (in most cases, this is equal to laboratory detection limits), the potential for discharge of PCBs and/or remobilization of PCBs from existing deposits is a concern (as noted above, effluent limits are not provided and may differ from Treatment Targets).

  PCB's are considered a hazardous substance by the Province of Ontario. Provincial policy is to prevent the release of PCBs. It should be confirmed that the effluent limit for PCBs will be less than or equal to the laboratory detection limit (i.e. non-detect) for effluent from the WWTP.

  Given the factors that may exacerbate the release and/or re-suspension of PCBs from contaminated areas within the receiving waterbodies (discussed above), the BV of 189 µg/L (>10,000-times the APV for PCBs) is a concern.

- Uranium is known to occur at high concentration both within receiving waterbodies (East Swamp Weir and PL2) and elsewhere on the CRL property, associated with contaminant plumes from legacy sources (discussed above). As with Mercury, it does not appear that Uranium (as a non-radiological parameter) has been assessed with respect to the anticipated concentration in wastewater, nor is a Treatment Target for Uranium provided.

  Clarification should be provided with respect to the anticipated concentrations of parameters in wastewater that are known to occur at high concentrations on the CRL site, as reported by Golder (Section 5.4.2.5).

- Model results are summarized in section 5.4.2.7.2.1 of the report. In some cases, model outputs are not logical. These results should be more adequately qualified within the report. The reviewer's observations are summarized below:

  - Cadmium: Golder reports background concentrations exceeding the CWQG for ESW (0.107 µg/L) and Perch Lake (0.126 µg/L, estimate) and expected treated effluent concentration of 0.273 µg/L. Under Scenarios 1 and 2, concentrations of

Cd at ESW are increased. A smaller increase is noted downstream from ESW at PL2. In Perch Lake; however, the model appears to indicate that water quality is improved by discharge conditions (from 0.126 to 0.036 - 0.038 µg/L), despite the relatively higher effluent concentration.

- Copper: as above, model outputs for Perch Lake are not logical. The background value cited for Perch Lake (13.9 µg/L (exceeding PWQO/CWQG and APV)) seems very high compared to upstream (PL2) and downstream (PCW) background values.

- Total phosphorus (TP): The BV cited (5 mg/L) reflects the apparent unit error described elsewhere in this memo. The predicted concentrations are extremely high compared to the PWQO for phosphorus (0.03 mg/L) and the guidance framework forming the CWQG (0.01-0.1 mg/L for meso- through eutrophic lakes). Based on the model results reported, I disagree with Golder's assessment that the potential for increased algal blooms and eutrophication is negligible under the modelled scenarios.

  As with Cu and Cd, the values assumed for TP in Perch Lake are not reasonable to the reviewer (concentrations of TP within Perch Lake are reported to improve from a background of 0.19 mg/L to 0.04 – 0.05 mg/L following discharge of effluent with a TP concentration of 1.7 mg/L under Scenarios 1 and 2).

- No data is available for concentrations of Barium or Manganese in receiving waters. It is unclear what assumptions were made in deriving receiving water concentrations for modelling the effect of effluent / leachate.

• The potential for thermal impacts is not addressed within the Environmental Impact Statement. Thermal impacts may occur through the discharge of relatively warmer water (i.e. water stored in SWMP) to cold water streams. The nature of receiving streams with respect to thermal habitat should be confirmed, given that groundwater discharge to the streams/creeks on site is known to occur.

General Comments

• Spill scenarios are considered under Section 6.5.3 (credible accident scenarios), including mitigation measures (e.g. perimeter ditch, sloping of perimeter access road towards the perimeter ditch, measures for containment and/or treatment of potentially contaminated water). This is reasonable to the reviewer.

• Environmental effects on the Project are considered under Section 9.0, including extreme rainfall events, snowfall and flooding (Section 9.1.2) and climate change (Section 9.4).

• Table 10.0-1 includes a summary of potential effects of the project, proposed monitoring programs, proposed duration of monitoring and program under which the monitoring is expected to be implemented.

  The proposed monitoring described in that section and elsewhere in the report seems comprehensive. This includes: Hydrological monitoring (water levels) to be integrated into the NSDF Project Environmental Protection Plan (to be developed) and CNL's Environmental Monitoring Program, surface water and effluent monitoring to be integrated into and implemented under CNL's Environmental Monitoring Program, Effluent Verification Monitoring Program. Surface water monitoring for the project is expected to be compliant with the *CSA Standard N288.4-10 Environmental Monitoring at Class 1 Nuclear Facilities and Uranium Mines and Mill*s. Effluent from SWMP and WWTP is expected to be compliant with *CSA Standard N288.5-11 Effluent Monitoring Programs at Class 1 Nuclear Facilities and Uranium Mines and Mills* (note, details of these programs were not provided for review).

For water quality and effluent monitoring, laboratory methods should be selected to ensure that detection limits permit the comparison of water quality data to applicable objectives and guidelines, where possible.

If you have any questions about these comments, I would be happy to discuss them with you.

"Original Signed By"

Lauren Forrester, M.Sc.
LF/dv

ec: Greg Faaren, Water Resources Unit Supervisor
Shawn Trimper, Regional Hydrogeologist

c: SW 13-01-07-02 – Ottawa River Basin, General

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M E M O R A N D U M

July 14, 2017

TO: Peter Taylor
Technical Support Unit Manager
Ottawa District Office
Eastern Region

FROM: Shawn Trimper
Groundwater Scientist
Technical Support Section
Eastern Region

RE: Environmental Impact Assessment Report
Near Surface Disposal Facility
Canadian Nuclear Laboratories
Deep River, Renfrew County

At your request, I have reviewed the report titled "Environmental Impact Statement" (Volumes 1 and 2), prepared by Golder Associates Limited (GAL) and dated March 2017. The report provides technical and non-technical details related to the proposed Near Surface Disposal Facility (NSDF) at Chalk River Laboratories (CRL). I note that nuclear waste management and the movement of radiological parameters in groundwater are specialized fields of study and are beyond the scope of my review. The purpose of this review is to provide comments related to the general hydrogeological aspects of the report. Comments provided herein should not be interpreted to represent an endorsement for or against the project.

The Environmental Impact Assessment Report references information from numerous technical investigations and reports, and generally provides only a high level overview of methods and results. Insufficient information is typically provided within the Environmental Impact Assessment Report to verify the methodologies and findings presented and relied upon. A review of the supporting technical reports would be required to provide a more robust review of the methods and conclusions used to support the proposed project. As such, comments provided herein are generally limited to a higher technical and conceptual level.

Background

The purpose of the project is to provide a permanent disposal facility at CRL for radioactive waste from: existing waste storage areas, current and future operations, and future remediation and decommissioning projects at CRL. The location of the proposed NSDF is on lands owned by Atomic Energy of Canada Limited (AECL), which is property of the Crown. The footprint of the proposed NSDF is 34 hectares. The proposed solution is a near surface disposal facility (NSDF) which consists of an engineered containment mound (ECM) and supporting infrastructure. The ECM consists of: a primary liner; a secondary liner; a leachate collection system; a leak detection system; and a final cover system. Additional infrastructure includes roads and surface works as well as a surface water management system that includes retention ponds and a waste water treatment plant (WWTP). The WWTP will be designed to treat leachate and waste water prior to discharge to an exfiltration gallery. The ECM will have a capacity of approximately one million cubic metres and is expected to be operational for approximately 50 years. The ECM will be composed of ten (10) individual but contiguous disposal cells. It is reported that the design life of the ECM is 500 years.

The proposed waste stream will consist of 99% low-level waste (LLW) and 1% by volume of intermediate-level waste (ILW) and mixed waste. Mixed waste is defined as radioactive waste that also contains hazardous substances. It is indicated that any mixed wastes will only contain toxic wastes that meet the requirement for land disposal as outlined in Ontario Regulation 347. Examples of hazardous mixed wastes to be acceptable for disposal include: asbestos, petroleum hydrocarbons, trace solvents, lead containing materials, fiberglass, epoxy coatings, insecticides, pesticides, herbicides, chemical complexing and chelating agents, electrical equipment containing batteries, and materials contaminated with trace quantities of PCBs.

The Environmental Impact Assessment Report has also considered and assessed a number of alternative designs and locations. Alternative designs to the NSDF consisted of a deep geological waste management facility and above-ground concrete vaults. Alternative locations were considered off-site and on-site. Alternative designs and locations were compared based on a large number of technical, non-technical, and socio-economic factors.

It is proposed that the construction of the site will commence in 2018 and be completed by 2020. The site is expected to be operational from approximately 2020 until 2070. Closure activities are expected to begin in 2070 and continue through 2100. Once closure has been completed, the post-closure phase will consist of two distinct periods: the institutional control period (2100-2400; 300 years) and the post-institutional control period (after 2400). It is reported that the institutional control period will include active site management including: leachate collection, inspection and maintenance activities, and monitoring. During the post-institutional control period, active management of the site will not be conducted.

Physical Setting

The proposed location of the NSDF is on the southeast portion of the AECL property. At its closest point, the ECM is approximately 600 metres from the southeastern AECL property boundary. The site is located northeast of Perch Lake and within the Perch Lake Drainage Basin. East Wetland and Perch Lake Wetland are located northwest and southwest of the proposed NSDF, respectively. Perch Creek is located south of the proposed NSDF site. The Ottawa River is located approximately 1.1 kilometres northeast of the site.

The proposed site is located along the northeastern edge of the Perch Lake Drainage Basin which is defined by a bedrock ridge. The bedrock ridge corresponds with the topographic high from which the land slopes downward towards the west in the direction of Perch Creek. Perch Lake drains to Perch Creek which flows east and discharges to the Ottawa River.

The Perch Creek Basin is located in a highly disturbed area of the AECL property and various areas of the basin and the lake have been impacted by legacy activities. Multiple existing waste management areas are located within the Perch Lake Drainage Basin and are located to the west of the proposed NSDF area.

Geology

Overburden thickness in the area surrounding the proposed NSDF is reported to be less than 1 metre at higher elevations located along the bedrock ridge and increases in thickness in low lying areas within the drainage basin. In low-lying areas, the overburden thickness is reported to be up to 22 metres. The composition of the overburden is generally described as fine sands underlain by glacial till. Organic soils are also present in low lying wetland areas. The overburden sequences have been well characterized within the study area and have been divided into multiple units of coarse and fine-grained deposits.

Bedrock underlying the site is composed of igneous and metamorphic rocks of the Grenville Province of the Precambrian Shield.

Hydrogeology

Hydrogeological conditions have been determined based on historical subsurface investigations conducted within and surrounding the Perch Lake Drainage Basin and recent investigations in the vicinity of the proposed NSDF.

Depth to groundwater varies from less than 1 metre to greater than 12 metres. Groundwater depth is greatest in the vicinity of the bedrock ridge located east of the site. Horizontal gradients range from approximately 0.05 to 0.07 metres per metre (m/m) in vicinity of the NSDF. Horizontal gradients range from approximately 0.006 to 0.003 m/m in low lying areas. Consistent with topography, stronger gradients in areas of higher topography and topographic change. Vertical gradients indicate that recharging conditions are present at higher elevations and discharging conditions are present in low lying areas.

Hydraulic testing has been conducted within the overburden deposits and bedrock. The range of hydraulic conductivity measured ranged from $1.4x10^{-7}$ metres per second (m/s) to $1.6x10^{-5}$ m/s. The range of hydraulic conductivities measured in the bedrock ranged from $2.3x10^{-9}$ m/s to $1.5x10^{-5}$ m/s. The bedrock hydraulic conductivity is highest at the bedrock-overburden interface and within the upper 6 metres of the bedrock.

Groundwater flow and contaminant migration from the ECM are expected to primarily migrate horizontally through the high permeability layers of overburden deposits following topography and based on the presence of high permeability overburden materials. A discontinuous sand and gravel layer has been identified as the dominant flow path. Flow is in a generally westerly direction and is expected to discharge to wetlands, Perch Lake, and Perch Creek. All groundwater will be contained within the Perch Lake Drainage Basin and will ultimately discharge to Perch Lake or Perch Creek. The groundwater transit time from the ECM to Perch Creek has been determine based on numerical modeling and is estimated to range from 10 to 12 years.

Discussion & Conclusions

- The site location and physical setting consists of exposed bedrock and permeable overburden materials. This setting does not provide natural protections and the site will rely on engineered controls to contain the contamination.
- Two primary pathways exist that may result in the contamination of groundwater at the site: leakage of leachate from the ECM and, the discharge of treated water from the WWTP to the exfiltration gallery. The potential for impacts to groundwater due to leakage from the ECM is based on the adequacy of the ECM design. The suitability and expected design life of the engineered components of the ECM are beyond the scope of my review. The potential for impacts to groundwater due to the discharge of treated water to the exfiltration gallery will be dependent on the adequacy of the treatment provided by the WWTP. The suitability of the proposed water treatment system is beyond the scope of my review.
- From a groundwater impact perspective, the proposed site location and characteristics limits potential impacts to groundwater resources and users. Groundwater impacts will be limited to a small portion of the Perch Lake and Perch Creek Drainage Basins and groundwater impacts are expected to be contained on CNL property. Impacted groundwater will flow towards and discharge to downgradient surface water features (East Swamp, Perch Lake Wetland, Perch Lake, and Perch Creek) which ultimately drain to the Ottawa River. As such, the primary water related pathway/risk associated with the proposed NSDF is with respect to surface water. It is understood that a Regional Surface Water Scientist has provided comments with respect to surface water management.

- It is reported that the NSDF is not expected to have a significant influence on groundwater flow conditions (direction/quantity). I concur with this statement. The project may result in minor changes to infiltration rates in the vicinity of the engineered structures; however, the influences would be highly localized and would not affect groundwater flow conditions outside the Perch Lake Basin.
- The presented conceptual model of groundwater flow and leachate migration is dependent on the NSDF being located entirely within the Perch Lake Basin. It is reported that the location of the groundwater divide to the east of the ECM along the escarpment boundary is not well understood. Additional investigation should be conducted to confirm the location of the current and future groundwater divide.
- It is my understanding that groundwater monitoring conducted to date in the vicinity of the proposed ECM is very limited, with two data points collected over less than a one-year period in many areas. This level of groundwater data is significantly deficient in assessing the groundwater conditions. Longer term monitoring in the area of the ECM is strongly recommended to better understand groundwater conditions in this area. Data loggers allow for the continuous measurement of groundwater elevations and would provide considerably more detail than manual water level measurements. An essential component of the proposed design is that the ECM be constructed above the current and future groundwater elevation. As built drawings and cross sections have not been provided and I cannot confirm that the proposed design will be above the long-term groundwater table.
- Groundwater and contaminant migration times and discharge concentrations have been determined using numerical modeling; however, the details of this modeling have not been provided, and I cannot confirm the validity of the methods and outputs. I cannot confirm the validity of the reported 10 to 12 year travel time from the ECM to Perch Creek, as inadequate information has been provided.
- Limited details have been provided regarding the proposed groundwater monitoring program. A suitable groundwater monitoring program should contain monitoring locations in upgradient and downgradient areas in all relevant geological sequences, and should include the analysis of all relevant radiological and non-radiological leachate parameters.
- Leachate quality has been estimated based on leachate quality at other similar sites. This approach is reasonable; however, I cannot confirm if the provided values are realistic and conservative. The constituents and concentrations of leachate parameters are site specific and are subject to significant uncertainty. I note that not all hazardous compounds listed as acceptable components of mixed waste (i.e. insecticides, herbicides, pesticides) appear in the leachate parameter list. The list of leachate parameters assessed by the monitoring program should include all contaminants of concern contained in wastes deposited at the site.
- Based on my review of the report, I conclude that the site poses limited/negligible risk to groundwater resources and users. The proposed project is a highly engineered system and surface water is the primary receptor and pathway in the event of unexpected or premature failure of the ECM.

If you have any questions regarding the comments provided or wish to discuss this matter further, please let me know.

Signature redacted

Shawn Trimper, P.Eng.
SAT/

ec: Greg Faaren, Water Unit Supervisor
Lauren Forrester, Regional Surface Water Scientist