Project Status of the Port Hope Area Initiative: Application of the Adaptive Management Concept as Theory Becomes Reality – 14340

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ABSTRACT

The Port Hope Area Initiative (PHAI) involves the cleanup of historic low-level radioactive waste (LLRW) resulting from radium and uranium ore processing by the former crown corporation Eldorado Nuclear Limited and its predecessor companies, during the period between 1932 and 1988. The PHAI involves two separate projects designed to address the historic waste located in the adjacent municipalities of Port Hope and Clarington. The Port Hope Project involves the excavation, transportation and consolidation of an estimated 1.2 million m^3 of historic waste into an engineered long-term waste management facility. The Port Hope Project wastes are currently located in 13 known large-scale sites and an estimated 425 small-scale sites within the urban area of the community. The Port Granby Project in Clarington involves the relocation of an estimated 450,000 m^3 of historic waste from its current lakeside location to an engineered long-term waste management facility some 700 metres back from the shoreline of Lake Ontario.

As federally funded projects, environmental assessments (EAs) were conducted for each project under the provisions of the *Canadian Environmental Assessment Act 1992 (CEAA)*. The outcome of these EAs concluded that the projects were not likely to cause significant adverse environmental effects, with the application of identified measures to mitigate adverse effects should they arise.

An important concept presented in the EAs is that of “adaptive management”, which is defined as a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs. The concept of adaptive management based upon lessons learned by others and experienced directly by the PHAI has been and continues to be utilized in a number of project aspects. Examples that will be discussed include:

This paper provides an update [1] on the status of the implementation of the PHAI, as well as highlighting the importance of applying the concept of “adaptive management” utilizing information and data collected from lessons learned as these two projects progress from theoretical concepts into tenderable contracts requiring detailed specifications and design drawings.

BACKGROUND

The Port Hope Area Initiative (PHAI) is Canada’s largest cleanup of historic low-level radioactive waste (LLRW) resulting from the refining of radium and uranium by Eldorado Nuclear Limited, a former Crown corporation and its private sector predecessors. With a budget of Cdn$ 1.28 billion, the PHAI includes a broad and complex range of remedial components comprising construction and operation of two state-of-the-art waste water treatment plants, construction of two engineered above-ground long-term waste management facilities, removal of an estimated 50,000 m^3 of LLRW from a closed municipal solid waste landfill site, dredging and dewatering of some 120,000 m^3 of impacted harbour sediment, cleanup of close to one million m^3 of historic

LLRW currently located within two closed waste management facilities, investigation of an estimated 5,000 private and public properties to identify the presence of historic LLRW, and the remedial cleanup of 13 currently known large-scale sites plus an estimated 425 smaller scale sites. Based upon municipal boundaries, the PHAI has been divided into two separate projects, namely the Port Hope Project (in the Municipality of Port Hope) and the Port Granby Project (in the Municipality of Clarington). The Port Hope Project will address an estimated 1.2 million m^3 of historic LLRW, while the Port Granby Project will address close to 500,000 m^3 of historic LLRW. It is important to note that the term "historic LLRW" refers to low-level radioactive waste for which the original producer cannot reasonably be held responsible, and for which the Government of Canada has accepted responsibility.

Eldorado Nuclear Limited and its private sector predecessors operated a plant in Port Hope, Ontario (Canada), refining and processing radium and uranium ores from 1932 to 1988 for research, medical and industrial applications. Processing of pitchblende ore for radium was the initial focus of the refining operation until 1941 when operations at the plant were expanded to accommodate the refining of uranium. By 1954, the radium refining operation had ceased and the focus at the Port Hope plant was solely on uranium refining and processing.

The residues, generated by Eldorado's radium and uranium refining of pitchblende ores from their mine at Port Radium in Canada's Northwest Territories, contain many contaminants including antimony, arsenic, barium, cadmium, cobalt, copper, lead, molybdenum, nickel, silver, vanadium and zinc. Of these contaminants, arsenic, as well as Ra-226, Th-230, and uranium, are considered to be the "signature" indicators of historic LLRW when they are found at levels above-normal background in Port Hope.

For over six decades, residues and wastes containing extraction and leaching chemicals as well as elements found in the native pitchblende ores, such as arsenic, silver, cobalt and antimony, were taken by the truckload from the Eldorado refinery and dumped in locations that were deemed appropriate at the time. From 1932 to 1948, the Port Hope locations included the plant site itself, several ravines, the municipal landfill, numerous private properties and the harbour's turning basin. Commencing in 1948, the processing wastes were taken to a designated site on the outskirts of Port Hope at Welcome, where a residue storage area was established. Due to surface water and groundwater complications at this site, a new site was put into operation at a site located in the neighboring rural hamlet of Port Granby, which is now part of the Municipality of Clarington. From 1956 to 1988, residues and industrial wastes were transported to the Port Granby Waste Management Facility site on the north shore of Lake Ontario. All residue and waste depositions ceased in 1988 when Eldorado was dissolved as part of a merger that created the private-sector company, Cameco Corporation. Figure 1 presents the locations of Port Hope and Port Granby in relation to Toronto, Ontario.

As part of the Port Hope Area Initiative, in 2011 and 2012, ownership of the Welcome and Port Granby Waste Management sites was transferred from Cameco to the Government of Canada. These transfers took place following the issuance of Waste Nuclear Substance Licences (WNSLs) to Atomic Energy of Canada Limited (AECL) by the Canadian Nuclear Safety Commission (CNSC). Through these licences, AECL, under a Tripartite Agreement with Natural Resources Canada (NRCan) and Public Works and Government Services Canada (PWGSC) will implement the construction of the new long-term waste management facilities and the associated remedial cleanup activities at these two sites.

Figure 1: Locations of the Port Hope and Port Granby Projects (East of Toronto) in relation to Toronto, Ontario.

Figure 2: Port Hope Site – Aboveground Mound End Use Concept.

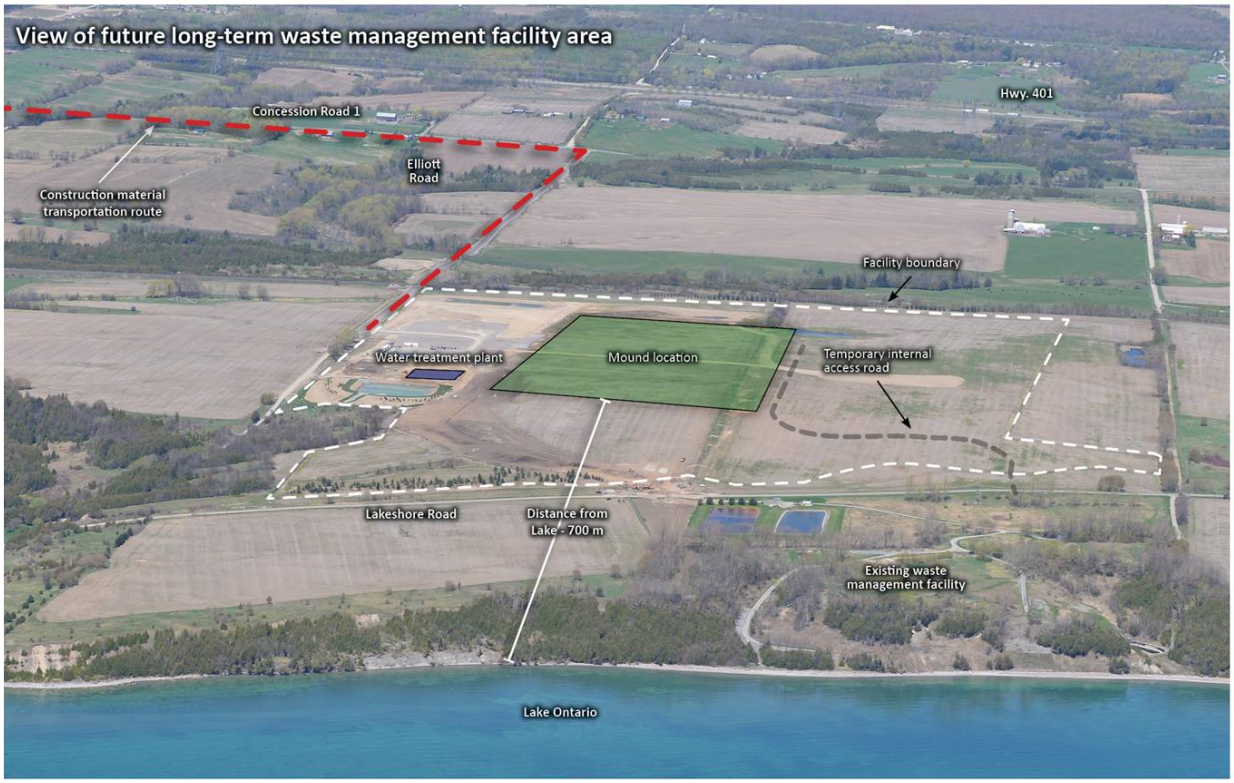


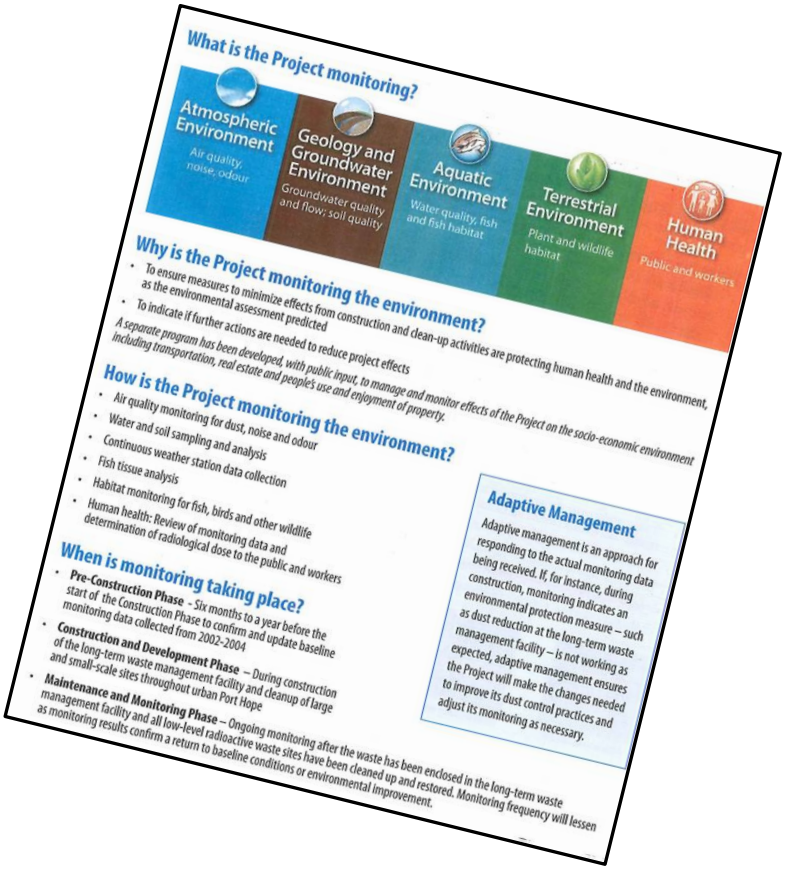
Figure 3: Port Granby Site – Future Long-Term Waste Management Facility Area.

PROJECT STATUS UPDATE

The WNSLs were issued to AECL by the CNSC for the Port Hope and Port Granby Projects in 2009 and 2011 respectively. Following the issuance of these licences, the activities associated with the projects has been focused in the following areas:

- updating of baseline environmental monitoring data;
- construction of enabling transportation infrastructure (access roads);
- development of detailed designs and contract specifications for the remediation of the existing Welcome and Port Granby Waste Management Facilities;
- development of detailed designs and contract specifications for the construction of the new Port Hope and Port Granby long-term waste management facilities;
- development of detailed designs and contract specifications for the known major remediation sites in Port Hope, including the harbour, ravines and municipal landfill site;
- implementation of the first of five investigation campaigns to identify the presence of historic LLRW on small-scale private and public properties; and,
- construction of new waste water treatment plants for the Port Hope and Port Granby long-term waste management facilities.

Throughout 2013, the collection of baseline environmental monitoring data continued, involving air quality monitoring (total and 2.5 micron suspended particulate as well as ambient outdoor radon), groundwater and surface water sampling and meteorological conditions monitoring of wind speed, direction and temperature. The data collected during the past two years will be undergoing analysis to identify any significant changes between the previous 2002 to 2004 baseline data. Appropriate follow-up actions will be taken based upon the outcome of this comparison.



The enabling transportation infrastructure for both projects was in full use during 2013. In the case of the Port Granby Project, detailed pre-planning by the waste water treatment plant contractor's suppliers eliminated the need for alternative transportation routing for oversize loads through the local community (see Figure 4).

This action clearly demonstrated to the area residents the Project's commitment to minimize its impact on the local community.

Because of the complexity of the Port Hope Project, the detailed designs and contract specifications for the remediation of the existing Welcome Waste Management Facility (WWMF) underwent significant revisions during 2013 to expedite the initial phase of on-site work. This was accomplished through the development of three early works packages designed to expedite the implementation of the enabling infrastructure (administration complex, monitoring and decontamination facility, vehicle radiation portal monitor and weigh scale control station), and construction of the first waste containment cell. Based upon the relatively straight forward nature of the Port Granby Project, the work has focused on the preparation of a single comprehensive tender package.

Figure 4: Clean construction equipment delivery en route to the Port Granby Waste Water Treatment Plant, Clarington (East of Toronto), Ontario.

The development of detailed designs and contract specifications for the known major remediation sites in Port Hope was rigorously examined by the Municipality of Port Hope through its peer review team, and challenges and issues raised were successfully addressed by the PHAI. These issues included such items as application of specific cleanup criteria for current and foreseeable land uses, contractor compliance with municipal by-laws, resolution of future public complaints, concurrence with proposed restoration plans, completeness of investigative data and adequacy of remedial cleanup plans.

The investigation of the estimated 5,000 small-scale sites is proposed to be conducted in five investigation campaigns. To identify the presence of historic LLRW on individual properties, the investigations involve exterior surface gamma radiation surveys, drilling of boreholes to permit subsurface gamma investigation and collection of soil samples that can be analyzed for contaminants of potential concern, interior gamma and contamination surveys, and long-term (six months) interior radon gas measurements. The radiological results from the 450 properties included in Campaign 1, identified historic waste on 44 properties. In addition, several modifications to the in-the-field investigation program were identified to make future investigations more representative, efficient and cost-effective (e.g., minimum six-month radon monitoring period, use of radon data to identify subsurface soil sampling areas, deployment of applicable level of radiation protection personnel).

Figure 5: Exterior Gamma Monitoring within the Community of Port Hope.

Figure 6: Interior Contamination Monitoring within the Community of Port Hope.

Construction of the new Port Hope and Port Granby waste water treatment plants progressed well over the past year (see Figure 7 and Figure 8). Non-active and active commissioning activities for the plants are scheduled to take place in the spring and summer of 2014. Despite some minor set-backs due to weather and equipment delivery, the plants will be in service to meet the needs of the remediation work at the existing Welcome and Port Granby Waste Management Facilities.

Figure 7: Port Hope Waste Water Treatment Plant Exterior

Figure 8: Port Granby Waste Water Treatment Plant Exterior

APPLICATION OF ADAPTIVE MANAGEMENT

An important concept presented in the Environmental Assessments is that of "adaptive management", which is defined as a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs. The concept of adaptive management, based upon lessons learned by others and experienced directly by the PHAI, has been and continues to be utilized in a number of project aspects and is proving to be an important component in the advancement of the Port Hope and Port Granby Projects. The following sections provide an overview of adaptive management applied to the PHAI.

Application in the Environmental Assessments

Relatively early into the Port Hope and Port Granby Projects, one can identify the concept of adaptive management being applied during the environmental assessment process. Although similar in nature (projects involving remediation of historic LLRW), the Port Hope and Port Granby Projects were each subject to separate EAs because of their locations in different municipalities. Each EA was prepared as a Screening Report in accordance with the *Canadian Environmental Assessment Act*. The Screening Report for the Port Hope Project was completed in 2007 while the Screening Report for the Port Granby Project was concluded in 2009. Both Screening Reports were supported by extensive baseline investigations and project effect assessment studies that were completed with substantial involvement from communities and jurisdictional authorities. The reports concluded that neither project was likely to result in significant adverse environmental effects with mitigation measures taken into account.

It is important to note that the original conceptual project descriptions were based upon community ideas developed in the late 1990s. For the Port Hope Project it involved the construction of two long-term waste management facilities, one for Hope Township and one for the Town of Port Hope that would be located within three kilometres of each other. In the case of Port Granby, the community concept involved in-situ management of the waste at the existing site on the north shore of Lake Ontario.

For both of the project assessments, the proponent (AECL) was required to conduct an evaluation of alternative means of carrying out the projects. The scope required an investigation of alternative means of carrying out the projects that are technically and economically-feasible and the environmental effects of any such alternative means. Alternative means were understood to imply the various ways that are technically and economically-feasible, that are local and for the management of the wastes over the long term and are functionally similar to the project as proposed in the original project description document. They could range from methods of development, implementation and mitigation, to alternative transportation routes and locations.

The alternative means process was conducted in two steps. First, feasible concepts were identified through consultation with the public and other stakeholders. Secondly, the identified feasible concepts were individually evaluated on the basis of five considerations: technical, health and safety, community, economic and environmental. Following this evaluation, the concepts were compared to identify *qualified* concepts. For the Port Granby Project, the evaluations identified that rather than in-situ management, the qualified concept to be pursued should be a new long-term waste management facility constructed northwest of the existing site, hundreds of metres away from Lake Ontario, on lands owned by Cameco north of Lakeshore Road. The new long-term waste management facility would consist of an above-ground engineered containment

mound with a single composite base liner system and a low permeability final cover that would include a capillary drainage layer. With respect to transportation of the historic LLRW, it would be conducted via an internal restricted access roadway between the existing and new site, not on public roadways.

For the Port Hope Project, the evaluations identified a single long-term waste management facility for consolidation of all Port Hope waste, which would be developed on the property currently occupied by the WWMF. The new long-term waste management facility would consist of an above-ground engineered containment mound with a double composite base liner system and low permeability final cover. Sites in the former Town of Port Hope would be remediated by excavating the historic LLRW and transferring it by highway-licensed trucks to the new long-term waste management facility via prescribed public transportation routes within the community. It should be noted that in 2001 the Town of Port Hope and Hope Township amalgamated into one community – The Municipality of Port Hope.

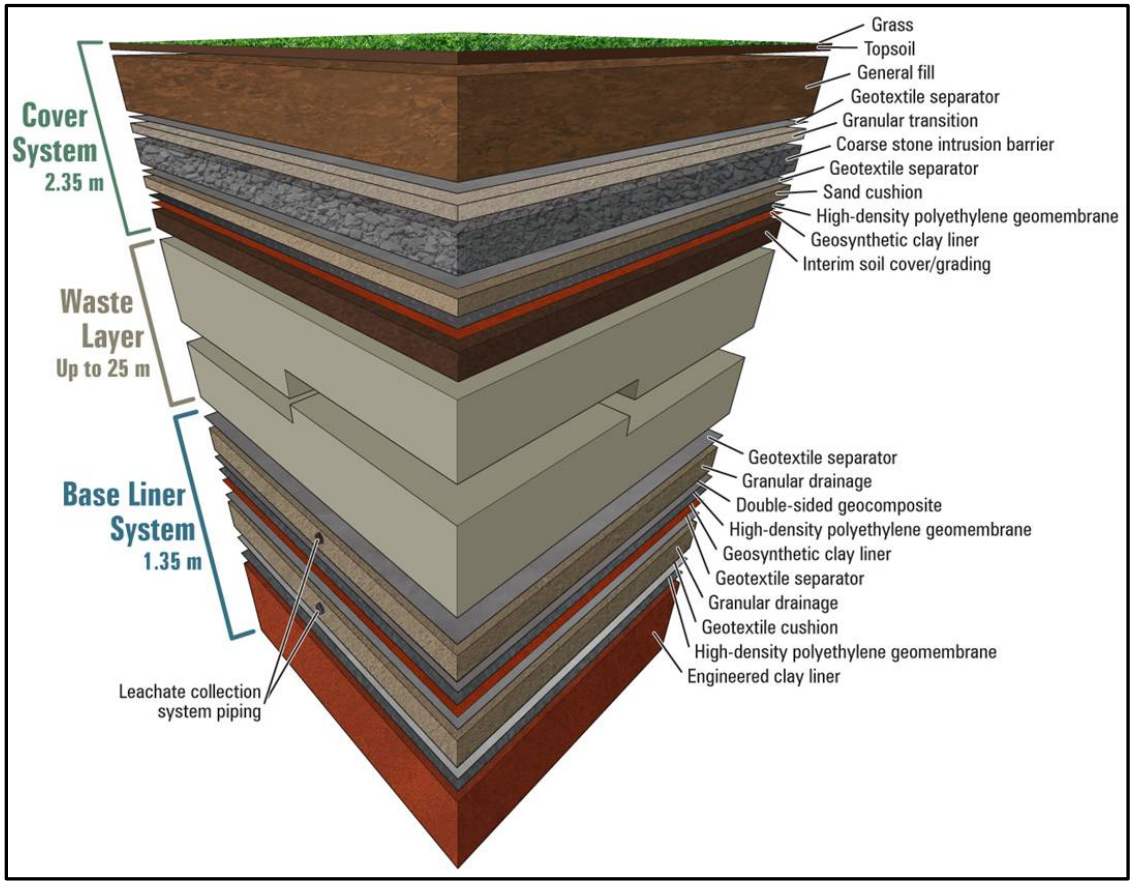


Figure 9: Above-Ground Engineered Mound Concept of the Future Port Hope Long-Term Waste Management Facility

Application to Biophysical Effects Monitoring

The Environmental Assessment Follow-up Program Plan describes the Follow-up Program for the Biophysical Environment. The biophysical effects Follow-up Program includes environmental aspects related to atmospheric, geology and groundwater, aquatic, and terrestrial components.

With respect to the atmospheric component, a comprehensive dust management plan has been developed to establish control and action limits and work stoppage requirements to ensure dust levels are kept within acceptable limits. Examples of management measures include application of water or mist (from mobile water trucks or static sources) to dust generating surfaces, washing construction vehicle wheels to limit dust traveling off-site, and paving of access roads to control dust during the various construction activities.

The results of the Follow-up Program will be used for implementing adaptive management measures and improving the quality of future environmental assessments. Adaptive management is an approach for responding to the actual monitoring data being received. If, for instance, monitoring indicates an environmental protection measure such as dust reduction at the construction sites is not working as expected, the adaptive management provisions ensure the changes needed to improve dust control practices are made and monitoring adjusted accordingly.

Currently, the monitoring conducted as part of the comprehensive dust monitoring plan implemented during the construction of the access roads and waste water treatment plants is being assessed from an adaptive management perspective. Early indications suggest that a network of remote telemetering dust monitors may provide a more effective deployment of resources rather than the current use of field staff for upwind and downwind sampling. The frequency of monitoring and environmental conditions at the time of sampling will also be assessed as part of this adaptive management process.

Continuing on the atmospheric theme, an assessment of dust monitoring data and corresponding locations is underway to determine the effectiveness and representativeness of the current network of monitoring stations. It is anticipated that the data will indicate that relocation or termination of some stations is warranted as well as the deployment of additional stations. The natural environment within the urban area of Port Hope with its many ravines will be an important consideration in the review process.

With respect to the geology and groundwater, and aquatic environments, baseline data collected over the past several years from monitoring wells and local area streams will undergo a comprehensive review and evaluation to determine if modifications and/or enhancements to the program are warranted. This evaluation will examine the existing program from the context of its applicability during the remedial work to monitor the effectiveness of mitigating actions, as well as its application for the long-term to monitor the effectiveness of the remedial actions in the improvement of groundwater and surface water quality. The groundwater assessment will look at all relevant sources of groundwater data in the Municipality of Port Hope and make recommendations on improvements to the PHAI groundwater monitoring program, in order to ensure the timely discovery of any potential impact from small-scale site remediations.

Application to Small-Scale Sites Investigations

The history of distribution of historic LLRW onto the small-scale properties in the community has varied. Near to the former Eldorado Nuclear Limited plant, there are properties that were impacted by airborne particulate emissions from the refinery stacks. In the larger community,

small-scale sites have been impacted by uncontrolled backfilling of low-lying areas using the structurally-sound process wastes available from the plant site during the 1930s through the 1950s. In addition, a very small number of properties have construction materials (e.g., lumber, steel beams and piping) that were removed from the plant site during demolition operations, and subsequently incorporated into the structures of homes.

Although much of the investigative work has been completed on the major waste occurrences in Port Hope, much work is still required to define the extent and details for the remediation of the small-scale sites and to develop contracts to implement the necessary remediation. The "small-scale sites" program involves the investigation of every property in Ward 1 of the Municipality of Port Hope and selected properties in Ward 2, yielding a total of approximately 5,000 properties to be studied. It is anticipated that of this total, roughly 425 will require some form of remedial cleanup work.

The small-scale site survey and cleanup program undertaken by the PHAI employs a new and more comprehensive list of cleanup criteria than those used by the Federal-Provincial Task Force on Radioactivity during the initial cleanup work conducted in the late 1970s. The investigation of the 5,000 properties has been initiated and is anticipated to take until 2017 to complete. The remedial cleanup of the approximately 425 sites is projected to take place between 2016 and 2020 when the mound at the Long-Term Waste Management Facility is open to receive waste from major remediation sites and these smaller scale sites.

The testing and remedial cleanup programs must address a suite of 21 Contaminants of Potential Concern (COPCs). However, for more than 20 years, only four of the 21 have been considered "signature parameters"[a], which can be used to reliably and indisputably identify historic LLRW. The first campaign of small-scale sites investigations was conducted on some 450 sites with samples from these sites being tested for the full suite of 21 COPCs. In parallel with these field investigations, two studies involving two sets of previously collected soil analysis data were underway to assess the premise that soil sample analysis for only the four signature parameters was required to confirm the presence of historic LLRW. The results of these studies validated the premise and concluded that although COPCs present in historic LLRW comprise 21 elements, analysis of the available data for thousands of samples of historic and marginally contaminated soil (MCS) from small-scale waste sites, the Port Hope Harbour, the Port Granby WMF and the Welcome WMF shows that contamination by historic LLRW invariably includes elevated concentrations of Ra-226, Th-230, arsenic and/or uranium above normal background concentrations. From an adaptive management perspective, the results of these studies have provided the necessary substantiation for the PHAI to put forward a recommendation that the list of analytes to be applied to soil testing be reduced to only include the four signature parameters. This recommendation has been supported by the Municipality of Port Hope and is under review by the CNSC. The use of these four signature parameters, rather that the full suite of 21, will result in efficiencies related to costs, scheduling and field time. The focus on the four signature parameters also results in data not being collected on parameters that may not be related to historic LLRW (e.g., lead) for which the Port Hope Area Initiative has no mandate to manage or remediate.

[a] *Signature parameters Ra-226, Th-230, uranium, and arsenic.*

CONCLUSION

The preliminary and enabling construction activities associated with the Port Hope Area Initiative, that includes the Port Hope and Port Granby Projects, are underway. As one would expect for an undertaking of this magnitude, momentum is slowly building towards the main construction and remediation activities. As this momentum builds, lessons learned during these initial stages are being compiled and assessed. These assessments are being applied in the context of adaptive management to enhance the efficiency, cost-effectiveness and cost-certainty of the Initiative. Already, enhancements and improvements are being identified and acted upon by the Initiative, proving the value of the adaptive management process. The process will continue to be applied throughout the remaining duration of the works to ensure the efficacy of this federally-funded undertaking [2].

The tender documents for the cleanup of the Port Hope area historic wastes and the construction of the long-term waste management facility mounds for the Port Hope and Port Granby Projects are anticipated to be released in 2014. The subsequent issuance of contracts will initiate the physical remediation component of the PHAI and will put assumptions used in the development of the contracts to the test. Ongoing monitoring and assessment will be part of this validation/ testing process yielding supportive or constructive lessons learned. It is important for the projects to recognize the value of this ongoing oversight and to be able to adapt and react appropriately to the findings.

REFERENCES

1. W. VAN VEEN and D. LAWRENCE, “From Pushing Paper to Pushing Dirt – Canada’s Largest LLRW Cleanup Gets Underway – 13111”, Phoenix, Arizona, USA, 2013 February 24-28, WM Symposium.
2. C. FAHEY, M. BLANCHETTE and T. PALMETER, “Finally Underway – Implementation of the Port Hope Area Initiative - 13151”, Phoenix, Arizona, USA, 2013 February 24-28, WM Symposium.