

Remediation of Residential Properties Contaminated with LLRW as Part of the Port Hope Area Initiative - 17456

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ABSTRACT

The Port Hope Area Initiative (PHAI) is a community-based solution for the long-term management of historic low level radioactive waste (LLRW) resulting from 60 years of uranium and radium processing operations in the urban setting of Port Hope, Ontario. The Eldorado refinery, on the shores of Lake Ontario, began refining Ra-226 from pitchblende ore, later transitioning to the refining of uranium ore. Within the community of Town of Port Hope, surveys are being conducted at approximately 5000 individual properties to identify the presence of LLRW resulting from fugitive emissions from the refinery and/or the use of refinery residue as construction backfill within the community. Of the 5000 properties being surveyed, it is expected that approximately 10% will contain some degree of LLRW requiring physical remediation.

The design phase for remediation of the first group of 44 residential properties to be included in the small scale sites program and the various challenges associated with working in a well-established community are presented. In developing the design packages for individual properties it is important to understand that this remedial phase represent the final and most intrusive aspect of the PHAI for those homeowners affected. As such, the success of the program is dependent on how well the needs and desires of the community and individual property owners are incorporated into the remedial designs and how well those designs are implemented to remove LLRW and restore properties to their original (or better) condition.

INTRODUCTION

The Port Hope Area Initiative (PHAI) is a community-based solution for the long-term management of historic low level radioactive waste (LLRW) in the Town of Port Hope, Township of Hope and the municipality of Clarington located on the north shore of Lake Ontario approximately 100 km east of the City of Toronto (Figure 1). A legal agreement between the government of Canada and the local municipalities forms the basis of the PHAI (1). The principal objective of this initiative is the identification, excavation and relocation of approximately 1.7 million cubic metres of low-level radioactive waste (LLRW) associated with the activities of the former Eldorado Gold Mines (which later became Eldorado Nuclear Limited) to two secure, long-term waste management facilities being constructed in the communities of Port Hope and Port Granby.



Figure 1: Port Hope, Ontario (courtesy of Port Hope Area Initiative)

The Eldorado refinery, which began refining radium-226 from pitchblende ore, later transitioning to the refining of uranium, generated considerable quantities of LLRW and plant residues. Process residues were deposited at the Welcome Waste Management Facility until the mid-1950s switching to the Port Granby Waste Management Facility that continued to accept waste until the late 1980s (2). Typical of many refineries of the era (i.e., prior to the recognition of the hazards associated with the waste material), processing waste, construction debris and contaminated soils were deposited at numerous locations in Port Hope, ostensibly for disposal, but often for re-use as fill and building materials resulting in contamination by LLRW at individual homes and properties (referred to as “small scale sites”) and larger undeveloped areas, ravines and the harbour turning basin (referred to as “large scale sites”). Properties close to the plant were also subject to deposition by material released to the air through normal or abnormal emissions.

Specific to the small scale sites program, property surveys have been conducted to: 1) identify those properties that have been impacted by LLRW; 2) delineate the extent of contamination, and 3) develop cost estimates for remediation. Identifying the presence of LLRW is based on multiple lines of evidence including: historical information; gamma radiation surveys; indoor radon gas testing; and confirmatory soil sampling for four signature contaminants (uranium, arsenic, radium-226 and thorium-230). Some 5,000 properties, most of which are residential, are being surveyed as part of the small scale sites program. Of the some 5000 properties to be surveyed, it is estimated that approximately 10% will require some form of remediation to remove LLRW that exceeds risk-based clean-up criteria.

Port Hope is an active and vibrant community and the PHAI management office has worked diligently to develop an effective working relationship with the community. For affected residents within the community, the remedial program for small scale sites program represents the final, and most intrusive chapter of the Port Hope Area Initiative, a program that began in the mid-1970s. As such, the success of the

program will largely depend on how well the needs and desires of the community and individual property owners are incorporated into the remedial designs and how well those designs are implemented to remove LLRW and restore properties to their original (or better) condition.

The principal challenge of residential remediation program involving the first set of 44 properties (Figure 2) is the development of remedial designs that strike an effective balance between the public health goal of removing of LLRW exceeding risk-based thresholds and the desire to minimize disruption to those valued features that help to define a neighborhood. While the small scale sites program also involves remediation of LLRW within affected homes, the present focus is on the challenges associated with exterior remedial designs only.



Figure 2: Remediation of First Group of Residential Sites - Port Hope, Ontario

METHODOLOGY

The presence of LLRW in the community of Port Hope is identified on the basis of high spatial resolution gamma surveys of private and public properties. Where LLRW is suspected, the gamma surveys are followed by intrusive subsurface investigations collecting soil samples from fill material at various depths to confirm the presence/absence of LLRW based on the analysis of four primary signature contaminants of concern (uranium, arsenic, radium-226 and thorium-230). LLRW is identified on the basis of analytical test results confirming one or more of the primary signature contaminants of concern exceeds the Port Hope Area Initiative Clean-up

Criteria.

The initial grouping of 450 properties assessed as part of the small scale sites program involved advancing some 2080 shallow boreholes (generally to 1.2 to 2.4 m below grade). Soil samples were screened using XRF and downhole gamma readings with approximately 4000 soil samples submitted to an accredited laboratory for chemical analysis. Where LLRW was not delineated with the first round of sampling, additional boreholes were completed to define the limits of LLRW.

Figure 3 provide an examples of the gamma survey results and the subsequent borehole drilling program for two adjacent properties.

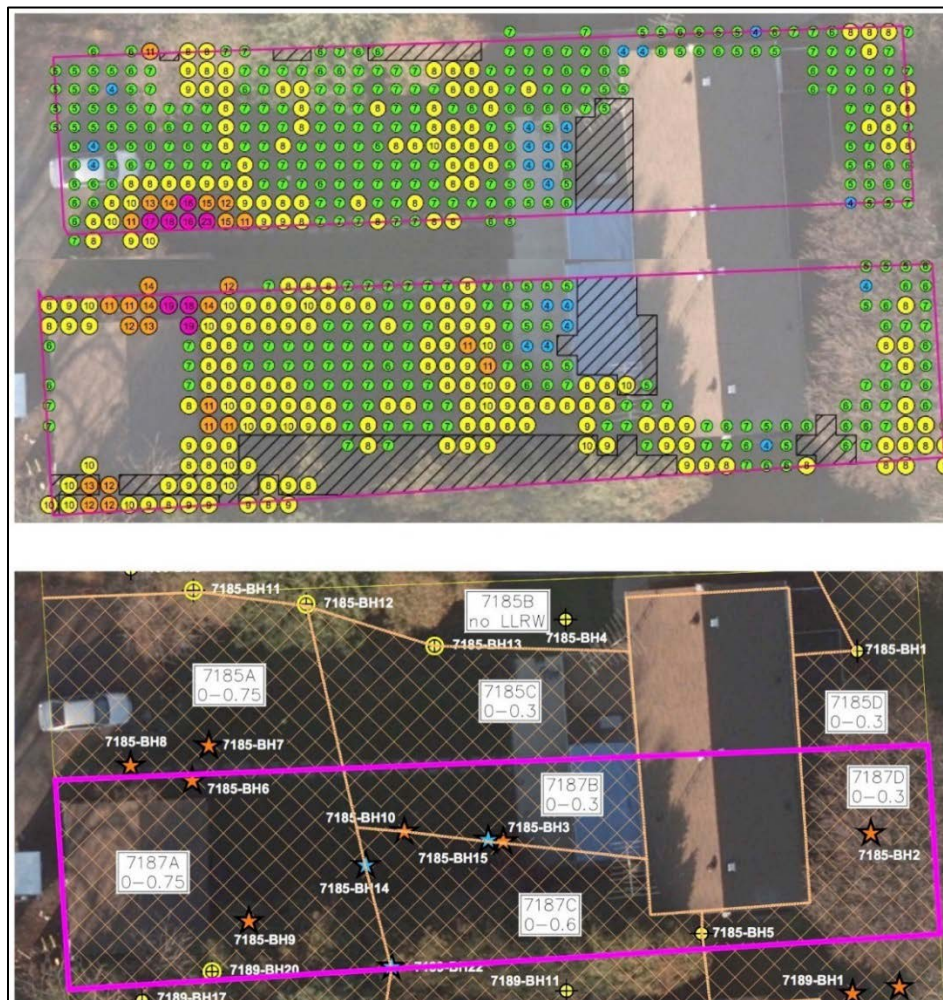


Figure 3: Top - Results of Gamma Radiation Survey (scale in $\mu\text{R/hr}$ – blue <5 , green 5-7; yellow 8-10; orange 11-15 and red >15) and Bottom - Soil Sampling (stars depict sample locations exceeding criteria; cross hatching depicts estimated extent of soil requiring removal; excavation depths shown in inset text boxes)

The results of the surveys, which were conducted by a separate contractor, were contaminant distribution profiles depicting the estimated horizontal and vertical extent of impact (Figure 3 bottom panel). Owing to the relatively wide spacing between boreholes and the fact that delineation is typically defined on the basis of the next nearest clean sampling location, contaminant distribution often extends across property boundaries and under significant features such as garages, decks, patios and mature trees. Accordingly, detailed remedial designs are required on a property-by-property basis to specify the horizontal and vertical limits of excavation; structural features to be demolished; landscaping features to be removed and replaced; laydown and staging areas; means of ingress/egress for residents etc.

The overall objective of the design packages, therefore, is to develop construction documents for tender. These are to cover:

- The safe removal of soil known to contain Low Level Radioactive Waste (LLRW) exceeding PHAI Clean-up Criteria (CC);
- Ensuring the work is completed in compliance with the Canadian Nuclear Safety Commission license governing the work, agreements with the Municipality of Port Hope and all applicable regulations;
- Minimizing disruption to homeowners and members of the community;
- Recognizing and being sensitive to features of cultural and community importance;
- Ensuring the design and process for developing the design builds on Lessons Learned from earlier remediation programs undertaken in Port Hope and from comparable programs undertaken elsewhere, and that Lessons Learned during the course of the project are captured and used as the basis for continuous improvement; and
- Recognizing the balance between the need for additional investigation to better refine limits of excavation/removal and the consequences of doing so in terms of project schedule, project

Lessons Learned

A trial survey of 35 small scale sites completed in Port Hope in 2010 provides several learnings that are directly applicable to this design project (PHAI, personal communication, April 25, 2016). The trial identified that communication with property owners throughout the process is key to a successful outcome. The property owner must be fully aware of when the work is going to begin, the extent of the work, how and when they can access their property safely, when the work is to be completed, and who to contact in case of complaints or warranty claims. In addition, during the execution of the work, property access, dust control, control of run-off water, safety and general housekeeper were all identified as being critical to a resident's perception of the quality and success of the program.

IMPLEMENTATION

Community Engagement

Maintaining the community's strong support for the overall program that has been fostered by the PHAI management office is a critical outcome of the work. During the course of the project, residents were engaged during the initial stages to arrange for and accommodate the following:

- Property surveyors to accurately determine property boundaries, locations of major structural features and topography.
- Utility locating to identify and located all public and private utilities.
- Species at risk survey to identify the presence of species at risk and/or their habitat
- Landscaping architects and arborists to inventory landscaping features; and
- Engineering teams to identify document structural features to be demolished and replaced or protected in place.

Residents were contacted to accommodate initial field work using trained staff who followed a standard talk track to arrange for property access. Prior to undertaking field work, all field staff received community awareness training that covered everything from obeying traffic speed limits, to how to behave when staying in the community and frequenting stores and restaurants. While in the field staff deployed a sign informing people of work in the area (Figure 4) and carried cards containing contact information for the PHAI Public Information Exchange. These were provided to anyone who had any questions that could not be addressed in the field.



Figure 4: Daily Notification of Work in the Community

Once preliminary designs are available depicting the extent of remediation and restoration activities for each property, a critical element is the need to meet with each homeowner to review the design and obtain their input. As participation in the program is purely voluntary (unless licensable quantities of waste are identified), it is important to reiterate to the homeowner the importance of the program, the long-term risk associated with LLRW and to address any concerns related to the overall design. This includes not only what the property will look like post-remediation but also such things as property access during construction activities, safety of pets, relocation and storage of any personal property that needs to be moved to accommodate construction, and property restoration. Considering the intrusive nature of the remediation/restoration activities, multiple meetings with property owners will be necessary to ensure any concerns they had are understood and reflected in the final designs.

Design Challenges

There are many design challenges that needed to be managed and accounted for in the remediation/restoration designs, ranging from building integrity issues to maintaining the look and feel of the community. Some of the more significant design challenges are discussed briefly below.

Conformance with the Ontario Building Code – Any work that is undertaken on a building or structure must conform to the Ontario Building Code. This means that in those cases where decks are removed from buildings to access soil underneath or where outbuildings are demolished to access contaminated soil, non-conforming features cannot be retained in the new design (Figure 5). In those instances it is important to recognize these potential non-conformances such that the property owner is fully informed and aware of the consequences of any changes to a building or structure. Similarly, there needs to be recognition of the cost of demolition/restoration of structures in relation to any health benefits realized from the remedial program.



Figure 5: Examples of non-conforming Structures (Deck left - exterior plumbing on an outbuilding right)

Vegetation and Topography – The area undergoing remediation lies in an older part of Port Hope where there are steep transitions between properties (Figure 6). The remedial design needs consider how best to excavate soil in these areas and reestablish the slope without leading to significant erosion and concerns over slope stability. The design also needs to consider how best to revegetate to maintain the natural topography, preserve privacy and maintain the look and feel of the established community.



Figure 6: Examples of Steep Topography and Heavy Vegetation

Maintaining Structural Stability of Adjacent Buildings – For most properties, excavation will abut existing houses, and while the depth of excavation will rarely exceed 0.6 metres, there are a number of instances where existing foundations are damaged (Figure 7). Considering the potential for further damage to the structure during excavation, foundations will need to be inspected and shored or repaired as necessary prior to construction.



Figure 7: Examples of Damaged Foundations

Miscellaneous – A variety of other design challenges have been encountered that needed to be accommodated during project execution. As the majority of houses are of older construction on large lots, they contain a number of outbuildings that are used variously as storage, garages and/or shop spaces (Figure 8). Prior to demolition, contents will need to be inventoried, labelled, and packaged for off-site storage. Similarly, landscaping features such as pools, gardens, privacy fences need to be documented such that when removed, they are replaced with items of similar size and functionality.



Figure 8: Examples of Miscellaneous Features

SUMMARY

The remediation of LLRW on residential properties in Port Hope represents the final, and likely most intrusive chapter of the Port Hope Area Initiative, a program that began in the mid-1970s. As such, the success of the program will largely depend on how well the needs and desires of the community and individual property owners are incorporated into the remedial designs and how well those designs are implemented to remove LLRW and restore properties to their original (or better) condition.

The design team, while needing to understand the overall objective of removing LLRW for the long-term benefit of the community, also needs to recognize and be sensitive to the unique qualities that define a neighbourhood. Beyond these overarching challenges, each residential property presents its own unique challenges that need to be effectively addressed in consultation with the homeowner to ensure an effective balance is achieved between remedial goals of the program and the desires of the homeowner in terms of property restoration.

As this is the first of many neighborhoods in Port Hope that will undergo a soil remedial program, a critical success criterion for this project will be maintaining and enhancing the positive relationship that had been fostered by the PHAI management office with the community. This will require frequent and effective communication with homeowners and other stakeholders (e.g. the Municipality of Port Hope) ensuring concerns are identified and effectively addressed in both the design of the remedial program and its execution.

REFERENCES

1. An Agreement for the Clean-up and Long-Term Safe Management of Low-Level Radioactive Waste Situate in the Town of Port Hope the township of Hope and the Municipality of Clarington 2001 (as amended 2006, 2009)
2. Government of Canada, Environmental Assessment Screening Report for the Port Hope Long-Term Low-Level Radioactive Waste Management Project, 2006 December.