

THE FORT McMURRAY HISTORIC URANIUM CLEANUP PROJECT

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ABSTRACT

The Fort McMurray Historic Uranium Cleanup Project involved the removal of 42,000 m³ of soils contaminated with uranium ores and ore concentrates from various properties in the City of Fort McMurray, Alberta. These soils were placed into long-term management in a dedicated, locally developed and secure facility. The soil contamination addressed by the program was the result of incidental spillage and tracking of ores during the unloading of barges and the loading of rail cars as materials were transported via Fort McMurray from uranium mines in the Northwest Territories to a refinery in Port Hope, Ontario. The project was executed over a 10-year time period, involved the participation of the local community at critical junctures, and restored 28 ha of land to productive use.

1.0 INTRODUCTION

In recent years, the re-development of former industrial properties has been a vexing problem for communities across North America. Environmental liabilities that might remain following the rehabilitation of these properties are oftentimes difficult to fully define. This uncertainty hampers investment and delays the return of sites to productive use. It is this uncertainty that is at the heart of the brownfields redevelopment issue many jurisdictions are finding difficult to practically address. Brownfield redevelopment in a context of low-level radioactive waste (LLRW) is particularly problematic given that opportunities for remediation are effectively limited to removal and transfer of the contaminants; and disposal facilities for such materials are not presently available.

The Fort McMurray Historic Uranium Cleanup Project offers an example of the successful treatment of brownfields redevelopment in a context of LLRW. This success was achieved through community involvement and the commitment of proponents, regulators and the public to find and apply workable solutions.

2.0 THE PROBLEM

From the 1930s until the 1960s, a 2,200 km water transportation network (shown on Figure 1) was used by the Northern Transportation Company Limited (NTCL) to carry uranium ore and ore concentrates from Port Radium, Northwest Territories on Great Bear Lake to the barge-to-rail transfer point in Fort McMurray, Alberta. From Fort McMurray, the ore was transported by rail car to its final destination in Port Hope, Ontario for refining.

In the summer of 1992, during investigations of transfer points along the water route, elevated levels of radioactivity were discovered on riverside properties in the Lower Town site of Fort McMurray. It is suspected that incidental spillage and tracking during unloading of barges and loading of railcars were the causes of the contamination. Subsequent investigations identified additional properties adjacent to the Clearwater River in the Lower Town areas of Fort McMurray affected by uranium ore contamination (see Figure 2). The uranium contamination was considered a historic waste and therefore fell under the mandate of the Low-Level Radioactive Waste Management Office (LLRWMO). The LLRWMO is a department within Atomic Energy of Canada Limited (AECL) that administers the federal government's responsibilities for the management of historical low-level radioactive waste.

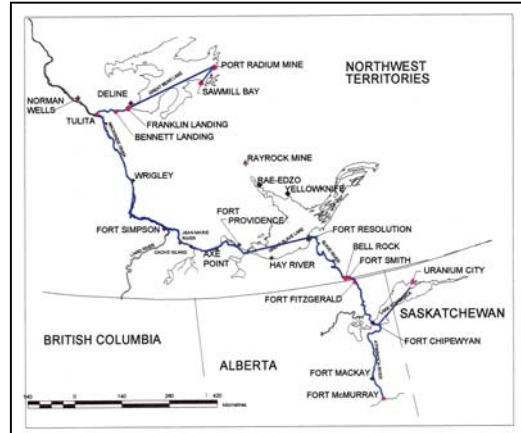


Figure 1: The Northern Transportation System



Figure 2: Uranium Cleanup Sites in Fort McMurray

3.0 FINDING A SOLUTION

A program of public consultation and engagement was initiated in 1992 to identify possible solutions to the uranium ore contamination and to guide the execution of remedial plans. A Working Group comprised of the local municipality, regulators, health authorities and the LLRWMO was maintained as work was planned and executed.

The LLRWMO and the Working Group developed a solution that involved removing the materials from the subject sites and placing them into long-term management in a dedicated cell at the local municipal landfill site. (*Note: For the purpose of the project, “long term” was not defined; however, it was intended that the facility remain in service until an alternative repository, probably intended to serve on a national scale, could be developed. A design objective of the storage cell was that it be capable of safely accommodating the stored materials for several decades.*)

4.0 RESOLVING THE PROBLEM

Cleanup of contaminated soils in the Lower Town area began in the fall of 1992, following a waste management plan developed by the Working Group. The plan provided for mildly contaminated soil, known as Category B material, to be placed in the management cell constructed at the municipal landfill. Materials considered low-level radioactive waste, or Category A material, were shipped to the LLRWMO storage facility at Chalk River Laboratories in Chalk River, Ontario. Between 1993 and 1995, a total of eight properties in the Lower Town area were remediated. Cleanup of the last remaining property in the Waterways area was planned and undertaken between 2000 and 2003.



The Storage Facility

4.1 Waste Volumes and Characteristics

Contaminated materials generated by the Fort McMurray cleanups completed between 1992 and 1995 were categorized as follows for purposes of material handling and long term management:

- *Category A Materials* — Materials that exhibited a uranium concentration at or above 500 ppm and that therefore required a licence under the Atomic Energy Control Act, which was in force at the time.
- *Category B Materials* — Materials that exhibited a uranium concentration less than 500 ppm but above one or more of the cleanup criteria for uranium (30 ppm), arsenic (30 ppm) or radium₂₂₆ (0.1 Bq/g). This was mainly mildly contaminated soil with an average uranium concentration that had been estimated at 50 ppm or less. It was defined and treated as industrial waste.
- *Category C Materials* — Materials that, on average, did not exceed any of the cleanup criteria for uranium, arsenic or radium₂₂₆, but might have contained occasional rocks with elevated amounts of one or more of these elements.



Cleanup Operations in Lower Town

With the promulgation of the *Nuclear Safety and Control Act (NSCA)* in 2000, the distinction between soils with uranium levels above and below 500 ppm was no longer relevant in a licensing context. From the Canadian Nuclear Safety Commission's (CNSC) perspective, decisions concerning licensing of radioactively-contaminated materials were now to be based on the total inventory of radionuclides rather than their specific activity. For the final stage of the Project, carried out during 2000-2003 the contaminated soils were categorized as 'Above 500 Soils' [materials with uranium concentrations above 500 µg/g, (i.e., micrograms of uranium per gram of soil); the former Category A materials] and 'Below 500 Soils' (soils with uranium concentrations below 500 µg/g; the former Category B materials). About 42,000 m³ of 'Below 500' and 25 m³ of 'Above 500' materials were addressed by the Historic Uranium Cleanup Project.

4.2 Cleanup Criteria

The principal contaminants of concern for the Fort McMurray Cleanup Project were radium, arsenic and uranium. The cleanup criteria adopted by the Working Group for these parameters were as follows:

- *radium*: 0.1 Bq/g
- *arsenic*: 30 µg/g
- *uranium*: 30 µg/g

These criteria were selected on the basis of unrestricted future use of the lands, including residential use. While this kind of development was unlikely for the lands in question over the near term, it was felt that adopting relatively conservative criteria was an appropriate way of minimizing long-term land use restrictions. The bases for selection of the criteria were as follows:

- *radium*: 0.1 Bq/g was near the upper end of background values determined by the project to exist in Fort McMurray;
- *arsenic*: 30 µg/g was the value promulgated by the Canadian Council of Ministers of the Environment¹ for residential/parkland developments (it is noted that the CCME criterion for arsenic has since been reduced to 12 µg/g); and
- *uranium*: 30 µg/g was selected on the premise that the human health and ecological risks posed by uranium are less than those associated with arsenic and that it would therefore be conservative to use the same criterion for both parameters.

4.3 Regulatory Status

Most industrial wastes in Alberta are addressed by the *Waste Control Regulation* under the province's *Environmental Protection and Enhancement Act*. The WCR includes a blanket exclusion for any materials regulated under the *Nuclear Safety and Control Act*. This means that the affected soils at the Fort McMurray sites, as licensable materials under the NSCA, were under the exclusive regulatory control of the CNSC. Based on the above and considering the volume of such soils and the entrained radionuclides, their management was required to be in accordance with the federal *Nuclear Safety and Control Act*.

4.4 Site Remediation

Remedial construction procedures for projects of this type have been developed over a number of years and generally involve the utilization of conventional earthmoving equipment and techniques. The non-conventional aspects typically relate to the methods used to identify materials requiring excavation and the particular regard that must be given to the health and safety of workers and the protection of the environment and the public. A comprehensive program of environmental monitoring and health and safety management was implemented throughout the Project.



**Contaminated Soil
Identification and Excavation**

¹ Interim Canadian Environmental Quality Criteria for Contaminated Sites. CCME. Prepared by the CCME Subcommittee on Environmental Quality Criteria for Contaminated Sites. CCME EPC-CS34, Winnipeg, Manitoba.

'Below 500' soil removal was carried out in a series of 15-cm cuts until no elevated gamma radiation readings were measured at the surface of the area. The target surface gamma radiation field for an excavated area was 8 μ R/hr (average), which was about the upper end of background gamma radiation in Fort McMurray.

Confirmatory surveys on a five metre grid were undertaken after the excavation with an Exploranium GR-256 portable gamma radiation spectrometer. Areas identified by these methods as exceeding the 'Below 500' criterion for radium₂₂₆ were further excavated and re-measured. Soils Samples were collected from the base of the completed excavations and analysed for all three parameters of concern by the LLRWMO Field Services Laboratory in Port Hope to verify that the cleanup objectives had, in fact, been met.



Confirmatory Testing

4.5 Restoration

Once the verification program confirmed that the project cleanup criteria were satisfied, completed excavations were backfilled and restored. This involved importing subsoils, compacting to a specified density and covering with a 100 mm layer of imported topsoil. Finished surfaces were then seeded.



Restored River Bank

4.6 Soil Transportation

Contaminated soils were hauled via truck to the long-term management facility in accordance with a Project-specific Transportation Emergency Response Plan. All trucks were tarped, signed and confirmed clear of extraneous contamination before leaving either the subject site or the long-term management facility, and were required to follow a designated haul route.



Truck Tarping



Truck Monitoring

4.7 Long-Term Management Facility (LTMF)

The contaminated materials excavated from the subject sites were transferred into long-term management at a dedicated facility constructed at the Fort McMurray landfill site. The management facility is a secure structure equipped with engineered containment, cover and leachate management systems.

Upon arrival at the LTMF the soils were managed using traditional construction equipment and procedures, modified to consider necessary health physics and radiation control aspects. The soils were placed in lifts, each with compaction control to minimize subsequent settlement and any associated adverse effects on cell features. As areas of the cell were brought to final grade, the cover was placed progressively so as to minimize potential adverse effects of the elements on the work in progress.



Soil Placement at LTMF

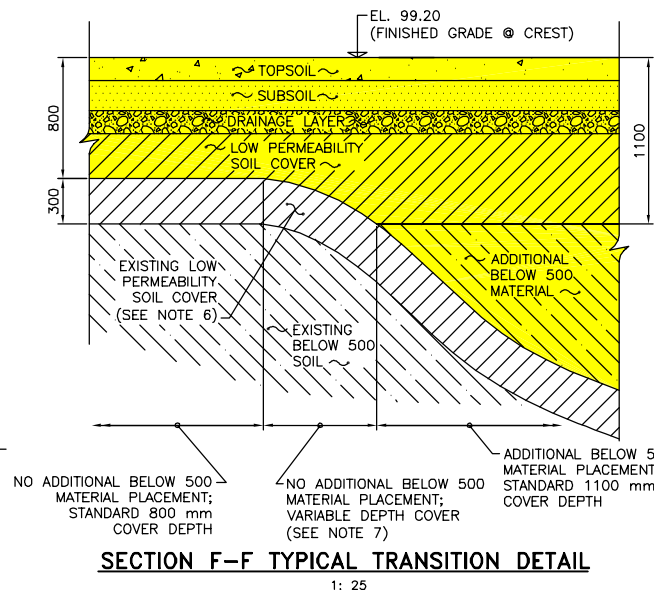
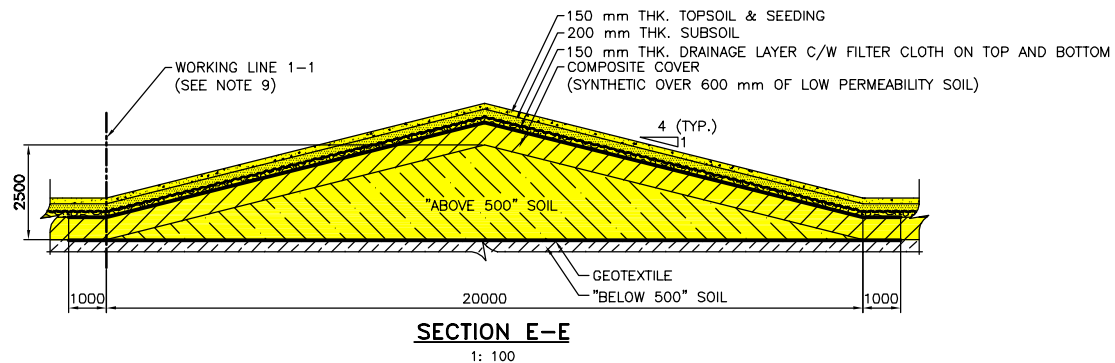
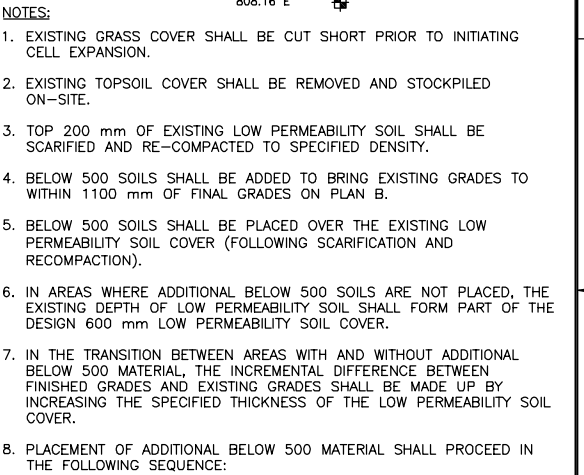
The following features or protocols were applied as the LTMF was developed:

- *Contamination Control Procedures* – a set of operating protocols designed to prevent the spread of both chemical and radioactive contamination and, as such, mitigate potential radiological impacts to the public, workers and the environment;
- *Utilization of Dedicated Equipment* – as part of the contamination control program, equipment was dedicated exclusively to site operations to ensure that all potentially contaminated items were maintained within a restricted area until such time as they had been monitored and decontaminated;
- *Erosion Control* – dust control protocols were applied to mitigate wind erosion and surface waters were directed and stored in ways that minimized sediment transport; and
- *Monitoring* – a comprehensive monitoring program was put in place to ensure that radiological exposures to workers and the public were maintained within acceptable limits.



Monitoring Equipment

Following completion of the LTMF, a program of long-term management, surveillance and monitoring was implemented to demonstrate that the facility is performing as designed and is in compliance with regulatory standards. This program was developed to fulfill the LLRWMO's obligations with respect to monitoring that are outlined in a legal agreement with the Regional Municipality of Wood Buffalo.



5.0 PUBLIC CONSULTATION – THE KEY TO SUCCESS

5.1 Consultation Program Overview


An effective process of engaging and informing the local community was always an integral component of the Historic Uranium Cleanup Project. A public participation program was implemented through the Working Group that guided the planning and implementation of the Project. In addition to the Working Group as key stakeholders, the consultation program extended into the community in several ways, including:

- local community consultation through one-on-one interviews and tracking of concerns and issues;
- information events (e.g., open houses) conducted in the community at appropriate project junctures; and
- media notices to advise the public about the project and its progress, and to provide details regarding pending information events.

5.2 Working Group (2000-2003 Phase)

For the final 2000-2003 phase of the Project, the Working Group was re-assembled and included representatives from the following organizations:

- *Regional Municipality of Wood Buffalo* – representatives from the municipality's waste management and planning and development departments;
- *Alberta Environment* – representation was from the Northeast Boreal Region Fort McMurray office;
- *Northern Lights Regional Health Authority* – advised about local health concerns;
- *Canadian Nuclear Safety Commission* – the CNSC was the regulator for the Project;
- *Low-Level Radioactive Waste Management Office* – the LLRWMO was the Project proponent;
- *Marshall, Macklin, Monaghan Limited* – provided Project management support to the LLRWMO;
- *Owner* – the owner(s) of the affected lands; and
- *AMEC Earth and Environmental* – the technical consultants to the LLRWMO.



Low-Level Radioactive
Waste Management Office

Historic Uranium Clean-up Project at Waterways


Information Sheet #2 – Project Update
Fall 2002

Last Uranium Contaminated Site in Fort McMurray to be Remediated

After several months of planning, environmental assessment, and public and regulatory consultation, clean-up of the uranium-contaminated soils on the CN property in the community of Waterways is about to begin.

The contamination at the Waterways site is the result of spillage during the barge-to-rail transfer of uranium ore shipped from the Northwest Territories between the 1930s and the 1960s.

The Waterways site is the ninth and last known site of uranium contamination to be cleaned up in Fort McMurray. Two Open Houses have been held in the community during the past year to provide opportunity for the public to offer input to the clean-up and to review the environmental assessment.




Fall Clean-up

The work at Waterways is expected to begin in late September and extend through October. The contaminated soil will be excavated and transported during an estimated three-week interval during this period. Excavation will be followed by about a two-week period of transporting backfill into the site.

Approximately 4,000 cubic metres of contaminated soil from the Waterways site will be excavated and transferred to an existing containment cell at the Fort McMurray landfill. The cell was initially developed in 1993 to accommodate the materials resulting from the clean-ups carried out during the mid-1990s. It currently contains about 30,000 cubic metres of contaminated soils.

Construction activities associated with the clean-up program will be carried out by local contractors working under the direct supervision of the Low-Level Radioactive Waste Management Office (LLRWMO) and its engineering consultants. The LLRWMO represents the Government of Canada in the management of historic low-level radioactive waste for which no other owner can reasonably be held responsible.



Fact Sheet

5.3 Public Open Houses

To gather public opinions and answer questions about the Historic Uranium Cleanup Project, several public open houses were held in Fort McMurray, at key project junctures. Large panel displays were a central component of all Open Houses and provided information about:

- historic transportation routes that transported uranium and radium from Great Bear Lake to points in Fort McMurray;
- the public consultation process for the cleanup of the subject sites;
- the processes that would be used to excavate and transport the uranium wastes to the LTMF; and
- details of how the wastes would be stored.



Open House Display

5.4 Overview of Community Perspectives

Many of the stakeholders indicated that they were pleased that the sites would finally be cleaned-up. Following the inconvenience of the waste material hauling, the general feeling in the community was that past industrial activities were being addressed and that remediation of the sites would make Fort McMurray a more attractive community to live in and visit. In relation to many of the social and economic issues that this community was dealing with, this Project was viewed as a “good news” story.

6.0 THE RESULT

The end result of the Historic Uranium Cleanup Project has been that nine properties covering about 28 ha have been made available for alternate uses. Many of these properties are in prime commercial locations, and as a consequence, have already been redeveloped into retail outlets. This rehabilitation was completed at minimal risk to the community and by devoting only 1.5 ha of non-productive land to the long-term management of contaminated materials. In short, the Historic Uranium Cleanup Project is a prime example of the successful rehabilitation of brownfield sites, even as they may be complicated by the presence of LLRW.



Re-Developed Site

7.0 PARTICIPANTS

Owner: Atomic Energy of Canada Limited (AECL) through the Low-Level Radioactive Waste Management Office (LLRWMO)

Consultant: AMEC Earth & Environmental

Contractor: H. Wilson Industries, Ltd.

Other Key Participants: Marshall, Macklin, Monaghan Limited
Regional Municipality of Wood Buffalo
Alberta Environment
Northern Lights Regional Health Authority
Canadian Nuclear Safety Commission