



NUCLEAR WASTE SOCIÉTÉ DE GESTION
MANAGEMENT DES DÉCHETS
ORGANIZATION NUCLÉAIRES

August 27, 2012

The City of Elliot Lake
45 Hillside Drive North
Elliot Lake, ON P5A 1X5

Attn: Mayor Rick Hamilton

Re: Adaptive Phased Management Initial Screening – The City of Elliot Lake

Dear Mayor Hamilton,

Further to the City of Elliot Lake's request to Learn More about the Adaptive Phased Management program and request for an initial screening, I am pleased to attach a report outlining the findings from the initial screening, as described in the Process for Selecting a Site for Canada's Deep Geological Repository for Used Nuclear Fuel (May, 2010). As you know, the purpose of the initial screening in Step 2 of the process is to determine whether, based on readily-available information and five screening criteria, there are any obvious conditions that would exclude the City of Elliot Lake from further consideration in the site selection process.

As the report indicates, the review of readily available information and the application of the five initial screening criteria did not identify any obvious conditions that would exclude the City of Elliot Lake from further consideration in the NWMO site selection process. The areas considered in the initial screening comprise geological formations that are potentially suitable for hosting a deep geological repository for Canada's used nuclear fuel. It is important to note that this initial screening has not confirmed the suitability of your community. Should your community choose to continue to explore its potential interest in the project, your area would be the subject of progressively more detailed assessments against both technical and social factors. Several years of studies would be required to confirm whether a site within your area could be demonstrated to safely contain and isolate used nuclear fuel.

The process for identifying an informed and willing host community for a deep geological repository for the long-term management of Canada's used nuclear fuel is designed to ensure, above all, that the site which is selected is safe and secure for people and the environment, now and in the future. The NWMO expects that the selection of a preferred site would take between seven to ten years. It is important that any community which decides to host this project base its decisions on an understanding of the best scientific and social research available and its own aspirations. Should the City of Elliot Lake continue to be interested in exploring the project, over this period there would be ongoing engagement of your community, surrounding communities and others who may be affected. By the end of this process, Elliot Lake as a whole community would need to clearly demonstrate that it is willing to host the repository in order for this project to proceed.

The next evaluation step would be to conduct a feasibility study as described in Step 3 of the site selection process. This feasibility study would focus on areas selected in collaboration with the community. As your community considers whether it is interested in advancing to the feasibility study phase, the NWMO encourages you to continue community discussion and further learning about the project. Support programs are available to assist your community to reflect on its long-term vision and whether this project is consistent with achieving that vision. Programs and resources are also available to engage your community residents in learning more about this project and becoming involved. We would be very pleased to provide further information about these programs.

Once again, I thank you for taking the time to learn about Canada's plan for the safe, secure management of Canada's used nuclear fuel.

Sincerely,

A handwritten signature in blue ink that reads "Kathryn Shaver". The signature is written in a cursive style.

Kathryn Shaver,
Vice President, APM Engagement and Site Selection

Cc: Rob deBortoli, CAO

SUMMARY REPORT

Initial Screening for Siting a Deep Geological Repository for Canada's Used Nuclear Fuel

City of Elliot Lake, Ontario

Revision: 0 (Final)

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Nuclear Waste Management Organization
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Document ID: 10-214-5_Elliot Lake Summary Report_R0

August 24, 2012

Title:	SUMMARY REPORT Initial Screening for Siting a Deep Geological Repository for Canada's Used Nuclear Fuel, City of Elliot Lake, Ontario	
Client:	Nuclear Waste Management Organization	
Document ID:	10-214-5_Elliot Lake Summary Report_R0	
Revision Number:	0	Date: August 24, 2012
Prepared by:	Dru Heagle, Sean Sterling, Vanessa Scharf	
Reviewed by:	Kenneth Raven	
Approved by:	 Kenneth Raven	

EXECUTIVE SUMMARY

On March 12, 2012, the City of Elliot Lake expressed interest in learning more about the Nuclear Waste Management Organization (NWMO) site selection process to find an informed and willing community to host a deep geological repository for Canada's used nuclear fuel (NWMO, 2010). This report summarizes the findings of an initial screening, conducted by Geofirma Engineering Ltd., to evaluate the potential suitability of the City of Elliot Lake against five screening criteria using readily available information (Geofirma Engineering Ltd., 2012). The purpose of the initial screening is to identify whether there are any obvious conditions that would exclude the City of Elliot Lake from being further considered in the site selection process. The initial screening focused only on the areas within the boundaries of the City of Elliot Lake. Areas within neighboring municipalities were not included in the initial screening.

The review of readily-available information and the application of the five initial screening criteria did not identify any obvious conditions that would exclude the City of Elliot Lake from being further considered in the NWMO site selection process. The initial screening indicates that the City of Elliot Lake contains portions of lands that are potentially suitable for hosting a deep geological repository. The bedrock geology in these areas is dominated by the Ramsey-Algoma Granitoid Complex, which covers the southern third and some northern parts of the City and extends well beyond the municipal boundaries to the north and east. Rocks of the Huronian Supergroup and the Whiskey Lake Greenstone Belt in the northern part of the City are likely unsuitable for hosting a deep geological repository due to their compositional heterogeneity, structural complexity and potential for natural resources.

It is important to note that at this early stage of the site selection process, the intent of this initial screening was not to confirm the suitability of the City of Elliot Lake to host a deep geological repository, but rather to identify whether there are any obvious conditions that would exclude it from the site selection process. Should the City of Elliot Lake remain interested in continuing with the site selection process, more detailed studies would be required to confirm and demonstrate whether the City of Elliot Lake contains sites that can safely contain and isolate used nuclear fuel. The process for identifying an informed and willing host community for a deep geological repository for Canada's used nuclear fuel is designed to ensure, above all, that the site which is selected is safe and secure for people and the environment, now and in the future.

The five initial screening criteria are defined in the site selection process document (NWMO, 2010) and relate to: having sufficient space to accommodate surface and underground facilities, being outside protected areas and heritage features, absence of known groundwater resources at repository depth, absence of known economically exploitable natural resources and avoiding known hydrogeologic and geologic conditions that would make an area or site unsuitable for hosting a deep geological repository.

1 INTRODUCTION

In May 2010, the NWMO published and initiated a nine-step site selection process to find an informed and willing community to host a deep geological repository for Canada's used nuclear fuel (NWMO, 2010). The site selection process is designed to address a broad range of technical and social, economic and cultural factors as identified through dialogue with Canadians and Aboriginal peoples, and draws from experiences and lessons learned from past work and processes developed in Canada to site facilities for the management of other hazardous material. It also draws from similar projects in other countries pursuing the development of deep geological repositories for used nuclear fuel. The suitability of potential candidate sites will ultimately be assessed against a number of site evaluation factors, both technical and social in nature.

The site evaluation process includes three main phases over a period of several years, with each step designed to evaluate the site in progressively greater detail upon request of the community. These are: Initial Screenings (Step 2) to evaluate the potential suitability of the community against a list of initial screening criteria; Feasibility Studies (Step 3) to determine if candidate sites within the proposed areas may be potentially suitable for developing a safe used nuclear fuel repository; and Detailed Site Evaluations (Step 4), at one or more selected sites, to confirm suitability based on detailed site evaluation criteria. It is up to the communities to decide whether they wish to continue to participate in each step of the process.

2 OBJECTIVE OF THE INITIAL SCREENING

The overall objective of the initial screening is to evaluate proposed geographic areas against a list of screening criteria, using readily available information. Initial screening criteria require that:

- 1) The site must have enough available land of sufficient size to accommodate the surface and underground facilities.
- 2) This available land must be outside of protected areas, heritage sites, provincial parks and national parks.
- 3) This available land must not contain known groundwater resources at the repository depth, so that the repository site is unlikely to be disturbed by future generations.
- 4) This available land must not contain economically exploitable natural resources as known today, so that the repository site is unlikely to be disturbed by future generations.
- 5) This available land must not be located in areas with known geological and hydrogeological characteristics that would prevent the site from being safe, considering the safety factors outlined in Section 6 of the Site Selection Document (NWMO, 2010).

For cases where readily available information is limited and where assessment of some of the criteria is not possible at the initial screening stage, the area would be advanced to the feasibility study stage for more detailed evaluation, if the community remains interested in participating in the siting process.

3 INITIAL SCREENING ASSESSMENT

This section provides a summary evaluation of each of the five initial screening criteria for the City of Elliot Lake, based on readily available information. The intent of this evaluation is not to conduct a detailed analysis of all available information or identify specific potentially suitable sites, but rather to identify any obvious conditions that would exclude the City of Elliot Lake from being further considered in the site selection process.

The City of Elliot Lake is approximately 845 km² in size. It is located on the north shore of Lake Huron approximately 160 km west of Sudbury.

Screening Criterion 1: The site must have enough available land of sufficient size to accommodate the surface and underground facilities.

The review of readily available information shows that the City of Elliot Lake contains sufficient land to accommodate the repository's surface and underground facilities. Surface facilities will require a land parcel of about 1 km by 1 km (100 ha) in size, although some additional space may be required to satisfy regulatory requirements. The underground footprint of the repository is about 1.5 km by 2.5 km (375 ha) at a typical depth of about 500 m.

Review of available mapping and satellite imagery shows that developed areas and large water bodies occupy only a small portion of the City of Elliot Lake. Although the City has a large range in topographic elevations, most of the City is unconstrained by topography.

The review of readily-available geological information also suggests that the City of Elliot Lake contains sufficient volumes of potentially suitable host rock at depth to accommodate the repository's underground facilities (see screening criterion 5).

Screening Criterion 2: Available land must be outside of protected areas, heritage sites, provincial parks and national parks.

The review of readily available information shows that the City of Elliot Lake contains sufficient land outside of protected areas, heritage sites, provincial parks and national parks to accommodate the repository's facilities.

The City of Elliot Lake was screened for federal, provincial and municipal parks, conservation areas, nature reserves, national wildlife areas and archaeological and historic sites using available data. Parts of the Blind River Provincial Park, Matinenda Provincial Park and the Glenn N. Crombie Conservation Reserve lie within the City of Elliot Lake. Overall these protected areas occupy a small percentage of the total area of the City. There are three known archaeological sites within the City, but these are localized and small in size.

The absence of locally protected areas and heritage sites would need to be confirmed in discussion with the community and Aboriginal peoples in the area during subsequent site evaluation stages, if the community remains interested in continuing with the site selection process.

Screening Criterion 3: Available land must not contain known groundwater resources at the repository depth, so that the repository site is unlikely to be disturbed by future generations.

The review of available information did not identify any known groundwater resources at repository depth (typically 500 m) for the City of Elliot Lake. The Ontario Ministry of the Environment Water Well Records indicate that no potable water supply wells are known to exploit aquifers at typical repository depths in the City of Elliot Lake or anywhere else in Northern Ontario. Water wells in the City of Elliot Lake source water from overburden or shallow bedrock aquifers at depths of up to 107 m.

Experience in similar geological settings across the Canadian Shield suggests that the potential for deep groundwater in the Ramsey-Algoma Granitoid Complex resources at repository depths is low throughout the City of Elliot Lake. Active groundwater flow is generally confined to localized shallow fractured systems, in the upper 300 m. At greater depth, permeability tends to decrease as fractures become less common and interconnected. Groundwater at such depths is also generally saline. The absence of groundwater resources at repository depth would need to be confirmed during subsequent site evaluation stages, if the community remains interested in continuing with the site selection process.

Screening Criterion 4: Available land must not contain economically exploitable natural resources as known today, so that the repository site is unlikely to be disturbed by future generations.

Based on the review of available information, the City of Elliot Lake contains sufficient lands, free of known economically exploitable natural resources, to accommodate the required repository's facilities.

The City of Elliot Lake has a negligible potential for oil and gas resources. There are currently no operating mines within the City of Elliot Lake. There are, however, five past producing mines with reserves and seven without reserves. The potential for economically exploitable natural resources, such as copper, iron and uranium, in the City of Elliot Lake is associated with specific geological units such as the Huronian Supergroup and the Whiskey Lake Greenstone Belt. The natural resource potential of the Ramsey-Algoma Granitoid Complex is for the most part low.

Extraction of sand and gravel has occurred in the City of Elliot Lake in the past and continues today. However, the risk that these resources pose for future human intrusion and breaching of the repository is negligible, as quarrying operations are typically limited to the near surface.

Screening Criterion 5: Available land must not be located in areas with known geological and hydrogeological characteristics that would prevent the site from being safe, considering the safety factors outlined in Section 6 of the Site Selection Document.

Based on the review of available geological and hydrogeological information, the City of Elliot Lake includes portions of land that do not contain obvious known geological and hydrogeological conditions that would make the area unsuitable for hosting a deep geological repository.

The safety-related geoscientific factors outlined in Section 6 of the Site Selection Document (NWMO, 2010) relate to: safe containment and isolation of used nuclear fuel; long-term resilience to future geological processes and climate change; safe construction, operation and closure of the repository;

isolation from future human activities; and amenability to site characterization and data interpretation activities. At this early stage of the site evaluation process, where limited data at repository depth exist, these factors are assessed using readily available information, with the objective of identifying any obvious unfavourable hydrogeological and geological conditions that would exclude the City of Elliot Lake from further consideration. They would be gradually assessed in more detail as the site evaluation process progresses and more site specific data is collected during subsequent evaluation phases, provided the community remains interested in continuing in the site selection process.

Safe Containment and Isolation

The geological and hydrogeological conditions of a suitable site should promote long-term containment and isolation of used nuclear fuel and retard the movement of any potentially released radioactive material. This requires that the repository be located at a sufficient depth, typically around 500 m, in a sufficient rock volume with characteristics that limit groundwater movement. The review of readily available information indicates that the City of Elliot Lake contains areas with no obvious geological and hydrogeological conditions that would fail the containment and isolation requirements.

Approximately half of the City of Elliot Lake is underlain by felsic gneissic intrusive rocks of the Ramsey-Algoma Granitoid Complex, which covers the southern third of the City of Elliot Lake, as well as some areas in the northern part of the City. This granitic complex extends over large areas beyond the City boundaries to the east and to the north. The Ramsey-Algoma Granitoid Complex is a multiphase intrusive complex composed of massive to foliated granitic and gneissic rocks and is laterally very extensive. Diamond drill holes east of the City of Elliot Lake indicate a thickness of granitoid rocks of at least 1.6 km. The granitic rocks of the Ramsey-Algoma Granitoid Complex appear to have favourable geological characteristic and sufficient rock volume (lateral extent and thickness) to potentially host a deep geological repository.

The bedrock in the northern two thirds of the City of Elliot Lake consists of mostly metasedimentary rocks of the Huronian Supergroup, and rocks of the Whiskey Lake Greenstone Belt. The Huronian Supergroup comprises a succession of coarse-grained metasedimentary units arranged in layers of varying thicknesses. The metasedimentary package is highly deformed, fractured and it is structurally complex. Although the Huronian Supergroup may have sufficient overall thickness and lateral extent, these rocks are unlikely to be suitable for hosting a deep geological repository due to unsuitable geological characteristics, structural complexity and lithological heterogeneity. The Whiskey Lake Greenstone Belt is also unlikely to be suitable for hosting a deep geological repository. It is also lithologically heterogeneous, highly deformed, fractured and structurally complex.

From a hydrogeological point of view, the review of readily available information did not reveal the existence of known deep fracture systems or deep aquifers within the City of Elliot Lake. The presence of active deep groundwater flow systems in crystalline rocks is controlled by the frequency and interconnectivity of fractures at depth. Experience from other areas in the Canadian Shield, particularly for granitic intrusions, indicates that active groundwater flow tends to be generally limited to shallow fractured systems, typically less than 300 m. In deeper rock, fractures are less common and less likely to be interconnected, leading to very slow groundwater movement.

Long-term Stability

A suitable site for hosting a repository is a site that would remain stable over the very long-term in a manner that will ensure that the performance of the repository will not be substantially altered by future geological and climate change processes, such as earthquakes or glaciation. A full assessment of this geoscientific factor requires detailed site specific data that would be typically collected and analyzed through detailed field investigations.

At this early stage of the site evaluation process, the long-term stability factor is evaluated by assessing whether there is any evidence that would raise concerns about the long-term hydrogeological and geological stability of the City of Elliot Lake. The review did not reveal any obvious geological or hydrogeological conditions that would clearly fail to meet the long-term stability requirement for a potential repository within the City of Elliot Lake.

The City of Elliot Lake is located in the Superior Province and the Southern Province of the Canadian Shield, where large portions of land have remained tectonically stable for the last 1.75 billion years. There is also no evidence to suggest that the faults identified in the City of Elliot Lake have been tectonically active within the past billion years. The geology of the City of Elliot Lake is typical of many areas of the Canadian Shield, which has been subjected to numerous glacial cycles during the last million years. Glaciation is a significant past perturbation that could occur in the future. However, findings from studies conducted in other areas of the Canadian Shield suggest that deep crystalline formations, particularly the plutonic intrusions, have remained largely unaffected by past perturbations such as glaciation.

Potential for Human Intrusion

The site should not be located in areas where the containment and isolation functions of the repository are likely to be disrupted by future human activities such as exploration or mining. This factor has already been addressed in previous sections, which concluded that the potential for groundwater resources at repository depths and known economically exploitable natural resources is low in the Ramsey-Algoma Granitoid Complex. Potential for mineral resources in the Huronian Supergroup and in the Whiskey Lake Greenstone, however, is high.

Amenability to Construction and Site Characterization

The characteristics of a suitable site should be favourable for the safe construction, operation, closure and long-term performance of the repository. This requires that the strength of the host rock and in-situ stress at repository depth are such that the repository could be safely excavated, operated and closed without unacceptable rock instabilities; and that the soil cover depth over the host rock should not adversely impact repository construction and site investigation activities. Similarly, the host rock geometry and structure should be predictable and amenable to site characterization and interpretation activities.

From a constructability perspective, limited site specific information is available on the local rock strength characteristics and in-situ stresses for the City of Elliot Lake. However, available information from similar geological settings suggests that crystalline rock formations within the Canadian Shield, particularly within plutonic intrusions, generally possess geomechanical characteristics that are good

to very good and amenable to the type of excavation activities involved in the development of a deep geological repository for used nuclear fuel.

In terms of predictability, the review of readily-available information on the bedrock geology and Quaternary geology for the City of Elliot Lake did not indicate any obvious conditions which could make the Ramsey-Algoma Granitoid Complex difficult to characterize, although conditions such as thick overburden cover may exist in localized areas. Because of their compositional variability and high degree of deformation, the rocks of the Huronian Supergroup and of the Whiskey Lake Greenstone Belt are not amenable to characterization.

The degree to which factors such as geologic variability and overburden thickness might affect the characterization and data interpretation activities of the granitoid intrusions would require further assessment during subsequent site evaluation phases, provided the community remains interested in continuing in the site selection process.

4 INITIAL SCREENING FINDINGS

This report presents the results of an initial screening to assess the potential suitability of the City of Elliot Lake against five initial screening criteria using readily-available information. As outlined in NWMO's site selection process (NWMO, 2010), the five initial screening criteria relate to: having sufficient space to accommodate surface and underground facilities, being outside protected areas and heritage sites, absence of known groundwater resources at repository depth, absence of known economically exploitable natural resources and avoiding known hydrogeologic and geologic conditions that would make an area or site unsuitable for hosting a deep geological repository.

The review of readily available information and the application of the five initial screening criteria did not identify any obvious conditions that would exclude the City of Elliot Lake from further consideration in the NWMO site selection process. The initial screening indicates that the City of Elliot Lake contains areas that are potentially suitable for hosting a deep geological repository. The bedrock geology in these areas is dominated by the Ramsey-Algoma Granitoid Complex, which covers the southern third and some northern parts of the City and extends well beyond the municipal boundaries to the north and east. Rocks of the Huronian Supergroup and the Whiskey Greenstone Belt in the northern part of the City are likely unsuitable for hosting a deep geological repository due to their compositional heterogeneity, structural complexity and potential for natural resources.

It is important to note that at this early stage of the site evaluation process, the intent of the initial screening was not to confirm the suitability of the City of Elliot Lake, but rather to identify whether there are any obvious conditions that would exclude it from further consideration in the site selection process. Should the City of Elliot Lake remain interested in continuing with the site selection process, several years of progressively more detailed studies would be required to confirm and demonstrate whether the City of Elliot Lake contains sites that can safely contain and isolate used nuclear fuel.

The process for identifying an informed and willing host community for a deep geological repository for Canada's used nuclear fuel is designed to ensure, above all, that the site which is selected is safe and secure for people and the environment, now and in the future.

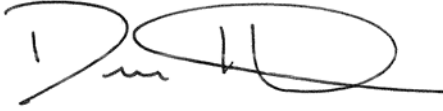
5 REFERENCES

Geofirma Engineering Ltd., 2012. Initial Screening for Siting a Deep Geologic Repository for Canada's Used Nuclear Fuel – City of Elliot Lake, Ontario. Final Report Reference No. 10-214-5, August 24.

NWMO, 2010. Moving Forward Together: Process for Selecting a Site for Canada's Deep Geological Repository for Used Nuclear Fuel, Nuclear Waste Management Organization. (Available at www.nwmo.ca)

6 REPORT SIGNATURE PAGE

Respectfully submitted,
Geofirma Engineering Ltd.



Dru Heagle, Ph.D., P.Geo.
Senior Geoscientist



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Principal