PLANNING THE DECOMMISSIONING OF THE CANADIAN UNDERGROUND RESEARCH LABORATORY

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ABSTRACT

After more then twenty-one years of activity, Atomic Energy of Canada Limited (AECL) is planning to decommission the Canadian Underground Research Laboratory (URL). The URL was designed and constructed by AECL to carry out *in situ* geotechnical research and development work needed for the Canadian Nuclear Fuel Waste Management (CNFWM) program. The URL is now entering a decommissioning phase, the final phase of several phases that have included siting, site evaluation, construction and operation. Comprehensive plans are being prepared to ensure that the site is returned to a safe and environmentally secure state. The requirements and obligations identified in the site leases, screening documents, federal and provincial legislation and agreements under the CNFWM program applicable to the restoration of the URL lease area are discussed in this paper.

INTRODUCTION

The Underground Research Laboratory (URL) near Lac du Bonnet, Manitoba, Canada is now in its 21st year of operation. Shaft collar site selection and the start of surface facility construction occurred in 1982. The URL is situated in a granite batholith towards the western edge of the Precambrian Canadian Shield (Figure 1). Atomic Energy of Canada Limited (AECL) constructed the facility to provide a representative geological setting for research and development activities in support of the Canadian Nuclear Fuel Waste Management (CNFWM) program [1].

The URL is situated on land leased from the Province of Manitoba. The leases comprise land and mineral rights for a four-square-kilometre area located in the Rural Municipality of Lac du Bonnet. AECL has a 31-year surface and a 34-year underground mineral lease for the URL site from the province of Manitoba, currently expiring in 2011 and 2014, respectively. These leases have been extended once in the past, and AECL can apply for future extensions, if warranted. Detailed environmental screening to identify all potentially adverse impacts that could result from the construction and operation of the URL was carried out prior to starting the construction of the facility in 1983 and again in 1987 prior to a major project to deepen the shaft and extend the facilities. The screening led to the conclusion that the URL project was unlikely to create any adverse environmental effects for most potential areas of impact. Design solutions or mitigative actions were identified for those areas where there could be adverse effects.

In Canada, over 25 years has been spent advancing the technologies for disposal of nuclear fuel waste from nuclear reactors. Between 1978 and 1996, AECL took a lead role in developing the disposal technology. AECL's multidisciplinary research and development program has contributed to defining a robust conceptual design for an underground repository. Results from research at the URL were used in the assessment of the feasibility and safety of deep geological disposal as documented in an Environmental Impact Statement (EIS) [2]. The Federal Environmental Assessment Panel that conducted a public review of the disposal concept [3] acknowledged that, from a technical perspective, the safety of Canada's concept for nuclear fuel waste disposal was adequately demonstrated.

Upon completion of the public hearings for review of the EIS in 1997, AECL and Ontario Power Generation Inc. (OPG) moved forward together into the next phase, which has been the development of technologies required for design and construction of a deep geologic repository. Since 1997, OPG, the principal producer of nuclear fuel waste in Canada, has assumed the responsibility under its Deep Geologic Repository Technology Program (DGRTP). The current status of nuclear fuel waste management in Canada and the role of the URL is summarized by Chandler [4]. At present, a public process for reviewing the various options available for long-term management of Canada’s spent fuel is ongoing. OPG and AECL continue to work to address identified technological gaps in the DGRTP, should a decision be made for Canada to move towards eventual construction of a deep geologic repository.

Over the years of operation, a comprehensive program of geologic characterization and underground R&D projects provided data on the mechanical, thermal, geochemical and hydrogeologic properties of the Lac du Bonnet granite pluton, typical of intrusive igneous rock that is widely spread across the Canadian Shield. Relationships between natural characteristics studied from surface (local and regional flow studies) and underground were assessed. Interactions between various engineered components and natural systems were modeled and evaluated. In situ measurement of excavation damage to the rock and investigations of alternative repository-sealing methods were carried out. Environmental surveillance and monitoring has been conducted throughout the operation of the URL site, the results of which are archived. Collaboration in the URL projects was encouraged and has resulted in global cooperation and participation with other waste management organizations.

GEOLOGICAL SETTING OF THE URL

A site or preferred siting region for nuclear fuel waste disposal has not been identified in Canada. The disposal concept specified in the EIS stated only that the site would be located somewhere in intrusive igneous rock in the Canadian Precambrian Shield at a depth of between 500 and 1,000 m. The Canadian Shield has a wide distribution, and occupies millions of square kilometres, roughly half of the size of Canada (Fig. 1). The URL is located within the Canadian Shield in the Lac du Bonnet granite batholith (Fig. 1). The batholith is one of a number of similar post-tectonic and post-metamorphic batholiths within the Bird River and Winnipeg River sub-provinces of the Canadian Shield [5]. The batholith has an areal extent of 1,400 km^2 on surface and extends in depth to between 6 and 25 km. The granite at the URL is approximately 2.6 billion years old.

The URL has much to offer as a generic site for conducting studies into storage and disposal of nuclear fuel waste. The site has interesting and varied geology and is crosscut by two low-dipping thrust faults, or fracture zones (Fig. 1). There is also a deeper third thrust fault that dies out below the URL excavation. Structural domains between the faults can be distinguished by the presence of intrusions and segregations and by the pattern and frequency of subvertical fracturing, as well as by differing in situ stress regimes.

People who visit the URL often leave with the impression that the site is a large sparsely fractured block of predominately intact granite. This impression is supported by observing only one water-bearing fracture as they walk around the main test levels at depths of 240 m and 420 m below surface. However, visitors do not generally have an opportunity to observe the fracture zones and associated splays and the 200 m of subvertical fracturing nearer to the surface. Actually, experiments conducted at the URL make use of five geologically diverse testing regions as identified in Fig. 1. These include:

1. 5 km^2 of exposed granite outcrop on the surface of the URL lease;
2. Zones of highly fractured rock in three fracture zones or thrust faults;

3. Moderately fractured rock with an inter-connected fracture network;
4. Low-to-moderately stressed sparsely fractured rock; and
5. Highly-stressed sparsely fractured rock in a region of high pore water salinity.

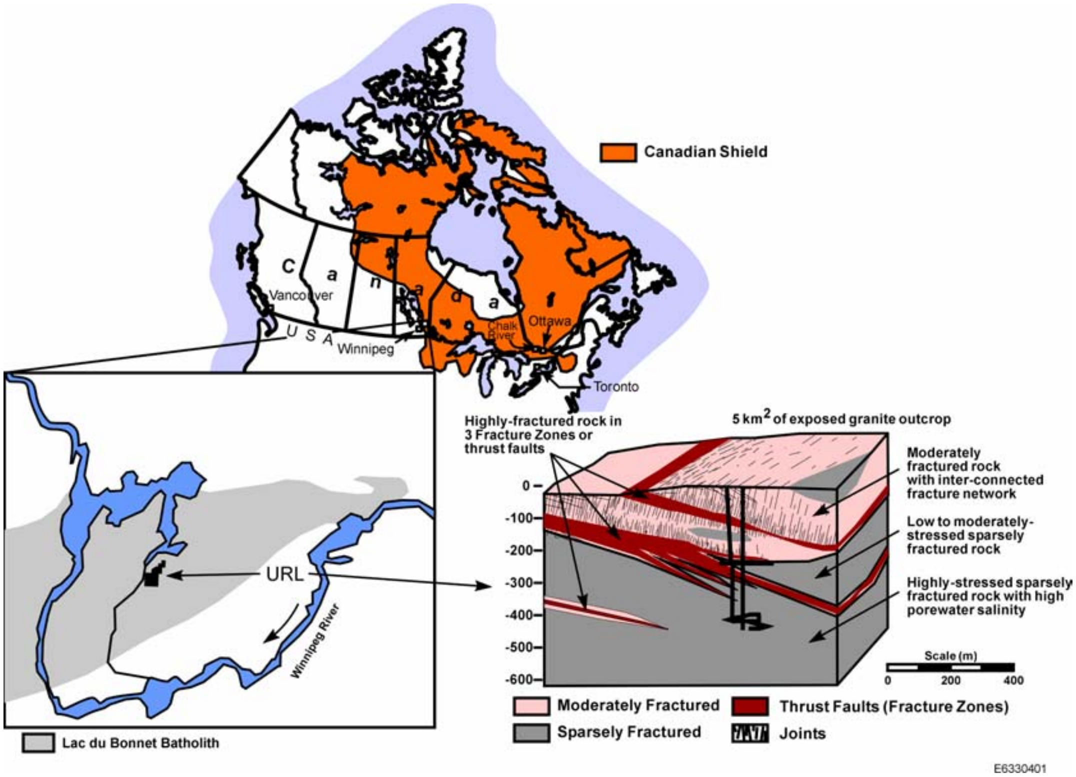

Fig. 1 The location of the URL within the Canadian shield (above) and the geologic setting of the URL.

PHASES OF THE URL

The siting of the URL facility, the initial evaluation phase, construction and lessons learned in developing the operating phase experiments have been described previously [6, 7] and therefore will be discussed briefly in this paper.

Siting Phase

The URL siting phase started in 1978. A regional reconnaissance was performed to identify a suitable location for an underground research facility on the Lac du Bonnet batholith. A small set of screening criteria was established for selecting a site. The site had to be larger than 1 km^2, be predominantly outcrop, and be undisturbed by previous excavations. The site had to be within, but not close to, well defined hydrologic boundaries. The site had to be accessible, near power, near AECL's Whiteshell Laboratories and available for lease. Eight potential sites were identified, with the current site chosen as the one best meeting the screening criteria [8].

Site Evaluation Phase

The site evaluation phase was carried out between 1980 and 1983. The objective was to develop an approach to characterization that would provide the necessary information for designing and constructing a repository in granite. This phase was also directed at providing site-specific information for the design, construction and safe operation of the URL facility, and the design of experiments and interpretation of results. It involved surface mapping, airborne and ground geophysical surveys, surface water and meteorological data collection, and the drilling of shallow boreholes for piezometric measurements. Drilling of seven deep, cored boreholes and a number of shallower boreholes intended for use in a hydrogeologic monitoring system, followed these initial surveys [9]. The detailed characterization revealed three low-dipping fracture zones that controlled the large-scale patterns of groundwater movement and groundwater chemistry within the rock mass (Fig. 1). The location of the shaft was specified in a region with moderate fracture zone permeability to allow access to proposed areas of future underground experiments. Based on the experience gained at the URL, an approach to underground characterization for a deep geologic repository has been developed [10]. The objective of such a program would be to obtain information for optimizing the design of excavations and engineered barriers and to provide a baseline against which to monitor the performance of a repository during its operation and following its closure.

Construction Phase

Shaft collar excavation and construction of the surface facilities took place during 1982 and 1983. Excavation of the URL shaft to a depth of 255 m began in 1984 May and continued for the remainder of the year [11]. The current URL excavations are illustrated in Fig. 2. The loop of horizontal excavations on the 240 Level (240 m below surface) and the raise-bored ventilation shaft were completed by 1987. The main shaft was extended to a depth of 443 m in 1988 [12, 13, 14, 15], followed by excavation of the 420 Level and the ventilation shaft over the following three years. The URL construction phase [11, 16] adhered to the observational method, following a design process similar to that followed on many large geotechnical construction projects. Design specifications were based on evolving characterization information. The primary objective was always to provide a safe and efficient underground research facility. The design-as-you-go (or observational) method adopted for the construction phase was aimed at minimizing construction and operating costs, providing underground access to a variety of hydrogeologic and geomechanical environments, and accommodating development and evaluation of characterization techniques during construction. During all phases of URL development, research activities generally had priority over construction activities, although the objectives of both were not always divergent. The guiding principle was to maximize the benefit to the research program in order to best achieve the objectives set out for the URL.

Operating Phase

The program of URL operating phase experiments was developed in 1989 and underwent ongoing peer review by a panel of leading Canadian scientists. The peer review panel and the AECL experiment managers together defined experimental priorities and objectives, which were subsequently reviewed and approved by the URL Experiment Committee [17]. The planned URL program included seven major operating phase experiments, and two experimental programs:

1. Solute Transport in Highly Fractured Rock Experiment
2. Solute Transport in Moderately Fractured Rock Experiment
3. Grouting Experiment
4. Buffer/Container Experiment
5. Shaft Sealing Experiment
6. Mine-by Experiment
7. Multi-Component Experiment

8. In Situ Stress Program
9. URL Characterization Program

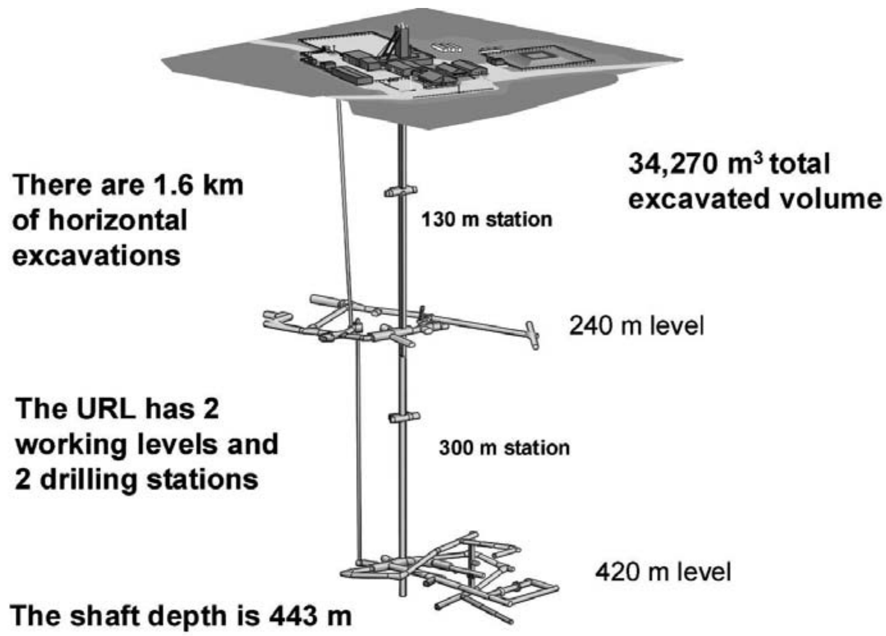

Fig. 2 The underground research laboratory excavations

The initial operating phase experimental program was started in 1990, six years after the beginning of URL shaft construction. As of 2004, seven of the nine operating phase experiments and experimental programs have been completed. The exceptions are the Grouting Experiment (although experimental grouting activities have been completed) and the Multi-Component Experiment. The Shaft Sealing Experiment was redesigned to become the Tunnel Sealing Experiment (TSX).

Evolution of the Operating Phase

The URL experimental program performed before 1997 had somewhat different objectives than the experiment program carried out later. Public hearings for the EIS were held in 1996 and AECL was given an opportunity to present field evidence from in situ experiments. Most of the initial operating experiments were completed by 1996. The results of these experiments were very useful in addressing some of the concerns held by the Environment Assessment Panel after their initial review of the EIS documentation. Subsequently, OPG as the principal waste owner, assumed responsibility for experimental programs that supported the plan for the management of Canada's spent fuel. This included responsibility for underground experiments and demonstrations in support of their Deep Geologic Repository Technology Program (DGRTP). OPG directly funded a large portion of the costs associated with the operation and maintenance of the URL. Also during this time, organizations from Japan, France and the USA were collaborating on major experiments at the URL such as the Tunnel Sealing Experiment and the Quarried Block Radionuclide Migration Experiment. Thirty-five experiments, studies or experimental programs have been carried out. These are listed under four broad experimental categories in Table I.

Table I URL program of experiments

Solute Transport	**Excavation Damage/Excavation Stability**
• Highly Fractured Rock (HFR) • Moderately Fractured Rock (MFR) • Quarried Block Radionuclide Migration Experiment (QBRME) • JAERI Rockmass Experiment • In Situ Diffusion Experiment • EDZ Solute Transport Test • Recharge Infiltration Experiment (RIEX) • URL Hydrogeological Monitoring **Materials and Sealing Studies** • Buffer/Container Experiment (BCE) • Isothermal Buffer-Rock-Concrete Plug • Interaction Test (ITT) • Fracture Zone Grouting Experiment • High Pressure Grouting Simulator • Large Concrete Blocks • Light Backfill Placement Trials • Seal and Interface Evaluation / Effect of Salinity (SEAS) • Buffer-Coupon Long-Term Test (BCLT) • Dedicated Microbial Borehole and Microbial Studies • Concrete-Rock Interface Study (CRIS)	• Room 209 Excavation Response Test • In Situ Stress Measurement Program and Stress Characterization in Deep Boreholes and Fractured Rock • Room 209 Excavation Response Test • ANDRA Engineered Blast Feasibility Study • Mine-by Excavation Response Test • Room 209 Connected Permeability Test • Heated Failure Tests (HFT) • Blast Damage Assessment Study (BDA) • Mine-by Connected Permeability Test • Excavation Stability Study (ESS) • Thermal-Hydraulic Experiment (THE) • Thermal-Mechanical Stability Study (TMSS) **Multi-disciplinary** • URL Characterization Program • Composite Seal Experiment (CSE) • Tunnel Sealing Experiment (TSX) • Engineering Design of Repository Sealing Systems (ENDRES)

Decommissioning Phase

In 2003 OPG informed AECL that an operating underground laboratory was no longer required to meet the objectives of their DGRTP. As a result, the decision was made by AECL to plan the decommissioning of the URL.

The URL is therefore currently entering a decommissioning phase. Legislative requirements, the scope of work, and costs associated with the operational shutdown and decommissioning of the URL facility will be addressed in a decommissioning plan, currently being prepared by AECL. It will be returned to the Province of Manitoba according to the conditions established in the URL environmental screening documents prepared by Pollock and Barrados in 1983 [19] and the land and minerals leases provided by the Province of Manitoba. Effort, to the extent considered reasonable by the regulators, will be made to minimize the possibility of polluting, contaminating or diminishing the purity of the groundwater and environment in the surrounding areas. Where necessary, equipment and furnishing from the URL site boreholes, surface and underground facilities will be removed. Open fractures, whether in boreholes, underground tunnels and raises or the shaft, will be sealed. The shaft and return-air ventilation raise open to surface will be covered with bulkheads constructed of reinforced concrete resting on bedrock or a reinforced concrete collar, as required by the Province of Manitoba Workplace Safety and Health Act and Mining Regulations.

DECOMMISSIONING STRATEGY

The first nine months (2003 June to 2004 March) of the Decommissioning Phase includes a planning phase for the creation and submission of the decommissioning plan, development of an environmental assessment proposal, implementing a decommissioning quality assurance plan, and creation of the necessary work instructions required to start the decommissioning activities. The environmental assessment proposal is expected to be submitted for acceptance by the Province of Manitoba in 2004. Subsequent site investigation activities are planned to take place during more accessible warmer months, possibly requiring three or four summer seasons to complete the full suite of planned investigations.

The shutdown of experiments currently operating underground, such as the Tunnel Sealing Experiment (TSX) and the Composite Sealing Experiment (CSE), will commence early in the 2004 calendar year. Underground equipment and services can be removed from some of the areas not required to support the operational shutdown of operating experiments or continued operation of the underground facilities. Major underground decommissioning activities are expected to commence in the summer of 2004, after completion of the TSX and CSE decommissioning and sampling activities,

Dismantling Strategy and Methodology

Generally, activities will progress from the lower levels up to surface and farthest from the shaft to closest. The plans for dismantling experiments and removing hydrogeological equipment from boreholes will dictate where the dismantling of services, equipment and fixtures will take place. The large number of tunnels and rooms underground will ease the coordination of technical and operational activities. Problems that may arise in the removal of experimental equipment, borehole equipment and/or grouting of boreholes should have minimal effect on overall schedule, as there are numerous areas free of experiments suitable for shutdown in the meantime.

Services will continue to be provided to areas in which the operation or dismantling of experiments requires them. As tunnels and rooms are cleared of experimental equipment and boreholes are sealed, they will be stripped of their services, fixtures and protective wire mesh, and the entrance to these areas will be barricaded to prevent access. Ventilation and emergency egress requirements will be considered in the sequence of tunnel closure planning.

Equipment, services and furnishings will be removed from 300 Level and the 420 Level, in each case retreating towards the shaft (Fig. 2). While the shutdown activities on the 300 and 420 Levels are proceeding, hydrogeological equipment will be removed from the boreholes. Following completion of decommissioning activities on the 420 Level, the ventilation raise furnishings connecting the 240 and 420 Levels will be removed. Removal of the vent raise furnishings from the 240 Level to surface, decommissioning activities on the 130 and 240 Levels, and sealing of a major fracture zone in the return air ventilation raise will then be carried out.

Removal of shaft furnishings will require specialty crews experienced in this type of work. Removal of furnishings in the shaft will be delayed for a short time to seal a major fracture zone in the shaft just below the 240 Level (Fig. 1). The instruments at the seven instrument arrays located within the shaft will be removed and the boreholes will be sealed. The ventilation raise surface bulkhead can be installed during the delay period in the shaft, and the shaft surface bulkhead can be installed upon completion of shaft decommissioning.

The dismantling of the surface facilities can commence, after the underground and shaft has been decommissioned. Upon removal of all shaft services and furnishings, the hoist and head frame can be removed. Further surface buildings and structures can be dismantled, leaving the main office building until last to accommodate personnel and security requirements during decommissioning.

Dismantling of hydrogeological equipment and sealing surface boreholes will be conducted with AECL's work-over drill rigs. Decommissioning of the surface borehole network is dependant upon the difficulties encountered during borehole equipment removal and subsequent grouting operations. It is proposed that surface borehole decommissioning take place in two distinct phases so 20 to 25 boreholes can be kept in service for a period of time, e.g. up to three years, to monitor the performance of the shaft and vent raise sealing systems.

Quality Assurance During Decommissioning

The decommissioning of the underground and surface infrastructure will follow AECL's Company Wide Decommissioning Quality Assurance Manual. The URL is a non-license-listed nuclear facility and therefore is not required to follow the nuclear standards for the decommissioning of Nuclear Power Plants. The URL is part of the Waste Technology Unit (WTU) which is registered to ISO 9001. The WTU Quality Assurance Manual WT-01913-QAM-001, and referenced Procedures & Operating Instructions will be used.

A URL Decommissioning QA Plan will be produced documenting the quality assurance program as it applies specifically to decommissioning activities at the URL site. Compliance with the program will contribute to achieving decommissioning objectives, meeting the requirements of relevant regulations, standards, codes and customers, and protecting the health and safety of personnel and the environment.

Environmental Monitoring

The URL is located in the Winnipeg River drainage basin in southeastern Manitoba, near the western boundary of the Lac du Bonnet batholith (Figs. 1 and 3). A notable feature of the area is exposed bedrock outcroppings interspersed with bottomlands. The prevailing vegetation is typical of the Canadian Shield - jack pine and blueberry dominate the well-drained uplands, while trembling aspen, willow and alder frequent the more moist bottom lands. There are also many temporal and several permanent wetlands - fens, swamps, marshes and bogs. Boggy Creek harbours several species of fish including white sucker, northern pike, yellow perch and various minnows. Many typical Shield mammals inhabit the area, including moose, white-tailed deer, black bear and red fox. There are also several species of amphibians and reptiles as well as many varieties of resident and migratory birds. Drainage from the URL is mainly through Boggy Creek, which enters Boggy Lake, Lee River and Lake Lac du Bonnet, which is part of the Winnipeg River system draining into Lake Winnipeg (see Fig. 3).

Lac du Bonnet and Pinawa are the closest towns (Fig. 3), but there are many farms and cottages in the surrounding areas. The URL lease area and the adjoining portion of AECL land are uninhabited by people and only used recreationally.

Before starting development and construction of the URL in the early 1980's, environmental baseline data was first collected by Dunford [18] and an initial screening document was prepared by Pollock and Barrados in 1983 [19]. Based on the initial 1983 screening document, and subsequent input from the Provincial Environmental Management Division (EMD) and a Federal-Provincial Review Committee (FPRC) concerned with environmental safety at the URL, a formal URL Environmental Monitoring Program was established. This program was refined over time but does focus on water quality, ambient background radiation level, noise level, habitat protection, and underground air quality, including radon level. Environmental data continues to be collected and the URL environmental program has reported its findings on the impact of construction and operation activities through a series of annual environmental monitoring reports. Furthermore, the FPRC has issued some of its own reports.

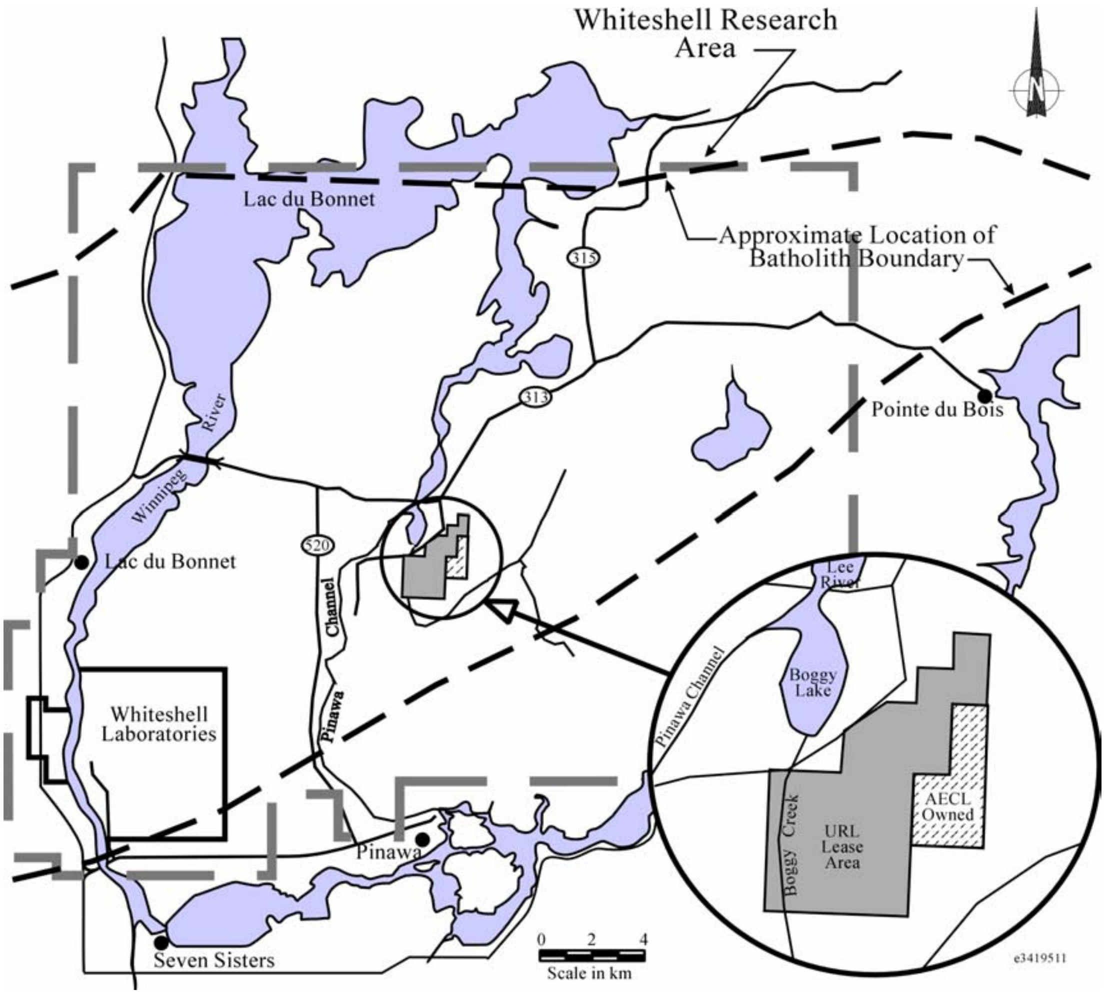

Fig. 3 Location of the underground research laboratory in southeastern Manitoba

An important focus of the URL Environmental Monitoring Program is on the 1,000 m^3 holding pond and its discharge path. Groundwater seepage into the main shaft, ventilation raise, and related underground excavations is pumped to the surface into the holding pond for retention, settling and re-circulating as service water for underground operations. The water in the holding pond is also available for fire protection. Excess water is periodically discharged from the pond to the environment. This is required about every two weeks and is subject to meeting a number of water quality criteria established by the FPRC (see Table II). Because infiltration of precipitation and spring melt water drives groundwater seepage into the URL, discharges tend to be more frequent in spring and summer. This trend is further enhanced because melt water and precipitation reach the holding pond even though the pond is covered to reduce evaporation and to prevent it from freezing over. Since 1988, discharge has occurred through a pipe that directs water north to northwest as shown in Fig. 4.

Table II Holding pond discharge criteria* established (1986) by FPRC

Parameter	**Discharge Limit (mg/L)**	**Parameter**	**Discharge Limit (mg/L)**
Ammonia (NH_3 - un-ionized)	0.20	Nitrate-nitrite (NO_3-NO_2 as N)	10
Cadmium (Cd)	0.01	pH	6.5 to 9.0
Chloride (Cl)	150	Radium-226	1 Bq/L
Cobalt (Co)	0.05	Uranium (total U)	0.10
Copper (Cu)	0.06	Total radioactive material$^+$	$(C_U/0.1 + C_{Ra}/1) < 1$
Iron (Fe)	0.30	Sulphate (SO_4)	250
Lead (Pb)	0.007	Total dissolved solids (TDS)	500
Mercury (Hg)	0.0006	Total suspended solids (TSS)	25
Nickel (Ni)	0.06	Zinc (total) (Zn)	0.20
Oil and grease	No visible film or sheen		

NOTE: Parameters refer to total regardless of source, i.e., background plus added as a result of URL activities.

*Maximum allowable concentration at the point of discharge from the holding pond or on the URL property.

^+C_u - observed uranium concentration in water, and C_{Ra} - observed radium concentration in water.

The plutonic rock surrounding the URL is slightly enriched in uranium ($^{234}U/^{238}U$) and its decay products including Ra-226. Thus, the water from the ventilation raise and main shaft seepage entering the pond contains natural uranium (65 to 225 µg/L). EXPURRT (EXPerimental Uranium and Radium Removal Technology) filtration systems [20] and mixed bed ion exchangers have been used successfully to treat the ventilation raise and main shaft seepages, and have effectively reduced elevated natural uranium concentrations in the holding-pond water.

The Total Dissolved Solids (TDS) levels in the URL holding-pond water have been historically between 400 and 500 mg/L, and on occasion have slightly exceeded the FPRC discharge criteria of 500 mg/L [21]. Efforts to identify the sources and major components of the TDS have been initiated as required in the URL screening documents [18, 22].

The decommissioning plan includes provisions to conduct a site investigation and preparation of an environmental assessment/screening proposal for submission to Federal and Provincial authorities during the dismantling and restoration of the URL site, as required by the Canada-Manitoba Agreement for Environmental Assessment Co-operation. Historical monitoring data from the URL annual environmental monitoring reports will be reviewed as part of the information gathering process for this assessment. The environmental assessment is not expected to reveal any currently unforeseen site remediation needs.

The Guideline for Environmental Site Investigation in Manitoba will be used to provide direction for the environmental assessment and URL site investigation. The objective of a site investigation is to characterize the contamination (degree, nature, estimated extent and media affected) and geological, ecological, hydrogeological and hydrological site conditions. Such an intrusive environmental site investigation generally includes a planning stage, a field investigation program, a monitoring program, a laboratory analytical program, an interpretation and evaluation stage, and report preparation.

A monitoring program will be conducted during the decommissioning phase. It will be described within the environmental assessment/screening proposal submitted to the Province of Manitoba. The program may be revised by additional requirements or considerations developed during a Provincial review of the proposal. It is currently envisioned that the monitoring program will consist of holding pond sediment sampling and analysis, holding pond discharge path(s) soil sampling and analysis, surrounding area soil sampling and analysis, and any other special considerations. The monitoring program is expected to be conducted over three or four summer seasons and will require additional analysis support from AECL’s Analytical Science Branch located at Whiteshell Laboratories. Fig. 4 shows possible sampling locations.

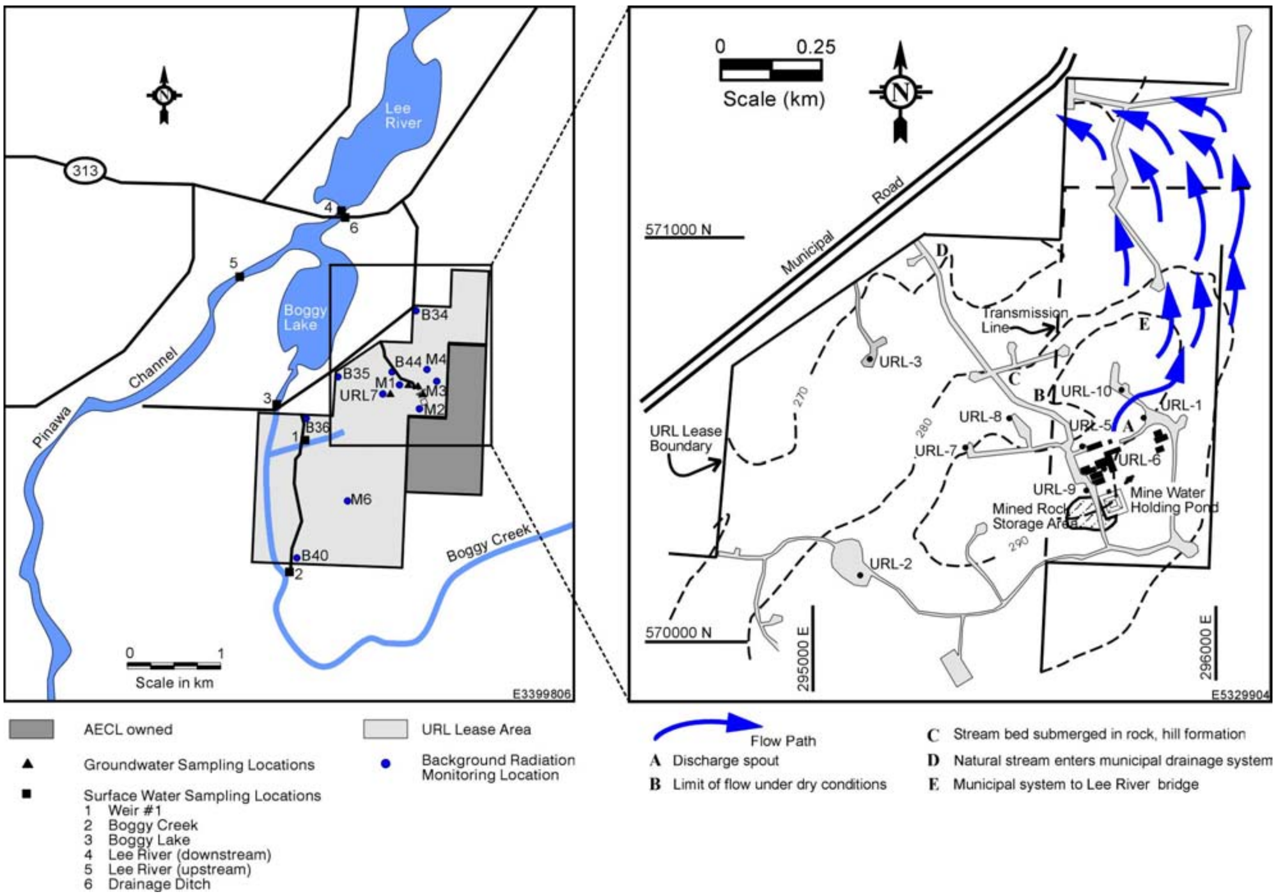

Fig. 4 The URL lease area sampling locations and surface holding pond discharge path.

End-State Objectives

The end-state objectives are to meet all the requirements of existing Federal and Provincial regulations and to restore the URL site to “as close to natural conditions as possible” as required by the Province of Manitoba General Closure Plan Guidelines. The aim of the decommissioning plan is to ensure the site is returned to a satisfactory condition by:

a) Eliminating unacceptable health hazards and ensuring public safety.
b) Limiting the production and circulation of substances that could damage the receiving environment and, in the long-term, eliminate the need for maintenance and monitoring.
c) Restoring the site to a condition in which it is visually acceptable to the community.
d) Reclaiming for future use the areas where infrastructures are located.

CONCLUSION

After more then twenty-one years of continuous operation, AECL is planning to decommission and close the Canadian Underground Research Laboratory. Since its conception in the early seventies, the URL has been a focus of world-class R&D, playing a strategic role in the development of the Canadian Nuclear Fuel Waste Management Program. The geological setting with five testing regions has been ideal for developing the technologies and methodologies needed to construct a repository in the intrusive igneous rock of the Canadian Shield.

The URL project, having gone through siting, site evaluation, construction and operating phases, is now entering a decommissioning phase. AECL is currently preparing a decommissioning plan which provides for environmental monitoring and end-state objectives that will meet the requirements of the regulatory bodies in Canada.

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FOOTNOTES

* Unrestricted, unpublished report available from the Information Centre, Atomic Energy of Canada Limited, Chalk River, Ontario, Canada, K0J 1J0