**PEOPLE. SCIENCE. INDIGENOUS KNOWLEDGE.**

# Moving towards partnership

Annual Report 2017

nwmo

NUCLEAR WASTE MANAGEMENT ORGANIZATION

SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

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SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

The Honourable James Gordon Carr
Minister of Natural Resources
Ottawa, ON K1A 0A6

March 2018

Dear Minister,

We are pleased to submit to you the annual report of the Nuclear Waste Management Organization (NWMO) for fiscal year 2017.

We submit this report in compliance with sections 16(1) and 23(1) of the *Nuclear Fuel Waste Act*.

In fulfilment of our obligations under section 24 of the *Act*, we are also making this report available to the public.

Respectfully submitted,

Wayne Robbins
Chairman

Laurie Swami
President and CEO

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# 1 Introduction to the NWMO

## Welcome

Welcome to the Nuclear Waste Management Organization's (NWMO) 2017 Annual Report. The theme of this report is "Moving towards partnership," which reflects our progress in creating partnerships on many levels. Partnerships with communities. With Canadians. With Indigenous peoples. With universities. With other countries.

In the pages that follow, we outline our activities and achievements for the year, describe our work, highlight some of the dedicated people powering this project, and provide an update on our financial position. The NWMO is powered by people, and this year we have included profiles of staff members from across the organization. These are only a few of the many diverse specialties and human interests that drive our unique and important mission.

Submitting this report to the Minister of Natural Resources and making it available to the public fulfil one of our obligations under the *Nuclear Fuel Waste Act* (2002). With its new design and more concise format, we hope this report also serves to inform and enlighten our many stakeholders on our progress.

This is Canada's plan, and it belongs to all of us.

Thank you for taking the time to learn more.

## Six fundamental values guide the work of the NWMO*

### SAFETY

We place all aspects of public and employee safety – including environmental, conventional, nuclear, and radiological safety – first and foremost in everything we do.

### INTEGRITY

We act with openness, honesty and respect.

### EXCELLENCE

We use the best knowledge, understanding, and innovative thinking, and seek continuous improvement in all that we do in our pursuit of excellence.

### COLLABORATION

We engage in a manner that is inclusive, is responsive, and supports trust, constructive dialogue, and meaningful partnership.

### ACCOUNTABILITY

We take responsibility for our actions, including wise, prudent and efficient management of resources.

### TRANSPARENCY

We communicate openly and responsibly, providing information about our approach, processes and decision-making.

* In 2017, we updated our statement of values to make them more clear and direct, and to better reflect who we are as an organization today and as we proceed to the next phase of work.

## About the NWMO

As worldwide demand for energy grows, nuclear power is part of the conversation. Canada and many other countries have been generating electricity from nuclear power – to light homes, businesses and hospitals – for several decades.

A byproduct of this process is used nuclear fuel, which remains radioactive for hundreds of thousands of years. Isolating this waste so that people and the environment are safe in perpetuity is critical. This responsibility, undertaken now and not left as a legacy for future generations, underpins the work of nuclear waste organizations around the world.

In Canada, the NWMO is responsible for implementing the country's plan – developed through dialogue – for the safe, long-term management of used nuclear fuel.

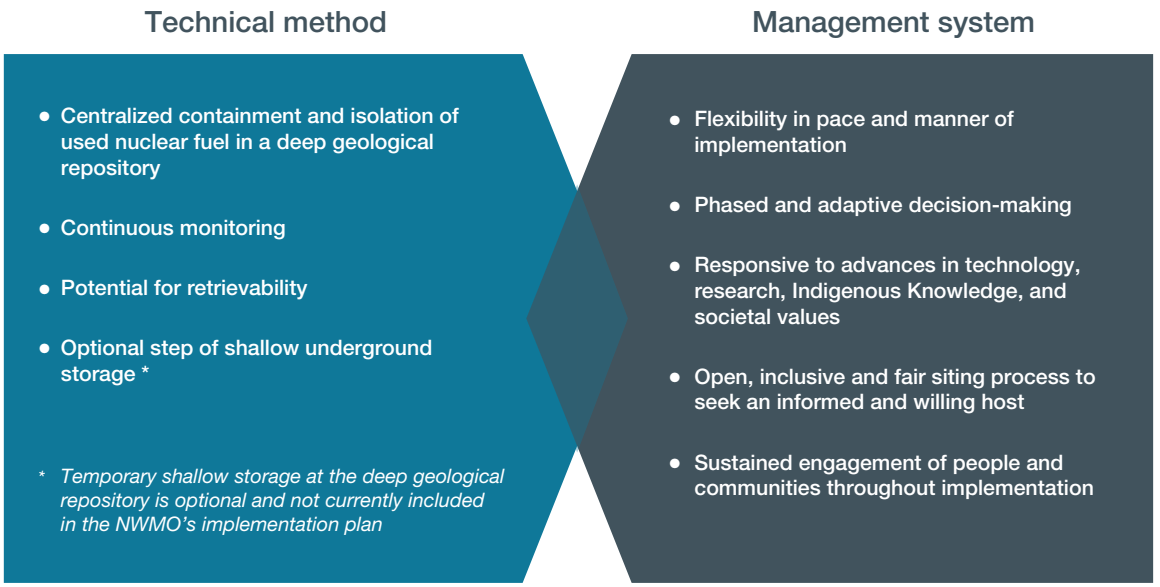
The plan, which was selected by the Government of Canada in 2007, is called Adaptive Phased Management (APM). It is being carried out in a series of manageable steps, and is adaptable to changing social conditions and emerging technical knowledge.

APM involves constructing a deep geological repository in which to safely manage the used fuel. It must be located in an area where communities, including First Nation and Métis communities, are willing hosts, working in partnership with the NWMO to implement it. Two-way dialogue within communities and inclusion of Indigenous perspectives are fundamental tenets of the NWMO's work.

Deep geological repositories are internationally recognized as best practice for managing used fuel over the long term.

Our team consists of some of Canada's – and the world's – leading specialists in the many disciplines needed to implement a complex project of this scale and scope: geologists, engineers, scientists, as well as specialists in community engagement and Indigenous Knowledge.

## Adaptive Phased Management at a glance




APM is a technical method and management system. It is being carried out in a series of manageable steps, and is adaptable to changing social conditions and emerging technical knowledge.

## Safety

The NWMO has a deep commitment to safety – safety of people and the environment from used nuclear fuel over the long term, and safety throughout all phases of activity. All aspects of the NWMO's work will meet or exceed applicable federal and provincial regulatory standards and requirements for protecting the health, safety and security of people and the environment.

## Guided by an Ethical and Social Framework

We are guided by an Ethical and Social Framework developed during the study phase of work. We continue to use it and build upon it as we advance to new phases of our work.

The ethical principles incorporated in the framework are respect for life in all its forms, including minimization of harm to human beings and other sentient creatures; respect for future generations of human beings, other species and the biosphere as a whole; respect for peoples and cultures; justice (across groups, regions and generations); fairness (to everyone affected, and particularly to minorities and marginalized groups); and sensitivity to the differences of values and interpretation that different individuals and groups bring to the dialogue. For more detail, please see www.nwmo.ca/ethicalandsocial.

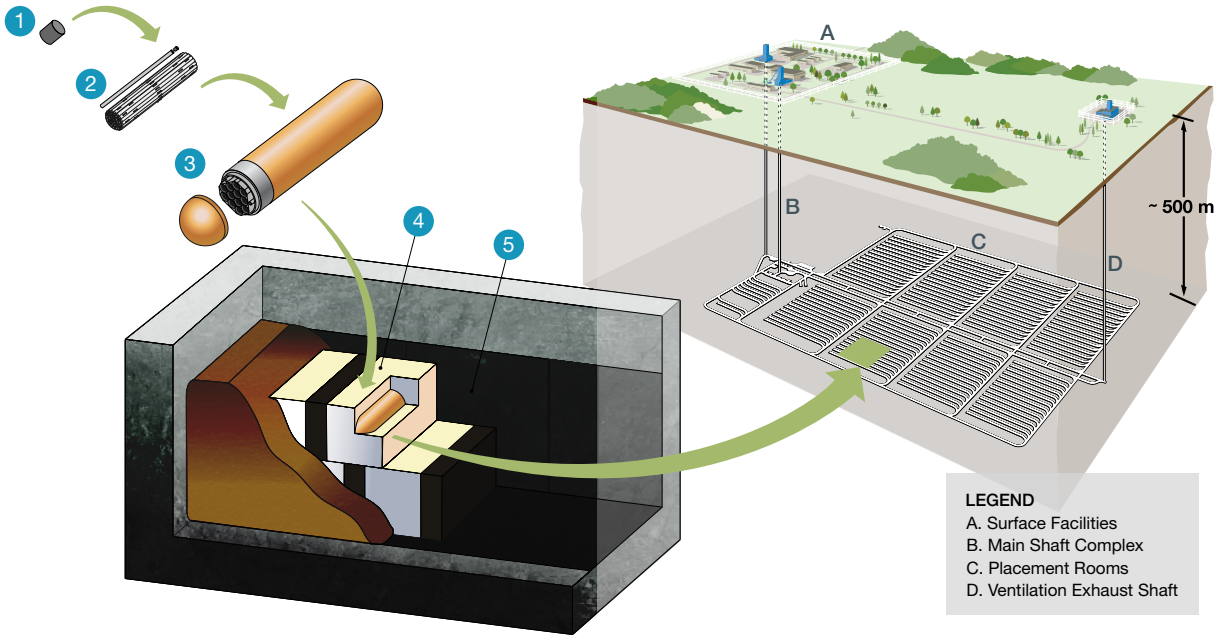
## The deep geological repository

Inside the deep geological repository, to be constructed approximately 500 metres underground, five barriers will work together to safely contain and isolate the used nuclear fuel from people and the environment.

1. The first barrier is the fuel pellet. Fuel pellets are ceramic, made from highly durable baked uranium dioxide powder; they are stored end-to-end in long tubes made of a strong corrosion-resistant metal.
2. The second barrier is the fuel bundle, which contains a number of these tubes.
3. The third barrier is a copper-coated, steel container. The containers are engineered to resist corrosion, and strong enough to keep the used nuclear fuel completely isolated until its radioactivity decreases to safe levels.
4. The fourth barrier is a buffer box made of highly compacted bentonite clay, which encases each container. Bentonite clay is a natural material proven to be a powerful barrier to water flow. It is also very stable, as observed in natural formations that are hundreds of millions years old. Buffer boxes will be robotically placed in rooms deep within the repository.
5. The fifth barrier is the rock itself, which will protect the repository from disruptive natural events, water flow and human intrusion.

On the surface above the deep geological repository, facilities will be built to receive, inspect and repackage used nuclear fuel bundles for transfer to the repository's main shaft and placement underground. There will also be facilities to support the ongoing operation of the site.

A safe and secure transportation system will be developed to transport used nuclear fuel from the facilities where it is stored now, to the site. The project also involves development of a Centre of Expertise for technical, environmental and community studies.




The five barriers work together to safely contain and isolate the used nuclear fuel from people and the environment.

## Selecting a site

Selecting a site is a multi-year, community-driven process. The process was launched in 2010, and in the two years that followed, 22 communities stepped forward to express interest in learning more about the project. The NWMO's staff began working together with people in those areas, and used progressively more detailed scientific, technical and social studies to assess suitability.

As the site selection process has unfolded, we have narrowed our focus to five of these communities, while expanding relationship-building activities beyond the boundaries of the communities themselves. Engagement includes neighbours, and nearby First Nation and Métis communities.

We expect to identify a preferred site by 2023.

## Timelines

Once a preferred site is identified, detailed site characterization and licensing activities can begin; based on the latest planning assumptions, they are expected to take approximately eight years. Once those are complete, construction will take about 10 years. It is therefore assumed that operations should begin between 2040 and 2045.

Operations are expected to last for about 40 years, depending on the volume of used fuel to be managed. After that, the repository will be monitored for an extended period of time – we have assumed 70 years for planning purposes.

## Funding

The project is funded by the owners of used nuclear fuel in Canada: Ontario Power Generation, NB Power, Hydro-Québec, and Atomic Energy of Canada Limited.

## Milestones

| | | |
|---|---|---|
| Developing Canada's plan | 2002 | The NWMO is created. |
| | 2005 | The NWMO completes three-year study with interested individuals, including specialists, Indigenous peoples and the Canadian public. |
| | 2007 | Government of Canada selects APM and mandates the NWMO to begin implementation. |
| Developing the siting process | 2008 to 2009 | Work takes place with citizens to design a process for selecting a preferred central site for the deep geological repository and Centre of Expertise. |
| Identifying a site using the siting process | 2010 | The siting process is initiated, with a program to provide information, answer questions and build awareness. |
| | 2010 to 2013 | Twenty-two communities initially express interest. In collaboration with interested communities, the NWMO conducts initial screenings. |
| | 2012 to 2015 | Preliminary studies are conducted to further assess suitability. Areas with less potential to meet project requirements are eliminated from further consideration. |
| | 2015 to 2022 | The NWMO expands assessment to include field studies. Areas with less potential are eliminated from further consideration. |
| | 2017 | **By the end of 2017, five communities remain in the site selection process. Initial borehole drilling begins.** |
| | 2018 to 2022 | Narrowing down process and subsurface studies continue. |
| | 2023 | A single preferred site is identified. |
| Towards construction | 2024 | Detailed site characterization begins. Construction of the Centre of Expertise begins. |
| | 2028 | Licensing applications submitted. |
| | 2032 | Construction licence granted (estimate). |
| Beginning operations | 2040 to 2045 | Operations of the deep geological repository begin. |

Included in this graphic are past and future milestones. Future milestones are estimates, and will be shaped by communities and the time required to complete assessments, studies and partnership-building activities.

## The NWMO by the numbers

We are within **6** years of selecting a preferred single site for the deep geological repository.

We have signed knowledge-sharing agreements with **7** countries around the world.

The NWMO is **15** years old.

## In 2017:

Our mobile transportation exhibit visited **15** Métis, First Nation and municipal events.

The NWMO has research projects underway with **16** universities.

Our staff hosted **22** tours at our proof test facility.

We published **40** news articles and **49** reports on our website at www.nwmo.ca.

We sponsored **133** local initiatives proposed by communities.

We have **156** people working for us at our Toronto headquarters, at our proof test facility in Oakville and in community offices.

# 2 Messages

## Wayne Robbins, Chairman

It is my pleasure to welcome you to the NWMO's 2017 Annual Report, which outlines the organization's activities, achievements and financial position.

I find it appropriate that the title of this year's report begins with the word "moving." As Chair of the Board of Directors since September 2016, I have often marvelled at the multitude of moving parts that make up the NWMO, each working towards the singular goal of safely managing Canada's used nuclear fuel over the long term.

Progressing in unison are a technical program dedicated to ensuring the safety of the project, a broad social engagement effort delivered with scrupulous care, a visionary and impactful Indigenous relations program, and a number of specialized teams providing assurance the project is properly funded, governed, staffed, and communicated.

That all these dynamic components remain synchronized, even as the pace of work quickens, is a testament to Laurie Swami, who took over as President and CEO in 2016, and her executive team members, some of whom are also new to their positions. A time of change in leadership calls for strong oversight, and it has been our great privilege as a Board to provide that oversight. We believe the NWMO, led by a committed and capable management team, is making excellent progress in implementing the Adaptive Phased Management (APM) program for Canada's used nuclear fuel.

In 2017, the Board approved the organization's business plans, performance objectives and budgets. We continued to oversee activities to ensure that: the necessary financial and human resources were available to implement Canada's APM plan; the process by which the NWMO narrowed down the number of potential siting areas under consideration was rigorous and fair; and all aspects of the technical program met or exceeded safety and scientific standards.

I am pleased to report that the NWMO identified ways to increase efficiency and reduce costs while delivering conscientiously on the mission that Canadians have entrusted to us.

In the summer, we held a strategic planning session with the NWMO executive team to consider long-term challenges and opportunities in implementing APM.

Consistent with the NWMO's commitment to interweave Indigenous Knowledge into decision-making, the Board held a joint meeting with the Council of Elders and Youth, an advisory body made up of First Nation and Métis Elders and youth. The gathering was opened by ceremony and concluded with a talking circle. We look forward to more of these valuable meetings in the future.

With sound governance comes a necessary understanding of the context in which the NWMO operates. To this end, the Board stays informed of local, national and international factors that may impact the APM project, including advances in the energy sector, developments in nuclear waste management, progress towards reconciliation, and developments in the sphere of obtaining social licence.

The following pages contain highlights of the NWMO's many activities in 2017. I invite you and all Canadians to become acquainted with the country's APM plan for used nuclear fuel.

Wayne Robbins

Chairman

# Laurie Swami, President and Chief Executive Officer

This has been a year of action at the NWMO. In implementing the country's plan for the safe, long-term management of used nuclear fuel, we are entering a critical stage – one that demands both accelerated movement and extraordinary care.

In the next five or six years, we aim to have a single site at which to proceed with more detailed studies. This process takes into careful consideration technical, geological, and environmental factors, and the outcome of engagement activities with municipalities, together with First Nation and Métis peoples. From the more than 20 communities that originally put up their hand to learn more about this project, we started the year with nine and finished with five.

As we proceed down this path, the need for respectful engagement and open dialogue – offered at the right pace – deepens and becomes more complex. All communities that stepped forward did so on behalf of Canada and Canadians, and I believe our attention to treating them fairly and equitably through this process is respected around the world.

Besides sharpening our focus to a smaller number of areas for further study, several other developments helped to define our progress this last year. We started drilling our first borehole at a potential repository site; we advanced discussions to explore potential partnership agreements; we enhanced our employee safety program; we strengthened transportation planning and engagement; and we continued to design and test engineered materials to safely manage used nuclear fuel over almost indefinite time periods.

We signed a historic agreement with our Japanese counterpart, NUMO, demonstrating our leading-edge work in the field of nuclear waste management, as well as our commitment to international co-operation.

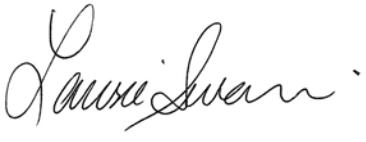
These exciting developments took place in an organization that is now 15 years old. Back in 2002, we committed to behaving ethically and with integrity. That has not changed. Nor has the trust our stakeholders can place in knowing we operate under tight regulatory control, strong corporate governance, and solid financial assurance.

In 2017, we undertook a number of important changes to our organizational structure, which position us to achieve our goals and address the inevitable challenges that will emerge as we get closer to the licensing phase. We have an exceptionally strong leadership team and a workforce that is highly skilled in a broad range of specialties, from engineering, geology, environmental science to Indigenous Knowledge, communications, finance, law, and social engagement. I see all around me passionate dedication to this unique and multi-generational infrastructure project.

I would like to thank not only our dedicated staff, but also the many Canadians – municipal and Indigenous leaders, as well as people in communities, including First Nation and Métis communities – who have paused to learn about our project and to engage with us. I have personally met many special people, and I am grateful they have welcomed me to share in the events, meetings and ceremonies that form the pulse of community life.

Finally, I would like to acknowledge the Advisory Council for its continued insight, the Council of Elders and Youth for its unique perspective, and our Board of Directors for its ongoing oversight.

Canadians need us all to work together and do this right.



Laurie Swami

President and CEO

# 3 Honouring Indigenous perspectives

Honouring Indigenous perspectives is an essential element of implementing Canada's plan for used nuclear fuel. "It is part of the fabric of the NWMO, manifest in our mindfulness of legacy issues, our deep commitment to reconciliation, our interweaving of Indigenous Knowledge with western science, and our ongoing dialogue with First Nation and Métis peoples," says Bob Watts, Vice-President of Indigenous Relations.

Seeing the challenges and opportunities associated with Adaptive Phased Management (APM) through an Indigenous lens will be vital for our future success. Increasingly, this is an area where the NWMO is demonstrating real leadership. "Bringing advice from the Council of Elders and Youth and other Indigenous Knowledge keepers to bear on how our project can go forward is really significant," says Bob. "It is reflected in how our geologists look at rock, how our geographers look at maps, how our environmental specialists look at land and water, and even how our receptionist greets guests. This is a deliberate decision by the organization."

There are many examples of steps the NWMO has taken to ensure Indigenous perspectives are sought and included: engaging respectfully with Indigenous communities, seeking and receiving ongoing advice from the Council of Elders and Youth, using guidance drawn from the NWMO's Aboriginal Policy and Indigenous Knowledge Policy, having staff and contractors participate in Indigenous cultural awareness training, and marking important occasions through ceremony.

Having the staff and contractors participate in Indigenous cultural awareness training is one of the ways the NWMO ensures Indigenous perspectives are sought, understood and included.

“The western science that I practise as an ecologist is complementary in many ways with Indigenous Knowledge, and the interweaving of these knowledge systems can greatly contribute to decision-making when trying to understand something as complex as an ecosystem. On a personal level, I have found a deep admiration for the commitment to protecting Mother Earth that Elders, youth and community members demonstrate each time we meet to learn together.”

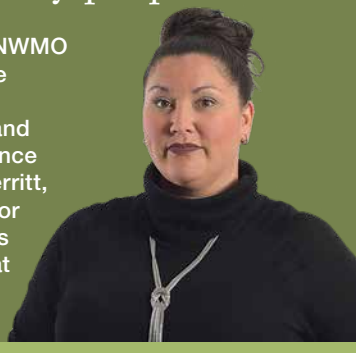
— Melissa Mayhew,
Senior Environmental Scientist at the NWMO

## Leading in reconciliation

Through these initiatives, the NWMO is following calls to action made by the Truth and Reconciliation Commission of Canada in 2015. The Commission called upon Canadians and Indigenous peoples to establish a new and respectful relationship. One of the things it called upon corporations to provide was education for employees on the history of Indigenous peoples. The NWMO is committed to reconciliation and is working to broadly examine how it can respond to the Commission’s recommendations.

## Powered by people

**Helping the NWMO to interweave Indigenous Knowledge and western science is Jessica Perritt, Senior Advisor of Indigenous Knowledge at the NWMO.**



Jessica Perritt’s work life is focused on finding ways to interweave two different knowledge systems – Indigenous Knowledge and western science – into the fabric of the APM project. This is perhaps fitting for a woman who is Ojibway and a member of the Chippewas of Nawash Unceded First Nation, and who holds a bachelor of science degree majoring in Physics and Mathematics.

“I feel that I am meant to be here,” smiles Jessica.

On staff since 2008, she has been instrumental in creating the NWMO’s Aboriginal and Indigenous Knowledge policies, and liaising with the Council of Elders and Youth. In essence, she has brought respect for Indigenous perspectives to life at the NWMO.

Her work is not only professionally rewarding, but also personally impactful. Like many in her generation, she has grandparents who are residential school survivors. Thus, the education she might have received in traditional teachings was interrupted. “The Elders I have been privileged to work with and ceremonies I have attended through my work have helped me to discover my roots and understand who I am as an Anishnaabekwe (Ojibway woman),” she says. “I feel blessed to be able to pass those teachings down to my children.”

Jessica’s next big project is helping the NWMO take further steps towards reconciliation, a true example for the rest of Canada. “My goal is to be part of changing how corporate Canada works with Indigenous peoples, and in doing so, I feel the NWMO can really contribute to reconciliation in a meaningful way,” she says. “We know we need many Indigenous voices to help us figure it out.”

# 4 2017. Achieving our objectives

In this section of the Annual Report, we provide a portrait of our achievements and milestones over the last year. We have structured this by arranging it into eight sections, reflecting our eight strategic objectives.

Building sustainable relationships and adapting plans

1

2

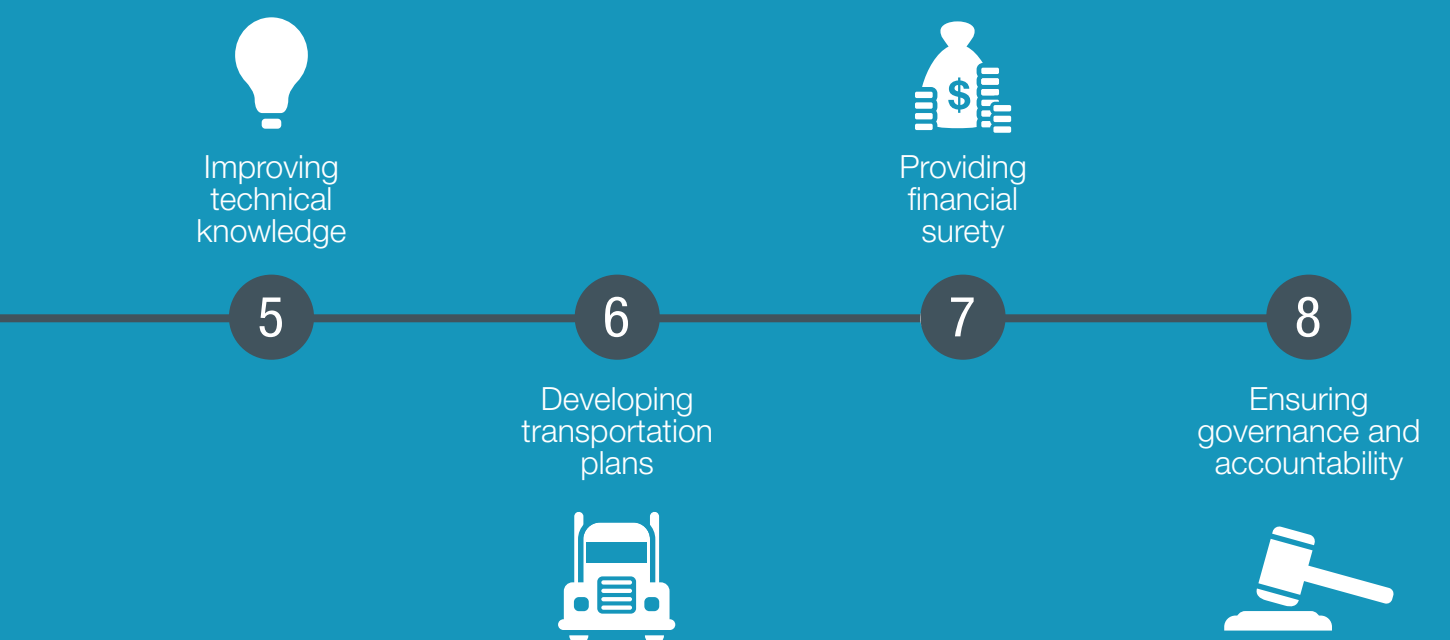
Collaboratively advancing the site selection process

Demonstrating safety and feasibility of the repository and engineered-barrier system

3

4

Planning for construction and operation


Improving technical knowledge
5
6
Developing transportation plans
Providing financial surety
7
8
Ensuring governance and accountability

# 1 Building sustainable relationships and adapting plans

## Objective

The NWMO will build sustainable, long-term relationships with interested Canadians and Indigenous peoples of Canada, and involve them in setting future directions for the safe, long-term management of used nuclear fuel. The NWMO will continue to adapt plans for the management of used nuclear fuel in response to evolving societal expectations and values, insight from Indigenous Knowledge, and changes in public policies.

## Highlights

- Our work, including relationship-building activities, was guided by strong ethical principles.
- The NWMO deepened its existing relationships with municipalities and Indigenous communities, and broadened its reach to surrounding communities.
- We adapted plans in response to communities' expectations, values and insights.

Through events such as this open house in Manitouwadge, the NWMO continues to build and sustain relationships with people in and near study areas.

# 2017: Year in review

## Introduction

Strong relationships, built on inclusiveness and respect, are the cornerstones of Adaptive Phased Management (APM). Through collaboration, we build and maintain relationships with many people and groups: communities that initiated involvement in the site selection process, First Nation and Métis communities and organizations, nearby municipalities, a wide range of associations and organizations, federal and provincial governments and agencies, and youth – those who will one day be responsible for moving Canada's plan forward.

Among topics of interest in 2017 were safety, borehole drilling, water, partnership, and transportation.

## Municipal engagement activities

In 2017, the NWMO continued to build and sustain relationships with people in and near study areas. We also maintained a high level of engagement with municipal associations across Ontario, Saskatchewan and New Brunswick.

Engagement activities in each area focused on sustaining a dialogue to facilitate learning about the project, collaboratively planning technical field studies, and identifying socially acceptable sites for borehole drilling at potential repository locations. In addition, we explored the potential to foster well-being through implementation of the project.

Beginning with the communities that initiated their area's involvement in the process, we broadened engagement to include trappers, camp owners, hunters and fishers, recreationalists, local services boards, and others in the area.

Engagement activities in 2017 included having conversations through our storefront Learn More Centres, bringing NWMO specialists to communities to meet residents and provide presentations in their subject areas, and regularly hosting information sessions, open houses, and workshops.

# 4 2017. Achieving our objectives

## 1 Building sustainable relationships and adapting plans

We conducted briefings about the project to service clubs and community organizations. We participated in learning and sharing gatherings, trade shows, meetings, tours, exhibits at community events, one-on-one conversations, workshops, other community events, science classes, barbecues, and information nights.

All communities in our site selection process took advantage of learning tours to interim storage facilities for used nuclear fuel and to our proof test facility. These tours provided tangible demonstrations of how used fuel is safely stored now, and how the NWMO is engineering and testing technical components for future long-term management.

Other activities in 2017 included:

- Sharing information about the project and NWMO-sponsored events through direct mail, email, and advertising in local newspapers and radio;
- Attending monthly Community Liaison Committee (CLC) meetings, which are advertised and have a public agenda; we also helped maintain CLC websites;
- Presenting updates to municipal councils; and
- Continuing discussions about transportation (for more detail, see Chapter 4.6, *Developing transportation plans*).

### First Nation and Métis engagement activities

In 2017, the NWMO continued to build and sustain relationships with Indigenous peoples in and near the study areas, and maintain a high level of engagement with national, provincial, and treaty organizations. In interweaving Indigenous Knowledge into the site selection process, we rely on and appreciate the contributions of First Nation and Métis peoples.

Staff of the NWMO engage with visitors to our booth at the 2017 International Plowing Match and Rural Expo in Walton, Ont.

### Duty to consult: Ignace borehole number one

A key achievement in 2017 was the successful conclusion of consultation with six First Nation and Métis communities on drilling our first borehole in the Ignace and Wabigoon Lake Ojibway Nation area. For more information on the significance of the first borehole in advancing the site selection process, see the subsection *Borehole drilling* in the next chapter (4.2).

The Ontario Ministry of Natural Resources and Forestry (MNRF) delegated the procedural aspects of the duty to consult to the NWMO prior to issuing permission to access Crown land for borehole drilling. After consulting the six communities the MNRF had identified as being potentially impacted, the NWMO received permission to drill.

The successful conclusion of the first of many consultation processes and the commencement of drilling soon after signified major milestones for the NWMO.

Our team then turned its focus to preparing for the next two planned boreholes in the area.

### Other Indigenous engagement activities

The NWMO participated in a wide range of First Nation and Métis cultural awareness activities, conferences, general assemblies, and community events:

- Members of First Nation communities attended learning tours of used nuclear fuel dry storage facilities;
- Ceremonies and walking-the-land activities took place before initial field studies;
- Cultural verification studies took place before borehole drilling. For these studies, Elders, guides and other knowledge keepers identified areas with key resources such as cultural sites, moose, fish, migratory birds, and water;
- The NWMO leadership and staff attended First Nation and Métis ceremonies and cultural events in study areas; and
- A six-part informational column about the NWMO's work was published in two First Nation newsletters.

# 4 2017. Achieving our objectives

## 1 Building sustainable relationships and adapting plans

### Sharing our expertise

The NWMO's engagement activities have been regarded as exemplars internationally. We are regularly asked to share our experience on dialogue and engagement methods and practices in international forums such as the Nuclear Energy Agency Forum on Stakeholder Confidence.

In 2017, municipal and Indigenous community representatives, along with NWMO staff members, shared their experiences with more than 20 other countries at an International Atomic Energy Agency meeting. Attending international conferences also provides us with an opportunity to learn from other countries.

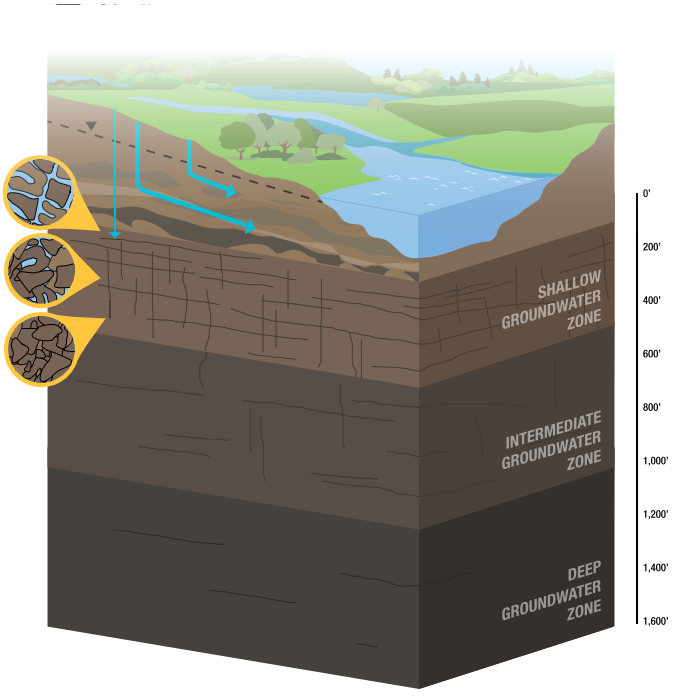
### Adapting to change

A core principle of APM is the commitment to adapt plans in response to society's expectations, values and insights. By way of example, in the last year we responded to interest from stakeholders on the subjects of water and new nuclear technologies.

#### The journey of water

In 2017, we formed a cross-disciplinary team to focus on the subject of water. This was largely driven by an Indigenous community in northwestern Ontario, as well as several communities north of Lake Superior, where people encouraged us to provide more information about how a deep geological repository will protect water.

In close consultation with interested parties, our team developed the first iteration of a plain-language, visual presentation that tells the story of water. It includes cross-sectional diagrams illustrating that while water flows freely near the surface of the Earth, it often dries up or stagnates deep underground. Among the many criteria for siting the repository is the requirement that it be located in a rock formation far below the surface that has low permeability and little interaction with water.




This diagram was developed in response to interest from communities. It illustrates that unlike water near the surface, water deep underground often dries up or stagnates.

### New nuclear technologies

Our stakeholders asked us whether APM can be adapted to include fuel waste that may be generated in the future through emerging technologies such as small modular reactors. Indeed, our funding formulas and deep geological repository plans can be adapted to include new entrants. We acknowledge it is important to monitor the development of new reactors and new owners of used nuclear fuel, updating our plans and communications materials as the industry evolves.

## Strengthening relationships with government

In 2017, the NWMO's staff continued to provide representatives of federal and provincial governments with information about the project and our progress in implementing it. We also stayed connected on topics of shared interest such as transportation, fieldwork, the duty to consult Indigenous peoples, and access to Crown land. The NWMO works with lead ministries within the federal and provincial governments to be our primary points of contact.

# 4 2017. Achieving our objectives

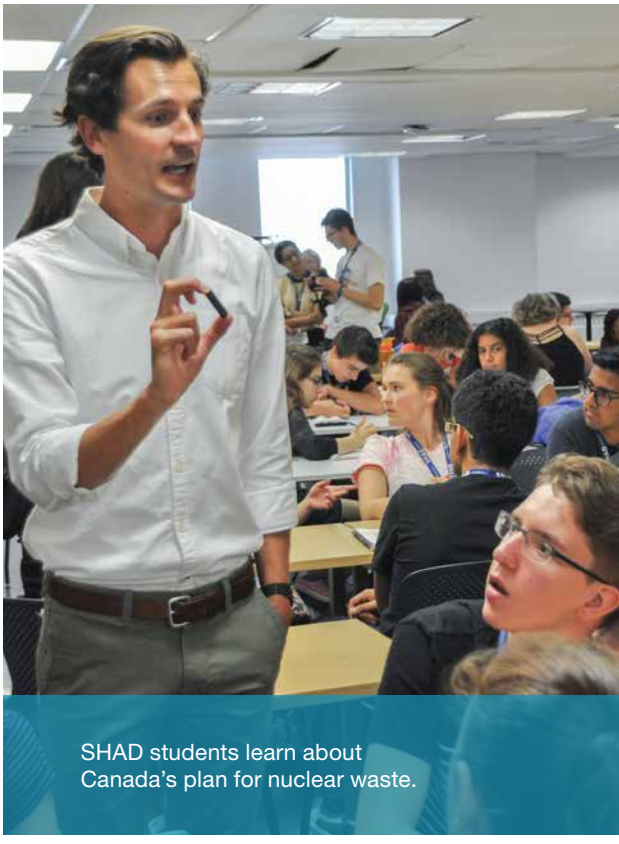
## 1 Building sustainable relationships and adapting plans

### Engaging youth

Engaging young people is an important element of the NWMO's work, as the young people of today will carry this long-term project forward in the decades to come.

To this end, the NWMO funds communities to encourage youth learning about nuclear energy and APM, including opportunities for First Nation and Métis youth. In 2017, these opportunities included school visits to interim storage facilities, to events where our displays were featured, and to our community offices, proof test facility, and open houses. We invested in summer student employment and co-op work terms in fields that contribute to the APM project.


Enthusiastic Grade 5 students in Huron-Kinloss learn about the safe, long-term management of used nuclear fuel.



SHAD students learn about Canada's plan for nuclear waste.

“In July 2017, I enjoyed taking part in the NWMO’s outstanding workshop at SHAD Lakehead in Thunder Bay. The information shared was impactful and relevant, and opened a lot of young minds about the large-scale scientific and engineering planning underway to deal with Canada’s used nuclear fuel. The students were left with a much better understanding of the complex strategies and relationships that come into play. I appreciated the chance to personally experience the NWMO’s commitment to educating the next generation of STEM leaders.”

– Tim Jackson,
SHAD President and CEO

We continued to provide sponsorships and donations that advance local initiatives identified by communities. In 2017, we supported 133 initiatives, including a wide range of youth activities ranging from education and cultural initiatives to community well-being and sports initiatives.

For the past several years, the NWMO has also sponsored three organizations that are focused on STEM (science, technology, engineering, and math) education – SHAD, Scientists in School, and Science North.

SHAD is a four-week science and technology enrichment program for high-achieving students in Grades 10 through 12. In 2017, the NWMO engaged more than 500 SHAD students at eight Canadian university campuses in interactive workshops, exploring various aspects of APM.

Scientists in School, which we sponsor in our southern Ontario siting areas, is a charity providing science workshops for students in kindergarten to Grade 8. In the 2016-2017 school year, we reached about 2,900 eager young scientists through this partnership. Our support of Science North, meanwhile, helped to bring science engagement programs to 5,035 students in our northern siting areas.

# 4 2017. Achieving our objectives

## 1 Building sustainable relationships and adapting plans

The NWMO's new open house exhibit allows visitors of all ages to explore the many aspects of Canada's plan by walking around or even inside eight colourful modules.

## Building understanding and awareness through communications

Central to meeting the objectives of the APM project in an open, transparent and inclusive manner is an ongoing commitment to inform and involve a diverse audience. Our stakeholders include siting area communities, First Nation and Métis groups, scientists, governments, media, youth, and the public at large.

The topic of managing used nuclear fuel can be complex, controversial and challenging. We use a wide variety of communication methods to proactively build awareness and understanding of Canada's plan, and to correct misinformation.

In 2017, we increased our use of images, infographics and multimedia material, as well as plain-language news. In parallel, we developed a social media presence, for the first time, on Facebook, and expanded our content on LinkedIn.

We created a new open house exhibit, which allows visitors of all ages to explore the many aspects of Canada's plan by walking around or even inside eight colourful modules. In addition, we provided communication materials such as newsletters, backgrounders and brochures that reflect subjects of interest as the project evolves.

In the fall of 2017, we published a more concise and easy-to-read draft of our five-year strategic plan, *Implementing Adaptive Phased Management 2018 to 2022 – Draft for Public Review*. We welcomed the public's comments and ideas about our work and how we can help people learn more.

## Powered by people

**Cherie Leslie is one of the NWMO's staff members who work in communities involved in the site selection process. She helps to deepen our connection in the communities of South Bruce and Huron-Kinloss.**

Cherie Leslie is passionate about the community where she lives and works.

She grew up in South Bruce and is now raising three young, active children of her own. A former community planner and municipal recreation manager, Cherie has her finger on the pulse of life in this agricultural area.

As a Senior Engagement Advisor, she is one of the NWMO faces in Bruce County. She divides her time between working in our Learn More Centres in Teeswater and Ripley, inspiring people to come out and learn about the APM project, attending public meetings, doing presentations, and participating at community events.

"Sharing information and engaging people in the APM project is my primary role," says Cherie. "It is not always easy talking to friends and family about permanently storing nuclear waste in our community, but socially it is a very important topic, especially since we live in close proximity to the world's largest nuclear generating station."

Cherie and her NWMO colleagues were very busy in the fall of 2017 staffing an APM information booth during the International Plowing Match and Rural Expo in Walton, Ont. The NWMO was a corporate sponsor for the event, which is one of North America's largest outdoor agricultural expos.

"I love this job, and I am very passionate about it," says Cherie, who draws energy from hearing people's opinions and comments. "It is exciting to be involved in such a large infrastructure project, working with world-renowned experts, in a region where people are interested in learning about the project and exploring the possibilities it could have in this area."

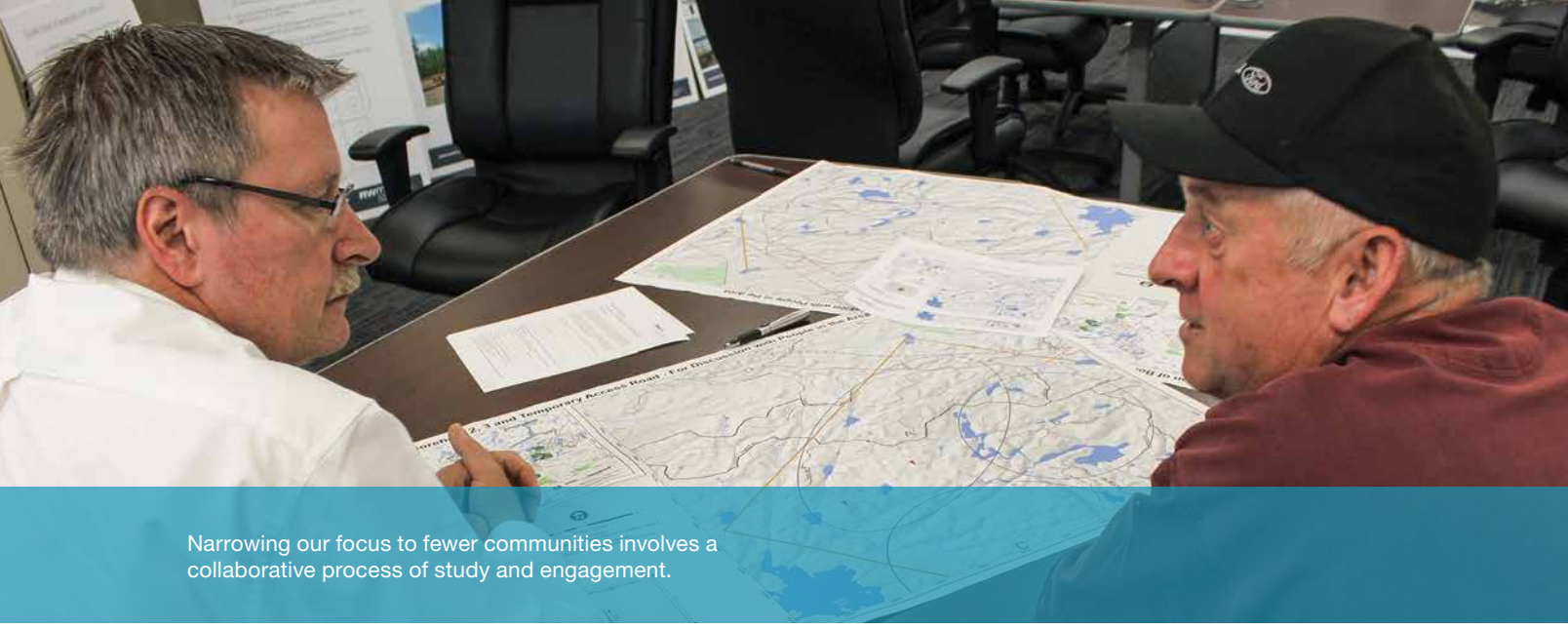
# 2 Collaboratively advancing the site selection process

## Objective

The NWMO will implement collaboratively with communities the process to select a site suitable for locating the deep geological repository and Centre of Expertise in a safe location in an area with an informed, willing host.

## Highlights

- The NWMO narrowed its focus to fewer communities as it advanced the site selection process – a process grounded in fairness and transparency.
- We created a framework to guide conversations about partnership with communities, including developing shared values and principles.
- We began to drill our first borehole in one of the areas currently in the process.



Narrowing our focus to fewer communities involves a collaborative process of study and engagement.

# 2017: Year in review

## Narrowing down the number of communities

After the Adaptive Phased Management (APM) site selection process was started in 2010, 22 communities expressed interest in learning more about the project. In looking for a safe, geologically appropriate site with an informed and willing host, we began an increasingly intensive – and always collaborative – process of study and engagement.

Over time, guided by carefully established values, principles and ethical standards, we have successfully narrowed down the number of potential sites. The last year has seen further advancement of this process. We started 2017 with nine communities in four regions of Ontario; in June, we narrowed our focus to seven communities within those same regions; and in December, we further narrowed down to five communities in three regions. Throughout this process, our work includes neighbouring First Nation and Métis communities and municipalities.

We thank communities exiting the process for their invaluable contributions and leadership.

## 2 Collaboratively advancing the site selection process

> "At the back end of the fuel cycle, Canadian companies are addressing concerns related to the safe, long-term management of nuclear fuel waste. Canada's NWMO – an organization established by Canadian nuclear electricity producers – is advancing an open, transparent and collaborative siting process. This process is unparalleled in our country in its innovative and broad engagement of the public, stakeholders and Indigenous groups. We point to it as a best practice for identifying a willing host community for a radioactive waste repository."
>
> – Philip Jennings, Canada's Associate Deputy Minister of Natural Resources, at an International Atomic Energy Agency conference in Abu Dhabi, United Arab Emirates

### Moving towards partnership

As the site selection process continues to advance, we are within five or six years of identifying a preferred site – one with suitable geology, and informed and willing hosts.

The exploratory path to defining and building partnerships in siting areas has been a focus of work in 2017. Partnership agreements will ultimately need to be based on a common set of values and principles. They will be anchored by a clear demonstration of safety, strong evidence of enhanced well-being for communities, and an understanding that willingness stems from grassroots acceptance.

In 2017, the NWMO created a road map to guide conversations aimed at establishing each community's unique values and principles. This foundational work will help to form a clear understanding of the project in detail, to appreciate the benefits and risks of accepting the project, and to begin to chart a plan for how the project can be configured to fit with local priorities and objectives.

## Borehole drilling

In November 2017, the NWMO began the process of drilling our first borehole to study core samples at a potential repository site. This took place in the Ignace-Wabigoon area, in a rock formation known as the Revell Batholith. The borehole is being drilled to a depth of about one kilometre and includes a series of tests to further advance understanding of the geoscientific characteristics of the site.

The location was identified based on a wide range of technical studies, and through extensive engagement activities with people in the area, including First Nation and Métis communities in the area and the region.

Borehole drilling signifies an important advance for the NWMO in obtaining a more complete knowledge of the characteristics of the rock that lies deep beneath the surface. Our multidisciplinary data management team has developed a state-of-the-art system to receive and manage information from the borehole site.

The fall of 2017 marked a significant advance for the NWMO: drilling our first borehole. Specialists will study core samples at the potential repository site.

# Powered by people

**Mahrez Ben Belfadhel, Vice-President of Site Selection at the NWMO, is motivated by hearing people's perspectives.**

Dr. Mahrez Ben Belfadhel, fondly known as "Ben," has worked in geotechnical engineering and radioactive waste management for more than 30 years, 10 of them at the NWMO.

While he is fully at ease talking to people about the technical components of the APM project, he is also a patient and humble listener. "I am driven by social engagement," he says. "People energize me. They give me ideas; they motivate me. That is what APM is all about; we are there to listen to people's concerns and learn together."

Ben, who has a bachelor's degree in Civil Engineering and a master's degree and PhD in Geotechnical Engineering, leads the site selection process at the NWMO. "Right now, what excites me," he says, "is we are demonstrating that working collaboratively with people is the right path forward. We are moving towards our goal in a way that is consistent with our values and principles, and those of the communities we are working with, including First Nation and Métis communities."

Ben grew up in a large, boisterous family in Algiers in North Africa; his formative years provided him with comfort in being surrounded by people, and a deep respect for the wisdom of elders. These attributes have helped him connect on a profound level with community members in municipalities, and with Indigenous communities and holders of traditional knowledge. "I have been honoured to be welcomed into Indigenous ceremonies and community events. These relationships are very special to me."

When not at work, Ben can often be found near water. His passion is sailing, perhaps inherited from his father, who was a sailor in the merchant navy. He has built several small boats, including an Inuit kayak and two sailing dinghies. His wife is a biologist, and they have four children in their 20s.

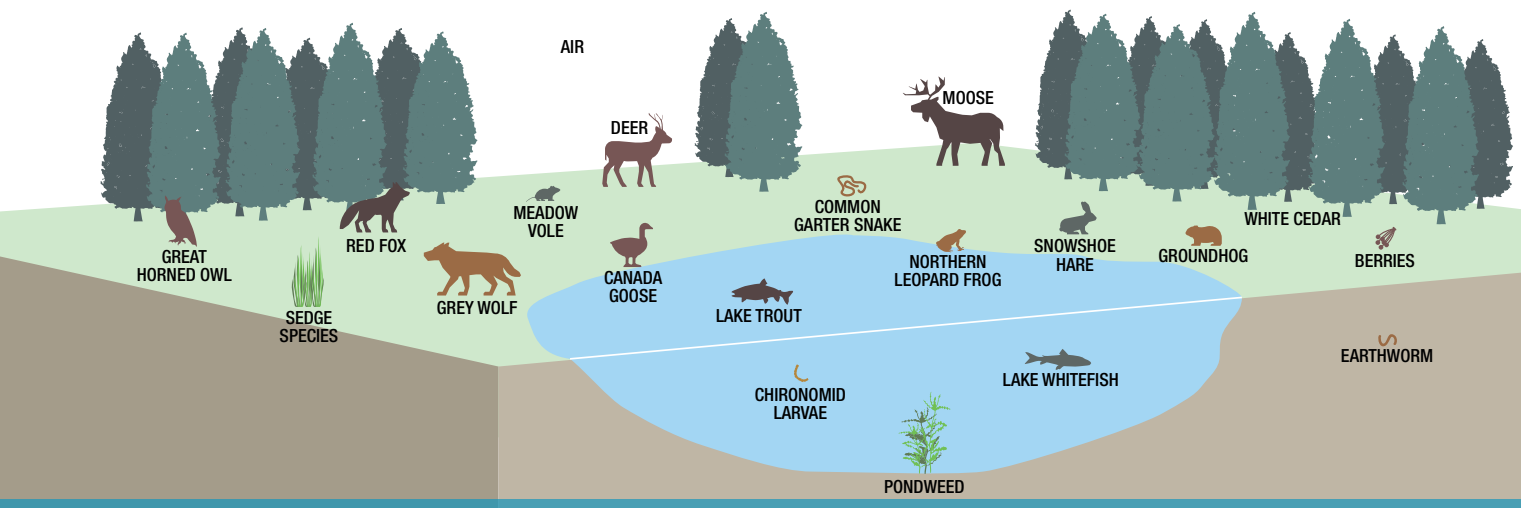
# 3 Demonstrating safety and feasibility of the repository and engineered-barrier system

## Objective

The NWMO will conduct testing of the engineered-barrier system (EBS) in order to demonstrate that it meets safety requirements, and can be produced effectively and efficiently.

## Highlights

- The NWMO completed a preliminary postclosure safety case study for a hypothetical site in crystalline rock.
- Our technical specialists further advanced the design and fabrication of testing and manufacturing equipment for future serial production of used fuel containers.
- We designed, manufactured and installed a highly compacted bentonite shaping cell at our test facility to produce buffer boxes in support of future full-scale emplacement trials.
- We completed the design specification for the container that will be used to contain and isolate used nuclear fuel in the repository.




An important element of Adaptive Phased Management (APM) is ensuring plants and animals living above a future repository remain safe hundreds of thousands of years from now. This illustration depicts a Canadian ecosystem, and the plants and animals we are studying.

# 2017: Year in review

In 2017, our specialists continued the rigorous process of optimizing and testing the safety and effectiveness of the EBS. Our safety team performed detailed scientific analyses of how components such as the used fuel containers and buffer boxes would hold up in a number of scenarios over the very long term. These analyses are important to confirming that even in the unlikely event of a malfunction, people and the environment will be protected.

## Assessing safety

Keeping people and the environment safe is paramount in designing the components of the repository. To ensure safety, we regularly update our detailed safety assessments. These are divided into two time frames: the period in which we are constructing and operating the deep geological repository and associated facilities (preclosure), and the period after the deep geological repository has been backfilled and sealed (postclosure).

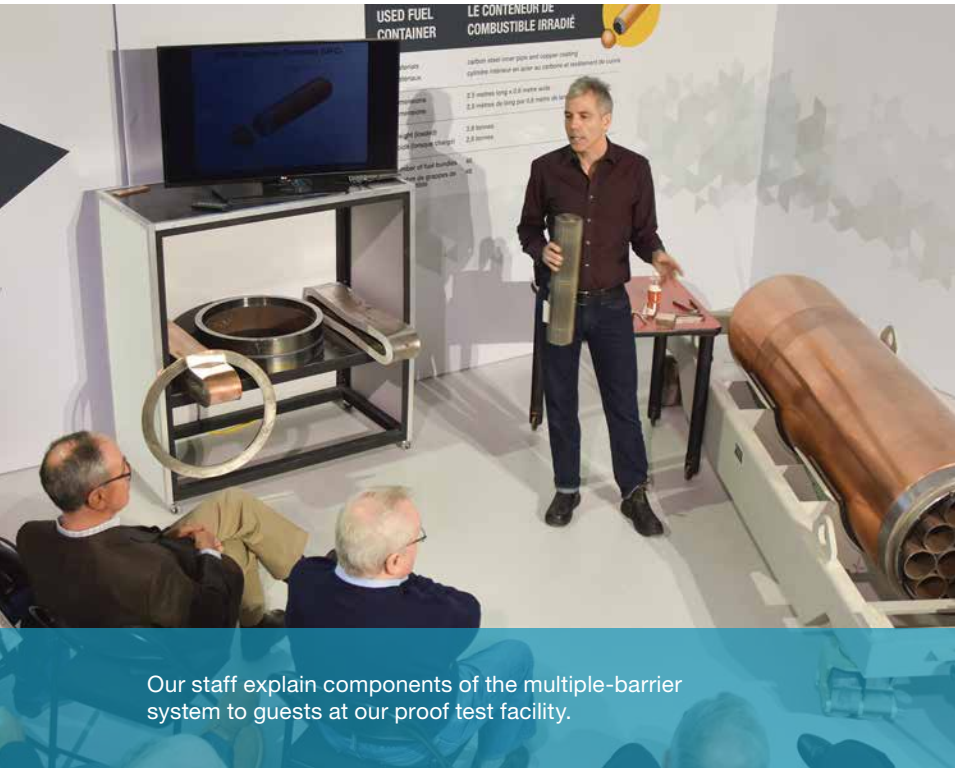
These detailed studies, known as safety case studies, examine potential accidents and events that could occur, assess their potential impacts, and consider methods that can be incorporated into the design of the facility to mitigate them. They will be submitted in support of a licence application once a site is selected.

In 2017, the NWMO completed the 6$^{th}$ case study ("Postclosure Safety Assessment of a Used Fuel Repository in Crystalline Rock"). This updated safety case is for a hypothetical crystalline rock repository and incorporates the latest NWMO-designed EBS and emplacement room layout.

The NWMO also initiated a program to update our fuel and radionuclide inventory estimates. Understanding Canada's entire inventory of used nuclear fuel – currently about 2.8 million bundles in total – is an important part of planning for its safe, long-term management.

This update included analysis of the characteristics of fuel and fuel bundle material, as well as information on the current number of used fuel bundles and their burn-up. Burn-up tells us how much power has been extracted from the fuel, an indicator of its radioactivity.

## 3 Demonstrating safety and feasibility of the repository and engineered-barrier system




Our staff explain components of the multiple-barrier system to guests at our proof test facility.

### Expanding proof test facility and activities

The NWMO proof test facility in Oakville, Ont., is used to test and demonstrate technical components of the APM project. It was recently expanded to meet two crucial objectives. One was to prepare and test full-scale prototype equipment, and the other was to showcase the components and technologies to interested communities, delegations from other countries' independent reviewers, and members of the public. The facility hosted 22 tours in 2017.

## Used fuel container

The NWMO's innovative and award-winning used fuel container is designed specifically for CANDU fuel bundles. One of its unique features is that, unlike used fuel containers in other countries, the copper coating is applied directly to the steel container to make it a single, unified component. Work is continuing on optimizing the application of copper to the container using both electrodeposition and cold spray processes. Another feature is that the container has a hemispherical head that is designed to withstand significant pressure. A state-of-the-art robotic laser welding technique has been developed to seal the container.

In 2017, the NWMO focused on documenting the specifications for the used fuel container, as well as preparing for serial production trials. This included designing and fabricating a new version of the equipment that will be used to hold and rotate the used fuel container during welding. This equipment, known as the ROTEQ 2.0, was delivered to our welding technology vendor.

We also designed and constructed the non-destructive examination process and test bench that will be used to inspect used fuel containers following the various stages of fabrication such as welding, copper deposition and machining.


Work is continuing on optimizing the application of copper to the steel container using both electrodeposition and cold spray processes.

## 3 Demonstrating safety and feasibility of the repository and engineered-barrier system

### Buffer Box

During placement in the repository, each used fuel container will be encased in a highly compacted bentonite clay buffer box as a barrier to water and microbes.

The NWMO has developed the capability over the past couple of years to produce large-scale, highly compacted bentonite clay blocks that are integral to the design of the EBS. We have designed, fabricated and commissioned a bentonite shaping cell in our proof test facility that uses robotics to precisely shape the 4,000-kilogram bentonite blocks into the correct dimensions for the deep geological repository. In preparation for emplacement trials beginning in late 2019, there will be a requirement for more than 50 of these blocks.

Used fuel containers will be encased in highly compacted bentonite clay buffer boxes as a barrier to water and microbes. We have developed the capacity to produce these blocks.

# Powered by people

**Helping the technical team to assess the long-term safety of the repository is Senior Scientist Chantal Medri.**

Chantal Medri's research calls to mind a family like hers. They are active and spend a lot of time outdoors. They appreciate simple pleasures and the land around them – the trees, plants and wildlife.

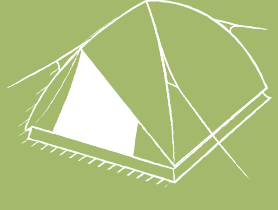
But the family that Chantal studies is only hypothetical. They inhabit a time that is far beyond what most people can even imagine – millions of years in the future.

She is an expert in health and radiation physics, ensuring people are protected from harmful radiation. She studied Physics at Queen's University and went on to earn a master's degree in Health and Radiation Physics from McMaster University.

Using international scientific practices, she is well-qualified to determine that the hypothetical future family she studies remains safe from radiation as they grow their own vegetables, raise animals, and draw water from a well above a repository.

A researcher at the NWMO for more than eight years, Chantal is passionate about her work. "I love being a part of this big, broad team, for such an important project for Canada. There is such a wide variety of skills and expertise, spanning so many fields, that there is always something new to learn," she says.

When not working, Chantal and her own family enjoy their outdoor environment. "In my free time, you will find me biking, camping, running, or skiing with my husband and three young kids in tow," she says.



"This is a very collaborative environment where all parties are interested in addressing important technical and scientific issues regarding nuclear waste disposal. We classify it as an ideal partnership between researchers and industry, and a model for how these partnerships should be implemented in the world."

– from Natural Sciences and Engineering Research Council of Canada Site Visit Committee comments on the NWMO–co-funded corrosion research at the University of Western Ontario

# 4 Planning for construction and operation

## Objective

The NWMO will advance planning and capabilities for the construction and operation of the deep geological repository and the associated Centre of Expertise.

## Highlights

- We updated the regulator on our progress in implementing Adaptive Phased Management (APM).
- In support of the future licensing application, we advanced engineering work to support future construction and operation of the deep geological repository and related surface facilities.
- We continued to build capacity in communities so that local people will benefit from employment related to the project.

Once a preferred site is selected for the APM project, there will be an escalation of activity at the local and regional level.

# 2017: Year in review

## Introduction

As mentioned in the introduction to this annual report, the NWMO is committed to meeting or exceeding all applicable regulatory standards and requirements for protecting the health, safety, and security of people and the environment.

Work is underway to support the future construction and operation of the deep geological repository and related surface facilities. Planning continues for the Centre of Expertise that will initially support a multi-year program of technical testing and verification, and ultimately become a hub of knowledge-sharing across Canada and internationally.

Once a preferred site is selected for the APM project, there will be an escalation of activity at the local and regional level. These include a range of verification and demonstration activities, planning for detailed site characterization, regulatory submissions, and preparing communities to participate in the project through associated jobs and services.

The NWMO continues to interact with the Canadian Nuclear Safety Commission (CNSC), consistent with the terms of a special project arrangement prior to submission of a licence application. These activities include providing briefings to the CNSC on the progress of APM implementation. In November, we briefed the CNSC on our progress in site selection and in technical programs, as well as our latest assumptions for project timing. This briefing was webcast and was publicly available on the CNSC website and via the NWMO's Facebook page.

## 4 Planning for construction and operation

### Regulatory oversight

Implementation of a deep geological repository falls within federal jurisdiction and will be regulated under the *Nuclear Safety and Control Act* (*NSCA*) and its associated regulations. The Canadian Nuclear Safety Commission (CNSC), as Canada's independent regulatory authority, regulates the use of nuclear energy and materials to protect the health, safety, and security of Canadians and the environment; and to implement Canada's international commitments on the peaceful use of nuclear energy. The CNSC's mandate also includes the dissemination of objective scientific, technical and regulatory information to the public.

Under section 26 of the *NSCA*, activities associated with a nuclear facility can occur only in accordance with a licence issued by the CNSC. The repository for Canada's used nuclear fuel will be subject to the CNSC's comprehensive licensing system, which covers the entire life cycle of the repository, from site preparation to construction, operation, decommissioning (closure and postclosure), and abandonment (release from CNSC licensing).

This stepwise approach will require a licence for each phase of the repository life cycle. The process for obtaining a "site preparation" licence will be initiated by the NWMO. The NWMO would submit an application for a Licence to Prepare Site (and possibly construct) to the CNSC. A licensing decision by the CNSC on a repository can be taken only after the successful completion of the environmental assessment, following the process established under the *Canadian Environmental Assessment Act* (currently under review). More information about the CNSC's licensing process is available at www.nuclearsafety.gc.ca.

The transportation of used nuclear fuel is jointly regulated by the CNSC and Transport Canada.

Although the CNSC is the main licensing authority, it administers its licensing system in co-operation with other federal and provincial government departments and agencies in areas such as health, environment, transport, and labour.

## Building local capacity and employment opportunities

APM is a multi-generational project that will be developed and implemented in phases over more than 150 years. The project will generate hundreds of direct and indirect jobs, and create new opportunities involving scientists, engineers, tradespeople, and others.

Though decisions about the project and where it will be located are some years away, early capacity-building activities are underway in siting regions to maximize local job opportunities once a site is selected.

We continued to build a stronger local staffing presence in potential siting regions through locally based staff and contractors. In 2017, for example, our geoscience team hired Brayden Moore, who grew up in Ignace, Ont., to support our Ignace drilling work program. Brayden, who had been a summer student with us in 2016, recently graduated from Queen's University with a bachelor of science in Geology.


Teens from Aamjiwnaang First Nation participated in a two-day skills development workshop supported by the NWMO.

## 4 Planning for construction and operation

> "The best part of the two-day workshop was – EVERYTHING!"
>
> – a teen from Aamjiwnaang First Nation who participated in a two-day skills development workshop supported by the NWMO's EIES program

We also ramped up the Early Investments in Education and Skills (EIES) program to support training and education activities. Over the long term, this program is intended to equip community members, including both Indigenous and non-Indigenous adults and youth, with transferable skills that could be applied to APM or other projects and workplaces.

Over the past year, communities identified a broad range of youth initiatives which aimed to encourage student exploration of science and technology subjects, locally relevant subjects such as agriculture, as well as arts and culture. We supported initiatives such as summer science and/or cultural camps, robotics, youth wellness activities, educational field trips, and graduation awards. A total of 47 youth initiatives were identified and funded as part of this year's program. The program is expected to continue and grow over the coming years.

For adults in the broader community, we supported 39 education and skills development activities. These included training for First Aid, coding and customer service. Examples of skills training and workshops included, for example, working from heights, aerial lift and elevated platforms, business in challenging environments, and starting your own business.

As the NWMO and communities learn together how best to build knowledge and skills in an area, the focus of these activities is expected to evolve.

# Powered by people

**Helping the NWMO to manufacture and test components of the engineered-barrier system in support of a future licence application is Chris Boyle, Director of Engineering.**

Children at the Hornepayne library enjoy educational programming sponsored by the NWMO.


The NWMO's EIES program provides safety training in South Bruce.

Chris Boyle has great enthusiasm for mechanical systems and design. One of his first jobs was working at his uncle's marina on the Rideau Canal in Elgin, Ont. The then-teenager was in his element – taking apart and fixing boat engines.

A later job at the Honda plant in Alliston, Ont., provided him with hands-on experience in welding, robotics and serial production of hundreds of automobiles a day. Meanwhile, he obtained a bachelor of applied science, as well as a master's degree, in Mechanical Engineering, at Queen's University.

Chris' fixation with the mechanics of "anything that moves" conveyed him in September 2011 into his first role at the NWMO, as a mechanical designer. In his first two years in the organization, he was an integral part of the team that designed the new, innovative used fuel container, which is specially designed for CANDU fuel bundles. "It is really novel in the world," he says.

He is now Director of Engineering at the NWMO, responsible for building and testing components of the engineered-barrier system that will be used in the deep geological repository.

While Chris' job is very demanding, he delights in the common sense of purpose shared by the multidisciplinary group. "This team is highly educated, highly motivated and highly competent. Most importantly, we all believe in the work we are doing and the benefit it will eventually provide to Canadians," he says. "We have mechanical engineers, corrosion scientists, chemical engineers, welding engineers, designers, coating engineers, and structural analysts – all pulling in the same direction."

With a very busy job and a new baby son, he rarely has time for himself. When he does get a break, the first place he heads is back to the Rideau Canal, where his extended family surrounds the marina on all sides.

# 5 Improving technical knowledge

## Objective

The NWMO will continuously improve technical knowledge in collaboration with universities and international partners, and adapt plans consistent with international best practices.

## Highlights

- We initiated new research studies to understand corrosion processes of used fuel and the used fuel container.
- Our researchers continued to participate in collaborative underground research laboratory projects with their counterparts in other waste management organizations, including Sweden, Finland and Switzerland.
- We supported research projects with more than a dozen Canadian universities, and our scientists continue to publish peer-reviewed journal articles.
- The NWMO entered into a sharing agreement with NUMO, our Japanese counterpart.

NWMO scientists presented their findings at the International High-Level Radioactive Waste Management Conference in Charlotte, N.C. in April.

# 2017: Year in review

## Research and development

The key objective of the NWMO's research and development program is to advance our understanding of the technical elements of our project. This body of knowledge will support the development of a safety case for a deep geological repository for used nuclear fuel.

## Canadian university research

In 2017, the NWMO supported innovative research at 16 universities, a majority of which were in Canada. Research partnerships with universities play an important role in ensuring we understand how the system of engineered and natural barriers will work together to help isolate used nuclear fuel from the surrounding environment over the very long term.

This science is important to our project and also is of interest internationally to other deep geological repository projects.

### Corrosion

To understand corrosion of used fuel and the used fuel container, we support a comprehensive research program.

Together with the Natural Sciences and Engineering Research Council of Canada (NSERC) and the University Network of Excellence in Nuclear Engineering, in 2017, we established a new three-year Collaborative Research and Development Program at Western University.

Our corrosion program also continued work at Western University exploring the safety of the weld design and internal components of the used fuel container. In addition, work continues at the University of Toronto to study the effects of salinity on copper corrosion.

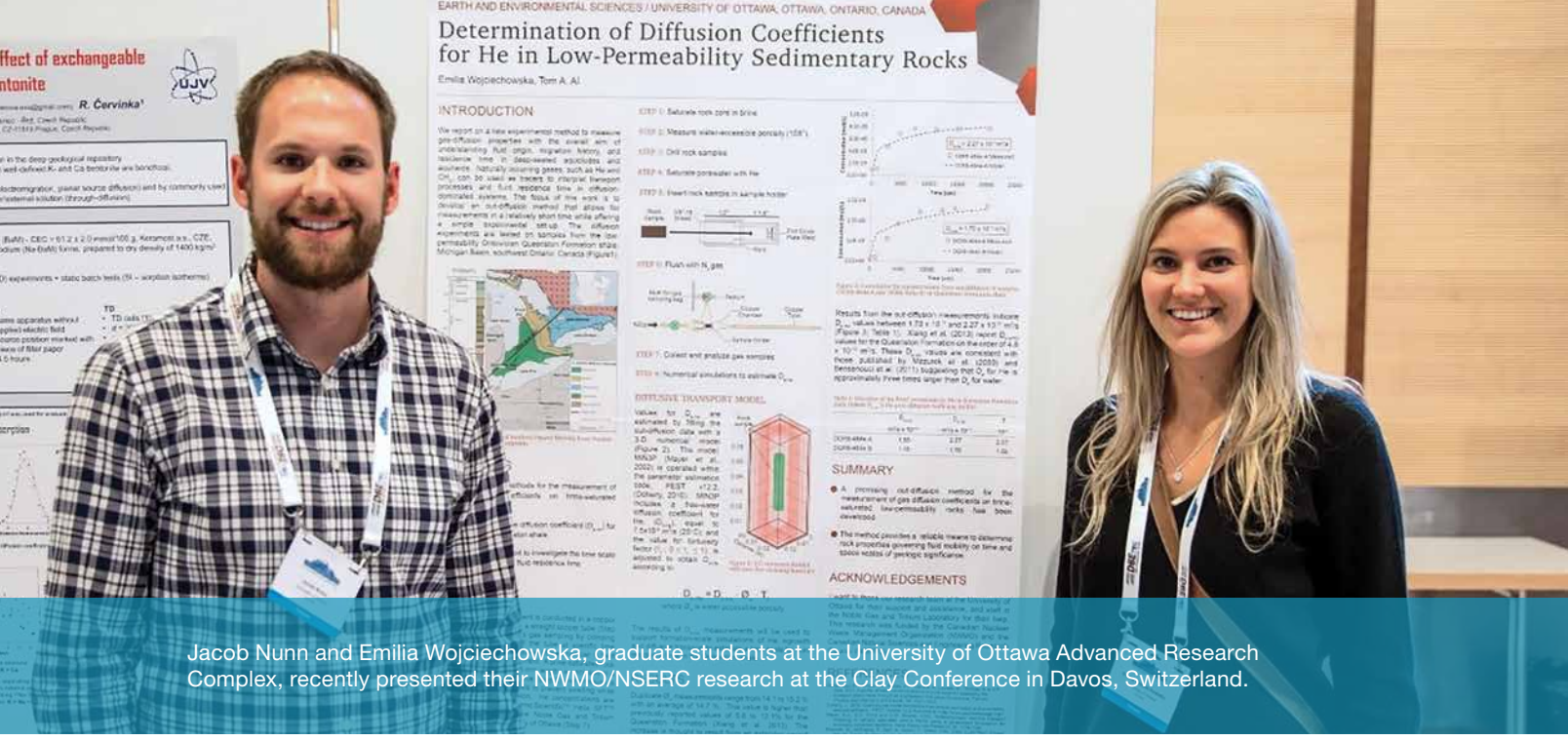
## 5 Improving technical knowledge

### Understanding the geosphere

At the University of Ottawa, scientists are conducting laboratory analyses of the composition of chemicals and elements that exist in the type of rock considered suitable for the repository – low permeability sedimentary and crystalline rock. These studies provide information on where traces of water came from, how they got there, and how long ago they were transported.

Researchers at Queen's University used data from borehole samples, combined with state-of-science computer modelling, to determine how the strength of sedimentary rock develops over different scales and time periods. This helps to predict how rock will behave near the repository and serves to determine what steps need to be taken to minimize fracturing.

Attendees at the NWMO's 15th annual Geoscience Seminar, held in Toronto in June, learn about the latest geoscience research related to deep geological repositories.




Jacob Nunn and Emilia Wojciechowska, graduate students at the University of Ottawa Advanced Research Complex, recently presented their NWMO/NSERC research at the Clay Conference in Davos, Switzerland.

### Inhibiting contaminants

The NWMO supports research at several Canadian universities that looks at chemical processes that potentially can transport contaminants through the buffer or rock – processes such as diffusion, sorption and solubility. Highlights in 2017 include:

- At the University of Ottawa, scientists are developing novel imaging techniques to measure diffusion rates of radionuclides through low porosity, low permeability rock;
- At York University, a program is underway modelling sulphide transport underground to understand its potential effect on used nuclear fuel containers;
- At the University of Guelph, work focuses on improving our understanding of the solubility of key elements under saline conditions at expected temperatures; and
- At McMaster University, scientists are using state-of-the-art laser technology to measure sorption reactions involving radionuclides interacting with buffer and rock.

### Long-term climate change

How will long-term climate change, including ice ages, impact a deep geological repository?

To explore this question, the NWMO supports research at the University of Toronto to develop models of long-term climate change. This includes understanding the formation of continental-scale glaciation, permafrost and slow depression of the continent under ice sheets.

Related work at the University of Waterloo focuses on developing tools to assess how low permeability deep groundwater systems respond to glacial loading, including for example the infiltration depth of glacial meltwater.

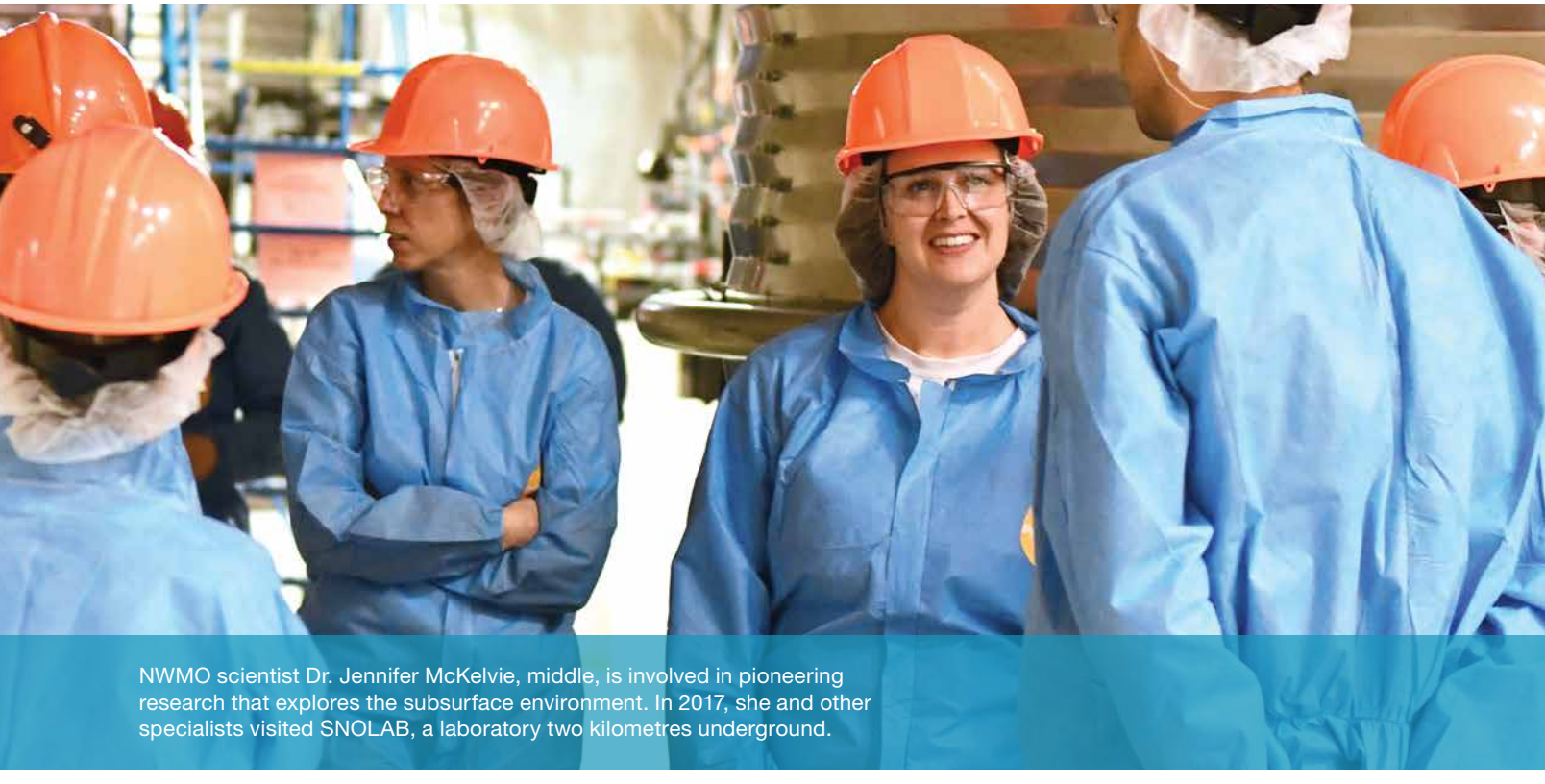
## 5 Improving technical knowledge

### Microbiology

The potential effect of microbes on the longevity of used nuclear fuel containers is an important area of study. We are partnering with leading Canadian universities to support programs that will anticipate the sorts of microbiological conditions that might be found in a deep geological repository.

In 2017, work was undertaken at the University of Toronto to measure characteristics of subsurface microbial communities that could influence radionuclide release and mobility. This pioneering research on low organic, low water, low biomass environments is relevant because the deep geological repository will be built hundreds of metres underground.

In addition, ongoing work at the University of Waterloo measures the DNA of micro-organisms in bentonite.



NWMO scientist Dr. Jennifer McKelvie, middle, is involved in pioneering research that explores the subsurface environment. In 2017, she and other specialists visited SNOLAB, a laboratory two kilometres underground.

“Countries around the world are working together to improve their collective knowledge on how to safely manage used nuclear fuel. At Nagra, we appreciate collaborating with Canada’s NWMO; both organizations have benefited from each other’s technical expertise. By sharing innovations in research and design, and seeking to establish international best practices, we are together benefiting future generations globally.”

– Dr. Tim Vietor,
Department Head, Safety, Geology and Radioactive Materials, Nagra
(Switzerland’s National Cooperative for the Disposal of Radioactive Waste)

## Repository integrity

The NWMO engages external specialists to advance knowledge of repository safety. For instance, specialists conducted modelling analyses of how the repository and surrounding rock would perform under the expected heating from the used fuel canisters, as well as scenarios such as buildup of gas in the repository, and potential impacts related to glaciation and earthquakes. These assessments demonstrated the stability of the repository and the surrounding geosphere barriers.

To help understand the structure of rock fractures deep underground, a geostatistical software tool has been developed and validated. It generates three-dimensional models of fractures based on readily available surface information. These models aid in site characterization studies, and ultimately influence repository positioning and safety.

In addition, work continued on measuring the properties and performance of the sealing materials for the bentonite clay buffer box and the repository shaft, especially in highly saline conditions.

We also undertook computer modelling of thermal conditions inside a used fuel container in order to ensure internal temperatures are well within safe margins.

## 5 Improving technical knowledge

### Criticality safety

In 2017, we assessed whether criticality (a self-sustaining nuclear chain reaction as occurs in a reactor) can be ruled out. Numerical calculations demonstrated that criticality was not possible for used CANDU fuel in the Adaptive Phased Management (APM) deep geological repository as designed.


Laurie Swami, President and CEO of the NWMO, and Dr. Shunsuke Kondo, President of the Nuclear Waste Management Organization of Japan (NUMO), sign a co-operation agreement.

## Collaborative work

Partnering with other radioactive waste management organizations allows us to foster international co-operation on developing and demonstrating technology innovations. We learn from other countries' experiences, and keep abreast of developments in repository design and safety case development for various host rock formations. The NWMO has ongoing co-operation agreements with its counterparts in Sweden, Finland, France, Switzerland, the United Kingdom, and South Korea.

In 2017, we entered into our seventh co-operation agreement – with NUMO, Japan's nuclear waste management organization. The two-part agreement involves the exchange of knowledge pertaining to many aspects of managing used nuclear fuel, as well as a specific agreement on our copper-coating program.

Through our international agreements, the NWMO is currently co-sponsoring research at underground laboratories in Switzerland. Projects include studies of corrosion and sealing system performance under natural underground conditions.

The NWMO also participated in collaborative projects to advance knowledge in scientific areas that pertain to the APM project. These include the Nuclear Energy Agency (NEA), the International Atomic Energy Agency, and the international BioProta and DECOVALEX projects. One example of such a project is the NEA Expert Group on Operational Safety to identify and define international best practices in safely operating geological repositories for radioactive waste.

## Powered by people

**Helping the NWMO to improve and share technical knowledge is Peter Keech, Manager of the Engineered-Barrier Science.**

One of the state-of-the-art components of Canada's engineered-barrier system is its NWMO-designed used fuel container, coated in copper.

Predicting with extreme precision the stability of copper over long periods of time in a deep geological repository is the focus of Dr. Peter Keech and his team. Peter, who obtained his PhD in electrochemistry at the University of Calgary and worked as a post-doc at Western University, is one of Canada's leading experts in the field.

"Scientists have 30 years of research in copper, but we need to increase our confidence. We are always working to eliminate the unknowns," he says.

The NWMO's copper-coating program recently caught the attention of Japan. "Our Japanese counterparts are very keen to learn more about this as it might be a promising option for their used fuel container," says Peter. He facilitated a visit by senior officials from Japan's NUMO to our head office and proof test facility in June 2017.

When not at work delving into the finer details of how copper interacts with other elements, Peter can be found at home with his wife and two daughters obsessing over chemical alchemy of a different sort – how to create the perfect hot salsa. The strategy is highly scientific. "You need peppers that build heat gradually and those that are hot at first and fade quickly," he explains.

While Peter is quick to share his expertise on copper corrosion with colleagues from research organizations and universities around the world, the particulars of the salsa recipe are "a closely guarded household secret."

# 6 Developing transportation plans

## Objective

The NWMO will establish safe, secure and socially acceptable plans for transporting used nuclear fuel.

## Highlights

- Our engineers continued to work on routing and logistics options for transporting used fuel from interim storage sites to siting regions.
- We developed modelling capabilities and materials databases for transportation packages.
- Our engagement team continued the dialogue with communities to support learning and build confidence in the safety of transportation, and to develop common values, principles and objectives to guide development of the transportation plan.
- We initiated public attitude research activities to deepen our understanding of the social considerations that will need to be addressed.


Canada's used nuclear fuel is safely stored on an interim basis at seven licensed facilities.

# 2017: Year in review

## Introduction

Canada's used nuclear fuel, which is safely stored on an interim basis at seven licensed facilities, will eventually be loaded into specially designed, certified packages and transported to the repository site for emplacement in the repository.

Current locations include four in Ontario (Bruce, Pickering and Darlington Nuclear Generating Stations, as well as Chalk River Laboratories), and one in each of Manitoba (Whiteshell Laboratories), Quebec (Gentilly Nuclear Generating Station), and New Brunswick (Point Lepreau Nuclear Generating Station).

While transportation is not expected to begin until at least 2040, work is underway to ensure used fuel transportation will be technically safe and secure, with a plan that reflects public priorities and concerns.

We are studying road and rail as transportation modes.

## 6 Developing transportation plans

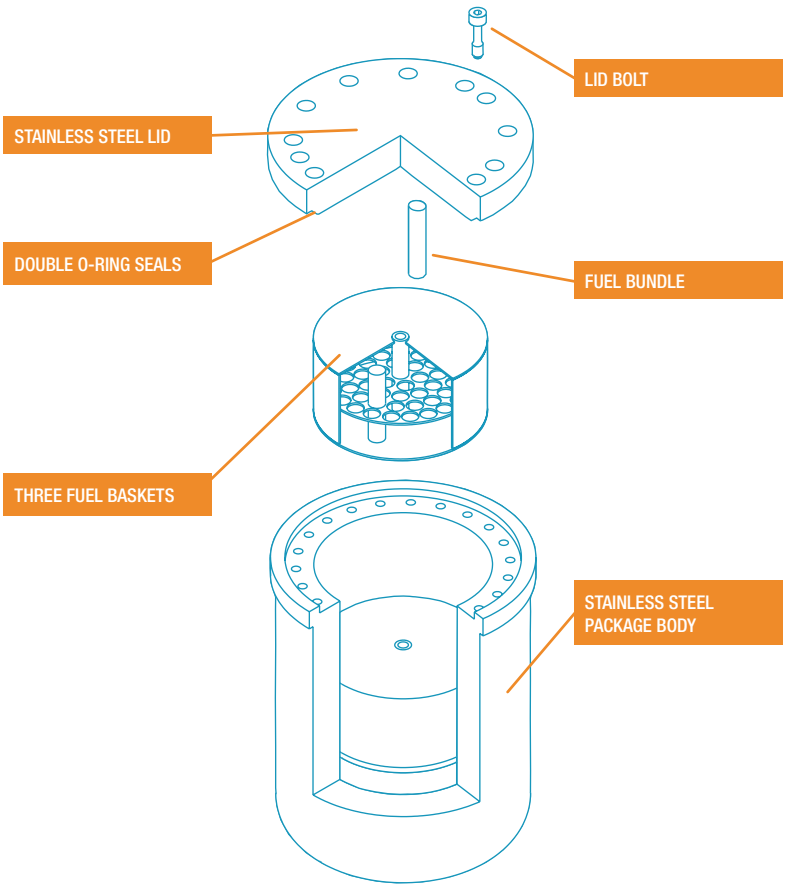
### Technical aspects

From a technical perspective, used nuclear fuel can be transported safely and securely, with radiological safety assured, through the use of robust transportation packages.

In 2017, the NWMO continued our work on transportation package designs. Specifically, we focused on the "basket" transportation package. This package is being designed to transport fuel that is currently stored in a basket configuration – at Hydro-Québec (HQ), NB Power (NBP) and Atomic Energy of Canada Limited (AECL) – to the repository site. We prepared technical reports analyzing radiological shielding, as well as structural and thermal modelling of the basket transportation package.

To further support the development of the transportation package models, we also undertook activities to advance our materials databases for stainless steel and compressible foams that would be used in the manufacture of used fuel transportation packages.

We continued our technical work in determining routing and logistics options for transporting used fuel from HQ, NBP and AECL interim storage sites to the potential siting regions. This work builds from previous analysis that was focused on fuel movements from Ontario Power Generation sites.




Technical work in 2017 focused on the "basket" transportation package that is being designed to transport fuel currently stored in a basket configuration.

We also continued to develop our transportation risk assessment, analysing technical parameters of transporting used fuel by both road and rail. In addition, the NWMO developed an advanced computational fluid dynamics combustion model. This model is used to assess the integrity of the transportation package in hypothetical accidents.


Hornepayne students are among visitors to our truck-mounted mobile transportation exhibit that travelled with specialists to communities in the site selection process.

## Social considerations

The NWMO has engaged thousands of Canadians in conversations to hear their comments, questions, and concerns, and to provide information on transportation topics. Understanding and addressing these interests and concerns will help us to chart a path to collaboratively planning and implementing a safe and socially acceptable transportation plan.

In 2017, we published "What we heard about transportation planning from working with communities," our annual rolling summary of conversations about transportation. This reflects engagement using a wide range of tools and what we learned from public opinion research.

## Engagement using a wide range of tools

In 2017, we used a wide array of engagement tools to facilitate conversations on the safe transportation of used nuclear fuel. These include our truck-mounted mobile transportation exhibit, as well as standing exhibits in community offices, and a multi-module exhibit used at open house events. We recently added a transportation-themed tabletop display to our interactive kiosk, which was deployed at trade shows and conferences of numerous municipal associations.

In the last year, the NWMO's transportation specialists and mobile exhibit visited 15 Métis, First Nation, and municipal events. Five of these were inaugural events that provided us with opportunities to reach new audiences beyond our siting communities.

Our transportation specialists also made formal presentations to local municipal Community Liaison Committees and the Municipal Forum.

During the tours of the NWMO's demonstration and proof test facility in Oakville, we also engaged people on transportation through the mobile exhibit.

To facilitate learning and dialogue with municipal representatives beyond the siting regions on transportation, our staff participated in municipal association conferences in nuclear fuel cycle provinces, providing information and displays. This included the Ontario Good Roads Association and the Association of Ontario Road Supervisors, where we reached municipal and county road staff, first responders, and emergency management personnel. Similarly, we also worked to engage First Nation and Métis peoples in nuclear fuel cycle provinces.

## 6 Developing transportation plans

> "Overall [participants] were positive about the direction they believed the NWMO was taking and applauded its effort in community engagement. However, all agreed that the conversation on transportation should continue...They called on the NWMO to push forward with broader and more proactive communications and engagement on the issue, particularly with youth and with communities along potential routes."
>
> – from Hill+Knowlton Strategies' "Public Attitude Research and Dialogue Workshop Report," October 2017

### Public opinion research

In late 2016, the NWMO published a discussion document to contribute to the ongoing dialogue on transportation. This document was designed to encourage discussion on five key questions, and to explore areas of interest being raised by communities. In 2017, we implemented a public attitude research project using the discussion document to engage a cross-section of citizens from Ontario, Quebec and New Brunswick. The project involved:

- 20 two-hour-long focus groups sessions;
- Two workshops involving representatives of Indigenous and municipal communities participating in the siting process; and
- A 45-person public dialogue session held in Toronto.

Participants noted that the NWMO was generally heading in the right direction, and provided recommendations on future activities and next steps.

This feedback, along with insight from ongoing conversations with communities, will help guide development of a draft transportation planning framework

.

# Powered by people

**Yang Sui, Design Engineer, is helping the NWMO establish safety in used fuel transportation packages.**


The transportation container, shown here as part of an exhibit, is a solid stainless steel box with walls nearly 30 centimetres thick. It has been safety tested under even the most severe accident conditions.

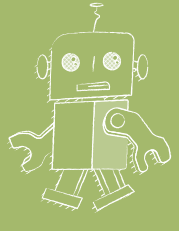
Yang Sui knows that the most important rewards in life stem from taking responsibility for something, working hard and having a positive impact on others.

As a design engineer in the transportation group, Yang is helping with the design of the 35-tonne, stainless steel packages that will be used to transport used fuel from its current locations to the site of the deep geological repository. He and his colleagues use computer analysis and physical testing to ensure the packages can withstand even the most severe conditions.

The job is a natural fit for Yang, who has always been fascinated by mechanics. “When I was a kid, the fun was taking apart toys and putting them back together,” he says. Yang did his bachelor of applied science and then master’s degree in Mechanical Engineering at the University of Waterloo, particularly focusing on mechatronics, a discipline that stands at the intersection of mechanical engineering, electronics and computer science. Think industrial robots and electric cars.

Soon entering his fifth year at the NWMO, Yang is enthused about his role in the APM project. “Transportation will become a key aspect of the project. We have millions of bundles to move, and it will take 30 to 40 years to move them. Our challenge is to make sure they are moved safely, even given the variables of road and rail,” he says.

He finds this deeply rewarding. “I feel like I have a meaningful purpose. Not many people have a job that has this kind of meaning – keeping people safe, taking responsibility for a challenge.”



# 7 Providing financial surety

## Objective

The NWMO will ensure funds are available to pay for the safe, long-term management of Canada's used nuclear fuel.

## Highlights

- The NWMO performed its annual assessment of all factors that impact Adaptive Phased Management (APM) cost estimates and funding requirements.
- We determined 2018 trust fund contribution requirements in accordance with the funding formula.
- We continued to ensure these resources are used prudently.

The NWMO team performs annual assessments of factors that impact APM cost estimates and funding requirements.

# 2017: Year in review

## Funding APM

Canadians expect that the money necessary to pay for the long-term care of used nuclear fuel will be available when needed. This expectation is being met.

The funders of this project are the major owners of used nuclear fuel in Canada: Ontario Power Generation (OPG), NB Power (NBP), Hydro-Québec (HQ) and Atomic Energy of Canada Limited (AECL); the amounts they pay are relative to the number of fuel bundles each company has produced to date.

As required by the *Nuclear Fuel Waste Act* (*NFWA*), each of these companies makes annual deposits to a trust fund, to be accessed only after a construction licence has been issued. There is enough money saved in these trust funds ($4.2 billion) to cover post-licensing costs of APM for the country's existing inventory of used nuclear fuel.

These companies also fund the NWMO's annual operating costs for the period prior to construction.

## Our responsibilities

The NWMO is responsible for determining what costs can reasonably be expected to arise over the life of the project, along with a contingency for unexpected events, and for designing a system that collects enough money to fund it. We also monitor these funds to ensure that the entire cost can be covered under a variety of social and economic circumstances and within the required time frame.

The federal government provides oversight through the Minister of Natural Resources. Audited financial statements are submitted to the minister as part of the NWMO Annual Report. In addition, audited financial statements of the trust funds established by the waste owners are required to be submitted to the minister annually.

APM cost estimates include costs to develop, construct and operate a long-term facility, including a deep geological repository and Centre of Expertise, and to transport the used nuclear fuel to the repository.

## 7 Providing financial surety

### Factors that influence cost

The eventual cost of the project is impacted by many factors, including the volume of used nuclear fuel to be managed, location of the facility, surrounding infrastructure, rock type and characteristics, design of the repository, and length of time allocated to monitoring the site following fuel placement.

The existing inventory of used nuclear fuel in Canada is about 2.8 million bundles, and bundles continue to be produced in order to generate electricity. The eventual number of bundles to be managed could be between 3.6 million and 5.4 million bundles, depending on factors such as the longevity and productivity of the nuclear reactors and decisions on refurbishments. If new reactors are built, the potential volume could rise to 7.2 million bundles.

For planning purposes, our cost estimate is based on an expected volume of about 5.2 million fuel bundles.

### Financial reporting requirements

The *NFWA* specifically addresses the future financial obligations for managing used fuel over the long term. The requirements of the Act are described in the box on the right. The following section of the annual report is structured to be consistent with requirements defined in subsection 16(2) of the *NFWA*.

**Requirements of the *NFWA* (2002)**

The NWMO is required to provide a range of financial information in each of its annual reports following the government's decision, as defined in subsection 16(2) of the *NFWA*.

16(2) Each annual report after the date of the decision of the Governor in Council under section 15 must include:

(a) the form and amount of any financial guarantees that have been provided during that fiscal year by the nuclear energy corporations and Atomic Energy of Canada Limited under the Nuclear Safety and Control Act and relate to implementing the approach that the Governor in Council selects under section 15 or approves under subsection 20(5);

(b) the updated estimated total cost of the management of nuclear fuel waste;

(c) the budget forecast for the next fiscal year;

(d) the proposed formula for the next fiscal year to calculate the amount required to finance the management of nuclear fuel waste and an explanation of the assumptions behind each term of the formula; and

(e) the amount of the deposit required to be paid during the next fiscal year by each of the nuclear energy corporations and Atomic Energy of Canada Limited, and the rationale by which those respective amounts were arrived at.

The *NFWA* requires the establishment of trust funds by each waste owner. The funds were established in 2002, and annual contributions have been made by each waste owner since. The total value of these funds, including investment income, was approximately $4.2 billion as of the end of 2017. This money is in addition to other segregated funds and financial guarantees the companies have set aside for nuclear waste management and decommissioning.

| Owner | Trust fund balance ($ million) December 2017 |
|---|---|
| OPG | 3,882 |
| HQ | 147 |
| NBP | 161 |
| AECL | 51 |
| Total | 4,241 |

Experience in other countries has demonstrated the importance of safeguarding these funds so that they will be preserved for their intended purpose. The *NFWA* built in explicit provisions to ensure that the trust funds are maintained securely and used only for their intended purpose. The NWMO may have access to these funds only for the purpose of implementing the management approach selected by the Government once a construction or operating licence has been issued under the *Nuclear Safety and Control Act* (*NSCA*).

These legislated obligations are the responsibilities of the individual companies named, and not the responsibility of the NWMO. The trust funds are noted here because of their significance in the overall provision for long-term nuclear waste management.

As required by the *NFWA*, the NWMO makes public the audited financial statements of the trust funds when they are provided by the financial institutions annually. They are posted at www.nwmo.ca/trustfunds.

7 Providing financial surety

## Reporting of the Canadian Nuclear Safety Commission (CNSC) financial guarantees

As noted under section 16(2)(a) of the *NFWA*, we are required to report on the form and amount of any financial guarantees that have been provided during the fiscal year by all NWMO members – OPG, HQ and NBP – and AECL. Financial guarantees are required by the CNSC under the *NSCA* to cover the cost (in present value terms) associated with decommissioning, interim storage and long-term management of radioactive waste (including used nuclear fuel) produced to date.

These financial guarantees available for year 2018 total $20.3 billion. They are reviewed independently by the CNSC as part of the waste owner licence requirements. A large portion of these guarantees, approximately $19.6 billion (as of year-end 2017), exists in segregated funds dedicated to nuclear waste management and decommissioning, with any of the remainder in the form of Provincial Guarantees.

Details of the status of these guarantees are presented in Attachment 1.

## Total cost estimate

The *NFWA* Section 16(2)(b) requires the NWMO to address the cost and funding of the long-term management of used nuclear fuel. The NWMO completed a full update of the cost estimates for APM in 2016, with the next update planned for 2021. These estimates provide the basis for financial planning and trust fund deposits for future years.

On the basis of an expected volume of 5.2 million fuel bundles, the total lifecycle cost of APM – from the beginning of site selection in 2010 to the completion of the project – is $23 billion (in 2015 dollars). This figure covers many decades of lifecycle activity.

It is also important to determine the amount that is required, in today's dollars, in order to have those funds available from now until the conclusion of the project. The funding required (using Jan. 1, 2018, present value) to manage 5.2 million fuel bundles from 2018 onwards is $8.9 billion. This takes into consideration expected investment income and does not include costs already paid for.

### Pre- and post-construction costs

Included in the $8.9 billion funding requirement is $2.7 billion to select a site for the repository, complete a detailed design, develop the Centre of Expertise, acquire the site, evaluate environmental impacts, and obtain a site preparation and construction licence from the CNSC. These pre-construction costs are paid for by the waste owners based on the annual budget as approved by the Board of Directors.

Also included is $6.2 billion to complete construction, transport the fuel to the repository, and operate, close, and monitor the repository. The NFWA requires that these post-construction costs must be funded through contributions to the NFWA Trust Funds established by OPG, HQ, NBP, and AECL. As of December 2017, the total value of these funds, including investment income, was approximately $4.2 billion.

The costs of interim storage at the reactor sites and retrieval of the used fuel from storage are not funded through the NWMO since they are the responsibility of the waste owners.

## Budget forecast for 2018

The *NFWA* Section 16(2)(c) requires us to report a budget forecast for the next year. For 2018, the NWMO Board of Directors approved a budget envelope of $76.5 million. Annual costs beyond 2018 are subject to further review. Sharing of these costs will be in accordance with the percentages defined in the Membership Agreement, as amended from time to time. The 2018 cost-sharing percentage among the waste owners is approximately: OPG: 91.94%, HQ: 3.64%, NBP: 3.49%, and AECL: 0.93%.

## Funding formula

The *NFWA* Section 16(2)(d) requires the NWMO to provide the formula to calculate the funding requirements for the next fiscal year.

The NWMO funding formula has been in place since its approval by the Minister of Natural Resources in April 2009. The formula, based partly on projections of used fuel to be generated by each waste owner, allocates liabilities and trust fund contribution requirements to each waste owner. Costs common to all waste owners are shared based on a cost-sharing percentage agreed to by the members. Costs specific to a nuclear fuel waste owner, such as special fuel and special transportation costs that are owner specific, are attributed to the owner.

## 7 Providing financial surety

### Possible future reactors

Discussions have been held with a number of stakeholders regarding the development of a funding formula that could apply to possible new waste owners and used fuel from new reactors. The results of the discussions are summarized below:

1. The principles used in the approved funding formula are reasonable and should apply to new owners and new reactors.
2. Fixed and variable costs and investments made to date need to be considered in any new funding formula for new owners and new reactors.
3. The characteristics of new fuel types must be considered.
4. The existing funding formula should be adapted when specific circumstances are clear for new reactors and new owners.
5. The changes in funding formula for new owners of new reactors may be different than the changes for an existing owner with new reactors.

The NWMO has proposed to apply the above principles to specific circumstances related to new owners and new reactors when they arise.

### Trust fund deposits for 2018

The *NFWA* Section 16(2)(e) requires us to report on the amount of the deposit required to be paid during the next fiscal year by each of the nuclear energy corporations and AECL.

Beginning in 2002, used nuclear fuel owners have been making annual contributions to the *NFWA* Trust Funds.

The 2018 *NFWA* Trust Fund deposits stated herein have been developed based on the APM cost estimate completed in 2016. This estimate reflects updated engineered-barrier system design and planning assumptions for the duration to select a single site.

Under the approved funding formula, the funding for the post-construction licence costs is divided into two parts:

1. Funding for historical used fuel bundles (Committed Liability)
2. Funding for used fuel to be produced each year (Future Liability)

Committed Liability represents all costs that will be incurred regardless of whether any further used fuel bundles are generated in the future. This liability includes all fixed costs for the facility and variable costs attributed to the historical used fuel bundles. Contributions for the Committed Liability are to be amortized to the year 2043 in equal present value payments. The rationale for this amortization period is that 2043 is consistent with the earliest planned date when the deep geological repository would be available. This funding method has the advantage of distributing the funding obligations evenly to each year taking into account the time value of money.

Future Liability represents the incremental cost of transferring to the repository, facility expansion, and additional operating and monitoring costs of used fuel bundles to be produced each year. Each future used fuel bundle would incur the same cost in present value terms taking into account the time value of money.

The 2018 trust fund deposits are shown in the table below.

**Total trust fund deposits: Year 2018**

| Owner | Deposits to trust funds (Committed and future bundles) ($ million)* 2018 |
|---|---|
| OPG | 63.0 |
| HQ | 0.5 |
| NBP | 4.0 |
| AECL | 0.2 |
| Total | 67.7 |

* Annual trust fund deposits are required to be made within 30 days of the submission of the Annual Report. A deposit date of April 30 is assumed for illustrative purposes.

# Powered by people

**Chris Vardy, Director of Business Planning and Cost Management, is helping to ensure APM funding is secure.**

Chris Vardy, who has two teenage daughters, likens working at the NWMO to parenting. “This is a very long-term project,” he says. “It will continue on long after we are gone. We are getting it on its path and ready for the future.”

Entering his eighth year at the NWMO, Chris’ role is a crucial one: to oversee the financial surety of the APM project, making sure the trust fund balances are in place, establishing owners’ contributions for the coming year, and figuring out members’ share of the total lifecycle cost.

His career covers many aspects of business – budgeting, reporting, billing, technology, finance, human resources, procurement, and administration – for a wide range of companies. He is a mathematician, chartered accountant and information systems specialist. Chris’ roles have provided him and his family with opportunities and adventures far from his home in Toronto, including Dallas, New York, Los Angeles, and most excitingly, Doha, the capital city of Qatar.

“Our two years in Qatar were a great experience. Fantastic,” says Chris. The growing family enjoyed the multicultural flavour of the country, the many friends they made there, and unique activities such as searching for fossils in desert caves. While living in Qatar, they travelled to Egypt, Jordan, Dubai, and Iran, where they went skiing.

At the NWMO, Chris enjoys nurturing the project, along with his “super smart” colleagues in a wide range of fields. “It is great watching this unfold,” he says. “I will always have an interest in watching this baby grow.”

7 Providing financial surety

# Attachment 1

## Financial Guarantee Status – Used Fuel Owners

### Hydro-Québec (HQ)

The HQ *NFWA* Trust Fund contained $147 million as of December 31, 2017, and the fair value is estimated at $163 million.

In addition to the trust fund, HQ has provided the CNSC with a Decommissioning Financial Guarantee of $685 million that includes a guarantee associated with used fuel arising from the operation of Gentilly-2 and the cost of station decommissioning, including the long-term management of low- and intermediate-level radioactive waste. The guarantee is in the form of an expressed commitment of the Province of Quebec to HQ that provides a guarantee of payment.

The *NFWA* Trust Fund and the Financial Guarantee provided by the Province of Quebec covered the future financial obligations as follows:

- $497 million for decommissioning and long-term management of low- and intermediate-level radioactive waste
- $329 million for used fuel

### Ontario Power Generation (OPG)

In accordance with the *NSCA*, the CNSC requires OPG to have sufficient funds available to discharge its existing nuclear waste management and nuclear decommissioning obligations. The CNSC process requires the CNSC Financial Guarantee requirement to be updated once every five years, and OPG to provide an annual report to the CNSC on the assumptions, asset values, and resulting financial guarantee requirements. The CNSC Financial Guarantee requirement calculation takes into account nuclear waste expected to be generated to the end of each year.

In November 2017, the CNSC accepted OPG's proposed 2018-2022 CNSC Financial Guarantee requirement to be satisfied, in part, by the forecast fair market value of the federally mandated Ontario *NFWA* Trust, and remainder by the two segregated funds governed by the *Ontario Nuclear Funds Agreement* (*ONFA*) between OPG and the Province of Ontario (collectively, the "Nuclear Funds") without the requirement of a Provincial Guarantee for the 2018-2022 period. As provided for by the terms of the *ONFA*, the province is committed to provide a Provincial Guarantee to the CNSC as required, on behalf of OPG, should there be a shortfall between the CNSC Financial Guarantee requirement and the fair market value of the Nuclear Funds during the 2018-2022 period, as it has been done in the past.

The CNSC Financial Guarantee requirement for 2018 is $16,543 million (January 1, 2018, present value). This will be satisfied by the 2017 year-end fair market value of the Nuclear Funds of $18,689 million without the requirement of a Provincial Guarantee.

### NB Power (NBP)

NBP has provided the CNSC with a Decommissioning Financial Guarantee that covers the costs associated with the long-term management of used fuel projected to be produced from the Point Lepreau Generating Station and the cost of station decommissioning, including the long-term management of low- and intermediate-level radioactive waste.

- The Financial Guarantee requirement is based on the present value of future costs to manage used fuel produced to the end of 2017 and present value of future estimated costs for station decommissioning.
- The Financial Guarantee requirement is satisfied by three separate funds: a Used Fuel Fund, a Station Decommissioning Fund, and the *NFWA* Trust Fund.
- The total market value of the funds at December 31, 2017, was approximately $721 million and was comprised of the following:
  - Used Fuel Fund – $209 million
  - Station Decommissioning Fund – $352 million
  - *NFWA* Trust Fund – $160 million

### Atomic Energy of Canada Limited (AECL)

AECL is not a member of the NWMO. Its Financial Guarantee is in the form of an expressed commitment by the Government of Canada to the CNSC, combined with supporting estimates of the financial liability and the basis for same. The AECL *NFWA* Trust Fund contained approximately $50.5 million as of December 31, 2017.

# 8 Ensuring governance and accountability

## Objective

The NWMO will maintain an accountable governance structure that provides confidence to the Canadian public in the conduct of the NWMO's work.

## Highlights

- The NWMO's governance structure ensured the organization remained accountable to the Canadian public as it progressed towards identifying a single preferred site.
- Careful oversight by the Board of Directors, as well as advice and review on technical and social matters obtained through the Advisory Council and other independent expert bodies, provided assurance the organization is continuously driving to excel.
- The NWMO's integrated management system ensured the organization was well equipped to implement its vision while safeguarding people and the environment.

Chief executive officers of member companies, as well as our Board of Directors, toured our proof test facility in 2017.

# 2017: Year in review

## Annual reporting to Minister

The NWMO reports to the Minister of Natural Resources on an annual basis, as required by the *Nuclear Fuel Waste Act* (*NFWA*). The annual report is made public and tabled in Parliament, and the Minister issues a statement on it each year. The Minister's full statement can be viewed online at www.nrcan.gc.ca. Every third year, an expanded version of the annual report, which reports on the previous three years and includes comments of the Advisory Council, is required under the *NFWA*. The last Triennial Report was published in March 2017, and the next one will be published in March 2020.

## Reporting to Member organizations

Ontario Power Generation (OPG), New Brunswick Power Corporation and Hydro-Québec are the founding Members of the NWMO. The Members' Agreement and NWMO bylaws set out Member roles and responsibilities in supporting the objectives of the *NFWA* and the NWMO's implementation mandate. The NWMO regularly briefs its member organizations.

## 8 Ensuring governance and accountability

### Board of Directors

**Chair of the Board:** Wayne Robbins

**President and CEO:** Laurie Swami

**Directors:** Carlo Crozzoli, Mark Elliott, Lesley Gallinger, Ronald L. Jamieson, Darren Murphy, Josée Pilon, Janet Rieksts-Alderman

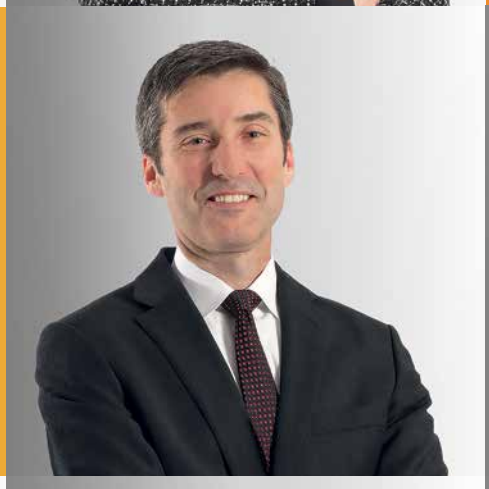
The Board of Directors is responsible for oversight and taking a leadership role in development of the corporation's strategic direction. The Board is elected by Member organizations. There are currently nine members of the Board, representing a range of perspectives from both within and outside the nuclear industry, including capabilities in Indigenous culture and financial management.

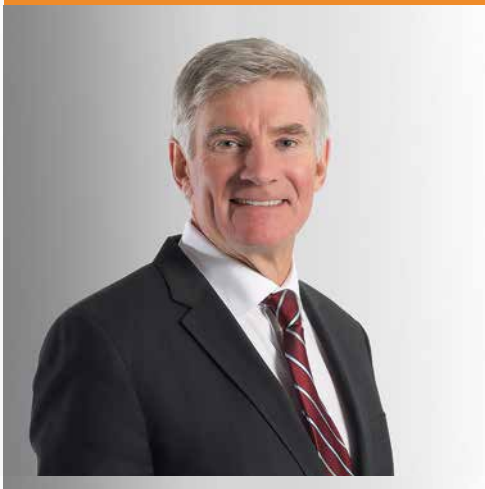
The Board was informed and supportive of the NWMO's procedures and activities in 2017. In addition to four regular meetings, it held a strategy session in the summer with the NWMO's executive team to consider long-term challenges and opportunities as the siting process unfolds. Discussions focused on gaining efficiencies in internal programming while maintaining high performance in delivering on strategic goals.

The Board met with the Council of Elders and Youth to exchange ideas and understand decision-making that reflects upon and respects the traditions, customs and values of Indigenous peoples; the Board and Council committed to conducting regular dialogue.

The Board also receives regular reports from the Advisory Council.

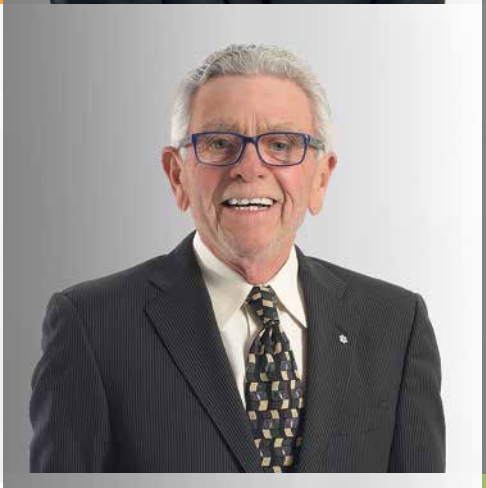
# Board of Directors





First row: Wayne Robbins – Chair, Laurie Swami – President and CEO.

Second row: Carlo Crozzoli, Mark Elliott.



Third row: Lesley Gallinger, Ronald L. Jamieson, Darren Murphy.

Fourth row: Josée Pilon, Janet Rieksts-Alderman.

## 8 Ensuring governance and accountability

### Committees of the Board

#### Audit, Finance and Risk (AFR) committee

The AFR committee met four times in 2017, plus one joint AFR-Human Resources and Compensation (HRC) committee meeting. The AFR committee is responsible for monitoring the integrity of the NWMO's internal control and management information systems, approving annual financial plans, ensuring the integrity of the NWMO's reported financial performance, and providing oversight of the NWMO's pension fund.

As of December 31, 2017, the committee had four directors: Lesley Gallinger (Chair), Carlo Crozzoli, Ronald L. Jamieson, and Josée Pilon.

#### Siting committee

The Siting committee met four times in 2017. Through this committee, the Board maintains oversight of the site selection process and manages risks associated with its execution.

As of December 31, 2017, the committee had five directors: Ronald L. Jamieson (Chair), Janet Rieksts-Alderman, Mark Elliott, Darren Murphy, and Wayne Robbins.

#### Human Resources and Compensation (HRC) committee

The HRC committee met four times in 2017, plus one joint AFR-HRC committee meeting. It is responsible for overseeing the NWMO's human resources functions, including compensation practices, human resources policy, organization design, labour relations, and the pension plan.

As of December 31, 2017, the committee had five directors: Janet Rieksts-Alderman (Chair), Carlo Crozzoli, Darren Murphy, Josée Pilon, and Wayne Robbins.

#### Low- and Intermediate-Level Waste Deep Geologic Repository Oversight Committee

The committee met twice in 2017. It is responsible for monitoring the NWMO's role in managing the regulatory approvals, engineering, procurement, and construction for OPG's deep geologic repository project in Kincardine, Ont. This includes review of the NWMO's performance under its Deep Geologic Repository Services Agreement, and Engineering, Procurement and Construction Management Agreement with OPG, as well as risk management related to the project.

As of December 31, 2017, the committee had six directors and members: Mark Elliott (Chair), Carlo Crozzoli, Lesley Gallinger, Morris Medd (non-director), Wolf Seidler (non-director), and Laurie Swami.

## Officers

| | |
|---|---|
| **Chair of the Board:** | Wayne Robbins |
| **President and CEO:** | Laurie Swami |
| **Vice-President, Site Selection:** | Mahrez Ben Belfadhel |
| **Vice-President, Stakeholder Relations:** | Lisa Frizzell |
| **Chief Financial and Risk Officer:** | Michael Hung |
| **Vice-President, Human Resources and Chief Ethics Officer:** | Jennifer Spragge |
| **Vice-President and General Counsel:** | Doug Taylor |
| **Vice-President, Indigenous Relations:** | Bob Watts |
| **Chief Engineer and Vice-President, Contract Management:** | Derek Wilson |
| **Board Secretary:** | Gillian Morris |

Members of the NWMO's executive committee (left to right): Mahrez Ben Belfadhel, Doug Taylor, Jennifer Spragge, Michael Hung, Laurie Swami, Derek Wilson, Bob Watts, Lisa Frizzell.

## 8 Ensuring governance and accountability

### Advisory Council

The Advisory Council reviews and comments on the NWMO's work. This is a requirement of the *NFWA*. The Council's reports appear in the NWMO's triennial reports every three years.

There are 10 Advisory Council members. The Honourable David Crombie has been Chair of the Advisory Council for 15 years. Expertise reflected in the members includes geotechnical engineering, chemical engineering, nuclear engineering, engagement, public affairs, nuclear community relations, environment, sustainable development, law, political science, municipal affairs and government relations, Indigenous relations, Indigenous Knowledge, and community-based research.

The full Advisory Council membership is profiled online at www.nwmo.ca/advisory.

In 2017, the Advisory Council focused on providing the NWMO with advice in these key areas:

- Site assessment activities;
- Plans for narrowing down the number of communities in the siting process;
- Ethical Framework and road map for building partnerships with communities;
- Community well-being funding to support building partnership agreements;
- A fair and ethical plan for recognition of communities exiting the siting process; and
- The addition of safety to the NWMO's values.



# Advisory Council

First row: David Crombie – Chair, David R. Cameron – Vice-Chair, Joseph Cavalancia.

Second row: Dean Jacobs, Diane M. Kelly.




Third row: Eva Ligeti, Derek H. Lister.

Fourth row: Dougal McCreath, Donald Obonsawin, Linda Thompson.



## 8 Ensuring governance and accountability

> "Over the last 15 years, the NWMO has demonstrated an inclusive, patient and thorough approach to technical and engagement activities. In doing so, it has adhered to its fundamental values – safety, integrity, excellence, collaboration, accountability, and transparency. This strong track record has laid the groundwork for building productive and trusting partnerships with host communities over the long term."
>
> – The Honourable David Crombie, Advisory Council Chair since 2002

### Peer reviews

The NWMO continues to co-ordinate peer reviews of technical work and to invite independent comment. Such external reviews help ensure high technical standards are being met, as well as consistency with international practice.

For example, last year, we convened an expert panel to review plans to use copper coating on used fuel containers to minimize corrosion. The panel's report, produced in 2017, was complimentary of our copper corrosion program.

Review of our underground microbial research program was in the planning stages in 2017, with recommendations expected in late 2018 or early 2019.

We also routinely request peer review of key technical reports. For example, in 2017, two external reviewers provided detailed comments on the draft sixth safety case study report. Also, external experts in sedimentary and crystalline rock settings provide reviews on key geoscience reports.

We publish regularly in peer-reviewed journals in our technical fields.

Adaptive Phased Management-Geoscientific Review Group members and NWMO staff look closely at rock near Ignace, Ont.

### Adaptive Phased Management-Geoscientific Review Group (APM-GRG)

The APM-GRG is a group of internationally recognized experts in geoscience disciplines that reviews the NWMO's geoscience plans and findings. The group plays an important role in ensuring the NWMO's technical work consistently meets or exceeds international best practices.

In 2017, the APM-GRG visited the site near Ignace where the NWMO is drilling a borehole. This provided the group with not only a first-hand look at the rock, but also an opportunity to meet people in the area, including keepers of Indigenous Knowledge. This helped the scientists appreciate the kinds of social considerations, in addition to geology, that influence decisions.

## 8 Ensuring governance and accountability

### International commitment

The NWMO continues to support Canada's international obligations under the *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*. Under the Joint Convention, Canada must demonstrate that it is meeting international commitments to manage radioactive waste and used nuclear fuel safely. The NWMO will next contribute to Canada's reporting at the 2018 and 2021 conventions.

### Council of Elders and Youth

The Council of Elders and Youth is an advisory body made up of First Nation and Métis Elders and youth. It meets regularly throughout the year and provides counsel to the NWMO on how to apply Indigenous Knowledge in implementing APM. The emphasis of the group is on protecting and respecting air, land, fire, water, plants, medicines, animals, and humans.

In 2017, the Council met three times with the NWMO. Two significant themes of discussion were harmonizing the policies and frameworks that guide Indigenous relations and developing a reconciliation agenda, including defining partnership and consent. Members of the Council also engaged with people in communities that may be impacted by APM, attending open houses, trade shows and cultural events, as well as First Nation and Métis community meetings. These activities were well-received by communities.


The Council of Elders and Youth is active in providing counsel on the application of Indigenous Knowledge to the APM project.

Members of the Municipal Forum visit the NWMO's proof test facility in Oakville.

## Municipal Forum

The Municipal Forum provides advice on municipal perspectives and processes to help guide the NWMO's engagement and outreach.

The forum is an assembly of municipal association representatives with experience and expertise on municipal issues and challenges. It helps the NWMO to incorporate best practices when communicating with local governments and associations, and understand the needs and practices of municipalities that are considering hosting the project.

## Quality Management System

The NWMO operates its integrated management system for activities supporting the long-term management of nuclear waste. As part of its plan to ensure excellence and accountability in governance, the organization maintains certifications to ISO 9001:2008 for quality, ISO 14001:2004 for environment, and CSA Z1000:2015 for health and safety management.

In addition to maintaining conformance to these standards, the NWMO's management system is augmented to meet CSA N286-12 Management System Requirements for Nuclear Facilities, which includes nuclear waste facilities. The NWMO's integrated management system ensures the organization is well equipped to implement its vision. The focus on safeguarding people is fully aligned with the CSA N286-12 management principle that safety is the paramount consideration guiding decisions and actions.

# Powered by people

**Helping the NWMO to meet its governance objectives is Gillian Morris, Board Secretary.**

Gillian Morris' job sounds a little dry, until you realize she holds the beating heart of the operation in her gloved hands. As Board Secretary, Gilllian is in the highly valued and trusted position of liaising with the Board of Directors and ensuring their decisions are implemented. She is an Officer of the NWMO and was appointed by the Board.

"It is such an interesting role," she says. "I get to see how the entire company is managed and decisions are made – it is a unique vantage point." One of the most important traits of board secretaries is discretion, as they are privy to strategic initiatives in the making.

Gillian is also hyper organized. Her job entails being responsible for the efficient administration of the Board. She works with our legal team to ensure the Board and committees of the Board meet the obligations of their Charters, company bylaws, and relevant legislation, and have comprehensive corporate governance practices. She manages meetings, schedules, agendas, materials, and minutes for the Board, Board committees and Advisory Council. She attends all Board meetings, and manages Board logistics and communication. "I enjoy being at the pulse centre of all these vital governance activities," she says.

Gillian has been at the NWMO almost since its first days, having started in 2003 as a special assistant to then-CEO the Honourable Elizabeth Dowdeswell, who is now the Lieutenant Governor of Ontario. Before joining the NWMO, Gillian worked in board governance for International Thermonuclear Experimental Reactor Canada.

When not working, Gillian can be found painting beautiful, restful scenes from her travels, in acrylic and watercolour. She lives with her partner and their cat and dog.

# 5 Auditor's report and financial statements

## Management's responsibility for financial reporting

The accompanying financial statements of the Nuclear Waste Management Organization (NWMO) and all the information in this annual report are the responsibility of management and have been approved by the Board of Directors.

The financial statements have been prepared by management in accordance with Canadian accounting standards for not-for-profit organizations set out in Part III of the Chartered Professional Accountants Canada Handbook. When alternative accounting methods exist, management has chosen those it deems most appropriate in the circumstances. Financial statements are not precise since they include certain amounts based on estimates and judgments, particularly when transactions affecting the current accounting period cannot be finalized until future periods.

Management has determined such amounts on a reasonable basis in order to ensure that the financial statements are presented fairly, in all material respects, and in light of information available up to February 14, 2018.

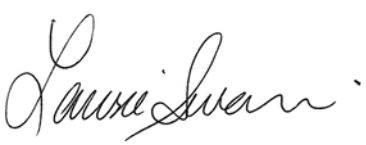
Management has a system of internal controls designed to provide reasonable assurance that the financial statements are accurate and complete in all material respects. The internal control system includes an established business conduct policy that applies to all employees. Management believes that the systems provide reasonable assurance that transactions are properly authorized and recorded, financial information is relevant, reliable and accurate, and the Organization's assets are appropriately accounted for and adequately safeguarded.

The Board of Directors is responsible for ensuring management fulfils its responsibilities for financial reporting, and is ultimately responsible for reviewing and approving the financial statements. The Board carries out this responsibility through its Audit, Finance and Risk Committee (the Committee).

The Committee is appointed by the Board and meets periodically with management, as well as the external auditor, to discuss internal controls over the financial reporting process, auditing matters and financial reporting issues; to satisfy itself that each party is properly discharging its responsibilities; and to review the financial statements and the external auditor's report. The Committee reports its findings to the Board for consideration when approving the financial statements for issuance to the members. The Committee also considers, for review by the Board and approval by the members, the engagement or reappointment of the external auditor.

The financial statements have been audited by Deloitte LLP, the independent external auditor, in accordance with Canadian generally accepted auditing standards on behalf of the members.

February 14, 2018



Laurie Swami

President and CEO

Michael Hung

Chief Financial Officer

# Independent Auditor's Report

## To the Members of Nuclear Waste Management Organization

We have audited the accompanying financial statements of Nuclear Waste Management Organization, which comprise the statement of financial position as at December 31, 2017, and the statements of operations, changes in net assets and cash flows for the year then ended, and a summary of significant accounting policies and other explanatory information.

## Management's Responsibility for the Financial Statements

Management is responsible for the preparation and fair presentation of these financial statements in accordance with Canadian accounting standards for not-for-profit organizations, and for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

## Auditor's Responsibility

Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with Canadian generally accepted auditing standards. Those standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained in our audit is sufficient and appropriate to provide a basis for our audit opinion.

# 5 Auditor's report and financial statements

## Opinion

In our opinion, the financial statements present fairly, in all material respects, the financial position of Nuclear Waste Management Organization as at December 31, 2017, and the results of its operations and its cash flows for the year then ended, in accordance with Canadian accounting standards for not-for-profit organizations.

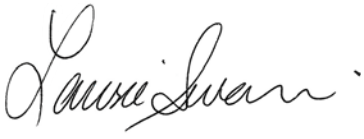
Deloitte LLP

Chartered Professional Accountants
Licensed Public Accountants
February 14, 2018
Vaughan, Ontario

# Statement of financial position
# as at December 31, 2017

| | 2017 | 2016 |
|---|---|---|
| | $ | $ |
| **Assets** | | |
| Current assets | | |
| Cash | 5,551,887 | 2,344,119 |
| Member contributions receivable (Note 5a) | 7,296,543 | 7,279,915 |
| Other receivable from members | 1,004,345 | 751 |
| Prepaid expenses and deposits | 1,098,315 | 852,831 |
| | 14,951,090 | 10,477,616 |
| Capital assets (Note 3) | 3,061,573 | 3,788,446 |
| Accrued pension asset (Note 7) | 43,026,314 | 36,848,322 |
| | 61,038,977 | 51,114,384 |
| **Liabilities** | | |
| Current liabilities | | |
| Accounts payable and accrued liabilities (Note 12) | 14,297,256 | 10,583,376 |
| Deferred lease inducements (Note 8) | 794,842 | 26,229 |
| Deferred/payable member contributions (Note 5b) | 308,992 | 168,011 |
| | 15,401,090 | 10,777,616 |
| Deferred capital contribution (Note 6) | 3,061,573 | 3,788,446 |
| Deferred member contributions (Note 5c) | 11,563,719 | 11,349,500 |
| Other post-employment and pension benefits liability (Note 7) | 24,647,641 | 20,034,868 |
| | 39,272,933 | 35,172,814 |
| **Net assets** | 6,364,954 | 5,163,954 |
| | 61,038,977 | 51,114,384 |

Approved by the Board of Directors, February 14, 2018



Laurie Swami

President and CEO
Toronto, Ontario

Lesley Gallinger

Chair – Audit, Finance and Risk Committee
Toronto, Ontario

The accompanying notes to the financial statements are an integral part of this financial statement.

## Statement of operations
## year ended December 31, 2017

| | 2017 | 2016 |
|---|---|---|
| | $ | $ |
| **Revenue** | | |
| Member cash contributions received (Note 4) | 64,974,390 | 61,122,670 |
| Non-member cash contributions received | 618,109 | 586,071 |
| | 65,592,499 | 61,708,741 |
| Change in deferred capital contributions (Note 6) | 726,873 | (331,601) |
| Change in long-term deferred member contributions (Note 5c) | (214,219) | (854,038) |
| Change in member contributions receivable (Note 5a) | 16,628 | 1,495,064 |
| Change in deferred/payable member contributions (Note 5b) | (140,981) | (39,485) |
| Total contribution revenue (Note 11) | 65,980,800 | 61,978,681 |
| Interest income (Note 11) | 47,691 | 8,646 |
| **Total revenue** | 66,028,491 | 61,987,327 |
| **Expenses** | | |
| Adaptive Phased Management | | |
| Staffing and administration | 27,300,051 | 25,293,545 |
| Siting process | 17,846,281 | 14,463,059 |
| Design and development safety case | 11,728,829 | 13,006,750 |
| Building relationships | 2,016,792 | 1,664,096 |
| Governance structure | 508,612 | 583,149 |
| Adapting to change | 252,882 | 259,624 |
| Funding formula/financial surety | 6,000 | - |
| | 59,659,447 | 55,270,223 |
| Deep Geologic Repository | | |
| Regulatory review stage | 1,138,143 | 1,710,714 |
| Design stage | 1,221,926 | 858,918 |
| Staffing and administration | 2,393,097 | 1,549,719 |
| | 4,753,166 | 4,119,351 |
| Lifecycle Liability Management | | |
| Contract services | - | 119,062 |
| Staffing and administration | 339,325 | 1,231,232 |
| | 339,325 | 1,350,294 |
| Amortization | 1,276,553 | 1,247,459 |
| **Total expenses (Note 11)** | 66,028,491 | 61,987,327 |
| **Excess of revenue over expenses for the year** | - | - |

The accompanying notes to the financial statements are an integral part of this financial statement.

## Statement of changes in net assets
## year ended December 31, 2017

| | 2017 | 2016 |
|---|---|---|
| | $ | $ |
| **Net assets, beginning of year** | 5,163,954 | 8,200,354 |
| Excess of revenue over expenses for the year | - | - |
| Remeasurements during the year: | | |
| Accrued pension asset | 4,122,000 | (2,237,000) |
| Other post-employment and pension benefits liability | (2,921,000) | (799,400) |
| **Net assets, end of year** | 6,364,954 | 5,163,954 |

## Statement of cash flows
## year ended December 31, 2017

| | 2017 | 2016 |
|---|---|---|
| | $ | $ |
| **Operating activities** | | |
| Cash received from contributions | 65,592,499 | 61,708,741 |
| Interest received | 47,691 | 8,646 |
| | 65,640,190 | 61,717,387 |
| Cash paid for salaries and benefits, materials and services | (61,881,864) | (59,756,688) |
| | 3,758,326 | 1,960,699 |
| **Investing activities** | | |
| Purchase of capital assets (Note 3) | (550,558) | (1,532,365) |
| Net increase in cash | 3,207,768 | 428,334 |
| Cash, beginning of year | 2,344,119 | 1,915,785 |
| **Cash, end of year** | 5,551,887 | 2,344,119 |

The accompanying notes to the financial statements are an integral part of these financial statements.

## Notes to the financial statements
## December 31, 2017

### 1. Description of organization

The Nuclear Waste Management Organization ("NWMO") is a not-for-profit corporation without share capital, established under the *Canada Corporations Act*, 1970 ("the Act"), as required by the *Nuclear Fuel Waste Act* ("*NFWA*"), 2002, which came into force November 15, 2002.

The *NFWA* requires electricity-generating companies which produce used nuclear fuel to establish a waste management organization. In accordance with the *NFWA*, the NWMO established an Advisory Council, conducted a study and provided recommendations on the long-term management of used nuclear fuel to the Government of Canada. The results of the study and the recommendations were submitted in November 2005. As part of the long-term mandate, the NWMO is now responsible for implementing Adaptive Phased Management ("APM"), an approach selected by the Government of Canada to address the management of used nuclear fuel.

The NWMO formally began operations on October 1, 2002. Its founding members are Hydro-Québec, New Brunswick Power Corporation, and Ontario Power Generation Inc. ("Members").

Pursuant to a Membership Agreement, cost sharing of APM costs in 2017 is based on the number of fuel bundles produced as of June 30, 2013, adjusted to account for the assumed timing of transfer of used fuel to the repository. These cost sharing percentages have been in effect since January 1, 2015.

Members are currently finalizing the Membership Agreement to revise the cost sharing percentages based on the principles of projected total number of fuel bundles and assumed timing of access to the long-term used fuel management facility. It is expected that the revised cost sharing percentages will be effective in 2018.

The Lifecycle Liability Management ("LLM") Service Agreement for the provision of certain costing and accounting services with Ontario Power Generation ("OPG") was terminated in March 2017. The affected employees were transferred to OPG.

In late 2017, OPG advised that it was reviewing the level of NWMO support related to its Low and Intermediate Level Waste Deep Geologic Repository ("DGR") given the status of the regulatory approvals. As such, the NWMO reduced activities in the 2018 work plan and will continue to work with OPG to define the level of NWMO support for the project moving forward.

## 2. Significant accounting policies

**Basis of presentation**

The financial statements of the NWMO are the representations of management prepared in accordance with Canadian accounting standards for not-for-profit organizations set out in Part III of the Chartered Professional Accountants Canada ("CPA Canada") Handbook using the deferral method of reporting restricted contributions. The significant accounting policies adopted by the NWMO are as follows:

**Capital assets**

Capital assets are recorded at cost. Amortization is provided for on the straight-line basis over their estimated useful lives as follows:

| | |
|---|---|
| Office building | 15 years |
| Furniture and office equipment | 7 years |
| Transport and work equipment | 7 years |
| Vehicles | 5 years |
| Computer equipment and software | 3 years |
| Leasehold improvements | Initial lease term plus one renewal period |

**Income tax**

The NWMO is a not-for-profit organization, and pursuant to section 149(1)(1) of the *Income Tax Act*, is not subject to income tax.

**Revenue recognition**

Contributions received from members are treated as restricted contributions, and as such, they are not recognized as revenue until associated costs have been incurred. Any excess or shortfall of member contributions is recorded as deferred revenue or member contribution receivable, respectively.

Contributions used for the purchase of capital assets owned by the NWMO are deferred and amortized into revenue at the rate corresponding with the amortization rate of the related capital assets.

**Pension and other post-employment benefits**

The NWMO's post-employment benefit programs include a contributory defined benefit registered pension plan, a defined benefit supplementary pension plan, and other post-employment benefits, including group life insurance, health care and long-term disability benefits. The NWMO has adopted the following policies with respect to accounting for these post-employment benefits as per CPA Canada Handbook Part III, Section 3463, effective January 1, 2014:

(i) The NWMO accrues its obligations under pension, supplementary pension plan, and other post-employment benefit ("OPEB") plans. The defined benefit obligation for pension is determined using the projected benefit method pro-rated on service and is measured based on the actuarial valuation prepared for funding purposes (but not one prepared using a solvency, wind up, or similar valuation basis). Under this method, the benefit costs are amortized over the average remaining service period of active employees as indicated in Note 7. For other unfunded plans such as supplementary pension plan and OPEB, a similar accrual method is used and the benefit obligations are measured based on the actuarial valuation for accounting purposes. Remeasurements and other items for the period are recorded through net assets.

## 2. Significant accounting policies (continued)

(ii) The obligations are affected by salary levels, inflation, and cost escalation of specific items (e.g., dental and health claims). Pension and OPEB costs and obligations are determined annually by independent actuaries using management's best estimate assumptions. The discount rate used by the NWMO in determining projected benefit obligations and the costs for the NWMO's pension plan is based on the funding valuation on a going concern basis, while other employee benefit plans' discount rates are based on representative AA corporate bond yields in effect at the end of the year.

(iii) Pension fund assets are valued using market-related values for the purposes of determining actuarial gains or losses and the actual return on plan assets. The plan's assets consist of investment grade securities. Market and credit risk on these securities are managed by the plan by placing plan assets in trust and through the plan investment policy.

**Research and development**

Research and development costs are charged to operations in the year incurred.

**Foreign currency translation**

Monetary assets and liabilities denominated in foreign currencies are translated into Canadian currency at the year-end exchange rate. Any resulting gain or loss is reflected in staffing and administration expenses. Transactions in foreign currencies throughout the year have been converted at the exchange rate prevailing at the date of the transaction.

**Financial instruments**

Financial instruments include cash, accounts receivable, and accounts payable and accrued liabilities.

Financial assets and financial liabilities are initially recognized at fair value when the NWMO becomes a party to the contractual provisions of the financial instrument. Subsequently, all financial instruments are measured at amortized cost. Financial assets measured at amortized cost are assessed at each reporting date for indications of impairment. If such impairment exists, the asset is written down and the resulting impairment loss is recognized in the statement of operations.

**Related party transactions**

Related party transactions are recorded at the exchange amount.

**Use of estimates**

The preparation of financial statements in conformity with Canadian generally accepted accounting principles requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities, disclosures of contingent assets and liabilities at the date of the financial statements, and the reported amounts of revenues and expenses during the reporting period. Due to the inherent uncertainty in making estimates, actual results could differ from those estimates. Accounts requiring significant estimates include pension and other post-employment benefits, certain accrued liabilities and amortization which is based on the estimated useful life of the capital assets.

## 3. Capital assets

| | | | 2017 | 2016 |
|---|---|---|---|---|
| | Cost | Accumulated amortization | Net book value | Net book value |
| | $ | $ | $ | $ |
| Land | 10,000 | - | 10,000 | 10,000 |
| Computer equipment and software | 3,776,674 | 3,251,179 | 525,495 | 878,505 |
| Furniture and office equipment | 2,328,124 | 1,971,413 | 356,711 | 465,403 |
| Leasehold improvements | 2,234,099 | 2,234,099 | - | 231,722 |
| Transport and work equipment | 1,436,926 | 369,644 | 1,067,282 | 965,344 |
| Office building | 1,182,612 | 117,180 | 1,065,432 | 1,127,513 |
| Vehicles | 374,231 | 337,578 | 36,653 | 109,959 |
| | 11,342,666 | 8,281,093 | 3,061,573 | 3,788,446 |

Capital asset additions totalling $211,163 (2016 – $212,041) have been excluded from the statement of cash flows as they remain unpaid at year-end. During 2017, capital asset additions totalling $212,041 (2016 – $165,345) have been included in the statement of cash flows as they were accrued at December 31, 2016, and paid in 2017 (2016 – accrued at December 31, 2015, and paid in 2016).

## 4. Related party transactions and balances

Transactions and balances not otherwise disclosed separately in the financial statements are as follows:

| | | | 2017 | 2016 |
|---|---|---|---|---|
| | APM | LLM/DGR | Total | Total |
| | $ | $ | $ | $ |
| Transactions during the year | | | | |
| Member contributions received | | | | |
| Ontario Power Generation Inc. | 55,340,000 | 5,238,390 | 60,578,390 | 57,040,498 |
| New Brunswick Power Corporation | 2,101,000 | - | 2,101,000 | 2,010,000 |
| Hydro-Québec | 2,295,000 | - | 2,295,000 | 2,072,172 |
| | 59,736,000 | 5,238,390 | 64,974,390 | 61,122,670 |

## 5. Member contributions receivable and deferred/payable member contributions

The NWMO receives contributions from its members and is solely funded through their contributions. The contributions received from the members are restricted in nature, and thus revenue is recognized when qualifying expenses are incurred. Amounts received in advance of qualifying expenses are recorded as deferred member contributions. Commitments for contributions which have not been received by the NWMO are recorded as contributions receivable when the amount is determinable and the ultimate collection is likely. Information in this note includes amounts related to Atomic Energy of Canada Limited.

(a) Member contributions receivable
Member contributions receivable are made up of the following:

| | 2017 | 2016 |
|---|---|---|
| | $ | $ |
| Ontario Power Generation | 7,089,277 | 7,064,239 |
| New Brunswick Power Corporation | 207,266 | 201,628 |
| Hydro-Québec | - | 14,048 |
| | 7,296,543 | 7,279,915 |

(b) Deferred/payable member contributions
Deferred/payable member contributions are made up of the following:

| | 2017 | 2016 |
|---|---|---|
| | $ | $ |
| Atomic Energy of Canada Limited | 224,978 | 168,011 |
| Hydro-Québec | 84,014 | - |
| | 308,992 | 168,011 |

(c) Long-term deferred member contributions
Long-term deferred member contributions represent amounts received or receivable to fund various employee future benefits as follows:

| | 2017 | 2016 |
|---|---|---|
| | $ | $ |
| Accrued pension asset | 43,026,314 | 36,848,322 |
| Other post-employment benefits | (24,647,641) | (20,034,868) |
| Pension and other post-employment benefit liabilities – short term (Note 7) | (450,000) | (300,000) |
| Less remeasurements and other items in net assets | (6,364,954) | (5,163,954) |
| | 11,563,719 | 11,349,500 |

(d) Continuity of deferred member contributions

The continuity of deferred member contributions is as follows:

| | 2017 | 2016 |
|---|---|---|
| | $ | $ |
| Balance, beginning of year | | |
| Deferred/payable member contributions – current | 168,011 | 128,526 |
| Deferred member contributions – long term | 11,349,500 | 10,495,462 |
| | 11,517,511 | 10,623,988 |
| Contributions received | 65,592,499 | 61,708,741 |
| Contributions receivable | 7,296,543 | 7,279,915 |
| Contribution revenue recognized | (65,980,800) | (61,978,681) |
| Amounts received previously recognized | (7,279,915) | (5,784,851) |
| Change related to capital contributions | 726,873 | (331,601) |
| | 11,872,711 | 11,517,511 |
| Balance, end of year | | |
| Deferred/payable member contributions – current | (308,992) | (168,011) |
| Deferred member contributions – long term | 11,563,719 | 11,349,500 |

## 6. Deferred capital contributions

| | 2017 | 2016 |
|---|---|---|
| | $ | $ |
| Balance, beginning of year | 3,788,446 | 3,456,844 |
| Contributions for the purchase of capital assets | 549,680 | 1,579,061 |
| Less amortization into revenue | (1,276,553) | (1,247,459) |
| Balance, end of year | 3,061,573 | 3,788,446 |

## 7. Pension and other post-employment benefit plans

Effective January 1, 2009, the NWMO offers certain benefits to employees and retirees. A brief overview of these benefit plans is set out below:

(a) Registered pension plan
The registered pension plan is a contributory defined benefit plan covering most employees and retirees. The Plan is funded, and fund assets include pooled funds that are managed by a third party. The benefit costs and assets related to this plan are recorded in the NWMO's financial statements.

(b) Supplementary pension plan
The supplementary pension plan is a defined benefit plan covering certain employees and retirees. The plan is unfunded.

(c) Other post-employment benefit plans
These other post-employment benefit plans provide medical, dental, and group life insurance coverage for certain groups of full-time employees who have retired from the NWMO.

The most recent actuarial valuations in accordance with CPA Canada Handbook Section 3463 of the registered pension plan and supplementary pension plan were performed as at December 31, 2016, and other post-retirement plan as at December 31, 2014. The liability as at December 31, 2017, is based on an extrapolation of the previous valuations.

A funding valuation, which was completed for the pension plan as of January 1, 2017, reported a surplus of $36.7 million on a going concern basis and a surplus of $2 million on a solvency basis.

The significant actuarial assumptions for benefit obligation and costs adopted in estimating the NWMO's accrued benefit obligations are as follows :

| | Registered pension plan | | Supplementary pension plan | | Other post-employment benefit plans | |
|---|---|---|---|---|---|---|
| | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 |
| | % | % | % | % | % | % |
| Discount rate at the beginning of the period | 5.75 | 6.0 | 4.0 | 4.2 | 4.0 | 4.2 |
| Salary schedule escalation rate | 3 | 3 | 3 | 3 | - | - |
| Rate of cost of living increase | 2 | 2 | 2 | 2 | - | - |
| Rate of increase in health-care cost trend | - | - | - | - | 5.7 | 5.9 |
| Discount rate at the end of the period | 5.75 | 5.75 | 3.5 | 4.0 | 3.5 | 4.0 |
| Average remaining service life for employees | 13 years | 13 years | 13 years | 13 years | 12 years | 12 years |

Information for the NWMO's pension and post-employment benefits, including long-term disability ("LTD") is as follows:

| | Registered pension plan | | Supplementary pension plan | | Other post-employment benefit plans | |
|---|---|---|---|---|---|---|
| | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 |
| | $ | $ | $ | $ | $ | $ |
| Changes in accrued benefit obligation | | | | | | |
| Accrued benefit obligation, January 1 | (58,646,000) | (51,299,000) | (5,354,700) | (4,812,400) | (14,980,168) | (13,218,394) |
| Current service cost | (2,027,000) | (1,945,000) | (331,000) | (319,000) | (885,000) | (807,000) |
| Interest cost | (3,470,000) | (3,182,000) | (245,000) | (231,000) | (628,000) | (584,000) |
| Employee contribution | (1,055,000) | (1,017,000) | - | - | - | - |
| Benefits paid | 2,858,000 | 1,241,000 | 210,347 | 153,100 | 272,604 | 283,226 |
| Net actuarial gain (loss) | (119,000) | (2,444,000) | (1,071,724) | (145,400) | (2,085,000) | (654,000) |
| Accrued benefit obligation, December 31 | (62,459,000) | (58,646,000) | (6,792,077) | (5,354,700) | (18,305,564) | (14,980,168) |
| Changes in plan assets | | | | | | |
| Fair value of plan assets, January 1 | 95,494,322 | 88,025,610 | - | - | - | - |
| Expected return on plan assets | 5,542,992 | 5,327,712 | - | - | - | - |
| Benefits paid | (2,858,000) | (1,241,000) | - | - | (273,000) | (283,000) |
| Net actuarial gain (loss) | 4,241,000 | 207,000 | - | - | - | - |
| Employer contribution | 2,010,000 | 2,158,000 | - | - | 273,000 | 283,000 |
| Employee contribution | 1,055,000 | 1,017,000 | - | - | - | - |
| Fair value of plan assets, December 31 | 105,485,314 | 95,494,322 | - | - | - | - |
| Funded status | | | | | | |
| Fair value of plan assets | 105,485,314 | 95,494,322 | - | - | - | - |
| Accrued benefit obligation | (62,459,000) | (58,646,000) | (6,792,077) | (5,354,700) | (18,305,564) | (14,980,168) |
| Accrued benefit asset (liability) | 43,026,314 | 36,848,322 | (6,792,077) | (5,354,700) | (18,305,564) | (14,980,168) |
| Short-term portion | - | - | (200,000) | (150,000) | (250,000) | (150,000) |
| Long-term portion | 43,026,314 | 36,848,322 | (6,592,077) | (5,204,700) | (18,055,564) | (14,830,168) |
| | 43,026,314 | 36,848,322 | (6,792,077) | (5,354,700) | (18,305,564) | (14,980,168) |
| Components of cost recognized | | | | | | |
| Current service cost | 2,027,000 | 1,945,000 | 331,000 | 319,000 | 885,000 | 807,000 |
| Interest cost on accrued benefit obligation | 3,470,000 | 3,182,000 | 245,000 | 231,000 | 628,000 | 584,000 |
| Expected return on plan asset | (5,543,000) | (5,327,712) | - | - | - | - |
| Cost recognized | (46,000) | (200,712) | 576,000 | 550,000 | 1,513,000 | 1,391,000 |

An amount of $450,000 (2016 – $300,000) that is included in accounts payable and accrued liabilities is part of the total $25,097,641 (2016 – $20,334,868) accrued benefit liability at the end of the year for the supplementary pension and other post-employment benefits/LTD plans.

The pension and other post-employment benefit costs recognized are included in the respective expense categories in the statement of operations.

### 7. Pension and other post-employment benefit plans (continued)

Sensitivity information related to the other post-employment benefit plans is as follows:

| | 2017 | 2016 |
|---|---|---|
| | $ | $ |
| Effect of 1% increase in health-care cost trends on | | |
| Accrued benefit obligation | 4,696,000 | 3,543,000 |
| Service cost and interest cost | 437,000 | 389,000 |
| Effect of 1% decrease in health-care cost trends on | | |
| Accrued benefit obligation | (3,432,000) | (2,635,000) |
| Service cost and interest cost | (313,000) | (281,000) |

The supplementary pension plan is unfunded and is secured by a Letter of Credit of $8,079,900 (2016 – $7,896,300) issued by OPG.

### 8. Deferred lease inducements

| | 2017 | 2016 |
|---|---|---|
| | $ | $ |
| Tenant inducements | 1,127,523 | 461,757 |
| Less accumulated amortization | (332,681) | (435,528) |
| | 794,842 | 26,229 |

### 9. Guarantees

In the normal course of business, the NWMO enters into agreements that meet the definition of a guarantee.

(a) The NWMO has provided indemnities for various agreements. Under the terms of these agreements, the NWMO agrees to indemnify the counterparty for various items, including, but not limited to, all liabilities, loss, suits, and damages arising during, on or after the term of the agreement.

(b) The NWMO indemnifies all directors, officers and employees acting on behalf of the NWMO for various items, including, but not limited to, all costs to settle suits or actions due to services provided to the NWMO, subject to certain restrictions.

The nature of these indemnification agreements prevents the NWMO from making a reasonable estimate of the maximum exposure due to the difficulties in assessing the amount of liability which stems from the unpredictability of future events and the unlimited coverage offered to counterparties. Historically, the NWMO has not made any payments under such or similar indemnification agreements, and therefore, no amount has been accrued with respect to these agreements.

The NWMO also arranged a standby Letter of Credit issued by OPG to secure its supplementary pension plan (Note 7).

## 10. Operating leases

The NWMO has entered into a number of leases for office premises and vehicle which expire at various dates up to June 30, 2027.

The estimated annual minimum payments over the initial term of these leases up to their expiration are as follows:

| | $ |
|---|---|
| 2018 | 1,028,407 |
| 2019 | 951,601 |
| 2020 | 980,498 |
| 2021 | 997,870 |
| 2022 | 1,011,348 |
| Thereafter | 4,678,036 |
| | 9,647,760 |

## 11. Segment reporting

The NWMO has two reportable segments as follows:

- Federal mandated program (APM);
- Other direct services outside its mandated programs, which include DGR and LLM for OPG, with service contracts which became effective January 1, 2009, and February 1, 2011.

Segment information is as follows:

| | APM | | DGR/LLM | | Total | |
|---|---|---|---|---|---|---|
| | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 |
| | $ | $ | $ | $ | $ | $ |
| Contribution revenue | 60,845,400 | 56,385,974 | 5,135,400 | 5,592,707 | 65,980,800 | 61,978,681 |
| Interest income | 43,418 | 7,789 | 4,273 | 857 | 47,691 | 8,646 |
| Total revenue | 60,888,818 | 56,393,763 | 5,139,673 | 5,593,564 | 66,028,491 | 61,987,327 |
| Amortization of capital assets | 1,229,371 | 1,123,540 | 47,182 | 123,919 | 1,276,553 | 1,247,459 |
| Operating cost | 59,659,447 | 55,270,223 | 5,092,491 | 5,469,645 | 64,751,938 | 60,739,868 |
| Total cost | 60,888,818 | 56,393,763 | 5,139,673 | 5,593,564 | 66,028,491 | 61,987,327 |
| Expenditure for capital assets | 549,680 | 1,575,136 | - | 3,925 | 549,680 | 1,579,061 |

The allocation of the common service costs to each function of the above segment is based on direct staff in each function.

## 12. Government remittances

Accounts payable and accrued liabilities include the following amounts with respect to government remittances:

| | 2017 | 2016 |
|---|---|---|
| | $ | $ |
| Goods and Services Tax/Harmonized Sales Tax ("GST/HST") | 1,004,345 | 705,900 |
| Less GST/HST receivable | (179,505) | (368,762) |
| Net GST/HST payable | 824,840 | 337,138 |

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