
# 2017 ENVIROVISTA REPORT

PROVIDING MORE EPCOR

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# INTRODUCTION

## Recognizing ‘Green’ Champions

The EnviroVista program promotes environmental leadership and recognizes environmental excellence through emissions performance and continuous improvement initiatives. This voluntary provincial program is a part of Alberta Environment and Parks’ (AEP) Partners in Excellence initiative. EnviroVista provides unique regulatory status for Alberta industrial and manufacturing facilities, including municipal water operations. Only four approval holders within the Province are currently designated as EnviroVista Champions by AEP, including EPCOR for the Edmonton Waterworks System.

A key requirement for participation in the program is at least five years of approved emissions performance with no AEP enforcement actions. Champion status involves a new ten-year outcome-based AEP Approval to Operate (648-03-00) and a ten year Stewardship Agreement.

At EPCOR, environmental excellence includes both providing safe drinking water and minimizing our impact to the environment.

## Committed to Environmental Stewardship

The health of our water supply affects us today and tomorrow. That’s why EPCOR goes above and beyond to protect the environment while ensuring future generations have access to clean, safe water.

The EPCOR Edmonton Waterworks System was granted EnviroVista Champion status by Alberta Environment and Parks on June 1, 2011. In its Stewardship Agreement with the province, EPCOR committed to a set of environmental initiatives that go beyond the typical approval-to-operate requirements for municipal water operations.

Many of these commitments are programs and activities EPCOR established that have evolved over the years. While the Stewardship Agreement now recognizes these continuous improvement initiatives, it also commits EPCOR to maintaining certain performance levels going forward.

Why are we making these commitments? Because we know that continuing these programs is the right thing to do if we want to continue to improve and protect the environment and public health.

**In this report, you’ll learn how we’re protecting public health, our drinking water supply and the environment for future generations to come.**

# HIGHLIGHTS OF 2017 ENVIROVISTA INITIATIVES AND CHALLENGES

Our actions demonstrate a strong commitment to the environmental management and sustainability of the North Saskatchewan River, including the following highlights from 2017.

- The Distribution and Transmission system **achieved full ISO14001 registration** in 2017. The entire Edmonton Drinking Water System, including the Water Treatment Plants (WTPs), now operates under this international standard for Environmental Management Systems.
- Significant progress was made working with multiple stakeholders, including Alberta Environment and Parks, the North Saskatchewan Watershed Alliance, the City of Edmonton and the City of Edmonton's Drainage Services (EPCOR Drainage as of September 2017), to develop a comprehensive multi-year **water quality monitoring program** for the North Saskatchewan River. This program will involve construction of a network of water quality monitoring stations on key tributaries in the watershed. When implemented, this program will allow us to better understand, predict and manage changes in water quality in the North Saskatchewan River, the source of our drinking water.
- We continued to review and expand our **Drinking Water Safety Plan** (DWSP). A DWSP is a risk-based approach for determining what improvements should be made to a drinking water system to improve public health protection. Seven new risks were added to the key risk action registry and five were considered complete and removed.
- EPCOR continued to emphasize **water emergency preparation**. The "Troubled Water" series of discussions and exercises continued with AEP, Alberta Health Services, Alberta Emergency Management Association and the Regional Customer Water Group. The group focused on the management of a major system-wide water crisis and a plan for an emergency water supply.
- In 2017, we completed a significant study on the potential impact and possible mitigation measures in the event of a major hydrocarbon spill in the river upstream of Edmonton.
- We also began development of a long-term plan for the Water Treatment Plants that will address anticipated growth in demand, changes in source water quality, evolving regulatory requirements and climate change driven fluctuations well into the future.
- EPCOR removed 187 lead service lines that were providing water to customer residences and businesses. We have now **replaced 1822 lead lines** since the program began in 2008. We also tested for lead in samples collected randomly from 165 homes across the City as part of the Random Day Time (RDT) sampling program. We have now tested 668 homes across the city in this random program and the results are giving us a clearer picture of lead levels at the tap.
- Per capita, water use in the City of Edmonton continued to trend downward in 2017. We achieved total per capita water use of 286 litres per person per day (L/p/d) or 184 L/p/d based on domestic use only. This is well below the Alberta Urban Municipality Association water use target of 341 L/p/d by 2020. We continued our targeted information program aimed at addressing high water consumption in schools and subsidized housing.
- We once again achieved the **lowest level of water loss** in the distribution system with an all-time low infrastructure leakage index (ILI) of 0.90. The industry benchmark is less than 3.0.
- EPCOR was not able to not meet the internal system Energy Index target of 665 kWh/ML of water produced in 2017 (achieved 682 kWh/ML) mainly due to the impact of a decrease in per-household water consumption and growth located predominantly at the edge of the city. We continued to move ahead with energy efficiency initiatives that include improving building envelopes and operational optimization of our large water pumps.

- EPCOR also continued the development of a **plan for a 12 MW solar farm** on available land within our fence line at the E. L. Smith Water Treatment Plant and has been actively engaging stakeholders and pursuing the required approvals. This facility will provide all the power required to operate the E. L. Smith Water Treatment Plant and possibly extra power that can be provided to the grid.
- EPCOR operates our water treatment plants in Direct Filtration (DF) mode during the winter and fall seasons, when river water conditions allow it, in order to reduce the amount of chemical (alum) used to treat the water and the amount of solids residuals discharged back to the river. In 2017, we set an internal target for the number of days in DF mode. Despite a very early spring runoff in February, we were able to achieve a **25% reduction in solids released to the river in the winter and a 29% reduction in the fall.** This performance was a substantial improvement over 2016, which was a very challenging treatment year, but was not as good as earlier years (2012-2014). EPCOR made a significant change to the filtration polymer in 2017 that will help with DF operation going forward.
- EPCOR continued to investigate the environmental impacts of the solids discharged to the river with an **in-river monitoring program**. In 2017, we added the dissolved oxygen measurements to the list of variables monitored.

# ENSURING PUBLIC HEALTH PROTECTION AND MINIMIZING ENVIRONMENTAL RISKS

## Environmental Management System (EMS)

EPCOR's E.L. Smith and Rossdale Water Treatment Plants (including the system reservoirs) were first registered in February 2015 under both ISO 14001:2004 and OHSAS 18001:2007. These are two international standards for managing facility environmental and worker safety (Occupational Health & Safety Management System) requirements, respectively. Collectively, these are referred to as the Edmonton Water Treatment Plants integrated Management System (EWTPiMS).

The EMS was originally certified under ISO 14001:2004 by the registrar SAI Global in early 2015. In November 2017, the EMS was registered to the updated ISO 14001:2015 Standard. An internal audit of the EWTPiMS was also completed in August 2016. All audit findings are tracked in a formal Audit Tracker worksheet to facilitate managing corrective actions to address audit findings. The EWTPiMS conforms to the EPCOR enterprise-wide HSE-MS, which provides an overarching set of high-level standards and procedures that support operational activities. At the Edmonton WTPs and reservoirs, site-specific standard operating procedures (SOPs) address environmental risks and significant aspects and related worker hazards in each operational functional area.

In addition to the WTPs and reservoirs, the Edmonton Waterworks System also includes a large network of pipes and transmission mains – collectively known as the Water Distribution & Transmission (D&T) system; this infrastructure delivers potable water from the WTPs to the reservoirs, and from the reservoirs to customers. The EMS and OH&S-MS for Water D&T, referred to as the EWDTiMS, was registered in June 2017 under the ISO 14001:2015 and OHSAS 18001:2007 standards. With the EMS for both the WTPs and Water D&T accredited, the EnviroVista commitment to have the complete Edmonton Waterworks System certified under ISO 14001 has been fulfilled.

## Operations Program

The Operations Program comprises plans, operational philosophies and procedures used by staff to manage the Edmonton Waterworks System. This ensures consistent production and reliable delivery of high quality drinking water while reducing environmental impacts. The comprehensive Operations program document is a requirement of the EnviroVista Approval and is an integral component of the Edmonton Waterworks' Environmental Management System accredited under ISO 14001. A team of subject matter experts from across EPCOR collaborate throughout the year to keep the Operations program up to date and changes to the Operations program are reviewed annually by EPCOR management. The first Operations program was released on December 31, 2012. The most recent revisions to the Operations program were completed on February 28, 2018 and included the following:

- EPCOR's Water Distribution operations are also now registered to the ISO14001 and OHSAS 18001 Standards. This is in addition to the WTPs and reservoirs registrations.
- For 2018, EPCOR brought in a new internal reporting system to manage Health, Safety and Environmental events (incidents) and to track corrective actions within our ISO and OHSAS management systems.
- EPCOR assumed operation of the City of Edmonton Drainage infrastructure in September 2017. This is reflected in references throughout the document.
- Under Edmonton's Source Water Protection Plan, EPCOR is partnering with AEP to complete a comprehensive monitoring program for the North Saskatchewan River basin. Beginning this year, EPCOR will contribute $1 million through water rates for four years.
- In 2017, EPCOR refurbished and added a third chemical spill storage tank at Rossdale WTP. This will allow our operations to better manage onsite spills and wasted chemicals.

- A new tool is being in developed in 2018 called the Water Quality Situational Awareness Map. This tool will help collect water quality concerns from across the city on a graphical interface that will help EPCOR identify trends in water quality sooner and help troubleshoot and solve issues in a more efficient manner.
- EPCOR added monitoring for Perfluorooctanoic Acid and Perfluorooctane Sulfonate to the monitoring program (raw, treated, random distribution) as we expect Health Canada to introduce new drinking water guidelines for these compounds of emerging concern sometime in 2018.
- In the 2018 review of the Drinking Water Safety Plan, seven new action plans were identified and added to the Key Risk Action Plan register and five were removed as complete. There are currently 38 risks with actions plans on the register.
- As the City of Edmonton continues to grow, EPCOR will begin notifying AEP of extensions to our water distribution and transmission network. The first notification was in March 2018 and will occur annually at the same time in future years.

## Drinking Water Safety Plan

EPCOR is committed to maintaining a source-to-tap, multi barrier approach to provide safe drinking water to its customers. The Drinking Water Safety Plan (DWSP) addresses environmental considerations related to public health risks associated with the supply of drinking water. Over 40 EPCOR employees were involved in identifying and assessing these risks to the water system and public health. The risks were broken down into five “Source-to-Tap” areas: Source Risk, Treatment Risks, Reservoir Risks, Pipeline Risks and Customer Risks. The DWSP risk assessment was first completed for the Edmonton Waterworks System in 2012 and an action plan was developed in 2013 to address eight key risks that were determined to require further action.

The DWSP process is based on the concept of continuous improvement and the Plan-Do-Check-Act cycle that is inherent to the ISO14001 Environmental Management System. This system requires us to regularly review and re-evaluate the DWSP risks, and update as necessary. The DWSP is reviewed and updated each year. In early 2017, EPCOR convened a team of subject matter experts once again to review the entire DWSP in depth. The team was asked to re-assess all of the existing risks and action plans and identify any new or emerging risks, or risks that required re-evaluation. When assessing risks, the team looked at developing trends and issues in water treatment and supply and incidents that have occurred at EPCOR and in the industry in general. In 2017, the team took a deeper look at how we move water within the system, the inherent redundancy levels and potential modes of failure. This in-depth review resulted in the addition of seven new risks to the 36 risks that were on the 2017 key risk registry. These new risks included:

- Failure of a critical transmission line during a pump station/reservoir outage for maintenance or upgrade that might result in inability to supply water to an area.
- Failure of a critical pump station when another pump station is off line for maintenance or an upgrade that might result in inability to supply water to an area.
- Shutdown of a pump station at the same that a critical water line is under repair that might result in an inability to supply water to an area.
- Failure to meet demand due to an inability to operate valves as required or as a result of insufficient valves to isolate area affected by a large water main break.
- Failure to meet demand and supply an area as a result of failure of pipe suspended from a bridge.
- Potential of regional water customer demand impacting EPCOR’s ability to service customers and for us to provide service to a regional group.
- Contamination of drinking water in a main due to leaking air relief valves.

Action plans and programs will be developed in 2018 to mitigate these key risks. Five of the action plans for the 36 risks on the 2017 key risk registry were considered complete. There are now 38 risks remaining on the key risk registry with action plans that are in progress.

# PROTECTING OUR DRINKING WATER SUPPLY

## EPCOR's Source-to-Tap Multi-Barrier Approach

### 1. Source Water Protection

EPCOR maintains a source water protection and monitoring program that identifies risks in the raw water supply (North Saskatchewan River). EPCOR's Source Water Protection Plan (SWPP) was first developed in 2008 to help mitigate potential risks to Edmonton's source water supplies by understanding the pressures on the watershed. We published an update to the plan earlier this year, which included enhanced land use maps, water quality assessment and incorporation of the Drinking Water Safety Plan Risk Assessment. Key SWPP risks were reviewed in 2015, 2016, 2017 and early 2018 as part of the annual Drinking Water Safety Plan review (see section on DWSP).

### 2. Treatment

Both Rossdale and E. L. Smith use conventional and direct filtration treatment methods. When raw water quality is good (typically in the fall and winter months), the plants will shift to direct filtration. This requires a substantially lower dose of alum and results in a significant reduction in the amount of waste discharged to the North Saskatchewan River. (See details in the Reducing Environmental Impacts section of this report). Both conventional and direct filtration treatments remove harmful bacteria, viruses and parasites (especially *Giardia* cysts and *Cryptosporidium* oocysts) that might be present in the untreated river water, as follows:

- EPCOR achieves at least 99.97% (3.5 log) physical removal credit for *Giardia* cysts and *Cryptosporidium* oocysts from the raw water during conventional operation by ensuring turbidity of the treated water produced by each filter in the water treatment plant is very low. Filter effluent turbidity is maintained at less than 0.1 NTU on individual filters at all times. The internal target is to be less than 0.08 NTU. This performance readily exceeds the AEP requirement of less than 0.3 NTU.
- During direct filtration operation, the individual filter effluent turbidity is still maintained at 0.1 NTU or less but the physical removal credit is reduced to 3.0 log removal. Although *Giardia* cyst and *Cryptosporidium* oocyst removal credit is slightly lower during direct filtration (99.9% versus 99.97% or 3 log versus 3.5 log), the concentration of these parasites in the river is much lower during this period. We monitor the concentration of the parasites in the river at least biweekly during direct filtration operation and at least monthly at other times.
- Ultraviolet light (UV) disinfection provides an additional 99.9% (3 log) inactivation credit of any *Giardia* cysts and *Cryptosporidium* oocysts remaining in the water after filtration.
- Primary disinfection provided by free chlorine provides an additional barrier against *Giardia* cysts, and is the primary barrier against bacteria and viruses.
- The overall removal credit of *Cryptosporidium* oocysts is 99.99997% (6.5 log) during conventional operation and 99.9999% (6.0 log) during direct filtration operation. This exceeds the minimum approval requirement of 99.9997% (5.5 log) that is based on the raw water quality and a health risk assessment. *Giardia* cyst removal is slightly higher due to chlorination.
- Bacteria and viruses are inactivated by chlorination but are also removed to some extent by filtration. Additional inactivation is achieved by UV disinfection.
- Ammonia is added to the water to form chloramines, which provide a lasting disinfectant residual through reservoir storage and throughout the distribution system within Edmonton and the regional waterworks systems.

## 3. Distribution System

EPCOR ensures the safety of water in the distribution system by confirming that the piping system is maintained and that there is adequate supply pressure. Ongoing programs that safeguard distribution system integrity and water quality include:

- distribution system pipe and appurtenance replacement
- main break repair
- valve exercising and replacement
- unidirectional flushing and hydrant servicing
- distribution system leak detection
- distribution system pressure monitoring

See details in the Industry Leadership section of this report.

A **Cross Connection Control** (CCC) program maintained by EPCOR provides an additional public health protection barrier. The goal of the CCC program is to minimize the potential for unintended backflow into the distribution system from moderate and severe risk customers in the multi-residential, commercial and industrial customer segments. This is done by ensuring Canadian Standards Association approved backflow prevention assemblies are in place for premise isolation and are tested annually as required by the National Plumbing Code of Canada, CSA B64.10 Standard, and the City of Edmonton Bylaw # 17698 EPCOR Water Services and Wastewater Treatment EPCOR Bylaw.

Every year, additional facilities are added to the program. In 2017, 764 facilities were added for a total of 11,071. In 2017, EPCOR staff inspected 1,090 facilities and issued 10,740 notices to customers and testers for installation requirements, annual testing, test-kit calibration and certification renewals. Overall compliance (tracking overdue tests and devices not installed), was at 70% at year-end, which is a 4% improvement relative to the end of 2016.

The **Lead Response** program reduces the potential for exposure to lead in tap water for approximately 3,000 homes in mature neighbourhoods of the city that are supplied through lead service lines. See details on this program in the Lead Response Program section of this report.

## 4. Monitoring

To ensure safety of the drinking water up to customer taps, EPCOR monitors raw water entering the Rossdale and E.L. Smith WTPs, as well as partially treated water and treated drinking water entering the distribution system. In addition, a routine monitoring program ensures water quality throughout the field reservoirs and distribution system. The water is also tested in response to valid customer complaints and following system depressurizations due to main breaks or planned maintenance work.

EPCOR exceeds the minimum amount of monitoring and testing required by the regulator. In a city the size of Edmonton, Health Canada recommends bacteriological testing on 178 samples collected from the distribution system each month. **In 2017, 2,814 samples were collected, or, an average of 235 per month**. In addition, EPCOR sent an average of 50 duplicate samples to the Provincial Laboratory for Public Health each month for an inter-lab quality check.

When samples collected after water quality and depressurizations are included, 3,737 samples were collected in the distribution system in 2016. In the last two years, EPCOR has been using our water meter reading team to collect truly random bacteriological samples from homes across Edmonton. This has allowed us to significantly increase the number of samples collected and get a more complete picture of water quality across the city.

In 2017, the EPCOR Water Laboratory carried out approximately 123,000 tests on 8,100 samples of raw water that entered the WTPs, partially treated water, treated water that entered the distribution system, water from the field reservoirs and from various points within the distribution system. EPCOR tested for 141 chemical, physical or microbial parameters. A further 3,100 tests were conducted on 1,300 samples and included another 252 additional parameters by external commercial laboratories. These figures don't include testing conducted for special projects or initiatives such as EPCOR's Home Sniffing program or the Lead Response program. Full details of all testing and monitoring that take place are published in monthly and annual Edmonton Waterworks reports that are posted on EPCOR's website.

In addition to laboratory testing, EPCOR also uses numerous online analyzers to continuously monitor critical treatment performance and water quality variables in the treatment plants, such as chlorine concentration and filtered water turbidity. Back-ups are provided for critical analyzers. There are 137 online analyzers at the E.L. Smith WTP and almost 80 at the Rossdale WTP with a quality assurance program in place to confirm they are reliable. Operators at the plants perform frequent bench tests to ensure the performance of these analyzers. **In 2017, operators performed approximately 40,000 and 30,000 tests at the E. L. Smith and Rossdale Water Treatment Plants respectively**.

# OUR STRINGENT WATER QUALITY STANDARDS

## Meeting Regulatory Requirements and Health Canada Guidelines

In 2017, EPCOR met guidelines for all Canadian Drinking Water Quality health-based limits for radiochemical, chemical and physical parameters. Of the 59,915 applicable water quality tests EPCOR conducted, only 94 (< 0.16 per cent) did not meet the requirements of EPCOR's internal water quality standards. None of these tests, however, failed to meet Canadian Drinking Water Guidelines or the AEP Approval-to-Operate water quality parameter limits.

EPCOR notified AEP of water quality events or approval contraventions in 2017 that did not involve a failure to meet drinking water guidelines. Each incident was investigated to determine root causes and corrective actions taken, as per the EPCOR Incident Management standard; a subsequent written report was also produced. The following describe the reported incidents:

- One event where a water sample collected from the distribution system resulted in an *E. coli* positive and total coliform bacterial result. The sample was collected from a kitchen sink in a fire station. As per the *Communication and Action Protocol for Failed Bacteriological Results in Drinking Water,* a set of four resamples were collected (upstream and downstream in the distribution system and two locations at the fire station) and all tested negative for *E. coli* and total coliform. A second set of four resamples all tested negative as well. It was concluded that the original positive sample was collected from a contaminated sample point and there was no contamination of the water in the distribution system.
- Eleven events where water samples collected from the distribution system resulted in a total coliform positive bacterial result. After follow-up testing and investigation according to the *Communication and Action Protocol for Failed Bacteriological Results in Drinking Water*, these were confirmed to be related to sample collection, a contaminated sample point condition or contamination of a replaced fire hydrant; these events were determined not be related to the quality of the water in the distribution system.

EPCOR collected 3,737 samples for bacteriological testing in the distribution system in 2017 and the false positive rate was 0.3% (i.e. 12 samples). This is a relatively low rate for total coliform testing and is typically achieved by EPCOR samplers. Nevertheless, EPCOR continues to emphasize training of water samplers in an effort to further reduce the number for total coliform positive bacteria results in water samples that are determined to be due to sampler error.

In 2016, Health Canada introduced a proposed guideline for two contaminants of emerging concern: Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA). Both PFOS and PFOA are manmade compounds that are used in specialized applications, such as firefighting and fabric/paper treatments, and are very stable and long lasting in the environment. Health Canada is proposing very low maximum acceptable concentrations for both these compounds (0.6 ug/L and 0.2 ug/L). Even though the guideline is not yet in place, EPCOR began monitoring for PFOS and PFOA in raw and treated water in 2017; the results thus far have below detection (< 0.02 ug/L).

## The Water Quality Index

The Water Quality Index measures the number of treated drinking water tests that meet EPCOR's internal water quality standards. EPCOR's standards are often more stringent than provincial requirements or Health Canada Drinking Water Guidelines. In 2017, 59,821 out of a total of 59,915 applicable tests on treated water passed EPCOR's internal quality standards.

EPCOR's **Water Quality Index score of 99.84 percent in 2017** was an increase over the 2016 score of 99.73 percent, and well above the target of 99.6 percent set in EPCOR's Performance Based Regulation (PBR), which is established through a City of Edmonton bylaw.

## Spring Runoff Program and the Home Sniffing Program

Spring runoff conditions in the North Saskatchewan River vary from year to year and can significantly affect the taste and odour of drinking water. Spring runoff (typically mid-March to mid-April) results in an increase in the turbidity, colour, taste and odour of the raw water supply drawn from the river. During the winter months, our water treatment plants use direct filtration and must transition back to conventional treatment mode of operation prior to spring runoff. This allows us to add powdered activated carbon (PAC) as a taste and odour control measure.

In 2017, spring runoff began February 18 after an unusually warm February. The WTPs converted to conventional treatment and began adding PAC as the ammonia, colour and odour in the raw water increased. The runoff conditions abated in about a week as winter conditions returned and we were able to convert back to direct filtration. Spring runoff conditions returned March 21 with a second increase in raw water ammonia, colour and odour. We stopped adding PAC to control odours April 8 when spring runoff ended.

### Home Sniffing Program

This program measures the effectiveness of EPCOR's spring runoff water treatment strategy. A panel of about 100 EPCOR customer volunteers rates the odour of the treated water from the hot and cold taps in their home. A satisfied customer is one who rated the intensity of the odour as 0.5 or less on a scale of 1 to 3. This means the water has either a slight non-objectionable odour, trace odour or no odour at all.

We ran the program from February 19 to May 20, 2017 and each day 46 to 101 volunteer "sniffers" participated. The overall Customer Satisfaction Rating for this period (which included two spring runoff peaks) was 94.46%. This slightly surpassed our internal performance target of 94.4%. The result was lower than the 96.2% Customer Satisfaction Rating of 2016, which was a relatively mild runoff year. The success of spring runoff heavily depends on the conditions of the river water and 2017 was an example of a challenging year.

## Performance Based Regulation Requirements

In addition to the Water Quality Index and the Home Sniffing Customer Satisfaction Rating, EPCOR strives to meet other requirements set by the City of Edmonton Performance-Based Regulation (PBR). These measures ensure EPCOR maintains performance in a number of areas.

Performance against the five PBR aggregate measures is summarized in the following table. In 2017, EPCOR maintained the same five aggregate performance measures; however, some of the information used to calculate the measures changed. For example, the number of days where the water treatment plants operated in direct filtration mode was added as a factor in the Environmental Index. This factor will incent efforts to maintain and increase direct filtration operation and thus drive a reduction in solids residuals released to the river. The overall score of 107.6 points indicates consistent high performance when compared with the 2013 to 2016 scores of 106.8, 107.2, 108.7 and 108.5 points, respectively.

EPCOR submits a yearly report to the City of Edmonton on the Performance Based Regulation, which includes detailed information on each of our performance measures.

| Performance Measure | Basis | 2017 Target Points[1] | Actual Points Earned[1] |
|---|---|---|---|
| System Reliability and Optimization Index | Number of water main breaks, repair duration, water loss factor and energy use | 25.0 | 28.5 |
| Water Quality Index | Percentage of water quality tests that meet or exceed EPCOR internal standards | 25.0 | 25.0 |
| Customer Service Index | Customer service satisfaction for EPCOR Emergency Group and Home Sniffing programs, response time factor and planned construction notification where EPCOR complies with required construction notification procedures | 20.0 | 21.1 |
| Environmental Index | Residential consumption rolling average, environment incident reporting and days operating in direct filtration mode | 15.0 | 16.5 |
| Safety Index | Near miss reporting, work site inspections and observations, lost time frequency rate and injury frequency rate | 15.0 | 16.5 |
| Total | | 100.0 | 107.6 |

[1]Bonus points can be earned for exceeding performance measures

# PUBLIC INVOLVEMENT AND CONSULTATION

## Communication

EPCOR is committed to becoming a 'neighbour of choice.' Working together with our stakeholders, we accomplish this goal through open communication and consultation with our customers. We demonstrate a commitment to two-way, transparent communication through face-to-face discussions, open houses and our community advisory panels. In and around our plant sites, EPCOR engages with the community leagues and residents to ensure we are keeping our neighbours informed of construction activities and are building a positive rapport with community members.

Within the broader community of Edmonton, we engage with our customers and communicate about emerging issues through multiple channels such as customer newsletters, broadcast media, news media, our external website and social media. EPCOR's external communications encourage wise water use, promote environmental stewardship and create a broader awareness of the importance of safe and clean public drinking water.

## Corporate Accountability and Public Transparency

EPCOR keeps its customers informed about our activities to ensure a safe and reliable supply of tap water. A number of reports are made available to the public, including customer-friendly water quality reports:

- 2017 EnviroVista Report (this report)
- 2017 Waterworks Annual Report
- Monthly Waterworks Reports (Operations and Water Quality)
- Monthly Water Quality Summary and Bacteriological Data Reports

## Community Outreach

EPCOR staff participated in several community outreach activities in 2017. Some of the events that were particularly relevant to drinking water treatment included:

- Winter & Summer Family Fun Days in the Cameron Heights and Greater Hardisty communities where we provided water treatment education to event attendees; and
- Highlands, Rossdale and Gold Bar events in which EPCOR educated the community on river quality and reinforced what not to flush to protect our river.

In addition, EPCOR attended the Southwest Edmonton Farmers' Market and hosted open houses to share information about our proposed E.L. Smith solar farm project. The proposed solar farm will generate renewable energy to help power the existing E.L. Smith Water Treatment Plant and its water treatment and distribution processes, while reducing our greenhouse gas emissions. EPCOR is committed to the City of Edmonton's objective to become a leader in energy efficiency and conservation, and this project aligns with its The Way We Green: Environmental Strategic Plan.

In the second year of our school tour program for grade five students at Edmonton schools, we conducted interactive water treatment experiments and tours of the E. L. Smith Water Treatment Plant for approximately 150 students, teachers and parent volunteers.

## Community Advisory Panel

EPCOR places a high priority on obtaining public input into all aspects of water service delivery. Since 1993, a voluntary panel has provided feedback on EPCOR policies and programs that have an impact on customers and the community in general. The panel gathers stakeholder input on emerging issues such as water efficiency, legislative and technological changes, pricing, customer care and watershed management.

The Water Community Advisory Panel (CAP) includes representatives for the environment, the City of Edmonton, commercial customers, industrial and residential customers.

EPCOR sought input from CAP members and provided information on various topics including:

- water quality testing and guidelines;
- the E.L. Smith school tour program;
- an update on the E.L. Smith solar farm project; and
- an overview of Edmonton water use and conservation initiatives.

## Consultation with Industry Experts – Water Quality Advisory Committee

The Water Quality and Advisory Committee includes representatives from EPCOR, Alberta Health Services, Alberta Health, Alberta Environment and Parks, University of Alberta, City of Edmonton and the Regional Water Customer Group (RWCG) that represents the municipalities supplied directly or indirectly by the EPCOR drinking water system.

The committee shares information, advises on water quality and treatment issues, reviews water quality standards and guidelines and develops joint risk management protocols. Its scope includes drinking water emergency response, watershed issues, home water treatment devices, bottled water and related drinking water health issues.

The Water Quality Advisory Committee met on January 19, 2018 at the Rossdale Water Treatment Plant. The topics discussed included:

- drinking water quality updates: issues, challenges and new guidelines from Health Canada;
- lead program: status update on EPCOR's program and potential future directions;
- communications update: how EPCOR communicated with the public on drinking water issues;
- drinking water emergency exercises: "Troubled Water" program update and challenges;
- plans for emergency water supply; and
- *Legionella* risk in buildings.

### Water Emergency Exercise Plans

EPCOR continues to lead the initiative to develop and implement a drinking water emergency exercise plan for the Edmonton and region water system in participation with key stakeholders including Alberta Health Services, Alberta Environment and Parks, Alberta Emergency Management Agency, City of Edmonton and the Regional Water Customer Group. Since 2014, we have conducted four "Troubled Water" tabletop exercises, with two taking place last year. Two working groups were created in late 2017 to focus on the challenge of providing an emergency drinking water supply in the event of a widespread drinking water quality issue or loss of supply. EPCOR has developed a working plan for providing an emergency drinking water supply in such an event. Although the likelihood of such an event occurring is very low, we must be prepared and have plans in place.

# INDUSTRY LEADERSHIP

## Working Partnerships with Alberta Environment and Parks/Advice and Support to Industry

In 2017, EPCOR continued to provide expertise and advice to provincial government agencies and the water and wastewater treatment industry in Alberta. Examples include:

- EPCOR continued its participation in the AEP-led Capital Region-Industry Heartland Water Management Framework initiative and sat on the Advisory Committee and Modelling Sub-Committee. Through this committee, EPCOR provides stakeholder feedback on AEP's initiative to develop a total loading management system for the stretch of the North Saskatchewan River between Devon (upstream of Edmonton) and Pakan (downstream of Edmonton and the Industrial Heartland). More information on this initiative can be found on AEP's website.
- We continued to be involved in the Alberta Drinking Water Laboratory Technical Advisory Committee that is providing advice to the government on matters related to drinking water testing and development of new drinking water testing requirements.
- On an international level, EPCOR continued support of Bob Sandford as the EPCOR Chair for Water and Climate Security at the United Nations University Institute for Water, Environment and Health.

## Laboratory Accreditation

The quality of the water testing data produced by EPCOR Water Laboratory adheres to the international management system standard ISO/IEC 17025 “General Requirements for the Competence of Testing and Calibration Laboratories.” The accreditation ensures that water quality testing results produced by the water laboratory are reliable and technically and legally defensible.

The EPCOR Rossdale Water Laboratory has been accredited to ISO/IEC 17025:2005 since 2001 by the Canadian Association for Laboratory Accreditation (CALA). It successfully retained accreditation in October 2017 after CALA completed an assessment as part of the biannual audit cycle. Our next full external assessment is scheduled for October 2019. In the meantime, the Rossdale Water Treatment Plant operations lab will be assessed in October 2018 to become part of the scope of the accreditation. This will provide us with another lab facility where we can produce accredited water testing results. In addition, EPCOR will be transitioning our quality management system to meet the new ISO/IEC 17025:2017 standard.

As part of our commitment to CALA, several EPCOR employees volunteered as laboratory assessors and were involved in 10 assessments of other laboratories in 2017. In addition to assessing other laboratories, our Senior Manager of Analytical Operations currently sits on the Board of Directors for CALA as a representative of the Prairies (private sector laboratories) and serves as CALA’s Vice Chair.

# Watershed and Source Water Protection Programs

### EPCOR's Watershed Protection Program has two primary goals:

- To provide a safe, secure drinking water supply through source water protection principles.
- To ensure minimal effects from our operations on water quality and aquatic ecosystem health in receiving water bodies.

EPCOR recognizes watershed-wide environmental planning is necessary and is best achieved by openly collaborating with all stakeholders. In 2017, EPCOR updated its three year rolling Strategic Watershed Protection Plan and completed initiatives under four broad categories: watershed planning, monitoring and research, implementation and education and awareness.

### 1. Watershed Planning

EPCOR recognizes the importance of working within multiple initiatives and/or frameworks to help meet its commitment to safeguard the health of customers from a source water protection perspective and to minimize the effect of its activities on local water quality and aquatic ecosystems. Planning initiatives and/or frameworks that EPCOR continued to support in 2017 include:

- **Source Water Protection Plan:** A major milestone was the completion and publication of EPCOR's updated Source Water Protection Plan, which has the goal of protecting source drinking water. Highlights of the updated plan include detailed water quality and quantity research summaries, comprehensive land use maps and inclusion of the source risk assessment completed through the Drinking Water Safety Plan process.

  In 2017, mitigation plans for the key risks outlined in the Source Water Protection Plan and Drinking Water Safety Plan were developed. Key risks that remained with action items in the Drinking Water Safety Plan included forest fires, climate change, source contamination from spills/releases from upstream oil and gas facilities or spills from an upstream bridge. Work is underway to better understand how forest fires contribute to poor water quality, to develop a climate change adaptation strategy and to develop a Geographic Response Plan in partnership with AEP if a spill in the river should occur upstream of Edmonton.

- **North Saskatchewan Watershed Alliance** (NSWA): EPCOR provides both financial and in-kind support to the NSWA. In 2017, EPCOR employees were involved in the NSWA Headwaters Sub-Watershed working group that involved projects to assess the condition of riparian areas on Modeste Creek and Strawberry Creek. EPCOR employees were also involved in the governance of the NSWA by serving on the Board of Directors and Executive Committee.
- **Capital Region-Industrial Heartland Water Management Framework**: AEP has continued to lead this framework through 2017 and EPCOR was directly involved through the Advisory Committee. This work will set environmental outcomes (including water quality) for the area just upstream of Edmonton to downstream of the proposed industrial development area. The framework includes Maximum Acceptable Loads for about 20 water quality parameters of concern. In 2017, EPCOR presented to the Advisory Committee on the proposed Monitoring Program for the North Saskatchewan River.
- The **North Saskatchewan Regional Plan** is being developed by AEP under their Land Use Framework initiative. EPCOR has been engaged in the development of the plan since the beginning, including participation in the Phase I consultation workshops, the Regional Advisory Council and the Environmental Quality Management Framework stakeholder engagement sessions. In early 2018, EPCOR also provided feedback on the Regional Advisory Council's final recommendations.

- EPCOR, through representation on **Watershed Planning and Advisory Councils** and the **Alberta Lake Management Society**, is involved with numerous teams that are making recommendations for management and policy to the Alberta Water Council and, ultimately, Alberta Environment and Parks. In 2017, EPCOR co-chaired the Source Water Protection working group. In addition, an EPCOR employee acted as an alternate board member representing the Lake Conservation sector.

## 2. Implementation

In 2017, EPCOR continued financial support of **Clear Water Landcare**, which implements agricultural Beneficial Management Practices (BMPs) in the North Saskatchewan River basin, such as 'off stream' watering systems and fencing-off of streams, as well as educational stewardship events. In 2017, Clear Water Landcare co-hosted a digital story workshop that combined storytelling and digital media to share individual connections on land and water that are shown to be part of behaviour change. Clear Water Landcare also distributed copies of the *Our Backyard* children's activity book while Sasquatch & Partners discussed activities in the headwaters. EPCOR supported the implementation of Leduc County's BMP program through monitoring support and providing information on where to target BMPs in the Strawberry Creek Watershed.

## 3. Research and Monitoring

EPCOR continued collaboration with AEP, NSWA and the City of Edmonton in 2017 to develop an integrated, efficient and effective **water quality monitoring program** that meets the needs and interests of major stakeholders in the basin. Beginning in 2018, EPCOR is contributing $1 million per year for the next four years towards funding and supporting this program, with monitoring to begin this year. The funds will be used to equip a network of tributary monitoring stations throughout the basins. The group is planning to have the network in operation by the end of 2018.

In 2017, EPCOR provided funding to ALUS Canada and the NSWA to support research on evaluating the health and importance of riparian areas as part of the Modeste Watershed Pilot Project. In 2018, work on this project will extend to include the Strawberry Creek Watershed. These two creeks are located in the lower headwaters upstream of Edmonton and they have a significant impact on water quality in the river in Edmonton at certain times of the year.

In 2017, EPCOR continued an enhanced monitoring program for 13 select tributaries upstream of Edmonton. As part of an effort to better characterize water quality in the headwaters, Clear Water Landcare, Leduc County and Parkland County took additional samples during storm events for EPCOR, as data for high flow events were sparse. As part of this work, a pilot project on Strawberry Creek, which began in 2014, continued and more frequent and widespread sampling was completed on the creek (at 11 locations) in an effort to understand water quality drivers on a smaller scale. This multi-year project on a sub-watershed that experiences intensive agricultural activity will provide information on the effectiveness of best management practices.

EPCOR contributed funding for Year One of the **NSERC Network for Forested Drinking Water Source Protection Technologies**, otherwise known as the ForWater Network. This network of researchers from across Canada will provide new knowledge on the impact of different forest management strategies on drinking water source quality and treatability and will assess their suitability for source water protection across the major ecological/forest regions of Canada. This initiative is led out of the University of Waterloo and is funded by the Natural Sciences and Engineering Research Council of Canada (NSERC) under its Strategic Partnerships Grants for Networks program.

Last year, EPCOR began work on a **North Saskatchewan River Climate Change Adaptation Strategy**. Additional details about this strategy and an overview of the climate change research that is being supported by EPCOR can be found in the Research on Impacts of Climate Change on Source Water section.

EPCOR continued to partner with the City of Edmonton's Drainage Services (EPCOR Drainage as of September 2017) to support their Environmental Monitoring Program through assessment of water quality samples and assistance in monitoring plan development. Quarterly monitoring also continued for pharmaceuticals and personal

care products in the raw and treated water at both the E. L. Smith and Rossdale Water Treatment Plants. As well as providing information relevant to drinking water quality and public health protection, this monitoring program also provided environmental water quality data that was useful for the AEP-led Capital Region Industrial Heartland Water Management Framework.

### 4. Education and Public Awareness

In 2017, EPCOR sponsored Alberta RiverWatch, which is a science-based education program for secondary students. As a corporate sponsor of RiverWatch, EPCOR subsidizes the fees for disadvantaged students so they can participate in a guided river-study along the North Saskatchewan River.

EPCOR is also a proud partner of the City of Edmonton's North Saskatchewan River Clean Up. This program works with various groups to help keep garbage and debris out of the river.

In the past year, EPCOR staff also served on the Board of Directors for the Alberta Lake Management Society and Red Deer Watershed Alliance. Our professionals also spoke at the NSWA's Water Quality Forum and the Partners for the Saskatchewan River Basin Flowing Waters Conference and gave several presentations on Source Water Protection Planning. As well, EPCOR gave its 8$^{th}$ annual guest lecture at the University of Alberta to engineering students on watershed and land use management.

## Distribution System Upgrades

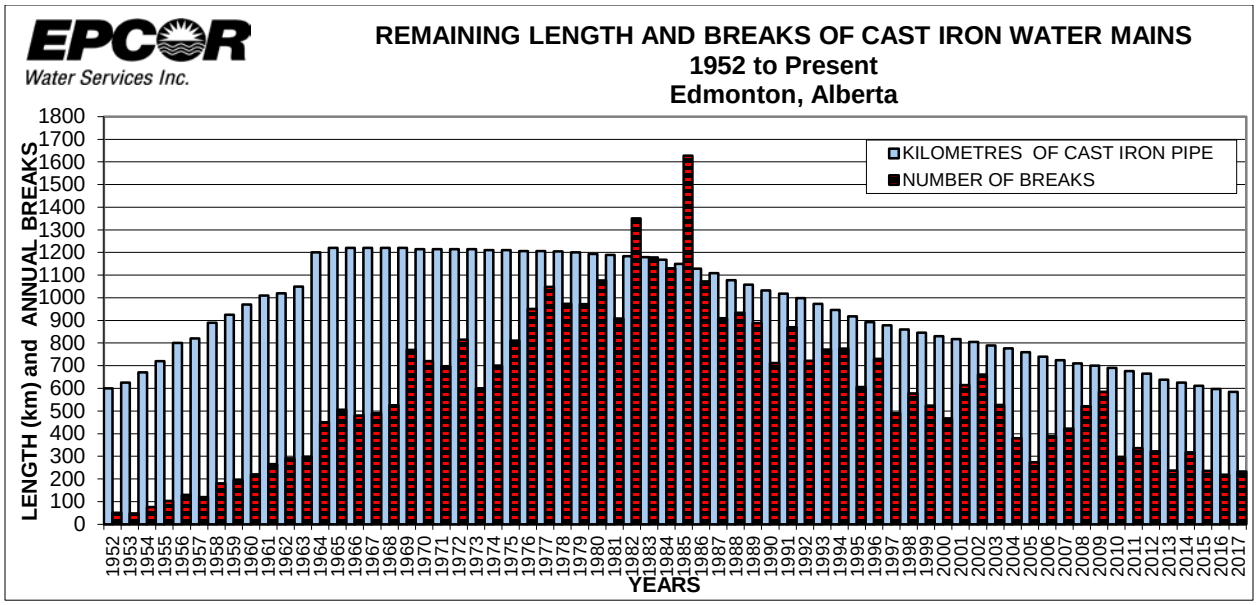
EPCOR undertakes a number of annual capital and operating programs to maintain and continually improve water quality in the distribution system and to minimize unplanned customer disruptions. In 2017, the following water assets were replaced:

| Water Asset | Number Replaced |
|---|---|
| Main Line Valves | 273 |
| Hydrants | 196 |

### Water Main Replacement

EPCOR has replaced more than 50% of cast iron water mains in Edmonton's distribution system since 1986. The ongoing replacement of the most deteriorated sections of cast iron pipe has led to continued improvements in overall system reliability and resulted in low numbers of water main breaks from 2015 to 2017. In 2017, **12.8 km of water mains were replaced** in Edmonton, as shown in the graph below.

More than 80% of all water main breaks occur on the cast iron portion of the distribution system, declining from 90% over the past decade. Despite this success, it is important to maintain the rate of water main replacements to keep up with Edmonton's aging water infrastructure. As the distribution system continues to age, asbestos cement (AC) mains will present an increasing challenge. In some European and American cities, AC mains currently surpass cast iron mains in break frequencies. The estimated useful lives of AC mains range from 60 to 70 years and a significant portion of Edmonton's AC mains will begin reaching this age within the next decade. Increased levels of main breaks continue to be experienced on both cast iron and AC pipes when extreme winter events occur.




1952 to Present, Edmonton, Alberta

## Water Main Cathodic Protection

In 2017, cathodic protection was implemented in water main distribution main piping as follows:

| Water Asset | Length Protected (Km) |
|---|---|
| Cast Iron Distribution Mains | 30 |
| Steel Transmission Mains | 2.7 |

## Transmission Main Blow-Offs

Historically, it was standard practice to connect transmission mains to the sanitary or combined sewer system in order to drain the water main as needed for maintenance work. In 2007, there were more than 200 locations identified as potential “blow-off cross-connections” within Edmonton’s water network, which could present a cross-contamination risk if certain conditions occur (for example, if a system depressurization occurs at the same time that a nearby sewer is surcharging due to high rainfall). In 2008, a program to systematically remove these connections from the water network was implemented. EPCOR had committed to Alberta Environment to eliminate all high, medium and low-risk blow-off cross connections, plus all negligible-risk cross connections discharging to sanitary sewers, by April 2016. In 2013, it was identified that five low-risk cross connections were in the direct path of the west leg of the future planned LRT, and Alberta Environment and Parks approved a proposal to wait until such time that the water mains are relocated or abandoned to complete this work. All other negligible risk cross-connections were to be removed on an opportunistic basis as the mains qualify for replacement or rehabilitation. The number and type of blow-offs remaining at the end of 2017 are described below.

### Transmission Main Blow-Offs Cross Connections Remaining at the end of 2017

| Risk Score | Characteristics | Number of Chambers | |
|---|---|---|---|
| | | End of 2007 | End of 2017 |
| **High** | Combined sewer that is in close proximity to a water treatment plant and a known surcharge area | **7** | **0** |
| **Medium** | Combined sewer that is in close proximity to a water treatment plant or a known surcharge area | **34** | **0** |
| **Low** | Combined sewer that is not in close proximity to a water treatment plant or a known surcharge area | **84** | **5*** |
| **Negligible** | A sanitary sewer that is not in close proximity to a water treatment plant or a known surcharge area | **96** | **46** |
| | **Total** | **221** | **51** |

* The five remaining low risk cross-connections were not removed by April 2016 because they are in conflict with the future west LRT expansion. These blow-offs will be abandoned when the water main is relocated to accommodate the track construction.

## Main Break Repair

In 2017, Edmonton experienced 256 water main breaks as reported in the final 2017 Performance Based Regulation (PBR) progress report to City of Edmonton. This was an increase of 14 main breaks compared to 242 in 2016. This increase was mainly due to variations in weather conditions between the years.

Despite the year-to-year variation, we have seen the number of main breaks generally decrease for the past 30 years. Most of the main breaks (229) occurred in cast iron water mains. Since 1985, EPCOR has had an aggressive program of renewal and cathodic protection of these cast iron mains. The long-term trend of a reduction in the number of breaks in the cast iron system since the mid-1980s directly reflects the effectiveness of these programs. EPCOR also has a performance target to repair 93.7% of main breaks within 24 hours. In 2017, 96.21% of the 212 breaks affecting water supply to customers were repaired within 24 hours of the water being shut off, exceeding the target.

## Unidirectional Flushing and Hydrant Maintenance

Each year, water mains throughout Edmonton are flushed to remove sediment build-up and biological growth. In 2017, EPCOR continued with the Unidirectional Flushing (UDF) program and flushed 30% of the distribution system. There were 19,805 fire hydrants in the public water system at the end of December 2017. The operation of all fire hydrants located in public right of ways is checked at least twice annually, once as part of the summer UDF\Hydrant Purging program and once as part of the winter check program. This ensures that the hydrants are functional in the event of a fire and the system is compliant with fire code recommendations. EPCOR also has performance measures limiting the amount of time a hydrant can be out of service (no more than 90 days) and limiting the total number of hydrants that can be out of service on any one day (no more than 120). In 2017, one hydrant was out of service for more than 90 days and 50 hydrants were out of service for more than 30 days. The maximum number of hydrants out of service on any one day was 68. The maximum number of days out of service for any one hydrant was 365.

## Lead Response Program

A service pipe is the piece of pipe that connects the home or business to the municipal water main beneath the street or alley. There are two sections to the service pipe: the section between the water main and the property line is the responsibility of EPCOR and the section from the property line to the home is the responsibility of the property owner. About 1.5% (or 3,700) of the 250,000 homes and small businesses in Edmonton have water service pipes made of lead. These homes and buildings were mostly built before 1950.

In 2008, EPCOR proactively initiated a program to address residences and small businesses in the City of Edmonton serviced through lead service pipes. This program includes:

- annual notification to Edmonton customers with lead service pipes;
- offer of testing for lead concentration in the tap water for those customers;
- offer to provide customers with point-of-use filters that remove lead;
- prioritized lead service pipe replacement of the EPCOR section; and
- public education on the issue of lead in tap water.

In 2017, we continued with our annual notification to customers with a known lead service. As well as sampling water from homes and small businesses with lead service lines, EPCOR has also sampled homes in older neighbourhoods where we believe there is no lead service pipe in response to customer requests.

The table below summarizes the results of testing of water samples collected at the tap from homes and businesses that are supplied through lead service pipes for the years 2008-2017. Approximately 5,000 samples have been collected and tested from the 1.5% (or 3,700) homes in the city with lead service pipes in that time period. All samples were collected using a sampling protocol that is designed to measure the impact of lead service pipes on lead levels measured at the tap. This involves collecting a 4 L sample after no water in the home for 30 minutes.

### At-the-Tap Lead Test Results from Homes with Existing Lead Pipes (2008-2017)

| **Number of Samples Collected and Tested** | **5038** |
|---|---|
| % where lead concentration was greater than 0.010 mg/L | 31.3% |
| % where lead concentration was greater than 0.030 mg/L | 5.7% |
| 50th percentile lead concentration (mg/L) | 0.007 |
| 90th percentile lead concentration (mg/L) | 0.026 |

To compare, the **Health Canada Guideline for Canadian Drinking Water Quality** health-based Maximum Acceptable Concentration (MAC) for lead is **0.010 mg/L**. The lead concentration has been **less than the MAC in the majority 68.7% of the approximately 1.5% of homes with lead pipes** that were tested. The lead concentration has exceeded the MAC in 31.3% of samples collected. That represents about 1,160 homes in Edmonton. Of those tested, 5% (or about 190 homes) have concentrations greater than 0.030 mg/L. EPCOR provides information for homeowners and small businesses that are impacted by lead service pipes, including recommendations for maintaining good water quality, on our website.

In 2015, EPCOR introduced the Random Day Time (RDT) sampling program to assess the level of lead at the tap in all homes in Edmonton, not just those with lead service pipes. Building plumbing components, such as older solder used to join copper pipes and brass fittings, may also contribute to lead in drinking water at the tap. EPCOR will use the data from this program to help us determine ways to reduce lead leaching of lead from lead service pipes and plumbing components.

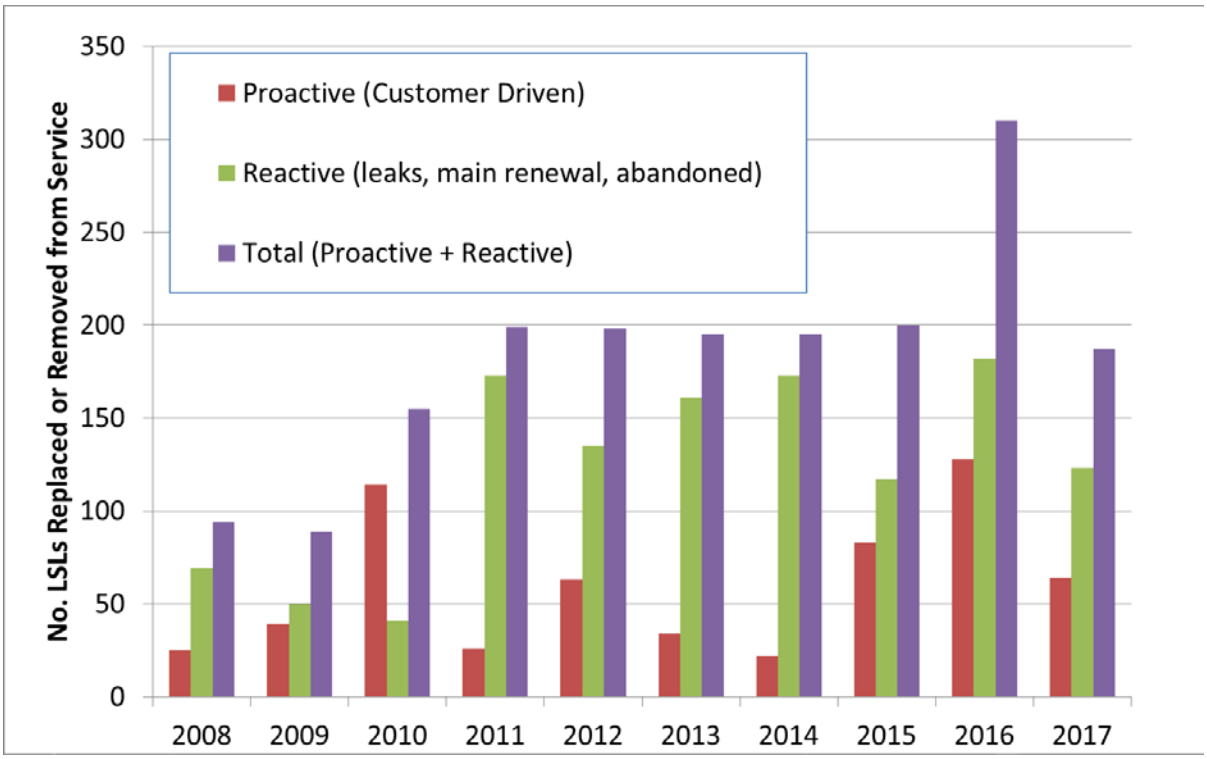
In 2017, EPCOR collected RDT samples from 165 homes. The results of the 2017 study are shown in the table below along with the results since the program began. The results indicate that lead concentrations may exceed the Health Canada Guideline in some homes that do not have lead service lines due to lead release from internal plumbing fixtures, lines or connections on private property. This study will be continued in 2018 with a goal of collecting samples from more than 300 randomly selected addresses across the city to better understand lead release from plumbing in homes.

| Results of Random Daytime Lead Testing | 2015 | 2016 | 2017 |
|---|---|---|---|
| No. Tested | 187 | 316 | 165 |
| Mean Pb (ug/L) | 0.7 | 1 | 0.2 |
| $90^{th}$ ile (ug/L) | 10 | 6 | 3 |
| % < 10 ug/L | 90% | 94% | 97% |
| % > 30 ug/L | 3% | 2% | 2% |

## Comparing Customer Driven Replacements to Maintenance Driven Replacements

There have been 1,822 lead services removed from service since 2008; of those, 598 were replaced proactively as part of the lead program, 1,224 were replaced reactively (due to leaks and other emergency repairs or as part of water main renewal programs) or were otherwise removed from service. At the end of 2017, approximately 3,032 Edmonton homes still had lead service pipes. See figure below.

EPCOR is avoiding partial service pipe replacements, where the EPCOR piece is replaced but the owner's lead piece is left in place. Studies have shown that these partial replacements are not effective for reducing lead at the tap and may even result in a temporary increase in lead concentration. As a result, we proactively replace the lead service lines on the EPCOR side only when customers have replaced the lead piece on their end. These are "customer driven" replacements. The priority for these customer driven replacements is based on the concentration of lead measured at the tap and the presence of high-risk individuals in the home (children under five years old or expectant mothers).




In 2018, EPCOR will be continuing with a neighbourhood approach to lead service line replacement. We will notify residents of planned activity in their neighbourhood in order to coordinate lead service line renewal. For infill developments, EPCOR will be requiring that service line piping material must meet current standards.

Lead service pipe replacement is progressing slowly and is determined by the rate of customer-driven replacements and the rate of infill development. The results of the RDT samples show that lead can be present at the tap even in homes without lead service lines; therefore, EPCOR will be evaluating treatment additives at the water treatment plants that will help reduce lead concentrations at the tap. Treatment additives have been effective in other communities to reduce lead concentration at the tap and further protect public health not only in homes with lead service pipes but also in homes with other sources of lead such as solder and brass. EPCOR has been testing drinking water additives for lead reduction since early 2017 in a small, closed pipe-loop test facility.  We expect this testing to be completed by the end of 2018.

# MEMBERSHIP IN INDUSTRY AND RESEARCH ORGANIZATIONS

EPCOR strives to be an active member of industry organizations that promote public health protection, such as the Water Research Foundation (WaterRF). WaterRF is a not-for-profit organization that coordinates and funds a comprehensive research program related to drinking water. EPCOR renewed its subscription and financial commitment to WaterRF in 2017. As well, EPCOR and its employees were directly involved in a number of WaterRF initiatives. Our roles included:

Member of the Technical Advisory Committee for the following research-focused program:

- Water Utility Finance: Best Practices for Setting Rates, Financing Capital Improvements and Achieving Public Support

Member of the Project Advisory Committee for the following eight research projects:

- Demonstration of Quantitative Microbial Risk Assessment (QMRA) to Estimate Health Risks of Pathogens in Drinking Water
- Using Next Generation QMRA to Estimate Human Health Risk Posed by Pathogens in Drinking Water
- Corrosion of Nonleaded Pump Impeller Alloys in Chlorinated Potable Water
- Integrated Treatment Process Management for Drinking Water and Wastewater Treatment Operations: Research Roadmap
- An Evaluation of the Value of Structurally Enhanced PVC Pipe
- Developing Water Use Metrics and Class Characterization for Categories in the Commercial, Industrial and Institutional sector
- Identifying and Evaluating Opportunities for Reducing Variability of Utility Revenues
- Potable Water Pipeline Defect Condition Rating

Involvement in the following research projects as a participating utility, in-kind contributor or co-funder of the following seven projects:

- Managing Infrastructure Risk: The Consequence of Failure for Buried Assets
- Leveraging Data from Non-Destructive Examinations to Help Select Ferrous Water Mains for Renewal
- Defining Attributes and Demonstrating Benefits of Intelligent Water Systems
- Case Study Compilation on Applying Risk Management Principles and Innovative Technologies to Effectively Manage Deteriorating Infrastructure
- Full Lead Service Line Replacement Guidance
- Innovative Technologies to Effectively Manage Deteriorating Infrastructure
- Real-life Enterprise Resilience

Continued engagement in various university led research efforts. These included:

- Increased financial support for the renewal of the University of Waterloo NSERC Senior Industrial Research Chair in Advancing Treatment and Reducing Risk

- In-kind support for the University of Alberta NSERC Strategic Project “Innovative Tools for Characterization of New Drinking Water Disinfection By-Products and Health Effects”

- Financial and in-kind support for the University of Alberta NSERC Collaborative Research and Development Project "Operational Optimization for the Removal of *Cryptosporidium* Oocyst Surrogates in Drinking Water Direct Filtration Processes: A Multi-Scale Approach"
- Financial support to for the newly established "NSERC Network for Forested Drinking Water Source Protection led out University of Waterloo"
- Financial support for the newly established "NSERC Industrial Research Chair in Sustain Urban Water Development" at the University of Alberta.

EPCOR renewed its membership with the Canadian Water and Wastewater Association and the Canadian Association on Water Quality. EPCOR or its employees were involved in various other industry organizations in different capacities, including:

- Canadian Water and Wastewater Association (board and working committee members)
- Canadian Water Network (subscriber) and Canadian Municipal Water Consortium (member)
- American Waterworks Association (member)
- American Waterworks Association—Western Canada Section (board membership)
- Western Canada Water (member)
- Canadian Association for Laboratory Accreditation (board membership)

## Participation in Water for Life and other AEP Initiatives

EPCOR continues to actively participate in Water for Life and other Alberta Environment and Parks initiatives. EPCOR is involved in Watershed Protection and Advisory Councils (WPACs) and supports Watershed Stewardship groups. Activities in 2017 included:

- Direct financial and in-kind support to the North Saskatchewan Watershed Alliance and representation on the board, executive (Treasurer) and technical committees.
- Ongoing involvement with the Alberta Water Council. An EPCOR employee sat on the board as an alternate and contributed to development of new projects on Lake Management and Source Water Protection.
- Participation on the Advisory Committee for Capital Region – Industrial Heartland Water Management Framework.

## Research on Impacts of Climate Change on Source Water

In 2017, EPCOR began work on an EPCOR Water Canada Climate Change Adaptation Strategy. This strategy will include a summary of the current state of knowledge on changes in water quality and quantity in the North Saskatchewan River, as well as providing an adaptation strategy for operations and a research strategy to better understand and predict the impacts of climate change. Mitigation and adaption approaches will be an important component of these plans to ensure resiliency of the Edmonton Waterworks System in the 21$^{st}$ century.

As part of the EPCOR Water Canada Climate Change Adaptation Strategy, we are supporting a number of research studies that are looking at the impacts of climate change. Below, we outline the research we supported in 2017.

**Collaborative Research and Development Grant**: EPCOR partnered with Dr. David Sauchyn of the University of Regina and submitted this grant to the Natural Sciences and Engineering Research Council of Canada (NSERC). This study would overlay future climate change scenarios onto historic flow rate data to project a range of possible future water supply scenarios for the decades ahead. It would build upon previous EPCOR-supported research that examined historical variability and generated a 900-year weekly flow reconstruction of the North Saskatchewan River.

The study will include predictions of watershed yield for sub-basins that could then be used in water quality models to predict changes in water quality. This federal grant was awarded in early 2018 and work will begin this year.

***forWater*—the NSERC Network for Forested Drinking Water Source Protection Technologies**: In 2017, EPCOR began supporting this network of Canadian researchers and other organizations, which is funded by the NSERC Strategic Partnership Grant program. The network will look at source water protection for communities like Edmonton that depend on source water originating from forested landscapes. Healthy forests typically produce high-quality water; however, climate change-associated disturbances such as wildfires and floods are causing increasingly variable or deteriorated water quality and challenging water treatment plants. This network of researchers will examine forest management practices in the context of drinking water treatment and source water protection. It will provide new knowledge on how different forest management strategies impact source water quality and treatability. We have committed our support for the next five years.

**University of Waterloo**: EPCOR has partnered with the University on a project to characterize organic matter in source water, which plays an important role in water treatment processes and can challenge the ability to generate clean drinking water. Climate change and extreme weather events, such as droughts and floods due to climate change, can have large impacts on organic material in source water. This study will look at ways to characterize organic material and how the various components affect water treatment processes.

**Global Water Futures Project**: EPCOR has expressed its support for the project, which is a seven-year study that will facilitate the development of risk management approaches so communities across Canada can adapt to expected water resource challenges that will come from a changing climate and hydrologic water balance

EPCOR is contributing to the Water Research Foundation Funded project entitled **Real-Life Enterprise Resilience** that is led by the University of Cranfield Institute for Environmental Futures, School of Water Energy and Environment. The goal of this project is to provide a practice-led resource for water utility managers to identify, assess and establish tolerance levels to a full range of business risks, including risks impacted by climate change.

EPCOR has also been involved in historical climate change work completed by the North Saskatchewan Watershed Alliance and is an active participant in the City of Edmonton Climate Change Adaption and Resilience Working Group. The City of Edmonton is now in the third and final year of this initiative to look at the risks and mitigation plans for various infrastructure and services in the city, including water and wastewater. The City of Edmonton's working group generates predictions of climate change and takes a much broader look at the impacts of climate change on services provided by a city. EPCOR Water Canada's Climate Change Adaptation Strategy focuses primarily on the North Saskatchewan River. Find out more about the City of Edmonton's Climate Change Adaption and Resilience Plan on its website.

## Energy Efficiency Initiatives

EPCOR's major energy efficiency initiatives for 2017 to 2021 focus on three main aspects:

1) Continue to improve building envelopes at our facilities for higher energy efficiency and greenhouse gas emission reduction.
2) Implement a Pump Health Visualization Pilot program and other operational changes to assist operators monitoring the Variable Frequency Drive (VFD) pump performance.
3) Plan and design an E.L. Smith solar farm in order to generate green energy locally.

These initiatives will continue to move ahead in 2018.

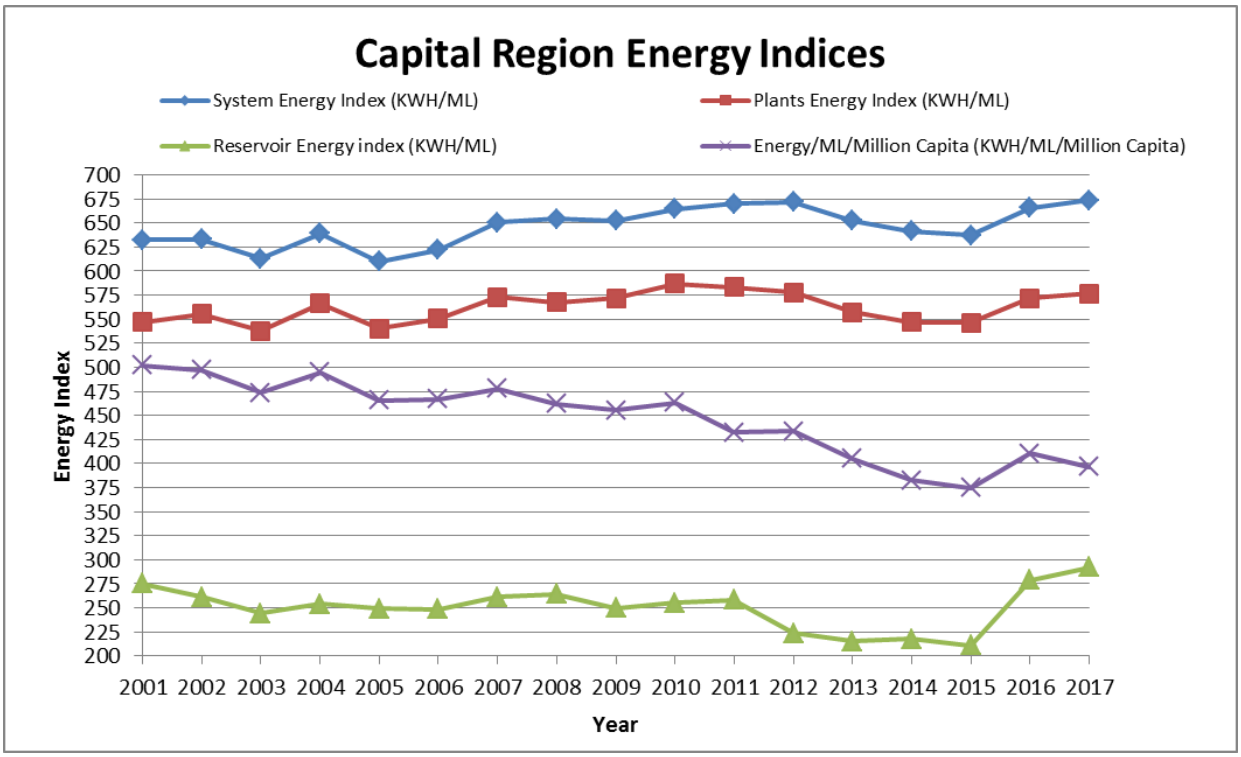
The following projects are designed to improve the energy efficiency of building envelopes:

- We will replace 408 large windows and glass doors for the clarifier and filter area at the E.L. Smith Water Treatment Plant with new double glazed floating glass units (low E with Argon gap) and new aluminum curtain wall framing. The project was initiated in 2017 and is scheduled to be completed by June 2018. The project is expected to generate 1200 GJ/year in energy savings and a lifetime savings of $148,000.
- We will replace the current HVAC equipment at our E.L. Smith WTP that should increase efficiency by 85% to 90%. The project was initiated in 2017, and is scheduled to be completed by 2019. The project is currently at the 30% design stage.
- The HVAC upgrade project at our Rossdale WTP will also replace equipment for greater efficiency. During Phase I, two of the four air-handling units and the condensers were upgraded with newer and higher efficiency units. Phase I was completed in 2018 and Phase II will be completed in 2020.
- EPCOR has many Variable Frequency Drive pumps in our 16 reservoirs and booster stations to maintain sufficient water supply and water pressure in the distribution system. Over the years, many VFD pumps have experienced damage related to cavitation when pumps are running in the non-optimal modes. This pump health visualization project would utilize visual/colour indicators of pump running status on the SCADA screen to identify pumps that are running in the poor energy efficiency zones. This will prompt operators to change the pumping pattern to bring the pumps back into an optimal mode. This program requires installation of a flow meter for each VFD pump, and a new interactive interface. In addition, this approach will resolve the parallel pump operation efficiency issue. With individual flow meters, it would be possible to know what combination of pumps works well and what could cause problems. Maintenance savings and extending pump life will enhance the payback. The project is currently in the pilot phase until the end of 2018.
- We are currently engaging stakeholders to plan and design a solar farm at the E.L. Smith WTP. If approved by the Alberta Utilities Commission and the City of Edmonton, the solar farm will generate renewable energy to help power the water treatment plant and its distribution processes, while reducing greenhouse gas emissions. This project aligns with the City of Edmonton's, *"The Way We Green": Environmental Strategic Plan*. The solar farm will have approximately 45,000 solar panels with a peak generation capacity of about 12 megawatts. The estimated annual production of solar energy is about 21,600 MWH, which is over 20% of the total water system annual power consumption. If the solar farm produces more energy than the water treatment plant can use, any excess will be exported back to the electrical grid. The project is currently at the 30% design stage.

## Energy Indices

The overall system energy efficiency performance in 2017 was below the operational target of 665, but met the Performance Based Regulation target of 309. The primary reason for missing the operational target is that even though the population is growing, the per-household water consumption is decreasing. As such, the overall water consumption volume of 2017 is less than that of 2016. In addition, the majority of population growth happened at the edges of Edmonton, in surrounding communities. These factors reduced energy efficiency, as more energy was required to supply the distribution network and to maintain the distribution system pressure.

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| System Energy Index | 703 | 707 | 701 | 696 | 671 | 666 | 649 | 657 | 654 | 689 | 702 | 693 | 682 |
| PBR System Energy Index Monthly | 274 | 276 | 272 | 270 | 259 | 256 | 250 | 252 | 251 | 264 | 268 | 265 | 263 |
| PBR System Energy Index YTD | 274 | 275 | 274 | 273 | 270 | 268 | 265 | 264 | 262 | 262 | 263 | 262 | 263 |
| Rossdale Energy Index | 623 | 623 | 634 | 633 | 590 | 612 | 585 | 580 | 593 | 626 | 615 | 616 | 611 |
| EL Smith Energy Index | 561 | 567 | 551 | 557 | 540 | 527 | 518 | 520 | 515 | 528 | 550 | 541 | 540 |
| Zone I Reservoirs Index | 442 | 393 | 379 | 451 | 256 | 250 | 231 | 234 | 241 | 249 | 264 | 341 | 311 |
| Zone II Reservoirs Index | 237 | 234 | 228 | 230 | 212 | 204 | 203 | 205 | 207 | 232 | 227 | 222 | 220 |
| Zone III Reservoirs Index | 108 | 108 | 108 | 105 | 104 | 102 | 103 | 101 | 102 | 101 | 105 | 107 | 105 |
| Zone IV Reservoirs Index | 358 | 330 | 350 | 357 | 324 | 314 | 315 | 329 | 332 | 332 | 337 | 355 | 336 |




EPCOR has been successful in continuous energy efficiency improvement over the past few years. The Energy Index Trend (above) shows that both water treatment plants and reservoirs energy efficiency are on an increasing trend over the past two years. To meet these challenges, in addition to the Pump Health Visualization pilot program mentioned above, EPCOR has also implemented a number of operational energy efficiency initiatives to maximize pumping efficiency and minimize energy loss in the system. These initiatives include:

- revised energy efficiency pumping strategy and subsequent training for operators;
- refraining from pumping below 75 MLD in the Rossdale high lift pumping station; and
- managing the pumping volume during the day and at night to ensure pumping is at the energy efficient zone at full speed with proper flow.

## Active Staff Recruitment

EPCOR strives to attain a variety of employment achievements in Canada. In 2018, we were named one of Alberta's Top 70 Employers for the 13th consecutive year, one of Canada's Top Employers for Young People for the 7th consecutive year and one of Corporate Knights' 2018 Best 50 Corporate Citizens in Canada.

We have a dedicated Talent Sourcing team that focuses on finding high quality external candidates and on internal employee training and development for technical and leadership positions. EPCOR's Talent Management department operates the EPCOR School of Business, which hosts a multitude of leadership training and professional development courses. Our managers are increasingly involved in succession planning to ensure we have a strong pool of talent, now and in the future.

Since 2012, EPCOR has been conducting employee engagement surveys. In 2016, our overall engagement score surpassed other large Canadian organizations in our benchmark. In 2018, we will distribute another company-wide engagement survey. All managers are expected to follow up on survey results by creating action plans with their employees to help improve overall engagement.

These efforts ensure that as we move forward, our teams will remain strong and engaged and will provide our customers with safe and reliable water services while meeting or exceeding environmental requirements.

## Water Conservation

At EPCOR, we're dedicated to ensuring a strong water supply is in place for generations to come. We look for ways to increase awareness within our community regarding water usage and conservation. While most homes and businesses in the city are, generally, conservative users there are still opportunities of improvement. EPCOR implements a variety of industry best management efficiency practices that have resulted in significant water efficiency improvements in Edmonton. Below, are some of our conservation initiatives from 2017:

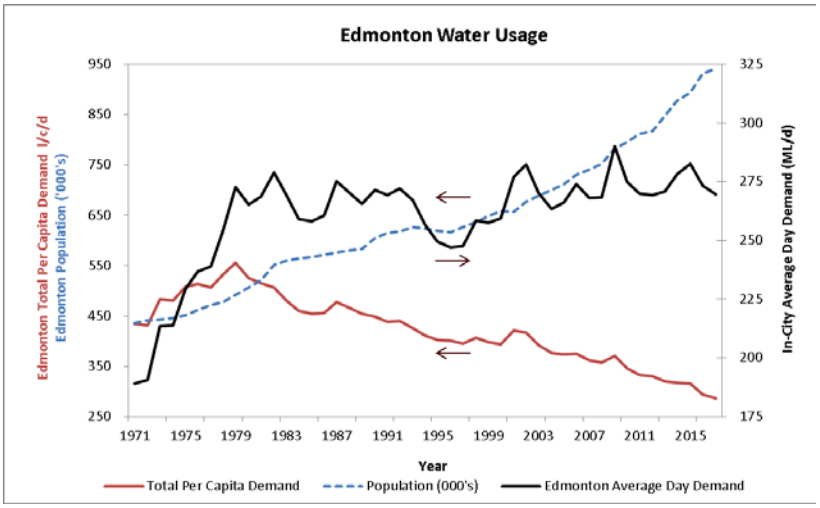
- RONA, EPCOR and the City of Edmonton partnered to host a Home$aver Eco sale. This event focuses on educating customers and promoting the use of water- and energy-efficient products. EPCOR's participation in this event included sponsorship and promotion of rain barrels for outdoor water conservation as well as other water efficient household products.
- EPCOR notified schools and subsidized housing operators and sent conservation information packages as a way to address high water consumption:
    - Ten schools were contacted that had twice the average water consumption per student per month as compared to the average.
    - Five subsidized housing operators were contacted and provided with their highest usage accounts.
- During Environment Week, Canada Water Week and World Water Day, EPCOR promoted conservation and efficiency initiatives as a way to increase awareness and education.
- Throughout the year, conservation and water efficiency efforts were promoted through social media channels, bill inserts and updating efficiency information and tools on EPCOR's website to help customers reduce their water use.
- EPCOR supplied online tools and resources for teachers and students that support education around water and wise water use:
    - Esmart Kids: An online resource for teachers and students built to encourage learning about using water wisely, and electricity safety/efficiency. During 2017, we saw 60,335 interactions with this site at: http://smartkids.epcor.ca
    - Water Quest: A joint project between EPCOR and Alberta Agriculture, Food and Rural Development. Throughout 2017, the site had 1,649 sessions and 6,230 page views of this resource at: http://www.waterquest.ca/

Water usage trends are monitored regularly to ensure the conservation program is meeting operational objectives as well as our customers' needs. The figure below shows the trend of Edmonton's total water demand between 1971 and 2017. While population has steadily increased over this period, in-city average day demand has leveled off (with year-to-year fluctuations) and total per capita water use has been on the decline since the early 1980s. In 2017, the total per capita water use was 286 litres per person per day (L/p/d). Residential water use was 184 L/p/d. Edmontonians' continued conversion to high efficiency toilets and washing machines is projected to decrease per capita water use over the long term.

In comparison, the Alberta Urban Municipality Association has set targets to achieve a total per capita water use of 341 L/p/d and an average per capita residential water use of 195 L/p/d (which is 30% below Alberta municipal sector reported water use from 2001-2006) by 2020. EPCOR has achieved the total per capita metric since 2011, and first achieved the residential per capita metric in 2014.

Going forward, EPCOR's conservation platform will focus on identifying and addressing inefficient water use in different high use customer classes or groups.

### Edmonton Water Usage 1971-2017




## System Water Losses

EPCOR has a program for monitoring and controlling water losses in the distribution system and has adopted the Infrastructure Leakage Index (ILI) as the primary measure of water loss performance. The ILI is the ratio of real water losses compared to the lowest losses possible if all available best management practices were successfully applied. The ILI was developed by the International Water Association and is the industry recommended metric to measure the effectiveness of managing and maintaining a municipal water system. It is considered a good overall measure of system performance because it adjusts for water system size and complexity and also enables comparisons between different water systems. For a system of the same size and characteristics as Edmonton's, the Water Research Foundation suggests an ILI of > 3.0 to 5.0. Based on these factors, EPCOR had previously set an ILI benchmark of < 3.0. As shown below, EPCOR has consistently achieved ILI's below 2.0 in the past five years. As such, in 2016, EPCOR set an ILI benchmark of < 2.0 as a reasonable goal in the 2017- 2021 PBR renewal.

| Year | ILI | EPCOR Benchmark Target |
|---|---|---|
| 2013 | 1.27 | < 3.0 |
| 2014 | 1.46 | < 3.0 |
| 2015 | 1.18 | < 3.0 |
| 2016 | 1.06 | < 2.0 |
| 2017 | 0.90* | < 2.0 |

*Preliminary metric. The 2017 Water Loss Audit is not yet published and therefore the ILI is subject to change.

Consistently low ILI values indicate that EPCOR is managing real losses in a qualified manner. This can be attributed to the cumulative effects of the following factors:

- EPCOR has been actively renewing water mains for 30 years and maintains a strong commitment to continually replace cast iron piping (that is more prone to breaking and leakage) with PVC piping.
- We maintain a proactive leak management strategy that targets areas with lead services and areas close to the river valley, where the slopes are unstable and susceptible to sliding. In 2013, the program was expanded to include leakage surveys of the older neighbourhoods that were selected for neighbourhood renewal by the City.
- Our active customer meter replacement program ensures average meter life remains low. This results in high levels of meter accuracy and confidence in sales figures.
- EPCOR has a Performance Based Regulation requirement regarding main break repairs. This ensures real losses associated with main breaks are minimized.
- We track a large portion of unbilled authorized consumption through the hydrant permit program. This ensures accurate volumes are used to calculate real losses.
- Edmonton's clay based impermeable soil conditions ensure that most major leakage seeps to the surface close to the leak. This allows citizens to promptly report main breaks.

# REDUCING ENVIRONMENTAL IMPACTS

The treatment of river water to produce clean, safe drinking water generates waste or “residual” streams. Some of these streams, such as the underflow from clarifiers and filter backwash, contain solid material that is a mixture of the suspended solid material removed from the river water and the solids produced by the addition of alum and, at times, powdered activated carbon. Some of these residual streams, such as filter backwash or treated water that does not meet the drinking water specification, also contain chlorine that can be toxic to fish. These waste streams have historically been released back to the river.

EPCOR has evaluated alternative strategies for managing these waste streams. Any successful strategy must balance reduction of environmental impact on the river against cost and our primary objectives to meet drinking water treatment standards and to protect public health. Other environmental impacts, such as the energy footprint resulting from processing and transport of residuals to alternate disposal locations, must also be factored into the equation.

## The Importance of Dechlorination

Drinking water contains residual chlorine, which is added at the treatment plants to disinfect the water. While it is important to ensure a minimum residual in the water delivered to all customers for protection of public health, the chlorine residual can be toxic to fish as it damages their gills. EPCOR has committed to eliminating all discharges of chlorinated water from its facilities to the river or any other water bodies. This includes routine discharges of chlorinated water from the E. L. Smith and Rossdale Water Treatment Plants arising from filter backwashes, filter-to-waste and release of water that does not meet drinking water specifications. EPCOR is also eliminating discharges of chlorinated water arising from activities at field reservoirs and in the water distribution system wherever possible.

### Dechlorination at the Water Treatment Plants and Field Reservoirs

Bisulfite dechlorination systems have been in place and operating at the E. L. Smith and Rossdale WTPs since 2009 and 2012, respectively, and meeting AEP approval limits since 2010 and 2012. These systems remove chlorine from chlorinated water streams including filter backwash, filter-to-waste and plant by-by passes before the water is returned to the river. As well, procedures are in place to ensure that all planned discharges of chlorinated drinking water from the field reservoirs are dechlorinated prior to release.

In 2017, there were no releases of chlorinated water to the river from the water treatment plants or field reservoirs due to failure of the dechlorination systems. There was, however, one event where chlorinated water was released to the river inadvertently during a construction project. This incident was reported and reviewed. Preventative measures were put into place to prevent another occurrence from taking place.

In the past year, EPCOR has continued to improve our procedures and to identify other potential sources of release of chlorinated water to the river at the water treatment plants. All sources of chlorinated water at both treatment plants (like service water) have been identified and labelled. Shutdown permits were updated to include environmental risks and procedures required to mitigate those risks. An innovative in-house dechlorination unit was also designed and built by employees and was put into service during the annual washing of the clarifiers at the Rossdale Water Treatment Plant.

### Dechlorination of Water Released to the Environment in the Distribution System

EPCOR also has procedures in place to dechlorinate drinking water released into the environment from the distribution system. This includes both planned releases (e.g. flushing and draining of pipes for maintenance) and unplanned releases (e.g. water main breaks and other emergency events). While it may be difficult to ensure 100% dechlorination of all releases, the procedures will ensure the majority of water released from the distribution system is dechlorinated and that potential environmental impacts are mitigated**.** In 2017, there was one significant

release of chlorinated water from the distribution system during planned maintenance work to replace a defective valve on a pipe. Dechlorination pucks were quickly deployed to neutralize the chlorine in the water that was released before it reached a nearby creek. This release was reported to AEP.

## Residuals Solids Management Program

EPCOR's Residuals Solids Management program strives to reduce the impact of solids present in the residual streams released into the North Saskatchewan River from its water treatment plants. Complete, year-round diversion of all solid residual streams from both Edmonton water treatment plants would require building very large, expensive treatment facilities at both water treatment plants and would involve trucking large volumes of solid material to landfills. This zero-discharge option was determined to be very costly and would result in other environmental impacts such as construction of large facilities near the river, energy use and trucking and off-site disposal of solids. The environmental benefit of this option is not clear. The volumetric flow and background solids concentration in the river fluctuates significantly during the year due to natural phenomena, which means that very large facilities would be required to manage the load during all seasons.

This program has emphasized minimizing the loading of solids to the river during the fall and winter seasons, when river flow and the background suspended solid concentration are lowest and the relative impact of the solids discharged on the river quality is greatest. This is achieved by reduction at source, that is by optimizing and minimizing the amount of alum added without compromising drinking water treatment. If less alum is added to the water for treatment, the amount of solid residuals produced and discharged to the river (especially the amount of chemical residuals) is reduced.

## Solids Residual Reduction Strategy

Since 2009, the Rossdale and E. L. Smith Water Treatment Plants have converted to direct filtration mode of operation during the winter months to reduce the amount of residuals released to the river. The switch from conventional mode to direct filtration mode involves reducing alum dosing during treatment by up to 80%. This reduces the total mass of solids residuals produced during treatment that has to be discharged to the river by up to 50%. EPCOR's Stewardship Commitment was to operate in direct filtration mode from November to February, and to build facilities to divert the remaining solids produced during these months to on-site solids treatment facilities for eventual landfill disposal (E.L. Smith plant) or sewer disposal (Rossdale plant).

Early on, we determined that direct filtration can only be operated successfully under variable raw water colour conditions with appropriate alum dosing and use of clarifiers for some settling. This option, however, eliminated the possibility of on-site treatment and disposal of solids during the fall and winter without substantial capital investment. With approval from AEP (Sept 2013), we modified our residual reduction plan to focus on extending the operation of direct filtration into the fall (September to October) and spring seasons (March), when the water quality of the river is often amenable to direct filtration treatment.

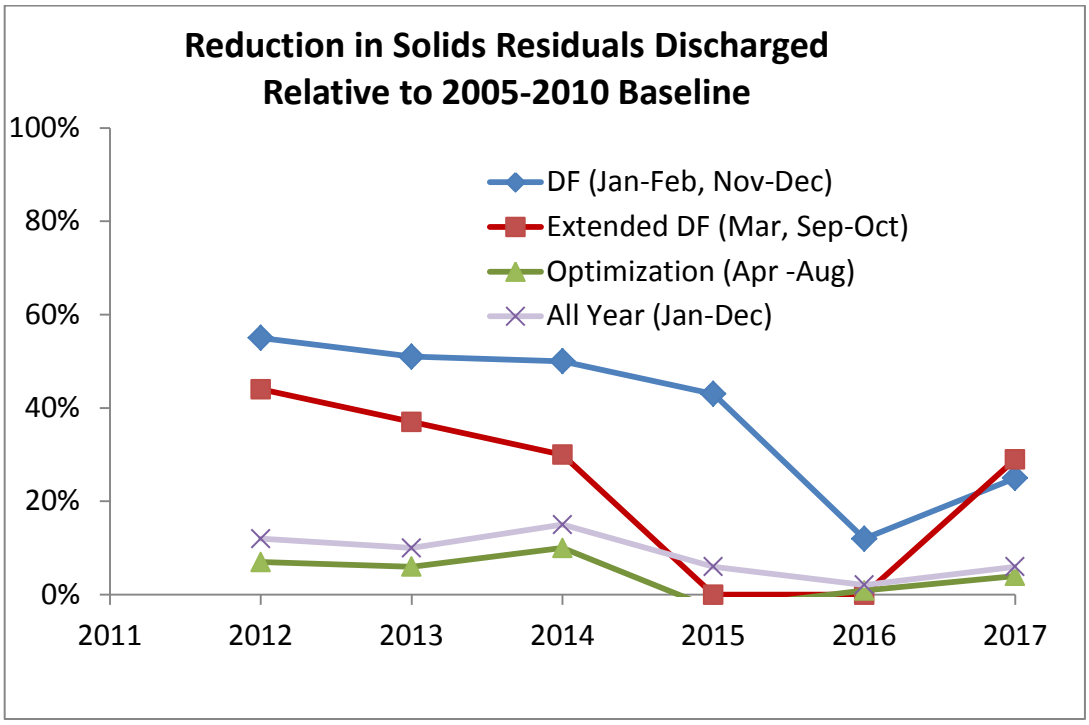
The graph below summarizes the solids discharged to the river from the two water treatment plants as a result of implementing this strategy since 2012. The amount of solids discharged to the river varies considerably from year to year and depends heavily on the raw water conditions in the river. To determine the effectiveness of the solids reduction strategy against this background variation, EPCOR determines the reduction in solids discharged from the two treatment plants relative to the amount that would have been discharged using the 2005-2010 conventional treatment strategy.

For example, in 2017, we achieved a 25% reduction in solids discharged during the winter direct filtration period (Jan-Feb, Nov-Dec) relative to conventional operation with same raw water conditions. We were able to operate in direction filtration mode for several days in late spring (March), before runoff, and in early fall (Sep-Oct). This resulted in an additional 29% reduction during this period relative to conventional operation with same raw water conditions. Finally, through optimization of alum addition during conventional operation from April to August, we reduced the

solids discharged by 4% relative to conventional operation. For the entire year, the amount of solids discharged was reduced 6% with the most substantial reductions occurring in the fall and winter when the river is more sensitive to solid discharges.

As the graph shows, our success with this strategy has varied from year to year and has depended heavily on river conditions and the ability to run in DF mode. Reducing solids discharge in the range of 40 to 50% was achieved from 2012 to 2014 in the fall and winter when the river water conditions were favorable for DF operation. The most challenging year to date for direct filtration was 2016 due to an early spring runoff and very high colour levels in the river in the fall and early winter. In 2016, we achieved a 12% reduction in solids released to the river during the normal direct filtration season (Jan-Feb, Nov-Dec) and there was no extended DF operation. Fortunately, 2017 was a better year for direct filtration operation. Even though spring runoff came very early in 2017, with run-off conditions appearing in late February, we were able to achieve a 25% reduction in solids release during the direction filtration season (Jan-Feb, Nov-Dec) and a 29% reduction during the extended direction filtration operation (Mar, Sept to Oct). This was an improvement over 2016 but still not as good as 2012 to 2014.

In 2017, EPCOR set an internal environmental performance target for the number of days in direct filtration operation at both water treatment plants. EPCOR was able to exceed the internal performance target of 120 plant-days in direction filtration operation. This new performance target provides additional incentive for EPCOR to continue to find ways to improve direct filtration operation.




*DF = Direct Filtration*
*Baseline load is calculated using 2005-2010 conventional treatment strategy and actual raw water conditions*

## Environmental Monitoring

EPCOR continued to investigate the environmental impact of the solids that are discharged to the river in 2017 and to build on the work we completed in previous years (2013-2016). The focus of this program has evolved over the years, and has included monitoring water quality, sediment quality, benthic invertebrate communities and toxicity downstream of the discharge points. In 2017, emphasis was given to monitoring the impact of the solids discharges

on dissolved oxygen (DO), dissolved aluminum, sediment toxicity, and benthic invertebrate communities. The key findings from 2017 were:

- The discharge of the clarifier blowdown stream, the most concentrated residuals stream, does not have a significant effect on DO concentrations in the river.
- The addition of sodium bisulfite to dechlorinate waste streams did not have a significant effect on DO concentrations in the river.
- Dissolved aluminum concentrations in some samples collected from the river in the mixing zone downstream of the water treatment plant discharge points did exceed Alberta Surface Water Quality Guidelines. EPCOR will explore this further in 2018.
- Benthic invertebrate communities were similar in abundance, community composition and diversity upstream and downstream of the Rossdale WTP. Benthic invertebrates were highly variable between and among sampling locations, and more testing will be needed to confirm whether or not the benthic community is impacted by WTP operation.
- The growth rate and survival rates of chironomids were significantly lower downstream of the Rossdale WTP than upstream. The cause for the decreased growth and survival observed in the toxicity tests is unclear. Chironomids are small organisms used to test the ecological impact of discharges on sediment communities.

EPCOR will continue its environmental monitoring program in 2018.

## Impacts of Residuals Management Strategy on Drinking Water Quality

One of the primary objectives of the residuals management strategy is to achieve environmental benefit (reducing solids loading to the river), without compromising the health and safety of drinking water. Direction filtration has a slight impact on a few quality variables including turbidity, total aluminum, total organic carbon and disinfection by-products; however, the impact is minor and these parameters remain well within health-based guideline levels or approval limits. EPCOR monitors both the raw and the treated water for *Cryptosporidium* more intensively during direct filtration operation. We know that the frequency of detection of very low levels of *Cryptosporidium* oocysts in the treated drinking water at the Rossdale and E. L. Smith WTP tend to increase during direction filtration operation. Using Quantitative Microbial Risk Analysis, the risk associated with these very low level of parasites in the drinking water was determined to be well below negligible risk levels established by Health Canada and the World Health Organization. Very low levels of *Cryptosporidium* oocysts were detected in a few treated water samples during direction filtration in late October and early November 2017. The levels of oocysts in the raw water remained below the level of concern. EPCOR has UV disinfection in place to ensure that all oocysts that escape filtration are inactivated. Nevertheless, we continue to monitor this very closely.

## Continuous Improvement Initiatives

EPCOR has been investigating strategies to further reduce alum dosing and, thereby, reduce solids loading. These efforts have focused mainly on improving and optimizing direct filtration operation. In 2017, these included the following strategies:

- **The use of Zeta Potential (ZP), alternative filter polymers and doses**: ZP is a measure of the charge on the surface of very small particles in water. We have found that ZP is closely related to filtration polymer dose and this provides some insights into using filter polymer dose to improve direct filtration operation. In 2017, a new filter polymer was implemented in the water treatment plants based on the success of pilot plant testing. This new polymer has helped improve direction filtration performance.

- **Improving Cryptosporidium Oocyst Removal:** In 2014, EPCOR initiated a research project led by the University of Alberta to study the physical removal of *Cryptosporidium* oocysts during direct filtration operation. The study involved a combination of laboratory bench experiments and pilot-plant challenge experiments using surrogate particles in place of *Cryptosporidium* oocysts. The objective was to determine the mechanisms and variables affecting oocyst removal during filter operation. The project started in 2015 and received funding from the Natural Sciences and Engineering Research Council of Canada (NSERC) for two years. The experimental work for this study was completed in 2017. The results indicated that high levels of *Cryptosporidium* removal can be achieved during direct filtration operation under the right conditions. Polymer type, polymer dose and zeta potential were determined to be key variables for optimizing *Cryptosporidium* oocyst removal during direct filtration. The results of this study will be published in an open journal in due course.
- **Using Deep Bed Filters:** From 2013-2014, a comprehensive pilot study was completed to assess the feasibility of deep bed filters to provide additional plant capacity and facilitate direct filtration operation. An engineering analysis was also completed to determine the technical and economic feasibility of converting some of the filters at the E. L. Smith Water Treatment Plant to deep bed operation. In 2016, a proposal for a capital project to convert 12 of 18 filters at the E. L. Smith plant to direct filtration mode was approved as part of the EPCOR's 2017-2021 Performance Based Regulation rate application to the City of Edmonton. In 2017, an additional set of pilot plant studies was completed to determine the level of removal of *Cryptosporidium* removal in deep bed filters during direct filtration operation. As expected, removal of *Cryptosporidium* was consistently better in deep bed filters than in regular bed filters. Preliminary planning and design work has begun for implementation of Deep Bed Filters.

## LOOKING FORWARD

As we move into the 8th year of Champion status, EPCOR will continue to improve environment performance through various programs and initiatives in 2018 and beyond. We will strive to pursue and make progress on each of our Stewardship Agreements. Going forward, EPCOR will:

- Continue to maintain registration to ISO14001:2015 at our Water Treatment Plants and in our Distribution and Transmission operations. The ISO systems are based on the Plan-Do-Check-Act principle and required regular auditing, review and continuous improvement. This includes the annual update of the 2018 Drinking Water Safety Plan and implementation of the action plan.
- In 2018, we will complete development and implementation of a network of water quality and flow monitoring stations on key tributaries of the North Saskatchewan River. This network is being developed in conjunction with Alberta Environment and Parks, the North Saskatchewan Watershed Alliance and the City of Edmonton as part of a comprehensive water quality monitoring initiative in the basin.
- Secure approval and begin construction of a solar panel installation at the E. L. Smith Water Treatment Plant to meet our commitment to have up to 10% of the water system energy provided by green energy.
- Continue to work with regulatory authorities and utility partners on the “Troubled Water” emergency exercise plan. A key part of this will be completion of a plan for an emergency water supply.
- Complete the development of the EPCOR Water Canada Climate Change Adaption Strategy that will include management plans for various low-flow (drought) and high flow (flood) conditions in the North Saskatchewan River basin as well as challenging water quality conditions.
- Continue specific climate change adaption planning activities such as a next phase of a research program with the University of Regina to understand the impacts of climate change on project water availability in the North Saskatchewan River.
- Complete the development of a long-term plan for the water treatment plants that will address anticipated growth in demand, changes in source water quality, evolving regulatory requirements and climate change driven fluctuations well into the future.
- Begin design for a capital project to convert to deep bed filtration at the E. L. Smith Water Treatment Plant. As well as increasing the treatment capacity of the plant, this initiative will also facilitate and, potentially, extend direct filtration operation and thereby result in further reduction of solids residuals discharged to the river.
- Continue to examine the environmental impact of solids residuals discharged to the river through a program of in-stream water quality sampling and testing including examination on the impacts on the benthic organism community.
- Share with industry, through peer-review publication, the results of the completed research project with the University of Alberta on removal of *Cryptosporidium* oocysts from the filters in the water treatment plant during direct filtration operation.
- Continue to participate in Alberta Environment and Parks’ Water Management Framework Advisory Committee, the Alberta Water Council, the North Saskatchewan Watershed Alliance, the Alberta Drinking-water Laboratory Technical Advisory Committee and other government led or Water for Life related initiatives.