EPCOR 2015 ENVIROVISTA REPORT

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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.

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, as well as minimizing our impact to the environment.

A CHAMPION IN YOUR BACKYARD

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 Water Works 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 above and beyond the typical approval-to-operate requirements for a municipal water operation (see Stewardship Commitments below).

Many of these commitments are programs and activities EPCOR has had in place for a long time. These commitments are simply how we operate, well before they became regulatory requirements. 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 are the right thing to do 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.

Our actions demonstrate a strong commitment to the environmental management and sustainability of the North Saskatchewan River, including these highlights from 2015:

HIGHLIGHTS OF 2015 ENVIROVISTA INITIATIVES:

- Achieved **ISO14001 registration** early in 2015 for the Environmental Management System for the Edmonton Drinking Water Treatment Plants and completed almost a full year of operation under the management system;
- Reviewed and updated the **Drinking Water Safety Plan**, addressed five risks, and added several new action plans to address other risks;

- Began the development of a **Geographical Response plan with Alberta Environment** and Parks to help address the risks of source water contamination via a spill to the river upstream of Edmonton;
- **Achieved total per capita water use of 288 litres per person per day** (L/p/d). This is well below the Alberta Urban Municipality Association (AUMA) water use target of 341 L/p/d by 2020;
- Achieved the lowest level of water loss in the distribution system with an **all-time low infrastructure leakage index of 1.14**. The industry bench mark is to be less than 3.0;
- Completed a field study to help **optimize the frequency of unidirectional flushing (UDF)** of water mains. Optimizing UDF will reduce the amount of water losses in the system;
- Further **reduced the energy consumed to pump and distribute water** on a kWh per ML basis throughout the system compared to 2014 and exceeded the performance benchmark of 670 kWh/ML for overall system energy performance;
- Completed construction of a **new Water Laboratory facility** at the Rossdale site and renewed accreditation of the lab to ISO/IEC17025 for the new facility;
- Continued to fund a research project with the City of Calgary on **sustainable urban water management**;
- Achieved a **43 per cent reduction** in the water treatment plant solids discharged to the river during winter and fall months converting to direct filtration operation; and
- Tested a datasonde instrument to **collect better information on the localized impact of releases** from the water treatment plants to the North Saskatchewan River.

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 registered under ISO 14001:2004 and OHSAS 18001:2007 in February 2015. These are two international standards for managing facility environmental (EMS) and worker safety (Occupational Health & Safety Management System) requirements. Collectively these are both referred to as the Edmonton Water Treatment Plants integrated Management System (EWTPiMS).

The EMS was formally certified under ISO 14001:2004 by the registrar SAI Global in early 2015. Dual audits and registration allowed for the OHSMS for the Water Treatment Plants (WTPs) to be certified under OHSAS 18001 as well in early 2015. 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) have been developed to address particular environmental items and related worker hazards in each of the operational areas.

The EWTPiMS requires regular internal audits be conducted to assess the management system as a driver for continual improvement. The 2015 internal audit was conducted July 12-17, 2015 by an external consultant who reviewed both the environmental and OH&S management systems. All audit findings are tracked in a formal Audit Tracker worksheet to facilitate managing the corrective actions taken to address each audit finding. As per the audit schedule for the EWTPiMS, the annual surveillance audit by the registrar SAI Global was conducted November 23-25, 2015. This audit demonstrated that the EWTPiMS is conforming to all the requirements of these two standards for environment and safety. The certified EWTPiMS satisfies the commitment for EPCOR Water Treatment Plants to have an ISO 14001 accredited EMS under the EnviroVista Champion Approval and the related Stewardship Agreement.

The ISO 14001 international standard was updated in 2015 to include some additional requirements – it is now referred to as the ISO 14001:2015 Standard. To transition the EWTPiMS to this new version of the ISO 14001 standard (facilities have up to three years to transition), EPCOR held a full-day Transition Workshop on January 28, 2016. An external consultant whom is a subject matter expert on the :2004 and :2015 versions of ISO 14001 provided insights to allow management to set a clear path for transitioning the EMS in 2016. A gap analysis to identify changes needed to the EWTPiMS will be completed mid-2016.

In addition to the WTPs and reservoirs, the Edmonton Waterworks System also consists of the Water Distribution & Transmission (D&T) system facilities, i.e. the infrastructure to deliver potable water from the WTPs to the reservoirs, and from the reservoirs to each customer. The EMS and OH&S-MS for Water D&T is being further developed to meet all the conformance requirements of ISO 14001:2015 and OHSAS 18001:2007. An internal audit of Water D&T was completed in February 2016. It is expected that SAI Global will conduct dual registration audits in late 2016 and Water D&T will have its EMS accredited under ISO 14001:2015 before 2017. With the EMS for both the WTPs and Water D&T accredited, this will fulfill the EnviroVista commitment to have the entire Edmonton Waterworks system certified under ISO 14001 – a major milestone and coming success for EPCOR Water Canada.

OPERATIONS PROGRAM

The Operations Program for the Edmonton Waterworks is comprised of plans, operational philosophies and procedures used by staff to manage the waterworks system. This ensures consistent production and reliable delivery of high quality drinking water while reducing environmental impacts. The Operations Program overview document is a requirement of the EnviroVista Approval and is an integral component of the Edmonton Waterworks' Environmental Management System (EMS) accredited under ISO 14001. A team of subject matter experts from across EPCOR Water Canada collaborate throughout the year to keep the Operations Program up to date and changes to the Operations Program are reviewed annually by management. The first Operations Program was released on December 31, 2012. The most recent revisions to the Operations Program were completed on February 28, 2016 and included:

- a new Notification Procedure for communication with Alberta Environment and Parks and Environment Canada regarding planned releases to the North Saskatchewan River, e.g. powder activated carbon in Rossdale water treatment waste stream released to the river during the spring runoff period (this compound has minimal environmental impact when returned to the river);
- a new Communication Protocol for releases from the water treatment plants and the inclusion of a screen capture illustration of the Water Outage Map from EPCOR's internet site;
- updates to the list of analytical parameters (section 4.2) in the Water Quality Monitoring Plan and related Appendix A;
- updates to field reservoir storage volumes and distribution system pressure zone map for City;
- updates to Emergency Response Plans; and
- updates to key Risk Action Plans in the Drinking Water Safety Plan.

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. DWSP risk assessment was completed for the Edmonton Waterworks 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. The DWSP was reviewed and updated in early 2015. In early 2016, EPCOR convened the subject matter experts once again to review the entire DWSP in depth. The team was asked to re-assess all of the risks and identify any new or emerging risks. This in-depth review resulted in the addition of twelve more key risks and interventions to the 16 key risks that were on the Action Plan. The action plan for 2016 will mitigate these 28 risks and are broken down into five "Source-to-Tap" areas; Source Risk, Treatment Risks, Reservoir Risks, Pipeline Risks and Customer Risks. For details on this analysis, contact EPCOR.

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 developed in 2008 to help mitigate potential risks to Edmonton's source water supplies by understanding the pressures on the watershed. An update to the plan, including enhanced land use maps, water quality assessment, and incorporation of the Drinking Water Safety Plan Risk Assessment, was published in 2014. Key SWPP risks were reviewed in early 2016 as part of the Drinking Water Safety Plan review.

2. Treatment

EPCOR Edmonton water treatment plants (Rossdale and E. L. Smith) use both 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). This treatment process removes any bacteria, viruses, *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 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 credit for 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;
- 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; and
- 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 monochloramine which provides a lasting disinfectant residual through reservoir storage and throughout the distribution system within the City of Edmonton and the regional waterworks systems.

3. Distribution System

EPCOR ensures the safety of water in the distribution system by maintaining adequate supply pressure. There are continuous pressure monitors at several locations throughout the system. Ongoing maintenance programs that safeguard distribution system integrity and water quality include:

- distribution system pipe and appurtenance replacement;
- main break repair;
- unidirectional flushing and hydrant servicing;
- distribution system leak detection; and
- 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 # 15816 EPCOR Water Services and Wastewater Treatment Bylaw. Every year, additional facilities are added to the program. In 2015, 697 facilities were added for a total of 9,560 at the end of the year. In 2014, EPCOR staff inspected 1,148 facilities and issued 13,006 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), met the target of 70% for the year and was up 3% relative to 2014.

The Lead Response Program reduces the potential for exposure to lead in tap water for approximately 3,400 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 Water Treatment Plants, as well as partially treated water and finished drinking water entering the distribution system. In addition, a routine monitoring program ensures water quality throughout the 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. On average, in 2015, 200 samples were collected monthly. 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.

In 2015, the EPCOR Water Laboratory carried out approximately 127,000 tests on 7,800 samples of the treated water that entered the distribution system, water in the distribution system and field reservoirs, as well as raw water that entered the Rossdale and E. L. Smith Water Treatment plants, and partially treated water. EPCOR tested for 192 parameters for Edmonton water. A further 5,500 tests were conducted on 1,230 samples and included another 203 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. Details of all testing and

monitoring done are published in monthly and annual Edmonton Waterworks reports that are posted on EPCOR's public website.

In addition to the laboratory testing, EPCOR also uses numerous on-line 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 on-line 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 2015, operators performed approximately 40,000 and 30,000 tests at the E. L. Smith and Rossdale water treatment plants respectively.

MEETING REGULATORY REQUIREMENTS AND HEALTH CANADA GUIDELINES

In 2015, EPCOR met guidelines for all Canadian Drinking Water Quality health-based limits for radiochemical, chemical and physical parameters. Of the 56,937 applicable water quality tests EWC conducted, only 109 (or 0.19 per cent) did not meet the requirements of EPCOR internal lab quality management system, and of those, only six did not meet Approval to Operate monitoring standards. Each one of these tests were reported to Alberta Environment and Parks and an internal investigation and root cause analysis was completed as per EPCOR's Incident Management Standard.

These six incidents are described as follows:

- Failure to meet Approval to Operate requirements. In May, a sample collected after a distribution system depressurization had a chlorine result less than 0.5 mg/L. Approval requirement is for at least 75% of distribution system samples collected in a particular day to have chlorine levels above 0.5 mg/L. The failure to meet Approval requirements was due to failure to follow the resampling protocol of collecting at least three additional samples from the area within 24 hours of the original low chlorine sample. A single resample was collected within 24 hours which showed chlorine in normal operating range. The communication and resampling protocol was reviewed.
- Failure to follow AEP Communication and Action Protocol for Failed Bacteriological Results in Drinking Water (Action Protocol). In June, a routine distribution system sample was positive for total coliforms. Resamples were not collected within 24 hours as required by the Action Protocol. The delay in collecting resamples was due to new personnel not identifying the urgency of the need to collect resamples. All resamples (collected within 55 hours) were negative for total coliforms and *E. coli*. An accelerated training program was implemented.
- Failure to follow Action Protocol. In July, a sample collected after a distribution system depressurization was total coliform positive. Resamples were not collected and AEP was not notified within 24 hours as required by the Action Protocol. The failure to collect resamples and notify AEP was due to staff not using the standard communication document. All resamples (collected within 48 hours) were negative for total coliforms and *E. coli*. Communication protocol was reviewed with staff.
- Failure to follow Action Protocol. In August, a sample collected in response to a customer complaint was positive for total coliforms. AEP was not notified of the total coliform positive as required by the Action Protocol. The failure to notify AEP was due to lab personnel not following notification protocols. All resamples were negative for total coliforms and *E. coli*. Communication protocol was reviewed with staff.
- Failure to meet Approval to Operate requirements - Sampling and testing of parameters listed in Schedule 4 of the Approval is required between June and August. Only a partial set of the parameters in Schedule 4 were tested for during the specified timeframe. Missing were Cyanide, Total Dissolved Solids, Total Organic Carbon, Metals and Sulphide. These parameters were tested in May and September. Results for May and September samples showed that all health-based guidelines were met. A process to monitor completion of required sampling and testing was implemented to prevent future occurrences.

- Failure to meet Approval to Operate requirements. On a monthly basis, sampling from 4 locations (water entering the distribution system, two locations within the distribution system, furthest from treatment), collected within 24 hours and tested for Haloacetic Acids is required. In August, the locations were sampled within 48 hours instead of the required 24 hours. A process to monitor completion of required sampling and testing was implemented to prevent future occurrences.

Training in a classroom setting focusing on aseptic sampling techniques and selection of appropriate sample points was implemented for all EPCOR staff that collect water samples in 2014. In 2015 there were 10 instances of total coliform positive samples (including the three above). This is in comparison to 15 in 2014 and 13 in 2013. Training will continue for all new employees that collect water samples. The capability of identifying the bacteria using molecular genetics is being developed at the EPCOR Water Laboratory and this will help to better identify the source and appropriate corrective actions for coliform positive tests in the future.

OUR STRINGENT WATER QUALITY STANDARDS

THE WATER QUALITY INDEX

The Water Quality Index measures the number of treated 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 2015, 56,828 out of a total of 56,937 applicable tests on treated water passed EPCOR's internal quality standards.

EPCOR's Water Quality Index score of 99.81 per cent in 2015 was slightly lower than the 2014 score of 99.84 per cent, but still surpassed the target of 99.6 per cent set in EPCOR's Performance Based Regulation (PBR), which is established through a City of Edmonton bylaw. Although an improvement was seen in the number of total coliform positives (10 in 2015 compared to 15 in 2014 and 13 in 2013) there were six incidents which were a result of procedures not being followed or poor communication internally. A more rigorous internal operating and communication procedure and a better system for monitoring completion requirements have been implemented to reduce these preventable incidents.

SPRING RUN-OFF PROGRAM AND THE HOME SNIFFING PROGRAM

Spring run-off 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 starts mid-March to mid-April) results in an increase in the turbidity, colour, taste & odour of the raw water supply drawn from the North Saskatchewan River. Depending on these conditions, EPCOR adjusts its treatment process to remove odour-causing compounds by adding powdered activated carbon. During the winter months our water treatment plants use direct filtration and we must transition back to our conventional treatment mode of operation prior to spring runoff. This allows us to use powdered activated carbon (PAC) used as a taste and odour control measure. In 2015, conversion to conventional treatment was planned for March 16 at the E. L. Smith plant and March 31 for the Rossdale plant. However, unseasonably warm temperatures in early March resulted in runoff conditions even earlier than anticipated (in fact earlier than any time in the last 20 years). Conversion was moved forward to March 10 and runoff conditions arrived before the transition to conventional operation was fully established. Although raw water odours were relatively low at the time, very strong chlorinous odours were observed in the treated water and these odours persisted for a few days after PAC addition had been started. Chlorine added for disinfection may have reacted with non-odorous organic precursor compounds that were present in the raw water and not effectively removed by PAC.

The Home Water Sniffing Program measures the effectiveness of EPCOR's spring run-off water treatment strategy. A panel of EPCOR customer volunteers rate the odour of the treated water from the hot and cold taps in their home. The Home Sniffing Program ran from February 26 to May 29, 2015 and each day between 97 to 150 volunteer sniffers participated. The overall Customer Satisfaction Rating was 93.9%. This met the performance target of 93.8%.

Treatment for spring run-off taste and odour typically focuses on musty and earthy odours. However, chlorinous odours in 2015 had a significant impact on our customer satisfaction. In 2016, conversion to treatment occurred earlier in the year and an initiative to monitor potential precursors to chlorinous odours (organic nitrogen compounds) on a daily basis was implemented. However, data collected in 2016 may not be as illuminating as anticipated. Preliminary evidence indicates that the actual water quality impact of spring runoff in 2016 was very mild. Efforts will continue to improve future spring run-off operational strategies.

PERFORMANCE-BASED RATES 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 Rates 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. The overall score of 108.7 points indicates continuous improvement over the 2012, 2013 and 2014 scores of 106.4, 106.8 and 107.2 points, respectively.

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

Performance Measure	Basis	2015 Target Points[1]	Actual Points Earned[1]
System Reliability Index	water main breaks, repair duration, planned construction, water pressure factor, water loss factor	25.0	31.2
Water Quality Index	number of tests meeting internal standards	25.0	25.1
Customer Service Index	post service audit factor, response time factor, home sniffing factor	20.0	21.3
Environmental Index	emergency response training, completeness of reporting, timeliness of reporting, environment incident reporting, water conservation, watershed protection	15.0	14.6
Safety Index	Safety meetings, formal safe work plans, first aid training, work site inspections/observations, lost time frequency rate, injury frequency rate, injury severity rate	15.0	16.5
Total		100.0	108.7

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

PUBLIC INVOLVEMENT AND CONSULTATION

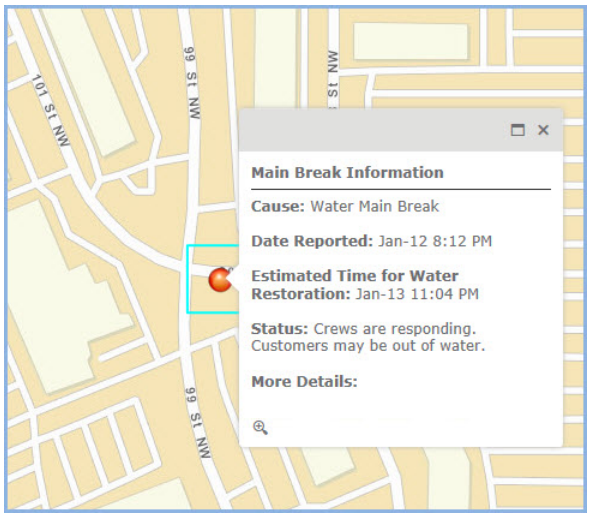
COMMUNICATION

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 league 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 our customer newsletter, broadcast media, news media, EPCOR's 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.

ONLINE OUTAGE MAP

EPCOR added a new online outage map to our website so customers can view outages in near real-time, along with additional information about estimated restoration time. When a work order is created by EPCOR Water's field or dispatch teams, an icon automatically appears on the map. Customers can expand this icon to find information about how our crews are responding and what activity is taking place to restore service; it also helps the public plan their traffic routes accordingly.



Since the tool launched four months ago, the outage pages on our external website have been viewed more than 127,000 times, and EPCOR dispatch has noticed a decrease in call volume. Customers now have up-to-date information when and where they want it most.

CORPORATE ACCOUNTABILITY AND PUBLIC TRANSPARENCY

EPCOR keeps its customers informed about what we are doing 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:

- 2015 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 2014. Two events that were particularly relevant to drinking water treatment included:

- Get Ready in the Park at Hawrelak Park. EPCOR presented an experiment for kids to build their own water filters as EPCOR lab technicians demonstrated the process of water treatment;
- At the Winter & Summer Family Fun Days in the Cameron Heights community we provided water treatment education to event attendees; and
- EPCOR was involved in Highlandia and Gold Bar Events to educate the community on river quality and reinforce what not to flush to protect our river.

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 impacting 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 panel includes representatives for the environment, the City of Edmonton, commercial customers, industrial and residential customers. The members meet quarterly and an annual report of activities is posted on EPCOR's website.

The Water Community Advisory Panel (CAP) reviewed the terms of reference for the group to seek input into EPCOR initiatives and provide information sessions on those initiatives, including:

- overview of drinking water flavour profile analysis;
- overview of EPCORs involvement with the City of Edmonton's Stewarding Great Neighbourhoods initiative;
- outline of 2015 on-street construction; and
- overview of Rossdale's new lab building.

A new Community Advisory Panel was assembled late in 2015 and began meeting in 2016. The new group includes members from the City of Edmonton along with commercial, industrial and residential customers.

INDUSTRY LEADERSHIP

CONSULTATION WITH INDUSTRY EXPERTS – WATER QUALITY ADVISORY COMMITTEE

The Water Quality and Advisory Committee (WQAC) includes representatives from EPCOR, Alberta Health Services (AHS), Alberta Health and Wellness, Alberta Environment and Parks (the water regulator), the University of Alberta, the 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 panel 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 29, 2016 at the Rossdale Water Treatment Plant. The topics discussed included:

- EPCOR 2015 Drinking Water Quality Summary – Trends, Challenges and Focus Areas;
- EPCOR Water Quality Initiatives;
- EPCOR Lead Program - Status Update and Future Direction;
- Drinking Water Emergency Exercise Planning; and
- EPCOR Communications Update.

As a follow-up to the October 2014 "Troubled Waters" Regional Water Contamination Event Exercise, a subcommittee will be set-up in 2016 to develop a 2016-2020 Emergency Exercise plan for the regional water system. The plan will look at various scenarios in which the quality or availability of water is compromised.

WORKING PARTNERSHIPS WITH ALBERTA ENVIRONMENT AND PARKS (AEP)/ADVICE AND SUPPORT TO INDUSTRY

In 2015, EPCOR continued to provide expertise and advice to Provincial Government agencies and the water and wastewater treatment industry in Alberta. Examples include:

- EPCOR continued to participate 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;
- EPCOR continued to participate on the AEP Standards Advisory Panel provided technical feedback and guidance into the development of revised drinking water standards for the Province. The committee completed its work in early 2015 and produced a report for AEP;
- EPCOR continued to participate in the Alberta Drinking Water Laboratory Technical Advisory Committee (ADLTAC) that is providing advice to the government on matters related to drinking water testing and development of new drinking water testing requirements;
- EPCOR hosted a stakeholder consultation meeting with AEP in March on the proposed new drinking water regulations for Alberta and submitted consultation comments to AEP;

- On an international level, EPCOR continued to support Bob Sandford, as the EPCOR Chair for Water and Climate Security at the United Nations University Institute for Water, Environment and Health. Our sponsorship continues moving forward;
- EPCOR staff participated on the Western Canada Section of the American Water Work Association Cross Connection Control Committee and contributed to the AWWA manual *M14 Backflow Prevention and Cross-Connection Control: Recommended Practices, Fourth Edition* that was published in 2015; and
- EPCOR participated in a number of industry consultation sessions held by both the Province of Alberta and the City of Edmonton to provide input into the proposed changes to the Municipal Government Act.

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 EPCOR Water Laboratory has been accredited to ISO/IEC 17025 since 2001 by the Canadian Association for Laboratory Accreditation (CALA). It successfully retained accreditation in October 2015 after CALA completed an assessment as part of the biannual audit cycle.

As part of our commitment to CALA, several EPCOR employees contributed to the CALA program by volunteering as laboratory assessors and were involved in eight assessments of other laboratories in 2015.

A new laboratory facility was built at the Rossdale Water Treatment Plant to help maintain the high level of water testing capabilities for many years to come. That facility opened in August 2015. A plan was put into place to ensure that all required testing and support functions to the water utility continued during the transition between the two labs.

WATERSHED AND SOURCE WATER PROTECTION PROGRAMS

EPCOR's Watershed Protection Program (WPP) 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 2015, 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 2015 include:

- North Saskatchewan Watershed Alliance (NSWA): EPCOR provides both financial and in-kind support to the NSWA. In 2012, the NSWA published the Integrated Watershed Management Plan (IWMP) for the North

Saskatchewan Basin after five years of extensive stakeholder engagement and input. The plan lays out recommendations and an approach to manage the North Saskatchewan River watershed, sustain water resources for the long-term and to meet the three strategic goals of Alberta's Water for Life strategy. The underlying principle of the plan is that no further degradation of water quality should occur and improvements should be made where degradation has occurred, based on Water Quality Objectives proposed for the river. In 2015, EPCOR employees were involved in the IWMP Implementation Committee and the Water Quality and Instream Flow Needs working groups of the NSWA. As well, EPCOR was represented on the Board of Directors of the NSWA and is part of the Headwaters Group;

- Capital Region-Industrial Heartland Water Management Framework (CRIH-WMF): The Government of Alberta led CRIH-WMF continued through 2015 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 (MALs) for each of the parameters of concern which is now under stakeholder review;
- A Regional Plan under the Land Use Framework for the North Saskatchewan River is scheduled to be released in the fall of 2016. In 2014, EPCOR participated in the Phase One consultation workshops for the North Saskatchewan Regional Plan and in 2015, participated on the Environmental Quality Management Framework stakeholder engagement sessions;
- Source Water Protection Plan: A major milestone of 2014 was the completion and publication of EPCOR's updated Source Water Protection Plan (SWPP) 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 2015, continued investigation and mitigation plans of the key risks outlined in the SWPP were developed. Two of the most significant risks (potential source contamination from spills/releases from upstream oil and gas facilities, or from a spill on an upstream bridge) remained action items in the Drinking Water Safety Plan. As such, work is underway to develop a Geographic Response Plan in partnership with AEP; and
- Alberta Water Council (AWC): 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 AWC and, ultimately, AEP. In 2015, EPCOR continued involvement with the development of a statement of opportunities for Source Water Protection Planning and Lake Conservation and Management. As well an EPCOR employee acted as an alternate board member for the AWC Board, representing the Lake Conservation Sector.

2. Implementation

In 2015, EPCOR continued financial support of the Clear Water Landcare Group which implements agricultural Beneficial Management Practices (BMPs) in the North Saskatchewan River basin, such as 'off stream' watering systems and fencing off of streams. EPCOR also supported the Alberta Low Impact Development Partnership (ALIDP) through corporate sponsorship. The goal of ALIDP is to reduce urban land use effects on North Saskatchewan River habitat degradation, water quality and ecological health.

3. Research and Monitoring

In 2015, EPCOR continued an enhanced monitoring program for thirteen select tributaries upstream of Edmonton. As part of an effort to better characterize water quality in the headwaters, Clearwater Land Care took additional samples during storm events as data for high flow events were sparse. As part of this work, a pilot project on Strawberry Creek was initiated 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. In 2015, this work included community watershed workshops in Strawberry Creek where EPCOR presented water quality data and

showed stakeholders how to complete water quality sampling and riparian assessments.

EPCOR also partnered with the Alberta Biodiversity Monitoring Institute to develop an ecosystem services model for the NSR watershed and, in particular, Strawberry Creek.

EPCOR also continued to partner with the City of Edmonton to support their Environmental Monitoring Program (EMP) through assessment of water quality samples and assistance in monitoring plan development. Quarterly monitoring also continued for Pharmaceuticals and Personal Care Products (PPCP) 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 Capital Region - Industrial Heartland Water Management Framework.

Ongoing assessment and refinement of monitoring programs continued through the NSR Water Quality and Aquatic Ecosystem Health Monitoring Group in partnership with the NSWA. This group's goal is to develop an integrated, efficient and effective water quality monitoring program that meets the needs and interests of major stakeholders in the basin. In 2015 the focus of the work was to take the integrated watershed monitoring plan and work with AEMERA (Alberta Environmental Monitoring, Evaluation and Reporting Agency) to implement the program, through a sustainable funding program.

4. Education and Public Awareness

In 2015, EPCOR sponsored the City of Edmonton's River Valley Clean Up Project, participated in the City of Edmonton's River for Life initiative and supported RiverWatch. EPCOR is a long-time sponsor of the City of Edmonton's River Valley Clean Up as funding is specifically targeted towards public education initiatives that keep garbage and debris out of the North Saskatchewan River. EPCOR provides financial support to Alberta RiverWatch, a science education program for secondary students. As a corporate sponsor, EPCOR subsidizes the fees for disadvantaged students so that they can participate in a guided river-study along the North Saskatchewan River. EPCOR staff also served on the Board of Directors for the Alberta Lake Management Society and Red Deer Watershed Alliance (RDWA).

EPCOR employees spoke at the Bow River Basin Council quarterly forum, the RDWA's Public Lake Days forum, the NSWA's Headwaters Meeting, and gave several other conference/workshop presentations on Source Water Protection including one for the Mighty Peace Watershed Alliance. As well, EPCOR gave its sixth annual guest lecture at the University of Alberta to engineering students on watershed and land use management.

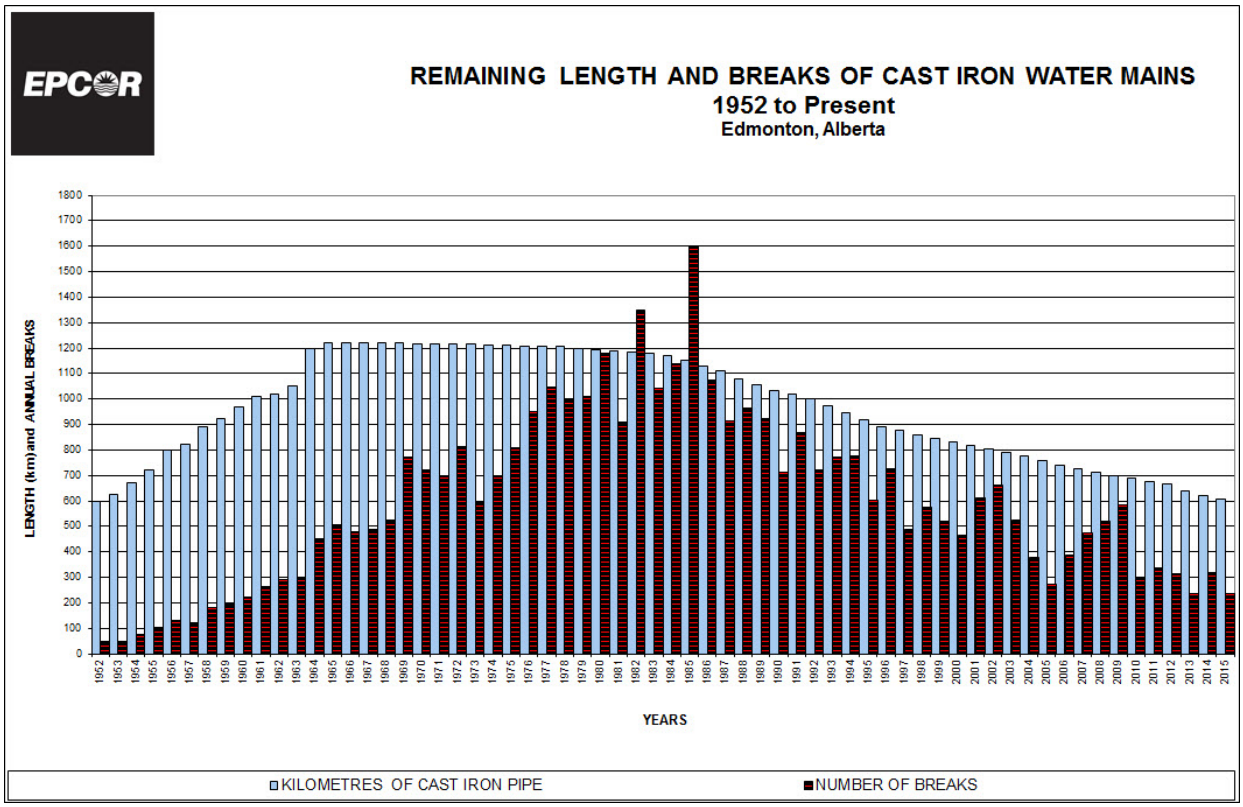
DISTRIBUTION SYSTEM UPGRADES

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 2015, the following water assets were replaced:

Water Asset	
Main Line Valves	321
Hydrants	157

Water Main Replacement

EPCOR has replaced approximately 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 the lowest average number of water main breaks in Edmonton over the most recent five years since 1960 to 1964. In 2015, 14.1 km of water mains were replaced in Edmonton.



1952 to Present, Edmonton, Alberta
Cast Iron Water Mains (km) blue bar, Compared to Number of Breaks (per year) red bar

Water Main Cathodic Protection

Water Asset	Number/Length Replaced
Cast iron distribution Mains	17.4
Steel Transmission Blow-Offs	1.0

Transmission Main Blow-Offs

Historically, it was standard practice to connect transmission mains to the sanitary or combined sewer system to allow draining of the distribution system for maintenance work. In 2007 there were more than 200 of these "blow-off chambers" within the EPCOR system. Since these chambers are a direct connection between the water and sewer systems, they could present a cross connection 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 has committed to remove all High, Medium, and Low Risk chambers in addition to all Negligible Risk chambers connected to the sanitary system by April of 2016. The number and type of blow-offs remaining at the end of 2015 are described below.

Transmission Main Blow-Offs Cross Connections Remaining at the End of 2015

Risk Score	Characteristics	Number of Chambers	
		End of 2007	End of 2015
High	Combined sewer that is in close proximity to a Water Treatment plant and a known surcharge area	**7**	**0**
Medium	Medium Combined sewer that is in close proximity to a Water Treatment plant or a known surcharge area	**34**	**0**
Low	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, or	**96**	**64**
	Total	**221**	**69**

* The 5 remaining low risk cross-connections will not be 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 2015, Edmonton experienced 277 water main breaks as reported in the final 2015 Performance Based Regulation (PBR) progress report to City of Edmonton. Subsequent to the PBR report being published, one main break was removed from the total. This main break occurred on December 29th, but upon excavation it was discovered it was a service repair and not a main break. The 2015 total main breaks were, therefore, 276, down 113 from our 2014 total and continues the generally decreasing trend we have seen over the past 30 years. Most of the main breaks (234) 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 1980's directly reflects the effectiveness of those programs. EPCOR also has a performance target to repair 93.7 per cent of main breaks within 24 hours. In 2015, 97.44 per cent of the 260 breaks affecting water supply to customers were repaired within 24 hours of the water being shut off, exceeding the target of 93.70 per cent.

UNIDIRECTIONAL FLUSHING AND HYDRANT MAINTENANCE

Each year, water mains throughout Edmonton are flushed to remove sediment build-up and biological growth. In 2015, EPCOR continued with the Unidirectional Flushing (UDF) program and flushed 30% of the distribution system. There were 18,938 fire hydrants in the public water system at the end of December 2015. 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 2015, zero hydrants were out of service for more than 90 days and 41 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 78.

EPCOR studied the rate of sediment accumulation as a potential way of further optimizing flushing frequency for each area. We were able to estimate the amount and characterize the type of sediments removed during several UDF runs in cast iron (CI), asbestos cement (AC), and polyvinyl chloride (PVC) areas. The results showed that there was at least 10 times greater mass of removable sediments in CI areas than in areas with mostly AC or PVC pipes. The chlorine residual was almost unaffected in PVC areas, but significantly deteriorated in CI areas. This study supported the proposal to reduce the flushing frequency in areas of 100% PVC pipes and retain the current flushing cycle in other areas.

EPCOR studied the rate of sediment accumulation in the distribution system to further optimize the flushing frequency for each area of the city. The study, which estimates the amount of particles and characterizes the type of sediments removed during UDF, showed that there was at least 10 times greater mass of removable sediments in CI areas than in areas with mostly AC or PVC pipes. This study supported the proposal to reduce the flushing frequency in areas with PVC pipes.

LEAD RESPONSE PROGRAM

Approximately 2% of Edmonton homes (typically built before 1950) use lead as the material for service pipes. A service pipe is the section that connects the home or business with the municipal water main beneath the street or alley. There are two parts 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.

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

- Annual notification (reminders) of residents at all homes and small businesses within the city serviced by lead service pipes;
- Offer of testing for lead concentration in the tap water for those residents;
- Offer to provide point-of-use filters that remove lead for customers in homes and small businesses serviced through lead pipes;
- Prioritized lead service pipe replacement of the EPCOR section; and
- Public education on the issue of lead in tap water.

In 2015, the residents at all homes or small businesses with a known lead service were once again reminded of the program by letter. As well as sampling water from homes with lead service lines, EPCOR is also sampling from some homes with non-lead service pipes (mainly copper) because older building plumbing is also a potential source of lead in tap water.

The table below summarizes the lead testing results from 2008 to 2015 that has been provided for homes with and without lead service pipes.

Lead test results from 2008-2015

	Lead Service Pipes	Other Service Pipes
Number Homes Samples and Tested	**3522**	**376**
% where lead concentration was greater than 0.010 mg/L	30%	8%
% where lead concentration was greater than 0.030 mg/L	5%	0.5%
50th percentile lead concentration (mg/L)	0.0054	0.0004
90th percentile lead concentration (mg/L)	0.023	0.008

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 70% of homes with lead pipes** that were tested. 5% (188 samples) have tested greater than 0.030 mg/L. The lead concentration in the majority (greater than 92.3%) of homes with non-lead service pipe is less than the Health Canada MAC. Residents of all homes and small businesses are encouraged to flush the building plumbing before consuming the water after the water has been stagnant for more than six hours. This can usually be done by running the kitchen faucet for a few minutes.

In 2015 EPCOR conducted a study of 178 addresses spatially distributed across the city using a sampling protocol described as "random daytime sampling". This protocol differs from the Health Canada protocol in that there is no requirement for water stagnation in the pipes before sample collection. The goal of the study was to determine an unbiased estimate of the average lead concentration in the city and will be used to inform future decisions regarding the addition of corrosion control chemicals to the water treatment process. The results of the study are shown in the table below. This study will be continued in 2016 with a goal of sampling from 200 randomly selected addresses

Results of Random Daytime Testing

Type of Service Line Pipe	Lead Concentration (mg/L)		
	Average	90th percentile	Count
Non-lead on both EPCOR and private side	0.0018	0.0045	119 (67%)
Unknown material on either EPCOR or private side	0.0017	0.0034	23 (13%)
Lead pipe present at meter or EPCOR side	0.0067	0.0145	36 (20%)

EPCOR is avoiding partial service pipe replacements, where the EPCOR piece is replaced but the owner's lead piece remains. Studies have shown that partial replacements are not effective for reducing lead at the tap and may even result in a temporary increase in lead concentration. The priority for replacement 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 and expectant mothers).

As the table show below, there have been 1244 lead services removed from service since 2008— 416 were replaced proactively as part of the lead program, 804 were replaced reactively (due to leaks and other emergency repairs, or as part of water main renewal programs) or were otherwise removed from service. There were approximately 3355 Edmonton homes that still had lead service pipes at the end of 2015.

Lead Service Replacements Comparing Customer Driven Replacements to Maintenance Driven Replacements

Year	Customer Driven due to program[1]	Maintenance Driven due to leaks, main renewal, abandoned	Total
2008	25	65	90
2009	39	46	85
2010	114	36	150
2011	26	169	195
2012	63	120	183
2013	34	109	143
2014	31	162	193
2015	84	97	181
Total	416	804	1244

[1]Studies have shown that 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, EPCOR prefers to switch out lead service lines on the public side if the customer is changing out the lead piece on the private side also. This category is called "customer driven" replacements.

In 2016, EPCOR will be implementing a neighborhood approach to lead service line replacement. EPCOR will provide advanced notice of planned activity in specific neighborhoods to residents living in homes with lead services. This will allow opportunity to plan and coordinate lead service line renewal with the property owner. For in-fill developments EPCOR will be requiring that service line piping material must meet current standards.

Lead service pipe replacement is occurring, but the progress is slow and will eventually be limited mainly by customer service line replacement and the rate of infill development. The results of the random day time sample show that, even in homes without lead service lines, lead can be present at the tap in random samples. EPCOR, therefore, will be evaluating the use of phosphate addition to the water at the water treatment plant for corrosion control. The addition of phosphate as a corrosion inhibitor is expected to reduce lead concentration at the tap not only in homes with lead service pipes but also in homes with other sources of lead such as solder and brass. This testing will be carried out in our pilot plant and will take up to two years to complete.

MEMBERSHIP IN INDUSTRY AND RESEARCH ORGANIZATIONS

EPCOR strives to be an active member in 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 2015. 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 focus area 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 research projects:

- An Evaluation of the Value of Structurally Enhanced PVC Pipe;
- Developing Water Use Metrics and Class Characterization for Categories in the CII Sector;
- Identifying and Evaluating Opportunities for Reducing Variability of Utility Revenues;
- Using Next Generation QMRA to Estimate Human Health Risk Posed by Pathogens in Drinking Water; and
- Selecting Methods for Projecting Life Cycle Asset Management Investment Needs.

EPCOR participated in the following research projects as a participating utility, in-kind contributor, or co-funder:

- Securing Value: Integrating Risk Governance with Other Business Functions for the International Water Sector;
- Bench-Scale Evaluation of Alternative Cr(VI) Removal Options for Small Systems;
- Leveraging Data from Non-Destructive Examinations to Help Select Ferrous Water Mains for Renewal;
- Utility Risk Management Methodologies for Buried Assets with Improved Triple Bottom Line Understanding of Pipe Failures;
- Rate Approval Process Communication Strategy and Toolkit;
- Nitrosamine Occurrence Survey;
- Main Breaks: State of the Science and Research Roadmap;
- Residential End Uses of Water, Version 2; and
- Intelligent Distribution Systems Research Agenda Workshop.

EPCOR also continued engagement in various university lead research efforts. These included:

- Providing financial support to 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 ProjectOperational Optimization for the Removal of *Cryptosporidium* Oocyst Surrogates in Drinking Water Direct Filtration Processes: A Multi-Scale Approach; and
- Participation in a site review of the NSERC Senior Industrial Research Chair in Drinking Water Treatment at Polytechnique University in Montreal.

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 Network – Canadian Leadership Group;
- Canadian Association on Water Quality (Board Membership);
- American Waterworks Association;
- American Waterworks Association—Western Canada Section;
- Western Canada Water;
- Canadian Water and Wastewater Association;
- American Public Works Association; and
- 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 2015 included:

- 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;
- direct financial and in-kind support to the North Saskatchewan Watershed Alliance and representation on the board, executive (Treasurer) and technical committees;
- participation on the Bow River Basin Council initiatives; and
- contribution to the development and implementation of the AEP-led Bow River Phosphorous Management Plan.

RESEARCH ON IMPACTS OF CLIMATE CHANGE ON SOURCE WATER

EPCOR supports a number of Canadian research studies that are looking at the impacts of climate change on source water. In 2015 we continued our support of the following research:

"Sustainable Urban Water Management in the Context of Climate Variability and Change"
This University of Regina study led by Dr. Dave Sauchyn was co-funded by EPCOR and the City of Calgary, and major support was provided by Alberta Innovates – Energy and Environment Solutions (AI-EES). This latest two-year study, completed in November 2015, was supported financially and through in-kind support included staff hours and the acquisition of a 2-D hydrodynamic river water quality model for the North Saskatchewan River (NSR). This model will allow EPCOR to build on the findings of this latest study to examine how changes in NSR seasonal flows may impact water quality.

The study completed for both the NSR and Bow River provided historic weekly river flow rates (m3/s) that were calculated for years as far back as 1060 A.D. This latest work expanded upon the earlier tree ring analysis data and 2011 study ("*Past, Recent and Future Hydroclimactic Variability, North Saskatchewan River*") that related tree ring characteristics to river flow monitoring station gauge data. The reconstructed historic weekly river flow rates show the extreme variability in the hydrologic water balance that has occurred in the past one thousand years in Alberta. This is even before any human-induced changes to the climate. EPCOR is considering support of a follow-up study to this latest work that 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.

Next steps for EPCOR include forming a working group to develop a Climate Change Strategy. This strategy would include developing management plans for various multi-year drought scenarios and conversely flood conditions in the NSR basin. Mitigation and adaption approaches will be an important component of these plans to ensure resiliency of the Edmonton Waterworks System in the 21st century. EPCOR has also expressed its support for the proposed *Global Water Futures* (GWF) – a seven-year study that, if funded by the Federal Government, would involve numerous research teams from across Canada and in which EPCOR could serve as a water utility case example. This study would facilitate the development of risk management approaches so communities across Canada could adapt to future expected water resource challenges that will come from a changing climate and hydrologic water balance.

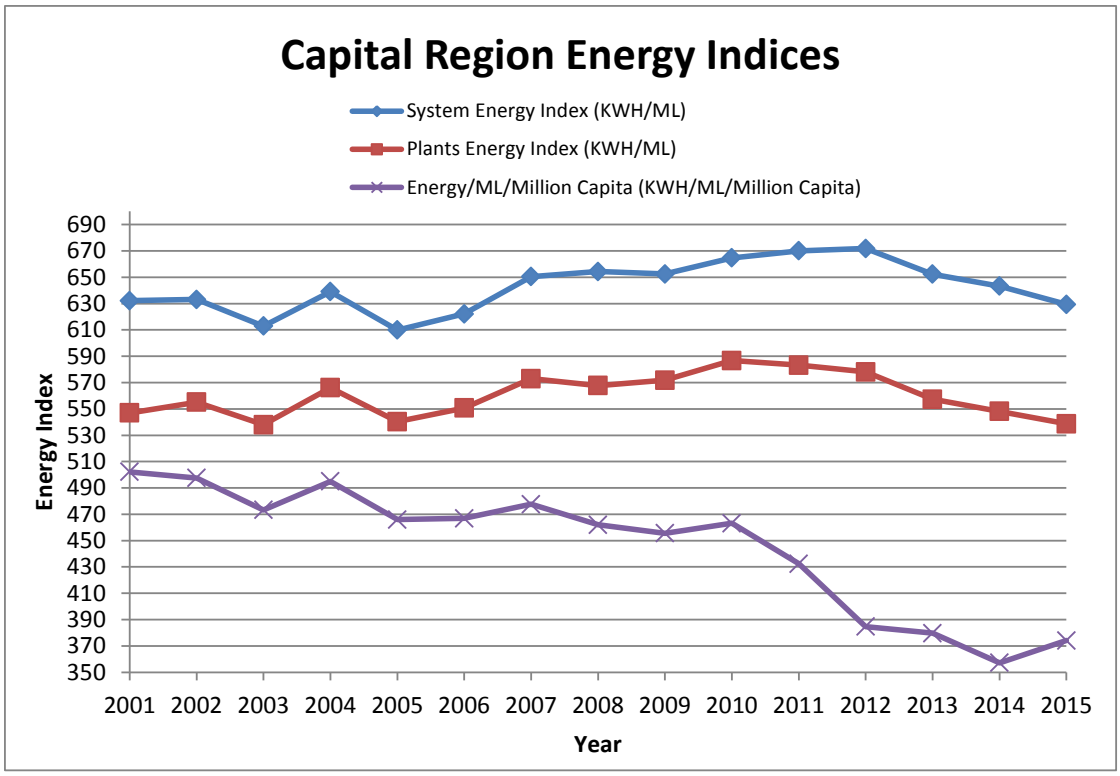
ENERGY EFFICIENCY INITIATIVES

EPCOR's energy efficiency initiatives focus on improving energy related asset efficiency at the water treatment plants, the field reservoirs, and the booster stations. EPCOR not only continues to monitor the water treatment plant energy performance, but also started to monitor the reservoir energy efficiency in three existing pressure zones in 2015.

Energy Indices

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
System Energy Index	685	665	693	653	604	621	626	596	670	669	673	655	651
Rossdale Energy Index	593	587	643	600	491	548	525	459	578	577	586	532	560
EL Smith Energy Index	565	539	551	524	518	507	528	508	546	545	529	545	534
Zone I Reservoirs Index	295	348	339	305	240	234	232	229	250	253	324	474	294
Zone II Reservoirs Index	233	231	231	222	205	219	207	206	211	219	234	235	221
Zone III Reservoirs Index	105	105	103	103	101	109	100	89	99	99	101	102	101

The overall system energy efficiency performance in 2015 exceeded the target and benchmark of 670 by 2.8%. The indices show a consistent downward improvement trend.



Although EPCOR has been successful in continuous energy efficiency improvement over past few years, there are more challenges ahead. The population of the capital region has been growing fast with an annual average population increase of 2.3% over the past 10 years. This trend has been consistent even in the recent economic downturn. In 2015, the total number residential water accounts increased about 3.6% over 2014. However, the new properties are mostly located at the city's edges. More pumping energy is required to overcome the head loses in the water distribution system to reach these new properties. Aging infrastructure also negatively impacts energy efficiency. To meet these challenges, EWSI has implemented a number of energy efficiency initiatives to maximize pumping efficiency and minimize energy loss in the system.

The energy initiatives for 2015 included:

- EWSI conducted a major review and assessment of its assets to prepare the 2017 to 2021 next PBR rate filing period. Energy efficiency improvements have been integrated into the proposed capital programs such as replacing reservoir pumps and valves with higher energy efficiency units earlier than their normal life cycle, upgrading building envelops with better window or window insulation, HVAC upgrades, office lighting improvements with LED lights, etc.; and
- Upgrades to the Millwoods Reservoir pump station to allow for more energy efficient booster mode operation progressed and targeted completion is 2016.

The energy initiatives for 2016 are:

- EPCOR will continue an annual program to upgrade capital assets to improve energy efficiency;
- EPCOR is planning to implement a new energy index KWH/(ML*water residential account) to better reflect the challenges in population growth. This new energy index will be reported to City of Edmonton as public information starting in 2017; and
- Going forward, EPCOR will be exploring options for green energy in the Edmonton water system.

ACTIVE STAFF RECRUITMENT

EPCOR strives to attain a variety of employment achievements in Canada. In 2015 we were named one of Alberta's Top 70 Employers for the 11th year in a row, Canada's top employers for Young People for the fifth year, and the Corporate Knight's Future 40 Responsible Corporate Leaders in Canada list. We have a dedicated Talent Sourcing team that focuses on finding top quality candidates from the external talent pool. We also focus on internal employee development and training 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. EPCOR managers are increasingly involved in succession planning to support employee development to ensure we have a strong pool of talent, now and in the future. EPCOR has been conducting engagement surveys since 2012. In 2012 EPCOR's overall engagement score surpassed other large Canadian organizations that made up the benchmark group. In 2016 EPCOR is planning another company wide full Engagement Survey. All Managers are expected to follow up on survey results by creating action plans in collaboration with employees to continually 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 PROGRAM

EPCOR Water is interested in ensuring a strong water supply remains in place for generations to come. We are looking 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 for us all to consider. EPCOR implements a variety of industry best management efficiency practices which have resulted in significant water efficiency improvements in Edmonton. Some of our 2015 conservation initiatives included:

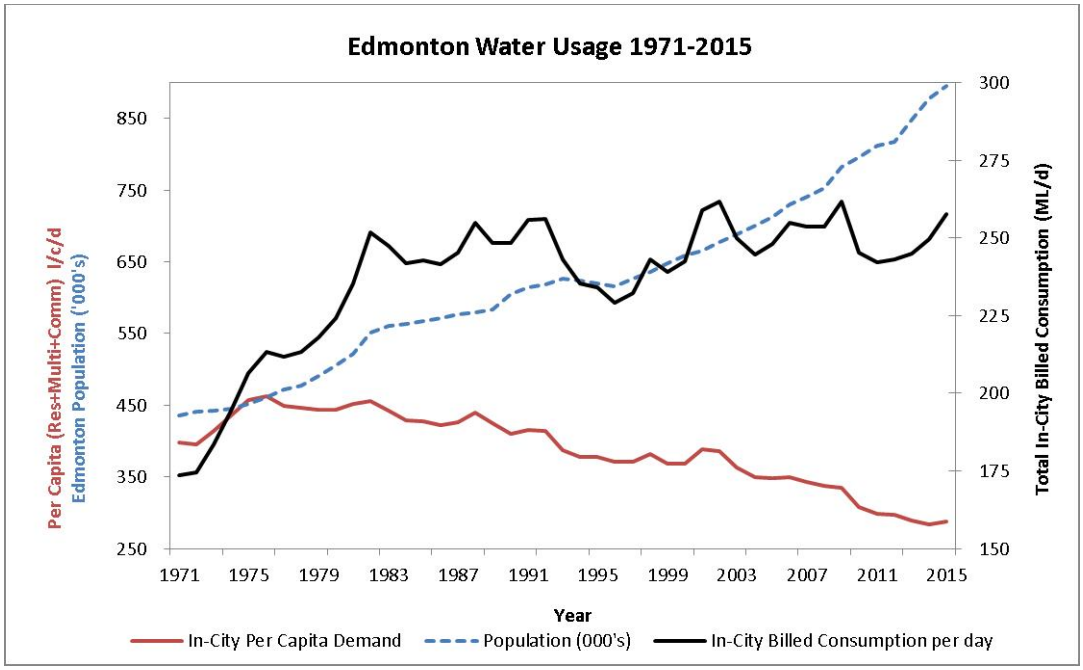
- Partnership between the City of Edmonton, RONA and EPCOR to host a Home$aver Eco sale. This event promotes the use of water and energy efficient products, general education and awareness. EPCOR's participation in this event included sponsorship and promotion of rain barrels for outdoor water conservation and low-flow shower heads for indoor use;
- Partnering with government and business to support water efficiency and conservation programs including: City of Edmonton Environment Week, World Water Day and Canada Water Week;
- Promoting conservation and water efficiency through social media channels and updating efficiency information and tools on EPCOR's website to help customers reduce their water wastage; and
- Promotion of 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 2015, we saw 17,176 interactions with this site at: http://smartkids.epcor.ca
    - Water Quest: A joint project between EPCOR and Alberta Agriculture, Food and Rural Development. Throughout 2015, we saw 2748 Visits and 12,106 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 usage between 1971 and 2015. While population has steadily increased over this period, total water consumption has leveled off (with year-to-year fluctuations) and per capita water use has been on the decline since the late 1970's. In 2015, the total per capita water use was 288 litres per person per day (L/p/d). Residential water use was 199 L/p/d. Due to the hot, drought-like conditions of the summer of 2015, both total and residential per person water use increased slightly over 2014 due to increased outdoor use. However, Edmontonians' continued conversion to high efficiency toilets and clothes washers is projected to decrease per capita water use over the long term.

In comparison, the Alberta Urban Municipality Association (AUMA) has set targets to achieve an average per capita residential water use of 195 L/p/d and a total per capita water use of 341 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 2009, and first achieved the 195 l/p/d 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 1971-2015



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 (IWA) 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 has set an ILI benchmark of < 3.0 as a reasonable goal. The ILI computed for the EPCOR Edmonton waterworks system for the past five years is provided in the following table.

	ILI	EPCOR Benchmark Target
2011	1.47	<3.0
2012	1.29	<3.0
2013	1.27	<3.0
2014	1.46	<3.0
2015	1.18	<3.0

EPCOR's 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.
- EPCOR maintains 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.
- EPCOR has an active customer meter replacement program that 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.
- EPCOR tracks 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.
- Significant effort has been spent in the last couple of years to manage the amount of water used during new water distribution system commissioning in new subdivisions. This has included programs to ensure proper use of pipe lubricants to reduce unnecessary flushing for taste and odor control and implementation of flushing programs in non-contiguous development in the early stages of subdivision construction. As development levels increase to maintain water quality residuals with normal customer consumption levels these flushing programs, which are fully metered and charged to the developer cease.

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 a lot of 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, sometimes, 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 which 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 objective 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.

RESIDUALS MANAGEMENT PROGRAM

EPCOR has a program of continuous improvement in place 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 the net Environmental benefit was 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.

The EPCOR program has emphasized minimizing the loading of solids to the river during the fall and winter season, when river flow and the background suspended solid concentration are lowest and the relative impact of the solids discharged on the river quality is the 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.

REDUCTION OF WATER TREATMENT PLANTS WINTER SOLIDS RESIDUAL PRODUCTION

Since 2009, the EPCOR Rossdale and E. L. Smith Water Treatment Plants have converted to the 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 original plan was to operate in direct filtration mode during the months of November through 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).

While direct filtration operation has been successful in terms of maintaining excellent treated water quality and substantially reducing residuals discharged to the river, there have been some operational challenges. After seven seasons of direct filtration operation, EPCOR has learned that the key variable in determining operational success is the color in the raw water. During the first two seasons (2009-2010, 2010-2011) the colour was relatively low and stable. However, in subsequent years (2010-2013), the color was higher and more variable. This trend of higher colour,

especially in the fall, has continued in subsequent years (2014-15). EPCOR determined that direct filtration can be operated successfully under the higher and more variable raw water colour conditions with appropriate alum dosing and by using all of the clarifiers at the plant for treatment. Unfortunately, direct filtration operation conflicted with the proposed design of the on-site solids treatment facilities wherein some of the unused clarifiers would have been used to thicken solids prior to removal and disposal.

With approval from AEP (Sept 2013), EPCOR modified its residual reduction plan to focus on extending the operation of direct filtration into the fall (September to October) and spring season (March), when the water quality of the river is often amenable to direct filtration treatment. In addition, EPCOR has been further reducing residuals production by optimizing and reducing alum and powdered activated carbon treatment in conventional mode operation during other times of the year.

The table below summarizes the actual solids discharged to the river from the two water treatment plants by application of this strategy over the last four years (2012-2015). In a given year, the actual solid loading to the river depends on the raw water conditions for that year and will, therefore, vary. To determine the effectiveness of the solids reduction strategy against this background variation, EPCOR compares the actual solids discharged from the two treatment plants to the amount that would have been discharged using the 2005-2010 conventional treatment strategy.

For example, in 2015 the actual amount of solids residual produced and discharged was 470 tonnes during the winter Direct Filtration period (Jan-Feb, Nov-Dec). If the plant had been operated in conventional mode with the same raw water conditions, 825 tonnes of residual solid would have been produced and discharged. Direct filtration operation, therefore, achieved a 43 per cent reduction in solids reduced and discharged during this period. During the extended direct filtration operation period of late winter (March) and fall (Sept-Oct), 654 tonnes were discharged compared to 936 tonnes that would have been discharged by conventional operation (a 30 per cent decrease during this period).

Solid residuals discharged to the river from the Edmonton Water Treatment plants for the last four years (tonnes)

Operating Mode	Season	2012			2013		
		Baseline+	Actual	Decrease	Baseline+	Actual	Decrease
DF	Jan-Feb Nov-Dec	1,070	489	55%	1,060	523	51%
Extended DF*	Mar Sep-Oct	898	394	44%	935	586	37%
Chemical Optimization	Apr-Aug	16,600	15,430	7%	18,950	17,840	6%
Total	Jan-Dec	18,600	16,423	12%	20,940	18,940	10%

Operating Mode	Season	2014			2015		
		Baseline+	Actual	Decrease	Baseline+	Actual	Decrease
DF	Jan-Feb Nov-Dec	1,170	581	50%	825	470	43%
Extended DF*	Mar Sep-Oct	936	654	30%	Conventional Mode Operation		
Chemical Optimization	Apr-Aug	10,190	9,190	10%	3,690	3,780	-3%
Total	Jan-Dec	12,290	10,420	15%	4,500	4,240	6%

** Direct Filtration*
+ Baseline load is calculated using 2005-2010 conventional treatment strategy and actual raw water conditions in 2012, 2013, 2014 and 2015

The reduction in solids discharged over the entire year has varied from year to year but has been modest (6 % to 15%). The reductions in the winter and fall seasons, when the flow and background solids loading in the river is lower, and the relative environmental impact larger, have been far more significant. During the winter season, under ice cover (Nov-Feb), reductions in loading ranging from 43% to 55% have been achieved. Reductions in the extended direct filtration period (Mar, Sept-Oct) have varied from none in 2015 to 44% in 2012.

The overall performance of direction filtration is variable and highly dependent on water quality conditions in the river in the fall and winter seasons. The extended direct filtration season was shorter in 2013 and 2014 due to poorer raw water quality conditions, late summer water demand and challenges with plant equipment (2014). This resulted in lower decreases in 2013 and 2014 relative to 2012. In 2015, higher river pH in the fall made direct filtration operation very difficult and the water treatment plants were not able to run in full direction filtration mode until November. Also, spring run-off in the river started relatively early in 2015 and it was not possible to operate in direct filtration in March. As a result, there was essentially no extended direct filtration season in 2015. During the chemical optimization period (Apr–Aug), the amount of solids discharged was actually greater then baseline condition. Despite all this, the actual amount of solids discharged to the river in 2015 was by far the lowest of the four years at 4,240 tonnes. This largely reflects the natural conditions in the river during the year where the turbidity was unusually low.

ENVIRONMENTAL MONITORING

In addition to reducing the solids loading to the river, EPCOR has also been investigating the environmental impact of the solids that are discharged to the river.

- In 2013 EPCOR began a program of river water sampling and testing to determine the extent of impact of solids discharges on the river immediately downstream of the discharge points. This sampling program continued through 2014 and 2015. In 2013 and 2014, this work involved collecting grab samples from the river or making measurements using hand-held probes from a boat during discharge events. In 2015, this work continued, but a datasonde was deployed directly in the river downstream of the discharge points to gather additional information. The datasonde is a device that allows essentially continuous in-stream monitoring of key water quality parameters like pH and turbidity.

- So far, the results indicate that suspended solids, pH and total aluminum concentration increase within the near-field mixing zone in the immediate vicinity of the discharge points but return to normal levels within 2000 m downstream. The exception is dissolved aluminum where limited data has shown increased levels at the discharge point that still persist 2000 m downstream.

Since 2010, EPCOR has been submitting quarterly composite samples of the solids discharges to a third party laboratory for determination of acute lethality using the 96 hour rainbow trout assay. None of the samples submitted have indicated acute toxicity to fish.

EPCOR will continue this monitoring program based on grab samples and datasonde information in 2016. The program will be expanded to include:

- Development of a computer model to analyze the impact of total suspended solids and pH during discharges; and
- Development of a monitoring program to assess the impact of the discharges on the benthic community (the benthic community are the organism live on the bottom of the river).

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 these parameters remain well within health-based guideline levels or approval limits. As in earlier years, direct filtration operation in 2015 correlated with an increase in the number of detects of very low levels of *Cryptosporidium* oocysts in the treated drinking water at the Rossdale and E. L. Smith water treatment plants. *Cryptosporidium* oocysts were detected in three weekly samples (one from the Rossdale plant and one from the E. L. Smith plant) during fall direct filtration operation. Using Quantitative Microbial Risk Analysis, the risk associated with this 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.

CONTINUOUS IMPROVEMENT INITIATIVES

In the spirit of continuous improvement, 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 2015 these included:

- Zeta Potential: EPCOR has investigated the use of Zeta Potential (ZP) potential measurements as a way of better understanding and optimizing direct filtration operation. ZP is a measure of the charge on the surface of very small particles in water. In 2015, we used a ZP analyzer to measure particle surface charge at various points in the water treatment process. We have found that ZP potential is closely related to filtration polymer dose and this provides some insights into using filter polymer dose to improve direct filtration operation;
- 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 involves a combination of laboratory bench experiments and pilot-plant challenge experiments. The objective is to determine the mechanisms and variables affecting oocyst removal during filter operation. This will lead to strategies to further optimize oocyst removal during direct filtration. The project continued in 2015 and received funding from the Natural Sciences and Engineering Research Council of Canada (NSERC) for two years. In 2015, we were able to complete preliminary pilot plant experiments using glycopolymer-

coated microspheres as surrogates for *Cryptosporidium* oocysts to assess the effect of filter polymer dose and filtration on the effectiveness of direct filtration. These experiments will continue in 2016;

- Raw Water pH Adjustment: One of the challenges with direct filtration in the early fall months is the naturally high pH of the river water. In September and October, raw water pH is around 8.5 which is higher than optimal for direction filtration. In 2015, a trial to test the effect of lowering pH by addition of sulfuric acid to the raw water was carried out at the E. L. Smith water treatment plant. Although there were technical challenges with the trial, the results were sufficiently promising to plan further trials in 2016; and
- Using Deep Bed Filters: In 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 2015, a proposal for a capital project to convert 12 of 18 filters at the E. L. Smith plant to direct filtration mode was developed. The proposal will be submitted to City of Edmonton in 2016 for approval as part of the 2017-2021 Performance Based Regulation rate application.

THE IMPORTANCE OF DECHLORINATION

Drinking water contains residual chlorine, 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. This includes routine discharges of chlorinated water from the E. L. Smith and Rossdale Water Treatment Plants arising from filter backwashes, filter-to-waste, release of other water that does not meet drinking water specifications, and less frequent discharges of chlorinated water arising from activities at field reservoirs and in the water distribution system.

DECHLORINATION AT THE WATER TREATMENT PLANTS AND FIELD RESERVOIRS

Bisulfite dechlorination systems have been in place and operating the E. L. Smith and Rossdale drinking water treatment plants 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 2015, these systems and procedures functioned properly and there were no releases of chlorinated water to the river due to failure of these systems or procedures.

There was one reportable incident at the E. L Smith water treatment plant when chlorine was detected in the water released from one of the clarifiers. Normally, the water in the clarifier does not contain any chlorine, but 0.2 ppm chlorine was measured in a sample of clarifier blowdown during a routine fish toxicity test. An investigation showed that the presence of chlorine was due to a leaking valve on a cross connection between the clarifier blowdown line and a chlorinated service water. As a follow-up, EPCOR is carrying out a survey to identify all potential cross connections between chlorinated water and non-chlorinated wastewater streams at each of the treatment plants.

DECHLORINATION OF WATER RELEASED TO THE ENVIRONMENT IN THE DISTRIBUTION SYSTEM

EPCOR has procedures in place to dechlorinate all drinking water released into the environment. This includes both planned releases (i.e. flushing and draining of pipes for maintenance) and unplanned releases (i.e. water main breaks and other emergency events). While it may be difficult to ensure 100 per cent dechlorination of all releases (especially

those that occur due to unplanned events like main breaks), the procedures will ensure the majority of the water released from the distribution system is dechlorinated and that potential environmental impacts are mitigated.

In 2015, there were two releases of chlorinated water from the distribution to water courses reported during the year. Both were investigated and corrective actions put into place to prevent reoccurrence. These were:

- An EPCOR contractor left drinking water running from a hose overnight to prevent freezing. The hose was discharging to a catch basin that contained bisulfite pucks for dechlorination, but the hose accidently moved during the night resulting in a release of chlorinated water chlorine to a combined sewer. The contractor revised their dechlorination procedures to better secure hoses.
- About 300 m^3 chlorinated drinking water was released to Wedgewood creek when a contractor doing work in the area damaged an old, unused service line and valve. A new procedure to properly identify and abandon these old service lines was developed.

EPCOR is committed to eliminating these kinds of occurrences through root cause investigations and implementation of corrective actions.

LOOKING FORWARD

EPCOR will continue to work to maintain its EnviroVista Champion status through various programs and initiatives in 2016. We will strive to pursue and make progress on each of our Stewardship agreements. Going forward, EPCOR will:

- Work to **maintain the newly acquired ISO14001 status** for the Environmental Management System in the Water treatment Plants and **expand the registration to include the Water Distribution and Transmission system** by end of 2016. This will meet the Champion commitment to work towards ISO14001 across the Edmonton drinking water system;
- Implement the action plans for the priority risks identified in the **Drinking Water Safety Plan;**
- Begin to develop a **Geographical Response Plan with Alberta Environment and Parks** to address the risk of spill in the North Saskatchewan River upstream of Edmonton;
- Continue reactive and accelerated **cast-iron main renewal** programs in 2016;
- Continue the Lead Service Line Program **lead service line replacements** in 2016 with a focus on a neighborhood replacement program;
- Refocus EPCOR's conservation platform on **identifying and addressing inefficient water use** in different high use customer classes or groups;
- Complete a program of research carried out by the Prairie Adaptive Research Council, and co-funded by City of Calgary and Alberta Innovates, to better **understand the impacts of climate and climate change on the water supply**. Communicate the results of the research to other stakeholders such as Alberta Environment and Parks and the City of Edmonton;
- Pursue a program of continuous improvement to **reduce the amount of water treatment solids released to the North Saskatchewan River**. This will include phase two of a study of raw water pH adjustment and pursuit of approval for a capital project to convert to deep bed filtration at the E. L. Smith water treatment plant. Both these initiatives will facilitate and potentially **extend direct filtration operation**;
- Continue to **examine the environmental impact of solid residuals** discharged to the river through a program of in-stream water quality sampling and testing;
- Continue to partner with University of Alberta on a research program to **better understand and control low levels of breakthrough of *Cryptosporidium* oocysts** during direct filtration;
- Ensure the Water Treatment Plants meet the goal of **full dechlorination of 100 per cent of all water released to the river** in 2016 with no contraventions of the approval requirements;
- Complete a **drain audit at the water treatment plants and reservoirs** to identify any cross connections that might result in environmental releases to the river or creeks;
- Continue to participate in **Alberta Environment and Park's 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;
- Explore **green energy options** for the Edmonton water system; and
- Propose a **comprehensive and multiyear water quality monitoring program** for the North Saskatchewan River that will help ensure a reliable source water supply for the long term.

EPCOR'S ENVIROVISTA CHAMPION STEWARDSHIP COMMITMENTS

1. **EPCOR will maintain a robust Environmental Management System (EMS) that will include an environmental policy, required and voluntary undertakings, objectives and targets, roles and responsibilities, operational control, corrective actions, training, decision making/planning, document control and continuous evaluation and improvement. EPCOR will strive towards achieving and maintaining ISO14001 certification of the EMS;**
2. **EPCOR will strive toward continuous improvement in its Environmental Activities and will set and regularly review environmental goals and targets. EPCOR will identify and proactively address emerging issues in the water treatment industry and will work towards implementation of industry best practices;**
3. **EPCOR will use a source-to-tap, multi-barrier approach to provide a consistent supply of potable public water that ensures protection of public health to both the City of Edmonton and Regional customers. The treated water will meet or exceed all current Guidelines for Canadian Drinking Water Quality (GCDWQ) and other regulatory requirements. In addition:**

    a. EPCOR will set and strive to meet its own internal water quality and plant treatment performance standards that exceed the minimum regulatory requirements;
    b. EPCOR will monitor for all GCDWQ guideline parameters and will also carry out additional monitoring programs for unregulated parameters (including pesticides, pharmaceuticals, and disinfection byproducts) in both source water and treated drinking water in order to better understand and mitigate both current and emerging public health risks; and
    c. EPCOR will strive to meet index targets (as updated) set in EPCOR's Performance Based Regulation, which is established through a City of Edmonton bylaw:
        i. System Reliability index;
        ii. Water Quality Index;
        iii. Customer Service Index;
        iv. Environmental Index;
        v. Safety Index; and
        vi. Any others as required or updated.

4. **EPCOR will develop and document, by January 1, 2013, an operations program for its drinking water treatment and distribution system and will review and update the operations program on an annual basis.**
5. **With respect to public involvement and consultation, EPCOR will:**

    a. Continue with open communication with customers by means of website postings, open houses and/or mail outs;
    b. Prepare and make public an annual EPCOR performance report with respect to progress toward and achievement of EnviroVista Commitments;
    c. Maintain a Community Advisory Panel that strives for representation from multiple sectors including commercial/industrial, environmental, governmental, and the community;
    d. Maintain a Water Quality Advisory Committee that consists of representatives from Alberta Environment and other representatives from Government of Alberta, University of Alberta, Alberta Provincial Laboratory, the City of Edmonton Emergency Response and the Regional Customer Group and other stakeholder groups as amended and required; and
    e. Maintain working partnerships with Alberta Environment and other stakeholders and will provide advice and support on water supply, quality and treatment issues in the Edmonton region and throughout Alberta.

6. **With respect to industry leadership, EPCOR will:**

    a. maintain accreditation to ISO/ANSI 17025 in its Quality Assurance Laboratories;
    b. Actively participate in the North Saskatchewan Watershed Alliance W PAC to enhance watershed and drinking water source protection, and will maintain and implement an EPCOR Source Water Protection Plan;
    c. Maintain distribution system pipe and appurtenance (valves, hydrants, blow-offs, etc.) replacement programs to minimize customer impacts from aging infrastructure;
    d. Maintain a main break repair program which provides rapid response for isolation and repair of main breaks (with better than 90% of breaks repaired within 24 hours);
    e. Maintain an annual unidirectional flushing and hydrant servicing program;
    f. Maintain a Lead Response Program to provide protection for customers from exposure to high lead concentrations at the tap arising from lead service lines;
    g. Maintain active membership in industry and research organizations including American Waterworks Association, the Water Research Foundation and Canadian Water and Wastewater Association and will participate in water industry research projects as contributors, lead researches, and reviewers;
    h. Actively participate in Water for Life and other Alberta Environment initiatives as invited;
    i. Support a program of research on the potential impacts of climate change on source water quantity and quality and treated water supply;
    j. Continue to examine the energy efficiency of its operations and will continuously evaluate capital and operational improvements to increase energy efficiency;
    k. Partner with the City of Edmonton to support and promote a water conservation program;
    l. Maintain active staff recruitment, training, engagement and succession planning programs; and
    m. Share the results of the above initiatives with Alberta Environment.

7. **With respect to reducing environmental impacts, EPCOR will:**

    a. Strive to reduce the impact of water treatment plant residual streams released to the North Saskatchewan River through a long-term residuals management program of continuous improvement that will include (as updated):
        - Reduction of water treatment plants winter solid residuals production by converting to direct filtration mode of operation during winter months (Nov-Feb) while maintaining treated water quality;
        - Diversion of water treatment plants winter solids residuals to sanitary sewer, landfill or other solids disposal options; and
        - Exploration of opportunities to further reduce solids loading to the river and expanding water plants residual solids management to other seasons.
    b. Eliminate all chlorinated discharges to surface water bodies by:
        - Operating treatment systems to dechlorinate all chlorinated waste streams generated at both water treatment plants; and
        - Implementing procedures to dechlorinate discharges of chlorinated water released from the distribution system during system flushing, reservoir draining, commissioning of new water lines and as a result of main breaks (after measures have been taken to isolate the break).