

## Background of Completed Project

In response to the 2016 Fort McMurray Wildfire, the Regional Municipality of Wood Buffalo (RMWB) engaged Stantec to assist in the expeditious recovery of the storm water drainage and wastewater collection and treatment systems in Fort McMurray and in the other communities throughout the Municipality. Because of the nature of the emergency and the terms of engagement, the project scope and specific work activities were developed as the engineering teams were mobilizing, and continued to develop after work on the project had been initiated.

On Tuesday May 3, 2016, the RMWB declared a state of emergency and evacuated Fort McMurray and surrounding areas. At this time and in the days that followed, the RMWB and provincial first responders fought the fire that was destroying neighborhoods and threatening municipal infrastructure.

On Sunday May 8, 2016, Stantec was asked by the RMWB to mobilize forces to Fort McMurray. Our role was to support RMWB municipal forces in their efforts to protect and stabilize the infrastructure systems and to ensure the safe re-entry of the RMWB population at the

earliest opportunity. While we had this charter to guide our actions, information was scarce, and the condition of the infrastructure, and more importantly the people on site, was unclear.

### Charter

The project charter was as follows:

*Develop and recommend a recovery plan for the RMWB's waste water treatment and waste water and storm water conveyance systems. When endorsed, the plan will be executed to restore the systems to proper functional conditions and to mitigate future negative impacts to infrastructure and the environment that may result from damage sustained to the systems and/or the environment during the fire event.*

The plan was to include specific actions necessary to complete the recovery and return the systems to a state of normalcy.

## Innovation, Technical Excellence and Advancement of Technology

### Triage

Early on, the Stantec team took an inventory of the storm water and sewage collection system assets, and began the task of assessing the condition of all the assets with respect to their serviceability.

The population of Fort McMurray was completely evacuated with the exception of emergency services first responders, and a few key municipal employees who were operating and maintaining critical municipal infrastructure including the sanitary and storm sewer systems.

### LIFT STATIONS

It was noted during the system assessment that the lift stations in Fort McMurray were generally in operational condition. Stantec personnel visited each lift station and conducted a visual inspection of pump function, building condition, and controls and electrical equipment condition, among many other facility properties. This information was logged as the inspections were conducted and each lift station given a status of: Serviceable | Needs Attention | Non-functional.

Required repairs were logged and prioritized and repairs were scheduled daily. The repairs included items like: reconnect natural gas service, reconnect utility power service, fill backup generator fuel tank, and clean ash and dust out of the electrical and control equipment.

In some cases, there were extremely high flows of water entering the lift stations. It was concluded that the source of the water was from water service connections of the homes destroyed by the fire, where water service piping melted, and water filled up the basements and drained through the basement sewer drains and into the sewage collection system. In most cases, the lift stations were able to keep up with the flows, however there were some wet wells that flooded because of the extreme flows.

As a result of the wet well flooding, repairs to gas detection equipment, lights and HVAC ducts was required.



Generally, the RMWB's lift stations performed well under extreme conditions and survived despite being in very close proximity to other structures destroyed by the fire. Observations of the cause of failures, and the subsequent repair of the failures, will affect design recommendations of many Stantec designers, particularly for RMWB projects, in many ways, including:

1. Preferring diesel over natural gas backup power generators
2. Specifying non-flammable building exterior materials
3. Providing filters for electrical equipment
4. Minimizing electrical gear in lift station wet wells

In addition to the main threat of fire itself, the forcemains downstream of the lift stations were sensitive to the collection of silt and debris generated by the fire, and if compromised, the consequences would be significant. This risk resulted in a program where the facility operators pumped the wet wells as low as possible by manually operating the pumps so that the benching could be observed and if there was any significant accumulation of silt, it could be extricated by hydrovac truck as required.

#### GRAVITY SEWER SYSTEM

Members of the Stantec team reviewed the operation of strategic manholes throughout the municipality. The objective of these observations was to identify points where sediment and debris was building up and had the potential to degrade the gravity sewer main performance. Extraneous flows were also noted and

information was provided to the consultant working on the restoration of the water system to help them pin point the sources of the damaged water services.

The photos and notes of the observations were georeferenced so that the remediation of deficiencies could be determined, and addressed according to priority. The focus of the observations was in the fire damaged areas and the downstream sewers. Sewage pipe siphons and siphons headwork were identified as points of risk and it would be catastrophic if a sewage siphon were compromised. An action plan was prepared and action taken to protect the siphons under the Athabasca River and in other key locations.

As soon as the magnitude of the fire was apparent, and even before the scope of the recovery efforts was defined, Stantec forces began planning and gathering resources that would assist Fort McMurray in their recover efforts so we could hit the ground running. One key document was the "2011 Wisdom Gained" report published by the Town of Slave Lake as an outcome of their Wildfire Emergency. Silt, toxins and debris entering the sewage collection system were noted as major costly issues for the Town of Slave Lake to deal with in the aftermath of their event. Given this important lesson from the past, it was deemed advantageous to protect the sewage collection system against the entry of silt, toxins and debris. This led to the sewage service connection "Cut and Cap" initiative, the program for monitoring and cleaning the siphon headworks vaults, and the sewer main plug initiative, among other infrastructure protection plans.

## ANZAC WASTEWATER TREATMENT PLAN

Stantec forces conducted the first inspections of the Anzac Wastewater Treatment Plant after the fire. The immediate observation was that the facility had sustained significant structural damage during the fire. During the assessment, it was noted that the power to the facility was on, and there were chemicals stored on site. Action was taken for the utility to shut off power to the site and for hazardous materials forces to remove the chemicals. With the destruction of the HVAC equipment and compromised condition of the roof, the facility was in-operable, and the existing Anzac wastewater lagoons were prepared for long term usage.

## Biomass Transplant & Treatment Plant Recovery

While high water flows through the wastewater collection system helped mitigate system plugging, the high flows with minimal nutrient loading was nearly catastrophic for the Biological Nutrient Removal (BNR) process at the Wastewater Treatment Plant (WWTP). The microbiological organism biomass at the WWTP was beginning to starve, which, left alone would result in wastewater discharges into the Athabasca River exceeding regulated toxicity limits.

Rather than evacuate with the rest of Fort McMurray, key RMWB wastewater treatment plant staff stayed behind to keep the facility operating. Their efforts were effective and as such when Stantec arrived, the plant was functional from a mechanical perspective, but the health of the microbiological biomass was in peril. To mitigate the speed of biomass loss, all but 1 plant bioreactor were taken offline so that the little bit of organic material entering the plant could sustain some biomass for longer. Then, as repopulation of Fort



McMurray neared, an innovative biomass transplant using Thickened Waste Activated Sludge from the Red Deer WWTP, 700km away, was carried out in two events. The biologically active material was trucked from Red Deer and deposited into the Fort McMurray WWTP just upstream of the bioreactor. Five days after the second transplant, there was a sudden noticeable improvement in the plant biology, which ensured a return to normal WWTP operations without exceedance of regulated toxicity limits in the plant discharges.

## Erosion Prevention & Protection of Watercourses

In assessing the existing RMWB storm water drainage infrastructure, it was noted that significant debris was collected in the storm sewer system, particularly in areas where buildings were lost due to the fire. It was also noted that remediation was required at several locations, especially where significant vegetation was lost for fire break construction. Left unattended, these areas will lead to significant erosion and potential further infrastructure damage. As such, an inventory was made of the storm drainage infrastructure damage in the fire break zones, and captured in a GIS database. Manhole lids were broken, frame and covers were displaced and covers were removed. This was a significant public safety concern for the team and an action plan was prepared to have the covers repaired and replaced immediately. The contractors who were actively working in the Municipality during the evacuation period were very responsive and there was exceptional collaboration during this period.







The fire resulted in ash, debris, and burnt cars littering the streets of the fire destroyed neighborhoods., which presented a risk of toxic materials entering the drainage system and downstream watercourses. To mitigate this risk, silt socks and erosion barriers were installed on all the catch basins in and adjacent to the fire destroyed neighborhoods. Each catch basin was then photographed and tagged in the GIS system to ensure all catch basins were addressed and checked regularly, and particularly after rain events, to ensure

collected debris was cleared before any flooding could result.

GIS technology was again employed as part of the water system flushing program. As the RMWB flushed its water distribution mains, the entry point of the water into the storm sewer system was tracked, and the resulting discharge for downstream storm sewer outfalls was also tracked and sampled to confirm if toxic substances had entered the storm sewer or receiving watercourses.

## Project Delivery

### Stakeholder Management

The stakeholder list for the emergency response was extensive and evolved as operations changed from assessment to recovery to repopulation of the community. To keep the many stakeholders informed, daily reports were generated and provided information to key stakeholders in Regional Emergency Operations Center (REOC), RMWB Underground Services (UGS), the Wastewater Treatment Plant

(WWTP), and AEP. This timely, accurate and relevant information was important because of all the concurrent activities that were being coordinated through the emergency response centre.

As the stakeholder requirements and constraints evolved, so did the recovery plan, and work initiatives were adjusted accordingly. The following is a list of some of the stakeholders with whom regular communication took place:

REOC (Regional Emergency Operation Center)	POC (Provincial Operation Center)	Regulatory and Emergency Services Stakeholders
RCMP	RMWB Fire Department	Provincial Disaster Recovery
Alberta Environment and Parks	Fisheries and Oceans Canada	Alberta Health Services
RMWB Administration	RMWB WTP and WWTP Operations	Stantec Consulting Ltd. team

## Communications

Efficient communication within the response team was also of paramount importance in order to clearly communicate instructions, technical information, expectations, response time, risks, safety, and deliverables among other important requirements.

This effective communication was achieved through several means:

1. On the ground representatives who communicated between the RMWB decision makers, and the internal subject matter experts and implementation teams.
2. Daily meetings with representatives from the various department leads who each presented situation reports on their tasks and other relevant information.

One of the exciting parts of the project was how the Stantec team understood the emergency response project paradigm. Nearly everyone who contributed to the project understood that any request for action pertaining the project was to be treated with the utmost urgency. Normal business hours were extended and the team went above and beyond to complete their assignments. There are provisions in the OH&S code that permit workers to work up to 14 hours per day providing specific provisions for health and safety are in place. The Stantec team implemented these protocols so that the team could put in the additional effort warranted by the situation.

## Scope Definition

One of the first actions taken by the response team was to identify all the components of the RMWB's storm and sewage collection and treatment systems. It is a bit unusual to consider an entire sewage collection system in one assignment. Having experts who regularly complete master planning for municipalities including team members who worked on the RMWB master plan and who have been working for up to ten years in the RMWB completing capital improvement projects definitely enabled the team to be immediately effective.

### Sewage Collection System Components

Private service connections	Gravity sewage pipe siphons
Forcemain piping	Gravity sewage piping
Wastewater Plant	Sewage lift stations

### Storm Water Collection System Components

Private service connections	Storm water collection piping
Roads	Storm water ponds (wet and dry)
Catch basins	Outfalls to water bodies

The ongoing reliable operation of each of these system components were put at risk as a result of the extensive fire damage. The team assessed the damage or risk for each of these systems, cataloged the issues, prioritized actions and planned remediation or mitigation provisions and presented these documents to the RMWB for action or otherwise.

## HSE Management

Our worker safety was paramount and as such, we had our internal HSE professionals engaged to ensure appropriate hazard assessments and risk mitigation procedures were in place and the field team was well prepared to take action accordingly.

Beds were at a premium, and some of our workers were temporarily housed in offices within the Underground Services shop. Our HSE team was careful to have fatigue management protocols in place to ensure fatigue did not have a negative effect on the safe execution of work. We also implemented journey management plans and cell phone tracking of all personnel in the RMWB to ensure that nobody was lost or alone and out of contact during the emergency.

Air quality was a major issue for the first three weeks of the project. Most employees wore their half mask air filters anytime they were outdoors, and regularly when they were indoors for the first two weeks after the fire.

Stantec leadership conducted their business with the knowledge that safety remained a paramount consideration during recovery efforts to prevent loss or injury. A work plan was developed that included the following specific activities:

- Confirm contractors have a plan in place to deal with the unique health and safety protocols incumbent with these circumstances.
- Review safety plans before work commences or when conditions change and warrant a review.
- Perform safety audits on engaged contractors who are conducting work on site to confirm they

are implementing controls to keep employees safe and compliant with applicable regulatory safety requirements and client safety requirements.

- Stop any unsafe work immediately, provide guidance on hazard recognition, assessment, and control, and implement corrective action as required.

While the city was evacuated, it was crucial to know where all employees were working so that they could be accounted for if an evacuation was called for. Stantec used the iPhone "Find Friends" application to keep track of the on-site employees.

## Delivery Schedule

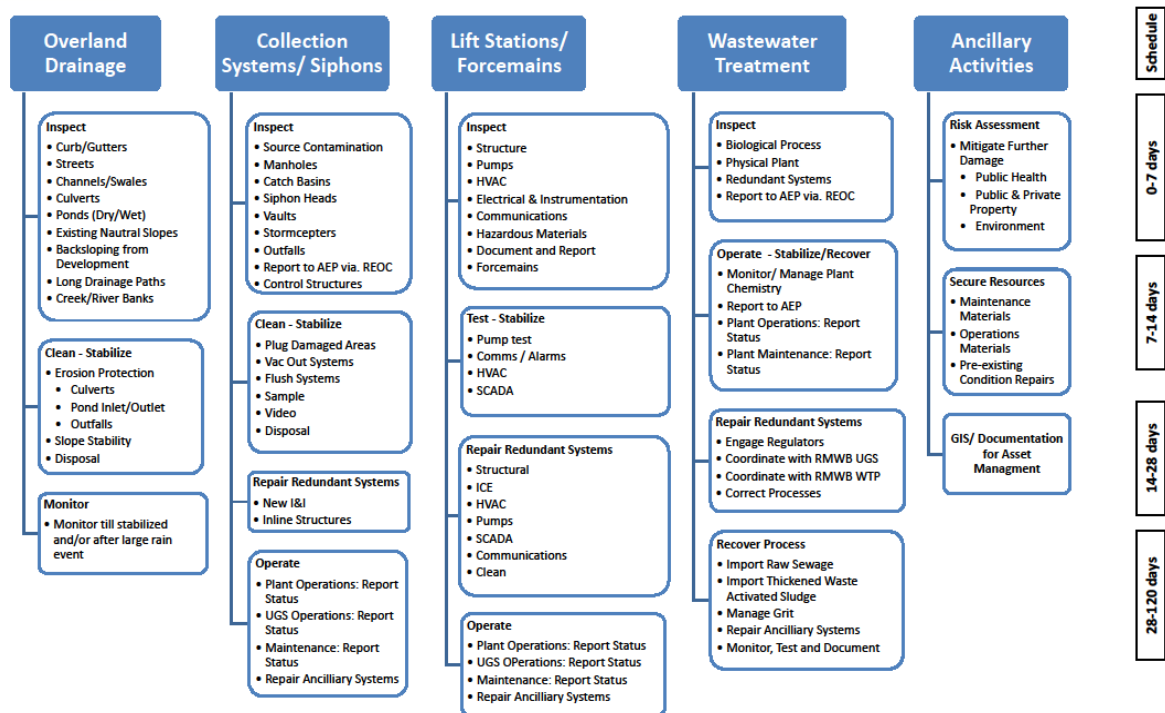
The schedule Stantec developed shortly after arriving on scene was as follows:

- Inspect and triage existing infrastructure: 0-14 days
- Stabilize and secure resources: 7-14 days
- Repair priority systems: 14 – 28 days
- Operate/repair ancillary systems: 28 – 120 days



## 2016 RMWB Wastewater and Storm System Recovery Plan

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13:15



## Management of Risk

The team that was mobilized to site for field work had worked on projects for the municipality on many occasions and had a fundamental knowledge of their risk tolerance and order of priorities. This previous experience helped to make managing risk a collaborative effort. The following condition categories, risk categories and priority was established and guided the team's actions.

What is the condition of the assets?

- Functional
- Needs Attention

Where are the key risks?

- Public safety
- Environmental impact
- Costs

What are the order of priorities?

- People
- Environment
- Assets
- Reputation





## Risks Identification

The work plan included the following specific activities:

- Conduct daily risk assessments
- Conduct risk assessments for recommended remediation activities

The Stantec team knew that risks change throughout the lifecycle of a project and were prepared to monitor the changes for the duration of the project. One excellent example of evolving risks was the planning that took place in preparation for the general population to re-enter the city.

A comprehensive plan was prepared in preparation for re-entry based on the knowledge that the general population was going to be allowed back in to the city based on the district in which they lived. Standby hydrovac trucks were mobilized to high risk areas, supplemental sewer system operator routes were planned and maps distributed, shifts for 24 hour daily operations were scheduled and standby maintenance personnel and equipment were mobilized.

### LIFT STATION INSPECTIONS

All lift stations were inspected when our team first arrived in Fort McMurray on May 9, 2016. The preliminary inspection reports found that of the 14 total lift stations, 5 required remedial action, while the other 9 were assessed as having minimal to no damage. The 5 lift stations requiring some measure of repair were continually monitored until the repairs were completed to a point that accommodated basic working levels. Siphons in Fort McMurray were also assessed. As a

result of the assessment, maintenance crews were mobilized to clean the bar grating and sumps to ensure the ongoing free flow of sewage through the facilities.

On May 10 - 11, 2016, team personnel made a detailed electrical assessment of each lift station for the purposes of insurance reporting. Mechanical assessments were also completed at the four flooded lift stations (Waterways, Wood Buffalo, Grayling Terrace, Mackenzie). No other types of inspections, such as structural, were deemed to be needed at this time.

A particular risk identified during the assessment was related to grit getting into the lift station wet wells and compromising the operability of the pumps. During the period prior to re-entry, many observations of the wetwell benching were made to determine if in fact grit was collecting in the system. The observations did not result in mobilization of equipment and personnel to clean the grit from the wet wells.

## Action Plans

To facilitate construction action and to track the various initiatives, Stantec forces prepared action plans for RMWB consideration and approval prior to engaging field contractor services. The action plans included a description of the work, the justification for the work, required resources and cost approximation. This helped the RMWB and Stantec team to make informed decisions and to get approval from appropriate authorities.



## RULES OF ENGAGEMENT

There are numerous Acts and Regulations in Alberta that address pollution prevention including the Fisheries Act, Environmental Protection and Enhancement Act, and Water Act. These Acts are governed by Environment and Climate Change Canada and Alberta Environment and Parks (AEP). Following large wildfires there is a risk of pollution to waterways from damage sustained to infrastructure, loss of vegetation, and increased soil erosion.

The Fisheries Act plays a major role in preserving the quality of the natural environment and provides guidance on fisheries protection. Stantec worked with Fisheries and Oceans Canada to address concerns regarding pollution of waterways and provide weekly updates describing work that had been completed, as well as the work projections.

The Environmental Protection and Enhancement Act aims to protect air, land and water by covering a wide range of activities including wastewater, storm

There were entire residential subdivisions where the homes were destroyed by the fire. The remnants of the foundations acted as collection points and allowed debris, hazardous materials from household products consumed by the fire and water from the uncontrolled water services and precipitation to flow from the fire destroyed basements into the sewage collection and sewage treatment system. The engineering and operations team concluded that this uncontrolled flow situation could not be allowed to persist until all the homes were rebuilt. The team also concluded that as part of securing the fire destroyed subdivisions, cleaning up the debris and removing the concrete foundations it would be necessary to disconnect the water, sanitary and storm municipal utility service connections from the homes. This was called service connection Cut and Cap initiative.

Once the team agreed that the service connections to all the homes would be cut and capped, the question became, when should it be done, and did locators, utility companies, surveyors, inspectors, and contractors among many other tasks. Progress tracking

drainage, and substance release. The Water Act applies to all work undertaken in and around Alberta water bodies that have the potential to affect the aquatic environment. Both Acts are administered by AEP and Stantec worked closely with the regulator to get storm water and wastewater infrastructure operating in a timely manner, while implementing mitigation measures to protect water quality.

Throughout the project and during the state of emergency, our team and the RMWB worked in close cooperation with Alberta Environment and Parks (AEP). Inspections were made, discussions took place, plans were prepared and approved, and action was taken throughout the state of emergency. Communication was paramount to ensure appropriate action was taking place. We provided daily updates describing work that was completed and assisted in reporting compliance deviations to AEP as issues arose. This allowed for timely and appropriate management of issues.

## GRAVITY SEWER PIPES CUT & CAP INITIATIVE

the RMWB have the social license to conduct the work. It was clear that the sooner the service connections cut and capping was completed, the less risk there was to significant damage to the sewage collection system. Completing the cut and cap service isolation for 1700 homes was a large undertaking, but completing the work in bulk would be cost effective and could be done quickly.

On May 31, 2016 the RMWB authorized Stantec to proceed with a partial cut and cap program of 712 homes. It was projected to take less than 30 days and cost less than \$5,000 per lot to complete the service isolations.

Many tasks were required to initiate and complete the goal. This included coordination of shallow utility locates to comply with ground disturbance regulations, a work procedure to develop, contractors engagement, development of manageable contractor packages, and the creation of maps for

and inspection logs also had to be developed and maintained. Time was of the essence, and this



initiative was developed and the work completed very quickly and without incident to the credit of all involved. Provincial OH&S representatives were regularly on site to ensure contractors and other field staff were adhering to designated safety apparel which included wearing Tyvek coveralls and half mask air filters.

On Friday, June 25, 2016, 25 days after starting, the capping of service connections on 712 lots was complete. Photos were taken of each isolated connection and the data was cataloged for future reference. There were nine contractors who participated in this program, and the average cost to complete each lot isolation was approximately \$4,000.

### STORM SEWER PROTECTION

The fire resulted in ash, debris, and burnt cars littering the streets of the fire destroyed neighborhoods. There was a fear that this debris and toxic material would enter the storm sewer system, clog pipes, and allow deleterious materials to enter the Athabasca River and other sensitive waterbodies. AEP initiated the installation of silt socks on all the catch basins in and adjacent to the fire destroyed neighborhoods, and Stantec was requested to manage the initiative. There was a significant amount of debris that collected at the silt socks and needed regular maintenance. Stantec initiated a program of cleaning and reporting and generating GIS mapping of how the provisions were being maintained. AEP was keen to see that the program they initiated was being maintained to their satisfaction.

The team had the contractor field crews fill in Microsoft excel spreadsheet matrix daily which tracked which catch basins had been visited. This spreadsheet was used to automatically generate a GIS tracking map daily and effectively allowed field personnel to efficiently participate in the GIS map making process.

Most of the catch basins in the RMWB have sumps to collect silt and other heavy debris that enters through the catch basin grate. It was decided to clean out all the catch basin sumps in the fire destroyed neighborhoods to ensure any heavy debris that entered the storm system had a place to collect, rather than overflowing the sump and ending up in a waterbody.

Protecting the storm sewer system was particularly important considering that a tackifier material was applied to all the fire damaged homes to stabilize the ash from blowing around and becoming a hazard. Some of this tackifier material washed away and was trapped by the silt socks and catch basin sumps. This alone validated the need for these programs.



### Risk Mitigation/ Management / Acceptance

#### Re-Entry Risk Mitigation

To prepare for re-entry, a Repopulation Risk Management Plan was created that detailed the information needed to operate each lift station. Some lift station operators employed during the re-entry were not familiar with the Fort McMurray lift stations, so this plan allowed them to be prepared for every situation. Lift station operators were also given an orientation to the lift stations by Stantec staff in the days leading up to the re-entry. Re-entry went smoothly, and no major incidents at the lift stations were reported. Syphons were also being monitored daily during the re-entry.

#### VAC TRUCKS/COMBO UNITS

During the re-entry, the hot standby resources which included electricians and vac trucks and combo sewer flushing units were managed closely. The decision was made to have these resources working on general maintenance tasks that could be stopped at any time. In this way, the RMWB was getting value for their expenditures, and there was an added level of protection because of the increased ability to respond to sewer plugs or electrical issue very quickly.

## Degree of Difficulty

The greatest challenges of the assignment were tied to the limited ability to bring equipment and personnel from outside of Fort McMurray. This meant that there was a need for considerable support by resources stationed in the Edmonton, Red Deer and Calgary offices. Through careful selection of teams and knowledge of our peers operational constraints, we were able to deliver integrated engineering solutions in the form of:

- Contract Administration
- Technical Support & Reporting
- Geomatics
- GIS
- Health and Safety Services
- Field Engineering
- Engineering (Civil, Electrical, Process, HVAC, Instrumentation, Controls, Electrical, Structural)
- Risk Management

- Project Management
- Environmental Testing & Monitoring

As much as it was challenging to mobilize the forces necessary to meet the requirements of the charter under which Stantec was retained, knowing when to demobilize was also very important to the team. Because part of our responsibility was to develop scope, we needed to self-evaluate when to demobilize. Consulting is a business, and there were many consultants looking to help with the recovery effort and we respect the RMWB's desire to distribute the work to several consultants. Our team has great appreciation for the trust the RMWB's engineering branch showed by retaining our team for this assignment and we hope we have demonstrated this by closing our open tasks and turning our attention to the normal activities we conduct for the municipality.

## Benefit to Society

In the midst of a disaster, our people aided the RMWB personnel in returning the Fort McMurray wastewater and storm water systems, allowing residents to return home to functioning municipal infrastructure, with minimal impact to the area's watercourses, public facilities and private property.

One of the key objectives of this program was to monitor and to prevent sewer backups from damaging homes that had not already sustained damage due to the fires. Ensuring the lift stations remained in operation, monitoring the storm and sanitary sewer flows and having critical infrastructure support in place during the re-entry were crucial to achieving this objective. Throughout the recovery efforts and in the following weeks there were no reports of sewer backups into houses that had not sustained fire damage.

Throughout the wastewater system recovery, all wastewater was routed through the WWTP without emergency releases or license contraventions. By isolating deleterious materials at the source and minimizing their migration into wastewater system, toxic impacts to the WWTP microbiology were also minimized. The introduction of seed micro-organisms to the plant helped sustain the biomass and as a result of the hard work of Stantec and RMWB employees the wastewater treatment plant was able to maintain an effluent quality that meets the facility's operating license parameters throughout the crisis.

In addition, measures were taken to reduce the ash and contaminants that entered the storm water system and were released into water bodies, mitigating harmful environmental impacts. Fort McMurray will be recovering from the social and environmental impacts of the 2016 Wildfire for years to come. However, thanks to timely response of the early responders in preventing further damage to critical infrastructure due to the aftermath of the fire, the residents of Fort McMurray were able to return home to functioning wastewater and stormwater systems.

