Town of Strasbourg – Waterworks System Assessment (Round 3) 2015

Final Report

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Town of Strasbourg

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Sign-off Sheet

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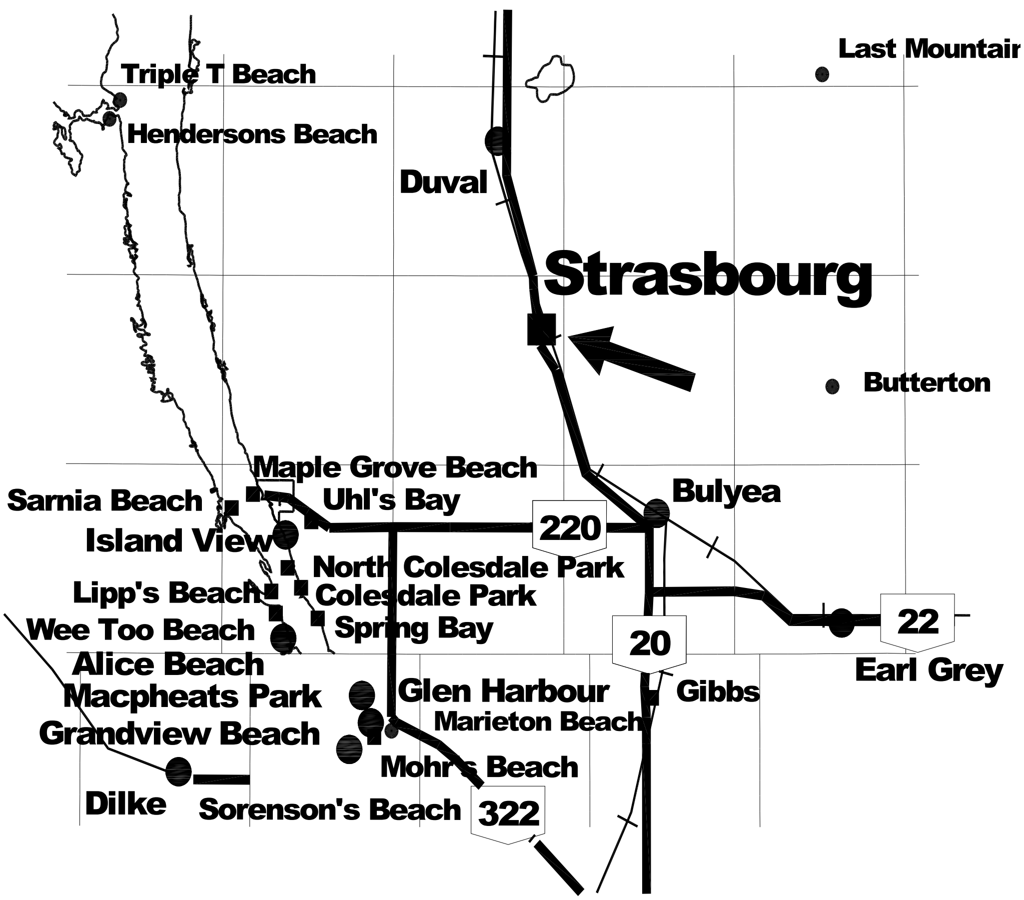
1.0 BACKGROUND AND GENERAL OVERVIEW

The Water Regulations (2002), Section 35 (1), require that each permittee of a waterworks supplying water for human consumptive use provide an independent engineering assessment to the provincial Water Security Agency at least once every five years.

The first Waterworks System Assessment (WSA) of the Town of Strasbourg was completed December 31, 2005 by Stantec Consulting Ltd. The second assessment, or Round 2, was also completed by Stantec Consulting Ltd. in December, 2010. Stantec Consulting Ltd. was also engaged to complete the Round 3.

Strasbourg is located about 75 km northwest of the City of Regina along Highway 20, as shown on Figure 1-1.

Figure 1-1 Town of Strasbourg



1.1 WATER SYSTEM OVERVIEW

The Town of Strasbourg has the ability to obtain raw water from one of three wells. Two are located near the Water Treatment Plant (WTP)and one is remote from the WTP. The groundwater is pumped to the plant where treatment includes iron and manganese reduction and disinfection. Storage is provided with two underground reinforced concrete reservoirs. Treated water is pumped to the distribution network using one of three submersible pumps located in the WTP.

1.2 POPULATION

The following are the population statistics compiled for the Town of Strasbourg:

Statistic Canada	2006	732
Statistics Canada	2011	752

1.3 WATER DEMAND

Water use from Saskatchewan Water Security Agency's 2010 to 2012 records and the Town's records for 2013 and 2014 are shown below:

Table 1-1 Water Demand

Year	Average Daily Demand (m^3/day)	Maximum Daily Demand (m^3/day)	Population	Total Volume of Water (dam^3)
2014(1)		455	752	
2013	317	760	752	115.6
2012	384	769	902	140.3
2011	341	792	880	129.3
2010	318	728		116.2
Note: (1) 2014 data is based on recorded values to November 30, 2014.				

The Average and Maximum Daily Demand have decreased since the 2010 Waterworks System Assessment. Based upon the highest values in the last five years, the Average Daily Demand (ADD) is 384 m^3/d. The highest Maximum Daily Demand (MDD) observed in the last five years is 792 m^3/d. These values will be used in the remainder of the report. The reduction in the Average and Maximum Daily demand from the 2010 Waterworks System Assessment may be attributed to the Town implementing higher water rates in recent years and this is known to have a common effect of reducing consumption. Recent summer weather patterns have also reduced demands for lawn and garden watering.

2.0 REVIEW OF AVAILABLE INFORMATION

As stated in Section 1.1, raw water is available from three wells. Two wells are located near the water treatment plant (WTP). A third well is located about 4.0 km from the WTP. The well names, locations, and typical use are shown in the following table.

Table 2-1 Raw Water Wells

Well Name	Location	Typical Use
Kerr	Across Highway 20 from the WTP	Primary supply to Town
In-Town	Near the WTP	Secondary supply to Town
Bender	4.0 km from the WTP	Back-up or emergency supply

More well details are provided in Section 3.1.

In recent years the Kerr well is used most frequently and the In-Town well is used as a secondary supply. The Bender well has not used for several years and is deemed by the operations staff to be unreliable.

The water treatment includes iron and manganese oxidation, manganese greensand filtration and disinfection. Storage is provided in two underground concrete reservoirs. The treated water is pumped to the distribution network with three electrically powered submersible pumps, and/or a natural gas powered engine driven pump.

2.1 WATER SUPPLY SYSTEM

The allocated raw water supply as licensed by the Water Security Agency is 159.9 dam3 or 35,200,000 gallons per year. This allocation is presently sufficient but this is an issue the Town will need to monitor. The highest annual use observed in the past five years (2012) was at 87% of the allocation. Correspondence received from the Water Security Agency confirming the raw water allocation is included in the appendix.

2.2 RAW AND TREATED WATER QUALITY

The water quality data on selected parameters for the raw and treated water is shown in Table 2-1. For comparison, the objectives as cited by Saskatchewan's Drinking Water Quality Standards and Objectives (SDWQSO) are also included in this table.

Treated water quality information was obtained from the SaskH$_2$O website. It is provided in Appendix A. Key parameters are presented in Table 2-1 and discussed in the following sections.

Table 2-2 Selected Water Quality Parameters

Parameter	Unit	Bender Well (2005)	Kerr Well (2010)	In-Town Well (2005)	Distribution 2014	SDWQSO
Alkalinity	mg/L	417	349	327	334	500$^{(1)}$
Arsenic	µg/L	**14**	**24**	**19**	2.3	10$^{(3)}$
Hardness	mg/L	380	463	421	475	800$^{(1)}$
Iron	mg/L	**3.7**	**0.92**	**1.4**	0.02	0.3$^{(1)}$
Manganese	mg/L	**0.26**	**0.56**	**0.39**	0.01 (7)	0.05$^{(1)}$
Nitrate	mg/L	0.0	<0.04	0.0	Not Tested	45$^{(2)}$
Organic Carbon	mg/L	5.6	2.8$^{(6)}$	2.6	Not Tested	-
pH	N/A	7.93	7.63	7.73	7.3	6.5 – 9.0$^{(1)}$
Sodium	mg/L	**502**	89	54	85	300$^{(1)}$
Sulphate	mg/L	**902**	280	201	271.2	500$^{(1)}$
TDS	mg/L	**2,120**	794	814	950	1,500$^{(1)}$
THMs	µg/L	Not Tested	Not Tested	Not Tested	Not Tested	100$^{(3)}$
Turbidity	NTU	**42**	**8.2$^{(6)}$**	**13**	0.26	1.0$^{(4)}$
Uranium	µg/L	2.0	5.0	2.5	4.7	20$^{(2)}$

Notes:
(1) Aesthetic Objective (AO)
(2) Maximum Acceptable Concentration (MAC)
(3) Maximum Acceptable Concentration (MAC), Health Canada 2006
(4) This routine standard objective is used as no limit has been established
(5) Bold values exceed the SDWQSO limits
(6) Values from 2005 analyses
(7) Values from 2012 analyses

Ammonia is not recorded in the raw water analyses. The concentration in the In-Town and Kerr wells was last reported to be 1.65 mg/L.

From a review of all treated water data, the treated water is in full compliance with all provincial standards and objectives. Disinfection is achieved with true free chlorine after breakpoint.

2.3 PLANS, REPORTS AND MANUALS

The Town provided several sets of drawings for the 2010 Waterworks System Assessment and reported no changes to the drawings. The Town changed the distribution pumps to submersible units in phases between December 2010 and February 2011. The Town changed the Kerr well pump in 2013 and the In-Town well pump in 2014. The maintenance manuals for the new Distribution and Well pumps were reviewed during the Waterworks System Assessment. Adequate maintenance manuals are now in place to aid staff in operating the water treatment plant. The Town does not have the original (1961) WTP and clearwell plans and efforts to obtain the plans were unsuccessful.

Selected photos of various parts of the waterworks, taken during the December 1, 2014 site visit as well as selected photos of the inside of the clearwell provided by the Town Foreman are provided in the Appendix.

2.4 HISTORIC PROBLEMS

Corrosion in the cast iron water distribution mains and the water supply pipeline from the Bender well was reported as a chronic problem. The well and the water supply pipeline have not been used in the past four years due to the corrosion concerns.

2.5 MAINTENANCE RECORDS

The Town maintains detailed records of daily operation and maintenance tasks performed. The records include systematic equipment and instrumentation checks including the blower unit, pumps, chlorine gas detector, chlorine feed equipment, and chemical metering pumps. General maintenance repairs are recorded but documentation of contracted major overhaul and pump replacements should be stored at the water treatment plant and archived in the town office.

2.6 NEW COMPONENTS/UPGRADES

A list of the recent upgrades includes:

- Kerr Well: New Pump, New Pit-less Adapter in June 2013
- Town Well: New Pump, New Pit-less Adapter in November, 2014
- Three new Distribution Pumps, installed between December 2010 to February 2011
- Reservoirs Cleaned in July, 2013
- Valve Stems replaced on reservoir connection valves in July 2013
- New Hach 2100 Q Turbidimeter in July 2013
- $KMnO_4$ mixer rebuilt in December, 2013
- New solenoid on chlorinated water line in September 2014
- Chlorinator head and chlorine flow rate control valve / rotameter replaced in September, 2014
- Second water line for chlorine injection in October, 2014

3.0 WATERWORKS ASSESSMENT FINDINGS

3.1 RAW WATER SUPPLY

3.1.1 Raw Water Supply, Wells/Intakes & Pumping Stations

The Town receives its groundwater supply from three drilled deep wells. Each well is equipped with a pit-less adapter and a submersible pump. Water is pumped directly from any one of three wells to the WTP.

3.1.1.1 Kerr Well (1990)

This well is located approximately 150 metres northwest of the WTP along the top of a drainage channel in the SE ¼ 26-24-22 W2. There appears to be no potential for aquifer contamination from surface runoff due to flood depths at or near the top of the pit-less adapter. The Town has reported there are no reports of flood depths that would permit surface water contamination of the well.

The well depth is 48.8 m including the screen length of about 6 m. The casing is 200 mm diameter PVC, Schedule 40. The well pump capacity as measured at the WTP is about 12.5 L/s or 1,080 m^3/d which exceeds the current MDD of 792 m^3/d. In periods of high use (Maximum Day Demand) the Town may request that users irrigate on alternate days or enact other rationing strategies. Overall, the well capacity and the waterworks capacity meets the demand for the current population, and practically, for a population increase to about 1,000.

The Kerr well is the primary supply of water to the Town. The well pump is controlled automatically based on reservoir levels via an underground power line from the WTP.

This well is very important to the Town as the other two wells are unable to reliably provide the Town's maximum day demand. To protect and potentially extend the service life of this well, several improvements are recommended in Section 4.2.

3.1.1.2 In-Town Well (1980)

This well is located about 50 m north of the WTP along the top of a drainage channel in the SW ¼ 25-24-22 W2. There appears to be no potential for aquifer contamination from surface runoff due to flood depths at or near the top of the pit-less adapter.

The well depth is 48.8 m including the screen. The casing is 200 mm diameter steel. The well capacity as measured at the WTP is about 7.6 L/s or 655 m^3/d (100 igpm). This well and pump do not meet the MDD of 792 m^3/d. This well is used primarily as a backup to the Kerr well.

The well pump is controlled based on reservoir levels, if selected, via an underground power line from the WTP.

3.1.1.3 Bender Well (1981)

This well is located about 4.0 km northwest of the WTP in the SE ¼ 33-24-22 W2. The well has not been used in the past few years and the Town operators consider the well and the supply line from the well to be unreliable. It was not visually inspected during the December, 2014 site visit. When last inspected the pit-less adapter was about 300 mm above the top of the ground surface. To meet current design standards the pit-less adapter should be 400 mm above the ground surface. It is recommended that the Town verify there is no potential for flood depths (above about 200 mm) in an extreme storm or during snow melt to reach near the top of the pit-less adapter.

The well has a 200 mm diameter casing. The casing material is unknown. The depth is 70.1 m including the screen length. The well capacity was originally rated at about 15.76 L/s or 1,362 m^3/d. However, this well is not normally used; it could only be considered as a back-up supply as the water quality is poor compared with the water quality of the other two wells. The Town would have to test operate the well to verify the current capacity and availability.

The well pump is controlled by the level controller at the clearwell. The signals are sent in a buried telephone line from the WTP to the well site. Overhead power and control panels are located at the well site.

3.1.1.4 Well Pump Data

The pump/motor data for each of the three wells are provided below in Table 3-1.

Table 3-1 Raw Water Supply Wells

Well	Year Drilled	Pump Manufacturer	Type	kW	Flow Rate L/s	HP	Flow Rate IGPM
In-Town	1980	Goulds (2014)	Submersible	5.6	7.6	7.5	100
Kerr	1990	Goulds (2013)	Submersible	7.5	12.5	10	165
Bender	1981	Goulds	Submersible	5.62	15.76	7.5	208

3.1.1.5 Quality and Quantity

There was no available information to assess if the water quality in the wells has changed appreciably since the last Waterworks System Assessment. The treated water quality continues to meet Drinking Water Quality Objectives.

From the reported information, the aquifer levels (quantity of water) in the Kerr and In-Town wells have been sustainable since 1981, including periods of drought (1988, in particular). The Bender well is not used; however, the water has remained available to Strasbourg. The Town continually monitors and records water levels from observation wells at the Kerr and In-Town wells.

There is limited information on the capacities and long term sustainability of each aquifer. Recommendation was made in the 2010 Waterworks System Assessment that a hydrogeologist be engaged to evaluate the two aquifers including the recorded water level data and assist the Town to plan for a back-up well in one of the two aquifers. Part of this decision would include the best plan to replace or abandon the water supply pipeline from the Bender well. The pipeline is discussed below in Section 3.1.2.

If the aquifer near the WTP is reliable, a well of equal capacity to the Kerr well appears to be the optimal solution for the backup well. It would normally be operated as an alternate well supply at least once per day.

3.1.2 Supply Lines and Storage Reservoirs

Data for the supply lines from each well is presented in Table 3-2.

Table 3-2 Raw Water Supply Mains

Well	Material	Nominal Diameter (mm)	Approx. Length (km)
In-Town	PVC	100	0.05
Kerr	PVC	150	0.15
Bender	Cast Iron	150	4.0

The PVC water supply lines from the In-Town and Kerr wells have performed well.

The water supply pipeline from the Bender well is 150 mm diameter cast iron. This pipeline is the original CPR water supply pipeline. As stated previously and shown in Table 3.2, the length is about 4.0 km. The condition of the pipeline is reported to be in poor condition and it is considered unreliable.

Replacement of the 4.0 km pipeline is not recommended due to its poor condition, the age of the well which is near the end of its service life and the poor water quality. However, it is also recommended that the Town engage a hydrogeologist to study the two aquifers before a final decision is made.

There is no raw water reservoir.

3.1.3 Operation and Maintenance Procedures

The wells are checked weekly. The Kerr and In-Town well pumps have both been replaced in the last 16 months.

3.2 OVERVIEW OF WATER TREATMENT PROCESS AND DISINFECTION SYSTEM

The WTP and storage facility is located northeast of the intersection of Castle Street and Highway 20. The water treatment process consists of iron and manganese reduction and disinfection. Treated water is stored in two reservoirs and pumped to consumers via the distribution network.

One reservoir, the clearwell, is located beneath the WTP and the second larger reservoir is located adjacent to the north side of the WTP. The clearwell and the south section of the superstructure were constructed in 1961. The reservoir north of the WTP was constructed in 1985. The superstructure and process equipment of the WTP was expanded in 1985.

The existing WTP superstructure is a metal clad concrete block building approximately 9.1 m long and 9.1 m wide built above the clearwell. The roof of the WTP is a conventional sloped roof with gable ends. The roof is covered with asphalt shingles. The clear ceiling height of the building was increased to 3.05 m in 1985. The building appears to have been well maintained.

The key components of the WTP include:

- Four (4) pressure filters with anthracite and manganese greensand media
- Three submersible distribution duty pumps with electric motors
- One standby unit, which consists of a vertical turbine pump, right angle gear drive, and natural gas engine
- Air blower unit
- One chemical metering pump/tank system for potassium permanganate
- Chlorine gas feed and storage room with two 68 kg cylinders
- Pipes and valves
- Electrical and mechanical equipment

3.2.1 Treatment Process, Equipment and Impact on Water Quality

Well pumps convey water to the WTP from any one of the three wells. The raw water is pumped directly through pressure filters. The filter effluent water can be directed to either the clearwell or to the adjacent reservoir. The usual practice is to direct the water to the adjacent reservoir and to pump to distribution from the clearwell below the water treatment plant. It is recommended this practice be continued because of the increased chlorine contact time.

First, a chlorine solution is injected in the raw water influent. This injection point was introduced in 2010 to permit an increased chlorine dosage that satisfies the chlorine demand from ammonia and other constituents such as organic compounds. Refer to Section 3.2.2 and 3.2.4 for further discussion.

Second, potassium permanganate is injected and mixed with an inline static mixer. Potassium permanganate is used for iron and manganese oxidation, and to regenerate the manganese greensand media. Typically, the oxidized iron is removed by the anthracite layer, whereas manganese ions are adsorbed and oxidized on the surface of the greensand media.

There are four 1,524 mm diameter pressure filters complete with steel piping and manual valves. The filter media includes anthracite and manganese greensand.

The raw water supply to the filters is normally as follows:

- Kerr Well (12.5 L/s) – Primary Supply
- In-Town Well (7.6 L/s) – Secondary Supply
- Bender Well (15.76 L/s) - Not Used

The filter flow rate for each pressure filter is 6.2 m/h (m^3/m^2/hour), based upon the Kerr well pump capacity of 12.5 L/s or 1,080 m^3/d, which is above the MDD of 792 m^3/d. The filtration rate of 6.2 m/h is in the low range of the typical recommended flow rate range of 5 to 12.5 m/h used for water containing low concentrations of iron, manganese and organic matter, as is the case for the Kerr well and the In-Town well. If one of the four filters is out of service for repair, the remaining three filters should have the production capacity, based on a flow rate of approximately 8.3 m/h, to meet the MDD as required by the regulation.

The filtration rate of 7.8 m/h, based upon the reported Bender well flow rate of 15.8 L/s is well above the suggested maximum filtration rate of 5 m/h used for water containing high concentrations of iron and organic matter. Typically, effective iron and manganese reduction in raw water containing high concentrations of dissolved organic carbon cannot be achieved without sufficient chemical contact time after addition of potassium permanganate. At 15.8 L/s and a minimum of 60 minutes detention time, the volume of a contact chamber would need to be about 57 m^3. No recommendations are offered for treatment of the Bender well due to its poor water quality and questionable pipeline integrity. Refer to the recommendation for a hydrogeology study for a backup well.

The original two pressure vessels were installed in 1961. Two pressure vessels were added in 1985. Each filter was upgraded in 2000 with a PVC hub and lateral distribution system, air scour system, and complete media replacement including anthracite and manganese greensand. The interiors of the vessels were inspected. The interior was then reported to be epoxy lined and in good condition. Some welding was undertaken in 2000 for new fittings and this work was also protected with epoxy lining. A new air blower unit and ancillary piping were installed as part of the 2000 upgrade. Upgrades after 2005 were reported in Section 2.6.

The filter tanks, piping, and controls as upgraded in 2000 appear to be in good condition. Typically, the service life of the manganese greensand media is about seven to ten years. It is recommended that media samples be inspected every two to three years to monitor the condition and determine the appropriate replacement date. The filter media for the two filters which were not replaced in 2008 and 2009 are reaching their service life and are due for replacement. Part of the next upgrade for these filters should include replacement of piping inside the filters.

The greensand filters are backwashed at a maximum of 945 m^3 of water treatment. This corresponds to approximately three times per week in summer and two times per week in winter. Air scouring is initially injected at an unknown flow rate for five minutes. Water is then injected at a measured flow rate of 18.9 L/s for 8 to 15 minutes depending on the observed backwash water quality. Backwash water is provided by the distribution pumps. Backwash effluent is collected at the sump and discharged by gravity flow to the sanitary sewer system.

The Saskatchewan Water Security Agency generally conducts two inspections per year of the Strasbourg waterworks. Abatement action was required and taken on three of the inspection reports since 2011. In July 2013 distributed water turbidity exceeded regulated values when the In-Town well was utilized during repairs of the Kerr well. The Operator reported the issue to the Water Security Agency and a Precautionary Drinking Water Advisory was issued. In July 2012 the Town was requested to update its Quality Assurance / Quality Control policy and forward the document to the Water Security Agency. In 2011 the Town had not submitted the required bacteriological samples on two occasions. After all of these inspections the necessary actions were taken to address any issues of non-compliance.

Over the past few years the Town has reported that there are no consumer complaints due to marginally high manganese levels. There are no practical recommendations for improvements. Typically, the Town would require detention time to improve the reduction of manganese levels. There does not appear to be justification to recommend further improvements. Late in 2010, the Town made chemical injection point and dosage changes discussed above that have led to manganese levels which are within the acceptable provincial standard.

High organic carbon in the Bender well indicates this source of water will be difficult to treat. If this water supply is chosen in the future, an engineering study is recommended to evaluate changes needed to the treatment process. At a minimum, the need for detention pre-treatment should be evaluated. A recommendation is not included in Section 4.2 as it is understood the Bender well will not be used. Depending on the results of the hydrogeology study for a backup well it may be appropriate to decommission the Bender well.

3.2.2 Chemicals, Equipment and Dosages

Chlorine gas is used for primary disinfection and oxidation of iron and manganese. Solid potassium permanganate is dosed to further the iron and manganese oxidation aiding removal in the manganese greensand filters.

A chlorine solution is injected into the raw water filter influent upstream of the filters using an automatic chlorination system. The applied chlorine dosage typically varies in the range of 5.0 to 9.0 mg/L resulting in a free chlorine residual in the range of 0.4 to 0.7 mg/L and a total chlorine residual in the range of 0.2 to 1.0 mg/L.

Potassium permanganate is dissolved in a batch tank by manually adding a weighed amount to 20 litres of water to create a 2.5% solution. The 2.5% solution is injected into the raw water influent downstream of the chlorine injection point and upstream of the filters. The theoretical potassium permanganate dosage required for iron and manganese oxidation is approximately 2.0 mg/L for the Kerr well or In-Town well and 4.0 mg/L for the Bender well. In practice, the optimal dosage may be determined by plant experience. Strasbourg reduces Mn to levels that are reasonable. There is no recommendation for plant optimization as the existing system achieves reasonable reduction.

The age of the metering pump for potassium permanganate is unknown. The Town has a spare pump and a replacement could be acquired expediently if necessary. The Town fabricated a new potassium permanganate mixing saturation batch tank in 2013. Secondary containment of the saturation batch tank is recommended.

Chlorine gas is used by Strasbourg. The gas is maintained under vacuum. The chlorine gas flows to the filter influent pipe (vacuum control) in the WTP where it is mixed with water and injected as a solution. Typically, in most water treatment plants the mixing with water occurs in the chlorine room. It is recommended that the practice of conveying gas beyond the chlorine room be reviewed. Refer to Section 4.1 for discussion of the current practice.

The Town has key replacement parts for the chlorine gas system.

3.2.3 Water Treatment Plant Wastewater Disposal

Backwash waste water (BWW) is discharged into the sump pit adjacent to the filters and then directed to sewer. The WTP main floor is elevated; therefore, the worst case sewage back-up should overflow in the streets through manhole covers and not reach the main floor elevation of the WTP.

3.2.4 Disinfection Process Effectiveness

Groundwater treatment plants use a disinfecting agent to inactivate potential pathogenic micro-organisms such as bacteria and viruses. The presence of viruses in groundwater is more likely than that of bacteria and, therefore, the assessment of groundwater disinfection is based on 4-log inactivation of viruses.

The level of inactivation for a disinfection system is quantified using the CT factor. The CT factor is defined as the product of the following: free residual chlorine concentration leaving the plant; contact time; and a baffling factor.

Determination of the level of disinfection is simplified in the following analysis to provide an overview of the disinfection performance. The following simplifications were applied to assess the worst condition:

1. The required free chlorine residual concentration leaving the plant was used.
2. Peak hourly flow was used to compute the Hydraulic Residence Time (HRT). A conservative value of ADD x 4 was used.
3. The contact time (effective residence time) was computed by multiplying the HRT by a correction factor (T_{10}/T) obtained from Table 4.2 of the Long Term 1 Enhanced Surface Water Rule (LT1ESWTR) Disinfection Profiling and Benchmarking. This factor takes into account the short-circuiting which occurs in the main reservoir (normal operation) not provided with baffles.
4. One-half of the reservoir volume was used to calculate the HRT at the peak hourly flow rate.

The procedure to determine the inactivation capability of a water treatment plant (for true groundwater) is shown in Figure 3-1 and summarized as follows:

1. Determine the Hydraulic Residence Time: HRT = Volume (V) / Peak hourly flow (Q).
2. Find the correction factor T_{10}/T.
3. Compute the Effective Residence Time ERT= HRT*T_{10}/T.
4. Calculate the CT for the clearwell and reservoir (the two separate operations represent the worst conditions).
5. Find the $CT_{4\text{-log, virus}}$ value from Appendix A of A Guide to Waterworks Design, Saskatchewan Ministry of Environment, 2008 (EPB 201).
6. Compute the inactivation ratio $CT_{Actual}/CT_{4\text{-log, virus}}$ for viruses.
7. Multiply the inactivation ratio by 4.
8. Sum up log inactivation values for each segment, as applicable.
9. Determine whether the inactivation level is adequate.

Figure 3-1 Procedure to Compute the Level of Inactivation

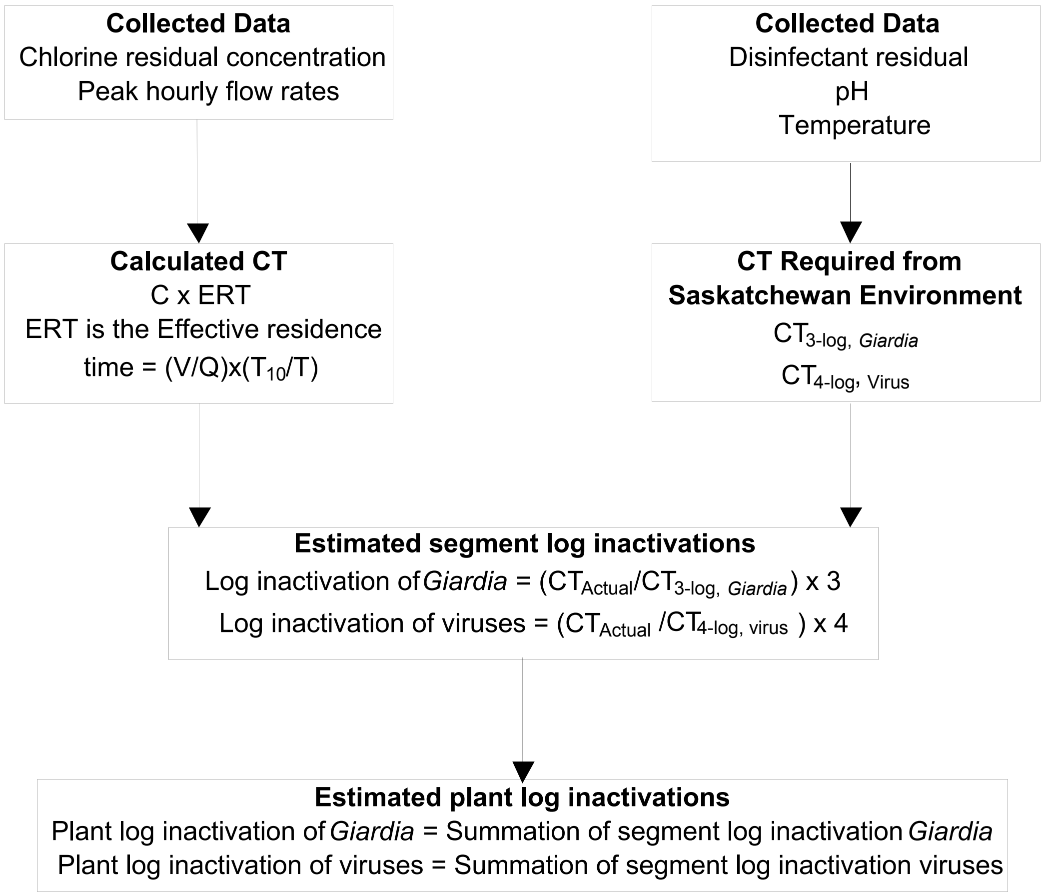


Table 3-3 System Contact Time (Effective Residence Time)

Location	Details		Contact Time (minutes)
Clearwell	ADD x 4, m^3/minute	1.066	36.1
	Volume, m^3	128.2	
	T_{10}/T	0.3	
Reservoir	ADD x 4, m^3/minute	1.066	49.8
	Volume, m^3	177.1	
	T_{10}/T	0.3	

Table 3-4 Calculated Virus Inactivation

Required Free Residual	Actual Calculated CT, (mg/L*min)	Log Inactivation $CT_{4\ log,\ virus}$ = 8.0 at pH 7.5 & 5°C
0.23 mg/L Clearwell	8.30	4.15
0.17 mg/L Reservoir	8.47	4.23
0.10 mg/L (Legislated Minimum) Clearwell and Reservoir	8.59	4.30

3.2.4.1 Clearwell Only – recommended 0.23 mg/L free chlorine residual

When the main reservoir is out of service, 0.23 mg/L free chlorine residual is required leaving the water treatment plant after breakpoint.

3.2.4.2 Reservoir Only – recommended 0.17 mg/L free chlorine residual

When the Clearwell is out of service, 0.17 mg/L free chlorine residual is required leaving the water treatment plant after breakpoint.

3.2.4.3 Main Reservoir Combined with Clearwell – recommended 0.1 mg/L free chlorine residual

Under normal plant operation with both the Clearwell and the Reservoir in service, 0.1 mg/L free chlorine residual after breakpoint would meet legislated minimum standards. The Operators target 0.45 to 0.55 mg/L for the free chlorine residual leaving the water treatment plant; this target remains validated with the newer distribution pumps.

3.2.5 Testing Procedures and Equipment

Testing for free and total chlorine concentrations, iron, manganese, and turbidity is conducted routinely at the WTP. The operator collects samples in the distribution system at regular intervals and performs tests for free and total chlorine concentrations, and turbidity.

Testing equipment includes a Hach DR890 colorimeter and a Hach 2100Q Turbidimeter.

3.2.6 Daily Operational Procedures

The WTP is checked seven days a week. The daily operational procedures include:

- Test treated water parameters (as listed in Section 3.2.5 above)
- Record meter readings
- Monitor well flow, pumps, filters (backwash at every 945 m^3 of treated water)

- Monitor clearwell and reservoir levels
- Monitor pressure in the distribution system
- Monitor chlorine and potassium permanganate
- Record chemical usage
- Other general duties

3.2.7 Controls and Instrumentation

Strasbourg's electrical controls are typical of a WTP built in 1961 and expanded in 1985 except for the addition of the variable frequency drives for the distribution pumps. The following outlines the main electrical and hydraulic systems:

- A Milltronics Multi-Ranger 100 ultrasonic reservoir level controller
- The pumps at the Kerr and In-Town wells are controlled directly from the reservoir controls (hard-wired)
- The submersible pump motor at the Bender well is controlled by reservoir levels if it were to be selected. The communication is via a buried telephone line to the well site control panel.
- The three Distribution pumps are identical 7.5 kW units controlled by variable frequency drives to maintain a constant pressure in the distribution system.
- The chemical metering pump ($KMnO_4$) is interlocked with the selected well pump. Consideration should be given to hard-wiring this pump versus a conventional 110 volt duplex and plug-in.
- A solenoid valve controls water flow to activate chlorine gas feed. It is interlocked with the selected well pump.

It is recommended that an experienced engineering consultant be engaged to provide a study of the condition of the existing electrical controls and instrumentation. The study should recommend phased upgrades and provide cost opinions.

3.3 STORAGE AND DISTRIBUTION SYSTEM

Storage is provided in a clearwell and a reservoir. Storage and the location of the distribution pumps are an integral part of the assessment of effective disinfection. This section should be read in conjunction with Section 3.2.4.

The distribution system includes four distribution pumps and a network of distribution mains and service connections.

3.3.1 Storage Reservoirs

Strasbourg has one clearwell and one reservoir. The date of the construction for the clearwell is unknown. The main reservoir was built in 1979. Both reservoirs are underground reinforced concrete structures. The clearwell is located beneath the WTP. The reservoir is located adjacent to the WTP. The clearwell is approximately 8.1 m x 8.2 m x 5.0 m. The three distribution pumps were replaced with identical submersible units in late 2010 and early 2011. According to the pump supplier these pumps require a minimum depth of 1.14 meters to operate. Using an effective depth of 3.86 m the corresponding effective volume is 256.4 m^3. The main reservoir is 7.4 m x 12.4 m x 4.416 m. Using a depth of 3.86 m the corresponding effective volume is 354.2 m3. The total effective storage volume is 610.6 m^3.

For systems requiring fire protection, the minimum storage capacity should equal twice the average day demand (ADD). Based on an ADD of 384 m^3/day, a storage capacity of 768 m^3 is required to meet the minimum requirements. Therefore, Strasbourg's storage is below the acceptable standard and it is recommended that a reservoir expansion be considered.

The two reservoirs are interconnected with a 200 mm diameter pipe. Treated filter effluent may be directed to the clearwell or to the main reservoir by a 100 mm diameter pipe. Normally, the treated filter effluent is directed to the main reservoir. During maintenance of the main reservoir treated effluent is directed to the clearwell. Both reservoirs provide active storage. In normal operation the selected well pump starts when the clearwell depth drops to 3.96 meters and an red flashing alarm light on the outside of the WTP building comes on if the clearwell level drops below 3.35 meters.

The reservoirs are cleaned periodically. Both the clearwell and the main reservoir were cleaned and inspected in July 2013.

3.3.2 Distribution System

The distribution system consists of four pumps at the WTP and distribution mains and services. The existing pump data are shown in Table 3-5.

Table 3-5 Distribution and Emergency Pumps (December 2010)

Pump Manufacturer	Type	Motor (kW)	Motor Manufacturer	Flow Rate (L/s)
Franklin 225ST10D6X	Submersible	7.5	Franklin	17.0
Franklin 225ST10D6X	Submersible	7.5	Franklin	17.0
Franklin 225ST10D6X	Submersible	7.5	Franklin	17.0
Layne (1961)	Vertical Turbine	22.5	US Motor	31.5 @ B.E.P.

The three main-duty distribution pumps are submersible, driven by variable frequency drives, and pressure controlled. The engine driven pump consists of a Layne vertical turbine pump, right-angle gear drive, and a 22.5 kW natural gas engine. There are several concerns with respect to the standby unit:

- The age of the standby unit is 53 years. As soon as parts are not available the unit is obsolete.
- There are no automated features, including automatic start on power failure or low pressure. The manual operation presents excessive risk to the community.
- The natural gas engine is cooled by a small water line that could reportedly affect distribution water if the cooling line fails. It is recommended this cooling line be immediately re-routed directly to the backwash water sump and the floor penetrations by the unit be sealed.

It is recommended that the Town engage an experienced consultant to study options to replace the standby unit within 1 to 5 years. One option that may be considered is an enclosed skid-mounted generator to supply backup power to the entire water treatment plant.

The pipe materials of the distribution mains are a mix of cast iron, asbestos cement (AC), and PVC. The pipe materials in the service connections are 20 mm copper.

The cast iron water mains were installed in 1961. The number of service connection line breaks ranges from two to eight and the number of water main breaks ranges from zero to two per year or an average of about one break per year as indicated in the following table:

Table 3-6 Water Main and Service Connection Line Breaks

Year	Water Main Breaks	Service Connection Line Breaks
2014	2	4
2013	1	2
2012	1	5
2011	0	8

The Town has replaced sections of cast iron pipe with PVC in stages in the past. Five blocks were completed before 2005 and one additional block was completed after 2005. As mains are replaced the valves are also replaced. No cast iron mains have been replaced since the 2010 Waterworks System Assessment. It is recommended that the Town replace aging cast iron mains when funds are available. Refer to Section 3.6 for additional discussion and cost estimates.

Valves and hydrants are exercised routinely. About six fire hydrants were replaced before 2005 and one additional hydrant was replaced in 2008. Only one fire hydrant has required replacement due to performance issues since the 2010 Waterworks System Assessment; another was replaced when hit accidentally by a vehicle.

3.3.3 Fire Protection

The Town of Strasbourg distribution piping meets all minimum provincial requirements for fire protection. Reservoir storage should be increased. All the hydrants are located on 150 mm water mains and the standby pump and engine are operational (the age of the unit increases the risk of a failure during an emergency.

3.3.4 Metering

Strasbourg meters the raw water influent at the WTP and treated water at all consumer locations.

3.4 BACK FLOW PREVENTION

A back flow prevention device was installed at the truck fill station in 2005. This backflow prevention device was replaced with a new double check valve in March 2010.

3.5 SECURITY AND RELATED ISSUES

The WTP is secured with a standard lock and key. There is no intrusion alarm system. Potassium permanganate and sodium hypochlorite solutions are stored within the WTP building at Strasbourg. It is recommended that the Town take the following steps in an expedient fashion:

- Install an intrusion alarm system.
- Install a system that will generate an alarm if the WTP building experiences a low temperature.
- Install an exterior alarm and signaling device that would be activated by the chlorine leak detector.
- Install a system that will alert Town Operations or Administration staff if the above alarms or a low clearwell alarm is generated.
- Review the operating procedures for changing chlorine gas cylinders.
- Review the best practices for storage of potassium permanganate and liquid sodium hypochlorite.
- Install bollards or other devices around the Kerr and In-Town well-heads and pit-less adaptors.

3.6 ESTIMATED CAPITAL REPLACEMENT COSTS AND REMAINING SERVICE LIFE

A discussion of the remaining service life of components of the waterworks is provided in the following paragraphs. The replacement costs are summarized in Table 3-7.

3.6.1 Potable Water Storage

The potable water storage consists of two underground reinforced concrete chambers. For planning purposes, the typical service life of underground reinforced concrete reservoirs is 75 years. It could be much more with good maintenance. The age of the clearwell (1961) and reservoir (1979) is 53 and 35 years, respectively. The clearwell and reservoir may last for decades if periodic maintenance that is related to replacement of metal piping and surface restoration - plant floor is provided. A need for replacement of the reservoirs is not anticipated.

3.6.2 Distribution System

The cast iron (1961) distribution mains have been subject to corrosion, which has led to a certain amount of maintenance. Replacement of all the cast iron mains with polyvinyl chloride (PVC) mains is recommended to be completed in stages. Prior to 2005 the Town replaced a length of about 800 m. Between 2005 and 2010 a length of 266 m was replaced. Since the last Waterworks System Assessment none has been replaced.

The water mains installed in 1975 and 1983 are AC and PVC, respectively and have performed well. Replacement of these mains, and the PVC mains which replaced the cast iron mains is not anticipated. The service life shown in Table 3-7 is a typical service life, but the actual service life is unknown.

The distribution system will require systematic maintenance of valves, hydrants, curb stops and valve boxes, and other fittings.

3.6.3 Wells

The In-Town well was installed in 1980. The casing is steel. The typical service life of a well is about 25 to 30 years and this well is nearing the end of its service life. The Town should anticipate the need to replace this well to provide a full back-up supply to the Kerr well. The pump was replaced in November, 2014.

It is recommended that the Town complete planning for a backup well in 2015. The location of a backup well is subject to a study of the two aquifers as discussed in other recommendations of this report. An estimated cost of a backup well is $210,000 including, chain link fence enclosure, engineering fees, hydrogeologist fees, and contingencies.

The Kerr well was installed in 1990. The casing is PVC. The typical service life of a well is 25 to 30 years. The need for replacement is not an immediate issue but should be planned for in the period from about 2018 to 2023. Well servicing and improvements to security are recommended in Section 4.0. The pump was replaced in July, 2013.

The Bender well was installed in 1981. The typical well service life is 25 to 30 years. The well is near the end of its service life and the well water quality is poor.

A review by a hydrogeologist, as stated in Section 3.1.1, is recommended to assist the Town to assess the optimal solution for a replacement well as backup to the Kerr well.

3.6.4 Raw Water Supply Pipeline

The water supply pipeline from the Bender well to the WTP is about 4.0 km in length. The pipe material is cast iron. It is suggested that this pipeline be abandoned due to its high replacement cost, the poor source water, and the age of the Bender well. Careful examination of the sustainability and capacity of the aquifer below the Town is recommended before the location of a backup well is chosen. A hydrogeologist's study is recommended to assist the Town with this decision.

3.6.5 WTP Superstructure

The age of the superstructure is 49 and 25 years. Typically, the life of the building can be extended indefinitely with staged upgrades. Replacement is not anticipated. However, for this WSA report a service life of 80 years is suggested.

3.6.6 WTP Process

Studies of the numerous components of the WTP Process including all equipment, electrical, mechanical, and controls should be undertaken by experienced consulting engineers at regular intervals. The details exceed the terms of reference for WSA reports. However, for this WSA report a service life of 60 years is suggested as a general guide. The Town has taken a positive step by installing variable frequency drives for the three distribution pumps. This WSA recommends a need to evaluate the remaining electrical switchgear, controls and instrumentation.

3.6.7 Filters

The age of the two oldest filters is 54 years. The age of the newer filters is 29 years. The service life of steel pressure filters may be extended indefinitely with welding repairs and coating. However, for the purposes of this WSA report a service life of 60 years is suggested. An actual service life is difficult to predict.

Table 3-7 Estimated Remaining Service Life and Replacement Costs

Component	Year of Construction or Installation	Typical Service Life (Years)	Estimated Remaining Service Life (Years)	Estimated Replacement Cost
Storage Reservoirs				
1. Clearwell	1979	75	40	$600,000
2. Reservoir	1985	75	46	$800,000
Distribution Mains				
Cast iron, approx. L = 5,600 m	1961	50 - 75	0 - 22	$4,500,000
PVC, approx. L = 1,500 m	2000	75	61	$1,200,000
Wells				
In-Town	1980	30	0	$210,000
Kerr	1990	30	6	$210,000
Bender	1981	30	0	See Note 1
Pipelines				
In-Town (HDPE, L = 0.05 km)	1980	100	66	$2,000
Kerr (HDPE, L = 0.1 km	1990	100	76	$30,000
Bender (Cast iron, L = 4.0 km)	1981	25	0	See Note 1.
WTP Superstructure	1961/1985	80	27	$600,000
WTP Process – excluding filters	1961/1985	60	7	$520,000
WTP Filters				
2 pressure vessels	1961	60	7	$300,000
2 pressure vessels	1985	60	31	$300,000
Value of Assets or Replacement Costs				**$9,272,000**

Notes:
1. Replacement of the Bender well and pipeline are not recommended.
2. The Estimated Remaining Service Life is based on the years each component can be anticipated to operate with reasonable repair and maintenance. Replacement of components of the water works will normally occur in stages. This report provides a broad indication of the approximate schedule (service life remaining).
3. Engineering and contingencies (40%) are included.
4. The above does not include the complete water works (eg., services, hydrants, etc. are not included).
5. Distribution main replacement costs based on $800.00 per metre including street asphalt repair. (Budget estimate provided by a Saskatchewan contractor in January, 2015.)

4.0 RECOMMENDATIONS

4.1 IMMEDIATE HEALTH-RELATED ISSUES AND RISKS

While there are no immediate health-related issues or risks the revision to the standby pump engine cooling water line and sealing the floor penetrations are simple tasks that should be addressed expediently.

4.2 GENERAL RECOMMENDED IMPROVEMENTS

General recommendations include:

- Engage a municipal engineering consultant and hydrogeologist to assist with planning for the following:
  - Determine the optimal location (aquifer) for a back-up well that can match or exceed the capacity of the Kerr well.
  - Decommission the Bender well.
  - Abandon the water supply pipeline from the Bender well to the Water Treatment Plant.
  - In the longer term after a standby well is available, assess the future of the In-Town well.
- Improve security and protection of the Kerr well including: ensure there is adequate drainage in the area around the pit-less adapter, provide a chain link or metal enclosure with lockable gates and protect from traffic as required.
- Provide additional security for the In-Town well with a chain link or metal enclosure.
- Review the chlorine feed system. The chlorine gas line extends from the Chlorine Room to the water supply in the WTP. The following are items for consideration:
  - Provincial authorities may not approve the current practice in an upgraded installation.
  - The current practice may not meet Occupational Health and Safety Regulations (e.g., eye protection merits review).
- Retain an engineering consultant to evaluate options for the expansion of the reservoir to meet storage standards for fire protection.

Other general recommendations include:

- Increase automation of controls and alarms beginning with critical items such as low building temperature, chlorine leakage and building intrusion.
- Provide secondary or curbed containment of potassium permanganate solution.
- Calibrate the water meters annually.
- Consider changing the raw water meter to metric and using only the metric system.
- Report daily chlorine and potassium permanganate usage as mg/L.
- Test for total trihalomethanes (TTHM) periodically (not mandatory).

- If the Bender well is used it has high organic carbon which is a precursor for disinfection byproducts and TTHMs should be monitored quarterly.

4.3 CONCEPTUAL COST SUMMARY TABLE

A summary of cost estimates recommended in this report is provided in Table 4-1. Several of these recommendations are carried forward from the 2010 Waterworks System Assessment and are starred (*) in the following table:

Table 4-1 Conceptual Cost Summary of Items Required Within 10 Years

Item	Priority	Cost Estimate
*Hydrogeologist study to select aquifer for replacement of In-Town Well	High	$18,000
*Backup well, engineering, and construction for replacement of In-Town Well	High	$210,000
WTP Reservoir Expansion	High	$520,000
*Kerr and In-Town Well Security Improvements	High	$6,000
*Curbed or Secondary containment of chemicals	High	$1,200
*Standby Power Study – replacement cost not included	High	$10,000
Standby Generator and Electrical Upgrades	Medium	$200,000
Filter Pressure Vessels	Medium	$300,000
Eventual Kerr Well Replacement	Medium	$210,000
*Controls & Instrumentation Condition Study	Medium	$20,000
*Replace water meter – metric register	Low	$1,800
Total Anticipated Expenditures (within 10 years)		**$1,497,000**

The replacement of the cast iron water mains could add as much as $4,500,000 to the total anticipated expenditures.

5.0 WATERWORKS COST ANALYSIS AND ECONOMIC SUSTAINABILITY

The Water Security Agency has developed standards that prescribe how engineering consultants are to complete the Waterworks System Assessments – Round 3. This Round requires engineering consultants to recommend appropriate water rates to meet "all Operation and Maintenance costs as well as expected or anticipated future costs." The Water Security Agency wants to ensure that waterworks are "financially self-sustainable."

Quoting from the Standards, "the analysis to be completed by the engineering consultant shall include:

- The annual operation and maintenance costs of the waterworks, including items such as chemical costs, electrical costs, personnel costs, sampling and monitoring costs, and routine maintenance costs.
- An estimate of the capital replacement costs of any major system components that are expected to require replacement within the next 10 years.
- Approximate cost estimates for anticipated non-routine maintenance, upgrades or expansions."

The Water Security Agency implies in their Standards that for the economic sustainability analysis completed in this Waterworks System Assessment, large capital replacement expenditures required within the next 10 years need to be financed by revenues generated within that period of time. Those expenditures may, in fact, be debt-financed over a longer period of time which would have an impact on the calculated and recommended water rates.

The Town of Strasbourg provided the following information with respect to water rates and revenues:

Table 5-1 Town of Strasbourg Water and Sewer Utility Revenues

	2014 (YTD)	2013	2012	2011
Water Revenue	$154,945	$153,812	$150,907	$144,279
Sewer Revenue	$57,808	$52,100	$46,880	$41,186
Infrastructure Revenue	$79,005	$39,195	-	-

The Sewer Revenues and Infrastructure Revenues are included for information purposes only. The Water Revenue was solely used in the Water Rate Analysis as upgrades for the sewage works, streets, sidewalks and other infrastructure needs will need to be financed from the other sources.

The Town's published future and current rates for residences are as follows:

2015: Water Rate $84.00/3 months for 10,000 gallons ($5.00/1000 gallons over)
Sewer Rate $36.00/3 months
Infrastructure Rate $45.00/3 months

2014: Water Rate $81.00/3 months for 10,000 gallons ($5.00/1000 gallons over)
Sewer Rate $33.00/3 months
Infrastructure Rate $45.00/3 months

The Town passed Bylaw 337 / 13 that set the water, sewer and infrastructure rates from January 1, 2013 to December 31, 2016. A copy of the Rate Bylaw is included in Appendix D that indicates the various rates for different classes of buildings.

The Town of Strasbourg provided the following information with respect to the Waterworks expenditures:

Table 5-2 Town of Strasbourg Waterworks Expenditures

	2014 (YTD)	2013	2012	2011
Water Treatment Plant Maintenance	$1,020	$11,793	$4,755	$4,653
Water Analytical Costs	$1,788	$5,014	$3,760	$2,954
Power and Gas Utilities	$8,840	$13,428	$10,507	$10,476
Chemicals	$10,246	$6,833	$5,056	$4,838
Waterworks System Assessment(s) annualized	$2,000	$2,000	$2,000	$2,000
Labour	$35,025	$34,448	$32,045	$35,110
Total Expenditures	**$58,919**	**$73,516**	**$58,123**	**$60,031**
Total Revenues minus Total Expenditures	**$96,026**	**$80,296**	**$92,784**	**$84,248**

As explained in Table 4-1 earlier, over the next 10 years to maintain and upgrade the Waterworks the Town of Strasbourg could face expenditures as high as $1,497,000 plus whatever expenditures are made to replace cast iron mains. The following analysis, based on the Water Security Agency's prescribed method of calculating water rates leads to the following conclusions.

Current annual water revenues exceed expenditures by about $90,000 per year which if accumulated in a reserve would provide approximately $900,000 over the next 10 years. The amount of reserves accumulated in the past four years is approximately $355,000 leaving an anticipated deficit of about $242,000. For this analysis the effect of interest accumulated by the reserve is being ignored as is the effect of inflation on the capital expenditure amounts as these may be approximately equal and offset each other.

To raise an additional $242,000 over the next ten years would require water revenues to increase by $24,200 per year. To achieve the increased revenues, a water rate increase in the order of 16% would be necessary, leading to a calculated 2015 residential water rate of $97.44 every three months for 10,000 gallons plus $5.80 per 1,000 gallons over the 10,000 gallons. On a per monthly basis the rate would be $32.48 per month.

For comparative information, the Government of Saskatchewan publishes a table of Average Water & Sewer Cost for Saskatchewan Communities as at May 31, 2014. For the Town of Strasbourg it lists the current average monthly cost at $44.33 based on a household consumption of 7,000 gallons. Assuming a 16% water rate increase this would rise to $51.42. This compares favorably with the provincial average of $55.19 for the 529 communities listed in the Government of Saskatchewan table.

Given that the Town of Strasbourg has set utility rates to the end of 2016 and that the Town is generating increasing reserves from these rates, Stantec does not recommend any immediate changes to Bylaw 337 / 13. Stantec recommends that prior to revising the Bylaw, the Town take the following actions to improve the economic and operating sustainability of the Waterworks:

- Initiate the engineering and hydrogeological studies to provide a new well with a capacity equal to or greater than the Kerr well.
- Address the High priority recommendations of Table 4-1, especially improvements to the water treatment plant and a reservoir expansion.
- Commence the engineering study to provide a reliable backup pumping unit or standby generator.
- Perform a more detailed water rate analysis so that the fixed and variable revenues better match the Utility's fixed and variable costs. The present rate structure does not encourage water conservation below 10,000 gallons per household. The rate for water in excess of 10,000 gallons per three months is presently $5.00 per 1,000 gallons and does not increase over the four years noted in the current Bylaw. A rate structure that has a fixed monthly or quarterly amount for the provision of service and a variable rate that starts at 0, versus 10,000 gallons, for the water actually consumed, would better align revenues with costs. Before setting rates for 2017 and onward the Town should also evaluate the reserves available for the capital improvements and revise the three month rate and infrastructure fees appropriately. Though not part of the Waterworks System Assessment, Stantec recommends a similar analysis be conducted for the sewage works.

6.0 CLOSURE

The assessment found that Strasbourg's waterworks is functionally capable of meeting the community's needs. The treated water meets all maximum and interim maximum acceptable concentration limits as defined by the SDWQSO. The waterworks is maintained, but components require planned maintenance, continual replacement, and upgrades now, and in the future, to sustain the water system.

I, the undersigned, declare that the information contained within this submission is, to the best of my knowledge, complete and accurate, and has been prepared in accordance with the standard for this submission as published by the Saskatchewan Water Security Agency.

Prepared by: ______________________
Ben F. Boots, P.Eng., FEC

APPENDICES

Appendix A SAMPLING REQUIREMENTS

Appendix A SAMPLING REQUIREMENTS
February 18, 2015

00002520 04 00
Strasbourg Waterworks, Strasbourg, Box 369, Permit To Operate Renewal

The parameters below are most applicable to drinking water quality and the most recent measurement received is displayed. Follow-up sampling is required for all positive bacteriological samples. Where possible, limits are shown beside the measurement. (Limits marked with an asterisk (*) are in Saskatchewan Drinking Water Quality Standards and Objectives)

If the value exceeds the limit, Saskatchewan Environment is in contact with the waterworks operator and will advise them on proper actions to take to ensure safe drinking water.

CURRENT SAMPLING REQUIREMENTS

Location	Parameter	Sample Frequency	Sample Date	Value	Minimum Allowable Limit	Maximum Allowable Limit	
Random Location- Strasbourg Distribution System	Distributed Water Alkalinity Total Caco3	Every Two Years (Effective: March 10, 2004)	February 19, 2014	334 MG/L	Not Applicable*	500 MG/L*	Previous values...
Random Location- Strasbourg Distribution System	Distributed Water Aluminum Total	Every Two Years (Effective: March 10, 2004)	February 19, 2014	8.4 UG/L	Not Applicable*	.1 MG/L*	Previous values...
Random Location- Strasbourg Distribution System	Distributed Water Arsenic Total	Every Two Years (Effective: March 10, 2004)	February 19, 2014	2.3 UG/L	Not Applicable*	10 UG/L*	Previous values...
Random Location- Strasbourg Distribution System	Distributed Water Barium Total	Every Two Years (Effective: March 10, 2004)	February 19, 2014	19.8 UG/L	Not Applicable*	1000 UG/L*	Previous values...
Random Location- Strasbourg Distribution System	Distributed Water Bicarbonate (Calcd.)	Every Two Years (Effective: March 10, 2004)	February 19, 2014	407 MG/L	Not Applicable	No Limit Established	Previous values...
Random Location- Strasbourg Distribution System	Distributed Water Boron Total	Every Two Years (Effective: March 10, 2004)	May 23, 2012	.26 MG/L	Not Applicable*	5 MG/L*	Previous values...

Random Location-Strasbourg Distribution System	Distributed Water Cadmium Total	Every Two Years (Effective: March 10, 2004)	February 19, 2014	< .03 UG/L	Not Applicable*	5 UG/L*	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Calcium Dissolved	Every Two Years (Effective: March 10, 2004)	February 19, 2014	111 MG/L	Not Applicable	No Limit Established	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Carbonate (Calcd.)	Every Two Years (Effective: March 10, 2004)	February 19, 2014	0 MG/L	Not Applicable	No Limit Established	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Chloride Dissolved	Every Two Years (Effective: March 10, 2004)	February 19, 2014	21.5 MG/L	Not Applicable*	250 MG/L*	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Chlorine Free - Client	Followup Sampling (Effective: March 10, 2005)	November 29, 2010	1.04 MG/L	Not Applicable	No Limit Established	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Chlorine Free - Client	Weekly (Effective: March 11, 2005)	January 05, 2015	.28 MG/L	.1 MG/L	No Limit Established	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Chlorine Total - Client	Followup Sampling (Effective: March 10, 2005)	November 29, 2010	1.07 MG/L	Not Applicable	No Limit Established	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Chlorine Total - Client	Weekly (Effective: March 11, 2005)	January 05, 2015	.49 MG/L	.5 MG/L	No Limit Established	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Chromium Total	Every Two Years (Effective: March 10, 2004)	February 19, 2014	< .03 UG/L	Not Applicable*	50 UG/L*	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Coliforms Total	Followup Sampling (Effective: March 10, 2005)	November 29, 2010	0 NO/100ML	Not Applicable*	0 NO/100ML*	Previous values...
Random	Distributed	Weekly	January	0	Not	0 NO/100ML*	Previous

Location-Strasbourg Distribution System	Water Coliforms Total	(Effective: March 11, 2005)	05, 2015	NO/100ML	Applicable*		values...
Random Location-Strasbourg Distribution System	Distributed Water Copper Total	Every Two Years (Effective: March 10, 2004)	February 19, 2014	12 UG/L	Not Applicable*	1 MG/L*	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Escherichia, Coli	As Required (Effective: March 10, 2005)	January 05, 2015	0 NO/100ML	Not Applicable*	0 ABSEN/PRES*	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Escherichia, Coli	Followup Sampling (Effective: March 10, 2005)	November 29, 2010	0 NO/100ML	Not Applicable*	0 ABSEN/PRES*	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Fluoride Dissolved	Every Two Years (Effective: March 10, 2004)	February 19, 2014	.37 MG/L	Not Applicable*	1.5 MG/L*	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Hardness Total (Calcd.) Caco3	Every Two Years (Effective: March 10, 2004)	February 19, 2014	475 MG/L	Not Applicable*	800 MG/L*	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Iron Total	Every Two Years (Effective: March 10, 2004)	May 23, 2012	.02 MG/L	Not Applicable*	.3 MG/L*	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Lead Total	Every Two Years (Effective: March 10, 2004)	February 19, 2014	.4 UG/L	Not Applicable*	10 UG/L*	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Magnesium Dissolved	Every Two Years (Effective: March 10, 2004)	February 19, 2014	48 MG/L	Not Applicable*	200 MG/L*	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Manganese Total	Every Two Years (Effective: March 10, 2004)	May 23, 2012	.01 MG/L	Not Applicable*	.05 MG/L*	Previous values...
Random Location-	Distributed Water Ph	Every Two Years	February 19, 2014	7.3 PH UNITS	6.5 PH UNITS*	9 PH UNITS*	Previous values...

Strasbourg Distribution System		(Effective: March 10, 2004)					
Random Location-Strasbourg Distribution System	Distributed Water Selenium Total	Every Two Years (Effective: March 10, 2004)	February 19, 2014	< .96 UG/L	Not Applicable*	10 UG/L*	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Sodium Dissolved	Every Two Years (Effective: March 10, 2004)	February 19, 2014	85 MG/L	Not Applicable*	300 MG/L*	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Specific Conductance	Every Two Years (Effective: March 10, 2004)	February 19, 2014	1121 USIE/CM	Not Applicable	No Limit Established	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Total Dissolved Solids (Calcd.)	Every Two Years (Effective: March 10, 2004)	February 19, 2014	950 MG/L	Not Applicable*	1500 MG/L*	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Turbidity - Client	Followup Sampling (Effective: March 10, 2005)	November 29, 2010	.83 NTU	Not Applicable	No Limit Established	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Turbidity - Client	Weekly (Effective: March 11, 2005)	January 05, 2015	.15 NTU	Not Applicable	No Limit Established	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Uranium Total	Every Two Years (Effective: March 10, 2004)	February 19, 2014	4.7 UG/L	Not Applicable*	20 UG/L*	Previous values...
Random Location-Strasbourg Distribution System	Distributed Water Zinc Total	Every Two Years (Effective: March 10, 2004)	February 19, 2014	14.2 UG/L	Not Applicable*	5 MG/L*	Previous values...

Appendix B PHOTOS

Appendix B PHOTOS
February 18, 2015

Strasbourg Water Treatment Plant Building and Truck Fill Station

Strasbourg Water Treatment Plant Manganese Greensand Filters

Appendix B PHOTOS
February 18, 2015

Valves to direct Filter Effluent Flow to either Clearwell or Reservoir. Flow is usually directed to Reservoir as shown.

Air Blower Unit to provide air scour during backwash of pressure manganese greensand filters.

Appendix B PHOTOS
February 18, 2015

Submersible Distribution Pumps No. 1 and No. 2

Submersible Distribution Pump No. 3

Variable Frequency Drives for Submersible Distribution Pumps

Standby Pumping Unit (Natural Gas Engine, Right Angle Gear Drive and Vertical Turbine Pump)

Appendix B PHOTOS
February 18, 2015

Kerr Well Pit-less Adaptor

Kerr Well Gauge Station

Appendix B PHOTOS
February 18, 2015

In Town Well Pit-less Adaptor

In Town Well Gauge Station

Appendix B PHOTOS
February 18, 2015

Breathing Air Supply to Hood

Hood (Personal Protective Equipment)

Right Side of Electrical Panel Cluster

Left Side of Electrical Panel Cluster

Left to Right: Distribution Pump No. 2, Distribution Pump No. 1 and Standby Pump
Photo Supplied by Town Foreman

Underside of Main Floor over Clearwell showing Backwash Sump and Floor Drain Lines
Photo Supplied by Town Foreman

Underside of Main Floor over Clearwell showing Floor Drains
Photo Supplied by Town Foreman

Appendix C **CORRESPONDENCE**

From:	Jeff Hovdebo
To:	Nolan Shaheen; Boots, Ben
Cc:	Jayson Ford
Subject:	RE: Town of Strasbourg Allocation
Date:	December-03-14 2:28:22 PM
Attachments:	image001.png image002.png 201412031415.pdf

Hi Ben,

As Nolan mentioned and based on a review of our records, Strasbourg has four licenced wells as outlined on the attached summary. Current total allocation is 159.9 dam3 per year.

Reported use for the last 5 years is as follows.

2013 115.62
2012 140.25
2011 129.32
2010 116.20
2009 133.62

Their current allocation appears sufficient but might become limiting depending on their projected future growth.

Cheers.

Jeff Hovdebo
Manager, Water Rights, Approvals & Compliance
400-111 Fairford Street East
Moose Jaw, SK S6H 7X9
Ph: 306.694.8915 | Fax: 306.694.3944
wsask.ca | Jeff.Hovdebo@wsask.ca

Please consider the environment before printing this e-mail

Water Security Agency

From: Nolan Shaheen
Sent: December-03-14 1:29 PM
To: Boots, Ben
Cc: Jeff Hovdebo
Subject: RE: Town of Strasbourg Allocation

Hi Ben
I had quick look at some older info and it looks like they have 4 wells with a total allocation of 159.9 cubic decameters/yr. However, this info may be dated so by copy of this I will forward your request to Jeff Hovdebo who is manager of our approvals group and he can get back to you with the current status of their wells/allocations.
If you need anything else give me a shout or drop me a line!
Regards
Nolan

IENT NAME

lters: Client Name (Client) Is Like STRASBOURG

#0121 **Sub File** **Client** STRASBOURG, BOX 369, STRASBOURG, SASKATCHEWAN S0G 4V0

NTS Map # 72P03 **RU** 36 **RM** 220 **MB** 05 **SB** 75 **Client #** 050479 **WW Driller #** 018200

Land Location 03 SW1/4 33-24-22-W2M **Riverlot** **Reserve** **Purpose** Municipal **Type** Urba

UTM 13-498300-5659000 **NAD** 83 **UTM Source** Measured **Well Id** WELL #1 Pro

Pipeline	Treated	Water Charge	Water Rate	Water Level	Volume Measured	Observation Well	Depth	TDS	Application	Construction	Operation
Yes	Yes	No		No	Yes	Unknown	6.1 M	734 mg/l	07/12/1967	10/07/1972	02/08/1983

Dates (dd/mm/yyyy)

Comments

D R

#0341 **Sub File** **Client** STRASBOURG, BOX 369, STRASBOURG, SASKATCHEWAN S0G 4V0

NTS Map # 72P02 **RU** 36 **RM** 220 **MB** 05 **SB** 75 **Client #** 050479 **WW Driller #**

Land Location SW1/4 25-24-22-W2M **Riverlot** **Reserve** **Purpose** Municipal **Type** Urba

UTM 13-503000-5657600 **NAD** 83 **UTM Source** Measured **Well Id** WELL #4 Pro

Pipeline	Treated	Water Charge	Water Rate	Water Level	Volume Measured	Observation Well	Depth	TDS	Application	Construction	Operation
No	Yes	No		No	Yes	Unknown	39.6 M	847 mg/l	18/12/1967	14/10/1971	02/08/1983

Dates (dd/mm/yyyy)

Comments
Drilled in 1980 on Blk K - to replace WELL #2 which now serves as an observation well processed under the same file number.

D R

#1082 **Sub File** **Client** STRASBOURG, BOX 369, STRASBOURG, SASKATCHEWAN S0G 4V0

NTS Map # 72P02 **RU** 36 **RM** 220 **MB** 05 **SB** 75 **Client #** 050479 **WW Driller #** 050651

Land Location 08 SE1/4 26-24-22-W2M **Riverlot** **Reserve** **Purpose** Municipal **Type** Urba

UTM 13-502650-5657750 **NAD** 83 **UTM Source** Measured **Well Id** WELL #3 Pro

Pipeline	Treated	Water Charge	Water Rate	Water Level	Volume Measured	Observation Well	Depth	TDS	Application	Construction	Operation
Yes	Yes	No		Yes	Yes	Unknown	39.0 M	mg/l	26/04/1977	06/05/1977	17/11/1978

Dates (dd/mm/yyyy)

Comments
Drilled in 1977

D R

#1491 **Sub File** **Client** STRASBOURG, BOX 369, STRASBOURG, SASKATCHEWAN S0G 4V0

NTS Map # 72P03 **RU** 36 **RM** 220 **MB** 05 **SB** 75 **Client #** 050479 **WW Driller #**

Land Location 01 SE1/4 33-24-22-W2M **Riverlot** **Reserve** **Purpose** Municipal **Type** Urba

UTM 13-499425-5658850 **NAD** 83 **UTM Source** Measured **Well Id** WELL #5 Pro

Pipeline	Treated	Water Charge	Water Rate	Water Level	Volume Measured	Observation Well	Depth	TDS	Application	Construction	Operation
Yes	Yes	No		Unknown	Yes	Unknown	62.2 M	2150 mg/l	19/05/1981	21/05/1981	02/08/1983

Dates (dd/mm/yyyy)

Comments
COMMUNITY WELL

D R

Appendix D BYLAW 337/13

BYLAW NO. 337/13

A BYLAW OF THE TOWN OF STRASBOURG, IN THE PROVINCE OF SASKATCHEWAN, TO FIX THE RATES TO BE CHARGED FOR THE USE AND CONSUMPTION OF WATER AND TO FIX THE RATES TO BE CHARGED BY WAY OF RENT OR SERVICE CHARGE FOR THE USE OF SEWER

The Council of the Town of Strasbourg, in the Province of Saskatchewan enacts as follows:

1. All persons supplied with water from the municipal system shall make application to the Administration Office.

2. Water meters shall be read quarterly.

3. Accounts for water service and/or sewer service shall cover a period of three successive months, and shall be rendered on or before the first day of the month next following such period. Accounts shall be paid within a period of thirty days from the date on which such accounts are rendered. If an account is not paid within the said period of thirty days, the water service may be cut off. When the water service is cut off, it shall not be resumed until all arrears have been paid in full, together with a fee of $75.00 to cover the expenses of turning the water off and on again.

4. If the water supply is shut off from the premises of a user for infringement of the provisions of this bylaw, same shall not be turned on until all penalties, fees, rates, charges and arrears, if any, have been paid in full.

5. The charges to be paid by the water consumer whose water service has been turned on shall be those set out in Schedule "A" attached; provided, however, that the minimum shall be payable in every case whether or not any water is consumed.

6. Persons who own or occupy premises drained or that are by bylaw required to be drained in the sewer shall pay for such services a rental rate or service charge in accordance with Schedule "B" attached.

7. Persons who own or occupy premises drained into the water and sewage system shall pay an infrastructure fee in accordance with Schedule "C" attached.

8. Bylaw Number 333/12 is hereby repealed.

The rates, charges, tolls or rents contained in this bylaw shall come into force and take effect on the day of approval being issued by the Local Government Committee.

Mayor

Administrator

TOWN OF STRASBOURG INCORPORATED (S E A L) 1907 SASKATCHEWAN

Certified to be a true copy of Bylaw No. 337/13

TOWN OF STRASBOURG
SCHEDULE "A"
TO BYLAW NO. 337/13

1. The charge for a three month period for water usage shall be:

a) Effective January 1st, 2013

The charge for water service only:		
0 to 10,000 gallons	$78.00	
10,001 gallons or more		$5.00 per 1,000 gallons

b) Effective January 1st, 2014

The charge for water service only:		
0 to 10,000 gallons	$81.00	
10,001 gallons or more		$5.00 per 1,000 gallons

c) Effective January 1st, 2015

The charge for water service only:		
0 to 10,000 gallons	$84.00	
10,001 gallons or more		$5.00 per 1,000 gallons

d) Effective January 1st, 2016

The charge for water service only:		
0 to 10,000 gallons	$87.00	
10,001 gallons or more		$5.00 per 1,000 gallons

TOWN OF STRASBOURG
SCHEDULE "B"
TO BYLAW NO. 337/13

1. Person who own or occupy premises drained into the sewage system shall pay sewer rental fee in accordance with the following rates for a three month period;

a) Effective January 1st, 2013

Apartments, multiple housing	$30.00 per unit
Hotel	$ 60.00
Last Mountain Pioneer Home	$120.00
Laundromat	$60.00
Residences	$30.00
School	$120.00
All others	$30.00

b) Effective January 1st, 2014

Apartments, multiple housing	$33.00 per unit
Hotel	$66.00
Last Mountain Pioneer Home	$132.00
Laundromat	$66.00
Residences	$33.00
School	$132.00
All others	$33.00

c) Effective January 1st, 2015

Apartments, multiple housing	$36.00 per unit
Hotel	$72.00
Last Mountain Pioneer Home	$144.00
Laundromat	$72.00
Residences	$36.00
School	$144.00
All others	$36.00

d) Effective January 1st, 2016

Apartments, multiple housing	$39.00 per unit
Hotel	$78.00
Last Mountain Pioneer Home	$156.00
Laundromat	$78.00
Residences	$39.00
School	$156.00
All others	$39.00

TOWN OF STRASBOURG
SCHEDULE "C"
TO BYLAW NO. 337/13

1. Persons who own or occupy premises drained into the water and sewage system shall pay an infrastructure fee in accordance with the following rates for a three month period;

a) Effective July 1, 2013

Apartments, multiple housing	$45.00 per unit
Hotel	$90.00
Last Mountain Pioneer Home	$180.00
Laundromat	$90.00
Residences	$45.00
School	$180.00
All others	$45.00