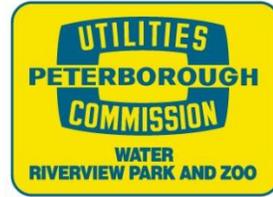

Peterborough
Utilities
Commission



2011 WATER QUALITY REPORT

On the Cover

Fire hydrant found near the Water Treatment Plant. Most hydrants in the city have painted caps, which indicate to firefighting crews flow capability. A blue cap indicates over 5,678 litres per minute (1,500 U.S. gallons/minute) at a pressure of 20 pounds per square inch (138 kpa).

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EXECUTIVE SUMMARY

With minimal disruptions to the plant process for construction or maintenance, the Peterborough Water Treatment Plant continued to produce an excellent quality of drinking water for the consumers in Peterborough during 2011.

The Otonabee River water temperature varied over the year from 0.0°C to 28.0°C. The 2011 annual average water temperature of 11.3°C was warmer than the last five year average of 11.0°C. Higher summer raw water temperatures contributed to the increased growth of algae in the Otonabee River, which historically has led to a higher level of taste and odour causing compounds (geosmin and 2MIB). A higher amount of sunlight reaching down into the water column will increase the algae activity, including taste and odour causing algae.

Reviewing data over the last fifteen year period, 2011 had the lowest pumping volume of raw water. The summer months saw average rainfall with occasional storm events. Customers used less water (including outdoor water use), resulting in the water staying in to distribution system longer. The longer retention times usually produces higher values of trihalomethanes (see page 17).

The highest pumpage day was on July 16, 2011 at 69,644 m³ (cubic metres). This was 76.5% of the historical daily high of 91,008 m³, recorded in 2005. A water volume of 13,492,575 m³ was treated during 2011 compared to an annual total of 13,817,865 m³ for 2010 – a 2.4% decrease from 2010.

2011 was the fifth year that the Ministry of Environment (MOE) lead sampling regulations was in place. In Peterborough, 99% of the sample results were below MOE lead standards. These results demonstrate that the corrosion control program (addition of sodium silicate) has been effectively maintaining the integrity of the infrastructure (see page 5). Peterborough obtained approval for the lead reduction program. In the future samples will only be collected for lead in the distribution system once every 3 years. The Peterborough Utilities Commission replaced the remaining municipal lead services in early 1990. There are however a few remaining homes in Peterborough with private lead pipes.

The maximum acceptable concentration (MAC) for filtered water is 0.30 Nephelometric Turbidity Units (NTU) for 95% of the time and never greater than 1.0 NTU. This value was previously set at 1.0 NTU for 100% of the time. The average filtered water level in the Peterborough's drinking water was 0.06 NTU for 2011 and filters are taken off-line when the turbidity exceeds 0.15 NTU.

In conclusion, the Peterborough Water Treatment Plant continued to produce an excellent quality of water for its consumers and once again exceeded the quality required in the Ontario Drinking Water Standards (ODWS). This is largely due to the optimization of the facilities and the continuing expertise and dedication of the staff to produce and maintain excellent quality drinking water.

Source Water

Zebra Mussel

During 2011, zebra mussel populations appeared to be stable with virtually no change in raw water turbidity. Since the introduction of zebra mussels (an invasive species) into Ontario and later into the Otonabee River system in 1997, the effects continue to cause slight changes in raw water turbidity. According to literature, one zebra mussel can clear 1 litre of water per day and large numbers of zebra mussels can actually clear a water body. Sunlight (when available) is then able to penetrate further down into the water column allowing other species of algae to flourish.

Turbidity

The average raw water turbidity in 2011 was 0.69 NTU, this is a slight increase from 2010 turbidity (0.02 NTU). The variable summer rainfall provided average Otonabee river flows, and close to average turbidity. A 20-year trend of Otonabee River (raw water) and finished treated water (plant effluent) turbidity is shown in Figure 1. The past 20-year average raw water turbidity was 0.73 NTU.

The zebra mussel population in the river could also be a contributing factor for the cyclical increase and decreases in raw water turbidity. Since zebra mussels feed on organic matter in the water, less zebra mussels feeding could show an increase in raw water turbidity.

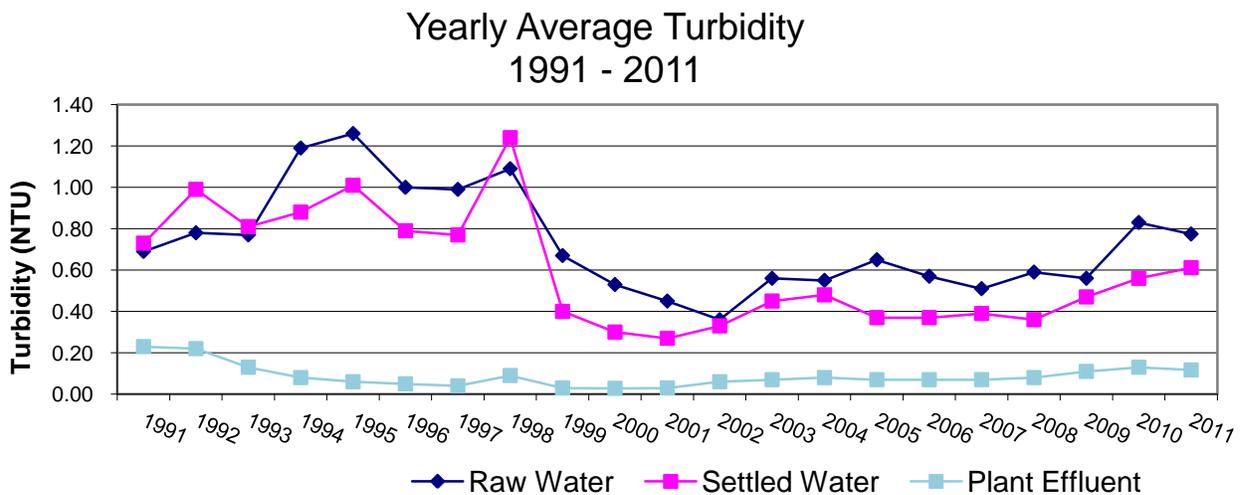


Figure 1

The annual raw water turbidity peak occurred January 17 at 4.5 NTU. At this time there appeared to be a large increase in river flows which could lead to an increase in turbidity.

The MAC for filtered water is 0.3 NTU for 95% of the time, without exceeding 1.0 NTU. The average filtered water turbidity was 0.06 NTU for 2011 and filters are taken off-line when the turbidity exceeds 0.15 NTU (half the MAC). The 2011 average treated water turbidity was 0.11 NTU.

Average Monthly Turbidity 2011

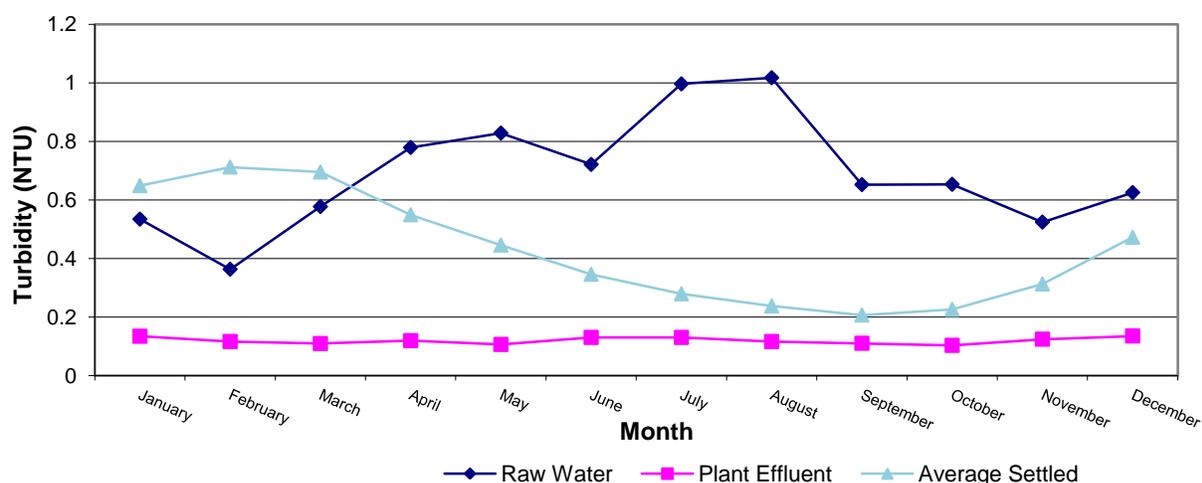


Figure 2

Taste and Odour

During 2011, the primary source of taste and odour in our raw water was from the naturally occurring compounds geosmin and 2MIB. These compounds are monitored as a precursor to taste and odour complaints of the water and are not a health concern. They can be detected by humans at very low levels (less than 10ng/L). A ng/L is equal to one billionth of a gram per litre. The bacteria actinomycetes, zebra mussels and some species of blue-green algae can produce geosmin and 2MIB, though the exact organisms are not known.

Previous annual data indicates that geosmin and 2MIB would hit peaks at the same time during the summer months. There is usually a large peak near the end of the summer when the water temperature is the highest. The concentration peaks for both taste and odour causing compounds occurred at approximately the same time (Figures 3 & 4).

Geosmin is thought to originate higher in the water column and produce an earthy odour. The average raw water value during 2011 was 10.4ng/L and the average plant effluent was 8.3ng/L (Figure 3). During the year, 50% of samples taken came back as too low to measure (3<MDL) for geosmin in the raw water.

2MIB is produced in the sediment or benthic layer and gives off a musty odour. 2MIB can reproduce well when sunlight can penetrate down to the bottom of lakes and streams. Zebra mussels may be clearing the water to allow sunlight to penetrate further down to these benthic layers. The average raw water value during 2011 was 4.9 ng/L and the average plant effluent was 4.5 ng/L (Figure 3). During the year, 75% of samples taken came back as too low to measure (3<MDL) for geosmin in the raw water.

A summer with plenty of sunlight (high water column algae) could contribute to higher amounts of geosmin and 2MIB. During 2011 one geosmin peak occurred in October 6th with a value of 34 ng/L (Figure 3) and the 2MIB peak occurred September 8th with a value of 14 ng/L.

The reduction of geosmin and 2MIB due to water treatment processes (coagulation, sedimentation, filtration and chlorination) was 20% and 8%, respectively. Both geosmin and 2MIB compounds resist oxidation (disinfection) and are difficult to remove by conventional water treatment processes.

Average Monthly Geosmin 2011

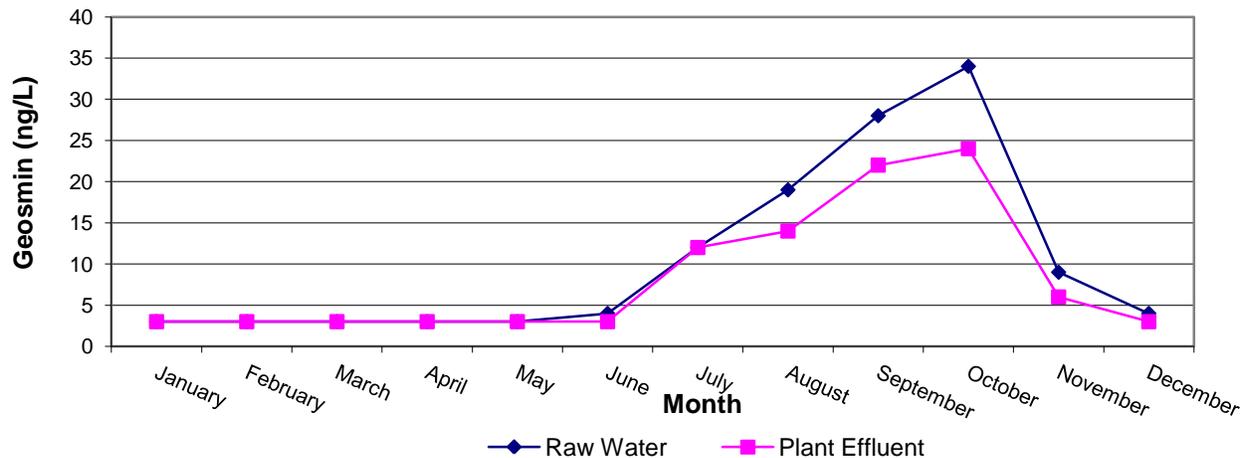


Figure 3

Average Monthly 2-Methylisoborneol (2-MIB) 2011

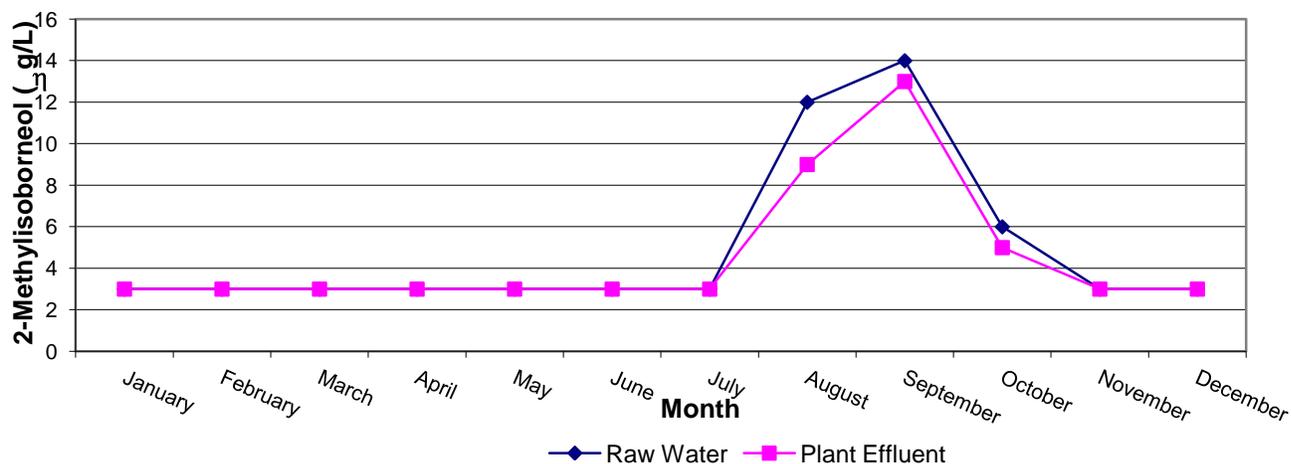


Figure 4

Blue Green Algae

Blue-green algae are technically known as cyanobacteria, a microscopic organism which is naturally present in our lakes and streams. Usually present in low numbers, however blue-green algae can become very abundant in warm, shallow, undisturbed surface water that receives a lot of sunlight. In 2011, there were an increase number of reported algae blooms, probably due to higher raw water temperatures (max. of 28.0°C with more sunlight) combined with lower river water flows. As a precaution, additional water quality samples were analyzed. However the increase in algae blooms had no significant impacts on the water treatment or quality.

Operational Parameters

Sodium Silicate

Sodium silicate (BW46) is added to the plant effluent for corrosion control within the distribution system as well as plant effluent pH adjustment. The use of chlorine and alum during the water treatment process lowers the pH level causing the water to be slightly acidic (corrosive). The addition of BW46 increases the pH to a more acceptable value of 7.1. The addition of BW46 contributes to the total silica level found in the water. The level of silica in the distribution system is monitored annually. Silica levels throughout the distribution system generally ranged between 2.3 mg/L and 20.2 mg/L with an annual average of 10.7 mg/L (from 23 different locations). The 2011 annual average silica level found leaving the water treatment plant was 11.1 mg/L.

Aluminum

Aluminium residual found in the plant effluent can be a by-product of the addition of aluminium sulphate (alum). Alum is used as our primary coagulant causing particles (silt, sand, algae, bacteria, etc.) to coagulate or 'clump' to form a floc, which can settle in the sedimentation basins. The water is further treated by filtration. Alum was added to the water during 2011 at an average rate of 44.9 mg/L. The average alum dosage during 2010 was 43.8 mg/L

A properly balanced/optimized treatment with coagulation, sedimentation and filtration resulted in reduced aluminium residuals in the plant effluent sample. The Province of Ontario's operational guideline for aluminium residual is 100µg/L. The average concentration of aluminium leaving the water treatment plant was found to be 40 µg/L. The annual average aluminium in the raw water (natural) was 9µg/L (Figure 5). The 2011 annual average aluminium found in the distribution was 38 µg/L. (from 137 samples) and the 2010 average value of aluminium found in the treated water was 46 µg/L

**Yearly Average Plant Effluent Aluminum
1991 - 2011**

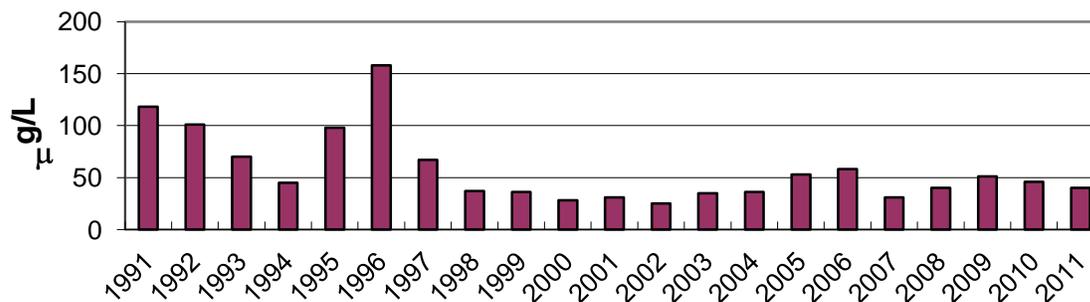


Figure 5

Chlorine

The Peterborough Water Treatment Plant uses chlorine for disinfection against virus and bacteria in accordance with O. Reg. 170/03. The primary disinfection dose of chlorine for 2011 ranged between 2.4mg/L and 3.5mg/L. During the summer months the primary chlorine dose could be as high as 3.5 mg/L due to warmer water temperatures and also to maintain the chlorine residual throughout the distribution system to comply with the Ontario Drinking Water Standards (ODWS).

Zebra mussel control for the water treatment plant included adding approximately 0.5mg/L of chlorine into the water treatment plant intakes from May to October. The addition of zebra mussel chlorine is dosed only during the months when we experience warmer water temperatures (usually when water temperature is above 12°C). This is when the zebra mussels will colonize on surfaces such as the intake pipe walls.

Post chlorine (or secondary chlorination) is dosed at approximately 0.1mg/L to 0.3mg/L to the finished water (plant effluent) in order to maintain a proper disinfection leaving the water treatment plant and to ensure that free chlorine residuals in the distribution system are maintained within MOE guidelines (target minimum of 0.20 mg/L free chlorine).



Zebra mussel chlorine dose modulator

Hardness

According to the MOE, the recommended operational guideline for hardness is 80mg/L to 100mg/L expressed as calcium carbonate (CaCO_3). This provides an acceptable balance between corrosion and incrustation.

Hardness is caused by the presence of certain dissolved chemical compounds with calcium and magnesium being the primary elements. The amount of hardness varies significantly depending on the source. Source water in areas where there are higher amounts of limestone and dolomite will have higher amounts of hardness. Calcium is dissolved as water passes over limestone deposits. Magnesium is dissolved as water passes over dolomite and other magnesium bearing minerals.

Groundwater usually has higher amounts of hardness due to the fact that groundwater will be in contact with these geologic formations for a longer period of time than surface waters. Average hardness values for Peterborough's raw water in 2011 was 89.2 mg/L as CaCO_3 and 90.3 mg/L in the treated water. Hardness at this level is considered to be moderately hard. Hardness does not appear to change from year to year substantially and treatment has little effect on it.

Alkalinity

Alkalinity is a measure of the capacity of water to neutralize acids and is also known as the buffering capacity. It is due primarily to the presence of naturally available bicarbonate, carbonate and hydroxide ions. According to the MOE, the recommended operational range for alkalinity in coagulant-treated drinking water is 30 mg/L to 500 mg/L as CaCO_3 . Alkalinity over 30mg/L assists flocculation formation during the coagulation process. Levels of 20 mg/L to 200 mg/L are typical for fresh water. Levels below 1 mg/L indicate that the system is poorly buffered and is very susceptible to changes in pH from natural and human-caused sources.

Average alkalinity values in 2011 were 94.3 mg/L for our raw water and 93.6 mg/L in the plant effluent (Figure 6). Alkalinity generally decreases when water is treated with alum (aluminium sulphate).

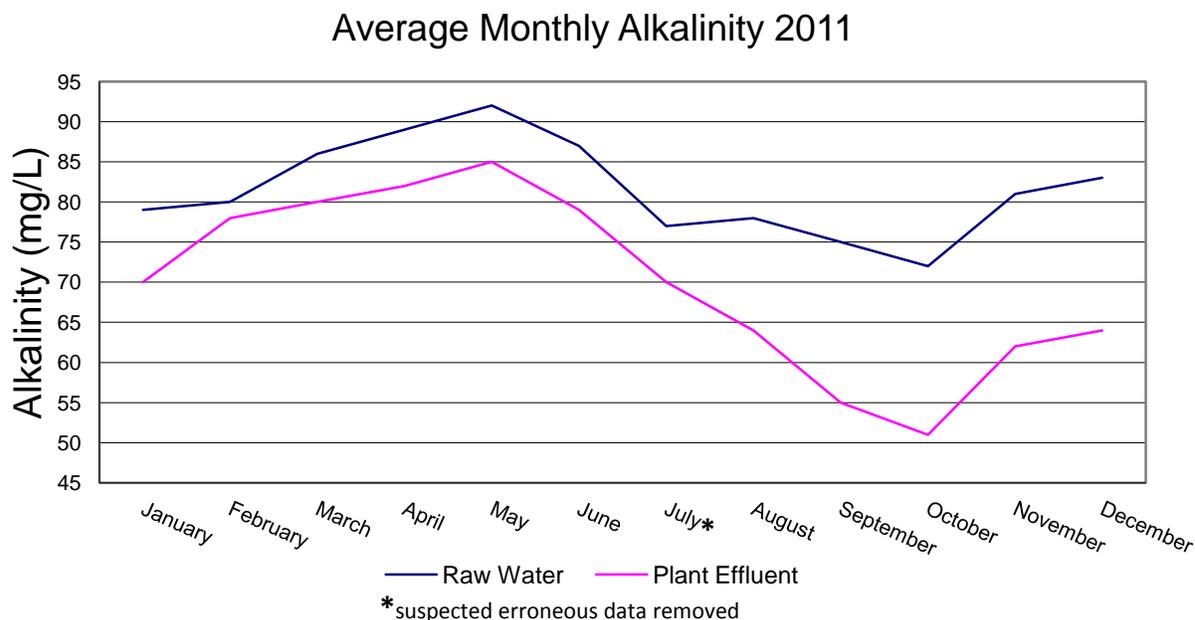


Figure 6

Hydrofluorosilicic Acid

Hydrofluorosilicic acid (fluoride) was added to the treated water to attain a combined average concentration of 0.65 mg/L (natural fluoride plus added fluoride). The fluoride feed system was off for a few days during 2011 due to preventative maintenance of the fluoridation feed and test equipment.

The MOE recommends that the fluoride residual be between 0.5 mg/L and 0.8 mg/L with a MAC of 1.5 mg/L. Approximately 1,300 samples taken at the water treatment plant, raw water and the distribution system and were tested for fluoride concentration during 2011. The average fluoride concentration found in the treated water was 0.60 mg/L. The average fluoride concentration found in the raw water (natural) was 0.15 mg/L.

Iron

Although not generally considered a health issue, excessive levels of iron in drinking water supplies may impart a brownish colour to laundered goods, plumbing fixtures and the water itself; it may produce a bitter, astringent taste in water and beverages. The precipitation of iron can also promote the growth of bacteria in water mains and pipes.

During 2011, 24 distribution locations were sampled each month and tested for iron. The 2011 average distribution iron levels were 0.029 mg/L (Figure 7). The average iron residual in 2010 was found to be 0.025 mg/L. The MOE aesthetic objective (for appearance effects only) is 0.30 mg/L.

Average Distribution Iron 2011

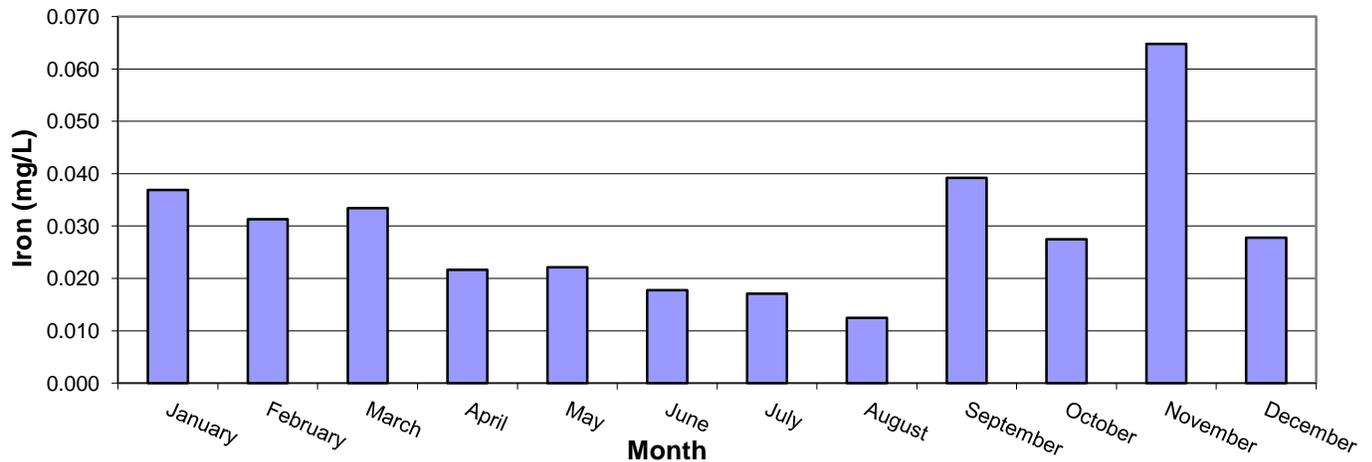


Figure 7

pH

The MOE operational guideline recommended in drinking water is to maintain a pH between 6.5 and 8.5. The principal objective in controlling pH is to produce a water that is neither corrosive nor produces incrustations. In 2011, the average raw water pH was 7.74 (Figure 8). With the addition of alum the pH is lowered to 6.86 (in the settled basins). With the addition of chlorine, pH is lowered further to 6.72 (in the chlorine contact tank). A pH of 6.72 is considered slightly corrosive so sodium silicate (BW46) is added to increase pH.

Sodium silicate (BW46) is added to the plant effluent water in order to raise the pH to an annual average of 7.1 and to deposit a thin silicate coating to the distribution piping for corrosion protection.

Average Monthly pH and BW 46 Dosage 2011

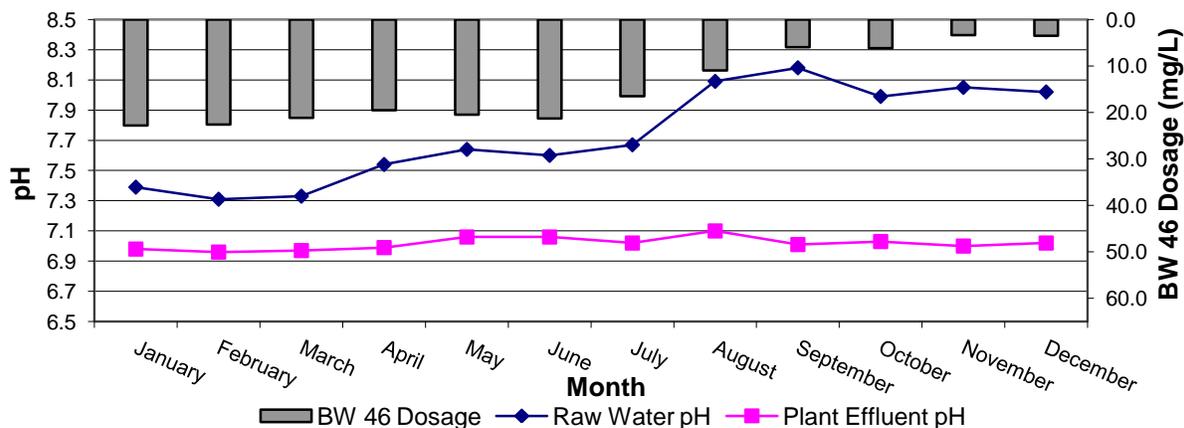


Figure 8

Regulatory Sampling

Lead Sampling

The lead sampling results have shown that over 99% of the sample results were below the Ministry's standard for lead (less than 10 $\mu\text{g/L}$). As a result of these low values, relief from full lead residential sampling was granted by the MOE in 2011. Through previous substantial lead sampling, it was determined that some residential locations (mostly built prior to 1920) might have internal lead piping and have lead in their drinking water. This may cause the level of lead in their tap water to be above 10 $\mu\text{g/L}$.

Bacteria

Clostridium Perfringens

The MOE guidelines for clostridium perfringens is to have all samples collected from the plant effluent to be zero CFU (colony forming units) per litre of water sampled. While the MOE does not require this parameter to be tested, the bacteria clostridium perfringens is analyzed as an indicator of treatment efficiency for protection from parasitic protozoan giardia and cryptosporidium. Clostridium perfringens frequent the intestines of humans and many domestic and feral animals. Spores of the organism persist in soil, sediments and areas subject to human or animal fecal pollution. Since this organism is spore forming it can be used to mimic other organisms that can be found in an oocyst stage such as giardia and cryptosporidium.

Giardia and cryptosporidium which are resistant to disinfection treatment and only through optimum coagulation, flocculation, sedimentation and filtration can these organisms be removed. If clostridium perfringens can be effectively removed from the water treatment train then there is a very low probability that giardia and cryptosporidium are present in the plant effluent. The relative sizes are as follows: Clostridium perfringens 1–2 μm, cryptosporidium 4–5 μm and giardia 8–14 μm.

The raw water, settled water and plant effluent were all monitored for clostridium perfringens during 2011. The raw water contained an average of 12 CFU/L of clostridium perfringens. All treated water samples for 2011 returned results of 0 CFU for clostridium perfringens (Figure 9), indicating an effective treatment process. During 2010, the average was 10 CFU/L in the raw water.

Average Monthly Clostridium Perfringens 2011

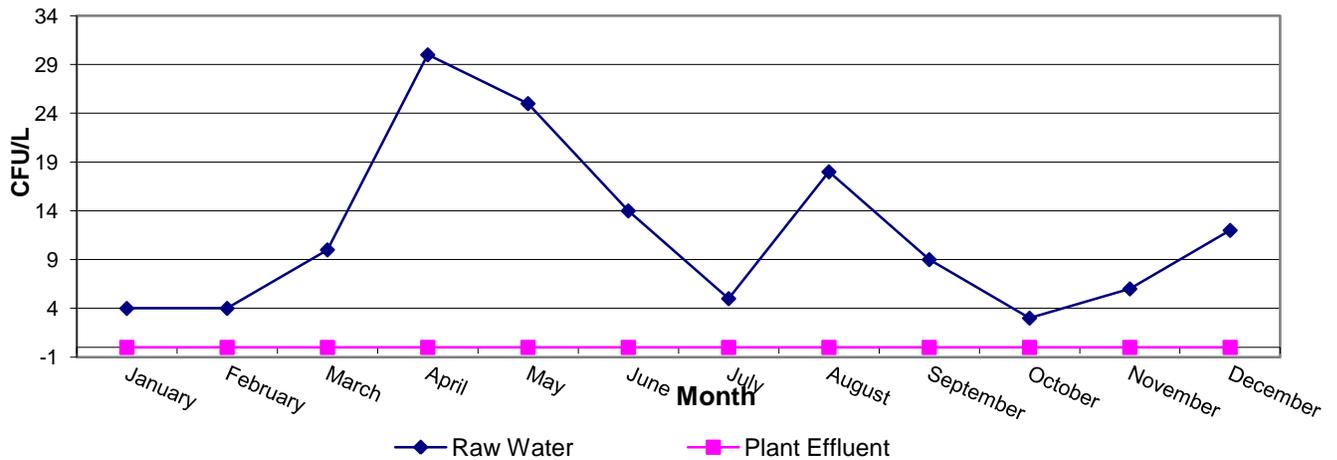


Figure 9

Fecal Streptococci & E. Coli Ratios

During 2011, a total of 12 fecal streptococci and E. coli samples were analyzed from the Otonabee River (at the WTP intake) to assist in determining the source of fecal contamination within our source water (Figure 10). Fecal streptococci are another species of bacteria (similar to E. coli) from warm-blooded animals.

A ratio between fecal streptococci and E. coli can assist in determining the species source of contamination. The ratio between 2011 average E. coli to fecal strep bacteria populations in the WTP raw water were found to be 1:0.5 CFU. This would indicate that the majority of fecal contamination in the Otonabee River found at the WTP was from ducks or geese.

Average Monthly Raw Water Fecal Streptococci & E. coli 2011

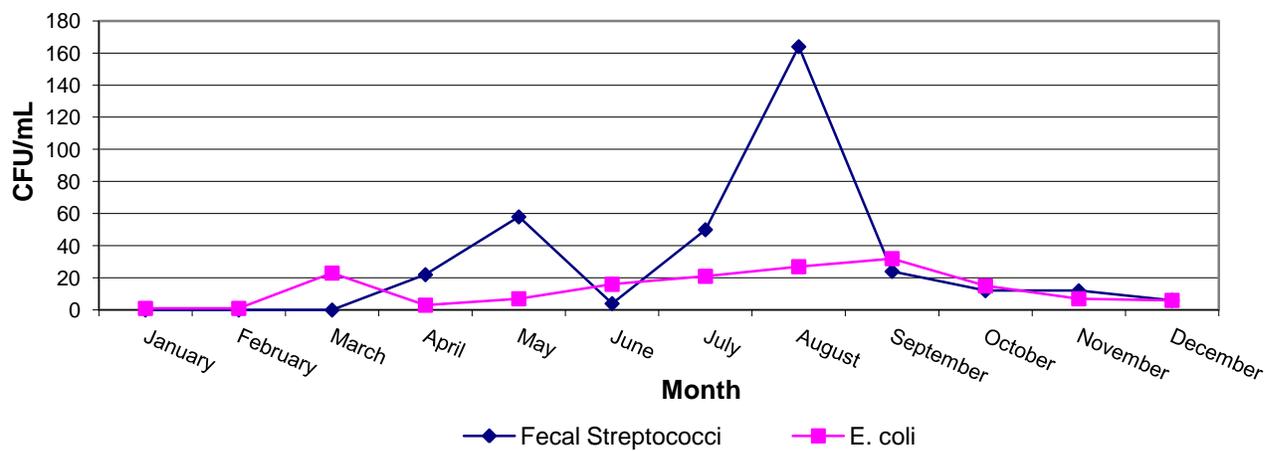


Figure 10

Testing

The Peterborough Water Treatment Plant fully complied with the quarterly and annual testing and reports required under the Ministry of the Environment's Drinking Water Systems Regulations 170/03 made under the Safe Drinking Water Act, 2002. Schedule 23 & 24 list the annual parameters required under the Drinking Water Standards, Regulations 170/03.

During 2011, there were two adverse water quality incidents reported to the MOE; a low free chlorine residual was detected (free chlorine lower than 0.05 mg/L) in the distribution system. The low free chlorine sampling location was flushed and re-sampled. The re-sample test results were in compliance to the MOE standards. The second adverse was sampled from an internal plumbing lead sample that was requested by a customer. This sample was found to have a high lead value (greater than 10 µg/L lead) and was reported to the MOE.

During 2011, there were over 20,000 individual water quality tests performed on samples taken from the Peterborough Water Treatment Plant and the distribution system. Approximately 13,000 tests were performed at the Peterborough Water Treatment Plant laboratory. SGS Lakefield Research Analytical Laboratory performed approximately 6,000 microbiological and chemical tests. The MOE laboratories performed approximately 1,000 tests including inorganic and organic parameters taken as part of the Drinking Water Surveillance Program (DWSP).

Please note that the majority of results indicated “< MDL” meaning that the results were below the Method Detection Limit (i.e. test could not detect any concentration). All tested parameters were found to be below the ODWS, MAC.

Lead is not part of Schedule 23 or 24 but is required to be sampled and tested annually. This sample must be taken from a location in the City's distribution system that may have the oldest water mains. Sherbrooke Street Sampling Station was selected as this location since it was indicated that the water mains in this area are over 100 years old.

Sodium is not part of Schedule 23 or 24 but is required to be tested at least once every 5 years. It has been sampled every year and was found to be below the ODWS aesthetic objective of 200mg/L. The local MOH must be notified when the sodium concentration exceeds 20mg/L so that this information may be passed on to local physicians.

Records of individual test results are kept on file at the Peterborough Water Treatment Plant laboratory. An updated copy of the Peterborough Water Treatment Plant annual report can be found on the Peterborough Utilities web site at www.peterboroughutilities.ca.

Ontario Drinking Water Standards Summary

Required under regulation 170/03

Note: All units are µg/L unless otherwise stated.

<MDL is less than laboratory Method Detection Level

MAC is the Maximum Acceptable Concentration

Schedule 23 – Inorganic Parameters

Parameter	Jan.06/11		MAC
Antimony	0.03		6
Arsenic	0.3		25
Barium	27.5		1000
Boron	8.1		5000
Cadmium	0.003	<MDL	5
Chromium	0.5	<MDL	50
Mercury	0.02	<MDL	1
Selenium	1	<MDL	10
Uranium	0.035		20
Lead* (Sampled at Sherbrooke Sampling Station)	0.15		10
Lead * (Treated Water)	0.03		10
Sodium** mg/L	11.7		20

Note: If any parameter from Schedules 23 and 24 were found to exceed half of the prescribed standard for the parameter, the frequency of sampling and testing for that parameter shall be increased so that at least one water sample is taken and tested every three months.

Schedule 24 – Organic Parameters

Parameter	Jan.06/11		MAC
Alachlor	0.02	<MDL	5
Aldicarb	0.01	<MDL	9
Aldrin + Dieldrin	0.01	<MDL	0.7
Aldrin	0.01	<MDL	
Atrazine + N-dealkylated metabolites	0.01	<MDL	5
Atrazine	0.01	<MDL	
Desethyl atrazine	0.01	<MDL	
Azinphos-methyl	0.02	<MDL	20
Bendiocarb	0.01	<MDL	40
Benzene	0.32	<MDL	5
Benzo(a)pyrene	0.004	<MDL	0.01
Bromoxynil	0.33	<MDL	5
Carbaryl	0.01	<MDL	90
Carbofuran	0.01	<MDL	90
Carbon Tetrachloride	0.16	<MDL	5
Chlordane (total)	0.01	<MDL	7
a-chlordane	0.01	<MDL	

Parameter	Jan.06/11		MAC
g-chlordane	0.01	<MDL	
Chlorpyrifos	0.02	<MDL	90
Cyanazine	0.03	<MDL	10
Diazinon	0.02	<MDL	20
Dicamba	0.20	<MDL	120
1,2-Dichlorobenzene	0.41	<MDL	200
1,4-Dichlorobenzene	0.36	<MDL	5
Dichlorodiphenyltrichloroethane (DDT) & Metabolites	0.01	<MDL	30
op-DDT	0.01	<MDL	
pp-DDD	0.01	<MDL	
pp-DDE	0.01	<MDL	
pp-DDT	0.01	<MDL	
1,2-dichloroethane	0.35	<MDL	5
1,1-Dichloroethylene (vinylidene chloride)	0.33	<MDL	14
Dichloromethane	0.35	<MDL	50
2-4-Dichlorophenol	0.15	<MDL	900
2,4-Dichlorophenoxy acetic acid (2,4-D)	0.19	<MDL	100
Diclofop-methyl	0.40	<MDL	9
Dimethoate	0.03	<MDL	20
Dinoseb	0.36	<MDL	10
Diquat	1	<MDL	70
Diuron	0.03	<MDL	150
Glyphosate	6	<MDL	280
Heptachlor + Heptachlor Epoxide	0.01	<MDL	3
Heptachlor	0.01	<MDL	
Heptachlor epoxide	0.01	<MDL	
Lindane (total)	0.01	<MDL	4
Malathion	0.02	<MDL	190
Methoxychlor	0.01	<MDL	900
Metolachlor	0.01	<MDL	50
Metribuzin	0.02	<MDL	80
Monochlorobenzene	0.30	<MDL	80
Oxychlordane	0.01	<MDL	
Paraquat	1	<MDL	10
Parathion	0.02	<MDL	50
Pentachlorophenol	0.15	<MDL	60
Phorate	0.01	<MDL	2
Picloram	0.25	<MDL	190
Polychlorinated Biphenyls (PCB)	0.04	<MDL	3
Prometryne	0.03	<MDL	1
Simazine	0.01	<MDL	10
Temephos	0.01	<MDL	280
Terbufos	0.01	<MDL	1
Tetrachloroethylene (perchloroethylene)	0.35	<MDL	30
2,3,4,6 - Tetrachlorophenol	0.14	<MDL	100
Triallate	0.01	<MDL	230
Trichloroethylene	0.43	<MDL	5

Parameter	Jan.06/11		MAC
2,4,6 - Trichlorophenol	0.25	<MDL	5
2,4,5 - Trichlorophenoxy acetic acid (2,4,5-T)	0.22	<MDL	280
Trifluralin	0.02	<MDL	45
Vinyl Chloride	0.17	<MDL	2
Dieldrin	0.01	<MDL	

Note: If any parameter from Schedules 23 and 24 were found to exceed half of the prescribed standard for the parameter, the frequency of sampling and testing for that parameter shall be increased so that at least one water sample is taken and tested every three months.

Disinfection By-Products

Colour

The colour of the water can indicate the degree of organic matter that may be present. The Otonabee River has ‘tea’ coloured water that indicates the presence of humic substances. Humic substances are the end product of decaying organic matter and most likely contain tannin (complex organic compound found naturally in soil and in certain tree barks) and lignin (natural compound common in woody plants and trees). These compounds are part of a natural group of organic substances in soil, produced by decaying vegetation. According to the Ministry of Environment colour is classed as a physical aesthetic parameter. The aesthetic objective for colour in treated water is 5 True Colour Units (TCU’s).

In 2011, the average raw water colour was 13 TCU and the average colour for our treated water was less than 1 TCU, this was the same value as 2010. The raw water colour tends to peak during the spring months when there is snow melt and/or high rainfall with a large amount of surface runoff. A large proportion of colour has been removed during our water treatment processes (Figure 11).

Average Monthly True Colour 2011

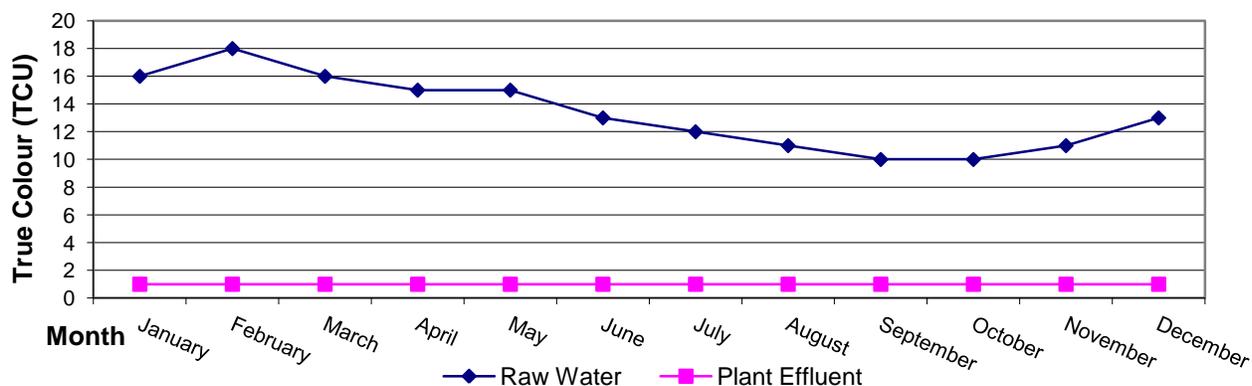


Figure 11

Trihalomethanes

Trihalomethanes (THM's) are formed as a by-product when chlorine is used to disinfect water for drinking. The presence of organic materials along with the use of chlorine in the water treatment process can contribute to the formation of disinfection by-products. The THM's may have adverse health effects at high concentrations and many governments set limits on the amount permissible in drinking water.

In Ontario, the Ministry of the Environment's MAC for total THM's (total concentration of chloroform, bromoform, bromodichloromethane and dibromochloromethane) are set to 100µg/L (sliding yearly average) for the distribution system. According to O. Reg. 170/03, THM samples must be collected and analyzed at least quarterly.

There are many factors which contribute to the formation of THM's with the more notable being water temperature, amount of organic material present (total organic carbon or TOC), chlorine residual present and time at which these chemicals are in contact with each other. The average water temperature was warmer which can increase the formation of THM's but the residency time (time that the water is in the water pipes) can be shorter since the water is being used more readily (for example lawn watering, etc.).

A lower TOC value in our finished water will help to lower the THM formation as the water travels through the distribution system. The water treatment plant processes (coagulation, sedimentation, filtration and disinfection) reduced TOC by 32% during 2011 to a value of 3.6 mg/L.

The THM average values found leaving the water treatment plant during 2011 was 44 µg/L. The average plant effluent THM level for 2010 was 55.0 µg/L. The past 10-year average plant effluent has been 47.7 µg/L (Figure 12).

Distribution levels are always found to be higher than those leaving the water treatment plant since THM's continue to form as the water travels through the distribution piping system. During 2011, one distribution location was selected to assist in determining areas of the city where THM's may be highest. The annual average THM value in the distribution system was 80.0 µg/L. The 10-year average of distribution THM concentration was found to be 71.3 µg/L.

If our customers are using more water, the reaction time between organics and chlorine is reduced. The less time that chlorine and organics are in contact with each other means that a lower concentration of THM's are produced. As noted in the executive summary, customers were using less water in 2011 which may have resulted in higher THM levels.

The raw water temperature during the summer hit a maximum of 28.0°C (26.9°C maximum in 2010). Since it is a chemical reaction, THM formation is greater when the water is warmer, more natural organics present and chlorination is used.

2011 Total Trihalomethanes

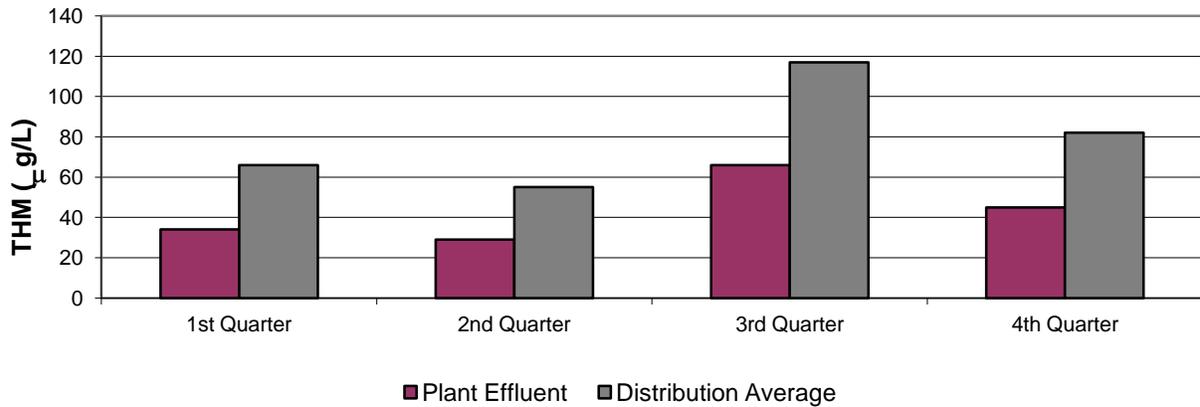


Figure 12

During 2011, 54% of the THM formation occurred in the water treatment plant and the remaining 46% was formed in the distribution system. In other years approximately 60% of the total THM formation took place at the Water Treatment Plant and the remaining 40% was formed in the distribution system (Figure 13).

The maximum amount of chlorine dosed during 2011 summer months was 3.5mg/L compared to 3.0mg/L in 2010. A higher amount of chlorine used will also increase the amount of THM formation.

**Peterborough Utilities Commission
Total Trihalomethane
2001 - 2011**

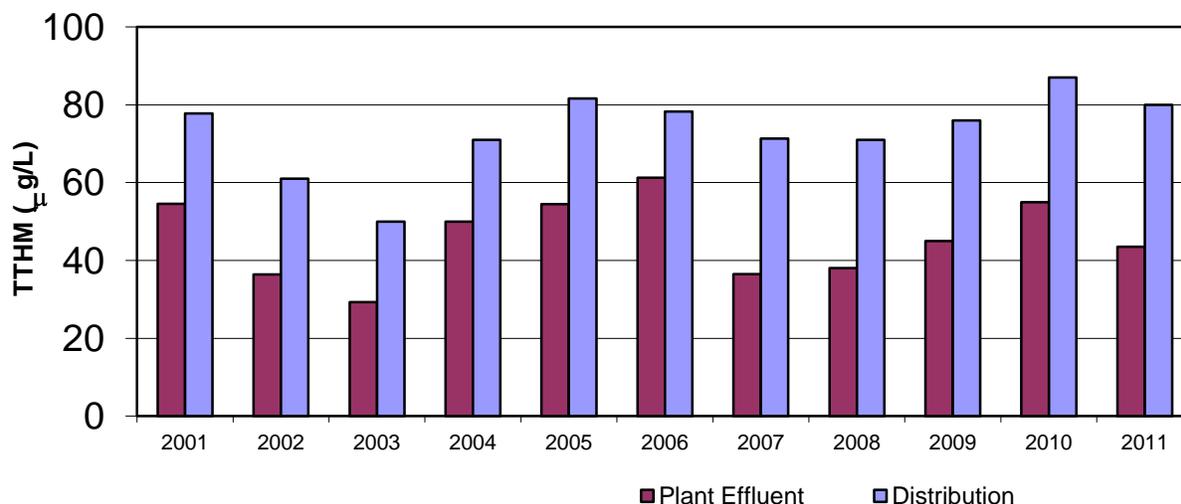


Figure 13

Total Organic Carbon (TOC)

Another test that indicates the amount of organic matter in the raw and treated water is TOC. The overall health of the natural river environment can be determined by TOC since these compounds can consume more oxygen. Sources for TOC are organic contaminants (natural organic substances, insecticides, herbicides and other agricultural chemicals) that enter waterways in rainfall runoff. Domestic and industrial wastewaters also contribute organic contaminants in various amounts. However, this is not an issue for Peterborough.

Some of the contaminants may not be completely removed by treatment processes; therefore, they could become a problem for drinking water sources. Higher amounts of TOC in the treated water can contribute to the formation of THM's in the distribution system.

The difference between TOC raw water and TOC treated water would indicate the amount of organic matter that has been removed through the water treatment process. The water treatment plant removed 32% of TOC from the raw water during 2011. During 2011, raw water TOC varied from 4.1 mg/L to 6.8mg/L (Figure 14).

Total Organic Carbon 2011

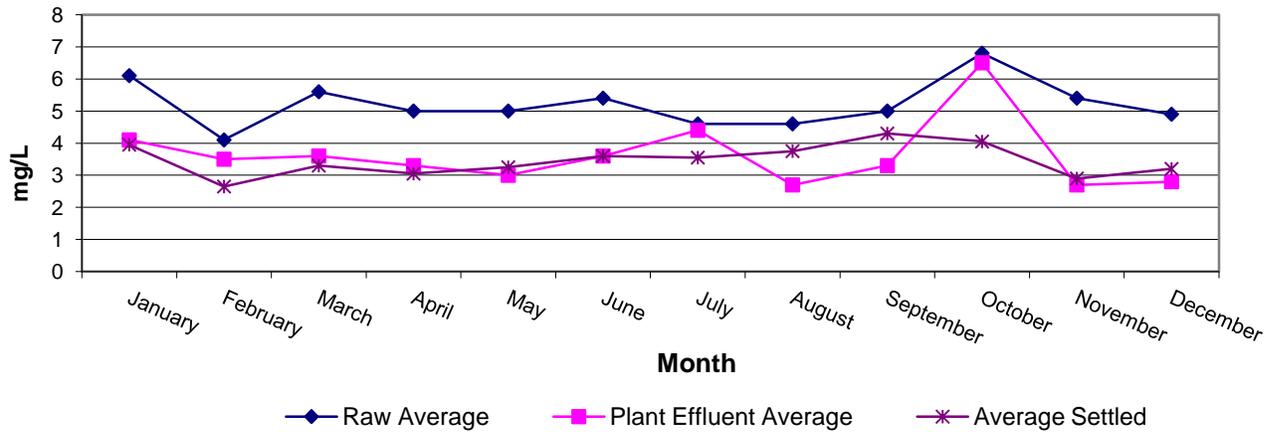


Figure 14

During the last 9 years the water treatment process has removed on average 40% of organic material as measured by TOC. Since 2009, the raw water natural TOC has steadily increased. 2011 has shown an increase in raw water TOC levels. Higher levels of TOC's when combined with chlorine (used for WTP disinfection) can form a higher concentration of THM's. TOC levels may have increased during 2011 due to fluctuations in river flows during storm events (Figure 15).

Total Organic Carbon - Raw Water 2006 to 2011

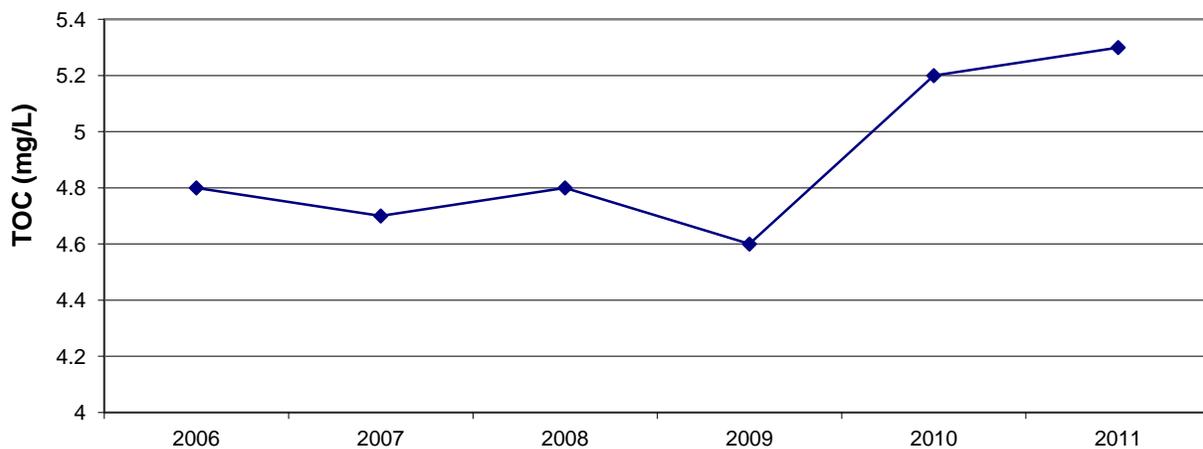


Figure 15

Haloacetic Acid

Since 2009 testing has been conducted on the raw and treated water for halogenic acetic acid (HAA) in anticipation that this will be introduced as a sampling amendment. The 2011 average treated water HAA was 32.5 µg/L and the average distribution sample was found to be 60.5 µg/L (Figure 16). The reported HAA value refer to the sum of the concentration of six haloacetic acid compounds which include monochloroacetic acids, dichloroacetic acids, trichloroacetic acids, monobromoacetic acids, dibromoacetic acids and bromochloroacetic acid.

HAA's are another group of chemicals that are formed as disinfection by-products similar to trihalomethanes (THM); they are a relatively new disinfection by-product being studied. HAA's are formed when chlorine is used to disinfect drinking water which reacts with naturally occurring organic matter (NOM) in water.

Presently there are no provincial guidelines or standards for HAA's in the Ontario Drinking Water Systems Regulation. The Guidelines for Canadian Drinking Water Quality recommend a MAC of 80 µg/L for HAA's in drinking water, based on a running annual average of a minimum of quarterly samples taken in the distribution system.

Haloacetic Acid 2011

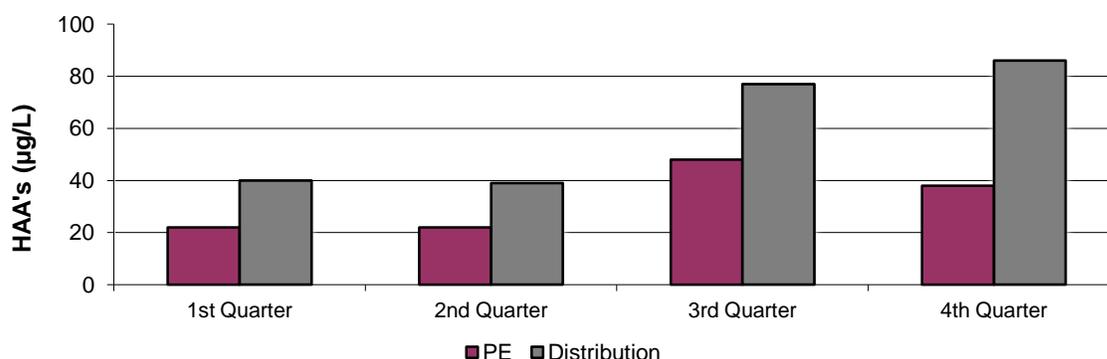


Figure 16

Ultraviolet (UV) Absorption

An Ultraviolet Absorption or UV test was introduced in 2005. This test is carried out daily on raw filter #1 and plant effluent samples to determine how well UV (at a wavelength of 253.7 nm) can penetrate our coloured waters, especially our filtered water. UV was studied since it may be a viable disinfection complement with chlorine.

The inability for UV to penetrate the water sample would indicate the presence of organic material. A higher UV transmittance would indicate that there is a lower amount of organic material present – less organic material to absorb the UV radiation. A higher UV transmittance in the plant effluent and filtered water indicates that most of the

organic material has been removed during flocculation, sedimentation and filtration.

During 2011, the average UV transmittance for raw water was 71.1%, the average for filter #1 was 87.5% and the plant effluent average was 89.3%. The UV results would indicate that the Water Treatment Plant process of flocculation, coagulation, sedimentation and filtration removed enough organic material to possibly utilize UV as an alternative disinfectant, provided that this technology is used after filtration. A high UV transmittance in our filtered and finished waters shows great promise to this technology as an alternative or complementary disinfectant.

Customer Calls

A customer concern computer program was initiated during 2006 to track all questions and concerns relating to water. Some questions and concerns that were asked from our WTP staff were related to taste and odour, colour, hardness, general water quality, information on water treatment, sampling, operations, ground water systems and questions to assist with school projects on water treatment.

In 2011 the staff at the Water Treatment Plant responded to a total of 53 inquiries (Figure 17). There were 8 requests for information such as hardness results, water quality reports and how the water treatment plant operates. There was also 1 request for lead sampling. The remaining 44 inquiries were related to the following concerns; 48% of customer concern calls were related to taste and odours (earthy/musty or chlorine). Another 34% of were relating to colour concerns (usually rusty coloured water). Some of these concerns were mainly due to water main construction or rehabilitation and routine water main maintenance. 16% of the concerns were related to particulate matter that the customer indicated was present in their water. This may also be due to rusty coloured water. Customers concerned about bacteria in the water accounted for about 2% of the overall complaints. In every case the water was tested for bacteria and none was found.

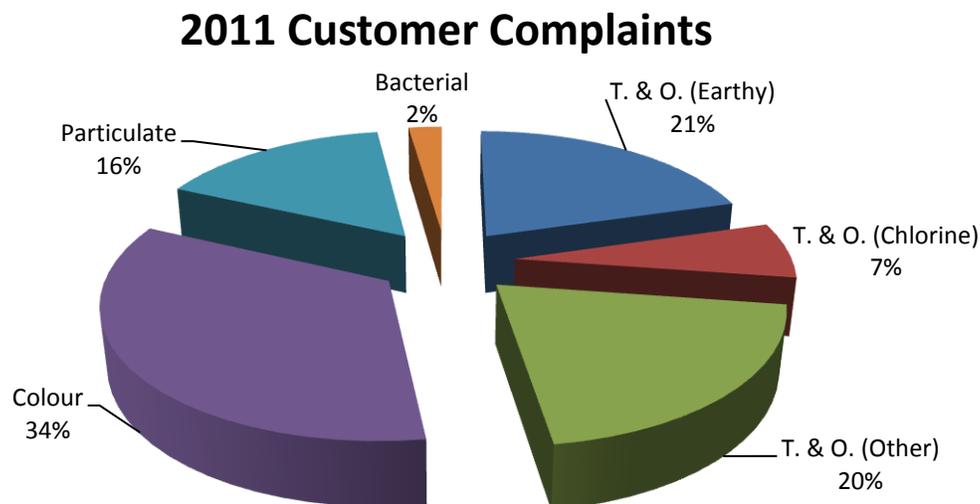


Figure 17

A further breakdown of the 21 taste and odour complaints revealed the following; 9 concerns were for an earthy musty odour, 3 concerns were for a chlorine taste and odour, and 9 concerns were for various other taste and odours, from metallic to medicinal. Since 2006 the number of customer concerns has decreased each year from a total of 367 concerns in 2006 down to a total of 44 concerns in 2011.

Number of Customer Concerns 2008 to 2011

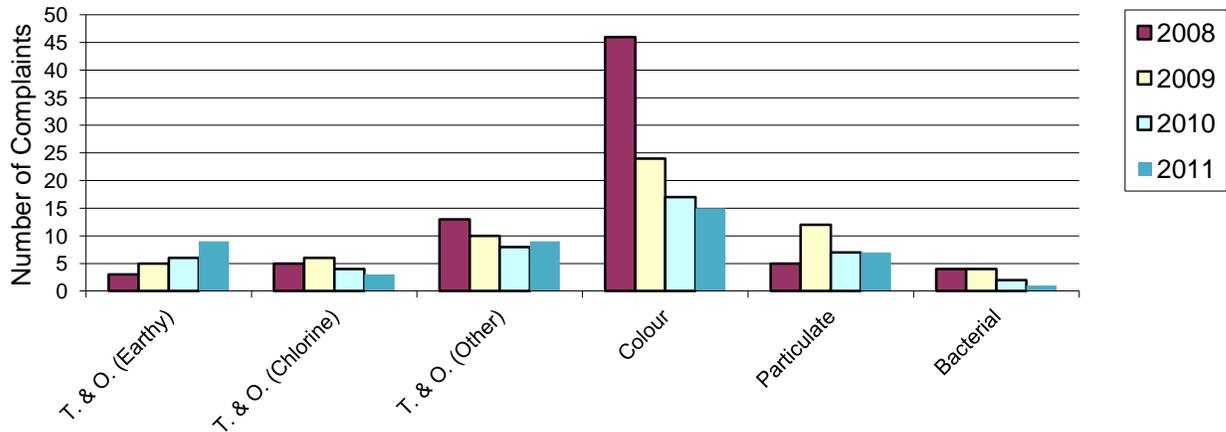


Figure 18

Tours

Tours have been an important part of public education at the Peterborough Water Treatment Plant. Over 220 people have had a tour of the water plant process during 2011 (over 1,300 people in the last 7 years).

Abbreviations

<MDL	Less than Method Detection Limit
2MIB	2-Methylisoborneol
Alum	Aluminum Sulphate
CaCo ₃	Calcium Carbonate
CFU	Colony Forming Unit
DNA	Deoxyribonucleic Acid
DWSP	Drinking Water Surveillance Program
HPC	Heterotrophic Plate Count
m ³	Cubic Meters
MAC	Maximum Acceptable Concentration
mg/L	Milligram (one in one thousand) per Litre
MOE	Ministry of Environment
MOH	Ministry of Health
ng/L	Nanogram (one in one billion) per litre
nm	Nanometer (one in one billion) per meter
NOM	Natural Organic Matter
NTU	Nephelometric Turbidity Units
°C	Degree Celsius
ODWS	Ontario Drinking Water Standards
TCU	True colour Units
THM	Trihalomethanes
TOC	Total Organic Carbon
µg/L	Microgram (one in one million) per litre
WTP	Water Treatment Plant