The City of Barrie owns and operates its own wastewater treatment facility which receives domestic, commercial and industrial wastewater and provides a level of treatment to meet the water quality standards of Kempenfelt Bay.

In Ontario, the Ministry of the Environment is the governmental body responsible for water quality. The effluent from the City of Barrie’s treatment facility is required to meet stringent limits established by the Ministry for discharge to receiving waters.

Considerable advances have been made in wastewater treatment since the first sewers were constructed in the 1890’s. These advances have not only been technological but conceptual as well. The old saying, “The solution to pollution is dilution” has since been rejected and today’s water quality standards are based on the best available technology as well as the ability of the receiving waters to assimilate the residual impurities remaining after the treatment process.
Why Do We Want to Treat Wastewater?

If wastewater was discharged without treatment directly to a receiving water system such as Kempenfelt Bay, it would severely damage the water quality and render it unsuitable for swimming, fishing and other recreational activities. Wastewater is a carrier of harmful bacteria and micro-organisms known as pathogens. Several pathogens include Cryptosporidium, Salmonella, Typhoid, E-Coli, Hepatitis A & B and Giardiasis also known as "beaver fever". Wastewater is also rich in nitrogen and phosphorus nutrients which stimulate excessive aquatic growth, which in turn, can be detrimental to aquatic life such as fish and waterfowl.

Where Does Wastewater Come From?

Every community produces wastewater. Wastewater is that portion of the water supply which has been contaminated through residential, commercial, institutional and industrial use. Every drop of water that goes down your drain is wastewater. This includes showers, washers, toilets, sinks, fountains, urinals and floor drains. Wastewater is approximately ninety-nine percent water and only one percent solids. The removal of these solids and disinfection of the water before discharge is the basic concept of wastewater treatment.

How Do We Evaluate Wastewater?

Wastewater can be measured and evaluated in many different ways. Physical characteristics such as colour, odour and temperature are perhaps the most obvious to us. Two of the most important measurements that have a wide application in wastewater treatment are Suspended Solids and Biological Oxygen Demand. Suspended solids refer to undissolved particulate matter which may be filtered from the liquid portion. Wastewater containing excessive amounts of suspended solids can cause turbidity providing protection for pathogens to live or blanketing of the lake bottom and, in turn, destroying spawning beds for aquatic life. Biochemical Oxygen Demand, or B.O.D., represents the quantity of oxygen utilized in the stabilization of wastewater under controlled laboratory conditions. High values are indicative of the capacity of wastewater to cause rapid depletion of this dissolved oxygen content of a receiving body of water, rendering it incapable of sustaining higher life forms.

Wastewater also contains ammonia and phosphorus which are important in the sewage treatment process, however when discharged to the receiving waters act to promote the growth of algae.
HOW DOES WASTEWATER ARRIVE AT THE WATER POLLUTION CONTROL CENTRE?

A system of sanitary sewers receives wastewater from the community and conveys it by gravity – in other words, from a higher point to a lower point – directly to the Pollution Control Centre. Several pumping stations lift wastewater from isolated topographical depressions into the sanitary sewer system.

History of Pollution Control Development in Barrie

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>1850</td>
<td>Town of Barrie is incorporated</td>
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<tr>
<td>1890</td>
<td>A sewer system is installed to discharge directly to Kempenfelt Bay via underground pipes and outfalls</td>
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<tr>
<td>1897</td>
<td>Town of Barrie and Village of Allandale amalgamate</td>
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<tr>
<td>1908</td>
<td>A sewer system is proposed in two wards of the town with direct discharge to Kempenfelt Bay outfalls. The system is designed with open joints and connections to receive as much ground water as possible, and with appurtenances at creeks and springs to allow additional water into the system to reduce the strength of wastes by dilution.</td>
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<tr>
<td>1911</td>
<td>Population of Barrie is approximately 7000</td>
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<tr>
<td>1911</td>
<td>A sedimentation (Imhoff) tank is built on the present plant site</td>
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<tr>
<td>1940</td>
<td>A treatment plant is constructed consisting of three 25’ diameter clarifiers and a 30” diameter outfall 470’ into the Bay. An interceptor sewer was built to divert all outfalls to the treatment plant, although overflows were maintained to handle storm flow.</td>
</tr>
<tr>
<td>1952</td>
<td>Treatment addition consisting of aerated grit tank, 80’ diameter clarifier, and sludge digester gives full primary treatment.</td>
</tr>
<tr>
<td>1959</td>
<td>Incorporation of the City of Barrie</td>
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1960
The Toronto Street pumping station and 16” force main were constructed to replace the deteriorated 1940 interceptor.

1962
The Lakeshore trunk interceptor is installed from the Toronto Street pumping station to Blake and Steel Streets, cutting off old sewage outfalls.

1965
Two digesters, two aeration and final settling tanks and administration facilities were added to provide secondary treatment.

1970
Renovations to secondary treatment provide additional air supply. Another Primary clarifier is added and the raw sewage pumping capacity at the Main Plant pumping station is increased.

1974
Nutrient removal begins. A third final settling tank is added.

1977
A secondary digester is built.

1980
Completion of a new building housing administration and laboratory facilities.

1988
Completion of a major expansion comprising of a high purity oxygen treatment process and tertiary filtration at an increased hydraulic capacity. Toronto Street pumping station is abandoned.

1992
Completion of additional primary settling tank. New garage and workshop built with renovations to the administration building. Outfall to Kempenfelt Bay modified to a staged diffuser.
1996
Completion of Digestion Facilities Upgrade with renovations to digesters and gas mixing systems, construction of aerobic reactors for the dual digestion process and co-generation for the recovery of heat and production of electricity from methane gas.

1999
Completion of an Effluent Quality Upgrade to expand secondary settling, produce nitrified effluent by rotating biological contactors and replace effluent chlorination with ultra-violet disinfection. Biosolids storage lagoons in Oro-Medonte Township are re-constructed and lined to facilitate winter storage.

1999
Completion of a Waste Sludge Thickening Facility to improve primary settling tank efficiency and assist solids handling in the dual digestion process. The capacity of the Biosolids Storage Facility in Oro-Medonte Township is increased by the construction of four enclosed storage tanks.

2004
Completion of the Primary Treatment Expansion with the addition of a third clarifier and two aerated grit tanks. An Influent Building is added to incorporate coarse grinders, fine grinders and screenings press to replace the former bar screens. Renovations to the administration building are completed.

Southeastern view of plant
Preliminary Treatment

Coarse grinders are located at the inlet to the wastewater plant to grind up any large objects in order to protect the subsequent pumps. Wastewater is then lifted up by large raw sewage pumps from the level of the incoming sewers to a higher elevation so that it may flow by gravity down through the further steps of treatment in the plant. The sewage then passes through fine grinders and augers that further grind up solids which are then removed by augers for disposal to the municipal sanitary landfill site. Wastewater then flows by gravity to the aerated grit chambers.

Fine Grinders and Augers

The principle function of the aerated grit chamber is the removal of heavier inorganic solids like sand that may damage equipment and interfere with downstream treatment processes. The velocity of roll or agitation in the tank is controlled by the tank dimensions and the quantity of air added. The velocity of roll is maintained at approximately 0.3 m/sec. As the velocity of the incoming wastewater is reduced, the heavier inorganic particles settle out while the lighter more buoyant organic particles remain in suspension. The accumulated inorganic material is removed by an auger, pumped into classifiers for dewatering before being transported to the municipal sanitary landfill site.

Primary Treatment

The wastewater now proceeds through primary settling tanks. Under quiescent conditions, with flow-through velocities of less than 0.3 m/sec., the readily settleable solids, (those sufficiently heavier than the liquid settle within hours), and floating materials are separated. A chain and flight mechanism scrapes the settled solids (raw sludge) and floating materials (scum) into separate storage hoppers. These wastes are discussed later under dual digestion.

Primary and Aerated Grit Tanks
UNOX/Aeration Tanks

Secondary Treatment

The settled wastewater effluent from the primary settling tank contains finely divided and dissolved organic material not removed through conventional physical treatment methods. In secondary treatment, both chemical and biological processes are used to further treat the wastewater. The core of the biological waste treatment is the activated sludge process, so named because of the active mass of biological floc maintained in suspension by mechanical mixing. The settled wastewater is combined with return activated sludge from the five secondary settling tanks, and is then fed into three Aeration Tanks.

High Purity Oxygen Storage

Activated sludge treatment is really a natural purification process that is sped up by optimizing the environment to permit rapid growth by expending energy. In the aeration basins, colonies of micro-organisms (mostly bacteria) utilize the sewage as a food source. High purity oxygen is incorporated into the biological floc to create and maintain an environment that permits rapid biological growth without becoming oxygen limiting. It is in these tanks that the bacteria consumes the dissolved organic material from the wastewater thereby, remains the BOD (Biological Oxygen Demand). The bacteria, after feeding, becomes settleable.

The secondary settling tanks and aeration basins are the basic integral parts of the secondary treatment process. Solids settled from the liquid are recycled back into the aeration basins so that the process remains continuous. Routinely, a portion of the returning solids are removed and thickened for treatment by dual digestion. This “wasting” operation occurs continuously to control the total amount of biological floc active in the system.
Simultaneous phosphorus removal is achieved by chemical addition into the activated sludge at the pure oxygen reactors inlet. Aluminum sulphate combines with the phosphorus, producing a floc that settles with the biological solids.

Secondary effluent is pumped to rotating biological contactors which through a process called nitrification converts ammonia and organic nitrogen to nitrates. High ammonia levels can cause excessive algae growth and oxygen depletion in the receiving waterbody. There are twenty rotating biological contactors arranged into 5 cells of 4 units running parallel to one another. Nitrified effluent from the R.B.C. is flash mixed with alum and then flocculated to further assist the removal of phosphorus in tertiary treatment. The biologically treated wastewater effluent from the secondary treatment process is channeled to the sand filtration process. The wastewater is passed through the filtration media to remove the remaining suspended solids prior to ultra-violet disinfection and discharge to the Kempenfelt bay outfall sewer.
Dual Digestion

Raw sludge from the primary settling tanks and thickened waste activated sludge is pumped to the aerobic digesters for treatment. Pure oxygen is injected and mixed with the sludge to promote microbial activity and auto-thermally raise the temperature to between 55°C and 60 °C. The sludge is then pumped to the primary anaerobic digesters where the further breakdown of organic material occurs in the absence of air between 35°C and 40°C. Anaerobic digestion also receives scum waste from the primary settling tanks. An unheated secondary digester receives sludge from the primary digesters and completes the stabilization process. This permits sludge settlement and formation of a thinner layer on top called supernatant. Supernatant is returned to the treatment process and results in a thicker sludge to be further handled.

The final sludge referred to as “biosolids” is a black, relatively odourless liquid which is used as a fertilizer and soil conditioner on agricultural land. Aerobic digestion produces heat by biological activity in the digester; however, additional heat is required for the anaerobic digestion process. This, in turn, results in all recovered digester gas being made available for other energy recovery processes. Compared to conventional anaerobic digestion, dual digestion kills more pathogens allowing more choices for off-site utilization of biosolids and reducing the hydraulic retention time for sludge processing.

Digester gas (principally methane) produced by the digestion process is used to run hot water boilers to provide heat to the plant as well as run gas engines to drive generators and produce a portion of the plant’s electrical requirements as well as hot water for space and process heating.

Aerobic Digester
Laboratory

The environmental services laboratory is located within the administration building at the Water Pollution Control Centre (WPCC). It provides analysis and support for the Environmental Services branch including the WPCC Operations as well as Environmental Response and Investigation. The lab is under the supervision of the Senior Environmental Officer – Laboratory. Analysis is performed on a routine basis including, but is not limited to; Ammonia, Phosphorus, pH, Turbidity, Solids analysis and Biological Oxygen Demand. The immediate availability of results aids in plant performance evaluation and compliance assurance of the plant’s discharge with the Ministry of Environment Guidelines. Internal quality and assurance control are equivalent to those set out by regulatory authorities.

Environmental Services Laboratory

Summary

In brief, the entire treatment process can be described as the transformation of wastewater into three (3) useful products: treated effluent, an agricultural crop fertilization supplement and energy in the form of heat and electricity. The City of Barrie will continue to keep abreast of the best available technology in the treatment of wastewater. With good planning and selective growth, we look forward to the future with confidence that the City of Barrie and the surrounding municipalities will always be able to enjoy the recreational waters of Kempenfelt Bay while maintaining growth and prosperity in a healthy environment.