# Town of Petrolia Wastewater Treatment Plant Upgrades

# Canadian Consulting Engineer Awards 2018

Category: C. Water Resources

April 19, 2018



# TABLE OF CONTENTS



1	Project Information1
2	Project Summary2
3	Innovation
4	Complexity6
5	Social/Economic Benefits7
6	Environmental Benefits
7	Meeting Clients Needs9

# 1. PROJECT INFORMATION

Location of Project

The Petrolia Wastewater Treatment Plant (WWTP) Upgrades project is located at 546 Maude Street in the Town of Petrolia, located in central Lambton County in Southwestern Ontario, near Sarnia. The Town, including the WWTP and Landfill, are shown in Figure 1.

#### Category

This award submission is in Category C – Water Resources

#### Engineering Firm(s)

This project was engineered by CIMA Canada Inc. (CIMA+)

101 Frederick Street Suite 900 Kitchener, Ontario N2H 6R2 Canada

#### 1.4 Role

CIMA+ provided comprehensive engineering (process, structural, electrical, civil, building mechanical), landscape design, architectural, project management, and contract administration functions.

#### 1.5 ACEC

CIMA+ is a member of the Association of Consulting Engineering Companies of Canada.

#### 1.6 CIMA+ Contacts

Lauren Fox	Tom Montgomery, P.Eng.	Troy Briggs, M.Eng., P.Eng
Tel: 905-695-1005	Tel: 519-772-2299	Tel: 905-695-1005
Lauren.Fox@cima.ca	Tom.Montgomery@cima.ca	Troy.Briggs@cima.ca



Figure 1: Map of Petrolia.

# 2. PROJECT SUMMARY

The Petrolia Wastewater Treatment Plant (WWTP) infrastructure was deteriorating after 40 years of service. The Town of Petrolia, a critical central community of 5,500 in the County of Lambton, retained CIMA+ to provide an innovative approach to upgrade and retrofit the existing plant and treat the Town's local landfill leachate with an expanded plant capacity. The project produced a state-of-the-art plant that reduced the Town's emergency wastewater expenditures and supports Petrolia's community growth development plan.



Figure 2: Existing Petrolia WWTP, Including Lagoon



**Figure 3:** Newly Built WWTP Upgrades (Front), Repurposed Existing Plant (Back)



Figure 4: Completed Petrolia WWTP

## 3. INNOVATION



Figure 5: Projected Future Flows to Petrolia WWTP



Figure 6: New High-efficiency Turbo Blowers



Figure 7: New Disk Filters

CIMA+ undertook the complex task of upgrading and expanding the Petrolia WWTP at the existing site to accommodate future growth and leachate loadings while the existing plant remained in operation.

CIMA+ planned construction and start-up of the upgraded facility to ensure continuity of treatment. Once the upgraded plant was built, the old plant was sequentially decommissioned; the existing secondary clarifiers were retrofitted to aerobic digesters and, the existing aeration tanks were converted to a maintenance storage facility.

The upgraded Petrolia WWTP, located in the Town of Petrolia in the County of Lambton, is an extended aeration facility with tertiary filtration and an ultraviolet (UV) disinfection system which discharges treated effluent into Bear Creek. This expansion project increased the plant's rated capacity by 39% to accommodate current flows (which frequently approached or exceeded previous rated capacity), and future growth in the area within the next 25 years. This growth and current limitations are shown in Figure 5.

The design to provide reliable capacity, redundancy, and performance for the expansion, included the following major components in a state-of-the-art facility in rural Ontario:

 Construction of new Headworks, including two fine, mechanically-cleaned bar screens, channel aeration system including positive displacement blower, and vortex grit removal.

- Construction of the two new extended aeration tanks, each with anoxic and aerobic zones and full floor fine bubble diffusers.
- Construction of two new chain-and-flight secondary clarifiers.
- Construction of a new blower building to house the new RAS/WAS and scum pumps, high-efficiency turbo blowers (shown in Figure 6), alum dosing system.
- New Administration Building, including new Control and Electrical Rooms, laboratory, offices.
- Construction of new integrated Tertiary Filtration and UV disinfection facility designed for peak flows, including two disk filters (shown in Figure 7), energy-efficient UV disinfection, and chlorinated plant water supply.
- Automation upgrades to provide monitoring and control of most process equipment and instrumentation in the upgraded WWTP to match the plant's design flow (screenshots shown in Figure 8).
- Upgraded WWTP Inlet pumping station.
- Repurposing of existing WWTP secondary clarifiers as two aerobic digesters for the upgraded WWTP.
- Construction of Lagoon Pumping Station to return bypass lagoon supernatant to the Headworks for treatment.

#### 3. INNOVATION





1

• Standby power equipment for all major components of the plant.

CIMA+ designed the upgraded WWTP on the expectation that leachate from the local landfill could be treated there. The ability for the plant to treat leachate is expected to eliminate leachate haulage operations once the local landfill completes a 1 km connection to the Petrolia collection system.





**Figure 8:** SCADA Screenshots (Clockwise from Top Left: Headworks, Aeration Tanks and Blowers, Secondary Clarifiers and RAS/WAS, Tertiary Treatment and Disinfection, Aerobic Digesters, Alum Dosing System).

Figure 9: New Headworks Building Overlooking New Plant



Figure 10 and 11: Retrofitted Existing Aeration Tanks for Storage and Aerobic Digester Blowers

#### Petrolia's new WWTP is now a state-of-theart facility that combines new buildings with retrofit/repurposed existing buildings. The new Headworks Building provides power to all major components of the plant, and the inlet pumping station, functionally positioned to overlook the plant as shown in Figure 9.

The existing aeration tanks were covered with a roof structure, externally cladded and repurposed into a maintenance and storage facility that also houses the blowers for the aerobic digesters (Figure 10 and 11). Two overhead entrance doors and separate access doors were cut in through the existing concrete walls to allow for equipment and machinery access. Electrical and mechanical including lights, overhead door openers, and HVAC were installed in the repurposed tanks. The design incorporated site grading, and front and rear driveway entrances to the overhead doors. Half of the existing tanks will be repurposed into a training facility for the Petrolia & North Enniskillen Fire Department.



Figure 11

# 3. INNOVATION

### 4. COMPLEXITY



Figure 12: New Lagoon Pumping Station

The proximity of the residential area (slightly more than 100 m clearance) around the facility's site was a significant constraint during the design and construction phases for the Petrolia WWTP Upgrades Project. The architecture of the facility was improved to be visually appealing; significant landscaping was also undertaken, including grading of berms and tree planting, as shown partially completed in Figure 13.

The new plant was constructed on the limited site while the existing plant remained in operation. CIMA+ engineers designed the new plant with the site's constraints in mind, eliminating larger sand filters in favour of compact tertiary treatment disk filters to meet effluent criteria, and utilizing common walls between many different process, administration and storage areas. The project also converted the existing secondary clarifiers into aerobic digesters to further reduce the new plant's footprint and the project's capital expenditure.

The project's design included a pumping station to service the existing lagoons adjacent to the facility, which were previously used for bypass flow and for digested sludge storage with seasonal discharge directly to Bear Creek. The pumping station will be used to transfer lagoon supernatant to the Headworks of the new plant for full treatment and disinfection. This is possible due to the new plant's expanded capacity.

The new plant's design also included for the treatment of the leachate from Petrolia's landfills.



Figure 13: Landscaping with New Trees

### 5. SOCIAL/ECONOMIC BENEFITS



**Figure 14:** Headworks Building Facade and Shared Wall with Aeration Tanks

The upgraded WWTP provides many economic and social benefits to the residents of Petrolia and the surrounding communities.

The new plant was developed in the most costeffective way possible. Its compact layout and shared-walls design provided improvements from an energy efficiency perspective by reducing heat loss from the buildings. The Town's unexpected expenditure on equipment malfunctions for the facility also decreased.

Tanks were designed with high efficiency aeration blowers capable of providing significant savings over the existing inefficient and obsolete mechanical aerators. Additionally, deeper tanks and fine-bubble diffusers provide further energy savings. As another cost saving measure, every effort was made to reuse existing tanks and buildings, where they are still structurally sound, to minimize the overall project cost. Reliable equipment will ensure that the residents of Petrolia are not burdened with emergency expenditure costs in the coming years.

The aesthetics of each of the new buildings at the facility (Headworks, blower/pump, and filter/ UV) incorporate Petrolia's Victorian heritage with 19th Century Victorian industrial style of the brick detailing, window placement, flat roof and brick parapet. Building construction and landscaping benefit the surrounding residential neighbourhoods for a pleasing view of the plant. These aesthetics are shown in the façade of the Headworks building, shown in Figure 14.



Figure 15: Overhead View of Plant Showing Aeration Tanks, Secondary Clarifiers, Tertiary Treatment Building, Architecture, Landscaping, Adjacent Residential Development



**Figure 16 and 17 (below):** Existing outdated plant unit process with insufficient current and future flow capacity

The Petrolia WWTP experienced 50 days of bypasses between 2008 and 2011 due to equipment malfunctions and insufficient capacity of the existing plant. One of the major objectives of the Petrolia WWTP Upgrades Project was to allow the plant to handle current and future flows and protect the Bear Creek receiving body. The resulting solution incorporated safeguarding against treatment plant bypasses by allowing emerging storage in the lagoons during extreme flow events. In addition, CIMA+ designed a new pumping station to transfer lagoon supernatant to the new plant Headworks for full treatment during low flows. Petrolia Landfill is located less than 1 km from the Petrolia wastewater collection system and approximately 2.5 km from the Petrolia WWTP, and an opportunity was identified to direct leachate through the wastewater collection system. This proximity is shown in Figure 1.

The Town will also have the ability to reduce or eliminate trucking of the solid waste leachate to external disposal facilities by treating the leachate at the new plant, upon completion of connecting a landfill leachate forcemain to the Town's collection system. This will further increase the Town's sustainability.



Figure 17



Figure 18: On-site lagoons and pump station for storage and conveyance of wet weather flows

# 7. MEETING THE NEEDS OF CLIENTS



you'll be surprised!

The Town of Petrolia was aware of the need for expansion at their wastewater treatment plant to meet current and future flows while reducing emergency operation and maintenance costs of aging equipment. Emergency shutdowns and bypasses at the plant were a detriment to the Town's limited wastewater expenditure budget. Without external funding, it was predicted that Town residents would have seen a 300% increase in wastewater taxation rates over a six-year period. CIMA+ assisted the Town in their application for the provincial and federal governments grant funding for the majority of the project. The provincial and federal governments supplied two-thirds of the project funding, approximately \$13.5M dollars, as shown in Figure 19.

The new Petrolia WWTP now suits the Town's needs as predictable expenditure will occur for the new equipment with increased redundancy in case of required maintenance. The new facility's design capacity provides room for growth in Petrolia's population which supports the Town's growth development plan.

The design approach provides the operational flexibility with component redundancy of all major equipment, allowing buffering during high flow events into the lagoons without compromising effluent quality or causing wash out of the plant's biomass.



Figure 19: Project Funding Board