# UNDERSTANDING AND OPTIMIZING THE PERFORMANCE

## OF MUNICIPAL WASTE STABILIZATION PONDS IN THE FAR NORTH

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### WHY DID WE DO THIS RESEARCH?

Wastewater management in Canada's Far North is challenging for many reasons: extreme cold climate, permafrost, short summers, remote locations, smaller populations and a shortage of skilled operators. Because of this, many communities use passive technologies like waste stabilization ponds — exclusively, or in combination with a wetland treatment area.

In 2012, Environment Canada introduced new Wastewater Systems Effluent Regulations that specify national performance standards for wastewater treatment. Communities in Canada's Far North were granted a temporary grace period to allow time for research to inform appropriate standards for treatment and monitoring.

This research examines existing treatment performance and methods to optimize treatment mechanisms in Arctic climates.

### WHAT DID WE DO?

The first phase of this project explored the performance of existing systems in Nunavut by installing *in-situ* probes that recorded the temperature, pH, specific conductivity and dissolved oxygen of waste stabilization ponds, and assessed treatment performance of each of these systems for $CBOD_5$, TSS, Escherichia coli (*E. coli*), total ammonia nitrogen, $NH_3$-N and total phosphorus.

In the second phase, bench scale studies assessed the conditions required to obtain effective treatment performance and the use of fixed film biological treatment mechanisms to understand how to optimize current waste stabilization pond designs.

### WHAT DID WE FIND?

Overall, single-cell waste stabilization ponds effectively remove TSS, but have difficulty reducing $CBOD_5$, bacteria, and nutrient concentrations to levels associated with secondary wastewater treatment specified in the national performance standards.

Waste stabilization ponds with low initial organic carbon concentrations, low daily organic loading rates and higher temperatures provided more effective treatment.

A geotextile filter on a permeable berm formed a biomat in arctic conditions, providing significant water quality improvements.

### WHAT ARE THE IMPLICATIONS FOR STAKEHOLDERS AND DECISION MAKERS?

Current waste stabilization pond systems used for municipal wastewater management in the Far North can provide reliable primary treatment, but design approaches will need to be refined to facilitate increased levels of biological treatment that meet secondary treatment standards specified by the Wastewater Systems Effluent Regulations.

Future systems should be designed as multi-cell systems to facilitate algae growth. The first cell should be a deep anaerobic pond, sized to accommodate wastewater generated during the dormant (October – June) season. Effluent from this cell could be decanted into shallow facultative cells during the summer season.

Incorporating alternative passive treatment technologies such as the installation of geotextiles on waste stabilization pond berms is a promising method to improve system design.

Pilot scale studies should be designed and implemented in arctic communities to test these recommendations.