



Environmental Engineering
UNIVERSITY OF COLORADO **BOULDER**

MS Thesis Defense

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Water Resources and Reuse for Remote Arctic Communities

Date: Monday, October 2nd, 2017

Time: 12pm

Place: SEEL 303

Chair: Professor Karl Linden



Abstract: Access to safe water and effective sanitation is an issue of major concern in developing communities. While most of the international focus on WASH (water, sanitation and hygiene) is on improving water quality in communities that don't have access to clean water resources, the challenge in the rural Arctic is making sure a sufficient quantity of water is available to households for drinking and washing.

Alaska has the highest percentage of households without access to piped water and sewer in the United States. Traditional piped utilities and pump-and-haul systems are expensive and difficult to build, operate and maintain in the rural Arctic. Instead, unserved communities self-haul water to their homes and drastically reduce the volume of water that they use each day for drinking, washing and cleaning – from 25 gallons/person/day in served communities to 1.5 gallons/person/day in unserved communities. The decreased quantity of water used in unserved communities has been linked to increased rates of skin, respiratory and gastrointestinal infections.

This research evaluates two alternative water resources that could increase the quantity of water available for hygiene purposes in rural Alaska: rainwater catchment systems and a household greywater reuse system. Rainwater samples were collected from 30 catchment tanks in two villages and analyzed alongside prior catchment data from rural Alaska. Overall, rainwater quality was very high and met US EPA drinking water standards in >80% of cases without any treatment required. Depending on the weather patterns in the village, rainwater use could be increased to account for 13-40% of annual household water use if proper infrastructure is used and best management practices are followed.

A pilot household greywater reuse system was built and operated daily for nine months under normal and stress conditions in Alaska to determine whether water can be produced onsite that is safe for human contact. Sixty gallons of water were produced per day under normal and stress conditions. Finished water was sufficiently clean to meet state and federal water quality standards with little variation in water quality during challenge tests that changed household use patterns and introduced new contaminants into the system. Wash water had low TOC, turbidity and conductivity, normal pH, and high UV transmittance. The treatment process provided at least 18-log reduction of viruses and >8-log reduction of bacteria. While the household treatment system produced wash water of sufficient quality and quantity to protect health, the concentrated wastes produced by the system could pose a threat to the household if proper waste disposal methods are not facilitated along with installation of the reuse systems.

Kaitlin Matos came to CU from the Northern Mariana Islands. She received her Bachelor's degree in Environmental Science from Washington University in St. Louis and is pursuing a M.S. in Environmental Engineering with a focus in Engineering in Developing Communities. Her career focus is on public health environmental protection, and resource management in remote and underserved communities.