

## In-ground and Above-ground Aquatic Mesocosms as Tools to Understand Short-term and Multi-year to Biological, Ecological and Chemical Effects of Reclamation Technologies

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Leading resource production companies have supported research to evaluate and mitigate potential environmental risks from anthropogenic activities for the last 3+ decades at scales from the laboratory bench top to full commercial scale. A mesocosm facility, incorporating in-ground and above-ground components and supporting infrastructure, was constructed at InnoTech Alberta's site in Vegreville in 2015 - 2016, to enable rigorous, semi-controlled scientific studies somewhere between bench top and pilot scales. The in-ground portion of the facility includes 30 open-top polypropylene tanks, each with an operational volume of 15,000 L, and double-walled to ensure containment. The above-ground facility includes 16 open-top polypropylene tanks, each with an operational volume of 4,500 L, in a lined berm; these tanks can be used as terrestrial or aquatic environments, and are moveable, so additional tanks can easily be added. The facility includes all storage and supply tanks, and additional ponds, necessary for an extensive range of studies. The modular design and adaptability in terms of the variety of materials that can be tested permit a wide range of sampling and monitoring options, including rhizotrons, lysimeters, autonomous sensors/data loggers and targeted sampling. A unique feature of the in-ground mesocosms is the ability to conduct studies overwinter without risking damage to the facility itself. These facilities are best suited to studies that aim to compare outcomes (a) between different types of treatment technologies, (b) multifactor studies to examine treatment interactions, (c) of a range of concentration/intensity gradients of the same technology to find the optimal application rate, and/or (d) over a time series (acute vs. chronic effects). Three studies have been completed at the facility since 2017, two multi-year studies using the in-ground tanks, and one seasonal study in the above-ground mesocosms. A broad range of physical, chemical, biological, toxicological and ecological parameters were sampled during these experiments, with the specific suite of variables monitored tailored to the experimental questions for each study. Each experiment at the facility has informed the next in terms of operational efficiencies, the most appropriate parameters to monitor, and how best to interpret the data generated. I will describe some of the main features of the facility, the types of experiments that can be performed using the mesocosms, and some of the key findings in terms of mesocosm operations.

### Ryan Melnichuk

After completing his graduate research at the University of Vermont (Plant and Soil Science), he returned to Alberta (where he had completed a BSc at the University of Alberta) to accept the role as Research Scientist at InnoTech Alberta. Here he's acted as Project Lead for the second, third and fifth years of the Aquatic Mesocosm Project in Vegreville, Alberta. Ryan looks forward to continuing to work with industry and academia to increase knowledge and understanding around managing water and mining materials.