Niverville Lagoon Bioremediation Project

Spring 2013 Newsletter

This newsletter, written by Native Plant Solutions, provides a brief update of the construction and research activities of the Niverville Lagoon Bioremediation Project from summer 2012 to spring 2013.

Construction Update

Recontouring of lagoon sludge in Cell 1, October 2012.

Lagoon Cell Redesign

Redesign and construction of the Niverville lagoon for the in-situ sludge bioremediation project was completed in the winter of 2012. Following the internal re-design of lagoon Cell 1 to support wetland vegetation in the summer of 2012, GENIVAR Engineering was engaged to ensure all proper water control systems were included to maintain appropriate water depth for establishing wetland vegetation over the first few growing seasons. Starting in September 2012, Tri-Line Construction was contracted by the Town of Niverville for the required earthworks. Lagoon sludge within Cell 1 and a portion of Cell 2 was stripped, stockpiled on site, and then recontoured appropriate to the wetland design of Cell 1. This design included the creation of 'sludge benches' that provide the appropriate water depth for wetland plants to grow, to support the uptake of contaminants from the sludge.

Wetland Plantings

Wetland plants to be used in the lagoon were scouted by Native Plant Solutions staff in fall 2012 from locations around the Town of Niverville. Cattail donor plants were extracted adjacent to the site of the new Niverville lagoon. The plants were then moved by heavy equipment and placed, stem side up, in pre-dug divots within the bioremediation wetland Cell 1. Cordgrass was also collected as donor plants from a site west of the old lagoon, between the dike and the train tracks. Cordgrass was then placed along the periphery of the new wetland cell.

Extraction of cattail plants from the new lagoon site, November 2012.

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New cattail plants placed within a divot (marked by stakes with pink flagging) in Cell 1, November 2012.

Water Level Manipulation

In spring 2013, flooding Cell 1 to the appropriate depth will be important to support cattails in their first growing season. Following a slow melt in April 2013, it became apparent that flow from ditches south of the lagoon would not provide a sufficient water source to bring Cell 1 up to the desired water level. As of May 6th 2013, pumping water from stormwater ponds within the Town of Niverville was to commence, to ensure the appropriate depth would be obtained for plant growth in Cell 1.

Research Update

In 2012, two graduate students began their research programs under the supervision of Dr. Francis Zvomuya, soil scientist at the University of Manitoba. Ms. Adenike Hassan began her Master's project in January 2012, undertaking laboratory and growth room research to support the bioremediation project. Mr. Nicholson Jeke began his Master's project in September 2012, and will undertake a portion of the fieldwork of the bioremediation project.

In April 2013, Dr. Francis Zvomuya provided an interim report updating the Niverville Town Council on the research activities of his two graduate students to date. A brief summary of the research design and preliminary results is given below.

Investigators: Francis Zvomuya (University of Manitoba), Pascal Badiou (Institute for Wetland and Waterfowl Research, Ducks Unlimited Canada), Lisette Ross (Native Plant Solutions)

Objective: Examine the efficacy of two alternative in-situ remediation approaches – a constructed wetland system and a traditional phytoremediation system – as alternative approaches for the decommissioning of municipal lagoons.

Sign marking Niverville Lagoon Bioremediation Project.

Phase 1: Growth Room Experiments (Student: Adenike Hassan; Started winter 2011)

Research questions:

- How do the contaminant levels in the soils and biosolids, from both the primary and secondary cell, compare?
- Will a combination of soil and biosolids enhance the effectiveness of remediation?
- Will repeated harvesting of the plants enhance the removal of contaminants in the sludge?
- How does the effectiveness of the wetland system, versus the phytoremediation system in Cell 2, compare for removing contaminants?
- Will the rate of biosolids clean-up be faster for the primary cell sludge, as compared to the secondary cell sludge?

Fall cattail plants, south of Niverville, MB.

Growth room phytoremediatiation experiment design:

- Switchgrass and cattail seedlings were grown within a growth room in either biosolids from the primary cell, biosolids from the secondary cell, or a mixture of soil and the primary cell biosolids.
- Plants were harvested once or twice over their growth (~90 day period).

Growth room wetland experiment design:

- Cattail seedlings were grown within a growth room in either biosolids from the primary cell, or a mixture of biosolids from the primary cell and soil.
- In the plant pots, water was kept ~10cm above the biosolids surface, to simulate the wetland environment.
- Cattail was harvested once or twice over their growth (~90 days).

Preliminary results and key messages:

- **Biosolids can support the growth of plants, without the need for soil amendment.**
- **In the phytoremediation experiment, repeated harvesting increased the yield of switchgrass but had no significant effect on the yield of cattail.**
- **In the wetland experiment, cattail biomass yield was greater with one, rather than two harvests.**
- **Across both systems (i.e., wetland vs. phytoremediation), repeated harvesting significantly improved nutrient uptake.**

Phase 2: Field, Laboratory and growth room studies (Student: Nicholson Jeke; Started Fall 2012)

Cordgrass donor site, west of bioremediation lagoon.

Research questions:

- What are the removal efficiencies of nitrogen, phosphorus and metals in a wetland and phytoremediation system, using cattail and switchgrass?
- How do nutrients and metals become distributed in the aboveground and belowground plant parts?

Field study wetland experiment design:

- To start in summer 2013, on site at the Niverville lagoon, in Cell 1.
- Control cell to be flooded to the same depth as Cell 1, but will not be vegetated.
- Two harvests per growing season will be tested on cattail, in 2013 and 2014.
- Sediment (biosolids; Cell 1 and control) and water samples (Cell 1 only) will be collected.
- Plant samples will be analyzed for nutrients and trace elements.

Field study phytoremediation experiment design:

- To start in summer 2013, on site at the Niverville lagoon, in Cell 2.
- Twenty four plots (2.5m x 2.5m) will be marked off in Cell 2 for the experiment.
- Two harvests per growing season will be tested on both cattail and switchgrass, in 2013 and 2014.
- Sediment (biosolids) samples will be taken; Plant samples will be analyzed for nutrients and trace elements.

Laboratory experiment design:

Part A – Destructive sampling experiment (Purpose: determine relocation of nutrients and trace metals to aboveground or belowground plant parts.)

- Cattails to be grown in primary cell biosolids.
- Harvesting, on a repeated basis, of aboveground and belowground plant parts.
- Nutrient, metals and biomass will be analyzed for in aboveground and belowground plant parts.

Part B – Mineralization experiment (Purpose: determine availability of key nutrients under different moisture levels, for plant uptake)

- Focus on forms of nitrogen and phosphorus.
- Both primary cell biosolids and secondary cell biosolids will be incubated under three moisture levels: 'dry' conditions, field capacity and near-saturation.
- Samples will be analyzed from experimental containers multiple times over a 120 day period.

Next Steps

A number of exciting activities related to the Niverville lagoon bioremediation project are planned for the 2013-2014 season:

- On May 13th 2013, three Niverville Collegiate Institute students and their teacher, Mr. Hank Dueck, will visit the bioremediation projects' graduate students at the University of Manitoba. A tour of the growth rooms and laboratory will be given, as well as presentations of the research. The high school students will then share information on the project with peers in their Ecology class.
- Notification of the results of Niverville's funding application to the Lake Winnipeg Basin Stewardship Fund are pending, as of May 2013.
- Once water levels are raised in the wetland lagoon cell, field research will commence on site at the Niverville bioremediation project.
- In 2013, a community open house is to be held to discuss and present the lagoon project and the associated research to the residents of Niverville.
- An article highlighting the Niverville bioremediation project is slated to be published in the Fall 2013 issue of Ducks Unlimited Canada's national Conservator magazine.
- Adenike Hassan has submitted a proposal to present her research findings to colleagues at this summer's national conference of the Canadian Society of Soil Science.

Contact

If you have any questions regarding activities of the Niverville bioremediation project, please do not hesitate to contact:

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