NATURAL TREATMENT SYSTEMS

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## *Introduction*

In March of 2002 a Wetland Biofilter System (WBS) was constructed to assess it's efficacy for treatment of Liquid Swine Manure (LSM). The WBS began operation on April 1, 2002. This demonstration project is located at a 2,000 head hog operation in the Niagara Region.

This project was initiated by Bill Hoeksema, owner of the farm, who is concerned about the impact of odor and nutrients his farm may have on the surrounding environment. The WBS was designed, installed and is maintained by AQUA Treatment Technologies Inc. ESG International Ltd. of Guelph, Ontario provided funds to pay for laboratory analytical costs. Staff from the Ontario Ministry of Agriculture and Food has participated in various forms from the beginning.

This paper presents data collected over an eight month period, from April 1 to October 31, 2002.

## *Purpose*

The purpose of this demonstration project is two-fold:

1) To determine if a WBS can reduce the odor from LSM.
2) To determine the level of nutrient reduction possible by a WBS treating LSM.

## *Project description*

The WBS consists of three separate cells that are operated in series. Each cell is approximately 3.7 m L X 3.7 m W and 1.2 m in depth. The cells are filled with layers of gravel and sand and planted with various types of semi-aquatic plants.

Originally LSM was pumped from the existing concrete storage lagoon and applied to the first cell in series. On July 19 a 10,000 L concrete septic tank was installed in an effort to reduce the suspended solids entering cell 1 of the WBS. Currently LSM receives primary treatment within this septic tank prior to being applied to cell 1 of the WBS. Discharge water from cell one is then applied to cell 2 and water from cell 2 is applied to cell 3 from where it is discharged back into the lagoon.

The WBS is being loaded at approximately 30 L/$m^2$/day or 1,200 L/day.

### *Sampling protocol*

Samples are collected every two weeks from the lagoon and effluent from each of the three cells. The samples are analyzed for BOD, suspended solids, phosphorus (TP & phosphate), nitrogen (TKN, $NO_3$ & $NH_3$) and E. coli.

### *Results*

*Odor* - The WBS is capable of significant odor reduction. The effluent from the WBS can be described as being a dark, tea colored water with an 'earthy' smell. There is little evidence of the typical 'swine' odor in the effluent from cell 3.

*Nutrients* - The WBS is capable of significantly reducing typical waste water pollutant parameters. Table 1 presents a statistical summary of the data presented in figures 1 through 7. The $BOD_5$ is being reduced by an average of 89%, suspended solids by 95%, total phosphorus by 88%, and E. coli by 99%. The reduction of total nitrogen required a 'maturation' period of approximately 2 - 3 months. As the WBS matured the reduction of total nitrogen rose from approximately 5% to 50% . As of the end of June greater than 94% of the ammonia is being converted into nitrate and nitrogen gases.

**Table 1.** Average pollutant concentration of the influent to cell 1 and effluent from cell 3 with average % reductions from April 1 to October 31, 2002.

| | Influent (mg/L) | effluent (mg/L) | % reduction |
|---|---|---|---|
| **BOD** | 1,967.70 | 159.60 | 89.17 |
| **suspended solids** | 2,900.20 | 33.20 | 95.14 |
| **total phosphorus** | 62.28 | 4.76 | 88.36 |
| **total nitrogen** | 1,307.06 | 754.30 | 41.58 |
| **ammonia & ammonium** | 1,117.40 | 353.89 | 70.29 |
| *(NH3 effluent concentration after system maturation)* | | 61.27 | 94.52 |
| **nitrate** | 0.66 | 402.52 | N/A |
| **TKN** | 1,306.40 | 351.78 | 72.41 |
| **e. coli (cfu/ 100 mL)** | 85,780.00 | 294.67 | 99.00 |

**Figure 1.** Liquid Swine Manure $BOD_5$ influent concentration versus Wetland Biofilter effluent concentration (cell 3) from April1, 2002 to October 31, 2002 in mg/L.

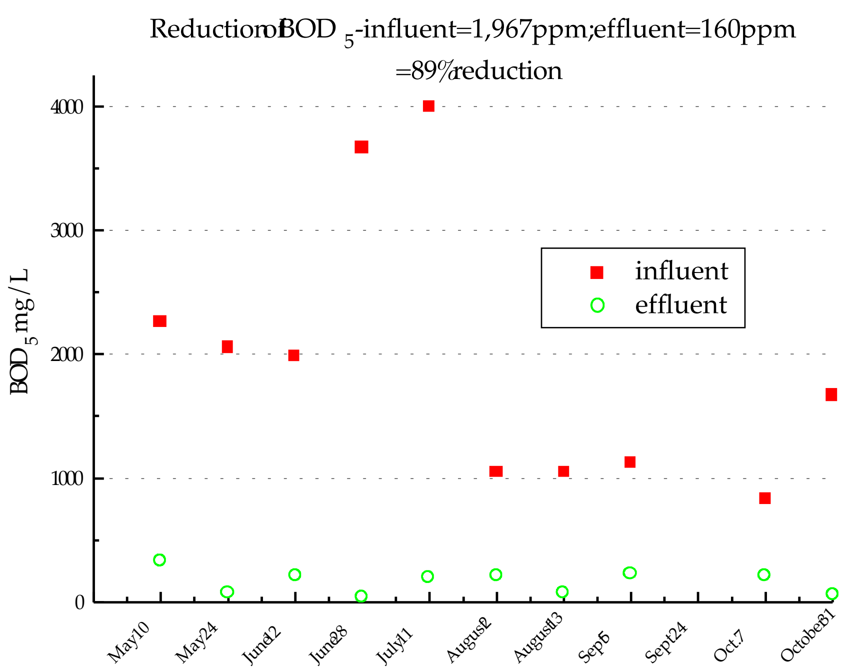


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**Figure 2.** Liquid Swine Manure suspended solids influent concentration versus Wetland Biofilter effluent concentration (cell 3) from April1, 2002 to October 31, 2002 in mg/L.

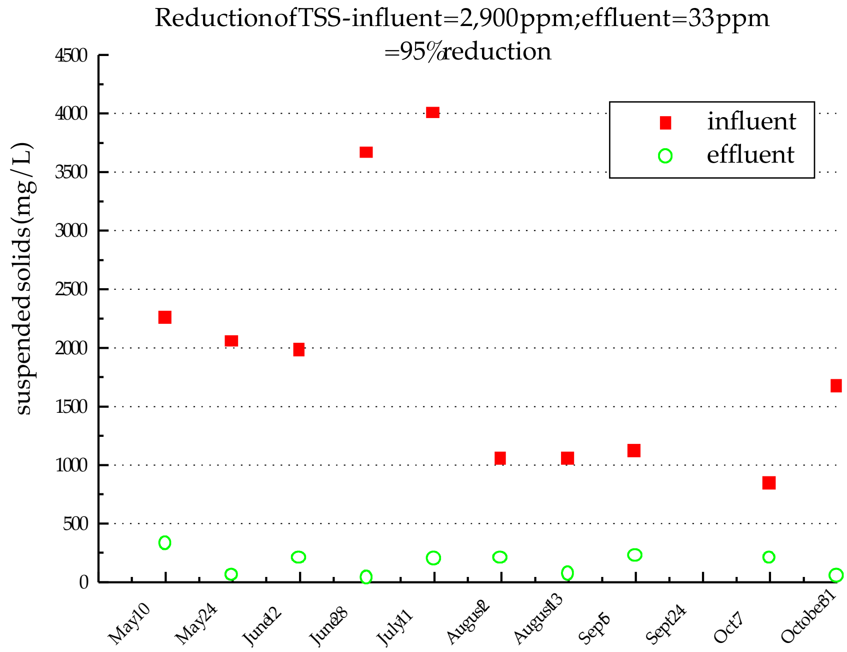


**Figure 3.** Liquid Swine Manure total phosphorus influent concentration versus Wetland Biofilter effluent concentration (cell 3) from April1, 2002 to October 31, 2002 in mg/L.

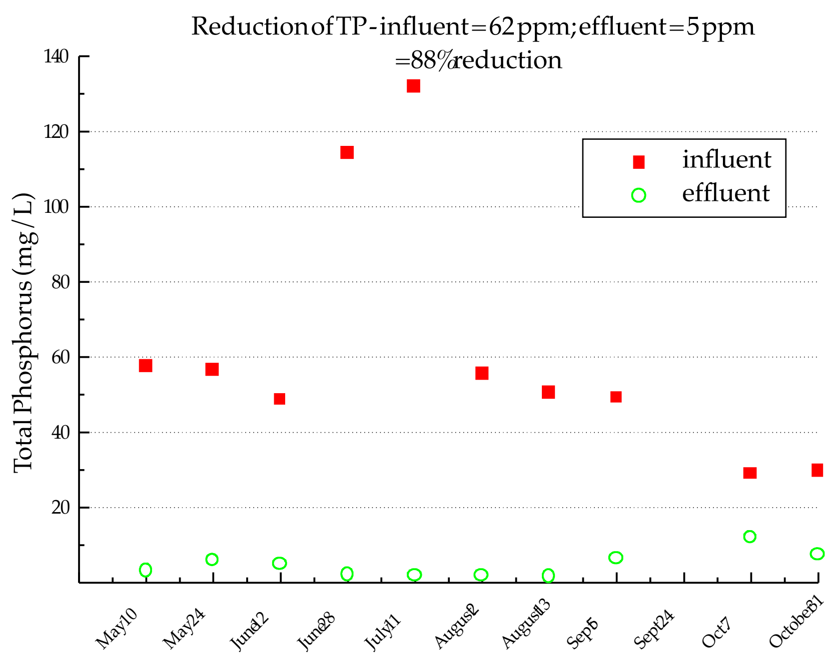


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**Figure 4.** Liquid Swine Manure total nitrogen influent concentration versus Wetland Biofilter effluent concentration (cell 3) from April1, 2002 to October 31, 2002 in mg/L.

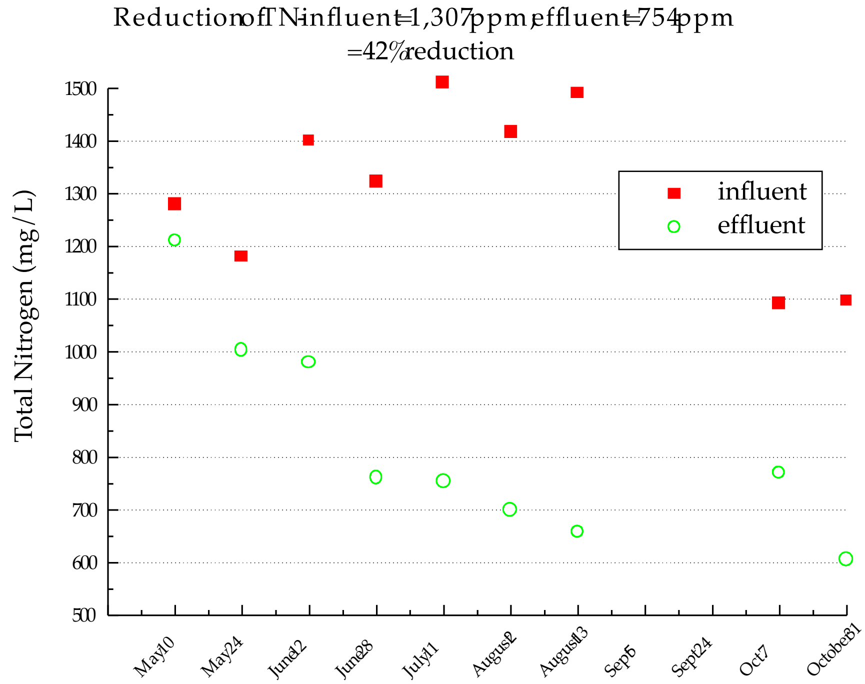


**Figure 5.** Liquid Swine Manure total ammonia & ammonium influent concentration versus Wetland Biofilter effluent concentration (cell 3) from April1, 2002 to October 31, 2002 in mg/L.

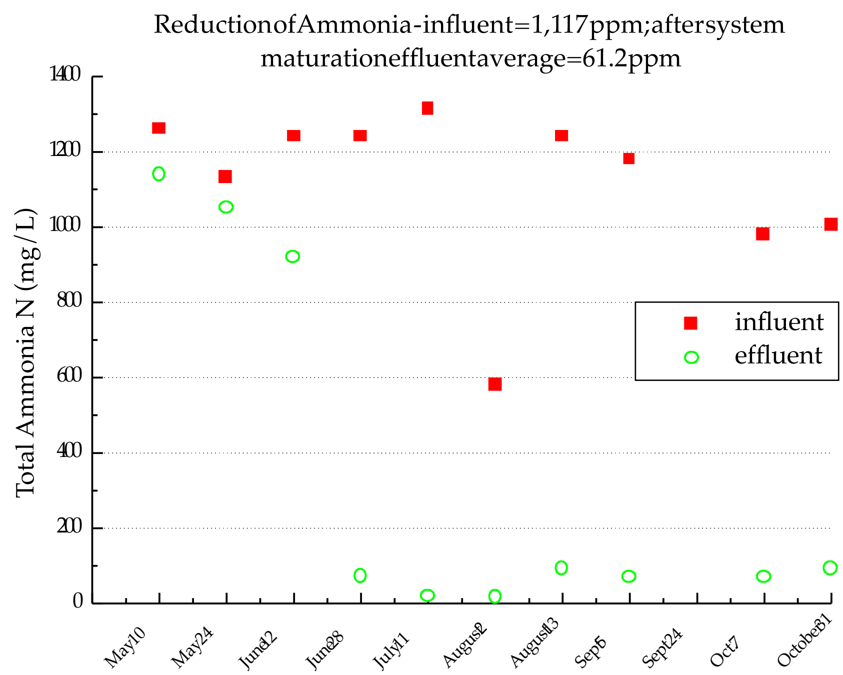


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**Figure 6.** Liquid Swine Manure nitrate influent concentration versus Wetland Biofilter effluent concentration (cell 3) from April1, 2002 to October 31, 2002 in mg/L.

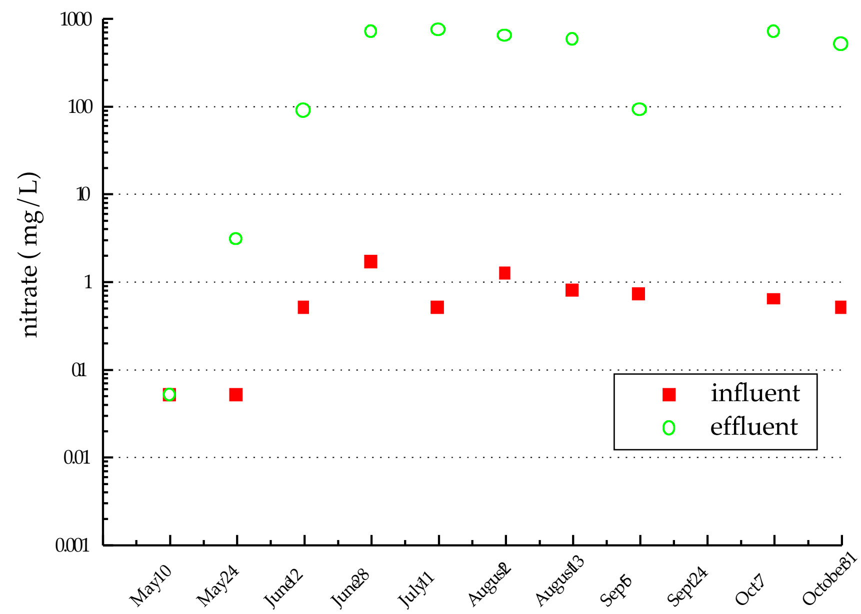
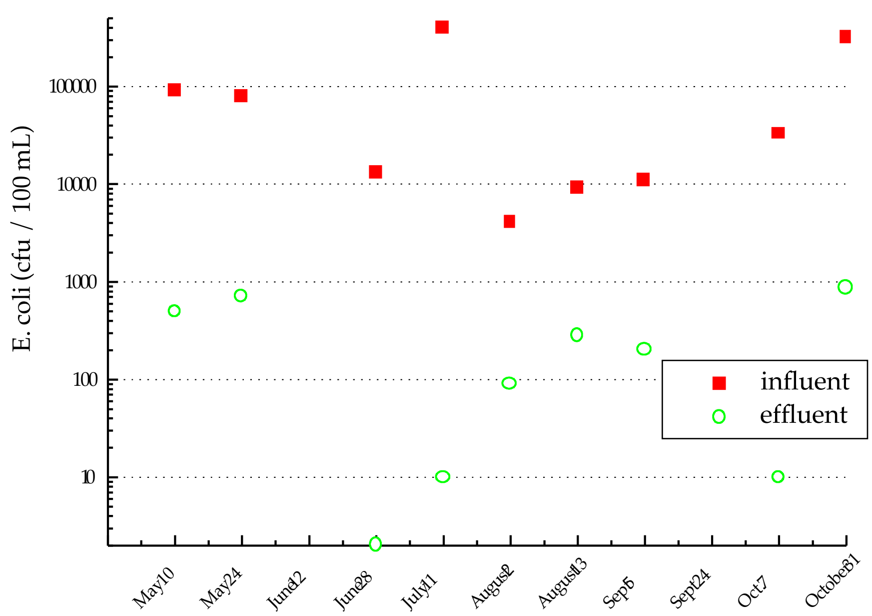



**Figure 7.** Liquid Swine Manure E. coli influent concentration versus Wetland Biofilter effluent concentration (cell 3) from April1, 2002 to October 31, 2002 in cfu/100 mL.

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