

## An Economically and Environmentally Responsible Technique for Decommissioning Lagoons

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**Abstract.** A phyto-remediation technology, which may serve as an alternative to the currently permitted animal waste lagoon closure techniques, which require removal of all the sludge, was installed and is being evaluated.

**Keywords.** Lagoons, phyto-remediation, lagoon closure, ground water.

The Ecolotree Cap (ECap) procedure being evaluated for the lagoon closure is a phyto-remediation system that uses perennial, fast growing and deep rooting trees to cover landfills and contaminated soils. ECap evolved from agricultural research using poplar tree buffers to eliminate nitrate nitrogen from farmland drainage (Licht, 1990); (Licht et. al., 1992); (Licht, 1992b). Manure-derived nutrients and precipitation grow into marketable wood fiber. Once remediated, the tree-capped area will be restored to a safe condition for future alternative land uses. The first permitted phyto-remediation ECap was installed in 1990 at a lakeside reclamation landfill in Oregon. Since that time, ECap has been installed at 12 additional landfills across the United States and one in Europe. Currently, ECaps are operating at fertilizer spill sites with 500-11,000 ppm ammonia nitrogen in the root zone soil matrix. Evaluations for ECaps on landfills using soil moisture sensors consistently show significant soil moisture reduction and thus minimization of ground water contamination. A landfill water balance currently being conducted by USEPA shows that the ECap has 98 percent less percolation than an adjacent clay-capped cell.

The ECap leaves residual manure sludge and the lagoon bottom seal in place. The lagoon is back filled and crowned with soil using techniques to minimize compaction. After placed and crowned, the soils are planted with cover vegetation and fast growing hybrid poplar trees to transpire sufficient moisture so that water movement through the sludge layer to ground water will be virtually eliminated.

Many lagoons, including about 4500 active and 1700 inactive swine wastes lagoons in North Carolina, will have to be closed in the future because of stricter regulations and pressure to implement environmentally superior technologies. The Natural Resource Conservation Service procedure permitted in many states requires that the sludge be removed from the lagoon and land applied. The currently approved technique of removing all bottom sludge is an expensive procedure which has the potential to break the lagoon bottom seal, result in multi-media environmental impacts and possibly stimulate environmental justice allegations that have been recalled by many when discussing the potential of land application of all the sludge from the many inactive swine waste lagoons in this area. The ECap leaves residual manure sludge and the lagoon bottom seal in place. The lagoon is backfilled and crowned with soils on site using

techniques to minimize compaction. After placed and crowned, the soils generally are planted with cover vegetation and fast growing hybrid poplar trees to transpire sufficient moisture so that water movement through the sludge layer to ground water will be virtually eliminated.

A lagoon approximately 75 ft x 190 ft x 7 ft deep constructed in 1980 which has not been loaded with manure for the past 3-5 years was selected. Lagoon liquid was pumped to a new, larger lagoon. Filling of the lagoon with on-site soil was delayed by the heavy rains, which began in October 2002. During December 2003, 322 poplar trees comprised of rooted and unrooted, 10-12 ft stock were placed on 60 square foot per tree spacing. Following tree planting a combination of grass and winter wheat was planted between tree rows to establish an undercover to reduce erosion. Experience gained in using this procedure is being utilized as the second lagoon about 75 ft x 75 ft x 5 ft deep was back filled with soil in August 2004. This improved procedure, which is being tailored more to North Carolina conditions such as planting trees from the North Carolina Forest Service with the assistance of NCSU Department of Forestry, resulted in more complete and faster total coverage of this lagoon. The details and cost of these two procedures to close lagoons will be presented. The North Carolina Department of Environment and Natural Resources Division of Water Quality installed nine, 2-inch diameter ground water sampling wells and performed the initial analyses to determine whether or not this lagoon closure process would meet permit requirements. Wells will be installed in each closed lagoon to determine the effectiveness of alternative procedures for minimizing soil moisture, nitrate formation and movement, zinc and copper concentrations and other constituents of environmental and health concerns. These in-lagoon wells in conjunction with other site wells will be used to determine the effectiveness of this procedure over the long term. Ground water has been sampled on 4/16/03, 5/27/03 and 6/24/04 for TKN, NH<sub>3</sub>, NO<sub>2</sub> + NO<sub>3</sub>, TP, Cl, TKN, fecal coliform, total coliform, Mg, Cu, Zn, Na, pH and water level. This sampling program was established by the North Carolina Department of Environment and Natural Resources Division of Water Quality, Ground Water Division to determine if this alternative lagoon closure technique can be permitted. Data for the first three sampling are shown in table 1. While it is too soon to determine long-term trends the preliminary analysis is that nitrate concentrations are not building up in ground water. Tree growth has been the best around the outside perimeter and then diminishes toward the top where some sludge is closer to the surface. The 11 of the 322 trees that died have been replanted and are now growing. Cooperative efforts have been developed with the Department of Forestry at NCSU to provide an evaluation of tree growth and causes for tree mortality. Cooperative efforts with North Carolina NRCS, Nash County Cooperative Extension, the North Carolina Department of Environment and Natural Resources Division of Water Quality, Ground water Section and the North Carolina Pork Council are maintained to continually evaluate ground water changes and tree growth for both the large and small lagoon. Ground water sampling will continue, as long as possible, to provide data to effectively evaluate this procedure as an alternative closure technique. The lagoon closure site has been established as a Nash Co. Extension Demonstration site and a field Day was conducted on August 12, 2004. The importance of this project is emphasized by the extensive media coverage resulting from the Media Contact Day on December 10, 2003, which included farm program interviews and nationwide media coverage including an article in USA Today and a front-page article in the Raleigh newspaper.

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