

**Progress Report on:**

**“Evaluation of the Algal Turf Scrubber  
Technology for Treatment of Agricultural  
Drainage Water”**

**A Project for the Caroline County Soil Conservation District**

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## Timeline

The footprint of the algal turf scrubber (ATS) at the Collier Farm in Caroline County, Maryland, including site grading, placement of the landfill liner and installation of the basic plumbing was constructed during the winter of 2009-2010 and into the early spring of 2010. The solar power system (panels, circuitry and pump) was tested off-site in early spring and it was added to the site so that the entire system was operational with flowing water in May of 2010. A propane generator with storage tank was added to the original design in order to supplement water flow rates from the solar powered pump. Problems occurred with the generator within a few weeks and it was found to be unable to provide continuous service. The generator was turned off in June and was not used again. Thus, the ATS was run solely with the original solar powered pump throughout the summer, with the consequence that water flowed on the ATS only during the daylight hours. Since algae are aquatic organisms and need to stay continuously wet, the situation with no flow at night was non-optimal.

Several major structural problems occurred during the spring and early summer. First, it was decided that the original placement of large metal tanks at the bottom of the system was an impediment to overall drainage of the site. The purpose of these tanks was to collect and to keep separate water flows from different experimental treatments on the ATS surface. Because of the drainage issue, the entire ATS footprint was rotated about 45 degrees and the tanks were re-installed. Afterwards, the tanks floated out of the ground when water seeped underneath them. Because they were not essential to the project, the tanks were then removed from the system. An open drainage ditch was constructed at the bottom of the system to replace the metal tanks. This drainage ditch did not allow for the separation of the water flowing from different experimental treatments but it was a more realistic design for a working ATS in the agricultural setting.

A working site design for the ATS was completed by the beginning of July 2010, which has been operated up to the present. An experiment was conducted during the summer which tested for the effect of daytime water flow rate on algal productivity with low (1 gallon per minute, gpm), intermediate (6 gpm) and high (15 gpm) rates.

## Results

Algae have grown on the surface of the ATS since May 2010, though with interruptions due to ongoing construction activities. The algal community was dominated by green algae species with minor contributions from diatoms and blue-green algae. A dense zone of *Ulothrix* sp. grew at the top of the system over the first 3-5 meters where turbulent energy from the dump buckets of the ATS is highest. This species has special attachment cells at the base of the filaments which allows it to grow under the most turbulent conditions. Farther down the ATS a variety of green algae added to the diversity of the community including species of *Mougeotia*, *Rhizoclonium*, *Spirogyra*, *Microspora* and *Oedogonium*. The filamentous diatom, *Melosira* sp., was found but it was only abundant during the spring. Single-celled, pennate diatoms and the blue-green algae, *Phormidium* sp., were uncommon.

Maximum algal productivity was about 5 grams dry weight/m<sup>2</sup>/day which is low compared to other experimental studies of ATS within the Chesapeake Bay watershed. Furthermore, productivity was typically much lower than the maximum rate throughout the summer. Potential limiting factors include low water flow rate, high water temperature, herbivory by Chironomid fly larvae and/or Physid snails, or other factors.

## Outreach

Tours of the ATS site were provided to several groups and to some interested individuals in 2010 (Table 1). During these tours the ATS concept as a best management practice was described and illustrated with the existing system. The potential use of the technology as applied along the extensive network of agricultural drainage canals on the Maryland Eastern Shore was highlighted during the tours. A handout that was provided on the most recent tour accompanies this report.

As another form of outreach, the project was also briefly described in the May-June 2010 issue of USDA's Agricultural Research magazine (Volume 58, number 5). This article was entitled "Algae: A Mean, Green Cleaning Machine" and it described the ATS research of Walter Mulbry at the Beltsville, Maryland Agricultural Research Service Laboratory.

## Future Plans

The project is scheduled to continue through early summer 2011. A second solar powered pump system with batteries has been ordered and it will be installed during the late fall/early winter of 2010. Thus, the ATS will have higher water flow rates and, hopefully, higher algal productivity during the 2011 growing season. The goals for 2011 are to measure productivity and nutrient content of algae and to use this data to estimate the potential of the solar powered ATS for nutrient removal in agricultural landscapes. If possible, the research will continue throughout the 2011 growing season to provide more information on this nutrient management technology.

Table 1. Listing of outreach activities at the Caroline County, Maryland ATS in 2010.

Date	tour description
May 20	State Soil Conservation Committee group
August 5	International exchange group of environmental students and faculty members from Brazil with the Maryland-Rio Partners of the Americas Program
September 18	John Hackney, Environmental Associates of Madison, Wisconsin who is starting a NRCS project on dairy waste treatment with algae
September 21	Bill Cook and Gene Tracy of the College of William and Mary in Williamsburg, Virginia who are working on ATS for off-shore biofuel production
September 21	Raleigh Hood of the Horn Point Environmental Laboratory of the University of Maryland who is interested in joining ATS research
October 21	Wilbur Levingood, local farmer and County Commissioner candidate
October 29	2010 Chesapeake Bay Agriculture Networking Form group