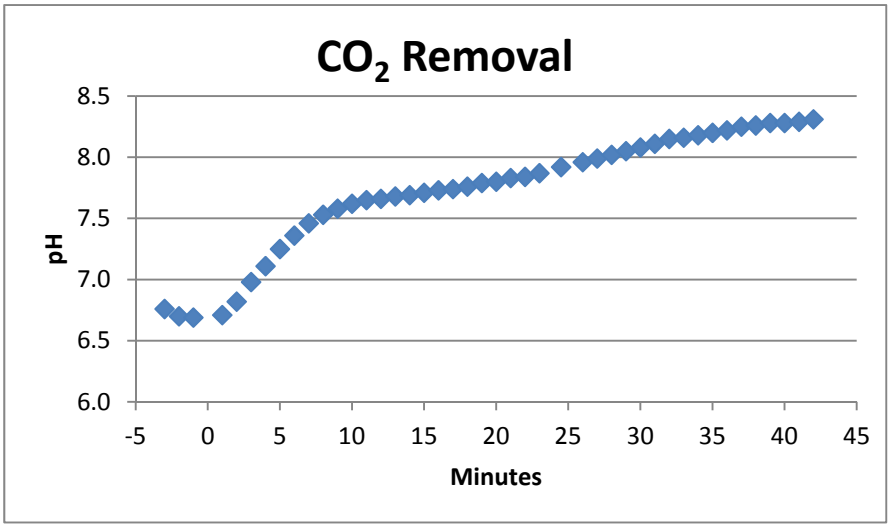
Tanoma South Passive Treatment System
SRI O&M TAG Project # 14 Request #1
OSM PTS ID: PA-60

Requesting Organization:	Evergreen Conservancy (in-kind partner)
Receiving Stream:	Crooked Creek (Crooked Creek Watershed)
Hydrologic Order:	Crooked Creek→Allegheny River→Ohio River
Municipality/County:	Rayne Township, Indiana County
Latitude/ Longitude:	40°41'38.0004"N / 79°03'02.9988"W
Construction Year:	2000

The Tanoma South Passive Treatment System was constructed ca. 2000 by the PA Department of Environmental Protection (PA DEP) to treat a net-alkaline, iron-bearing, discharge emanating from three boreholes that were drilled to lower the water level within an abandoned underground coal mine. The Evergreen Conservancy (EC) has since taken over the day-to-day operation of the passive system consisting of a Sediment Basin and Aerobic Wetlands, and has also included the site as part of their environmental education program.

On 3/27/12, SRI received an email from Branden Diehl, Foundation for PA Watersheds, who forwarded a request for assistance by Cindy Rogers of the EC regarding the treatment performance of the system. Monitoring by the EC indicated that the system was treating the water well during low flow conditions; however, during higher flow conditions, iron removal efficiencies tended to drop. The EC had previously invited Bruce Leavitt, a consulting hydrogeologist, to identify options to improve system performance. Bruce conducted an aeration test where a water sample is aerated with a small aquarium pump while pH is measured over time (Refer to graph below.) and determined that the problem was likely due to a depressed pH caused by high CO_2 concentrations, which resulted in lower iron oxidation rates. Bruce proposed a passive trompe aeration system to be installed for about $42,000. Due to the cost, the group decided to consider other options.

Tanoma South PTS: CO_2 Degassing Field Test



On 5/4/12, Cliff Denholm met with Cindy Rodgers and John Dudash from Evergreen Conservancy and Adam Cotchen and Megan Baskerville from Indiana County Conservation District. They provided a tour and explained the various challenges at the site, some of the solutions proposed by PA DEP, potential future upgrades, as well as their educational program. Since taking over the site, the EC also installed solar panels, a windmill, and a hydroelectric generator. The group believed that an aerator could be installed for roughly $2,000 that would provide sufficient aeration. According to Cindy, the PA DEP was planning on making some additional changes to the site such as, providing better equipment access and potentially expanding the size of the treatment system. For better iron oxidation, the PA DEP also considered installing a hydrogen peroxide tank. As the site is not only maintained by volunteers but is also used in environmental education programs for school children and the general public, the EC is very concerned and hesitant regarding the installation of a chemical treatment system. As the system is actively monitored by the EC and the PA DEP, additional water samples were not collected on 5/4/12; however, field parameters were measured at the outlet of the Sediment Basin and at the final effluent of the treatment wetland. The field testing results are provided in the table below. In addition, the final effluent sample was quickly stirred for about 30-60 seconds and the pH was observed to increase from 7.3 to over 8, indicating degassing of CO_2. Field testing also indicated that while there was enough oxygen in the water to oxidize the iron, the Oxidation Reduction Potential (ORP) was low and that significant CO_2 kept the pH depressed, resulting in a relatively slow iron oxidation rate, which confirmed Bruce Leavitt's initial conclusions.

Tanoma South PTS: 5/4/12 Field Measurements

Sample Point	pH	DO (mg/L)	Temp (°C)	ORP (mv)	Fe (mg/L)
SP1	6.6	4.63	14.4	1	>10
Final	7.3	7.09	15.7	100	3.4

Initially, SRI recommended that EC follow Bruce Leavitt's recommendations to install a trompe and to add some baffle curtains to increase retention time, but as stated above, EC wanted to try a less expensive approach that would also assist in demonstrating their alternative energy projects. On 6/19/12, a solution was proposed to EC to initially install an electric aerator that was powered by the on-site alternative energy system and to evaluate the level of success obtained in order to determine whether additional aeration is needed. The group agreed to this solution; however, they wanted to wait to proceed until the PA DEP completed upgrades. The EC volunteered to install the aerator system themselves. The Vertex Air1 Plus XL2 aerator was purchased by SRI in November 2012 and shipped directly to the EC who installed the aerator in the spring of 2013.

Comparison of the water monitoring pre- and post-installation of the aerator does not conclusively show that utilization of the aerator has resulted in improved water quality. Note, however, that pre- and post-installation comparison is somewhat tenuous as the frequency of flow rate measurement is not the same. What is apparent is that the iron concentrations in the final effluent are almost always greater than 1 mg/L and are often in the 3-8 mg/L range, which is not acceptable to EC. Also, there appears to be somewhat of a correlation between flow rate and iron concentration in the final effluent, i.e., higher iron concentrations are observed in the effluent at flow rates greater than about 1200 gpm. In addition, monitoring by EC has indicated that the flow rate of the discharge may have increased. One of the problems with the alternative

source-powered aerator is the reportedly insufficient power to operate the aerator 24 hours a day.

After further discussion of options, EC decided to seek funding to install a trompe. BioMost, Inc. developed a conceptual improvement design (See attached) and cost estimate as an in-kind contribution to the EC for their grant proposal. EC successfully received a Growing Greener grant for $123,896. Installation of the trompe is expected to take place in either 2015 or 2016. The aerator system previously purchased and installed can still be used at the site to provide additional aeration and the education program, but will likely be moved to another location.

The project team thanks the Evergreen Conservancy, Indiana County Conservation District, and the PA DEP for all of their efforts including support and assistance. Funding for technical assistance and maintenance was provided by the PA DEP's Growing Greener and the Foundation for Pennsylvania Watersheds grant programs and in-kind services by project partners.

At the Tanoma South Passive Treatment System, even though the water is net-alkaline, there is insufficient iron removal. There is limited iron oxidation and hydrolysis occurring in the first passive component as can be observed at the effluent end of the Sediment Basin *(top left)*. There are iron solids, however, being formed by the end of the final treatment wetland *(top right)*. High flow rates, which results in lower retention times, coupled with the pH being suppressed by CO_2, which results in slow iron oxidation rates, are believed to be responsible. To degas the CO_2 and raise the pH, thereby increasing the iron oxidation rate, aeration was proposed.

Funds were used to purchase a Vertex aerator (Top Left & Middle) which was installed by the Evergreen Conservancy. The aerator is powered by alternative energy sources such as wind and water turbines (Middle Right). While the aeration system works (Left) and will be of great value in their education program, it did not provide sufficient aeration. They have since received funding to install a trompe powered aeration system, which will be installed in the near future.