Reitz #1 Passive Treatment System
SRI O&M Project #9 Request #2
OSM PTS ID: PA-191

Requesting Organization:	Shade Creek Watershed Association
Receiving Stream:	Laurel Run
Watershed:	Dark Shade Creek
Municipality/County:	Shade Township, Somerset County
Latitude/Longitude:	40°07'04.0008"N / 78°48'11.0016"W

In July 2015, SRI was contacted by Larry Hutchinson of Shade Creek Watershed Association regarding concerns about the Laurel Run Reitz #1 Passive Treatment System. Maintenance had previously been conducted under the O&M TAG 1 grant in 2012 including stirring and leveling the VFP treatment media, lowering of emergency spillway and removing logs from the settling pond. Larry expressed interest in cleaning sludge from the settling pond, replacing compost in the VFP, and concern of high iron concentrations within the effluent. Unfortunately no laboratory data was available since 2013.

A site investigation was conducted on 11/5/15. During the site visit, iron staining was visible at the outlet, but this can be deceiving. Water samples were collected for laboratory analysis. The effluent was highly net-alkaline with an acidity of -111 mg/L. Total Fe was 3.8 mg/L while dissolved Fe was 2.0 mg/L and total Al of 0.3 mg/L indicating the system was working very well as a result of the previous maintenance. While on site Larry's concerns were discussed. To address his concerns of iron leaving the system, a suggestion was made to lower the water elevation and convert the Bioreactor, which was not being utilized as designed into a wetland and then add stone to the spillways to potentially increase aeration. Larry was advised that the compost did not need to be replaced at that time. Sludge removal was also discussed. Shade Creek Watershed Association obtained funding to complete the sludge removal on their own.

In summer 2017, SRI was again contacted by Larry to request that the Bioreactor be converted into a wetland to increase retention of iron solids and create wildlife habitat. As SRI and Saint Francis University (SFU) have been looking for opportunities to partner together to provide students hands-on experiences in watershed restoration, SRI contacted Dr. Julie LaBar to meet with Larry and investigate the site.

Julie met with Larry on June 26, 2017 and conducted a walk-through of the site. The Bioreactor has been bypassed for many years in an effort to alleviate the sulfide odors by allowing water to flow over the Bioreactor rather than through it. The unit had been bypassed by raising the effluent water level so that approximately half of the water exited through the emergency spillway at the end of the Bioreactor. Since the Bioreactor was not being used as it was initially intended, Larry was interested in converting it into a surface flow wetland to treat all of the water aerobically and prevent the potential for the sulfide odor to be produced. In addition, it was noted that debris, iron solids, vegetation, and rocks had accumulated behind the weir at the end of the emergency spillway and needed to be removed. Rock baffles between the settling ponds were degraded and large channels had developed in them, decreasing capacity to retain solids within the ponds. Julie suggested that maintenance work could be completed in the context of a Field Measurements class being held in Fall 2017 at SFU.

Julie returned to the site on August 31, 2017 with six undergraduate students and Dr. Bill Strosnider to meet with Larry and discuss what work would be completed by SFU. Water quality measurements taken on this trip indicated that the Bioreactor was working well, with influent pH and alkalinity of 6.39 and 191 mg/L, respectively, and effluent pH and alkalinity of 6.55 and 222.5 mg/L, respectively. A slight sulfide odor was detected within the Agri Drain at the end of the Bioreactor, but the odor dissipated outside of the Agri Drain. Given the age of the Bioreactor material and the idea that a higher flow rate through the material may actually prevent overwhelming sulfide odors, stop logs in the Agri Drain were removed to force all water to move through vertically through the Bioreactor. This configuration was left in place for two weeks to determine if the sulfide odor would increase. Also on this trip, students developed their plans for leveling and building up the rock baffles using a limestone stockpile located at the entrance to the system and for constructing a rectangular wetland in the middle of the Bioreactor to provide wildlife habitat.

On September 14, 2017, the sulfide odor at the end of the Bioreactor had not increased and, in fact, was nearly undetectable. Following the advice of the SFU professors, Larry decided to discontinue bypassing the Bioreactor and allow all water to flow vertically through the organic matter. Students began leveling and filling in gaps in the rock baffles. Immediately prior to leaving the site, the flush valves on the Vertical Flow Pond were opened to flush the organic material.

Upon arrival to the site on September 28, 2017, it was found that the flush valves on the Vertical Flow Pond were never closed and the substrate was mostly dry. The valves were immediately closed and while the cell was filling up, students and professors fluffed the top ~8” of material with hand tools to remove an iron oxide crust that had formed on top of the substrate. Using a raft and rakes, students also fluffed the top ~8” of the Bioreactor material. Prior to leaving the site, stop logs were removed from the Bioreactor Agri Drain to lower the water level to ~4” above the substrate in preparation for wetland construction the following week.

On October 5, 2017, the team finished leveling the rock baffles. Approximately 6” of limestone was also added to the first two baffles to raise the water levels, increase retention in the settling ponds, and create a “drop” to allow for aeration of the water. The baffle between the final settling pond and Bioreactor was vegetated with transplanted cattails from the rock baffles that had been elevated. Although the weir on the emergency spillway was no longer usable due to directing all of the water through the Bioreactor, material that had settle behind the weir was removed to prevent any flow restriction in the future.

On October 12 and 19, the group used logs found on site to form a rectangular frame in the middle of the Bioreactor. Compost taken from a stockpile near the Vertical Flow Pond was used to build up the substrate within the rectangle and was vegetated with transplanted cattails from areas where water levels has risen due to elevating the rock baffles. All stop logs were removed from every Agri Drain within the treatment system, cleaned of built-up iron oxides to allow for easier movement in the future, and replaced.

Sampling of Bioreactor influent and effluent, as well as Laurel Run downstream of the system, was conducted on October 26, 2017. Although Fe concentrations were somewhat high coming out of the

Bioreactor, this is most likely attributed to the perturbations of the system in the previous weeks. Despite this, Fe concentrations were within the range seen over the past several years at the site. Regular monitoring of the system should show Fe concentrations decrease as the system returns to equilibrium. The Bioreactor continues to produce water of circumneutral pH and high alkalinity, but it is no longer being bypassed by any of the flow. SFU recommended that stop logs in every Agri Drain at the site be cleaned quarterly to prevent build-up of iron solids and allow water levels to be more easily manipulated as needed by SCWA. In addition, iron sludge from the settling ponds will still need to be removed sooner rather than later. Elevation of the rock baffles will prolong the life of the ponds some, but not indefinitely.

Reitz #1 Passive Treatment System: 10/26/17 Bioreactor Influent and Effluent Quality

Sample Point	Field pH	Alkalinity	Total Fe	Total Mn
BIO in	6.77	117	>3.3	>7.0
BIO out	6.54	144	2.85	6.96
Laurel Run (dwnstm)	7.69	14.1	0.29	0.30

Completing these tasks through a cooperative agreement between SRI and SFU allowed the group to cost-effectively optimize overall system performance and possibly prolong the life of the system. The team appreciates the efforts of Larry Hutchinson with onsite assistance and input in the planning of the work. Funding for technical assistance and maintenance was provided by the PA DEP's Growing Greener grant program and in-kind services by SFU.

Additional Recommendations and Consideration

- Conduct site inspections and water monitoring on at least a quarterly basis. Include field measurements of pH, alkalinity, and flow at a minimum
- Clean stop logs regularly to prevent build-up and cementation of iron solids
- Begin developing plans for removal of iron solids in settling ponds






Top Left: SFU students learning about the system from Larry Hutchinson. **Top Right:** Students "fluffing" top of VFP media. **Center Left:** Bioreactor at beginning of project. Approximately 50% of the flow was being bypassed to the emergency spillway. **Center Right:** Compost island vegetated with transplanted cattails in the Bioreactor. **Bottom Left:** Large channels had formed in the rock baffles between the settling ponds and Bioreactor, preventing aeration and causing short-circuiting of the water. **Bottom Right:** Gaps were filled in and rock baffles were elevated using limestone found on site.