

Appendix 3

O&M Plan for Laurel Run #1



FILL PLACEMENT AREA

PARKING AREA

ACCESS RD

DOWNSTREAM (APPROX. 1/2 MILE
DOWNSTREAM AT AULDS RUN ROAD)

CULVERT CROSSING

STREAM

LAUREL RUN

WL (461)

TIF

LAUREL RUN

UNT. #15

JVFP1

JVFP2

JVFP3

EMERGENCY
SPILLWAY

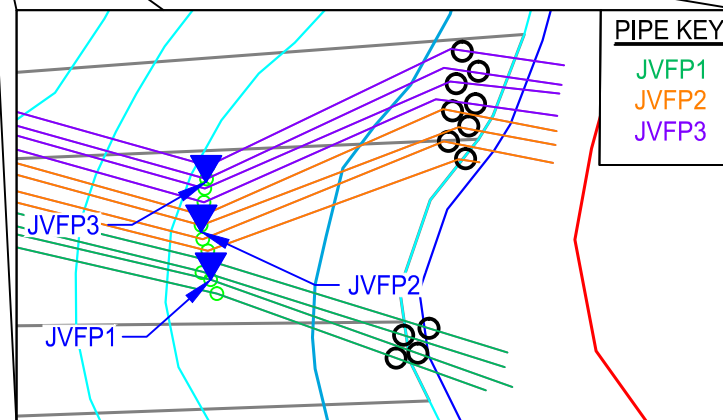
TERRACED IRON FORMATION (TIF)

COLLECTION CHANNEL

MAIN DISCHARGE

UPSTREAM

▼ SAMPLING LOCATION



BioMost, Inc.
434 Spring Street Ext.
Mars, PA 16046
www.biomost.com

SCALE:



COORDINATES:

N40.50785782
W79.11369619

LAUREL RUN #1 PASSIVE SYSTEM REHABILITATION

CENTER TOWNSHIP

INDIANA COUNTY/PA

SITE SCHEMATIC

DRAWING NUMBER:

1 of 1

Laurel Run #1 Passive Treatment System Rehabilitation

White Township, Indiana County, Pennsylvania

Operation & Maintenance Plan

May 2025



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Operation & Maintenance Plan

Section 1 – Project Information

Project Name	Laurel Run #1 Passive System Rehabilitation
Location (Site Access)	40.509078, -79.113444 (40.500486, -79.112941)
Site Access	Aulds Run Rd., Indiana, PA
Hydrologic Order	Laurel Run → Blacklick Creek → Conemaugh R. → Kiskiminetas R. → Allegheny R. → Ohio R.
Landowners	State Game Lands No. 276 and William and Shirley Wensell
Project Designer	BioMost, Inc., Mars, PA, www.biomost.com
Project Contractor	Joseph C. Puryear Trucking & Excavating Inc.

Design Summary	
Max Hydraulic Design Flow	1,600 GPM
Max Treatment Design Flow	430 GPM
Average Design Flow	200 GPM

Raw Loading Rates		
Treatment Load	Max	Average
Acid Load	660 lb/day	203 lb/day
Iron Load	20 lb/day	8 lb/day
Aluminum Load	32 lb/day	15 lb/day
Design Life: 15-25 Years		

Section 2 – Overview

The Laurel Run #1 Treatment System is located in White Township, Indiana County, Pennsylvania. The existing site has multiple acid mine drainage (AMD) sources that emanate from the hillside on the western side of Laurel Run. Due to hydrologic issues of the previous treatment system, the two southern raw sources were not being treated and were bypassing the treatment system and discharging into Laurel Run. The furthest north AMD source was not previously collected and was flowing directly into Laurel Run. Access to the site is obtained from Aulds Run Road (SR-2014) through the State Game Lands Number 276 access gate. The 2025 passive treatment system described herein is designed to collect and treat the AMD sources with a Collection Channel, followed by a Terraced Iron Formation (TIF) that is piped to a Flow Splitter Box that evenly splits the flow among three Jennings-type Vertical Flow Ponds (JVFPs) that work in parallel. Each JVFP outlets to the existing Treatment Wetland, which finally discharges into Laurel Run.

Section 3 – System Components

3.1 – Previous Treatment System

The original design system was installed in 2001 and consisted of a collection system that conveyed an underground mine discharge via a pipeline to two vertical flow ponds operating in series. In about 2014, Amerikohl Mining, Inc. operated a surface mine that intercepted the underground mine discharge and installed a new collection system, third vertical flow pond, and a concrete three-way flow splitter box and piping. Issues with the effectiveness of the new collection system, splitter box, all three vertical flow ponds were experienced resulted in the need to rehabilitate the entire system.

3.2 – Collection Channel (CC)

3.2.A – Purpose and Description

The CC is a 190 linear foot rock-lined channel with a 2-foot bottom width and collects the previously undiscovered northernmost discharge and conveys the discharge to the Terraced Iron Formation (TIF). The upper, flatter portion of the collection channel is AASHTO #1 rock-lined, and the lower, steeper portion is lined with R4 riprap.

3.2.B – Maintenance

Inspect the collection channel (CC) and remove any debris that obstructs flow. Since the CC is not designed for treatment, cleaning the stone or replacing the rock lining is not expected.

3.3 – Terraced Iron Formation (TIF)

3.3.A – Purpose and Description

The TIF collects and conveys diffuse discharges along the hillside, providing initial treatment primarily for iron removal. High Calcium AASHTO #1 limestone was used to line the TIF, acting as an alkaline buffer between acidic raw water and the underlying clay-bearing soil. Maintaining the flow of water in the TIF as a thin film optimizes treatment. This approach promotes oxidation with atmospheric oxygen and facilitates biogeochemical processes at the water/solid interface, particularly on the surface of metal precipitates in the channel.

The TIF consists of three main sections: an inlet pool that collects raw water from the collection channel (CC), a 350-foot-long treatment channel with a 20-foot bottom width, and an outlet pipe leading to the Flow Splitter Box. Approximately a quarter of the way down the TIF, two AMD seeps emanate from the upgradient hillside and flow into the TIF. To prevent erosion in these saturated areas, the seep zones are rock mulched with AASHTO #1 limestone. The combined drainage exits the TIF through an outlet pipe, which includes a twelve-inch SCH40 PVC pipe with an upward-facing tee to reduce clogging. Each opening features a bar guard inserted into the tee to block large debris. For maintenance, each bar guard is tied to a T-post, allowing personnel to pull on the rope to remove and clean the guard.

3.3.B – Maintenance

Over time, precipitates and debris will accumulate on the bottom of the TIF, leading to channelization and potentially causing overflow. Channelization reduces treatment effectiveness and increases the pollutant load on downstream components. To maintain optimal performance, clean the TIF using an excavator or compact track loader (skid steer) to remove accumulated precipitates and vegetation.

Remove the accumulated material to expose the original rock surface and re-level the rock to ensure even distribution of flow across the entire width of the channel. Place vegetation and other debris removed from the TIF on the downgradient side of the facility or in other locations to ensure any runoff is captured by the passive system.

3.4 – Flow Splitter Box

3.4.A – Purpose and Description

The flow splitter box is a 10'x8.5' concrete box with an aluminum grating cover. Within the flow splitter box is a stainless-steel three-sided baffle with V-notch weirs cut into each side to distribute flow equally to the three Jennings-type vertical flow ponds (JVFPs). Each weir is cut at a 90° angle. A weir lookup table can be found below as Table 1. A copy of this table is to be kept in the valve box of the 12" bypass valve. Water elevations should be read directly from the staff gauge mounted on the inside wall of the concrete splitter box. Alternatively, the flow can be determined by measuring down from the aluminum grating (within 1' of the staff gauge). Both staff gauge and 'measure down' readings are included on the lookup table.

3.4.B – Maintenance

During maintenance events it may be necessary to direct flow to one or more JVFP. Valves for each JVFP inlet can be opened or closed to achieve desired water handling. To ensure accurate flow measurement, the weirs should be kept free of debris or buildup. The staff gauge should be cleaned as needed. The seams between the box and stainless-steel weirs should be inspected to ensure no leaks have developed. Leaks can be addressed by cleaning the affected area and coating with Flex Seal or similar coating. The inlets to the pipes extending to the JVFPs should be cleaned as needed to ensure free flow. The 12" bypass can be opened as needed to drain the box to facilitate maintenance activities. After opening the bypass valve, please allow sufficient time for the Flow Splitter Box, Raw Water Pipeline, and Mine Drain to fill prior to taking a flow measurement.

3.5 – Jennings-type Vertical Flow Ponds 1, 2, and 3 (JVFP1, JVFP2 & JVFP3)

3.5.A – Flow Distribution

Each JVFP is designed to accept a third of the raw inlet flow which is split evenly by the Flow Splitter Box. A cleanout along the twelve-inch inlet pipe to the flow splitter box is positioned approximately halfway between the TIF and the splitter box for maintenance if required.

3.5.B – Purpose and Description

The JVFPs utilize a by-volume media mixture consisting of three parts limestone, two parts hardwood woodchips, and one part spent mushroom compost. This blend neutralizes acidity, generates alkalinity, and facilitates the precipitation of metals, particularly aluminum and iron.

Each JVFP includes a multi-cell underdrain system composed of four-inch SDR35 PVC perforated laterals connected to six-inch SDR35 PVC header pipes. The laterals are factory-perforated, while the headers are solid pipes with custom-drilled ¼-inch perforations positioned midway between laterals and every five feet thereafter (within the pond footprint) to reduce air lock. These headers transition into solid six-inch SCH40 PVC pipes that pass through the embankment and discharge into a downstream treatment wetland.

Each underdrain cell discharges through adjustable four-inch riser pipes, vertically connected to six-inch pipes using four-by-six-inch flexible rubber couplers. Operators can manipulate riser heights to adjust water levels or direct flow through selected treatment zones. Each JVFP includes two potential outlets: the primary outlet via riser pipes and secondary overflow via rock-lined emergency spillways into the treatment wetland. All outlet pipes also may be drained to the wetland with the individual 6" valves.

3.5.C – Treatment Process and Odor Management

The treatment media's biological activity produces both alkalinity and hydrogen sulfide gas. During startup or early operation, and under conditions of low temperature or high flow, nuisance odors may be deemed problematic. Operators can mitigate these odors by restricting flow to a single cell and rotating usage monthly during colder months.

During warmer weather or periods of lower influent flow, further reduction of flow may be necessary. To assist in this, operators can install flow-reduction assemblies using dry-fit bushings and one-inch PVC ball valves at the four-inch riser elbows. This allows fine-tuned flow control without cell rotation. If odors persist, further restrict or temporarily halting flow, forcing ponded water to discharge via the emergency spillways. This partially treated water will mix with fully treated effluent in the wetland. Over time, typically several years, odor issues diminish as the media matures. A persistent mild odor near outlet pipes signals proper system function, but operators should adjust treatment as needed to meet performance targets and minimize odor.

3.5.D – Treatment Media Stirring

Over time, the treatment media may compact and accumulate metals, reducing permeability to a point where water no longer passes through effectively. This condition can cause the pond water level to rise and overflow via the emergency spillway, thereby significantly diminishing treatment efficiency. Stirring the treatment media typically restores permeability. To facilitate maintenance and maintain continuous operation, the JVFP units are installed in parallel, allowing two units to remain online while the other undergoes servicing. The maintenance procedure is outlined below:

1. Divert flow from the JVFP scheduled for maintenance.
2. Open the drain valves to fully dewater the selected JVFP.
3. Allow the treatment media to dry—typically one week or more, depending on weather conditions—to enable access by a mini-excavator or other low-ground-pressure equipment.
4. If solids have accumulated on top of the media to a depth that can be effectively removed, excavate the solids as feasible and remove before subsequent steps.
5. Stir the full depth of media until loose and uncompacted, stopping at the underdrain stone. Avoid and repair any damage to underdrain piping. Close the drain valves and allow the pond to refill.
6. Reopen the drain valves to flush the stirred JVFP and remove fine materials from the piping system.
7. Close the drain valves once more, allow the pond to refill, and adjust the outlet risers to the normal operating elevation as needed.

3.5.E – Media or Underdrain Replacement

If stirring fails to restore flow, replace the treatment media and, if needed, underdrain stone and piping:

1. Divert flow from the targeted JVFP.
2. Fully dewater and allow the media to dry.
3. Remove spent media and underdrain components as necessary.
4. Transport and place of old media appropriately, then revegetate placement areas.
5. Install new stone, piping, and mixed treatment media per the original specifications or updated designs.
6. Before replacement, reassess system performance needs and water quality trends.

3.6 – Treatment Wetland

3.6.A – Purpose and Description

The treatment wetland is the final stage in the system, receiving water from each of the JVFPs. An inlet pool near the outlet risers traps solids and helps spread the flow of water before it enters the wetland. A rock distribution berm placed perpendicular to the flow distributes water evenly, minimizing short-circuiting.

The wetland is designed to remain free of standing water, with flow saturating the substrate. Over time, as organic matter, vegetation, and metal precipitates build up, the substrate thickens and the water level gradually rises. The wetland has two primary functions:

1. Re-aerate water that enters in a reduced state from the JVFPs.
2. Provide surface area for iron to oxidize and precipitate.

Treated water exits the wetland through a primary spillway to Laurel Run.

3.6.B – Maintenance

As the wetland fills with accumulated material, cleanout is required when the buildup nears the top of the distribution berm or when outlet function is obstructed. Remove excess substrate and dispose of it in an approved location, following all state and federal regulations. Visually inspect the distribution berm for debris or erosion that could lead to uneven flow. Restore or replace rock as needed to maintain even water distribution across the wetland.

3.7 – General Maintenance

Inspections described in the O&M schedule should take place to check for erosion of embankments and associated slopes. Any erosion shall immediately be graded as needed and stabilized utilizing seed and mulch or, in cases of bad erosion due to flooding or vandalism, erosion control fabric may be needed. The embankments should be kept free of woody vegetation typically achieved by mowing on an annual basis where feasible and removing woody growth on at least a triennial basis. The Flow Splitter Box should be checked every visit and cleaned of all debris that could obstruct any of the outlet pipes. If the box fills with metal precipitates and needs to be cleaned, open the twelve-inch Valterra valve and drain all precipitates, manual agitation of precipitates may be required.

Section 4 – Monitoring

The passive treatment system is designed to neutralize acidity and remove iron and aluminum from raw water. Under design flow and load conditions, the system should consistently remove acid, iron, and aluminum, and generate excess alkalinity, indicated by negative acidity in lab results. Effluent pH should stay at or above 6. During high flows or pollutant surges, short-term drops in effluent quality may occur, but effluent quality typically recovers as conditions return to normal. Frequent exceedance of design limits may reduce system life and increase maintenance needs.

To verify performance, calculate acid load removal using total flow at each JVFP outlet riser and lab-determined acidity (via the hot-peroxide method). Since the wetland does not add alkalinity, evaluate each JVFP's effluent against its influent. Also analyze water quality at the wetland outlet to assess overall system output to Laurel Run. Field alkalinity tests can provide a quick check of system function.

Equation 1: Influent Acid Load

Instructions: Collect sample at any inlet pipe to a JVFP from the Flow Splitter Box, or within the box
$$\text{Flow (GPM)} \times \text{Acid Concentration (mg/L CaCO}_3\text{)} \times 0.01202 \text{ (conversion factor)} = \text{Acid Load lb/day}$$

Equation 2: JVFP Effluent Acid Load

Instructions: Collect sample at JVFP outlet riser for each JVFP being evaluated, collect composite all the flowing pipes by holding a container under each pipe for an equal amount of time.
$$\text{Flow (GPM)} \times \text{Acid Concentration (mg/L CaCO}_3\text{)} \times 0.01202 \text{ (conversion factor)} = \text{Acid Load lb/day}$$

Add acid loads calculated from each VFP.
Note: If JVFPs are functioning as intended, the acid load will be a negative number.

Equation 3: Acid Load Removed

$$\text{Influent Acid Load (lb/d)} \text{ minus Combined Effluent Acid Load (lb/d)} = \text{Acid Load Removed}$$

Note that positive acid load minus a negative acid load will result in an acid load removed greater than the influent acid load. (e.g., 100 lb/day minus negative 10 lb/day = 110 lb/day total acid removed).

The acid load removed for the entire system may be calculated by using the chemistry measured at the Wetland outlet and using the total flow measured at the JVFPs.

To calculate the metal load removed, follow the above equations, substituting the metal concentration (mg/L) for acidity concentrations (mg/L CaCO₃). As manganese contributes a minor amount of the total acid load, the system was not designed to remove this metal, and no appreciable manganese removal is expected. However, manganese removal may still be observed.

Section 5 – O&M Schedule

Monthly (Frequency may be reduced based on system performance)

- Record flow by reading the staff gauge inside the flow splitter box.
 - Splitter box should be cleaned of debris and precipitates as needed
- Visual inspection of all components, channels, ditches, etc.
- Remove and clean TIF bar guards of vegetation and debris.
- Check pH at system effluent, WL
 - pH should always be >6.0
- Upload all monitoring data to www.datashed.org

Annually

- During typical high-flow (February – May) collect samples for laboratory analysis at:
 - CC, TIF (can be collected in flow splitter box or at inlet of any JVFP), and WL (See Attachment 1: Schematic). A composite sample from the four pipes discharging from each of the JVFPs should be taken.
 - Minimum parameters to include per sample point: pH, conductivity, acidity, alkalinity, iron, aluminum, manganese
 - At system effluent, WL, iron should be <3.0 mg/L
 - Measure flow at inlets and outlets of JVFP1, JVFP2 and JVFP3
 - Flow can be measured by taking the sum of each individual riser pipe outlet and combining for each respective JVFP total. There are four (4) outlets per JVFP. Large differences in flows into and out of the JVFP could be an early signal that the media may be losing permeability.
 - Upload all monitoring data to www.datashed.org
- Flush solids out of the flow splitter box by opening the 12" valve at the inlet of JVFP2.
- Exercise JVFP inlet valves along the eight-inch SCH40 PVC pipes following the flow splitter box.
- Exercise JVFP drain valves along six-inch SCH40 PVC underdrain pipes prior to the wetland; leave all valves in closed position, unless intentionally draining one of the JVFPs.

As Needed

- Remove unwanted vegetation from spillways, channels, pipes, etc.
- Remove woody vegetation from embankments.
- Maintain of ditches, level spreaders, etc. as described herein.
- Replace or stir treatment limestone or mixed media as described herein.

Section 6 – Weir Lookup Table

90-Degree V-Notch Weir Lookup Table (Per Weir and All Three Weirs)

<u>From Top of Grate</u> <u>(GPM)</u>	<u>Staff Gauge Read</u> <u>(feet)</u>	<u>Flow Per JVFP</u> <u>(GPM)</u>	<u>Flow All 3 JVFPs</u> <u>(GPM)</u>
0.68	0.20	20	60
0.69	0.21	23	68
0.70	0.22	25	76
0.71	0.23	28	85
0.72	0.24	32	95
0.73	0.25	35	105
0.74	0.26	39	116
0.75	0.27	43	128
0.76	0.28	47	140
0.77	0.29	51	152
0.78	0.30	55	166
0.79	0.31	60	180
0.80	0.32	65	195
0.81	0.33	70	211
0.82	0.34	76	227
0.83	0.35	81	244
0.84	0.36	87	262
0.85	0.37	93	280
0.86	0.38	100	300
0.87	0.39	107	320
0.88	0.40	114	341
0.89	0.41	121	362
0.90	0.42	128	385
0.91	0.43	136	408
0.92	0.44	144	432
0.93	0.45	152	457
0.94	0.46	161	483
0.95	0.47	170	510
0.96	0.48	179	537
0.97	0.49	189	566
0.98	0.50	198	595
0.99	0.51	208	625
1.00	0.52	219	656
1.01	0.53	229	688
1.02	0.54	240	721

<u>From Top of Grate</u> <u>(GPM)</u>	<u>Staff Gauge Read</u> <u>(feet)</u>	<u>Flow Per JVFP</u> <u>(GPM)</u>	<u>Flow All 3 JVFPs</u> <u>(GPM)</u>
1.02	0.54	240	721
1.03	0.55	252	755
1.04	0.56	263	790
1.05	0.57	275	826
1.06	0.58	287	862
1.07	0.59	300	900
1.08	0.60	313	939
1.09	0.61	326	978
1.10	0.62	340	1019
1.11	0.63	353	1060
1.12	0.64	368	1103
1.13	0.65	382	1147
1.14	0.66	397	1191
1.15	0.67	412	1237
1.16	0.68	428	1283
1.17	0.69	444	1331
1.18	0.70	460	1380
1.19	0.71	477	1430
1.20	0.72	494	1481
1.21	0.73	511	1533
1.22	0.74	529	1586
1.23	0.75	547	1640

Note: "From Top of Grate" column represents a lookup value for measurements taken by measuring down from the top of the grate near the staff gage to the water level in the Flow Splitter Box.