Oven Run B Passive Treatment System Redesign and Construction

Shade Township, Somerset County, Pennsylvania

Final Report

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September 2022

Stream Restoration Incorporated

www.streamrestorationinc.org

Introduction

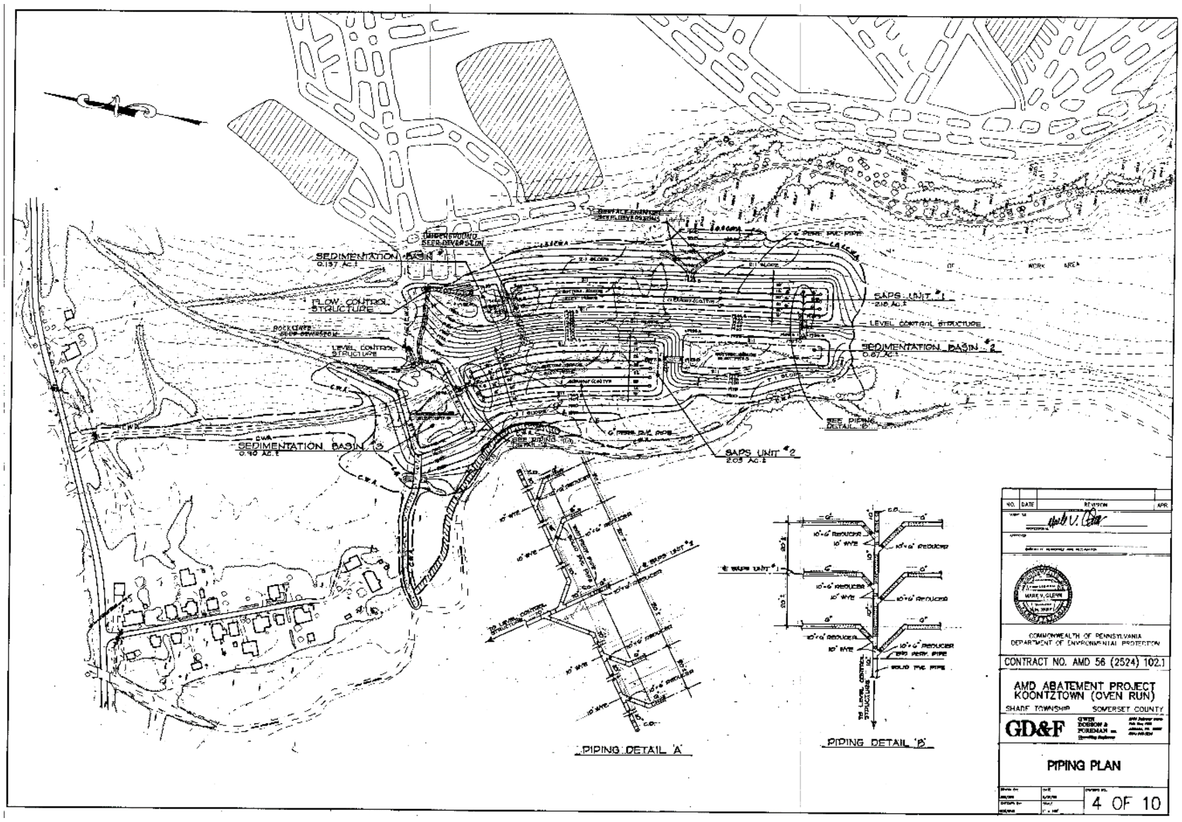


Figure 1. Original System Design (Sheet 4 of 10 – full set of plans available on www.datshed.org)

The Oven Run B passive treatment system (System) was originally constructed by the Pennsylvania Department of Environmental Protection (PA DEP), Bureau of Abandoned Mine Reclamation (BAMR) in 1999 to treat 350+ gallons per minute (gpm) of acid mine drainage (AMD) emanating from three sealed deep mine entries. An example original design sheet is included as Figure 1. The project was part of a larger effort of the Stonycreek-Conemaugh Improvement Project (SCRIP) to restore Oven Run and the Stonycreek River. Within a few years of construction, system performance began to decline, and the effluent water quality had typically remained poor although improved.

The System was evaluated as part of the Kiski-Conemaugh Basin Treatment System Operation & Maintenance (O&M) Assessment project funded through GenOn settlement funds administered by the Foundation for Pennsylvania Watersheds and completed by Stream Restoration Incorporated (SRI) and BioMost, Inc. in December 2017. Based on recommendations made in that report, SCRIP, and PA DEP BAMR, requested further evaluation and development of options, conceptual designs and cost estimates which were completed through SRI's O&M Technical Assistance Grant (TAG) program. Documents prepared during these efforts as well as other information can be found on the Oven Run Site B page on Datashed. (See: www.datashed.org/project-oven-run-site-b). PA DEP BAMR awarded SRI a grant in 2020 to rehabilitate the passive system. BioMost completed the final design and construction began in March 2021.

Treatment Targets

Oven Run flows into the Stonycreek River, which flows into the Conemaugh River. In accordance with PA Code Title 25 Chapter 93, the protected use for Oven Run is CWF (Cold Water Fishes). As the Oven Run B system treats mine drainage from an **abandoned** mine in-stream and effluent water quality standards **do not apply**; However, in an effort to provide context for the level of performance that would be typically expected at an active, permitted coal mine, both the in-stream water quality standards and the effluent standards for a passive treatment system are provided below in Table 1 and Table 2, respectively.

Table 1. Select Typical Stream Water Quality Standards (Title 25 PA Code Chapter 93)

Parameter	Standard	Source
Alkalinity	20 mg/L (minimum)	§93.7 Table 3
Iron (total)	1.5 mg/L (30-day average)	§93.7 Table 3
pH	6.0 to 9.0 (inclusive)	§93.7 Table 3
Aluminum (total)	0.75 mg/L (maximum)	§93.8c Table 5
Note: Manganese is included in §93.7 Table 3 as a water quality criterion for potable water supplies at 1.0 mg/L.		

Table 2. Typical Passive Treatment Effluent Standards (Title 25 PA Code Chapter 87.102(e)(3))

Parameter	Standard
Alkalinity	Alkalinity > Acidity
Iron (total)	3.0 mg/L (30-day average) / 7.0 mg/L (instantaneous maximum) or 90% reduction

In addition to the effluent standards included in Table 2, the design team also included treatment targets for the treatment system effluent of pH >6.0 and Aluminum <1.0 mg/L. Manganese removal was not a parameter that was targeted for removal. Treatment targets for the effluent of the passive system monitored at the outlet of SP3 (ORBO) are provided in Table 3.

Table 3. Oven Run B Treatment Targets

Parameter	Treatment Target
pH	$\geq$ 6.0
Alkalinity	$\geq$20 mg/L as $CaCO_3$
Acidity	$\leq$ 0 mg/L as $CaCO_3$
Iron (total)	$\leq$3 mg/L
Aluminum	$\leq$1 mg/L

Discharge Characteristics

The Oven Run B discharge (ORBI) was monitored by the Pennsylvania Department of Environmental Protection (PA DEP) and Stream Team on a quarterly basis from 1999 to 2010. After 2010, individual samples and monitoring happened more sporadically. The raw water quality characteristics that reflect more recent conditions are summarized in Table 4. Monitoring data is available on Datashed. (See: www.datashed.org/project-oven-run-site-b).

Table 4. Oven Run B Raw Water Characteristics (2010-2018)

Sample Point	Flow gpm (avg/max)	pH Field	pH Lab	Alkalinity mg/L	Acidity mg/L	Fe mg/L	Mn mg/L	Al mg/L	SO_4 mg/L
ORBI (Influent)	141/353	2.8	2.8	0	320	28	11	25	788
Average values except as noted. Total metals.									

Design Basis

In order to meet the treatment targets identified in Table 3, the applicable design characteristics provided in Table 5 were used to prepare the passive treatment system design. The average flow and pollutant loads were selected from the 2010-2018 dataset while the maximum flow is the highest flow recorded for ORBI from 1999 through 2018. Though manganese is present in the raw drainage, due to the need for additional components to remove this metal and the lack of inclusion as an in-stream CWF parameter, manganese was not targeted for removal by the Oven Run B passive treatment system.

Table 5. Oven Run B Raw Discharge Design Characteristics

Parameter	Flow gpm	pH lab	Acid mg/L	Fe mg/L	Al mg/L	Acid Load lb/day	Fe Load lb/day	Al Load lb/day
Average	141	2.8	320	28	25	533	42	43
Max./Worst Case	367	2.7	383	43	30	1339	95	101

Treatment Approach

The current project included an innovative approach to redesign and rehabilitate the treatment system. One of the assumed problems of the original system was the immense size of the SAPS ponds which each contained about 10,000 tons of limestone and were suspected to be short-circuiting. To alleviate this issue, the majority of SAPS1 was divided into three separate Auto-Flushing Limestone Only Vertical Flow Ponds (AFVFPs) that utilize solar-powered Agri Drain Smart Drainage structures (Smart Drains). The Smart Drains are programmed to have daily fill/flush cycles that not only reduce short-circuiting but help to alleviate armoring and plugging of the limestone. Over half of the total acidity is associated with the 2.8 pH and 25 mg/L of aluminum, about 79 mg/L and 139 mg/L of acidity, respectively. Most, if not all of the aforementioned acidity is expected to be neutralized by this initial treatment step. The original collection pond was expanded into a portion of what was SAPS1 and converted to a holding pond that provides the ability to quickly dose the AMD into the three AFVFPs on an alternating set schedule which increases retention time and improves limestone dissolution. The remaining segment of SAPS1 was left in place as a dewatering basin to facilitate future maintenance and is designed to receive sediment and other materials from the various treatment components. In addition, a Moat (forebay) was constructed to help collect and convey the AMD into the holding pond. A flume and data logger were installed to measure flow.

Similar to SAPS1, the majority of SAPS2 was split into two Jennings-type mixed media Vertical Flow Ponds (JVFPs). The initial treatment provided by the AFVFPs is projected to reduce long-term maintenance needs of the JVFPs. The remaining portion of SAPS2 was converted into a new settling pond (SP2) to provide additional settling of solids following the AFVPs.

The old compost was removed from both original SAPS, placed on site, and revegetated. The limestone removed from the SAPS was washed for reuse, with an estimated two-thirds recovery. Initial plans were to crush the SAPS2 limestone for use in the JVFP treatment media, however this proved cost prohibitive and the primary construction contractor, Earth Shapers, LLC from Ebensburg, PA was able to coordinate a trade with the nearby Gahagen treatment system whereby the AASHTO #1 aggregate from Oven Run B was traded for AASHTO #67 limestone purchased from New Enterprise Stone & Lime.

Settling ponds 1 (SP1) and 3 (SP3) have remained mostly unchanged except for the addition of baffle curtains and outlet piping.

An effort was made to incorporate the original existing treatment system pond structures into the renovation design when feasible to help reduce overall earthwork needed in system rehabilitation .This allowed current construction efforts to focus on maximizing treatment capacity; However, the existing pond elevations did limit the amount of elevation change available between some components, particularly between the Holding Pond and the AFVFPs as the presence of bedrock in SAPS1 limited the amount of excavation.

A detailed description of the treatment system is included in the Operation & Maintenance Plan (O&M Plan) that includes As-Built Drawings as an attachment. Photos of the construction process are included in Appendix 2.

System Performance Evaluation

Historic treatment system monitoring data is available on Datashed. A summary of historic data and pre-construction and post-construction monitoring is included in Table 6. Complete pre-construction and post-construction monitoring data is included in Appendix 1.

Pre-construction water samples were collected January 27th, 2021, which documented that there was little improvement of the AMD by the original system and that Oven Run was further degraded by the Oven Run B discharge. Post-construction samples collected on August 16th, 2022, document the system successfully treating the Oven Run B discharge and improving the water quality in Oven Run. The post-construction monitoring was a single sample event of a recently completed treatment system and on-going monitoring is recommended.

On August 16th, 2022, the primary system inflow (ORBI) was 121 gallons per minute (gpm). Additional raw water inflows were sampled at Rock Drain 1 (RD1) near the inlet to the Holding Pond, the outflow from the Dewatering Basin (DB) that receives flow from two other rock drains, and the two rock drain outlets that flow directly into SP1 (NRD and SRD). The total raw water inflow was 138 gpm, and the total acid load was 419 lb/day. The total influent iron, aluminum, and manganese loads were 28.6, 36.7, and 20.4 lb/day, respectively.

The system effluent measured at the outlet of SP3 (ORBO) had a pH of 7.01 and acidity of -168 mg/L indicating the water was net-alkaline. The entire acid load was neutralized with an additional 279 lb/day of alkalinity (as negative acid load) being discharged to Oven Run. The total acid change (acid neutralized plus excess alkalinity produced) was 697 lb/day. The total effluent iron, aluminum, and manganese loads were reduced to 2.5, 0.0, and 5.2 lb/day, respectively.

Oven Run was documented to be improved by the addition of the treated Oven Run B System water with the pH increased from 4.46 to 6.81 and acidity reduced from 15 mg/L to -39 mg/L. Both aluminum and manganese concentrations in Oven Run decreased from upstream to downstream of the treatment system. The in-stream iron concentration increased by less than 2 mg/L; However, this may be due to other influences as the system effluent had a dissolved iron concentration below detection limit and the downstream dissolved iron concentration was 1.8 mg/L.

Table 6. Water Monitoring Summary Table.

Sample Point	n	Flow gal/min	Cond. umhos/cm	Lab pH	Alkalinity mg/L	Acidity mg/L	T. Fe mg/L	D. Fe mg/L	T. Mn mg/L	D. Mn mg/L	T. Al mg/L	D. Al mg/L	Sulfate mg/L	TSS mg/L
Avg. ORBI	36	150	1692	2.81	0	317	27.3	22.6	11.1	10.3	24.6	24.4	782	5
ORBI	1	121	1670	2.92	0	254	16.2	13.7	12.3	11.8	22.2	21.8	665	<5
Avg. ORBO	10	190	1473	2.91	0	251	20.2	16.3	10.3	7.9	20.6	16.4	689	8
ORBO	1	141	1286	7.01	258	-168	1.5	<0.1	3.1	3.0	<0.1	<0.1	451	17
ORBUP	1	N.M.	641	5.00	2	14	2.5	2.3	4.0	3.8	1.5	0.7	278	5
ORBUP	1	N.M.	1069	4.93	3	15	0.1	<0.1	12.3	11.3	2.2	1.7	477	<5
ORBDN	1	N.M.	730	3.86	0	35	3.6	3.5	4.4	4.3	3.0	2.7	311	5
ORBDN	1	N.M.	1048	7.21	63	-39	2.0	1.8	7.1	6.5	0.8	<0.1	432	11

ORBDN & ORBUP Single prior to construction sample event (1/27/2021)

ORBI & ORBO Average values (2010-2021)

ORBI, ORBO, ORBUP, & ORBDN Single post-construction sample event (8/16/2022)

ORBI	Oven Run B Inflow - Raw mine water at H-Flume
ORBO	Oven Run B Outflow - Treated water at SP3 outlet
ORBUP	Upstream - Oven Run about 800 ft. above SP3 outlet
ORBDN	Downstream - Oven Run just below bridge at Koontztown Rd.

Sample Prior to Construction | Sample Post Construction

Conclusions

Overall, based on the single monitoring event conducted shortly after the system was constructed, the Oven Run B system is meeting all the treatment targets outlined in Table 3. The single downstream sample indicates that most of the in-stream standards outlined in Table 1 are being met with the exception of total iron (2.0 mg/L measured compared to the standard of 1.5 mg/L) and aluminum is very close to the 0.75 mg/L standard (within less than 0.1 mg/L). It is noted that the upstream dissolved aluminum was 1.7 mg/L while the downstream was below detection limits. The before and after in-stream comparison is likely affected by the pre-construction sample conducted in January (seasonally higher flow) and the post-construction sample collected in August (seasonally lower flow). The total measured acid change of 697 lb/day is equivalent to 127 tons which is comparable to > five truckloads of lime. Additional system and stream monitoring is recommended to assess long-term treatment system performance.

APPENDIX 1

Water Monitoring Data

(2 pages)

PRE-CONSTRUCTION WATER MONITORING DATA

	Sample Point	Date	Flow gpm	F. ORP mv	F. D.O. mg/L	Temp. °C	pH field	pH lab	Cond. umhos	Alk. mg/L	Acid. mg/L	T. Fe mg/L	D. Fe mg/L	T. Mn mg/L	D. Mn mg/L	T. Al mg/L	D. Al mg/L	SO4 mg/L	TSS mg/L
SYSTEM	ORBI	1/27/21	N.M.	450	10.08	9.8	2.85	2.87	1642	ND	231	16.34	13.22	8.64	6.90	13.90	10.38	574	<5
	ORBO	1/27/21	N.M.	512	12.26	3.6	3.05	2.96	1480	ND	203	13.27	13.16	7.45	7.38	12.92	12.57	505	<5
STREAM	ORBUP	1/27/21	N.M.	335	13.21	0.4	4.86	5.00	641	2	14	2.48	2.26	3.99	3.84	1.54	0.73	278	5
	ORBDN	1/27/21	N.M.	415	13.01	1.4	3.91	3.86	730	ND	35	3.64	3.47	4.38	4.25	3.04	2.67	311	5

Sample Point	Description
ORBI	Oven Run B Inlet
ORBO	Oven Run B Outlet at the effluent of SP3
ORBUP	Oven Run Upstream of the treatment system (About 800 feet upstream of SP3 confluence)
ORBDN	Oven Run Downstream of the system at the Koontztown Road bridge

See As-Built Drawings for sample point locations.

POST-CONSTRUCTION WATER MONITORING DATA

	Sample Point	Date	Flow gpm	F. ORP	F. D.O.	Temp. °C	FIELD pH	LAB pH	COND. umhos	F. Alk. mg/L	L. Alk mg/L	Acid. mg/L	T. Fe mg/L	D. Fe mg/L	T. Mn mg/L	D. Mn mg/L	T. Al mg/L	D. Al mg/L	SO4 mg/L	TSS mg/L	Acid. Ld. lb/day	T. Fe Ld. lb/day	T. Mn. Ld. lb/day	T. Al Ld. lb/day
INFLOW	ORBI	8/16/22	121	504	10.39	20.0	3.19	2.92	1670	0	ND	254	16.15	13.72	12.32	11.75	22.20	21.81	665	<5	370	23.5	17.9	32.3
	RD1	8/16/22	1	431	6.79	20.0	3.72	3.37	999	0	ND	54	7.21	5.29	11.37	8.97	4.47	4.23	379	<5	1	0.1	0.1	0.1
	DB	8/16/22	9	423	5.48	20.0	3.42	2.99	1353	0	ND	248	35.11	34.28	12.58	11.10	23.70	22.45	523	18	27	3.8	1.4	2.6
	NRD	8/16/22	0																		0	0.0	0.0	0.0
	SRD	8/16/22	7	468	7.93	20.0	3.20	2.99	1201	0	ND	251	14.81	<0.10	12.07	11.02	21.37	20.65	440	<5	21	1.2	1.0	1.8
	COMBINED IN		**138**									**252**	**17.25**		**12.32**		**22.13**				**419**	**28.6**	**20.4**	**36.7**
TREATMENT COMPONENTS	HP	8/16/22	N/S	363	10.12	19.1	3.15	2.94	1634	0	ND	255	15.67	13.88	13.87	9.54	21.27	20.81	644	<5				
	SP1	8/16/22	115	-20	8.51	19.5	7.16	7.08	1348	88	70	-55	0.79	<0.10	1.03	1.00	0.23	<0.10	635	<5	-76	1.1	1.4	0.3
	SP2	8/16/22	N/S	-43	8.52	19.6	7.68	7.68	1320	79	70	-52	0.20	<0.10	1.13	1.05	<0.10	<0.10	638	<5				
	JVFP1	8/16/22	64	-307	0.18	25.0	7.18	7.12	1294	286	247	-143	<0.10	<0.10	5.14	3.74	<0.10	<0.10	474	<5	-110	0.0	4.0	0.0
	JVFP2	8/16/22	69	-333	1.83	25.0	7.20	7.09	1330	272	207	-124	<0.10	<0.10	1.40	1.36	<0.10	<0.10	509	<5	-103	0.0	1.2	0.0
	JRD	8/16/22	5	134	5.58	25.0	6.74	7.01	1295	176	180	-141	<0.10	<0.10	4.53	2.76	<0.10	<0.10	540	<5	-8	0.0	0.3	0.0
	ORBO	**8/16/22**	**143**	**112**	**4.54**	**25.0**	**7.01**	**7.67**	**1286**	**257**	**258**	**-168**	**1.50**	**<0.10**	**3.11**	**3.03**	**<0.10**	**<0.10**	**451**	**17**	**-279**	**2.5**	**5.2**	**0.0**
STREAM	ORBUP	8/16/22	N/S	404	8.71	18.9	4.46	4.93	1069	0	3	15	0.14	<0.10	12.34	11.32	2.16	1.70	477	<5				
	ORBDN	8/16/22	N/S	149	8.21	21.1	6.81	7.21	1048	92	63	-39	1.96	1.84	7.07	6.48	0.79	<0.10	432	11				

Effluent load (ORBO) calculated using COMBINED IN flow (138 gpm); JRD is flow from rock drain along JVFPS, apparent impact from JVFPs suspected.

	T. Fe	D. Fe	T. Mn	D. Mn	T. Al	D. Al	SO4	TSS	Acid. Ld.	T. Fe Ld.	T. Mn. Ld.	T. Al Ld.
TOTAL REMOVED:	**15.75**		**9.21**		**22.13**				**697**	**26**	**15**	**37**
TOTAL REMOVED (t/yr):									**127**	**5**	**3**	**7**

Sample Point	Description
ORBI	Oven Run B Inlet
RD1	Rock Drain near ORBI
DB	Dewatering Basin drain
NRD	Rock Drain North discharges into SP1 near the AFVFP2 outlet
SRD	Rock Drain South discharges into SP1 near the AFVFP3 outlet
HP	Holding Pond outlet into AFVFP1
SP1	Settling Pond 1
SP2	Settling Pond 2
JVFP1	Jennings Vertical Flow Pond 1
JVFP2	Jennings Vertical Flow Pond 2
JRD	Jennings Rock Drain discharges to SP3 (flow not included with ORBO or total removel load calcuations)
ORBO	Oven Run B Outlet at the effluent of SP3
ORBUP	Oven Run Upstream of the treatment system (About 800 feet upstream of SP3 confluence)
ORBDN	Oven Run Downstream of the system at the Koontztown Road bridge

See As-Built Drawings for sample point locations.

APPENDIX 2

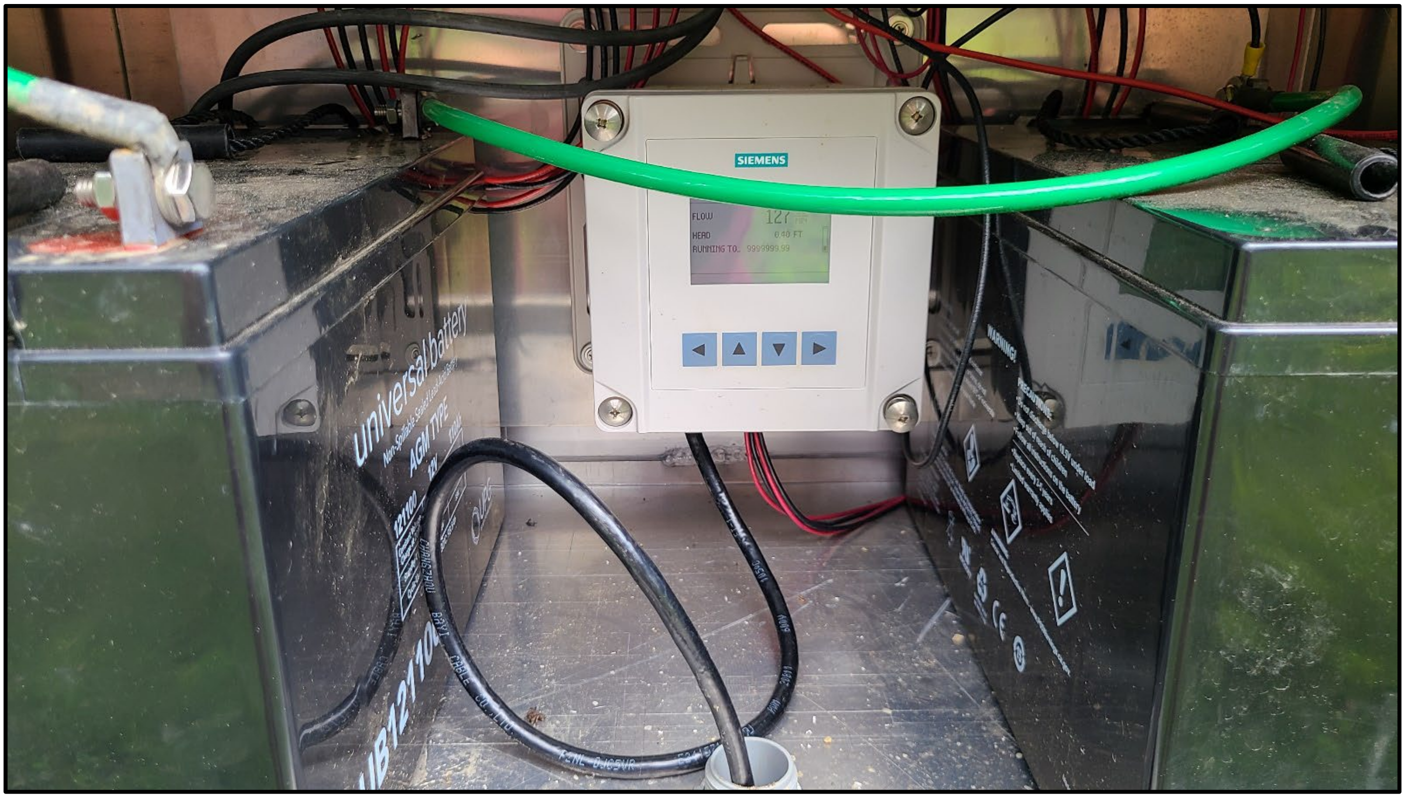
Photo Log

(10 pages)

Photo Log

Top: Three of five 18-inch SCH40 PVC pipes flowing into the Moat from underground coal mine. (6/28/20)

Bottom: H-Flume flowing into holding pond with solar panel and control panel to record flow. "ORBI" monitoring point. (7/7/22)



Top: Inside of H-Flume control box containing two batteries and the control panel connected to the water level sensor. (9/21/22)

Bottom: Overview of the extended holding pond section. (9/21/22)

Top: Overview of the dewatering basin. (9/21/22)

Bottom: Rock drain under construction showing 6-inch SDR35 PVC pipe and aggregate. (4/29/21)

Top: Three-Way Flow Splitter with Agri Drain Smart Drainage System structures connected to 12-inch SCH40 pipe that flow into AFVFPs. (2/16/22)

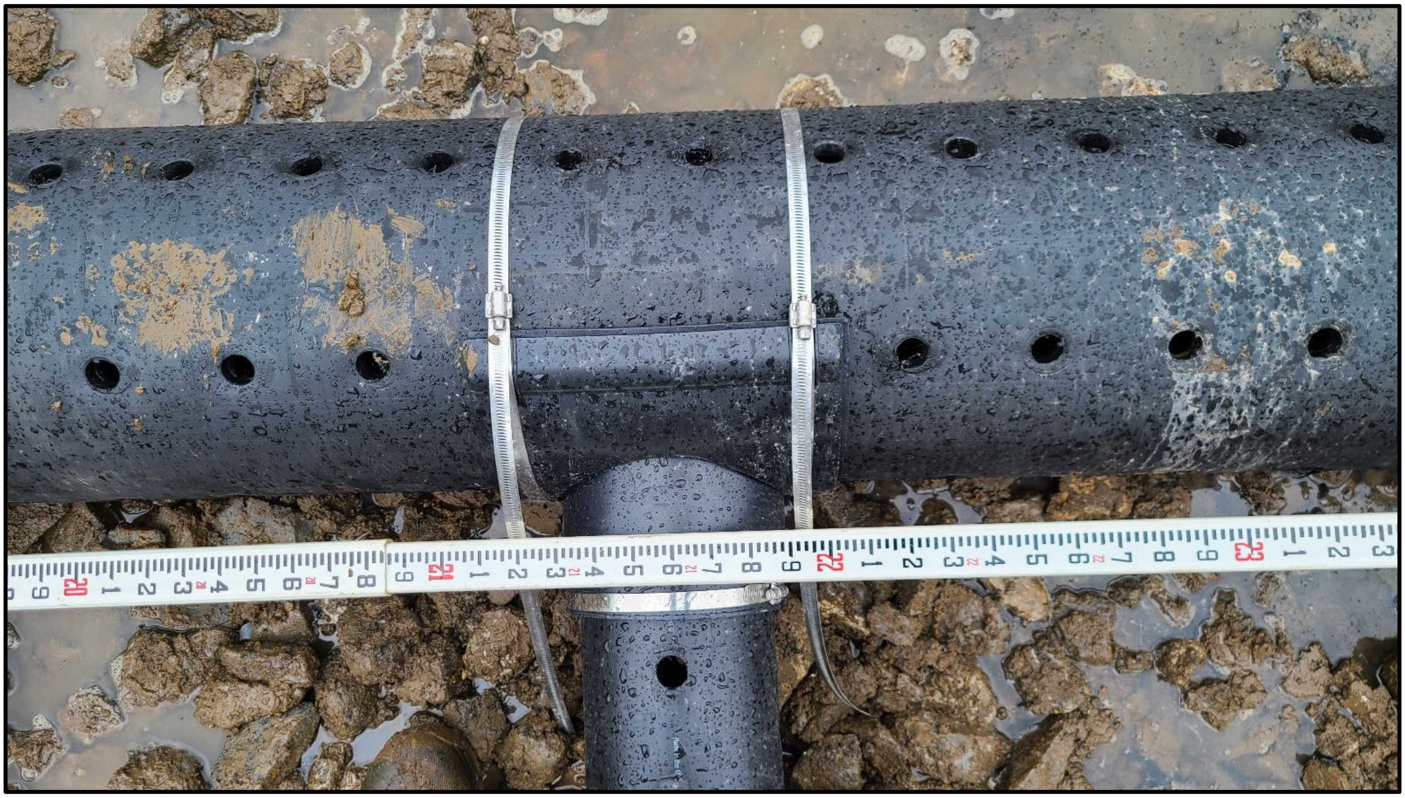
Bottom: 12-inch SCH40 PVC pipes from Three-Way Splitter to AFVFP 1 and AFVFP2. (10/20/21)

Top: Construction of AFVFP3 showing bedding stone, underdrain pipe and limestone. (4/29/21)

Bottom: Spreading and leveling limestone in AFVFPs. (9/21/22)

Top: Cleaning limestone to be reused. (9/21/21)

Bottom: Inlet pipe to AFVFP2 in place. (10/20/21)



Top: 12-inch DR-26 HDPE header pipe with 12-inch HDPE tee connected with 12-inch non-shear flexible couplers with 6-inch DR-17 perforated lateral. (4/29/21)

Bottom: Perforated lateral pipe with 12-inch x 6-inch flexible saddle tee connection. (4/29/21)

Top: Settling Pond 1 with direction baffle curtain. (9/21/22)

Bottom: Two-Way Splitter with top aluminum grating removed to access 10-inch SCH40 PVC 90° elbows connected to 12-inch SCH40 PVC pipes used to adjust flow to JVFPs. (10/06/22)

Top: Jennings-type Vertical Flow Pond underdrain with solid 6-inch SDR35 PVC header pipes and perforated 4-inch SDR35 PVC lateral pipes. To the right is the mix of 2,800 tons of limestone, 700 CY of spent mushroom, and 1,400 CY of wood chips. (10/20/21)

Bottom: Transition of 6-inch SDR35 PVC pipe to 8-inch SCH40 pipe to pass through embankment. (10/20/21)

Top: JFVP1 and JVFP2 riser pipes discharging to SP3 with baffle curtains. (9/8/22)

Bottom: Outlet of system at SP3 with solar powered pH meter portion of telemetry system. (9/21/22)