Assessment of Abandoned Mine Drainage in Two Lick Creek
Indiana County, Pennsylvania

Technical Report Provided by Hedin Environmental
for the Blacklick Creek Watershed Association
through the Trout Unlimited AMD Technical Assistance Program

Diamondville borehole discharge to Two Lick Creek

April 2020

Background

The Two Lick Creek watershed is a 192 square mile urban, suburban, and rural watershed in Indiana County, Pennsylvania. Two Lick Creek is the largest subwatershed in the Blacklick Creek Watershed, which is tributary to the Conemaugh River, the Kiskiminetas river, and ultimately the Allegheny River. The watershed is divided into upper and lower watersheds by the Two Lick Creek reservoir. The upper watershed (63 mi^2) flows through the town of Clymer and is otherwise largely rural and agricultural in land-use. The lower watershed (129mi^2) flows through Indiana and Homer City, and contains the large Yellow Creek watershed (67 mi^2), as well as the small Tearing Run watershed (4.5mi^2).

The entire Blacklick Creek watershed is heavily impacted by abandoned mine drainage (AMD), and Two Lick Creek is no exception. Yellow Creek is the subject of a current Growing Greener watershed assessment/restoration plan, but the rest of the Two Lick Creek watershed hasn't been studied comprehensively in more than a decade. The Blacklick Creek Watershed Association (BCWA) received a Trout Unlimited (TU) AMD Technical Assistance Grant to conduct background watershed monitoring and discharge reconnaissance to gain a better understanding of the current conditions of the watershed for upcoming grant applications. Local support was provided by TU's contractor, Hedin Environmental (HE).

The three main sources of background information for this project were the 2006 Two Lick Creek Cold Water Heritage Conservation and Restoration Plan, prepared by the Ken Sink TU chapter; the 2005 Phase II Watershed Assessment and Restoration Plan for the Upper Two Lick Creek Watershed prepared by the Indiana University of Pennsylvania; and a 1978 Scarlift report that was sifted through by Dennis Remy of the BCWA for historic discharge locations. The TU Coldwater Heritage document reported that the eight-mile section of Two Lick Creek below the reservoir and above the input of Yellow Creek supported a reproductive trout population. At that time, Yellow Creek and the Risinger discharge were the worst sources of pollution into the lower Two Lick Creek watershed. The IUP Upper Two Lick report was less comprehensive, and primarily considered discharges visible from the watershed's roads. Nonetheless, the report organized a list of nineteen discharges in the watershed.

Much of the Two Lick Creek watershed is designated as a Trout Stocked Fishery (TSF), with a few exceptions. Below the Two Lick Reservoir, Two Lick Creek is designated as a Cold Water Fishery (CWF) until its confluence with Yellow Creek, after which it is again designated as at Trout Stocked Fishery (TSF). The North and South branches of Two Lick Creek, in the upper watershed, are designated as CWF and High Quality CWF (HQ-CWF), respectively. Most of the main stem of Two Lick Creek is listed as impaired due to impacts from AMD and does not meet its designated use. The exception to this is the South Branch of Two Lick Creek, which is listed as attaining between its confluence with Whitaker Run and its confluence with Sides Run (above which it becomes impaired due to agricultural siltation).

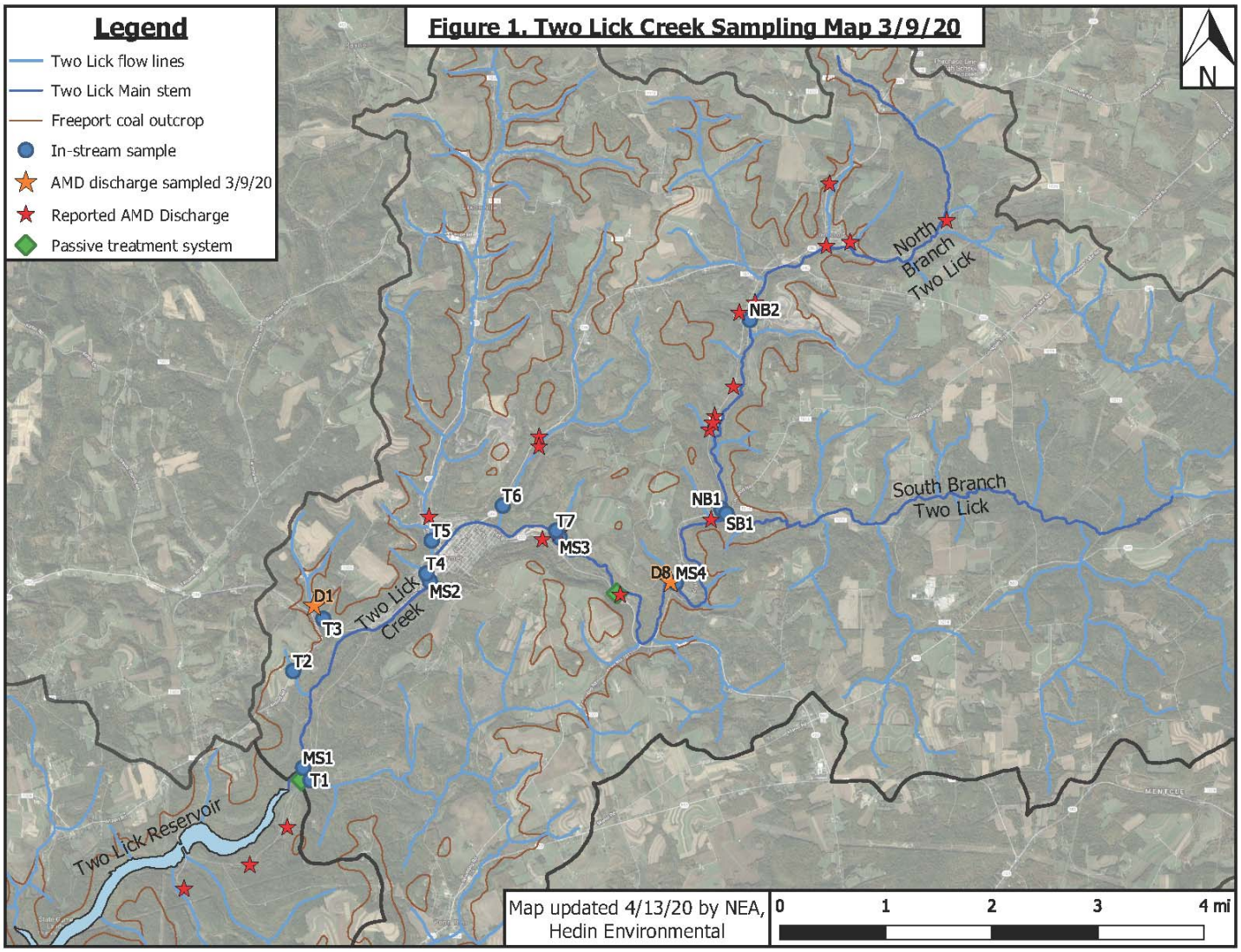
After reviewing the aforementioned sources and the synthesis of data provided by Dennis Remy (BCWA), HE staff decided to focus their reconnaissance efforts on the upper Two Lick watershed, since the lower watershed was better characterized by the TU report than the upper watershed was by the IUP report. Additionally, HE decided that, rather than purely surveying discharges, they would do a loading snapshot of the watershed to determine the overall health of Two Lick Creek and the relative impact of each input into the stream. Tearing Run, in the lower Two Lick watershed downstream of Yellow Creek, is the other major unknown area in the overall watershed. Due to time constraints, it was not sampled as part of this project.

Methods

HE's fieldwork took place on March 9th, 2020 by three of their staff. The day of the fieldwork, as well as the five days prior, did not have any major precipitation events. They sampled eleven tributaries to Two Lick Creek (including the North and South Branch), four points within Two Lick Creek, and two discharges. Water samples were submitted to G&C Coal Analysis Labs in Summerville, PA for standard

mine drainage analyses (pH, alkalinity, acidity, conductivity, sulfate, TSS, Fe, Al, Mn). Acidity and alkalinity are expressed in $CaCO_3$ equivalents. Concentrations of metals are total values (no filtration) and are reported as mg/L; loadings are reported in pounds per day (ppd). Instream flows were measured with a Swoffer velocity meter and small flows were measured with the timed volume (bucket/stopwatch) method and are reported as gallons per minute (gpm). The Diamondville borehole discharge was measured with the flow meter by using the existing weir as the measurement channel.

Figure 1 shows a sampling map of the watershed. The locations labeled "Reported AMD discharge" are from Dennis Remy's spreadsheet of AMD discharges from various historic data sources. Only discharges D1 and D8 were sampled on 3/9/20 and are indicated in orange. The exact location of the previous "D1" discharge was not known, but a slope ditch containing conveying highly polluted AMD into the Unnamed Tributary (UNT) T3 was sampled and subsequently referred to as D1.



Results

Lab results from the 3/9/20 sampling event are displayed in Table 1. Given the large number of reported discharges in the upper watershed, the water quality results were surprising. The instream water quality standards for streams in Pennsylvania are Fe < 1.5 mg/L, Mn < 1.0 mg/L, Al < 0.75, and pH between 6.0

and 9.0. All of the instream points sampled within Two Lick Creek were well within these standards—on the day it was sampled in March, the stream had low metals, circumneutral pH values, and was strongly net-alkaline. All of the tributaries (excluding the North and South Branches) showed signs of AMD impairment, but none of them were polluted enough to have an effect on the main stem except for T3.

UNT-T3 was extremely polluted, with a pH of 3.34 and Fe and Al concentrations of 50 and 28 mg/L respectively. The source of the AMD pollution in the headwaters of the tributary was not evaluated as part of the project, but the stream is already visibly polluted above the severe "D1" (slope ditch) discharge. The D1 discharge accounts for 60% of the acid loading, 90% of the iron loading, 30% of the aluminum loading measured at the mouth of T3. Downstream of D1, the trib flows past several refuse piles. Though it remained within the instream standards after the influent of T3, the main stem of Two Lick Creek had an observable response to this inflow of pollution. Two Lick Creek was measured above T3 at the sampling point "MS2" and downstream of T3 at the point "MS1". Between MS2 and MS1, the concentration of alkalinity decreased from 38 mg/L to 34 mg/L, the iron concentration increased from 0.8 mg/L to 1.4 mg/L, and the aluminum concentration increased from 0.5 mg/L to 0.7 mg/L. This tributary essentially acts as a large discharge to Two Lick Creek. The stream's iron and aluminum loading, measured at the upstream sampling point "MS2", increased by 51% and 45%, respectively, after the influent of UNT-T3.

The other notable change in the instream chemistry of Two Lick Creek is due to the Diamondville borehole discharge (discharge D8). The discharge drains the large Mack #2 mine on the northern side of Two Lick Creek and is pictured on the cover page of this report. Two Lick Creek is measured above D8 at "MS4" and downstream at "MS3". Between these two points, the stream's alkalinity decreases from 50 mg/L to 38 mg/L, the iron concentration increases from 0.3 mg/L to 1.2 mg/L, and the aluminum concentration increases from 0.1 mg/L to 0.7 mg/L. The Richards discharge also enters Two Lick Creek in this stretch and certainly accounts for some of this increase, as it is well-known that the system installed to treat this discharge is not functioning well after 20 years of operation. Additionally, historic mine maps (viewed on the Pennsylvania Mine Map Atlas, http://www.paminemaps.psu.edu) indicate that the Mack #2 mine has another large drain, slightly downstream and across Two Lick from the Richards discharge. This potential discharge may also contribute to the stream's change in chemistry in this stretch. The Richards discharge was not sampled because the poorly functioning treatment system obscured the location of the discharge, and the Mack #2 drain was not sampled because it was discovered on the mine maps after the sampling event had occurred. Because of the unknown inputs between D8 and MS3, it is more useful to compare D8 to the upstream sampling point, MS4. Between these two points, the iron and aluminum loading increased by 95% and 147%, respectively. The section of stream between MS4 and MS3 should be investigated further.

Though there were ten reported discharges along the North Branch of Two Lick Creek, the water quality in its headwaters and at its convergence with the South Branch indicated that if these discharges exist, they do not have a lasting impact on the stream during high flow conditions. The South Branch of Two Lick Creek, flowing higher than the North Branch, has even better water quality. This is consistent with its designation as HQ-CWF.

There are additional influents into Two Lick Creek that were not studied in this project or were only studied to a limited degree. Tributaries T2, T4, and T6 were only sampled for pH and conductivity, and based on these preliminary results, were determined to be low enough priority not to warrant further sampling (i.e. lab analysis). Due to time constraints on the day of sampling, T7 was the furthest upstream tributary that was measured until the North and South Branches of Two Lick Creek, and the reported discharges labeled with red stars were not visited. Finally, not all instream locations were suitable for flow measurement—MS1 was too deep and swift for flow measurement, and MS3 was visited without a flow meter.

Table 1. Lab results from 3/9/20 sampling event. Cond = conductivity, Alk = alkalinity, Fe = iron, Mn = manganese, Al = aluminum, SO4 =sulfate, TSS = total suspended solids. Acidity and alkalinity are expressed in CaCO3 equivalents. Samples with the asterisk (*) symbol were analyzed for field parameters only (pH, conductivity, temperature), and the pH and conductivity values given are those collected in the field.

ID	Description	Flow	Lab pH	Cond	Alk	Acid	Fe	Mn	Al	SO_4	TSS	Acid load	Fe load	Mn load	Al load	SO_4 load
		gpm	s.u.	umhos	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ppd	ppd	ppd	ppd	ppd
D1	Slope ditch D1 discharge area	13	2.53	5,348	0	4,405	1,054	6.0	192	4,925	<5	687	164	1	30	768
D8	Diamondville borehole	215	2.82	1,473	0	325	26.3	1.2	22.0	676	<5	840	68	3	57	1,744
T1	Penn Run Mouth	5,336	7.11	327	21	-11	1.8	0.9	0.7	112	5	-734	118	58	42	7,191
T2*	UNT to Two Lick Creek	~10	5.60	290												
T3	UNT to Two Lick Creek	304	3.34	921	0	316	50.3	1.4	28.0	470	32	1,154	184	5	102	1,716
T4*	UNT to Two Lick Creek	~20	5.96	120												
T5	Dixon Run	6,518	7.17	397	41	-18	2.0	0.4	1.4	132	11	-1,446	155	29	106	10,285
T6*	Buck Run		6.01	350												
T7	UNT to Two Lick Creek	45	4.29	356	0	18	0.3	1.4	1.7	160	<5	10	0	1	1	87
MS1	Two Lick Creek upstream of Penn Run		7.28	295	34	-25	1.4	0.2	0.7	81	9					
MS2	Two Lick Creek downstream of UNT T4	37,764	7.58	281	38	-32	0.8	0.1	0.5	70	6	-14,665	358	63	227	31,812
MS3	Two Lick Creek upstream of UNT T7		7.34	264	38	-28	1.2	0.2	0.7	71	8					
MS4	Two Lick Creek above Diamondville borehole	22,955	7.86	252	50	-42	0.3	0.1	0.1	53	<5	-11,572	72	22	39	14,599
NB1	North Branch Two Lick Creek at convergence	7,858	7.60	315	41	-33	0.5	0.2	0.2	91	6	-3,108	45	16	23	8,543
SB1	South Branch Two Lick Creek at convergence	13,108	7.94	205	66	-56	0.2	***0.1***	***0.1***	21	<5	-8790	36	8	16	3287
NB2	North Branch Two Lick Creek in Starford		7.72	315	42	-30	0.3	0.1	0.3	91	<5					

Conclusion/Recommendations

The results from the 3/9/20 sampling event show that Two Lick Creek's water quality, above the reservoir, is not strongly impaired by AMD in spring flow conditions. The two major sources of pollution studied in this part of the watershed, discharge D8 and UNT-T3, both cause the stream to have noticeable dip in alkalinity and an increase in metals concentration, but don't cause the stream to stray outside of the Pennsylvania instream water quality standards.

It is quite possible that under low-flow conditions, the water quality of Two Lick Creek could tell a different story. The Diamondville borehole discharge (D8) drains a large underground area and may produce high flows even after dry periods, thus potentially having a larger relative impact on the stream. Lower in-stream flow conditions may emphasize other discharge or tributary impacts that are obscured during high flow. One of the recommendations of this report is to conduct a similar study of Two Lick Creek in the late summer, or whenever the stream is flowing at a lower rate. The quantity of flow in the upper Two Lick Creek watershed can be estimated from viewing the data collected at the stream gauge on Two Lick Creek in Graceton, Pa. In future studies, the section of stream between MS4 and MS3 should be investigated further. The Richards discharge should be measured, and the potential Mack #2 discharge should be confirmed and measured. Its suspected coordinates are (40.664761, -78.980436).

Another recommendation of this report is to conduct a biological assessment of the upper Two Lick Creek watershed. Although the chemistry of creek in spring flow conditions is life-sustaining, there were some indications of biological impairment such as cemented substrate, siltation, etc. If the biological assessment and low-flow chemical assessment indicate positive results, re-designation or delisting should be requested from the PADEP.

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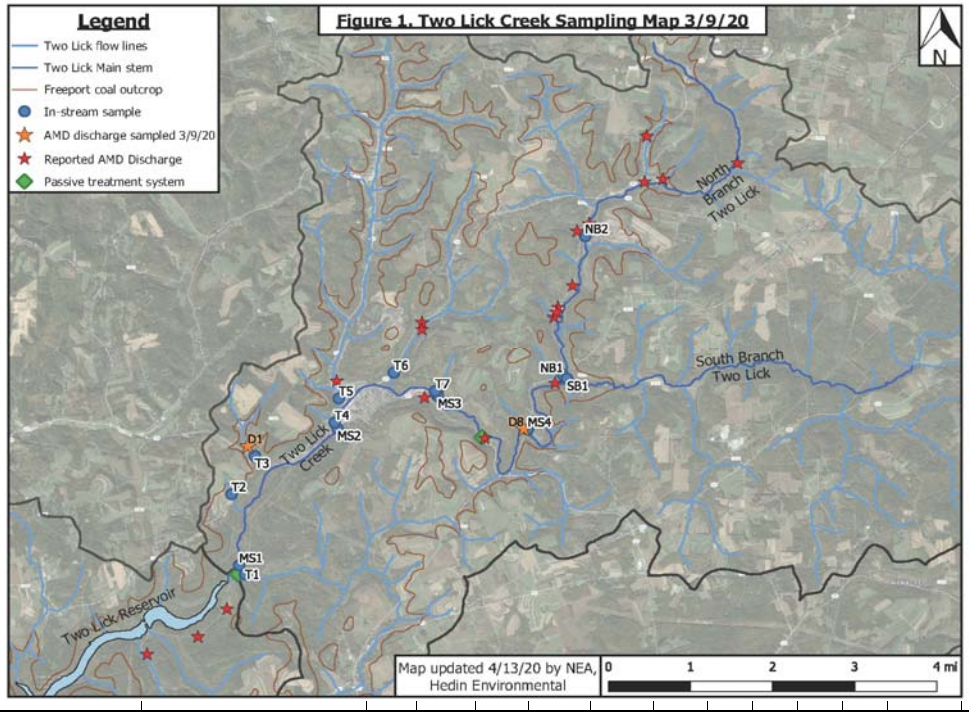
DATE RECEIVED: 03/09/20

DATED REPORTED: 03/13/20

TWO LICK TAG

Report Sample Name	Description	Flow	Lab pH	Cond	Alk	Acid	Fe	Mn	Al	SO_4	TSS	Acid load	Fe load	Mn load	Al Load	SO_4 Load	Field pH	Acid Calc	Acid Error	Acid dif
		gpm	s.u.	umhos	mg/L as $CaCO_3$	mg/L as $CaCO_3$	mg/L	mg/L	mg/L	mg/L	mg/L	ppd	ppd	ppd	ppd	ppd	s.u.	mg/L as $CaCO_3$	%	mg/L as $CaCO_3$
D1	Slope ditch D1 discharge area	13	2.53	5348	0	4405	1054.4	6.0	191.7	4925	<5	687	164	1	30	768	2.46	4049	8%	356.0
D8	Diamondville borehole	215	2.82	1473	0	325	26.3	1.2	22.0	676	<5	840	68	3	57	1744	2.65	271	17%	54.6
T1	Penn Run Mouth	5336	7.11	327	21	-11	1.8	0.9	0.7	112	5	-734	118	58	42	7191	6.20	-12	-5%	0.6
T2*	UNT to Two Lick Creek	~10	5.60	290																
T3	UNT to Two Lick Creek	304	3.34	921	0	316	50.3	1.4	28.0	470	32	1154	184	5	102	1716	3.33	271	14%	45.5
T4*	UNT to Two Lick Creek	~20	5.96	120																
T5	Dixon Run	6518	7.17	397	41	-18	2.0	0.4	1.4	132	11	-1446	155	29	106	10285	5.85	-29	-56%	10.3
T6*	Buck Run		6.01	350																
T7	UNT to Two Lick Creek	45	4.29	356	0	18	0.3	1.4	1.7	160	<5	10	0	1	1	87	4.56	15	19%	3.4
MS1	Two Lick Creek upstream of Penn Run		7.28	295	34	-25	1.4	0.2	0.7	81	9						6.30	-27	-7%	1.7
MS2	Two Lick Creek downstream of UNT T4	37764	7.58	281	38	-32	0.8	0.1	0.5	70	6	-14665	358	63	227	31812	6.10	-34	-5%	1.7
MS3	Two Lick Creek upstream of UNT T7		7.34	264	38	-28	1.2	0.2	0.7	71	8						5.78	-32	-16%	4.3
MS4	Two Lick Creek above Diamondville borehole	22955	7.86	252	50	-42	0.3	0.1	0.1	53	<5	-11572	72	22	39	14599	5.91	-49	-17%	7.1
NB1	North Branch Two Lick Creek	7858	7.60	315	41	-33	0.5	0.2	0.2	91	6	-3108	45	16	23	8543	6.18	-39	-17%	5.7
SB1	South Branch Two Lick Creek	13108	7.94	205	66	-56	0.2	***0.1***	***0.1***	21	<5	-8790	36	8	16	3287	6.15	-65	-16%	8.8
NB2	North Branch Two Lick Creek in Starford		7.72	315	42	-30	0.3	0.1	0.3	91	<5						6.16	-40	-32%	9.7
*field pH and cond																				
	North Branch + South Branch	20966											81	24	38					
	Two Lick Downstream convergence	22955											72	22	39					
	Error	9%											-14%	-8%	1%					
									T3/Downstream T4				51%	8%	45%	5%				
									D1/T3			60%	90%	18%	29%	45%				
									D8/Upstream D8				95%	14%	147%	12%				



N.D. - Not Detectable

Approved by _____