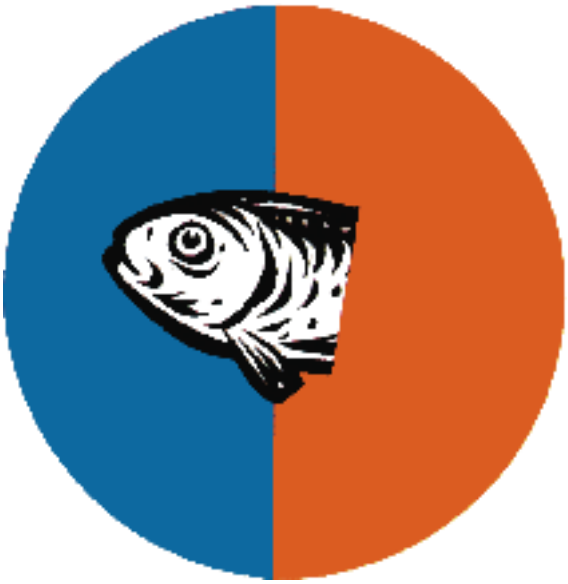
Assessment of AMD Discharges in the Downstream Section of Little Mill Creek, Clarion County, PA



This Document is Based on a January 25, 2016, Technical Report Provided by Hedin Environmental for Headwaters Charitable Trust Trout Unlimited AMD Technical Assistance Program

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Background

The Mill Creek Coalition (MCC) has been working on treating polluted mine drainage in the Mill Creek watershed for 25 years. Little Mill Creek is a major tributary to Mill Creek that has received significant remediation efforts and, as a result, the water quality in the upper watershed is known to be greatly improved. The condition of lower Little Mill Creek is not known. This project investigated the lower 2.5 miles of Little Mill Creek for mine drainage inputs between the Markle/Kotchey treatment system and the confluence of Little Mill Creek with Mill Creek.

Methodology

This specified section of Little Mill Creek was walked by Hedin Environmental (HE) and MCC personnel on 11/17/2015 and 11/18/2015. Lab samples, field chemistry, and flows were collected from every AMD source, including minor tributaries to Little Mill Creek, and strategic instream locations. Field chemistry was measured with a Hanna pH/conductivity probe and an alkalinity titration kit. Flows were measured using the timed volume method except for one large tributary and instream locations that were measured using a velocity meter. Lab samples were submitted to G&C Coal Laboratories in Brookville, PA for standard AMD analysis.

Samples were collected starting at the Markle/Kotchey discharge near the Asbury Road bridge and numbered sequentially on the way down to the mouth with Mill Creek, collecting samples on the eastern side of Little Mill, and then on the return, collecting samples on the western side with sample numbering increasing back towards the bridge. Coordinates for each sample are listed in Table 1. A map (Figure 1) shows the stream and sampling points.

Results

The Markle/Kotchey and Asbury Road tributary flows have a dramatic visual effect on Little Mill as well as affecting Little Mill's water chemistry (Figures 2, 3).

Sampling results from this study are presented in Table 2. The largest sources of acidity are the Markle/Kotchey treatment system (253 ppd acidity) and the Asbury Road tributary (71 ppd acidity). The largest source of iron is the Markle/Kotchey treatment system (358 ppd iron). Although the treatment system generates alkalinity, it is not

enough to precipitate all the iron in the discharge and thus provides a large source of acidity to the creek.

In addition, a significant amount of the iron leaving the treatment system is in a particulate form, thus suspended in the stream or coating the substrate. The iron coating as well as the iron turbidity decrease rather markedly as the stream flows the 2.5 miles toward Mill Creek. By the time Little Mill reaches Mill Creek, the iron has dropped several mg/l and the pH is near 6.0 (Table 2).

Many low flow sources of polluted mine drainage enter Little Mill Creek between the Markle/Kotchey treatment system and the confluence of Little Mill Creek with Mill Creek. Only one tributary, Little Crooked Creek, about 1.5 miles downstream, is long enough and of sufficient volume and water quality to hold a reproductively viable Brook Trout population (Figure1, Table 2). Except for LMR 8, all inputs are net acidic. Concentrations of Fe, Al and Mn vary widely for these discharges. Most of the AMD inputs originate very close to the stream at roughly the same elevation. These inputs occur along the entire length of Little Mill Creek, with the majority of polluted discharges occurring in the upper one mile, and appear to be base-flow pollution. There likely are additional flows of AMD directly to the streambed that were not measured. All of these factors, combined with the remoteness of this stretch of creek, make treatment of these polluted mine drainage inputs very complicated and difficult.

Discussion

The Markle/Kotchey treatment system is the largest source of acidity (about 50%) and iron (about 80%) to this lower segment of Little Mill Creek and should be the primary focus of future restoration efforts. TU conducted an AMD technical assistance project on the site in 2007. The primary treatment problems at that time were that the settling pond was too small for the iron loadings and the ALD did not generate enough alkalinity to yield a net alkaline discharge. The November 2015 site visit discovered additional problems. A clogged effluent pipe has resulted in water overtopping the berm and the presence of water underneath the liner (Figure 4). The raised water level causes other issues such as ineffective baffles and difficulty in measuring the total flow into the stream.

The Asbury Road tributary should also be considered in the restoration efforts. Sampling results provided to Hedin Environmental from the Mill Creek Coalition (Table 3) suggest that a tributary originating from the south side of I-80 is the second largest source of the acidity (about 15%) entering Little Mill, providing 50-128 ppd acidity (Tables 2, 3). A westerly spur of the Asbury Road tributary appears clean (pH 7.5, 73 mg/l alkalinity). The AMD primarily originates in a strip mine/high wall south of I-80 that was reclaimed by DEP in the 1990s. This remaining source of mine water pollution appears to originate from a greater depth largely unaffected by the reclamation efforts. After the AMD is carried by a culvert under I-80, there is suitable topography available north of I-80 to construct a passive treatment system.

Summary

Since the construction of the Markle/Kotchey passive treatment system, as well as addressing the reclamation of the strip mine/high wall at the headwaters of the Asbury Road tributary about 15 years ago, there has been a considerable amount of water chemistry collected at both sites. This study is the first to collect data from both AMD sources as well as the AMD sources along the final 2.5 miles of Little Mill at the same time.

The past data on both sites suggest that the November 2015 sampling period was conducted at a time when stream/AMD flows were nearly twice the volume of average flows. Therefore, another sampling effort is recommended near average and low flow periods, particularly on those AMD sites on the lower 2.5 miles of Little Mill.

Over the years, several studies, experimental efforts and discussions have taken place about how to improve the Markle/Kotchey treatment system, as well as how to address the remaining AMD effect on the Asbury Road tributary. There is no reason that serious discourse can't begin to arrive at the best option (options) to address the remaining water quality issues at both sites.

It is important to recognize that Little Mill has gone through a tremendous improvement from pH 3.5-4.5 waters with metals to the state in which it is presently found, with a coldwater fisheries recently established. The investment in time, energy and money have been significant to the success of this effort. A commitment to upgrade the Markle/Kotchey and Asbury Road tributary will result in a much healthier 2.5 miles of Little Mill. It will also have a positive impact on the recolonization of the coldwater fisheries on the lower 6.5 miles of Mill Creek to its entry into the Clarion River.

Table 1. Coordinates of samples collected during the 11/17/2015 to 11/18/2015 sampling effort of Little Mill Creek.		
Location	**Latitude**	**Longitude**
Little Mill Upstream	-79.2233930	41.2027537
Markle/Kotchey Out	-79.2239191	41.2018010
Asbury Road Trib	-79.2250508	41.2014466
Little Mill Bridge	-79.2250508	41.2014466
LMR 1	-79.2252127	41.2016441
LMR 2	-79.2255282	41.2017018
LMR 3	-79.2258908	41.2017129
LMR 4	-79.2311063	41.2037695
LMR 5	-79.2310924	41.2043288
LMR 6	-79.2317660	41.2054971
LMR 7	-79.2343794	41.2088318
LMR 8	-79.2363086	41.2155490
Little Crooked Creek	-79.2361229	41.2162082
LML 9	-79.2397532	41.2193192
LML 10	-79.2351844	41.2088077
LML 11	-79.2338025	41.2076506
LML 12	-79.2313442	41.2035965
LML 13	-79.2313442	41.2035965
LML 14	-79.2303573	41.2026493
LML 15	-79.2298446	41.2023747
LML 16	-79.2297493	41.2023056
LML 17	-79.2279720	41.2014384
LML 18	-79.2264723	41.2015541
Little Mill Mouth	-79.2505194	41.2225452
Mill Upstream	-79.2504235	41.2228171
Mill Downstream	-79.2516025	41.2220732

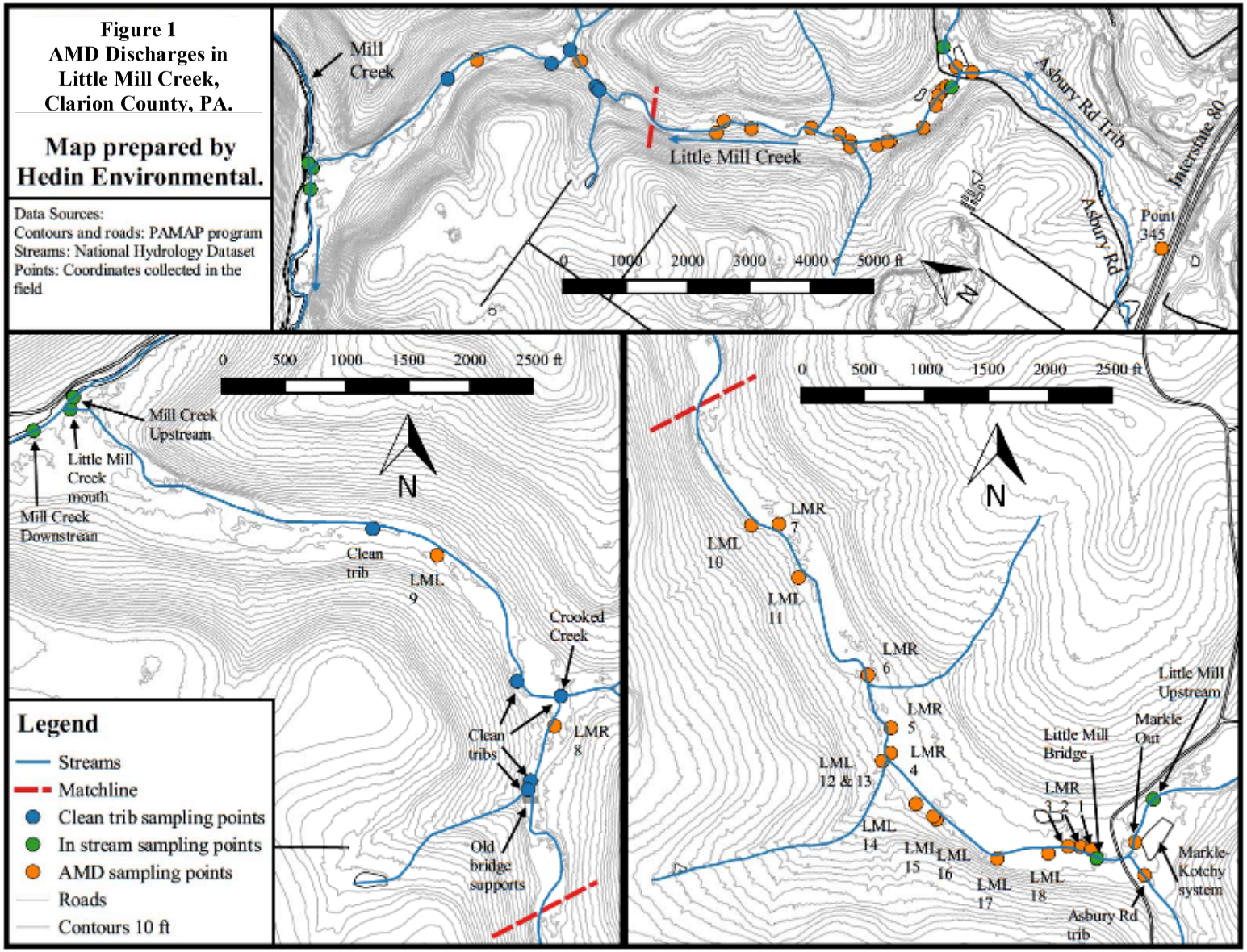
Figure 1
AMD Discharges in
Little Mill Creek,
Clarion County, PA.
Map prepared by
Hedin Environmental.
Data Sources:
Contours and roads: PAMAP program
Streams: National Hydrology Dataset
Points: Coordinates collected in the field
Mill Creek
Little Mill Creek
Asbury Rd Trib
Interstate 80
Asbury Rd
Point 345
0 1000 2000 3000 4000 5000 ft
N
0 500 1000 1500 2000 2500 ft
Mill Creek Upstream
Little Mill Creek mouth
Mill Creek Downstrean
Clean trib
LML 9
Crooked Creek
Clean tribs
LMR 8
Old bridge supports
LML 10
LMR 7
LML 11
LMR 6
LMR 5
LMR 4
LML 12 & 13
LML 14
LML 15
LML 16
LML 17
LML 18
LMR 3
LMR 2
LMR 1
Little Mill Bridge
Little Mill Upstream
Markle Out
Markle-Kotchy system
Asbury Rd trib
Legend
Streams
Matchline
Clean trib sampling points
In stream sampling points
AMD sampling points
Roads
Contours 10 ft

Table 2. Water chemistry data for inputs to Little Mill Creek and in stream samples (bolded). Samples were collected from 11/17/2015 and 11/18/2015. Italic values are below detection.

Location	Flow	pH	Alk	Acid	Fe	Mn	Al	SO4	Acid	Fe
	gpm		*mg/L $CaCO_3$*		---------- *mg/L* ----------				*lb/day*	
Little Mill Upstream	**3,714**	**7.0**	**7**	**0**	**0.5**	**2.3**	***0.1***	**190**	**-18**	**24**
Markle Out	370	5.8	76	57	80.6	21.1	*0.1*	916	253	358
Asbury Road Trib	344	4.0	0	17	1.1	3.6	1.8	169	71	4
Little Mill Bridge	**3,978**	**6.4**	**20**	**3**	**6.8**	**3.8**	**0.2**	**234**	**133**	**325**
LMR 1	2	3.2	0	48	10.7	16.6	0.1	663	1	0
LMR2	19	4.1	5	33	22.8	4.7	0.3	205	8	5
LMR3	2	3.9	0	14	3.6	2.8	*0.1*	134	0	0
LMR4		6.1	5	9	10.3	3.0	*0.1*	234		
LMR5	37	3.2	0	75	31.8	13.7	0.3	554	34	14
LMR6	27	3.7	0	33	12.7	6.0	0.7	255	11	4
LMR7	34	3.6	0	19	1.3	2.5	0.4	128	8	1
LMR8	27	6.9	22	-13	1.1	0.6	0.1	88	-4	0
Little Crooked Creek	717	6.5	3	2	0.3	0.1	*0.1*	11	14	2
LML 9	25	4.0	0	12	1.1	0.8	0.3	44	4	0
LML10	2	5.2	57	37	68.3	8.9	0.2	496	1	2
LML 11	12	6.0	10	15	8.2	12.0	*0.1*	154	2	1
LML12	17	3.8	0	33	0.7	3.9	4.5	96	7	0
LML13	31	3.4	0	73	3.1	6.3	11.1	198	27	1
LML14	10	5.6	48	126	100.2	14.7	*0.1*	735	15	12
LML15	1	4.8	3	38	16.6	6.3	1.3	227	0	0
LML16	9	3.7	0	52	1.5	6.5	7.9	169	6	0
LML17	28	3.6	0	39	2.5	12.0	2.0	183	13	1
LML18	31	3.3	0	89	52.5	15.0	0.4	663	33	19
Little Mill Mouth	**6,330**	**6.0**	**5**	**10**	**6.1**	**3.1**	**0.5**	**190**	**726**	**465**
Mill Upstream	**12,800**	**6.5**	**7**	**4**	**0.4**	**0.6**	**0.3**	**35**	**551**	**63**
Mill Downstream	**19,130**	**6.2**	**6**	**5**	**4.0**	**2.1**	**0.5**	**140**	**1,099**	**922**

Table 3. Water chemistry taken at the headwaters of the Asbury Road tributary, near the north opening of the culvert under I-80, is a significant AMD source flowing into the Asbury Road tributary. Data provided by the Mill Creek Coalition.

Date	Flow	pH	Alk	Acid	Fe	Mn	Al	SO4	Acid	Fe	Al
	gpm		*mg/L $CaCO_3$*		--------*mg/l*-------				*---lb/day---*		
11/5/2014	20	3.5	0	207	20.3	14.1	18.5	1,130	50	5	4
7/23/2014	80	3.7	0	133	12.0	13.3	15.5	815	128	12	15

Figure 2. Little Mill above the Markle/Kotchey treatment system. Iron levels are about 0.5-1.0 mg/l and the pH is about 7.0.

Figure 3. Little Mill below the treatment system discharge (looking downstream from the Asbury Rd. Bridge). The 60-80 mg/l of iron from the Markle/Kotchey site is diluted by Little Mill to 7-10 mg/l of iron and the pH has dropped to about 6.5.

Figure 4. A clogged discharge pipe at the Markle/Kotchey treatment system causes the settling pond to discharge over the berm. Accumulated iron solids suggest the pond has been discharging in this manner for a long time.