

Canoe Creek

Watershed Assessment and Conservation Plan

2026



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Authored by: Kylie Shaw, Watershed Specialist
Clarion Conservation District
249 S. 2nd Avenue
Clarion, PA 16214

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Canoe Creek Watershed Assessment

Introduction

Canoe Creek is a Chapter 93 designated high quality cold-water fishery (HQ-CWF) located in Clarion County, Pennsylvania (Fig. 1). It is a tributary to the Clairon River and ultimately to the Allegheny River. Canoe Creek is designated as an impaired Aquatic Life Use (ALU) watershed, with the source of the impairment being petroleum/natural gas activities and acid mine drainage (AMD). Canoe Creek has a drainage area of approximately 18.9 square miles with diverse landcover throughout the watershed. Approximately 55% of the watershed is covered by natural habitat, 26% of the watershed is agricultural land, and 7% is developed land. The largest developed area in the watershed is in the Borough of Knox with smaller developed areas around the watershed. The watershed is primarily within Beaver Township in Clarion County with the headwaters spanning Ashland Township and Elk Township and a tributary running through Knox Borough.

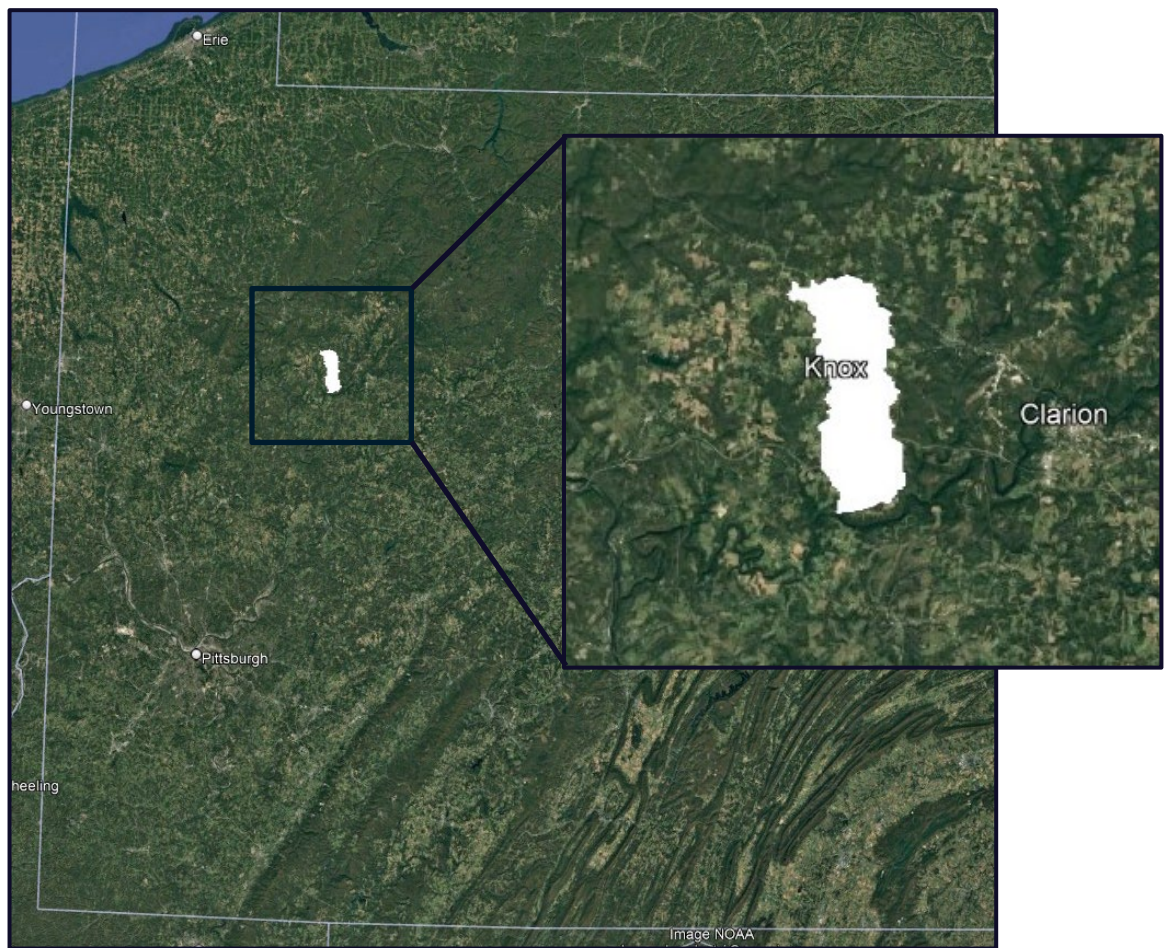


Fig. 1. Location map of the Canoe Creek watershed in Clarion County (Google Earth).

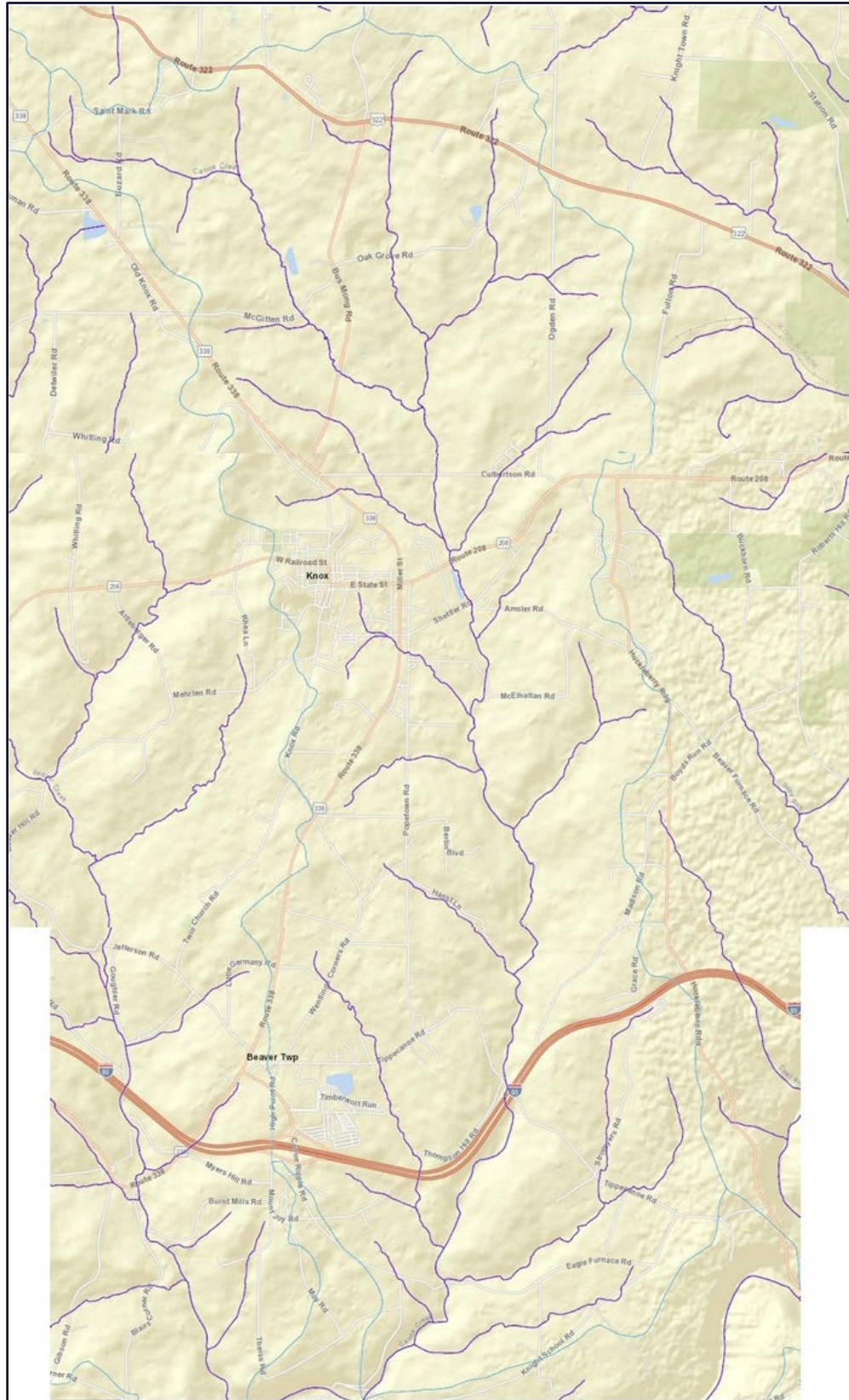


Figure 2. Streamlines of Canoe Creek and its tributaries (purple lines) and Canoe Creek watershed boundary (blue line)

Purpose of the Assessment

This assessment characterizes water quality, in-stream and riparian habitat, biological diversity, abandoned mine impacts, and waterway encroachments, such as bridges and culverts. This snapshot of resource conditions will be used by various non-profit and governmental agencies to prioritize, design, and plan watershed restoration and improvement through the use of best management practices.

Watershed Description

Canoe Creek drains approximately 18.9 square miles, has a mean basin slope of 4.8 degrees, and a mean elevation of 1395 feet above sea level. The mean annual precipitation is 44 inches and with minimal pond or wetland storage area (0.14% of total drainage area). Canoe Creek has 12 significant unnamed tributaries with the streamlength network totaling 37.64 miles. The watershed has 20.2 miles of first order streams, 9.7 miles of second order streams, and 7.7 miles of third order streamlength. Total stream miles and drainage area are presented in Table 1. The main stem of Canoe Creek is listed as a Natural Reproduction Trout Stream and the main stem is a Trout Stocked Stream for 2.4 miles from the Interstate 80 bridge to the mouth.

Table 1. Stream lengths and drainage areas for the Canoe Creek Watershed, Clarion County, PA.

Stream	Length (Miles)	Drainage Area (Square Miles)
UNT to Canoe Creek at Canoe Ripple Rd	1.71	0.7
UNT to Canoe Creek at Eagle Furnace Rd	3.88	1.84
UNT to Canoe Creek North of Eagle Furnace Rd	2.82	2.02
UNT to Canoe Creek at Hanst Ln	0.42	0.23
UNT to Canoe Creek at Berlin Blv	1.75	0.84
UNT to Canoe Creek South of Wagner Ln	1.07	0.77
UNT to Canoe Creek at Wagner Ln	1.60	0.96
UNT to Canoe Creek at Amsler Rd	1.02	0.55
UNT to Canoe Creek at Rt 208	2.15	0.86
UNT to Canoe Creek at Strafford Rd	2.38	1.04
UNT to Canoe Creek South of Oak Grove Rd	5.43	2.67
Stream length of Canoe Creek main stem	25.79	12.26
Total	37.64	18.9

Geology

The watershed resides entirely on the Allegheny Plateau and has not been influenced by the Laurentide ice sheet. Geology is composed of Mississippian, Allegheny, and Pottsville groups dominated by shale, sandstone, limestone, and coal layers (Fig. 3). Sections of the study area are underlain by the Vanport Limestone carbonate bedrock (Figure 4).

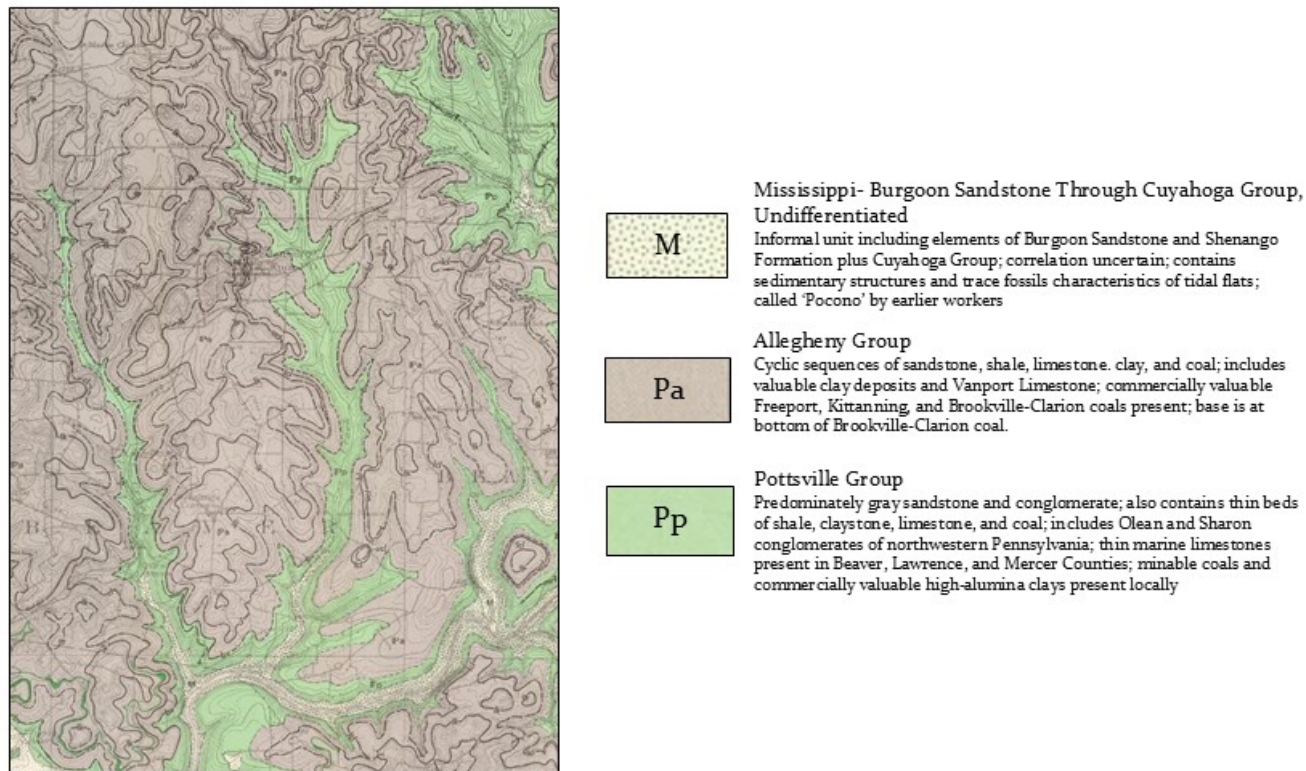


Fig. 3. USGS map of the Mississippi, Allegheny, and Pottsville formations (USGS Geologic Maps).

The Vanport limestone formation constitutes more than 450 linear miles of outcrop throughout Clarion County (Fig. 4) with an average thickness of 8 to 15 feet. The Vanport limestone in this region is unique due to its high calcium carbonate (CaCO_3) content, which adds alkalinity to the water when exposed. The alkalinity can act as a buffer for the acidity added from abandoned mine drainage and historical gas and oil well drilling throughout the watershed. Four historical site analyses have been made in the region and are provided in Table 2.

Table. 2. Four historical site analyses of the Vanport limestone formation in Clarion County, PA. No.23 Barger quarry, Perry Township: Rather coarse grained; mottled with calcite; bluish gray. No. 24 Sligo Furnace, Piney Township: Fine grained; rather tough; stained with ferric oxide; light bluish gray. No. 25 Hindman's quarry, Clarion Township: Fine grained; mottled with calcite; rather brittle; bluish gray. No. 26 On Long Run, Porter Township: Brittle; more or less stained with ferric oxide; generally pearl gray. (Clapp 1905).

<i>Analyses of Vanport limestone from Clarion County, Pa.</i>				
	No. 23	No.24	No.25	No.26
Insoluble residue.....	1.110	1.780	1.960	2.190
Calcium carbonate (CaCO_3).....	96.428	95.196	95.532	95.232
Magnesium carbonate (MgCO_3)	1.202	1.265	0.930	0.407
Alumina (Al_2O_3).....	0.867	1.529	1.050	1.310
Ferric oxide (Fe_2O_3).....				
Phosphorus.....	0.023	0.081	0.070	0.061

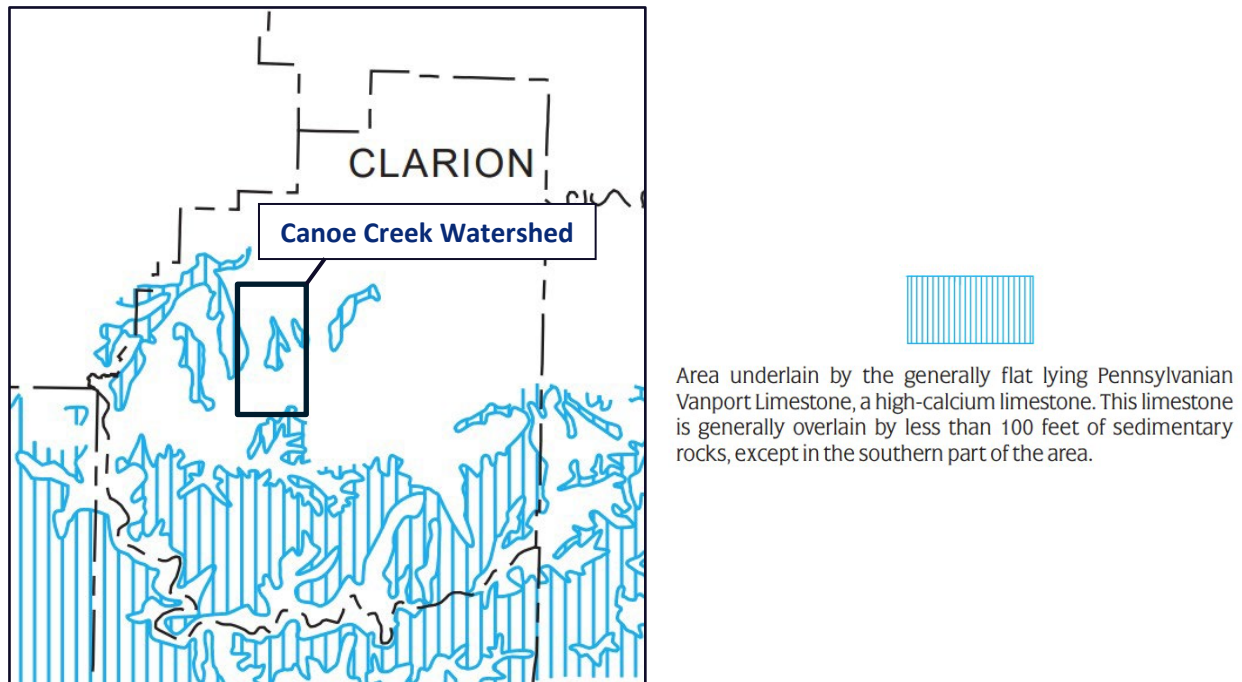


Figure 4. Carbonate rocks in Pennsylvania (Pennsylvania Geological Survey 2000).

Soils, Wetlands, and Floodplain

Cavode silt loam makes up the largest percentage of the soil in the Canoe Creek watershed. This is split between ‘cavode silt loam at 3 to 8% slope’ (CaB) which covers 24.4% of the watershed and ‘cavode silt loam at 8 to 15% slope’ (CaC) which covers 12.9% of the watershed. These Group C & D soils have slow infiltration characteristics that impede the downward movement of water into the water table (Table 3). The remainder of the watershed is made up of a diversity of soil types at small percentages (USDA NRCS).

There are four delineated wetlands within the Canoe Creek watershed as provided by the National Wetlands Inventory (Figure 5). One wetland is downstream of US Route 322, two are near the stream crossing on Bus Mong Rd, and one is near Interstate 80. Three of the wetlands are freshwater emergent wetland and one is a freshwater forested/shrub wetland.

According to the FEMA floodway maps, there are no floodways within the Borough of Knox, the area of highest population density within the Canoe Creek watershed (Figure 6A). The floodway of Canoe Creek and one of its tributaries do run under Interstate 80 (Figure 6B). The I-80 bridge that crosses Canoe Creek is currently under construction and the impact of floodway on the bridge should be reevaluated after construction is complete.

Table 3. Soils types composing greater than 1% of the watershed area with hydrologic rating. Group B: Soils having a moderate infiltration rate when thoroughly wet. Group C: Soils having a slow infiltration rate when thoroughly wet. Group D: Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet (USDA NRCS).

Soil Code	Unit Name	Rating	Acres in AOI	% of AOI
ArB	Armagh silt loam, 3 to 8 percent slopes	C/D	451.1	3.7%
AtA	Atkins-Philo complex, 0 to 3 percent slopes, frequently flooded	B/D	168.8	1.4%
BfB	Bethesda-Fairpoint channery silt loams, 0 to 8 percent slopes	C	169.5	1.4%
BhB	Bethesda-Fairpoint very channery silt loams, 0 to 8 percent slopes, very stony	C	146.5	1.2%
BhD	Bethesda-Fairpoint verychannery silt loams, 15 to 25 percent slopes, very stony	C	122.0	1.0%
BkA	Brinkerton silt loam, 0 to 3 percent slopes	C/D	120.9	1.0%
BxB	Buchanan silt loam, 0 to 8 percent slopes, extremely stony	C/D	158.4	1.3%
CaB	Cavode silt loam, 3 to 8 percent slopes	C/D	2,953.7	24.4%
CaC	Cavode silt loam, 8 to 15 percent slopes	C/D	1,557.5	12.9%
CdB	Cavode silt loam, 0 to 8 percent slopes, very stony	C/D	166.9	1.4%
ClA	Clymer channery loam, 0 to 3 percent slopes	B	115.5	1.0%
ClB	Clymer channery loam, 3 to 8 percent slopes	B	214.2	1.8%
ClC	Clymer channery loam, 8 to 15 percent slopes	B	212.3	1.8%
CoB	Cookport loam, 3 to 8 percent slopes	C/D	521.9	4.3%
CoC	Cookport loam, 8 to 15 percent slopes	C/D	179.0	1.5%
CpB	Cookport loam, 0 to 8 percent slopes, very stony	C/D	726.6	6.0%
EkA	Elkins silt loam, 0 to 3 percent slopes, occasionally flooded	C/D	311.1	2.6%
HnB	Hazleton channery sandy loam, 3 to 8 percent slopes	A	203.9	1.7%
HnC	Hazleton channery sandy loam, 8 to 15 percent slopes	A	234.5	1.9%
HnD	Hazleton channery sandy loam, 15 to 25 percent slopes	A	150.8	1.2%
HsD	Hazleton channery sandy loam, 8 to 25 percent slopes, extremely stony	A	602.6	5.0%
HsF	Hazleton channery sandy loam, 25 to 60 percent slopes, extremely stony	A	335.3	2.8%
PhA	Philo silt loam, 0 to 3 percent slopes, occasionally flooded	B/D	178.0	1.5%
UdB	Udorthents, 0 to 8 percent slopes	C	147.2	1.2%

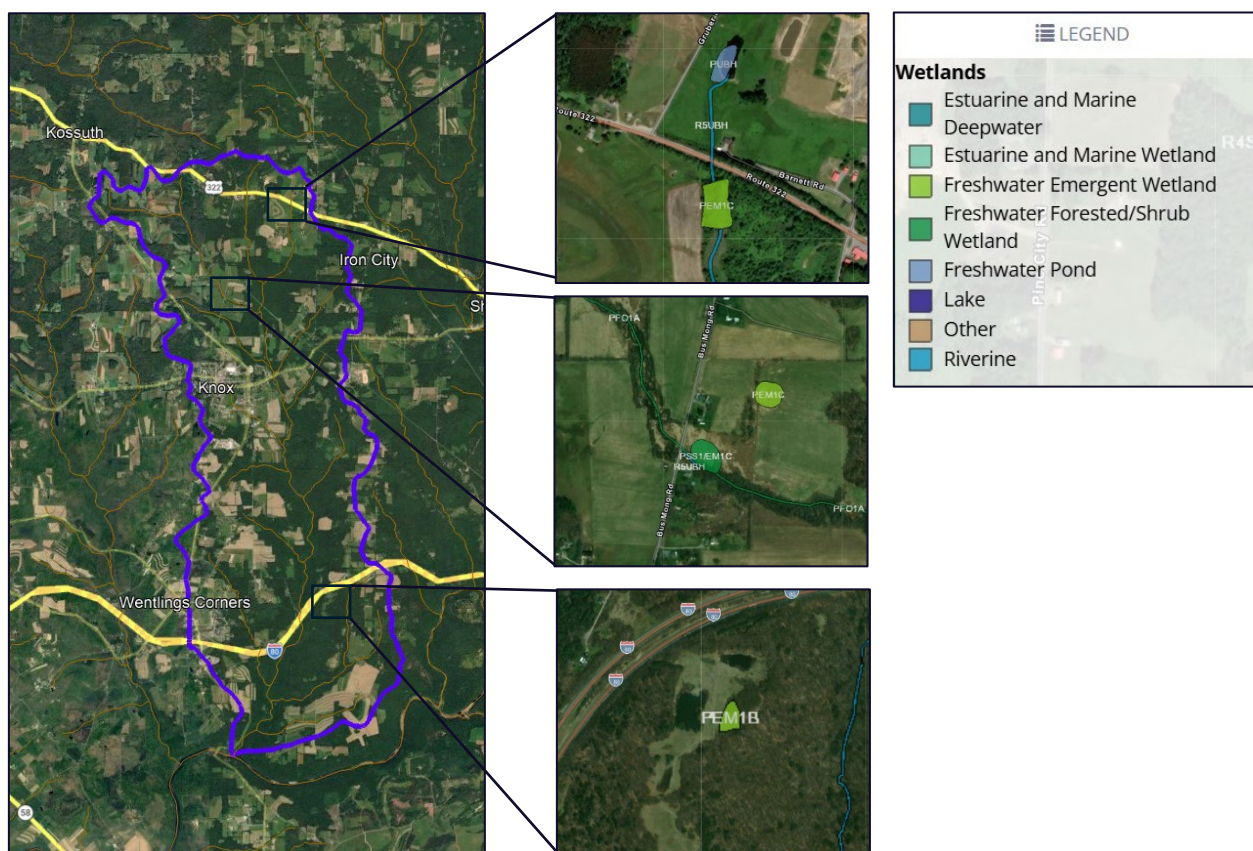


Fig. 5. Map of wetlands in Canoe Creek watershed (US Geological Survey).



Fig. 6A. Floodway map near Borough of Knox (FEMA).

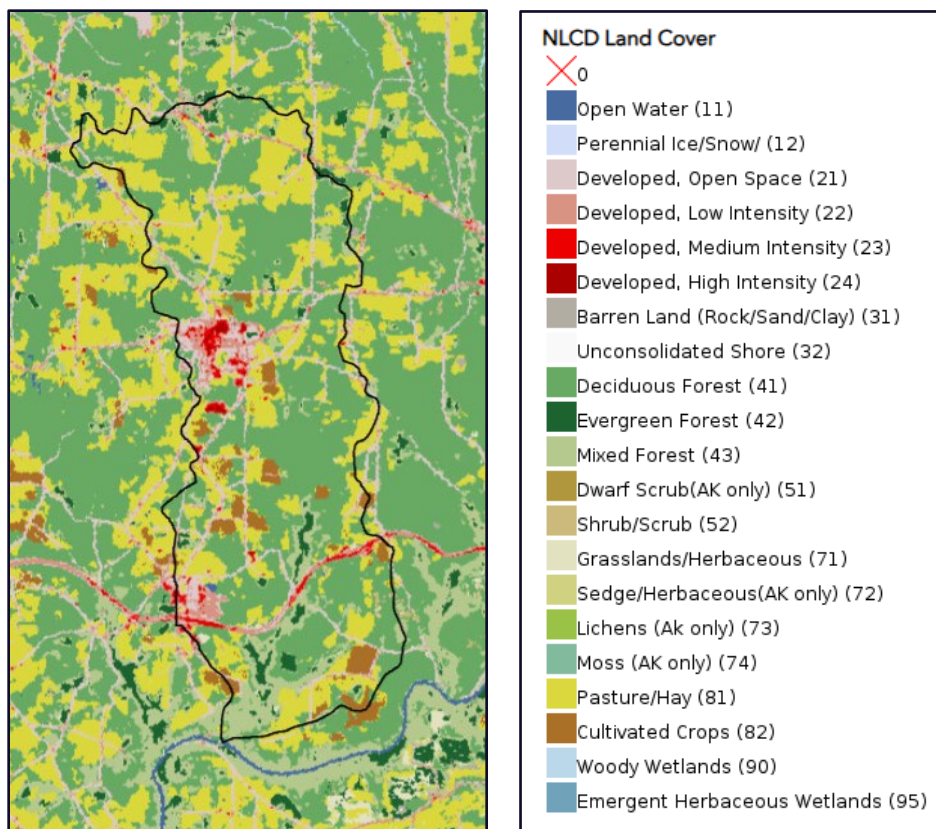


Fig. 6B. Floodway map area under Interstate 80 (FEMA).

Land Use

Land use in the Canoe Creek watershed consists primarily of natural areas (55%), followed by agricultural use (26%), and then developed area (7%). The development is concentrated in the Borough of Knox in the middle section of the watershed and in Wentlings Corner in the southwest section of the watershed (Fig. 7).

Fig. 7. Land use and land cover within the Canoe Creek Watershed. Data provided by the USGS National Map - National Land Cover Dataset.



Historical Mining Influences

The watershed has been mined primarily for bituminous coal, documented as early as 1950. Incomplete documentation of mining history in the watershed makes it difficult to ascertain the precise earliest date of mining operations in the area. There are 8 Abandoned Mine Land inventory sites throughout the watershed including spoil piles and dry strip mines with abundant acid producing rock (APR) exposed at the surface (See Appendix A). These mine features likely contribute to the low pH and elevated conductivity and sulfate levels detected at some of our sampling sites (Table 8). Further analysis of these sites to determine eligibility for Abandoned Mine Land reclamation funding through the DEP Bureau of Abandoned Mine Reclamation (BAMR) should be considered. Surface mining has occurred on the Upper, Middle and Lower Kittaning, Brookville, Hubert, and Clarion Coal Seams. The majority of mining operations were conducted in the 1950's and 1960's, with intermittent mining operations extending into the early 2000's (Table 4).

Table 4. Canoe Creek watershed documented coal mining history (eMapPA).

Company Name	Permit #	Mine Name	Date Issued	Coal Seam
Kahle Coal Co.	2767BSM14	Kahle #4	6/28/1967	Clarion
Harold A. Siegel Coal Co.	3778SM6	Siegel #22	8/9/1979	Lower Kittanning
Dean Coal Co., Inc.	362M107	Dean #6	1/23/1963	Lower Kittanning
Wilbur H. Kiser Coal Co.	16130	Taylor-Amsler Exley	11/9/1956	Lower Kittanning
Thomas E. Siegel	1679147	Thompson	NA	Lower Kittanning
A.P. Weaver & Sons	2768BSM23	McCanna	1/6/1969	Clarion
F. Howard Kahle	15891	Gruber-Forte	7/27/1956	Clarion
F. R. Zuck Coal Co.	16572	Wolfgang-Ogden	2/25/1957	Lower Kittanning
Wilson & Hartle Coal Co.	363M215	Wilson & Hartle #1	12/4/1963	Clarion
F. Howard Kahle Coal Co.	16177	Exley	10/19/1956	Lower Kittanning
Thomas E. Siegel	1679147	Thompson	NA	Clarion
Kahle Coal Co.	2766BSM69	Kahle #6	1/18/1967	Clarion
A.P. Weaver & Sons	2766BSM45	Otis Lewis	11/16/1966	Clarion
F. Howard Kahle	13934	Schies	8/27/1954	Clarion
F. Howard Kahle	11888	Kahle-Kahle	9/27/1951	Clarion
G.A. Stiles	362M107	E.O. Merryman	1/23/1963	Clarion
Wolf Contracting & Mining Co.	10306		4/24/1950	Clarion
Merle H. Phillips	3774SM14	Phillips #2	NA	Clarion
Ancient Sun, Inc.	16810101	#10	9/2/1981	Clarion
Kahle Coal Co.	3774SM6	Kahle #9	NA	Clarion
Zacherl Coal Co.	13934	Schies	8/27/1954	Clarion
C & K Coal Co.	14633	Mays	NA	Clarion
F. Howard Kahle Coal Co.	16177	Exley	10/19/1956	Clarion
A.P. Weaver & Sons	464BSM8	Otis Lewis	4/15/1964	Clarion
A.P. Weaver & Sons	464BSM68	Gruber	8/11/1965	Clarion
Harold A. Sigel Coal Co.	3775SM8	Sigel #19	4/28/1976	Clarion
Wilson & Hartle Coal Co.	363M215	Wilson & Hartle #1	12/4/1963	Lower Kittanning
Dean Coal Co., Inc.	15451	King #4	3/23/1956	Clarion
Lester C. Henry	16020901	Henry Mine	10/21/2002	Lower Kittanning
Wilber H. Kiser	11840	Kiser	9/27/1951	Clarion
Rupert Collieriers Inc	3777SM29	Hartzell	10/31/1978	Lower Kittanning
Rupert Collieriers Inc	3777SM29	Hartzell	10/31/1978	Clarion
Wilbur H. Kiser Coal Co.	17517	Patton #1	1/23/1958	Clarion
G.A. Stiles	362M107	E.O. Merryman	1/23/1963	Lower Kittanning
A.C. Benninger	18854	Benninger #2-B	10/30/1959	Upper Kittanning
A.C. Benninger	18854	Benninger #2-B	10/30/1959	Lower Kittanning
A.C. Benninger	18854	Benninger #2-B	10/30/1959	Clarion
F. Howard Kahle Coal Co.	19549	Kahle #6	9/22/1960	Lower Kittanning
Kahle Coal Co.	2767BSM20	Kahle #6	6/28/1967	Clarion
Ancient Sun, Inc.	16813001	#10	5/9/1985	Clarion

Dean Coal Co., Inc.	362M107	Dean #6	1/23/1963	Clarion
Ancient Sun, Inc.	3774SM23	Ancient Sun #1	7/26/1974	Clarion
F. Howard Kahle Coal Co.	15892	Young	7/27/1956	Clarion
Dean Coal Co., Inc.	15451	King #4	3/23/1956	Lower Kittanning
Narbert E. Wolbert	11332	Norbert E. Walbert	1/12/1951	Lower Kittanning
Ancient Sun, Inc.	16060101	Carmichael Mine	7/25/2006	Clarion #2
Wilbur H. Kiser Coal Co.	17518	Patton #2	1/9/1958	Brookville
Wilbur H. Kiser Coal Co.	17518	Patton #2	1/9/1958	Clarion
Wilbur H. Kiser Coal Co.	17517	Patton #1	1/23/1958	Brookville
Wolf Contracting & Mining Co., Inc.	1116	Wolf Cantr. & Mining co., Inc.	11/17/1950	Lower Kittanning
Wolf Contracting & Mining Co.	10306		4/24/1950	Lower Kittanning
H. & G. Coal & Clay Co., Inc.	1680110	McCanna	6/18/1981	Clarion
Glacial Minerals, Inc.	3778BC18	Black	NA	Lower Kittanning
F. R. Zuck Coal Co.	16572	Wolfgang-Ogden	2/25/1957	Middle Kittanning
Wilson & Hartle Coal Co.	363M215	Wilson & Hartle #1	12/4/1963	Humbert
Merle H. Phillips	1679102	Zuck	11/21/1979	Clarion
A.C. Benninger	18854	Benninger #2-B	10/30/1959	Middle Kittanning
Wilbur H. Kiser Coal Co.	16130	Taylor-Amsler Exley	11/9/1956	Clarion
Merle H. Phillips	3771BSM7	Phillips No. 2	12/17/1971	Clarion
Glacial Minerals, Inc.	16800110	McCanna	6/18/1981	Clarion
Ancient Sun, Inc.	3776SM5	Ancient Sun #A	9/28/1977	Clarion
F. Howard Kahle Coal Co.	19549	Kahle #6	9/22/1960	Clarion
Ancient Sun, Inc.	16120104	Gruber Mine	9/10/2013	Upper Clarion
Glacial Minerals, Inc.	3778BC18	Black	NA	Clarion
F. Howard Kahle Coal Co.	15095	Hook	12/9/1955	Lower Kittanning
F. R. Zuck Coal Co.	16574	Wolfgang-Dale	2/25/1957	Lower Kittanning
F. R. Zuck Coal Co.	16574	Wolfgang-Dale	2/25/1957	Middle Kittanning

Oil and Gas

242 oil and gas wells have been identified by the PA DEP in the Canoe Creek watershed (Fig. 8). Of those, 42 have been designated as abandoned, 26 are designated as inactive, 10 are designated as proposed but never materialized, and 164 remain designated as active. 40 of the wells have been plugged from a combination of abandoned, active, and inactive designated wells.

Abandoned wells act as a significant source of climate-warming methane emissions and can leak oil and gas into water sources, soil, and local homes and businesses. The Oil and Gas Act of 1984 requires oil and gas well operators to plug non-producing wells to protect the environment and public health and safety (PA DEP Article). Abandoned wells with no identifiable responsible party originating from prior to the 1984 act are plugged by PA DEP on a priority basis.

Landowners can report abandoned wells to PA DEP by contacting the Meadville district office at 1-570-327-3636.

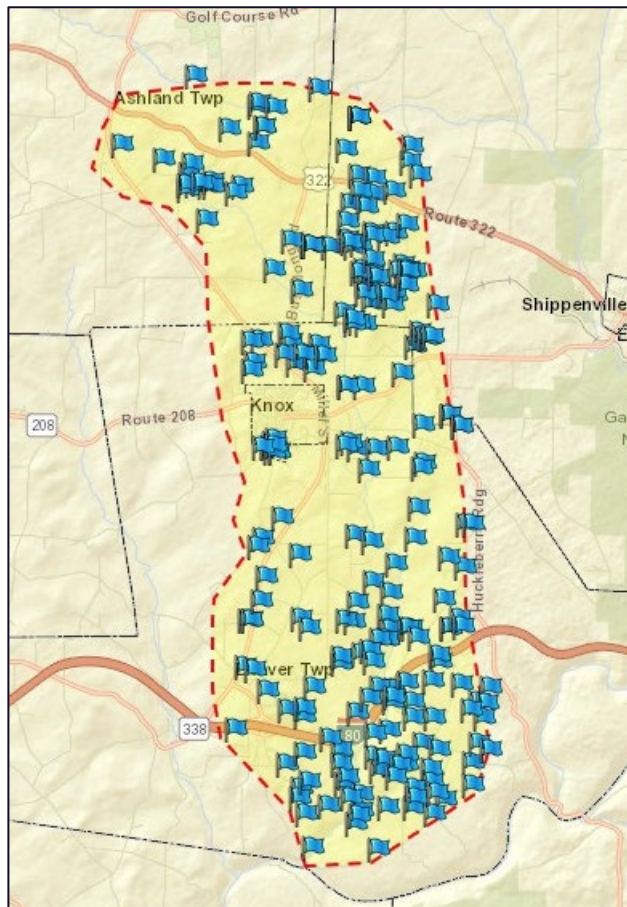


Fig. 8. Oil and gas wells in Canoe Creek watershed (eMap)

Road Crossings

41 road crossings were identified throughout the Canoe Creek watershed. A road crossing is defined as any structure that crosses the stream and allows for the conveyance of vehicular traffic. Of the 41 road crossings, 32 were assessed after considering access limitations. Road crossings were evaluated with the Penn State DGLVR Program Stream Crossing Replacement Policy (Penn State 2022), which assesses physical attributes of the crossing and how those attributes influence stream continuity and erosion. Multiple of the remaining road crossings were unassessed due to construction on and around the structure. Additional assessments of these road crossings should be considered after construction is complete to evaluate any impacts on the stream. Table 5 provides the location, physical characteristics, and the capability for aquatic passage.

Table 5. Characterization of road crossings in the Canoe Creek Watershed.

Type	Stream Average Bank Full Width (ft)	Structure Opening Width (ft)	Structure Width to Bank full Width Ratio (%)	Location	Location Name (Road Name)	Road Surface	Stream Continuity (aquatic passage) (Yes/No)	Erosion/Comments
Round	4.8	2.5	52.4	41.26945, -79.55978	Buzard Rd	Dirt/Gravel	Yes	Rusted out culvert
Round	7.5	2.7	36	41.27352, -79.56593	St. Mark Rd	Surfaced/Gravel	No	Perched
Footers and Bridge	22.7	16	70.6	41.22634, -79.51804	McElnattan Rd	Dirt/Gravel	Yes	
Footers and Bridge	27.1	21.9	80.8	41.23307, -79.51987	Shettler Rd	Surfaced	Yes	
Box Culvert	32.7	14	42.8	41.23662, -79.52227	Rt 208	Surfaced	Yes-Partial	Barrier across half of structure
Footers and Bridge	11.9	18	151.5	41.25225, -79.53493	Bus Mong Rd	Surfaced	Yes	Beaver dam upstream
Round	15	6	39.9	41.25710, -79.53939	McGriffen Rd	Surfaced/Gravel	No	Beaver dam, velocity barrier
Round	5.4	4	74.1	41.24442, -79.53180	Culbertson Rd	Surfaced/Gravel	Yes	No flow
Round	6.2	2.1	33.9	41.24748, -79.51113	Ogden Rd	Surfaced	No	Perched
Round	4.8	3	62.5	41.17122, -79.50315	Knight School Rd	Surfaced	Yes	
Round	3	1.5	50	41.17207, -79.50152	Knight School Rd	Surfaced	Yes	
Round	7.9	7.9	100	41.24443, -79.51614	Culbertson Rd	Surfaced/Gravel	Yes	No flow
Round	3.7	1.8	49	41.24979, -79.51112	Ogden Rd	Surfaced	No	Velocity barrier
Round	9.3	2.1	22.5	41.24779, -79.51121	Ogden Rd	Surfaced	No	Velocity varrier
Round	3.1	4	130.3	41.26171, -79.52904	Oak Grove Rd	Surfaced	No	Perched
Box Culvert	8	12.1	151	41.27286, -79.52841	Rt 322	Surfaced	Yes	Wetland upstream
Bottomless Arch	13.5	10	74	41.26465, -79.51800	Oak Grove Rd	Surfaced	Yes	
Arch with Bottom	10.5	6	57.1	41.27116, -79.51668	Rt 322	Surfaced	No	Perched
Round	7.2	2.1	29	41.25948, -79.51093	Ogden Rd	Surfaced	No	Perched
Round and Box Culvert	14.5	2.7	18.6	41.18176, -79.50415	Tippecanoe Rd	Surfaced	No	Velocity barrier
Round	11.9	4	33.6	41.18501, -79.50322	Stromyers Rd	Dirt/Gravel	No	Construction upstream, velocity barrier
Footers and Bridge	5.9	4.2	76.3	41.18082, -79.50051	Tippecanoe Rd	Surfaced	Yes	
Round	13.2	7	53	41.18019, -79.53069	Bashline Rd	Surfaced/Gravel	Yes	
Footers and Bridge	9.4	14	148.9	41.18352, -79.52681	Thompson Hill Rd	Dirt/Gravel	Yes	Construction downstream
Box Culvert	18.2	8	44	41.19266, -79.53062	Tippecanoe Rd	Surfaced	Yes	Baffles inside
Round	8.7	6.7	76.9	41.19937, -79.53768	Wentlings Corner Rd	Surfaced	Yes	Concrete in water
Round	4.7	3	64.2	41.20842, -79.52759	Popetown Rd	Surfaced/Gravel	Yes	No flow
Round	7.9	2.8	35.7	41.20928, -79.52964	Graff Rd	Surfaced	No	Rusted out culvert, velocity barrier
Round	12.9	11.7	90.3	41.21912, -79.52770	Popetown Rd	Surfaced/Gravel	Yes	No flow
Round	6.5	7	107.1	41.22787, -79.52553	McElnattan Rd	Dirt/Gravel	Yes	
Footers and Bridge	9.1	3.5	38.4	41.22860, -79.52742	Popetown Rd	Surfaced/Gravel	No	Velocity barrier
Round	10.4	4.5	43.4	41.23252, -79.51620	Amsler Rd	Surfaced	No	Velocity barrier

Biological Assessment

In partnership with the Penn West Clarion University Department of Biology and the Iron Furnace Chapter of Trout Unlimited, electrofishing surveys were conducted along the mainstem of Canoe Creek and the main tributary coming from the Borough of Knox. We used the PA DEP standardized Fish Data Collection Protocol to conduct all electrofishing surveys. Most of the electrofishing surveys were conducted in June - August of 2025. Two sites (called ‘Restoration Site’ and ‘Stream Mouth’) were conducted in July, 2026. The July, 2026 surveys were conducted about 4 days after heavy rain and the water was still at higher flow levels than normal.

The fish community of a stream is of interest to resource managers concerned with recreational opportunities and protecting biological diversity. The fish community of a stream also provides valuable insight into water quality and physical habitat. In fact, fish are such sensitive indicators of overall environmental quality that resource managers often assess the biotic integrity of a stream based on the diversity and composition of the fish community (Karr 1981).

Nine sites were sampled in Canoe Creek watershed, evenly dispersed from the headwaters to the mouth of the creek. At each site, we measured a 100 meter transect and sampled fish using a pulsed DC backpack electrofisher (Smith-Root Model 15). Fish were captured, identified to species, counted, and immediately released back to the stream.

The health of the fish community was measured by two metrics: species richness and species diversity. Fish species richness is simply the number of taxa collected at each site. Species diversity was calculated using Simpson’s Index of Diversity (SID), which takes both number of species and evenness into account (Equation 1).

Equation 1. Simpson’s Index of Diversity

Simpson’s Index of Diversity = $1 - D$

where $D = \sum(n / N)^2$

n = the total number of organisms of a particular species

N = the total number of organisms of all species

Canoe Creek has a diverse and abundant assemblage of fishes, with 21 species found throughout the watershed. The site at the mouth of Canoe Creek had the highest species richness of 15 species, with 9 of those being species not found elsewhere in the watershed. This is due to the addition of some larger stream species likely coming up Canoe Creek from the Clarion River. Excluding the site at the mouth, there were 11 species found in the watershed. Brook trout were notably absent from the watershed, despite being common inhabitants of small streams in the region and being a stocked species in the lower stretches of Canoe Creek. Brook Trout are cold stenotherms: they require cold water and are intolerant of warm summer temperatures. Peak temperatures in Canoe Creek are likely too high for the species to survive and reproduce year-round. The count of fish caught per species at each site as well as a presence/absence matrix is presented in Table 6.

Table 6. Count of fish and presence/absence matrix for fish species in the Canoe Creek watershed. Sampling sites are arranged from upstream to downstream in the watershed. The two sites located on a tributary are in yellow.

	McGriffen Crossing	Upstream Shetler Rd	Downstream Shetler Rd	Restoration Site	Keystone Trib Huston Ave	Keystone Trib at Confluence	Upstream 80 Bridge	Downstream 80 Bridge	Stream Mouth
Creek Chub	81	146	21	37	62	73	38	102	4
Johnny Darter	62	13	0	3	0	2	0	12	0
Redside Dace	54	35	5	28	0	1	0	0	0
Blacknose Dace	38	80	129	109	20	110	440	795	5
White Sucker	30	42	13	20	23	2	25	136	1
Bluegill Sunfish	3	1	0	0	0	0	0	2	0
Fantail Darter	1	0	0	0	0	0	0	0	2
Mottled Sculpin	0	11	59	41	14	85	68	13	15
Pumpkinseed Sunfish	0	8	0	0	0	0	0	0	0
Brown Bullhead	0	1	0	0	0	0	0	0	0
Largemouth Bass	0	0	0	1	0	0	0	0	0
Longnose Dace	0	0	0	0	0	0	4	4	4
Silver Shiner	0	0	0	0	0	0	0	0	7
River Chub	0	0	0	0	0	0	0	0	5
Northern Hog Sucker	0	0	0	0	0	0	0	0	4
Banded Darter	0	0	0	0	0	0	0	0	4
Rainbow Darter	0	0	0	0	0	0	0	0	3
Smallmouth Bass	0	0	0	0	0	0	0	0	2
Mimic Shiner	0	0	0	0	0	0	0	0	1
Logperch	0	0	0	0	0	0	0	0	1
Greenside Darter	0	0	0	0	0	0	0	0	1

Fish diversity has a wide range throughout the Canoe Creek watershed, with the highest SID score at the Stream Mouth site (0.88), with the next highest being at the headwaters site (0.78). The two lowest SID scores were upstream (0.39) and downstream (0.42) of the I-80 Bridge. Metrics on the fish community at each site is reported in Table 7.

The unnamed tributary that runs through the Borough of Knox is of particular interest because approximately 1,027 ft of the stream has been buried upstream of Huston Ave. Electrofishing surveys were conducted downstream of where the unnamed stream re-emerges and at the confluence of the tributary and Canoe Creek to assess the health of the fish community. The site at Huston Ave had the lowest species richness of all of the sites and moderate SID. At the tributary confluence, the species richness had increased, though the SID stayed about the same.

Table 7. Summary of fish community metrics for nine sites in the Canoe Creek watershed, ordered upstream to downstream. The two sites located on a tributary are highlighted in yellow.

Site	Species Richness	Simpson's Index of Diversity	Total Catch
McGriffen Crossing	7	0.78	269
Upstream Shetler Rd	9	0.73	337
Downstream Shetler Rd	5	0.60	227
Restoration Site	7	0.72	239
Unnamed Trib - Huston Ave	4	0.65	119
Unnamed Trib - at Confluence	6	0.67	273
Upstream 80 Bridge	5	0.39	575
Downstream 80 Bridge	7	0.42	1064
Stream Mouth	15	0.88	59

Water Quality

In July, 2026 we conducted a basin-wide survey of water quality. We measured pH, conductivity, and temperature at 16 sites in the field. We also collected water samples for laboratory analysis of alkalinity, iron, manganese, aluminum, sulfates, and total suspended solids (Table 8).

From the sample sites, there was one unnamed tributary in the headwaters of Canoe Creek with 2 sample sites that show the tributary to have impaired water quality. These two sites had the lowest pH measurements and the highest conductivity measurements in the watershed. The upstream site, located upstream of Rt 322, had a pH of 3.22 and a conductivity of 796 umhos. This site also had the highest levels of iron, manganese, and aluminum of the sample sites. The second site on the tributary is located just before the confluence of this stream and another unnamed tributary and had a pH of 5.44 and a conductivity of 627 umhos. These were also the only sites to have an alkalinity under 20.0 mg/L and sulfates over 250 mg/L. We note that sulfate concentrations in this range are not acutely toxic to aquatic organisms, but do generally exceed the Environmental Protection Agency (EPA) drinking water standard of 250 mg/L. This standard is not Federally enforceable, but is provided by the EPA as a guideline for States and public water systems. An Abandoned Mine Land (AML) Inventory Site is located at the headwaters of this tributary which is likely the source of water quality impairment and should be considered for (AML) restoration.

Table 8. Water chemistry data for the Canoe Creek watershed.

Site	Field pH	Cond. (us/cm)	Temp. (C)	Alk. (mg/l)	Iron (mg/l)	Mang. (mg/l)	Alum. (mg/l)	Sulfates (mg/l)	TSS (mg/l)
Canoe Creek Headwaters	6.16	215	18.3	56.47	1.34	0.43	0.25	36.1	27
UNT to UNT on Rt 322	3.22	796	20.7	<20.0	2.85	5.48	0.95	280.8	<5
Canoe Creek at McGriffen Rd	6.37	344	19.5	76.07	0.85	1.08	0.11	109.6	10
UNT to UNT Downstream of Oak Grove Rd (West)	5.44	627	20.6	<20.0	0.10	3.76	0.10	374.5	6
UNT to UNT Downstream of Oak Grove Rd (East)	6.02	138	20.0	54.07	0.32	0.26	<0.10	36.0	<5
Canoe Creek Upstream of Culberson Rd	6.63	360	20.0	68.51	1.17	0.53	<0.10	117.5	<5
Canoe Creek at Rt 208	6.85	391	16.8	74.51	0.72	0.76	<0.10	88.6	7
Canoe Creek at Shettler Rd	6.50	302	15.2	73.26	0.81	0.62	<0.10	62.4	8
UNT to Canoe Creek at Huston Ave	7.35	390	19.7	68.34	0.22	<0.05	<0.10	15.4	7
UNT to Canoe Creek at Wagner Ln	7.30	338	17.5	74.06	0.23	<0.05	<0.10	12.6	7
UNT to Canoe Creek at Thompson Hill Rd	6.85	168	16.3	64.79	0.40	<0.05	0.16	12.9	19
UNT to UNT at Stromyers Rd	6.25	319	16.5	70.84	0.79	0.12	0.40	19.6	7
Canoe Creek at Eagle Furnace Rd – Upstream	7.10	227	15.3	65.30	0.60	0.06	0.15	30.1	19
UNT to Canoe Creek at Eagle Furnace Rd	6.69	139	15.2	59.39	0.23	<0.05	0.10	<10.0	12
Canoe Creek at Eagle Furnace Rd – Downstream	7.11	219	15.5	67.52	0.48	0.05	0.12	28.5	14
Canoe Creek at Knight School Rd	6.50	226	15.6	64.29	0.48	<0.05	0.11	30.7	10

Downstream of the confluence of the impaired tributary and another unnamed tributary, an upwelling from a legacy artesian well has a constant discharge of water flowing directly into the stream. The discharged water is noticeably AMD impaired and the stream downstream of the well is impacted for 0.4 miles until the tributary meets Canoe Creek.

Of the remaining sites in the watershed, the data show that water quality is good overall. Removing the 2 impaired tributary sites, pH of the watershed ranges from 6.35 to 7.48 and conductivity ranges from 168 to 391 umhos. Alkalinity is generally high - greater than 50 mg/L. These data indicate that the main stem is able to absorb and buffer the impacted water coming from the impaired tributary and maintain good water quality downstream.

Habitat Assessment

We conducted 16 habitat evaluations and scored these evaluations using the PA DEP Stream Habitat Data Collection Protocol for riffle/run prevalent streams. The PA DEP protocol uses 12 instream and riparian parameters to predict ecological integrity and Aquatic Life Use (ALU) of the habitat. Each parameter is evaluated on a scale of 0-20 with 20 being the highest score and an overall total score possible of 240. The minimum overall ALU score indicating ecological integrity is 140. Scores less than 140 indicate impairment that would inhibit ALU.

4 of the 16 sites evaluated during this assessment had scores that indicate habitat impairment that would inhibit ALU (Fig 9). All of the impaired sites scored poorly for instream cover for aquatic organisms and for stream embeddedness, with a variety of other factors contributing to the impairment of each site. It should be noted that the assessment at the ‘Canoe Creek at McGriffen Rd’ site was completed upstream of a beaver dam, which is a natural variation in stream habitat that increases embeddedness and disrupts velocity/depth regimes in riffle/run streams. However, beaver dams provide important habitat and water

quality benefits as natural filtration systems and so this site will not be considered impaired habitat, leaving 3 of the 16 sites impaired for ALU.

4 of the 12 habitat parameters in the PA DEP protocol are strong predictors of habitat degradation leading to ALU impairment and when paired together can act as stand-alone parameters for assessment decisions. These pairs of parameters are ‘embeddedness + sediment deposition’ and ‘condition of banks + bank vegetative protection’. Scores less than 24 out of a possible 40 points are considered impaired. 5 of the 16 sites indicate habitat impairment that would inhibit ALU with the primary causal factors being ‘embeddedness + sediment deposition’, including the site at the beaver dam (Fig 10). 4 of the sites indicate habitat impairment that would inhibit ALU with the primary causal factors being ‘condition of banks + bank vegetative protection’. Comprehensive habitat data is available at Appendix B.

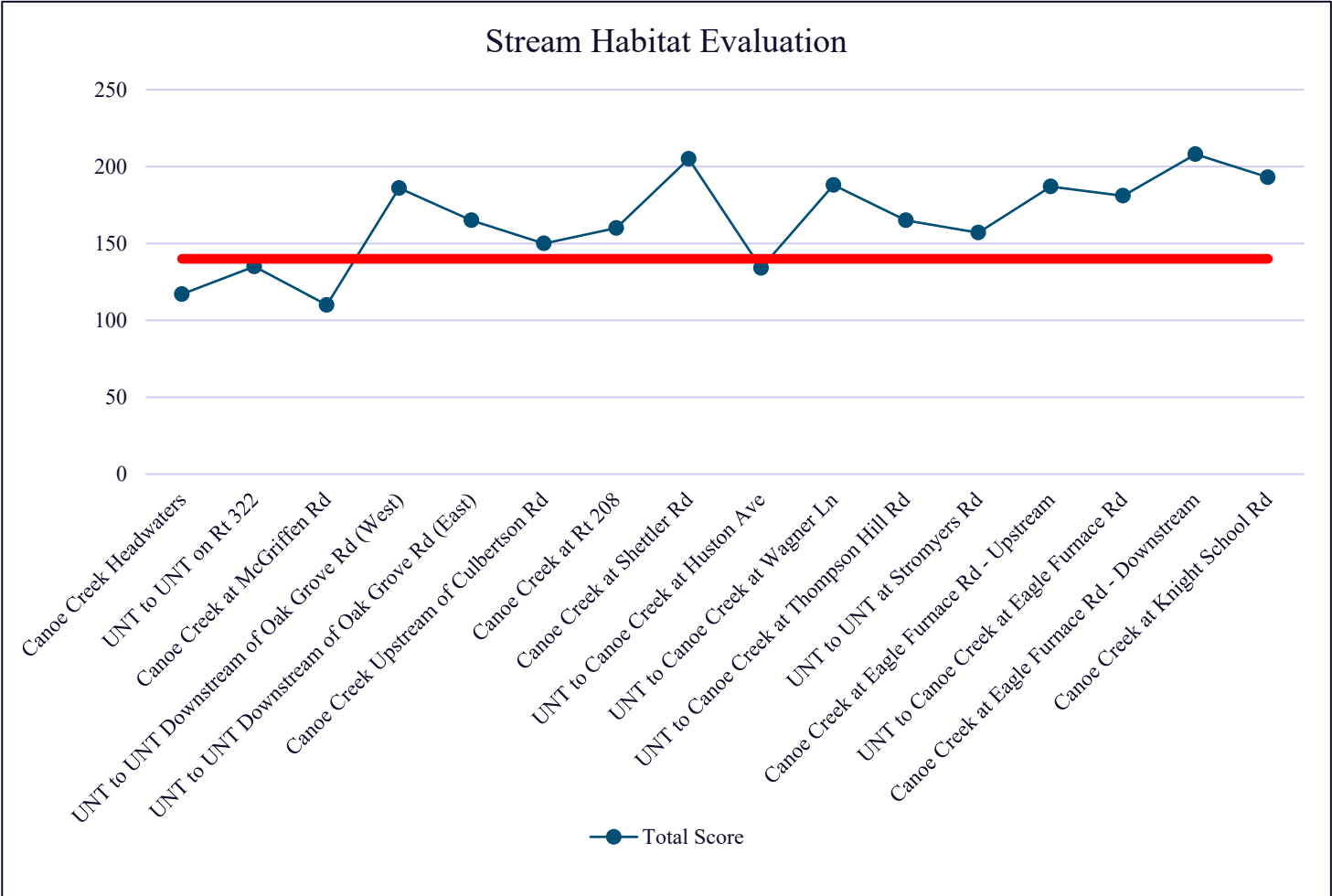


Fig. 9. Total ALU score out of a possible score of 240. The red line indicates the minimum ALU score necessary (140) to support ecological integrity and ensure ALU. Data are arranged from upstream to downstream.

Additional notes of the habitat at ‘Canoe Creek at Knight School Rd’ should also be taken into consideration. While the instream habitat and condition of the banks scored well, the riparian area along the right bank at that site consists entirely of invasive Japanese knotweed (*Reynoutria japonica*). The presence of this invasive species lowers the habitat quality of the riparian area and impacts recreational access to Canoe Creek and the Clarion River.

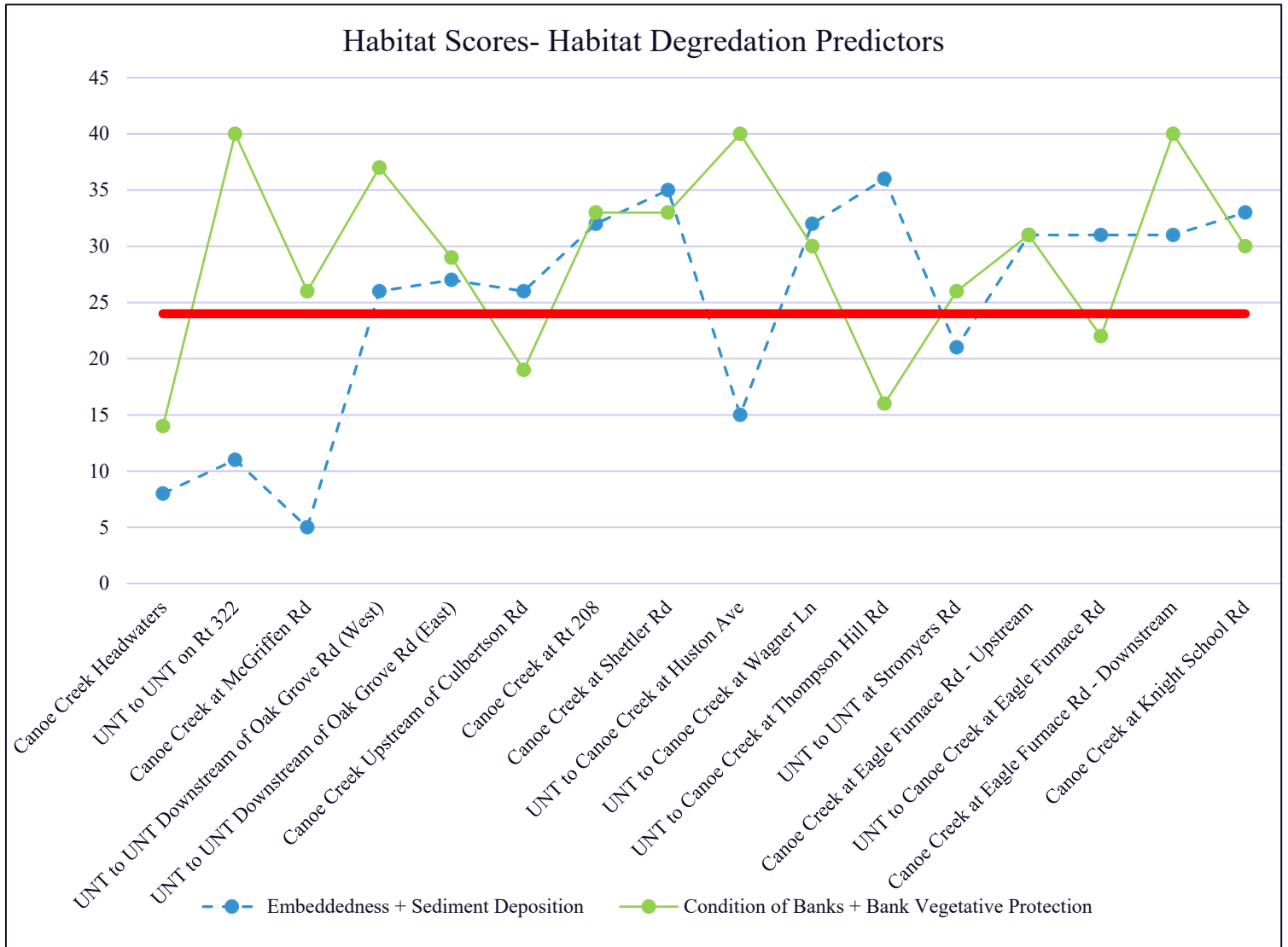


Fig. 10. Paired stand-alone predictors of ‘embeddedness and sediment deposition’ and ‘condition of banks and bank vegetative protection’. When paired together, a score of 24 (red line) or less out of a possible 40 indicates impaired habitat for ALU. Data are arranged from upstream to downstream.

Summary

Canoe Creek is designated as an impaired stream for Aquatic Life Use and is listed as a high quality cold-water fishery with Chapter 93 Water Quality Standards. While no native or wild trout populations were found, likely due to the water being too warm to sustain them, Canoe Creek has both a diverse and abundant assemblage of fishes. The stream could benefit from placement of in stream habitat to provide additional cover for fishes. Additionally, streambank stabilization is necessary to inhibit erosion and downstream sediment deposition.

Overall water quality is good, but additional investigative is necessary in the headwaters of the watershed to determine the source of the low pH and elevated metals in the unnamed tributary that flows from Rt 322 to Oak Grove Road. Opportunities for water quality improvement exists throughout the watershed by reclaiming abandoned mine land through the PA DEP BAMR AML program. Additional study to determine eligibility of private properties with abandoned mine features is necessary.

Habitat evaluations suggest the overall habitat in Canoe Creek is sufficient to sustain aquatic life use. Stream embeddedness, sediment deposition, and lack of in stream cover are areas of concern that inhibit an otherwise healthy stream. The addition of habitat improvement structures to the watershed would provide in stream habitat for aquatic life, while having the added benefit of reducing streambank erosion and sediment deposition downstream.

Emphasis should be placed on restoring riparian habitat to include a vegetative buffer to slow surface water runoff and provide streambank stabilization. Invasive plant species persist in the watershed and require an active plan to eradicate. The creation of a citizen led watershed organization would facilitate these processes and enhance awareness of the importance of active watershed management.

Our review of road crossings showed numerous undersized and perched culverts throughout the watershed. Undersized culverts result in excessive erosion through increasing the velocity of water through the culvert; increasing aggradation of materials below the culvert; and alluviation of sediment deposits upstream of the culvert; exacerbating problems with aquatic passage and flooding. Where eligible, road crossing improvement projects implemented by the dirt and gravel road programs through the conservation district and townships in the watershed should be considered to improve road crossings with impaired aquatic passage and altered hydrology. Non-profit and governmental organizations should place an emphasis on these areas as it directly contributes to flood concerns, blocked aquatic organism passage, and continued erosion concerns.

Management Options

The purpose of this assessment was to characterize the ecological health of the watershed and provide landowners, non-profit organizations, and governmental offices with options to improve the watershed. Here we offer a generally prioritized list of management options that can be implemented to improve water quality, aquatic organism habitat, riparian zones, and erosional concerns.

Investigation of the source of the low pH and elevated conductivity on the unnamed tributary should be a management priority. Additionally, the artesian well of AMD discharge in the unnamed tributary should be plugged. A more extensive water sampling effort may be necessary to confirm the source of impairment upstream and pinpoint areas for priority treatment and reclamation efforts. While Canoe Creek appears to be able to buffer the impacts of the impaired tributary downstream, reclamation efforts to remove this impairment would reconnect the biotic community in the lower Canoe Creek watershed to much of its headwaters and improve overall water quality.

Managers and landowners should report abandoned mine land issues located on their properties in the watershed to the PA DEP's Bureau of Abandoned Mine Reclamation (BAMR). To be eligible for reclamation through the PA DEP Abandoned Mine Land reclamation program, these properties must have been previously mined for coal prior to the enactment of the Surface Mining Control and Reclamation Act (SMCRA) of 1977. PA DEP BAMR (Cambria Office) can be reached at 1-814-472-1800.

Landowners should notify the Clarion Conservation District and the PA Department of Environmental Protection if they are aware of any abandoned oil or gas wells on their property. Plugging of the existing abandoned oil and gas wells should be a management priority.

The Clarion Conservation District, in conjunction with the municipalities and the Penn State Dirt & Gravel/Low Volume Road (DGLVR) program, should continue efforts to mitigate erosion and sediment pollution on eligible roadways throughout the watershed. Emphasis should be placed on perched culverts and velocity barriers as identified in this report to remove the largest barriers to aquatic organism passage.

The Clarion Conservation District, in conjunction with landowners and fisheries managers, should study potential solutions for improving instream habitat and streambed/streambank stabilization throughout the watershed. Instream habitat structures provide necessary cover for aquatic life while reducing erosion and downstream embeddedness. Canoe Creek has a diverse and abundant assemblage of fishes as documented in this report, but the need for in-stream habitat improvements and streambanks stabilization was evident at multiple sites throughout the watershed. In-stream habitat improvements should be prioritized based on the findings of the habitat surveys documented in this report.

The restoration of vegetated riparian buffers in the watershed would improve in stream and streamside habitat and reduce streambank erosion. While it's preferred to maintain a 50-150 foot riparian buffer, this may not be practical for all landowners in the watershed. This should not deter landowners and land managers from restoring what areas they can; even if only 5 to 10 feet from the stream bank. Any enhancement to the buffer will mitigate surface water runoff; provide increased water infiltration into the soil and filtering of pollutants; and lessen erosion of streambanks and stream channels. Perhaps the greatest value in slowing surface water runoff is the potential this has for mitigating flash flood events. There are many programs and grants available that would provide this service free of cost to the landowners. Landowners that are interested in planting a riparian buffer on their property can contact the Clarion Conservation District.

Removal and treatment of invasive plant species is a perpetual management activity that is critical to the ecosystem health of the watershed. Efforts to eradicate invasive plant species should be done in conjunction with riparian restoration and abandoned mine land reclamation efforts. In particular, the highly invaded area at the confluence of Canoe Creek and the Clarion River greatly impacts the quality of the riparian habitat and should be treated. Landowners should reach out to the Clarion Conservation District and the Penn State Extension office in Clarion for further information on invasive plant identification and management options.

Sustaining long-term water quality and biological monitoring of the stream, at a minimum of every 5 years, should be a management priority of the Clarion Conservation District and any established watershed organizations. This monitoring will enable early warning of changes in the watershed that result in degraded water quality.

The formation of a private watershed organization should be a management priority. A private watershed organization working in cooperation with the Clarion Conservation District and other government and non-profit organizations, will ensure active monitoring of the overall health of the watershed and enable close cooperation with landowners.

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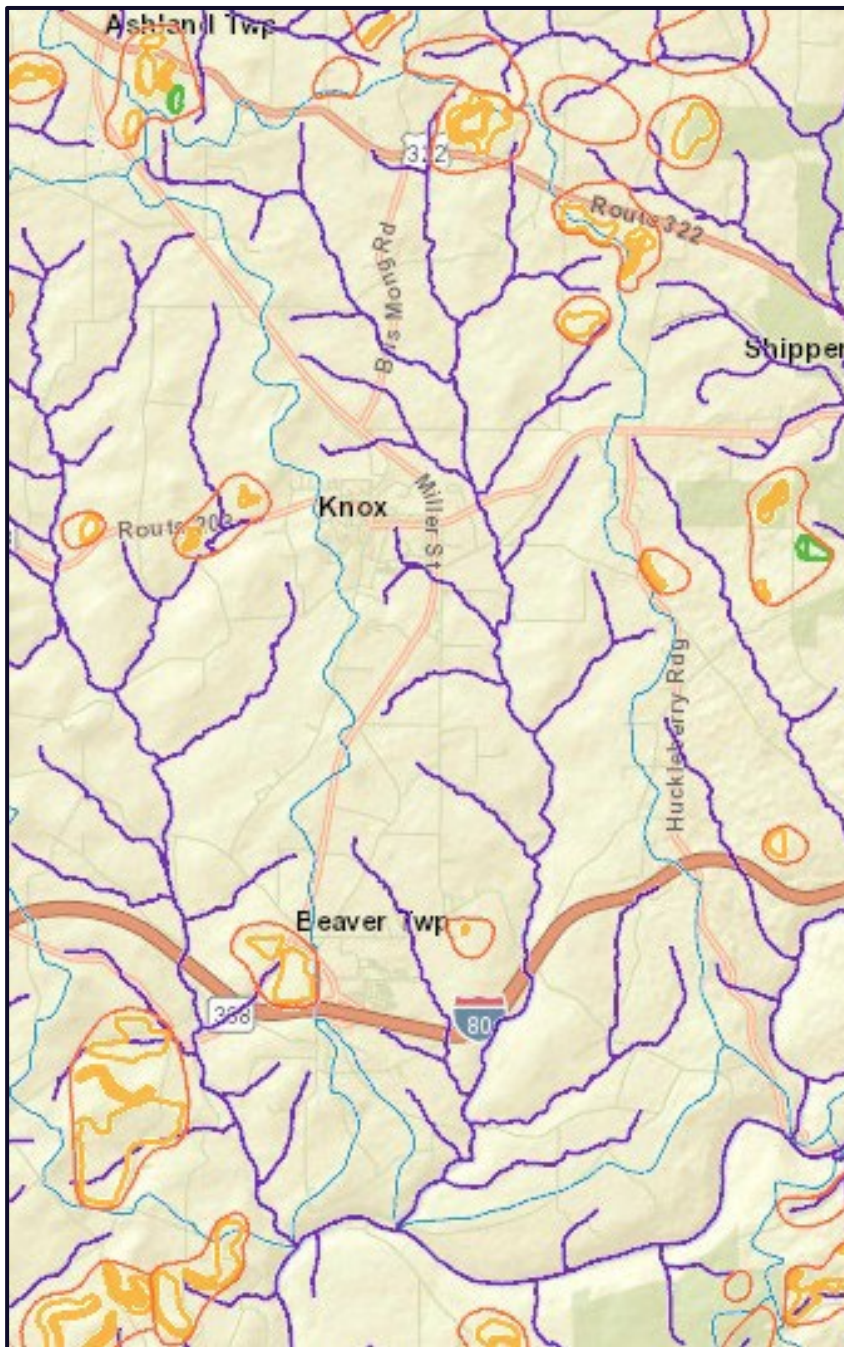
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Appendix A – PA DEP Abandoned Mine Land Inventory Sites



Legend

Watershed Boundary

Stream

AML Inv Site

AML Point Feature

AML – Abandoned Mine
Land

Appendix B – Habitat Assessment Data

Location	Coordinates	Instream Cover	Epifaunal Substrate	Embeddedness	Velocity/Depth Regime	Channel Alteration	Sediment Deposition	Riffle Frequency	Channel Flow Status	Condition of Banks	Bank Vegetative Protection	Grazing/Disruptive Pressure	Riparian Vegetative Zone	Aquatic Life Use Score (Out of 240)	Total Embed & Sediment	Total Banks & Veg
Canoe Creek Headwaters	41.269529, -79.561154	3	7	3	8	15	5	14	8	8	6	20	20	117	8	14
UNT to UNT on Rt 322	41.273017, -79.528876	5	3	1	5	14	10	2	19	20	20	18	18	135	11	40
Canoe Creek at MCGriffen Rd (beaver dam)	41.257401, -79.539831	1	1	1	1	17	4	1	20	16	10	19	19	110	5	26
UNT to UNT Downstream of Oak Grove Rd (West)	41.255262, -79.524959	11	10	12	10	20	14	18	14	18	19	20	20	186	26	37
UNT to UNT Downstream of Oak Grove Rd (East)	41.255123, -79.524363	18	11	16	6	20	11	11	3	13	16	20	20	165	27	29
Canoe Creek Upstream of Culbertson Rd	41.249347, -79.525908	16	12	13	13	15	13	8	16	10	9	11	14	150	26	19
Canoe Creek at Rt 208	41.236126, -79.521931	13	8	14	9	11	18	11	19	17	16	14	10	160	32	33
Canoe Creek at Shettler Rd	41.230970, -79.520380	19	14	17	17	15	18	17	18	17	16	19	18	205	35	33
UNT to Canoe Creek at Huston Ave	41.229820, -79.529780	4	11	2	8	12	13	3	19	20	20	13	9	134	15	40
UNT to Canoe Creek at Wagner Ln	41.224907, -79.521550	19	13	14	14	19	18	18	18	15	15	14	10	188	32	30
UNT to Canoe Creek at Thompson Hill Rd	41.184374, -79.527442	18	13	18	18	13	18	20	19	6	10	8	4	165	36	16
UNT to UNT at Stromyers Rd	41.185053, -79.503333	18	14	13	13	10	8	18	13	14	12	14	10	157	21	26
Canoe Creek at Eagle Furnace Rd- Upstream	41.173098, -79.523529	9	10	18	15	14	13	20	18	17	14	19	20	187	31	31
UNT to Canoe Creek at Eagle Furnace Rd	41.172926, -79.522471	19	16	16	16	16	15	18	8	16	10	19	16	181	31	22
Canoe Creek at Eagle Furnace Rd- Downstream	41.171195, -79.523026	15	18	16	10	14	15	20	20	20	20	20	20	208	31	40
Canoe Creek at Knight School Rd	41.163049, -79.532302	18	16	15	14	14	18	19	16	15	15	20	13	193	33	30
Minimum Aquatic Life Use (ALU) Score indicating ecological integrity is >140 our 240. Scores less than 140 indicate impairment.																
This habitat evaluation scores 12 parameters on a 20 point scale																
Certain instream and riparian area habitat parameters are strong predictors of habitat degradation leading to ALU impairment, and as a result, these parameters alone may warrant independent assessment decisions. These parameters are embeddedness, sediment deposition, condition of banks, and bank vegetative protection. The impairment threshold for the parameters of embeddedness + sediment deposition, or condition of banks + bank vegetative protection is a total score of 24 or less for either combination.																