

# Leisure Run

## *Watershed Assessment and Conservation Plan 2023*

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Photo Credit: Matt Kerr

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Finally, we thank Garrett Herigan, Fisheries Biologist with the Pennsylvania Fish and Boat Commission, Fisheries Management Area 2, for his assistance with our field survey work and for providing historical data for the watershed that enabled us to assess the relative health of Leisure Run.

# Leisure Run Watershed Assessment

## Introduction

Leisure Run is designated a cold-water fishery (CWF) located in southern Clarion County, Pennsylvania (Fig. 1). It is a tributary to Redbank Creek and ultimately to the Allegheny River. Leisure Run has a drainage area of approximately 6.64 square miles with 62% of the landscape being early successional forest and the remaining area primarily occupied by agricultural and residential properties. Leisure Run is designated as an attaining Aquatic Life Use (ALU) watershed. Threats to this attaining status include agriculture, siltation, highway runoff, and Abandoned Mine Drainage (AMD). Other threats to the watershed include introduction and proliferation of invasive plant species and numerous abandoned mine features as inventoried and listed on the Department of Environmental Protection's eMap Abandoned Mine Land (AML) inventory. The watershed spans two townships within Clarion County including Porter and Redbank and extends into the New Bethlehem Borough. Urban development only comprises 3.9% of the drainage area with much of the area comprised of abandoned agricultural and mine land. The main population center is the Borough of New Bethlehem with smaller towns and villages nearby including Hawthorne and South New Bethlehem. Leisure Run flows in a southerly direction and confluences with the middle Redbank Creek in the borough of New Bethlehem. Redbank Creek confluences with the Allegheny River just downstream from East Brady, PA.

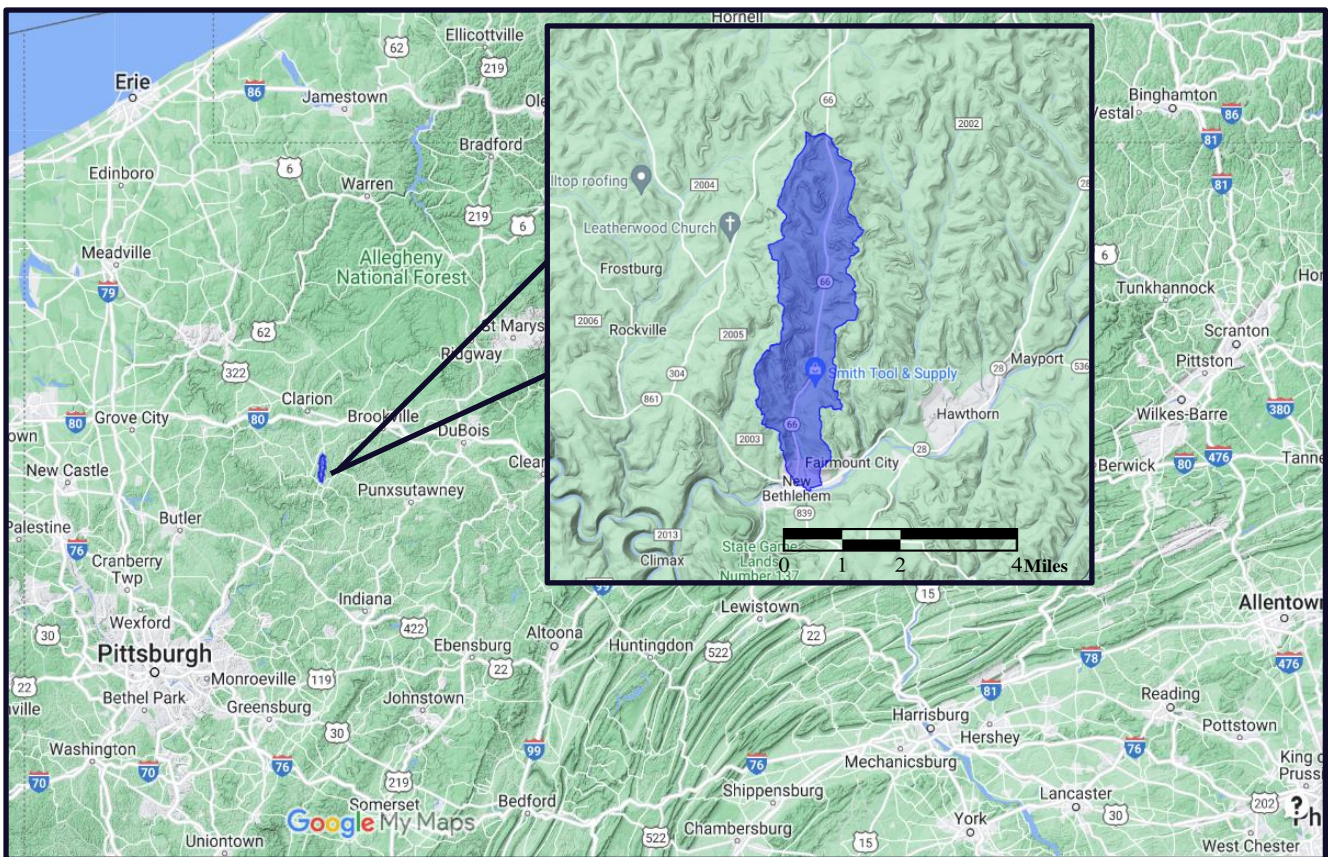


Fig. 1. Location map of the Leisure Run watershed in southern Clarion County (Google Earth/Google Maps).

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## Purpose of the Assessment

This assessment characterizes water quality, in-stream and riparian habitat, biological diversity, abandoned mine impacts, erosion concerns, and waterway encroachments such as bridges, culverts, and pipelines. 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

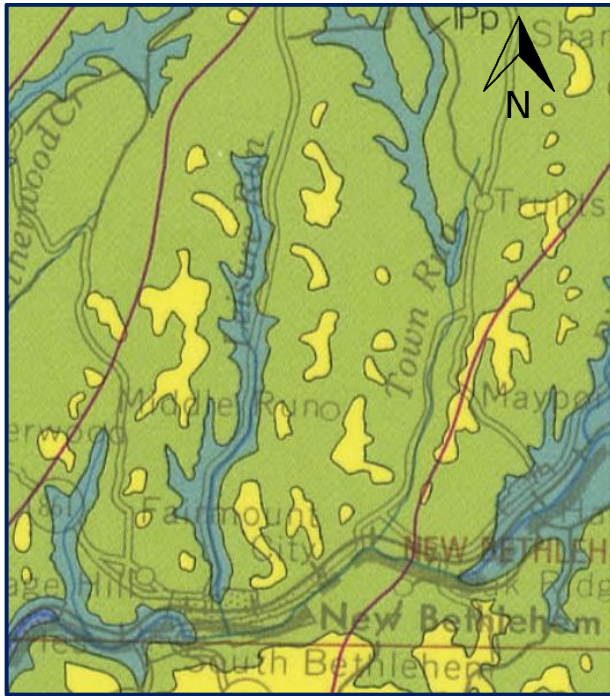
Leisure Run drains approximately 6.64 square miles and has a mean basin slope of 9.6 degrees. The mean annual precipitation is 44 inches and with minimal pond or wetland storage area (0.04% of total drainage area), the watershed is subject to rapid flash flooding events. The watershed has a mean elevation of 1430 feet above sea level. Leisure Run has seven significant unnamed tributaries with the total drainage network totaling 11.81 miles. 5.41 miles are first order streams and 6.40 miles constitute the 2nd order mainstem. Total stream miles and drainage area are presented in Table 1. None of these tributaries contain wild trout.

Table 1. Stream lengths and drainage areas for the Leisure Run Watershed, Clarion County, PA.

Stream	Length (Miles)	Drainage Area (Square Miles)
UNT to Leisure Run at Wayne Lane	0.70	0.46
UNT to Leisure Run at Champion Road	1.20	0.54
UNT to Leisure Run at RV Wells	0.49	0.25
UNT to Leisure Run at Rt 66	0.42	0.23
UNT to Leisure Run at Columbia Gas	1.10	0.41
UNT to Leisure Run at Smith Road	0.60	0.17
UNT to Leisure Run at Drummond	1.10	0.51
Leisure Run Main Stem	6.40	4.07
Total	11.81	6.64

## Geology

The watershed resides entirely on the Allegheny Plateau and has not been influenced by the Laurentide ice sheet. Geology is composed of Glenshaw, Allegheny, and Pottsville groups dominated by shale, sandstone, limestone, and coal layers (Fig. 2). Notably, the study area is underlain by the Vanport Limestone carbonate bedrock layer along its margins, as discussed later in this report.



- IPcg**    **GLENSHAW FORMATION**  
 Cyclic sequences of shale, sandstone, red beds, and thin limestone and coal; includes four marine limestone or shale horizons; red beds are involved in landslides; base is at top of Upper Freeport coal.
  
- IPa**    **ALLEGHENY GROUP**  
 Cyclic sequences of sandstone, shale, limestone, clay, and coal; includes valuable clay deposits and Vanport Limestone; commercially valuable Freeport, Kittanning, and Brookville-Clarion coals present; base is at bottom of Brookville-Clarion coal.
  
- IPp**    **POTTSVILLE GROUP**  
 Predominantly gray sandstone and conglomerate; also contains thin beds of shale, claystone, limestone, and coal; includes Olean and Sharon conglomerates of northwestern Pennsylvania; thin marine limestones present in Beaver, Lawrence, and Mercer Counties; minable coals and commercially valuable high-alumina clays present locally.

Fig. 2. USGS map of the Glenshaw, Allegheny, and Pottsville formations (USGS).

The Vanport limestone formation constitutes more than 450 linear miles of outcrop throughout Clarion County (Fig. 3) with an average thickness of 8 to 15 feet. The Vanport limestone in this region is unique due to its high calcium carbonate (CaCO<sub>3</sub>) content that likely contributes significant alkalinity to the Leisure Run watershed. This alkalinity contribution is important as it provides buffering capacity 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 <sub>3</sub> ).....	96.428	95.196	95.532	95.232
Magnesium carbonate (MgCO <sub>3</sub> )	1.202	1.265	0.930	0.407
Alumina (Al <sub>2</sub> O <sub>3</sub> ).....	0.867	1.529	1.050	1.310
Ferric oxide (Fe <sub>2</sub> O <sub>3</sub> ).....				
Phosphorus.....	0.023	0.081	0.070	0.061

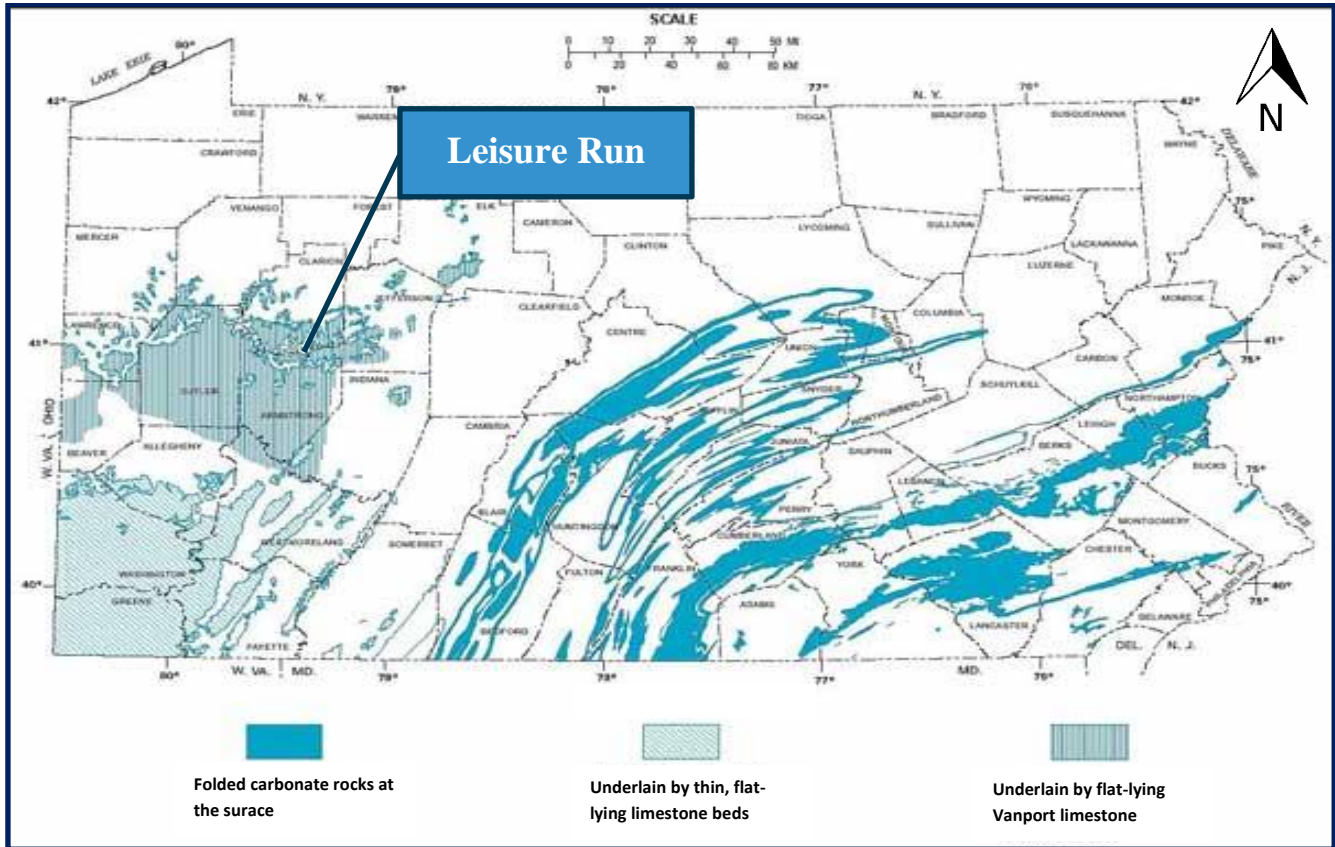


Figure 3. Carbonate rocks in Pennsylvania (Pennsylvania Geological Survey 2000).

### Soils, Wetlands, and Floodplain

Soil composition in the watershed is dominated by Bethesda very channery silt loam (BeD)(46.5%), Ernest silt loam (ErC)(13.5%), and Gilpin-Weikert channery silt loam (GwF)(10%). These Group C & D soils have slow infiltration characteristics that impede the downward movement of water into the water table (Table 3). This characteristic coupled with the lack of vegetative cover in the riparian zone throughout the middle and lower reaches of the watershed, likely contribute to the rapid drainage of the watershed after severe rain events and the resulting frequent flash flooding.

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
AtA	Atkins-Philo complex, 0 to 3 percent slopes, frequently flooded	B/D	216.8	1.7%
BeB	Bethesda very channery silt loam, 0 to 8 percent slopes	D	584.7	4.6%
BeD	Bethesda very channery silt loam, 8 to 25 percent slopes	D	2,536.8	19.9%
BhD	Bethesda very channery silt loam, 8 to 25 percent slopes, very stony	D	2,244.9	17.6%

Soil Code	Unit Name	Rating	Acres in AOI	% of AOI
BhF	Bethesda very channery silt loam, 25 to 75 percent slopes, very stony	D	557.1	4.4%
CaB	Cavode silt loam, 3 to 8 percent slopes	C/D	167.1	1.3%
CaC	Cavode silt loam, 8 to 15 percent slopes	C/D	259.6	2.0%
CdB	Cavode silt loam, 0 to 8 percent slopes, very stony	C/D	122.3	1.0%
ErB	Ernest silt loam, 3 to 8 percent slopes	C/D	535.4	4.2%
ErC	Ernest silt loam, 8 to 15 percent slopes	C/D	1,170.2	9.2%
GcC	Gilpin channery silt loam, 8 to 15 percent slopes	C	154.5	1.2%
GcD	Gilpin channery silt loam, 15 to 25 percent slopes	C	137.6	1.1%
GgD	Gilpin silt loam, 15 to 25 percent slopes	C	248.1	1.9%
GwC	Gilpin-Weikert channery silt loams, 8 to 15 percent slopes	C	319.0	2.5%
GwF	Gilpin-Weikert channery silt loams, 25 to 70 percent slopes	C	938.6	7.4%
PhA	Philo silt loam, 0 to 3 percent slopes, occasionally flooded	B/D	245.5	1.9%
WgD	Wharton-Gilpin silt loams, 15 to 25 percent slopes	C	520.9	4.1%

There are only two delineated wetlands within the Leisure Run watershed as provided by the National Wetlands Inventory. Both of these wetlands are in the area of Swartfager Road and are palustrine Freshwater Forested/Shrub wetlands (Fig. 4).

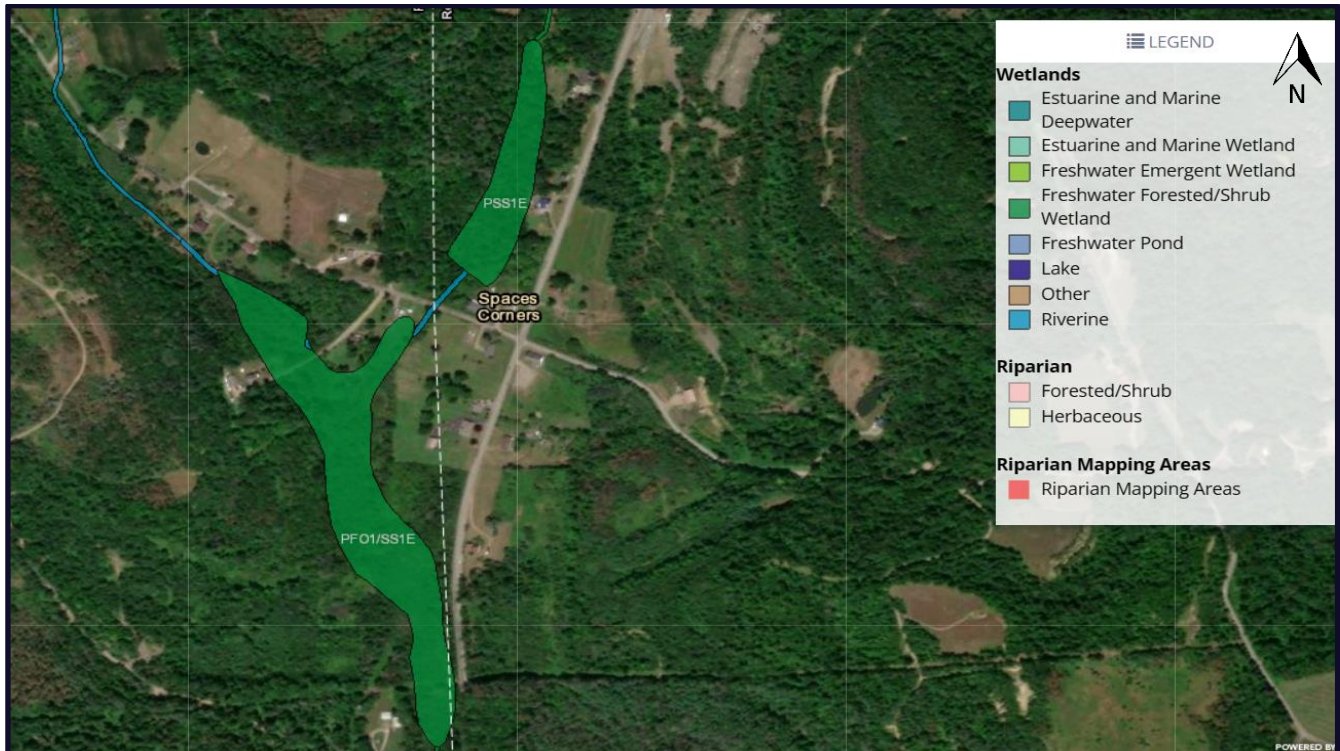


Fig. 4. Wetland map of Leisure Run at Swartfager Road (US Geological Survey).

Historical flooding in the Leisure Run watershed has been a persistent concern with more recent major flooding events occurring in 1996 and 2019. As discussed earlier, the combination of soils with low infiltration rates and severely degraded riparian buffers, leave this watershed vulnerable to flash flooding events (Fig. 5A-C). This concern has led to landowners taking drastic measures such as dredging the stream bed to construct earthen berms in an effort to protect their properties located within the designated floodway. Formation of a private watershed organization, in cooperation with the conservation district, could greatly enhance awareness and develop potential solutions to these persistent watershed issues.

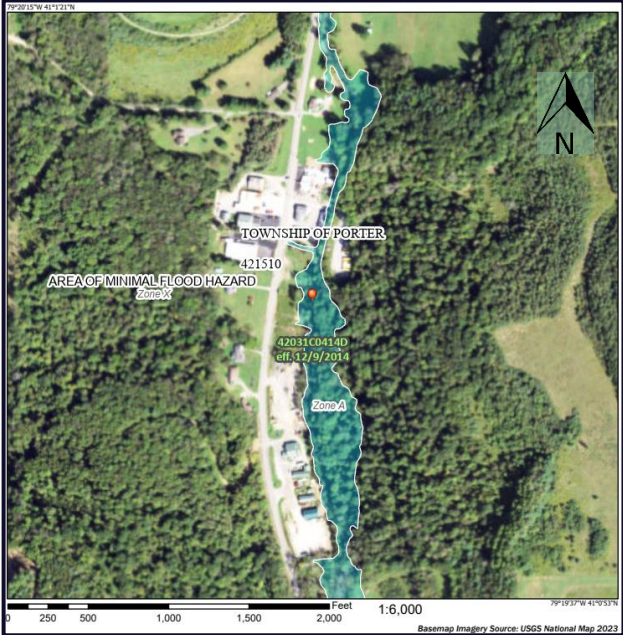


Fig. 5A. Floodway map area of concern on upper mid-reach of Leisure Run (eMapPA).

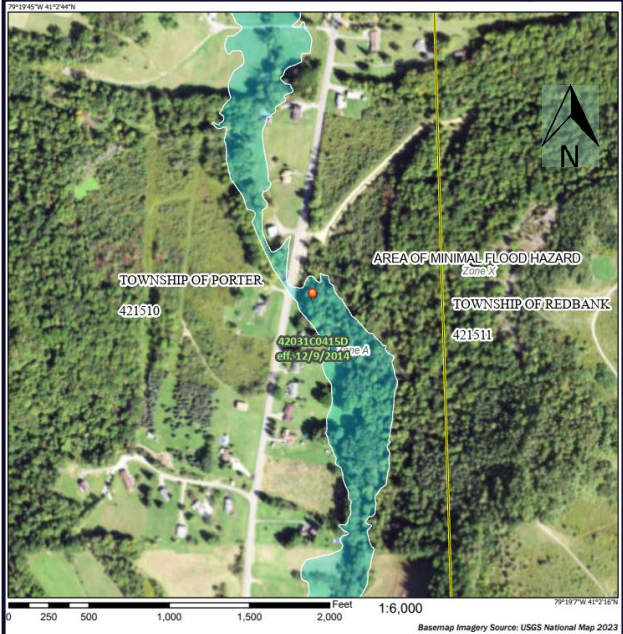


Fig. 5B. Floodway map area of concern on lower mid-reach of Leisure Run (eMapPA).



Fig. 5C. Floodway map of the Leisure Run watershed. The floodway encompassing FEMA Flood Zone A and AE is depicted in light blue (eMapPA).



## Land Use

Land use in the Leisure Run watershed consists primarily of agricultural areas, open and low intensity developed areas, deciduous and mixed forest, and near the confluence with Redbank Creek, medium intensity development in the New Bethlehem Borough (Fig. 6).

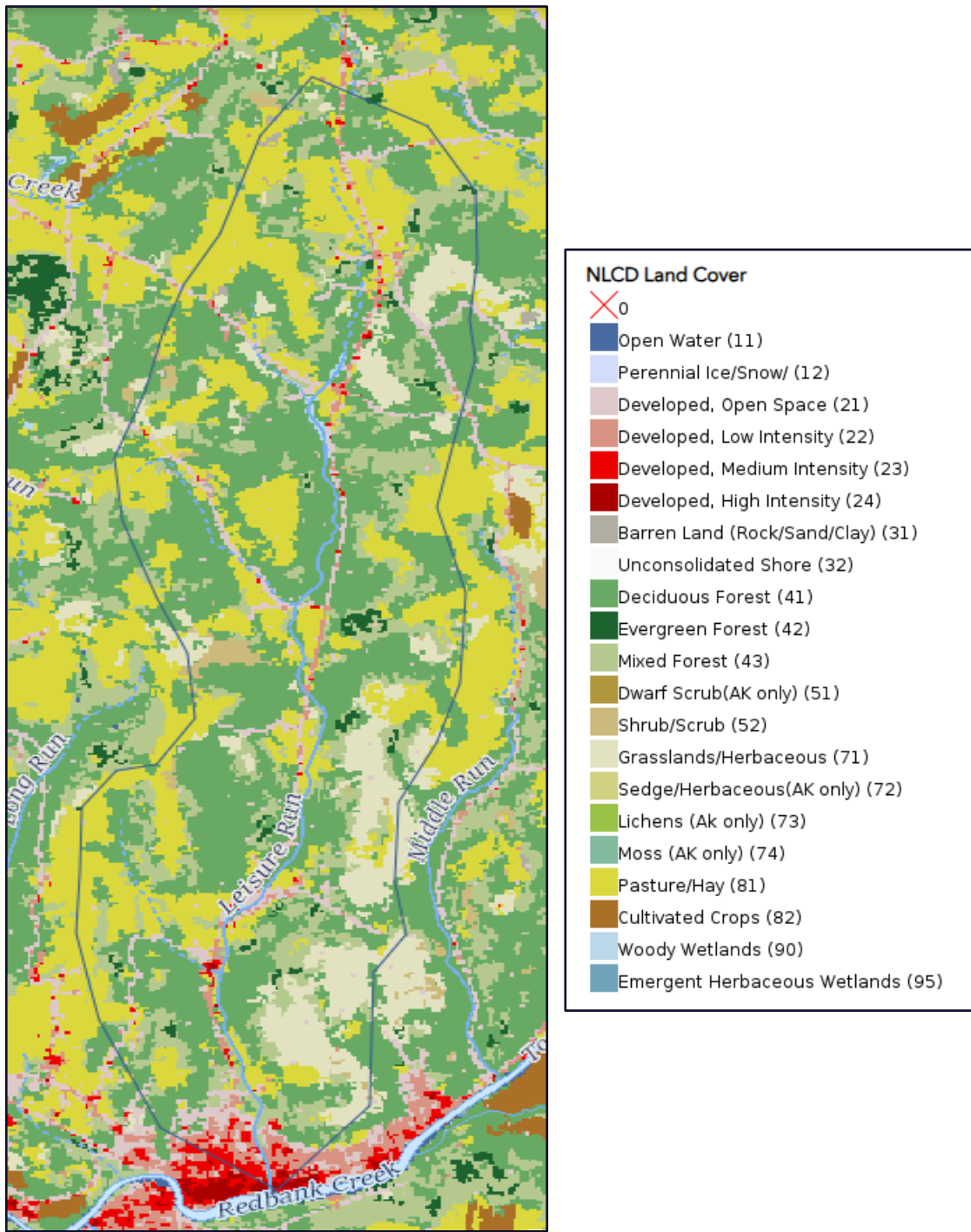


Fig. 6. Land use and land cover within the Leisure Run Watershed. Data provided by the USGS National Map - National Land Cover Dataset.

## Historical Mining Influences

The watershed has been heavily mined primarily for bituminous coal and documented as early as the 1940s. 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 at least 15 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 elevated conductivity and sulfate levels detected during our sampling (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 and Lower Freeport, Upper, Middle and Lower Kittaning, Brookville, and Clarion Coal Seams as well as mining for other commercially marketable minerals.

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 provides a brief summary of the mining history in the Leisure Run watershed.

Table 4. Leisure Run watershed documented mining history (eMapPA).

Company Name	Permit #	Mine Name	Date Issued	Coal Seam(s)
Allaman Mining Co	18105	Frogtown	11/6/1958	UF
Allaman Mining Co	14348	Allaman Mining Co	1/7/1955	LK
Arnold Doverspike	365M007	Shankel	7/28/1965	UK
Aspen Mineral Inc.	16930101	Jones Mine	8/11/1993	UF
C&K Coal Co	16743016	Mays No. 4	7/15/1985	LK, CL, Minerals
Clyde Miles Coal Co	16800124	Triple W	8/18/1981	CL, LK, UK, MK
Clyde Miles Coal Co	16803024	Triple W	4/22/1985	MK, UK
D&J Coal Co	11713	Evans	6/22/1951	LK,
Donald W. Deitz	3674SM51	Deitz #1	2/5/1975	UF
Earnest C. Dean Contr Inc.	2766BSM25	Iseman	5/18/1966	LF
EM. Reed Contr & Co	18676	Reid & Howley	7/20/1959	UK, MK, LF
EM. Reed Contr & Co	12636	Bowersox	8/18/1952	UK, LF
Ernest C. Dean Contr Inc.	2767BSM17	Iseman	8/23/1967	MK, UK, LF, LK
G.T. & K.P. Mauersburg	2766BSM22	Allison	3/16/1966	UK
Gary C. Doverspike	3677SM14	Reed	1/24/1978	UK, LK, UF, LF
Gene Reichard P & Ex	3671BSM2	Cottage Hill	5/5/1971	LK, UK, LF, MK
Hawk Brothers Inc.	361M154	Middle Run #2	9/21/1961	UK, LF, LK,
Hepburnia Coal Co	17000110	Penn #2	10/1/2001	LK
Iseman Brothers	15423	Iseman #10-4	3/23/1956	UF
Joe F. Sherman	12714	NA	10/21/1952	LF, UK
Leadbetter Coal Co	3676SM13	Minich	NA	LK, LF, UF, MK, UK
Lucinda Coal Co	1679119	Young	NA	LF, MK

Mauersburg Coal Co	2769BSM18	Drummond #2	5/26/1970	MK, LK, LF, UK,
Mauersburg Coal Co	2769BSM19	Drummond #1	5/13/1970	LF
Mays Coal Co	15603	NA	5/18/1956	LK
Mays Coal Co	11856	Kespeher	9/27/1951	UF, UK, LK, LF
Reichard Contr Inc.	16190102	Shankle Mine	1/23/2019	MK, UK
Robert Fagley	3674SM46	Ditty	2/24/1975	UK, LF, MK, LK
Robert Fagley	3676SM23	Fagley #1	10/19/1976	UF, MK, UK, LF
Terry Coal Sales Inc.	16840110	Young	8/4/1986	UK
Terry Coal Sales Inc.	3674SM57	Evans	6/10/1975	MK, UK, LF, LK
Terry Coal Sales Inc.	16820120	McNeal	6/10/1983	UK, LF, MK
Terry Reddinger	1679105	Reed	6/10/1980	LK, MK, LF, UK
Terry Reddinger	16793005	Reed	3/19/1985	UK, MK, LK, LF
W.P. Stahlman Coal Co	361M191	Stahlman #3A	10/28/1963	CL, LK
W.P. Stahlman Coal Co	2767BSM21	Stahlman 324	NA	BR, CL, LK, MK,
Walter J. Coyer	16859	Coyer	6/28/1957	MK
Zacherl Coal Co	3675SM65	Zacherl No. 35	4/22/1976	LF, LK, CL, MK, Mineral

## Oil and Gas

At least 181 oil and gas wells have been identified by the PA DEP in the Leisure Run watershed (Fig. 7). Of those, seven (7) have been designated as abandoned, nine (9) have been plugged, and 165 remain designated as active.

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.

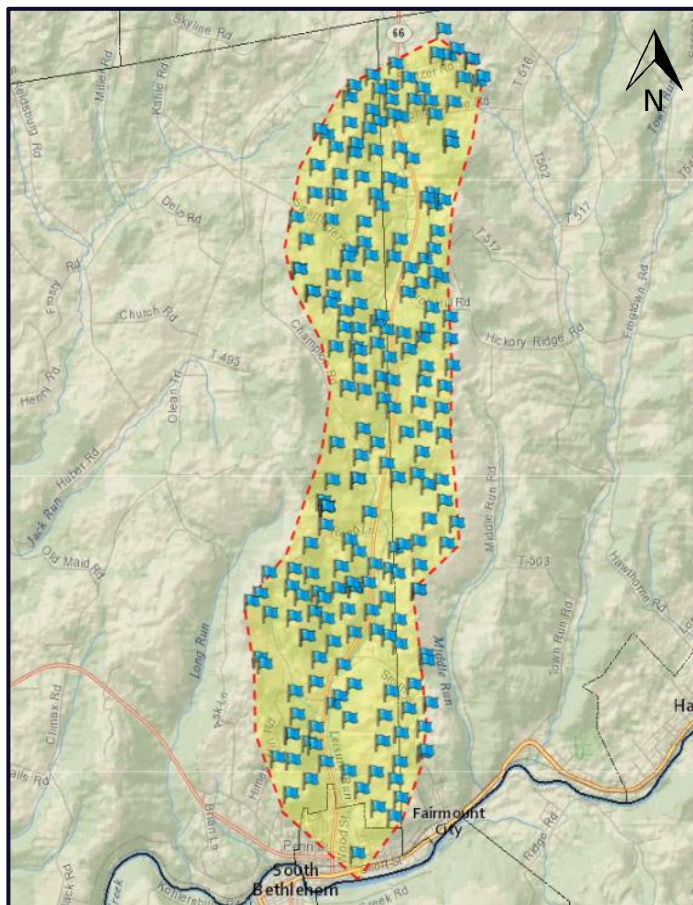


Fig. 7. Oil and gas wells in Leisure Run watershed (eMap)

## Road Network

This narrow watershed has a moderate network of roadways encompassing 21.9 miles of surfaced and non-surfaced (Dirt & Gravel) roadways and access roads to various gas wells and historical mining sites (Fig. 8). Significant work has been accomplished throughout the watershed via the Penn State Dirt & Gravel/Low Volume Road (DGLVR) program. This work has improved erosion and sediment deposition conditions in Leisure Run and should be a continued focus area. Additional projects are scheduled for the 2023-2024 construction seasons.

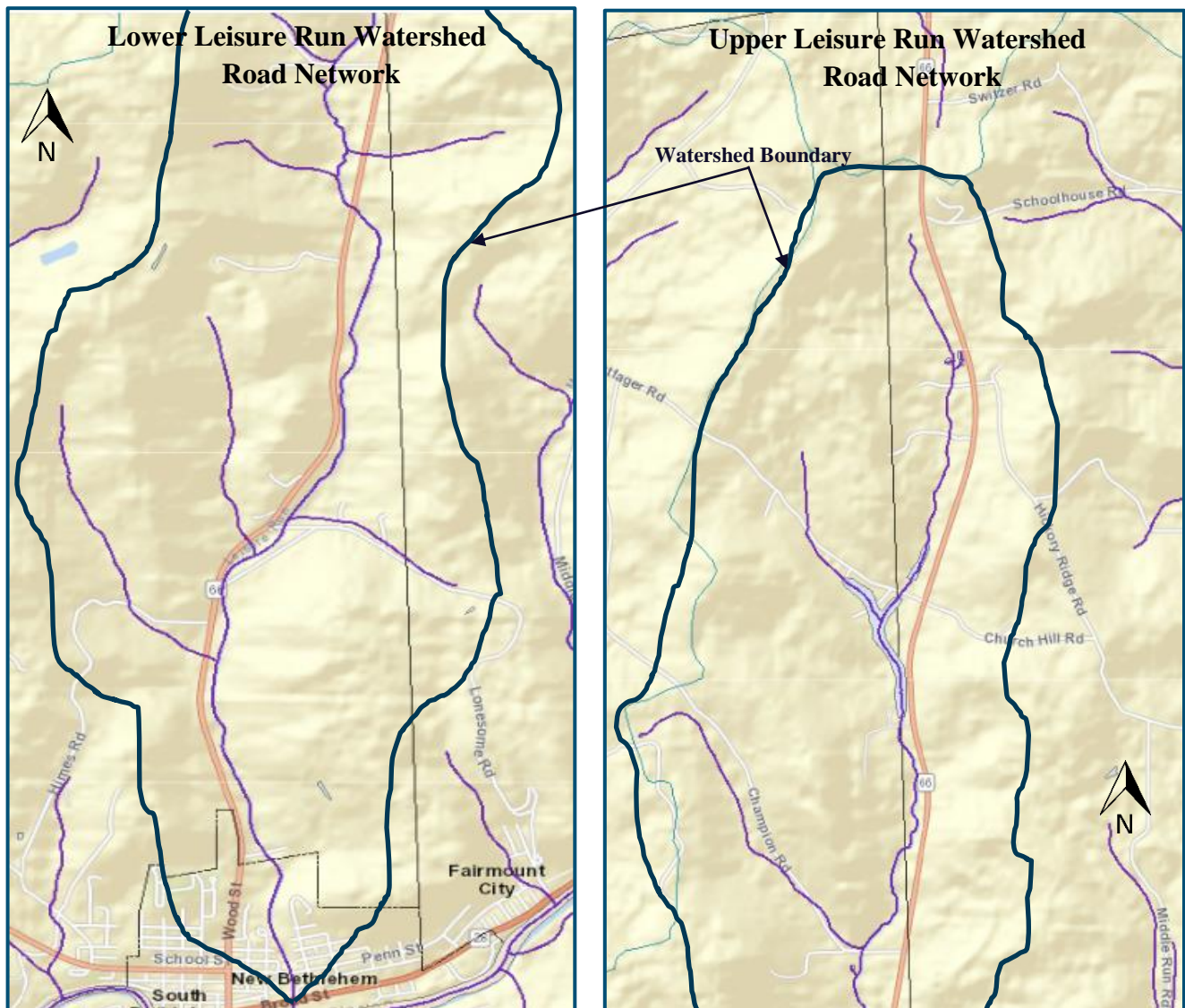


Fig. 8. Leisure Run watershed road network encompassing surfaced and dirt & gravel roads.

## Road Crossings

Thirty-one (31) road crossings were identified throughout the watershed. A road crossing is defined as any structure that crosses the stream and allows for the conveyance of vehicular traffic. These road crossings were evaluated for their physical attributes and how those attributes influence stream continuity and erosion. To standardize assessment efforts, we used the Penn State DGLVR Program Stream Crossing Replacement Policy (Penn State 2022) to evaluate all crossings. Five (5) of these road crossings are state (PennDOT) controlled and managed, seven (7) are township controlled and managed, seventeen (17) are privately controlled and managed, and two (2) are controlled and managed by the Borough of New Bethlehem. Additional assessments of private crossings are warranted to ensure comprehensive evaluation of stream continuity and erosion concerns in the watershed. Table 5 provides the location, physical characteristics, capacity to allow the stream to access its floodway, and the capability for aquatic passage.

Table 5. Characterization of road crossings in the Leisure Run Watershed.

Type	Stream Average Bank Full Width (ft)	Structure Opening Width (ft)	Structure Width to Bank full Width Ratio (%)	Location	Location Name (Road Name)	Managed By	Road Surface	Stream Continuity (aquatic passage) (Yes/No)	Erosion/Comments
Concrete Bridge	18.00	17.5	97.22	41.00211, -79.32756	Route 28 Crossing	State	Surfaced	Yes	Channelization
Concrete Bridge	15.24	2 @ 3.00	39.37	41.01941, -79.33275	Route 66 Crossing at Drummond	State	Surfaced	No	Channelization - Velocity barrier
Concrete/Galvanized	5.50	3.00	55.00	41.02527, -79.33030	Route 66 Crossing at Columbia Gas	State	Surfaced	No	Velocity barrier
Concrete/Galvanized	17.10	5.00	29.24	41.04462, -79.32368	Route 66 Crossing at RV Wells Trib	State	Surfaced	Yes - partial	Possible velocity barrier
Concrete Bridge	14.57	14.93	102.50	41.04192, -79.32429	Route 66 Crossing	State	Surfaced	Yes	
ABS Culvert	8.05	4.00	49.70	41.07753, -79.31934	Quail Road Crossing	Township	Surfaced	No	Perched 12" / Erosion around pipe
Dual Culvert - Concrete	17.50	2 @ 3.50	40.00	41.06711, -79.32258	Swartfager Road Crossing	Township	Surfaced	Yes - partial	Possible velocity barrier
Concrete Culvert	16.80	9.00	53.60	41.04914, -79.32516	Champion Road Crossing	Township	Surfaced	Yes	
Galvanized Culvert	22.60	11.61	51.40	41.02592, -79.32817	Smith Road Crossing	Township	Surfaced	Yes	Sched for replacement DGLVR
Concrete Bridge	26.08	23.56	90.30	41.02313, -79.33183	Leisure Run Road Crossing	Township	Surfaced	Yes	
Galvanized Culvert	N/A	2.00	N/A	41.02200, -79.33711	Himes Road Crossing	Township	Dirt/Gravel	No	Perched 24" / Scour pool
Galvanized Culvert	8.68	2.50	28.80	41.05387, -79.33096	UNT Crossing at Champion	Township	Surfaced/Grav	No	Perched ~12inch
Galvanized Culvert	16.90	5.00	29.60	41.06041, -79.32276	Unnamed Road/Lane	Private	Dirt/Gravel	No	Large scour hole / Velocity barrier
Culvert	Not assessed			41.05203, -79.32906	Private Drive Crossing of UNT	Private	Dirt/Gravel	Undetermined	
Culvert	Not assessed			41.08372, -79.32166	Minich Farm Pasture Crossing	Private	Dirt/Gravel	Undetermined	
Culvert	Not assessed			41.08323, -79.32199	Minich Farm Pasture Crossing	Private	Dirt/Gravel	Undetermined	
Culvert	Not assessed			41.08107, -79.32065	Daniels Lane Crossing	Private	Dirt/Gravel	Undetermined	
Culvert	Not assessed			41.07953, -79.31965	Rowe Lane Crossing	Private	Dirt/Gravel	Undetermined	
Culvert	Not assessed			41.07941, -79.31956	Casale Lane Crossing	Private	Dirt/Gravel	Undetermined	
Culvert	Not assessed			41.07505, -79.31955	Vasquez Lane Crossing	Private	Dirt/Gravel	Undetermined	
Culvert	Not assessed			41.04527, -79.32463	Schultz Lane Crossing	Private	Dirt/Gravel	Undetermined	
Culvert	Not assessed			41.03650, -79.32393	Rutkowski Field Crossing	Private	Dirt/Gravel	Undetermined	
Steel Bridge	21.66	43.00	198.52	41.01986, -79.33190	BC Storage Crossover	Private	Dirt/Gravel	Yes	In stream support - debris barrier
Culvert	Not assessed			41.00950, -79.32955	Sossong Lane Crossing	Private	Dirt/Gravel	Undetermined	
Private Timber Bridge	19.00	26.50	139.47	41.01975, -79.33385	Behind Drummond Crossing of UNT	Private	N/A	Yes	In stream support - debris barrier
Culvert	Not assessed			41.02595, -79.33081	Private Lane Crossing of UNT	Private	Dirt/Gravel	Undetermined	
Culvert	Not assessed			41.02782, -79.33167	Private Lane Crossing of UNT	Private	Dirt/Gravel	Undetermined	
Culvert	10.60	7.00	66.00	41.04932, -79.32562	Private Lane Crossing of UNT	Private	Dirt/Gravel	Yes	
Culvert	9.570	3.90	41.00	41.06641, -79.32467	Crossing of UNT at Wayne Lane	Private	Dirt/Gravel	Yes - partial	Perched 6" / Velocity barrier
Concrete Bridge	29.70	10.50	35.00	41.00349, -79.32785	Penn Avenue Bridge	New Beth Boro	Surfaced	Yes - partial	Large scour pool - velocity barrier
Rail Bridge	14.00	39.00	278.57	41.00249, -79.32764	Redbank Valley Trail Rail Bridge	New Beth Boro	N/A	Yes	Very channelized

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## Biological Assessment

In partnership with the Penn West Clarion University Department of Biology, we conducted eight electrofishing surveys distributed throughout the watershed. We used the PA DEP standardized Fish Data Collection Protocol to conduct all electrofishing surveys. All surveys were conducted during the week of 17-21 July, 2023. The weather was partly sunny with temperatures between 73-82 degrees Fahrenheit.

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). Here we present the results of a fisheries survey of Leisure Run, a second order stream located in southern Clarion County, Pennsylvania.

Eight sites were sampled in the Leisure Run watershed. Six were located on the mainstem and arranged in a uniform manner from the headwaters to the mouth. Two additional sites were located on two of the larger tributary streams. 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. We also measured routine physical and chemical aspects of the stream environment including stream width, pH, specific conductivity, alkalinity, and temperature.

Fish density was calculated with dividing overall catch by the area sampled (a product of transect length and stream width). Fish species richness is simply the number of taxa collected at each site. Species Diversity was calculated using Simpson's Reciprocal Index ( $1/D$ ). Simpson's Reciprocal can be thought of as the number of equally abundant species that would produce the observed level of diversity.

Leisure Run has a diverse and abundant assemblage of fishes. Species richness is a good measure of ecosystem health, and with ten species present in the downstream reaches, Leisure Run compares very favorably with other streams in the region of similar size. Two species were notably absent from the entire watershed. Brook Trout and Mottled Sculpin are common inhabitants of small streams in the region, but both are absent from the Leisure Run watershed. Brook Trout and Mottled Sculpin are cold stenotherms: they require cold water and are intolerant of warm summer temperatures. Temperatures in Leisure Run are likely too high for these two species.

A site-by-site comparison within the watershed shows the typical pattern of species richness and diversity increasing with stream size (Table 6). One locality stood out as having a lower than expected number of species: Leisure Run at Route 66 bridge. The reach we selected for study had been scoured down to bare bedrock, and the reach also lacked pools and any deep-water habitat. With little habitat diversity, fish diversity was also depressed below what we expected for this site. The fish community here was dominated by Blacknose Dace, a species that lives in fast runs.

Table 6. Presence/absence matrix for fish species in the Leisure Run watershed. Sampling sites are arranged from smallest (lowest baseflow) on left to largest on right. Species are listed in rank order of frequency of occurrence.

Site	UNT Wayne Lane	UNT Champ. Rd	Schwartz Rd	Champ. Rd	Route 66 crossing	Smith Road	Animal Hospital	School
Creek Chub								
Blacknose Dace								
Redside Dace								
White Sucker								
Northern Hogsucker								
Johnny Darter								
Central Stoneroller								
Common Shiner								
Fantail Darter								
Bluntnose Minnow								

Fish density is also relatively high in the mainstem of Leisure Run, reflecting the fertile nature of this watershed (Table 7). Fish density in the mainstem varied within a relatively narrow range (0.34-0.76 fish per meter square). The highest density was at the Rt. 66 site and reflects the lack of larger fish at this site. The two tributaries sampled yielded very disparate results. One trib (Wayne Lane) had very few fish, but the other (Champion Road trib) yielded a very high density, in part due to the narrow stream bed that concentrated the fish present.

Table 7. Summary of fish community metrics for eight sites in the Leisure Run watershed, Clarion County.

Site	Species Richness	Species Diversity	Total Catch	Fish Density (#/ha)
UNT Wayne Lane	1	1	3	0.02
UNT Champion Rd.	3	2.54	77	0.96
Leisure Run @ Schwartzfager Rd.	4	3.22	56	0.37
Leisure Run @ Champion Rd.	5	2.91	123	0.47
Leisure Run @ Rt. 66	4	1.65	266	0.76
Leisure Run @ Smith Rd.	8	4.79	151	0.63
Leisure Run @ Animal Hospital	10	6.42	188	0.46
Leisure Run @ School	9	4.75	228	0.34

## Water Quality

In early August, 2023 we conducted a basin-wide survey of water quality using the PA DEP Discrete Water Chemistry Data Collection Protocol. At twelve sites, pH, conductivity, and temperature were measured in the field, and we collected water samples for laboratory analysis of alkalinity, iron, manganese, aluminum, sulfates, and total suspended solids (Table 8).

Table 8. Water chemistry data for the Leisure Run 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)
UNT Wayne Lane	6.43	1012	15.1	5.2	0.12	13.4	<0.10	476	9
UNT Champion Rd.	7.86	883	15.0	118.1	<0.10	<0.05	<0.10	318	7
UNT R&V Wells Rd.	7.70	961	15.4	69.5	<0.10	0.26	0.32	383	<5
UNT Rt.66 crossing	7.66	973	15.0	97.7	0.16	0.31	<0.10	406	14
UNT Columbia Gas	7.76	905	15.5	98.4	0.52	0.44	0.23	405	20
UNT Drum. Anim Hosp.	7.72	491	15.3	111.9	0.14	1.08	<0.10	123	8
Leisure Run @ Schwartz. Rd.	7.10	1031	14.9	46.6	<0.10	1.47	0.39	453	9
Leisure Run @ Champ. Rd.	7.23	978	14.6	47.4	0.10	0.24	<0.10	416	10
Leisure Run @ Rt. 66	7.74	941	15.4	67.1	<0.10	<0.05	<0.10	398	9
Leisure Run @ Smith Rd.	7.74	953	15.4	66.3	<0.10	<0.05	<0.10	387	11
Leisure Run @ Animal Hosp.	8.09	931	15.8	66.9	<0.10	<0.05	<0.10	374	8
Leisure Run @ School	7.74	903	16.6	71.2	<0.10	<0.05	<0.10	357	5

A broad overview of these data show that water quality is overall good and there is no evidence of acute water quality impairment at any of our sites. pH ranges from 6.43 to 8.09, but only one of the sites had a pH less than 7.0. Alkalinity is generally high - greater than 40 mg/l at all sites except one. Iron concentrations are uniformly low, and manganese concentrations are generally low.

Two parameters warrant additional consideration. Conductivity is elevated to a higher level than is generally seen in local streams, and sulfate concentrations are also unusually high. It isn't possible to identify with certainty the source of these elevated values. High conductivity and sulfates are often indicators of abandoned mine drainage in the watershed. If the receiving waters are alkaline, the metals associated with abandoned mine drainage are immobilized, but the sulfates are not and persist far downstream. High conductivity and sulfate concentrations are also associated with oil and gas drilling operations that bring deep groundwater to the surface. Additional work is needed to determine if the source of these sulfates is oil and gas, or abandoned coal mines. 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.

One site, the unnamed tributary at Wayne Lane, had water quality readings that are significantly poorer than what was observed in the rest of the watershed. This tributary had very little flow, so it is not a major concern on a watershed scale. The low pH and elevated manganese are fingerprints of surface mining activity.



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Overall, the water chemistry data show that Leisure Run is a healthy stream that attains criteria for Aquatic Life Use (ALU).

## **Habitat Assessment**

We conducted twelve (12) 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 twelve (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.

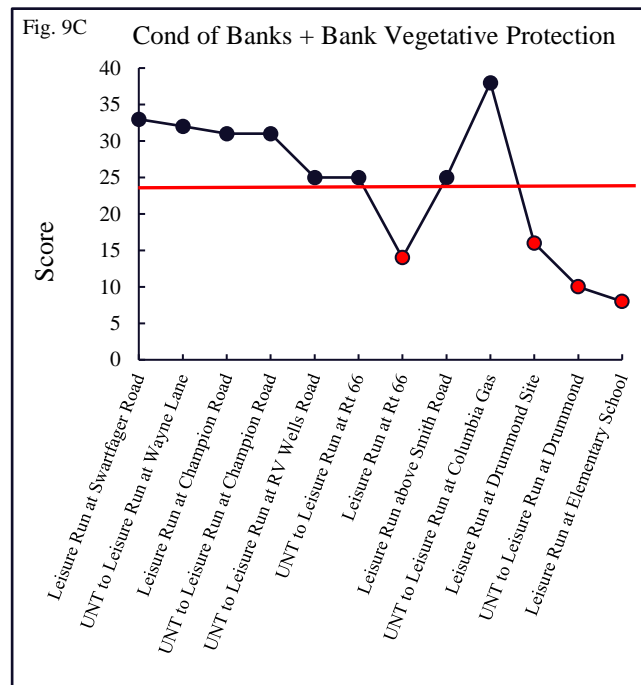
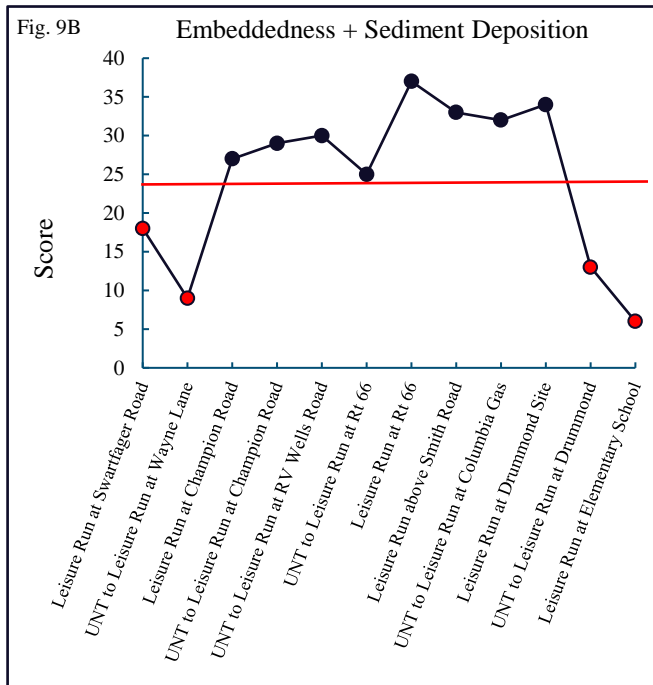
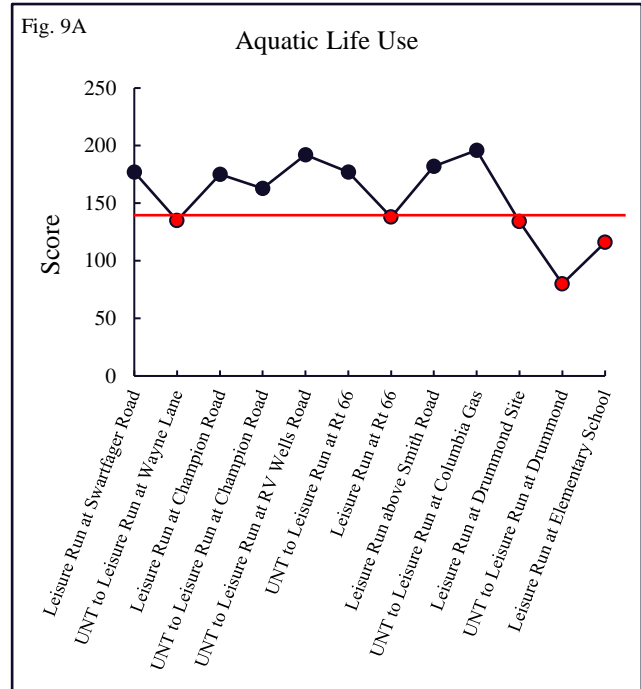
Five (5) of the twelve (12) sites evaluated during this assessment indicate habitat impairment that would inhibit ALU (Fig 9A). Three of those are marginally impaired while the remaining two are significantly impaired. The primary causal factors for the impairment are the lack of instream cover for aquatic organisms to utilize; lack of varied velocity/depth regimes that provide habitat for diverse species; stream embeddedness; and unstable or eroding stream banks.

Four of the twelve 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. 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 out of a possible 40 points. Of the sites evaluated in the Leisure Run watershed, 6 of the 12 sites indicate habitat impairment that would inhibit ALU with the primary causal factors being sedimentation and streambank erosion; particularly in the lower reaches of the watershed (Fig 9B and 9C). Comprehensive habitat data is available at Appendix B.

Fig. 9A. 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 is arranged from upstream to downstream.

Fig. 9B. Paired stand-alone predictors of embeddedness and sediment deposition. When paired together with a score of 24 or less out of a possible 40, indicates impaired habitat for ALU. Data is arranged from upstream to downstream.

Fig. 9C. Paired stand-alone predictors of condition of streambanks and streambank vegetative protection. When paired together with a score of 24 or less out of a possible 40, indicates impaired habitat for ALU. Data is arranged from upstream to downstream.



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## Invasive Species

We conducted a comprehensive review of invasive species throughout the watershed. Due to significant riparian, agricultural, and mining disturbances in the mid to upper reaches of Leisure Run, numerous invasive species have colonized the watershed.

Multiflora rose (*Rosa multiflora*), Japanese barberry (*Berberis Thunbergii*), Japanese knotweed (*Polygonum cuspidatum*), Garlic mustard (*Alliaria petiolata*), Crown-vetch (*Securigera varia*), Japanese stiltgrass (*Microstegium vimineum*), and Honeysuckle (*Lonicera spp.*) were prevalent and well-established throughout the watershed. No aquatic invasive plant species were observed; however, the potential for aquatic invasive plants exists in wetland and beaver pond areas that were not readily accessible.

No invasive insect species such as the Hemlock Woolly Adelgid or Spotted Lantern Fly were detected within the watershed. Despite the absence of these invasive species, public awareness of the potential for these species to colonize the watershed should be a focus of municipalities and conservation organizations. Significant habitat disturbances throughout the watershed lend themselves to the introduction of invasive flora and fauna.

No invasive fish species were detected within the watershed.

## Summary

Leisure Run is designated as an attaining stream for Aquatic Life Use and is listed as a cold-water fishery with the Pennsylvania Fish and Boat Commission. While no native or wild trout populations exist, likely due to the water being too warm to sustain them, Leisure Run 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 study is necessary to determine the source of the elevated conductivity and sulfate concentrations; likely resulting from historical mining and drilling operations in the watershed. Additional investigative work is necessary in the western part of the watershed to determine the source of the low pH and elevated manganese in the unnamed tributary that crosses Wayne Lane. 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 Leisure Run is sufficient to sustain aquatic life use. Stream embeddedness, sediment deposition, streambank erosion, in stream cover, and lack of riparian vegetative buffer are all areas of concern that inhibit an otherwise healthy stream. Emphasis should be

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placed on restoring riparian habitat to include a vegetative buffer and riparian planting 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. Dirt and gravel road programs implemented by the conservation district and townships in the watershed have made significant improvements in this area, but erosional concerns resulting from undersized or perched culvert road crossings persist. Additionally, there are numerous private road crossings that need to be evaluated further to determine if they are undersized, hinder aquatic organism passage, or represent a flood hazard. 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.

Restoration of riparian buffers throughout the watershed should be a high management priority. Restoring vegetated riparian buffers is the most impactful management action that can occur. While 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.

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.

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Investigation of the source of elevated conductivity and sulfate levels throughout the watershed should be a management priority. While the source is likely legacy mining and drilling operations, a more extensive water sampling effort may be necessary to confirm this hypothesis and pinpoint areas for priority treatment and reclamation efforts.

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.

In addition to programmatic efforts associated with the DGLVR program, emphasis must be placed on evaluating and improving private road crossings along Leisure Run as well. As most of these crossings will not be eligible for DGLVR funding, it will be critical for landowners and conservation planners to work with non-profit organizations to source creative funding options.

The Clarion Conservation District, in conjunction with landowners and fisheries managers, should study potential solutions for the instream habitat and streambed/streambank stabilization in the area of the Route 66 crossing of Leisure Run. As identified in the Biological Assessment in this report, this area has been scoured to bedrock. This condition has caused the velocity of the water to increase and the loss of fish habitat. Reconstructing this reach of stream bed will stabilize the erosional forces impacting the stream bed and mitigate increased water velocities contributing to recurring flood conditions in this area.

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 seven (7) abandoned oil and gas wells should be a management priority.

Investigation of the source of impairment in the unnamed tributary to Leisure Run at Wayne Lane should be given management priority. As a headwater tributary, locating and treating the source cause of the low pH and high levels of manganese will improve water quality conditions at this site and all locations downstream.

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. 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.

Leisure Run has a stable and abundant assemblage of fishes as documented in this report, but the need for in-stream habitat improvements and streambanks stabilization was evident at almost all sampling locations. In-stream habitat improvements should be prioritized based on the findings of the habitat surveys documented in this report.

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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 or threaten the streams attaining status.

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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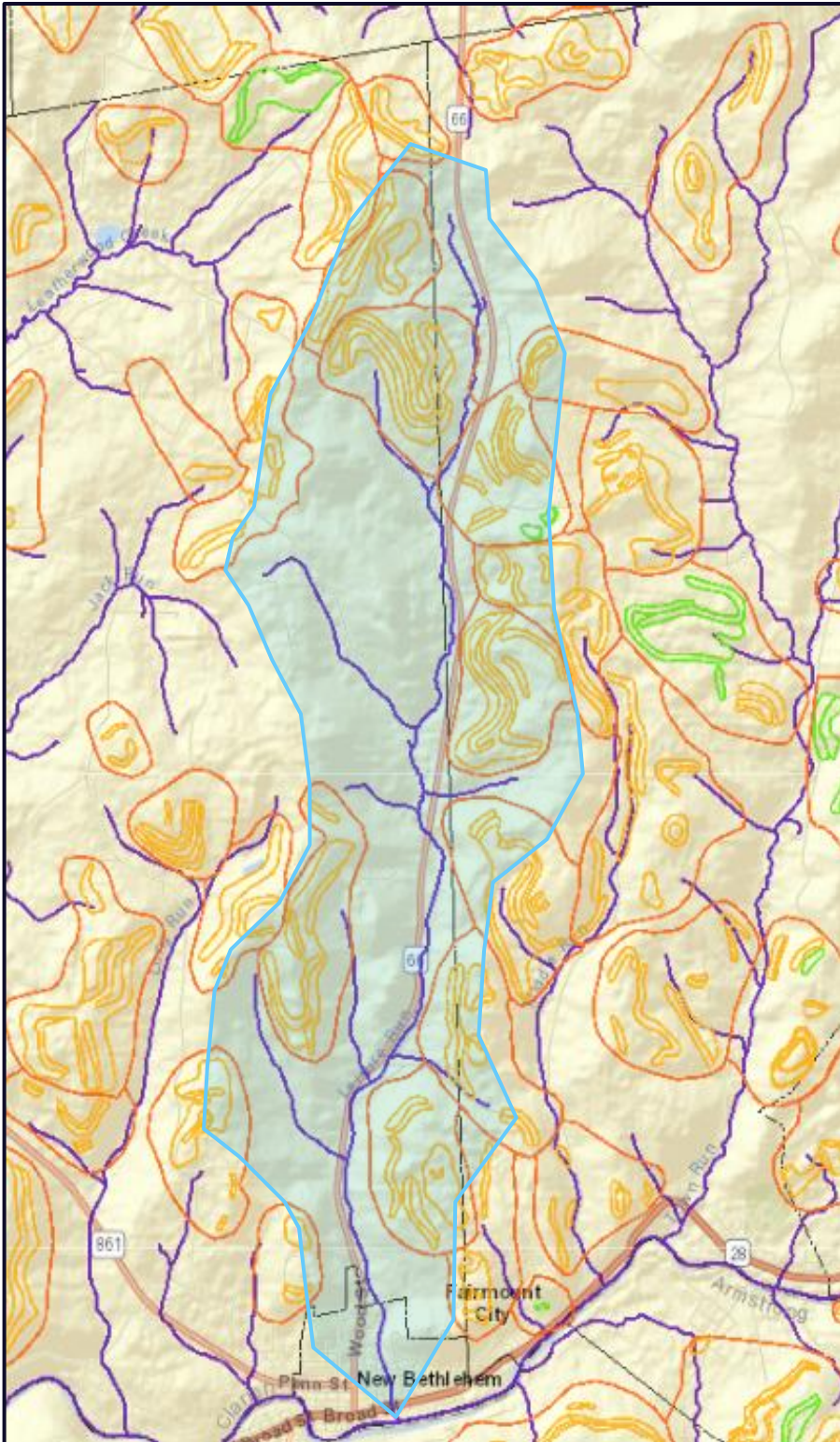
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# Appendix A – PA DEP Abandoned Mine Land Inventory Sites



**Legend**

- Watershed Boundary
- Stream
- AML Inv Site
- AML Point Feature

**AML – Abandoned Mine Land**



## Appendix B – Habitat Assessment Data

Location	Coordinates	River Mile (RM)	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
Leisure Run at Swartfager Road	41.06725, -79.32260	5.1	16	13	10	14	18	8	18	11	15	18	18	18	177	18	33
UNT to Leisure Run at Wayne Lane	41.06606, -79.32440	4.9	6	7	5	4	13	4	18	14	14	18	17	15	135	9	32
Leisure Run at Champion Road	41.04935, -79.32520	3.7	16	16	15	14	13	12	17	15	15	16	15	11	175	27	31
UNT to Leisure Run at Champion Road	41.04934, -79.32573	3.7	14	16	14	10	12	15	18	18	14	17	10	5	163	29	31
UNT to Leisure Run at RV Wells Road	41.04453, -79.32201	3.3	15	17	13	16	19	17	19	13	12	13	19	19	192	30	25
UNT to Leisure Run at Rt 66	41.04350, -79.32519	3.2	12	16	12	8	19	13	19	15	12	13	19	19	177	25	25
Leisure Run at Rt 66	41.04202, -79.32439	3.1	8	18	19	2	8	18	19	18	8	6	6	8	138	37	14
Leisure Run above Smith Road	41.02767, -79.32690	2	19	16	18	15	18	15	18	15	14	11	13	10	182	33	25
UNT to Leisure Run at Columbia Gas	41.02538, -79.33042	1.7	17	17	17	12	15	15	16	19	19	19	14	16	196	32	38
Leisure Run at Drummond Site	41.01984, -79.33181	1.4	16	14	16	18	6	18	17	8	2	14	3	2	134	34	16
UNT to Leisure Run at Drummond	41.01972, -79.33378	1.3	10	10	5	1	5	8	16	1	4	6	8	6	80	13	10
Leisure Run at Elementary School	41.00713, -79.32886	0.5	6	12	3	8	18	3	16	9	2	6	19	14	116	6	8
Minimum Aquatic Life Use (ALU) Score indicating ecological integrity is >140 out of 240. Scores less than 140 indicate impairment.																	
This habitat evaluation uses a twelve parameter – 20-point scoring method.																	
<p>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.</p>																	