Middle Fork East Branch Clarion River

Coldwater Conservation Plan

Elk County, Pennsylvania

FINAL

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Western Pennsylvania Conservancy

COLDWATER HERITAGE PARTNERSHIP

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Founded in 1932, the Western Pennsylvania Conservancy (WPC) is a non-profit conservation organization that protects and restores exceptional places to provide our region with clean waters and healthy forests, wildlife and natural areas for the benefit of present and future generations. The Conservancy creates green spaces and gardens, contributing to the vitality of our cities and towns, and preserves Fallingwater, a symbol of people living in harmony with nature.

The WPC's Watershed Conservation Program protects and restores rivers, lakes and streams to provide our region with sustainable, clean water supplies that are critical to our quality of life and economy. We provide cost-free, comprehensive assistance to communities and local watershed groups, helping with project selection and prioritization, funding proposals and project management. We also partner with individual landowners and businesses to help them improve water quality and protect the environment on their properties. The Watershed Conservation Program has extensive expertise applying on-the-ground restoration activities since 2001.

Project Funders

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Introduction and Background

The Middle Fork East Branch Clarion River (a.k.a. Middle Fork) watershed is a small, but important, watershed located in northeast Elk County, Pennsylvania. The 6.5 sq. mile watershed is comprised of 12.6 miles of High-Quality Coldwater Fishery (HQ-CWF) streams, including the main stem Middle Fork East Branch Clarion River and its tributaries. The Middle Fork drains into the East Branch Clarion River, which is also designated as a HQ-CWF by the PA Department of Environmental Protection (Title 25 PA Code). The Middle Fork watershed is a valuable and important system, as it is the last headwater tributary in which wild trout traveling upstream can seek refuge and reproduce along the East Branch Clarion River before their passage is interrupted by the dam of East Branch Clarion River Lake. The Middle Fork watershed is also unique because it is encompassed entirely by public lands, primarily within PA Game Commission (PGC) State Game Lands 025, with a small northern reach extending into Elk State Forest (Figure 2).

Table 1. Stream Geography and Forest Cover

NAME	Stream Total (miles)	Stream Density (mi/ sq. mi)	Drainage Area (sq. miles)	Percent Forested
Lower Middle Fork*	6.01	1.73	3.47	100%
Upper Middle Fork	3.48	2.4	1.45	100%
Maple Run	3.14	2.02	1.55	99%
Total	12.61	1.95	6.47	100%

** Lower Middle Fork includes tributary and main stem segments from the mouth to the top of segment 5.*

Elk State Forest covers 6% of this watershed and hosts the headwaters of Birch Hollow, one of the tributaries to Middle Fork. Elk State Forest, which encompasses 217,000 acres of northern hardwood forest in Elk and Cameron counties, is managed by the Pennsylvania Department of Conservation and Natural Resources (DCNR) Bureau of Forestry. Like all Pennsylvania State Forests, the management of Elk State Forest is guided by the *State Forest Resource Management Plan*, as well as the overall mission of the Bureau of Forestry to "…ensure the long-term health, viability, and productivity of the Commonwealth's forests and to conserve native wild plants" (DCNR 2019).

The remaining 94% of the Middle Fork watershed is located within PA State Game Lands (SGLs). The SGLs were officially established in 1919 when the PGC purchased 6,288 acres in Elk County for State Game Lands Preserve Number 025. This was the first of many purchases that the PGC made, with the goal of managing "Pennsylvania's wild birds, wild mammals, and their habitats for current and future generations" (PGC 2019). Since their formation more than a century ago, the SGLs have expanded vastly to include nearly 1.5 million acres of land across 65 of Pennsylvania's 67 counties (PGC 2015). Management of SGLs by the PGC is guided by the

North American model of wildlife conservation, as well as a set of core values set forth in the *PA Game Commission Strategic Plan*, foremost of which is to “place wildlife first in all decision-making” (PGC 2015). Activities supporting these goals include management and restoration of wildlife habitat, management of invasive species, ensuring accessibility for the public, and maintenance of physical infrastructure including buildings, roads and equipment. The Middle Fork watershed, which is located within the very first SGLs property, is not only an ecologically valuable system, but holds strong historical significance, as well.

Because of the watershed’s location on public lands, it offers excellent access to anglers and other recreational visitors of all ages and abilities through a network of dirt and gravel roads that traverse Middle Fork and its tributaries. However, these roads also present opportunities for – and challenges to – improving the health and functioning of the watershed.

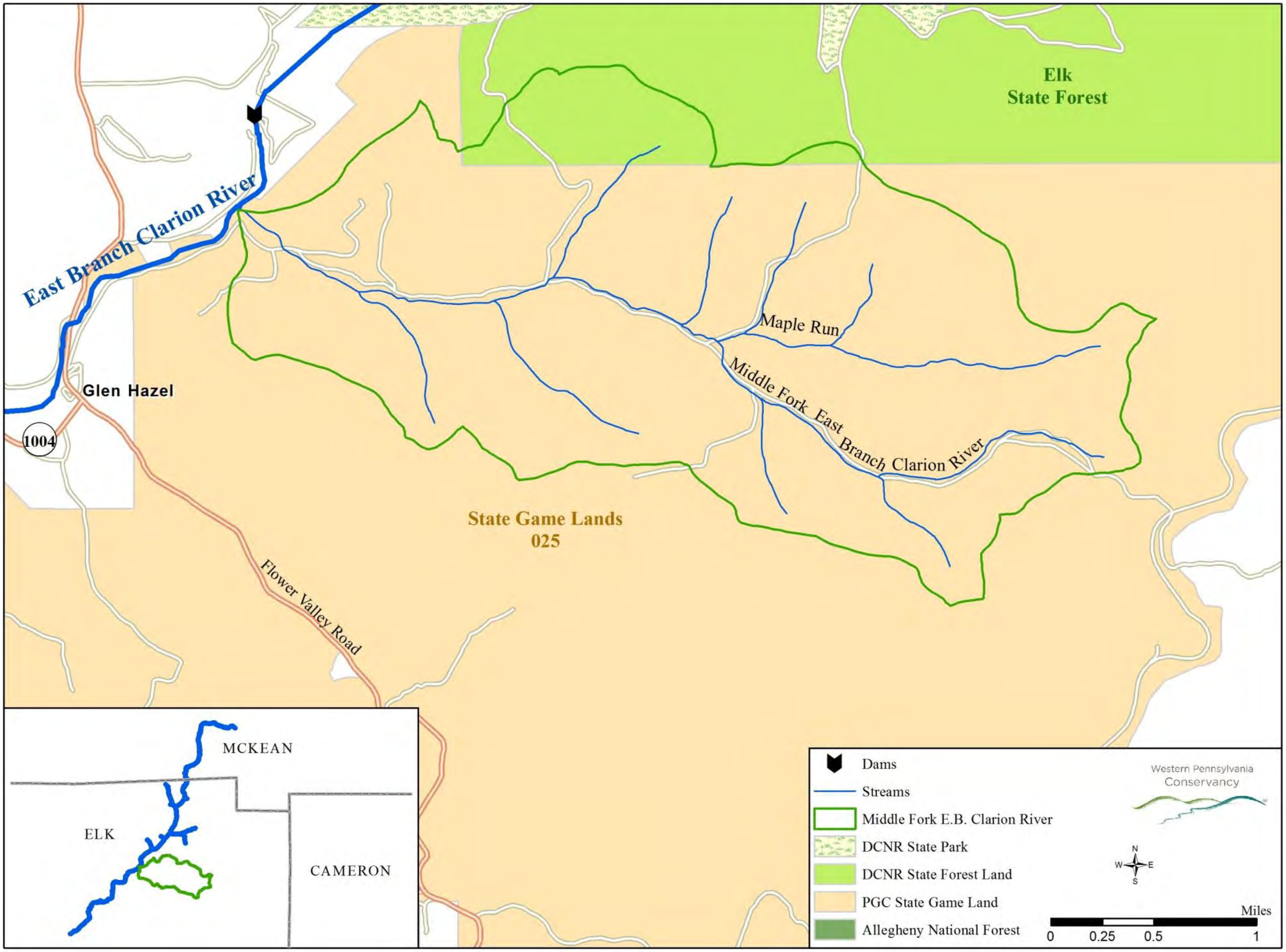
State Impairment Status

Middle Fork and its tributaries are designated “Category 2, Supporting Aquatic Life” in Pennsylvania’s *2018 Integrated List of All Waters* (Commonwealth of PA 2018).

Permitted Discharge

There are no permitted discharges within the Middle Fork watershed.

Middle Fork East Branch Clarion River Watershed



Watershed Data

Sampling Methods

The primary assessment protocol was based on the EPA's "Rapid Bioassessment Protocols (RBP) for Streams and Wadable Rivers – Habitat Assessment and Physiochemical Parameters" (Barbour et al. 1999) and was augmented with WPC's current standard Visual Assessment Datasheet to more closely align with the goals and concerns of this Coldwater Conservation Plan. Stream reach, width, depth and velocity, as well as canopy cover, proportion of stream morphology types, channelization and obstructions were recorded. Water quality parameters, including temperature, pH and conductivity were measured at the upstream and downstream terminus of each segment using standard methods.

Staff and volunteers conducted visual assessments in the field to collect the most accurate data on watershed characteristics. Streams were assessed by examining one "segment" at a time, with each segment being the length of stream between two confluences. These confluences could be at two small tributaries, or a tributary joining the main stem. Each segment is labeled with a GIS_ID number on the maps in Appendix 2, and it is by those numbers that the segments were referred to during field assessments, as well as in this plan.

On every assessment outing, each field team consisted of two to three crew members for safety, as well as to ensure objectivity in sampling. A Western Pennsylvania Conservancy (WPC) staff person led each assessment team, following the assessment methodology and standards established at an internal visual assessment training in late June, 2015.

Ten physical habitat parameters based on the standard EPA protocol (Barbour 1999) were evaluated at each segment during field assessments. These parameters were then combined to provide the most concise, informed snapshot of watershed health. These parameters were independently scored for each stream segment assessed, and then averaged to provide an overall score for that segment (Table 7). Any segments, which were dry or inaccessible, were not included in the analysis. Each parameter was worth a maximum of 20 points for the most ideal habitat condition and a minimum of 0 points for the least ideal habitat condition. Point awards of 16–20 scored in the Optimal category, 11–15.9 scored as Suboptimal, 6–10.9 scored as Marginal, and 0–5.9 scored in the Poor category.

In addition to parameters based on the EPA's Habitat Assessment Protocol, special attention was given to the amount of Large Woody Material (LWM) in a segment; the presence of Aquatic Organism Passage (AOP) barriers; the impact of Dirt and Gravel Roads (DGR) on the stream; if the habitat could be improved, in general; erosion throughout the segment; presence and length of channelization on the segment; if native or wild trout were observed; and any other miscellaneous improvement projects that could benefit the watershed. Descriptions of the methods for each of these categories follow below.

Large Woody Materials (LWM)

During field assessments, segments were classified as having significant, moderate, minimal, or none (not present) amounts of LWM. Guidelines for these categories were somewhat subjective, yet estimates of approximately 120, 80, 40, and zero pieces (respectively) of LWM per mile were used as loose standards for these categories. Minimal and moderately classified segments were further delineated as "Add LWM" segments, if within those reaches a section was obviously lacking this type of habitat, but overall would fall into a higher classification.

Aquatic Organism Passage (AOP)

An AOP barrier is a structure that impedes the up or downstream movement of fish and other aquatic and riparian species. For the purposes of this study, focus was held on anthropogenic (man-made) AOP barriers, but natural AOP barriers were also noted. AOP barriers included culvert and bridge structures at road-stream crossings, active and defunct dams, and any other man-made structures that would impede passage throughout the reach of the stream segment.

Passage barriers were assessed according to the North Atlantic Aquatic Connectivity Collaborative (NAACC) protocol for Aquatic Passability Assessments in Non-Tidal Streams and Rivers (NAACC 2019). The NAACC is a participatory network of practitioners united in their efforts to enhance aquatic connectivity (NAACC 2019). NAACC protocol provides a quick and efficient mechanism by which scientific professionals may rank the ability of a road-stream crossing structure to allow the passage of aquatic and terrestrial species. Data collected in the field was entered into the NAACC database at: https://naacc.org/naacc_search_crossing.cfm?sp=1. Evaluated attributes included elevation, slope, width, blockage, water depth and velocity, presence of a scour pool, substrate presence and composition, floodplain development, and alignment. Notes and latitude/longitude coordinates were taken for each suspected AOP barrier, and a Yes/No checkbox for "AOP barriers present" was marked on the datasheet. If a potential barrier existed, but the assessor(s) were unsure if it qualified, that distinction was made in the "potentially present" category.

Dirt and Gravel Roads (DGR)

During in-field assessments, dirt and gravel roads were noted when observed within each segment, as well as any obvious issues that may have been associated with them. These issues may have included stream fords, drainage ditches discharging high amounts of sediment to the stream, heavily eroded tire tracks leading to the stream, and changes in streambed substrate composition near the road-stream interaction zone.

Erosion

This study categorized the degree of erosion as None, Minimal, Moderate, or Heavy, based on the amount of erosion observed throughout an entire segment. The EPA habitat parameters of

Bank Stability and Vegetative Protection were also used, in part, to help make these determinations.

Channelization

The EPA's habitat parameter of Channel Alteration played heavily into the assessment of this specific category. The assessor(s)'s best professional and scientific judgment was used to estimate the length of channelization in a segment. This was done at the time the channelization was observed - usually culverts and bridge crossings, but in some instances a stream was forced to flow below ground.

Native or Wild Trout Observed

During field assessments of each segment, if fish were observed and a positive identification of species (trout) could be made, it was noted. Fish species were also documented during backpack electrofishing surveys conducted by the PA Fish and Boat Commission in June 2018. When present, brook trout (*Salvelinus fontinalis*) and brown trout (*Salmo trutta*) were captured, counted, and measured in order to provide data on population size, density, and estimated biomass within a given reach. Other fish species were tallied and totals were used to calculate species "coarse abundance," where <3 individuals suggests a Rare species, 3–25 is Present, 26–100 is Common, and >100 is Abundant.

Water Quality Testing

Measurements for pH, conductivity, and temperature were taken in the field with a *Waterproof Oakton PCSTestr 35 Multi-Parameter* multi-meter at the upstream and downstream termini of each assessed segment. The multi-meter was inserted into the water until a stable value was reached for each parameter, which was then recorded on the datasheet.

Results

Habitat Scores

The entire assessed watershed averaged an overall habitat quality score of 15.7, which falls in the high range of the Sub-optimal category. This analysis does not include segment 1A, which was classified as "dry" during the field assessment. The highest average habitat score an individual segment received was 18.3 (Optimal), while the lowest score was 13.8 (Sub-optimal). No average habitat scores fell into the Marginal to Poor categories (Table 2). These findings are generally consistent with assessment scores for streams designated as High-Quality Coldwater Fisheries. Ten individual stream segments scored a 20 (most Optimal) in at least one habitat category, while five of these segments were most Optimal in two or more categories. The remaining eight segments all received Optimal scores (>16) in at least four of the 10 categories. Velocity (min. score = 9) and Channel Alteration (min. score = 10) were the only categories in which Marginal scores were exhibited; however, these scores were not consistent with the average scores for their categories (15.2 and 15.4, respectively). The comprehensive list of habitat scores for all of the surveyed segments, as well as summary statistics for each habitat parameter, can be found in Appendix 1: Data Tables. Segment scores for each stream reach are represented visually in Appendix 2: Watershed Maps.

Water Quality

Acidity (pH) is the measure of free hydrogen ions within solution. pH is measured on a logarithmic scale ranging from 0–14, with a pH of 7.0 representing a neutral midpoint. Solutions become 10 times more acidic with each integral drop in pH value (e.g. a pH of 5 is 10 times more acidic than a pH of 6). Streambed elevation and groundwater interactions with the stream heavily influence stream pH value. Headwater streams on the Allegheny Plateau tend toward a pH of 4.5–6.0 due to acid precipitation and initial reduced groundwater interaction, while downstream pH values in lower elevations often range from 5.5–7.0, with some streams exhibiting pH values as high as 8.0. Systems that are considered to be impacted by acid precipitation typically exhibit pH values lower than 5.5 (PA DEP 2012). Coldwater fish on the Allegheny Plateau can survive through a range of acidic solutions, but thrive in the pH 6.0–7.0 range. Acidity in the assessed watershed was not as low as investigators expected, and largely improved or remained consistent as stream elevation dropped. Eleven segments experienced an increase in pH as water traveled downstream, while six segments remained within 0.2 of the initial upstream measurement and only two segments experienced declines in pH downstream (Figure 1). pH readings at the bottom of each stream segment ranged from 5.7–8.4, with the average of all measurements falling at 7.0 (neutral). As would be expected, at higher elevations in the watershed, pH values exhibited a larger range (4.6–8.1), and a slightly more acidic average of 6.4 (Table 8). Details of recorded pH can be found in the Watershed Acidity map (Appendix 2).

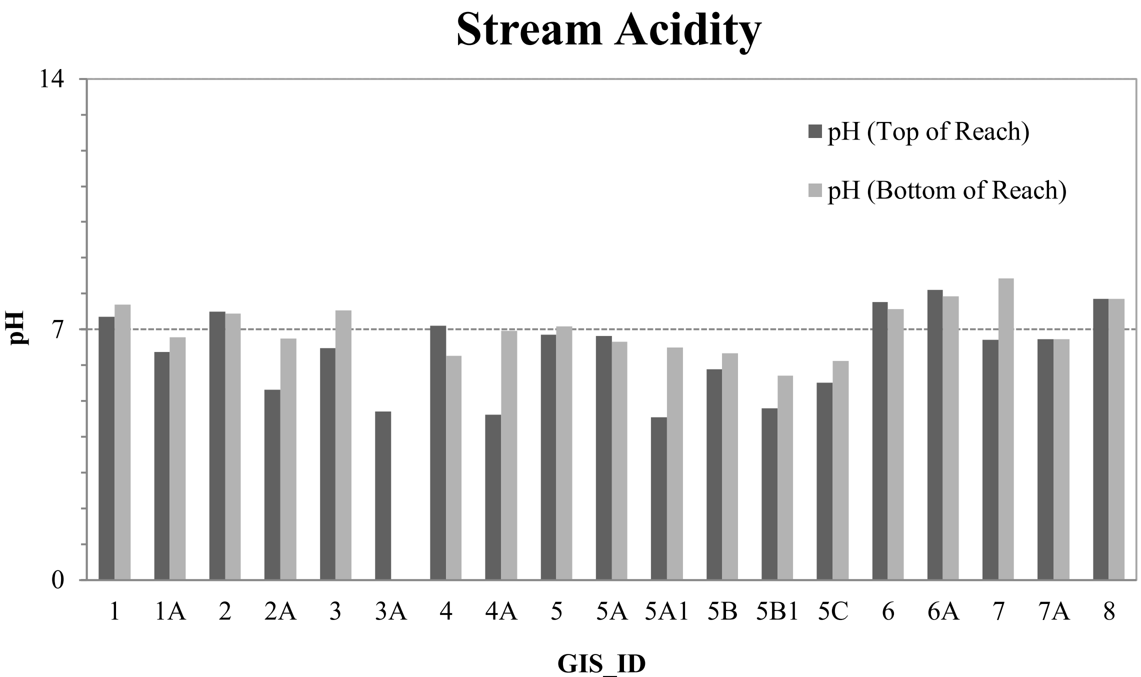


Figure 1. Stream Acidity measured at the top and bottom of each segment within the Middle Fork watershed. pH of 7 is neutral, while less than 7 is acidic and greater than 7 is basic. pH was not measured at the bottom of segment 3A due to technical difficulties with the multi-meter

Specific Conductance (or Conductivity) is the ability of water to conduct an electrical current. Pure water is unable to conduct electricity, but as the amount of dissolved ions in solution increases, water is increasingly able to pass electrons through it. On the Allegheny Plateau, conductivity in streams similar to Middle Fork generally ranged from 20–100 µs/cm, but "normal" values for a particular reach can be variable and are specific to an individual stream and its geologic composition. Like pH, conductivity is also influenced by elevation and groundwater interaction. Since it is a measure of dissolved ions (generally salts, metals, and other conductive materials), conductivity is influenced by human activity within a watershed. No "typical" conductivity observation (i.e. measurement taken at the top or bottom of a stream segment) exceeded 55 µs/cm, with the highest measurement occurring in the upstream reaches of an unnamed tributary (UNT) to Middle Fork (GIS_ID 7A). However, this tributary was an outlier, since the average conductivity across upper reaches was 32.8 µs/cm. At the bottom of the segments, average conductivity was 30.0 µs/cm, and the same tributary, 7A, provided the minimum measurement of 6.5 µs/cm. Recorded conductivity measurements can be found in Table 8.

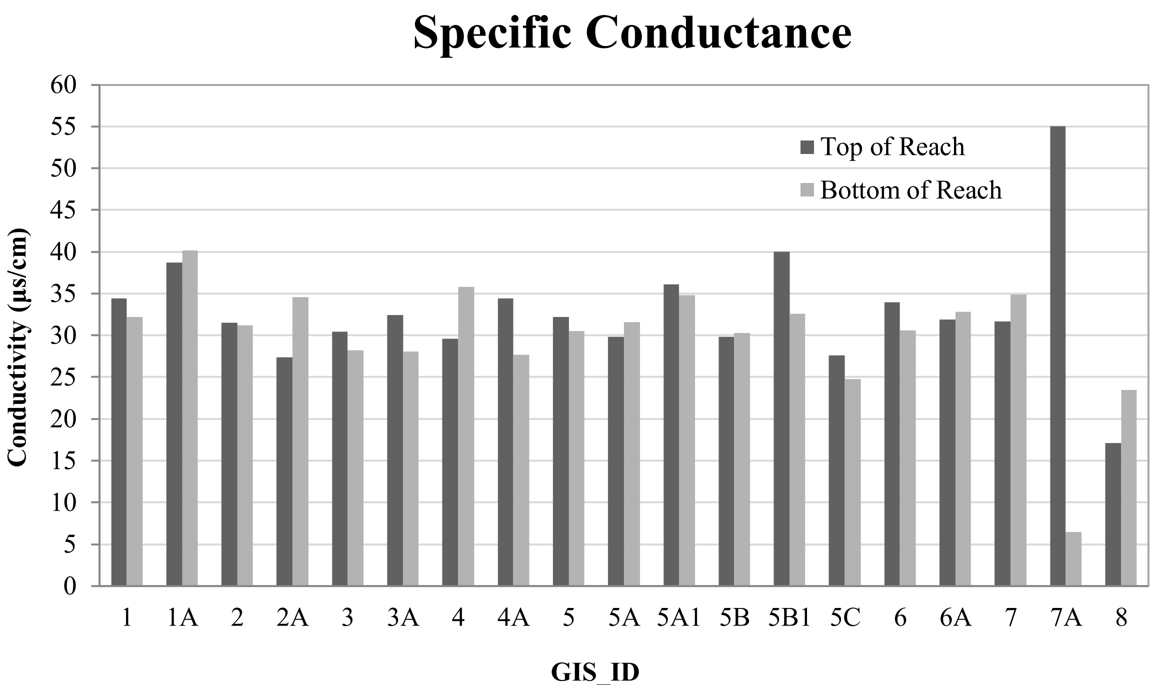


Figure 2. Specific Conductance measurements at the top and bottom of each stream segment

Water temperature is another important factor in the quality of a stream for fish habitat. Though there is some slight variation in temperature thresholds between species, in general, trout can survive in water temperatures near freezing (0°C or 32°F), and begin to experience thermal and oxygen-related stress around 18°C (65°F) (PA Fish and Boat Commission 2019). Field investigations were conducted from June, 2018 through June, 2019, leading to a wide range in observed temperatures across the sampled reaches. In-stream temperatures fell between 0.0 and 16.0°C, with an average temperature of 6.1°C. To standardize measurements across sampling dates, the difference in temperature from the top of a segment to the bottom of a segment were used (Figure 3). Data for each segment are available in Table 8.

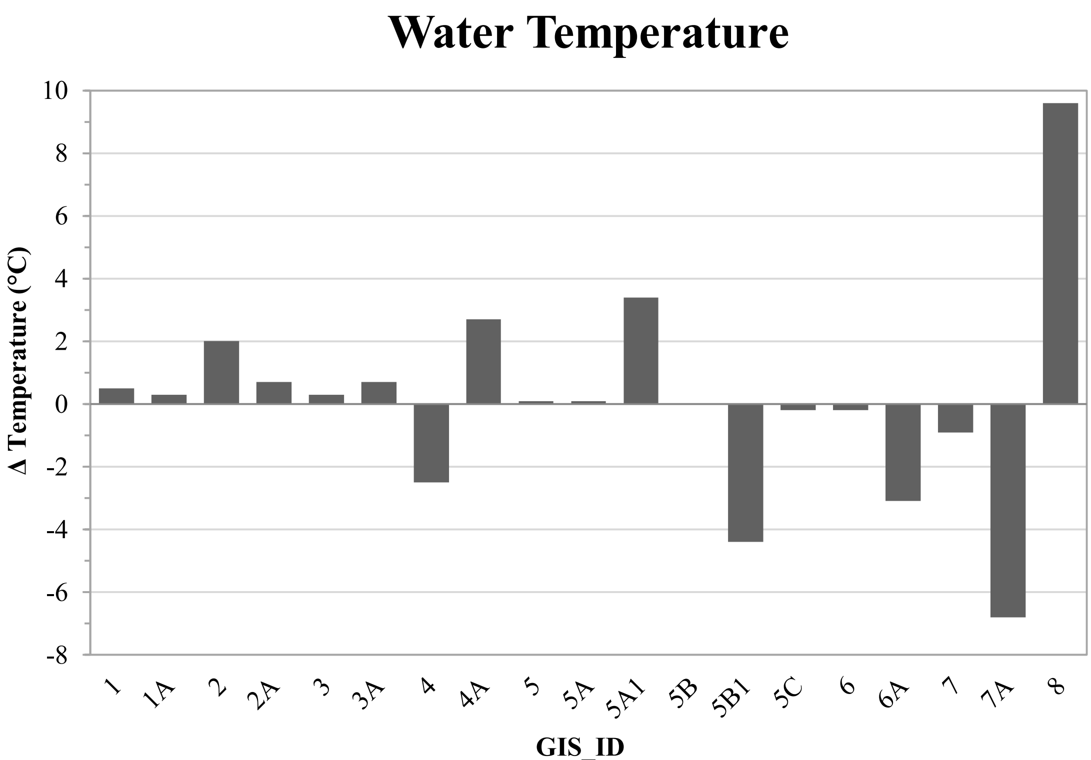


Figure 3. Change in water temperature from the top of the reach to the bottom. Positive values indicate warmer temperatures downstream, while negative values indicate a reduction in temperature as water flows downstream.

Fish Sampling

Pennsylvania Fish and Boat Commission (PFBC) has periodically sampled the fish populations along various segments of the Middle Fork using backpack electrofishing (BPEF) techniques. The first sampling occurred in 1990, with subsequent studies in 1998 and 2018. Table 2 below documents the diversity and abundance of species found along the four segments within the Middle Fork watershed in 2018, as well as the four tributaries which were sampled. This data is also represented in the Wild Trout Observed map in Appendix 2.

Invasive Species

Invasive vegetation species were present to some degree throughout the watershed, but documenting them in detail fell outside the scope of this analysis. However, the PGC has a robust invasive species monitoring and treatment program. Other than brown and rainbow trout caught during the backpack electrofishing surveys, no species of invasive animals were observed in the Middle Fork watershed. However, their absence from this assessment in no way indicates that they are not present in the area (PGC 2015b).

Table 2. Fish Species Observed in Middle Fork (Courtesy of PFBC)

Location	Site Length (m)	Total Species	Species Observed	Coarse Abundance	Estimated Wild Trout Biomass (Kg/ha)
GIS_ID 1 RM 0.34	300	6	Brook Trout	27	2.57
			Brown Trout	10	2.24
			Brook Trout (Hatchery)	Rare(<3)	
			Blacknose Dace	Common(26-100)	
			Mottled Sculpin	Common(26-100)	
			Rainbow Trout (Hatchery)	Present(3-25)	
			White Sucker	Rare(<3)	
GIS_ID 2A Jenkins Hollow	103	1	Brook Trout	17	3.35
GIS_ID 4 RM 2.05	315	6	Brook Trout	28	5.16
			Brown Trout	17	1.93
			Brown Trout (Hatchery)	Rare(<3)	
			Blacknose Dace	Present(3-25)	
			Mottled Sculpin	Abundant(>100)	
			Creek Chub	Present(3-25)	
			White Sucker	Rare(<3)	
GIS_ID 4A Larson Hollow	110	3	Brook Trout	45	7.16
			Brown Trout	1	0.06
			Mottled Sculpin	Present(3-25)	
GIS_ID 5A Maple Run	227	3	Brook Trout	134	18.14
			Blacknose Dace	Present(3-25)	
			Mottled Sculpin	Common(26-100)	
GIS_ID 5C Mealey Hollow	119	3	Brook Trout	11	1.45
			Blacknose Dace	Rare(<3)	
			Mottled Sculpin	Rare(<3)	
GIS_ID 6 RM 2.69	205	4	Brook Trout	3	0.13
			Blacknose Dace	Abundant(>100)	
			Creek Chub	Present(3-25)	
			Mottled Sculpin	Common(26-100)	
GIS_ID 7 RM 3.22	160	4	Brook Trout	30	0.86
			Blacknose Dace	Abundant(>100)	
			Creek Chub	Present(3-25)	
			Mottled Sculpin	Present(3-25)	

Discussion

Importance of Specific Evaluation Categories

Large Woody Materials (LWM)

Trees and forests play an integral role in the protection of coldwater resources. Not only do they shade and cool streams, but branches and entire trunks physically interact with water. Standing trees lessen the impact force of precipitation, reducing soil compaction and erosion, and provide channels along roots for water to seep underground. After they fall, trees on land become natural "water bars" on slopes, slowing and further infiltrating sheet-flow of water into the soil. Trees growing nearer to the water serve an equally vital role. On floodplains, fallen trees slow high water in route to downstream communities. Infiltration into floodplain groundwater tables also ensures that summer low-flows have a cool, clean, underground reservoir to draw from. As muddy, debris-filled flood flows are dispersed over the floodplain and their velocity is reduced, their ability to keep particles entrained (mobilized with the flow) is also reduced, forcing them to drop sediment. This nutrient-rich sediment fertilizes the land. Seeds from higher in the watershed are also caught by floodplain vegetation and woody debris, providing a freshly fertilized seedbed in the dropped sediment for the next generation of riparian plants to grow. In this manner, vegetation that has evolved to be in and near streams stays in those environments to provide habitat for aquatic and terrestrial species, and the associated ecosystem services they provide.

Woody materials in the channel help provide habitat for numerous aquatic and terrestrial species while interacting with water in much the same fashion as their upland counterparts. Multiple tree species, age classes, and states and rates of decay provide a diverse substrate for aquatic macroinvertebrates, fungi, and plants that then transfer that energy up the food web. Fish, reptiles, amphibians, birds and mammals all rely on these more "basic" food web pieces, as well as the trees themselves for cover and reproduction. As the volume of water flowing within a channel increases it interacts more forcefully with all substrates present, including LWM. If the individual pieces of LWM or those that they are entangled with are of sufficient size, mass, and shape to not be transported (a "key piece"), they can force the water to scour additional pools, sort gravels, and "aggrade" (collect and build-up) sediment in their slack waters. In this physical role, they help stabilize and set the grade of the stream, provide areas for nesting, feeding, breeding, and rearing young, as well as refuge from predators.

Aquatic Organism Passage (AOP)

In the course of field assessments, AOP barriers were encountered primarily in conjunction with roads. One additional barrier was noted in the form of a previously installed water jack. All encountered structures were evaluated on their ability to keep the aquatic ecosystem connected. A crossing structure that in some way hinders or prevents passage effectively serves as a bottleneck in that entire ecosystem, reducing the flow of nutrients and energy in both directions.

Flood flows can also become problematic for road managers at the road stream intersection as bridges and culverts become blocked by debris or sediment, or they may be undersized for the watershed they are conveying. Issues can include erosion of the crossing structure and road base, up to and including the whole road itself failing. Flooding of low-lying roads poses a safety hazard and flood debris may accumulate in ditches and on the road surface. Crossing structures that are adequately sized to the stream segment and location where they are installed, will allow for a stream banks to develop inside the structure, as well as provide passage at multiple flow levels for aquatic, semi-aquatic and terrestrial species to benefit the entire ecosystem.

Dirt and Gravel Roads (DGR)

Roads and trails surfaced with dirt and/or gravel can provide an economically appealing alternative to impervious surfacing materials, like concrete or asphalt. They provide environmental benefits, as well, allowing storm water to more readily infiltrate into the ground and slowing the flow of runoff. However, if improperly constructed or maintained they can negatively impact the watersheds they traverse. Sediment that washes off of DGRs quickly finds its way into streams, filling the interstitial spaces between cobble and gravel that provide habitat for fish and aquatic macroinvertebrates.

Habitat Improvements

Habitat improvements were included as a special evaluation category separate from *Large Woody Materials* and *Aquatic Organism Passage Barriers* to highlight improvements that wouldn't fit either of those two categories. This will allow a broader suite of conservation tools for stakeholders.

Erosion

While some erosion is natural and necessary in a stream system, it can also have negative consequences for aquatic ecosystems. Similar to the sediment originating from DGRs, erosion of a stream's bed and banks can produce sediment. This erosion is most often observed as scalloped, non-vegetated areas on banks, undercutting of the riparian vegetation's roots, and head-cutting of the substrate in an upstream direction.

Channelization

Though the EPA parameter of Channel Alteration is used in the determination of habitat scores, we felt it was also necessary to show how much channelization was present in each stream segment. By removing natural stream bed substrate, like boulders, cobbles, gravels, and woody materials from the aquatic ecosystem, the habitat qualities, as well as, energy dissipation abilities of some sections of streams in the Middle Fork watershed have been reduced. Channelization was often observed at road stream crossings, on both active and relic roads.

Native or Wild Trout Observed

As a state listed High-Quality Coldwater Fishery (HQ-CWF) as well as a Natural Reproduction Trout Stream, Middle Fork East Branch Clarion River and its tributaries are protected by stringent water quality protections under Pennsylvania law. Though the entirety of the watershed presently has water quality protections in place and is considered to contain naturally reproducing populations of trout, staff and volunteers in field investigations were encouraged to record any wild trout they observed, as an informal record for the future. If climate change or other stochastic events were to extirpate a portion of the trout population currently present in the Middle Fork watershed, locations where trout were observed in this study can serve as source populations or refuge areas for future restoration efforts. Additionally, trout species captured, their estimated biomass, and the species richness documented during the PA Fish and Boat Commission backpack electrofishing surveys provide habitat managers with scientific data to inform management of the watershed.

Water Quality Measurements

Just as air pollution can make terrestrial habitats inhospitable to human and animal life, so too can water pollution make aquatic habitats toxic. This pollution can be thermal, often resulting from a “top release” pond with a spillway or overflow pipe draining the warmest water in the pond into the stream; chemical, in the form of acid rain falling on soils with low buffering capacity or road runoff elevating the stream’s conductivity; or physical, with a substance (usually sediment) taking up the interstitial spaces that provide habitat for fish and aquatic macroinvertebrates. While the thermal and chemical qualities of water in Middle Fork were measured, sediment in the form of turbidity was not objectively measured, but was subjectively estimated.

Climate Change

Anthropogenic climate change is one of the most diverse and complicated issues facing humanity today. To the non-scientific observer, its effects may seem miniscule and irrelevant. Yet, numerous and far-reaching impacts have been documented in recent history due to climate-related drivers, including rising atmospheric CO_2, shifting rainfall patterns, and rising temperatures (Allen et al. 2018) . These impacts include drastic changes in species’ ranges and distributions due to a warming climate (Chen et. al 2011), as well as negative impacts on the health and resilience of natural and human systems including terrestrial and aquatic ecosystems and their services, agricultural production, and human health (Allen et al. 2018). Effects of climate change specific to coldwater ecosystems can be found in Table 6. Climate Change, Coldwater Ecosystems, and Mitigation Strategies.

Areas of Concern and Opportunity

Throughout the Middle Fork watershed, numerous areas of concern, as well as opportunities for improvement, were found and recorded over the course of this study. The most notable concerns relate to aquatic organism passage barriers and the lack of structure within various stream segments. Specific examples are included below and are organized by the primary concern they address. Maps presented in Appendix 2 provide a broader view of project recommendations across the watershed. These examples identify important opportunities for improvement, but should not be considered a comprehensive list of all potential projects present in the basin.

Large Woody Materials (LWM)

The majority of segments assessed are recommended to have additions of LWM to improve aquatic and terrestrial habitats. See Table 4 below, as well as the LWM map in Appendix 2 for recommendations.

Table 3. Stream Reaches Needing Additions of Large Wood

Stream Name	GIS_ID	Large Wood Needed?	Distance (ft.)	Area/Location
Middle Fork	1	Yes	3700	Entire Segment
UNT to Middle Fork	1A	Dry/spring channel		
Middle Fork	2	Yes	300	41.54516,-78.57948
Jenkins Hollow	2A	Yes	4400	Majority of Segment
Middle Fork	3	Yes	300	41.54649,-78.57121, in over-widened reach
Birch Hollow	3A	Yes	4000	Entire segment
Middle Fork	4	Yes	2800	Majority of segment
Larson Hollow	4A	Yes	2800	Entire Segment
Middle Fork	5	Yes	300	From below 2 section RW sill rd. stabilization to bottom of segment
Maple Run	5A	No		
Myers Hollow	5A1	Yes	2200	From mouth to AOP culvert barrier
Maple Run	5B	Yes	2200	Entire Segment
Maple Run	5B1	Yes	2100	Entire Segment
Mealey Hollow	5C	Yes	6500	Entire Segment
Middle Fork	6	Yes	300	From below Middle Fork Rd culvert to end of segment
UNT to Middle Fork	6A	Yes	300	Forested area upstream of SGL food plot
Middle Fork	7	Yes	2700	From beaver meadow top to top of segment
UNT to Middle Fork	7A	N		
Middle Fork	8	Y	3200	Forested area upstream of culvert
Totals:	**19**	**16**	**38100 Feet 7.22 Miles**	

Adding large, stable pieces of LWM to sections like the one depicted above on segment 6 will prevent smaller, mobile woody materials seen in the photo from moving downstream to block culverts. Large wood installations are also anticipated to benefit the wild trout populations in Middle Fork. In monitoring studies conducted by WPC on the Allegheny National Forest, the number of wild trout captured during backpack electrofishing studies increased by 45% from pre-to post installation of LWM structures at other project sites.

Aquatic Organism Passage (AOP)

Aquatic organism passage barriers were present on stream segments as listed in Table 5 and their map in Appendix 2. The majority of these passage barriers are corrugated metal 'squash pipes' in varying degrees of structural integrity. In the most extreme cases, culverts were rusted through on sections of the top and bottom, presenting a safety issue for road travelers as well as a barrier to aquatic organism passage. Partners, including PGC, WPC, and Elk County Conservation District, staff met in October, 2019, to discuss potential solutions to these passage barriers. Based on the management plan for SGL 025, as well as resources available to the project partners, recommendations were developed for each crossing. These passage restoration projects are planned to occur over the next five to 10 years, pending funding and staff availability.

Several instances asterisked in Table 5 bear need for explanation. In Birch Hollow, it becomes an anastomosed (multi-threaded) channel as it exits its own narrow, confined valley and enters the larger Middle Fork valley. Three channels are present with one making a confluence before Middle Fork crosses the road, eliminating a total passage barrier to Birch Hollow. However, the culvert crossing Middle Fork just below the Birch Hollow confluence is a partial passage barrier, cutting off Birch Hollow from downstream watersheds. The remaining two channels cross at barriers 4 and 5, with barrier 5 on an ephemeral (seasonally dry) channel that serves as an overflow for the upstream Middle Fork culvert (barrier 6), as well as a road cross drain. Replacement of barriers 4 and 6 with bridges will negate the need for establishing aquatic connectivity at barrier 5, thus making its replacement primarily a road management issue.

Barrier 11 is located on segment 8. On the map in Appendix 2, it appears to be located on section 7. This is due to the disagreement of stream layers in the GIS mapping system being slightly inaccurate compared with field conditions. In the interest of presenting the most accurate data, the latitude and longitude available in Table 5 are accurate to field conditions, with the barrier being located where segment 8 passes under Middle Fork Road.

All AOP barrier replacement or removal projects should include a stream simulation design component to maintain habitat conditions and infrastructure integrity. Options for removal and replacement are described in the *Recommendations* section of this plan.

Table 4. Identified AOP barriers within the Middle Fork watershed

Stream Name	GIS ID	Barrier ID	Barrier Description	Lat.	Long.	Recommendation
Middle Fork	3	1	Brookie Water Jack	41.54649	-78.57127	Remove
Middle Fork	3	2	undersized culvert	41.54617	-78.57233	Replace with 40' bridge
Middle Fork	3	3	undersized culvert	41.54665	-78.56976	Replace with 50' bridge
Birch Hollow*	3A	4	undersized culvert	41.546852	-78.56761	Replace with 20' bridge
Birch Hollow *cross drain	3A	5	N/A-cross drain	41.546756	-78.568016	Replace with 36"+ culvert
Middle Fork	3	6	undersized culvert	41.546913	-78.56752	Replace with 40' bridge
Middle Fork	5	7	undersized culvert	41.54272	-78.55345	Remove and Restore Floodplain
Middle Fork	6	8	undersized culvert	41.540732	-78.552165	Replace with 30' bridge
Middle Fork	6	9	undersized culvert	41.53886	-78.549853	Remove and restore floodplain
UNT	6A	10	undersized culvert	41.53784	-78.548959	Replace pipe with stream ford
Middle Fork*	8	11	undersized culvert	41.533694	-78.539365	Replace with 30' bridge
Myers Hollow	5A1	12	undersized culvert	41.54855	-78.54665	Replace with 40' bridge

Barrier 1: Brookie Water Jack is elevated and provides a low-water partial passage barrier

Barrier 2 Outlet: note the size of the scour pool compared to the culvert

Barrier 3: illustrates how undersized culverts collect flood debris; adequately-sized culverts pass debris of this size, and much larger, more easily

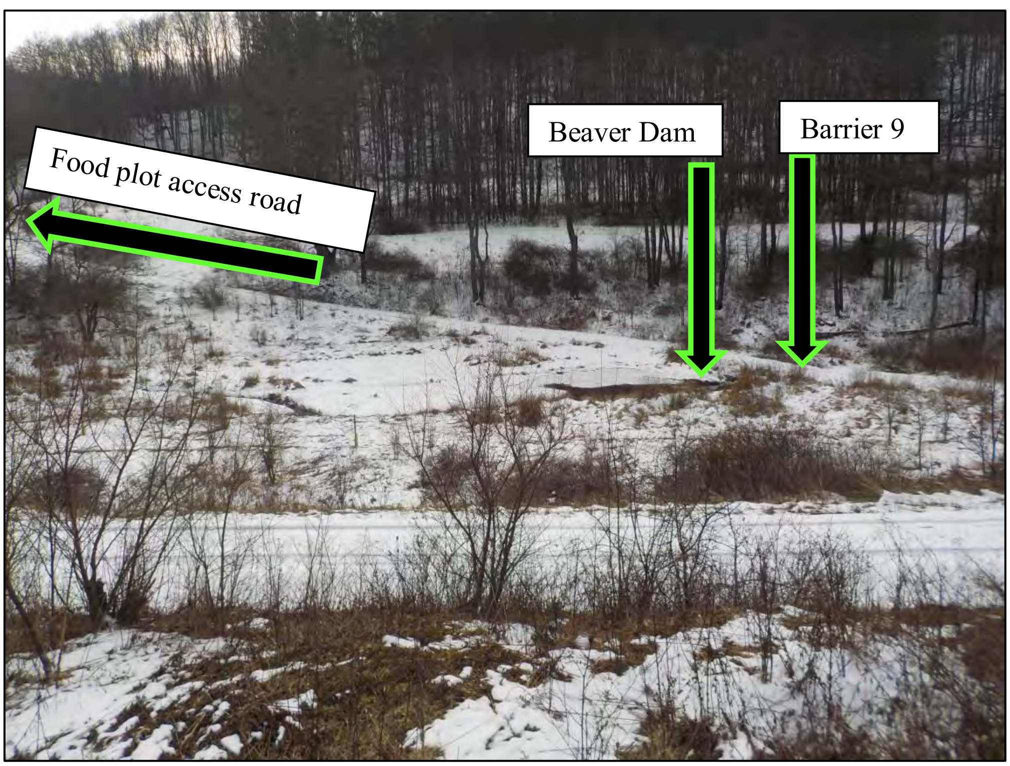
Barrier 4: conveys one of the anastomosed channels of Birch Hollow

Barrier 5: no photo available

Barrier 6: exhibits "fire hose effect" scour pool at its outlet

Barrier 7: a perched high-density polyethylene (HDPE) pipe with a smooth bore is a complete passage barrier. Access roads to both sides of the valley are present on the ridges. This passage barrier is recommended to be removed and the stream and floodplain fully restored.

Barrier 8 outlet: some stream substrate is present through the crossing, making this barrier one of the more passable crossings in the watershed



Barrier 9 is located immediately downstream of an active beaver dam. Access to food plots for management is provided by a road on the opposite side of the stream. Therefore, this crossing is not needed, and is recommended for removal.

Barrier 10 is located on a vegetated road that provides access for PGC to manage food plots located in this area. Due to the minimal amount of traffic this crossing receives, a stable ford is recommended to replace this undersized culvert.

Barrier 11 outlet: Located on segment 8, this HDPE pipe has a smooth bore and, due to high velocities in the pipe, prevents aquatic organisms from migrating upstream.

Barrier 12: squash pipe outlet on segment 5A1-Meyers Hollow; this culvert is rusted through portions of the bottom

Dirt and Gravel Roads (DGR)

Ideal stream conditions do not include DGRs within a minimum of 200 feet of their margins. However, removal of a DGR may not always be feasible given land management needs. If possible, DGRs should be resurfaced with limestone Driving Surface Aggregate (DSA) to reduce erosion and sedimentation, as well as, provide a slight buffering capacity improvement to the watershed.

Additionally, areas of localized erosion were present at road-stream interfaces. These areas are outlined in Table 6, along with fish habitat improvement/bank stabilization structures recommended to remediate the issue. Standard drawings for these structures are available in the PFBC's Habitat Improvement Guidelines for Trout Streams: https://www.fishandboat.com/Resource/Habitat/Pages/default.aspx

Table 5. Specific locations for toe-of-road bank stabilization

Lat.	Long.	Loc. ID	Structures Recommended	# logs	# Root Wads	R5 Stone (tons)	# 2' Rebar	# 4' Rebar	Notes: Unless otherwise noted, all log/RW sizes: Root Wads size=3-5' root fan diameter, stem 12-15' long x 8-12" diameter at cut end. Log size = 20-25' long x 8-14" diameter on the large end.
41.54705	-78.58879	1	Modified Mudsill (MMS)/Root Wad (RW) Sill at bend	12	3	60	20	18	60'stretch for MMS/RWs; 300' stretch needs LWM additions also
41.54689	-78.56680	2	RW stabilization jam	0	10	40	10	20	approximately 40' long section RW deflector structure to protect road;
41.54606	-78.56462	3	RW/MMS	4	5	30	6	24	RW/MMS deflector to protect road; approximately 30' long section
41.54585	-78.58331	4	RWs and MMS	20	6	100	30	32	approximately 110' long section
41.54415	-78.55782	5	RWs	6	8	60	12	16	RW deflectors to protect road toe
41.54649	-78.57127	6	LWM jams/ directional felling	3 per 100 '	0	0	0	0	Remove relic Brookie Water Jack. Leave stone abutments in place to maintain pool. Add LWM (felled trees) to stream upstream of this location.
41.54293	-78.55542	7	RW mud sill	6	4	40	12	8	2-section RW sill (use root wads as sill logs) to protect road. Add LWM from below this 2-section RW sill to 41.54373,-78.55680.
41.54311	-78.55100	8	RW mud sill	3	5	20	0	0	RW jam to protect toe of Myers Hollow Rd. Two RWs should have 10–15' stem, three RWs should have 30'+ stems (potential to harvest onsite).
			Total	**51**	**41**	**350**	**90**	**118**	

Toe-of-road bank stabilization # 7 on Segment 4: Installing a 2-section modified root wad sill here will deflect flows away from the road and provide overhanging cover for fish

Erosion

Eroding right descending bank on a less accessible section of Segment 4. This is an ideal location for a manually-installed lateral bar jam to deflect flow and create deep water habitats. Erosion was fairly minimal throughout the watershed, with moderate erosion on segments 2A, 4A, 5A1, and 5C.

Channelization

Channelization was present on nearly every segment in the watershed. The most severely channelized areas are the aquatic organism passage barriers on the current road system and will be remediated as passage barriers are removed. In areas where active roads do not channelize a stream, relict railroad lines from the early 1900s are still impacting the stream's ability to access its floodplain and function naturally. In the very headwaters of Middle Fork (segment 8), the stream has been forced underground by a valley fill that facilitated the ability of the logging railroad to run in the center of the valley, straight to the top. In Mealey Hollow (segment 5C), the relic rail line restricts floodplain access in numerous areas where it transects the stream. More in-depth hydrologic modeling, as well as a cost-benefit analysis is suggested prior to endeavoring to remediate these issues.

The very top of Segment 8, the headwater spring of Middle Fork emerges from a relict railroad bed on its left descending bank

Native or Wild Trout Observed

Young-of-the-year brook trout in March, 2019, on segment 5B1; this fish is likely less than two months old

This much-older fish was captured during backpack electrofishing surveys with PFBC

Water Quality Measurements

Birch Hollow (segment 5A) exhibited the third lowest overall pH at 4.71. However, due to technical difficulties with the multimeter, an accurate assessment of pH change from the top of the reach to the bottom of the reach was unable to be obtained.

Abandoned well adjacent to segment 1; No water was leaking from the well at the time of the assessment, but drainage patterns indicate flow does come from the well and ends up in Middle Fork.

Climate Change

Adding LWM to streams, such as this stretch on segment 5, will increase development of deep-water habitats trout need. Cool, deep places to reside in are especially important in the face of a changing climate.

Recommendations

PLEASE NOTE: It is important to acquire all appropriate state and federal permits before implementing any recommendations in this plan.

Targeted efforts to protect and restore Middle Fork and its tributaries should focus on improving the lowest scoring categories from the habitat assessments, as well as specific recommendations made in the following section. Based on habitat scores and fish sampling data, improvements for coldwater organisms can be best accomplished by improving the quantity and variety of epifaunal substrate within the segments and ensuring they are connected. General habitat improvements will help address these issues as well as other ecosystem concerns, and specific recommendations for various segments and issues are discussed below.

Large Woody Materials (LWM)

Restoring the LWM component of habitat to the Middle Fork watershed can best be implemented by referencing the "LWM Present" map in Appendix 2, and adding material to the specific sections identified in Table 4. This method of improving the ecosystem should be used judiciously and be considerate of downstream infrastructure risks. Installation should use primarily on-site materials; and structure designs may be based on those in the *Guidance for Stream Restoration and Rehabilitation* (Yochum 2016). The level of complexity of these projects is proportional to the amount of drainage area upstream of the project site and inversely proportional to the distance to downstream infrastructure. On 1st and 2nd order streams with little risk (or greater distance) to downstream infrastructure, simple directional felling techniques can be used to improve habitat. Trees with root wads still attached can also be uprooted by hand/winch and drug into the stream or installed by heavy equipment. Root wads and the amount of winching or need for heavy equipment, as well as, increased engineering and design, become more necessary as streams grow into 3rd and 4th order size streams.

As mentioned in the retrofit method of AOP recommendations and (Abbe et al. 2009), LWM installations can also be used as a tool to stabilize and protect infrastructure, such as roads and crossings. This applies widely to the Middle Fork drainage, as eroding banks and/or undersized road-stream crossing structures were found on nearly every stream segment. If attempting to protect infrastructure in this manner, it is highly recommended that project partners have the plans designed by a professional engineer in order to provide the greatest ecological benefit, as well as, protections for landowners and the environment.

Aquatic Organism Passage Barriers

Barriers to aquatic organism passage should be remediated to allow for unhindered passage of aquatic and terrestrial/riparian species. This suite of species includes fish, macroinvertebrates, mollusks, amphibians, mammals, reptiles, birds, or any other organism that would use a waterway as a natural travel corridor. Several options are available to accomplish this goal, including:

1. *Replacement*

   As in the case along stream Segment 3 in the Middle Fork watershed, undersized culverts are present where a PGC road crosses the Middle Fork, putting both the stream and roadway at risk. Where a road needs to remain for land management activities, culverts should be replaced with larger, more suitable structures. Some recommended replacement options include a squashed pipe, a bottomless arch, or a bridge. Structure type and installation will vary by site based on the stream and roadway needs, as well as, available funding. The structure should be sized, at a minimum, to 120% of the stream's current bankfull width as measured out of the "zone of influence" of the existing crossing structure. A substrate/bedload mix comparable to that present naturally in the stream channel should be used to simulate it through the crossing. Stream banks should be allowed to develop or be physically simulated on the margins inside the crossing structure to facilitate higher flows expected to be associated with climate change trends (thus reducing future maintenance), as well as, assist non-fish species in utilizing the waterway for travel.

2. *Removal*

If culverts are no longer performing their intended purpose of assisting people in crossing the stream or a road that crosses a stream is no longer necessary, culvert removal is the ideal solution to remove passage barriers and return the stream to a more fully-connected ecosystem. The stream crossing along Meyers Hollow Road is currently a passage barrier to aquatic organisms and would be an ideal candidate for removal. This site, in particular, is a suggested removal project, because the road beyond the culvert is no longer necessary and could be decommissioned due to newer roads that provide better accessibility to destinations on the other side of the stream. While replacement or retrofit are still options, complete removal is recommended in conjunction with decommissioning the road.

It is important to acknowledge the rich history of industry and transportation on Pennsylvania's waterways and to keep this heritage in mind when working on restoration and conservation projects. If an AOP project threatens to impact evidence of the region's history, efforts should be made to involve all stakeholders in the planning and construction process. To facilitate AOP, it may be necessary to remove entire structures, but remnants of abutments or approaches to the structure may be left to preserve the historical integrity of the site. Interpretive signs and preservation of removed materials (i.e. timbers, cut stone, other archaeological evidence) by historical societies or other qualified organizations may also be beneficial to include in AOP barrier removal projects from their inception.

Dirt and Gravel Roads (DGRs)

Dirt and gravel roads are recommended to be managed to have a minimal impact on aquatic resources and be removed, decommissioned, or vegetated when they are no longer needed. Proper Best Management Practices (BMPs) should be installed whenever possible, including but not limited to re-surfacing with DSA, grade breaks, and cross drains. Segments 4 and 8 had the greatest impacts from DGRs, with moderate impacts being observed. Segments 2, 3, 5, 5A, and 7 had minimal impacts. Roads upstream of and bordering segments 4 and 8 are the highest priority in the Middle Fork watershed for improvements. If possible, while working on DGR improvements, AOP barriers also should be removed/replaced/decommissioned within the same project. The USDA Forest Service, Penn State Center for Dirt and Gravel Road Studies, Natural Resources Conservation Service (NRCS), county conservation districts, and Western Pennsylvania Conservancy are resources to assist these types of projects.

Erosion

Coupled with contributions from DGRs and stormwater runoff, excessive bank erosion is the primary supplier of stream sedimentation and pollution. Erosion issues can be addressed with "hard" stabilization structures (Lutz 2007, Yochum 2016) in the short term and with vegetation in the long term. Where feasible, the LWM approach should be used to stabilize eroding banks as it more closely mimics natural conditions and can be more effective at reducing the erosive force of shear stress on channel walls. In some cases, such as those recommended in Table 6, structures like those in the PA Fish and Boat Commission's *Habitat Improvement for Trout Streams* hand book (Lutz 2007) may be used, as they are less intrusive into the stream and the bank. Both approaches abate erosion and help sequester sediment in slack waters they create. The longevity of such structures is projected to be 20 years, but wood that is completely submerged underwater can often persist for 50–100 years or longer. These approaches can be further augmented by installing soil bioengineering (intensive vegetative planting) practices along with them.

Soil bioengineering is the practice of installing live, dormant plant materials into streambanks in pre-designed configurations for stabilization. Native species, such as willows and dogwoods, have the natural capability to grow roots quickly from dormant cuttings, producing viable adult plants. The resulting network of roots creates a self-healing basket of "root rebar" that stabilizes the bank. A diversity of native species may be used and harvested on site, if possible. This will simultaneously reduce project costs and keep site-specific plant genomes (specifically adapted to that location's climate, photoperiod, and hydrologic cycle) within their native range. For a full list of species and their rooting capabilities for soil bioengineering projects, see *NRCS Plant Materials Technical Note No. One* (Burgdorf et. al. 2007). This document also lists several additional reference documents and provides a brief overview of some of the installation techniques. The most recent U.S. Army Corps of Engineers *Wetland Plants List for the Eastern Mountains and Piedmont* (Lichvar et. al 2016) may be beneficial to review during a soil bioengineering project to assist in determining planting zones.

Channelization

Wherever possible, it is recommended to reduce the amount of channelization in the watershed. Future channelization efforts should be reduced or avoided completely to reduce flooding, erosion, and pollution. Streams should be returned to a natural form and function, dependent on stream order, size, and where they occur within the watershed. As mentioned in the *Areas of Concern and Opportunity* section, de-channelization includes removing existing passage barriers on roads and relict rail roads that prevent the stream from accessing its floodplain. Geomorphic, hydrologic, and cost-benefit analyses should be completed before undertaking a project of this magnitude.

Native and Wild Trout

It is highly likely that wild brook trout inhabit the entirety of Middle Fork, with the exception of Birch Hollow. To improve conditions for native trout in Middle Fork, individuals and organizations may follow the recommendations in this section. Additionally, if the PFBC should deem it appropriate, the stocking of non-native trout and hatchery-raised brook trout should cease in Middle Fork. Competition from these introduced fish can reduce the ability of native trout to thrive in the watershed, giving a false impression to anglers and outdoors people of reduced productivity. Seasons, sizes, and creel limits may also need to be adjusted to protect the native trout until their populations reach the desired quality of sport fishery (potentially, Class A).

Water Quality

Low pH on the Allegheny Plateau is typically attributed to acid precipitation and the low buffering capacity of the soils. While it is not possible to directly prevent acidic precipitation from falling in the watershed, improvements to DGRs with limestone DSA, alkalinity basins, and other buffering BMPs would help neutralize the acidity of rain once it falls. Our study did not show pH values that were completely outside the range of existence for coldwater organisms, but they could be improved in some areas. Segments 3A, 4A, 5A1, and 5B1 all had pH values lower than 5 at the top of their reaches, but increased to more habitable alkalinity by the lower section of the reaches. If further study should determine that low pH is affecting the resource, a mitigation strategy can be developed at that time.

Measurements of specific conductance (conductivity) were not outside the normal range for headwater streams in this region. The forested, non-developed nature of the watershed should ensure this into the future. Several abandoned oil and gas wells were discovered in the watershed, but were having no measurable impact on water quality. Plugging of these abandoned oil and gas wells in the watershed is recommended as time and resources permit. The most notable instance is a well located on Segment 1, on the east bank of Middle Fork and approximately 150 yards from the parking lot on Middle Fork Road. This well is located at 41.55145, -78.59705. Specific conductance of the water in this pipe was measured at 6.15 µs/cm.

Water temperatures were documented to be in line with those of a High Quality Coldwater Fishery supporting wild trout. Keeping the banks forested and adding LWM to the channel to increase hyporheic exchange will ensure the stream stays cool into the future.

Climate Change

While individuals and organizations at the local scale cannot immediately change the pace of anthropogenic climate change at the global level, local action and initiatives can succeed in improving the resiliency of our coldwater ecosystems. By following recommendations in this plan, as well as those of the PFBC and Trout Unlimited, we can act together to improve the Middle Fork watershed, in turn impacting the rest of the Clarion River, Allegheny River, and ecosystems further downstream. Table 7 provides further information on climate change's effects on coldwater ecosystems and offers pertinent strategies for mitigating the effects of climate change in these precious environments.

Table 6. Climate Change, Coldwater Ecosystems, and Mitigation Strategies

Climate Change Condition	Effect on Coldwater Ecosystems	Mitigation Strategies
Increased drought frequency, intensity, and duration during summer and fall	Habitat fragmentation or loss as streams lose water	Ensure adequate AOP throughout the watershed to allow access to water of the proper quality and temperature
		Enhance groundwater infiltration from headwaters to mouth, through green stormwater infrastructure, LWM additions, and other BMPs
	Reduced prey abundance as seasonal wetlands dry before larval amphibians metamorphose and migrate	Provide native riparian tree or shrub plantings to the south of known wetlands to reduce evaporation
		Promote beaver usage of the watershed. This can include providing base structures in areas lacking riparian wood, so that upon colonization, the beaver structures remain in the system
Warmer average water temperature	Less dissolved oxygen available for aquatic organism respiration	Safeguard existing forest/shrub riparian areas and plant new areas where needed to shade and cool waters, increasing DO capacity
		Diminish or eliminate fishing pressure during hot summer months to reduce physical stress in hypoxic water conditions
	Habitat loss due to increased temperature	Decrease water temperatures through riparian plantings and increased hyporheic interaction
Increased precipitation event frequency, intensity, and duration during winter and spring, mostly as rain	Road-stream crossing structures become undersized as storm events increase in intensity, creating AOP barriers and further fragmenting habitat	Ensure adequate AOP throughout the watershed, simultaneously increasing hydraulic capacity of crossing structures
		Slow stormwater upslope and upstream to increase infiltration and reduce quantity of flood flows
	Less snowpack and more precipitation falling as rain means more runoff quicker, resulting in less infiltration to groundwater tables and reduced base flows	Slow stormwater upslope and upstream to increase infiltration, install stormwater BMPs
		Keep development out of floodplain areas to reduce negative interactions with water table

Table developed from Woodward et. al. 2010 and Moore et. al. 1997.

Summary

The Middle Fork watershed is well deserving of its designations as a High Quality Coldwater Fishery supporting the natural reproduction of wild trout. Efforts to increase in-stream habitat, connectivity, and reduce erosion and sedimentation in the watershed will ensure it retains these designations into the future. Additionally, efforts to improve pH in several of the tributary streams are anticipated to increase productivity of the watershed as a whole.

Potential Project Partners

The list on the following pages includes partners and potential funding sources for the variety of improvements recommended in this plan. In particular, road and upland managers may be interested in sources of funding to support their management activities. For instance, installing DGR best management practices (culverts, DSA, etc.) may make a road improvement project eligible for grant funding from the Coldwater Heritage Partnership, DEP's Growing Greener Program, the Commonwealth Financing Authority and others, since it will also have benefits to the aquatic ecosystem. Coordinating with a variety of partners is likely to increase the chances of a particular project getting funded, as the initiating party can rely on a wide field of expertise. The Western Pennsylvania Conservancy may be available to partner with willing parties to assist with grant applications and management; those interested should contact the Allegheny Regional Office.

Allegheny National Forest
United States Department of Agriculture
Forest Supervisor's Office
4 Farm Colony Drive
Warren, PA 16701
814-728-6100
www.fs.usda.gov/main/allegheny/home

Allegheny WINs Coalition
Coordinated by Allegheny National Forest
Fisheries Biologist Nathan Welker
4 Farm Colony Drive
Warren, PA 16701
814-728-6163
nwelker@fs.fed.us

American Rivers
Mid-Atlantic – Pittsburgh Office
150 Lloyd Ave
Pittsburgh, PA 15218
412-727-6130
www.americanrivers.org/

Domtar
Johnsonburg Mill
100 Center St.
Johnsonburg, PA 15845
814-965-2521

Ducks Unlimited
1383 Arcadia Road, Room 8
Lancaster, PA 17601
717-945-5068
www.ducks.org
jfeaga@ducks.org

Elk County Conservation District
850 Washington Street
Saint Marys, PA 15857
814-776-5373
http://www.co.elk.pa.us/index.php/conservation-district-homepage

James Zwald Chapter #314 of Trout Unlimited
418 Center Street
St. Marys, PA 15857
814-834-3472
https://www.facebook.com/JimZwaldTUChapter/

Jones Township, Elk County
320 Faries Street
PO Box 25
Wilcox, PA 15870
814-929-5138
http://www.jonestownship.com/index.html

National Wild Turkey Federation
Kinzua Valley Chapter
Mount Jewett, PA
Kinzua Allegheny Longbeards Chapter
Sheffield, PA
Contact Skip Motts for either Chapter
570-460-1495
www.nwtf.org
smotts@nwtf.net

North Atlantic Aquatic Connectivity Collaborative
https://streamcontinuity.org/
contact@streamcontinuity.org

Pennsylvania Department of Conservation and Natural Resources
Elk State Forest
258 Sizerville Road
Emporium, PA 15834
814-486-3353

Pennsylvania Department of Environmental Protection
Northwest Regional Office
230 Chestnut Street
Meadville, PA 16335-3481
Phone: 814-332-6945
Emergencies: 1-800-373-3398
http://www.dep.pa.gov/Business/Water/Pages/default.aspx

Pennsylvania Fish and Boat Commission
North Central Region Office
595 East Rolling Ridge Drive
Bellefonte, PA 16823
814-359-5250

PFBC Habitat Management Division
450 Robinson Lane
Pleasant Gap, PA 16823
814-359-5100
http://www.fishandboat.com/Pages/default.aspx

Pennsylvania Game Commission
North Central Region Office
1566 South Route 44 Hwy.
P.O. Box 5038
Jersey Shore, PA 17740-5038
570-398-4744
Pgc-ncregion@pa.gov

Ruffed Grouse Society
Allegheny Chapter
1016 Long Level Road
Johnsonburg, PA 15845-2402
www.ruffedgrousesociety.org
wlhab@windstream.net

Seneca Natural Resources
East Division Field Office
51 Zents Boulevard
Brookville, PA 15825
866-435-8017

Western Pennsylvania Conservancy
Allegheny Regional Office
159 Main Street
Ridgway, PA 15853
814-776-1114
alleghenyproject@paconserve.org
www.waterlandlife.org

Potential Funding Sources

Colcom Foundation

http://colcomfdn.org/

Coldwater Heritage Partnership

http://www.coldwaterheritage.org/

Commonwealth Financing Authority

http://dced.pa.gov/programs-funding/commonwealth-financing-authority-cfa/#.WGu8Bdjrvcu

Community Foundation of Warren County

http://communityfoundationofwarrencounty.org/grantseekers

Eastern Brook Trout Joint Venture

http://easternbrooktrout.org/

Eastern National Forest Interpretive Association

http://www.enfiamich.org/home.aspx

Foundation for Pennsylvania Watersheds

http://pennsylvaniawatersheds.org/apply-for-a-grant/

National Forest Foundation

https://www.nationalforests.org/grant-programs

North Central Greenways

http://www.ncentralgreenways.com/

Northwest Greenways

http://www.northwestpa.org/greenways-block-grant-program/

Ohio River Basin Fish Habitat Partnership

http://www.fishhabitat.org/the-partnerships/ohio-river-basin-fish-habitat-partnership

PA Department of Conservation and Natural Resources

http://www.dcnr.state.pa.us/brc/grants/

PA Department of Environmental Protection: Growing Greener

http://www.dep.pa.gov/Citizens/GrantsLoansRebates/Growing-Greener/Pages/default.aspx

PA Fish and Boat Commission- Cooperative Habitat Improvement Program

http://www.fishandboat.com/Resource/Habitat/Documents/CHIP-GuidelinesApplication.pdf

Patagonia

http://www.patagonia.com/environmental-grants-and-support.html

Richard King Mellon Foundation

http://fdnweb.org/rkmf/

Seneca Natural Resources Corporation

http://www.natfuel.com/seneca/contact_us.aspx

Shell Foundation

http://www.shellfoundation.org/

Stackpole-Hall Foundation

http://www.stackpolehall.org/

US Department of Agriculture: Natural Resources Conservation Service

https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/?cid=stelprdb1048817

US Fish and Wildlife Service Fish Passage Program

https://www.fws.gov/fisheries/whatwedo/nfpp/nfpp_faqs.html

List of Resources for BMPs relating to Watershed Conservation

North Atlantic Aquatic Connectivity Collaborative

https://streamcontinuity.org/

Pennsylvania Center for Dirt and Gravel Roads

http://www.dirtandgravel.psu.edu/

PA Department of Environmental Protection

http://www.dep.pa.gov/Business/Water/Waterways/Pages/default.aspx

PA Fish and Boat Commission

http://www.fishandboat.com/Pages/default.aspx

PA State Conservation Commission

http://www.agriculture.pa.gov/PROTECT/STATECONSERVATIONCOMMISSION/Pages/default.aspx

Penn State Extension Service

http://extension.psu.edu/natural-resources/water

Stroud Water Research Center

http://www.stroudcenter.org/

US Department of Agriculture: Natural Resource Conservation Service Field Office Technical Guide (FOTG)

https://efotg.sc.egov.usda.gov/

US Forest Service: Guidance for Stream Restoration and Rehabilitation

https://www.fs.fed.us/biology/nsaec/assets/yochumusfs-nsaec-tn102-2gudncstrmrstrtnrhbltn.pdf

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Appendix 1: Data Tables

Table 7. Habitat Scores

NAME	GIS_ID	Epifa. Subst.	Embed.	Velo. Depth	Sed. Dep.	Chan. Flow Sta.	Chan. Alt.	Freq. Rif.	Bank Stab.	Veg. Pro.	Rip. Zone Width	TOTAL SCORE
Middle Fork	1	16	16	17	15	15	14	16	16	16	13	**15.4**
UNT to Middle Fork	1A	DRY										
Middle Fork	2	16	15	17	13	15	19	17	18	18	19	**16.7**
Jenkins Hollow	2A	15	12	16	13	15	20	16	20	20	20	**16.7**
Middle Fork	3	15	16	16	13	15	10	16	18	17	17	**15.3**
Birch Hollow	3A	14	14	16	12	15	18	16	16	16	20	**15.7**
Middle Fork	4	13	15	16	12	14	16	18	16	18	18	**15.6**
Larson Hollow	4A	15	15	16	12	15	15	17	14	14	20	**15.3**
Middle Fork	5	14	12	16	12	11	13	14	18	19	17	**14.6**
Maple Run	5A	15	12	16	16	16	16	16	18	18	17	**16**
Myers Hollow	5A1	12	13	16	14	14	13	14	16	18	16	**14.6**
Maple Run	5B	14	16	16	15	15	13	16	18	20	20	**16.3**
Maple Run	5B1	14	13	13	13	13	19	15	18	20	20	**15.8**
Mealey Hollow	5C	11	13	16	16	15	14	16	18	18	20	**15.7**
Middle Fork	6	12	16	16	16	14	12	14	18	18	14	**15**
UNT to Middle Fork	6A	13	15	12	15	14	14	15	18	20	16	**15.2**
Middle Fork	7	13	12	16	11	13	19	15	18	20	18	**15.5**
UNT to Middle Fork	7A	12	16	9	16	17	20	17	20	20	20	**16.7**
Middle Fork	8	15	16	14	15	16	13	18	20	20	18	**16.5**

NAME	GIS_ID	Epifa. Subst.	Embed.	Velo. Depth	Sed. Dep.	Chan. Flow Sta.	Chan. Alt.	Freq. Rif.	Bank Stab.	Veg. Pro.	Rip. Zone Width	TOTAL SCORE
Minimum		11.0	12.0	9.0	11.0	11.0	10.0	14.0	14.0	14.0	12.0	**14.6**
Maximum		16.0	16.0	17.0	16.0	17.0	20.0	18.0	20.0	20.0	20.0	**16.7**
Median		14.0	15.0	16.0	13.5	15.0	14.5	16.0	18.0	18.0	20.0	**15.7**
Mean		13.8	14.3	15.2	13.8	14.6	15.4	15.9	17.7	18.3	17.9	**15.7**
Range		5.0	4.0	8.0	5.0	6.0	10.0	4.0	6.0	6.0	8.0	**2.1**

**Min., Max., Median, Mean, and Range habitat parameter scores do not include dry segment scores in their analysis.*

Table 8. Water Quality

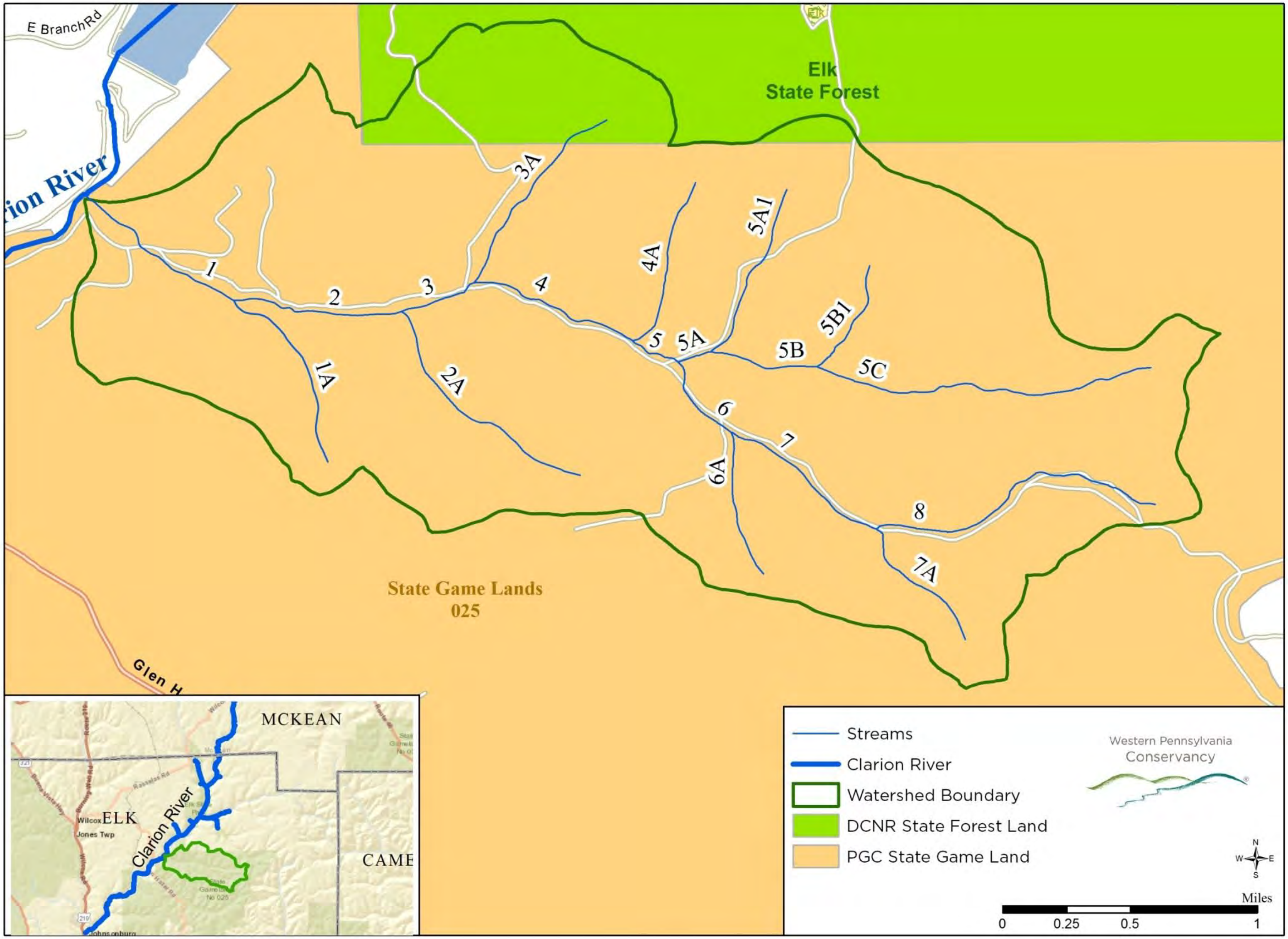
NAME	GIS_ID	pH Top of Reach	pH Bottom of Reach	Δ pH	H_2O Temp [°C] Top of Reach	H_2O Temp [°C] Bottom of Reach	Δ Temp [°C]	Conductivity [µs/cm] Top of Reach	Conductivity [µs/cm] Bottom of Reach	Δ Conductivity [µs/cm]
Middle Fork	1	7.36	7.69	-0.33	15.4	15.9	-0.5	34.4	32.2	2.2
UNT to Middle Fork	1A	6.37	6.78	-0.41	8.1	8.4	-0.3	38.7	40.2	-1.5
Middle Fork	2	7.49	7.44	0.05	13.4	15.4	-2	31.5	31.2	0.3
Jenkins Hollow	2A	5.32	6.74	-1.42	4.8	5.5	-0.7	27.4	34.6	-7.2
Middle Fork	3	6.47	7.53	-1.06	12.9	13.2	-0.3	30.4	28.2	2.2
Birch Hollow	3A	4.71		4.71	3.7	4.4	-0.7	32.4	28.1	4.3
Middle Fork	4	7.1	6.26	0.84	8.3	5.8	2.5	29.6	35.8	-6.2
Larson Hollow	4A	4.61	6.96	-2.35	2.7	5.4	-2.7	34.4	27.7	6.7
Middle Fork	5	6.85	7.08	-0.23	5	5.1	-0.1	32.2	30.5	1.7
Maple Run	5A	6.81	6.65	0.16	4.9	5	-0.1	29.8	31.6	-1.8
Myers Hollow	5A1	4.55	6.5	-1.95	0.6	4	-3.4	36.1	34.8	1.3
Maple Run	5B	5.88	6.34	-0.46	1.9	1.9	0	29.8	30.3	-0.5
Maple Run	5B1	4.8	5.7	-0.9	7	2.6	4.4	40	32.6	7.4
Mealey Hollow	5C	5.51	6.11	-0.6	1.2	1	0.2	27.6	24.8	2.8
Middle Fork	6	7.77	7.57	0.2	2.4	2.2	0.2	34	30.6	3.4
UNT to Middle Fork	6A	8.1	7.92	0.18	6.1	3	3.1	31.9	32.8	-0.9
Middle Fork	7	6.7	8.42	-1.72	0.9		0.9	31.7	34.9	-3.2
UNT to Middle Fork	7A	6.73	6.73	0	7.1	0.3	6.8	55	6.45	48.55
Middle Fork	8	7.86	7.86	0	5.5	15.1	-9.6	17.1	23.5	-6.4

NAME	GIS_ID	pH Top of Reach	pH Bottom of Reach	Δ pH	H_2O Temp [°C] Top of Reach	H_2O Temp [°C] Bottom of Reach	Δ Temp [°C]	Conductivity [µs/cm] Top of Reach	Conductivity [µs/cm] Bottom of Reach	Δ Conductivity [µs/cm]
Minimum		4.6	5.7	-2.4	0.6	0.3	-9.6	17.1	6.5	-7.2
Maximum		8.1	8.4	4.7	15.4	15.9	6.8	55.0	40.2	48.6
Median		6.7	6.9	-0.3	5.0	5.1	-0.1	31.9	31.2	1.3
Mean		6.4	7.0	-0.3	5.9	6.3	-0.1	32.8	30.0	2.8
Range		3.6	2.7	7.1	14.8	15.6	16.4	37.9	33.8	55.8

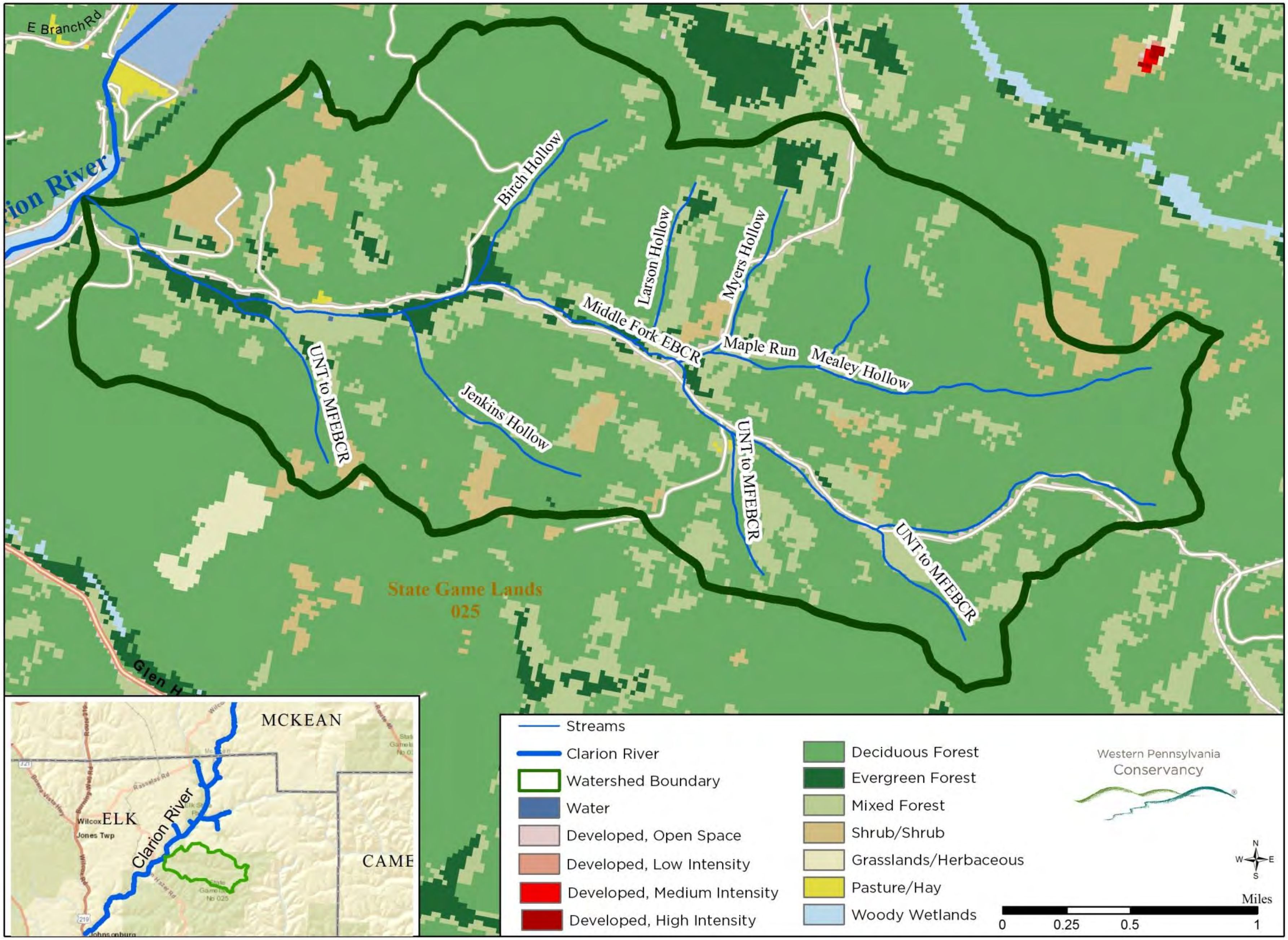
**Min., Max., Median, Mean, and Range habitat parameter scores do not include dry segment scores in their analysis.*

Appendix 2: Watershed Maps

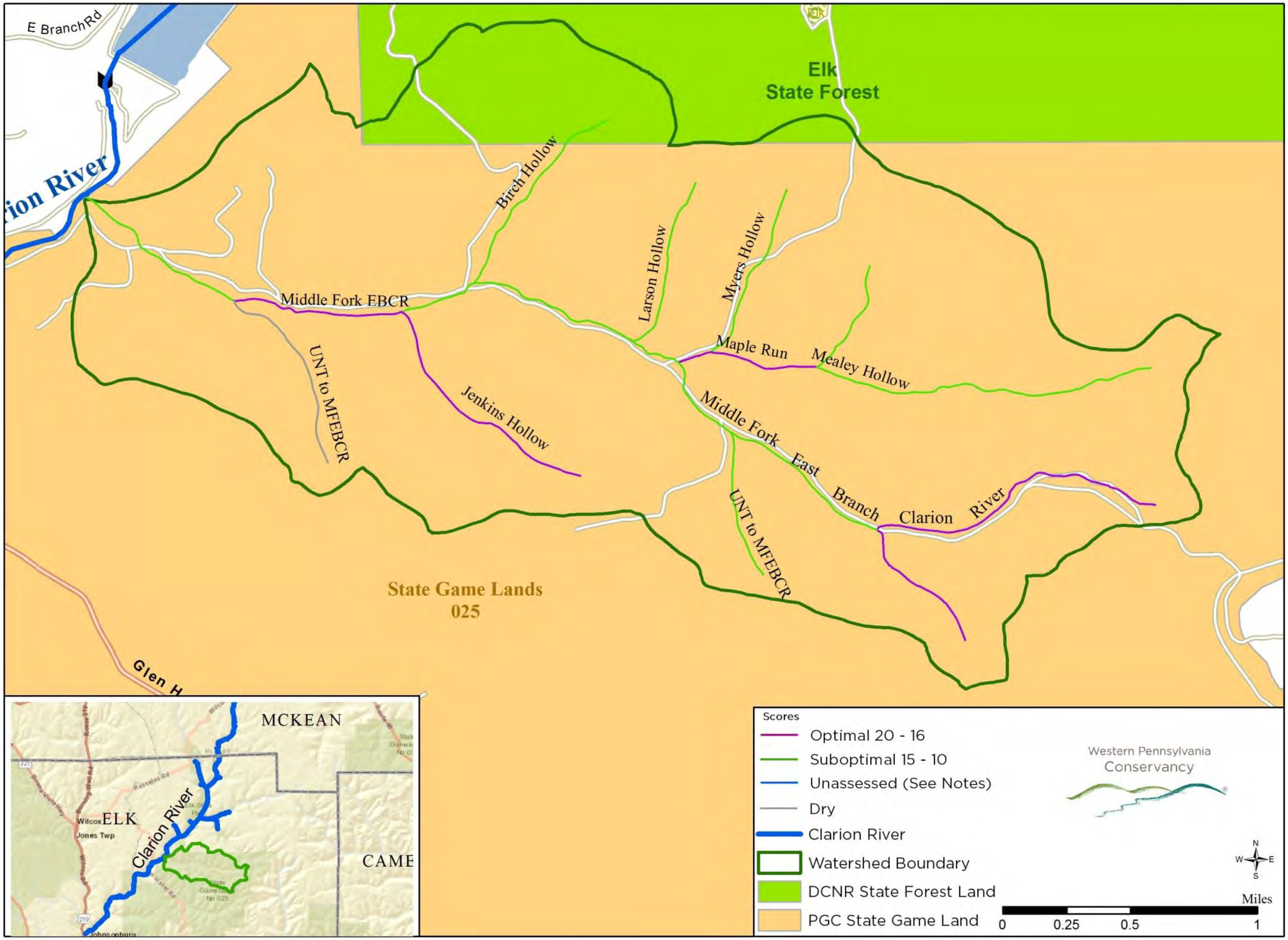
Middle Fork East Branch Clarion River - GIS ID's



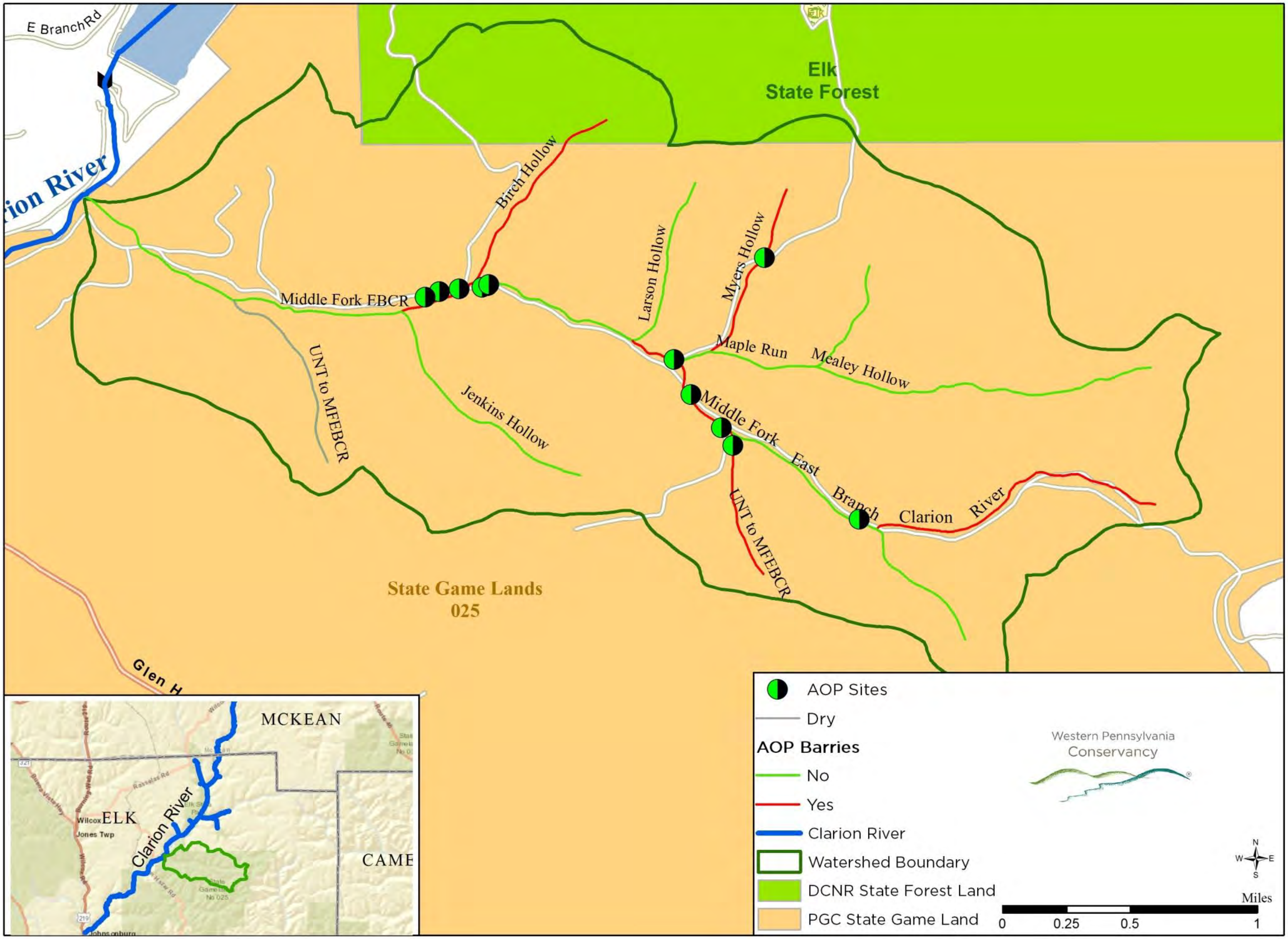
Middle Fork East Branch Clarion River - Land Cover



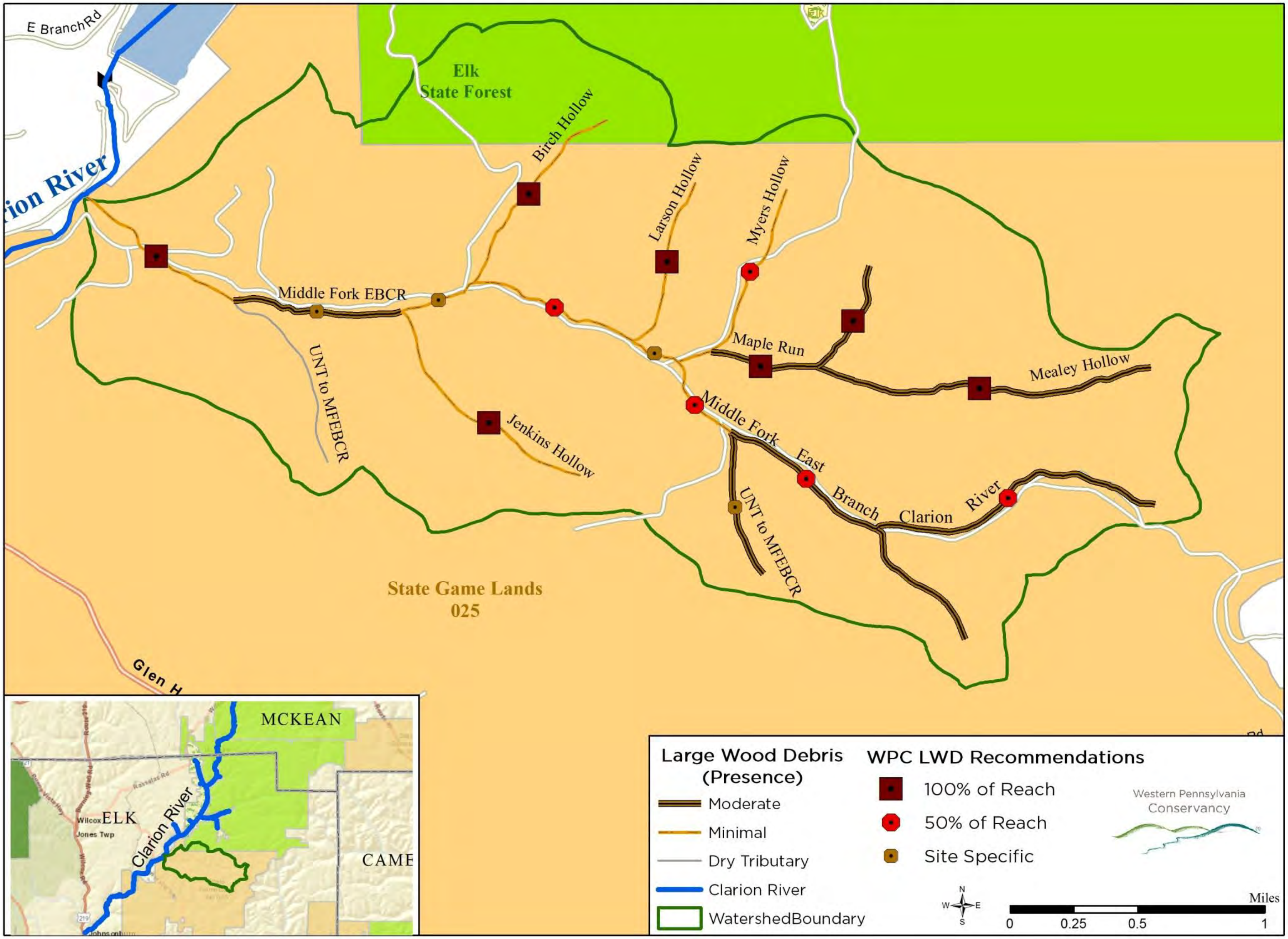
Middle Fork East Branch Clarion River - Total Habitat Scores



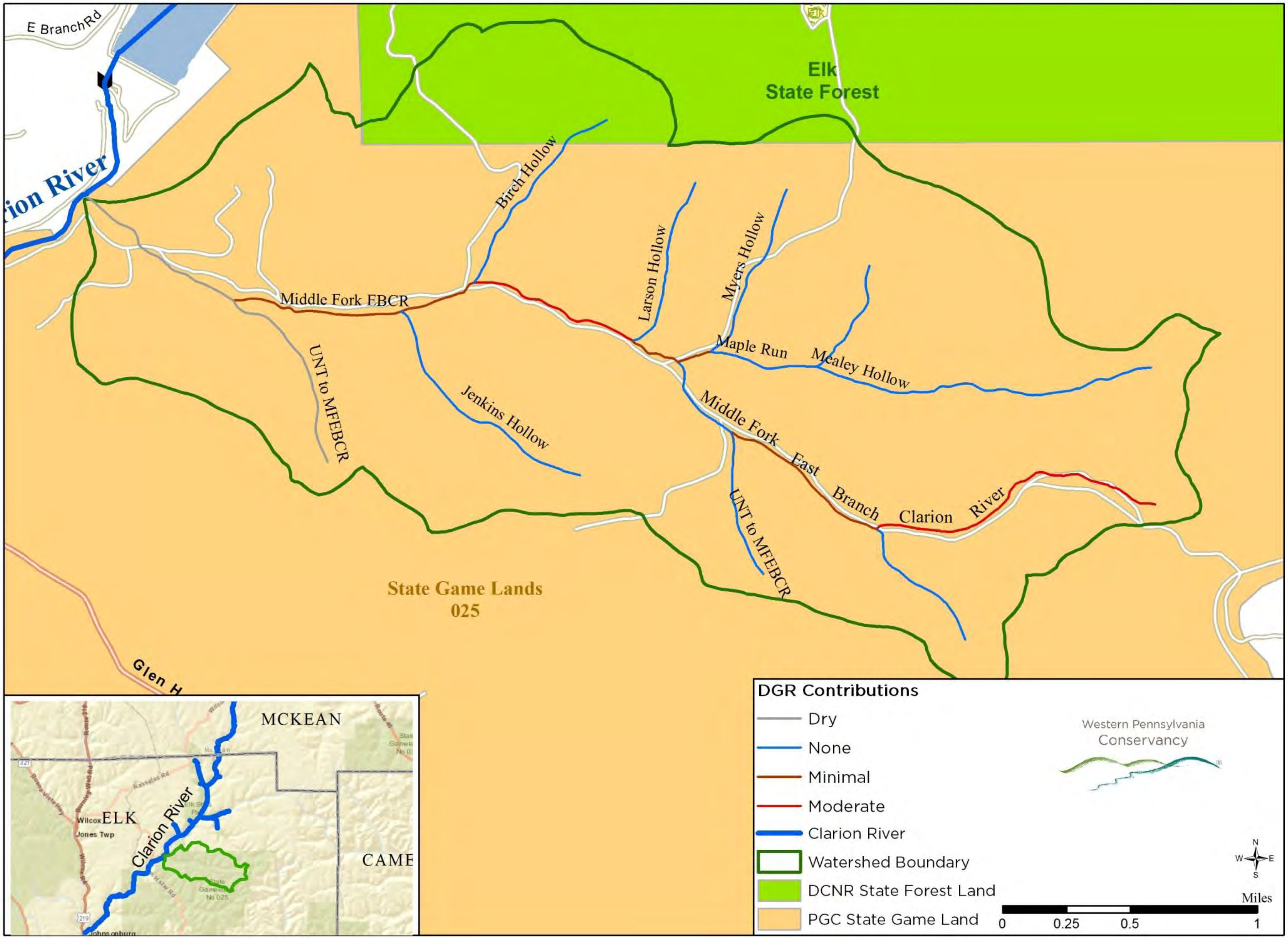
Middle Fork East Branch Clarion River - AOP Barriers Present



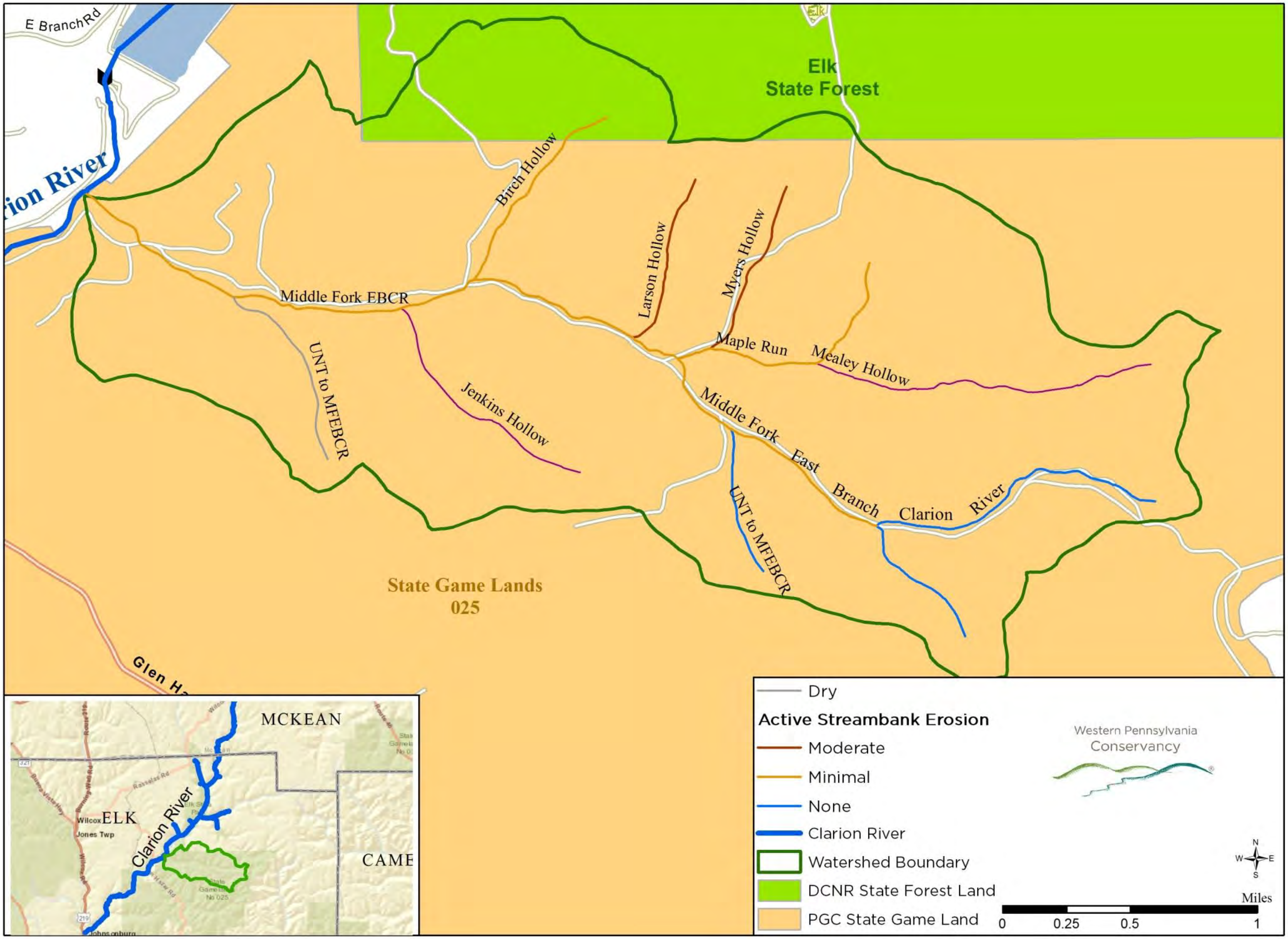
Middle Fork East Branch Clarion River Watershed



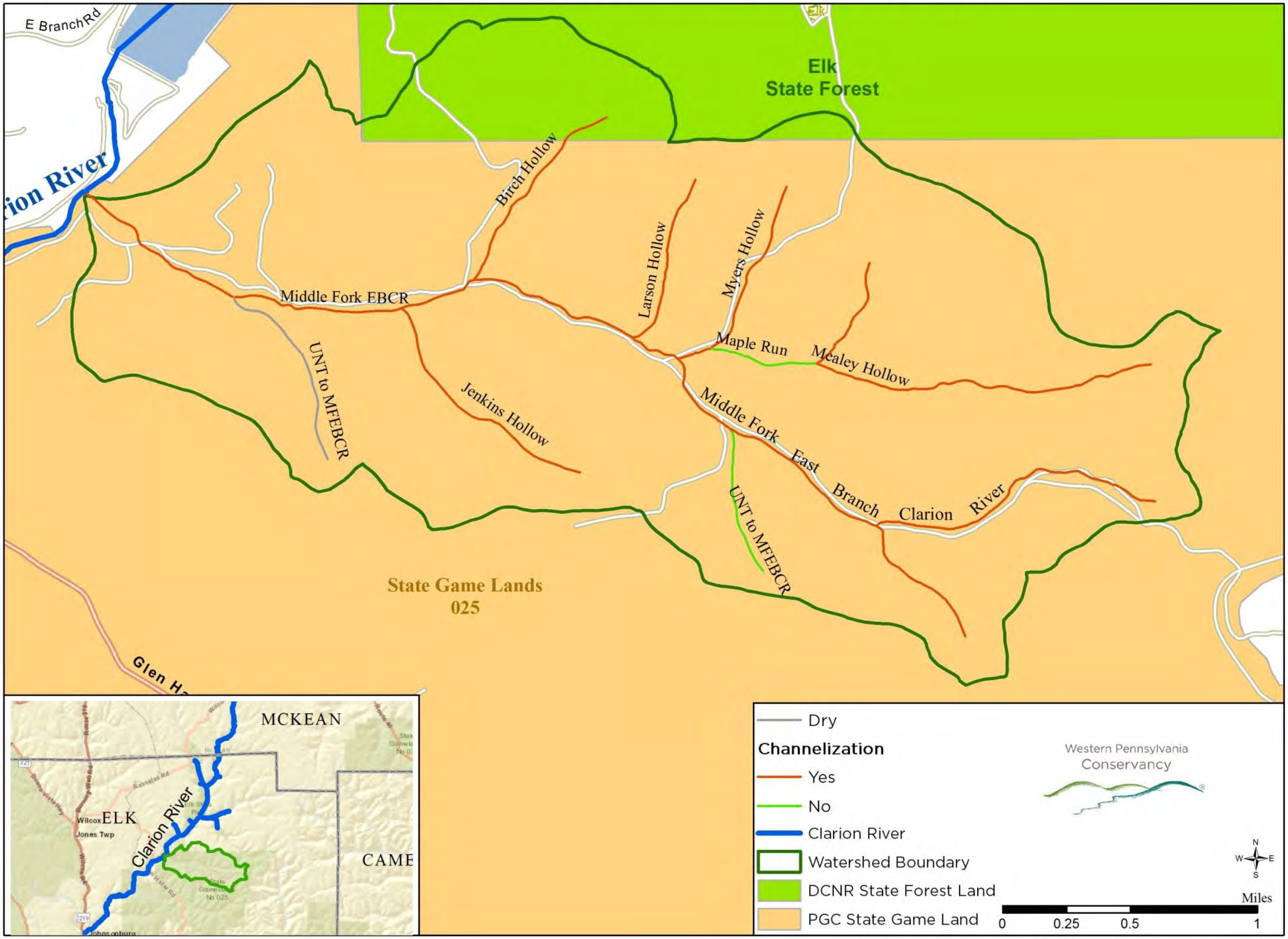
Middle Fork East Branch Clarion River - DGR Contributions



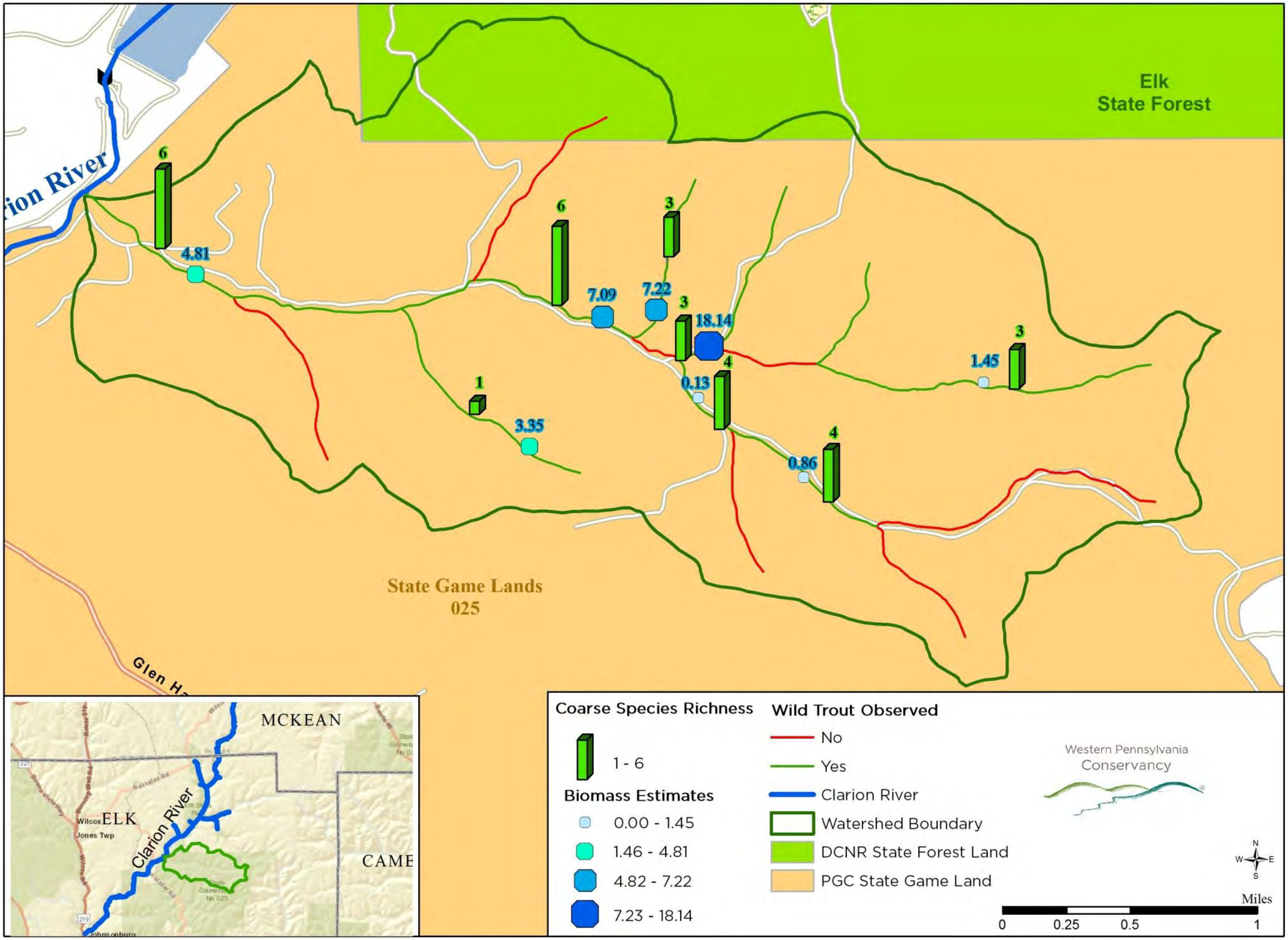
Middle Fork East Branch Clarion River - Erosion Presence



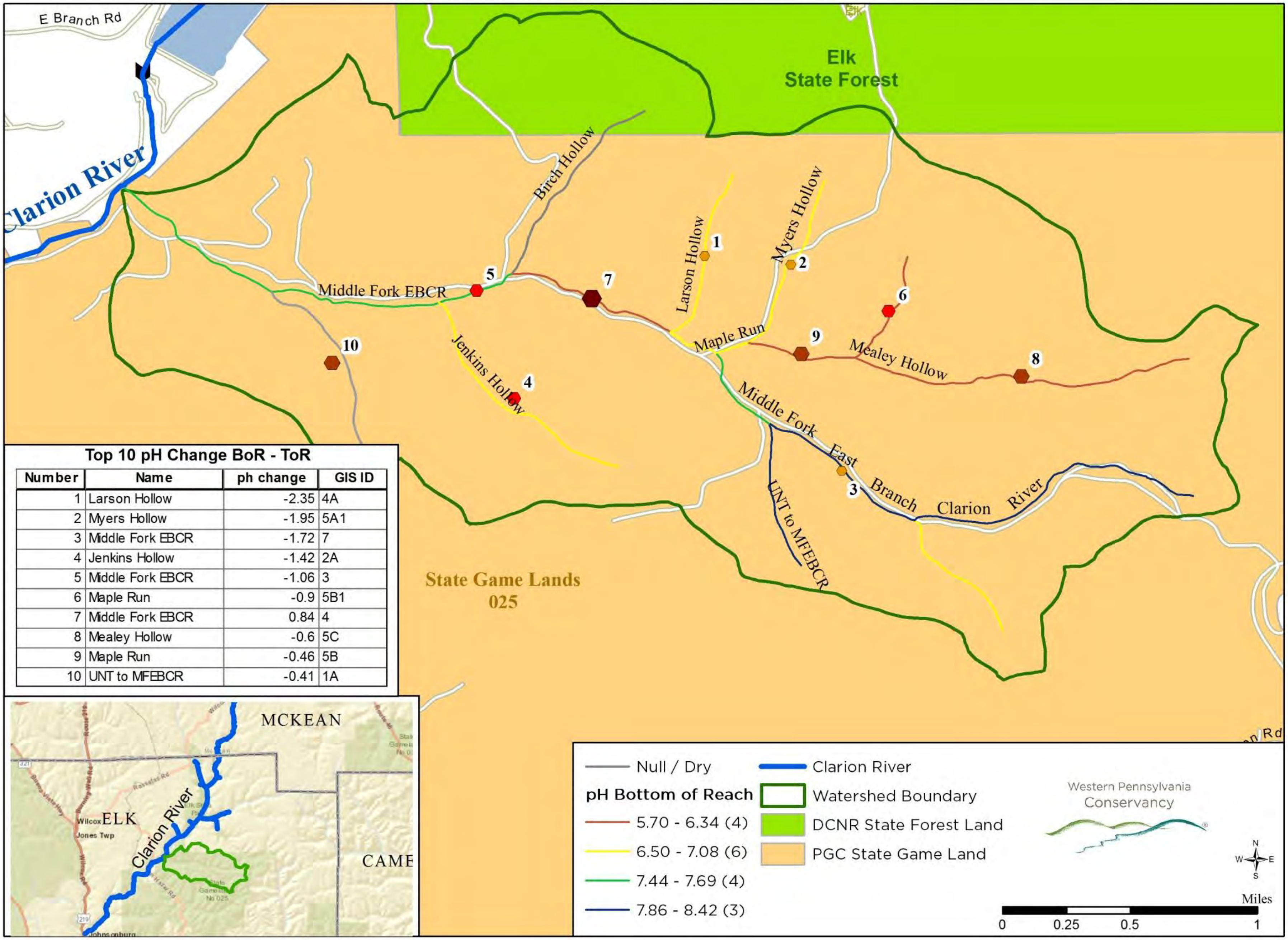
Middle Fork East Branch Clarion River - Channelization



Middle Fork East Branch Clarion River - Native and Wild Trout Observered



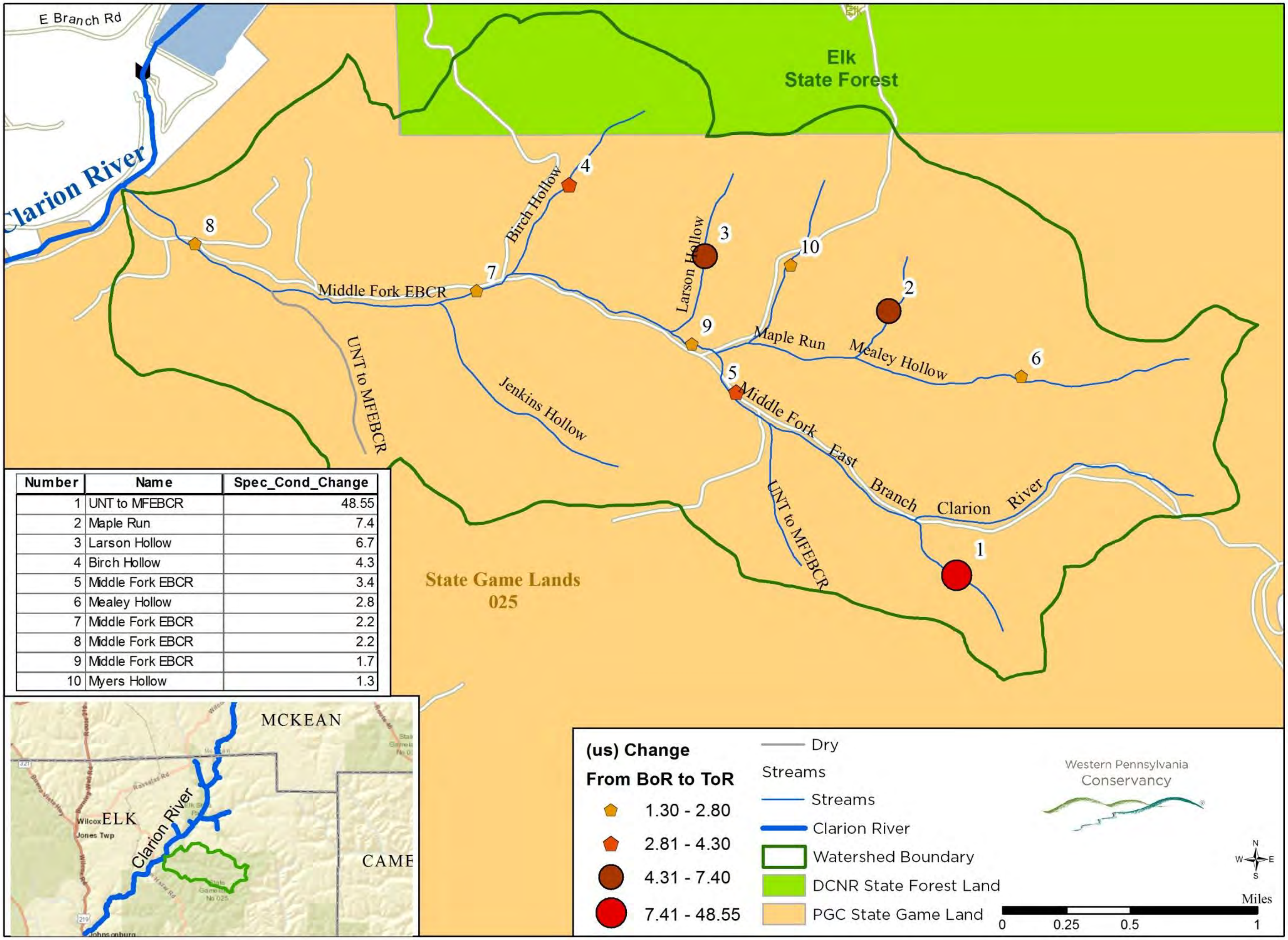
Middle Fork East Branch Clarion River - pH Bottom of Reach and Change



Top 10 pH Change BoR - ToR

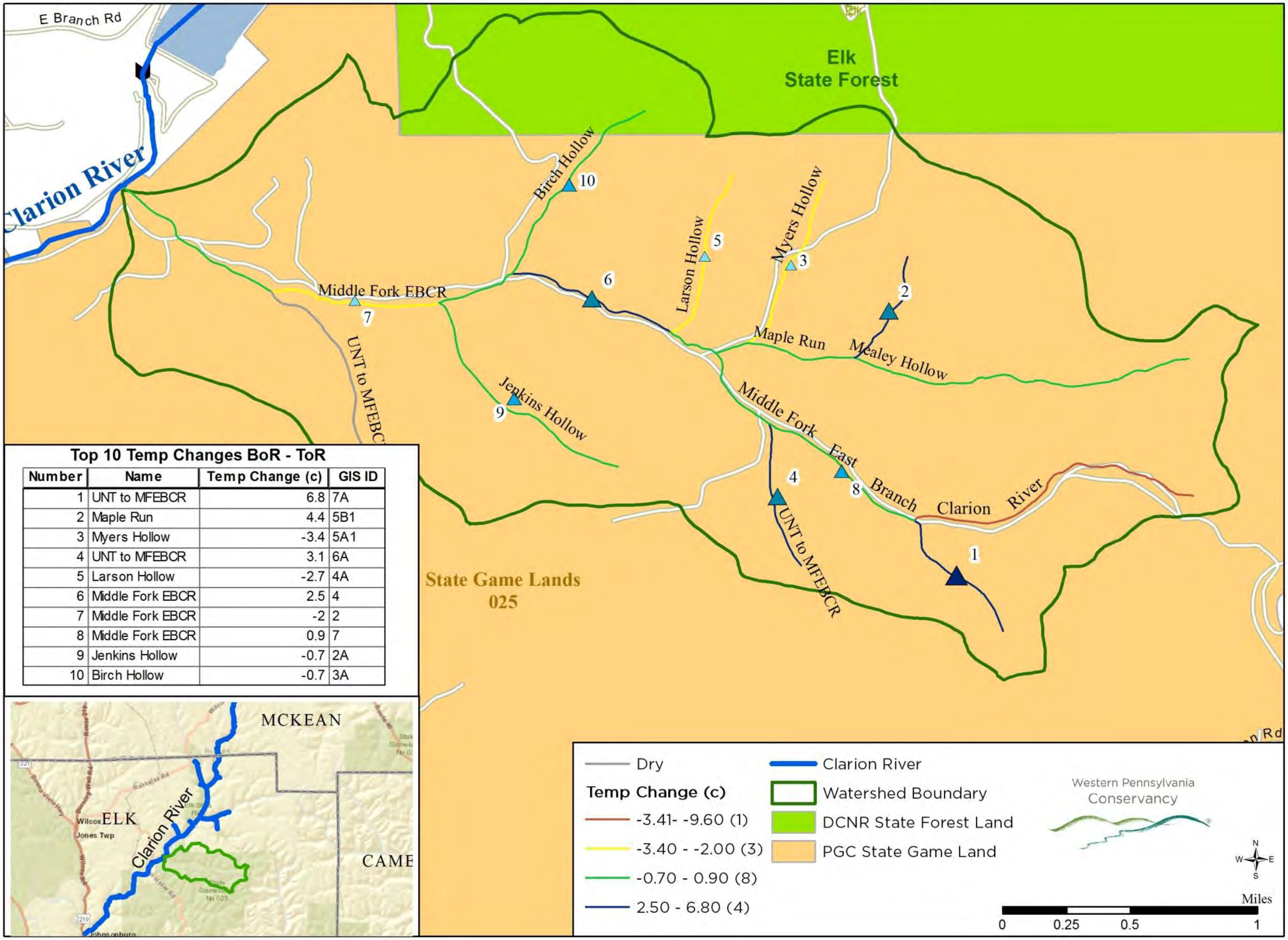
Number	Name	ph change	GIS ID
1	Larson Hollow	-2.35	4A
2	Myers Hollow	-1.95	5A1
3	Middle Fork EBCR	-1.72	7
4	Jenkins Hollow	-1.42	2A
5	Middle Fork EBCR	-1.06	3
6	Maple Run	-0.9	5B1
7	Middle Fork EBCR	0.84	4
8	Mealey Hollow	-0.6	5C
9	Maple Run	-0.46	5B
10	UNT to MFEBCR	-0.41	1A

Middle Fork East Branch Clarion River - Specific Conductivity Change



Number	Name	Spec_Cond_Change
1	UNT to MFEBCR	48.55
2	Maple Run	7.4
3	Larson Hollow	6.7
4	Birch Hollow	4.3
5	Middle Fork EBCR	3.4
6	Mealey Hollow	2.8
7	Middle Fork EBCR	2.2
8	Middle Fork EBCR	2.2
9	Middle Fork EBCR	1.7
10	Myers Hollow	1.3

Middle Fork East Branch Clarion River - Temp(c) Change - BoR - ToR



Top 10 Temp Changes BoR - ToR

Number	Name	Temp Change (c)	GIS ID
1	UNT to MFEBCR	6.8	7A
2	Maple Run	4.4	5B1
3	Myers Hollow	-3.4	5A1
4	UNT to MFEBCR	3.1	6A
5	Larson Hollow	-2.7	4A
6	Middle Fork EBCR	2.5	4
7	Middle Fork EBCR	-2	2
8	Middle Fork EBCR	0.9	7
9	Jenkins Hollow	-0.7	2A
10	Birch Hollow	-0.7	3A

Appendix 3: Standard Data Forms

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME	**SEGMENT ID**	
GIS ID # __________	**STREAM CLASS**	
LAT ______________ **LONG** ______________	**RIVER BASIN**	
STORET # N/A	**AGENCY** Western Pennsylvania Conservancy	
INVESTIGATORS		
FORM COMPLETED BY	**DATE** ___________________ **TIME** __________ **AM PM**	**REASON FOR SURVEY**

WEATHER CONDITIONS	**Now** ☐ clear/sunny ☐ storm (heavy rain) ☐ rain (steady rain) ☐ showers (intermittent) ☐ % cloud cover (circle %) 25% - 50 % - 75% - 100%	**Past 24 hours** ☐ clear/sunny ☐ storm (heavy rain) ☐ rain (steady rain) ☐ showers (intermittent) ☐ % cloud cover (circle %) 25% - 50 % - 75% - 100%	**Has there been a heavy rain in the last 7 days?** ☐ Yes ☐ No **Air Temperature** _____ °F **Other**________________________________

FEATURES of NOTE:

Describe significant features and/or impacts seen in section. Include GPS points when applicable

Latitude (North)	Longitude (West)

☐ Check box if stream is dry and record any significant info about section.

HABITAT IMPROVEMENT OPPORTUNITIES:

☐ Segment has need for improvement project(s)

Describe:

Recommendation(s):

Segment Accessibility:

☐ Excellent ☐ Good ☐ Poor ☐ In-Accessible – Describe:____

STREAM CHARACTERIZATION

Stream Subsystem
☐ Perennial ☐ Intermittent

Stream Type
☐ Main Stem ☐ Named Tributary
☐ Unnamed Tributary ☐
☐ Headwater UNT ☐ Other ________

Stream Type
☐ Coldwater ☐ Warmwater

WATERSHED FEATURES (with in 30 meter buffer)

Predominant Surrounding Land-Use (Must = 100%)

☐ Forest ____%
☐ Field/Pasture ____%
☐ Agricultural ____%
☐ Open space (i.e., parks/golf courses) ____%
☐ Commercial/Industrial ____%
☐ Residential ____%
☐ Paved Roads ____%
☐ Dirt and Gravel Roads ____% (TWP, Gas & Logging)
☐ Rail Line ____%
☐ Wetland ____%
☐ Other _______________ ____%

Stormwater Inputs ☐ None

☐ Tile Drain ☐ Road Ditch ☐ Urban Stormwater Pipe
☐ Field Ditch ☐ Overland Flow

D&GR Sediment Contribution (Runoff): ☐ None

☐ Minimal ☐ Moderate ☐ Heavy

Bank revetments: ☐ None

☐ Rip-rap ☐ Gabion ☐ Concrete ☐ Other ________

VEGETATION INFORMATION

NOTE: Bank side determined when facing DOWN Stream

Riparian Zone Width **Riparian Zone Encroachment** ☐ Yes ☐ No

Right Bank: ☐ 0 – 15 feet ☐ 16 – 50 feet ☐ 51 – 150 feet ☐ 150 – 300 feet ☐ Greater than 300 feet
Left Bank: ☐ 0 – 15 feet ☐ 16 – 50 feet ☐ 51 – 150 feet ☐ 150 – 300 feet ☐ Greater than 300 feet

Indicate dominant vegetation type within riparian zone (~18 meter buffer),and record dominant species present:

☐ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous ☐ Invasive - Dominant species present:____________________________

Bank Canopy Vegetation:
Left Bank ☐ 100% (Shaded) ☐ 75% ☐ 50% ☐ 25% ☐ 0% (No Cover)
Right Bank ☐ 100% (Shaded) ☐ 75% ☐ 50% ☐ 25% ☐ 0% (No Cover)

Channel Canopy:
☐ Open ☐ Closed

Presence of Large Woody Debris (LWD): ☐ Significant ☐ Moderate ☐ Minimal ☐ None

Presence of aquatic vegetation: ☐ None ☐ Normal ☐ Excessive - Describe:________________________________

INSTREAM FEATURES

Average Stream Width _________ ft

Active Streambank Erosion for Segment

☐ None ☐ Minimal ☐ Moderate ☐ Heavy

Surface Velocity: ☐ Slow ☐ Moderate ☐ Fast

Flow Status: ☐ Low ☐ Moderate ☐ High

Springs/Seeps: ☐ Abundant ☐ Minimal ☐ None

Adjacent Wetlands: ☐ Abundant ☐ Minimal ☐ None

Proportion of Stream Morphology Types

☐ Riffle_______% ☐ Run_______% ☐ Pool_______%

Average Number of Riffles in section _______________

Channelization ☐ No ☐ Yes: Length of Straitening ____ft

Dam Present (Beaver or Human) ☐ Yes ☐ No

Constrictions Present : ☐ None ☐ Culvert ☐ Bridge
☐ Old Abutment ☐ Bedrock Outcrop ☐ Other _________

Stream Ford or Animal Crossing Present ☐ Yes ☐ No

Debris Jam Present ☐ Yes ☐ No

Connectivity to Flood Plain
(Zero percent equals not connected to flood plain)

Right Bank: ☐ 100% ☐ 75% ☐ 50% ☐ 25% ☐ 0%
Left Bank: ☐ 100% ☐ 75% ☐ 50% ☐ 25% ☐ 0%

WATER QUALITY

(During visual assessment use pH and conductivity meters to take reading.)

WQ Instrument(s) Used
____
____

pH ________ (Top of section) H2O Temp ________(Top)
pH________(Bottom of section) °F or C ________(Bot.)

Specific Conductance (Top)________ (Bottom)________

Turbidity (if not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other______

Water Odors
☐ Normal/None ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Fishy ☐ Other___________

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☐ None ☐ Other________________________

Overall Water Quality

☐ Excellent ☐ Good ☐ Fair ☐ Poor

Primary source(s) of water quality impact

☐ Agriculture ☐ Active Pasture ☐ AMD
☐ Gas Wells ☐ Development ☐ Sewage
☐ Bank Erosion ☐ Sedimentation

INORGANIC SUBSTRATE COMPONENTS
(should add up to 100%)

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		
Boulder	> 256 mm (10")	
Cobble	64-256 mm (2.5"-10")	
Gravel	2-64 mm (0.1"-2.5")	
Sand	0.06-2mm (gritty)	
Silt	0.004-0.06 mm	
Clay	< 0.004 mm (slick)	

Additional Notes

WT Observed? Y or N **Coord. of Obs.:**

HABITAT ASSESSMENT FIELD DATA SHEET – HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	**GIS ID #** _________
SEGMENT ID	**STREAM CLASS**
LAT _____________ **LONG** _____________	**RIVER BASIN**
STOREET # N/A	**AGENCY** Western Pennsylvania Conservancy
INVESTIGATORS	

FORM COMPLETED BY	**DATE** __________________ **TIME** _________ **AM PM**	**REASON FOR SURVEY** Visual Assessment

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate & Available Cover	Greater than 70% (50% for low gradient streams) of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% (30-50% for low gradient streams) mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% (10-30% for low gradient streams) mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% (10% for low gradient streams) stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/ Depth Regimes	All 4 velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (slow is <0.3 m/s, deep is >0.5 m).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET – HIGH GRADIENT STREAMS (BACK)

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) **Note: determine left or right side by facing downstream**	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) **Note: determine left or right side by facing downstream**	More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

HABITAT ASSESSMENT SCORE SHEET
HIGH GRADIENT STREAM

STREAM NAME	SEGMENT ID	
GIS ID # __________	STREAM CLASS	
LAT ______________ LONG ______________	RIVER BASIN	
STORET # N/A	AGENCY Western Pennsylvania Conservancy	
INVESTIGATORS		
FORM COMPLETED BY	DATE ____________________ TIME __________ AM PM	REASON FOR SURVEY Visual Assessment

Habitat Parameter	Score	Explanation of Score Given *(Complete especially for poor rating)*	
1. Epifaunal Substrate /Available Cover			
2. Embeddedness			
3. Velocity/ Depth Regimes			
4. Sediment Deposition			
5. Channel Flow Status			
6. Channel Alteration			
7. Frequency of Riffles (or bends)			
8. Bank Stability (score each bank) *Note: determine left or right side by facing downstream*	Total of LB & RB	(LB)	
		(RB)	
9. Vegetative Protection (score each bank) *Note: determine left or right side by facing downstream*	Total of LB & RB	(LB)	
		(RB)	
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Total of LB & RB	(LB)	
		(RB)	
Total Score		**Add all scores and divide by the number of scores given.**	

Appendix 4: Permitted Discharges

Not Applicable/none present