WILDLIFE & FISHERIES

Wildlife and fisheries refers to all mammal, bird, amphibian, snake, turtle, fish, and invertebrate species. These species are an integral part of many recreational activities in the watershed including fishing, hunting, viewing, and photography and are renewable resources when given the proper habitat conditions. Ecologically, these species comprise a distinct biological community within Pennsylvania. The following chapter reviews the fisheries, physical habitat, and wildlife resource attributes of the Kettle Creek watershed.

Fishery Management Anthology

A fishery is a system composed of three interacting elements: habitat (the environment, including both living and non-living components); biota (the living organisms in a ecosystems, including fishes, plankton, aquatic insects, birds, mammals); and humans, who are both users of fishery resources (for example recreational anglers) and competitors for water. Fishery management is the manipulation of the three interacting elements in a fishery to meet intended and desirable objectives (Murphy and Willis 1996). This section summarizes the management strategies on Kettle Creek by the Pennsylvania Fish and Boat Commission (PFBC) from past to present and the current surface water protection designations given by the Department of Environmental Protection (DEP).

PLANKTON are free-floating microscopic organisms, including algae, plants, and animals that cannot swim against a current

BUFFERING CAPACITY is the ability of a stream to maintain the water pH within a narrow range.

INDIGENOUS refers to an organism that is native to a geographic region.

FISHERIES MANAGEMENT

Kettle Creek is a freestone stream, originating in a forest region of Elk Township, western Tioga County, near the Potter-Tioga County line. A freestone stream is one with very little buffering capacity having little to no limestone along with low alkalinity. The majority of the watershed is forested. Rolling farmlands cover the rim of the upper basin and the U-shaped valley is relatively undeveloped forest. A large portion of the drainage area is in the Susquehannock and Sproul state forests. Human habitation and development along the stream valley are limited to scattered hunting camps and small settlements with few permanent residents. Three state park impoundments (Ole Bull Dam, Kettle Creek Lake and Kettle Creek Recreation Dam) are present on Kettle Creek. The Ole Bull Dam and Kettle Creek Dam are small in height, 12-15 ft (4.2-4.6 meters), and the impoundments are used primarily for recreation. The Alvin R. Bush Dam, which forms Kettle Creek Lake, is 165 ft (50.3 m) in height and provides flood control and recreation. Kettle Creek becomes impacted by mine drainage about three miles (4.8 km) below the dam. Six miles (9.6 km) below the dam, where Two Mile Run enters Kettle Creek, is no longer suitable for stocking and maintaining trout populations.

Pennsylvania Fish and Boat Commission Kettle Creek access sign

The Department of Environmental Protection (DEP) designates the waters from the Alvin R. Bush Dam to the confluence of the Susquehanna River as a Trout Stocking Fishery (TSF). TSF requires the protected water use to be maintained with stocked trout from February 15 to July 31 and the maintenance and propagation of fish species and additional plants and animals, which are indigenous to warm water habitats. The DEP also designated the waters from the inlet of Kettle Creek Reservoir to Alvin R. Bush Dam as a High Quality- Trout Stocking Fishery (HQ-TSF). For waters to qualify as High Quality (HQ) the surface water must meet certain criteria. This section of Kettle Creek qualified to receive the HQ designation because of its Class A wild trout stream designation given by the PFBC. All waters above the reservoir pool elevation received the DEP designation of Exceptional Value Water (EV), in which the surface waters meet the criteria for HQ waters as well as more stringent criteria (Figures 4.4 and 4.5). The conditions that qualify Kettle Creek for EV status are 1) the majority of surface water is located in state park natural areas and state forest natural areas, 2) plus some of the water is labeled as exceptional recreational value and 3) that a portion of water is designated as "wilderness trout stream" by the PFBC (Department of Environmental Protection 1999).

Extensive logging occurred in the Kettle Creek watershed between 1890 and 1920. Whole tributary watersheds would be cut at one time after rail lines were installed to transport lumber to the mills (Taber 1972). Some lumber companies would transport their timber to downstream mills by binding the logs together and rafting them to the mill, while others built splash dams along the tributaries that retained the flows of natural springs and streams. The release of the water behind these dams would then carry the logs to the mainstem. Uncontrolled fires and poor logging practices used during this period

Photo Courtesy of Railroad Museum of Pennsylvania, Pannsylvania Historical and Museum Commission

Poor logging practices at Hammersley railway station in the early 1900s

were detrimental to the fishery resources; however, fishing was reported to have been best in the early 1900s (Watts and others 1942). Reasons for this apparent inconsistency are unclear. Timber removal produced increased water yields in the watershed for up to ten years, which may have kept stream temperatures low. Stream temperature is an important factor that influences the types of species and fish communities able to survive and reproduce in that environment. In turn, the increased water yield helped to flush the high amount of siltation produced by the lack of erosion control methods during logging (Hollender and others 1983).

Historically there has been a decline in the brook trout (*Salvelinus fontinalis*) fishery, which may have been due to the introduction of brown trout (*Salmo trutta*) into the watershed (Watts and Harvey 1946). Brown trout were first released in Cross Fork Creek in the 1920's because of their ability to reach larger sizes and survive at slightly higher temperatures than

brook trout. Brown trout became well established throughout the drainage by the 1940s. Increased angling pressure or harvesting on Kettle Creek may also have lead to the demise of the brook trout fishery, since brook trout are more susceptible to angling pressures than brown trout (Watts and others 1942). Brook and brown trout were stocked during the 1930s and trout stocking has continued to the present. Rainbow trout have also been stocked since 1936 in the Clinton County portion of Kettle Creek and since 1946 in the Potter County portion. Smallmouth bass (*Micropterus dolomieu*), catfish (*Ictalurus spp.*), and yellow perch (*Perca flavescens*) were stocked in the lower reaches during the mid 1930's to early 1940's (Hollender and others 1983). In addition to Kettle Creek, stocking included Kettle Creek Recreation Dam, Kettle Creek Lake, Cross Fork Creek, Little Kettle Creek, Germania Branch, Trout Run, and Hammersley Fork. Local cooperative nurseries also made additional stockings. While brook trout are dominant in the headwaters, they are quickly replaced downstream by brown trout, which yield to smallmouth bass near Kettle Creek Lake.

Not all management strategies have worked, even though they may be done with the best intentions. The addition of the Alvin R. Bush dam allowed for the waters below it to increase temperatures enough to negatively impact the trout fishery below the dam. The PFBC and Army Corps of Engineer cooperated in establishing a coldwater release to promote a coldwater tailwater fishery downstream from the dam to Owl Hollow; unfortunately this alteration did not improve conditions as much as intended (B. Hollender, PFBC, personal communication 2001).

Kettle Creek is managed chiefly for a catchable trout fishery. The Pennsylvania Fish and Boat Commission (PFBC) classify trout streams from A through D according to fish abundance or

Photo:Tim Stecko

Yellow perch (Perca flavescens)

Combined Trout Stream Classificatior		
Class	lbs/acre	Total biomass kg/ha
A	36 lbs/a	at least 40 kg/ha
B	18 lbs/a	at least 20 kg/ha
C	9 lbs/a	at least 10 kg/ha
D	< 9 lbs/a	less than 10 kg/ha

Figure 4.1 - Trout Stream Classification

Management Classifications			
Class	miles	km	%
A	60.1	96.9	14
B	7.9	12.7	1.9
C	7.6	12.3	1.7
D	27.1	43.7	6.3
NC	315.2	508.4	73.8
L	4.2	6.8	1
WWF	5.8	9.3	1.3

Figure 4.2 - Management Classification

biomass (the combined weight of a group of fish usually expressed by unit area or volume pounds per acre/kilograms per hectare) (Figure 4.1). Other stream categories defined by the PFBC are low density trout population (L) and warm water fishery (WWF) (Figure 4.2). Currently, of the 430 stream miles (694 km) of Kettle Creek and its tributaries, 73% are not classified (NC). Of the remaining 27%, class A dominates with 60 miles (97 km) or 14% of streams. Class B, C, L, and WWF are represented by a very

small percentage or number of miles, while class D streams encompass 27 miles (44 km) of Kettle Creek. The PFBC stocks approximately 26 miles (43 km) of Kettle Creek and its tributaries in streams classified as B, C, D, or L indicated by an (S) following the classification. There is a stream section below the Alvin R. Bush Dam that contains no trout due to poor water quality caused by acid mine drainage which is indicated by (MD). The PFBC manages 16 miles (27 km) of either Class A or B waters under the Heritage angling program or Wilderness Trout stream program indicated by a (H) or (W) respectively following the biomass classification (Figure 4.3). Drastic declines in the wild brown trout populations were recorded during the 1996 inventory on the section of Cross Fork Creek, managed under the Heritage Angling Program. These declines appear to have been the result of severe climatic events during the summer of 1995, during which a drought occurred, followed by an early winter flood of 1996.

Kettle Creek is one of the most intensively stocked streams in the Commonwealth. Currently, it is managed chiefly for catchable trout fishery under statewide angling regulations except for specially regulated areas. Two of these special areas are reserved for use by children under 12 and disabled persons and are located at Cross Fork and Ole Bull State Park. Cross Fork Creek; from Bear Trap Lodge downstream to the weed property encompassing 5.4 miles (9 km), is managed under the Heritage Trout Angling program for catch-and-release fishing with barbless artificial flies. The Delayed Harvest Fly-Fishing-Only area (formerly Fish-for-Fun) was purchased in 1971 by the Pennsylvania Fish and Boat Commission (PFBC) and is on the main-stem of Kettle Creek; from 500 feet (152 m) downstream of SR 0144 bridge upstream for a distance of 1.7 miles (2.8 km).

Class A wild trout water is a surface water classification by the PFBC, based on species-specific biomass standards, that says a stream must support a population of naturally produced trout of sufficient size and abundance to support a long-term and rewarding sport fishery.

ANGLING PRESSURE is the amount of fishing that takes place in a specific area over a period of time; it is usually measured in angler-hours or angler-trips.

The John Summerson Branch, a tributary of Trout Run and the upper section of Hammersley Fork, a tributary of Kettle Creek are managed under the Wilderness Trout Stream program, which is a surface water designation by the PFBC to protect and promote native trout fisheries and maintain and enhance wilderness aesthetics and ecological requirements necessary for the natural reproduction of trout (See Figure 4.3.). Kettle Creek Lake is a part of the Select Trout Stocked Lake Program, which allows anglers to fish the lake for trout during March when most stocked waters are closed to fishing. Kettle Creek Lake and a part of the main-stem from the Potter/Clinton county line to Owl Hollow are also classified as "approved trout waters", which means they meet the PFBC criteria to be stocked with trout (Pennsylvania Fish and Boat Commission 2001). At the present time no other fish are stocked in Kettle Creek or its tributaries except trout. Cooperative stocking is still occurring but varies every year.

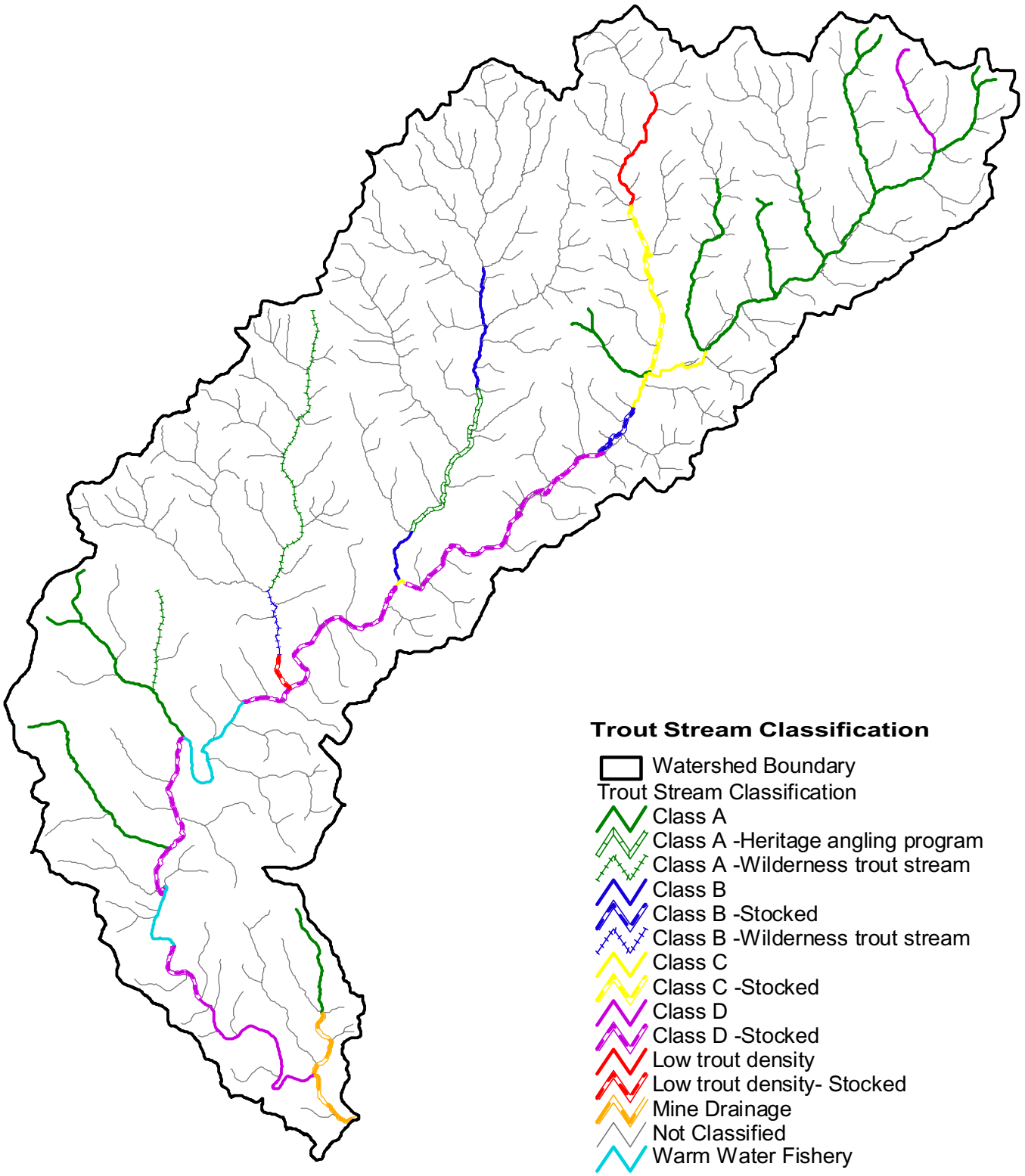


Figure 4.3 - Trout biomass and management programs

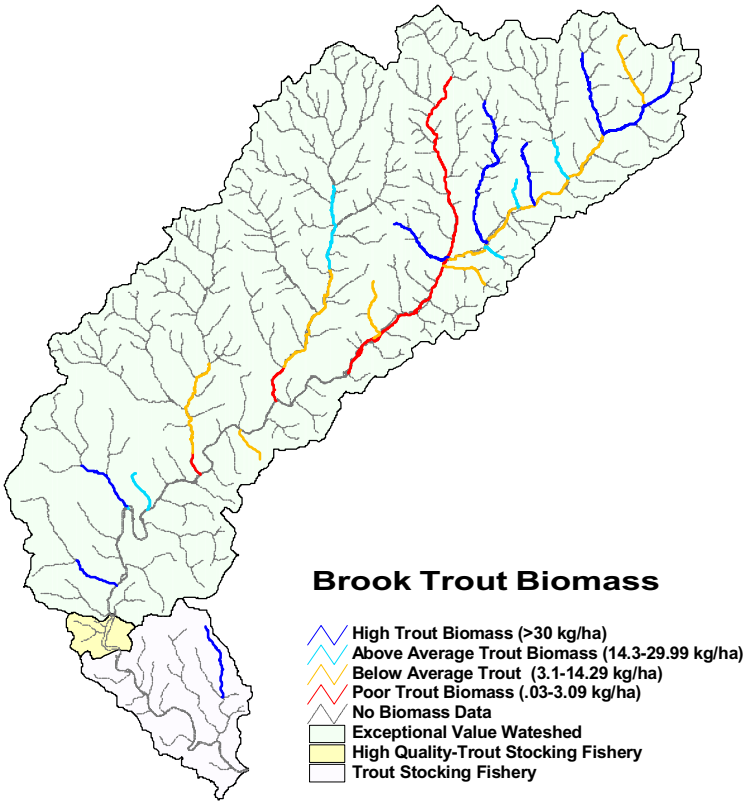


Figure 4.4 - Brook Trout Biomass

Photo:Tim Stecko

Brook trout (Salvelinus fontinalis) - male in breeding coloration.

Photo:Tim Stecko

Brown trout (Salmo trutta)

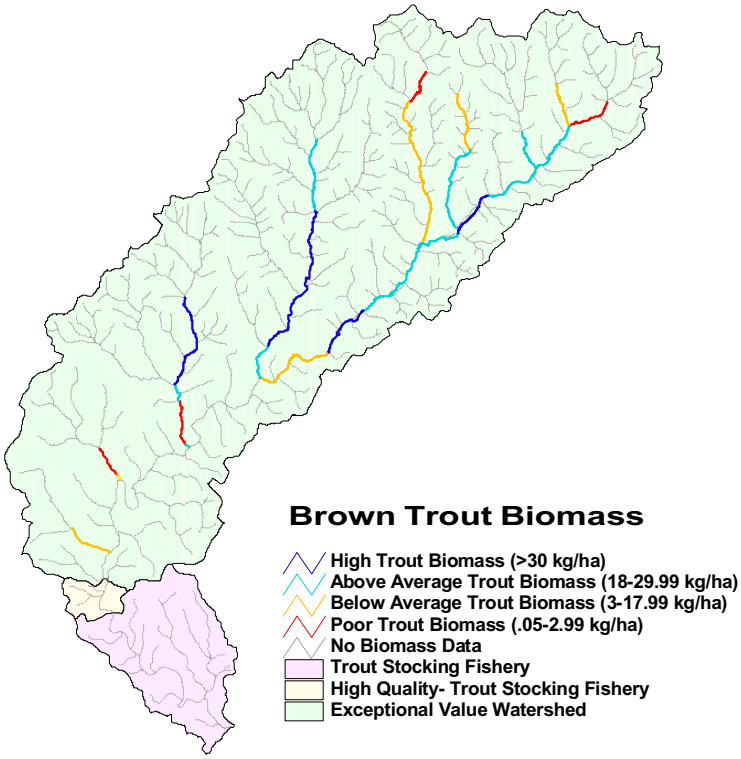


Figure 4.5 - Brown Trout Biomass

Photo:Tim Stecko

Rainbow trout (Oncorhynchus mykiss)

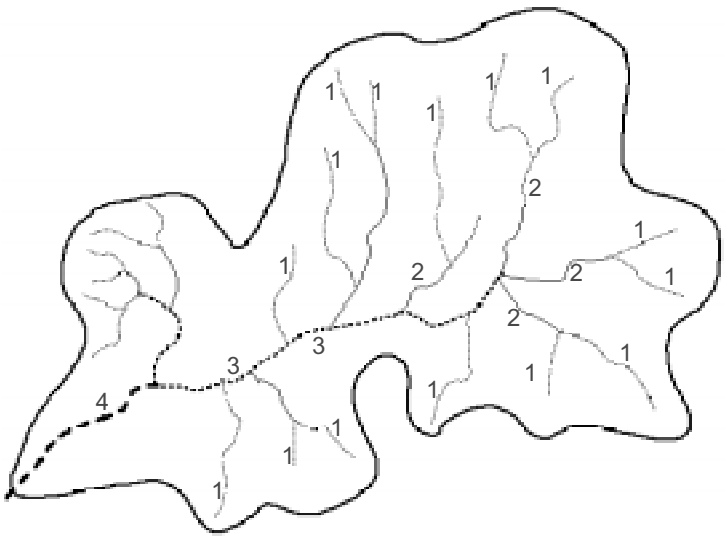


Figure 4.6 - Stream order ranking modified from Murphy and Willis (1996).

STREAM ORDER is the ranking of relative sizes of streams within a watershed based on the nature of their tributaries. A first-order stream receives no defined tributaries; a second-order stream results from the confluence of two first-order streams and so on.

In 2000, West Clinton Sportsman's Association stocked 1,237 trout in Kettle Creek. In both Clinton County and Potter County angler clubs stocked 3,976 trout in the Clinton County sections plus 11,143 in the Potter County portion.

Upper Kettle Creek provides anglers with a diverse quality trout fishing in an aesthetically pleasing natural environment. Water quality in upper Kettle Creek is affected by seasonally high water temperatures, which limits the wild trout populations (Figures 4.4 and 4.5). Channels that have scoured and shifted overtime may have reduced potential trout habitat. Anglers willing to walk to remote areas may be rewarded by sections of stream that support excellent wild brook and naturalized brown trout populations. Despite the rather sparse human population, angling pressure is comparatively heavy because many anglers travel to the area from other parts of Pennsylvania and surrounding states. Overall, trout stocking appears to be a sensible management strategy on Kettle Creek.

Trout: Biology

Many members of the trout family are highly valued game and sport fish, supporting important fisheries in coldwater ecosystems. The wide distribution of these species reflects, in part, historical popularity of trout transplants and stocking. Brook trout are native to eastern North America, from Canada to the southern Appalachians in Georgia and west to Minnesota, and have been introduced into many coldwater ecosystems in western regions. Rainbow trout (*Oncorhynchus mykiss*) are native to western North America, although they have been widely stocked throughout north central and northeastern America. Brown trout are native to Europe and western Asia but were transplanted to the United States in 1883 and now occur in coldwater ecosystems throughout Canada and the northern United States (Hocutt and Wiley 1986).

All trout prefer clear, cool, well-oxygenated lakes and streams. Brook trout occur most commonly in small first-order or headwater streams (Figure 4.6) and lakes, often at high elevations. The brook trout is able to survive in very cold conditions with a short growing season and are relatively intolerant of warm water, seeking

out temperatures below 68°F (20°C) in the summer. Rainbow trout are usually found in cool lakes and streams with adequate shallows and vegetation to support good food production. They are most successful in habitats with temperatures of 70°F (21°C) or slightly lower. Brown trout can remain active and can thrive at slightly higher temperatures than brook trout, but otherwise have similar habitat requirements. The optimum temperature range for brown trout is 65-70°F (18-21°C) (Willers 1981).

For streams and lakes to support self-sustaining trout populations, habitat suitable for spawning and survival of eggs and fry must be available. Brook, rainbow, and brown trout all spawn over gravel beds in small streams. Mature fish may travel upstream to reach suitable spawning streams. Brook and brown trout can also spawn on gravel shallows in lakes, although brook trout require groundwater upwelling and moderate current for successful reproduction. Brook and brown trout are both fall spawners. Brook trout eggs are deposited in late summer in northern regions and brown trout spawn in late autumn to early winter, at a temperature of 48-51°F (9-10°C). For both species, eggs hatch in mid-winter and fry emerge from the gravel in very early spring, just before ice breakup. Rainbow trout are primarily spring spawners and begin to spawn between temperatures 50-60°F (10-16°C). Eggs incubate for four to seven weeks before hatching and fry emerge from the gravel after another five days or two weeks (US EPA 1993). All species spawn in nests, referred to as "redds", prepared primarily by the female. The female clears away debris and silt from the redd by turning sideways and beating the bottom substrate using a series of rapid fanning movements of the tail. When the spawning process is completed, the female covers the redd with loose gravel using a similar motion. No further parental care or protection is provided. Trout do not die after spawning and generally spawn in multiple years.

Photo:Tim Stecko

Blacknose dace (Rhynichthys atractulutus)-male in breeding coloration

Photo:Tim Stecko

Creek chub (Semotilus atromaculatus)-a common cold water fish species

Photo:Tim Stecko

Fall fish (Semotilus corporalis)-a common cold water fish species

Brook, rainbow, and brown trout are carnivorous feeding on a wide variety of organisms, including aquatic and terrestrial insects, crayfish, leeches, mollusks, frogs, small fish, and

MANAGEMENT CONCERNS FOR TROUT FISHERIES

In general, trout fisheries require more intensive management than do many warm or cool water fisheries. Management problems and concerns could include the following:

HABITAT DEGRADATION

Poor land use practices can lead to siltation of spawning areas. Trout can reproduce successfully only in clean gravel substrate; egg and fry survival can be decreased dramatically by even small to moderate silt loads. Land clearing can also increase water temperatures, which in turn depletes oxygen levels, eliminating suitable habitat for trout during the summer.

ANGLER PRESSURE

Trout, in general, are highly catchable and susceptible to over-fishing during some seasons of the year. Brook trout in particular, tend to occur in small unproductive streams that support relatively few fish; therefore populations can be easily depleted. Remedies used for reducing angler pressure include fishing regulations and stocking. Slow-growing, late-maturing populations may require relatively large minimum size regulations to sustain adequate numbers of sexually mature, reproducing fish.

INADEQUATE NATURAL REPRODUCTION

Suitable spawning areas or habitat may be unavailable. Migrations into spawning streams may be blocked by beaver dams, or construction of dams or roads. Reproductive success may also be low as a result of fish predation on trout eggs, fry and juveniles. Often, populations with insufficient reproduction are supplemented or supported by stocking.

Excessive predators or competitors - Young trout are highly susceptible to predators, such as pickerel, or fish-eating water birds. Yellow perch may compete with juvenile trout and also potentially feed on trout eggs. Different species that utilize the same resources may also be a source competition (i.e. brown vs. brook trout).

large zooplankton (animal species only). In general, fish play a less important role in the diets of these species than for most other important game fish, such as bass. Brown trout and rainbow trout tend to reach larger sizes than the brook trout. Fish and crayfish figure more prominently in the diet of very large brown and rainbow trout (Kendall 1978).

Fish Species Composition and Species Diversity

Diversity simply refers to the number of different species in a given area. The fish diversity of Kettle Creek, in terms of those living species that are known and have been collected, is given in Figure 4.7. Many factors work together to determine the composition of a fish community in a given stream or lake. Small streams often receive much of their organic energy input from the terrestrial community in the forms of insects, leaves or pine needles. Aquatic primary production is usually low because small streams tend to be shaded. The leaves are processed by aquatic insects, which in turn are eaten by fishes and other predators. As streams become larger and broader, more sunlight and plant nutrients reach the water, and balance shifts to greater primary production. Algae attached to rock surfaces are the major source of food for insect species that scrape such surfaces and are eaten by fishes. As streams become still larger, turbidity may reduce the amount of light available for primary production.

Fish communities change from small streams, where most fish are feeding on insects and invertebrate leaf processors, to more complex communities that include fish that feed on a variety of sources such as plants, large invertebrates and other fish species. Fish species that occur in streams or lakes have naturally moved into these water bodies or historically been introduced (accidentally or on purpose) by human activities. Figure 4.7 also indicates whether a species is natively found in the Kettle Creek watershed (indigenous) or introduced to the watershed by accident or on purpose (nonindigenous). Natural patterns of fish species distribution tend to follow major drainage systems. Habitat characteristics and biotic interactions determine the actual species composition and relative species abundance. For a species to persist, the stream or lake must provide suitable habitat for reproduction, survival and growth. The greater the variety of habitats in an area the more fish species that area can support (Magnuson 1991).

Photo: Tim Stecko

Redbreast sunfish (Lepomis auritus)- a common warm water fish species.

Small streams are very susceptible to alterations of their environment. Habitat losses can occur from alterations such as channelization from erosion and flood control, siltation, agricultural runoff, and wastewater discharges. In most regions there are fish species that are especially sensitive or intolerant to human disturbance.

PRIMARY PRODUCTIVITY is the rate at which algae and other plants convert light, water, and carbon dioxide to sugar in plant cells.

Kettle Creek Species Composition		Temperature Preference	Range	Tolerance to human disturbances
		Coldwater= C = 50-60°F(10-16°C)	Indigenous = I	R = Rare Intolerant
		Coolwater= K = 68-77°F(20-25°C)	Nonindigenous = N	I = Common Intolerant
		Warmwater= W = 77-86°F(25-30°C)		M = Moderately Intolerant
				T = Highly Tolerant
				P = Moderately Tolerant
Common Name	Genus species	C / K / W	I / N	R / I / M / T / P
Central Stoneroller	*Campostoma anomalum*	-	I	-
Cutlips Minnow	*Exoglossum maxillingua*	-	I	-
Bluntnose Minnow	*Pimephales notatus*	-	I	T
Common Shiner	*Luxilus cornutus*	K	I	-
Golden Shiner	*Notemigonus crysoleucas*	K	I	T
Rosyface Shiner	*Notropis rubellus*	-	I	I
Blacknose Dace	*Rhinichthys atratulus*	C	I	T
Longnose Dace	*Rhinichthys cataractae*	C	I	R
Pearl Dace	*Margariscus margarita*	-	I	-
Creek Chub	*Semotilus atromaculatus*	C	I	T
Fallfish	*Semotilus corporalis*	C	I	-
River Chub	*Nocomis micropogon*	C	I	I
White Sucker	*Catostomus commersoni*	K	I	T
Northern Hog Sucker	*Hypentelium nigricans*	W	I	M
Margined Madtom	*Noturus insignis*	W	I	-
Brown Bullhead	*Ameiurus nebulosus*	W	I	T
Slimy Sculpin	*Cottus cognatus*	C	I	-
Shield Darter	*Percina peltata*	-	I	-
Greenside Darter	*Etheostoma blennioides*	-	I	M
Tessellated Darter	*Etheostoma olmstedi*	-	I	-
Brown Trout	*Salmo trutta*	C	N	-
Rainbow Trout	*Oncorhynchus mykiss*	C	N	-
Brook Trout	*Salvelinus fontinalis*	C	I	-
Tiger Trout	*Salvelinus fontinalis x Salmo trutta*	C	N	-
Pumpkinseed Sunfish	*Lepomis gibbosus*	W	N	P
Redbreast Sunfish	*Lepomis auritus*	W	N	-
Bluegill Sunfish	*Lepomis macrochirus*	W	N	P
Smallmouth Bass	*Micropterus dolomieu*	K	N	M
Largemouth Bass	*Micropterus salmoides*	W	N	-
Rock Bass	*Ambloplites rupestris*	W	N	-
Black Crappie	*Pomoxis nigromaculatus*	-	N	-
Yellow Perch	*Perca flavescens*	K	N	-
Redfin Pickerel	*Esox americanus americanus*	K	N	-
Northern Pike	*Esox lucius*	-	N	P
Tiger Musky	*Esox lucius x Esox masquinongy*	-	N	P

Figure 4.7 - Temperature and Tolerance Classification of Kettle Creek Fish Species

These disturbances involve a wide variety of environmental disturbances including water quality and habitat degradation (Karr 1991). For example, intolerance to siltation is common but other types of intolerance may also be present. The Kettle Creek fish species composition list (Figure 4.7) indicates the species in the watershed that fall into a tolerance category (Ohio Environmental Protection Agency 1988). The categoriesof intolerance pertaining to the Kettle Creek fish species composition include rare intolerant (R), common intolerant (I), and moderately intolerant (M) and the levels of tolerant include highly tolerant (T) and moderately tolerant (P). Young fish tend to be much more sensitive or intolerant to all environmental stresses than older fish.

Competition is another ecological interaction involved in the composition of fish species. Taub (1989) acknowledges competition as one of the major controlling mechanisms of species dominance. Streams and lakes typically have several species that compete for limited resources and the species most successful in capturing the resource will increase at the expense of the less successful. Fish using the same resources do not necessarily compete if the resource is so abundant that its use by some species does not distress others. Competition can be most severe among fish that use the same resources in the same way. This has been demonstrated in Kettle Creek when the introduction of the brown trout occurred in the late 1800's. The nonindigenous brown trout established itself in the watershed and eventually displaced the indigenous brook in many areas (Watts and others 1942). Often, however two species can coexist if predation, angling, or other forces prevent them from becoming extremely abundant. Fish can even change their feeding areas or types of food when competing with or being preyed upon by other fishes.

An important physical factor influencing the composition of fish species in a watershed is temperature. The temperature of the surrounding environment determines their body temperature. Thus, temperature directly influences fish growth rates, activity levels, reproduction, and most other aspects of fish biology. Different streams and different locations within a stream can exhibit very different thermal regimes or temperature ranges. These regimes have a critical influence on the fish that a site can support. Some streams remain very cold throughout hot summer months if they have groundwater inputs or have extensive shading, while others that are exposed to the sun and have relatively little groundwater contribution can come close to ambient air temperatures (Stoneman and Jones 1996). Freshwater fish are known to be able to detect small differences in water temperature (Eaton and others 1995) and to seek cooler water if it is available under conditions of heat stress (Headrick and Carline 1993). Different fish can tolerate different ranges of temperature, some can survive in a wide range of temperature and some can survive in a very narrow range of temperature. Every stream or lake has its own thermal regime and temperature variation that is an important factor which influences the types of species and fish communities able to survive and reproduce in that environment.

Photo: Tim Stecko

White sucker (Catostomus commersoni) - a cool water species.

Photo: Tim Stecko

Golden shiner (Notemigonus crysoleucas)- a cool water fish species

Fish species prefer to live at different temperatures. They are often classified as coldwater, coolwater, and warmwater fish, depending on their preferred water temperature (Figure 4.7). Coldwater fish require the approximate midpoint of water temperature to be 50-60°F (10-16°C), but in general less than 70°F (21°C) to grow and reproduce. Coolwater fish prefer their approximate midpoint for temperatures to be 68-77°F (20-25°C), or generally higher than 65°F (18°C) but less than 75°F (24°C). Warmwater fish require an approximate midpoint of 77-86°F (25-30°C), but usually higher than 75°F (24°C) to grow and reproduce (Magnuson and others 1979).

Many researchers have monitored species composition in Kettle Creek over the last 30 years. Argent and others (1997) constructed a geographical information database for Pennsylvania that shows fish collections completed by state agencies (e.g. universities, Pennsylvania Fish and Boat Commission (PFBC)), which can be linked to tables of data that contain information on the species composition and date of capture. Fish species collections on the mainstem of Kettle Creek were pooled together from Argent and others (1997) database ranging from the late 1960's to the end of the century. The PFBC has, by far, done the most extensive sampling in the watershed, due to its intensive management role. The other recorded investigator is Dr. Ed Cooper, an ichthyology professor from the Pennsylvania State University (PSU). The species composition in Kettle Creek did not change drastically over time from the pooled databases although noticeable changes occurred at a few collections sites. For instance, in 1967, Cooper sampled the confluence of Twomile Run with the mainstem of Kettle Creek, an area impacted by mine drainage, and collected no fish species. Thirty years later in 1997, the PFBC sampled the same area and collected two species of fish, the white sucker (*Catostomus commersoni*) that is highly tolerant to human disturbances, and the smallmouth bass (*Micropterus dolomieu*) that is moderately intolerant to human disturbances. Finding these fish could be an indication of a slight improvement in water quality. By far the most intensively sampled area by the PFBC for the longest duration (1978-present) is along the mainstem of Kettle Creek, just above the confluence of Cross Fork upstream to the confluence of Little Kettle Creek. Species composition has averaged 15 per sample, thus indicating a diversity of habitats that can support a variety of fish species. Collections upstream of the confluence with Germania Branch along the mainstem of Kettle Creek by the PFBC and Cooper from 1964 to the present are indicative of cold and cool water species as no warm water fish species have been recorded.

Another way to look at potential species composition in Kettle Creek is the Gap Analysis Project (GAP) (For more information on GAP, refer to page 151). The GAP analysis for Kettle Creek predicts potential habitat for 37 fish species (Appendix G, page 305), while fish species collection in the watershed totaled 35 (Figure 4.7). Out of the potential 37 fish species listed on the GAP analysis, 24 coincide with the actual species collected on the watershed. Eleven fish species actually collected in Kettle Creek watershed were not listed on the GAP fish species list for potential habitat.

Historical Pollution of Kettle Creek Fisheries

Summary of reports written by the Pennsylvania Fish Commission, 1966.

On Sunday September 4, 1966 near the town of Cross Fork, Potter County, Pa, Kettle Creek was severely damaged by pollution originating on State Forest lands in the vicinity of Clarks Hollow. The source of the pollution was a gas well drilling operation. The upstream limit of pollution was one mile below Bunnell Bridge on Route 144 and the downstream limit was the Alvin Bush Dam. Immediately below the point of entry, all aquatic invertebrates were killed. The absence of aquatic invertebrates persisted for approximately two miles (3.2 km), where very few organisms were found. Crayfish were extremely sensitive to the toxic material and were killed in large numbers, even in areas where other invertebrates survived. The crayfish appeared to be annihilated from the point of entry to at least the Leidy Bridge. The pollution depressed the fish population from Clark Hollow downstream to the area where Hogstock Run enters Kettle Creek. In this four mile (6.4 km) section, the only fish species that survived in any appreciable numbers was the margined madtom, a small non-game fish. The fish kill began on September 4th and reached the top of the Alvin Bush Dam by September 6th.

The estimated number of fish killed was 185,642, including species of trout, bass, suckers, fallfish, minnows, and chubs. Large numbers of juvenile bluegills and smallmouth bass were killed at the upper end of the lake where the stream first enters the lake; however, the kill did not extend far into the lake, apparently offset by dilution. The pollution also caused heavy siltation and an oily smelling, sandy material was reported to have completely covered the bottom of all pools for about two miles below the point of entry. Below this, siltation was still noticeable but became less pronounced.

Figure 4.8 - Historical Pollution in Kettle Creek.

Water in the damaged areas was brown in color and some areas were coated with clay deposits. By the time the water reached the backwaters of the lake, it resembled a colloidal suspension of clay in color, similar to cardboard. Some shoreline vegetation and soils were also damaged by oil, that collected at edges of the stream.

In conclusion, 4 miles (6.4 km) of Kettle Creek were so severely polluted as to be virtually devoid of aquatic invertebrates and desirable game fishes. Half this distance was so badly silted that it became esthetically unattractive to anglers and very poor habitat for most aquatic organisms. As the pollution progressed downstream, the toxicity decreased until it was neutralized in the backwaters of Kettle Creek Lake. The greatest damage downstream from Hammersley Fork was to the fish life. Overall, approximately 15 to 17 miles (24 to 27 km) of Kettle Creek suffered damage (Figure 4.8). At the present day, no visual effects of this pollution are present and the stream has appeared to recover from the pollution.

GOALS: FISHERIES

FH 1.1 Improve and develop habitat assessments.

FH 1.2 Improve stream habitat focusing on flow, substrate, and riparian areas.

FH 1.3 Monitor habitat to attain more self-sustaining wild trout populations.

FH 2.1 Recognize values and opportunities in Kettle Creek watershed.

Photo:Tim Stecko

Central stoneroller (Campostoma anomalum)

Photo:Rob Criswell

Shield darter (Percina peltata)

Photo:Tim Stecko

Bluntnose minnow(Pimephales notatus)

Photo:Tim Stecko

Rosyface Shiner (Notropis rubellus)

Photo:Tim Stecko

Pumpkinseed sunfish (Lepomis gibbosus)

Photo:Tim Stecko

Norther Hog sucker Hypentelium nigricans)

Introduction

Habitat assessments are defined as the evaluation of the structure of the surrounding physical habitat that influences the quality of the water resource and the condition of the resident aquatic community (Barbour and others 1996). Habitat assessments encompass many different aspects of the stream in order to provide a method of measuring the rating of the habitat. Assessments are usually conducted on a 328-foot (100 meter) section of the stream. There are many different categories upon which one obtains a score, based on a habitat assessment data sheet. Once complete, the score is totaled to acquire an overall habitat score and rating. There are two types of data forms for the habitat assessments already conducted in the Kettle Creek watershed. Both are versions adapted from the Environmental Protection Agency (EPA) rapid bioassessment protocol (EPA, 2001); copies are available in the Appendix.

The first form is used and distributed by the Pennsylvania Fish and Boat Commission (PFBC) (Appendix F - Page 295-296). The PFBC form includes ten categories: Epifaunal Substrate/Available Cover (subcategories of fish and macroinvertebrates); Riffle Quality; Embeddedness; Channel Alteration; Sediment Deposition; Frequency of Riffles (or bends)/ Velocity-Depth Combinations; Channel Flow Status; Bank Vegetative Protection (each bank scored separately); Bank Stability (each bank scored separately); and Riparian Vegetative Zone Width (each bank riparian zone scored separately). In this section, the groups that used this data sheet are Mansfield University (MU), Lock Haven University (LHU), and the Center for Watershed Stewardship at Penn State University (CWS) (Figure 4.9).

The second form is used and distributed by the Pennsylvania Department of Environmental Protection (PA DEP) (Appendix F - Page 297-8). The DEP form includes 12 categories that are similar to the categories listed previously. The differences between the two forms are as follows. The first category is labeled Instream Cover (fish only). This is similar to the Epifaunal Substrate/Available Cover PFBC category except that it does not consider macroinvertebrate habitat. The second DEP category is labeled Epifaunal Substrate and is exactly the same as the PFBC category of Riffle Quality. Another difference is the DEP habitat assessment data sheet separates the PFBC Frequency of Riffles /Velocity-Depth Combinations category into two separate categories (labeled Frequency of Riffles and Velocity-Depth Combinations). The DEP form also adds another category labeled Grazing or Other Disruptive Pressure. The remaining categories are consistent with the PFBC form except when scoring banks or zones, the DEP form does not score each bank separately. In this section, the samplers that used this data sheet are Lock Haven University (LHU) and the DEP (Figure 4.9).

HABITAT ASSESSMENT

In the Kettle Creek watershed, overall, the majority of the sites assessed rated Optimal or Suboptimal with a few Marginal ratings. In this section, the overall score was not discussed. Instead, the category ratings are used in order to pinpoint potential problems in the watershed. Each category will also be described in this section.

PFBC Epifaunal Substrate/Available Cover or DEP Instream Cover

Rating is determined by the amount of fish cover, logs, boulder, cobble, undercut banks or other substrate favorable to fish colonization. The PFBC forms also rates amount of macroinvertebrate habitat present. Good measures of fish habitat would include undercut banks, logs, pools and the presence of fish. Good measures of macroinvertebrate habitat

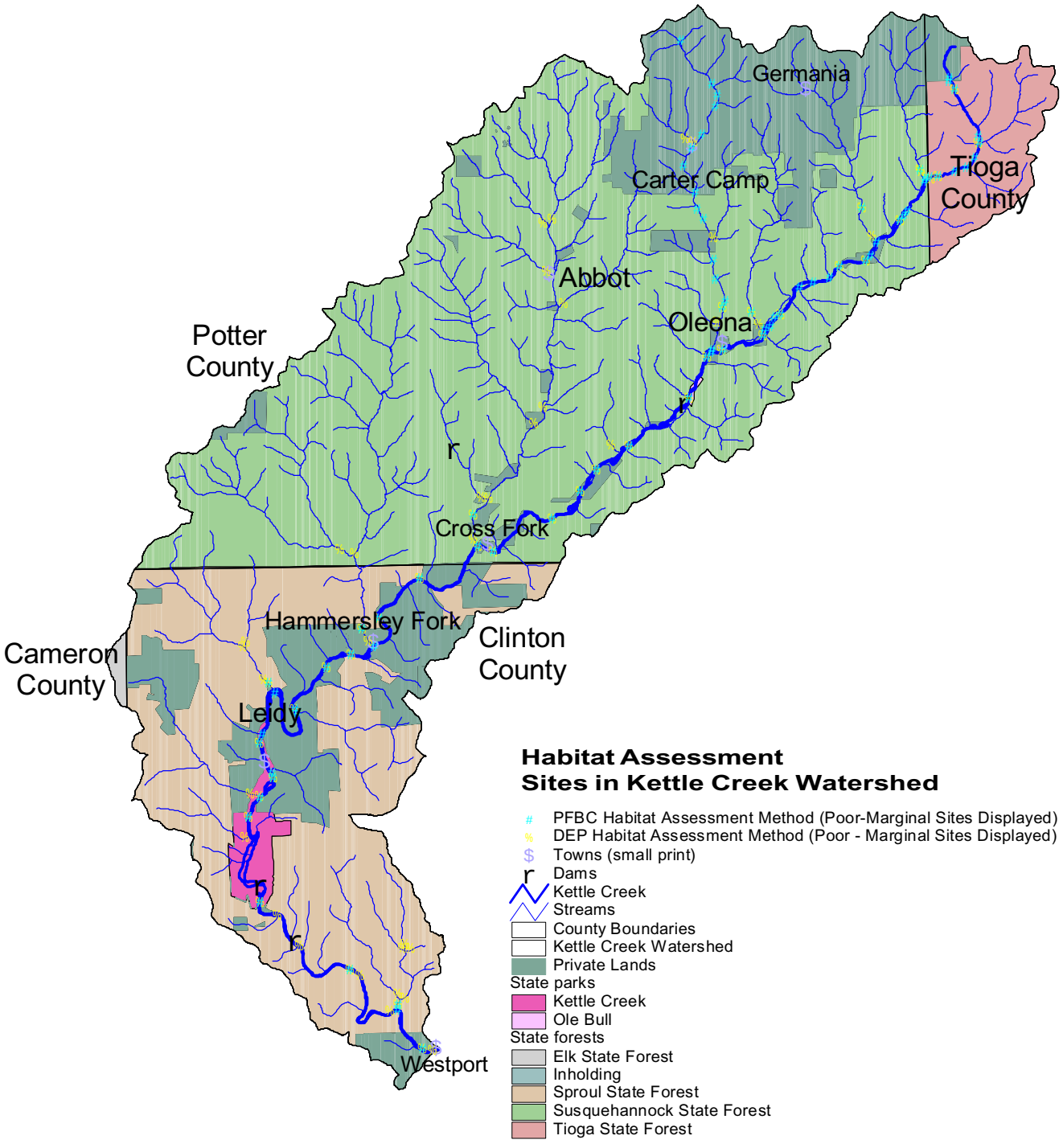


Figure 4.9 - Habitat assessment sites in the Kettle Creek watershed.

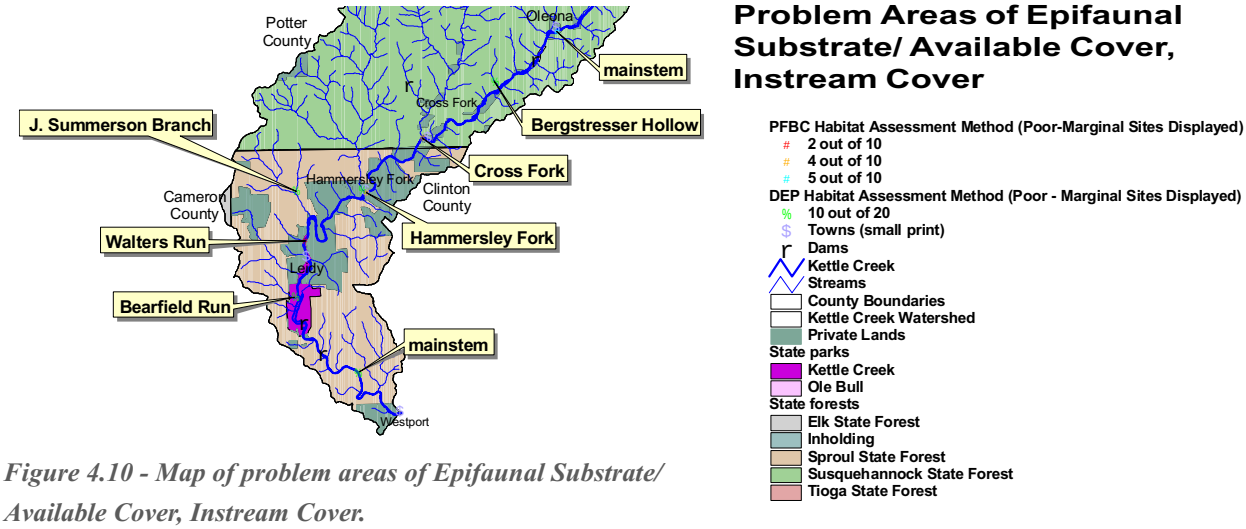


Figure 4.10 - Map of problem areas of Epifaunal Substrate/ Available Cover, Instream Cover.

would include boulders, cobbles, submerged logs, riffles and the presence of macroinvertebrates. Sections of stream that scored marginal - poor from the habitat assessment previously conducted in the Kettle Creek watershed are Bergstressor Hollow, Hammersley Fork, John Summerson Branch, Bearfield Run, Cross Fork, Walters Run, and two locations on the mainstem of Kettle Creek (one upstream of the USGS gauge at Cross Fork, and the other upstream of Little Kettle Creek). Locations of these sites can be seen on the map in Figure 4.10. Macroinvertebrate habitat was found to be suboptimal - optimal throughout the watershed.

PFBC Riffle Quality or DEP Epifaunal Substrate

An optimal rating is determined by area containing well-developed riffles and runs and abundance of cobble. An optimal riffle is as wide as the stream itself and as long as twice the width of the stream. Abundant bedrock would cause a decrease in riffles and would score low in this category. A better quality riffle will inhabit a diverse population of fish and macroinvertebrates. Sections of streams in the Kettle Creek watershed that scored marginal - poor in this category are Billings Branch, Hammersley Fork, Cross Fork, and Walters Run. Locations of these sites can be seen on the map in Figure 4.11.

PFBC and DEP Embeddedness

Embeddedness was rated by the amount of fine sediment surrounding the gravel, boulder, and cobble particles. A stream section with an optimal rating in embeddedness has a small percentage of gravel and cobble surrounded by fine sediment. The particles in the stream are easily moved with your hands. Embeddedness is important to macroinvertebrates because the more embedded a rock is, the less area there is for the macroinvertebrate to live on. If a stream bottom has high embeddedness, fish have difficulty in locating areas to lay eggs. Areas in the Kettle Creek watershed that may need some improvements because of a marginal - poor rating are sections of Little Kettle Creek, Twomile Run, Huling Branch, and two locations on the mainstem (at the mouth and upstream of the USGS gauge at Cross Fork). Locations of these sites can be seen on the map in Figure 4.12.

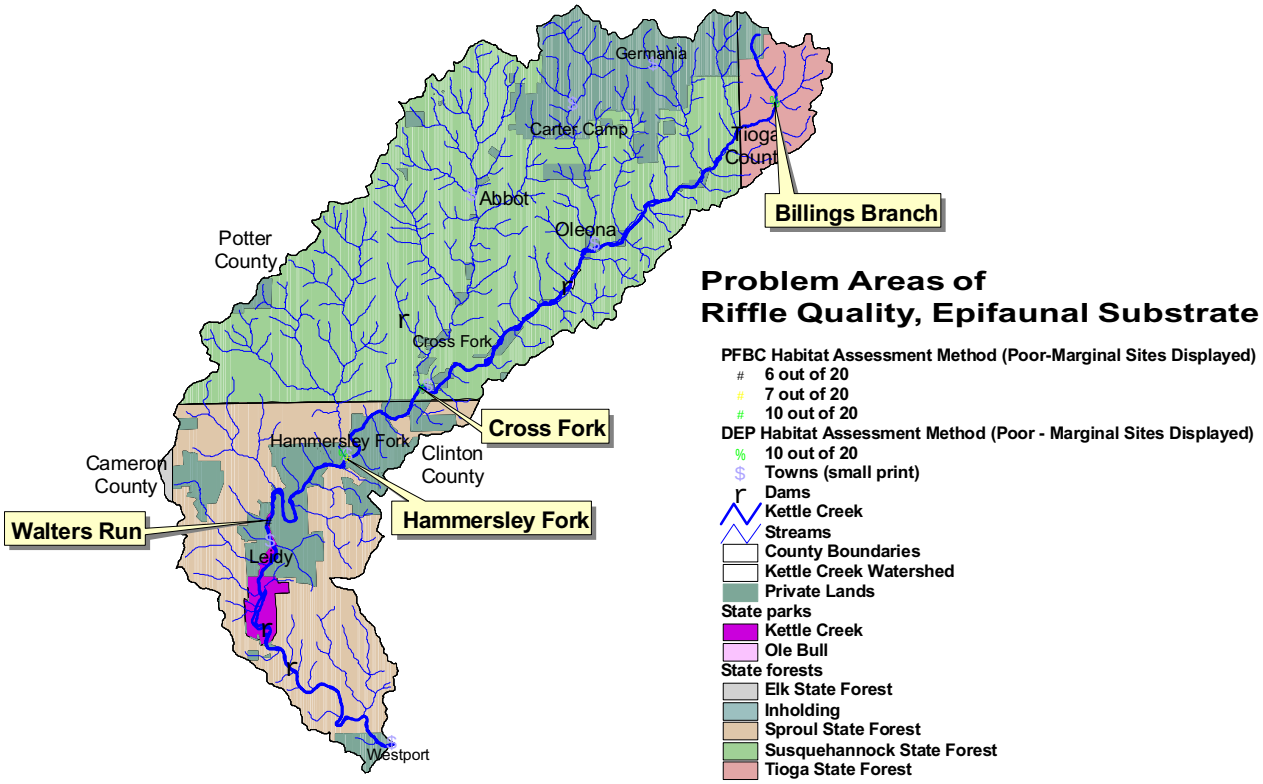


Figure 4.11 - Map of problem areas of Riffle Quality, Epifaunal Substrate.

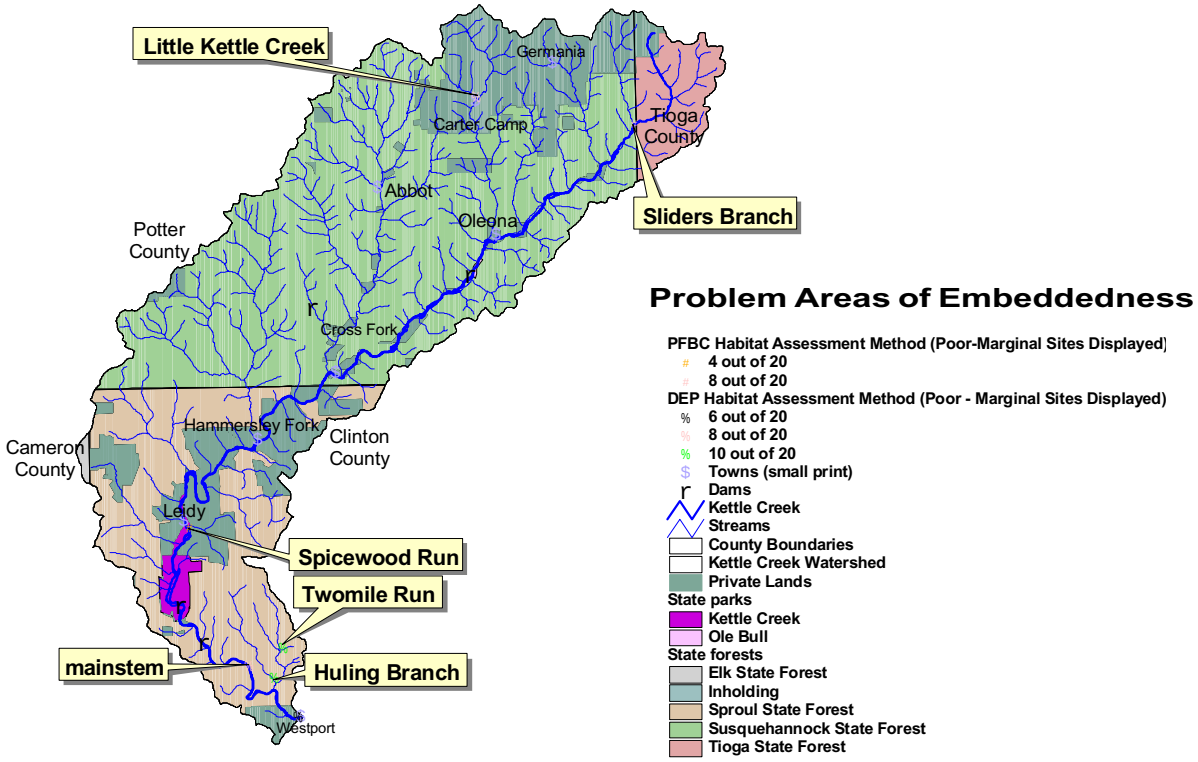


Figure 4.12 - Map of problem areas of Embeddedness

PFBC and DEP Channel Alteration

Channel alteration indicates the occurrence and amount of unnatural channelization or dredging within the stream section. An optimal score has minimal or no channelization or dredging. Channelization and dredging causes problems for fish and macroinvertebrates because it results in far less natural habitats than naturally meandering streams. According to the habitat assessments conducted, there was only one area within the Kettle Creek watershed where there was extensive channelization. The location of this site was on Hammersley Fork, just upstream of the confluence with Kettle Creek (Figure 4.13).

An example of channel alteration at Hammersley Fork.

PFBC and DEP Sediment Deposition

Sediment Deposition is rated by observing the number of sediment bars or island formations. Sediment deposition can restrict the presence of pools and reduce available surface area of boulders and cobbles, which can degrade fish and macroinvertebrate habitat. Little or no enlargement of islands and point bars would receive an optimal rating in this category. Marginal - poor areas in the Kettle Creek watershed are sections of Ives Hollow Run, Little Kettle Creek, Twomile Run, Huling Branch, Sliders Branch, Beaverdam Branch, and two sites on the mainstem of Kettle Creek (one upstream of the USGS gauging station and the other on the mainstem between Sliders and Germania Branch). The location of these sites can be seen in Figure 4.14.

PFBC and DEP Frequency of Riffles and/or Velocity-Depth Combinations

Frequency of Riffles refers to the quantity of riffles in the stream study section. According to both the PFBC and DEP data sheets, the distance between riffles divided by the width of the stream is an indicator of riffle quantity. An optimal riffle quantity indicator would be five to seven. A variety of habitat is also important in these categories. Velocity-Depth Combinations refers to four types of velocity-depth regimes (slow-deep, slow-shallow, fast-deep, and fast-shallow). Optimal streams will have all four velocity-depth combinations present. Macroinvertebrates prefer shallow combinations while fish prefer deeper combinations. As previously mentioned, the PFBC data sheet combines these two categories into one. Marginal - poor ratings within the Kettle Creek watershed occurred in sections of Cross Fork (velocity-depth good, but frequency of riffles low), Ives Hollow Run (velocity-depth low, but frequency of riffles good), Boone Run (velocity-depth low, but frequency of riffles good), Trout Run (velocity-depth low, but frequency of

BANK DESIGNATION: Left and right bank is determined by facing downstream.

CHANNELIZATION is a man-made alteration to the natural pathway of the stream

DREDGING is a process in which the natural channel of the stream has been deepened or widened by human activities

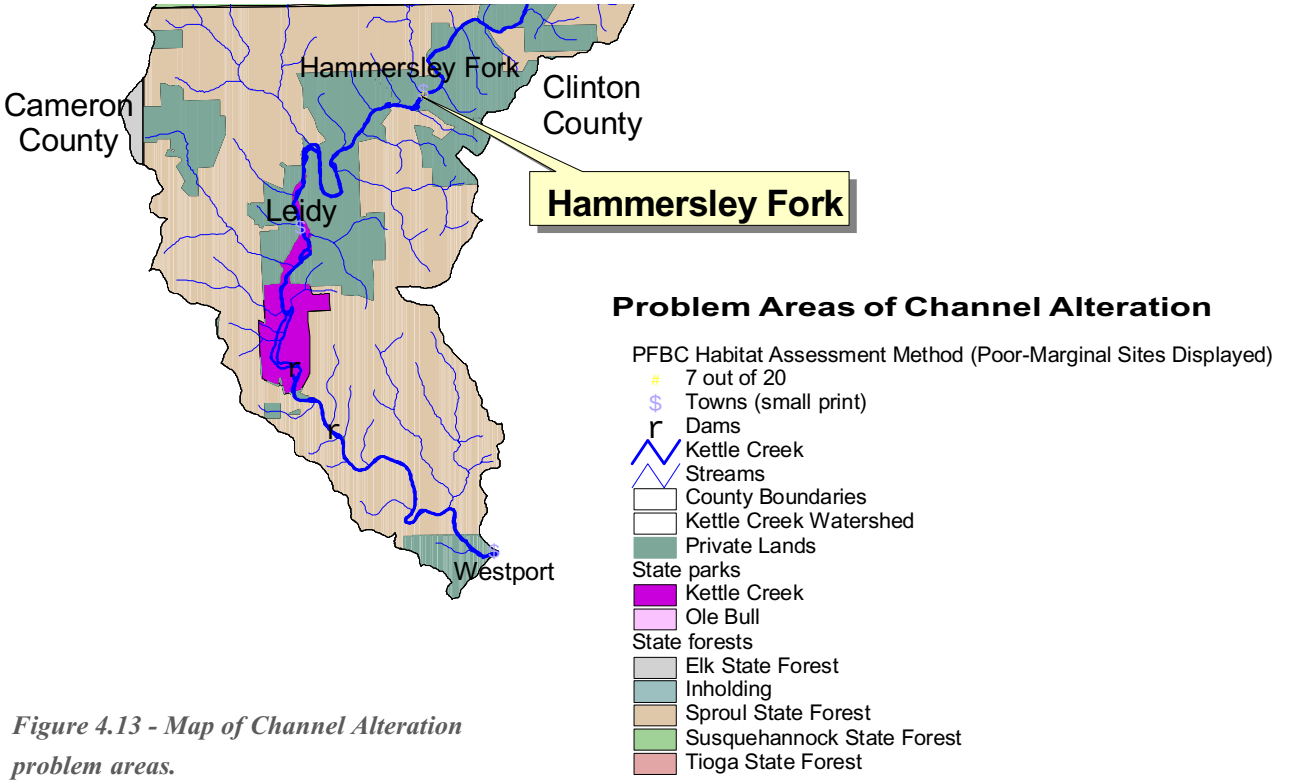


Figure 4.13 - Map of Channel Alteration problem areas.

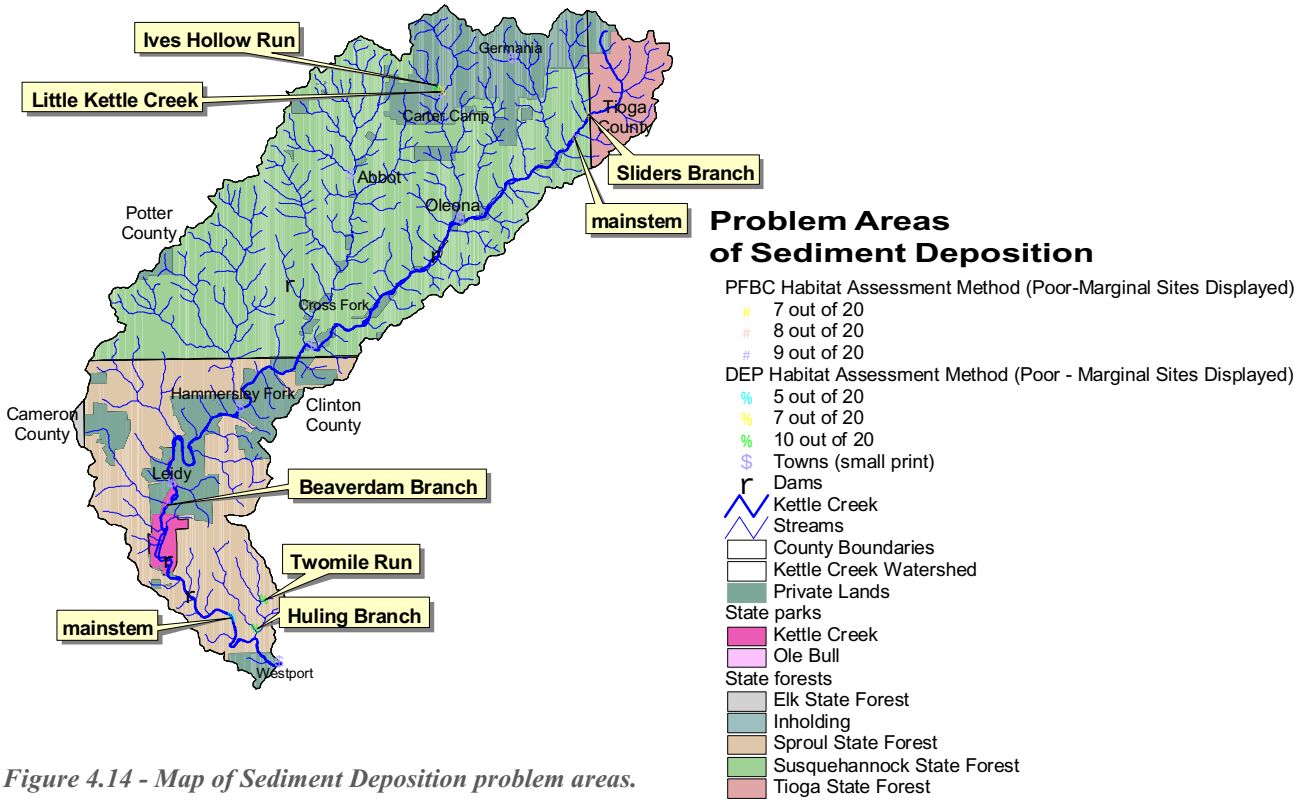
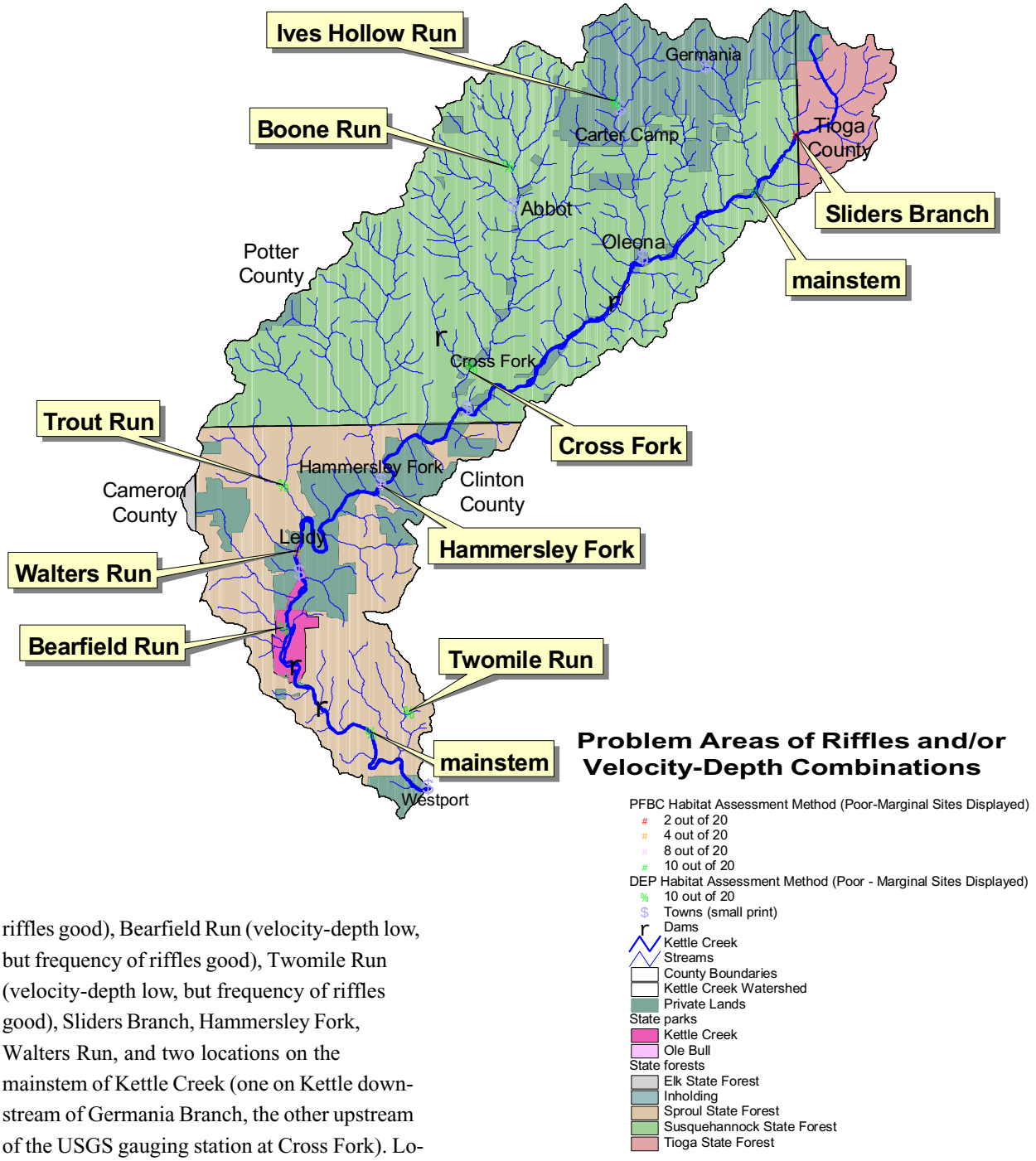


Figure 4.14 - Map of Sediment Deposition problem areas.



riffles good), Bearfield Run (velocity-depth low, but frequency of riffles good), Twomile Run (velocity-depth low, but frequency of riffles good), Sliders Branch, Hammersley Fork, Walters Run, and two locations on the mainstem of Kettle Creek (one on Kettle downstream of Germania Branch, the other upstream of the USGS gauging station at Cross Fork). Locations of these sites can be found on the map in Figure 4.15.

Figure 4.15 - Map of Frequency of Riffles and/or Velocity-Depth Combinations problem areas.

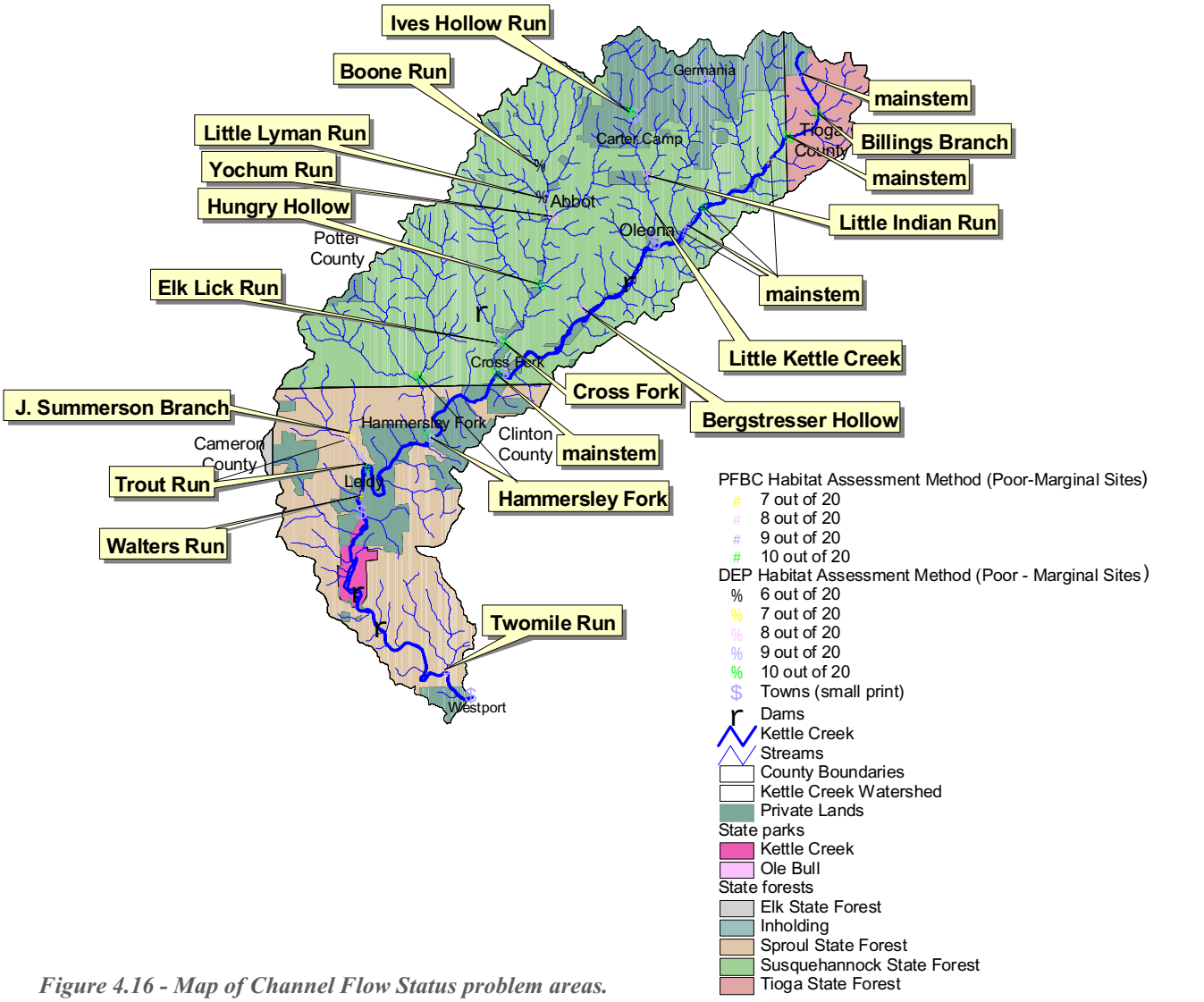


Figure 4.16 - Map of Channel Flow Status problem areas.

PFBC and DEP Channel Flow Status

Channel Flow Status assesses if the stream reaches both the left and right banks. It also indicates whether there is an abundance of channel substrate exposed. This category can depend on the time of year the stream is assessed. The flow should be noted because during low flow a stream section may score very low, but at high flow, it would score much higher. Channel flow status is important because if the channel substrate becomes exposed macroinvertebrate populations will decrease. Fish and macroinvertebrates populations depend strongly on the amount of water within the stream banks. Channel Flow Status seems to be a common problem in areas throughout the Kettle Creek watershed. Sections of streams that received a marginal - poor rating in this category within the Kettle Creek watershed are Billings Branch, Ives Hollow, Little Indian Run, Bergstressor Hollow, Boone Run, Little Lyman Run, Yochum Run, Hungry Hollow, Elk Lick, Cross Fork, Hammersley Fork, John Summerson Branch, Trout Run, Little Kettle Creek, Walters Run, Twomile Run, and seven sites on the mainstem of Kettle Creek. Locations of all these sites are located on the map in Figure 4.16.

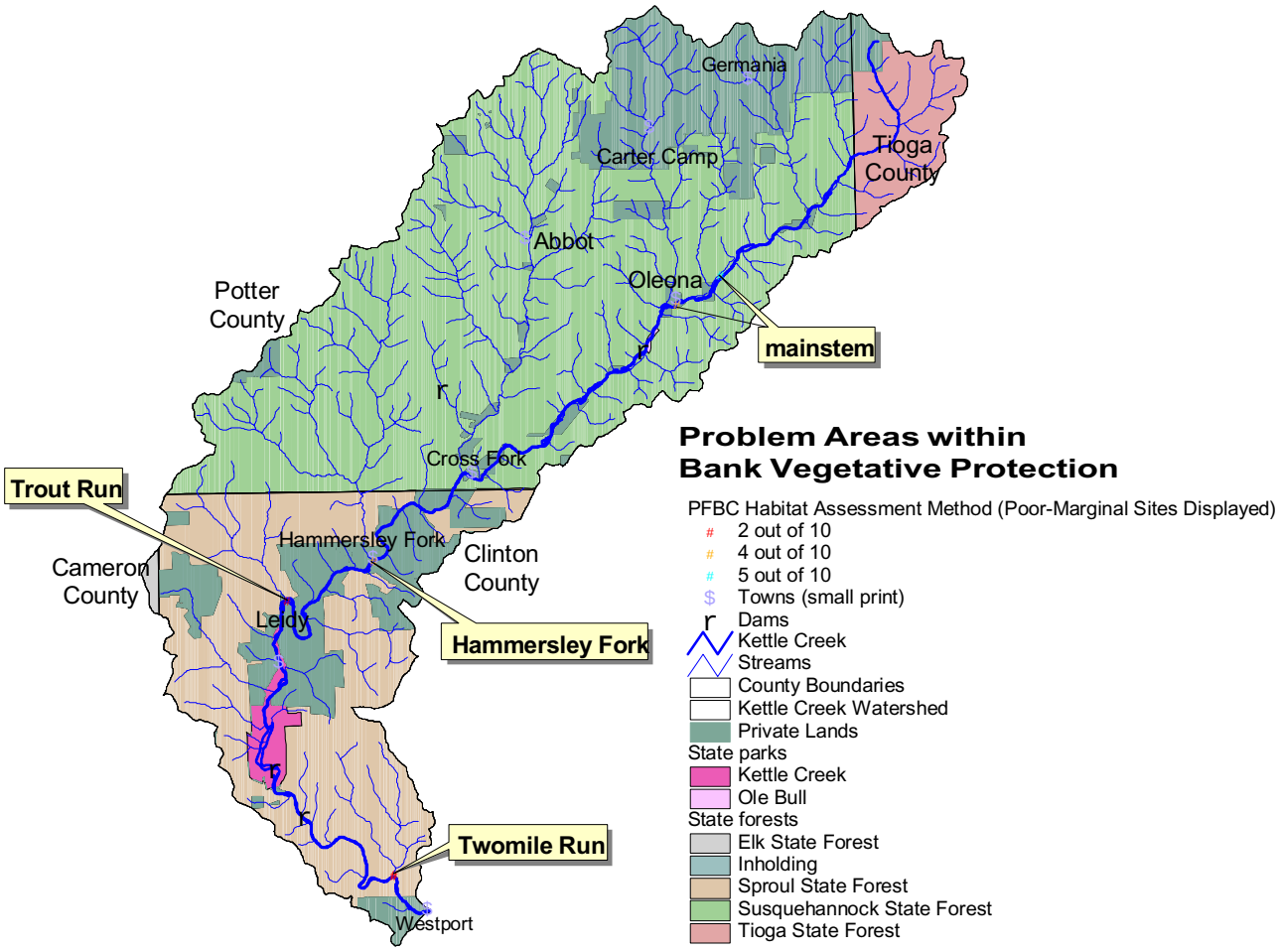


Figure 4.17 - Map of problem areas within the Bank Vegetative Protection category.

PFBC and DEP Bank Vegetative Protection

Bank Vegetative Protection is the amount of vegetation located on the streambanks. Bank vegetation aids in preventing erosion from occurring. Trees, shrubs, and grasses are the general categories of bank vegetative protection. Trees have the advantage of providing canopy cover over the stream, which helps to prevent a rise in stream temperature. The advantages of grasses and shrubs are to provide habitat and to prevent erosion of the stream banks. An optimal rated stream in this category would consist of more than ninety percent of the bank surface covered in vegetation. As previously mentioned, the DEP data sheet does not score the left and right banks separately, however no studies using the DEP sheet were rated marginal - poor. Areas with a marginal - poor bank vegetative protection rating within the Kettle Creek watershed were Trout Run (left bank), Twomile Run (left and right bank), and at two sites on Kettle Creek (one is upstream of Long Run, the other is upstream of Little Kettle Creek). Locations of these problem areas are found in Figure 4.17.

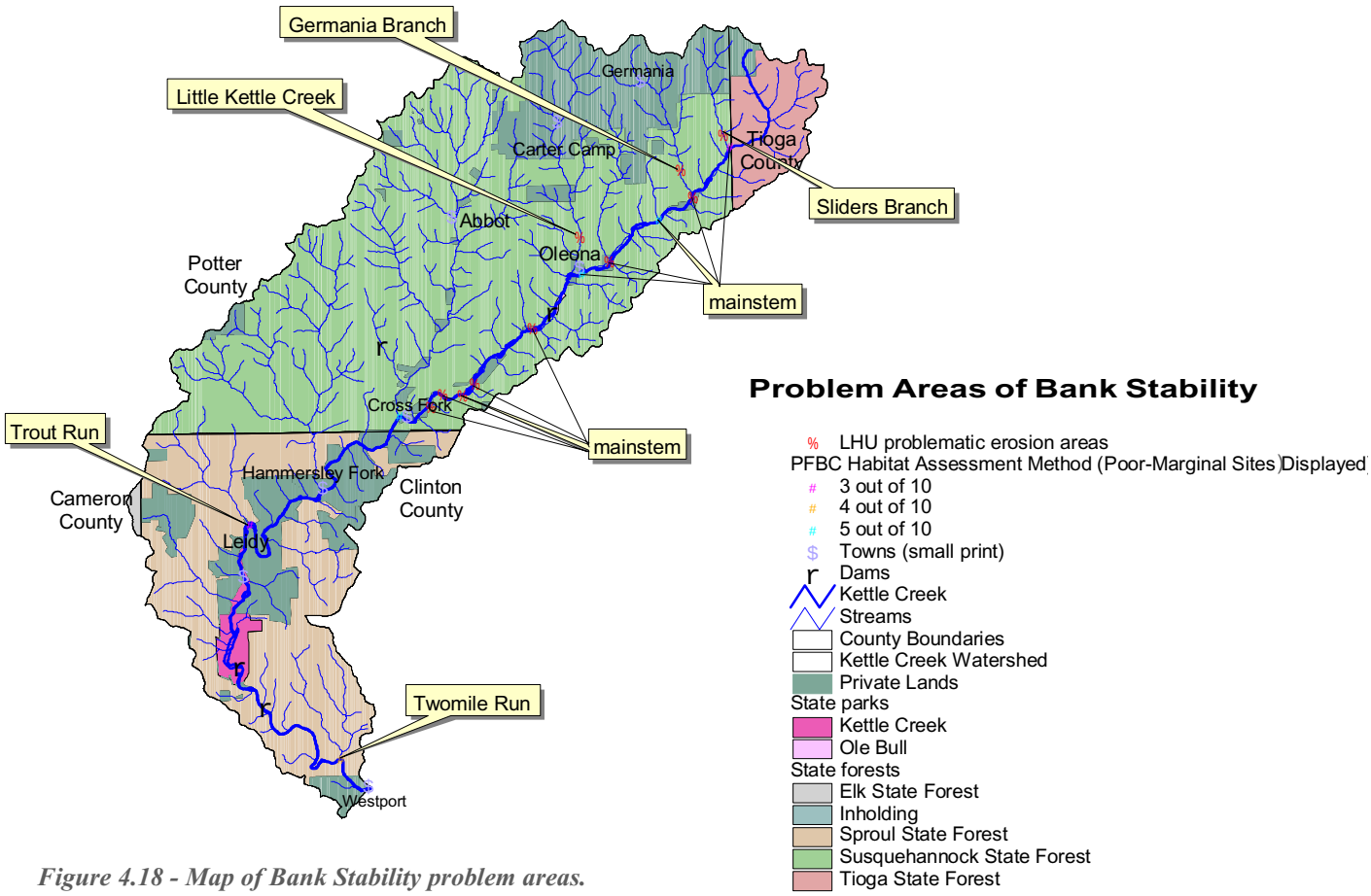


Figure 4.18 - Map of Bank Stability problem areas.

PFBC Bank Stability and DEP Condition of Banks

Bank Stability (or Condition of Banks) measures the amount of erodibility of the stream banks. This measurement is either the amount of erosion present or the potential for erosion to occur. Some indicators of erosion include unvegetated banks, exposed tree roots, exposed soil, and crumbling of banks. An optimal bank stability rating would have vegetated banks, and little or no signs of erosion or potential for erosion. Sections of streams within the Kettle Creek watershed which obtained a marginal - poor category rating are Trout Run (left bank), Cross Fork (right bank), Twomile Run (right bank) and two sites on the mainstem of Kettle Creek (one at the confluence of Kettle Creek with Germania Branch and the other site is located downstream of the Germania Branch). The LHU study noted that sections of Sliders Branch, Germania Branch, Little Kettle Creek, and four areas on Kettle Creek (one near Long Run, one near Germania Branch, and one near Berstresser Hollow, and a stretch upstream of Little Kettle Creek) also had some stability problems. Locations of all these problem areas are found in Figure 4.18.

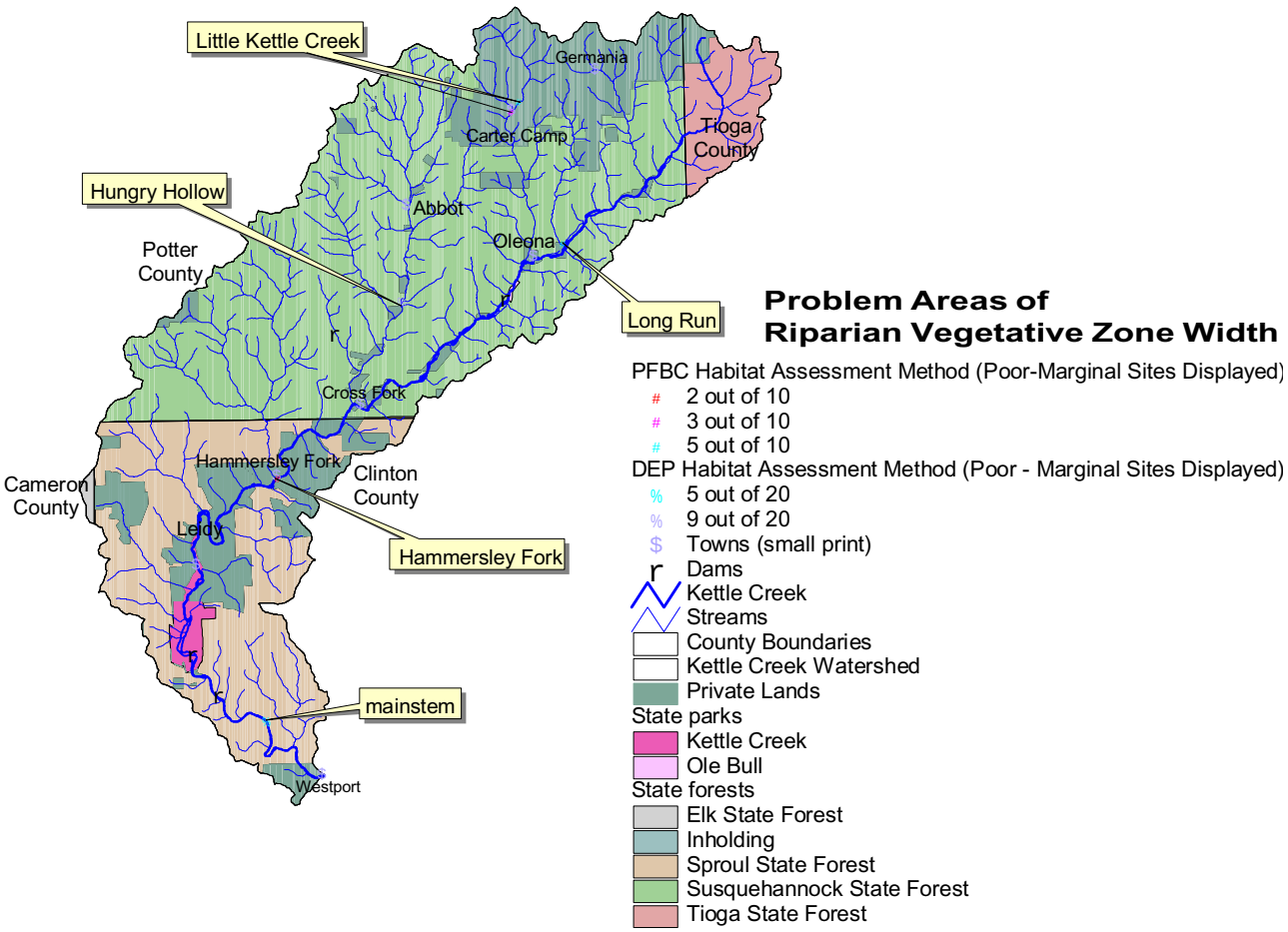


Figure 4.19 - Map of Riparian Vegetative Zone Width problem areas.

DEP Grazing or Other Disruptive Pressure

The Grazing or Other Disruptive Pressure category was only observed on the DEP data sheet. This category examines any vegetation disruption due to grazing or mowing. An optimal rating would have little or no sign of grazing or mowing. There were no marginal - poor ratings throughout the Kettle Creek watershed observed at the previous study sites.

PFBC and DEP Riparian Vegetative Zone Width

The Riparian Vegetative Zone Width measures the width of the area vegetated alongside the stream banks. Wide riparian vegetative zones are important because these zones can buffer pollutants entering a stream through runoff, prevent erosion, and provides habitat. An optimal rating is received when the riparian vegetative zone is greater than 59 feet (18 meters). No human activity is present within this zone. Marginal - poor category ratings in the Kettle Creek watershed occurred on sections of Hungry Hollow, Long Run (left bank), Hammersley Fork (both banks), Little Kettle Creek (right bank), and two sites on Kettle Creek (one is upstream of USGS gauging station at Cross Fork, the other is upstream of Long Run. Locations of these problem areas can be found on the map in Figure 4.19.

GOALS: HABITAT

FH 1.1 Improve and develop habitat assessments.

FH 1.2 Improve stream habitat focusing on flow, substrate and riparian areas.

EO 1.1 Promote baseline knowledge of the watershed and watershed issues to enable full participation in local resouce decision making by community members.

EO 2.1 Supply complete and accurate information on resources to enable effective participation in watershed decision-making discussions.

Summary

Based on the habitat assessments completed, marginal-poor site specific problems exist throughout the watershed. The subwatersheds of Hammersley Fork, Cross Fork, Little Kettle Creek, and Walters Run and also sections of the mainstem (near the Cross Fork USGS gauging station) seem to have the most variety of potential problems. These locations should be studied further to determine the extent of the problem(s). Many different improvement projects can be implemented in order to alleviate any problems and will be discussed in the Recommendation Section of this document.

Habitat enhancement project on Germania Branch

Cross vane on the mainstem of Kettle Creek

Gabion on Elk Lick Run

Introduction

Wildlife is defined as all mammals, birds, amphibians, snakes, and turtles which are plentiful in the watershed. Wildlife is plentiful and diverse in the watershed because of the large contiguous expanses of forest, the diverse habitats, the interconnectivity of the habitat, and the low human population density. Pennsylvania's Natural Diversity Inventory (PNDI) and the Gap Analysis Program (GAP) are two tools used to describe biological diversity. PNDI conducts inventories and collects data to identify and describe the Commonwealth's rarest and most significant ecological features. These features include plant and animal species of special concern, rare and exemplary natural communities, and outstanding geologic features. (Refer to page 101 for more information about PNDI designated areas in Kettle Creek, Refer to Appendix, page 312 for a discussion of PNDI). The purpose of GAP is to provide broad geographic information on the status of ordinary species (those not threatened with extinction or naturally rare) and their habitats by finding gaps in coverage of protected areas and species in need providing land managers, planners, scientists, and policy makers with the information needed to make better-informed decisions. (USGS 2000). GAP is a potential list of species based on multiple factors, including habitat (Refer to page 151 for a discussion of GAP analysis). GAP lists 285 potential wildlife species including mammals, birds, fish, amphibians, snakes & lizards, and turtles. GAP lists 27 PNDI species potentially in the watershed (See appendix, page 305) and the PNDI had confirmed that 7 unique species and 2 unique habitats exist in the watershed (Figure 4.20). Kettle Creek lake is frequented by American bald eagles (*Haliaeetus leucocephalus*) and osprey (*Pandion haliaetus*). Other birds of prey inhabit the watershed while migrating. The wetlands, ponds, and streams are prime habitat for waterfowl including herons, Canada geese (*Branta elaphus*), mallard ducks (*Anas platyrhynchos*), and wood ducks (*Aix sponsa*). Song birds are distributed throughout the watershed.

Pennsylvania Elk

Elk *(Cervis canadensis)* are attracted to forest clearcuts, revegetated strip mines, grassy meadows, open stream bottoms, and agricultural lands. They tend to avoid contact with humans, although they will venture into settled areas to reach favored food sources. Pennsylvania's elk live in Cameron, Clearfield, Clinton, Elk and Potter counties, in the state's north central region. The elk range covers about 835 square miles including portions of the Kettle Creek watershed. The Pennsylvania Game Commission (PGC) and state Department of Conservation and Natural Resources (DCNR) are managing public lands to make them more attractive to elk. The agencies create and maintain high-quality foraging areas and limit disturbance by humans. Elk habitat enhancement projects also benefit deer, turkeys, grouse and other wildlife.

Thousands of visitors travel to the watershed and surrounding areas to watch and

TERRESTRIAL WILDLIFE

GAP is a program developed by the USGS to assess unprotected areas at the landscape scale which have a high potential species diversity. Unprotected means that the habitat could be degraded or destroyed. Identification of unprotected areas is the first step in protecting the diverse habitat resources

PNDI is a state developed program to inventory species of special concern in PA.

PNDI Species and Habitat list			
Scientific Name	Common Name	PA Status	*Last Recorded Date
Crotalus horridus	Timber rattlesnake	PC	1998
Ardea herodias	Great blue heron		1974
Alasmidonta varicosa	Brook floater(fresh water mussel)		1997
Pyganodon cataracta	Eastern floater(freshwater mussel)		1994
Botaurus lentiginosus**	American bittern(migratory bird)	PE	1890
Sorex palustris albibarbis	Water shrew		1945
Neotoma magister	Allegheny woodrat	PT	1898
Habitats of interest:			
Meandering Channels			
High-gradient clearwater creek			
* Last recorded date is the date of the most recent documentation of the occurrence of the species in our database.			
** Record is based on an 1890 specimen with its location given only as Clinton County, so it might not actually have come from the Kettle Creek watershed.			
Source: PNDI database, search conducted by Kierstin Carlson of Western Pennsylvania Conservancy			

Figure 4.20 - List of species and habitats of special concern developed from the PNDI database.

A young black bear(Ursus americanus) spotted in the Kettle Creek watershed in Septem-

photograph the Pennsylvania Elk. An elk reintroduction release site is located adjacent to Bitumen near the southern western boundary of the watershed. Elk frequent the gas line right of ways and floodplains along the mainstem of Kettle Creek. Elk viewing areas have been developed in nearby Elk County which is a primary destination. However attempts are being to enhance elk viewing opportunities in the watershed through habitat enhancement associated with surface mine reclamation.

The Pennsylvania Game Commission

The Pennsylvania Game Commission (PGC) is responsible for managing both game and non-game wildlife species in Pennsylvania. Wildlife management is primarily accomplished through habitat management, hunting, trapping, and education. The PGC primarily develops land management practice on state game lands. State game lands do not exist on the watershed, thus minimizing the opportunity for wildlife management. Approximately 20 acres of land, located adjacent to Beaverdam Run downstream of Leidy, is actively managed for wildlife in the Kettle Creek watershed by the PGC in collaboration with Kettle Creek State Park (Dennis Dusza, personal communication). The wildlife management area has been planted with grains, grasses, and shrubs to enhance food and cover sources for elk, white tailed deer (*Odocoileus virginianus*), eastern wild turkey (*Meleagris gallopavo*), and song birds. Brush piles have been constructed to provide cover for small mammals and song birds.

The PGC has collaborated with the Bureau of Forestry (DCNR) to enhance wildlife habitat by sharing equipment, financial, and labor resources on projects located in the watershed.

The PGC recognizes the diversity of wildlife in the watershed and has made several attempts to increase wildlife diversity by introducing some species to historic ranges of those species. Elk, fishers (*Martes pennanti*) and river otters (*Lontra canadensis*) have been reintroduced to the watershed. (Dennis Dusza, personal communication). Elk and fisher populations are actively monitored, but it is undetermined if the river otter population is established or is currently monitored.

A recommendation from the PGC (Dennis Dusza, personal communication) is to acquire private lands along the riparian corridor for wildlife management areas. Currently, most of the private lands are located in the riparian corridor (see land use section for more information). Riparian areas provide ideal management opportunities because the land is typically flat, fertile, and accessible. Riparian areas are also under increasing development pressure and one preservation method is public ownership. Riparian areas provide movement corridors for wildlife, stable stream banks, thermal protection for the stream channel, and floodwater storage.

Hunting is a very popular activity in the watershed. Ninety-two percent of the watershed is publicly owned, providing large areas to hunt. The vast expanses of state land attract hunters from throughout Pennsylvania and the adjacent states. The big game species pursued are black bear, white tailed deer, and eastern wild turkey. The PGC has recently authorized a limited season for elk. Coyote (*Canis latrans*) hunting

THE PGC MISSION STATEMENT

"The basic goal of our (PGC) wildlife management program is to manage for healthy wildlife populations that are acceptable to Pennsylvanians and their communities. We (PGC) survey and monitor wildlife populations, study the relationships between wildlife, habitat and humans and theircommunities, develop management plans, and apply the management tools of hunting, trapping, habitat management, enforcement, communications and education to achieve the balance between biological and social acceptability." (PGC website).

Big Game Harvest in Clinton and Potter Counties						
	Clinton County Big Game Harvest Statistics			Potter County Big Game Harvest Statistics		
Year	Bear	Antlered Deer	Antlerless Deer	Bear	Antlered Deer	Antlerless Deer
1993	166	1,939	1,605	79	4,405	6,152
1994	95	1,961	1,768	41	3,438	5,958
1995	157	2,203	2,461	110	3,900	5,996
1996	134	1,608	1,258	69	3,869	3,748
1997	168	2,278	1,268	175	4,443	4,550
1998	219	2,045	1,294	89	4,828	3,982
1999	129	2,573	1,427	59	5,138	3,883
2000	248	2,493	2,186	203	4,660	6,409
Source: Pennsylvania Game Commission website.						

Figure 4.21 - Big Game Harvest in Clinton & Potter Counties.

and trapping is increasing in popularity and Kettle Creek provides prime habitat for this species. Small game species pursued include gray squirrels (*Sciurus carolinensis*), ruffed grouse (*Bonasa umbellus*), and ring-necked pheasants (*Phasianus colchicus*). Trapping of beaver (*Castor canadensis*), red fox (*Vulpes vulpes)* and grey fox (*Urocyon cinereoargenteus*), raccoons (*Procyon lotor*), mink (*Mustela vison*), and bobcats (*Lynx rufus*) is also popular.

Turtles caught basking in the sun at the Cross Fork mill ponds

Summary

Wildlife is an important economic and recreational resource in the Kettle Creek watershed. Wildlife diversity is high in the watershed, and diversity is dependent on many types of habitats that remain interconnected. Riparian habitats must remain connected to upland habitats. Mountain tops must remain connected to valleys. The corridors that are present in Kettle Creek must remain to preserve the abundance and diversity of wildlife in the watershed.

White tailed deer

1999 Pennsylvania Gap Analysis Project

The goal of the National Gap Analysis Project (GAP) is to provide regional landscape assessments of the conservation status of vertebrate species found throughout the nation as well as land cover types and to facilitate the application of this information to land management activities (USGS National Gap Analysis 2000). The Pennsylvania Gap Analysis Project primarily attempts to locate unprotected areas where there is potential for high vertebrate diversity. The first step in accomplishing this task was to map major areas that serve long-term conservation purposes. No gaps were found because the Kettle Creek watershed consists of 92% state forestland and is considered protected.

Other uses of GAP are to locate areas of potential species richness and to locate potential good habitat for an individual species. All maps developed using GAP have the state partitioned into landscape areas, which are further divided into one-kilometer square cells (0.62 miles). Pennsylvania GAP has considered 470 vertebrate species that are found in the state and has also taken into account the type of habitat each species prefers, the present landuse, and several other parameters. Out of these 470 vertebrate species, 285 vertebrate species have at least potential habitat in the Kettle Creek watershed. When mapped, it is apparent that stream corridors are high in total potential vertebrate diversity, especially along the mainstem of Kettle Creek (Figure 4.22). It is important to note that a large amount of the stream corridor is owned by private landowners and therefore opportunity exists for landowner participation in conservation efforts.

Individual richness maps were also created for this watershed (Figures 4.23, 4.24). Mammal and bird diversity potentially exists throughout the watershed but is highest along stream corridors. Turtle, amphibian, snake and lizard diversity was highest along stream corridors in the southern part of the watershed. Potentially, the most fish diverse area in the watershed is in the Twomile Run Subwatershed. This is important to note because presently this area is affected by acid mine drainage which has reduced or eliminated fish populations. According to GAP once the area is remediated, this could potentially host a very diverse fish population.

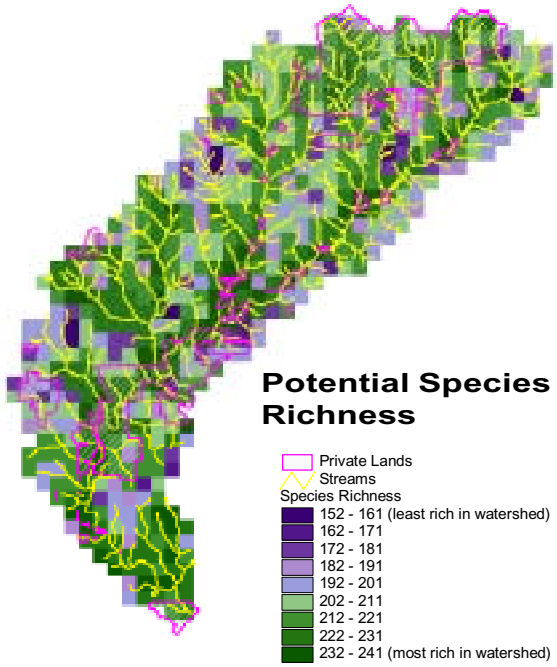
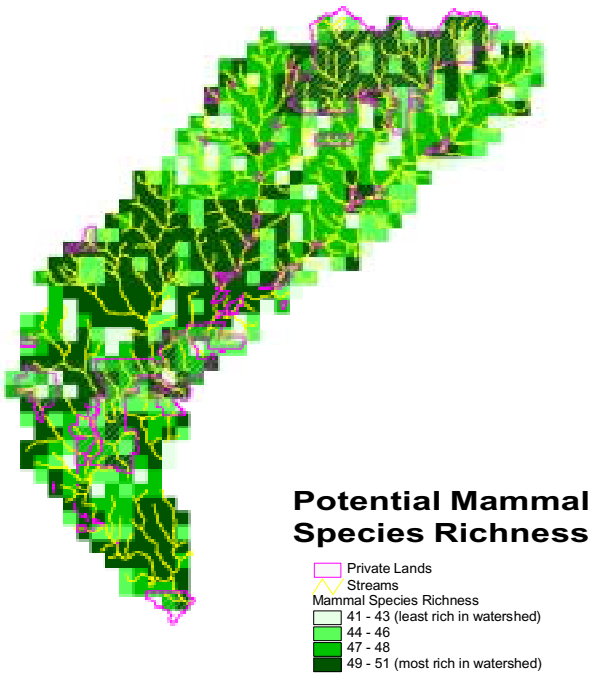
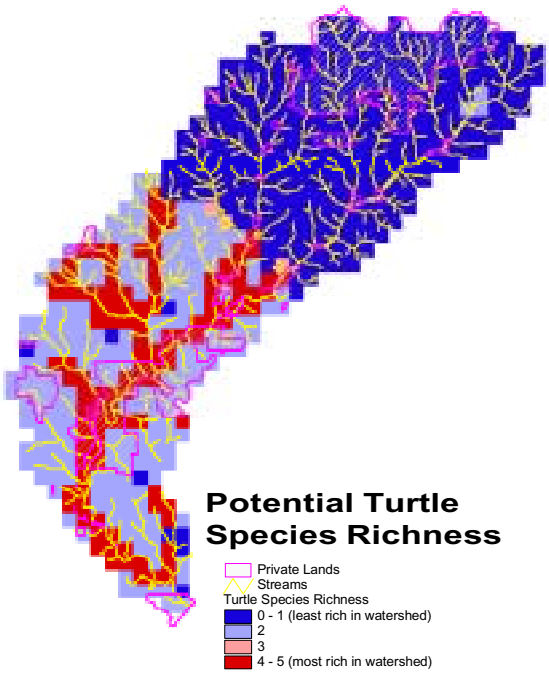


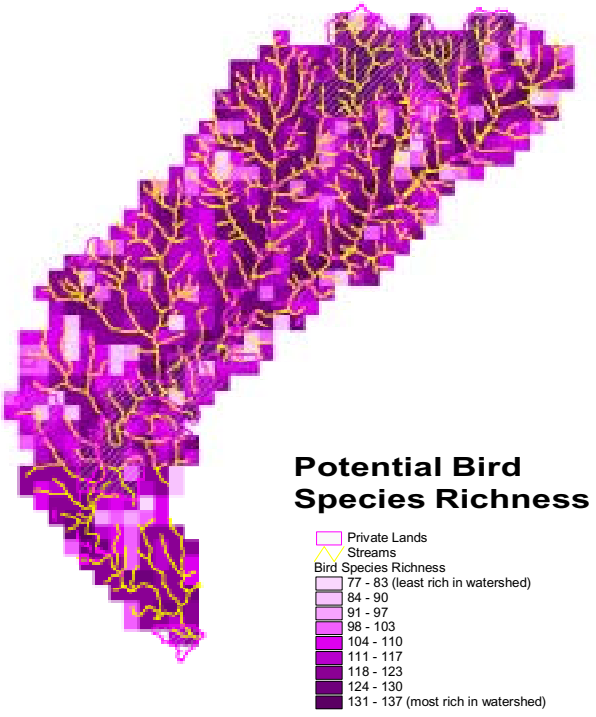
Figure 4.22 - Potential wildlife species richness throughout watershed. The riparian corridors are particularly species rich.

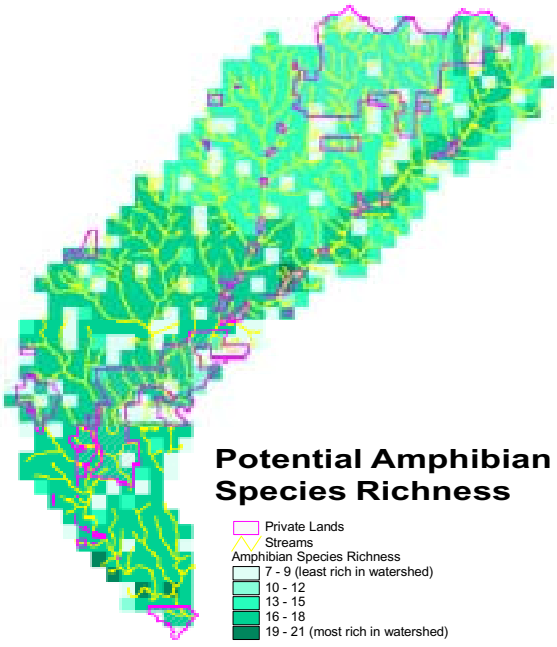
Another use of GAP is to use habitat maps as an aid in wildlife management. For example, if the watershed was to be managed for a specific species, the maps could locate areas in the watershed with suitable potential habitat for that species. Because there are 285 potential species in the Kettle Creek watershed, not all will be discussed here. However, maps are easily attainable using GAP data. Individual species, such as elk, white tailed deer, Allegheny wood rat (*Neotoma magister)*, northern goshawk (*Accipiter gentiles)*, brook trout, brown trout, and rainbow trout were selected to discuss here as examples of how GAP data may

GAP ANALYSIS



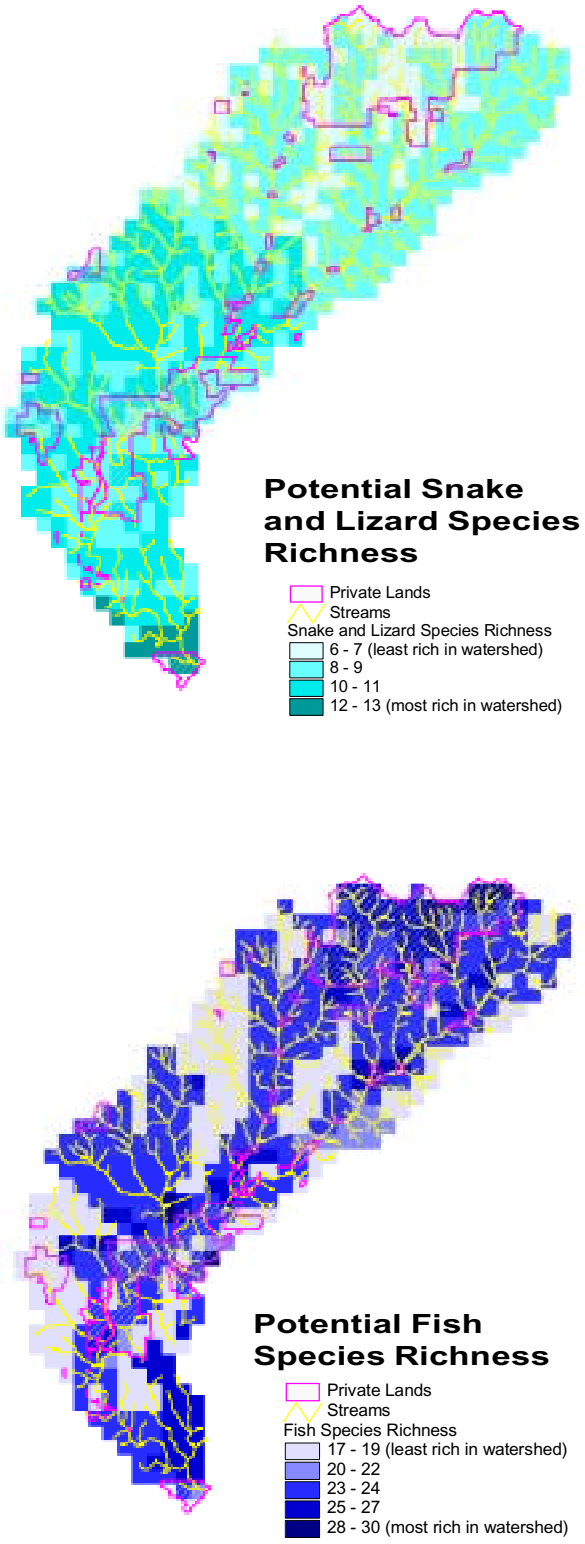




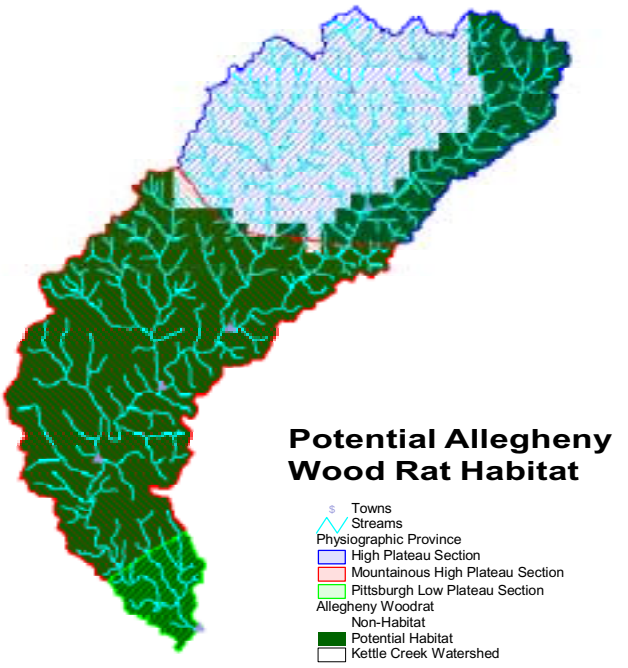


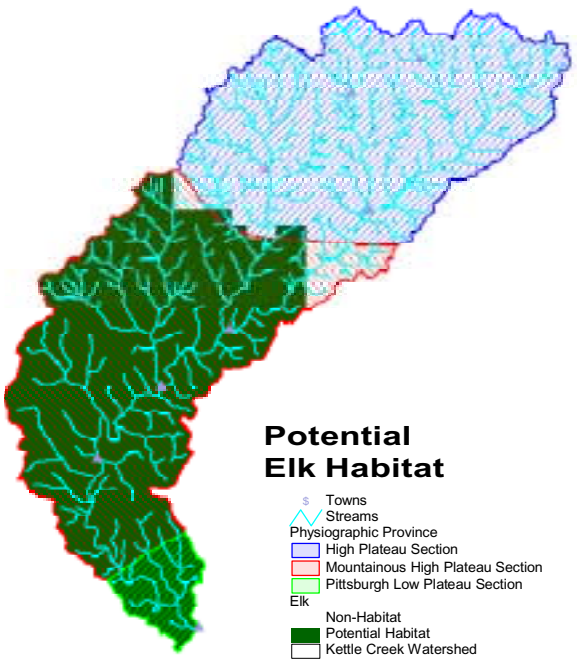
Figures 4.23 - 4.26 - Potential species richness maps aggragated by major groups: mammals, turtles, birds, and amphibians.

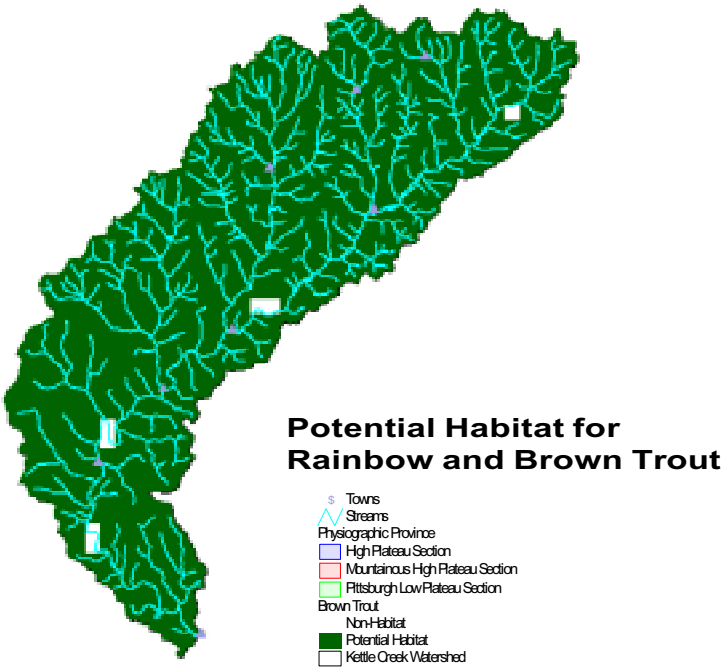
be interpreted. The best potential elk habitat is in the southern portion of the watershed, within the Mountainous High Plateau Section and the Pittsburgh Low Plateau Section of the Appalachian Plateau physiographic province (Figure 4.25). This distribution of potential habitat was true for many species. According to GAP, it seems that the High Plateau Section of the Appalachian Plateau physiographic province was potentially uninhabitable for various species, including elk. The Allegheny wood rat has potential habitat throughout the watershed, however in a small section of the northern half of the watershed, habitat is inadequate (Figure 4.25). White tailed deer and northern goshawk have potential habitat throughout the entire watershed. Northern goshawk and Allegheny wood rat are rare and uncommon species in Pennsylvania (Pennsylvania Natural Diversity Index). In the Kettle Creek watershed, there is potential habitat for 27 PNDI species (See Appendix G, page 305 for list and maps). Brown and rainbow trout can potentially exist thro out the watershed, except for a few localiz areas of the mainstem as can be seen in Fig 4.25. Brook trout also can potentially inhal most of the watershed, however, there are localized areas that are not suitable for bro trout habitat (Figure 4.25).

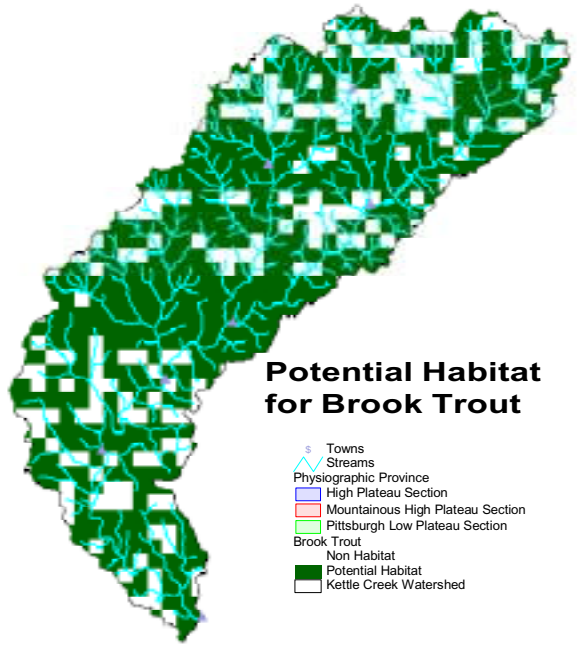


Figures 4.27, 4.28 - Potential species richness maps for snakes and lizards and fish.









Figures 4.29-32 - GAP Analysis maps displaying potential habitat for a specific species within the Kettle Creek watershed.

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