# THE NORTH FORK OF BENS CREEK

## COLDWATER CONSERVATION PLAN




**February 2014**

PREPARED BY THE SOMERSET CONSERVATION DISTRICT

Foundation for Pennsylvania Watersheds

The Pennsylvania Department of Conservation and Natural Resources

## Acknowledgements

This plan was funded and developed by a grant awarded to the Somerset Conservation District by the Cold Water Heritage Partnership, which is a multifaceted joint venture between the Pennsylvania State Council of Trout Unlimited, The Foundation for Pennsylvania Watersheds, The Pennsylvania Department of Conservation and Natural Resources and The Pennsylvania Fish and Boat Commission.

Author: Greg Shustrick, Somerset County Watershed Specialist
GIS mapping: Amanda Deal

Kind regards to the following contributors for their assistance with the plan development:

- Mr. Richard Lorson, PFBC SW Region 8 Area Fisheries Manager
- Mr. Michael Depew, PFBC Fisheries Biologist
- Mr. Scott Alexander, PADEP Biologist
- Mr. Len Lichvar, Somerset Conservation District Manager
- Mr. Drew Walker, Somerset Conservation District Intern
- Ms. Amanda Deal, Environmental Consultant
- Ms. Samantha Kutskel, Coldwater Resource Specialist, PATU / CWP
- Mr. James Shustrick, Public Volunteer
- Mr. Chris Mayla, Public Volunteer
- Mr. Travis Rudge, Public Volunteer
- Mr. Andy Fresch, Public Volunteer
- The Mountain Laurel Chapter of Trout Unlimited
- The Greater Johnstown Water Authority
- The Bens Creek Canoe Club

SOMERSET CONSERVATION DISTRICT, 6024 GLADES PIKE, SOMERSET, PA 15501
www.somersetcd.com , 814.445.4652 X 5
somersetcd@wpia.net

*Digital copies of this plan can be downloaded on the District's website and at www.coldwaterheritage.org/

COVER PHOTOS BY GJS

# CONTENTS

# PURPOSE

**The intent of this plan is to document the existing conditions natural, historic, public and privately owned components of this watershed. The data assembled within is a snapshot of the needs, potential threats and other factors that enable these waters to maintain quality. Although these waters and lands are not undisturbed, this unique watershed is a modern day example that business, industry, agriculture, residential and recreation can all occur within the same small watershed and maintain water quality and the biological integrity of the resources.**

# INTRODUCTION

**The North Fork of Bens Creek is the second largest tributary to the main stem of Bens Creek and a third order tributary to the Stonycreek River. The main stem of Bens Creek is a High-Quality Trout Stocked Fishery (HQ-TSF), and the South Fork of Bens Creek, a High- Quality Coldwater Fishery (HQ-CWF) with a small segment of the headwaters listed as Exceptional Value (EV), by the PA Department of Environmental Protection. The District found interest in the North Fork, because the watershed is virtually unimpaired and maintains extremely high water quality.**

**The origin of the North Fork cascades from 2800' off the North-Eastern face of Laurel Mountain, at the intersection of Westmorland, Somerset and Cambria counties. The Pennsylvania Department of Environmental Protection (DEP) designates the North Fork of Bens Creek as an Exceptional Value (EV) waterway in the headwaters and High-Quality Cold Water Fishery (HQ-CWF) in the lower reaches. The basin includes two primary sub-watersheds, Alwine's Creek and Riffle Run, both of which are designated as exceptional value (EV) watersheds. The Pennsylvania Fish & Boat Commission classifies the North Fork of Bens Creek Class B native brook trout fishery. Tributaries Alwines Creek and Riffle Run also hold reproducing populations of wild trout. Notably Alwines Creek is a Class A wild rainbow trout fishery, uncommon to Pennsylvania.**

**Greater than 90% of the North Fork of Bens Creek watershed is owned and managed by the Greater Johnstown Water Authority and is open to public access. The North Fork Reservoir is centrally located within the watershed and is a drinking water supply for the City of Johnstown and Ligoneir, PA. The entire watershed encompasses just over twelve square miles of area and scattered within, a number of unique and historical sites dot the hillsides. Some of these sites include old homesteads and graveyards. In addition a portion of the watershed includes a State Game Lands, State Park, hiking trail, trap and field club and a golf course. Although the watershed is heavily forested it has a number of rural homes and several farming operations.**

**Through the development of this plan the Somerset Conservation District has collected biological and water chemistry samples to identify potential or existing threats to this sensitive water resource. In addition the data collected in preparation of this plan will allow the Somerset Conservation District and other groups and organizations to utilize this document as a tool to implement future conservation and management recommendations, within the North Fork of Bens Creek drainage.**

# GEOGRAPHY

The North Fork of Bens Creek lies within the Allegheny Mountain Section of Pennsylvania, which consists of broad, rounded ridge tops separated by broad deep valleys, known as the “Laurel Highlands”. This section occurs in the southwestern of Pennsylvania and includes the entire portion of Somerset County, and approximately half of Fayette and Cambria Counties, parts of Westmoreland, Indiana, Blair, and Bedford Counties are also included in this region.

The ridges decrease in elevation from south towards the north of the Allegheny Mountain section. The ridges occur on the crests of anticlines and have eroded to expose the resistant rocks that form the ridges. However, there is less ridge top erosion than has occurred in the Appalachian Mountain Section of Pennsylvania. The southern parts of these ridges form the highest mountains in the state of Pennsylvania. Common characteristics of the valleys in this region are broad, with rolling surfaces and shallow to deeply incised stream channels. Elevation differences between the ridge crests and the adjacent valley lowlands can often exceed more than 1,000 feet. Landscape elevations in the section range from 775 to 3,213 feet, with the highest point in Pennsylvania at Mt. Davis.

There are several major routes that cross the Allegheny Mountain Section which provide a scenic views along the way, these include; Interstate 76 (PA Turnpike) from Somerset County to the New Stanton exit; Route 30 from the eastern end of Somerset County to Latrobe, also US Route 40 from Maryland to Uniontown. Additional routes that cross this section are included PA State Routes 31 and 653. Routes providing a scenic view that follow the length of this section north from Maryland are: US Route 219 and PA State Routes 281, 381 and 271. PA State Route 271 crosses the Laurel Ridge closest to the headwaters of the North Fork of Bens Creek

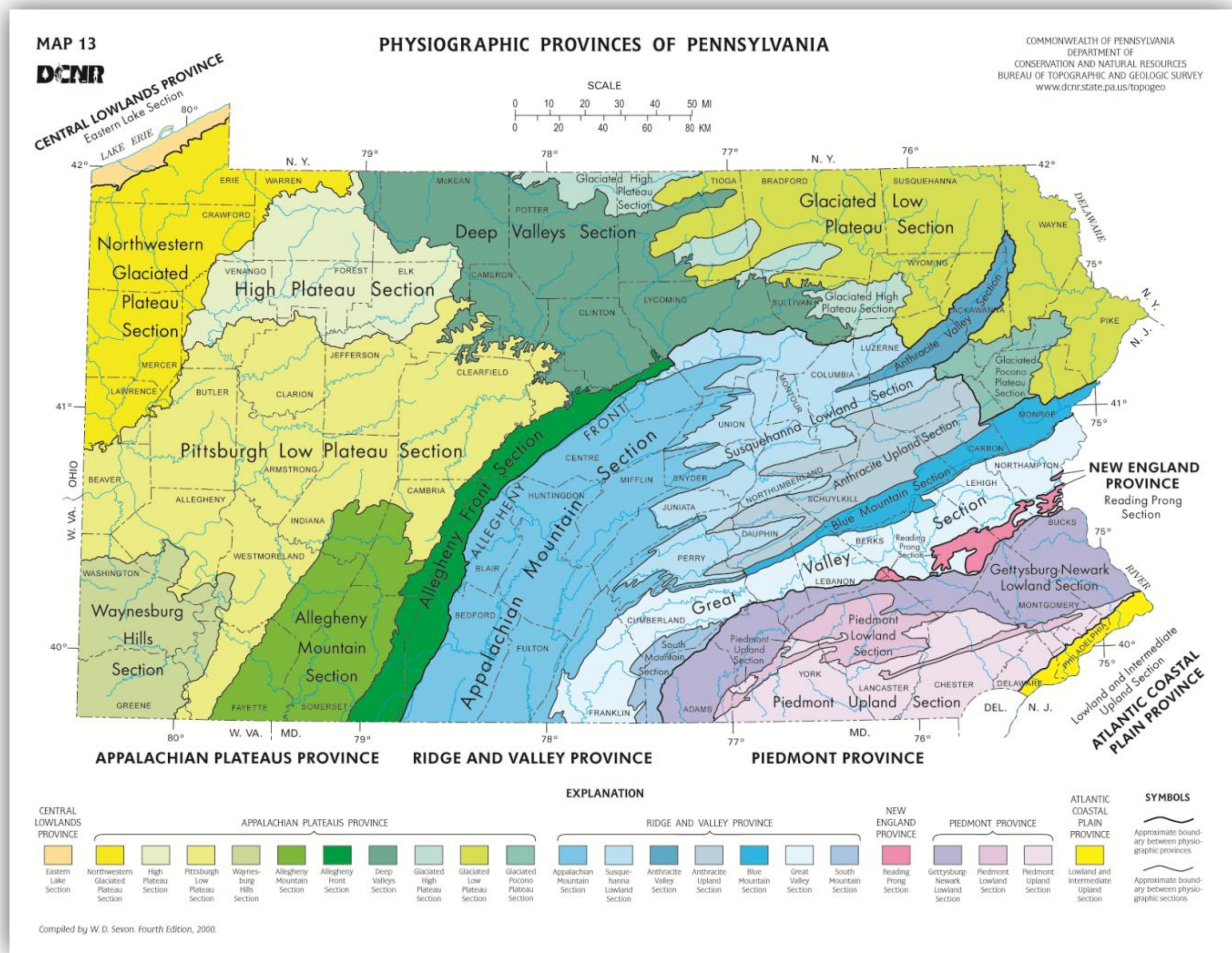



**Figure 1: This DCNR map of Pennsylvania, separates the state into 23 physiographic provinces. The North Fork of Bens Creek lies within the Allegheny Mountain section.**


PHOTO BY GJS

**Figure 2: This map of the Laurel Highlands Trail, shows where the North Fork of Bens Creek drainage is in relation to Cambria, Somerset and Westmorland counties.**

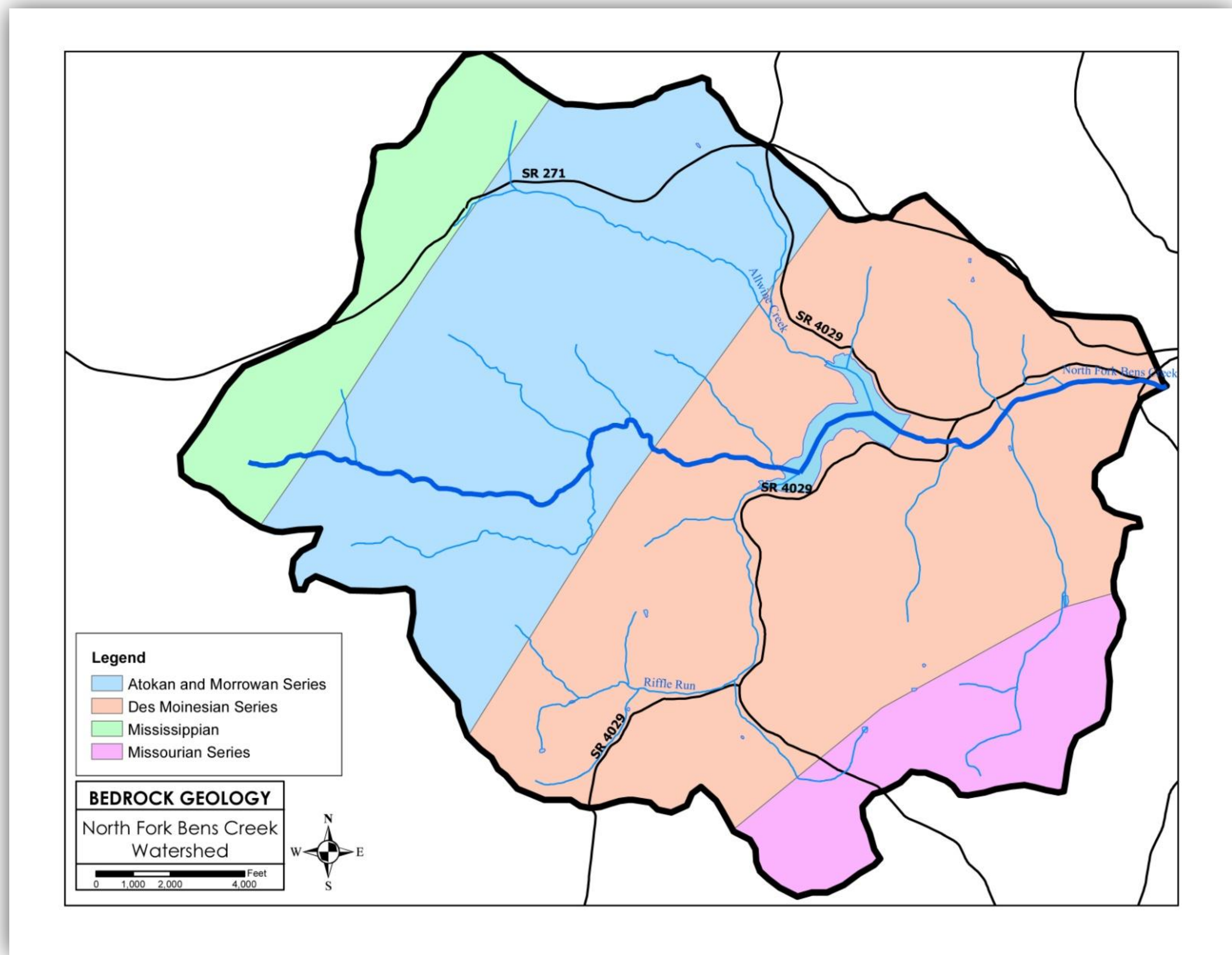
# GEOLOGY

Geologic records of sedimentary rocks within Somerset County span from the Devonian Scherr Formation to the Pennsylvanian Monongahela Formation. Most of these rocks are conglomerate, sandstone and shale and there is very little limestone exposed at the surface. There are no igneous or metamorphic rock formations found within Somerset County.

The primary formations that exist within the North Fork of Bens Creek watershed include the Attokan and Marrowan Series, Des Moinesian Series, Mississippian and Missourian Series.

Somerset County has a number of gentle folds, the axes of which trend north-northeast. Synclines in the county include the following:  Youghiogheny Syncline, New Lexington/Johnstown Syncline, Somerset Syncline, Berlin Syncline, and the Wellersburg Syncline. The southern end of Wilmore Syncline is located at the town of Windber. Anticlines within the county include the Laurel Hill Anticline, Centerville Dome, Boswell Dome, Negro Mountain Anticline, and an unnamed anticline between the Berlin and Wellersburg Syncline.

The larger mountains in the county are listed from west to east: Laurel Hill, Negro Mountain, Meadow Mountain, Savage Mountain and Allegheny Mountain.   Negro Mountain includes the highest peak in Pennsylvania, Mount Davis, reaching 3213’.  The origins of the North Fork of Bens Creek flow off the south-eastern face of Laurel Mountain form 2800’.



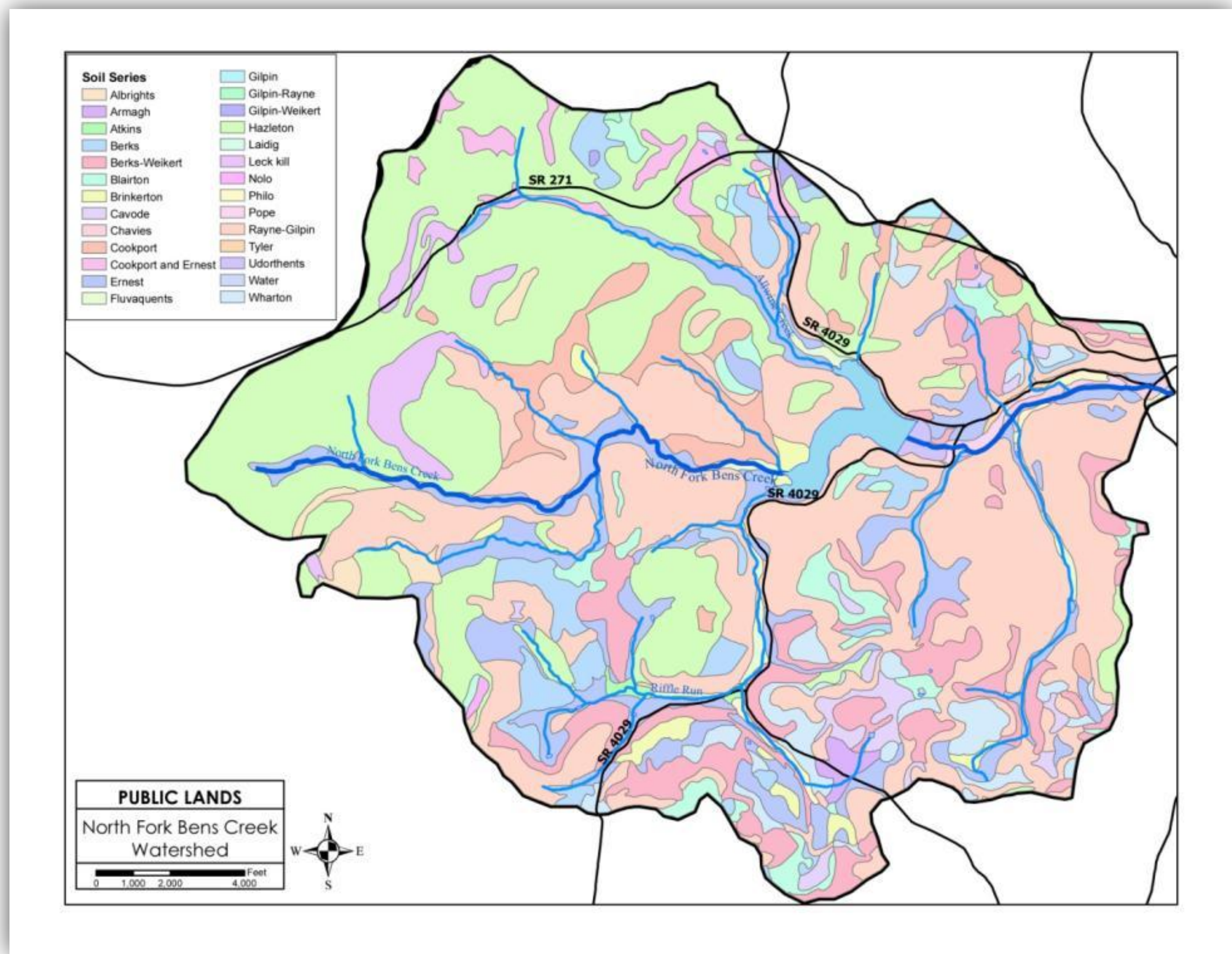

MAP BY AD

**Figure 3: The map above depicts the geologic formations within the North Fork of Bens Creek drainage.**

# SOILS

The soils within the county are complex and together form an intricate pattern across the landscape. The soils are comprised of weathered material from shale, siltstone and sandstone. The majority of the soils within Somerset County are suitable for cropland, hay and fruit production. The soils that lie on steeper facing slopes are prone to severe erosion if disturbed and left unprotected by vegetation. The primary limitations of the soils within the county are steepness of slope, wetness, depth to bedrock and rocky surface.

The Soils with in the North Fork of Bens Creek is predominately Rayne-Gilpen-Wharton-Cavode and Hazelton-Cookport soil series. These soils range from nearly level to very steep, deep and moderately deep, well drained to poorly drained on hilltops and ridges.




MAP BY AD

**Figure 4: The map above shows the soils series of the North Fork of Bens Creek basin.**

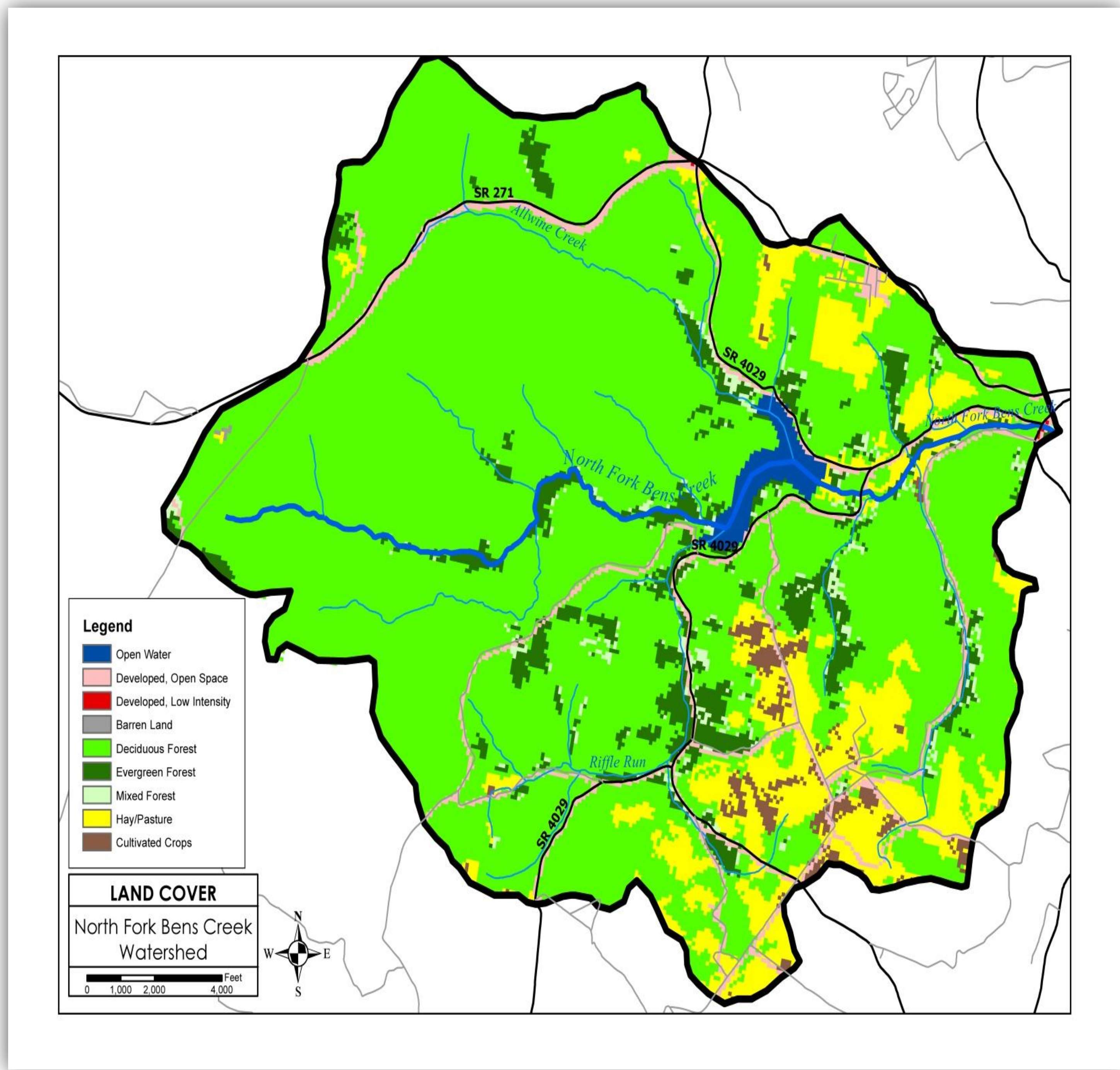
# LAND USE

The entire North Fork of Bens Creek drainage basin is 12.8 square miles or 8,312.5 acres in size. Although the majority of the watershed is heavily forested by 6,870 acres of woodlands, there is a wide variety of existing land uses within the watershed both publically and privately owned. Some of which include agriculture lands, state owned game lands, a state park, water authority owned reservoir and lands, residential lands, a sportsman's club and a golf course.

For the purpose of this report the major categories of use include low intensity developed, barren land, open water, cultivated crops, mixed forest, developed open space, evergreen forest, hay and pasture, deciduous forest. The following chart displays the percent of existing land use.

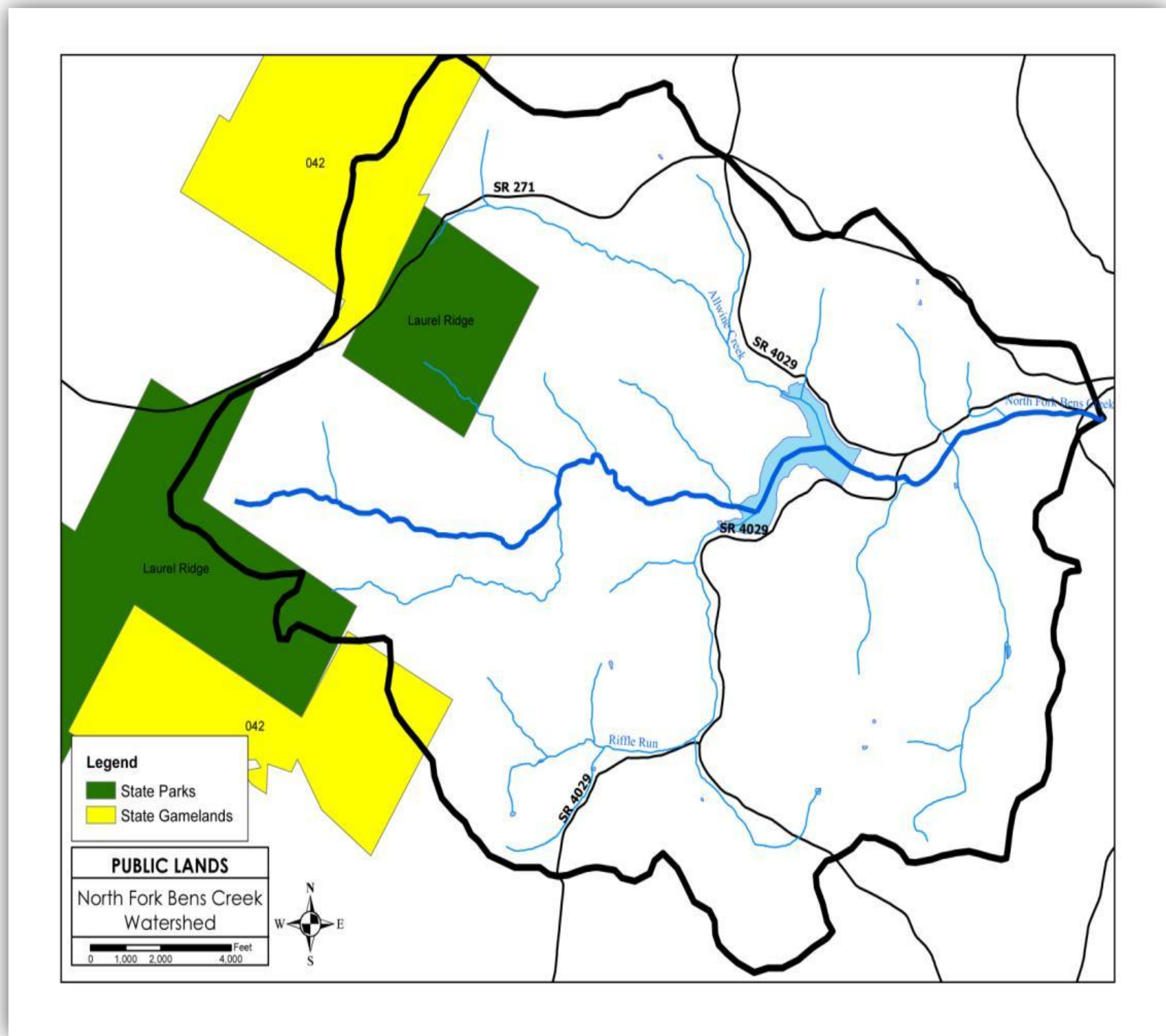
| LAND USE TYPE | % | ACRES |
|---|---|---|
| Developed, Low Intensity | 0 | 1.3 |
| Barren Land | 0 | 1.8 |
| Open Water | 1.2 | 97.4 |
| Cultivated Crops | 1.4 | 115.6 |
| Mixed Forest | 1.6 | 134.3 |
| Developed, Open Space | 4.2 | 345.3 |
| Evergreen Forest | 6.1 | 504.5 |
| Hay / Pasture | 10.6 | 879.1 |
| Deciduous Forest | 75 | 6233.3 |

**Figure 5: This table shows the breakdown of land use by percent and existing use.**




MAP BY AD

**Figure 6: The map above separates the land use within the watershed by color series.**




MAP BY AD

**Figure 7 : The map above highlights portions public lands within the North Fork of Bens Creek watershed.**

# LAUREL RIDGE STATE PARK


PHOTO BY GJS

The Laurel Ridge State Park is a 13,625 acre park that stretches along Laurel Hill from the Youghiogheny River at Ohiopyle, to the Conemaugh Gorge near Johnstown. This park covers sections of four counties Cambria, Fayette, Somerset and Westmoreland. The main feature of the park is the 70-mile Laurel Highlands Hiking Trail, which provides semi-wilderness backpacking and day hikingopputunities.  Other popular activities within the park include birding, hiking, hunting, cross country skiing and geo-caching

Another great reason to visit the park is for its scenery. In spring wildflowers begin to dot the forest floor during April followed by bright greens as leaf-out begins going into May. During the summer months mountain laurel begins to bloom in June and rhododendron blooms in early July. The colors in the park in mid-October are at their peak. Scenery in winter months can be stunning when the park is covered under a blanket of snow.

PHOTO BY GJS

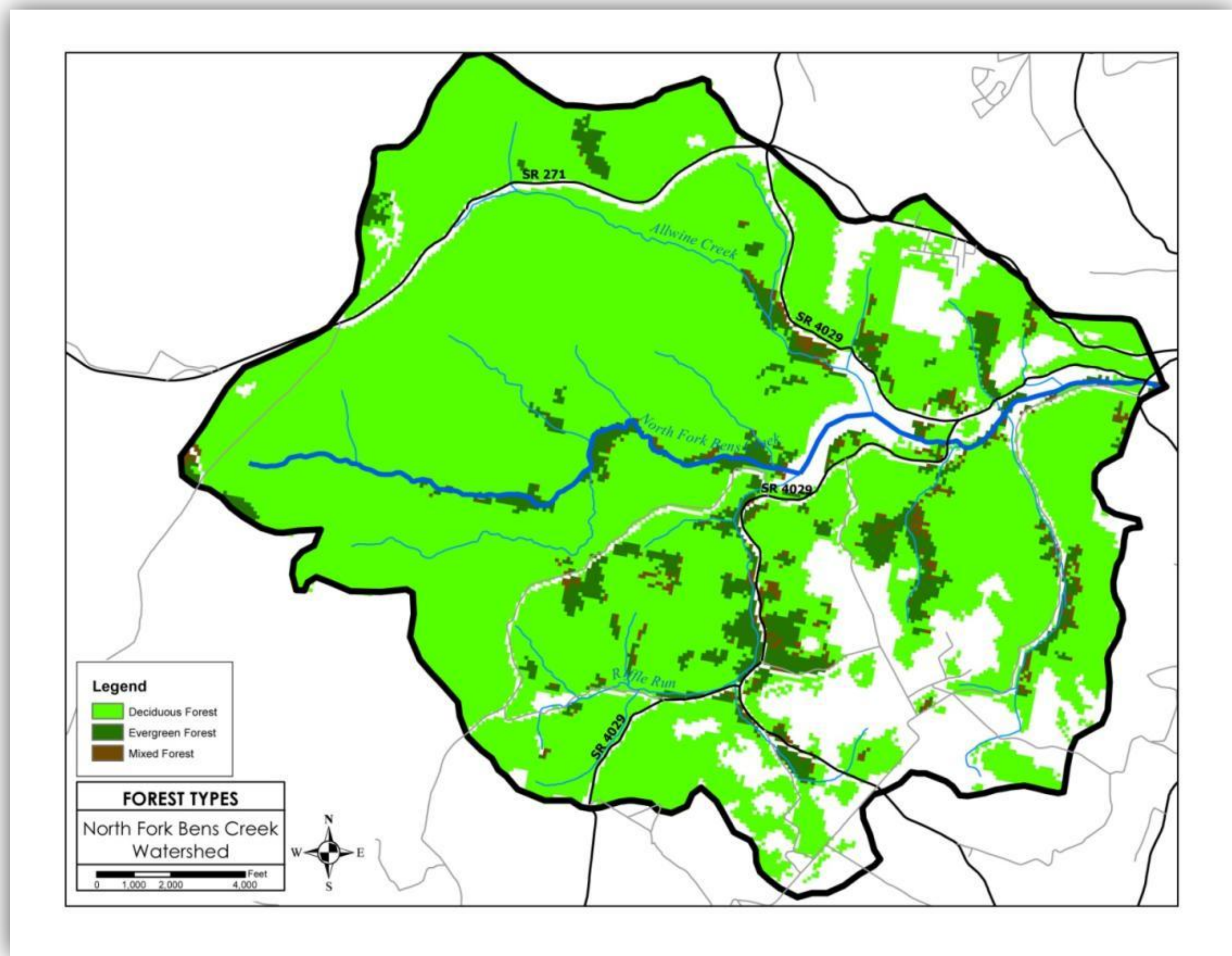
**Figure 8: Kiosk at the Laurel Highlands trailhead near SR 271.**

PHOTOS BY GJS

**Figure 9: An overnight shelter located along the Laurel Highlands Trail.**

# FORESTS

The basin primarily includes Appalachian mixed- mesophytic forests which are found on deep and enriched soils in sheltered low-elevation slopes, often occurring near small streams. The herbaceous layer is very rich and, in undisturbed areas, the trees can grow very large. Typical tree species include sugar maple, beech, tulip poplar, basswood, northern red oak , cucumber magnolia, black cherry and black walnut. Other tree species that are also found here are eastern hemlock, white ash, sweetgum, and yellow buckeye.  Mixed mesophytic forests found at higher elevations and further to the east typically include yellow birch, mountain maple, sugar maple, beech, black cherry and eastern hemlock with vast understories of mountain laurel and rhododendron.




MAP BY AD

**Figure 10: The map pictured above separates forest type by colors.  As shown a large portion of the watershed is covered by deciduous forest.**

# NORTH FORK RESERVOIR

The North Fork Reservoir Located in Conemaugh Township, Somerset County, is owned and operated by the Greater Johnstown Water Authority. The GJWA also owns two other reservoirs Dalton Run and Saltlick. All three supply water for industrial and residential use within Cambria, Somerset and Westmorland Counties. The North Fork Reservoir has the capacity of 1.1 billion gallons at a spillway elevation of 1,525 feet. The Reservoir has a rated safe yield of 6 million gallons per day. This reservoir accounts for approximately 70% of the water supplied to the Greater Johnstown Water Authority's customers.

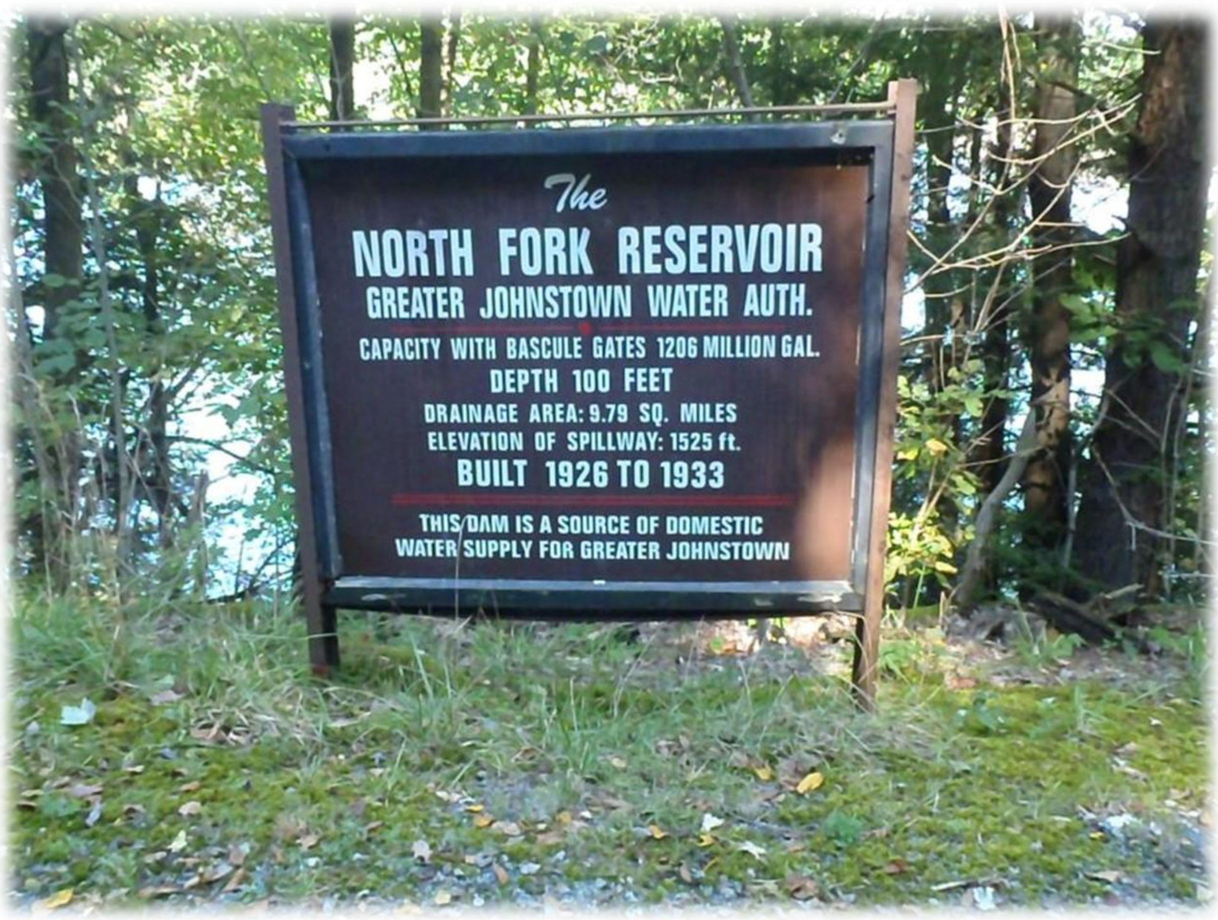



PHOTO BY GJS

The dam is constructed of an earthen embankment lined with cut stone on its upstream side. The construction of the embankment began in 1926 and was completed in 1933. The North Fork Reservoir drains an area of 9.79 square miles, nearly 2/3 of the entire North Fork of Bens Creek watershed.  The North Fork Reservoir has had its storage capacity increased by the installation of 3 foot "bascule gates". These gates are raised typically in the fall when the reservoir no longer overflows its spillway. The gates add approximately 100 million gallons of storage. The gates can also be lowered during periods of high flows to maximize the capacity of the spillway. The majority of this portion of the watershed is also owned by the water authority. These lands are heavily forested and managed strictly to protect and preserve the integrity of the water quality of the tributaries. In addition the authority's Manager, RDM-Johnstown, LLC provides professional forester services to manage tree cutting practices within the watershed. These practices maintain the health of the forest and generate revenues for the water authority.  The Water Authority keeps their lands open to public recreation, unless otherwise clearly marked by signs. North Fork Reservoir is closed to swimming, boating and fishing. The majority of the water from this reservoir supplies residents and businesses within the Greater Johnstown area water for drinking and industrial uses. However, a newly installed water line sends water over the Laurel Ridge to the residents of Ligonier, in Westmorland County. On average 520,000 gallons of water are pumped over the mountain daily.  This extension line has allowed the authority to expand their customer base.

In addition to the water supplied to residents, the reservoir is also equipped with a conservation release and has to meet a daily requirement that has been mandated by the Pennsylvania Department of Environmental Protection in 1983. The minimum releases requirement is 1.33 cubic feet per second or 860,000 gallons per day. This release ensures the downstream aquatic habitats are not robbed of the waters on which they depend. The waters that feed the conservation release are taken from either 30 feet below the water surface or 60 feet below the water surface. The elevation is dependent upon the level of the reservoir and the water turbidity the water within.

PHOTO BY GJS

**Figure 11: The spillway at North Fork Reservoir**

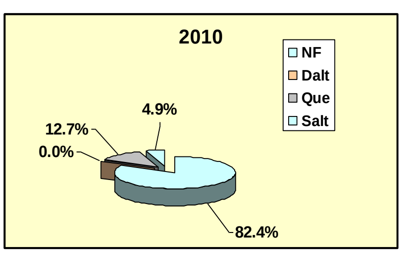
## RAW WATER SUPPLIED TO RIVERSIDE AND SALTLICK TREATMENTPLANTS

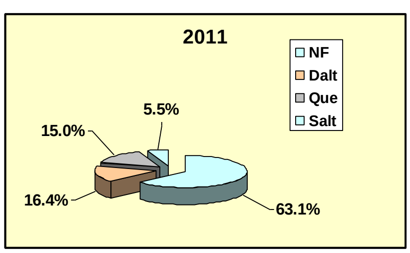
## (DAILY AVERAGE IN MILLION GALLONS)

| | NORTH FORK | DALTON RUN | QUE | SALTLICK | TOTAL |
|---|---|---|---|---|---|
| | | | | | |
| Allocation | 7.250 | 2.250 | 5.400 | 5.500 | |
| Yield | 6.500 | 0.800 | 62.000 | 4.800 | |
| Minimum Release | 0.860 | 0.410 | 0.000 | 0.000 | |
| Adjusted Yield | 5.640 | 0.390 | 62.000 | 4.800 | |
| | | | | | |
| 2010 Amount | 6.204 | 0.000 | 0.958 | 0.367 | 7.529 |
| 2011 Amount | 4.804 | 1.252 | 1.143 | 0.415 | 7.603 |
| 2012 Amount | 4.917 | 1.312 | 1.101 | 0.305 | 7.635 |
| | | | | | |
| 2010 Percentages | 82.4% | 0% | 12.7% | 4.9% | |
| 2011 Percentages | 63.1% | 16.4% | 15.0% | 5.5% | |
| 2012 Percentages | 64.4% | 17.2% | 14.4% | 4.0% | |

**Figure 12: The table above shows daily use of water by the Greater Johnstown Water Authority.**

**PERCENT OF RAW WATER SUPPLIED TO RIVERSIDE BY SOURCE**



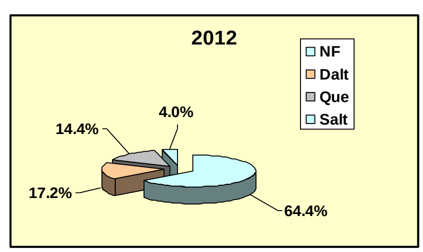




**Figure 13: These pie charts show the percent of water used from GJWA owned reservoirs for the past three years. North Fork Reservoir supplies over 60% of the water sold to customers.**

# TREATED WATER SUPPLIED

**TREATED WATER (Daily Average in Million Gallons)**

| | RIVERSIDE | SALTLICK | RED RUN WELL | TOTAL |
|---|---|---|---|---|
| Delivered Capacity | 14.7 | 5 | 0.25 | 19.95 |
| | | | | |
| 2010 | 6.927 | 0.332 | 0.110 | 7.369 |
| 2011 | 7.006 | 0.364 | 0.055 | 7.425 |
| 2012 | 7.174 | 0.259 | 0.000 | 7.433 |

**Figure 14: The table above depicts the amount of water treated per day by the GJWA.**

**METERED CONSUMPTION (Daily Average in Million Gallons)**

| YEAR | DOMESTIC | COMMERCIAL | INDUSTRIAL | INSTITUTIONAL | BULK SALES | PLANT USAGES | TOTAL |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 2010 | 1.964 | 0.631 | 0.695 | 0.226 | 0.465 | 0.506 | 4.487 |
| 2011 | 2.040 | 0.635 | 0.461 | 0.237 | 0.480 | 0.490 | 4.343 |
| 2012 | 1.999 | 0.605 | 0.428 | 0.213 | 0.438 | 0.492 | 4.175 |

**Figure 15: The table above shows the annual amount of water used by the primary customer groups.**

# WATERSHEDS

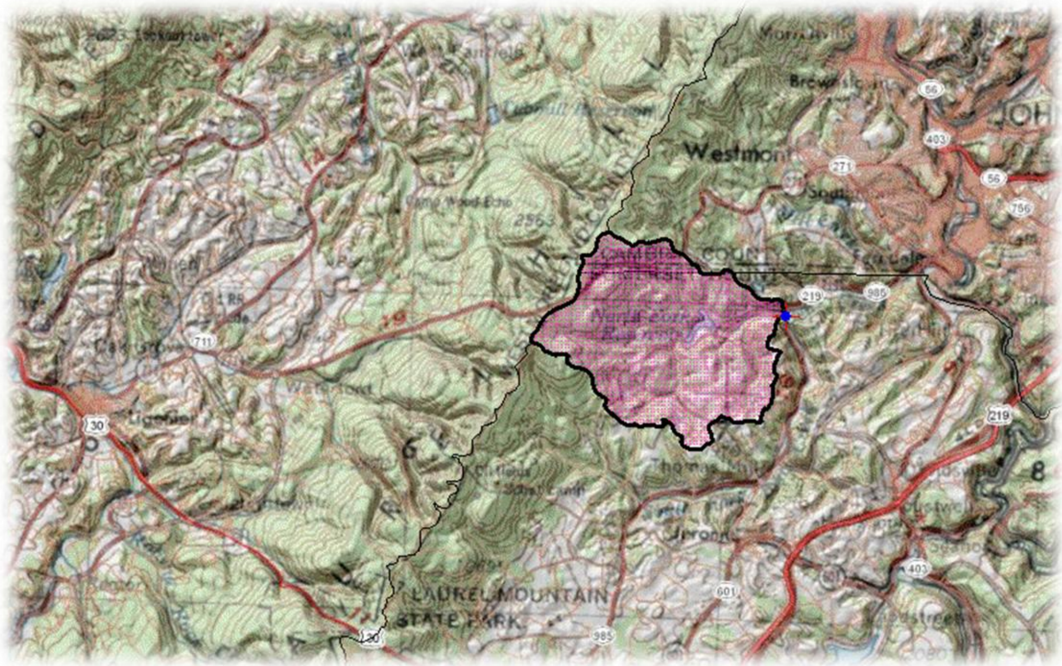



**Figure 16 :  The map above outlines the watershed boundary of the North Fork of Bens Creek**

The North Fork of Ben Creek drainage encompasses an area of 12.8 square miles, in which there are 26 streams miles that flow to form the main stem of Bens Creek. The North Fork Bens Creek is an eight mile long stream that is located in northwestern portion Somerset County and is approximately 6 miles southwest of Johnstown, Pennsylvania. The origin of the stream cascades off the north-eastern side of Laurel Hill near the Somerset-Westmoreland County line and flows northeast into North Fork Reservoir and then to its confluence with the South Fork Bens Creek on the north eastern side on SR 985.

The North Fork of Bens Creek has three major tributaries, Alwines Creek and Riffle Run and Heckman Hollow.  The head water of the North Fork of Bens Creek, Alwines Creek and Riffle Run all flow off the Laurel Ridge into the North Fork Reservoir.  Heckman Hollow meets the North Fork of Ben Creek below the dam in along Country Club Road. The two flow to meet the South Fork of Bens Creek and form the main stem of Bens Creek. Since the 1970s The Pennsylvania Fish and Boat Commission has managed these waters as wild trout fisheries and there is no supplemental fish stocking has taken place.

The stream sections above the dam have been designated in the PA Department of Environmental Protection (DEP) Chapter 93, as Exceptional Value (EV).   A DEP survey conducted in the early 1990's recommended an upgrade from High Quality – Coldwater Fishes (HQ-CWF) to EV for the portion of the North Fork above the reservoir.  This was based on the exceptional environmental features that are present in the watershed.  There is no higher level of watershed classification in Pennsylvania.

The North Fork of Bens Creek and Heckman Hollow below the reservoir are designated as High-Quality Cold Water Fishery and Wild Trout Waters.  Portions of these streams flow through a golf course as well as a semi-residential area.  In the section urbanization, surface release from the lake, water temperature and flow issues combined, have prevent these waters from being listed as Exceptional Value. In addition the mandated conservation release has helped with some of these issues but has not lifted the stream section to a higher designation.

# WATER QUALITY MONITORING

There has been ongoing water monitoring within the tributaries of the North Fork of Bens Creek by the Greater Johnstown Water Authority since 2011. The authority is tracking stream water level, temperature and conductivity. Additional water quality parameters and indicators have been measured during the data gathering potions of this plan. Additional temperature loggers were deployed into stream sections that were not previously being monitored. Also field pH, dissolved oxygen, conductivity were recorded. In addition to water chemistry samples biological samples of aquatic invertebrates or macroinvertebrates were taken as another measure of stream health.

# CONTINUOUS IN-STREAM MONITORING

The Greater Johnstown Water Authority has been collecting base line stream data on Alwines Creek and the North Fork of Bens Creek by using submersible data loggers. The units are capable of tracking water level, conductivity and water temperature. The devices continuously take readings every fifteen minutes. The data recorded documents baseline stream chemistry and will allow the authority to identify a pollution event or other watershed threat that may occur within the head waters of the drinking water reservoir. To date no serious instances have been documented to have occurred.


**Figure 17: The device pictured is currently being used within the water shed to track water level, temperature and conductivity.**

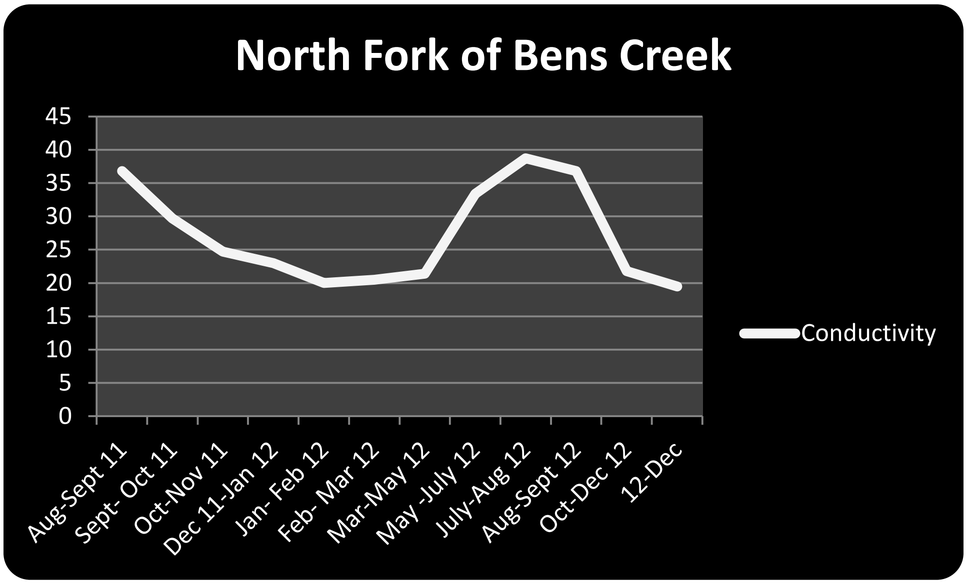



**Figure 18: The graph above displays the conductivity in the North Fork of Bens Creek from Aug 2011 to Dec 2012**

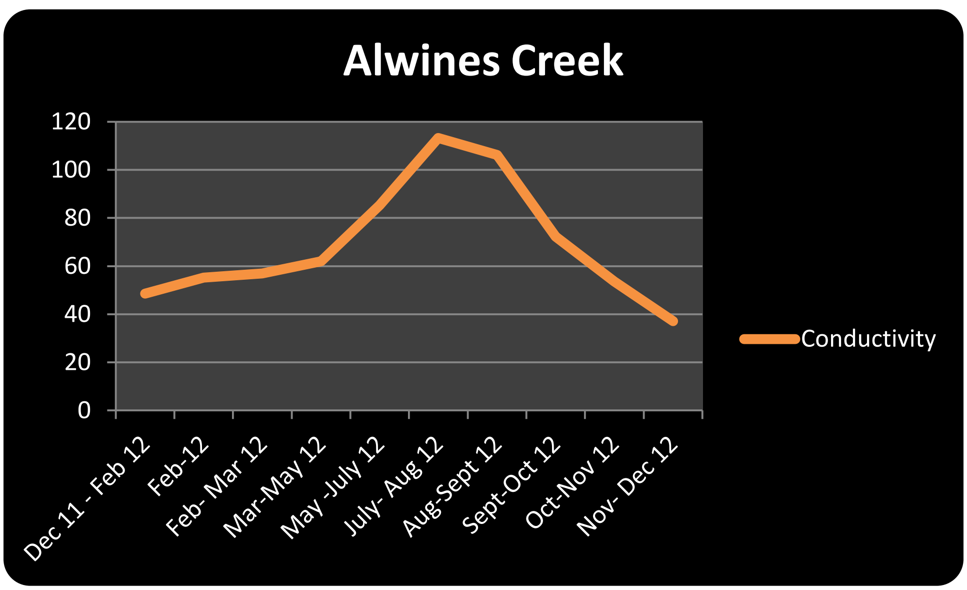



**Figure 19: The graph above shows the recorded conductivity from Dec. 2011 to Dec 2012 on Alwines Creek.**

# IN STREAM WATER TEMPERATURE MONITORING

The charts below display the average, minimum and maximum recorded temperatures of Alwines Creek, Riffle Run and two sites on the North Fork of Bens Creek. All trout, particularly wild brook trout depend on cold water for survival and will not survive in water much greater than seventy degrees Fahrenheit. The recorded temperatures indicate that there is minimal threat of thermal pollution above the North Fork Reservoir. However, the summer time high temperatures on the North Fork of Bens creek below the reservoir exceed the temperature regime for trout survival. Some of the contributing factors for the increased in water temperature are more than likely link to the following : warm surface water released from the reservoir, North Fork County Club water withdrawal, warm water released from the small impoundments on the golf course and the removal of riparian vegetation throughout the golf course corridor. Although below the reservoir a moderate number of trout, forage fish and aquatic invertebrates were present, excess water temperatures are a limiting factor in this section of stream.

| ALWINES CREEK WATER TEMP. | |
|---|---|
| MIN | 31.9 |
| AVG | 51 |
| MAX | 73.7 |

| RIFFLE RUN | |
|---|---|
| MIN | 44.9 |
| MAX | 68.9 |
| AVG | 56.9 |

| NORTHFORK ABOVE RESERVIOR | |
|---|---|
| MIN | 31.4 |
| MAX | 68 |
| AVG | 49.7 |

| NORTH FORK BELOW RESERVIOR | |
|---|---|
| MIN | 31.9 |
| AVG | 54.4 |
| MAX | 77.9 |

**Figure 20: The tables above show recorded water temperatures for the North Fork of Bens Creek, Riffle Run and Alwines Creek.**

## Dissolved Oxygen (DO) *Dissolved Oxygen Requirements by Fish Community*

**Cold Water Fishes:** 6 mg/l and above **Warm Water Fishes:** 5 mg/l

### *Solubility of Dissolved Oxygen*

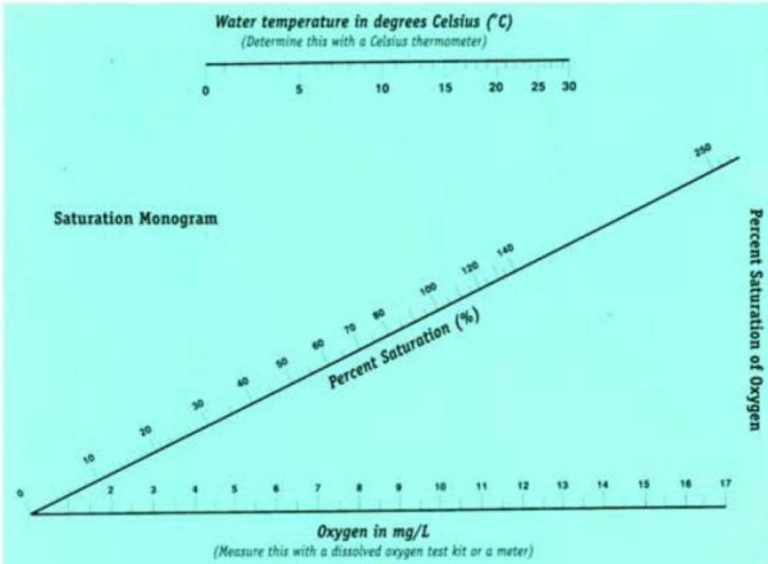
Solubility: Amount of dissolved oxygen that distilled water can hold at given temperature

| Temperature (C°): | Solubility (mg/l) |
|---|---|
| 0: | 14.6 |
| 1: | 14.2 |
| 2: | 13.8 |
| 3: | 13.5 |
| 4: | 13.1 |
| 5: | 12.8 |
| 6: | 12.5 |
| 7: | 12.2 |
| 8: | 11.9 |
| 9: | 11.6 |
| 10: | 11.3 |
| 11: | 11.1 |
| 12: | 10.9 |
| 13: | 10.6 |
| 14: | 10.4 |
| 15: | 10.2 |
| 16: | 10.0 |
| 17: | 9.8 |
| 18: | 9.6 |
| 19: | 9.4 |
| 20: | 9.2 |
| 21: | 9.0 |
| 22: | 8.9 |
| 23: | 8.7 |
| 24: | 8.6 |
| 25: | 8.4 |
| 26: | 8.2 |
| 27: | 8.1 |
| 28: | 7.9 |
| 29: | 7.8 |
| 30: | 7.7 |

### *Dissolved Oxygen Percent Saturation*

**Directions**

1. Determine water temperature in degrees C, and find that value on upper (temperature) scale. *To convert F to C: [(F-32) x 5]/9= C
2. Determine dissolved oxygen and find that value on the lower (DO) scale.
3. Using a straight edge (ruler, piece of paper), draw a line from the temperature value to the dissolved oxygen value. The point at which the line crosses the middle (saturation) scale is the percent saturation of oxygen.




**Example:**
Water sample at 15 C containing 11 gm/l of DO would be 110% saturated.

**% Saturation Values & What They Mean**
125% and greater: Too high, may be dangerous to fish
80-124%: Excellent 60-79%: Okay Below 60%: Poor

*Adapted from: Water, Water Everywhere: Water Quality Factors Reference Unit, HACH, Inc., Loveland CO, 800-227-4224.*

## pH and Aquatic Organisms

pH Scale: ACIDIC NEUTRAL ALKALINE
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

### *Tolerant ranges for certain species*

| | | | | | |
|---|---|---|---|---|---|
| Mayfly | 5.5 to 7.5 | Brown trout | 5.0 to 9.5 | Carp | 5.0 to 9.0 |
| Caddisfly | 5.5 to 7.5 | Brook trout | 4.5 to 7.5 | Catfish | 5.0 to 9.0 |
| Stonefly | 5.5 to 7.5 | Yellow perch | 4.5 to 7.5 | Bullfrog | 4.5 to 7.5 |
| Snails, clams, mussels | 6.0 to 9.0 | Smallmouth bass | 5.5 to 7.5 | Wood frog | 4.0 to 7.5 |
| Crayfish | 5.5 to 7.5 | Pumpkinseed | 5.0 to 7.5 | American toad | 4.5 to 7.5 |
| Rainbow trout | 5.5 to 9.5 | Fathead minnow | 6.0 to 7.5 | Spotted salamander | 5.0 to 7.5 |

## Alkalinity

(Calcium carbonate:)CaCo3

**Freestone Streams**
10 mg/l or less: Very sensitive to acid precipitation
10-20: Somewhat sensitive to acid precipitation
20mg/l or greater: Not sensitive to acid precipitation

**Limestone Streams**
75 mg/l or greater

**Figure 21: The diagram above explains pH and oxygen requirements for specific aquatic organisms.**

# MACROINVERTEBRATES

Aquatic insects or “marcoinvertebrates” are key indicators of water quality and provide a snapshot of the general health of any aquatic system. These organisms depend on a year round supply of clean, cold, well oxygenated water, if any of these parameters are impaired on any level; the number and diversity of these insects would decline as a result. Although the identification and classification of the organisms is a very tedious scientific process that involves microscope work and years of training, a general rule of thumb regarding the presence of these organisms is; the more diverse the bug community, the better the water quality. Particularly, insects from the orders Ephemeroptera (mayflies), Plicoptera (stoneflies) and Tricoptera (caddis) or EPT are the most sensitive to forms of water pollution.

During this study six macroinvertebrate samples sites were used to determine stream health. Three samples were taken above the reservoir one on Alwines Creek, Riffle Run and North Fork of Bens Creek. Below the reservoir there were also three sample sites the North Fork of Bens Creek below the dam near Saylor School Road and the North fork of Bens Creek above SR 985. The final sample site was located along Country Club Road on Heckman Hollow.

The North Fork of Bens Creek and tributaries contain a diverse aquatic invertebrate community and ranks very high among headwater streams within Somerset County. The macroinvertebrte samples collected from the North Fork of Bens Creek watershed, showed that 63% of all the specimens collected were EPT species and 37% were pollution tolerant invertebrates. These sample results indicate excellent water quality.

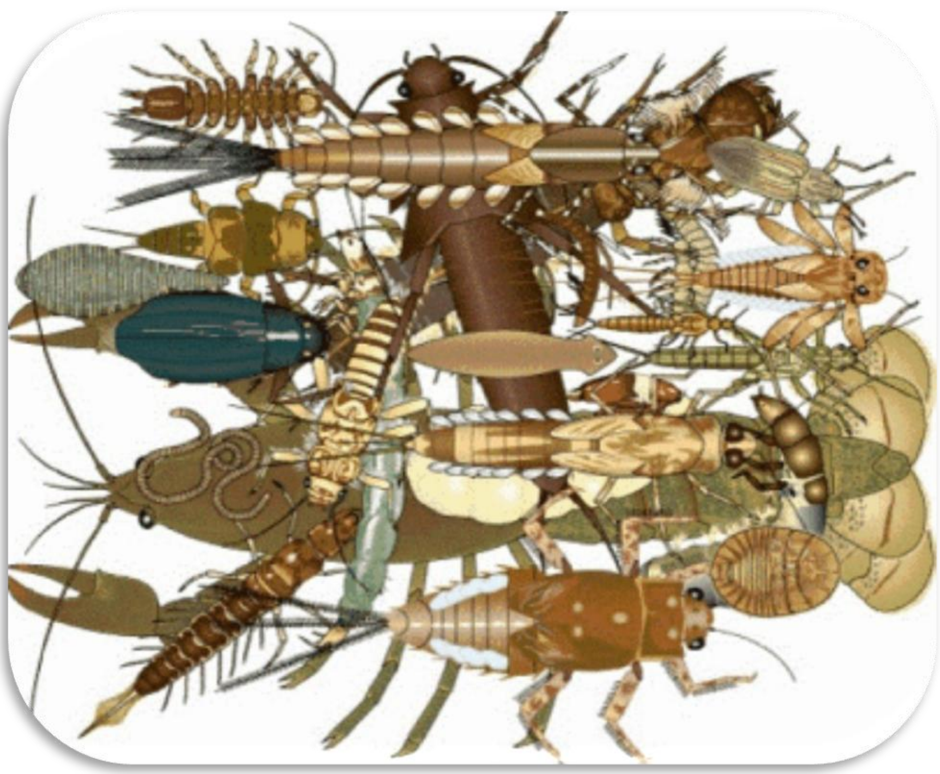


**Figure 22: A drawing of common macro-invertebrates.**

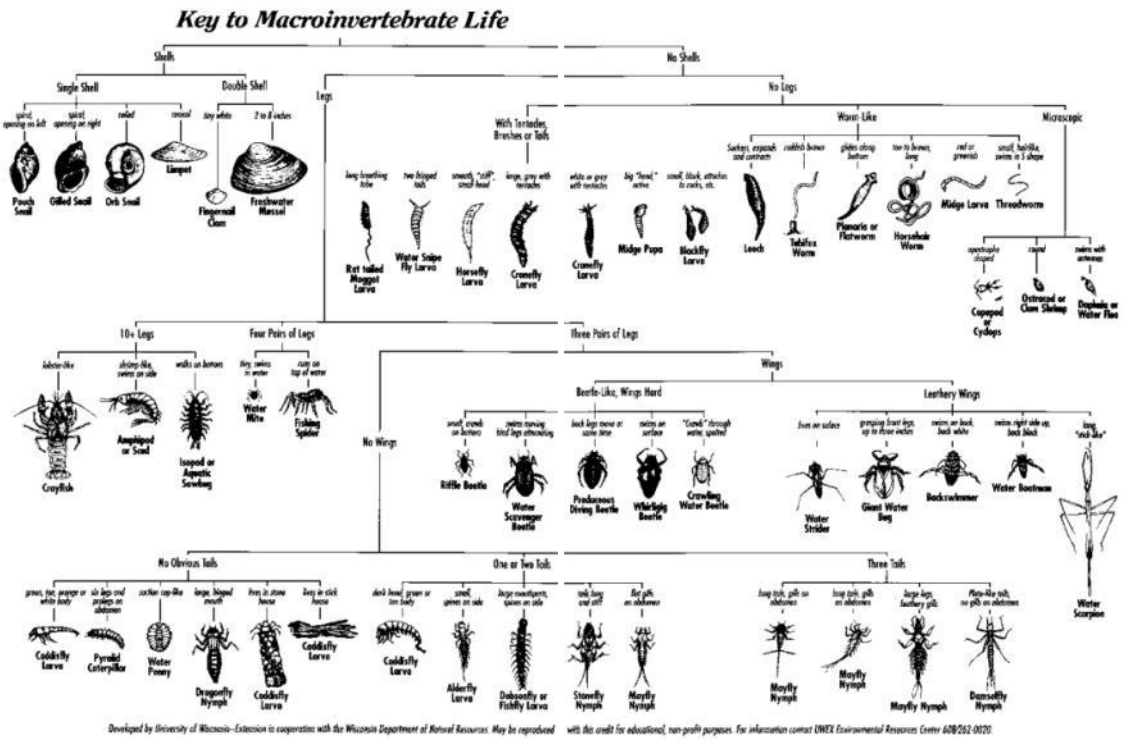



**Figure 23: The PFBC Identification key pictured above separates macroinvertebrates according to body structure.**

PHOTO GJS

**Figure 24: SCD intern Drew Walker perform water chemistry testing during macroinvertebrate sampling on Riffle Run.**

PHOTO GJS

**Figure 25: Trout Unlimited volunteer Chris Mahla assisting the District with macroinvertebrate sampling on Riffle Run.**

PHOTO GJS

**Figure 26: Examples of macorinvertebrate species from the orders Ephemeroptera (top), Plicoptera (lower right) and Tricoptera (lower left).**

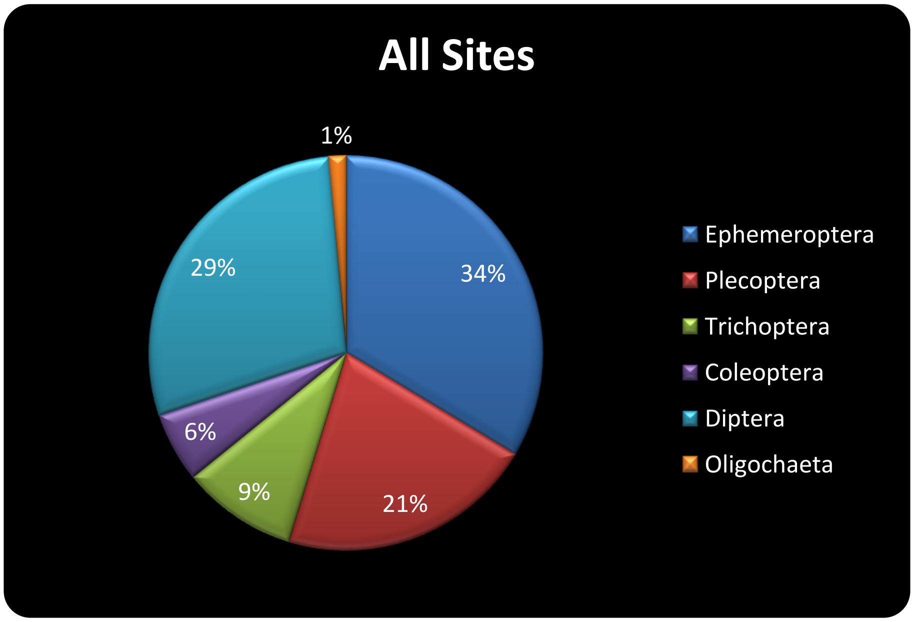



**Figure 27: This chart shows the diversity of the macroinvertabrate community of the North Fork of Bens Creek watershed.**

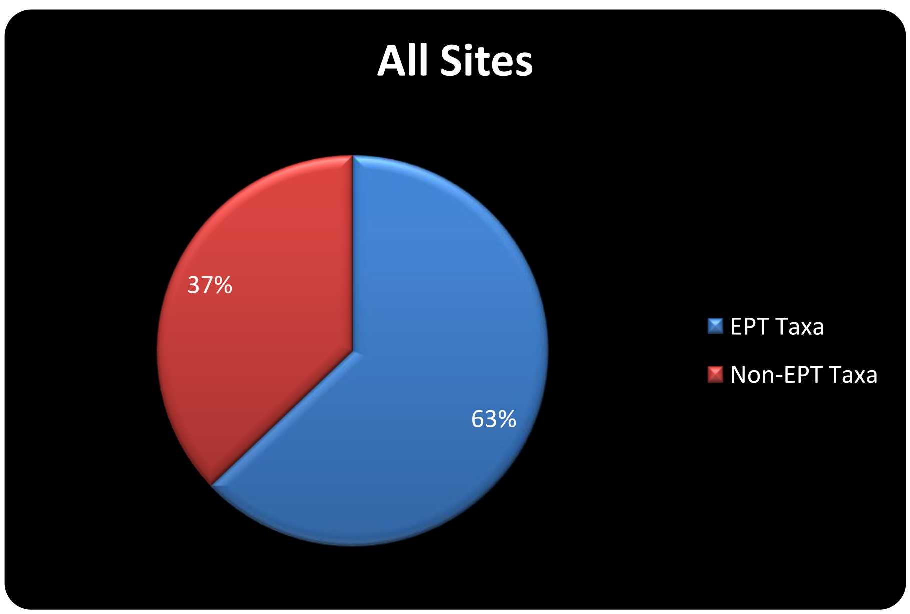



**Figure 28: The chart above shows the propotions of disturbance tollerant Non EPT taxa to the disturbance sensitive EPT taxa within the entire North Fork of Bens Creek Watershed.**

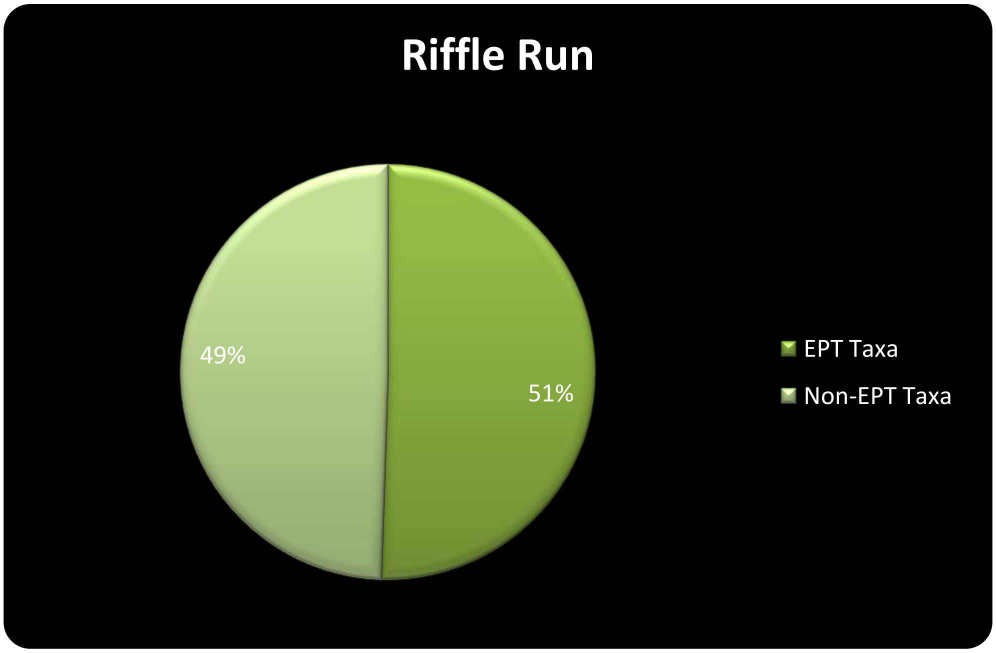



**Figure 29: This chart show the percentage of disturbance tollerant Non-EPT Taxa of macroinvertebrates to the disturbance sensitive EPT taxa of macroinvertebrates in Riffle Run.**

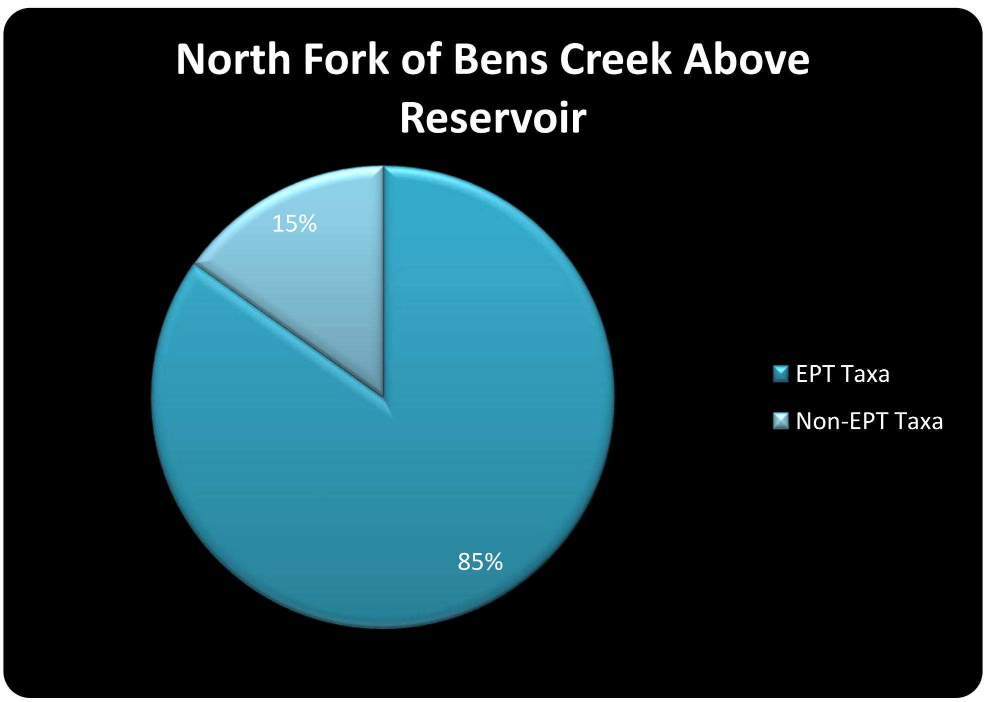



**Figure 30: This chart show the percentage of disturbance tollerant Non-EPT Taxa of macroinvertebrates to the disturbance sensitive EPT taxa of macroinvertebrates in North Fork of Bens Creek above the dam.**

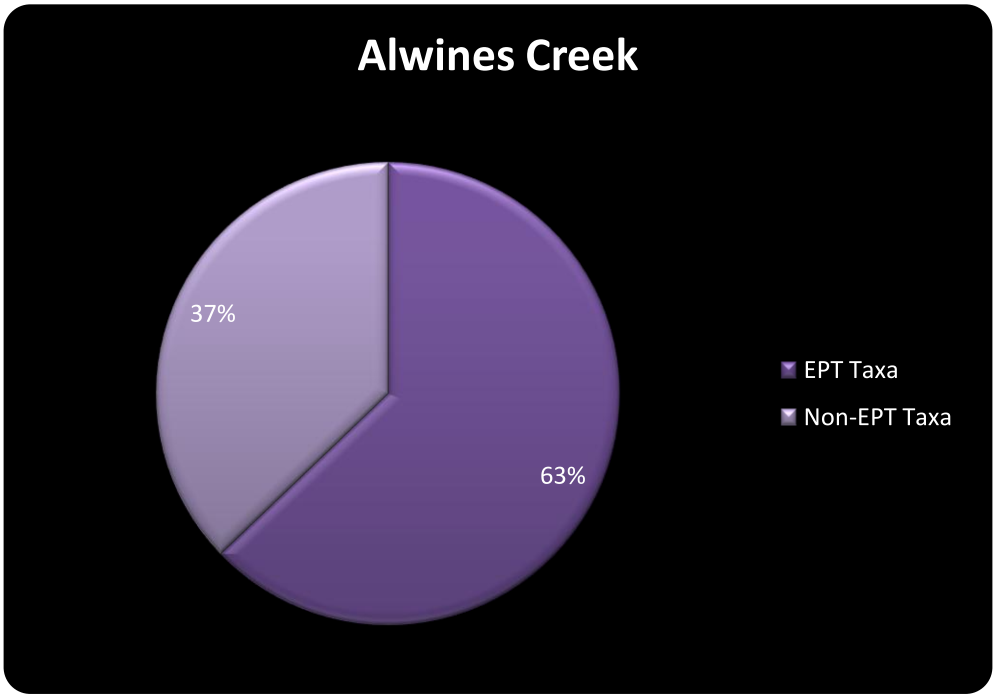



**Figure 31 : This chart show the percentage of disturbance tollerant Non-EPT Taxa of macroinvertebrates to the disturbance sensitive EPT taxa of macroinvertebrates in Alwines Creek.**

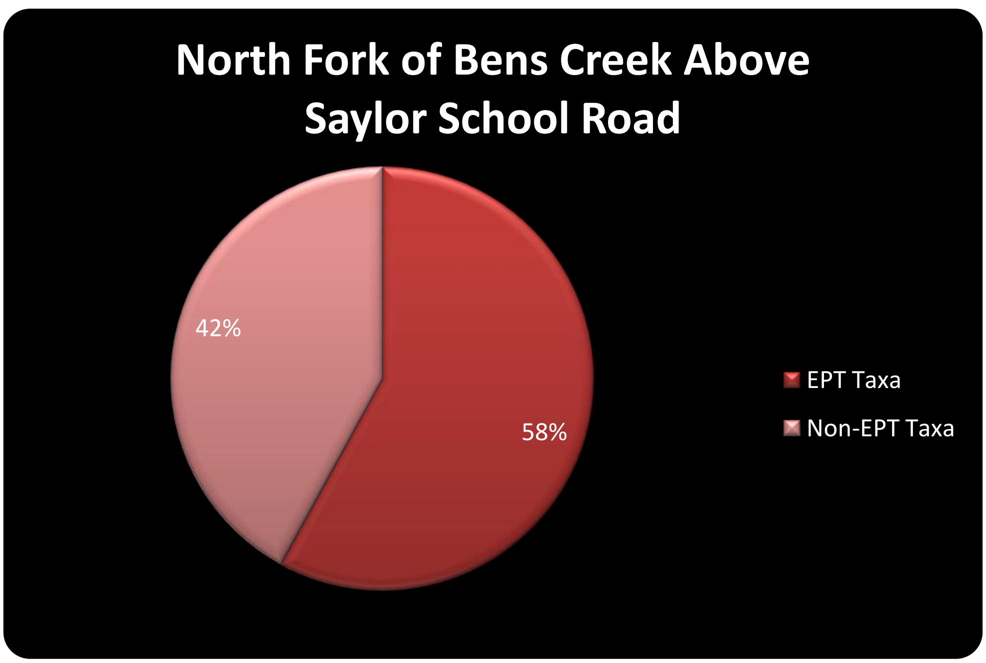



Figure 32: This chart show the percentage of disturbance tollerant Non-EPT Taxa of macroinvertebrates to the disturbance sensitive EPT taxa of macroinvertebrates in North Fork of Bens Creek above Saylor School Rd.

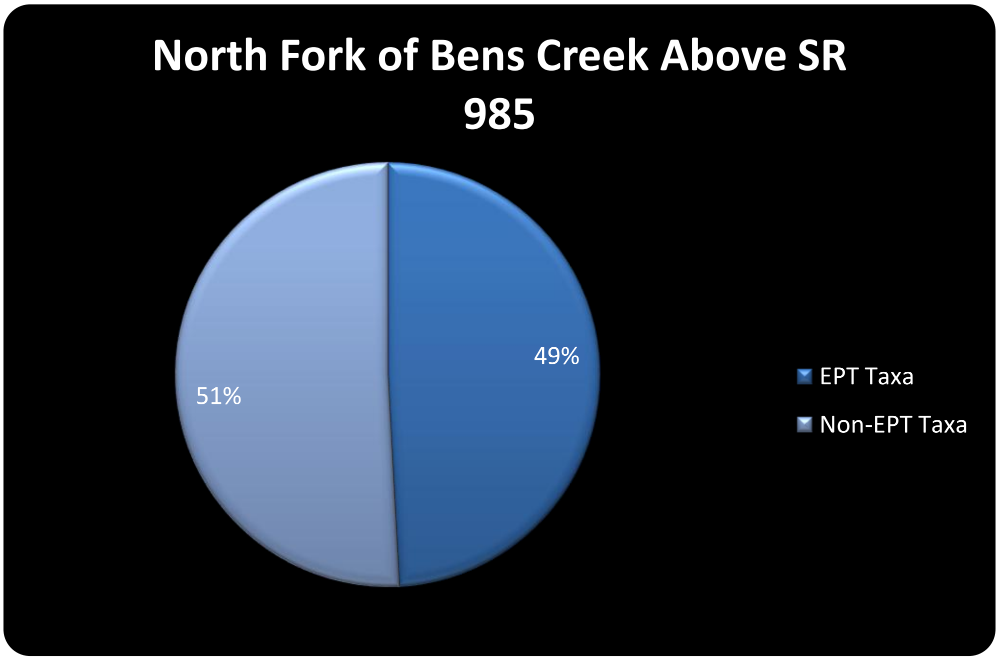



**Figure 33: This chart show the percentage of disturbance tollerant Non-EPT Taxa of macroinvertebrates to the disturbance sensitive EPT taxa of macroinvertebrates in North Fork of Bens Creek above SR 985.**

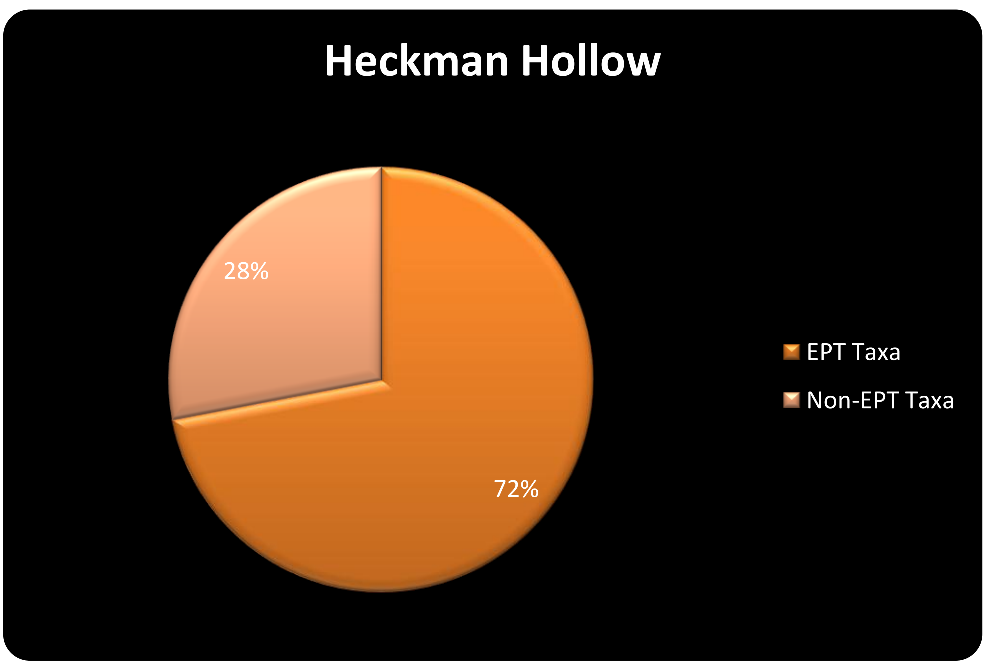



**Figure 34: This chart show the percentage of disturbance tollerant Non-EPT Taxa of macroinvertebrates to the disturbance sensitive EPT taxa of macroinvertebrates in Heckman Hollow.**

# FISHERY

The North Fork of Bens Creek, Alwines Creek and Riffle Run each support populations of wild trout and each have a slightly different biotic community also containing resident forage fish. Cold water fish species thrive within these watersheds and warm water species are also found within the reservoir itself. Fish species include salmonids, perches, sculpins, suckers, minnows and sunfishes. All of the North Fork of Bens Creek tributaries have been surveyed by the Pennsylvania Fish and Boat Commission since the 1970s. Results from these surveys indicate wild breeding populations of brook, brown and rainbow trout within the tributaries and main stem of the North Fork of Bens Creek. To have three wild trout species in the same watershed is a unique and uncommon occurrence in Pennsylvania.

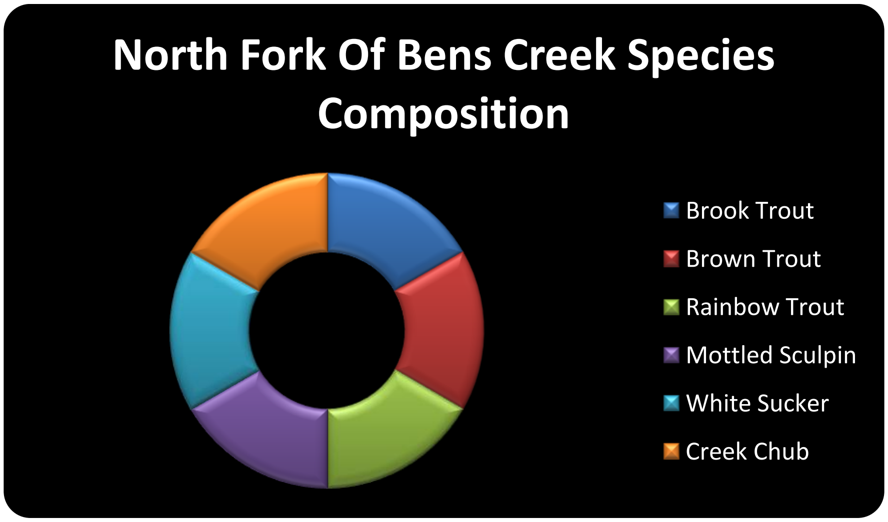



**Figure 35: The circle graph above displays the fish species compostion of the North Fork of Bens Creek drainage.**

PHOTO BY LLL

**Figure 36: Pictured above PFBC and SCD staff electro-fish a section of the North Fork of Bens Creek.**


**Figure 37: The PFBC publication pictured above separates fish species by water temperature**

# THE NORTH FORK OF BENS CREEK

The Pennsylvania Fish and Boat Commission manage the North Fork of Bens Creek as two sections. Section 01 is 2.6 miles long and starts at the headwaters and continues downstream to North Fork Reservoir. Section 02 begins at the outflow of the reservoir and continues downstream to the confluence with the South Fork of Bens Creek.

The PFBC conducted a previous survey of Section 01 of the North Fork of Bens Creek in 1983. Two sites were surveyed in Section 01 and a class D naturally reproducing wild brook trout (*Salvelinus fontinalis*) population was present. In addition a survey of Section 02 was also conducted in 1983 and only one brown trout (*Salmo trutta*) was captured. In July 2010 PFBC biologists conducted a routine re-inventory of the North Fork of Bens Creek, Section 01. The purpose of the survey was to assess the wild trout population and other resident fish populations, to perform water quality and habitat evaluations, and to update management plans for the North Fork of Bens Creek, Section 01.

At site 0101 a total of two species were captured in 2010, wild brook trout and mottled sculpin (*Cottus bairdii*). Species composition at site 0101 was the same as previous survey years. In 2010, a total of 202 wild brook trout ranging in size from 25 mm to 200 mm were captured during the survey at Site 0101. Eight of the 202 (4%) brook trout were of legal harvestable length (>175 mm). The estimated wild brook trout abundance and biomass was 1195 trout/km and 22.04 kg/ha. The 2010 survey results showed that the wild brook trout population numbers of the North Fork of Bens Creek to be nearly four times greater than the population surveyed in 1983.

The 2010 survey indicated that a quality wild brook trout population is present, despite what appears to be no improvement in water quality since the 1983 fish survey. Low stream pH and alkalinity indicate acid precipitation continues to impact the water quality of North Fork of Bens Creek. However, the wild trout population has increased substantially. The biomass estimates indicate that Section 01 now contains a Class B wild brook trout population compared to a Class D in 1983. It is possible that other variables may have prevented the North Fork of Bens Creek from achieving a higher biomass classification in previous years. Human factors, such as overharvest or climactic factors such as drought could have impacted the wild trout biomass in the North Fork of Bens Creek in 1983. In addition, the increase of a legal harvestable trout to seven inches in 1983 may have led to an increase in biomass.

PHOTO BY GJS

**Figure 38: The North Fork of Bens Creek Below the reservoir.**

PHOTO BY GJS

**Figure 38: Juvenile brook trout collected from the headwaters of the North Fork of Bens Creek.**

PHOTO BY GJS

**Figure 39: A fingerling brook trout is being measured for biomass data**.

In October 2013 section 02 of the North Fork of Bens Creek was resurveyed by PAFBC Area 8 biologists. During this survey twenty-three brown trout were captured within the three-hundred meter survey site. The results of this survey showed a 23 fold increase in brown trout within this section of stream. Although several fish were of hatchery origin and most likely moved in from downstream waters, the majority of the brown trout collected were wild stream bred fish. The dramatic increase in trout present in this section of stream is almost certainly a result of the DEP mandated conservation release from North Fork Reservoir that took place in 1984. The pervious fish survey was completed in 1983. This release increased low flows within the section of stream and the addition of cooler water has allowed brown trout to take hold in this stream section.

PHOTOS BY LLL

**Figure 40 : A mottled sculipin (left) and a fan tailed darter (right), collected in the North Fork of Bens Creek.**

PHOTO BY LLL

**Figure 41: Wild brown trout being measured during the North Fork of Bens Creek stream survey.**

# ALWINES CREEK

Allwine Creek is a small 1.9 mile long tributary to the North Fork Reservoir, originates in northwestern Somerset and flows to southwestern Cambria counties. The stream drains an area of 3.7 m². The Allwines Creek drainage is almost entirely forested with several residential areas along SR 271 in the headwaters. The riparian areas along the main stem are privately owned and a large percentage of this area is owned by the Greater Johnstown Water Authority.

The Pennsylvania Department of Environmental Protection (DEP) Chapter 93 designation for Allwine Creek is Exceptional Value (EV). Alwines Creek contains naturally reproducing populations of brook trout and rainbow trout. Previous surveys of Alwines Creek conducted by Weirich et al (1983) and Lorson and Shervinskie (1990) indicated consistent rainbow trout biomass and a widely fluctuating brook trout biomass. Both of these surveys found a Class A rainbow trout population but the brook trout population varied from Class D in 1983 to Class A in 1988.

On July 7th, 2010 Area 8 biologists conducted a routine re-inventory of Allwines Creek, Section 01. The purpose of the survey was to assess the wild trout population and other resident fish populations, to perform water quality and habitat evaluations, and to update management plans for Allwine Creek, Section 01. Allwine Creek has a total length of 3.20 km and a mean width of 4.20 m. Water quality data for site 0101 was good with a pH of 6.8 and total alkalinity of 12 mg/l. The RBP habitat score for site 0101 was in the optimal range at 172. Site 0101 had excellent bank stabilization, good vegetative cover, and light to moderate siltation.

At site 0101 a total of four fish species were captured in 2010 including wild brook trout, wild rainbow trout, creek chub and mottled sculpin. Species composition was similar to previous survey years. The survey produced a total of 102 wild brook trout ranging in length from 50 mm to 175 mm total length groups were captured at Site 0101 in 2010. Three of the 102 (3%) brook trout were of harvestable length (<175 mm). Estimated wild brook trout abundance and biomass was 444 trout/km and 13.99 kg/ha. Estimates in 2010 of brook trout abundance and biomass were higher than in 1983 but lower than in 1988. Additionally a total of 62 wild rainbow trout ranging in length from 25 mm to 125 mm total length groups were captured at site 0101 in 2010. None of the rainbow trout were of harvestable length. Estimated wild rainbow trout abundance and biomass were 281 trout/km and 4.89 kg/ha. Estimates in 2010 of rainbow trout abundance and biomass were higher than in both 1983 and 1988.

Another interesting observation that was brought to surface was that no wild rainbow trout were captured above an existing concrete weir that exists on Alwines Creek. This structure was built in the early 1900s to measure water flows entering the reservoir. This structure is too large for the rainbows to move upstream and isolates the populations. Brook trout populations exist both upstream and downstream of the structure, because they were naturally in the stream prior to the weirs placement. The original source rainbow trout is not documented, but prior to 1983 rainbow trout were released within the reservoir and have established a breeding population.

The wild rainbow trout population in Allwines Creek continues to maintain its Class A status whereas the wild brook trout population has fluctuated between surveys. The Class A wild brook trout population in 1988 has declined to a Class C population in 2010. The overall brook trout numbers are also lower than in 1988, however a sustainable fishery still exists. The wild rainbow trout population was composed entirely of fish less than 150 mm total length. Limited amounts of deep pools and low productivity likely limits the size of the wild brook and rainbow trout in this small mountain stream.

PHOTO BY GJS

**Figure 42 : A wild rainbow trout caught in Alwines Creek.**

PHOTO BY GJS

**Figure 43: A concrete weir on Alwines Creek. This structure prevented wild rainbow trout from accessing the headwaters of this stream**.

# RIFFLE RUN

Riffle Run is also an EV stream and has a drainage area of 2.9 square miles and is 2.1 miles long. The stream was surveyed by the PFBC in June of 2013. Six species of fish were captured during the survey blacknose dace, brook trout, creek chub, mottled sculpin, rainbow trout and white sucker were present. Field Chemistry at the time of the survey was 14°C, alkalinity was 34 mg/L , hardness 48 mg/L, specific conductance 141 and pH was 7.2

The fish survey produced 8 wild rainbow trout ranging from 75mm – 175mm. 12% of the fish captured were just shy of legal harvest limit. The wild rainbow trout biomass for Riffle Run is 1.5 kg/ha and an estimated 27 wild rainbow trout per kilometer. Native brook trout captured during this survey totaled 22 fish ranging from 50mm-225mm. 9% of the sample was over legal harvest limit. The estimated biomass of the native brook trout for Riffle Run is 6.67 kg/ha and an estimated 73 fish per kilometer.

PHOTO BY GJS

**Figure 44: The headwaters of Riffle Run. The Steam is small and well shaded in the upper reaches with a good pool to run ratio.**

PHOTO BY GJS

**Figure 45: Riffle run near the mouth. The stream widens significantly as it approaches the reservoir, loosing important habitat features.**

PHOTO BY GJS

**Figure 46: A large wild rainbow trout returning from spawning resting at the mouth of Riffle Run.**

# HECKMAN HOLLOW

Heckman Hollow drains 1.3 square miles on the eastern side of the watershed and flows 2.3 miles until it meets the North Fork of Bens Creek below the reservoir. Over 60% of this watershed is forested with the lower portion flowing through a semi-residential area near the North Fork Country Club and follows a road for nearly half of the length of the stream.

The stream was surveyed by the PFBC as part of Pennsylvania Un-assessed Waters program. The field water chemistry during the survey was 18°C water temperature, 7.3 pH, 52 mg/L alkalinity, 66 mg/L hardness, specific conductance was 194 and TDS was 135 mg/L.  Fish Species identified during the survey were mottled sculpin, blacknose dace, creek chub and wild brown trout. A total of 10 wild brown trout were captured during this survey ranging from 50mm-150mm. None of the fish captured were of legal harvestable length.

Although the wild brown trout population is relatively small and is below a Class D designation, this water serves as important rearing waters for the main stem of the North Fork of Bens Creek. Limiting factors for a small wild fish population are thermal impacts from the removal of canopy and water impoundments, siltation from agriculture lands and eroding stream banks. Stream habitat improvements could improve these existing conditions.

PHOTOS BY GJS

**Figure 47: The photos above show the upper, middle and lower reaches of Heckman Hollow. The head waters begin in agriculture lands, the middle flows through a forested ravine and the lower section is day lighted in a golf course.**

# ANGLING

The North Fork of Bens Creek watershed provides trout anglers with a quality angling experience for native brook trout, wild brown and rainbow trout in a remote and relatively undisturbed watershed.  A number of pools and riffles provide excellent habitat for wild trout to hide from predators and forage on aquatic organisms. Anglers looking to fish this area should practice a stealthy approach, as to not alert these weary fish. General spinning of fly fishing trout tackle can be used to catch these fish, they are not picky, just spooky. Take your time approaching the stream and practice casting in tight quarters. Minimal disturbance and well placed casts are the keys to catching these beautiful fish.

PHOTO BY GJS

**Figure 48: Andy Fresch fishing for wild trout in the North Fork of Bens Creek drainage.  Fishing upstream and staying low allows the angler to get close and place a perfect cast.**

PHOTO BY GJS

**Figure 49: Travis Rudge fishing  the headwaters of Riffle Run.  Earth tone clothing can also help the angler get into postion without being noticed by the fish.**

PHOTO BY GJS

**Figure 50: A brightly marked native brook trout took a dead drifted wooly bugger. Natural colored flies that represent the available food sources can be very productive.**

PHOTO BY GJS

**Figure 51: Another strikingly colored native brook trout from the North Fork of Bens Creek drainage. This fish took a high floating caddis imitation.**

# HISTORIC SITES

**The hillsides of the North Fork of Bens Creek are dotted with pieces of years past, over one dozen stone foundations from old homesteads rest moss covered and overgrown as part of the landscape. Old spring houses can also be found throughout the upper portions of the drainage. Four church and family cemeteries dating back to the early 19th century also lie among the forests. Several Civil War veterans are buried in these cemeteries. In addition another notable historic site is a one room school house from 1887, "Saylor School" stands on a ridge in the headwaters of the basin. There is plenty of evidence of early settlement in and around these streams that leaves one to wonder what these water were like in those times.**


PHOTO BY GJS

**Figure 52: Saylor School is a 126 year old school house that is located high in the watershed near the dividing line between the North and North fork of Bens Creek.**


PHOTOS BY GJS

**Figure 53: Graves of Civil War veterans laid to rest in the Mishler and Yoder cemeteries.**

# ENVIRONMENTAL CONCERNS

The following are several potential threats to the integrity of the water quality, quantity and the general environmental and biological components of this watershed and higher order receiving streams.  Although the presence of man has not greatly impacted the quality and richness of these waters, maintaining and improving the existing conditions needs to be on the radar of the residents and land owners holding properties within this unique watershed.

# WATER QUALITY THREATS

Within the North Fork of Bens Creek drainage there are several forms of existing and potential water pollution sources. The major forms indentified are as follows: 1) sedimentation from unimproved roadways and unstable stream banks 2) nutrient loading from agriculture lands, manicured lawns and failing septic systems 3) thermal pollution from small and large water impoundments 4) the removal of riparian canopy cover. Each of these impairments affects water quality and aquatic ecosystems individually, but when combined add measurable stressors to these headwater systems.

# SEDIMENTATION

Sedimentation is the number one form of non-point source water pollution in Pennsylvania and affects thousands of stream miles within the state.  Sediment transport is a natural function of a stream system which aids in stream channel formation and stabilization. However unnatural accelerated erosion can cause physiological and biological issues within the water course.  Unnatural forms of sediment can be introduced into a stream system in a variety of ways, the most common conveyances include run off from unpaved roadways, disturbed road ditches, un-vegetated agricultural lands, vehicle stream crossing and unstable stream banks.

Negative effects from excess sedimentation and erosion occur when soil particles fill the void spaces between the gravel, cobble and boulders on the stream bottom, the filling of stream pools, and obstructed flow paths form sediment bars.  The sediment deposition fouls mico-habitats within the stream system, making it difficult for aquatic life to populate favored habitats.  Fish are dependent on clean gravel for spawning, excess sediment deposition smothers fish eggs that are in the gravel along the streambed.  Sediment particles can also remain suspended within the water column for days at a time.  Long durations of muddy waters can damage fish gills and result in fish kills.

PHOTO BY GJS

**Figure 54: Sediment laden water on the headwater of Riffle Run. The source was tracked to an earth disturbance and abated shortly thereafter**.

PHOTO BY GJS

**Figure 55 : A sluffing stream bank on the lower section of Riffle Run. This site is a perfect candidate for an in-stream stabilization structure to aid with bank protection.**

PHOTO BY GJS

**Figure 56: This shot is of the North Fork of Bens Creek above the reservoir. It was taken in 2012 just after hurricane Sandy. The stream is very high and slightly off color, but not muddy, rocks and the stream bottom are still visible. This is a great example of how riparian vegetation within the forested buffer keep the surface waters clean and manage storm flows.**

## THERMAL POLLUTION

Thermal impacts from impounded water the removal of overhead tree canopy and water with drawl can change the temperature regime or mico-climate of that stretch of stream, in- turn making the water temperatures less favorable to the aquatic species that inhabit these waters, particularly macroinvertebrates and cold water fishes that depend on cold water with high levels of oxygen for survival. Although there is a conservation release that has been mandated by the Pennsylvania Department of Environmental Protection, the lower portion of the North Fork of Bens Creek is still threatened by thermal impacts where it flows through a residential area.

PHOTO BY GJS

**Figure 57: The North Fork of Ben Creek below the reservoir, note the removal of the riparian vegetation. This action can increase water temperatures and erosion by storm flows. The stream bank vegetation also offers fish overhead protection from predators.**

PHOTO BY GJS

**Figure 58: This photo is an irrigation pump used to withdrawal water directly from the main stem of North Fork of Bens Creek. It is used to water a golf course during dry summer months.**

# NUTRIENT LOADING

Another significant impairment identified during this study was nutrient loading. Nutrient enrichment can come from many sources. It primarily causes algal blooms that coat the stream bottom and lower the quality of instream habitat for aquatic organisms. During night time hours a portion of this fast growing alga dyes and begins to rapidly decay. The action of the rapid decomposition uses large amounts of oxygen and depletes the stream water of dissolved oxygen. The reduction of oxygen stresses the aquatic life and in some cases this leads to fish kills. Nutrient enrichment, particularly from animal feces can introduce high levels of bacteria into the waterway. For obvious reasons high bacteria levels are not safe for the aquatic organisms living in the stream or the people that recreate there.

PHOTO BY GJS

**Figure 59: A filamentous algae bloom on the main stem of the North Fork of Bens Creek. Algal blooms are a result of excess nutrients and warm water temperatures and can be detrimental to aquatic systems.**

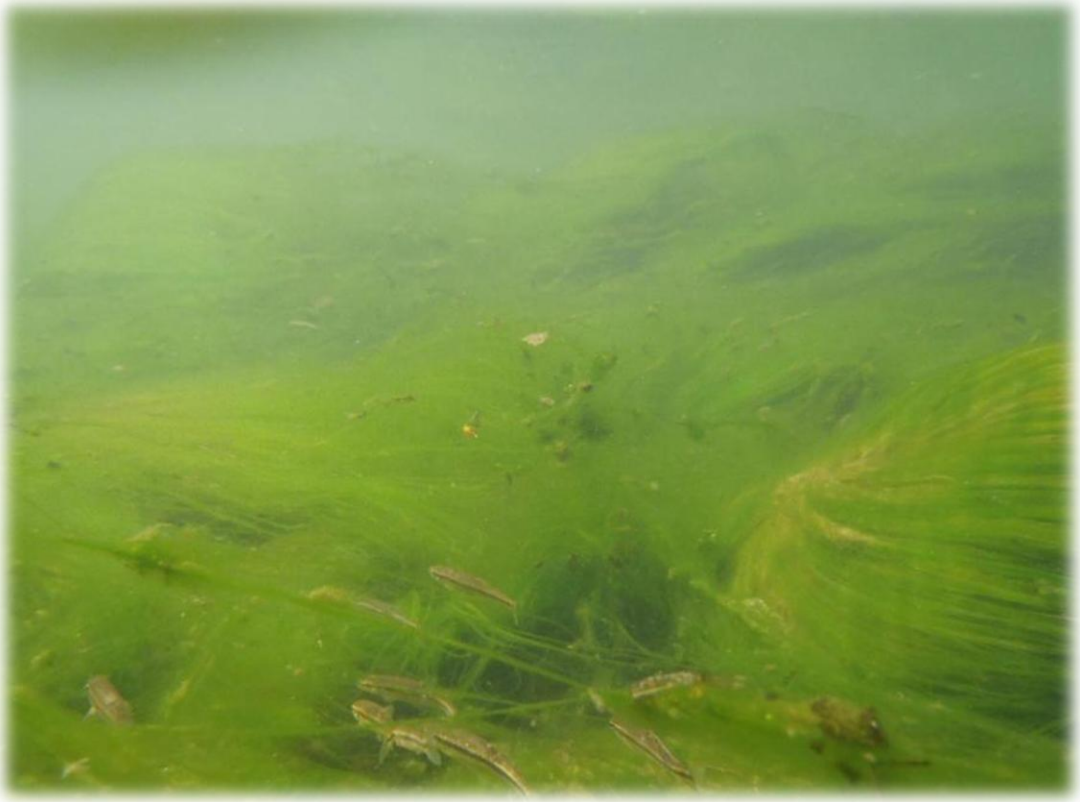


PHOTO BY GJS

**Figure 60: An underwater look at the filamentous algae, take notice of the blacknose dace swimming among the algae.**

PHOTO BY GJS

**Figure 61: The photo above is a picture of the headwaters of Heckman Hollow. Raw livestock manure makes up a large percentage of the non-point source impairments to rural waterways. Stream bank fencing and a vegetated buffer is a simple solution to the issue**.

# BEST MANAGEMENT PRACTICES

Best Management Practices or BMPs can be implemented within these watersheds to reduce the effects of these impairments. Erosion issues can be reduced through improvements to unpaved roadways, the stabilization of eroding stream banks as well as allowing disturbed areas to vegetate. Stream bank fencing projects within agriculture areas can be used to reduce the amount of sediment and nutrient loading into waterways, by establishing vegetated buffers. The stream side fences prevent livestock from entering the stream corridor and allow riparian vegetation to reclaim bare eroded stream banks. The vegetation shades the water and the root systems hold the stream bank in place. In addtion the buffers act as filters by reducing run off velocities and allowing the water to peculate into the ground. The application of stream bank fences will also reduce the amount of nutrients entering the streams through this same action.

# HEMLOCK WOOLY ADELGID

Pennsylvania's state tree the Eastern Hemlock, is threatened by the Asian insect *Adelges tsugae*, the hemlock woolly adelgid (HWD). This insect feeds on the fluid of hemlock trees and occurs throughout eastern North America, including Pennsylvania. The egg sacs of these insects look similar to the tips of Q-tips and are found clinging to the undersides of hemlock branches. The Hemlock woolly adelgid was first introduced into the Pacific Northwest in 1924, from Asia. It is thought to have been introduced into the northeastern US in the 1950's, and it was first discovered in Pennsylvania in 1967. This destructive insect has been stressing Pennsylvania hemlocks since 1967 and is spreading statewide. Forty-nine counties in Pennsylvania have been infested with this insect.

This pest is present in the watershed, particularly the trees surrounding the reservoir. No noticeable die back has been identified at the time of this report. Hemlocks that have been affected by the woolly adelgid often have a grayish-green appearance in there needles. Low winter temperatures and heavy thunderstorms can reduce populations of the hemlock woolly adelgid, particularly in higher elevations. It is not uncommon to find hemlocks with the top third of the trees free from pests, but survive on the bottom two-thirds. In addition mild winters can result in increases of hemlock woolly adelgid population.

The Pennsylvania Department of Conservation and Natural Resources has adopted three main methods to control this invasive pest. The controls included biological, chemical and silvicultural practices to reduce the populations to less damaging levels. Biological controls include the release of an Asian beetle that feeds on HWA eggs. The most common chemical control is to inject infested trees with a toxin that kills the HWA feeding on the tree. Lastly the forestry practices used to control HWD is to remove highly infested trees and to begin to plants other conifer species adjacent to infested stands. The choice of control method varies from site to site. Unfortunately, eradication is not the objective, because HWA is already firmly established in Pennsylvania.

If this tree species is lost or greatly reduced within the state our head water streams could suffer as a result. Large hemlocks shade streams, stabilize stream banks and provide over head cover for fish, particularly wild trout. Although rhododendron and mountain laurel grow in similar headwater habitats and there are other riparian tree species, no tree species will fill the niche of the Eastern Hemlock.

Figure 62 :  Hemlock Wooly Adelgid on the underside of the needles

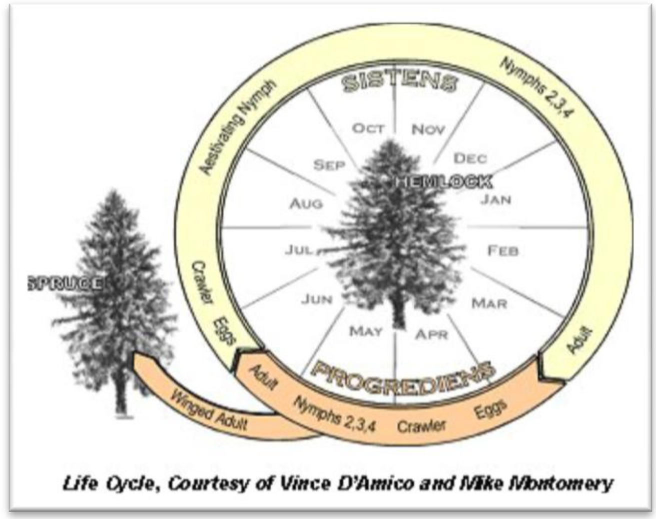



Figure 63: The life cycle of the Hemlock Wooly Adelgid

PHOTO BY GJS

**Figure 64:  A young eastern hemlock takes root along Alwines Creek, this tree was free from the threatening pest.**

# FISH PASSAGE

Obstructions within a watercourse such as culvert pipes, dams, weirs, sediment bars and manmade structures can impede fish movement throughout the stream systems. These blockades can make it difficult for fish to reach spawning sites or for young of the year fingerlings to return to the "big" waters. An impassable structure can create genetically isolated fish populations. The overall health of fish populations living in any stream system is dependent on migration and seasonal movement. Another impairment associated with unnatural stream obstructions is the transportation of sediment or "bed load". Sediment movement is a natural occurrence and stable streams rely on it to maintain deep pool, undercut banks, gravel bars and other important stream features and functions. When these flow paths are interrupted the stream balance becomes unstable head cutting and excessive bank erosion will occur. The stream will seek a bed load to maintain the flow channel. Bottomless arch structures and the removal of abandoned manmade structures can greatly improve fish passage within stream corridors.

PHOTO BY GJS

**Figure 65: A large diameter culvert stream crossing. Although this particular pipe is installed with enough slope to allow seasonal fish passage low flow may inhibit fish movement. Bottomless arch culverts are the best solution to smaller stream crossing.**

PHOTO BY GJS

**Figure 66: A concrete weir on Alwines Creek restricts fish movement throughout the stream. There are four of these weirs within the entire North Fork of Bens Creek watershed.**

# ENERGY EXPLORATION

Coal and natural gas resources have a long history in Somerset County. The coal within the county is all bituminous. Modern mining techniques and recent price increases in coal have increased mining activities within the county. This has also made re-mining of smaller coal reserves cost effective. Natural gas has also been extracted within the county, but has not yet been as widely developed as coal. Traditional shallow gas wells are dotted throughout the county. However, the recent “discovery” of shale gas, in addition to the advances in drilling techniques, has moved shale gas to the front of the line. Marcellus and Utica shale formations both lie under Somerset County and hold enormous natural gas reserves.

# NATURAL GAS

Natural gas occurs as a natural hydrocarbon gas mixture consisting of methane, carbon dioxide, nitrogen and hydrogen sulfide. Natural gas is used as an energy source to produce heat and electricity. It is also used as fuel for vehicles and in the manufacturing of plastics and other commercial organic chemicals. Natural gas is found deep underground in rock formations or associated with other hydrocarbon reservoirs such as coal.

Shale gas in the United States is rapidly increasing as a source of natural gas. In recent years, new applications of hydraulic fracturing and horizontal drilling have resulted in the development of new sources of shale gas. This has reduced gas production from conventional shallow gas reservoirs.

There are many small, deep natural gas fields in the northwestern region of the county, however, new developments of Marcellus and Utica Shale gas are being explored throughout the county. The majority of the gas wells are in the south western quad of the county and into Fayette County. At this time there are less than 50 drilled or fractured “fracked” shale gas wells in Somerset County.

# MARCELLUS SHALE FORMATION

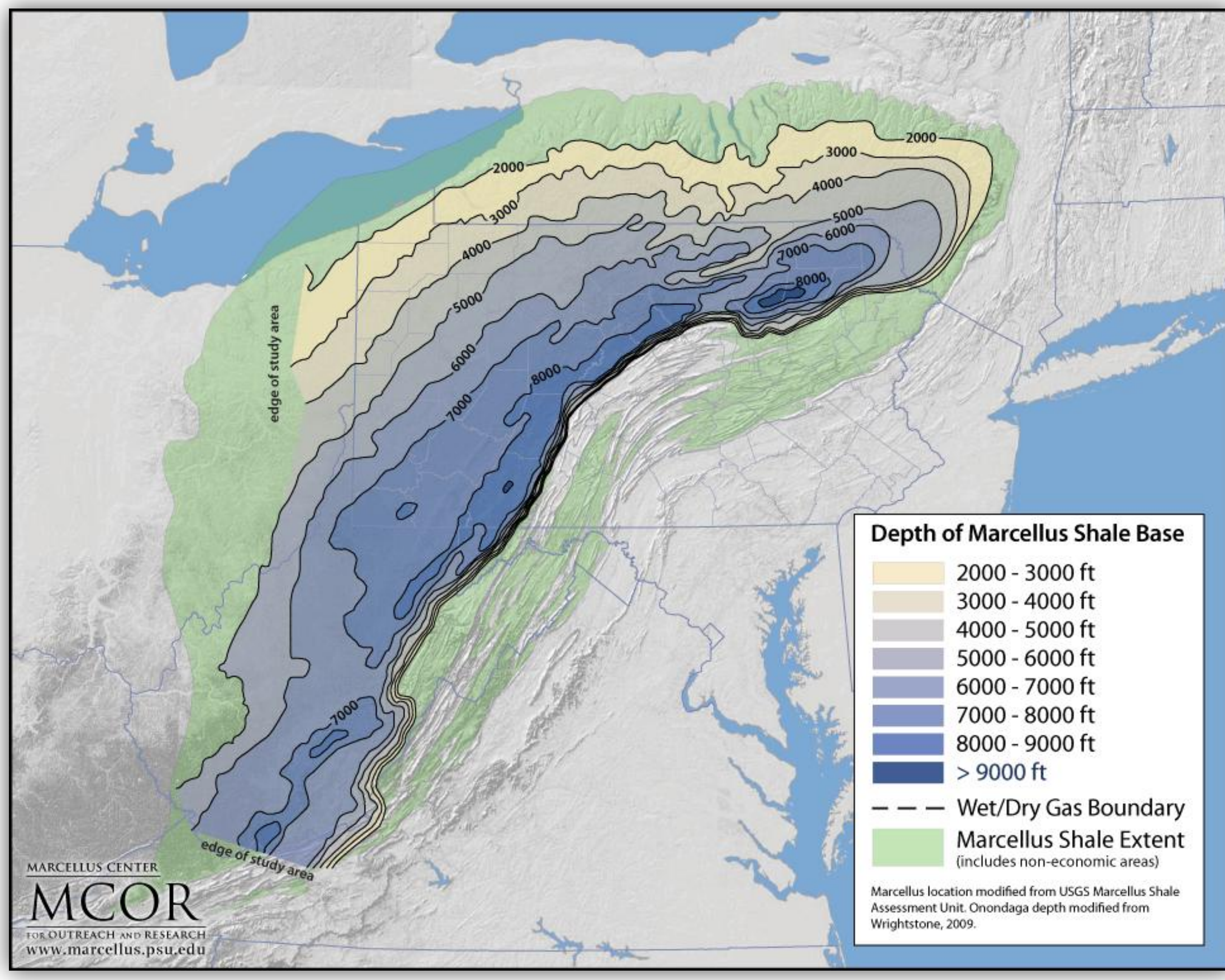



**Figure 67: The map above shows the Marcellus Formation in the Eastern United States.**

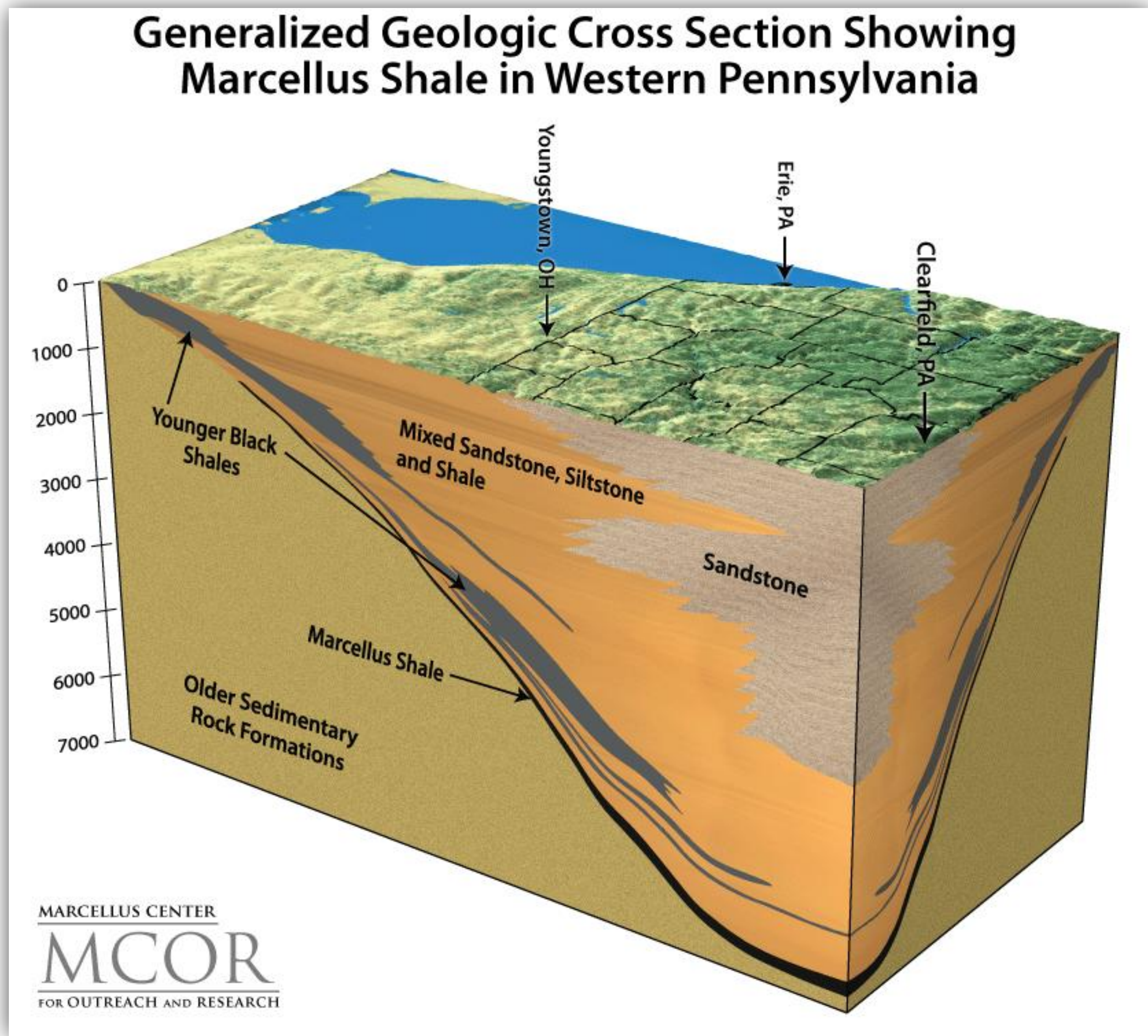



**Figure 68: The diagram above shows a cross sectional view of the Marcellus Shale formation. The strata lie very deep beneath the surface of the earth. These well are not only drilled below the water table but in some cases below sea level.**

# UTICA SHALE FORMATION

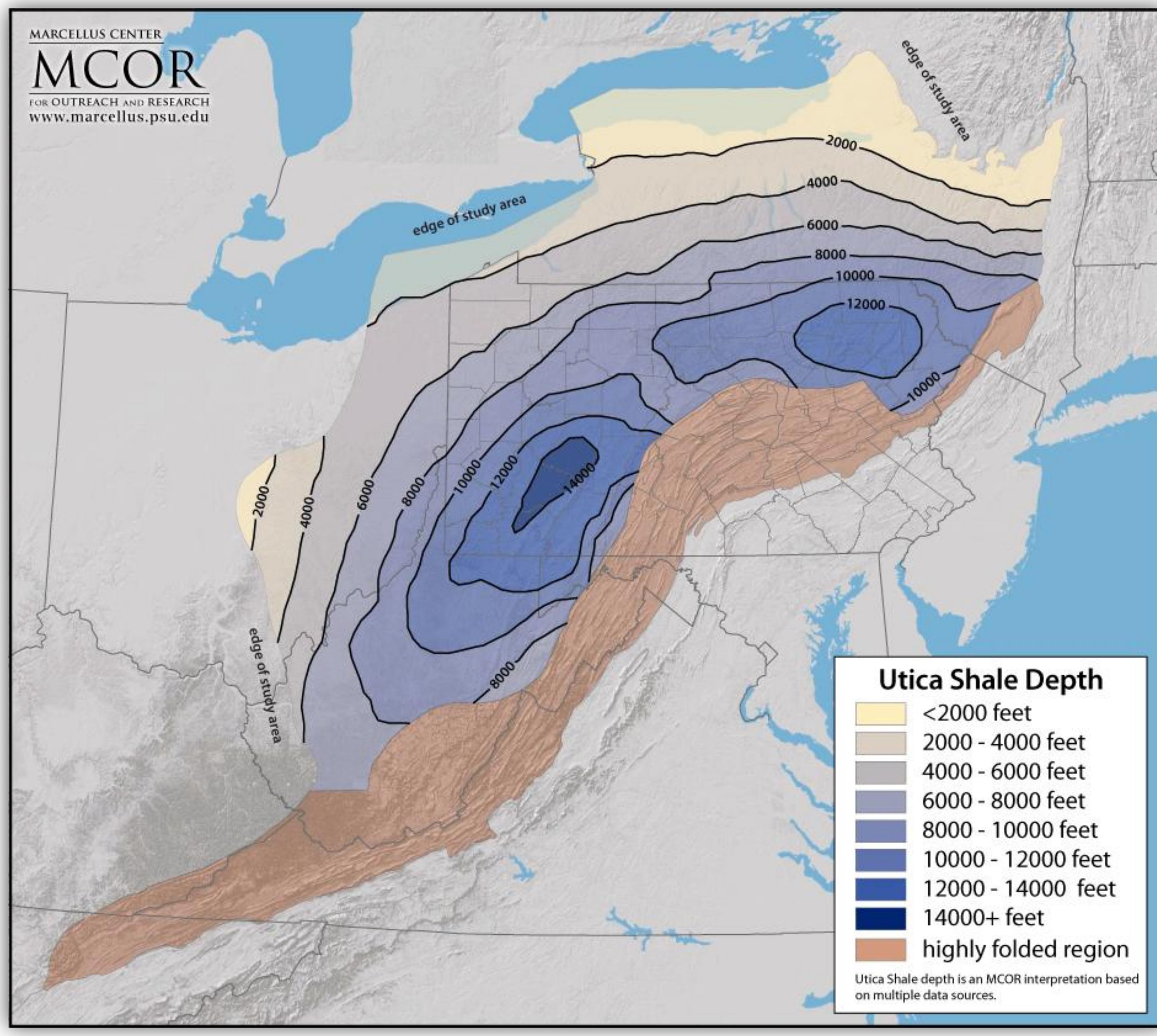



**Figure 69: The Utica formation lies beneath the Marcellus formation. It is believed the Utica formation may have a greater gas reserve than the Marcellus formation.**

# NATURAL GAS TRANSMISSION LINES

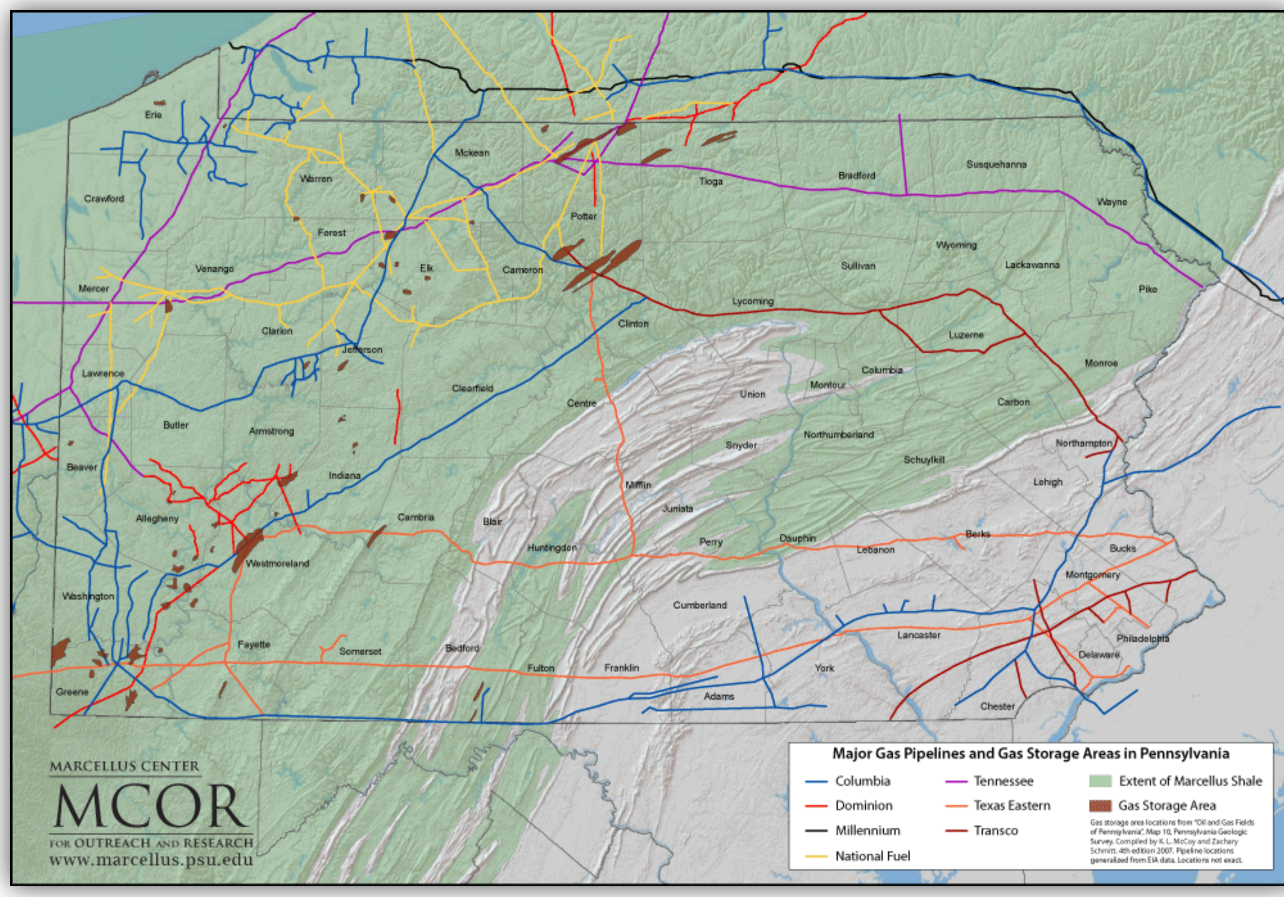



**Figure 70: The map above displays existing and proposed natural gas transmission lines in Pennsylvania.**

# WATERSHED ENHANCEMENT RECOMMENDATIONS

THE FOLLOWING RECOMMENDATIONS HAVE BEEN DEVELOPED THROUGH THE RESEARCH AND FIELD DATA RESULTS THAT WERE USED TO ASSEMBLE THIS PLAN. THE LIST OF RECOMMENDATIONS ARE INTENDED TO CONSERVE, PRESERVE AND ENHANCE THE QUALITIES OF THIS UNIQUE NATURAL RESOURCE FOR FUTURE GENERATIONS TO UTILIZE AND ENJOY WHAT IT HAS TO OFFER. IN ADDITION THE RECOMMENDATIONS HAVE A STRONG FOCUS ON MAINTAINING THE WATER QUALITY AND PRACTICING SENSIBLE MANAGEMENT OF THE LANDS SURROUNDING THESE WATERS. THE IMPLEMENTATION OF THESE RECOMMENDATIONS ARE AIMED TOWARDS THE BETTERMENT OF THE PHYSICAL AND BIOLOGICAL COMPONENTS OF THIS WATERSHED, FROM WHICH WE CAN ALL BENEFIT.

- CONTINUE TO MONITOR AND MANAGE A CONSERVATION RELEASE FROM THE NORTH FORK RESERVOIR. A VOLUNTARY INCREASE TO THESE FLOWS COULD REDUCE THE EFFECTS OF THERMAL POLLUTION TO THE MAIN STEM OF THE NORTH FORK OF BENS CREEK AND DOWNSTREAM WATERS.
- EMPLOY RIPARIAN BUFFER ZONE OUTREACH AND ASSIST LANDOWNERS WITH THE ESTABLISHMENT AND MANAGEMENT RIPARIAN BUFFER ZONES THROUGHOUT THE WATERSHED, PARTICULARLY BELOW THE RESERVOIR.
- IMPLEMENT BEST MANAGEMENT PRACTICES IN AGRICULTURE AREAS, PARTICULARLY WHERE LIVESTOCK HAVE DIRECT STREAM ACCESS. STREAM BANK FENCING AND SPRING DEVELOPMENT CAN AID IN THE ENHANCEMENT OF THESE ZONES.
- IMPLEMENT SOUND IMPROVEMENTS TO UNPAVED ROADWAYS AND ACCESS LANES. PLEASE REFERENCE THE PENN STATE ENVIRONMENTALLY SENSITIVE MAINTENANCE FOR DIRT AND GRAVEL ROADS MANUAL. WWW.DIRTANDGRAVELROADS.ORG
- IMPLEMENT FISH PASSAGE ENHANCEMENT WHERE FEASIBLE THROUGHOUT THE NORTH FORK OF BENS CREEK DRAINAGE. REMOVE ABANDONED STRUCTURES AND REPLACE INSUFFICIENT STREAM CROSSINGS THAT ENCUMBER FISH MOVEMENT.
- IMPLEMENT A LIMESTONE SAND DOSING PROJECT ON THE NORTH FORK OF BENS CREEK ABOVE THE RESERVOIR TO COMBAT ISSUES ASSOCIATED WITH LOW STREAM PH.
- CONTINUE TO MANAGE THE WATERS OF NORTH FORK OF BENS CREEK AS DESIGNATED IN THE PENNSYLVANIA CODE TITLE 25, CHAPTER 93, UNDER THE GUIDANCE OF THE PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION.
- CONTINUE TO MANAGE ALL FLOWING WATERS WITHIN THE NORTH FORK OF BENS CREEK DRAINAGE AS WILD TROUT FISHERIES, UNDER THE GUIDANCE OF THE PENNSYLVANIA FISH AND BOAT COMMISSION.
- CONTINUE TO MANAGE THE GREATER JOHNSTOWN WATER AUTHORITY LANDS FOR THE BETTERMENT OF A SOURCE WATER SUPPLY.
- CONTINUE TO COLLECT BASELINE BIOLOGICAL AND WATER CHEMISTRY DATA WITH THE NORTH FORK OF BENS CREEK WATERSHED.
- CONTINUE TO ALLOW PUBLIC ACCESS TO GJWA LANDS THAT ARE PRESENTLY OPEN FOR RECREATIONAL PURPOSES.

# SOURCES


- ***U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE. SOILS SURVEY OF SOMERSET COUNTY. 1985.***
- ***http://water.usgs.gov/osw/streamstats/pennsylvania.html***
- ***PENN STATE MARCELLUS CENTER FOR OUT REACH AND RESEARCH. MAPS AND GRAPHICS. PENN STATE UNIVERSITY, UNIVERSITY PARK, PENNSYLVANIA. 2010.WEB. 8 SEPTEMBER 2011***
- ***M.A. DEPEW AND R.D LORSON. NORTH FORK OF BENS CREEK, SEC 01 (18E) MANAGEMENT REPORT. MARCH 2011***
- ***M.A. DEPEW AND R.D. LORSON. ALWINE CREEK, SECTION 01 (18E) MANAGEMENT REPORT. DEC 2010.***
- ***M.A DEPEW. RIFFLE RUN FIELD DATA RESULTS (0818E). JUNE 2013***
- ***http://www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr_007179.pdf***
- ***http://www.dep.wv.gov/WWE/getinvolved/sos/Pages/Benthics.aspx***
- ***GREATER JOHNSTOWN WATER AUTHORITY 2012 ANNUAL REPORT***

# APENDICIES

**APENDIX 1**

## RIFFLE RUN MACROINVERTEBRATE TAXA REPORT

| | | | |
|---|---|---|---|
| | Stream | **Riffle Run** | **Riffle Run** |
| | Site ID | **100** | **100** |
| | Coordinates | **40.26435N, 79.01785W** | **40.26435N, 79.01785W** |
| | Collection Date | **07-01-2011** | **04-05-2012** |
| | Device | **serber** | **serber** |
| | Habitat | **riffle** | **riffle** |
| | | | |
| | | | |
| **Ephemeroptera** | Baetis flavistriga | 1 | 0 |
| | Baetis tricaudatus | 0 | 1 |
| | Cinygmula sp. | 0 | 49 |
| | Diphetor hageni | 0 | 2 |
| | Drunella sp. | 0 | 2 |
| | Epeorus sp. | 0 | 1 |
| | Ephemera sp. | 9 | 7 |
| | Ephemerella dorothea/excrucians | 0 | 82 |
| | Ephemerella invaria | 0 | 7 |
| | Eurylophella funeralis | 0 | 13 |
| | Eurylophella sp. | 1 | 0 |
| | Habrophlebia vibrans | 0 | 9 |
| | Isonychia sp. | 0 | 2 |
| | Leucrocuta sp. | 0 | 7 |
| | Maccaffertium sp. | 0 | 3 |
| | Paraleptophlebia sp. | 11 | 22 |
| | Stenacron interpunctatum | 0 | 5 |
| | Stenacron sp. | 1 | 0 |
| **Odonata** | Cordulegaster sp. | 0 | 1 |
| **Plecoptera** | Alloperla sp. | 0 | 3 |
| | Haploperla sp. | 0 | 24 |
| | Isoperla sp. | 0 | 5 |
| | Leuctra sp. | 15 | 7 |
| | Perlidae | 1 | 0 |
| | Pteronarcys sp. | 0 | 2 |
| | Sweltsa sp. | 0 | 2 |
| **Hemiptera** | Gerridae | 1 | 0 |
| | Rhagovelia sp. | 4 | 0 |
| **Coleoptera** | Anchytarsus bicolor | 0 | 1 |
| | Optioservus sp. | 2 | 6 |
| | Oulimnius sp. | 0 | 3 |
| **Megaloptera** | Nigronia sp. | 0 | 2 |
| | Sialis sp. | 1 | 1 |
| **Diptera-Chironomidae** | Ablabesmyia mallochi | 6 | 1 |
| | Brillia sp. | 2 | 0 |
| | Brundiniella sp. | 1 | 0 |

| | | | |
|---|---|---|---|
| | Cryptochironomus sp. | 2 | 0 |
| | Diamesa sp. | 2 | 16 |
| | Epoicocladius sp. | 1 | 1 |
| | Eukiefferiella coerulescens gr. | 0 | 2 |
| | Eukiefferiella tirolensis | 0 | 1 |
| | Heleniella sp. | 0 | 1 |
| | Heterotrissocladius marcidus gr. | 0 | 1 |
| | Larsia sp. | 1 | 0 |
| | Micropsectra sp. | 0 | 4 |
| | Microtendipes pedellus gr. | 40 | 4 |
| | Natarsia sp. | 0 | 2 |
| | Orthocladius Complex | 0 | 3 |
| | Orthocladius sp. | 0 | 2 |
| | Paracladopelma sp. | 0 | 1 |
| | Parametriocnemus sp. | 0 | 1 |
| | Paratanytarsus sp. | 0 | 1 |
| | Phaenopsectra sp. | 20 | 0 |
| | Polypedilum aviceps | 0 | 1 |
| | Polypedilum illinoense gr. | 0 | 1 |
| | Stempellinella sp. | 2 | 0 |
| | Stictochironomus sp. | 0 | 1 |
| | Tanytarsus sp. | 2 | 0 |
| | Thienemanniella sp. | 0 | 1 |
| | Thienemannimyia gr. sp. | 1 | 8 |
| | Tvetenia bavarica gr. | 0 | 1 |
| | Zavrelimyia sp. | 0 | 9 |
| **Diptera** | Hexatoma sp. | 0 | 9 |
| | Limnophila sp. | 0 | 2 |
| | Pseudolimnophila sp. | 0 | 3 |
| | Tabanidae | 0 | 1 |
| **Trichoptera** | Glossosoma sp. | 1 | 0 |
| | Goera sp. | 0 | 2 |
| | Hydropsyche morosa gr. | 0 | 2 |
| | Lepidostoma sp. | 1 | 0 |
| | Neophylax sp. | 0 | 28 |
| | Polycentropus sp. | 1 | 1 |
| | Pycnopsyche sp. | 0 | 4 |
| | Rhyacophila fuscula | 0 | 1 |
| | Rhyacophila minora | 0 | 2 |
| **Annelida** | Isochaetides curvisetosus | 17 | 13 |
| | Spirosperma nikolskyi | 0 | 1 |
| **Crustacea** | Cambarus sp. | 1 | 4 |
| **Other Organisms** | Nematoda | 1 | 0 |
| | TOTAL | **149** | **405** |

**APENDIX 2**

# NORTH FORK OF BENS CREEK ABOVE RESERVOIR TAXA REPORT

| | | | |
|---|---|---|---|
| | **Stream** | **North Fork of Bens Creek above Reservoir** | **North Fork of Bens Creek above Reservoir** |
| | **Site ID** | **200** | **200** |
| | **Coordinates** | **40.26623N, 79.01728W** | **40.26623N, 79.01728W** |
| | **Collection Date** | **07-01-2011** | **04-05-2012** |
| | **Device** | **serber** | **serber** |
| | **Habitat** | **riffle** | **riffle** |
| | | | |
| **Ephemeroptera** | Baetis sp. | 22 | 0 |
| | Epeorus sp. | 0 | 35 |
| | Eurylophella sp. | 17 | 0 |
| | Maccaffertium meririvulanum | 0 | 14 |
| | Maccaffertium pudicum | 0 | 2 |
| | Stenacron interpunctatum | 8 | 0 |
| | Stenacron sp. | 0 | 3 |
| **Plecoptera** | Acroneuria sp. | 1 | 0 |
| | Amphinemura sp. | 0 | 24 |
| | Chloroperlidae | 0 | 6 |
| | Leuctra sp. | 105 | 14 |
| | Peltoperla sp. | 0 | 1 |
| | Perlodidae | 0 | 3 |
| | Sweltsa sp. | 0 | 1 |
| **Coleoptera** | Oulimnius sp. | 3 | 0 |
| | Promoresia tardella | 0 | 1 |
| **Diptera-Chironomidae** | Ablabesmyia mallochi | 5 | 0 |
| | Brundiniella sp. | 1 | 0 |
| | Heterotrissocladius marcidus gr. | 3 | 0 |
| | Microtendipes pedellus gr. | 3 | 0 |
| | Parametriocnemus sp. | 2 | 0 |
| | Phaenopsectra sp. | 2 | 0 |
| | Polypedilum aviceps | 1 | 0 |
| | Rheotanytarsus exiguus gr. | 9 | 0 |
| | Stempellinella sp. | 1 | 0 |
| | Tanytarsus sp. | 12 | 0 |
| | Thienemannimyia gr. sp. | 11 | 0 |
| | Zavrelimyia sp. | 1 | 0 |
| **Diptera** | Bezzia/Palpomyia sp. | 2 | 0 |
| | Dicranota sp. | 4 | 0 |
| | Hexatoma sp. | 1 | 1 |
| | Limnophila sp. | 1 | 0 |
| | Rhabdomastix fascigera gr. | 1 | 0 |
| | Tipula sp. | 1 | 0 |
| **Trichoptera** | Diplectrona modesta | 2 | 5 |
| | Hydropsyche ventura | 0 | 13 |
| | Lepidostoma sp. | 4 | 0 |
| | Neophylax sp. | 0 | 1 |
| | Nyctiophylax sp. | 5 | 0 |
| | Polycentropus sp. | 3 | 3 |
| | Rhyacophila fuscula | 0 | 1 |
| | Rhyacophila invaria gr. | 0 | 2 |
| **Annelida** | Nais sp. | 1 | 0 |
| **Crustacea** | Cambarus sp. | 0 | 1 |
| | **TOTAL** | **232** | **131** |

# APENDIX 3

## ALWINES CREEK TAXA REPORT

| | | | |
|---|---|---|---|
| | Stream | Alwines Creek | Alwines Creek |
| | Site ID | 300 | 300 |
| | Coordinates | 40.27396N, 79.01200W | 40.27396N, 79.01200W |
| | Collection Date | 07-01-2011 | 04-05-2012 |
| | Device | serber | serber |
| | Habitat | riffle | riffle |
| | | | |
| | | | |
| **Ephemeroptera** | Baetis tricaudatus | 0 | 7 |
| | Dannella lita | 1 | 0 |
| | Epeorus sp. | 0 | 16 |
| | Ephemerella dorothea/excrucians | 0 | 98 |
| | Leptophlebiidae | 3 | 0 |
| | Maccaffertium sp. | 3 | 0 |
| | Paraleptophlebia sp. | 0 | 3 |
| | Plauditus sp. | 1 | 0 |
| **Odonata** | Lanthus parvulus | 0 | 1 |
| **Plecoptera** | Amphinemura sp. | 0 | 3 |
| | Isoperla sp. | 6 | 0 |
| | Leuctra sp. | 62 | 3 |
| | Peltoperlidae | 0 | 1 |
| | Perlodidae | 0 | 2 |
| | Pteronarcys sp. | 0 | 2 |
| | Sweltsa sp. | 7 | 0 |
| **Hemiptera** | Rhagovelia sp. | 1 | 0 |
| **Coleoptera** | Optioservus sp. | 1 | 1 |
| | Oulimnius sp. | 26 | 9 |
| | Promoresia tardella | 10 | 6 |
| **Diptera-Chironomidae** | Brundiniella sp. | 3 | 0 |
| | Chaetocladius sp. | 1 | 0 |
| | Diamesa sp. | 0 | 1 |
| | Eukiefferiella devonica gr. | 0 | 3 |
| | Heleniella sp. | 6 | 0 |
| | Heterotrissocladius marcidus gr. | 1 | 0 |
| | Lopescladius sp. | 6 | 0 |
| | Micropsectra sp. | 3 | 0 |
| | Microtendipes pedellus gr. | 1 | 0 |
| | Microtendipes rydalensis gr. | 2 | 0 |
| | Orthocladius Complex | 0 | 1 |
| | Pagastia sp. | 1 | 0 |
| | Parametriocnemus sp. | 1 | 2 |
| | Paraphaenocladius "n. sp." | 1 | 0 |
| | Phaenopsectra sp. | 1 | 0 |
| | Polypedilum aviceps | 2 | 1 |
| | Polypedilum illinoense gr. | 0 | 1 |
| | Potthastia gaedii gr. | 0 | 3 |
| | Rheocricotopus sp. | 0 | 1 |
| | Rheotanytarsus exiguus gr. | 8 | 0 |
| | Rheotanytarsus pellucidus gr. | 1 | 0 |
| | Tanytarsus sp. | 3 | 1 |
| | Thienemannimyia gr. sp. | 4 | 2 |
| **Diptera** | Antocha sp. | 1 | 0 |
| | Bezzia/Palpomyia sp. | 0 | 1 |

| | | | |
|---|---|---|---|
| | Dicranota sp. | 5 | 0 |
| | Hexatoma sp. | 4 | 6 |
| | Limnophila sp. | 0 | 1 |
| | Prosimulium sp. | 0 | 2 |
| | Pseudolimnophila sp. | 1 | 0 |
| | Rhabdomastix fascigera gr. | 1 | 0 |
| | Simulium sp. | 0 | 1 |
| | Tipula sp. | 0 | 1 |
| **Trichoptera** | Agapetus sp. | 2 | 0 |
| | Diplectrona modesta | 0 | 4 |
| | Glossosoma sp. | 2 | 0 |
| | Hydropsyche morosa gr. | 0 | 1 |
| | Lepidostoma sp. | 2 | 0 |
| | Lype diversa | 0 | 1 |
| | Nyctiophylax sp. | 2 | 0 |
| | Polycentropus sp. | 4 | 1 |
| | Rhyacophila torva | 0 | 1 |
| **Crustacea** | Cambaridae | 0 | 1 |
| | **TOTAL** | **190** | **189** |

# APENDIX 4

## NORTH FORK OF BENS CREEK ABOVE SAYLOR SCHOOL RD TAXA REPORT

| | Stream | NFBC above saylor bridge | NFBC above saylor bridge |
|---|---|---|---|
| | Site ID | 400 | 400 |
| | Coordinates | 40.26337N, 78.99948W | 40.26337N, 78.99948W |
| | Collection Date | 04-05-2012 | 07-01-2012 |
| | Device | serber | serber |
| | Habitat | riffle | riffle |
| | | | |
| | | | |
| **Ephemeroptera** | Caenis sp. | 0 | 1 |
| | Dannella lita | 0 | 1 |
| | Ephemerella sp. | 1 | 0 |
| | Eurylophella funeralis | 1 | 2 |
| | Maccaffertium sp. | 25 | 1 |
| | Maccaffertium vicarium | 10 | 0 |
| | Paraleptophlebia sp. | 4 | 71 |
| | Stenacron interpunctatum | 19 | 2 |
| **Odonata** | Aeshnidae | 0 | 1 |
| **Plecoptera** | Amphinemura sp. | 9 | 0 |
| | Diploperla sp. | 1 | 0 |
| | Haploperla sp. | 28 | 0 |
| | Leuctra sp. | 18 | 73 |
| **Hemiptera** | Microvelia sp. | 0 | 1 |
| | Rhagovelia sp. | 0 | 10 |
| **Coleoptera** | Optioservus sp. | 1 | 1 |
| **Megaloptera** | Nigronia serricornis | 1 | 0 |
| **Diptera-Chironomidae** | Ablabesmyia mallochi | 0 | 2 |
| | Cricotopus bicinctus gr. | 2 | 0 |
| | Eukiefferiella tirolensis | 1 | 0 |
| | Micropsectra sp. | 1 | 0 |
| | Microtendipes pedellus gr. | 22 | 9 |
| | Pagastia sp. | 0 | 11 |
| | Parametriocnemus sp. | 22 | 2 |
| | Phaenopsectra sp. | 0 | 1 |
| | Polypedilum aviceps | 13 | 2 |
| | Rheocricotopus sp. | 1 | 0 |
| | Rheotanytarsus exiguus gr. | 0 | 1 |
| | Stempellinella sp. | 0 | 1 |
| | Thienemanniella sp. | 1 | 0 |
| | Thienemannimyia gr. sp. | 138 | 34 |
| | Zavrelimyia sp. | 1 | 2 |
| **Diptera** | Ceratopogoninae | 1 | 0 |
| | Chelifera/Metachela sp. | 1 | 0 |
| | Empididae | 0 | 1 |
| | Hexatoma sp. | 1 | 0 |

| | | | |
|---|---|---|---|
| | Simulium sp. | 7 | 0 |
| **Trichoptera** | Cheumatopsyche sp. | 8 | 1 |
| | Chimarra aterrima | 2 | 0 |
| | Diplectrona modesta | 65 | 0 |
| | Hydropsyche bronta | 0 | 1 |
| | Hydropsyche morosa gr. | 2 | 0 |
| | Polycentropus sp. | 21 | 2 |
| | Rhyacophila carolina | 2 | 0 |
| | Rhyacophila fuscula | 2 | 0 |
| **Annelida** | Lumbriculidae | 0 | 1 |
| **Crustacea** | Cambarus sp. | 2 | 1 |
| | **TOTAL** | **434** | **236** |

# APENDIX 5

## NORTH FORK OF BENS CREEK ABOVE SR 985 TAXA REPORT

| | | | |
|---|---|---|---|
| | **Stream** | **NFBC above 985** | **NFBC above 985** |
| | **Site ID** | **500** | **500** |
| | **Coordinates** | **40.27298N, 78.9846W** | **40.27298N, 78.9846W** |
| | **Collection Date** | **07-01-2011** | **04-05-2012** |
| | **Device** | **serber** | **serber** |
| | **Habitat** | **riffle** | **riffle** |
| | | | |
| | | | |
| **Ephemeroptera** | Acentrella parvula | 1 | 0 |
| | Acentrella turbida | 1 | 0 |
| | Baetis sp. | 0 | 2 |
| | Caenis anceps | 13 | 0 |
| | Cinygmula sp. | 0 | 2 |
| | Eurylophella funeralis | 0 | 3 |
| | Isonychia sp. | 31 | 50 |
| | Maccaffertium ithaca | 0 | 19 |
| | Maccaffertium sp. | 4 | 0 |
| | Maccaffertium vicarium | 3 | 3 |
| | Paraleptophlebia sp. | 21 | 7 |
| | Stenacron interpunctatum | 0 | 1 |
| | Stenacron sp. | 1 | 0 |
| **Plecoptera** | Alloperla sp. | 0 | 1 |
| | Amphinemura sp. | 0 | 23 |
| | Haploperla sp. | 0 | 24 |
| | Leuctra sp. | 45 | 22 |
| | Nemouridae | 0 | 1 |
| | Perlidae | 2 | 0 |
| | Perlodidae | 0 | 1 |
| | Sweltsa sp. | 1 | 0 |
| **Hemiptera** | Microvelia sp. | 2 | 0 |
| | Rhagovelia sp. | 1 | 0 |
| **Coleoptera** | Optioservus sp. | 78 | 14 |
| | Oulimnius sp. | 4 | 1 |
| | Psephenus herricki | 0 | 1 |
| | Stenelmis sp. | 3 | 0 |
| **Megaloptera** | Corydalidae | 1 | 0 |
| | Sialis sp. | 2 | 0 |
| **Diptera-Chironomidae** | Cricotopus bicinctus gr. | 1 | 2 |
| | Cricotopus sp. | 0 | 1 |
| | Diamesa sp. | 31 | 1 |
| | Eukiefferiella tirolensis | 0 | 1 |
| | Micropsectra sp. | 0 | 3 |
| | Microtendipes pedellus gr. | 2 | 10 |
| | Orthocladius (Euorthocladius) sp. | 0 | 4 |
| | Orthocladius sp. | 0 | 3 |
| | Parametriocnemus sp. | 2 | 21 |
| | Polypedilum aviceps | 4 | 16 |
| | Rheocricotopus sp. | 0 | 3 |
| | Rheotanytarsus exiguus gr. | 1 | 1 |
| | Thienemannimyia gr. sp. | 21 | 53 |
| **Diptera** | Antocha sp. | 3 | 2 |
| | Atherix sp. | 4 | 0 |

| | | | |
|---|---|---|---|
| | Chelifera/Metachela sp. | 0 | 1 |
| | Clinocera sp. | 0 | 19 |
| | Dicranota sp. | 8 | 1 |
| | Neoplasta sp. | 0 | 2 |
| | Prosimulium sp. | 0 | 10 |
| | Pseudolimnophila sp. | 0 | 1 |
| | Simulium sp. | 0 | 15 |
| **Trichoptera** | Cheumatopsyche sp. | 3 | 17 |
| | Chimarra aterrima | 0 | 2 |
| | Diplectrona modesta | 0 | 3 |
| | Glossosoma sp. | 2 | 0 |
| | Hydropsyche bronta | 15 | 4 |
| | Hydropsyche sparna | 0 | 6 |
| | Neophylax sp. | 2 | 0 |
| | Polycentropus sp. | 7 | 10 |
| | Pycnopsyche sp. | 0 | 1 |
| | Rhyacophila carolina | 0 | 1 |
| **Gastropoda** | Ferrissia sp. | 0 | 2 |
| **Annelida** | Lumbriculidae | 1 | 0 |
| **Acari** | Torrenticola sp. | 1 | 0 |
| **Crustacea** | Cambarus sp. | 3 | 3 |
| | **TOTAL** | **325** | **394** |

# APENDIX 6

## HECKMAN HOLLOW TAXA REPORT

| | | |
|---|---|---|
| | **Stream** | **Heckman Hollow** |
| | **Site ID** | **600** |
| | **Coordinates** | **40.25838N, 78.98811W** |
| | **Collection Date** | **04-05-2012** |
| | **Device** | **Serber** |
| | **Habitat** | **Riffle** |
| | | |
| | | |
| **Ephemeroptera** | Ameletus sp. | 2 |
| | Baetis tricaudatus | 13 |
| | Cinygmula sp. | 96 |
| | Diphetor hageni | 10 |
| | Drunella sp. | 30 |
| | Epeorus sp. | 83 |
| | Ephemerella dorothea/excrucians | 134 |
| | Ephemerella invaria | 3 |
| | Leucrocuta sp. | 2 |
| | Maccaffertium vicarium | 14 |
| | Paraleptophlebia sp. | 68 |
| | Stenacron interpunctatum | 1 |
| **Odonata** | Lanthus sp. | 10 |
| **Plecoptera** | Acroneuria sp. | 13 |
| | Amphinemura sp. | 25 |
| | Chloroperlidae | 20 |
| | Isoperla sp. | 10 |
| | Leuctra sp. | 19 |
| | Sweltsa sp. | 8 |
| **Coleoptera** | Optioservus sp. | 1 |
| | Oulimnius sp. | 9 |
| **Megaloptera** | Nigronia sp. | 1 |
| **Diptera-Chironomidae** | Eukiefferiella tirolensis | 2 |
| | Micropsectra sp. | 1 |
| | Microtendipes pedellus gr. | 4 |
| | Parametriocnemus sp. | 19 |
| | Polypedilum aviceps | 1 |
| | Potthastia gaedii gr. | 2 |
| | Stempellinella sp. | 2 |
| | Thienemannimyia gr. sp. | 7 |
| **Diptera** | Antocha sp. | 1 |
| | Hexatoma sp. | 34 |
| | Limnophila sp. | 6 |
| | Molophilus sp. | 1 |
| | Prosimulium sp. | 134 |
| | Tipula sp. | 2 |
| **Trichoptera** | Cheumatopsyche sp. | 2 |
| | Diplectrona modesta | 39 |
| | Hydropsyche morosa gr. | 2 |
| | Neophylax sp. | 13 |
| | Polycentropus sp. | 9 |
| | Rhyacophila coloradensis gr. | 2 |
| | Rhyacophila fuscula | 1 |
| | Rhyacophila invaria gr. | 3 |
| | Rhyacophila minora | 2 |
| | Wormaldia sp. | 6 |
| **Annelida** | Lumbriculidae | 2 |
| **Crustacea** | Cambarus sp. | 6 |
| | **TOTAL** | **875** |