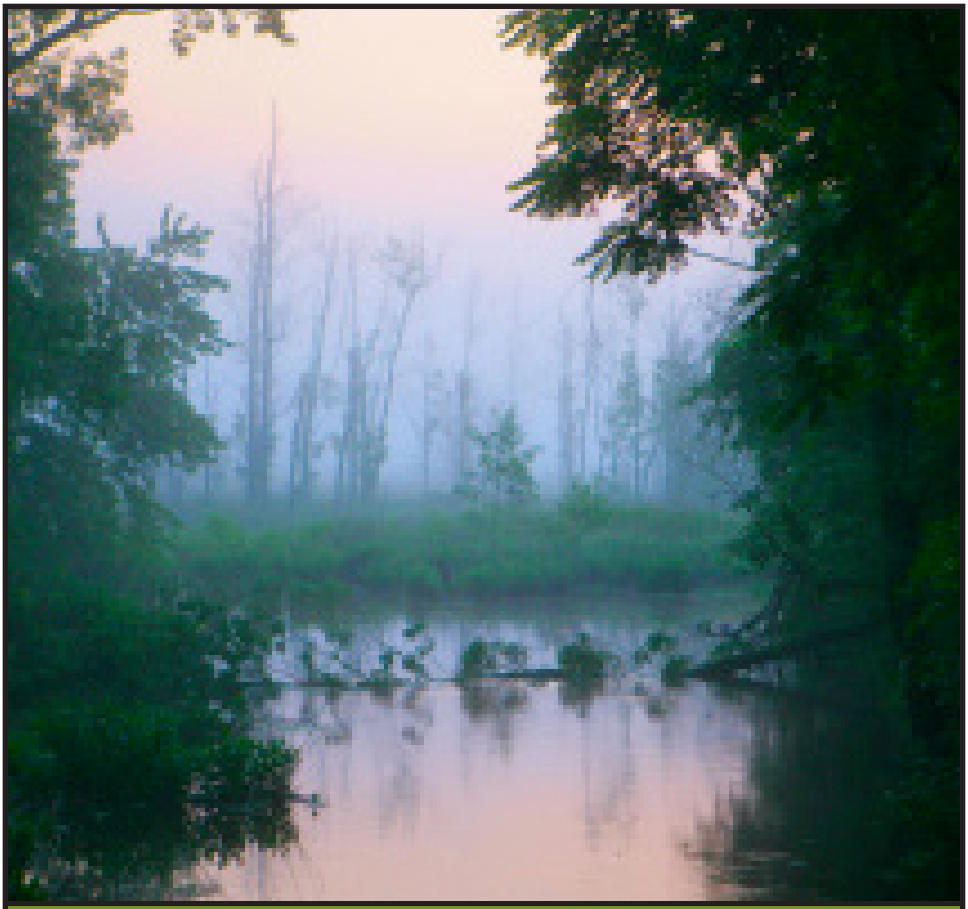

Great Swamp Watershed Report Card

2014

Great Swamp Watershed Association

Acknowledgments

Thanks to Great Swamp Watershed Association (GSWA) Stream Team volunteers who have contributed enormous amounts of time collecting water quality data, expanding and improving monitoring programs, and providing invaluable input throughout the creation of this report card. Special thanks to Roger Edwards, Guy Leland, Grant Hauck, and Ana Berthel for their work developing this report card. Many thanks to Jocelyn van den Akker for GIS assistance, and Lee Pollock for assistance with the macroinvertebrate data.

GSWA would like to thank the following, whose grants supported our water quality monitoring programs in 2014: Hyde and Watson Foundation, Norcross Wildlife Foundation, Royal Bank of Canada, and The Watershed Institute.

Support from GSWA members makes all of our programs possible. Thank you members!

September 2015
Prepared by Laura Kelm
Layout by Kelly Martin

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Great Swamp Watershed W

Stream	Macro-invert-brates	Visual Stream Assessment	Bacteria	Dissolved Oxygen
Black Brook	**Poor**	**Poor**	**Very Poor**	**Poor**
Great Brook (main stem)	**Poor**	**Good**	**Very Poor**	**Excellent**
Bayne Brook		**Poor**	**Excellent**	
Silver Brook		**Poor**	**Very Poor**	
Loantaka Brook	**Poor**	**Good**	**Very Poor**	**Excellent**
Passaic River (main stem)	**Good**	**Excellent**		**Good**
Indian Grave Brook	**Excellent**	**Good**		**Good**
Branta Pond			**Excellent**	
Primrose Brook (main stem)	**Excellent**	**Good**	**Excellent**	**Excellent**
Mount Kemble Lake Tributary				**Good**
Great Swamp Watershed Outlet			**Very Poor**	**Excellent**

Water Quality Report Card

Water Temperature	pH	Road Salt	Water Clarity	Nitrogen	Phosphorus
Excellent	Excellent	Good	Excellent	Very Poor	Poor
Excellent	Excellent	Good	Excellent	Excellent	Good
Excellent					
Excellent					
Excellent	Excellent	Poor	Excellent	Very Poor	Poor
Poor	Excellent	Excellent	Excellent	Good	Good
Poor	Excellent	Excellent	Excellent		
Excellent					
Excellent	Excellent	Excellent	Excellent	Good	Excellent
Excellent	Excellent	Excellent	Excellent	Poor	Excellent
Excellent	Excellent	Excellent	Excellent	Excellent	Good

Grading Key
Excellent
Good
Poor
Very Poor
No Data

Introduction to the Great Swamp Watershed

The Great Swamp Watershed is a 55-square mile region in Morris and Somerset Counties that includes portions of ten towns (Bernards, Bernardsville, Harding, Chatham Township, Long Hill, Madison, Mendham Township, Mendham Borough, Morris Township, and Morristown). There are approximately 138,000 people living in these towns, with about 38,000 residing in the Great Swamp Watershed.

There are five main streams in the Great Swamp Watershed: Black Brook, Loantaka Brook, Great Brook, Primrose Brook, and the Passaic River. The first four streams flow into the Passaic River before it leaves the watershed through Millington Gorge. Downstream of the Great Swamp Watershed, the Passaic River provides drinking water for over 1 million people.

Land uses in the Watershed vary from parks and forested areas to residential neighborhoods and commercial areas. Developed areas typically have the greatest impact on streams. Large areas of impervious surfaces such as roads, roofs, and parking lots, do not allow rain water to soak into the ground. Instead, precipitation falling on these surfaces "runs off," picking up any pollutants in its path, such as animal waste, trash, motor oil, and more. Stormwater runoff, as it is often called, flows across impervious surfaces directly into the nearest stream, or into a stormdrain, which eventually empties to a stream. Mown grassy areas like lawns and golf courses are also relatively impervious and contribute to runoff.

Stormwater runoff is the primary way that Watershed streams become impaired. Natural areas such as forests, wetlands, and meadows reduce runoff dramatically and allow precipitation and stormwater runoff to soak into the ground.

About This Report Card

GSWA has been involved in monitoring Watershed streams since 1999. Monitoring programs measure various parameters, each with a different timeline. **Chemical** monitoring, conducted quarterly, uses a combination of handheld meters to measure in-stream conditions and laboratory analysis of collected samples. **Visual** stream assessments are conducted biannually in the fall and spring. **Macroinvertebrate** surveys occur annually in June. ***E. coli*** monitoring is conducted during the summer months, with samples collected weekly for five consecutive weeks. **Temperature** data is collected during chemical and *E. coli* monitoring, and may also be measured continuously.

This report card compiles all stream monitoring data collected by GSWA staff and volunteers during 2014. Note that in 2014, Black Brook and Primrose Brook were the focus of chemical monitoring efforts, so a range of data was collected at multiple sites on these streams throughout the year.

Each of the five Watershed streams is assessed separately in this report card, and each is referred to as a *subwatershed*. Data collected at the Watershed outlet at Millington Gorge is also graded separately and is considered to be representative of the quality of water leaving the Great Swamp Watershed and heading towards our neighbors downstream.

Land use and land cover data is from 2012 (the most recent year available), and is publicly available data published by NJDEP.

How the Grades Were Created

Grading scales are based on New Jersey Department of Environmental Protection (NJDEP) or U.S. Environmental Protection Agency (EPA) standards when applicable. For categories without such standards, grading scales are based on ecological impact. Visit www.GreatSwamp.org for details.

How Water Quality is Measured

The following water quality parameters were considered in grading streams in the Great Swamp Watershed, along with suggestions for reducing their impact.

Dissolved oxygen is just what it says: the amount of oxygen dissolved in the water. Just like humans, aquatic life needs oxygen to survive. Poorly oxygenated water can harm and even kill animals that live in the water. Dissolved oxygen is introduced into streams from contact with the air, aquatic plants, and in places of stream turbulence such as waterfalls and shallow, rocky areas (also known as riffles). Low dissolved oxygen can be caused by algal blooms, high water temperatures, and slow flowing water (for example, due to impoundments). To help keep dissolved oxygen levels high in streams, you can plant trees near stream banks to shade the stream and keep water temperatures cool.

E. coli is a type of bacteria normally found in the intestines of mammals (including humans) and birds. Most strains of *E. coli* are harmless but can indicate the presence of fecal matter, which may contain harmful viruses. No natural body of water will be entirely free of *E. coli* because of the animal life surrounding it, but high levels can indicate fecal contamination which could be due to a failing septic system, broken sewer pipe, wildlife, or stormwater runoff carrying fecal matter deposited by wildlife and pets on land into the water. *E. Coli* data was used to score the bacteria level of each subwatershed. One easy way to reduce *E. coli* levels in local streams is always to pick up after your dog, even in your yard. Remember stormwater runoff flowing from your yard eventually winds up in a water body. If you have a septic system, be sure to perform regular maintenance on it to ensure that it is working properly.

Macroinvertebrates are small animals without backbones that live in the water, such as crayfish, insect larvae, and worms. These creatures can be used as a marker of water quality since some types of macroinvertebrates need high quality water and others can tolerate different levels of water pollution. The macroinvertebrates have life spans of anywhere from a few weeks to a few years, so the presence (or absence) of different types of macroinvertebrates tells the recent history of the water quality in the stream. Some of the factors that influence the variety and quantity of macroinvertebrates in streams include water temperature, dissolved oxygen, nitrogen, phosphorus, road salt, and aquatic habitats. Macroinvertebrates are a food source for fish, birds, and other wildlife.

Nitrogen is an essential nutrient for plants and animals, so there is naturally some nitrogen in streams. Because it is necessary for plant growth, nitrogen is also found in fertilizer. Too much nitrogen in streams, lakes, and ponds can work like fertilizer for aquatic plants, dramatically increasing plant growth and algal blooms. Algal blooms can compete with other aquatic plants for resources, such as nutrients and sunlight. When algae die off, it can lead to decreases in dissolved oxygen, which can suffocate aquatic animals. Nitrogen can come from many sources and often gets into local water bodies via stormwater runoff. In addition to fertilizer, animal waste (including from humans), and organic material such as leaves also contain nitrogen. You can reduce your impact on nitrogen in streams by picking up after your dog, reducing fertilizer use on your property, and ensuring that your septic system is functioning properly.

pH is a measure of how acidic or alkaline (basic) water is. The pH scale ranges from 0 to 14. Water with a low pH is considered acidic, while a high pH is considered alkaline or basic. Although 7 is considered neutral, streams in our area have an expected pH between 6.5 and 8.5. If the water in a stream is too acidic or basic, fish, plants, and other life forms cannot survive. People at home can reduce the human effect on the pH of streams by conserving energy. Power plants release chemicals into the air which can cause acid rain (which then falls into our streams), so reducing the amount of energy you use in your home reduces the pollution output of the power plants.

Phosphorus, like nitrogen, is an essential nutrient for plants and animals, so it is naturally occurring in streams. Too much phosphorus, like too much nitrogen, can lead to algal blooms. Algal blooms compete with aquatic plants for resources and can kill off those plants and decrease dissolved oxygen in the stream, leaving the water uninhabitable for aquatic life. Phosphorus can come from animal waste, specialized fertilizers, organic matter, and household products such as dish detergent. To reduce the impact of phosphorus in streams, use household cleaning products that are labeled *phosphate free.*

Road salt is the primary pollutant in Great Swamp Watershed streams. Winter use of road salt easily contaminates streams (through runoff from impervious roads, driveways, parking lots, and sidewalks). It can be deadly to aquatic life and plants on stream banks. Fish, insects, and macroinvertebrates often cannot tolerate high levels of road salt and may die when the levels are too high. Non-aquatic animals can also be negatively affected by road salt. As a homeowner, you can help to decrease road salt in the environment by using less or no road salt on driveways and walkways in the wintertime. If you must use salt, apply according to package directions and choose a product that is more environmentally benign. Sodium chloride has the highest environmental impact and should be avoided, while calcium magnesium acetate has the lowest environmental impact. Additionally, support municipal efforts to utilize lower salt alternatives.

Visual stream assessments are a way of assessing the condition of a stream segment that cannot be easily measured quantitatively. These assessments cover a range of topics, such as tree canopy cover over the stream, the presence of suitable habitats for aquatic life, and nearby land uses which might impact water quality. To learn more about visual assessments and see exactly what data is collected on the data sheet, visit www.GreatSwamp.org.

Water Clarity should be high to allow the plants living in the stream to thrive. Underwater plants serve many purposes in a stream ecosystem, from providing food for animals to oxygenating the water. However, plants need sunlight in order to thrive, and muddy, opaque water does not let light in. Additionally, poor water clarity frequently is a sign of excess sediment which can impact aquatic life by burying stream bottom habitat and making it harder for aquatic life to survive. To help improve water clarity, you can allow natural vegeation to grow along stream banks by planting trees and shrubs or simply reducing or eliminating mowing there. Taller vegetation acts as a filter, catching sediment before it enters the stream. If you have large areas of exposed soil due to construction, use silt fencing to keep it in place.

Water Temperature is critical because the fish, amphibians, and invertebrates that live in streams are cold-blooded, and the temperature of the stream can dictate whether they can survive and thrive. Different species of fish live best in different temperatures of water, and water that is consistently too hot or too cold for the native fauna will not support an ecosystem well. For example, trout are very sensitive to water temperature and cannot live in streams that are too warm. High water temperatures can also decrease dissolved oxygen levels, further negatively impacting aquatic life. To decrease water temperatures, trees and shrubs should be planted along streams to provide shade.

Stream Team volunteers assess water quality in Black Brook.

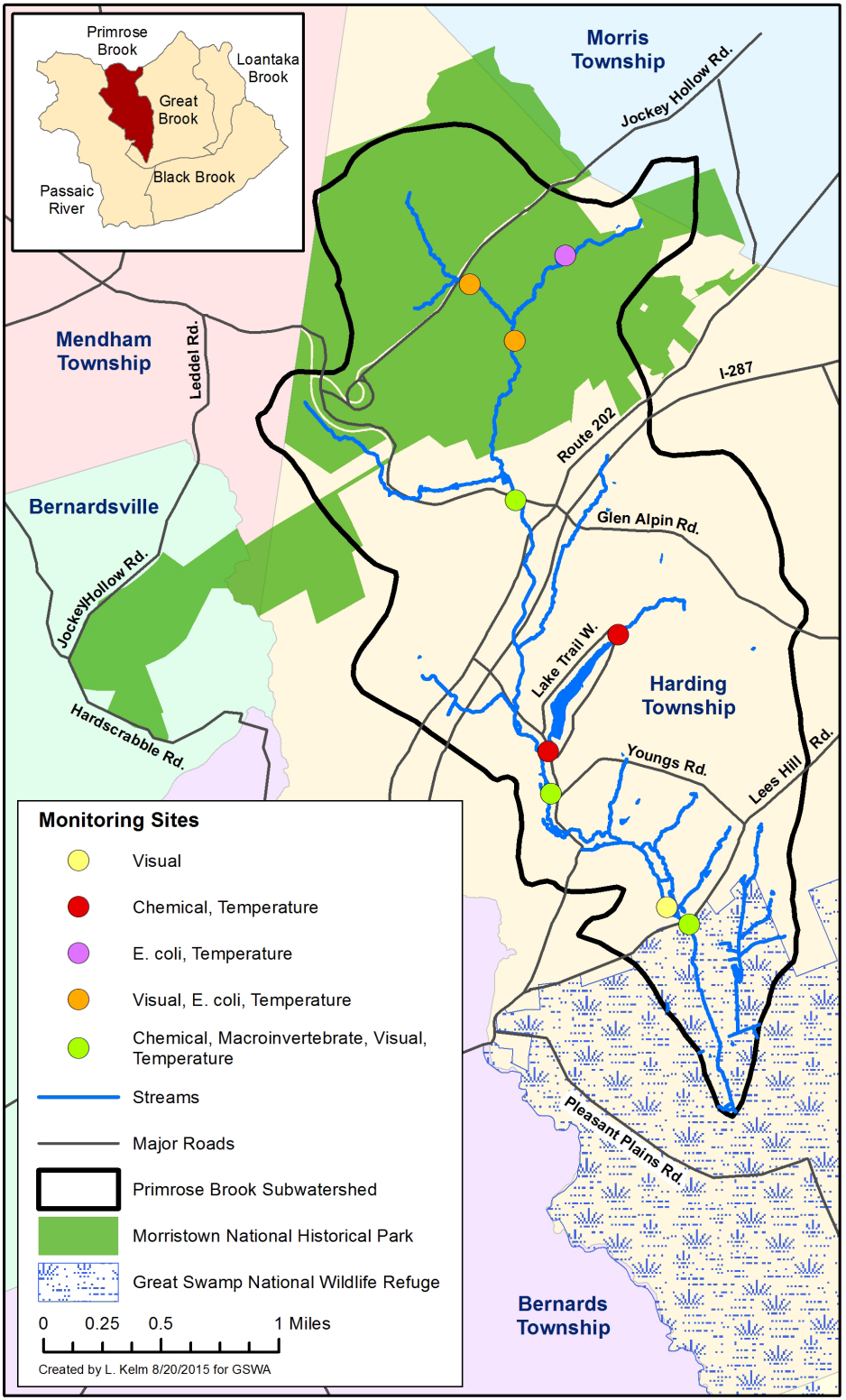
Primrose Brook

The Primrose Brook subwatershed is the second smallest at just over 5 square miles. It is comprised of primarily forested land (58%), with an additional 30% of its area developed. The upper reaches of the stream begin in and near the Jockey Hollow section of Morristown National Historical Park, and the stream traverses a relatively rural and suburban landscape to its outlet in the Great Swamp National Wildlife Refuge. An unnamed tributary, referred to by GSWA as the Mount Kemble Lake tributary, begins upstream of Mount Kemble Lake, flows into the Lake and then into the main stem of Primrose Brook. Primrose Brook is considered the healthiest stream in the Great Swamp Watershed, and two segments are classified as Category 1 by NJDEP, one of the highest stream classifications given by the State of New Jersey.

Category	Primrose Brook (main stem)	Mt. Kemble Lake tributary
Macroinvertebrates	Excellent	
Visual Assessment	Good	
Bacteria	Excellent	
Dissolved Oxygen	Excellent	Good
Water Temperature	Excellent	Excellent
pH	Excellent	Excellent
Road Salt	Excellent	Excellent
Water Clarity	Excellent	Excellent
Nitrogen	Good	Poor
Phosphorus	Excellent	Excellent

Comments

While Primrose Brook is very healthy in most respects, both chemical monitoring and visual assessments have shown areas that can be improved. Macroinvertebrate scores for Primrose Brook continue to be the highest of all watershed streams, indicating that the water quality in Primrose is healthy over a long time period. However, visual assessments have noted sedimentation in areas, which can bury aquatic habitat, and poor stream bank vegetation, which can lead to increased stormwater runoff and erosion. *Continued on page 24.*


Primrose Brook
Loantaka Brook
Great Brook
Black Brook
Passaic River
Morris Township
Jockey Hollow Rd.
Mendham Township
Leddel Rd.
I-287
Route 202
Bernardsville
Glen Alpin Rd.
Jockey Hollow Rd.
Lake Trail W.
Harding Township
Hardscrabble Rd.
Youngs Rd.
Lees Hill Rd.
Pleasant Plains Rd.
Bernards Township
Monitoring Sites
Visual
Chemical, Temperature
E. coli, Temperature
Visual, E. coli, Temperature
Chemical, Macroinvertebrate, Visual, Temperature
Streams
Major Roads
Primrose Brook Subwatershed
Morristown National Historical Park
Great Swamp National Wildlife Refuge
0 0.25 0.5 1 Miles
Created by L. Kelm 8/20/2015 for GSWA

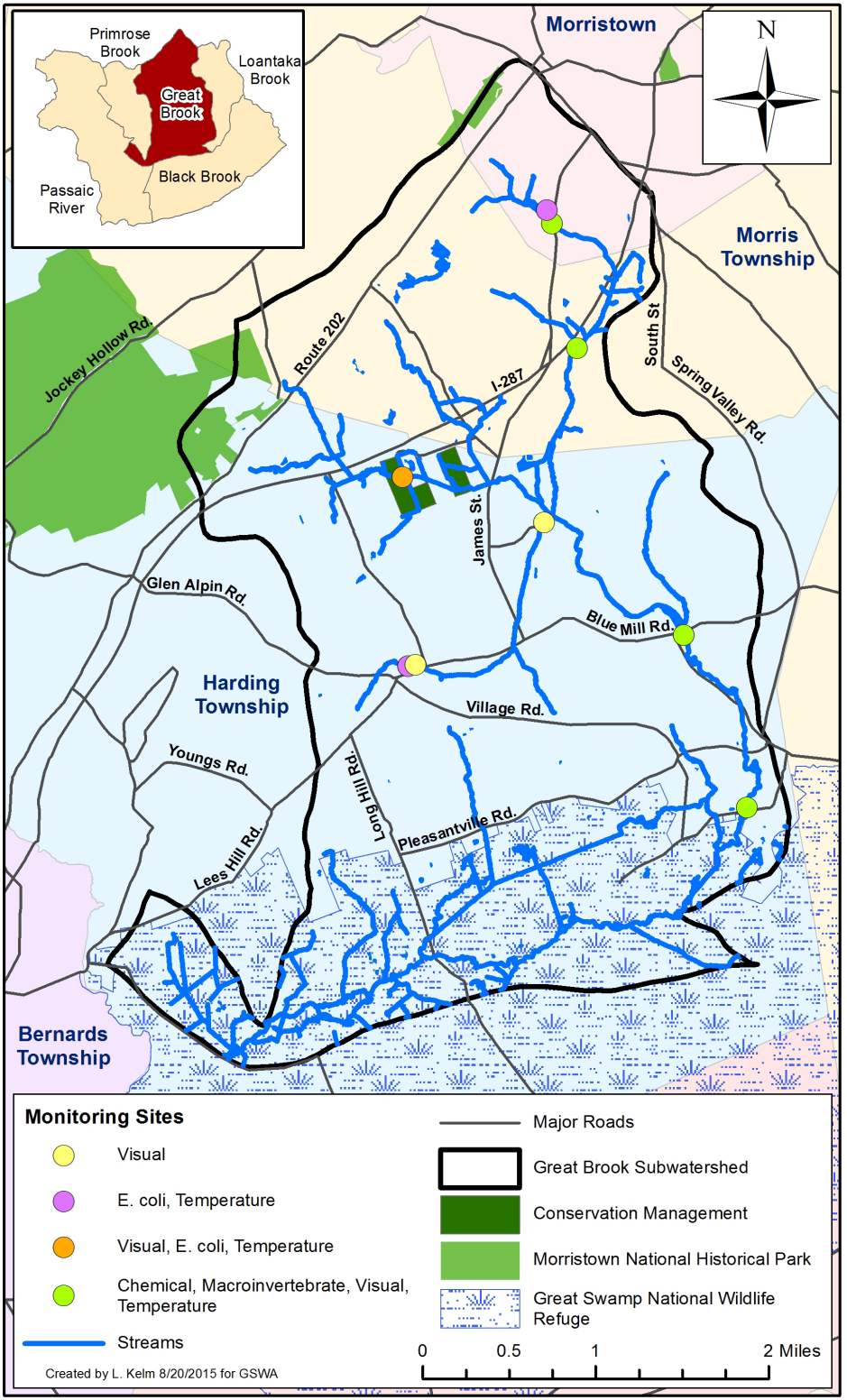
Great Brook

The Great Brook subwatershed encompasses almost 13 square miles of predominantly by developed land (40%) with a mix of forest (26%), wetlands (24%), and agriculture (9%). Great Brook originates in four locations, with the main stem beginning in Morris Township at Spring Brook Country Club. Silver Brook, a tributary, begins in Morris Township and flows through Harding, including GSWA's Conservation Management Area. Bayne Brook, another tributary, flows through Harding's Bayne Park. The two tributaries meet east of James St. in Harding, and flow shortly thereafter into the main stem of Great Brook. After its urban and suburban origins, Great Brook passes through protected lands scattered among suburban and rural landscapes until it enters the Great Swamp National Wildlife Refuge.

Category	Great Brook (main stem)	Bayne Brook	Silver Brook
Macroinvertebrates	Poor		
Visual Assessment	Good	Poor	Poor
Bacteria	Very Poor	Excellent	Very Poor
Dissolved Oxygen	Excellent		
Water Temperature	Excellent	Excellent	Excellent
pH	Excellent		
Road Salt	Good		
Water Clarity	Excellent		
Nitrogen	Excellent		
Phosphorus	Good		

Comments

Water quality in Great Brook often lies in the middle of Watershed streams - not the best, but not the most impaired. It is negatively impacted by its more developed headwaters, with higher road salt in the most upstream sites. Stormwater runoff caused decreased water clarity and elevated phosphorus levels (which would otherwise be "excellent") at a downstream site, while significantly increasing bacteria levels in Foote's Pond upstream. *Continued on page 24.*


Primrose Brook
Loantaka Brook
Great Brook
Black Brook
Passaic River
Morristown
N
Morris Township
Jockey Hollow Rd.
Route 202
I-287
South St
Spring Valley Rd.
James St.
Glen Alpin Rd.
Blue Mill Rd.
Harding Township
Village Rd.
Youngs Rd.
Long Hill Rd.
Pleasantville Rd.
Lees Hill Rd.
Bernards Township
Monitoring Sites
Visual
E. coli, Temperature
Visual, E. coli, Temperature
Chemical, Macroinvertebrate, Visual, Temperature
Streams
Major Roads
Great Brook Subwatershed
Conservation Management
Morristown National Historical Park
Great Swamp National Wildlife Refuge
0
0.5
1
2 Miles
Created by L. Kelm 8/20/2015 for GSWA

Loantaka Brook

At just over 5 square miles, Loantaka Brook is the smallest subwatershed. With its headwaters in Morristown and Morris Township, most of the land in the subwatershed is developed (53%), which tends to have a negative impact on the stream. There are however, significant areas of wetlands (21%) and forest (19%). Shortly downstream from its origins, Loantaka Brook flows past mown fields, Morris Township's Ginty Pool, Seaton Hackney Stables (where GSWA recently completed a 3-year remediation project), and the Woodland Water Pollution Control Utility (wastewater treatment plant). Any of these sites may contribute to stream impairment through potential input of nutrients, bacteria, and chemicals. Below the headwaters region, Loantaka Brook continues into Morris County Park Commission's Loantaka Brook Reservation. Within the park, the stream is dammed at Kitchell Pond, and then continues downstream through Green Village and into the Great Swamp National Wildlife Refuge.

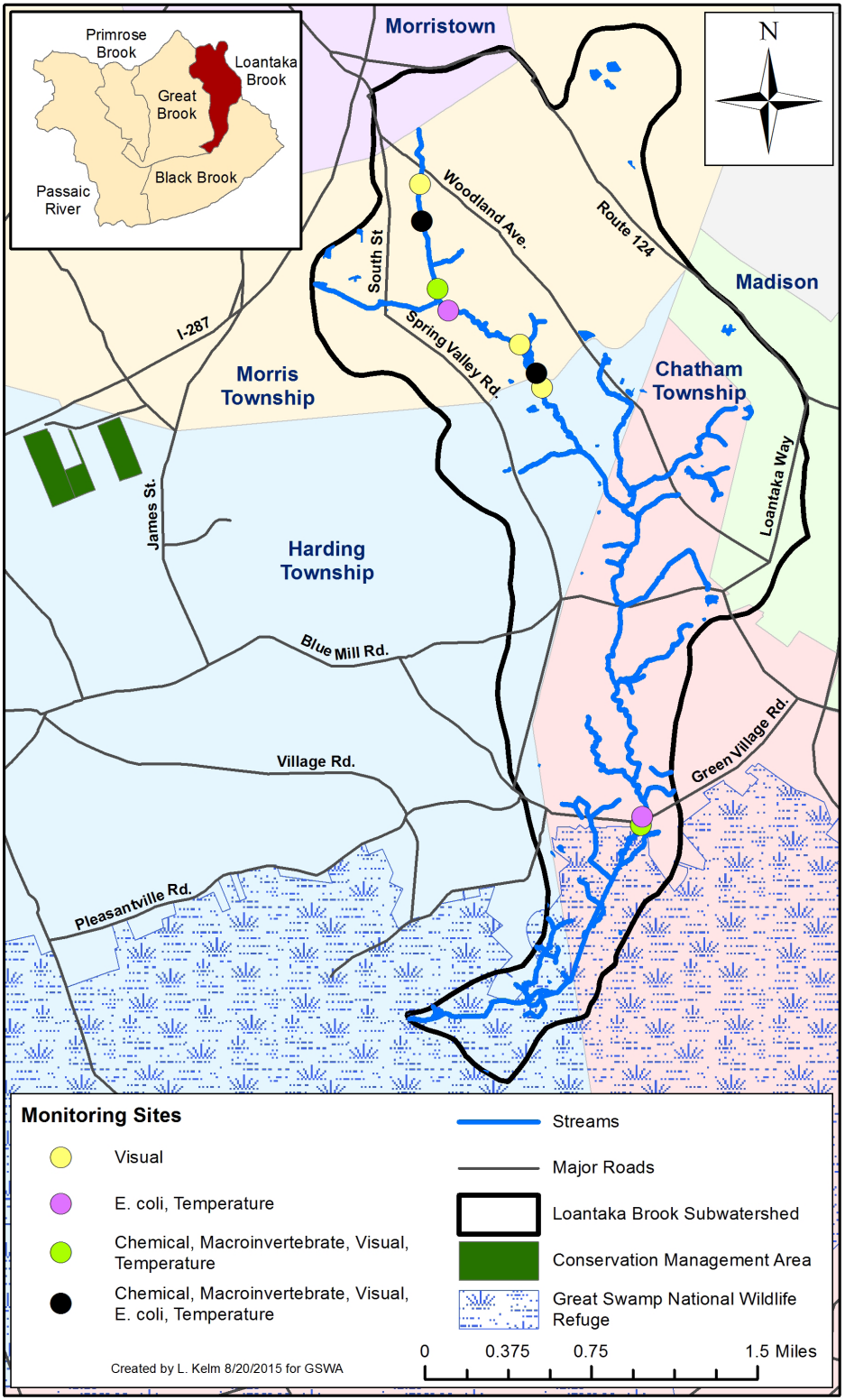
Category	Loantaka Brook
Macroinvertebrates	Poor
Visual Assessment	Good
Bacteria	Very Poor
Dissolved Oxygen	Excellent
Water Temperature	Excellent
pH	Excellent
Road Salt	Poor
Water Clarity	Excellent
Nitrogen	Very Poor
Phosphorus	Poor

Comments

Loantaka Brook is often considered to be the most impaired stream in the Watershed. Upstream development and land uses, detailed above, may also be the source of high nitrogen and phosphorus observed downstream. Sampling is needed at upstream sites to get more current information.

Normally high road salt levels were diluted by higher flows in the winter and spring (due to snowmelt and spring rains). In general, sites upstream had higher levels of road salt compared to those downstream. GSWA has observed this pattern in the past, and attributes it to denser development near the headwaters.

Continued on page 25.


Primrose Brook
Loantaka Brook
Great Brook
Black Brook
Passaic River
Morristown
N
Woodland Ave.
Route 124
South St
Madison
Spring Valley Rd.
I-287
Morris Township
Chatham Township
Loantaka Way
James St.
Harding Township
Blue Mill Rd.
Village Rd.
Green Village Rd.
Pleasantville Rd.
Monitoring Sites
Visual
E. coli, Temperature
Chemical, Macroinvertebrate, Visual, Temperature
Chemical, Macroinvertebrate, Visual, E. coli, Temperature
Streams
Major Roads
Loantaka Brook Subwatershed
Conservation Management Area
Great Swamp National Wildlife Refuge
0
0.375
0.75
1.5 Miles
Created by L. Kelm 8/20/2015 for GSWA

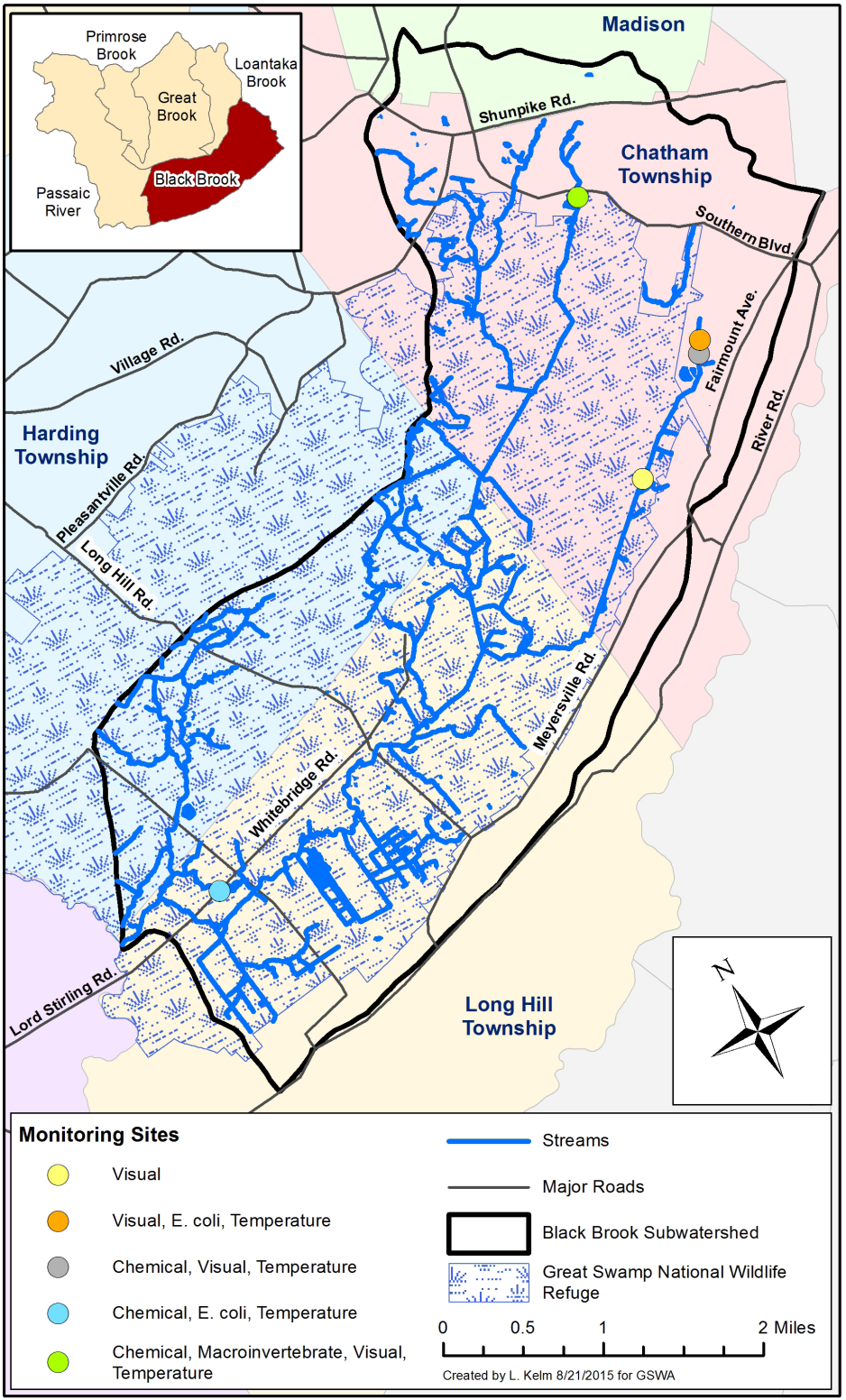
Black Brook

Black Brook, the second largest subwatershed with over 14 square miles, lies primarily within the Great Swamp National Wildlife Refuge. Reflective of this, wetlands are the predominant land cover (59%). Outside of the Refuge, much of the subwatershed is developed (27% total). The headwaters of Black Brook include several branches which begin in the developed areas of Chatham Township, with two originating in the Fairmount Country Club. After entering the Refuge, the branches converge and continue their course until entering the Passaic River. At sites near Whitebridge Road within the Refuge, the stream has taken on a darker "tea colored" appearance due to the decomposition of organic matter in the stream. Black Brook is a low gradient stream, meaning the elevation difference between the headwaters and the stream's outlet is relatively low. This causes the stream to generally have a slow flow.

Category	Black Brook
Macroinvertebrates	Poor
Visual Assessment	Poor
Bacteria	Very Poor
Dissolved Oxygen	Poor
Water Temperature	Excellent
pH	Excellent
Road Salt	Good
Water Clarity	Excellent
Nitrogen	Very Poor
Phosphorus	Poor

Comments

The southern-most branch of Black Brook was home to the outfall of Chatham Township's Main Water Pollution Control Utility (wastewater treatment plant) through mid-March 2015. This raised the amount of road salt, nitrogen, and phosphorus in the brook. The monitoring site on the northern branch of Black Brook is next to the Fairmount Country Club, and just downstream from Southern Boulevard, both of which are likely impacting water temperature, dissolved oxygen, nitrogen, road salt, and macroinvertebrates. *Continued on page 25.*


Primrose Brook
Loantaka Brook
Great Brook
Black Brook
Passaic River
Madison
Shunpike Rd.
Chatham Township
Southern Blvd.
Fairmount Ave.
River Rd.
Village Rd.
Harding Township
Pleasantville Rd.
Long Hill Rd.
Meyersville Rd.
Whitebridge Rd.
Lord Stirling Rd.
Long Hill Township
N
Monitoring Sites
Visual
Visual, E. coli, Temperature
Chemical, Visual, Temperature
Chemical, E. coli, Temperature
Chemical, Macroinvertebrate, Visual, Temperature
Streams
Major Roads
Black Brook Subwatershed
Great Swamp National Wildlife Refuge
0
0.5
1
2 Miles
Created by L. Kelm 8/21/2015 for GSWA

Passaic River

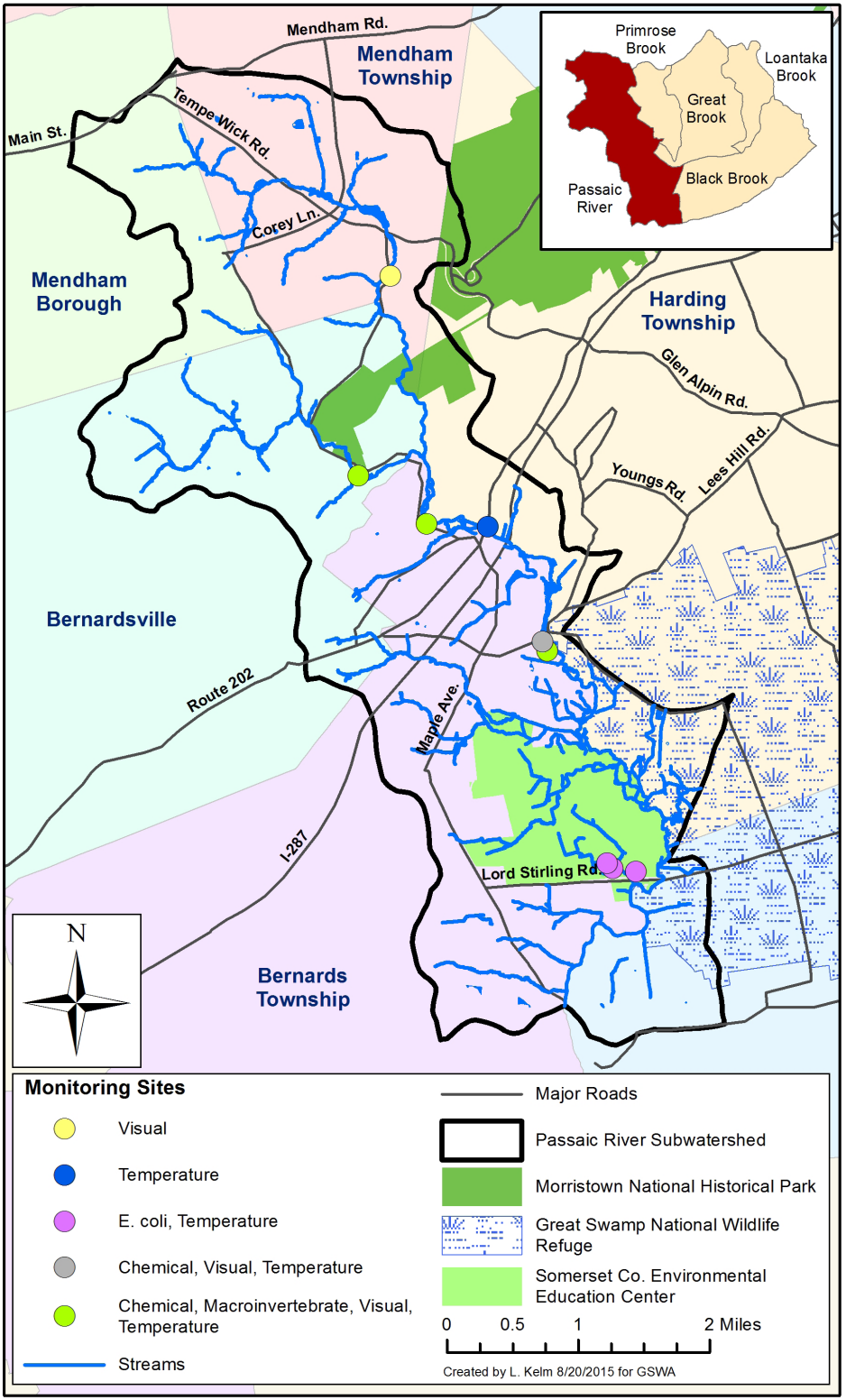
At almost 17 square miles, the Passaic River subwatershed is the largest within the Great Swamp Watershed. The headwaters of the Passaic River begin in downtown Mendham Borough and Mendham Township, and the river then flows through a heavily forested area before reaching more dense development along Route 202 and I-287. In total, 43% of the subwatershed is developed while 33% is forested. Like Primrose Brook, a segment of the Passaic River (above Osborne Pond) is classified by NJDEP as Category 1, one of the highest stream classifications given by the State of New Jersey. The Passaic River within the Great Swamp Watershed is considered, with Primrose Brook, to be one of the healthiest Watershed streams. A tributary, Indian Grave Brook, is often considered the reference stream for the Great Swamp Watershed due to its consistently high water quality. Branta Pond, located within the Somerset County Environmental Education Center, flows into the Passaic River downstream of Lord Stirling Road.

Category	Passaic River	Indian Grave Brook	Branta Pond
Macroinvertebrates	Good	Excellent	
Visual Assessment	Excellent	Good	
Bacteria			Excellent
Dissolved Oxygen	Good	Good	
Water Temperature	Poor	Poor	Excellent
pH	Excellent	Excellent	
Road Salt	Excellent	Excellent	
Water Clarity	Excellent	Excellent	
Nitrogen	Good		
Phosphorus	Good		

Comments

The Passaic River is considered one of the healthiest streams in the Great Swamp Watershed. Sites on the River upstream of Osborne Pond and on Indian Grave Brook are designated as trout-production (TP) waters, which carries more stringent standards for water temperature, dissolved oxygen, and water clarity compared with non-trout waters. Continuous temperature data showed high water temperatures at TP sites on the Passaic River and Indian Grave Brook, potentially having a negative impact on trout and other aquatic life. However, these sites also had "excellent" macroinvertebrate communities.

Continued on page 26.


Mendham Rd.
Mendham Township
Main St.
Tempe Wick Rd.
Corey Ln.
Mendham Borough
Harding Township
Glen Alpin Rd.
Youngs Rd.
Lees Hill Rd.
Bernardsville
Route 202
Maple Ave.
I-287
Lord Stirling Rd.
Bernards Township
N
Primrose Brook
Loantaka Brook
Great Brook
Black Brook
Passaic River
Monitoring Sites
Visual
Temperature
E. coli, Temperature
Chemical, Visual, Temperature
Chemical, Macroinvertebrate, Visual, Temperature
Streams
Major Roads
Passaic River Subwatershed
Morristown National Historical Park
Great Swamp National Wildlife Refuge
Somerset Co. Environmental Education Center
0
0.5
1
2 Miles
Created by L. Kelm 8/20/2015 for GSWA

Great Swamp Outlet

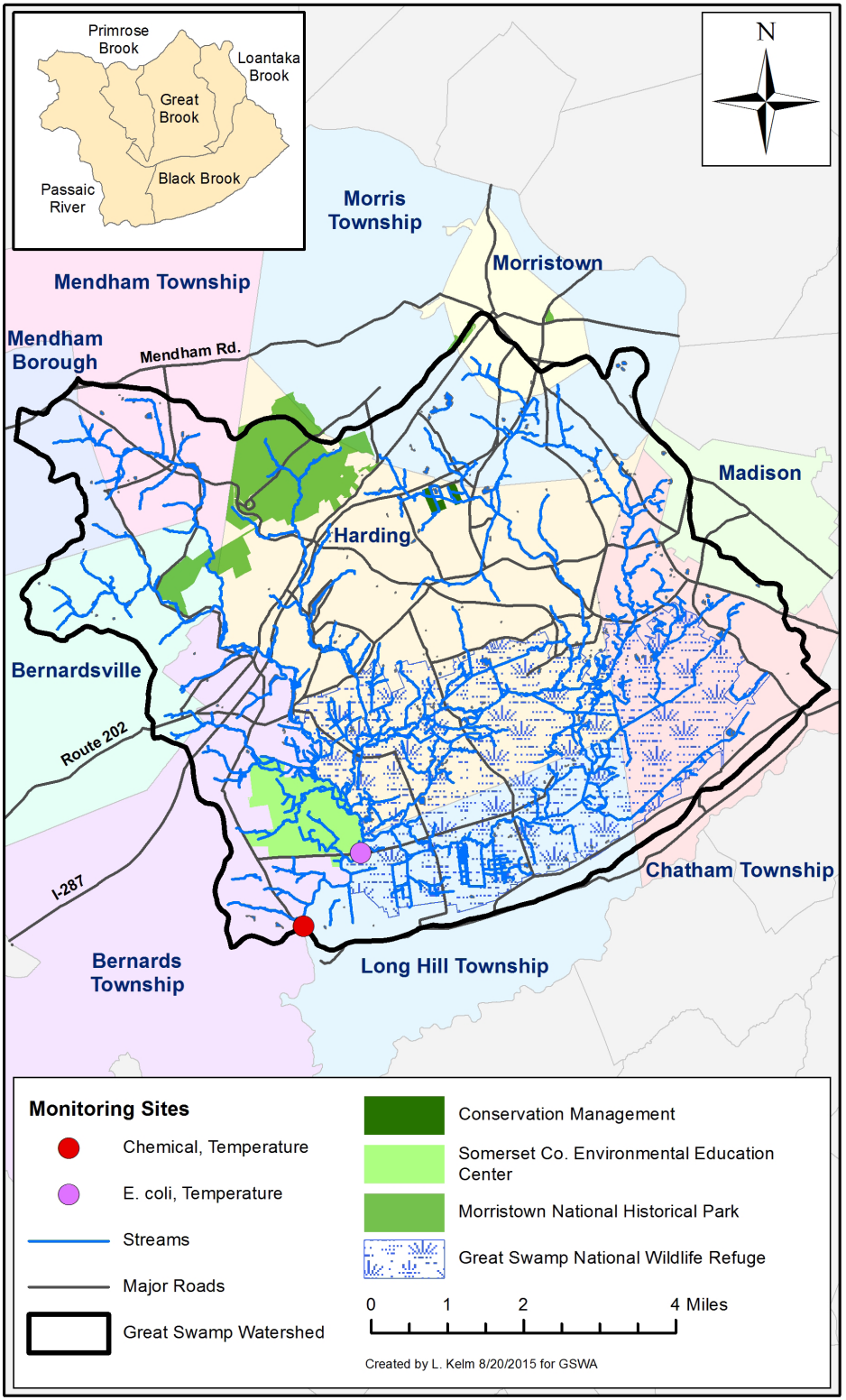
The outlet of the Great Swamp Watershed at Millington Gorge gives a snapshot of the combined water quality of all upstream sites. The results are directly impacting our downstream neighbors, and those whose drinking water comes from the Passaic River. Note that some data was collected upstream from Millington Gorge at the Fishermen's Parking Lot on the Passaic River. This site was considered to be a Watershed outlet site since it is below where all major tributaries empty into the main stem of the Passaic River, and data taken there also serves as an indicator of the quality of water leaving the Great Swamp Watershed.

Category	Great Swamp Outlet
Macroinvertebrates	
Visual Assessment	
Bacteria	Very Poor
Dissolved Oxygen	Excellent
Water Temperature	Excellent
pH	Excellent
Road Salt	Excellent
Water Clarity	Excellent
Nitrogen	Excellent
Phosphorus	Good

Comments

Since the watershed outlet is a combination of water quality input from all other streams, we would expect to see it negatively impacted by poorer quality streams or certain parameters. Conversely, higher quality streams would serve to dilute pollutants flowing from more impaired streams. In looking at the data, it appears that a larger area of land draining to the outlet, and subsequently higher stream flow than elsewhere in the Watershed, serve to dilute most negative inputs. That being said, water clarity at the outlet, although excellent, was consistently poorer than most other sites and decreased significantly during a storm event.

Continued on page 26.


Primrose Brook
Loantaka Brook
Great Brook
Black Brook
Passaic River
N
Morris Township
Morristown
Mendham Township
Mendham Borough
Mendham Rd.
Madison
Harding
Bernardsville
Route 202
I-287
Chatham Township
Bernards Township
Long Hill Township
Monitoring Sites
Chemical, Temperature
E. coli, Temperature
Streams
Major Roads
Great Swamp Watershed
Conservation Management
Somerset Co. Environmental Education Center
Morristown National Historical Park
Great Swamp National Wildlife Refuge
0
1
2
4 Miles
Created by L. Kelm 8/20/2015 for GSWA

Continued Comments

Primrose Brook (*continued from page 12*)

High nitrogen in Primrose Brook and the Mount Kemble Lake tributary is due to snowmelt conditions during March monitoring (a trend also observed in the Passaic River). Decomposing organic matter deposits nitrogen on the ground, which can be transported into nearby streams by snowmelt. This is a natural condition and should not be cause for concern. In the Mount Kemble Lake tributary, higher nitrate was measured upstream from Mount Kemble Lake compared to downstream. However, these measurements still comfortably meet the state standard for human health.

Cat Swamp Pond, located within Jockey Hollow, does not receive flow from, or contribute to, Primrose Brook (and therefore was not included in grades received by Primrose Brook). However, it was also sampled for bacteria and is considered "excellent" based on that data.

Great Brook (*continued from page 14*)

Stormwater runoff also increased bacteria levels in Bayne Pond, though the Pond had excellent bacteria levels during all dry weather measurements.

Two impoundments along Great Brook, Foote's Pond and Silver Lake, cause high water temperatures and may also contribute to poor macroinvertebrate communities at sites immediately downstream.

Visual assessments at sites on Bayne Brook and Silver Brook reveal poor in-stream habitat and sedimentation (which can bury aquatic habitats). Additionally, Bayne Brook within Bayne Park was noted for having only a narrow strip of natural vegetation along its banks, which makes the Brook susceptible to stormwater runoff and high water temperatures.

Silver Brook had high bacteria levels during all weather conditions, which indicates a constant source of bacteria into the stream, such as from a nearby failing septic system. The cause is currently under investigation by GSWA.

Loantaka Brook (*continued from page 16*)

Past stream monitoring has shown that effluent from the Woodland Water Pollution Control Utility contains significant amounts of salt components, though at concentrations somewhat lower than those often seen at sites further upstream.

Visual assessments conducted along Loantaka Brook noted poor in-stream habitat, sedimentation, streambank erosion, and buffers in need of improvement (through widening or improving the plant community in the buffer). These factors are all interrelated with poor buffers leading to stormwater runoff, which can increase erosion and cause sedimentation, which can bury aquatic habitat (critical for example for macroinvertebrates). During the storm event monitored in 2014, water clarity decreased significantly, illustrating some of these impacts.

Stormwater runoff is also the likely cause of high bacteria levels in Loantaka Brook. Conversely, bacteria levels immediately downstream from Morris Townships' Ginty Pool were artificially low. These were likely due to a chemical leak from the pool, which was remedied prior to summer 2015 sampling.

Water temperatures were noticeably higher immediately downstream of Kitchell Pond compared to upstream sites, showing the warming effect the pond has on the stream.

Black Brook (*continued from page 18*)

Black Brook near Whitebridge Road is a slow-moving stream exposed to the warming sun, leading to higher water temperatures and decreased dissolved oxygen. High bacteria at this site during all weather conditions may be due to wildlife, or the ability of wetland soils to harbor bacteria and allow it to grow. High bacteria at a site further upstream is caused by stormwater runoff from neighboring communities.

Visual assessments along Black Brook noted a lack of in-stream habitat, few riffles (which serve to oxygenate the water and provide aquatic habitat), and considerable sediment on the stream bottom. These are all possible effects of the Brook's topography. Additionally, visual assessments often noted that the plant community making up the stream's buffer could be improved.

Passaic River *(continued from page 20)*

Macroinvertebrates found further downstream on the Passaic River were "good," undoubtedly a reflection of greater development downstream in the subwatershed. Water chemistry at downstream sites was "excellent" or "good" despite this. As was observed in Primrose Brook, nitrogen in the Passaic River was increased significantly due to spring snowmelt (see Primrose Brook, page 24, for more information).

Stream chemistry data for Indian Grave Brook was only collected once during 2014. However the data are consistent with past data collected by GSWA and are considered representative of conditions in that stream.

Although not flowing into the Passaic River, two additional sites were monitored for bacteria at the Somerset County Environmental Education Center; Bullfrog Pond and Lily Pad Pond. As with Branta Pond (which does flow into the Passaic), those sites would each receive a grade of "excellent" for their low E. coli levels.

Great Swamp Outlet *(continued from page 22)*

Winter and spring monitoring showed lower phosphorus than summer and fall. This may be due to dilution from higher flows (due to recent snowmelt and rains, as we have seen with several parameters on other streams) or increased phosphorus input from fertilizer during the growing season.

Bacteria results collected at Fishermen's Parking Lot met the state standard during dry weather but increased significantly after recent rain.

Recommendations

Water monitoring data from 2014 showed several pervasive issues impacting watershed streams. Fortunately there are also many potential solutions:

High Water Temperatures

- Taller plants next to a stream, pond, or lake, can provide shade and help to keep water temperatures cool.

Sediment

- Multi-stemmed plants, such as shrubs and ground cover, next to a stream can act as a filter, catching sediment in stormwater runoff before it reaches a stream.
- Plants with complex root systems, such as those of many native plants, help hold soil in place, reducing soil erosion.
- Individuals and municipalities should ensure that any exposed soil on their property is surrounded by a silt fence to keep soil in place.

Stormwater Runoff

- Reducing impervious surfaces will reduce the volume of stormwater runoff. Pervious pavement options abound, or unused impervious cover can be removed and replaced it with pervious cover.
- The volume of stormwater runoff can be reduced through the use of rain barrels or cisterns to capture and store (or slowly release) roof runoff.
- Runoff from impervious surfaces can be directed into rain gardens or drainage swales where it will be absorbed.

Poor Stream Buffers

- Multi-stemmed plants, such as shrubs and ground cover, growing along a stream can slow down the flow of stormwater runoff, allowing it to soak into the ground.
- Larger native plants with deep and complex root systems can absorb stormwater runoff soaking into the ground.
- The wider a buffer is, the more time it has to slow down and soak up stormwater runoff.

High Bacteria

- Pet owners should pick up after their pets, even in their yard.

Road Salt

- Only use salt when necessary and follow package directions.
- Support municipal efforts to employ lower salt alternatives.

Great Swamp Watershed Association is a member supported organization. Our mission is to protect and improve water resources in the region by monitoring local streams, advocating for intelligent land use, and educating our communities about water quality and quantity and their effect on the health and natural beauty of the local environment.