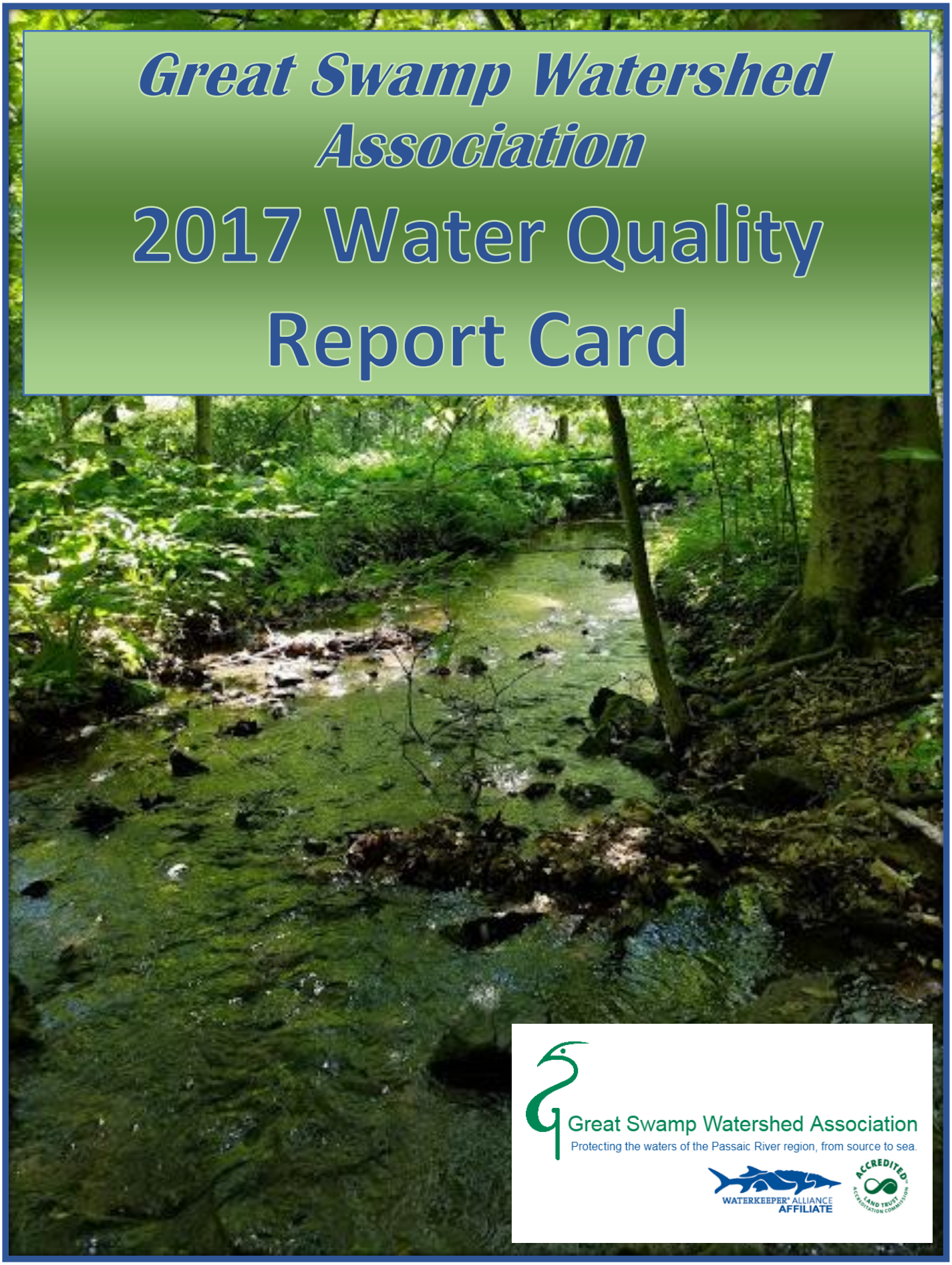
Great Swamp Watershed Association

2017 Water Quality Report Card



Great Swamp Watershed Association

Protecting the waters of the Passaic River region, from source to sea.

WATERKEEPER® ALLIANCE AFFILIATE

ACCREDITED LAND TRUST ACCREDITATION COMMISSION

Acknowledgments

The 2017 Watershed Report Card is the culmination of hours of hard work and dedication throughout the year. I would like to take this opportunity to thank the many hands that have worked together to make this report possible. GSWA is privileged to have an amazing group of volunteers called the Stream Team and our dedicated 2017 college and high school interns. These groups go out throughout the year to assist in collecting chemical samples for water quality data, macroinvertebrate samples, and to observe, through the NJDEP Visual Assessment protocols, miles of streams and track any changes that may be affecting them. Without their support and wealth of local knowledge about the watershed this report would not be possible. Special thanks to Roger Edwards for his assistance with data analysis and organization.

The 2017 water quality program was funded in part by a generous grant from **The Watershed Institute**.

GSWA would also like to sincerely thank our members, corporations, and foundation supporters whose generous contributions helped fund our water quality monitoring programs in 2017. It is the support of GSWA members that makes the work we do possible. Thank you!

Mason Scher - Drew University Intern

Report Prepared by Sandra LaVigne
Cover Photo Primrose Brook headwaters – Sandra LaVigne

Great Swamp Watershed Association
The Passaic River WATERKEEPER® ALLIANCE Affiliate

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This report and supplemental materials are available online at GreatSwamp.org or by contacting Sandra LaVigne, GSWA Director of Water Quality Programs, at SandraL@GreatSwamp.org or 973-538-3500.

Introduction to the Great Swamp Watershed

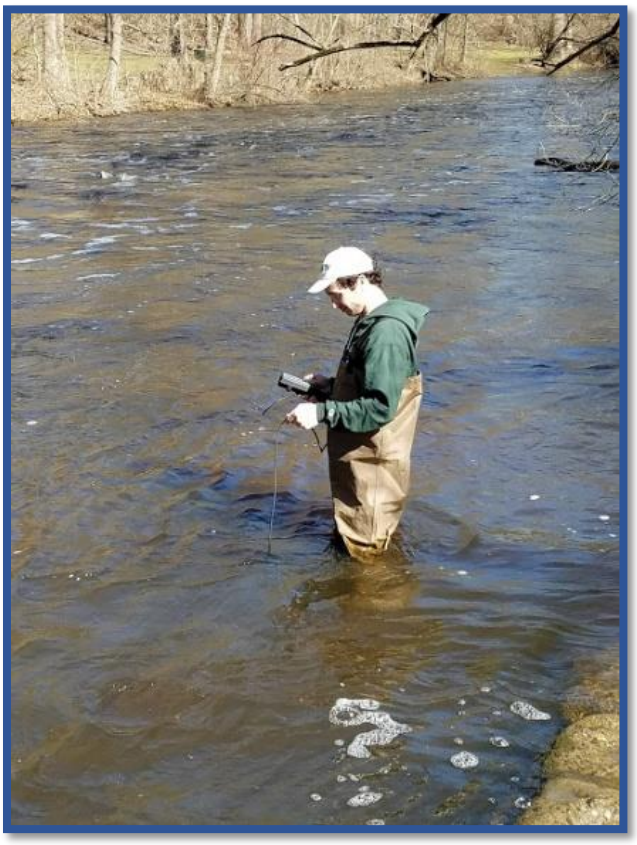
The Great Swamp Watershed is a 55-square mile region in Morris and Somerset Counties that includes portions of ten towns (Bernards, Bernardsville, Harding, Chatham Township, Long Hill, Madison, Mendham Township, Mendham Borough, Morris Township, and Morristown). There are approximately 138,000 people 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 headwaters of the Passaic River. The first four streams flow through the Great Swamp National Wildlife Refuge and then join with the Passaic River before it leaves the watershed through Millington Gorge. Downstream of the Great Swamp Watershed, the Passaic River flows for a further ~70 miles and provides drinking water for over two 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 our 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 storm drain, 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. These areas help to filter and clean the water before it reaches our streams.

The 2017 Water Quality Report Card



The 2017 Water Quality Report Card reviews all the monitoring data collected by staff and volunteer citizen scientists throughout the year. In 2017, GSWA began a new chapter in our monitoring program as we expanded beyond the Great Swamp Watershed and moved into the Upper Passaic River below Millington Gorge. With our Passaic River Expansion Project, we also reassessed the sampling sites within the Great Swamp Watershed to ensure that we were capturing the best possible sampling locations for monitoring our streams. This included increasing from one to two sites (capturing headwaters and downstream areas) on Loantaka Brook, Great Brook, and the Passaic River Headwaters region. Black Brook and Primrose Brook were both part of our final Adopt a Stream Program that ran from 2014 through 2016. In 2017, these two streams were also monitored at two sites each, down from three in the Adopt a Stream Program.

Our expansion covered four completely new sites to GSWA downstream of Millington Gorge, historically our most downstream location. The four new sites covered the area between the gorge and Summit (approximately 12 miles) with locations strategically selected to capture important differences in the surrounding communities and landscape. The data collected is a baseline for GSWA, though we are comparing it to some historic data obtained through the USGS and NJDEP to try to assess changes in the water quality in this region.

See below for a map of all the 2017 chemistry sampling sites, our newest sites are marked in blue.

Each of the five Great Swamp Watershed streams is assessed separately in this report card, with each area being referred to as a sub-watershed. Data collected at the Millington Gorge sampling site, the outlet of the Great Swamp Watershed, is also graded separately and is considered to be representative of the quality of the water, with all five streams combined, as it forms the upper Passaic River and heads downstream. Finally, the four new sites will be treated as the Upper Passaic sub watershed, these sites represent the beginning of our exploration of the full length of the Passaic River.

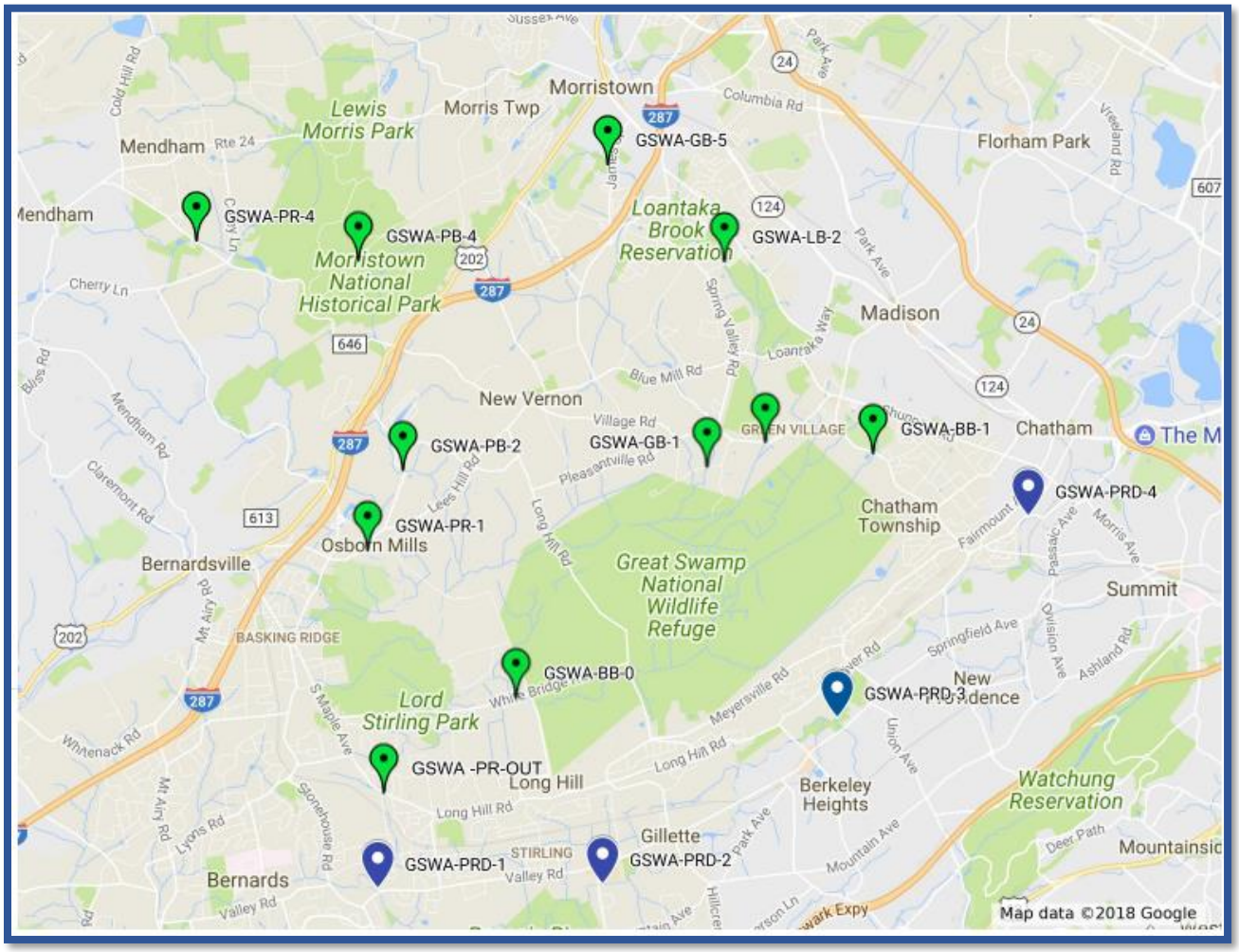
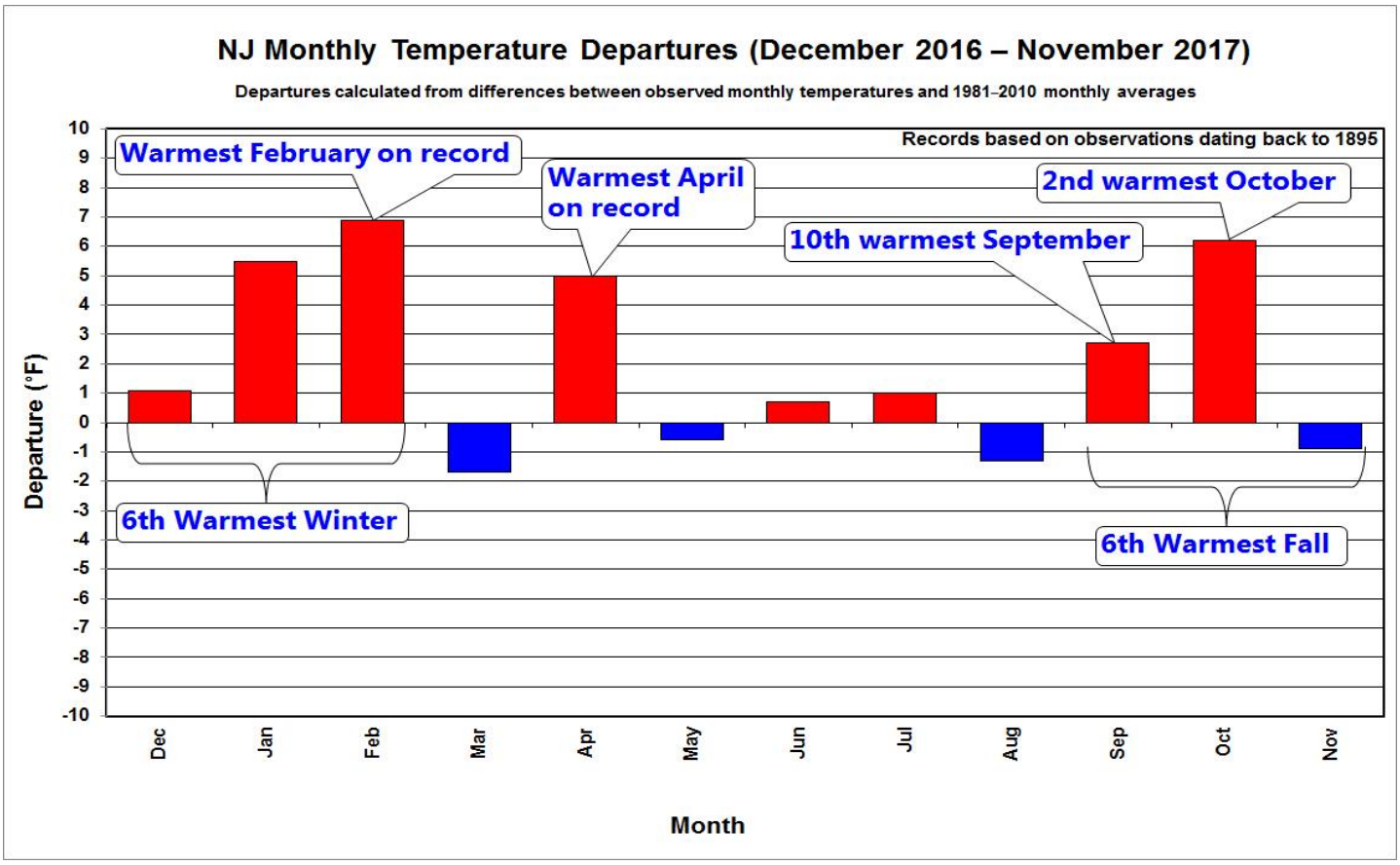


Figure 1: GSWA 2017 Water Chemistry Sampling Locations - New Downstream Locations marked in Blue

For a description of the parameters used in this report please refer to the "How Water Quality is Measured" section later in this report.

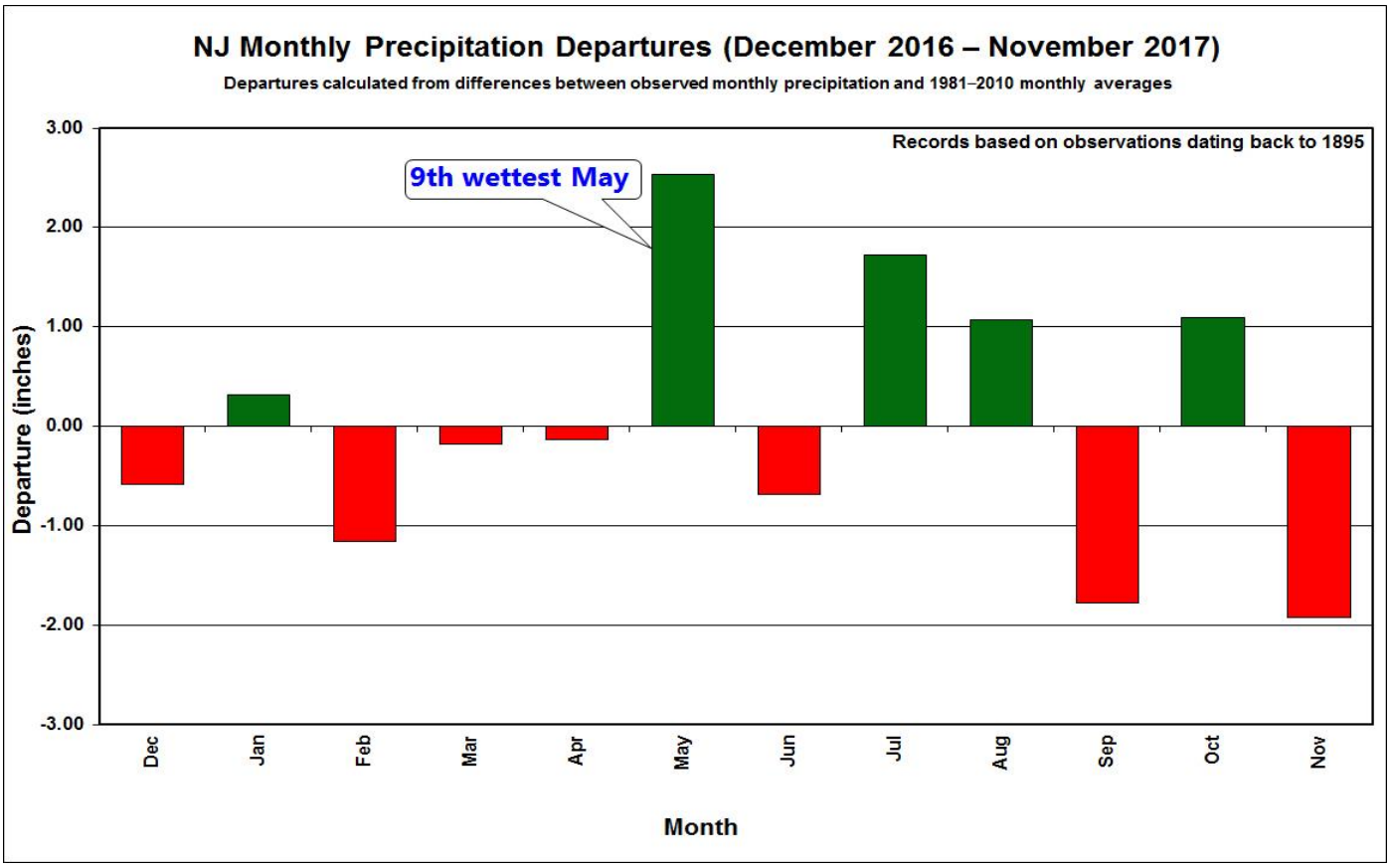
Climate and Water Quality

Overall climate, air temperatures, and precipitation, have a significant impact on water quality in our watershed. In 2017, winter temperatures (including Dec 2016) continued, as in 2016, to be well above average. As indicated on the chart below, it was recorded as the sixth overall warmest winter on record by the NJ State Climatology office, including the warmest February on record since 1895. Though March was slightly cooler than average, April was recorded as another record-breaking month. Overall, during two thirds of the year, eight months out of twelve, temperatures were warmer than average.



Precipitation was slightly below average through the winter and early spring, followed by heavy rainfalls in May, July, and August. Warm, dry conditions throughout the winter can increase early plant and algae growth in the spring and be detrimental to water quality and the biota supported in our streams. Heavy

rain following warm dry spells can also increase the effects of erosion along stream banks as water races over dry hardened areas of land, often with less vegetation due to the dry conditions that would normally allow water to percolate into the soil. Stormwater runoff that accompanies these rain events also increases impacts of non-point source pollutants, bringing with it higher levels of contaminants from roads and dry lawns.



How the 2017 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 and previous GSWA data.

For better clarity on the changes happening throughout the watershed, the 2017 report card includes the individual summary charts from 2015 and 2016 on the page of each sub-watershed. In the section covering the new Upper Passaic Region below

the watershed outlet, only 2017 results are included as we have no prior data from this area.

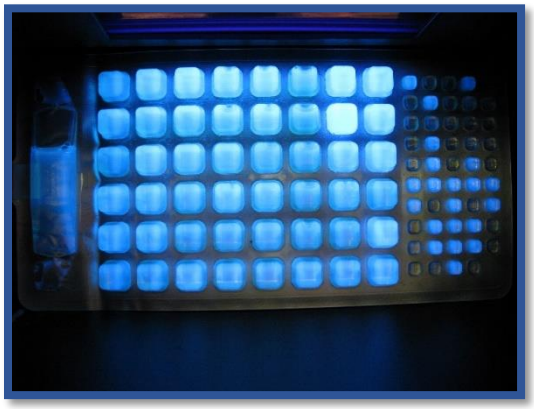
In 2015, the results for road salt were represented as seasonal results. In 2016 and 2017, this was not necessary as the results were consistent throughout the year. This was likely due to warmer temperatures and low winter precipitation for the last two winter seasons, resulting in lower quantities of road salt being used throughout the watershed.

Water Quality Parameters

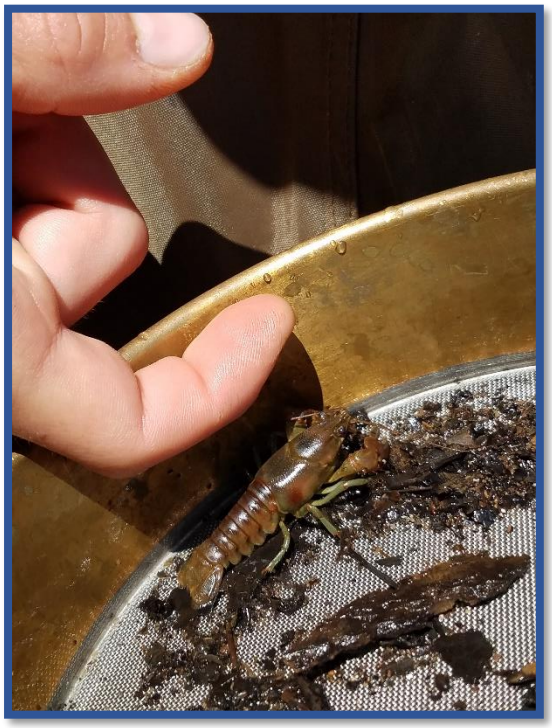
The following water quality parameters were considered in grading streams in the Great Swamp Watershed, along with suggestions for reducing their impact.

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. While we think of the chemical data as a snapshot of what is happening in the stream at the moment of collection, macroinvertebrate data helps us see long term effects of water quality. 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 and laundry detergent. To reduce the impact of phosphorus in streams, use household cleaning products that are labeled *phosphate free.* If you use a service for lawn maintenance, ask them to reduce the amount of fertilizer used on your lawn and to use fertilizers without phosphorus. Though the fertilizers sold to homeowners no longer contain phosphorus, professional landscaping companies are still able to purchase and apply them.

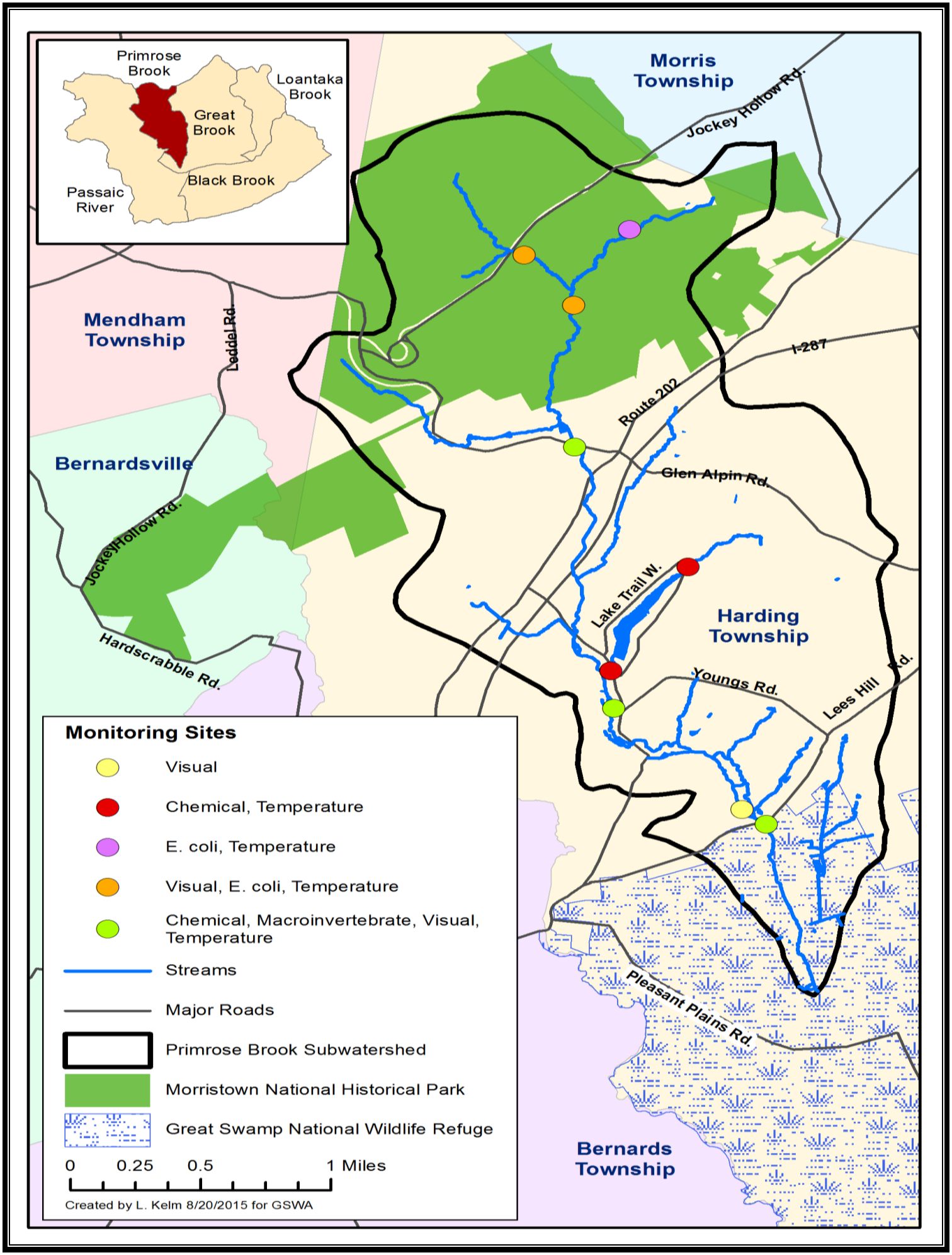
Water Quality Parameters continued on Page……30

Primrose Brook

The Primrose Brook sub-watershed 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)		
	2015	2016	2017
Macro-invertebrates	Good ↑	Good ↑	Good ↓
Visual Stream Assessment	Good	Good ↓	Good ↓
Bacteria	Good ↓	Poor ↓	Poor
Dissolved Oxygen	Excellent	Excellent ↑	Excellent ↑
Water Temperature	Excellent	Excellent ↑	Excellent ↑
pH	Excellent	Excellent	Excellent
Road Salt	Excellent	Excellent ↑	Excellent ↑
Water Clarity	Excellent	Excellent ↑	Excellent ↑
Nitrogen	Excellent ↑	Excellent	Excellent ↓

Comments – Primrose Brook continues to be an excellent example of a pristine stream habitat. Five parameters, all in the excellent range in 2016, still saw improvement in 2017. Continued mild conditions through the 2017 winter saw further decreases in salt contamination throughout the stream reach with a more significant reduction within the headwaters region in Jockey Hollow Park. Temperature data for Primrose showed slight improvement over 2016, with water temperatures remaining steady even though ……continued on page: 27

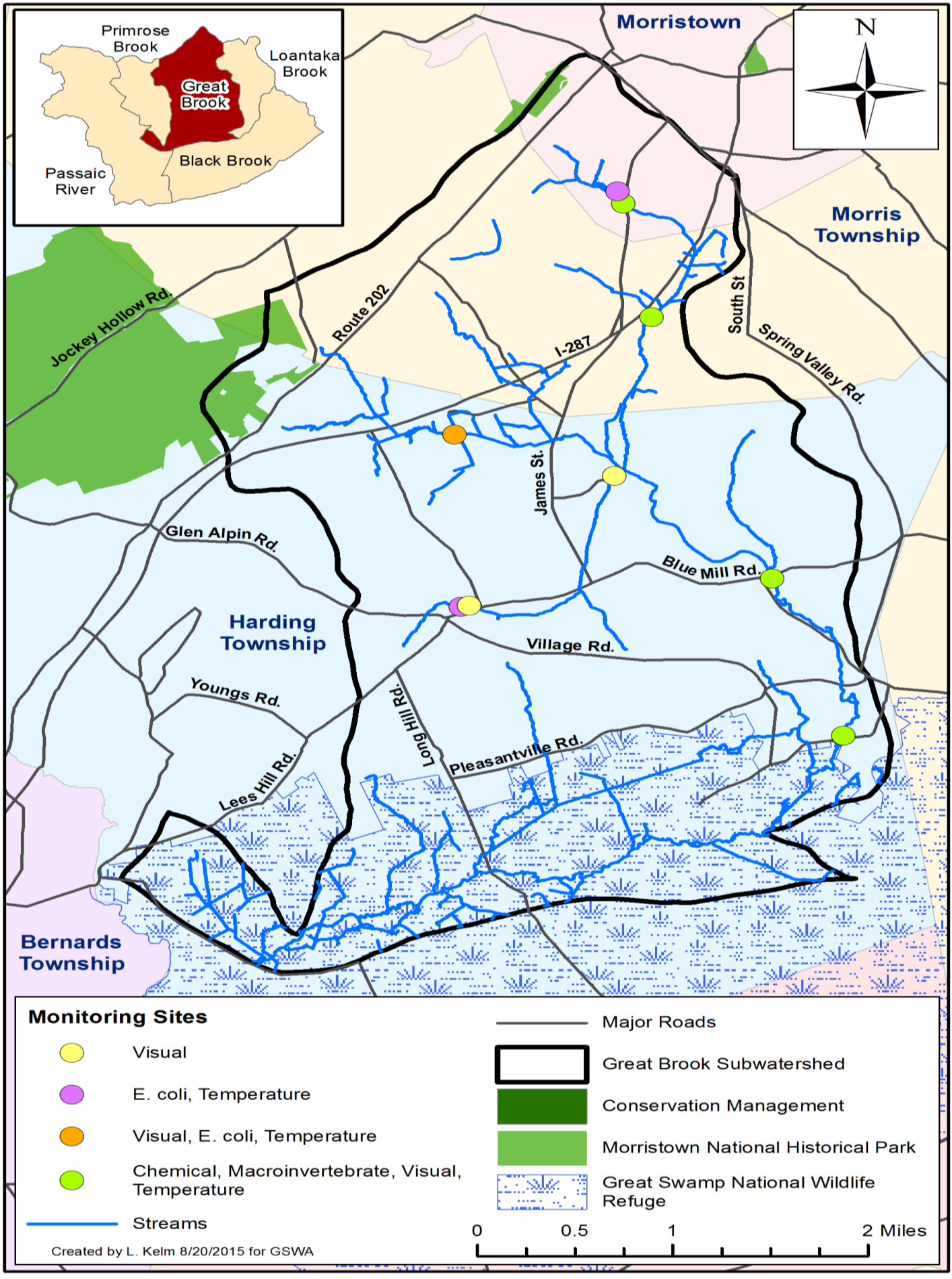

Primrose Brook
Loantaka Brook
Great Brook
Black Brook
Passaic River
Morris Township
Jockey Hollow Rd.
Mendham Township
Leddel Rd.
I-287
Route 202
Glen Alpin Rd.
Bernardsville
Jockey Hollow Rd.
Lake Trail W.
Harding Township
Hardscrabble Rd.
Youngs Rd.
Lees Hill Rd.
Pleasant Plains Rd.
Bernards Township
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 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)			Silver Brook		
	2015	2016	2017	2015	2016	2017
Macro-invertebrates	Poor ↑	Poor ↑	Good ↑			
Visual Stream Assessment	Good	Good ↓	Good ↓	Poor	Poor ↑	Poor ↑
Bacteria	Good ↑	Very Poor ↓	Very Poor ↑	Very Poor ↓	Very Poor ↓	Very Poor ↓
Dissolved Oxygen	Excellent	Excellent ↑	Excellent ↑			Good
Water Temperature	Excellent	Excellent ↓	Excellent ↓	Excellent		Excellent
pH	Excellent	Excellent	Excellent			Good
Road Salt		Good ↑	Good ↑			
Water Clarity	Good	Good ↓	Good ↓			
Nitrogen	Good ↓	Good	Poor ↓			
Phosphorus	Good	Good	Good			

Comments – In 2017, with the GSWA Passaic River Expansion, sampling on Great Brook was increased to two sites with one site located upstream near Foote's Pond and the second site, continuing from previous monitoring, near the stream's entrance to the Great Swamp Refuge. This allowed us to capture a better picture of what is happening throughout the sub-watershed. Great Brook continues to fall in the middle range of our water quality with some improvements seen in……continued on page: 27


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

Great Swamp Watershed

Stream	Macro-invertebrates	Visual Stream Assessment	Bacteria	Dissolved Oxygen
Black Brook	Poor ↑	Good	Very Poor ↑	Good ↑
Great Brook (main stem)	Good ↑	Good ↓	Very Poor ↑	Excellent ↑
Bayne Brook			Good ↑	
Silver Brook		Poor ↑	Very Poor ↓	Good
Loantaka Brook	Poor ↑	Good ↓	Very Poor	Excellent ↑
Primrose Brook (main stem)	Good ↓	Good ↓	Poor	Excellent ↑
Passaic River (Headwaters)	Good ↑	Good ↑		Excellent ↑
Indian Grave Brook	Excellent			
Passaic River Watershed Outlet			Very Poor ↓	Excellent
Passaic River (Upper Passaic)				
Millington (below outlet)		Good	Very Poor	Excellent
Berkley Hts (below Dead River)		Poor	Very Poor	Excellent
Summit (Stanley Park)		Good		Excellent

KEY				
Arrows indicate a >.5 change from the 2016 data and correspond with the grade not the measurement				
Excellent	Good	Poor	Very Poo	NO Data

Water Quality Report Card

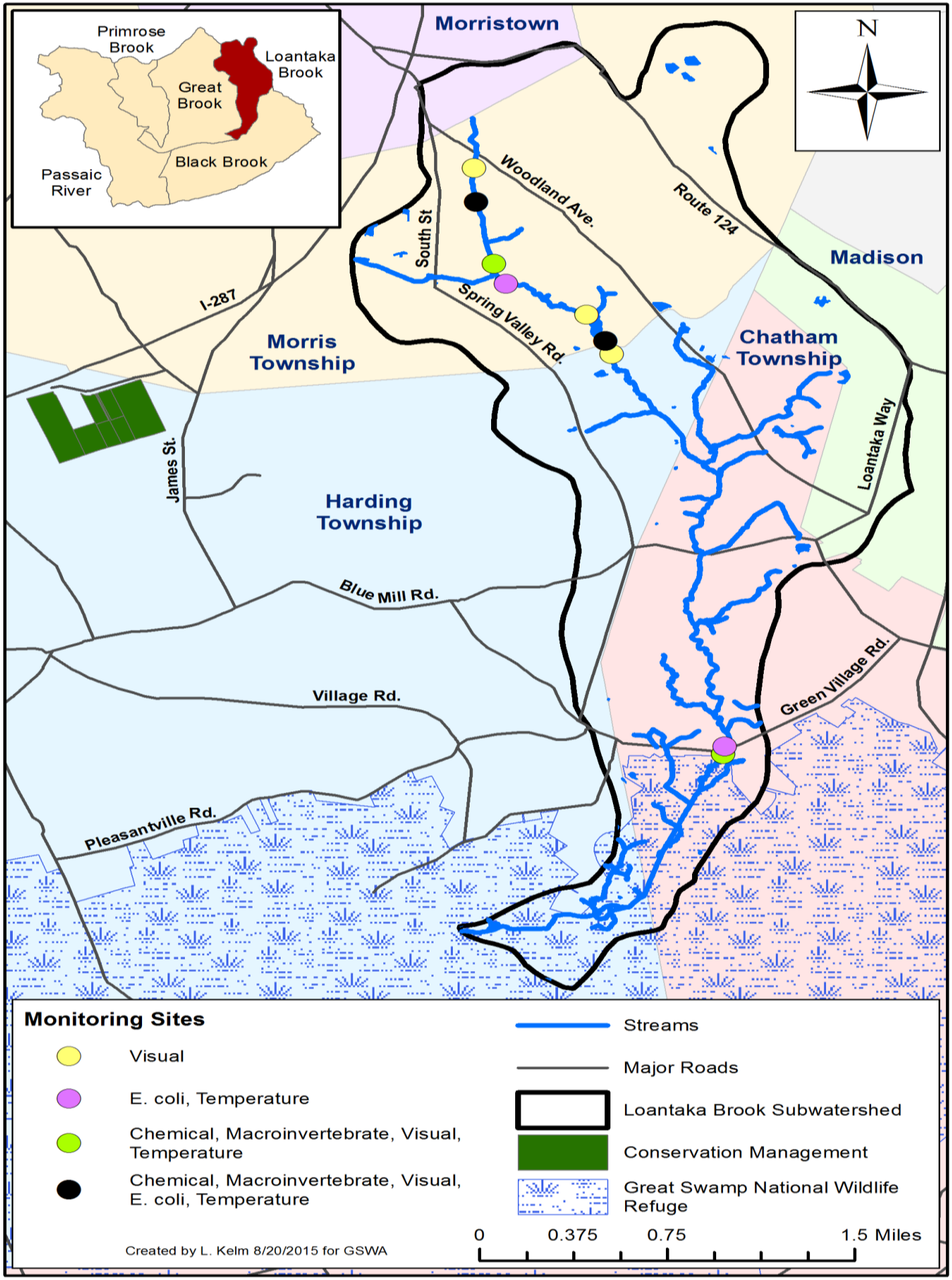
Water Temperature	pH	Road Salt	Water Clarity	Nitrogen	Phosphorus
Excellent ↑	Good ↓	Good ↑	Excellent	Good ↑	Poor ↑
Excellent ↓	Excellent	Good ↑	Good ↓	Poor ↓	Good
Excellent					
Excellent	Good				
Excellent ↓	Excellent	Poor ↑	Good	Very Poor ↓	Poor ↑
Excellent ↑	Excellent	Excellent ↑	Excellent ↑	Excellent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

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 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. Over the last few years GSWA volunteers and staff have worked with Morris County Park Commission to improve the buffer zone around Kitchell Pond and to remove invasive aquatic plants from the pond itself to help improve water quality in this area.

Category	2015	2016	2017
Macro-invertebrates	Very Poor ↓	Poor ↑	Poor ↑
Visual Stream Assessment	Good	Good ↓	Good ↓
Bacteria	Very Poor ↓	Very Poor ↓	Very Poor
Dissolved Oxygen	Excellent	Excellent ↑	Excellent ↑
Water Temperature	Excellent	Excellent ↓	Excellent ↓
pH	Excellent	Excellent	Excellent
Road Salt	Very Poor ↓	Poor ↑	Poor ↑
Water Clarity	Good	Good	Good
Nitrogen	Very Poor ↓	Very Poor	Very Poor ↓
Phosphorus	Very Poor ↓	Poor ↑	Poor ↑

Comments - Loantaka Brook continued to see improvements in 2017. Visual assessments of the stream indicated increased algae and some sedimentation below Kitchell Pond. Stream bank erosion in this area may account for some of the sediment deposition and is likely a result of the climate changes discussed earlier. However, phosphorus levels have ……continued on page: 28

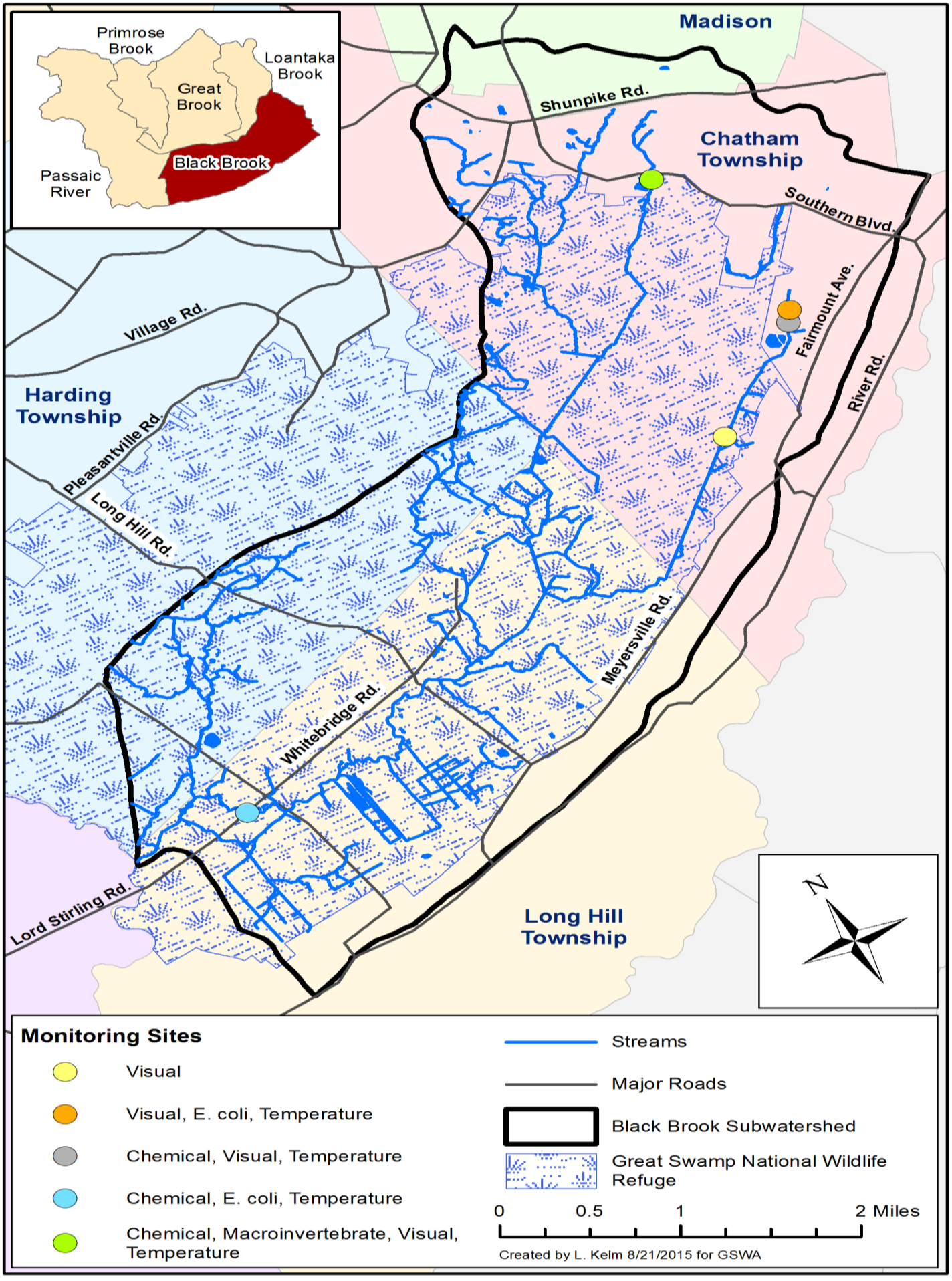

Primrose Brook
Loantaka Brook
Great Brook
Black Brook
Passaic River
Morristown
N
Woodland Ave.
Route 124
South St
Madison
Spring Valley Rd.
I-287
Morris Township
Chatham Township
James St.
Loantaka Way
Harding Township
Blue Mill Rd.
Village Rd.
Green Village Rd.
Pleasantville Rd.
Monitoring Sites
Visual
E. coli, Temperature
Chemical, Macroinvertebrate, Visual, Temperature
Chemical, Macroinvertebrate, Visual, E. coli, Temperature
Streams
Major Roads
Loantaka Brook Subwatershed
Conservation Management
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 in the Great Swamp Watershed 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 White Bridge 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	2015	2016	2017
Macro-invertebrates	Very Poor ↓	Poor ↑	Poor
Visual Stream Assessment	Good ↑	Good	Good
Bacteria	Very Poor ↓	Very Poor ↑	Very Poor ↓
Dissolved Oxygen	Good	Good ↑	Good ↑
Water Temperature	Excellent	Excellent ↑	Excellent ↑
pH	Excellent	Good ↓	Good
Road Salt		Good ↑	Good ↑
Water Clarity	Excellent	Excellent	Excellent
Nitrogen	Very Poor ↑	Poor ↑	Good ↑
Phosphorus	Poor	Poor ↑	Poor ↑

Comments – Nutrient levels, both phosphorus and nitrogen, are continuing to show improvements in Black Brook for the second year. Road salt levels were also improved with the subwatershed. At the Tanglewood Rd site, downstream of where the effluent from the Chatham WWTP previously entered Black Brook, bacteria levels remain elevated even after two years. Though a number of improvements in Black Brook have been ……continued on page: 28

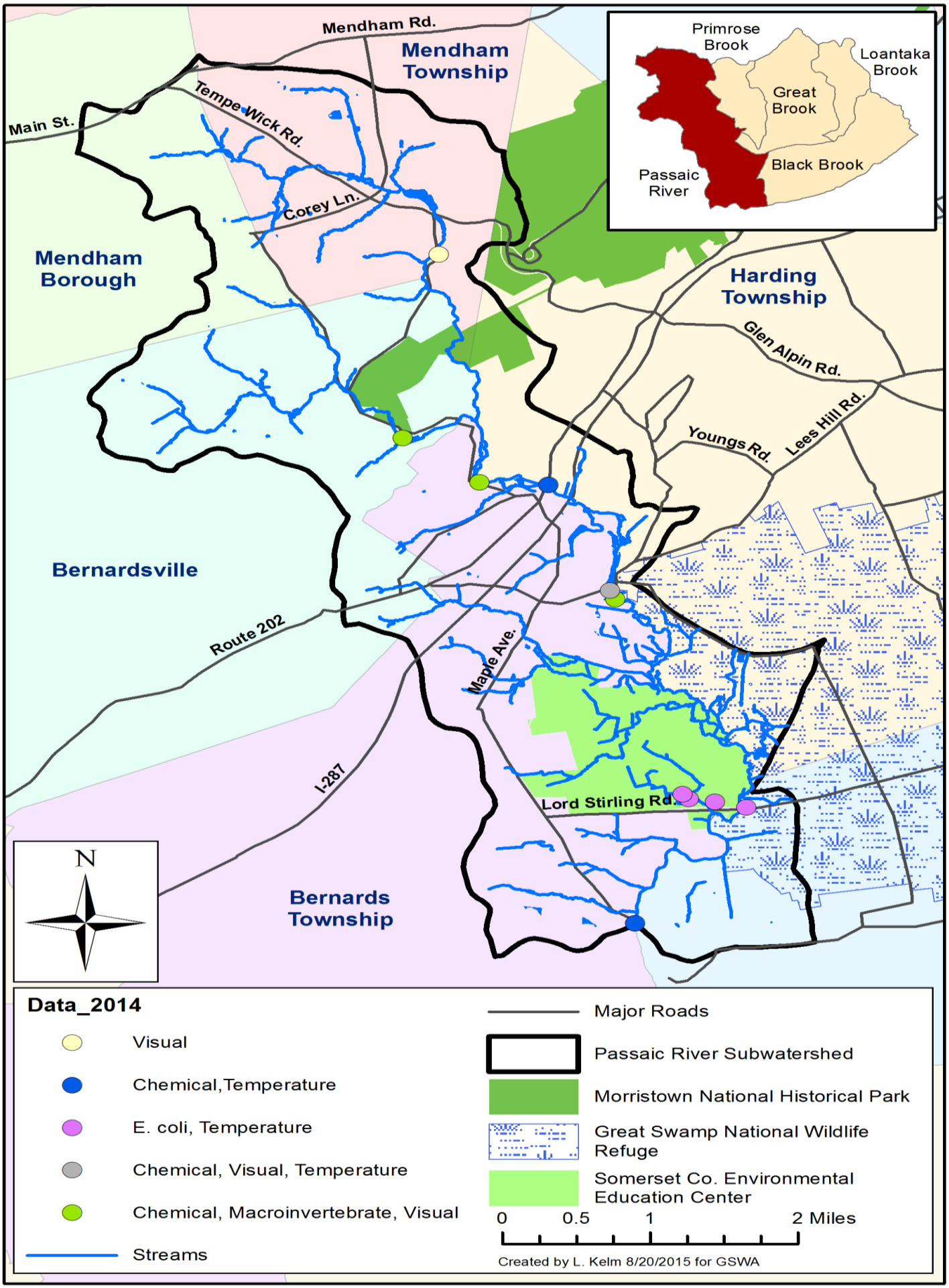

Primrose Brook
Loantaka Brook
Great Brook
Black Brook
Passaic River
Madison
Shunpike Rd.
Chatham Township
Southern Blvd.
Fairmount Ave.
River Rd.
Village Rd.
Harding Township
Pleasantville Rd.
Long Hill Rd.
Meyersville Rd.
Whitebridge Rd.
Lord Stirling Rd.
Long Hill Township
N
Monitoring Sites
Visual
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 Headwaters

At almost 17 square miles, the Passaic River headwaters 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 headwaters region 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. Branta Pond, located within the Somerset County Environmental Education Center, flows into the Passaic River downstream of Lord Stirling Road.

Category	Passaic River Headwaters		
	2015	2016	2017
Macro-invertebrates	Good ↑	Good ↑	Good ↓
Visual Stream Assessment	Good ↓	Good ↑	Good ↑
Bacteria			
Dissolved Oxygen	Excellent ↑	Excellent ↑	Excellent ↑
Water Temperature	Excellent ↑	Excellent ↑	Good ↓
pH	Excellent	Excellent	Excellent
Road Salt		Excellent ↑	Excellent ↑
Water Clarity	Good	Excellent ↑	Excellent ↑
Nitrogen	Excellent ↑	Excellent	Good
Phosphorus	Excellent	Excellent	Excellent

Comments – Sampling in the Passaic headwaters region was increased in 2017 giving us a broader range of data with which to measure water quality in this region. Data indicates that this stream continues to be one of the healthiest in the Great Swamp watershed. However, water temperatures in the upstream sampling location were impacted by the warmer than average air temperatures, it is possible that this is the cause for …Continued on page: 29


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
Data_2014
Visual
Chemical,Temperature
E. coli, Temperature
Chemical, Visual, Temperature
Chemical, Macroinvertebrate, Visual
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. Through 2017, this was the farthest site downstream on the Passaic River that was sampled by the GSWA. 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	2015	2016	2017
Macro-invertebrates			Poor
Visual Stream Assessment			Excellent
Bacteria	Very Poor ↑	Very Poor ↓	Very Poor ↓
Dissolved Oxygen	Excellent ↓	Excellent	Excellent
Water Temperature	Excellent ↓	Excellent	Excellent
pH	Excellent	Excellent	Excellent
Road Salt		Good	Good
Water Clarity	Poor	Excellent ↑	Excellent ↑
Nitrogen	Excellent	Excellent	Excellent ↓
Phosphorus	Good	Good ↓	Good ↑

2017 marks the first year that we have increased the scope of sampling at the Great Swamp outlet. Both visual assessments (spring and fall) and macroinvertebrate data were collected at this site. Historic water quality parameters continued to be measured as well with consistent results compared to the 2016 data. Our visual assessments indicated a healthy buffer and above average habitat for macroinvertebrates, however, the results form the macroinvertebrate survey indicated low diversity and density. Bacteria levels continue to be elevated. As with other sites ….continued on page:29

Passaic River – Upper Passaic

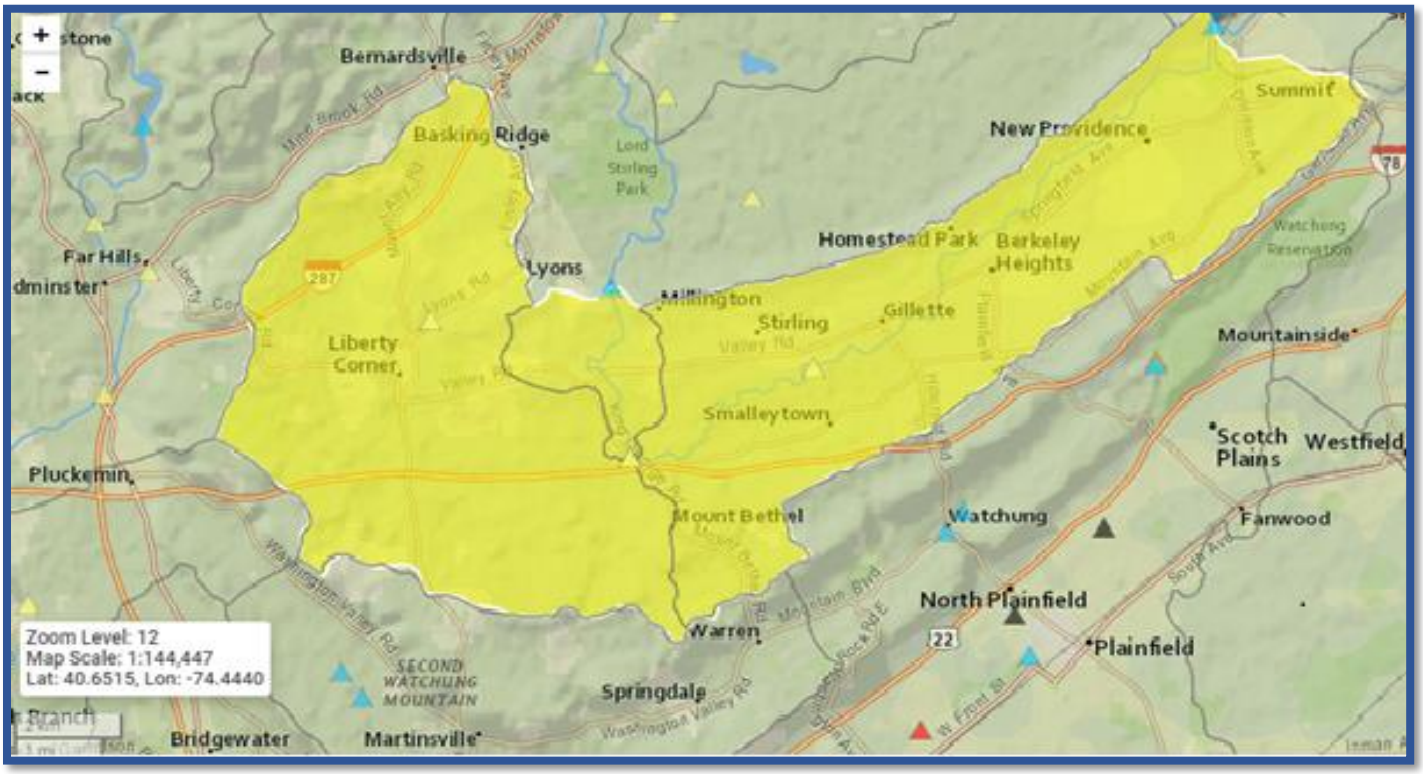
The first round of downstream data collection along the Upper Passaic River included four sampling sites along approximately 14.5 miles of the river from Millington Gorge to Stanley Ave in Chatham. This subwatershed encompasses the inputs from the Dead River, the first major tributary on the Passaic River below the Great Swamp Watershed. The area includes parts of Long Hill, Gillette, Berkeley Heights, New Providence, Chatham, and Summit. It captures the effluent from multiple WWTPs and flows through both industrial areas as well as small areas of protected park lands.

Category	Millington (Below the Gorge)	Berkley Hts (below Dead River)	Summit (Stanley Park)
	2017	2017	2017
Macro-invertebrates	Good		Poor
Visual Stream Assessment	Poor	Very Poor	Good
Bacteria	Very Poor	Very Poor	
Dissolved Oxygen	Excellent	Excellent	Excellent
Water Temperature	Excellent	Excellent	Excellent
pH	Excellent	Excellent	Excellent
Road Salt	Good	Good	Good
Water Clarity	Poor	Very Poor	Poor
Nitrogen	Excellent	Very Poor	Very Poor
Phosphorus	Good	Poor	Poor

The baseline data set collected in 2017 for the expanded reach of the Upper Passaic River showed a mix of results. While dissolved oxygen, temperature and pH were consistently well above state standards, water clarity was poor or very poor at all sites. The decrease in clarity is possibly attributed to a change in the substrate on the river bottom. Starting in the area below the Dead River confluence, the river bottom becomes silty or muddy and there is very little

Upper Passaic continued –

Cobble. This allows for changes in flow, following a heavy rain fall or with the release of high volumes of effluent, to stir the sediment up and impact the clarity of the water. Nutrient levels in the Upper Passaic subwatershed increased at each site respectively. Further research will need to be conducted to determine the definite cause of this compounding increase, but one possibility is the effect of multiple inputs from the WWTPs along the river. Though these plants may not be exceeding their allowable discharge amounts, much of the flow of the river through this section is determined by these outfalls. Finally, the visual assessments showed areas where stream buffers may be improved, and community clean ups may benefit the health of the river.

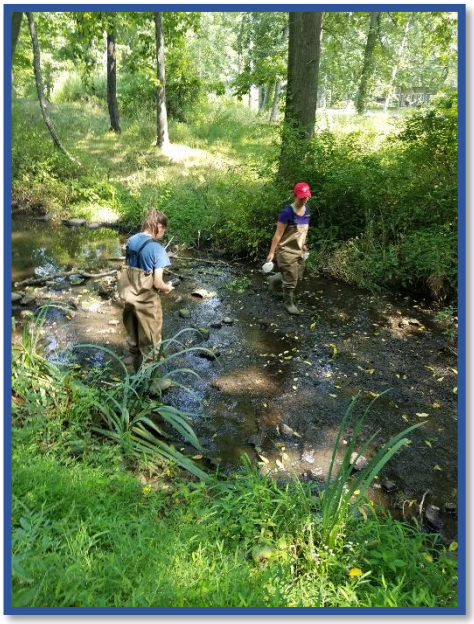


Continued Comments

Primrose Brook Continued

the air temperatures were some of the highest on record. The density of stream bank vegetation, shrubs and trees, keeps the shallow waters shaded and helps to reduce impacts of heat and direct sunlight on the water. Though water clarity also continued to improve in Primrose Brook, visual assessments indicated continued sedimentation build up in the headwaters region. This is likely due to extended warm, dry conditions in the winter and early spring followed by heavy rains in May. This type of weather pattern increases stream bank erosion, and runoff during these heavy storms carries significant amounts of soil particles. This sediment buildup may be impacting the macroinvertebrate population which has decreased for the first time in three years in the brook.

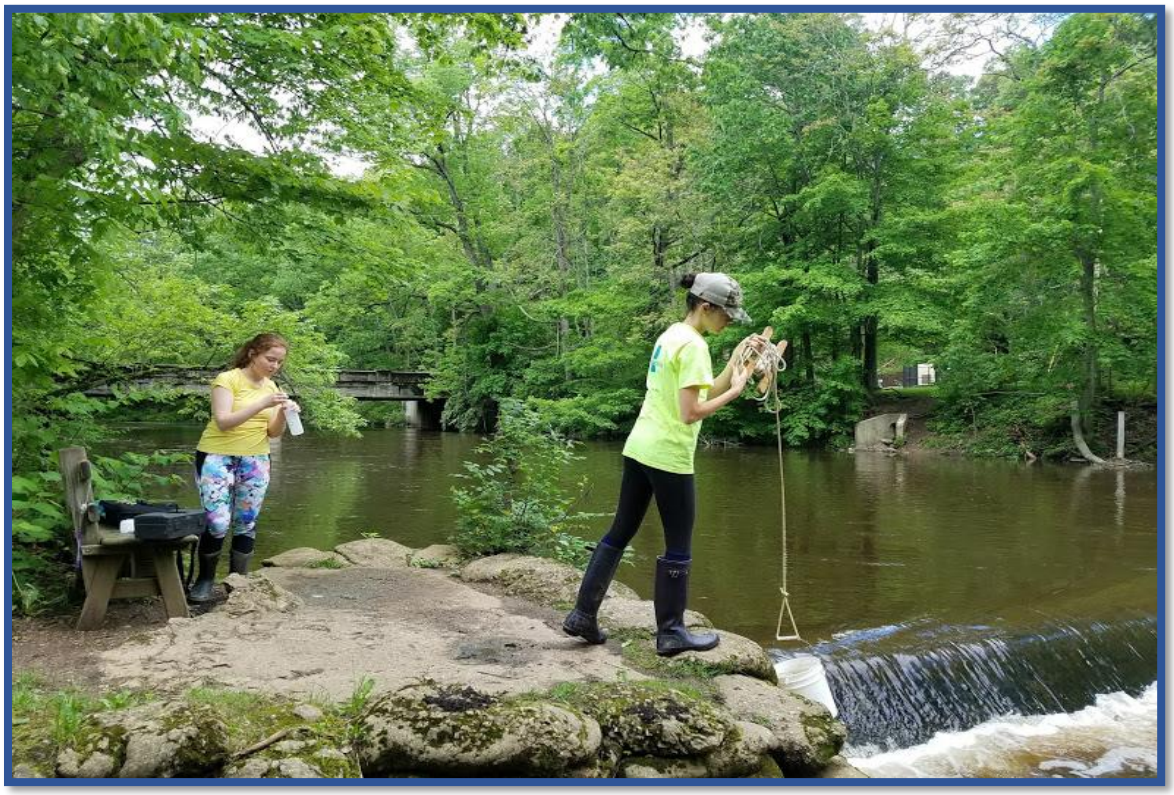
Great Brook Continued



dissolved oxygen and road salt concentrations. The macroinvertebrate population continues to improve for the second year with a significant increase in diversity. In 2017, GSWA began to explore elevated bacteria levels in the Silver Brook, a tributary of Great Brook, at our Conservation Management Area (CMA). Seven sites were sampled along the tributary between the CMA and the headwaters north of Rt 202 narrowing the possible source of the problem. In 2018, GSWA will work with the local sewer utility to further locate and address the issue. Finally, in 2018, sampling at Bayne Brook showed improved bacteria levels. Bayne Pond has worked to improve the buffer zone around the pond and reduce the population of Canada geese, both of which can help with reduction of nutrients and bacteria.

Loantaka Brook Continued

steadily decreased since 2015. This may be attributed to the improvements in the buffer area adjacent to the pond. By increasing the width of the buffer by installing native plants, shrubs and trees, the impacts of runoff from the nearby sports fields and park are reduced. Bacteria levels at Loantaka Brook remained similar to those observed in 2016. Loantaka Reservation, the park area which the upper reaches of the stream run through, is a popular area for local resident to walk with their pets. Waterfowl are regularly observed on the pond. Both of these factors can contribute to bacteria in a water body.



Black Brook Continued

noted in the data, visual assessments and the macroinvertebrate population remain similar to past seasons. The rerouting of the effluent from the WWTP has helped to reduce nutrient loading in the lower reach of Black Brook, however, it has also greatly reduced flow in this area so that it is not ideal habitat for macroinvertebrates.

Passaic River Headwaters Continued

the decreased macroinvertebrate diversity. Though both parameters were impacted they still fell well within the NJDEP standards. Nitrogen levels were also increased in the upper region of the subwatershed. This may be due to natural causes, decaying organic matter, such as seasonal leaf litter, can be carried into streams with runoff. Periods of intermittent hot dry weather followed by heavy rains can carry more substantial quantities of this into stream systems.

Watershed Outlet Continued

bacteria levels continue to be elevated for the second year. Elevated air and water temperatures as well as low flow rates through the swamp at the time of sampling allow for the buildup of naturally occurring bacteria. Nitrogen levels were slightly elevated from 2016 levels but still remained well below the NJDEP standards.

Water Quality Parameters Continued

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 such as brining.

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 vegetation 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.

Conclusions and Recommendations

Overall in 2017, the water quality within the Great Swamp Watershed continued to meet the stringent standards set forth by the NJDEP and GSWA for healthy streams. Warmer winter temperatures have meant a decrease in the use of road salts and an improvement in this parameter throughout the area. However, these temperatures are also a contributing factor in the increasing bacteria and algae levels seen throughout the region. As indications that this rise in temperatures is long term, it is more important than ever that we work as a community to protect our water in every way that we can.

Below are recommendations that everyone can help with:

- Elevated water temperatures, notably in our two NJDEP high classification streams –
  - Develop strategies with towns to increase tree and shrub buffers adjacent to streams
- Increasing levels of road salts at most sites –
  - Reduce salt usage by encouraging environmentally friendly solutions in homes and towns
- Increasingly elevated levels of nutrients moving downstream along the Passaic River –
  - Reduce fertilizer use, plant native shrubs and trees, break up large lawns with gardens
- Decreasing buffer zone quality at select sites –
  - Work with communities to build and preserve wider stream buffer areas and educate homeowners about the importance of buffers

Great Swamp Watershed Association is dedicated to protecting and improving the water resources of the Passaic River region, from the Great Swamp headwaters to Newark Bay, for present and future generations. Through education, advocacy, science, land preservation and stewardship, in collaboration with partners, we work to instill our communities with an awareness of water's effect on health and the beauty of the environment, from source to sea.

Great Swamp Watershed Association

Protecting the waters of the Passaic River region, from source to sea.

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