Restoring and Enhancing the Purity And Integrity of Raritan's North Branch

(REPAIR North Branch)

UAPP 411 - Regional Watershed Management

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Team 10

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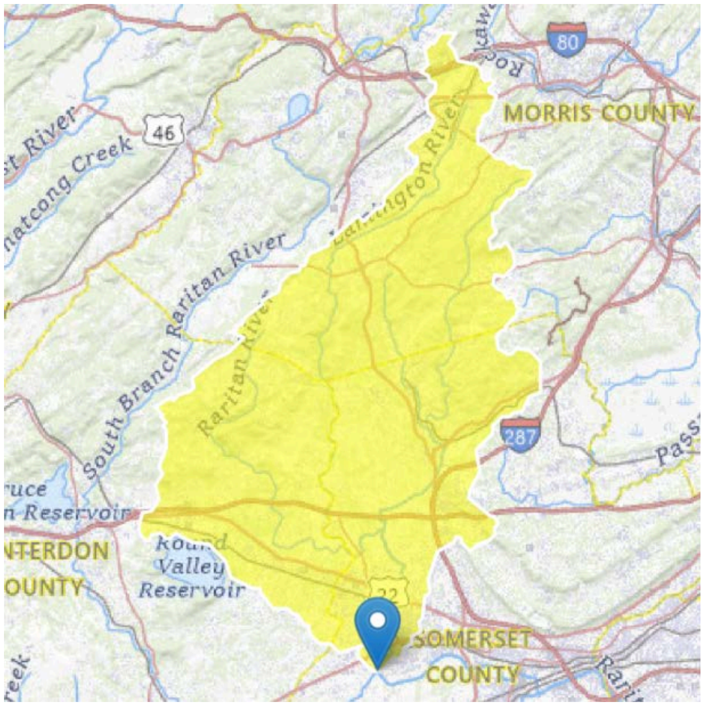
REPAIR Mission Statement

The goal of REPAIR North Branch is to address anthropogenic issues which threaten the health of the North Branch Raritan River Watershed in Morris and Somerset Counties in New Jersey. The Raritan River provides drinking water to 1.8 million people, so ensuring the health of its headwaters is crucial. This plan will introduce strategies to reduce major human-related pollutants below acceptable levels, measurably improve the ecosystem health of this watershed by removing dams for fish passage, and bring all tributaries to an acceptable stream temperature condition by 2040.

Background

The North Branch Raritan River is one of the two branches, along with the South Branch, that converge to form the Raritan River in North and Central New Jersey. Its watershed lies within ten municipalities, spans Somerset, Hunterdon, and Morris Counties, and has a drainage area of 189 square miles. The land uses within this watershed include urban, forest, agriculture, wetlands, and water. Notably, the agricultural land uses tend to be further north in the watershed, and the urban land uses occur closer to the confluence with the South Branch. As stated previously, the entire Raritan river serves 1.8 million people. Around 90,000 people live within the North Branch watershed with an average population density of 470 people per square mile. The two main organizations/agencies that oversee this watershed are the Raritan Headwaters Association and the New Jersey Department of Environmental Protection (Raritan Headwaters).



Map of North Branch Raritan River watershed boundary (StreamStats)

History

The North Branch Raritan River has its headwaters in eastern Mendham Borough in Morris County, New Jersey, and runs south through Somerset County before joining the South Branch to form the main stem of the Raritan. The Lenape called the confluence of the two branches "Tucca-Ramma-Hacking," roughly translated as "the flowing together of water." The Naraticongs, a band of the Lenape, were the first people to live in the valley. They fished the river, hunted the surrounding forests, and farmed the floodplain (Raritan Headwaters). Before European contact, the watershed was ecologically healthy and productive.

Colonial settlement changed things fast. Through the 1700s and 1800s, settlers built mill dams up and down the North Branch and its tributaries to power grist and sawmills. Those dams cut off migratory fish from upstream habitat. Shad populations that once ran into the tens of millions of pounds annually had collapsed to a fraction of that by the 20th century (NOAA

Fisheries). Then came industry. The American Cyanamid plant in Bridgewater, operating from the 1920s onward, discharged mercury, chromium, arsenic, lead, and PCBs directly into the Raritan for decades. The site was designated a federal Superfund site in 1983 (NOAA DARRP). The lower watershed still carries that contamination.

Restoration work in recent decades has made notable progress. The Raritan Headwaters Association and state and federal partners have run fish population recovery programs, and biological health has improved at some monitoring stations. Dam removal and fishway construction are the main tools for reconnecting migratory fish with upstream spawning habitat, and that work is ongoing through the Raritan River Fish Passage Initiative (NOAA Fisheries). Still, the watershed is carrying centuries of damage from industrial, agricultural, and urban sources.

Governance Structure

The Raritan Headwaters Association (RHA) was formed in 2011 through the merger of two existing watershed associations, the Upper Raritan Watershed Association and South Branch Watershed Association, both originally formed in 1959. The goal of RHA is to ensure the cleanliness of the Raritan River by taking care of its headwaters through various conservation efforts (Raritan Headwaters). The organization constructed a basic watershed plan in 2018 called the *North and South Branch Raritan Watershed Conservation Plan*. This plan revolves more around developing the tools, partnerships, and priorities for conserving the watershed than concrete, quantitative goals for remediating or preserving the waters. This involves creating GIS maps, forming partnerships with companies and municipalities, meeting with property owners, and ranking subwatersheds based on necessary remediation. Additionally, they release

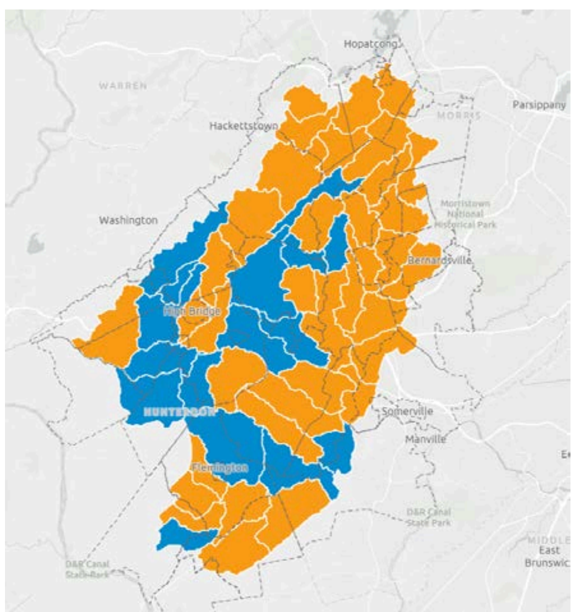
"Watershed Report Cards" where they rank the overall health of the headwaters in several different categories such as temperature, dissolved oxygen, and pH (Raritan Headwaters). The headwaters are divided into 52 subwatersheds, and these are given a pass or fail in each category, as well as an overall rating. This report also discusses what each category is, sources of impairment, and potential solutions.

The New Jersey Department of Environmental Protection (NJDEP) has many different responsibilities relating to the use, conservation, and remediation of waters within the state. NJDEP sets different water quality standards such as total maximum daily loads (TDMLs). They issue permits for activities that are nearby or affect bodies of water (i.e. fishing, agriculture), conduct water quality monitoring every two years, and either develop, or help develop, watershed management plans. A key difference between NJDEP and RHA is that they can enforce environmental protections. Examples of different environmental protection laws that NJDEP has helped get passed are the Freshwater Wetlands Protection Act, Stream Cleaning Act, and the Flood Hazard Area Control Act (NJDEP). These implement protections such as treating freshwater wetlands as vital environmental resources, ensuring stream cleaning doesn't further damage streams, and ensuring the preservation of natural floodplains.

Problem 1: High Specific Conductance

The North Branch received an F in the 2024 RHA Watershed Report Card for specific conductance. Specific conductance measures how well water conducts electricity, which is a proxy for dissolved ions, mainly chloride from road salt (New Jersey Watershed Watch). In the North Branch watershed, the main source is deicing salt applied to roads and parking lots during winter (Raritan Headwaters Association). When it rains or snow melts, that salt washes off impervious surfaces and drains directly into streams. The problem does not stop when winter does. Chloride leaches into groundwater and re-emerges as baseflow throughout the year, so conductance stays elevated well past the salting season (Moore et al.).

The connection between impervious cover and conductance shows up clearly in the monitoring data. Sites with more than 9 to 10 percent impervious cover regularly exceed chloride criteria. Sensitive macroinvertebrates start disappearing at conductance around 200 to 235 µS/cm. Amphibians follow, then fish at higher concentrations. The North Branch exceeds those thresholds at multiple stations. On top of the ecological damage, most large drinking water treatment plants in New Jersey cannot remove dissolved chloride, so elevated conductance is not just an ecological problem but a public water supply problem for the 1.8 million people the Raritan basin serves (New Jersey Watershed Watch). There is no state-level cap on how much road salt municipalities or contractors can apply. It is entirely discretionary.



Orange areas of the watershed failed the Raritan Headwaters' specific conductance indicator (Raritan Headwaters)

Solution 1: Smart Salting and Source Reduction

The goal for specific conductance is to get all currently failing monitoring stations below 388 µS/cm by 2035, moving the North Branch from an F to a passing grade. At that level, sensitive aquatic insects can return. That is the most measurable water quality improvement the watershed can realistically achieve in a ten-year window. Road salt is the dominant source, so nearly all of the reduction work has to start at the point of application.

Road salt pollution is almost entirely preventable with better application practices. The main recommendation is a regional smart salting program across all 38 municipalities in the North Branch watershed. The first step is training municipal road crews and private contractors on application rates, spreader calibration, and timing. Properly calibrated equipment can cut salt use by 30 to 70 percent without any loss of road safety. Pre-treating pavement with liquid brine before a storm also requires far less salt than treating packed snow after the fact, because it prevents ice from bonding to the surface rather than breaking that bond once it forms (Sustainable Jersey).

Implementation should start with ride-alongs on actual public works salting operations in the highest-impervious subwatersheds to see where oversalting is happening and why. That fieldwork informs targeted retraining and gives baseline data to track reductions over time. REPAIR North Branch would work with RHA and NJDEP to expand the Sustainable Jersey salt reduction certification program, giving municipalities an incentive to adopt smart salting policies through grant eligibility and public recognition. Municipal and industrial wastewater discharge is a secondary conductance source and should be addressed in parallel by upgrading treatment facilities to incorporate salt removal where feasible. Done together, these steps should bring the

North Branch to a passing grade for specific conductance by 2035 and restore the water chemistry needed to support sensitive aquatic life.

Problem 2: Poor Ecosystem Health

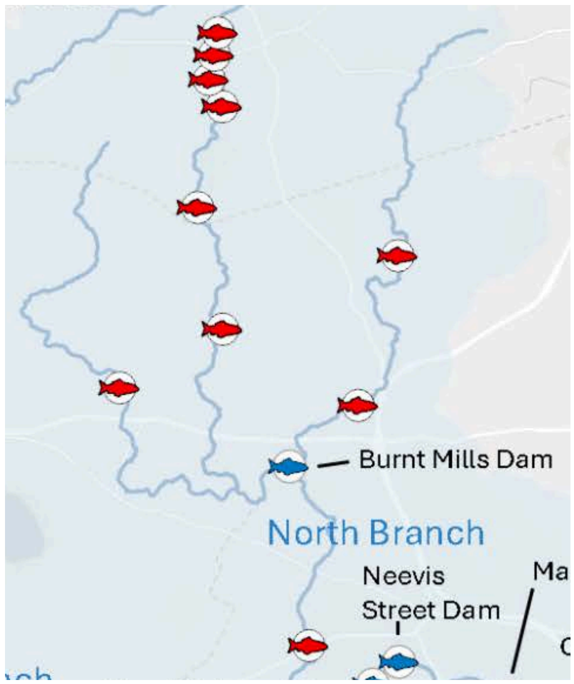
The ecological health of the North Branch Raritan River has been on a decline over the past two decades. This has been driven by hydrological changes and degraded riparian conditions. The ecological health in this watershed is evaluated through both riparian habitat quality and the High Gradient Macroinvertebrate Index (HGMI), a biological indicator that reflects long term water and habitat conditions. These HGMI trends from 1999-2017 have shown a decline in excellent and good streams, while fair and poor streams are increasing (Raritan Headwaters). The alterations to the stream's flow are believed to be causing scour and erosion from fast moving runoff. This is causing destabilized streambanks and reduced habitat complexity. Increased impervious cover in suburban areas, cause an increase in stormwater velocities, making high flows that erode banks, widen channels, and bury habitats under fine sediment. These physical changes reduce the abundance of macroinvertebrates and diminish spawning and habitats for fish. This watershed also contains numerous dams and weirds that are blocking organism passage. This fragments habitats and prevents migratory species from accessing upstream spawning. This problem has been noted since colonial era mill dams were constructed throughout the 1700s and 1800s. Although some restoration has occurred in recent decades, ten dams remain on the North Branch alone, which continue to restrict fish movement and alter natural sediment transport (NOAA Fisheries). The effects of these stressors are reflected in long term biological monitoring. Taxa such as mayflies, stoneflies, and caddisflies, all require cold, well oxygenated, and low sediment habitats (Alliance for the Chesapeake Bay).

These species are being replaced by organisms that thrive in disturbed areas. This shift signals ecological degradation, and without intervention, the watershed risks further loss of biodiversity.

Solution 2: Dam Removal

To reverse the decline in ecosystem health, REPAIR North Branch proposes a measurable goal of one dam removal every two years. This will mean that by 2040, seven upstream dams will be removed. This will restore fish passage, reduce downstream scour, and reconnect habitats. Dam removal is believed to be the best watershed restoration tool available for our watershed, due to many structures being obsolete remnants of past mill operations. Our timeline is achievable and aligns with the successful regional efforts such as the Raritan River Fish Passage Initiative. The strategy begins with securing increased funding for dam removal by expanding partnerships and enlisting dedicated grant writers. Funding sources include federal programs, conservation organizations, and settlements from local Superfund and Natural Resource Damage Assessment (NRDA) cases. This approach mirrors successful dam removal financing from other New Jersey watersheds (NOAA Fisheries).

Removing these structures will have many ecological benefits. It will allow migratory species, such as the American Shad, access upstream spawning and nursery habitats. Even resident species benefit from increased movement, which improves genetic diversity and resilience. Next, the dam removal will reduce sediment accumulation and downstream scour. This helps stabilize channels and improve substrate quality for macroinvertebrates. Lastly, connecting the river will enhance the effectiveness of other restoration actions, such as riparian buffers expansion and stormwater facility improvements. Dam removal will prioritize removal based on ecological benefits, structural conditions, and landowner cooperation. This will ensure that the seven targeted removals produce the greatest possible improvement in HGMI scores and riparian habitat quality. By 2040, the measurable outcome will be a substantial increase in excellent and good HGMI ratings, improved fish survival statistics, and a more resilient watershed capable of withstanding climate driven stressors.



Locations of the ten existing dams on the tributaries of the North Branch marked in red (NOAA Fisheries)

Problem 3: High Stream Temperature

The third problem affecting the North Branch watershed is high stream temperature. In the watershed, many streams border on, or exceed, safe temperatures for organisms (Raritan Headwaters). These areas include the Peapack Creek, Rockaway Creek, and the parts of the main North Branch itself. Warmer water leads to high growth of cyanobacteria, which triggers harmful algal blooms that release toxins into the stream environment. Higher stream temperatures also have effects on the biological cycles of organisms. Fish and insects grow and mature faster, but their reproductive systems develop improperly, so they struggle to reproduce (Willig). As climate change leads to rising atmospheric temperatures, this problem is only likely to worsen, and more streams in the watershed will transition above acceptable temperatures. Stream temperatures reaching over 75°F can kill trout after only a few hours (NJ DEP).

Solution 3: Buffers and Basins

Two methods can be enacted to address the problem of rising stream temperatures. The first is to expand buffers. According to research by the Yale School of Forestry, a buffer width of at least 50 ft can successfully aid in not only temperature control for aquatic habitats, but can also catch litter/debris, nutrients, pesticides, biocontaminants, and can aid in erosion and sediment control (We Conserve PA). To expand buffers most effectively, planting needs to be concentrated near the areas that are most suburbanized, and which send the “hottest” runoff to the North Branch Raritan River. This can be done by mapping areas of the highest impervious surface, concentrated in the southern third of the watershed. Then, by 2035, 50 ft of buffer can be planted around 25% of suburban streams where the space for buffers exists.

The second method to reduce the temperature of streams is by controlling temperature at the source through shade trees, infiltration basins, and rain gardens. Shade trees can be planted on existing unshaded streets in order to cool the pavement that the stormwater runs along. Detention basins, which are very common in suburban New Jersey, can be retrofitted into infiltration basins and rain gardens. By loosening the soil, flattening the base, and planting native vegetation, detention basins can be transformed into infiltration basins, which store and slowly release the water to recharge the groundwater, and eventually, the streams of the watershed, in a less detrimental way (Haberland et al.). Slow infiltration reduces excessive sediment runoff and reduces the temperature of the water flowing into the streams. The retrofit solution is economically advantageous, as detention basins have high maintenance costs for municipal, county, or private owners due to the landscaping of their expansive turf grass cover (Haberland et al.). Local municipalities and regional planners can be encouraged to implement green stormwater management requirements in code for new commercial or residential construction. Alternatively, green stormwater management can also be encouraged through a stormwater credit program, which can be modeled after existing programs like that of the Philadelphia Water Department, which save on infrastructure maintenance costs while encouraging infiltration (Philadelphia Water Department).

A traditional detention basin common in suburban New Jersey (Haberland et al.)

A rain garden (Virginia's Soil & Water Conservation District)

According to the New Jersey Department of Environmental Protection, less than 20ºC (68ºF) is the optimal stream temperature range for trout, 20-22ºC (68-72.6ºF) is sub-optimal, where temperature begins to affect feeding and growth, and above those regions the water is tolerable for only short durations (NJ DEP). Therefore, a measurable goal for Solution 3 is to ensure that by 2040, the maximum weekly maximum temperatures (MWMT) year-round in all streams in the watershed do not exceed 70º. MWMT is used as a metric because it better reflects spikes in transient water temperature (Klamath Resource).

Conclusion and Recommendations

While the North Branch Raritan River watershed suffers from a host of issues tied to development and human activities, such as high specific conductance, poor ecosystem health, and high stream temperatures, actionable measures can be taken to stall and reverse these problems. These solution strategies, as well as the way in which their effectiveness will be measured, are summarized in the table below. The strength of the chosen solutions is that they have wide-reaching impacts that address not just one problem, but aid in solving the other problems too. Smart salting does not just reduce the specific conductance in the streams, but also improves the habitat and survival statistics of fish. Restoring buffers helps in all three problem areas, as buffers help reduce specific conductance, improve aquatic habitats, and lower stream temperatures. By focusing fiscal and volunteer resources on these reasonable solution strategies, the North Branch Raritan River and its tributaries can once again become thriving, healthy ecosystems that support both the aquatic organisms and people that call the watershed home.

Summary Table of Problems, Solution Strategies, and Measurable Goals

Problem	**Solution Strategies**	**Measurable Goal**
High Specific Conductance	● Train road crews on sustainability-conscious application techniques ● Apply liquid brine pre-storm ● Upgrade wastewater treatment	Reduce specific conductance at all failing sites to 388 µS/cm, moving the North Branch from an F to a passing grade by 2035 and bringing back sensitive aquatic insects
Poor Ecosystem Health	● Expand Raritan River Fish Passage Initiative	Remove 7 upstream dams by 2040, at a rate of 1 per 2 years, to reduce scour downstream, expand healthy riparian habitat, and provide fish passage
High Stream Temperatures	● Expand buffers ● Retrofit detention basins ● Work with planners to encourage green stormwater management in code	● Plant 50 ft of buffer in 25% of suburban streams by 2035 ● Ensure that all tributaries of the North Raritan River do not exceed 70º MWMT by 2040

Works Cited

Alliance for the Chesapeake Bay. “Macroinvertebrate Menagerie.” https://www.allianceforthebay.org/2021/03/macroinvertebrate-menagerie/.

Haberland, Michael, et al. “Green Infrastructure: Converting Dry Detention Basins to Natural Ecosystems.” *New Jersey Agricultural Experiment Station*, https://njaes.rutgers.edu/fs1195/.

Klamath Resource Information System. “Setting Appropriate Temperature Standards.” https://krisweb.com/stream/temp_standards.htm.

Moore, Joel, et al. “High-Frequency Data Reveal Deicing Salts Drive Elevated Specific Conductance and Chloride along with Pervasive and Frequent Exceedances of the U.S. Environmental Protection Agency Aquatic Life Criteria for Chloride in Urban Streams.” *Environmental Science & Technology*, vol. 54, no. 2, https://pubs.acs.org/doi/10.1021/acs.est.9b04316.

“New Dam Removal Project Reinvigorates Effort to Open the Raritan River for Migratory Fish.” *NOAA Fisheries*, 2025, https://www.fisheries.noaa.gov/feature-story/new-dam-removal-project-reinvigorates-effort-open-raritan-river-migratory-fish.

New Jersey Watershed Watch. “NJ Salt Watch.” *New Jersey Watershed Watch*, https://njwatershedwatch.org/road-salt/.

NJDEP. *NJDEP | New Jersey Department of Environmental Protection*, https://dep.nj.gov/. Accessed 3 May 2026.

NJ DEP. “Stream Temperature Monitoring.” https://dep.nj.gov/njfw/wp-content/uploads/njfw/TemperatureProjects2020.pdf.

NOAA DARRP. “American Cyanamid.” *Damage Assessment, Remediation, and Restoration Program*, https://darrp.noaa.gov/hazardous-waste/american-cyanamid.

Philadelphia Water Department. “Stormwater Credits.” https://water.phila.gov/stormwater/incentives/credits/.

Raritan Headwaters. *Raritan Headwaters: Protecting the Watershed, Clean safe water for all*, https://www.raritanheadwaters.org. Accessed 3 May 2026.

Raritan Headwaters. “Watershed Report Card.” *Raritan Headwaters*, 2025, https://www.raritanheadwaters.org/watershed-report-card/.

Sustainable Jersey. “Winter Best Practices to Reduce Road Salt Impacts.” *Sustainable Jersey*, https://www.sustainablejersey.com/fileadmin/media/Actions_and_Certification/Actions/NaturalResources/Winter_Best_Practices_to_Reduce_Road_Salt/Resource_2_Best_Management_Practices.pdf.

Virginia's Soil & Water Conservation District. “Rain Garden.” *VASWCD*, https://vaswcd.org/rain-garden/.

We Conserve PA. “A Scientific Foundation for Shaping Riparian Buffer Protection Regulations.” *We Conserve PA*, https://library.weconservepa.org/guides/132-a-scientific-foundation-for-shaping-riparian-buffer-protection-regulations.

Willig, Anna. “Taking the Temperature of Local Streams.” *Willistown Conservation Trust*, 2023, https://wctrust.org/taking-the-temperature-of-local-streams/.