NATIONAL ENVIRONMENTAL MONITORING CONFERENCE

Microbial Source Tracking (MST) – Analyses in the Saco Brook, Lower Farm River, and Goodwives River Watersheds in Connecticut

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Our Local Commitment

- Change starts locally and we are doing our part to improve water quality.



Long Island Sound – Why Protect It?

- Once called the "American Mediterranean" and more recently described as "The Urban Sea," Long Island Sound is considered one of North America's most urban yet biologically diverse estuaries.
- Long Island Sound (LIS) has been designated as an Atlantic Ocean tidal estuary of national significance by the United States Congress with a population of over nine (9) million people living within the watershed area, with its coastline shared by three states.
- LIS is a mix of freshwater from tributaries and saltwater from the ocean, Long Island Sound is 21 miles (34 km) at its widest point and varies in depth from 65 to 230 feet (20 to 70 m).
- The Sound generates between $17 billion and $36.6 billion in economic value every year.
- Due to public health concerns, swimming waters and shellfish beds are closed when bacteria levels are elevated, causing residents and commercial users to lose access to these resources.

Background/History

- In 2011 - 2012, our local health department teamed-up with Yale University to improve our local water quality.
- Working with a Graduate-level Student, we embarked on a non-approved EPA source tracking research study.
- Goal was to determine whether the fecal contamination was from human or animal sources.
- Results indicated it was mostly animal, non-human contamination.

Background Continued:
Bacterial contamination in Long Island Sound: improving beach closure policy and assessing the effects of climate change

- In 2016, we worked with a team of Yale students to investigate better marine beach water closure policies – Three (3) Aims:
  - **Aim 1:** Based on retrospective data, to examine the relationship between weather-related and other variables and bacterial contamination in Long Island Sound bathing water
  - **Aim 2:** Potential predictors will include rainfall amount, air temperature, water temperature, humidity, and tide. The endpoint will be enterococcal organisms per 100 ml. Effect modification by beach and temporal trends in predictors will also be examined.
  - **Aim 3:** To perform a critical review of saltwater beach closing policies in Connecticut and nationally, examining pros and cons of various policy options and making a policy recommendation for Connecticut local beaches. The report included an assessment of the effect of climate change on bacterial contamination and beach closure policy.

Background Continued:
Bacterial contamination in Long Island Sound: improving beach closure policy and assessing the effects of climate change

- Finding: Current policy did not effectively protect the public health of our residents/visitors.

- Specifically, prior to closure, two samples (initial and resample) were needed, exceeding a concentration of enterococcal organisms greater than 104 CFU/ 100 ml.

- Thus, there was a 24-48 hour window of potential unnecessary exposure to high bacteria levels for recreational marine water activities.

- Improvements were necessary to our beach closure policy, to include preemptive beach closure if rainfall exceeds a certain threshold.

- Based on water sampling data of 9-13 years (depending on the Town), we established a 2.0 inch preemptive beach closure policy (Within a 24-hour Period)

Microbial Source Tracking (MST) - An Analyses of Three CT Watersheds of Long Island Sound

- Fast-forward to 2017: Three Connecticut local health departments worked in partnership - The Town of Darian, East Shore District Health Department and the Westport-Weston Health District through a Connecticut Grant Opportunity, and in collaboration with Yale University, the Connecticut Agricultural Experiment Station, and Earthplace Laboratory.
- ***Learning Objectives:***
  - Understand the current State and EPA water sampling protocols.
  - Learn the importance of local health department interventions of improving water quality within our communities.
  - Recognize the importance of DNA sampling as a public health water quality tool.

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Microbial Source Tracking (MST) Analyses in the Sasco Brook, Lower Farm River and Goodwives River Watersheds

- The three watersheds totaling 37.4 sq. miles of drainage basin, the Sasco Brook Watershed, the Lower Farm River Watershed, and the Goodwives River Watershed have a history of elevated bacteria counts leading to the closures of beaches for contact recreation (swimming) use and/or shellfishing areas. It should also be noted that kelp farming and other fisheries are being developed in LIS which could be impacted, resulting in lost economic opportunities for Connecticut, and its shoreline communities.

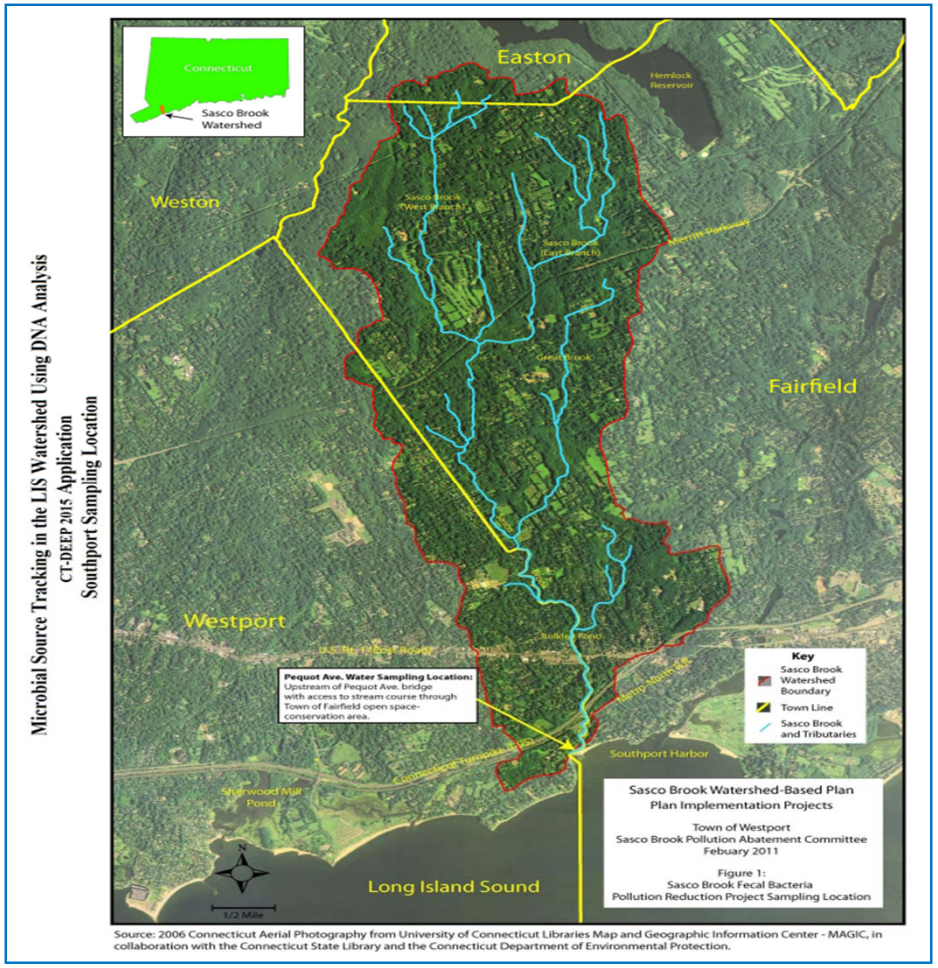
Westport Weston Health District

Microbial Source Tracking (MST) Analyses in the Sasco Brook, Lower Farm River and Goodwives River Watersheds.

Project Lead: Mark Cooper, Director of Health

Watershed Area: Saco Brook, Westbrook, Connecticut

Description: The Sasco Brook watershed is located in southwestern Connecticut, encompassing portions of the Towns of Fairfield, Westport, and a small area of Easton, Connecticut. Approximately 78% of the watershed is located in Fairfield, 19% in Westport, and 3% in Easton. The brook drains a watershed of 10.2 square miles from its headwaters near the Easton/Fairfield

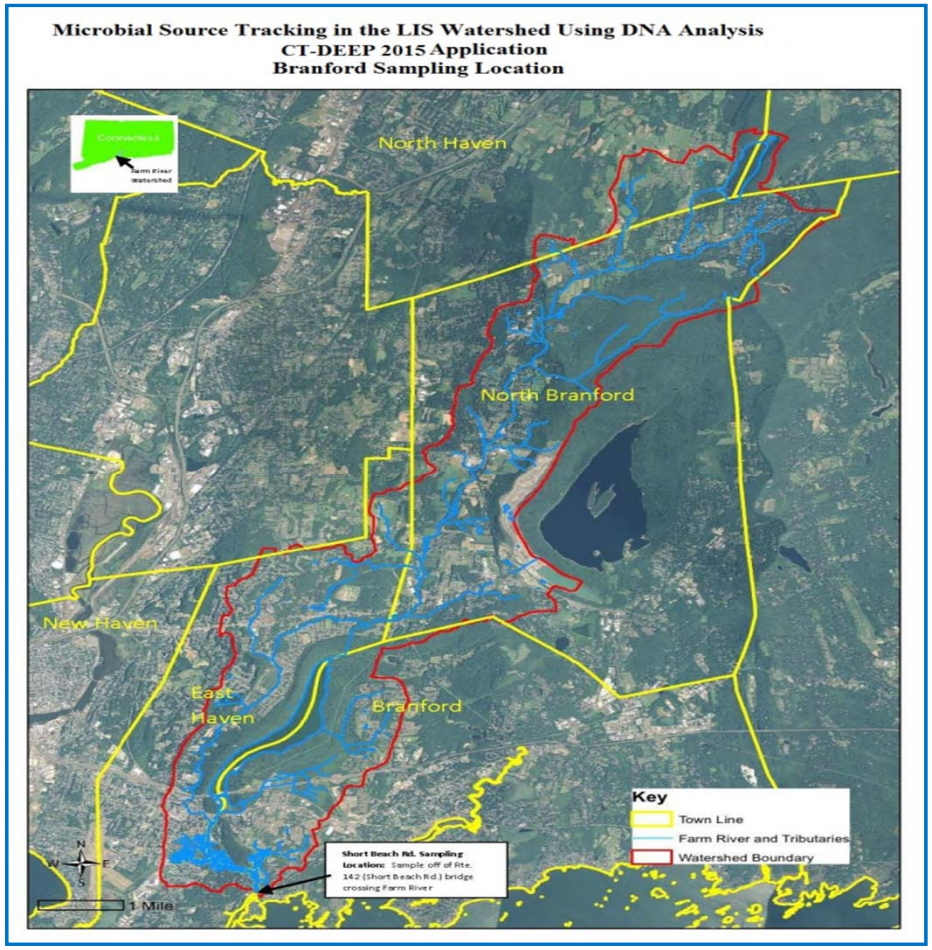


Microbial Source Tracking (MST) Analyses in the Sasco Brook, Lower Farm River and Goodwives River Watersheds.

Project Lead: Michael A. Pascucilla, Director of Health

Watershed Area: Lower Farm River, Branford, Connecticut

Description: The Farm River Estuary is a wild, pristine and enormously complex productive, and fragile estuarine ecosystem with wooded uplands, high quality fresh water, and brackish tidal marshes. These picturesque floodplains, coves, and inlets provide a critical natural habitat for an immense variety of microbes, plants, insects, amphibians, reptiles, birds, fish, shellfish and mammals that rely on it for food, water, and shelter, especially during migration and breeding. The Farm River drains parts of Durham, Wallingford and North Branford on its 16.5 mile journey past Farm River State Park to Long Island Sound. The Farm River has been used for navigation by a fertilizer factory, stone quarry, paper mill, saloon, salt hay harvesters, fisherman and boating enthusiasts.

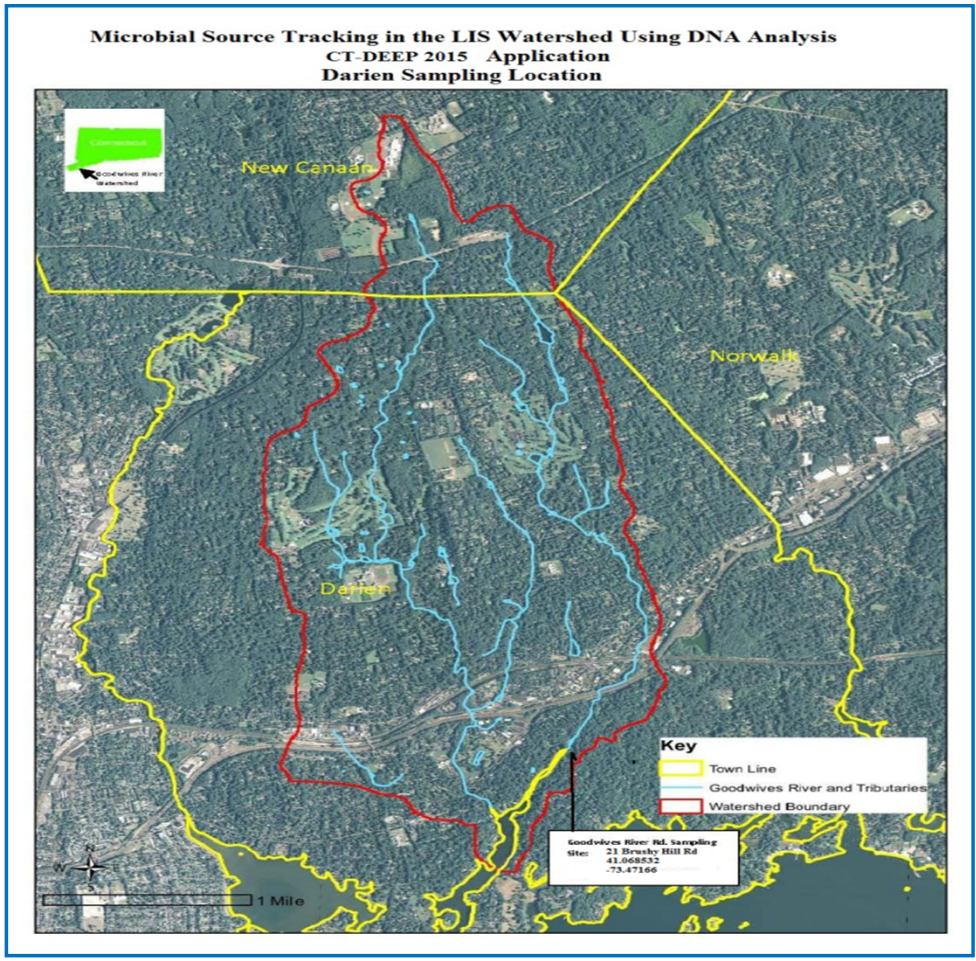


Microbial Source Tracking (MST) Analyses in the Sasco Brook, Lower Farm River and Goodwives River Watersheds.

Project Lead: David Knauf Director of Health

Watershed Area: Goodwives River, Darien, Connecticut

Description: Like Sasco Brook, Darien Cove has also been classified as impaired by CT DEEP for not meeting state water quality standards regarding fecal coliform (a class of organisms including *E. coli)* levels. This classification has prevented the harvesting of shellfish for direct consumption in this area. Additionally, water samples collected by the Darien Health Department at various locations along the Goodwives River, the primary source of fresh water to the Darien Cove, have shown consistently elevated levels of bacteria since 2009. According to the assessment conducted by the CT DEEP, likely sources of the bacteria are storm water and non-point sources, including decentralized treatment systems (such as septic systems), vessel discharges, and waterfowl. Detailed sanitary surveys have been conducted throughout the watershed with numerous potential but inconclusive sources of bacteria found.



Study Limitation

- The two assays specific for seagulls and birds that failed to pass the screening for successful runs could not be included in further analyses. Thus, the study could not validate nor refute the significance of geese or seagulls as a source of pollution, even though they were periodically observed at collection sites.

- Traditional monitoring for fecal contamination relies on the culturing of fecal indicator bacteria (FIB). Numerous short comings associated with these methods have since been identified, including a lack of correlation with pathogen counts or reported illnesses (Colford et al., 2007; Wade, Pai, Eisenberg, & Colford, 2003), and the fact that samples must be cultured for 24 hours before results are known.

- The time lapse between sample collection and test results presents a dilemma since, in marine waters, the 24 hour time period represents two tide changes ensuring different water quality when samples are taken, and the results obtained.

- Bacteria found at a beach or shellfish bed may originate in beach sand or be transported downstream, making it difficult to pinpoint specific non-point sources.

Future Considerations

- Limitations posed by using indicator organisms illustrate the need to develop other methodologies for assessing sources of potential contamination.

- An additional or alternate direction for future studies could be to employ next generation sequencing technologies to assess likely sources of bacteria, and to attempt to detect actual pathogens rather than focusing on surrogate indicators.

- Additionally, a modified sampling schedule could be utilized.

- This approach could also be used to evaluate whether the discrepancies between E. coli and GenBac results are due to the differential survival rates of the two 15 types of indicators.

Special Thanks

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Questions/Comments