6 Water Quality

6.1 Classifications, Standards, and Impairments

The North Branch Park River is impaired for recreational uses and habitat for fish, other aquatic life, and wildlife due to physical alteration and elevated levels of indicator bacteria.

The Federal Clean Water Act (CWA) was developed to protect the nation's surface waters. Through authorization of the CWA, the United States Congress declared as a national goal "water quality which provides for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water wherever attainable." The CWA requires states to:

1. Adopt Water Quality Standards,
2. Assess surface waters to evaluate compliance with Water Quality Standards,
3. Identify those waters not currently meeting Water Quality Standards, and
4. Develop Total Maximum Daily Load (TMDL) analysis and other management plans to bring water bodies into compliance with Water Quality Standards.

Connecticut Water Quality Standards are established in accordance with Section 22a-426 of the Connecticut General Statutes and Section 303 of the CWA. The Water Quality Standards are used to establish priorities for pollution abatement efforts. Based on the Water Quality Standards, Water Quality Classifications establish designated uses for surface and ground waters and identify the criteria necessary to support these uses. The Water Quality Classification system classifies inland surface waters into four different categories ranging from Class AA to D. *Table 6-1* summarizes the Connecticut Surface Water Quality Classifications.

Table 6-1. Connecticut Inland Surface Water Quality Classifications

Designated Use	Class AA	Class A	Class B	Class C	Class D
Existing/proposed drinking water supply	•				
Potential drinking water supply	•	•			
Fish and wildlife habitat	•	•	•	Class C and D waters may be suitable for certain fish and wildlife habitat, certain recreational activities, industrial use, and navigation	
Recreational use	•	•	•		
Agricultural and industrial use	•	•	•		

Figure 6-1 depicts the Water Quality Classifications of surface waters in the North Branch Park River watershed. The North Branch Park River is classified as C/A meaning that the river is currently only meeting Class C criteria or designated uses but has a goal of Class A. The North Branch Park River is also listed as impaired for recreational uses and habitat for fish, other aquatic life, and wildlife in the *2008 List of Connecticut Waterbodies Not Meeting Water Quality Standards*. *Table 6-2* summarizes the location and nature of the impairment. Multiple factors are identified as responsible for the impairment, including physical habitat alteration and elevated levels of *Escherichia coli* (*E.Coli*). The potential source of the *E. Coli* contamination is combined sewer overflows and urban stormwater.

Table 6-2. North Branch Park River Watershed Impaired Waters

Waterbody Name/ Segment ID	Location Description	Waterbody Segment Length	Impaired Designated Use	Cause	TMDL Priority/ Category	Potential Source
North Branch Park River-01/ CT4404-00_01	From mouth at confluence with Park River just downstream of I84 crossing, upstream to entrance of conduit (entire segment in pipe) near Farmington Avenue, Hartford	0.51 miles	Habitat for Fish, Other Aquatic Life and Wildlife	Physical substrate habitat alterations	N/4C	Channelization
			Recreation	Physical substrate habitat alterations	N/4C	Channelization
			Recreation	Escherichia coli	L/5	Combined Sewer Overflows
North Branch Park River-02/ CT4404-00_02	From downstream side of Farmington Avenue (at entrance of conduit), upstream to confluence with Wash Brook (just downstream of confluence of Wash Brook and Beamans Brook), Bloomfield	5.39 miles	Habitat for Fish, Other Aquatic Life and Wildlife	Unknown	L/5	Unspecified Urban Stormwater, Combined Sewer Overflows
			Recreation	Escherichia coli	L/5	Unspecified Urban Stormwater, Combined Sewer Overflows

Source: CTDEP, 2008

[1] TMDL Priority Definitions (i.e., Potential for TMDL Development within 3 Years):
H – high priority for which there is assessment information that suggests that a TMDL may be needed to restore the water quality impairment; TMDLs may be developed within 3 years.
M – medium priority indicates that there may be insufficient information to assess the impairment or that other programs are likely to remedy the water quality impairment; TMDLs may be developed within 3-7 years.
L – low priority; may be reassigned to another EPA category or TMDLs may be developed in 7-11 years.
N – not applicable; the impact to the stream is not being caused by a pollutant.

[2] TMDL Category Definitions for Waterbodies Not Meeting State Water Quality Standards:
4A – A TMDL to address a specific pollutant combination has been approved or established by EPA.
4B – A use impairment caused by a pollutant is being addressed by the State through pollution control requirements other than a TMDL.
4C – A use is impaired, but the impairment is not caused by a pollutant.
5 – Available data and/or information indicate that at least one designated use is not being supported and a TMDL is needed.

Figure 6-1

Total Maximum Daily Loads (TMDLs) provide the framework to restore impaired waters by establishing the maximum amount of a pollutant that a water body can assimilate without adverse impact to aquatic life, recreation, or other public uses. The *2008 List of Connecticut Waterbodies Not Meeting Water Quality Standards* includes a priority ranking system for development of a TMDL specific to the contaminants in each impaired segment: high (H), medium (M), low (L), under study (T), or Not Applicable (N). CTDEP has identified the need for a TMDL to address the impairment for Escherichia coli, although the priority is low at this time.

Other tributaries, lakes and ponds throughout the North Branch Park River watershed are classified as Class A with the exception of Tumbledown Brook, Beamans Brook, and Wash Brook, which are classified as Class B/A; the West Hartford Reservoir No. 6, which is classified as B/AA; and Hoe Pond in the upper northwest portion of the watershed, which is classified as AA since it feeds West Hartford Reservoir No. 6.

Currently, there is a statewide advisory that recommends limiting the consumption of freshwater fish due to elevated levels of mercury in some species. However, only those designated uses specifically identified in the Connecticut Water Quality Standards are assessed. In making water quality assessments, each designated use of a waterbody is assigned a level of support (e.g., full support, not supporting, or not assessed), which characterizes the degree to which the water is suitable for that use. The North Branch Park River is designated full support for fish consumption, although this designation is superseded by the statewide advisory.

6.2 Water Quality Monitoring

Water quality monitoring within the North Branch Park River watershed is conducted by the CTDEP and by the Trinity College Environmental Science program. Both water quality monitoring programs are described in the following sections, followed by a discussion of the monitoring results.

6.2.1 CTDEP Monitoring Program

The CWA requires each state to monitor, assess and report on the quality of its waters relative to attainment of designated uses established by the State's Water Quality Standards. For assessing statewide water quality conditions and complying with the CWA monitoring requirements, the CTDEP relies on monitoring data collected by two programs, the Ambient Monitoring Program and the Rapid Bioassessment in Wadeable Streams & Rivers by Volunteer Monitors (RBV) Program.

The determination of the supported uses in rivers across the state relies on the collection of physical, chemical and biological monitoring data of stream water quality. In 2005 a new Comprehensive Ambient Water Quality Monitoring Strategy was adopted. The strategy incorporates a composite of targeted and probabilistic sampling designs to assess aquatic life use support. The monitoring includes a mix of sites visited on five-year, two-year and annual basis.

The RBV program is a citizen-based water quality-monitoring program developed by the CTDEP ambient monitoring program. The RBV program is a standardized screening bioassessment method that identifies sections of streams with pollution sensitive organisms. Organisms are categorized as Least Sensitive, Moderately Sensitive, or Most Sensitive, which together with chemical monitoring data can serve as an indicator of overall stream health.

Table 6-3 provides a summary of the CTDEP water quality monitoring programs within the North Branch Park River watershed. The monitoring locations are depicted in *Figure 6-1*. The Ambient Monitoring Program conducted water quality monitoring of the North Branch Park River at Albany Avenue and a second location at Upper Campus Road (on the University of Hartford campus) in the winter, spring and summer of 1999. Additional water quality samples were collected and analyzed from a monitoring location on the North Branch Park River at Farmington Avenue (behind 19 Woodland Street) in June, July, August, and September of 2008. Sampling was not coordinated with wet or dry weather. Ambient monitoring results are also available for other locations within the watershed. Bioassessments in the North Branch Park River were performed by the RBV program in September of 2008.

Table 6-3. Summary of DEP Ambient Water Quality Monitoring Program

Stream	Location	Program	Parameters Monitored	Dates
North Branch Park River	Farmington Avenue behind 19 Woodland Street	AMP1	Temperature, DO, ORP, BOD5, pH, TDS, TSS, Turbidity, Alkalinity, Hardness, Total P, Total N, NO3, NO2, Org-C, TKN, Ca, Mg, E. coli	6/13/2008 6/16/2008 7/1/2008 7/10/2008 8/28/2008 9/2/2008 9/22/2008 10/8/2008
		RBV2	Macroinvertebrates	9/20/2008
	Watkinson School	RBV2	Macroinvertebrates	9/20/2008
	Albany Avenue	AMP1 - Quarterly Monitoring	Temperature, DO, ORP, BOD5, pH, TSS, Turbidity, Alkalinity, Hardness Total N, NO3, NO2, Ammonia, Org N, TKN, PO43-Cd, Cl, Cr, Cu, Pb, Ni, Zn, Fe Total Coliform, Enterococci, E. coli	3/30/1999 6/16/1999 9/27/1999
		AMP1 – Ambient Fish Community Sampling	Fish Species	8/22/2000
	Sunny Reach Drive	AMP1	DO, pH, TDS, water depth, Temperature	9/17/2008
	Upper Campus Road at University of Hartford	AMP1 - Quarterly Monitoring	Temperature, DO, ORP, BOD5, pH, TSS, Turbidity, Alkalinity, Hardness, Total N, NO3, NO2, Ammonia, Org N, TKN, PO43, Cd, Cl, Cr, Cu, Pb, Ni, Zn, Fe, Total Coliform, Enterococci, E. coli	3/30/1999 6/16/1999 9/27/1999
Wash Brook	US Cottage Grove Road (Route 218)	AMP1 - Ambient Fish Community Sampling	Fish Species Ammonia, NO3, NO2, pH, TSS, TKN, Total Solids, Turbidity, NOX, Org N, Ca, Mg, PO4-3, Alkalinity, Cl, PO4-2, K, Na, Total N, Hardness, SO4	6/13/2008

6.2.2 Trinity College Monitoring Program

Dr. Jonathan Gourley of the Trinity College Environmental Science Program is conducting an ongoing water quality monitoring project in the North and South Branches of the Park River. During the summer of 2008 a team of five undergraduate research students collected water quality samples at twelve locations from the headwaters of the North Branch Park River watershed through the main stem of the North Branch Park River (*Figure 6-1*). The samples were analyzed for temperature, pH, conductivity, total dissolved solids (TDS), salinity, dissolved oxygen (DO), hardness, major anions (chloride, nitrates and sulfates), fecal coliform, and macroinvertebrates. Sampling was not coordinated with wet or dry weather.

6.3 CTDEP Monitoring Results

The following sections summarize the CTDEP water quality monitoring results for the North Branch Park River watershed. Water quality monitoring results for additional parameters that were analyzed during the 1999 and 2008 sampling events are summarized in *Appendix C*.

6.3.1 Turbidity

Turbidity, a measure of the scattering of light through water, is a common indicator of suspended particulate and colloidal material and is typically included in ambient water quality monitoring programs (EPA, 2000). Turbidity can be caused by any small, undissolved material in water such as suspended algal cells or by inorganic suspended soils. Turbidity is typically reported in either Nephelometric Turbidity Units (NTUs) or Formazin Turbidity Units (FTUs) (although the NTU and FTU units are not necessarily synonymous, for the purposes of this report they are used interchangeably).

Turbidity levels can vary significantly in the environment and may depend on the surficial soils, level of development, nutrient loadings, and other watershed characteristics as well as rainfall conditions prior to sampling. EPA suggests a reference criteria level of 3.04 FTU for the Eastern Coastal Plain Ecoregion (Ecoregion XIV), which includes the majority of Connecticut (EPA, 2000b). The Connecticut Water Quality Standards turbidity criteria for waters in Class AA through B do not allow an increase in turbidity of more than 5 NTU above ambient conditions. Elevated turbidity can be symptomatic of excessive nutrients loads, resulting in algal growth, or sediment loads from soil erosion.

Figure 6-3 presents turbidity results for the CTDEP Ambient Monitoring Program data within the watershed. Turbidity levels measured in 1999 generally ranged from 1 to 3 NTU, with one measurement approaching 4.5 NTU at Albany Avenue. In 2008, measured turbidity levels varied from 1.6 to 6.7 NTU.

6.3.2 Total Suspended Solids

Similar to turbidity, Total Suspended Solids (TSS) describes the quantity of particulate matter suspended in the water column. TSS attenuates light and reduces transparency, whether the source is algae, algal detritus or inorganic sediment. Unlike turbidity, TSS is directly measured; water is filtered directly to remove the suspended material, and then the material is weighed. Solids that pass the filter are assumed to be dissolved.

During high streamflow, the concentration of suspended solids (and water clarity) is more strongly influenced by inputs of inorganic sediment or channel erosion in streams than by algae, especially in urbanized and agricultural watersheds. As shown in *Figure 6-4*, the Albany Avenue sampling location had the highest average TSS levels of the four sampling locations. However, the sample with the single highest measured TSS concentration was collected at the Farmington Avenue sample location.

There are no numerical state or federal water quality criteria for TSS. The Connecticut Water Quality Standards require that suspended and settleable solids not be present in concentrations or combinations that would impair designated uses, alter the composition of the water body substrate, or impact aquatic organisms.

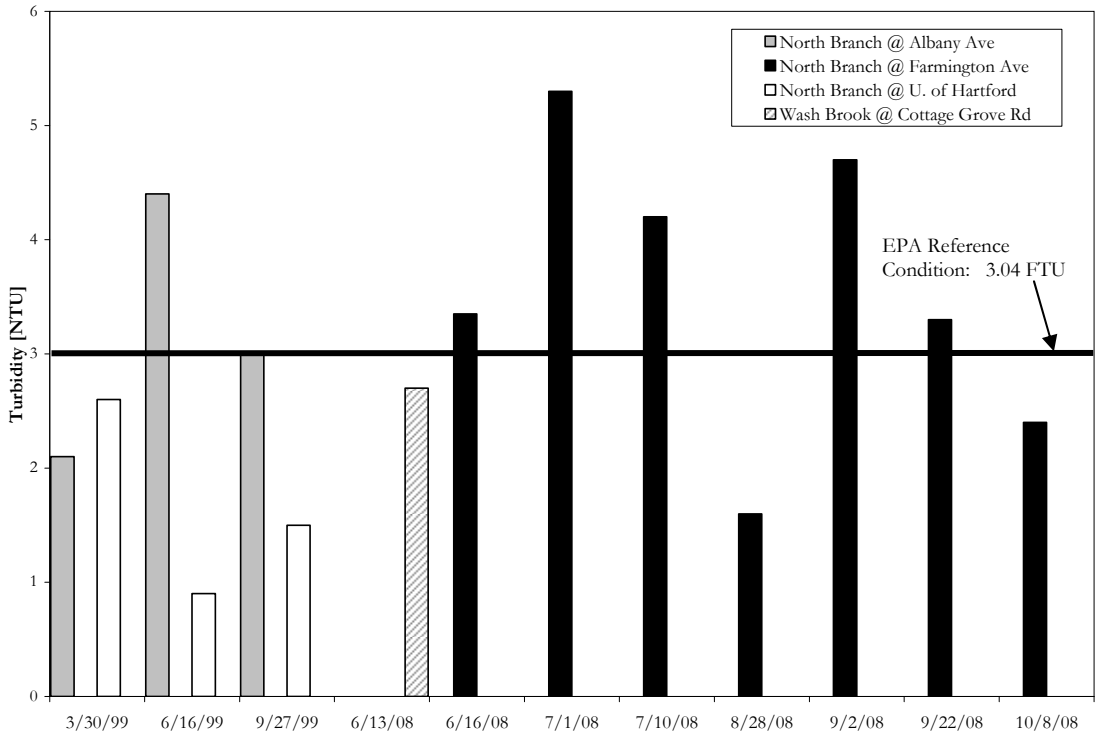


Figure 6-3. Turbidity – North Branch Park River Watershed

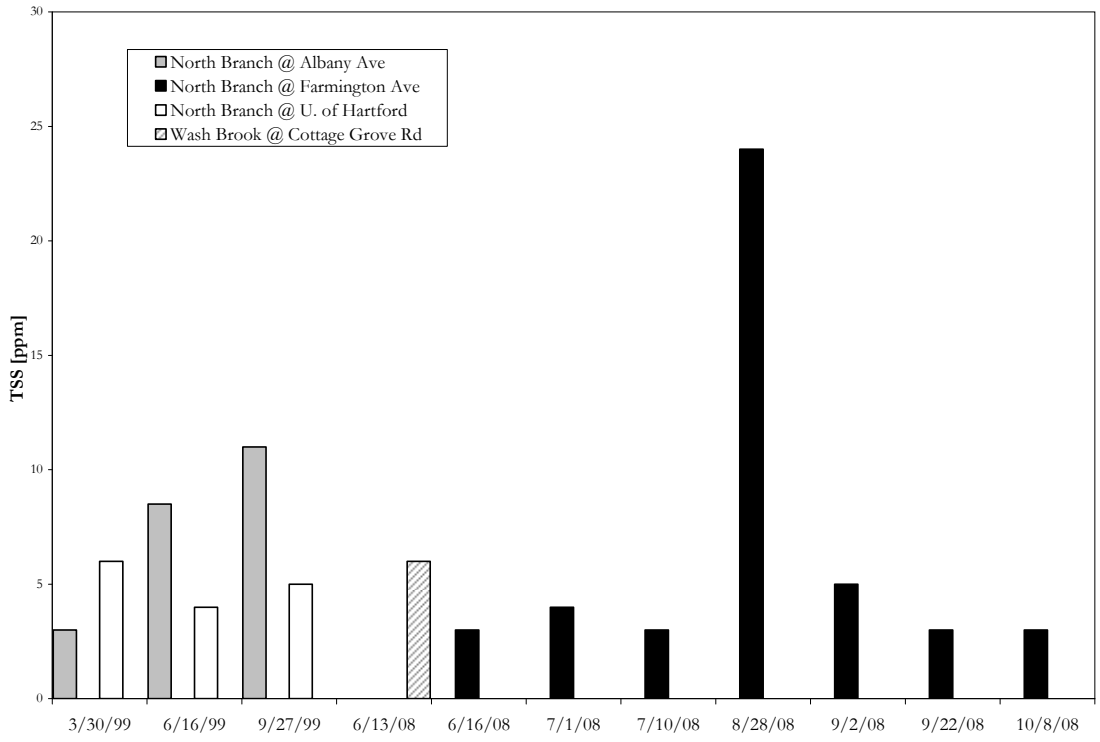


Figure 6-4. Total Suspended Solids (TSS) – North Branch Park River Watershed

6.3.3 Metals

Metals occur naturally in the environment, but human activities can alter their distribution. When metals are released into the environment in higher than natural concentrations they can be toxic and disrupt aquatic ecosystems. Metals in their dissolved form are typically more harmful (i.e., bioavailable) to aquatic organisms.

Dissolved copper was measured at two locations within the watershed on three occasions in 1999, and has not been sampled since. Both locations, at Albany Avenue and the University of Hartford, were found to have levels above the Connecticut Water Quality Standards freshwater chronic aquatic life limit of 4.8 micrograms per liter *(Figures 6-5*) during two of the three monitoring events. Biological integrity can be impaired when the ambient concentration of dissolved copper exceeds this value on more than 50 percent of days in any year (Connecticut Water Quality Standards, 2002). These elevated copper levels may result from stormwater runoff and combined sewer overflows.

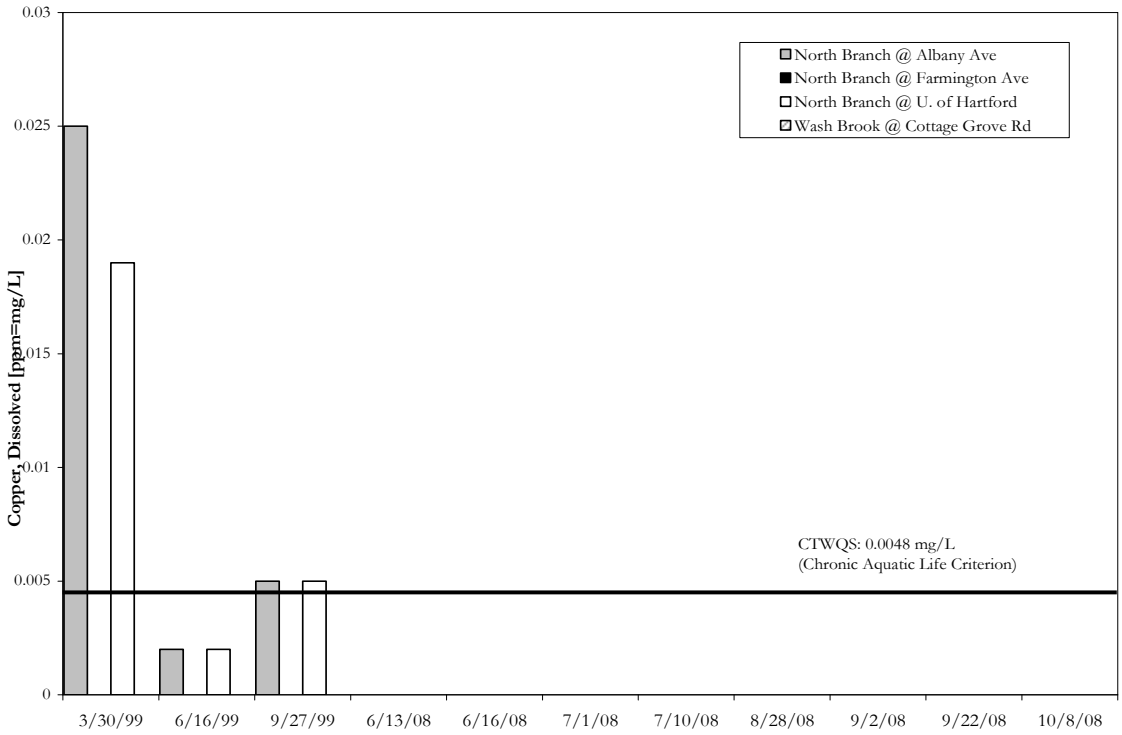


Figure 6-5. Dissolved Copper – North Branch Park River Watershed

Figure 6-6 summarizes dissolved lead concentrations at watershed sampling locations relative to the freshwater chronic aquatic life criterion of 1.2 micrograms per liter. None of the measured dissolved lead concentrations exceeded the criterion. Dissolved zinc concentrations were measured on three dates at two locations (Albany Avenue and University of Hartford) in 1999 (*Figure 6-7*). Of the six samples, two (one at each location) exceeded the freshwater chronic aquatic life criterion of 6.5 micrograms per liter.

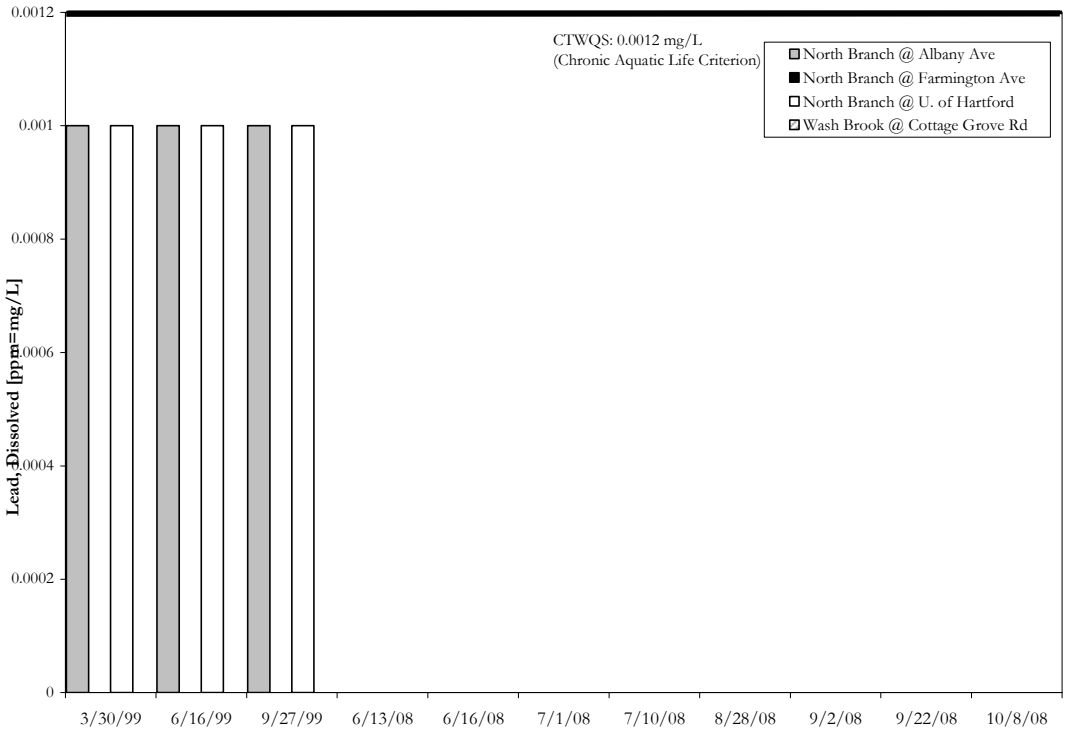


Figure 6-6. Dissolved Lead – North Branch Park River Watershed

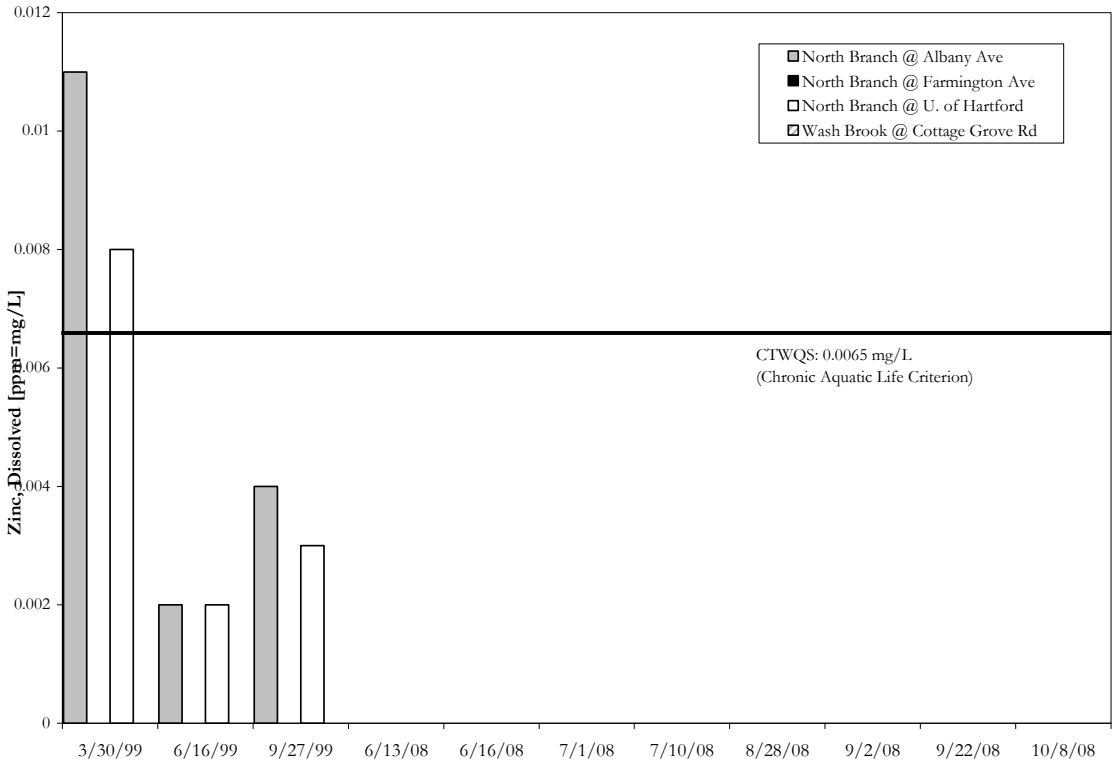


Figure 6-7. Dissolved Zinc – North Branch Park River Watershed

6.3.4 Nitrogen

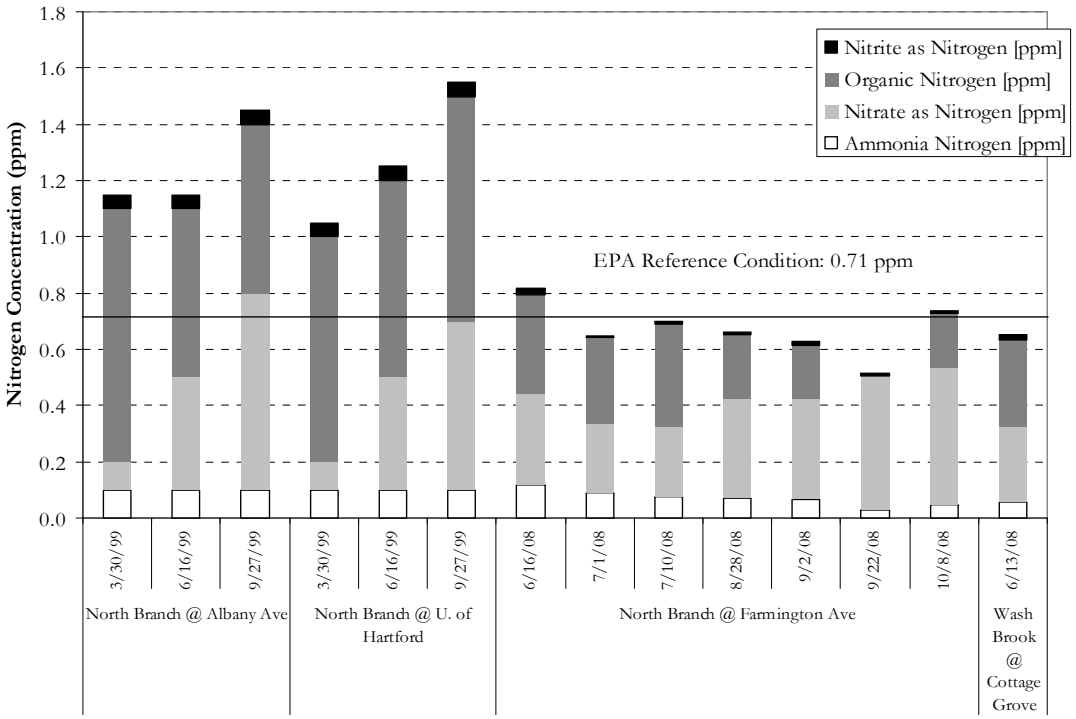
Nitrogen and phosphorus are the primary nutrients that enrich streams and rivers and cause nuisance levels of algae. Nutrients, especially phosphorus, are frequently the key stimulus to increased and excess algal biomass in many freshwaters. Nitrogen is more of a concern in marine systems and estuaries, such as the Lower Connecticut River and Long Island Sound to which the North Branch Park River eventually discharges.

The nitrogen species monitored within the watershed include ammonia, nitrate, nitrite, total nitrogen, nitrate and nitrite, and organic nitrogen. Total nitrogen can be calculated as the sum of ammonia, nitrate, and organic nitrogen, in addition to nitrite, which is rapidly converted to nitrate in surface waters. Total nitrogen levels measured at many of the monitoring locations exceeded the EPA reference criterion for rivers in Ecoregion XIV of 0.71 mg/L. This may reflect the significant contribution of nitrogen from sources in the watershed such as precipitation and atmospheric deposition, urban stormwater runoff, septic system effluent, and sewer overflows. *Figure 6-8* presents a subset of the total nitrogen data set for comparison with the EPA reference condition.

Organic nitrogen was the dominant nitrogen species at the Albany Avenue and University of Hartford sampling locations in 1999, although nitrate levels were similar to or greater than organic nitrogen levels at the Farmington River sampling location and in Wash Brook in 2008. However, organic nitrogen generally accounted for up to approximately 50% of all nitrogen in the collected samples.

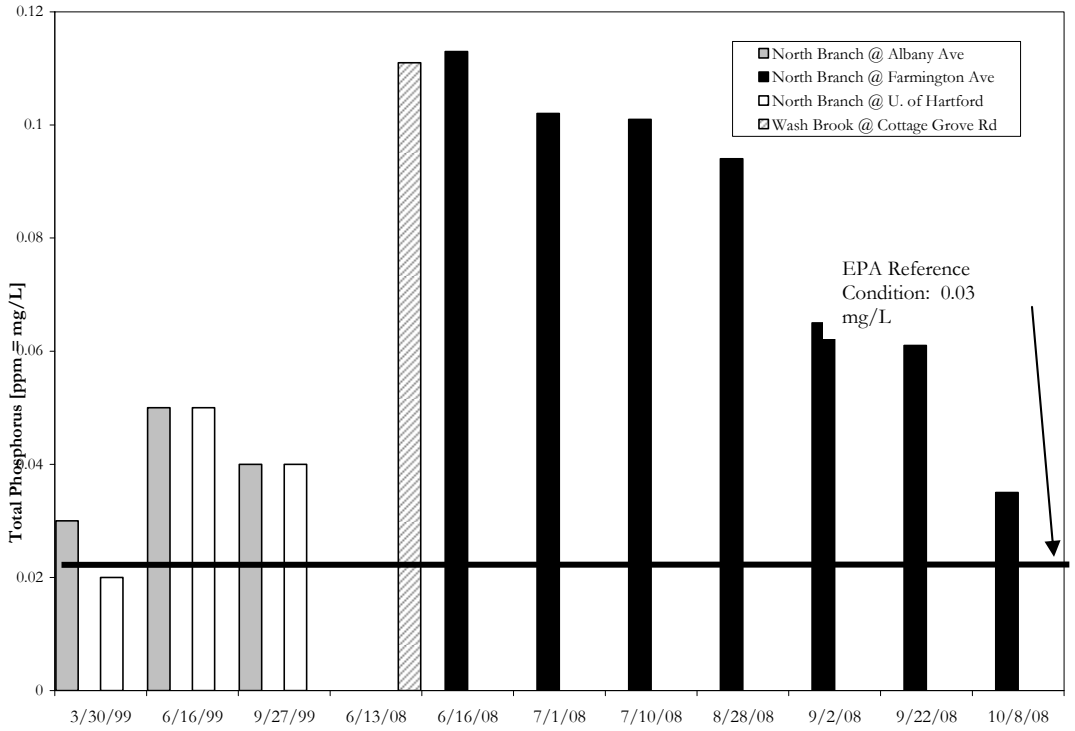
6.3.5 Phosphorus

Elevated phosphorus levels are an indicator of potential organic enrichment, which can enhance algal growth and impair aquatic life support and contact recreation under certain conditions. Total phosphorus concentrations measured at the four sampling locations (*Figure 6-9*) consistently exceeded the EPA reference criterion of 0.03 mg/L, which is also the Connecticut Water Quality Standards summer phosphorus concentration for lakes that would be expected to fully support contact recreational uses.



Note: Organic nitrogen data were unavailable for 9/22/08 at the Farmington Avenue sampling site.

Figure 6-8. Total Nitrogen – North Branch Park River Watershed



*Note: Samples dated 3/30/99-9/27/99 were analyzed using EPA Method 365.1 (Determination of Phosphorus by Semi-Automated Colorimetry), samples collected 6/13/08-10/8/08 we analyzed using EPA Method 365.4 (Phosphorous, Total (Colorimetric, Automated, Block Digester AA II)), both for Total Phosphorus

Figure 6-9. Total Phosphorus – North Branch Park River Watershed

6.3.6 Indicator Bacteria

Elevated levels of indicator bacteria (*Escherichia coli*) were measured at all monitoring locations sampled by the CTDEP (Wash Brook at Cottage Grove Road was not sampled for *Escherichia coli*). *Figure 6-10* presents *Escherichia coli* monitoring results. According to the Connecticut Water Quality Standards, Class AA, A, or B waters designated for freshwater recreational use have a single sample maximum criterion of 235 Colony Forming Units or CFU/100 ml of *Escherichia coli* for designated bathing areas, 410 CFU/100 ml for non-designated swimming areas, and 576 CFU/100 ml for other recreational uses. Since the North Branch Park River is not considered a bathing area (designated or non-designated), sample results are compared against the latter criterion (576 CFU/100 ml). Additionally, the maximum geometric mean criterion is 126 CFU/100 ml.

Determining the potential sources of indicator bacteria is difficult, especially since precipitation conditions prior to and during the sampling events are not known. Elevated bacteria levels during wet weather suggest stormwater runoff and other non-point sources (sewer overflows, pet waste, waterfowl, septic systems, etc.) as likely contributors of pathogens in the North Branch Park River and its tributaries. Alternately, elevated dry weather concentrations may be related to illicit discharges, septic system failures, or natural sources of bacteria such as waterfowl or wildlife. Samples collected at the Farmington Avenue (6/16/08) and University of Hartford (6/16/99) monitoring locations exceeded the single sample water quality standard of 576 CFU/100 ml.

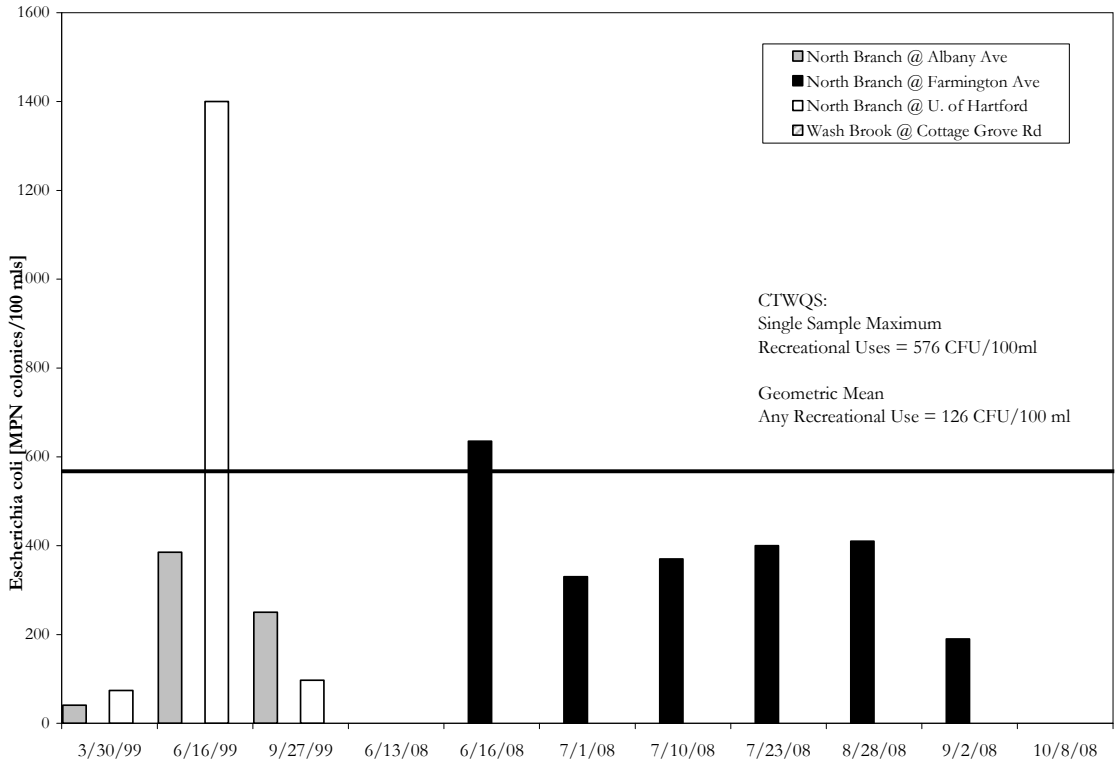


Figure 6-10. *Escherichia coli* – North Branch Park River Watershed

6.3.7 Bioassessments

The September 2008 RBV data generally indicate impacted water quality at the North Branch Park River monitoring locations, which suggests that the river is not fully supporting the state water quality standard for aquatic life. This finding is consistent with the impaired status of the North Branch Park River. No "most wanted" and a total of six "moderately wanted" macroinvertebrate types were found at the two assessment sites located on the North Branch Park River (Farmington Avenue and Watkinson School), while a total of nine "least wanted" types were noted. The CTDEP considers those locations where samples document 4 or more types of organisms in the "most wanted" category as fully supporting the state water quality standard for aquatic life.

6.4 Trinity College Monitoring Results

The results of the 2008 water quality monitoring project conducted by the Trinity College Environmental Science program (*Appendix D*) indicate relatively good water quality throughout most of the North Branch Park River watershed, except for Filley Brook where degraded water quality was observed (elevated chemical parameters, low dissolved oxygen, and physical observations of turbid water and a pungent odor). Chloride, nitrate and sulfate levels generally increased from the headwaters to the main stem of the North Branch Park River. Anion concentrations were elevated in Tumbledown Brook just downstream of the Wampanoag Golf Course, which may reflect impacts from golf course fertilizer runoff.

The Trinity College bioassessment results indicate fair to good water quality throughout the watershed. There was also little variability in the number (e.g., biotic index) or diversity of species (e.g., taxa richness) throughout the length of the river or over the duration of the monitoring event. Findings indicated that Wash Brook was the healthiest section of the watershed for both the number and diversity of aquatic macroinvertebrates. In general, the Beamans Brook and Tumbledown Brook tributaries were observed to have the greatest impacts. The Trinity College findings also indicate that the water quality in the North Branch Park River compared favorably to water quality measured by the program in the South Branch Park River (Gourley et al., 2008).