

## Introduction

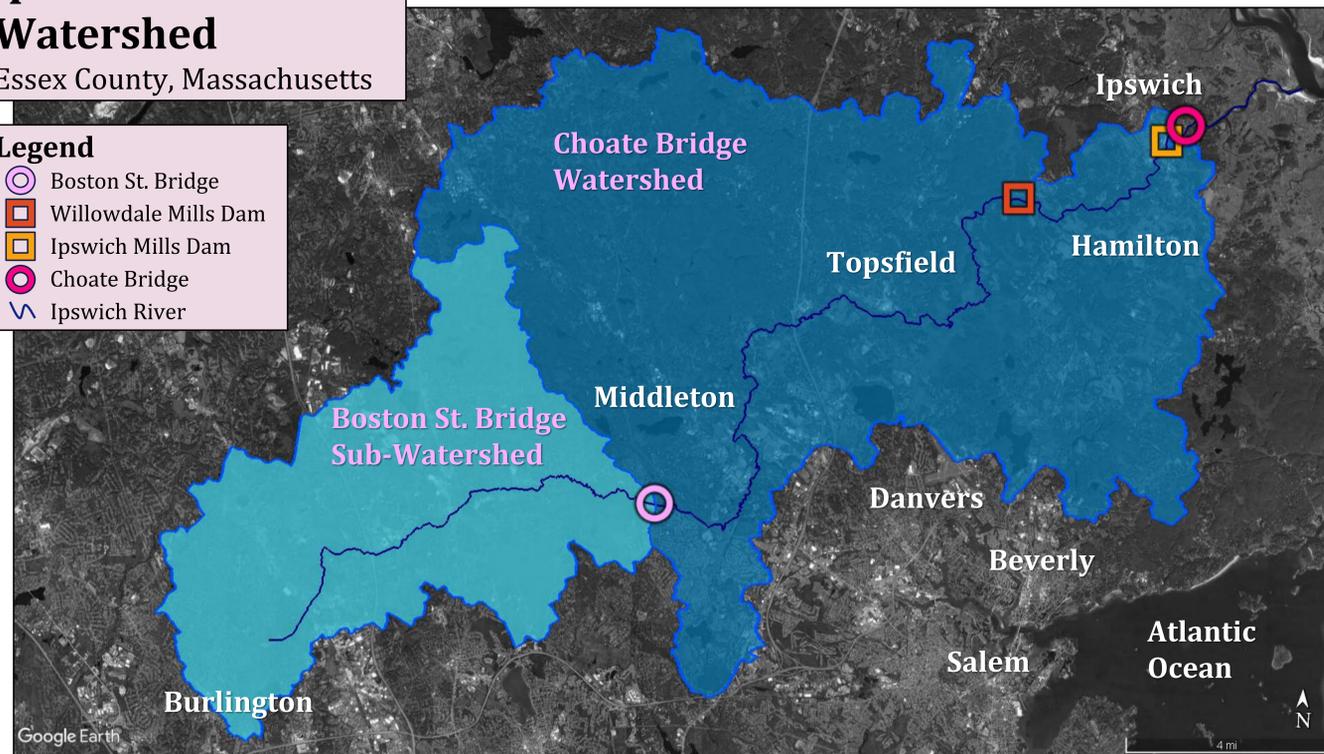
The Northshore of New England is a rapidly changing landscape where water quality is at risk of eutrophication due to suburbanization. Eutrophic conditions are due to increased plant nutrients allowing for algal bloom; decaying flora decreases levels of dissolved oxygen which inhibits biotic diversity. About fifty kilometers north of Boston the Ipswich River stretches from Burlington to Atlantic Ocean. There has been much research on the river, but a myopic approach to water quality is more illustrative of the anthropogenic impacts on riverine health on a local scale. Since environmental protections can be implemented municipally, a closer look at the Ipswich portion of the river may help to create modern policy to protect vulnerable subzones of surface water within the watershed from eutrophication.

## Ipswich River Watershed

Essex County, Massachusetts

### Legend

- Boston St. Bridge
- Willowdale Mills Dam
- Ipswich Mills Dam
- Choate Bridge
- Ipswich River



**Figure 1.** Map of the Ipswich River Watershed. Field sites are marked with various shapes defined within the legend. From east to west: the Boston Street Bridge site is in South Middleton while the Willowdale Mills Dam, Ipswich Mills Dam, and the Choate Bridge are each in Ipswich. The entire watershed is displayed in dark blue and the Boston St. Bridge sub-watershed in light blue. The water which precipitates into the total blue area is draining to the Choate Bridge site.

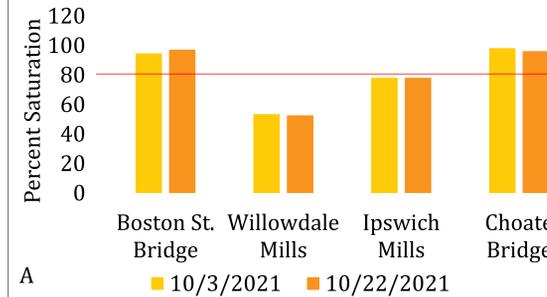
## Methods

- Water samples were collected along with in-situ hydrochemical measurements taken with the YSI-sonde instrument.
- Water samples were filtered in the lab, filters are awaiting processing to be run in the mass spectrometer to evaluate isotopic carbon, sulfur, and nitrogen ratios.
- Water chemistry data was evaluated with respect to discharge rates.

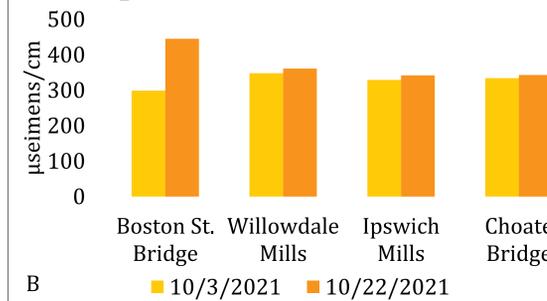
**Table 1:** Hydrochemical data collected from all four sites in order from upstream to downstream on each of the data collection days is displayed. Eutrophication can be chemically identified by low dissolved oxygen due to biotic decay, high specific conductance due to plant nutrients, high turbidity due to algae dominating the water column, and high pH due to plant nutrients.

	Date	Boston St. Bridge	Willowdale Mills	Ipswich Mills	Choate Bridge
DO%	10/3/2021	94.6	53.4	78.1	98.1
	10/22/2021	97.1	52.6	78.1	96.1
µseimens/c cm	10/3/2021	299	348	329	334
	10/22/2021	445	361	342	343
Turbidity NTU	10/3/2021	4.2	0.4	2.7	2
	10/22/2021	4	0	0.1	0
pH	10/3/2021	6.79	6.98	7	7.1
	10/22/2021	6.4	6.55	6.77	6.82

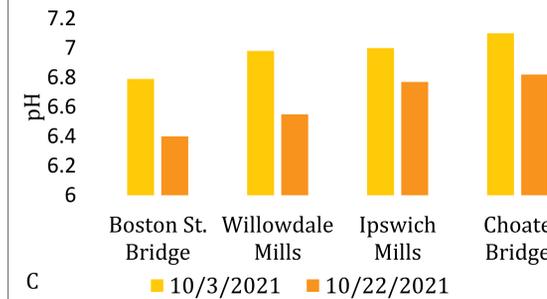
## Dissolved Oxygen



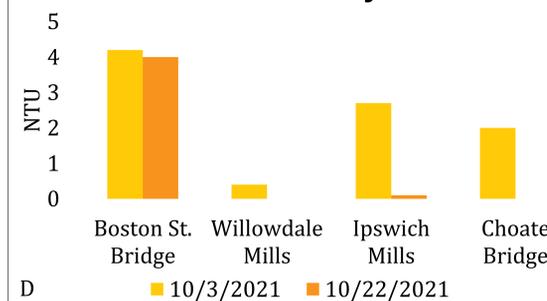
## Specific Conductance



## pH



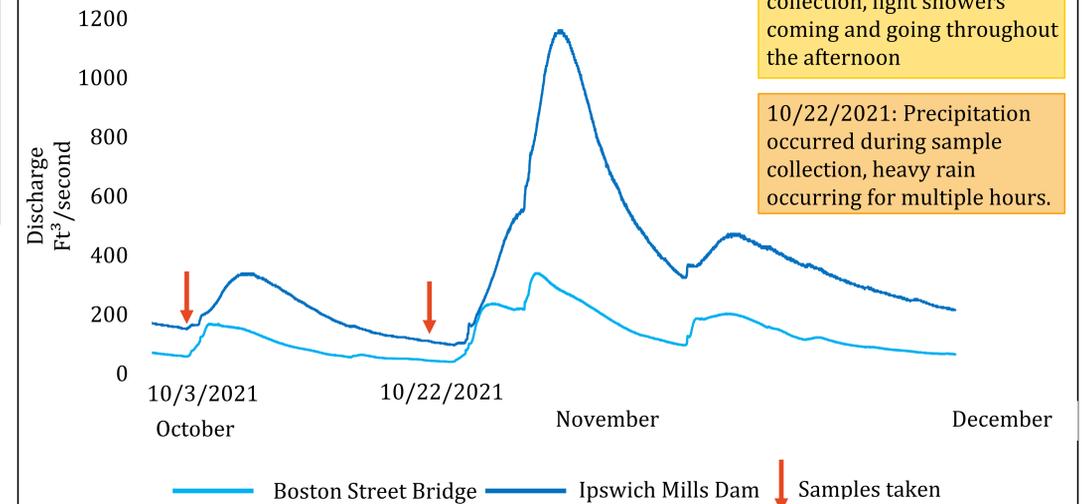
## Turbidity



**Figure 2:**  
**A:** Dissolved oxygen saturation levels are lowest at the dam sites. Dissolved oxygen rates between 80-120% are considered healthy, below 80% is not ideal and a signifier of eutrophication risk.  
**B:** Specific conductance increases with increased runoff.  
**C:** pH increases with increased photosynthesis.  
**D:** Turbidity increases with algae in the water column.

## Ipswich River Hydrographs

Fall 2021



**Figure 3:** Hydrograph created using discharge data from the USGS Stream Stats program. The portions of the curve with positive slope are rising limbs; displaying precipitation recharging the watershed. The portions which have a negative slope are falling limbs; water which is recharging the river but reached the measurement point more slowly. The peaks of the curves show the peak discharge; the highest water level. Inflow events show a steeper curve at the Boston Street Bridge location. This is likely due to a higher percentage of urbanized area within this watershed. The recharge curve of the Ipswich Mills Dam is gentler, likely due to a lower percentage of urbanized areas.

## Results

- Dissolved oxygen levels at the dam sites range from 52.6% to 78.1%. Levels at the bridge sites range from 94.6% to 98.1%.
- Specific conductance ranges between 299 and 445 µseimens/cm.
- pH ranges from 6.4 to 7.1.
- Turbidity ranges from 0 NTU to 4.2 NTU. The highest turbidities were measured at the Boston St. Bridge on both sampling days.
- Slope of the rising limbs for the Ipswich Mills Dam are lower than those for the Boston Street Bridge.
- Isotopic data pending.

## Discussion

While microzones of low dissolved oxygen saturation have been identified at the dam sites, present data is not supportive of eutrophication. Dissolved oxygen levels are lowest at the dams; while the percentages at the Willowdale Mills site were in a very low range, more data will be needed to further evaluate this phenomenon (Table 1, Figure 2A). Specific conductance levels are not directly correlated to eutrophication, but to runoff. Measured levels are indicative of runoff, each of the measurement sites are roadside. Turbidity is highest at the Boston Street Bridge, but not particularly high at the dam sites. Measured pH at all sites, on both sample days is not indicative of eutrophication. Basic pH is an indicator of eutrophication; pH ranged from acidic to neutral. Discharge data displays steeper recharge curves at the Boston Street Bridge and gentler curves at the Willowdale Mills Dam. This may be due to a higher percentage of urbanized, impermeable land within the Boston Street sub-watershed which restricts percolation of precipitated water into the ground. Since eutrophication is associated with increased plant nutrients from runoff, this data is relevant to whether this area may also be at risk of eutrophication. Present research shows that while this river is not experiencing major eutrophic conditions, water flow just before the dams is restricted which decreases dissolved oxygen saturation.