VRMP ANALYSIS IN THE PRESUMPSCOT RIVER WATERSHED

A View of Water Quality Monitoring in Maine

INTRODUCTION

The main stem of the Presumpscot River in Southern Maine flows 25.8 miles from Sebago Lake to Casco Bay. Water quality in the Presumpscot ranges from Class AA, or excellent quality, at its head to Class C, or poor quality, where it runs through highly developed urban areas. Starting in 2010, the Maine Department of Environmental Protection (DEP) began collecting water quality data from the Presumpscot River and its tributaries, among others, under a new initiative called the Volunteer River Monitoring Program (VRMP). Quality controlled data, including sample analysis for E. coli concentrations, is collected over eight sampling sessions from May through August by a non-profit organization called the Presumpscot River Watch.

2014 marked the fifth sampling season for the Presumpscot River Watch, which means that enough data exists for certain sites to be evaluated for future seasons. Eight sites were sampled consistently for the five-year period and the changes in average E. coli concentrations and river classes may be observed under *Results.* A number of possible explanations for changes in water quality exist. **These sites were examined in conjunction with sources of non-point pollution resulting from changes in land use (i.e. impervious cover) over the five year period.**

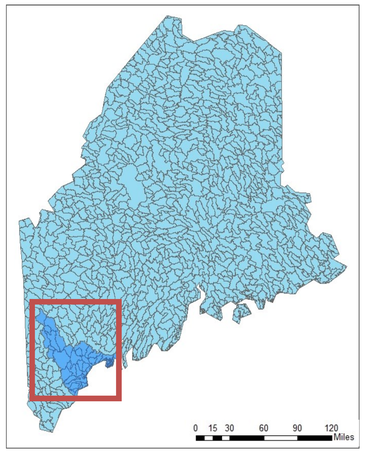
METHODS

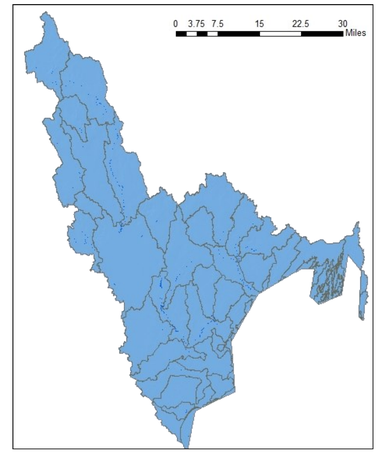
To identify changes in annual averages for E. coli at each of the eight sites:

- Annual E. coli data was compiled from the Maine DEP VRMP Reports (2010-2014) in Microsoft Excel and converted into ArcMap shapefiles.
- Water quality data tables by year were joined with georeferenced tables of site IDs and coordinates in latitude and longitude
- E. coli data points were classified by graduated color based on the DEP contamination threshold (maximum of 63 MPN/100 mL for Class B; maximum of 126 MPN/100 mL for Class C)

To compare to changes in land use:

- Sites where water quality **remained static** were referenced with the 2011 Land Cover raster (see *Figure 6.*)
- Sites where water quality **increased** were referenced with Figure 6. then compared to relative impervious cover shown in aerial photographs. Sites where water quality **decreased** were evaluated using the same method.





RESULTS

Table 1. River Class by E. Coli Concentration

Year	BB010	DB010	PL040	N010	PL010	P135	M010	P020
2010	<	C	<	<	B	B	<	C
2011	C	B	<	<	C	B	<	<
2012	C	B	<	<	<	B	<	C
2013	C	B	<	<	<	C	<	C
2014	C	B	<	<	<	<	<	<

Table 1 (left) shows the classification of each site based on average E. coli concentration (in MPN/100 mL) for each annual sampling season 2010-2014. "Less than" symbols indicate sites with average E. coli concentrations exceeded the maximum geometric mean for Class C rivers (126/100 mL), and thus are classified below Class C.

These values are represented in figures 1-5 below.

Table 2 (right) describes the changes in water quality based on E. coli concentration shown above (Table 1) along with the degree of development in land directly surrounding the site.

The sites where water quality **increased** (BB010, DB010) were areas of permeable surfaces and relatively low development. These are residential areas in Windham, Maine.

The sites where water quality **remained static** (PL040, N010, M010) varied in intensity of development but %IC did not significantly change over the five year period. PL040 and N010 are residential areas; M010 is at the end of a culvert.

The sites where water quality **decreased** (PL010, P135) have seen an increase in %IC as the areas have been developed.

Table 2. Change in Water Quality and Land Use

Site ID	Quality	Land Use
BB010	Increase	Low Intensity Development
DB010	Increase	Mixed Forest, Low Intensity Development
PL040	Static	Low/Medium Intensity Development
N010	Static	Low Intensity Development
PL010	Decrease	Increase in % Impervious Cover
P135	Decrease	Increase in % IC and Recreation
M010	Static	Medium/High Intensity Development
P020	Variable	High Intensity Development

Figures 1-5. VRMP Site Classifications

Maps below show water quality classifications (AA through below C) based on sampled E. coli concentrations.

- Class B
- Class C
- < Class C

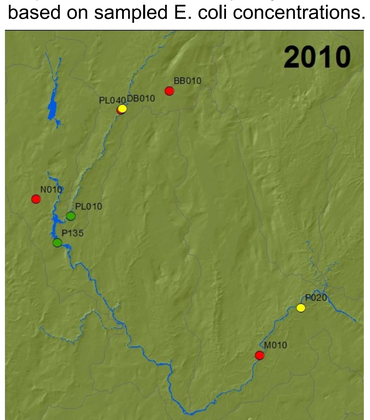


Figure 1.

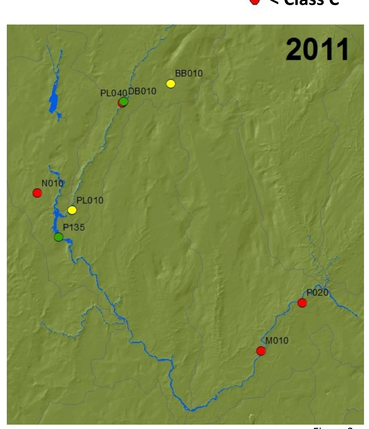


Figure 2.

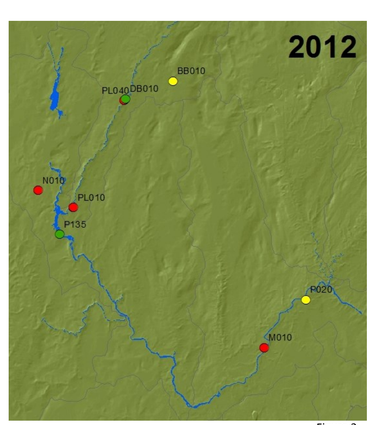


Figure 3.

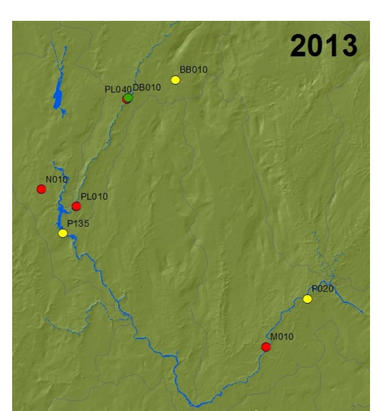


Figure 4.

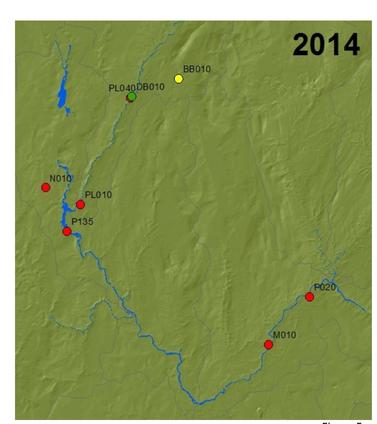


Figure 5.

CONCLUSIONS

Of the eight VRMP sites with five year of water quality data, three remained static with average E. coli concentrations above the maximum for Class C stream health, two saw steady improvement in water quality, and two experienced a steady decline in water quality over that period. The eighth site, P020 (Portland), showed no clear trend in water quality, fluctuating between Class C and exceeding Class C E. coli concentrations.

As can be seen in Figure 6 below, sampling sites in more developed areas (medium to high intensity, as indicated in the legend) consistently report lower classes of water quality. This is an expected correlation because of the impact of impervious cover on rates of runoff and sedimentation especially during storm events. Decreases in water quality at sites PL010 and P135 coincides with increases in the intensity of development and, by extension, increases in impervious cover (%IC) since Figure 6 was mapped in 2011.

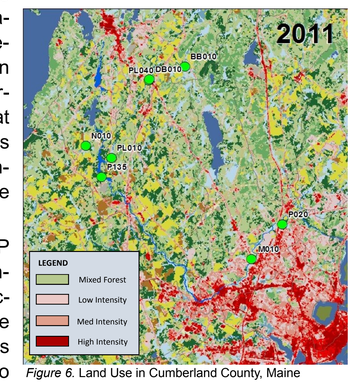


Figure 6. Land Use in Cumberland County, Maine

Volunteer monitoring programs like VRMP are an invaluable resource in water quality monitoring, but that resource is not unlimited. I recommend that sampling be discontinued at site DB010, which has maintained its improved class B status for four seasons. Sampling could also be discontinued at BB010 for the same reason.

For sites not meeting standards for Class C streams, sampling should continue alongside community outreach campaigns to raise awareness and improve the stagnant water quality. Sampling should continue for declining sites PL010 and P135 until improvement is consistently observed.

Nonpoint source pollution is hard to trace by nature. Because of this, while impervious cover is a good proxy for determining general sources of pollution, it cannot be directly translated to quantitative water quality data in the qualitative way that it was applied here. For the purposes discussed above, using degree of development qualitatively does not significantly hinder the proposed recommendations (see *Conclusions*).

Here, water quality was classified solely based on bacterial content. While E. coli, as a form of fecal coliform, is a good indicator of stream contamination, it cannot serve as the sole determinant of the health of a stream. The scope of this project did not allow for further detailed analysis including variables such as dissolved oxygen concentration, flow direction, and agricultural activity as was originally intended.

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Data Sources: ***National Elevation Dataset (2004); National Hydrography Dataset (2014), Maine DEP VRMP Data Reports (2010-2014), NLCD Land Cover Raster (2011)***

Projection: ***NAD 1983 UTM Zone 19N***