Community awareness of the water quality surrounding them
(Sensibiliser les communautés à la qualité de l'eau qui les entoure)

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November 2015

New Nouveau Brunswick
CANADA

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1. Introduction

For the last 15 years, the Southeastern Anglers Association Inc. has been collecting water quality data in the Cocagne, Bouctouche and Chockpish watersheds. In the summer (June, July, August and September) of 2015, the following parameters were recorded:

- Physical
  - Water temperature
  - Dissolved oxygen
  - pH
  - Specific conductivity
  - Salinity
- Chemical
  - Nitrates
  - Phosphates
- Bacterial
  - E. coli

Watersheds along New Brunswick coasts have a long history of land use. Unfortunately, the over-development along our coastline results in the degradation of our water quality. To make sure that nothing alarming is occurring in our rivers, we have choose sites that are easy to access, and seem to be of more concern.

The objectives of this project is to monitor water quality data and compare them with the previous years so we can see if something is happening in a location that need further actions. Also, we want to make the data accessible to the public via our website.

2. Sampling Sites

The Cocagne, Bouctouche and Chockpish watersheds are located in Kent County, in southeastern New Brunswick (fig.1). All waters flows into the Northumberland Strait drainage, which is part of the Gulf of St. Lawrence ecosystem. Table 1 list the sampling site with GPS coordinates.

The sampling site BC25 is a little upstream from the original sampling site BC23. We changed the location of the site and only started to monitor it in July because the Department of Transportation was replacing an old bridge on route 490.

Table 1: Sampling sites in Bouctouche, Cocagne and Chockpish watersheds with the name of river/stream and GPS coordinates.

Site ID	Watershed	Name of river/stream	GPS Coordinates (N)	GPS Coordinates (W)
BC02	Bouctouche	Mill Creek	46 26 44.2	064 49 36.2
BC08	Bouctouche	North Branch	46 22 15.6	064 56 36.5
BC25	Bouctouche	South Branch	46 19 00.6	064 53 88.4
BR01	Bouctouche	Black River	46 30 17.5	064 45 09.6
CO01	Cocagne	Murray Brook	46 20 22.5	064 39 58.8
CO03	Cocagne	Cocagne	46 18 54.4	064 43 43.9
CO04	Cocagne	Northwest Branch	46 18 40.3	064 44 44.8
CO09	Cocagne	Cocagne	46 15 25.1	064 50 50.8
LBOC	Bouctouche	Little Bouctouche	46 25 09.4	064 43 42.0
CH01	Chockpish	Chockpish	46 33 56.7	064 45 33.4

Figure 1: Location of the water quality sampling sites within the Bouctouche, Cocagne and Chockpish watersheds.

3. Material and Methods

Once a month, we are going in the field collecting our water samples. For that, we need:
-Map
-GPS
-All-weather notebook and pencils
-Waders
-Camera
-YSI meter
-pH meter
-bottles from the laboratory
-cooler with ice packs
-first aid kit

- Parameters measured *in-situ*

With the YSI meter, we can measure in the field the water temperature, the dissolved oxygen, the conductivity and the salinity. We also have a pH meter.

- Parameters measured in the laboratory

As we wanted to know the level of E.coli and nitrates and phosphates in our rivers but we don't have the equipment to do the analysis, we have contracted the Petitcodiac Watershed Monitoring Group to do the analysis for us. They were providing us with pre-washed bottles that we filled up in the field. However, in July we noticed that their detection limits for E.coli was below the guideline limit for recreational water (400 MPN/100ml). So there was no way for us to know if there was a problem of E.coli concentration in our rivers. In August we contacted another laboratory (RPC Science & Engineering) and their analysis were more helpful. Except that their costs were higher so we only had enough money to do another month of sampling.

- Mapping

The mapping was done with the program ArcGIS and will be accessible to all via our website: www.saa-aprse.ca.

4. Results and Discussion

- Physical parameters:

Water temperature

Water temperature is a parameter that can affect the whole aquatic community. Temperature determines which organisms are able to survive in a certain environment. For example, the family Salmonidae has the lowest thermal tolerance found to date with maximum upper lethal temperature barely exceeding 25°C (Brett 1956). Of that family, the Atlantic salmon has the highest temperature tolerance (Elliott and Elliott 2010) and at the opposite Brook trout are one of the most sensitive to warm water, and tend to avoid temperatures greater than 20°C (Garside 1973).

Also, when the temperature is higher, this allows for increased biological growth (e-coli and total coliform growth)

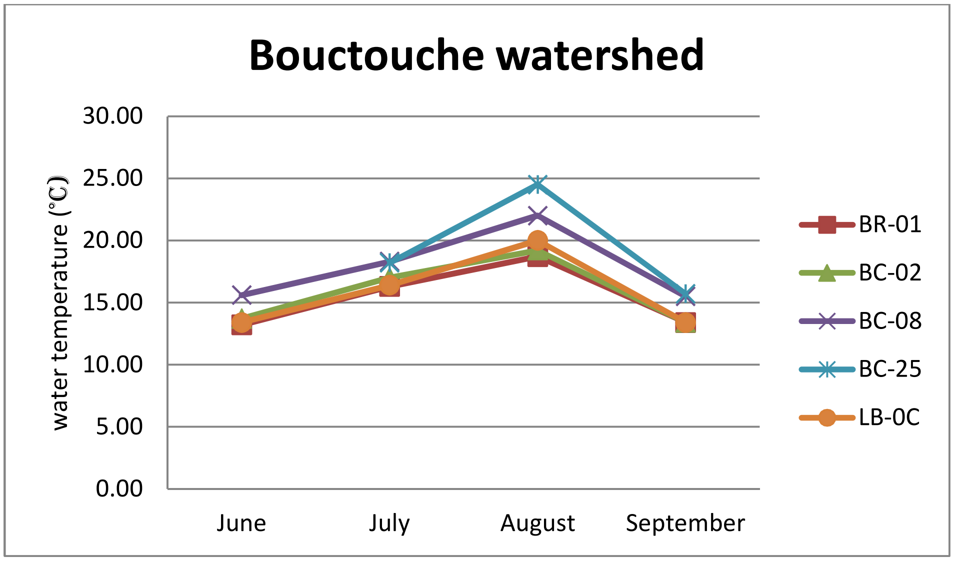

Figure 2: Water temperature (°C) per month (June, July, August and September) at 5 sampling sites (BR01, BC02, BC08, BC25 and LBOC) in the Bouctouche Watershed.

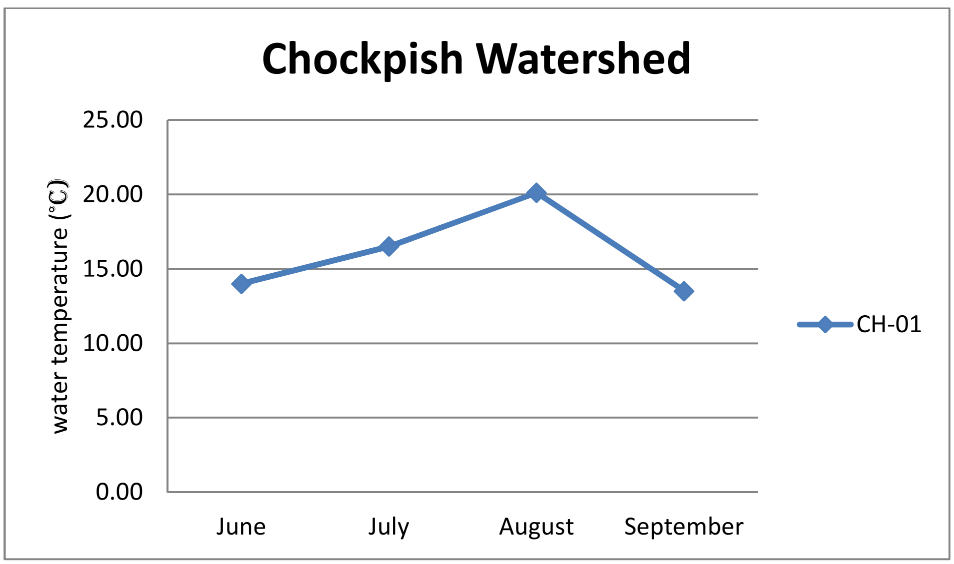

Figure 3: Water temperature (°C) per month (June, July, August and September) at 1 sampling site (CH01) in the Chockpish watershed.

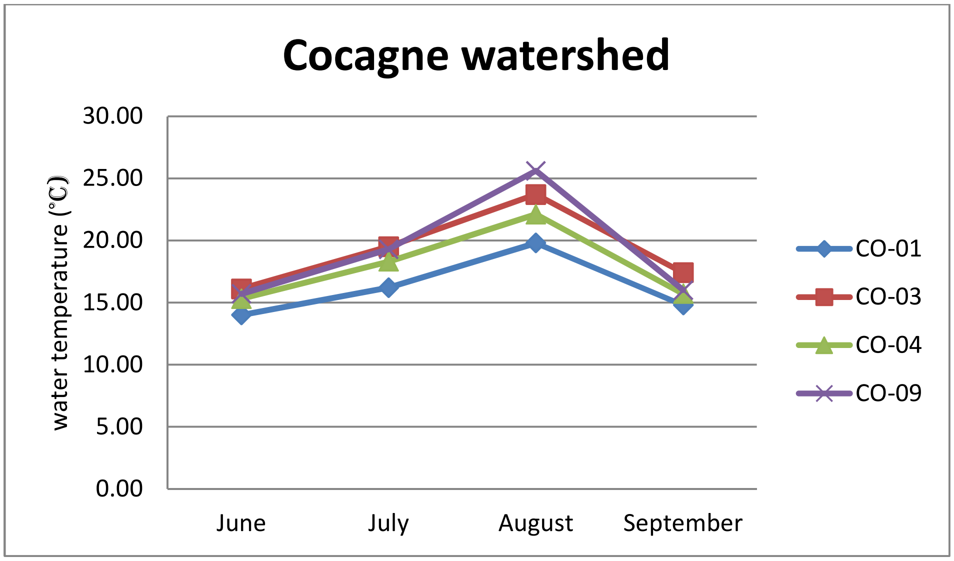

Figure 4: Water temperature (˚C) per month (June, July, August and September) at 4 sampling site (CO01, CO03, CO04 and CO09) in the Cocagne watershed.

As displayed in the figures 2, 3 and 4 above, several sites reached temperature above 20˚C in August. August 2015 was exceptionally hot and dry with a temperature average of 27˚C and only 38mm of rain (http://climate.weather.gc.ca). In the Bouctouche watershed, the water temperature reached a concerning 22˚C in the North Branch (BC08) and an alarming 24.5˚C in the South Branch (BC25). This is supporting the fact that anglers in these regions haven't caught trout as usual this year. In the Chockpish watershed the highest temperature recorded this summer was 20.1˚C. And finally, in the Cocagne watershed, the water temperature reached 22.10˚C in the Northwest Branch (CO04) and 23.7˚C and 25.6˚C in the Cocagne, respectively at CO03 and CO09. This is indicating us that the water temperature may no longer provide a suitable habitat for the family Salmonidae in the summer.

Dissolved oxygen

The amount of dissolved oxygen can have a huge effect on the quality and quantity of aquatic life present in a given water body. The proportion of dissolved oxygen is influenced by several factors like, salinity, currents, biological processes (CCME 1999). Also, temperature directly affects this parameter, whereas higher temperatures diminish the amount of dissolved oxygen present in a water body. As you can see in the figures 5, 6 and 7 below, the dissolved oxygen dropped at all sites in August following the water temperature trend.

With the guidelines in Table 2 in mind, we can see in the graphs 5, 6 and 7 that in August at 7/10 sites the dissolved oxygen levels were lower then what needed for all life stages.

Table 2: Water quality guidelines for dissolved oxygen in freshwater for the protection of aquatic life (CCME1999).

	Guidelines value (mg/l)	
Ecosystem	**Early life stages**	**Other life stages**
Warm water	6	5.5
Cold water	9.5	6.5

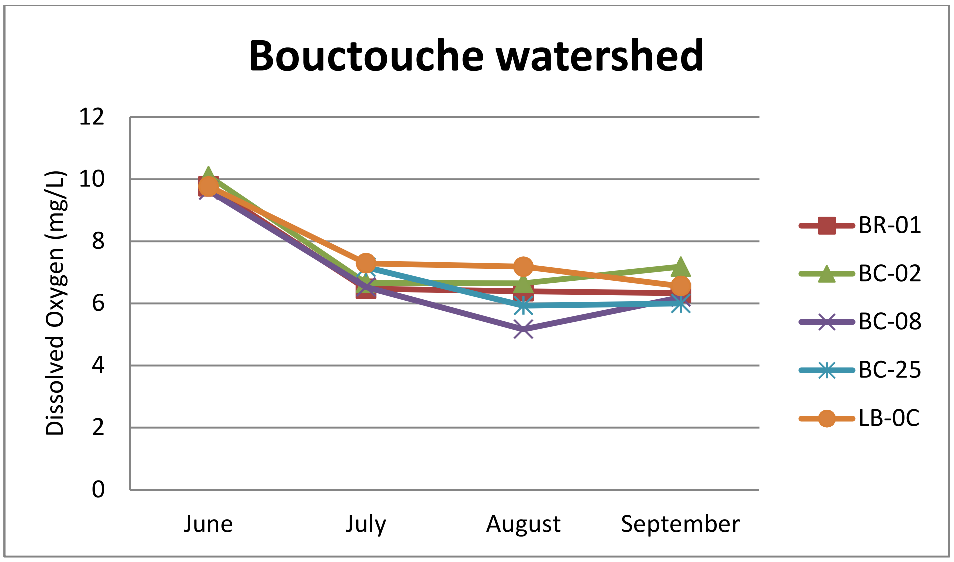

Figure 5: Dissolved oxygen (mg/l) per month (June, July, August and September) at 5 sampling sites (BR01, BC02, BC08, BC25 and LBOC) in the Bouctouche Watershed.

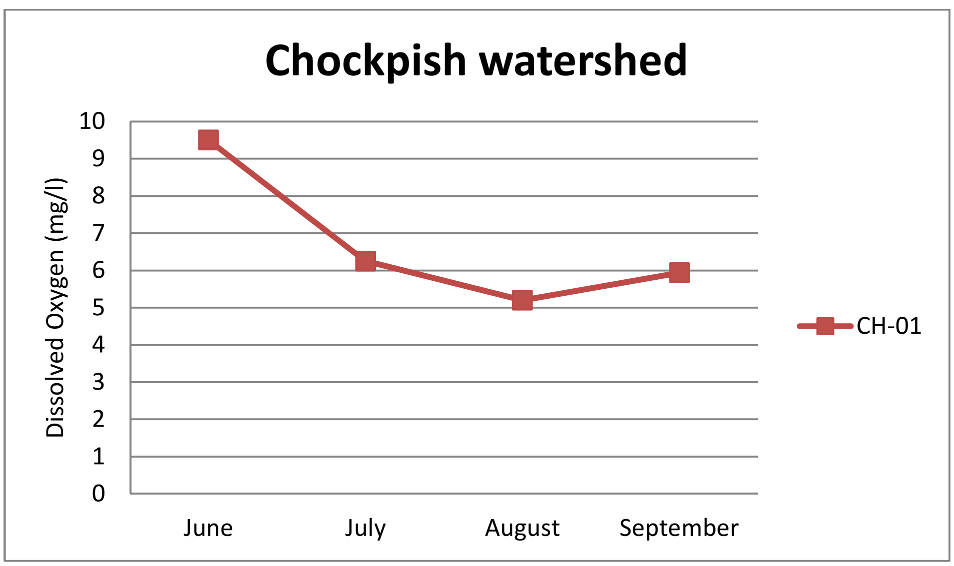

Figure 6: Dissolved oxygen (mg/l) per month (June, July, August and September) at 1 sampling site (CH01) in the Chockpish watershed.

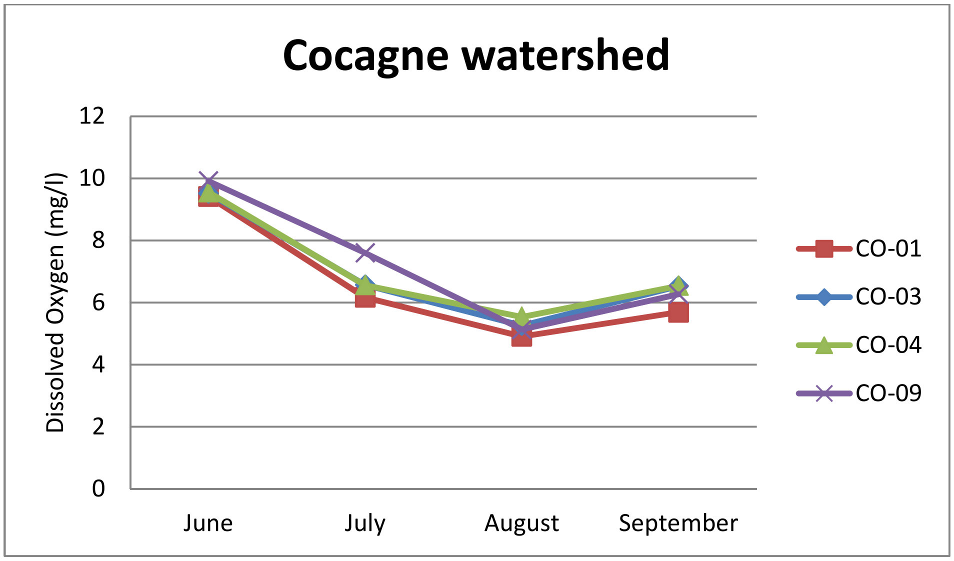

Figure 7: Dissolved oxygen (mg/l) per month (June, July, August and September) at 4 sampling site (CO01, CO03, CO04 and CO09) in the Cocagne watershed.

pH

This parameter measures the acidity of water. A pH range of 6.5 to 9 is recommended for the protection of aquatic life. This suggested range is preferred by most aquatic life; below this range the diversity of aquatic life in the watercourse would be reduced because of the stress (Province of New Brunswick 2000). Figure 8 shows that the pH drops below 6.5 at most of the sites in September. The same pattern is happening in the Chockpish watershed (figure 9). In the Cocagne watershed, the pH is also variable but always above 6.

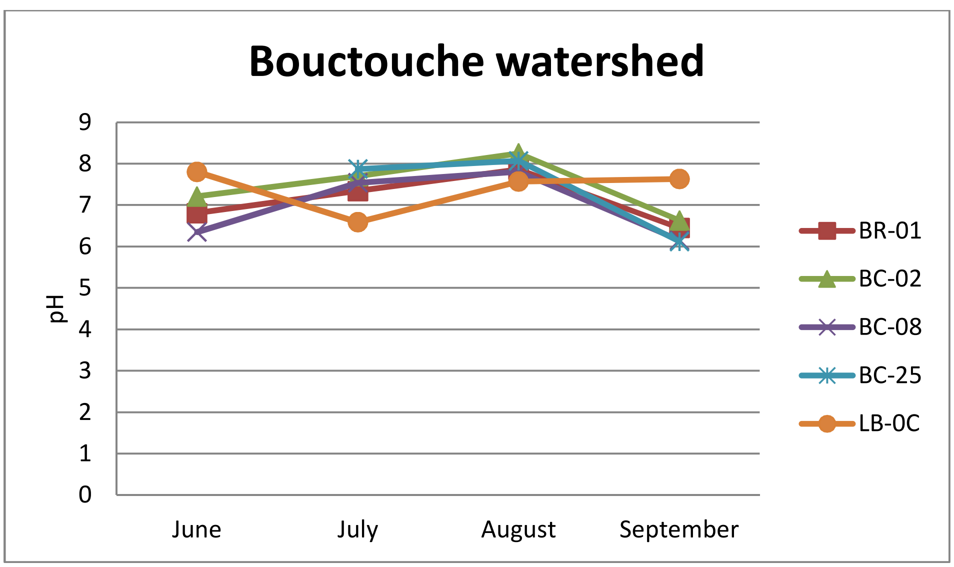

Figure 8: pH per month (June, July, August and September) at 5 sampling sites (BR01, BC02, BC08, BC25 and LBOC) in the Bouctouche Watershed.

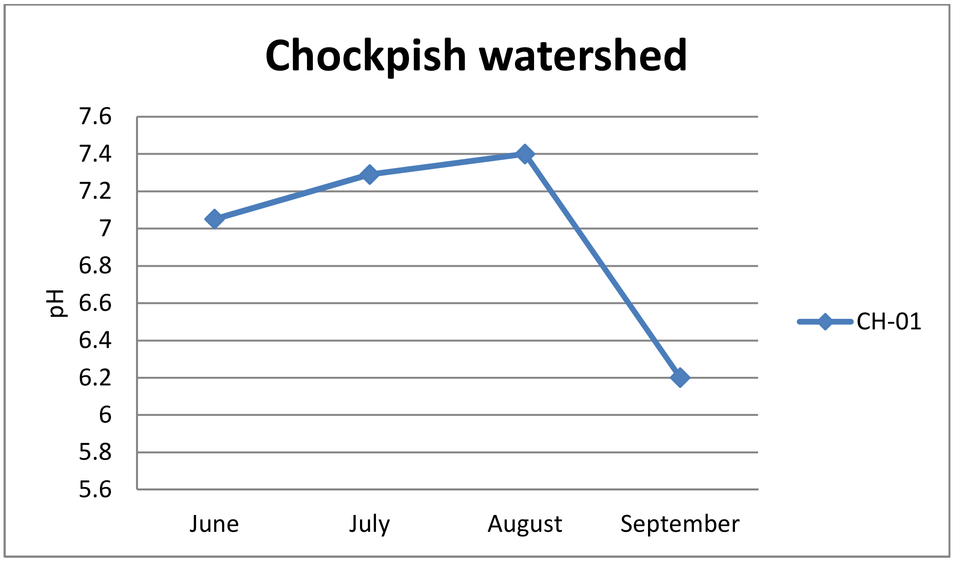

Figure 9: pH per month (June, July, August and September) at 1 sampling site (CH01) in the Chockpish watershed.

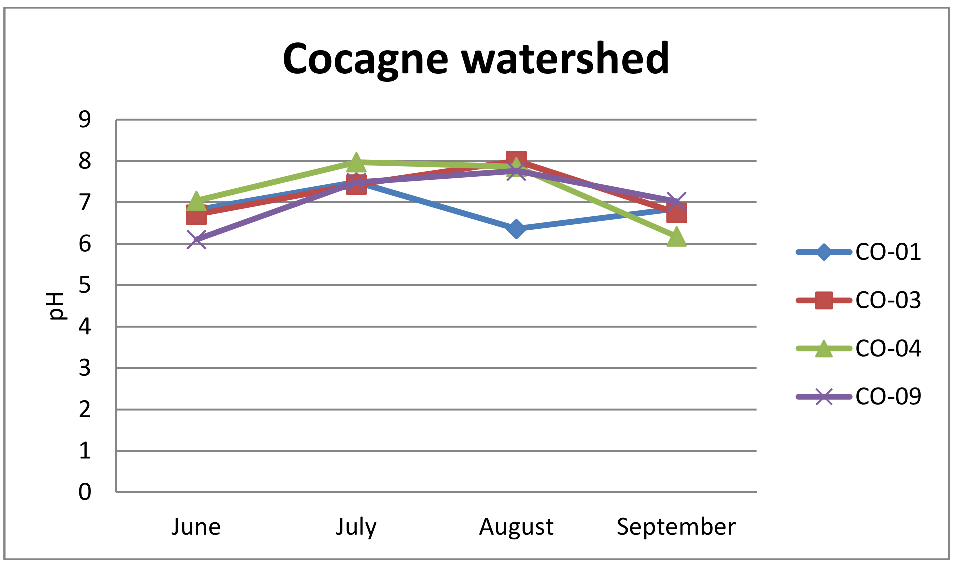

Figure 10: pH per month (June, July, August and September) at 4 sampling site (CO01, CO03, CO04 and CO09) in the Cocagne watershed.

Specific conductivity

Conductivity is the measure of mineralization or the number of total dissolved solids found in water. Total dissolved solids information can be used to determine the overall ionic effect in a water source. The number of available ions in a water body can have certain physiological effects on plants and animals. When there is an excess of dissolved solids in a water body, this can contribute to the elimination of desirable food plants and habitat forming plant species.There are no limits for conductivity. Watercourses that are not subject to influences by tidal waters will have fairly constant values for conductivity

(Province of New Brunswick 2000). This would explain why the most upstream sites have constant values (figures 11, 12 and 13). Also, figures 14, 15 and 16 are showing a slightly increase in salinity which would explain the influences by tidal waters.

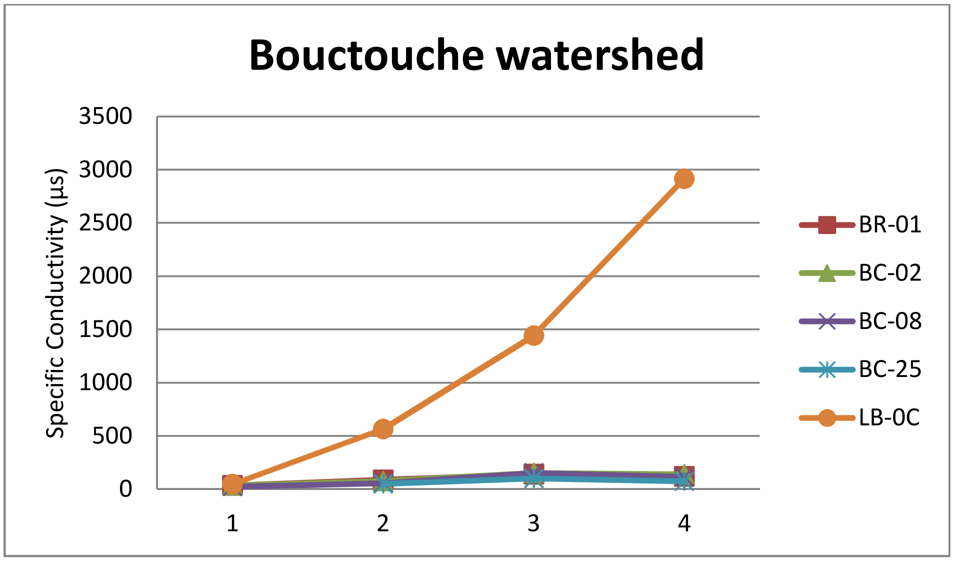

Figure 11: pH per month (June, July, August and September) at 5 sampling sites (BR01, BC02, BC08, BC25 and LBOC) in the Bouctouche Watershed.

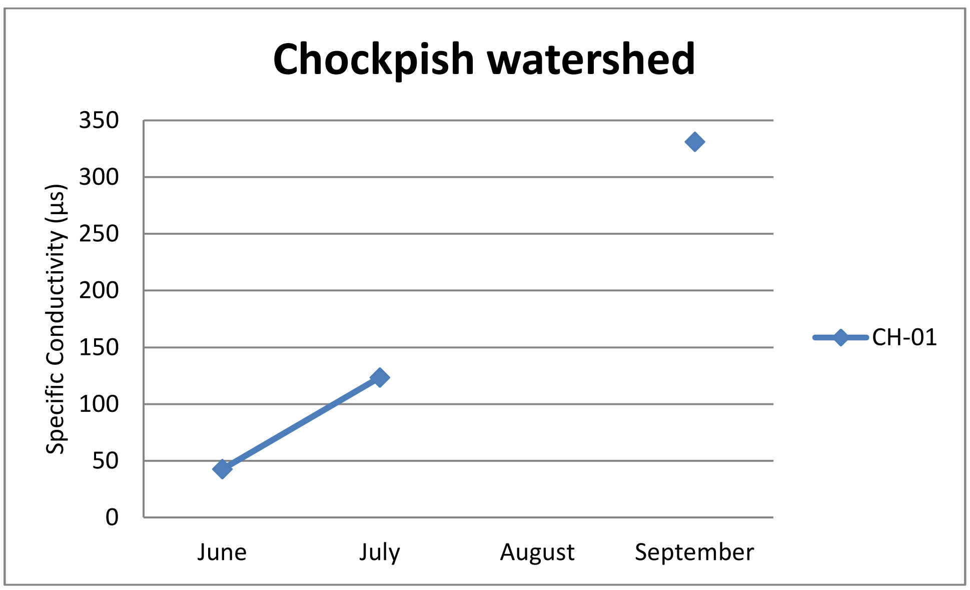

Figure 12: Specific conductivity (µs) per month (June, July, August and September) at 1 sampling site (CH01) in the Chockpish watershed.

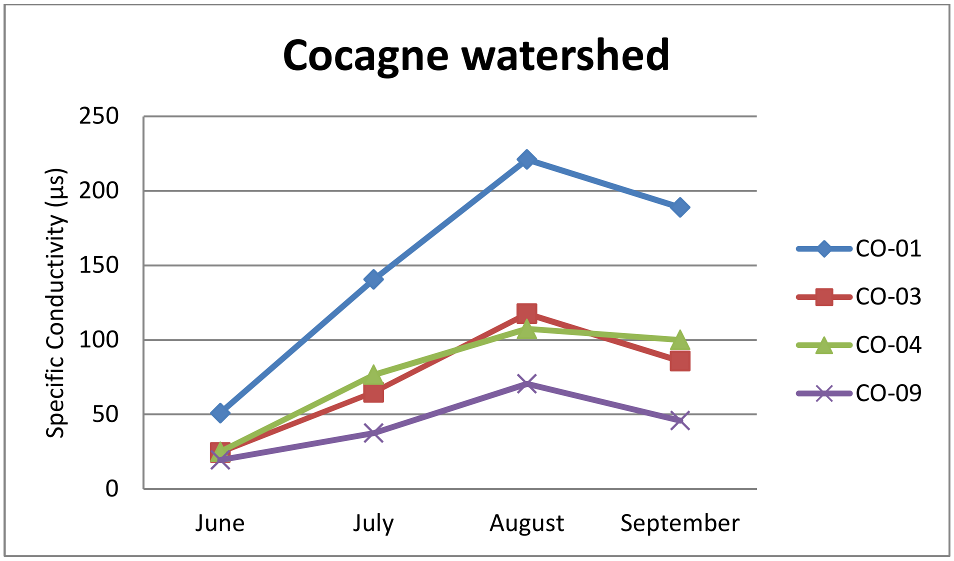

Figure 13: Specific conductivity (µs) per month (June, July, August and September) at 4 sampling site (CO01, CO03, CO04 and CO09) in the Cocagne watershed.

Salinity

The salinity of freshwater should be 0 ppt, but the influences of tidal waters can change it a little in time.

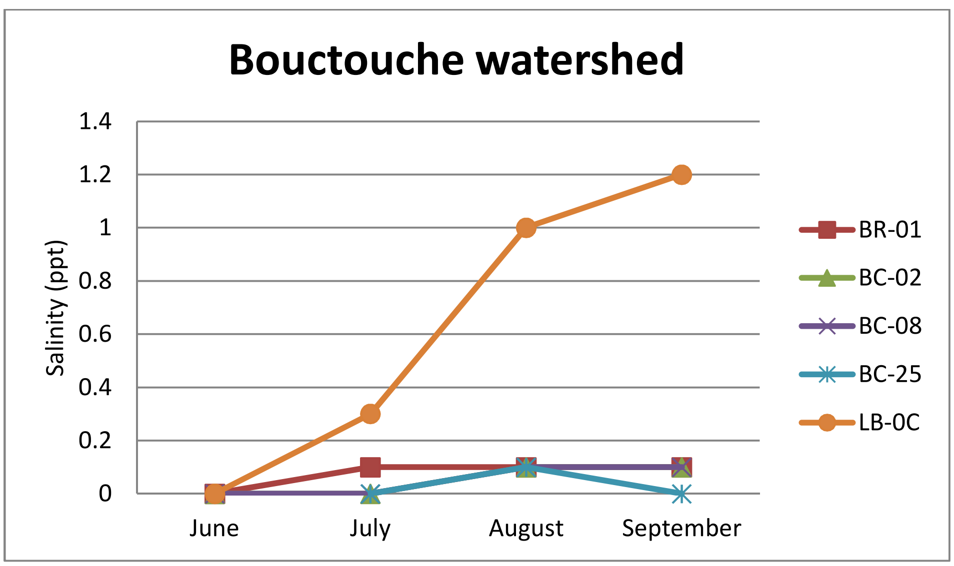

Figure 14: Salinity (ppt) per month (June, July, August and September) at 5 sampling sites (BR01, BC02, BC08, BC25 and LBOC) in the Bouctouche Watershed.

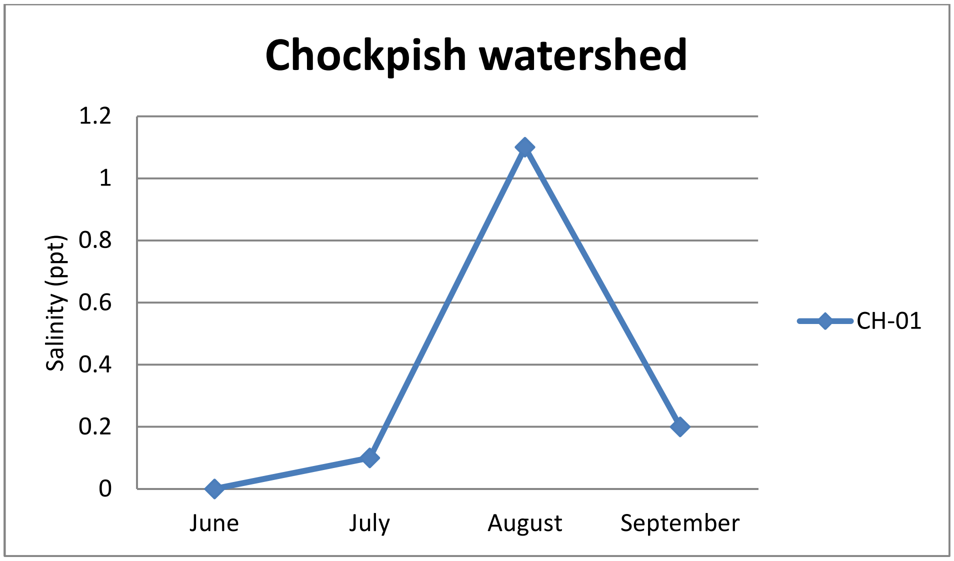

Figure 15: Salinity (ppt) per month (June, July, August and September) at 1 sampling site (CH01) in the Chockpish watershed.

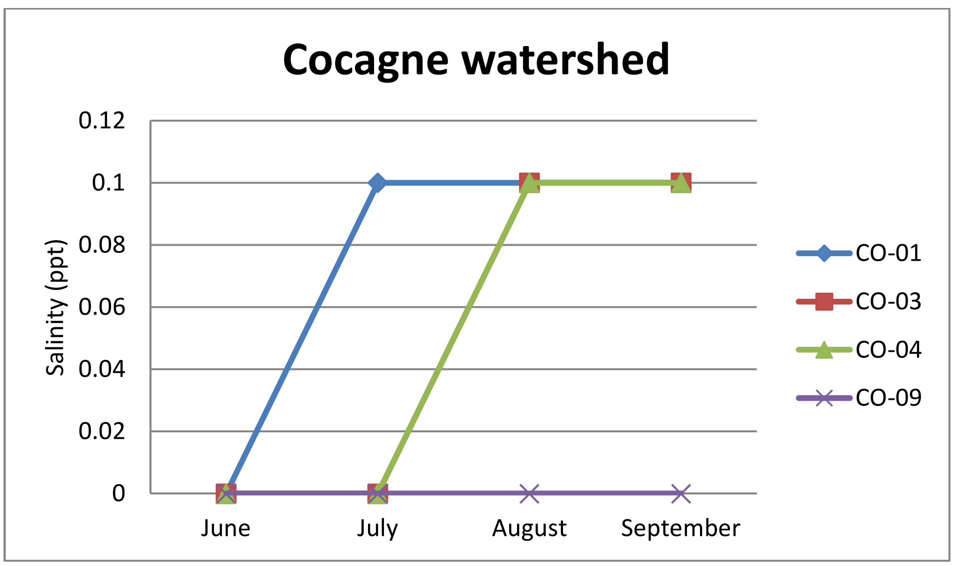

Figure 16: Salinity (ppt) per month (June, July, August and September) at 4 sampling site (CO01, CO03, CO04 and CO09) in the Cocagne watershed.

- Chemical parameters:

Nitrates and Phosphates

Although the presence of small amounts of phosphates and nitrates in a water body is normal, too much of these can be problematic. Excess nitrates and phosphates encourage plant growth and can result in algae blooms. When there is excessive plant growth and decomposition, the dissolved oxygen levels decrease, potentially affecting fish population and habitat (Province of New Brunswick 2000).

Excessive phosphates and nitrates in a water body can come from many sources such as nearby septic tanks, runoff from feeding lots, runoff from agriculture or runoff from wastewater treatment plants. There is no phosphates guideline limit for aquatic life. The guideline limit for the nitrate in freshwater is 13 mg/l (CCME 2003). Nitrates levels in fresh surface water are usually 1 to 5 mg/l. Figures 17 through 22 show that nitrates and phosphates values are fairly low in the Bouctouche, Cocagne and Chockpish watersheds and that even the peaks are not concerning.

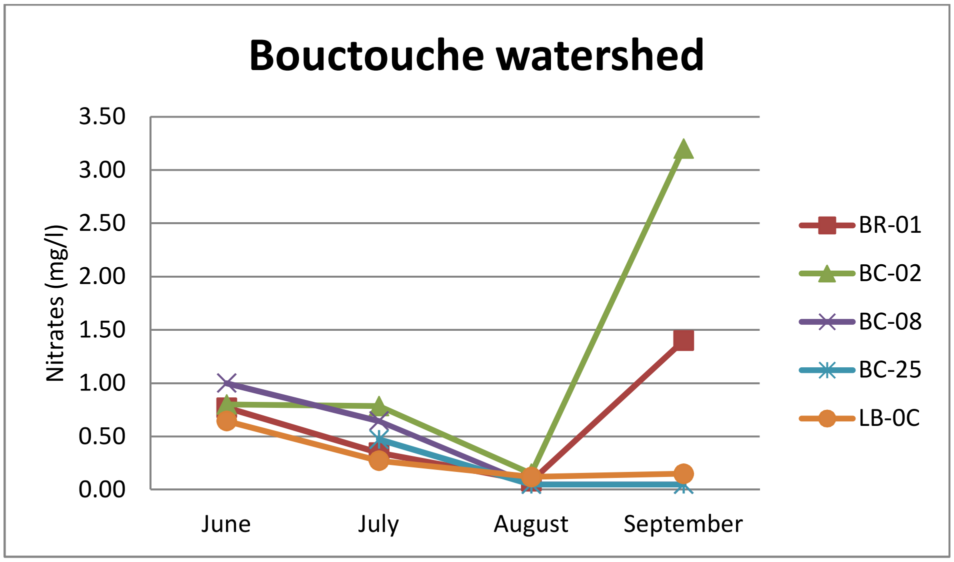

Figure 17: Nitrates (mg/l) per month (June, July, August and September) at 5 sampling sites (BR01, BC02, BC08, BC25 and LBOC) in the Bouctouche Watershed.

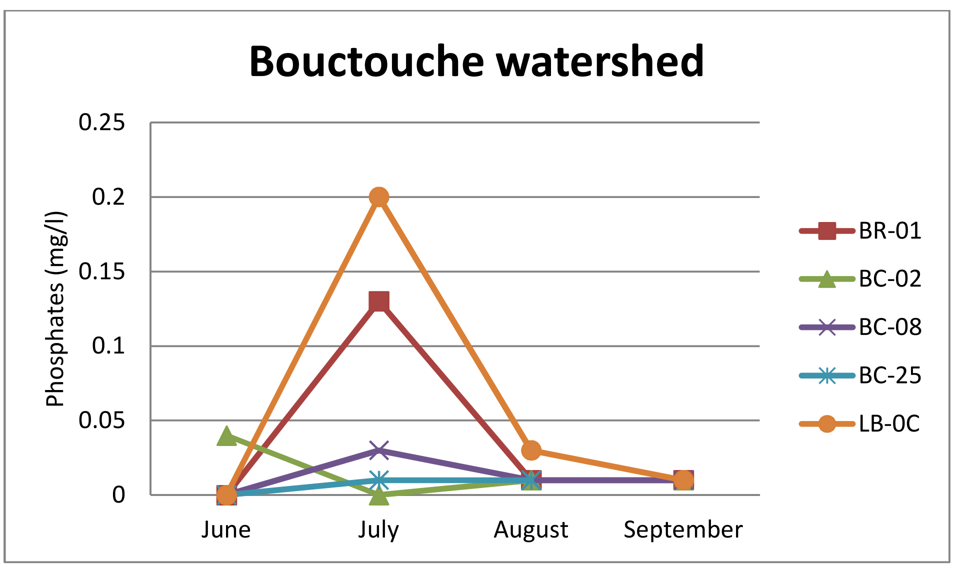

Figure 18: Phosphates (mg/l) per month (June, July, August and September) at 5 sampling sites (BR01, BC02, BC08, BC25 and LBOC) in the Bouctouche Watershed.

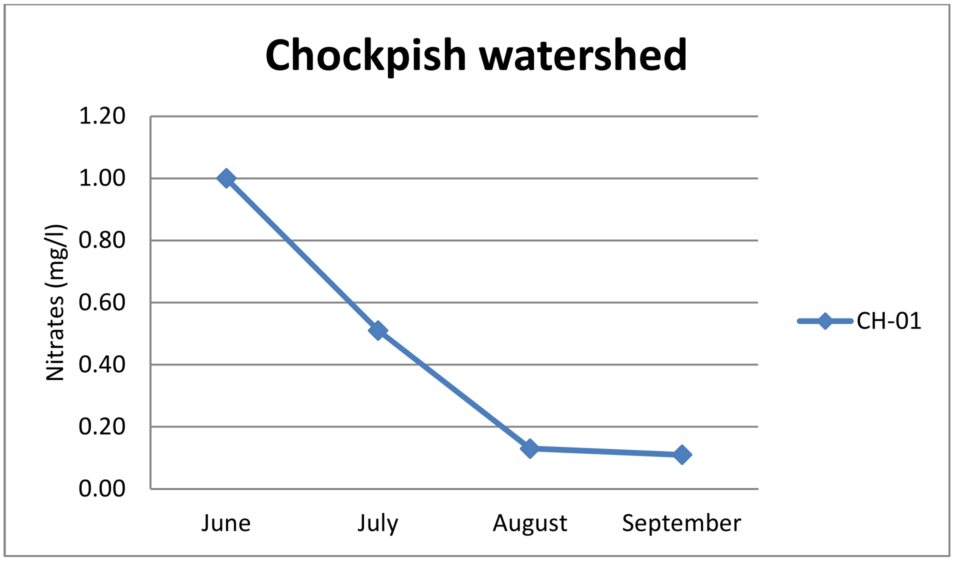

Figure 19: Nitrates (mg/l) per month (June, July, August and September) at 1 sampling site (CH01) in the Chockpish watershed.

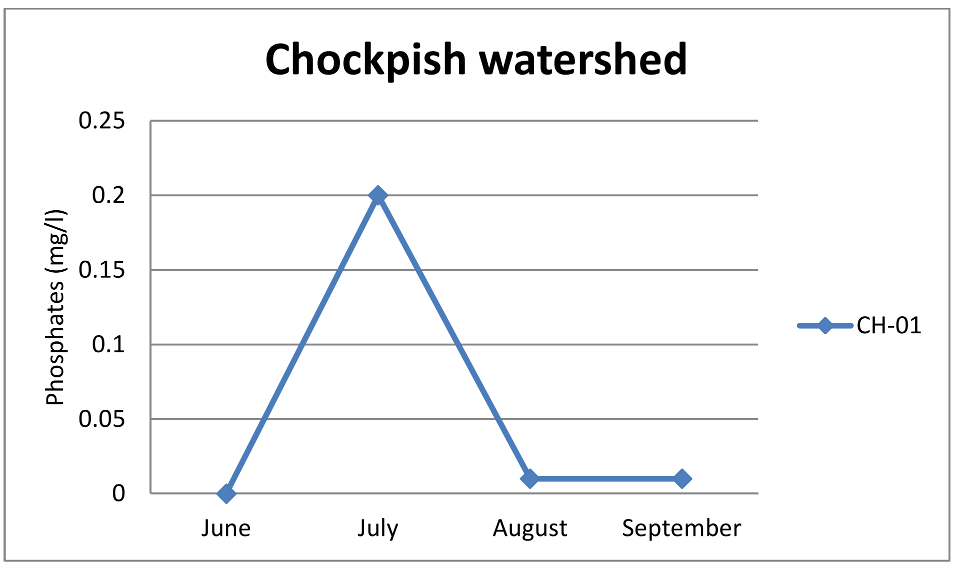

Figure 20: Phosphate (mg/l) per month (June, July, August and September) at 1 sampling site (CH01) in the Chockpish watershed.

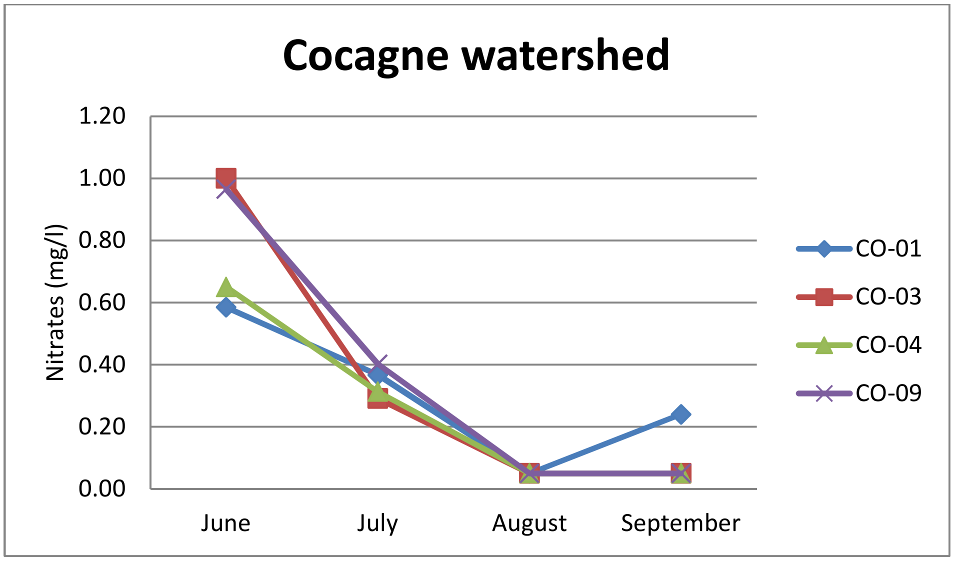

Figure 21: Nitrates (mg/l) per month (June, July, August and September) at 4 sampling site (CO01, CO03, CO04 and CO09) in the Cocagne watershed.

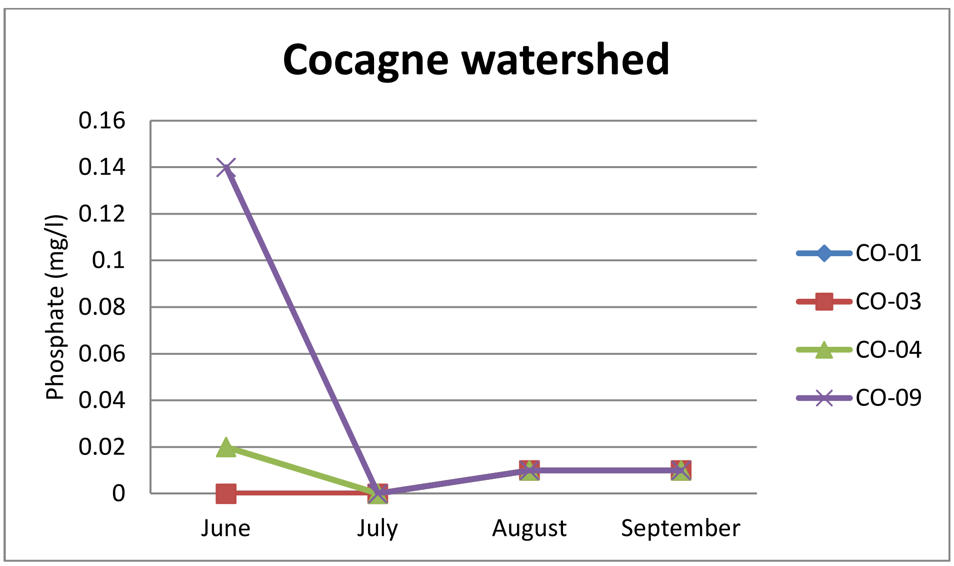

Figure 22: Phosphates (mg/l) per month (June, July, August and September) at 4 sampling site (CO01, CO03, CO04 and CO09) in the Cocagne watershed.

- Bacterial parameters:

E.coli (Escherichia coli)

Escherichia coli is the most appropriate indicator of faecal contamination in fresh recreational waters (Health Canada 2012). The presence of E. coli indicates recent fecal contamination and therefore poses a possible health risk (Province of New Brunswick 2000). There is no guideline limit for *E.coli* for the protection if aquatic life (Province of New Brunswick 2000). The limit for recreational water is 400 cfu/100ml (Health Canada 2012).

As discuss in the Material and Methods, for June and July the laboratory analysing our samples had a detection limit for E.coli of 200 cfu/100ml. Unfortunately, we have no idea how high the real number of E.coli was in the Black River (BR01) in June and July and in the Little Bouctouche (LBOC) in July. For the rest, as shown in figures 23, 24 and 25, the level of E.coli was below the threshold.

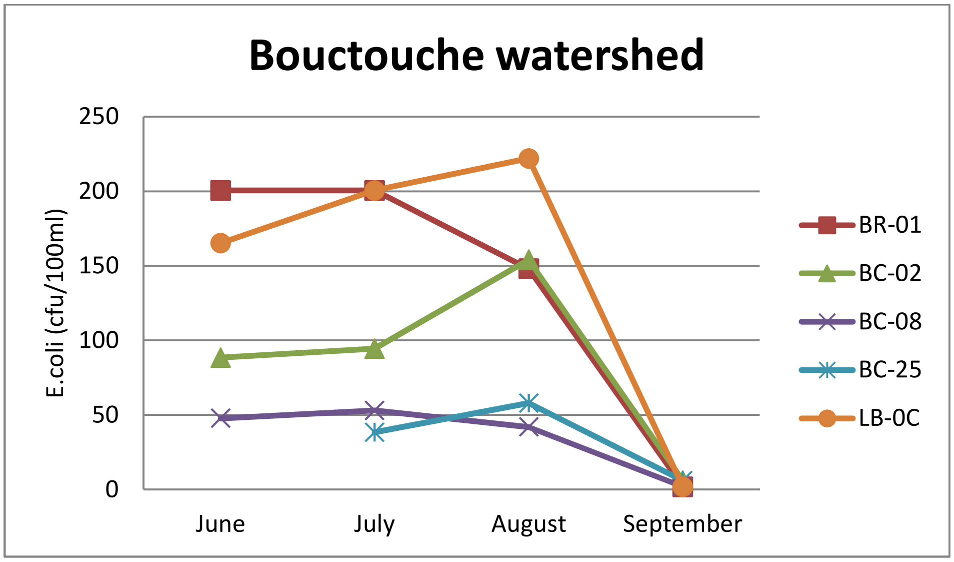

Figure 23: E.coli (cfu/100ml) per month (June, July, August and September) at 5 sampling sites (BR01, BC02, BC08, BC25 and LBOC) in the Bouctouche Watershed.

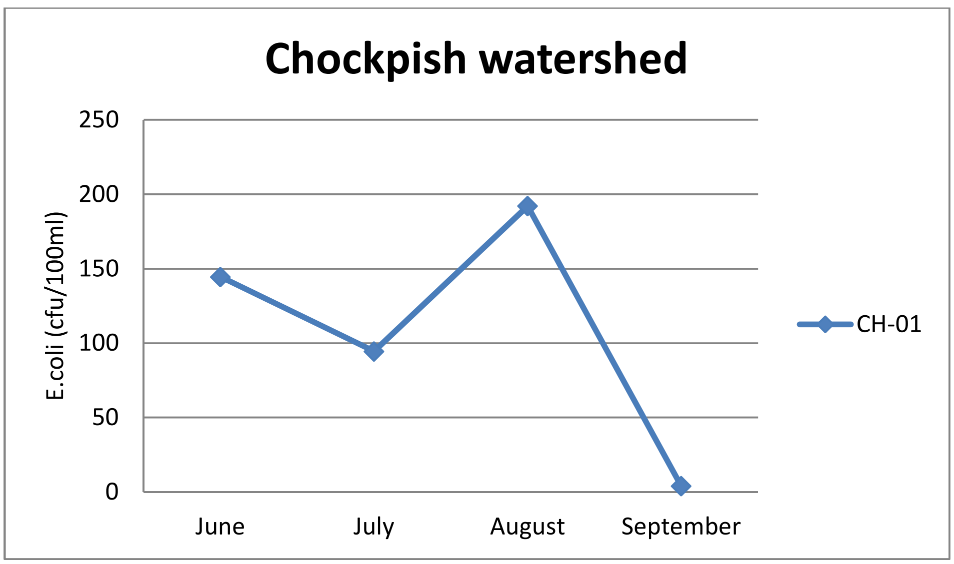

Figure 24: E.coli (cfu/100ml) per month (June, July, August and September) at 1 sampling site (CH01) in the Chockpish watershed.

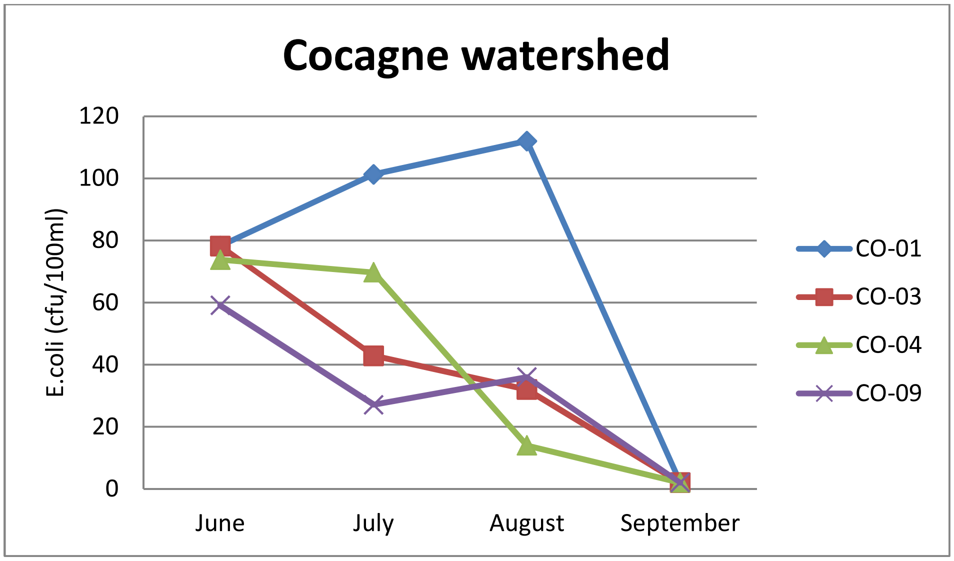

Figure 25: E.coli (cfu/100ml) per month (June, July, August and September) at 4 sampling site (CO01, CO03, CO04 and CO09) in the Cocagne watershed.

Other

We have noticed the presence of an orange slime at the Black river sampling site (BR01). This seems to be iron bacteria. These bacteria naturally occur in soil, surface water and groundwater and are not known to cause health problems or disease in humans (https://www.novascotia.ca/nse/water/docs/droponwaterFAQ_IronBacteria.pdf).

Figure 26: Orange slime produced by iron bacteria in the Black River (BR01).

5. Conclusion

During the 2015 water quality sampling season, the main concern was the increasing water temperature associated with the decrease of the dissolved oxygen. Also, the pH was often below the recommended limit of 6.5. Next year, it would be interesting to monitor those parameters more closely, maybe twice a month. And I strongly recommend to contract RPC Science & Engineering for the samples analysis.

6. References

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