Organic Carbon Exports within the Upper Rapid Creek Watershed due to the Mountain Pine Beetle Outbreak

Erik Vik, Dr. Scott Kenner, Dr. Lisa Kunza, Heidi Sieverding, Dr. James Stone

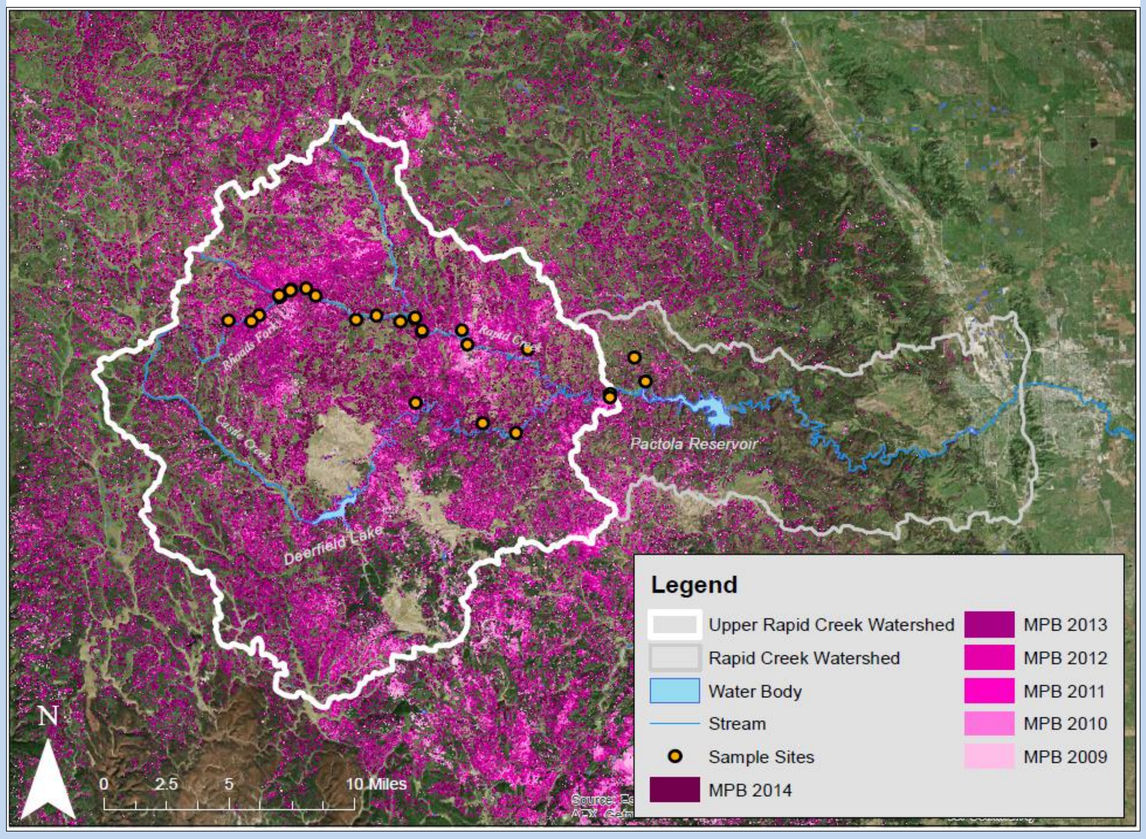
South Dakota School of Mines and Technology
erik.vik@mines.sdsmt.edu

Introduction

Mountain Pine Beetle (MPB) infestation in the Black Hills of South Dakota has impacted over 430,000 acres of forested landscape. Each year, an estimated 75,000 – 100,000 acres of forested land becomes infested (Thom, 2014). Close proximity of Ponderosa pine trees and tree stress induced by competition, has created an environment well suited for beetle infestation.

MPB infestation may be effecting Black Hills municipal drinking water supplies through increased organic carbon loading, which is a precursor to the formation of disinfection byproducts (DBPs) such as trihalomethanes (THMs) and haloacetic acids (HAAs). DBPs form during water treatment, when organic matter (OM) interacts with chlorine. Increased carbon loading due to recent MPB outbreak may necessitate future alterations to municipal drinking water treatment plants in the Black Hills, as well as throughout the Western U.S. and Canada.

Study Area



Research Plan

The goal of this work was to develop an understanding of organic carbon input to surface water due to MPB infestation, and what effect precipitation, forest regrowth, and water chemistry have on organic carbon input.

Surface Water Sampling

- 24 sites located throughout Rapid Creek Watershed
- Areas of variable MPB impact
- Relatively consistent underlying geology throughout study area
- 1 year sampling time frame

Total Organic Carbon (TOC) and Dissolved Organic Carbon (DOC) Analysis

- Shimadzu TOC-L CSN TOC Analyzer

DBP Formation Predictive Models

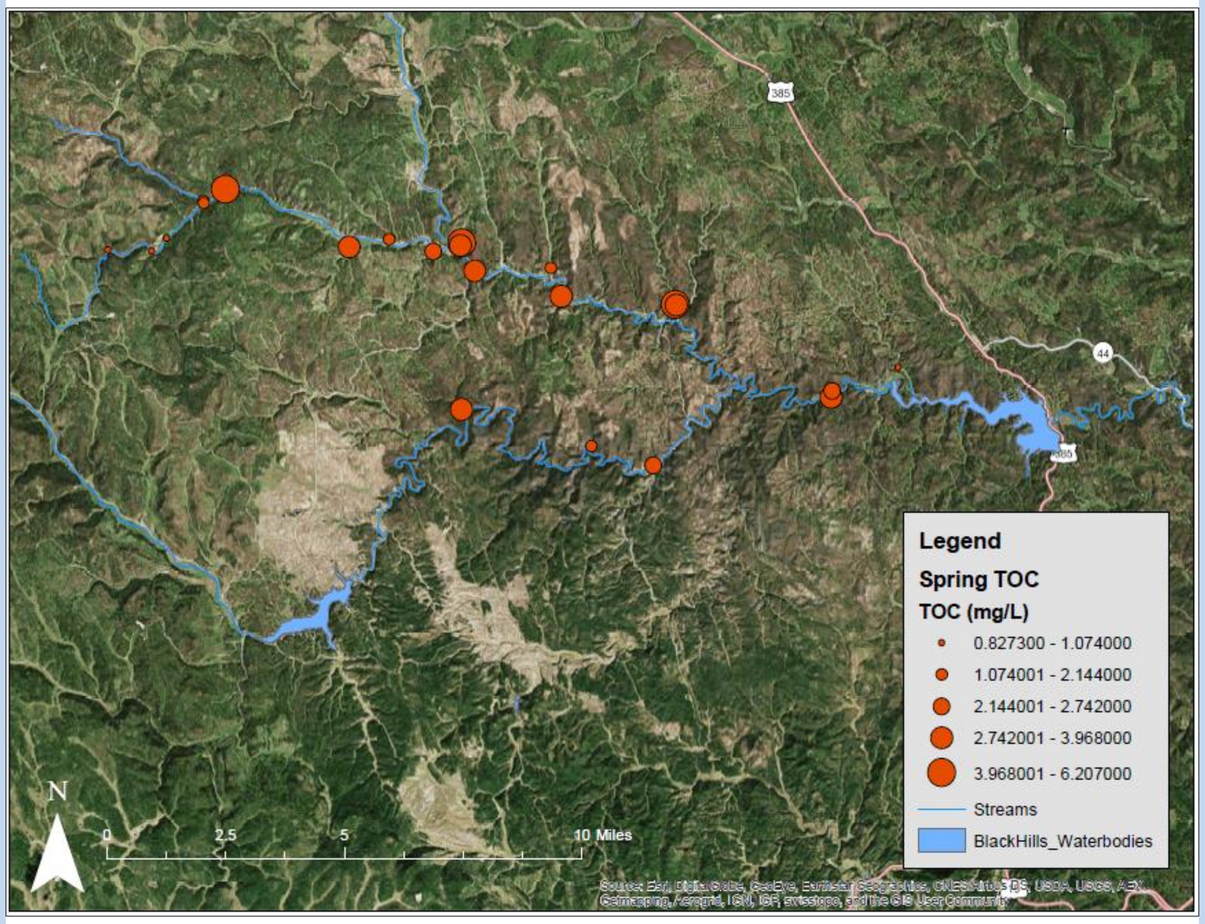
- Equations to predict THM formation
- TOC, DOC, chlorine dose, reaction time, temperature, pH

Statistical Correlations

- Pearson Moment Correlations
- Look for statistical correlations, primarily between stream flow rate, TOC & DOC, and water chemistry parameters

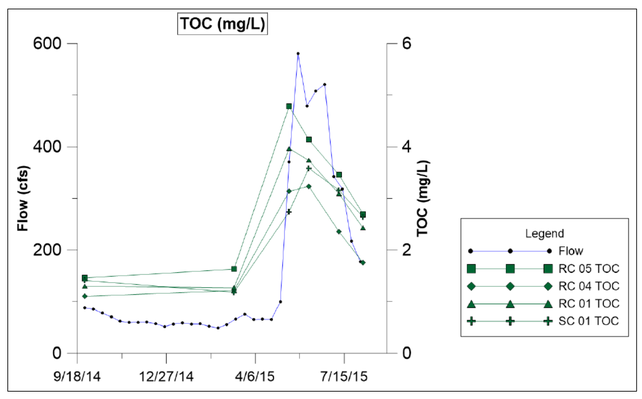
Results

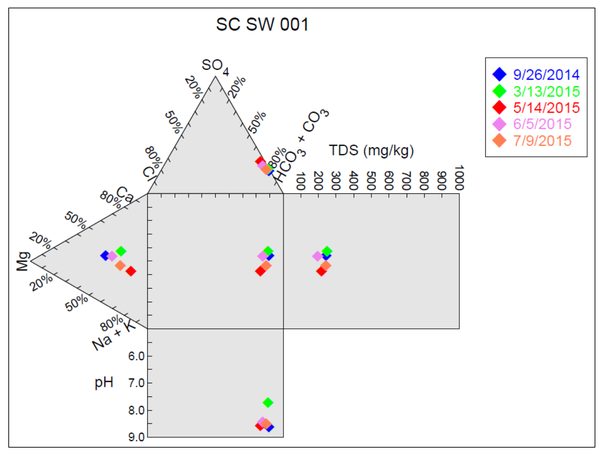
TOC results ranged in value from 1 – 6 mg/L throughout the study area.



For most sample locations, general water chemistry remained relatively consistent throughout the 1 year timeframe. General water chemistry is somewhat indicative of stream origin. The majority of sampled streams in this study had water chemistry indicating limestone origin.

TOC showed a very strong correlation with flow rate throughout the study area. An initial flush of organic carbon, just before the highest flows, was observed for many sample sites. It is believed that as precipitation and runoff increase, contact between water and organic tree litter increases, thus increasing the amount of organic carbon found in surface water. Additional statistical analysis will be used to determine correlations between TOC and water chemistry parameters.





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