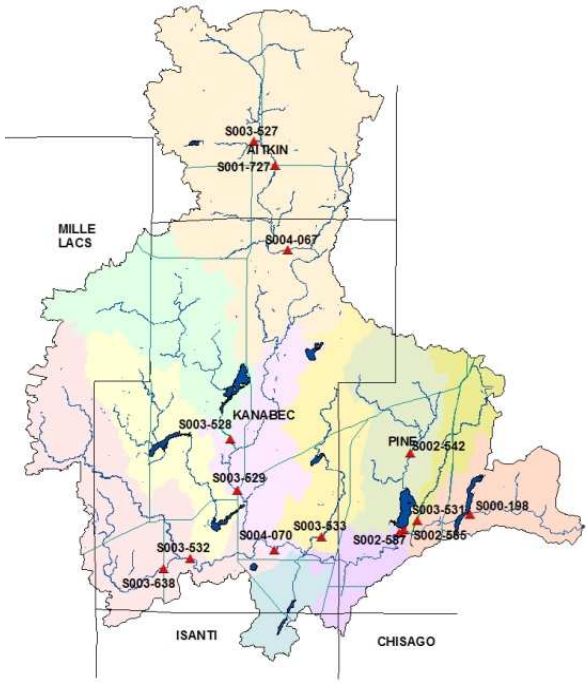
SNAKE RIVER WATERSHED

10 YEAR WATER QUALITY STREAM MONITORING DATA

SUMMARY REPORT
(1998-2008)



September 22nd, 2009

SNAKE RIVER WATERSHED MANAGEMENT BOARD

Aitkin. Kanabec. Mille Lacs. Pine

Yigliola T. Malca
Snake River Watershed Management Board
Water Technician

INTRODUCTION

This report is an analysis of the ten year stream monitoring water quality data collected for fourteen sites within the watershed from 1998-2008. Several tools were used to perform the analysis of data. The Seasonal Kendall Trend analysis test was used to identify improvements or deterioration (decreasing/increasing trends) of streams' water quality in the watershed.

The Seasonal Kendall test is a statistical test well suited for identifying trends in data over time. It was developed by the U.S. Geological Survey and it is one of the most frequently used tests for trends in non-parametric data (data that is not normally distributed) such as water quality data that varies seasonally.

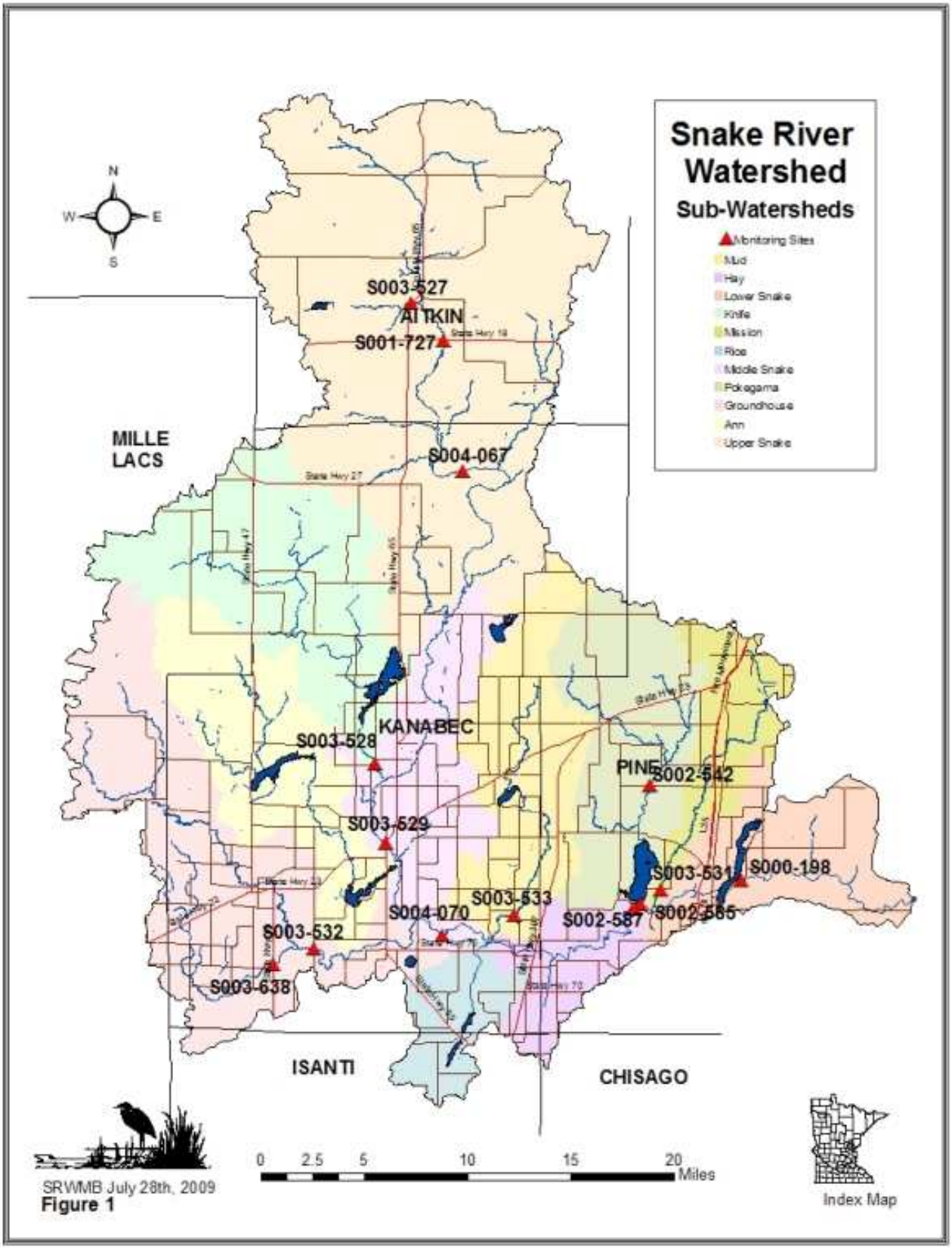
The Seasonal Kendall test was performed on five water quality parameters: Total Suspended Solids, Total Kjeldahl Nitrogen, Nitrate plus Nitrite Nitrogen, Total Phosphorus, Ortho Phosphorus. These parameters provided the minimum requirements (at least five years of data) to run the test.

In addition, monitoring data were compared with state water quality standards and minimally impacted streams' 25th and 75th percentiles for both North Central Hardwood Forest and Northern Lakes and Forest ecoregions. Sites in Aitkin County fall within the Northern Lakes and Forest ecoregion which has more restrictive benchmarks than the rest of the sites that fall within the North Central Hardwood Forest Ecoregion. Results of this analysis have helped define important characteristics of point and non-point sources pollution in the Snake River Watershed.

This analysis was performed on fourteen sites; however this report only includes a summary of the highlights of the analysis performed on twelve sites that are still being monitored. A copy of the complete report is available at the Environmental Office of Kanabec County Court house.

STREAM MONITORING SITE LOCATIONS

- S001-727 Snake R at CSAH 18, 2.35 mi SE of McGrath.
- S004-067 Snake R at Olympic St, 3 mi E of Woodland.
- S003-528 Knife R at CR-77 3 mi N of Mora.
- S003-529 Snake R at MN-65, 0.7 mi S of Mora.
- S004-070 Snake R along 150th Ave, 3 mi E of Brunswick.
- S003-638 Groundhouse R at MN-47, 3.6 mi S of Ogilvie.
- S003-532 Groundhouse R at CR-12 (Harbor St), 3.6 mi W of Brunswick.
- S003-533 Mud Ck at CSAH 5, 1.6 mi NW Grasston.
- S002-542 Pokegama Ck at CSAH 14, 3.6 mi W of Beroun.
- S003-531 Mission Ck at CR-53, 2.3 mi W of Pine City
- S002-585 Pokegama Lk Outlet at CR-53, 3.5 mi W Pine City.
- S000-198 Cross Lk Outlet at CSAH-9 2 mi NE of Pine City.
- S002-587 Snake River at CSAH 7 3.5 mi west of Pine City.
- S003-527 Bear Ck at CR-9 in McGrath.



SRWMB July 28th, 2009
Figure 1

RESULTS

1. SEASONAL KENDALL TEST TREND

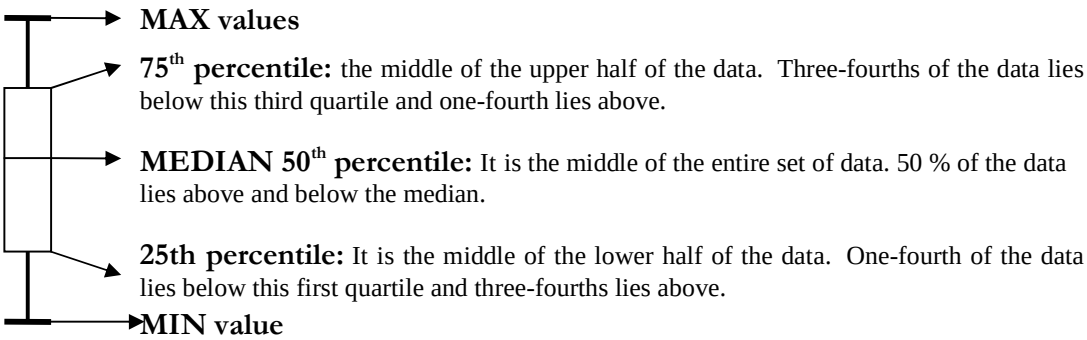
Kendall test results showed decreasing trends for site S003-529 (Snake River in Mora) for Nitrite plus Nitrate, Total Phosphorus, Ortho-Phosphorus and Total Suspended Solids parameters. On the other hand, increasing trends for Nitrite plus Nitrate were observed for sites S003-531 (Mission Creek), S002-585 (Pokegama Lake outlet) and S002-542 (Pokegama Creek). Site S003-533 (Mud Creek) showed an increasing trend in Total Suspended Solids (Figure 2).

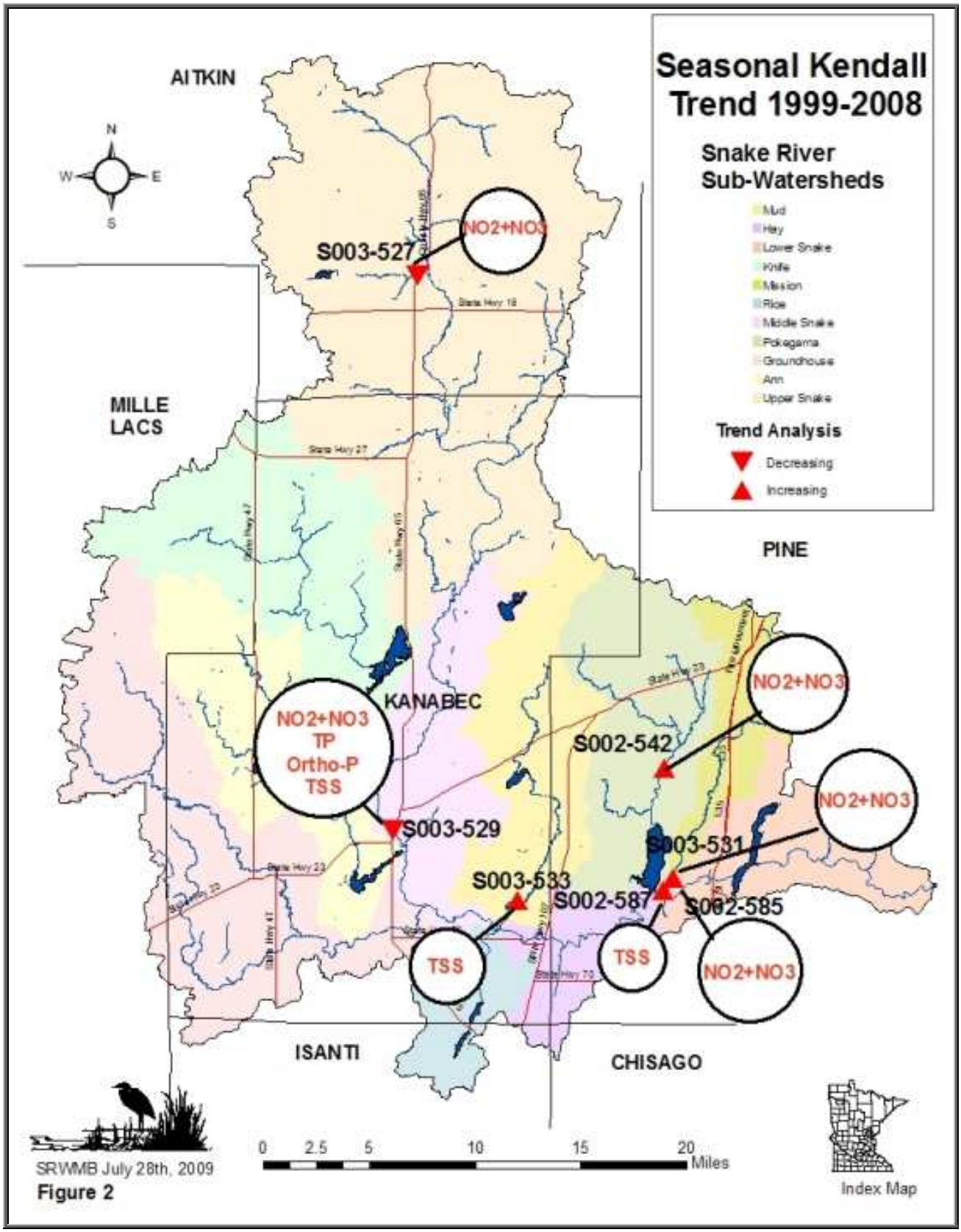
From these results we can observe a spatial trend in the water quality of the streams. Decreasing Nitrates and Total Suspended Solids trends were observed for sites to the north and central part of the watershed while increasing trends were observed for sites to the southeast part of the watershed.

Most of the Seasonal Kendall Test results indicated "No Trend". There are two possible explanations for these results. There is "No Trend" because the water quality parameters' concentrations measured at a site are neither increasing nor decreasing. The second explanation is that the cause for "No Trend" is due to the gap in the data for years 2000, 2003, 2006 and 2007 which influenced the results. The Seasonal Kendall statistical analysis tool is designed to make the best of such gaps in data, however.

2. MINIMAL IMPACTED STREAMS AND WATER QUALITY STANDARD COMPARISON

Box plots were used to graphically represent the distribution of the monitoring data. Size of the box indicates the distribution of the data.




Seasonal Kendall Trend 1999-2008
Snake River Sub-Watersheds
Mud
Hay
Lower Snake
Knife
Mission
Rice
Middle Snake
Pokegama
Groundhouse
Ann
Upper Snake
Trend Analysis
Decreasing
Increasing
AITKIN
MILLE LACS
PINE
KANABEC
ISANTI
CHISAGO
N
S
E
W
S003-527
NO2+NO3
NO2+NO3
TP
Ortho-P
TSS
S003-529
S002-542
NO2+NO3
NO2+NO3
S003-531
S003-533
S002-587
S002-585
TSS
TSS
NO2+NO3
0 2.5 5 10 15 20 Miles
Index Map
SRWMB July 28th, 2009
Figure 2

NITRITE PLUS NITRATE AS NITROGEN

High levels of Nitrite plus Nitrate were found at both sites on the Groundhouse River. The maximum values occurred in relatively dry periods, which could be an indication of point sources such as leaching nitrates from agricultural farms, individual septic systems, and manure application.

63 and 72 percent of the samples taken at S003-638 and S003-532 sites (Groundhouse River) exceeded the 0.24 mg/L (75th percentile) NCHF minimal impacted streams benchmark respectively (Figures 3).

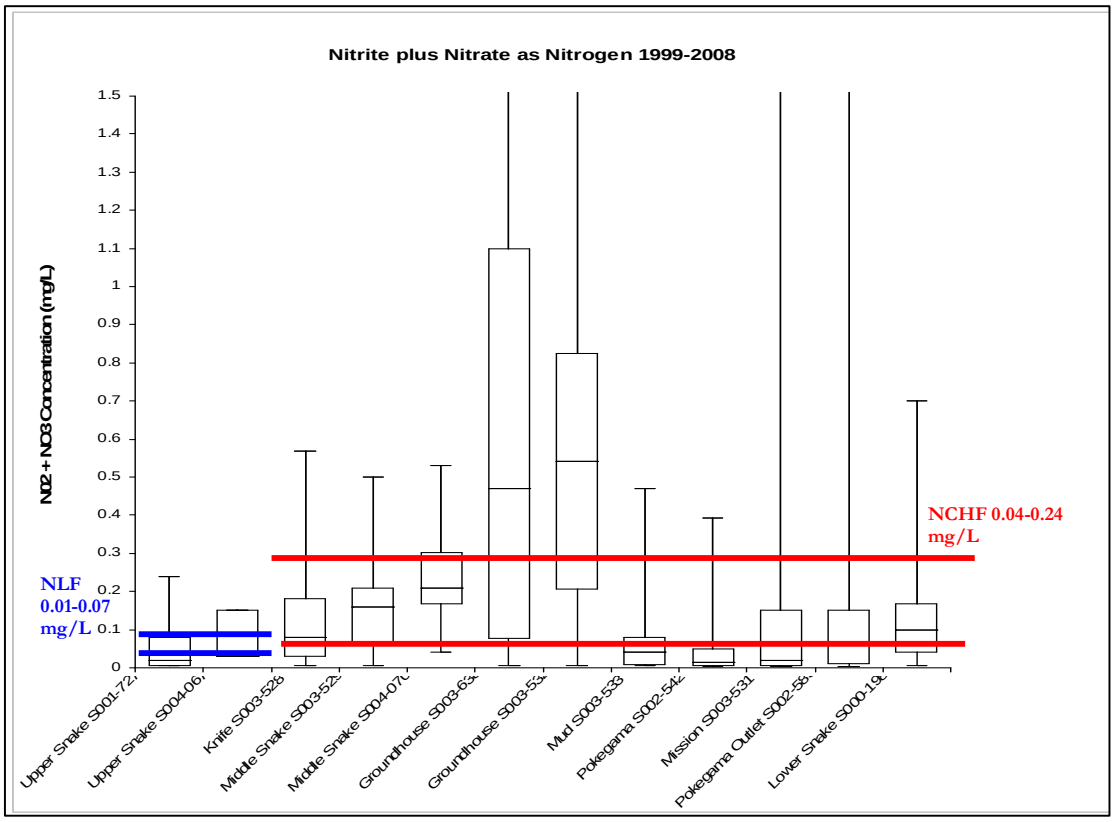


Figure 3

TOTAL PHOSPHORUS

Phosphorus is the major pollutant in several of the streams in the watershed. Eight sites exceeded the 75th percentiles total phosphorus levels of the minimally impacted streams benchmark in North Central Hardwood Forest and Northern Lakes and Forest Ecoregions (Figure 4). The highest total phosphorus levels were observed at site S003-531 (Mission Creek). 54 percent of the samples collected at S003-531 (Mission Creek) exceeded the 0.09 mg/L total phosphorus benchmark as well as 52 percent of the samples collected at S003-638 (Groundhouse River).

Currently there is a lot of effort to reduce the amount of phosphorus loads into the Snake River which discharges into the St. Croix River. The Snake River Watershed contributes approximately 51,000 kg/year of total phosphorus to the St. Croix Basin of which 25,000 kg/year comes from point and non-point sources. The other 26,000 kg/year phosphorus load is coming from natural sources. The proposed TMDL is looking for a total phosphorus reduction from the Snake River Watershed of about 9,500 kg/year (38% reduction of 25,000 kg/year) (Barr Engineering, 2009).

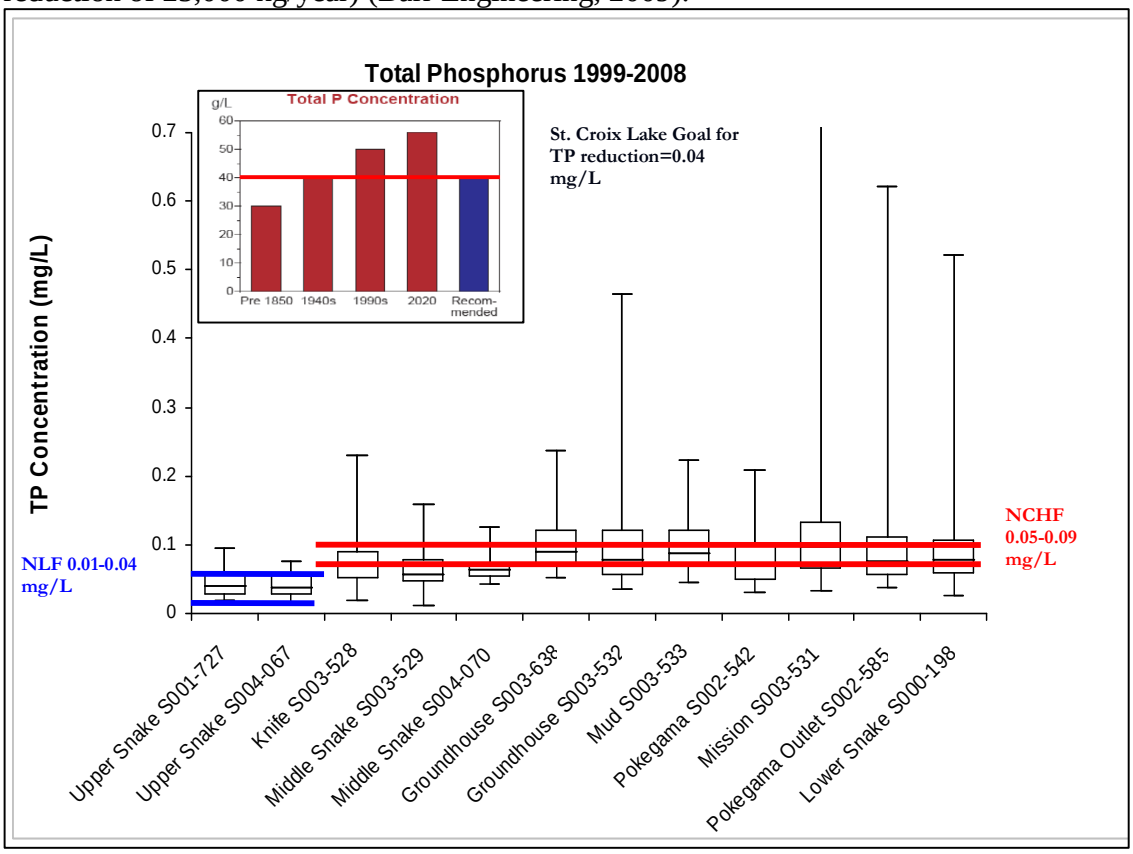


Figure 4

FECAL COLIFORM AND ESCHERECHIA COLI

Both of the Groundhouse River sites, Middle Snake River site and Mud Creek site exceeded Fecal coliform and E. coli state standards from 2004 to 2008 (Figure 5). However, in 2008 there were signs of improvement for the Middle Snake River site in Mora. E.coli levels have dropped at this site and it only exceeded state standards during July sampling. This decrease of e.coli at Middle Snake River site could be due to fewer non-point source input and/or low flow conditions in the river.

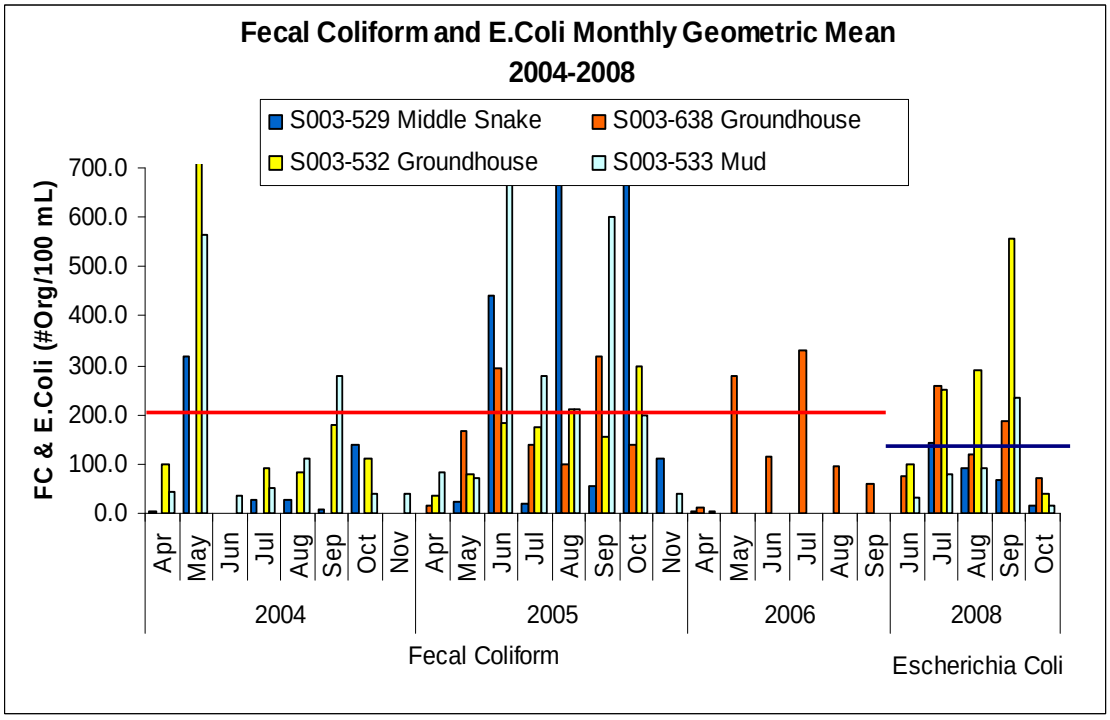


Figure 5

DISSOLVED OXYGEN

Oxygen levels in the streams across the watershed are high with the exception of site S003-531 (Mission Creek) which failed to meet the water quality standard minimum of 5 mg/L for oxygen levels (Figure 6). Dissolved oxygen has been decreasing since the beginning of monitoring at this site (2004). The physical and chemical characteristics of this site indicate that it is functioning more like a wetland. There are a lot of plants growing in the main channel which in turn consume oxygen during photosynthesis.

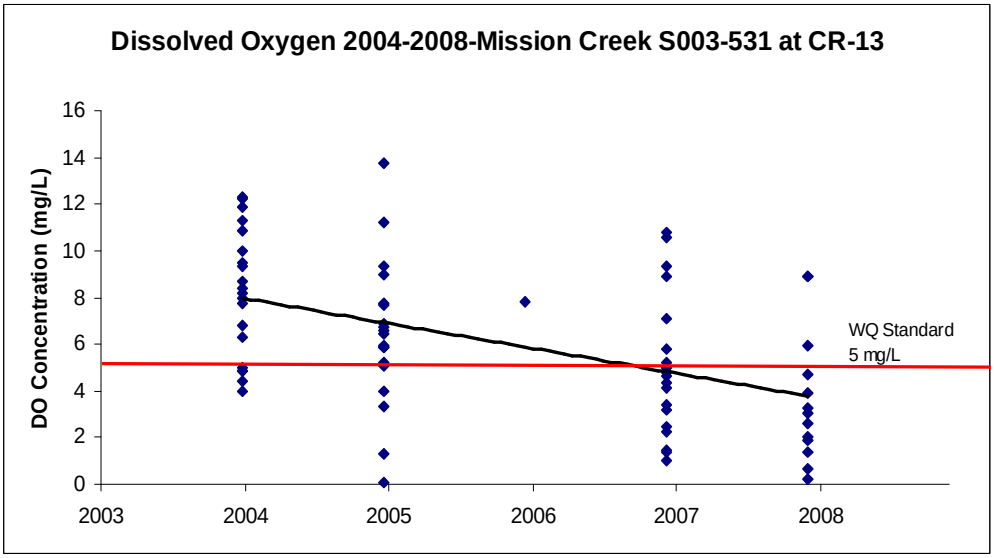


Figure 6

CONCLUSION

Results from this analysis suggest that some of the major impairments in the watershed are nitrates, phosphorus, bacteria and dissolved oxygen. The analysis of the monitored water quality parameters provides some insight into the health status for some sections of streams in the Snake River watershed. However, additional work is needed to better understand the cause of biota and biological impairments in the watershed for which some of the streams are listed as impaired in the state 303(d) list.

More detailed examination of the water quality parameters during dry and wet conditions should be pursued in a watershed approach that integrates other stream and lake sites monitored by partners (MPCA, SWCDs, volunteers) within the Snake River Watershed. In addition, in order to avoid any uncertainty in the results for future trend analysis, it is recommended to continue consistent monitoring of the water quality parameters. Some "good" monitoring plans suggest collecting water quality data bi-weekly for four years to establish a baseline for evaluating trends. Once a baseline is established, sampling frequency can be reduced to monitor trends in subsequent years (i.e. from bi-weekly to monthly) (USGS, 2004).