Niobrara National Scenic River

Water Quality Report

Summer 2012

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Objective

As the primary managing agency of Niobrara National Scenic River (NSR), the National Park Service (NPS) is charged with protection of the river and its resources. Objectives of the park's Water Quality and Streamflow Monitoring Program include sampling selected indicators 1) to determine whether they meet state and federal standards, 2) to monitor trends and assess impacts from various land uses, and 3) to provide tools to assist resource managers in decision-making.

Design

Sampling in 2012 spanned the entire length of Niobrara NSR (Figure 1) and took place between May 17 and August 13. Primary sampling sites included Borman, Cornell, Berry, Brewer, Norden, Meadville, and Highway 7 and Highway 137 Bridge. Samples were collected approximately weekly between Borman and Brewer Bridge, and approximately biweekly between Norden and Highway 137 Bridge. In addition, biweekly samples were collected from Minnechaduza and Ft. Falls Creek on the Ft. Niobrara National Wildlife Refuge (NWR), and at the request of the U.S. Fish and Wildlife Service (USFWS), samples were occasionally collected from Big Beaver and Crooked Creek, both located within the designated wilderness area of the refuge.

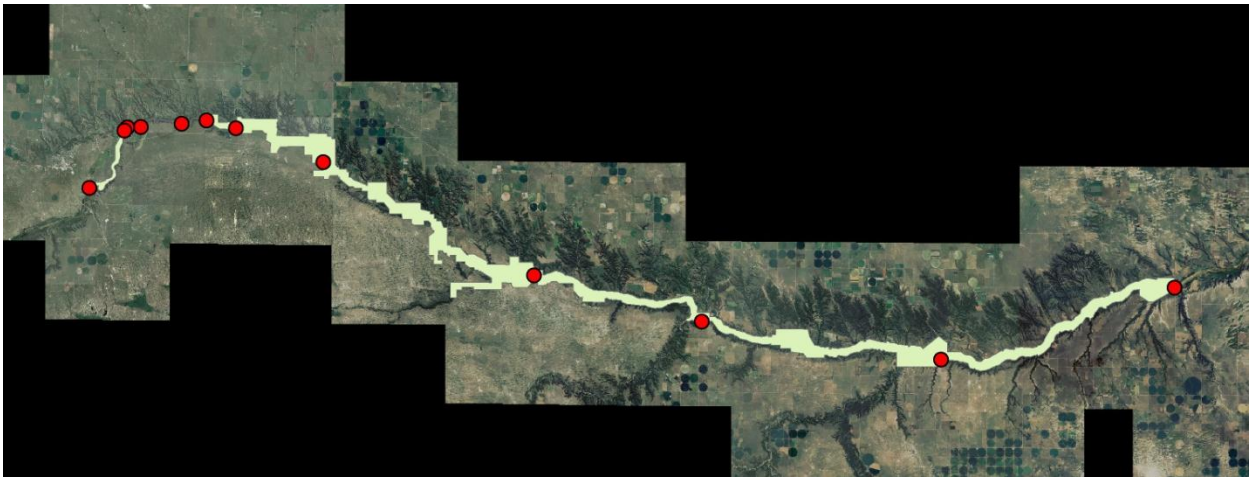

Figure 1
Relative locations of 2012 summer water quality sampling sites along Niobrara NSR (lands within the boundary are shown in light fill). The western- and eastern-most sites were Borman and Highway 137 Bridge, respectively.

Methods

A YSI Model 85 meter was used to measure dissolved oxygen in parts per million (ppm) and percentage, specific conductivity (raw conductivity adjusted to 25 degrees Celsius) in microsiemens per centimeter (uS/cm), salinity in parts per thousand (ppt), and water temperature in degrees Celsius. The meter was calibrated for dissolved oxygen and conductivity according to the manual.

A LaMotte 2020 Turbidimeter was used to measure turbidity in Nephelometric Turbidity Units (NTU). It was calibrated in the field before each use with a 10 NTU standard.

A pH Tester 2 unit was used to measure water pH. The instrument was calibrated with pH 7.00 buffer solution prior to each sampling trip.

Alkalinity, orthophosphates, nitrate-nitrogen, and ammonia-nitrogen were all measured in parts per million (ppm) using LaMotte chemical test kits. After each use, test tubes were rinsed three times with distilled water, thoroughly drained, and then turned upside down to dry and prevent contamination of future samples.

E. coli bacteria counts were obtained from water samples collected from each site. Samples were kept chilled between the time of collection and arrival back at headquarters. Of each sample taken, 5 milliliters (ml) were mixed with Easygel Coliscan media and plated on a pretreated Petri dish. The plates were left to incubate at 35 degrees Celsius for 24 hours at which time the colonies were counted. Counts were normalized to colonies per 100 ml.

Results

Late spring-early summer river flows recorded for 2012 were well-below the 20-year mean and notably lower than those recorded for the previous year, ranging from 72% of the 2011 value on June 6 to 37% on July 30 (Figure 2). The contrast was not surprising given the dramatic transition from the relatively wet 2011 to the mild, dry winter and near-precipitation-free summer of 2012.

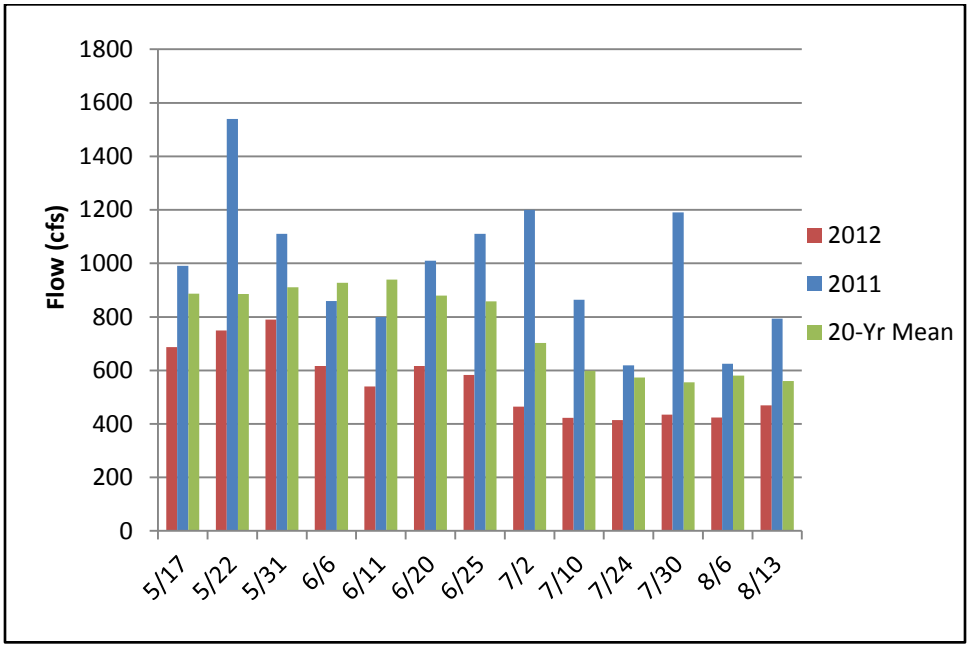

Figure 2
Hydrograph (mean daily discharge in cubic feet per second (cfs) at the U.S. Geological Survey (USGS) gauge located at Berry Bridge) recorded over the main period of water quality sampling at Niobrara NSR. Current year data are considered provisional until vetted by the USGS.

In the absence of rain and associated run-off, turbidity values were uniformly low throughout all river and creek samples taken, ranging from about 2 to 21 NTU. Figure 3 depicts the moderate correlation between turbidity and flows for the sample set collected.

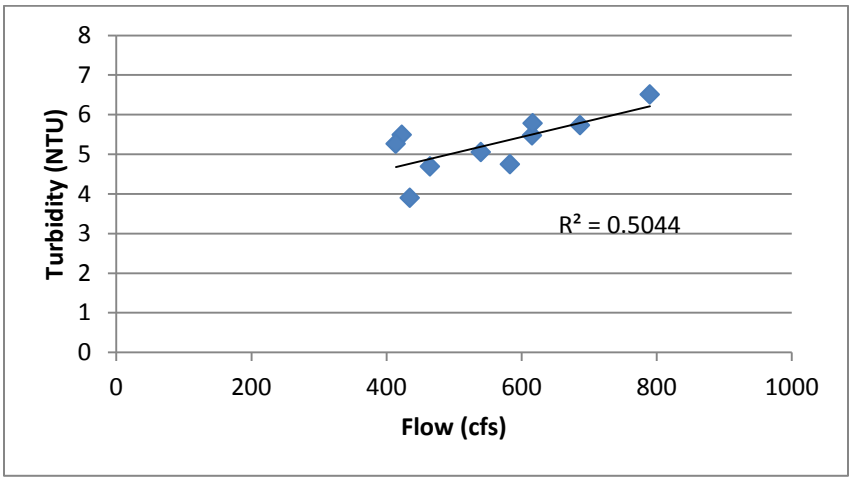

Figure 3
Relationship between turbidity and river flow measured at Berry Bridge during the summer of 2012. The Berry Bridge sampling site is adjacent to the USGS gauge at which flows are measured.

During the sampling period air temperatures ranged from a low of 9° C to a high of 40° C. A modest correlation between air temperature and water temperature was observed at the river sites (Figure 4), but not for the creeks (data not shown).

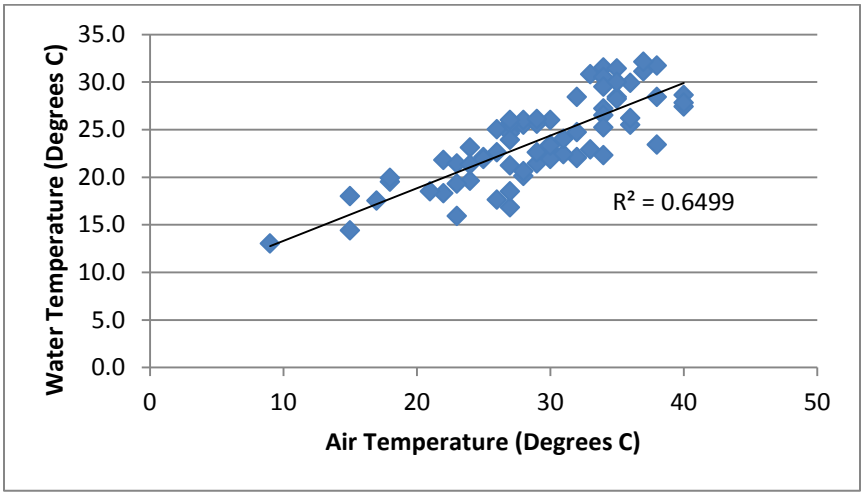

Figure 4
Relationship between air and water temperatures at river sampling sites.

Water temperatures rose as high as 32° C at several sites during the two sampling visits in late July, but were otherwise unremarkable. On days when Minnechaduza and Ft. Falls Creek were sampled along

with the western river sites, Ft. Falls Creek most often showed the lowest water temperatures and Minnechaduza the highest (Figure 5).

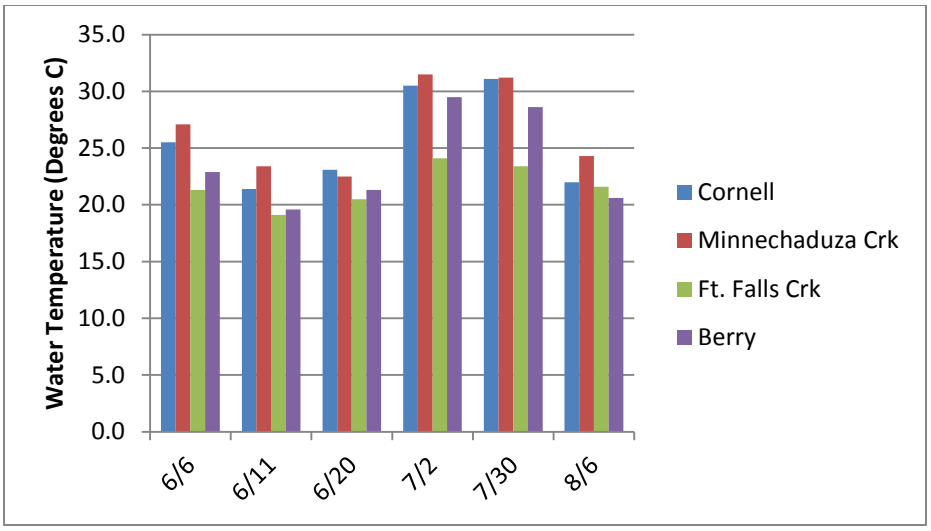

Figure 5
Water temperatures recorded for representative river and creek sites within or near Ft. Niobrara NWR. Temperatures peaked during late July.

Dissolved oxygen values ranged from 6.14 to 10.9 ppm for the river sites and from 6.78 to 9.53 ppm for the creeks. Levels remained relatively high throughout the summer, even in the face of July's heat, and showed only a modest relationship to water temperature (Figure 6). The highest dissolved oxygen levels were most frequently found at Berry and Brewer Bridge (Figure 7).

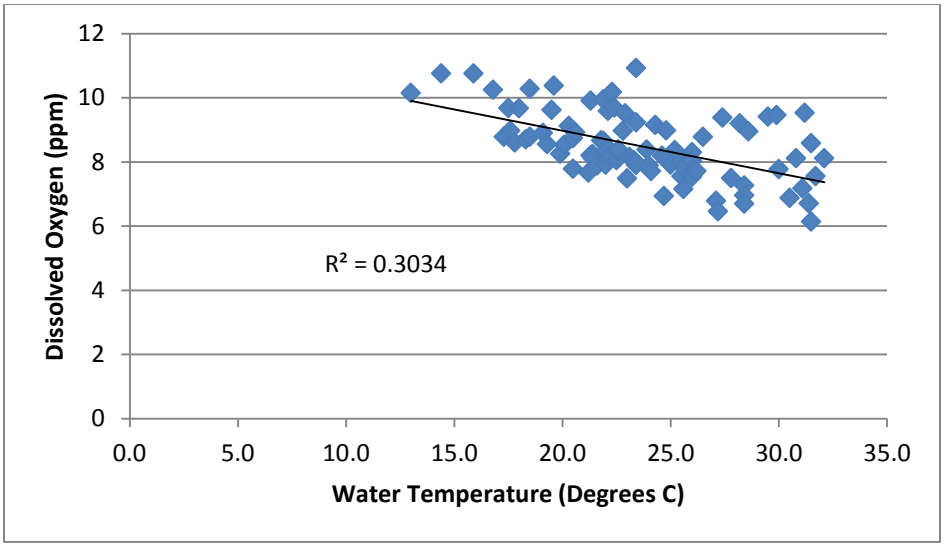

Figure 6
Data showed only a weak correlation between dissolved oxygen and water temperature. Values remained above critical levels (about 4 ppm) even during the prolonged high temperatures encountered in mid- to late July

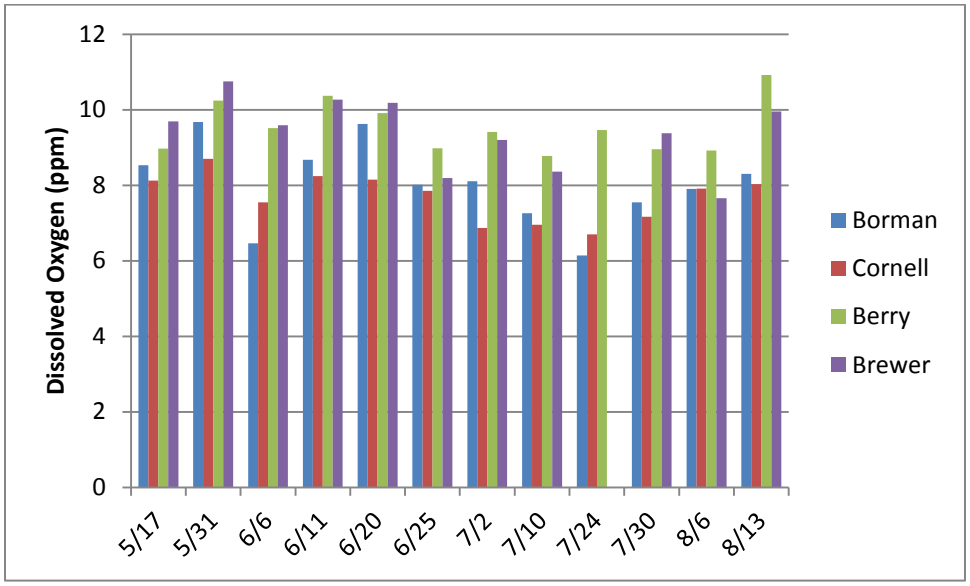

Figure 7
Dissolved oxygen values recorded at the four primary sampling sites in the western third of Niobrara NSR. While no values failed to meet EPA standards, there was notable variability among sites within this segment of the river. River sites further east (Norden, Meadville, Highway 7, and Highway 137 Bridge) generally showed less inter-site variation (data not shown).

pH values were unremarkable among the river sites, ranging from 6.81 to 9.03. Relatively high readings of 9.28 were measured at Minnechaduza Creek on June 11 and 9.47 at Ft. Falls Creek on June 20, but creek data were otherwise unremarkable as well.

Salinity values read from the YSI meter were either 0.1 or 0.2 ppt. Salinity value was strongly related to specific conductance, with there being no overlap between the distribution of specific conductance values at the two salinity values recorded (Figure 8).

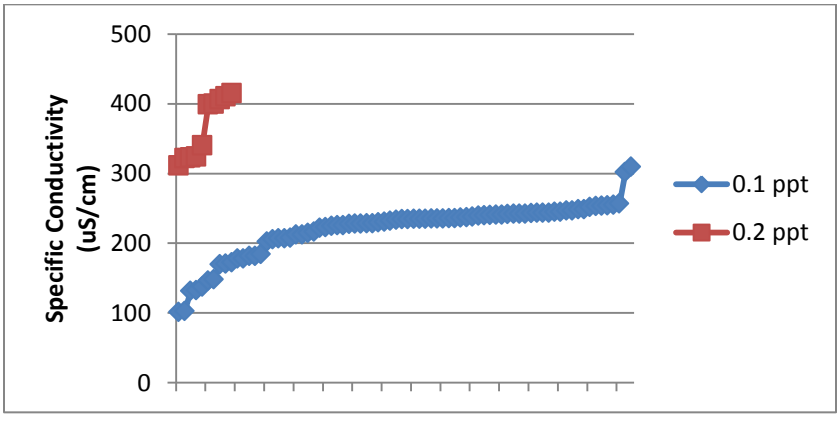

Figure 8
Robust relationship between salinity and specific conductance. The length of the curve reflects the number of samples having a value of 0.1 ppt (78 samples) or 0.2 ppt (10 samples).

As shown by representative data in Figure 9, creek sites had notably higher specific conductivity values than the river sites, with the exception of Ft. Falls Creek, which was the only creek sampled on the south side of the river. All values were within the normal range.

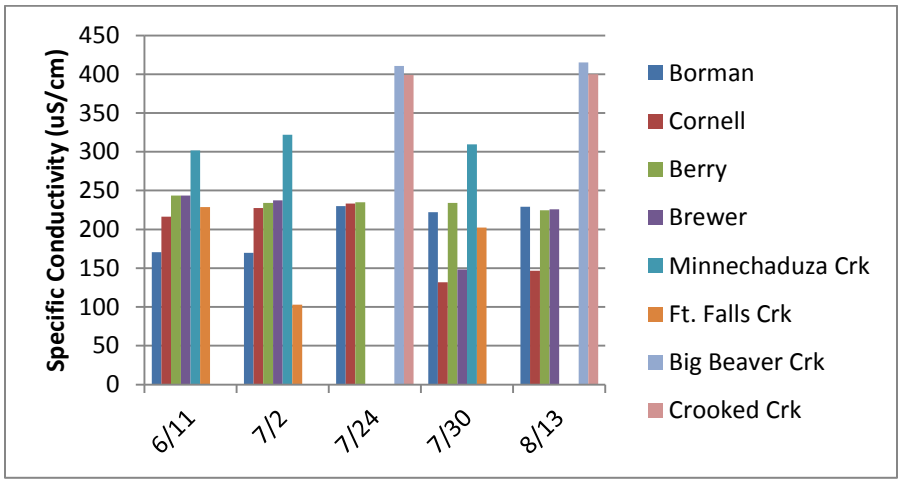

Figure 9
Association of higher specific conductivities with most creek sites. Data pulled from five sampling visits are fairly representative of the entire summer dataset. By design Minnechaduza and Ft. Falls Creek were sampled less frequently than the river sites, and Big Beaver and Crooked Creek were sampled only three times all summer; thus the reason for the gaps in the bar graph.

Alkalinities recorded for the river sites ranged from 76 to 136 ppm and from 84 to 180 ppm for the creeks. As with specific conductivity values, the creek sites generally showed higher alkalinities than the river sites (Figure 10). No other remarkable differences were noted.

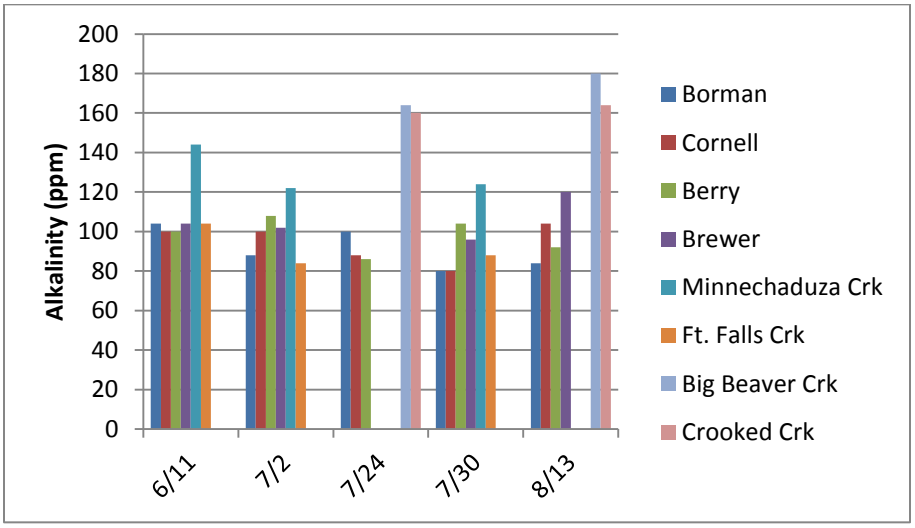

Figure 10
Alkalinities observed for representative visits to river and creek sites along the western third of Niobrara NSR. Sites along the eastern two-thirds of the river exhibited the same random variation as the western river sites.

Nutrient data did not differ between the river and creek sites and were otherwise unremarkable. Orthophosphate levels were always 0 ppm. Nitrate-nitrogen levels were predominately 0 ppm, with a very few values of 1 ppm. Ammonia-nitrogen values were always less than or equal to 0.1 ppm, most often the former.

E. coli levels remained low at most sites throughout the summer, with only two of 89 values exceeding the single sample EPA standard of 235 colonies/100 ml (Figure 11). No river site had a value greater than 100 colonies/100 ml. Crooked Creek levels exceeded the standard on two of three visits (values were 200, 480, and 240 colonies/100 ml). Not surprisingly, no correlation was found between turbidity and *E. coli* counts, given the absence of rainwater run-off and the narrow range of values observed for both parameters (data not shown).

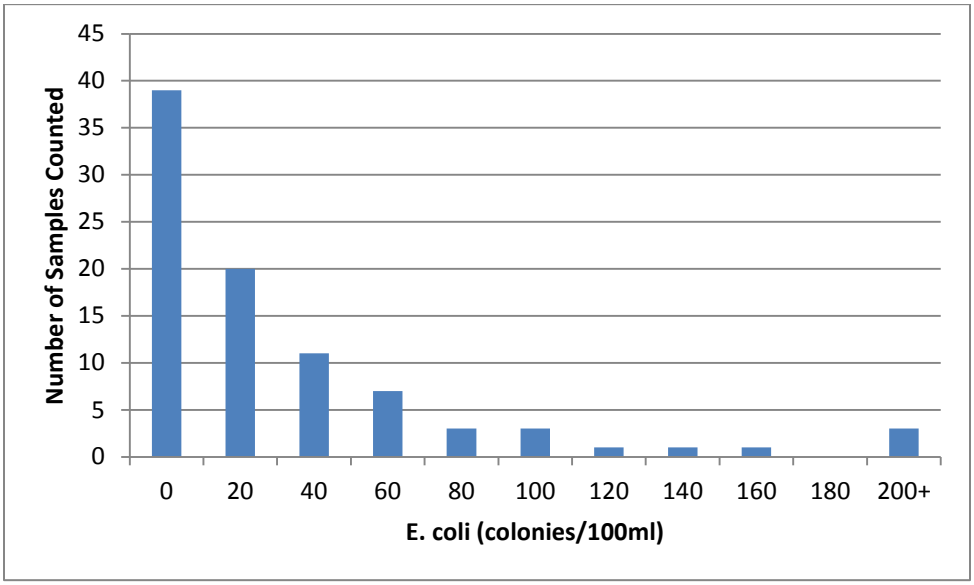

Figure 11
Distribution of *E. coli* readings over all river and creek sites. Only samples from Crooked Creek exceeded the EPA standard.

Conclusions and Comments

While 2012 summer river flows at Niobrara NSR were significantly below 20-year means, water quality data collected at eight bridges spanning the scenic river were all within normal ranges and showed no obvious, systematic inter-site differences.

Data collected at creek sites showed anticipated differences with river sites related to salinity, specific conductivity, and alkalinity; these and all other parameters measured were within normal ranges at Minnechaduza, Ft. Falls, and Big Beaver. The elevated *E. coli* levels observed at Crooked Creek on two separate occasions may be of interest to Ft. Niobrara NWR staff for possible follow-up.