Cannon River Watershed
Water Monitoring Results, 2010-2012

Project Purpose

Cannon River Watershed Partnership just wrapped up a three year Surface Water Assessment Grant (SWAG) to assist the Minnesota Pollution Control Agency (MPCA) in assessment of lake and stream water quality in the Cannon River Watershed. For this type of assessment, a thorough suite of measurements are made including chemical and biological parameters which are then used to determine if a water body is meeting its designated use. Those that do not meet their designated uses are listed on the Impaired Waters list for the parameter which needs improvement. Many lakes, streams, and rivers in this watershed are impaired for nutrients (phosphorus and nitrogen), sediment, and bacteria.

Thirteen stream and four lake sites were chosen for one of two reasons. Sites were originally chosen because they were in need of more information before an accurate assessment could be made to determine if a waterbody should be listed on the MPCA's Impaired Waters list. Later, site selections were adjusted to gain some efficiency and support the Intensive Watershed Monitoring Plan. This watershed scale approach is intended evaluate a watershed's aquatic health on a chemical and biological level and are conducted on every watershed in the state on a 10 year rotation.

Data collected by Cannon River Watershed Partnership (CRWP) under this grant are summarized here. More information is also available on our website (www.crwp.net).

Thank you, volunteers!

We were fortunate to have some fantastic volunteers to help with lake and stream monitoring. Volunteers help us to accomplish more than we could do on our own and we are grateful for their time, talent, and commitment.

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Project Funding

Funding for this project was provided by a Surface Water Assessment Grant awarded by the MPCA.

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Cannon River Watershed Partnership

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Site Selection

Three lakes and thirteen stream and river sites were evaluated for various chemical and biological parameters and field observations each summer from 2010 to 2012 throughout the watershed. Project sites are also shown on a map (Figure 1).

Table 1. *Project lakes, streams, and rivers by county.*

County	Water body
Dakota	Chub Creek
Goodhue	Prairie Creek, Belle Creek, Cannon River near Red Wing, Cannon River in Cannon Falls, Little Cannon River
Rice	Wolf Creek, Straight River in Faribault, Cannon River near Morristown, Heath Creek
Steele	Turtle Creek, Straight River south of Owatonna, Crane Creek
Waseca	Rice Lake, Watkins Lake, Goose Lake

Lakes

Goose Lake, Rice Lake, and Watkins Lake of Waseca County were assessed under this project. A total of 10 samples (including two quality control/quality assurance samples) were collected at each of the lakes between June and September 2010 and 2011.

To fully assess a lake, 10 samples must be taken to obtain data for total phosphorus, chlorophyll *a*, and Secchi depth. The implications of these sampling parameters are discussed below, followed by the standards and typical values for local lakes. Table 3 shows the data collected for the three lakes assessed in this project.

Total Phosphorus (TP)

Phosphorus is a nutrient required by all living organisms. It is a natural element found in rocks, soils and organic material. Its concentrations in clean waters is generally very low; however, phosphorus is used extensively in fertilizer and other chemicals, so it can be found in higher concentrations in areas of human activity. Phosphorus is generally found as phosphate (PO_4^{3-}). High levels of phosphate, along with nitrate, can over-stimulate the growth of aquatic plants and algae, resulting in high dissolved oxygen consumption, causing death of fish and other aquatic organisms. The primary sources of phosphates to surface water are detergents, fertilizers, and natural mineral deposits.

Chlorophyll a

Chlorophyll *a* is a plant pigment needed for photosynthesis and is often used as an indicator of algal abundance in water. When algal biomass is high, water appears greener due to greater chlorophyll concentrations. This lowers the ability for light to penetrate the water and reach aquatic plants on the bottom. It also reduces visibility, making it difficult for prey species of fish to hunt for food.

Secchi depth

Secchi is a measurement of the clarity of the water. A black and white disk is slowly lowered in a lake until it can no longer be seen. Clear water has a large Secchi measurement while cloudy or muddy water has a small Secchi measurement.

Lakes vary widely throughout the state based on the geology, land use, population density, and a multitude of other factors. For this reason, the MPCA has divided the state into "ecoregions" which contain geographically distinct collections of plants, animals, natural communities, and environmental conditions.

The lakes included in this study are all within the Western Corn Belt Plains ecoregion. This ecoregion is heavily cultivated with row crops. Chief surface water quality problems are sedimentation and high levels of nutrients as sediment and fertilizers from agricultural land are washed into the area's streams and shallow lakes. The lakes in this ecoregion can be further divided into deep lakes and shallow lakes (less than 15 meters at their deepest point) as these two categories of waters also tend to behave very differently, even when in the same ecoregion.

Goose Lake has a max depth of 2.5 feet and Rice Lake has a max depth of 5.0 feet (MN DNR). The maximum depth of Watkins Lake is Unknown according to MN DNR; however, Waseca County Soil and Water Conservation District staff confirms that Watkins Lake is less than 15 feet deep at its deepest. Table 2 provides typical values for lakes in the Western Corn Belt Plains ecoregion as well as chronic standards for this ecoregion that are specific to shallow lakes.

Table 2. *Western Corn Belt Plains shallow lake (<15m) chronic standards and typical water quality conditions for lakes in Minnesota's Western Corn Belt Plains ecoregion. Typical summer lake water quality conditions represent surface water (0-2m) in summer (June-September).*

	Total Phosphorus (mg/L)	**Chlorophyll *a* (µg/L)**	**Secchi (m)**
Chronic standard	0.090	30	Not <0.7
Typical values	0.065-0.150	30-80	0.5-1.0

Table 3. *Actual average TP, Chlorophyll a, and Secchi values for Goose, Rice, and Watkins Lakes during summer months (June-September) 2010 and 2011.*

Lake Name and MPCA ID	**Average Total Phosphorus (mg/L)**	**Average Chlorophyll *a* (µg/L)**	**Average Secchi (m)**
Goose Lake (81-0016)	0.165	33.1	0.78
% of samples exceeding standard	*75%*	*38%*	*38%*
Rice Lake (81-0022)	0.363	72.9	0.57
% of samples exceeding standard	*88%*	*63%*	*63%*
Watkins Lake (81-0013)	0.159	34.9	0.87
% of samples exceeding standard	*100%*	*25%*	*25%*

All three lakes exceed the chronic standard for total phosphorus (TP) and Chlorophyll *a*. Only Rice Lake exceeded the Secchi depth chronic standard. As for the typical values for the Western Corn Belt Plains ecoregion, all three lakes exceeded typical values for TP, but chlorophyll *a* and Secchi seem typical of other Minnesota lakes in the WCBP ecoregion.

Streams

Streams and rivers surveyed in this assessment project fall into three ecoregions, The Western Corn Belt Plains, North Central Hardwood Forest, and the Driftless Area. The three lakes sampled under this project are in the Western Corn Belt Plains ecoregion, thus, the characteristics of this ecoregion were described in the "Lakes" section of this report.

The North Central Hardwood Forest (NCHF) ecoregion is an area of transition between the forested areas to the north and east and the agricultural areas to the south and wet. The terrain varies from rolling hills to smaller plains. Upland areas are forested by hardwoods and conifers. Plains include livestock pastures, hay fields, and row crops such as potatoes, beans, peas, and corn. The ecoregion contains many lakes, and water clarity and nutrient levels are moderate. Land surrounding many of these lakes has been developed for housing and recreation, and the densely populated metropolitan area dominates the eastern portion of this region. Water quality problems that face many of the water bodies in this area are associated with contaminated runoff from paved surfaces and lawns.

The Driftless Area (DA) is the smallest ecoregion in the state. The hilly DA is named for its lack of recent glacial activity. Soils are thin and karst formations underlay most of the area. Lakes are practically non-existent in this area. Animal feedlots are prominent in this region and nitrate contamination of surface water is of special concern.

Each stream and river site was visited about twice per month between May and September 2011 and 2012 and evaluated for a suite of chemical, biological, and physical parameters (Table 4). A total of 12 samples were collected for each parameter at each site and the results are shown in Table 7.

Table 4. *Various samples and measurements collected at each stream or river site visit*.

Chemical	Biological	Field meter and Secchi tube	Observations
Nitrate + Nitrite (NO_x) Total Kjeldahl Nitrogen (TKN) Ammonia, Nitrogen (NH_3) Total Phosphorus (TP) Total Suspended Solids (TSS) Total Suspended Volatile Solids (TSVS) Chloride Sulfate Hardness	*E. coli* bacteria	Dissolved Oxygen (DO) pH Specific Conductance Temperature Clarity (Secchi tube)	Level Appearance Recreational Suitability Photographs

Description of Stream Parameters

Each of the typical water quality parameters is associated with a particular source of pollution. Understanding the amount of pollutants in a waterbody can be used to develop a targeted management strategy. Table 5, adapted from the Minnesota Pollution Control Agency, describes the various sources and associated pollutants. A description of each of these associated pollutants is provided to aid in interpretation of values provided in this report.

Table 5. *Sources and associated pollutants*.

Source	Associated pollutants
Cropland	Turbidity, nutrients (phosphorus, nitrate + nitrite), temperature, total suspended solids
Construction	Turbidity, temperature, dissolved oxygen, total suspended solids
Forestry harvesting	Turbidity, temperature, total suspended solids
Grazing and feedlots	Bacteria, turbidity, nutrients (phosphorus, nitrate + nitrite), total suspended solids, temperature
Industrial discharge	Temperature, conductivity, total suspended solids, pH
Property development/ lakeshore urbanization	Total suspended solids, total phosphorus
Septic systems	Bacteria, nutrients (phosphorus, nitrate + nitrite), dissolved oxygen, conductivity, temperature
Sewage treatment plants	Dissolved oxygen, turbidity, conductivity, nutrients (phosphorus, nitrate + nitrite), bacteria, temperature, total suspended solids, pH
Urban runoff	Turbidity, nutrients (phosphorus, nitrate + nitrite), temperature, conductivity, dissolved oxygen

Minnesota Pollution Control Agency. "Volunteer Surface Water Monitoring Guide." November 2009.

Nutrients

Phosphorus and nitrogen are essential plant nutrients that stimulate the growth of algae and other aquatic plants. Algae are microscopic plants that, when over-abundant, turn surface waters green and scummy. Of the two plant nutrients, phosphorus is often considered to be the nutrient that regulates the production of algae in most lakes and is also the most amenable to control.

Solids

A variety of parameters provide information on the amount of dissolved and suspended material in water. Suspended materials influence the transparency, color, and overall health of an aquatic ecosystem.

Transparency and Turbidity

Turbidity is a measure of light scattering properties of suspended materials. Transparency is the depth to which light penetrates the water column. In theory, the more suspended material exists, the more light scattering (turbid), and hence, the less transparent. Secchi discs and Secchi tubes are used to measure transparency in lakes and rivers, respectively. Transparency is a measurement of water clarity, and is considered an indirect measurement of algae or suspended sediment in the water.

Conductivity

Conductivity is a measure of the ability of water to pass an electrical current. It is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions (ions that carry a negative charge) or sodium magnesium, calcium, iron, and aluminum cations (ions that carry a positive charge). Conductivity is also affected by temperature. Water with low conductivity would be considered “soft”, and water with high conductivity would be considered “hard.”

Dissolved Oxygen

Dissolved oxygen (DO) is measured to characterize the amount of oxygen available for aquatic life. At low DO concentrations, sensitive animals may move away, weaken, or die. It also influences decomposition rates and the composition and cycling of other water quality parameters. Low dissolved oxygen concentrations indicate either high demand for oxygen or limited reaeration from the atmosphere.

Temperature

The rates at which biological and chemical processes progress depend on temperature. Aquatic organisms, from microbes to fish, are dependent on certain temperature ranges for their optimum health. If temperatures are outside this optimal range for a prolonged period of time, organisms are stressed and can die.

pH

The acidity of water, as measured by pH, is a concern to aquatic life. A desirable range is between 6.5 and 9.0 units. pH is not an indicator of a particular pollutant; however, it affects many chemical and biological processes in water. For example, low pH can allow toxic elements and compounds to become mobile and “available” for uptake by aquatic plants and animals.

Bacteria

Bacteria are indicators of possible sewage contamination because they are commonly found in human and animal feces. Large numbers of bacteria suggest that other pathogenic (disease-causing) microorganisms found in human and animal waste might also be present and swimming may be a health risk. Bacteria data from this project are provided in Table 9 and are described more thoroughly in site specific reports available on the CRWP website.

Streams – Typical Values and Standards

Few standards have been developed for evaluation of Minnesota streams (Table 6). In cases where standards do not exist, data can sometimes be compared to typical values for streams which are in the same ecoregion (Table 6). Stream data collected under this project are shown in Table 7; where underlined values are those that exceed the typical values of streams in that particular ecoregion and bolded values are those that exceed the chronic standard. It is important to note here that many measured values could not be compared to standards or typical values because they simply do not exist.

Summary tables of *E. coli* bacteria, field meter data, and observational data for each site are included in Table 9.

Table 6. *Typical annual stream water quality conditions in Minnesota's ecoregions and chronic standards for chemical parameters where they exist.*

Ecoregion	Average (mg/L)								
	NH_3	TKN	NO_x	TP	TSS	TSVS	Chloride	Sulfate	Hardness
North Central Hardwood Forests (NCHF)			0.04-0.26	0.06-0.15	4.8-16				
Western Corn Belt Plains (WCBP)			1.4-7.4	0.16-0.33	10-61				
Driftless Area (DA)			0.04-0.26	0.06-0.15	4.8-16				
Chronic Standard	0.040	--	--	--	58	--	230	--	--

Table 7. *Actual stream chemistry data collected May-September 2011 and 2012, grouped by ecoregion (color coincides with map (Figure1)). Underlined values are those that exceeds typical values as shown in Table 6,* ***bolded*** *values are those that exceed chronic standards as shown in Table 6. Sample size = 12.*

Stream site, grouped by ecoregion		Average (mg/L)								
		NH_3	TKN	NO_x	TP	TSS	TSVS	Chloride	Sulfate	Hardness
NCHF	Cannon River at Sakatah Trail (S000-545)	**0.061**	0.868	0.72	0.179	36	8	17.7	16.0	192
	Wolf Creek (S001-397)	**0.105**	1.422	2.32	0.255	32	11	16.1	21.2	213
	Heath Creek (S006-521)	**0.170**	1.511	1.65	0.350	33	8	28.8	18.5	234
	Straight River in Faribault (S006-527)	**0.052**	0.797	6.45	0.183	26	5	31.6	39.0	286
WCBP	Straight River south of Owatonna (S001-343)	**0.064**	0.835	4.51	0.139	29	7	20.2	48.1	297
	Prairie Creek (S001-785)	**0.066**	0.944	6.60	0.143	**93**	15	17.6	29.1	262
	Chub Creek (S002-533)	**0.066**	0.930	3.97	0.173	22	6	22.0	21.4	258
	Crane Creek (S003-009)	**0.083**	1.111	4.87	0.150	32	7	22.2	36.5	280
	Turtle Creek (S003-628)	**0.065**	0.778	5.79	0.155	13	4	18.7	18.3	279
DA	Cannon River – 5 miles NW of Red Wing (S001-766)	**0.072**	1.027	4.51	0.223	**103**	17	24.1	24.6	247
	Belle Creek (S002-532)	**0.065**	0.715	4.60	0.161	57	9	23.1	18.9	275
	Cannon River in Cannon Falls (S003-818)	**0.158**	1.257	3.98	0.201	16	7	28.6	29.1	224
	Little Cannon River (S004-512)	**0.079**	1.892	5.96	0.157	**419** **68***	27	21.1	25.9	284

68* at the Little Cannon River is the average TSS value with one outlier value of 3580 mg/L removed.

Escherichia coli (E. coli) bacteria

E. coli bacteria samples were collected at all stream sites for use as an indicator of fecal contamination and to evaluate public health risk in fresh waters. Single sample values above 235 organisms/100mL and geometric mean values above 126 organisms/100mL suggest that disease-causing pathogens may be present.

What is E. coli and why monitor it?
Escherichia coli (E. coli) bacteria are an indicator of fecal contamination and used by the Environmental Protection Agency to evaluate public health risk in fresh waters. High levels suggest that disease-causing pathogens may be present.

With the exception of the Cannon River in Cannon Falls, the remaining twelve stream sites have a geometric mean which suggests that there may be disease-causing pathogens above the level that the Environmental Protection Agency has set to protect public health. The geometric mean helps to dampen the effect of very high or very low numbers, thus reducing bias and allowing for meaningful statistical results. Even so, the geometric mean is still above the EPA standard for safe recreation for 12 of the 13 stream sites. Additionally, this is a 90-day geometric mean which means it is quite conservative.

Individual site reports regarding bacterial abundance for 2011 and 2012 can be accessed at CRWP's website. The best way to protect yourself is to use common sense; don't swim if you are sick, bathe after swimming, wash your hands before you eat or drink, and avoid swimming immediately after rain events.

"What can I do to help?"

"Where can I learn more?"

"How can I monitor a stream or lake near me?"

Contact Jessica Van Der Werff at Jessica@crwp.net or (507)786-3912

Table 8. *Appearance and Recreational Suitability score definitions.*

Rating	Appearance Definition	Recreational Suitability Definition
1	Clear – transparent water	Beautiful, could not be better
2	Cloudy – not quite crystal clear; cloudy white, gray or light brown	Very minor aesthetic problems; excellent for body-contact recreation
3	Muddy – cloudy brown due to high sediment levels	Body-contact recreation and aesthetic enjoyment slightly impaired
4	Green – due to algae growth; indicative of excess nutrients released into the stream	Recreation potential and level of enjoyment of the stream substantially reduced (would not swim but boating/canoeing is okay)
5	Muddy and Green – a combination of cloudy brown from high sediment levels and green from algae growth	Swimming and aesthetic enjoyment of the stream nearly impossible.

Table 9. *Summary tables of* E. coli *bacteria, field meter data, and observational data for 13 stream sites, June-August 2011 and 2012. ***indicates geometric mean. * indicates measurement made one week after major flood event on June 14, 2012. Appearance and Recreational Suitability scores can be found in Table 8.*

Cannon River at Sakatah Trail (S000-545)

Parameter	Count	Mean	Min	Max
E. coli 2011 (MPN/100mL)	9	214***	78.2	>2419.6
E. coli 2012 (MPN/100mL)	6	135***	98.8	235.9
Recreational Suitability	15	2.5	2	4
Appearance	15	1.2	1	3
Clarity (cm)	15	96	40	>100
Temperature (deg Celcius)	15	24.9	20.7	30.1
Dissolved oxygen (mg/L)	15	6.4	3.6	9.1
pH	15	7.77	7.51	8.08
Specific conductance (µS/cm)	15	459	410	642

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Straight River – South of Owatonna (S001-343)

Parameter	Count	Mean	Min	Max
E. coli 2011 (MPN/100mL)	9	479***	185	>2419.6
E. coli 2012 (MPN/100mL)	6	348***	150	1299.7
Recreational Suitability	15	2.1	1	4
Appearance	15	1.7	1	3
Clarity (cm)	15	60	7	>100
Temperature (deg Celcius)	15	23.6	17	28.1
Dissolved oxygen (mg/L)	15	7.9	5.4	10.3
pH	15	7.9	7	8.1
Specific conductance (µS/cm)	15	602	425	696

Wolf Creek (S001-397)

Parameter	Count	Mean	Min	Max
E. coli 2011 (MPN/100mL)	9	445***	125.9	>2419.6
E. coli 2012 (MPN/100mL)	6	315***	155.3	816.4
Recreational Suitability	16	3.3	1	5
Appearance	16	2.7	1	5
Clarity (cm) (2012 only)	7	34	19	74
Temperature (deg Celcius)	15	23.9	16.8	30.3
Dissolved oxygen (mg/L)	16	7.7	5.1	10
pH	16	8	7.6	8.5
Specific conductance (µS/cm)	15	419	283	605

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Cannon River – 5 miles NW of Red Wing (S001-766)

Parameter	Count	Mean	Min	Max
E. coli 2011 (MPN/100mL)	9	197***	41	>2419.6
E. coli 2012 (MPN/100mL)	6	332***	31	10860*
Recreational Suitability	15	3.9	1	5
Appearance	15	2.3	1	3
Clarity (cm)	15	36	2	96
Temperature (deg Celcius)	15	22.5	17.9	26
Dissolved oxygen (mg/L)	15	7.5	6.7	9
pH	15	8	7.8	8.2
Specific conductance (µS/cm)	14	816	336	2008

Prairie Creek (S001-785)

Parameter	Count	Mean	Min	Max
E. coli 2011 (MPN/100mL)	9	977***	214.2	12997
E. coli 2012 (MPN/100mL)	6	505***	196.8	5475*
Recreational Suitability	20	3	1	5
Appearance	20	2.1	1	3
Clarity (cm)	20	46	5	>100
Temperature (deg Celcius)	20	20.4	15.8	25
Dissolved oxygen (mg/L)	20	8.6	7.3	9.7
pH	20	8.1	7.7	8.5
Specific conductance (µS/cm)	20	602	396	660

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Belle Creek (S002-532)

Parameter	Count	Mean	Min	Max
E. coli 2011 (MPN/100mL)	9	339***	59.4	>2419.6
E. coli 2012 (MPN/100mL)	6	290***	20	11533*
Recreational Suitability	18	3.1	1	5
Appearance	18	1.9	1	3
Clarity (cm)	18	50	3	>100
Temperature (deg Celcius)	17	20.3	14.6	27
Dissolved oxygen (mg/L)	17	9.3	7.8	11.6
pH	17	8.1	7.6	8.9
Specific conductance (µS/cm)	17	562	360	631

Chub Creek (S002-533)

Parameter	Count	Mean	Min	Max
E. coli 2011 (MPN/100mL)	8	927***	556	>2419.6
E. coli 2012 (MPN/100mL)	7	946***	727	2613
Recreational Suitability	19	3.4	1	5
Appearance	19	2.2	1	4
Clarity (cm) (2012 only)	12	61	16	>100
Temperature (deg Celcius)	18	21.3	16	25.8
Dissolved oxygen (mg/L)	18	7.7	5.8	9.5
pH	18	8	7.5	8.2
Specific conductance (µS/cm)	17	542	263	637

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Crane Creek (S003-009)

Parameter	Count	Mean	Min	Max
E. coli 2011 (MPN/100mL)	9	272***	31	>2419.6
E. coli 2012 (MPN/100mL)	6	260***	90.6	727
Recreational Suitability	15	2.7	1	4
Appearance	15	1.7	1	3
Clarity (cm)	15	57	6	>100
Temperature (deg Celcius)	15	24.1	18.8	30
Dissolved oxygen (mg/L)	15	8.8	5.7	12
pH	15	7.88	7.53	8.29
Specific conductance (µS/cm)	15	598	523	732

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Turtle Creek (S003-628)

Parameter	Count	Mean	Min	Max
E. coli 2011 (MPN/100mL)	9	444***	93.3	>2419.6
E. coli 2012 (MPN/100mL)	6	447***	307.6	648.8
Recreational Suitability	15	3.3	2	5
Appearance	15	1.8	1	3
Clarity (cm)	15	68	4	>100
Temperature (deg Celcius)	15	22	17.3	27
Dissolved oxygen (mg/L)	15	8.1	7.1	10
pH	15	8	7.5	8.2
Specific conductance (µS/cm)	15	604	397	684

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Cannon River in Cannon Falls (S003-818)

Parameter	Count	Mean	Min	Max
E. coli 2011 (MPN/100mL)	10	26***	<1	>2419.6
E. coli 2012 (MPN/100mL)	6	32***	10.8	173*
Recreational Suitability	19	3.1	2	5
Appearance	19	2.5	1	4
Clarity (cm)	19	54	13	>100
Temperature (deg Celcius)	19	23.7	15.5	28
Dissolved oxygen (mg/L)	16	8.2	5.5	12.4
pH	18	7.88	7.26	8.48
Specific conductance (µS/cm)	18	533	344	723

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Little Cannon River (S004-512)

Parameter	Count	Mean	Min	Max
E. coli 2011 (MPN/100mL)	8	578***	171	>2419.6
E. coli 2012 (MPN/100mL)	7	457***	100	29090*
Recreational Suitability	20	2.9	1	5
Appearance	20	2	1	3
Clarity (cm)	19	60	4	>100
Temperature (deg Celcius)	20	20	15.9	25
Dissolved oxygen (mg/L)	20	8.6	7.7	9.7
pH	20	8.08	7.82	8.31
Specific conductance (µS/cm)	20	617	274	697

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Heath Creek (S006-521)

Parameter	Count	Mean	Min	Max
E. coli 2011 (MPN/100mL)	9	339***	98.5	>2419.6
E. coli 2012 (MPN/100mL)	6	276***	88.6	648.8
Recreational Suitability	16	2.7	1	4
Appearance	16	2.1	1	4
Clarity (cm) (2012 only)	7	70	34	>100
Temperature (deg Celcius)	15	23.3	17.7	29.8
Dissolved oxygen (mg/L)	16	6.9	4.7	8.9
pH	16	7.82	6.53	8.45
Specific conductance (µS/cm)	16	448	303	578

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Straight River in Faribault (S006-527)

Parameter	Count	Mean	Min	Max
E. coli 2011 (MPN/100mL)	9	279***	75.4	>2419.6
E. coli 2012 (MPN/100mL)	6	150***	90.8	648.8*
Recreational Suitability	27	3.3	1	5
Appearance	27	2.1	1	5
Clarity (cm)	27	49	5	>100
Temperature (deg Celcius)	17	24	18	30
Dissolved oxygen (mg/L)	17	8.3	6.72	11.3
pH	17	8.08	7.86	8.4
Specific conductance (µS/cm)	17	675	516	837

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Figure 1. *Watershed map with sampling sites and delineated by ecoregion.*