



Water-Data Report 2011

05140515 WARROAD RIVER NEAR HIGHWAY 11 AT WARROAD, MN

Rainy Basin
Lake of the Woods Subbasin

LOCATION.--Lat 48°54'11", long 95°19'12" referenced to North American Datum of 1983, Roseau County, MN, Hydrologic Unit 09030009, at northeast corner of MN Hwy 11 bridge over the Warroad River in Warroad.

DRAINAGE AREA.--263 mi², 263 sq. mi. (from StreamStats)

SURFACE-WATER RECORDS

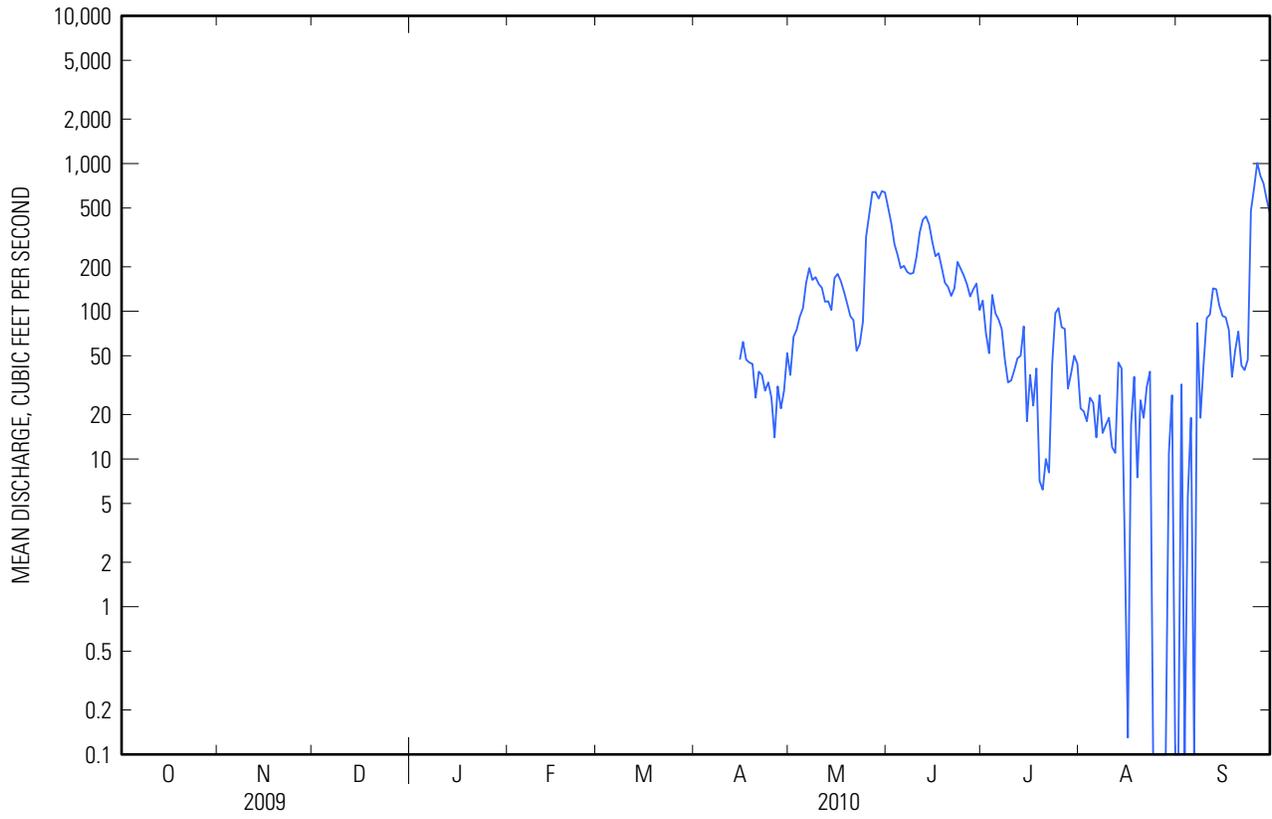
PERIOD OF RECORD.--April 2010 to October, 2011, seasonal record only.

GAGE.--Records fair to poor due to seiche interaction with Lake of the Woods. Estimated days are considered poor.

**DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2009 TO SEPTEMBER 2010
DAILY MEAN VALUES**
[e, estimated]

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	---	---	---	---	---	---	---	e37	503	118	22	-21
2	---	---	---	---	---	---	---	e67	394	e71	21	e32
3	---	---	---	---	---	---	---	e75	285	e52	18	-18
4	---	---	---	---	---	---	---	e92	e240	e129	26	5.6
5	---	---	---	---	---	---	---	e105	196	97	24	19
6	---	---	---	---	---	---	---	156	203	88	14	e-46
7	---	---	---	---	---	---	---	196	185	76	27	e83
8	---	---	---	---	---	---	---	163	179	47	15	19
9	---	---	---	---	---	---	---	170	182	33	17	44
10	---	---	---	---	---	---	---	153	235	e34	19	90
11	---	---	---	---	---	---	---	144	341	40	12	95
12	---	---	---	---	---	---	---	116	417	48	e11	143
13	---	---	---	---	---	---	---	117	439	50	e45	141
14	---	---	---	---	---	---	---	102	387	e79	e41	109
15	---	---	---	---	---	---	e47	168	295	18	2.7	93
16	---	---	---	---	---	---	62	179	236	37	0.13	91
17	---	---	---	---	---	---	47	160	e247	23	17	75
18	---	---	---	---	---	---	45	136	e197	41	36	36
19	---	---	---	---	---	---	44	113	e156	7.1	7.5	54
20	---	---	---	---	---	---	26	93	146	6.2	e25	e73
21	---	---	---	---	---	---	39	87	127	10	19	e43
22	---	---	---	---	---	---	37	e54	143	e8.1	31	40
23	---	---	---	---	---	---	29	e60	216	e44	39	47
24	---	---	---	---	---	---	33	85	194	97	-6.3	480
25	---	---	---	---	---	---	26	318	174	105	-23	682
26	---	---	---	---	---	---	14	451	e152	78	-4.2	1,010
27	---	---	---	---	---	---	31	642	e126	76	e-1.00	826
28	---	---	---	---	---	---	e22	641	141	30	e-10	e733
29	---	---	---	---	---	---	e29	580	154	38	e11	e569
30	---	---	---	---	---	---	e52	650	102	50	e27	463
31	---	---	---	---	---	---	---	638	---	44	e0.10	---

05140515 WARROAD RIVER NEAR HIGHWAY 11 AT WARROAD, MN—Continued



05140515 WARROAD RIVER NEAR HIGHWAY 11 AT WARROAD, MN—Continued

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2010 TO SEPTEMBER 2011
DAILY MEAN VALUES

[e, estimated]

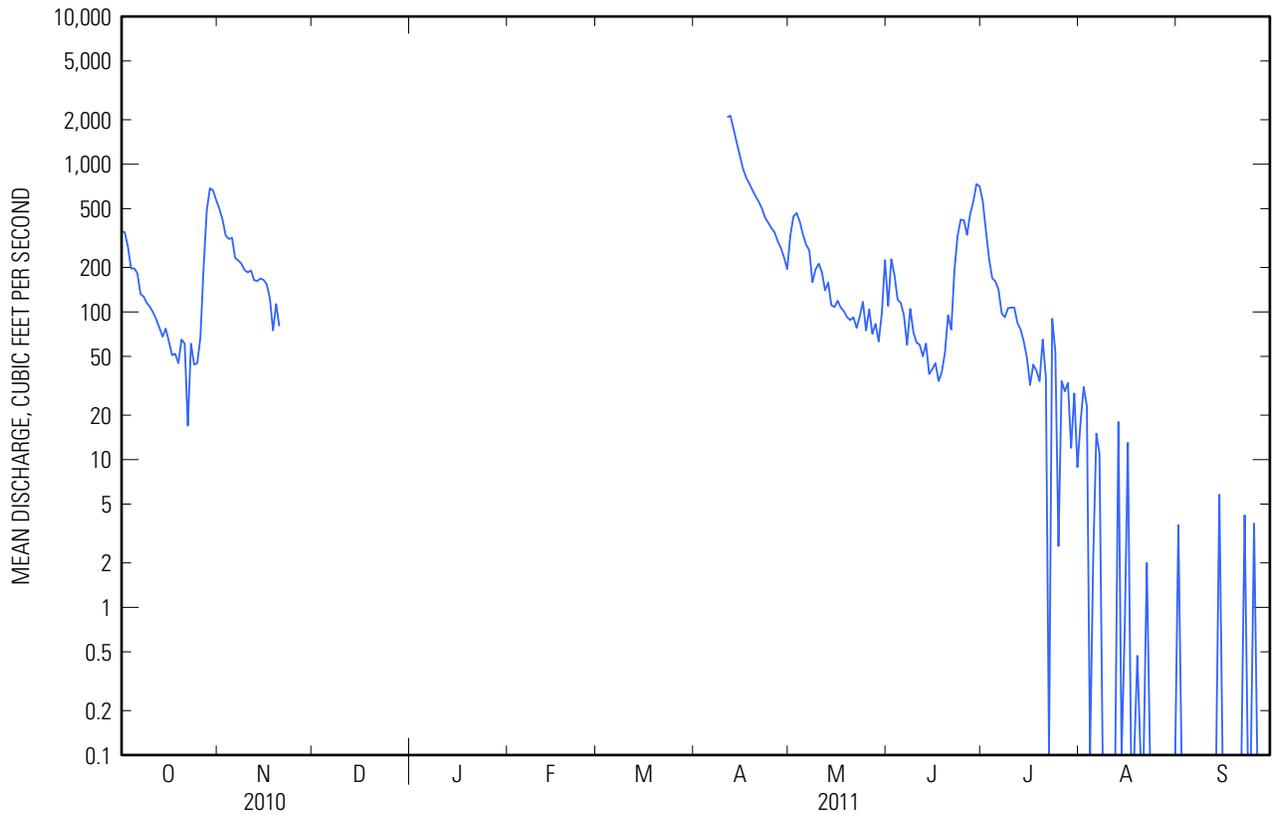
Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	351	499	---	---	---	---	---	e330	110	e559	e18	e3.6
2	346	422	---	---	---	---	---	444	227	355	e31	-5.7
3	277	329	---	---	---	---	---	467	178	229	23	-29
4	197	312	---	---	---	---	---	408	121	169	-6.4	-5.6
5	197	317	---	---	---	---	---	334	115	161	2.1	-3.5
6	183	232	---	---	---	---	---	285	95	141	15	-13
7	132	223	---	---	---	---	---	262	e60	98	11	-2.5
8	127	212	---	---	---	---	---	159	e105	92	e-0.55	-21
9	115	192	---	---	---	---	---	194	73	e106	e-2.5	-3.7
10	108	185	---	---	---	---	---	e212	62	107	-2.8	-9.2
11	99	191	---	---	---	---	2,080	186	60	107	-8.4	-17
12	89	164	---	---	---	---	2,130	140	50	84	-30	e-0.14
13	78	162	---	---	---	---	1,730	158	61	76	18	-27
14	68	168	---	---	---	---	1,400	111	38	63	-9.7	5.8
15	77	165	---	---	---	---	1,140	108	e41	49	0.71	-13
16	63	154	---	---	---	---	932	119	45	32	e13	-0.76
17	51	124	---	---	---	---	810	107	34	44	-20	-14
18	52	75	---	---	---	---	739	101	39	40	-5.8	-3.0
19	e45	113	---	---	---	---	667	92	53	e34	0.47	-24
20	e65	80	---	---	---	---	606	88	95	e65	-17	e-12
21	61	---	---	---	---	---	556	e92	76	e36	-8.1	-11
22	17	---	---	---	---	---	501	e78	189	-13	e2.0	4.2
23	61	---	---	---	---	---	435	e93	326	90	e-8.0	-17
24	e44	---	---	---	---	---	401	117	422	54	e-14	-4.3
25	e45	---	---	---	---	---	370	75	418	2.6	-8.7	3.7
26	e68	---	---	---	---	---	346	104	333	34	-16	-0.80
27	e199	---	---	---	---	---	301	71	458	e29	-10	-10
28	485	---	---	---	---	---	271	e83	558	33	-12	-7.6
29	687	---	---	---	---	---	234	e63	734	12	-27	-6.6
30	664	---	---	---	---	---	e195	e98	e709	28	-13	-2.1
31	570	---	---	---	---	---	---	e224	---	8.9	-6.3	---

SUMMARY STATISTICS

Water Years 2010 - 2011	
Highest daily mean	2,130 Apr 12, 2011
Lowest daily mean	-46 Sep 6, 2010
Annual seven-day minimum	-14 Aug 24, 2011
Maximum peak flow	2,280 Apr 12, 2011
Maximum peak stage	6.13 Jul 27, 2010
Instantaneous low flow	-1,600 Jul 4, 2011

^a Due in part to seiche.^b Result of seiche.

05140515 WARROAD RIVER NEAR HIGHWAY 11 AT WARROAD, MN—Continued



05140515 WARROAD RIVER NEAR HIGHWAY 11 AT WARROAD, MN—Continued

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2011 TO SEPTEMBER 2012
DAILY MEAN VALUES

[e, estimated]

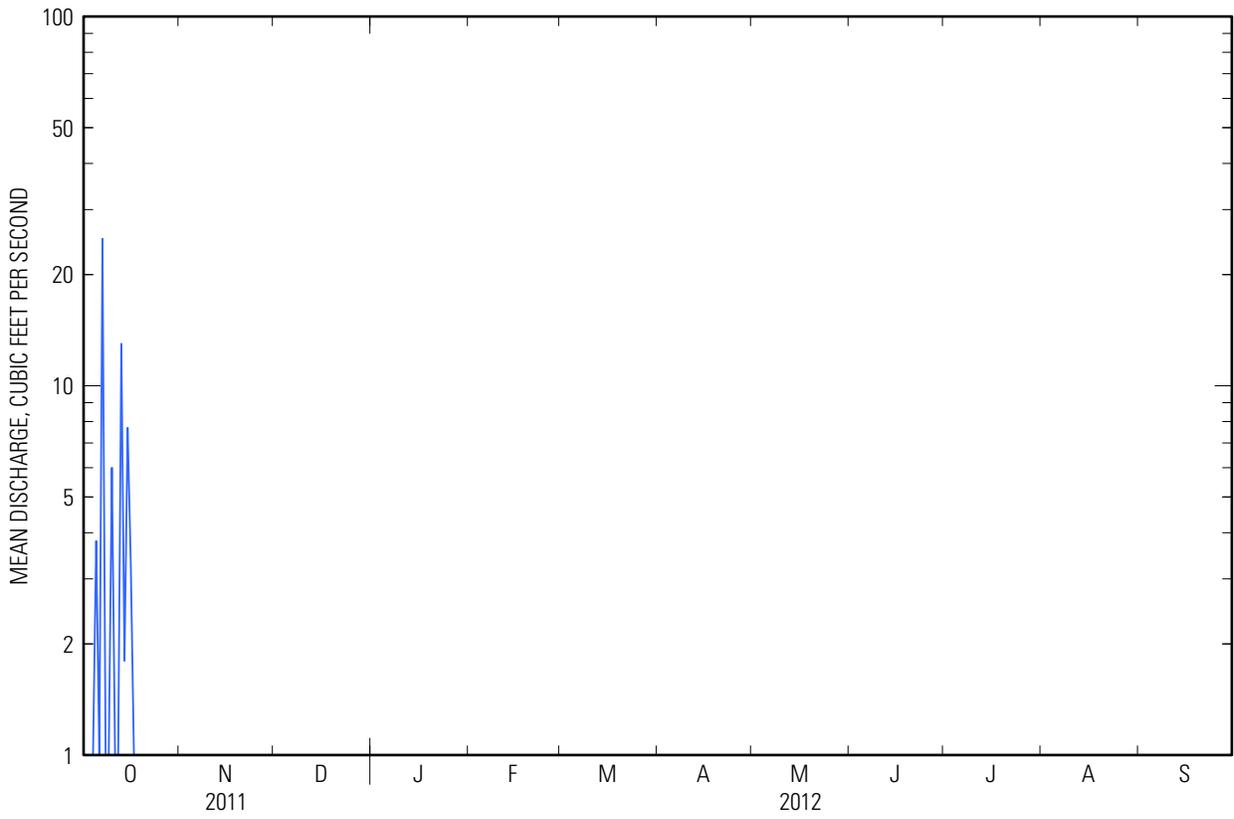
Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	-12	---	---	---	---	---	---	---	---	---	---	---
2	-9.7	---	---	---	---	---	---	---	---	---	---	---
3	-17	---	---	---	---	---	---	---	---	---	---	---
4	-12	---	---	---	---	---	---	---	---	---	---	---
5	3.8	---	---	---	---	---	---	---	---	---	---	---
6	-2.8	---	---	---	---	---	---	---	---	---	---	---
7	e25	---	---	---	---	---	---	---	---	---	---	---
8	e-45	---	---	---	---	---	---	---	---	---	---	---
9	-9.8	---	---	---	---	---	---	---	---	---	---	---
10	6.0	---	---	---	---	---	---	---	---	---	---	---
11	-16	---	---	---	---	---	---	---	---	---	---	---
12	-7.8	---	---	---	---	---	---	---	---	---	---	---
13	e13	---	---	---	---	---	---	---	---	---	---	---
14	1.8	---	---	---	---	---	---	---	---	---	---	---
15	7.7	---	---	---	---	---	---	---	---	---	---	---
16	3.3	---	---	---	---	---	---	---	---	---	---	---
17	e-9.0	---	---	---	---	---	---	---	---	---	---	---
18	---	---	---	---	---	---	---	---	---	---	---	---
19	---	---	---	---	---	---	---	---	---	---	---	---
20	---	---	---	---	---	---	---	---	---	---	---	---
21	---	---	---	---	---	---	---	---	---	---	---	---
22	---	---	---	---	---	---	---	---	---	---	---	---
23	---	---	---	---	---	---	---	---	---	---	---	---
24	---	---	---	---	---	---	---	---	---	---	---	---
25	---	---	---	---	---	---	---	---	---	---	---	---
26	---	---	---	---	---	---	---	---	---	---	---	---
27	---	---	---	---	---	---	---	---	---	---	---	---
28	---	---	---	---	---	---	---	---	---	---	---	---
29	---	---	---	---	---	---	---	---	---	---	---	---
30	---	---	---	---	---	---	---	---	---	---	---	---
31	---	---	---	---	---	---	---	---	---	---	---	---

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05140515 WARROAD RIVER NEAR HIGHWAY 11 AT WARROAD, MN—Continued



05140515 WARROAD RIVER NEAR HIGHWAY 11 AT WARROAD, MN—Continued**WATER-QUALITY RECORDS**

REMARKS.--The USGS, in cooperation with the Minnesota Pollution Control Agency (MPCA), collected hydrologic and water-quality data from the primary U.S. inflows, main body, and outflow channels of Lake of the Woods. The data were collected to support the development of a water-quality model being developed by the MPCA.

The objectives of this study are to: (1) Collect water-quality samples and gage streamflow near the mouths of the Rainy and Warroad Rivers during the open water season of 2010, as part of the Nutrient-Sediment Loading Study, Phase I. Streamgaging and water-quality sampling continued during the open-water season of 2011 to better develop index-velocity/discharge relations. (2) Collect water-quality samples at 10 sites in Lake of the Woods during the open-water season of 2010, as part of the In-Lake Nutrient Study, Phase I. (3) Measure streamflow velocities and cross-sectional areas of 5 channel constrictions in Lake of the Woods, as part of the Big Traverse Outlet Hydrology Study, Phase I. If velocities are sufficient. Channel locations near the Northwest Angle are Tug Channel, Canadian Channel, Sturgeon Channel, Flag Island Channel, and NW Angle Flowage.

WATER-QUALITY DATA
WATER YEAR OCTOBER 2010 TO SEPTEMBER 2011

Part 1 of 4

[CaCO₃, calcium carbonate; FNU, Formazin nephelometric units; LED, light-emitting diode; N, nitrogen; P, phosphorus; SiO₂, silicon dioxide; ft, feet; ft³/s, cubic feet per second; ft³/s, cubic feet per second; mg/L, milligrams per liter; mm Hg, millimeters of mercury; nm, nanometers; °C, degrees Celsius; µS/cm, microsiemens per centimeter; µg/L, micrograms per liter; --, no data; <, less than; E, estimated]

Date	Sample start time	Medium name	Barometric pressure, mm Hg (00025)	Temperature, air, °C (00020)	Discharge, ft ³ /s (00060)	Discharge, instantaneous, ft ³ /s (00061)	Dissolved oxygen, unfiltered, mg/L (00300)	pH, water, unfiltered, field, standard units (00400)	Specific conductance, water, unfiltered, µS/cm at 25 °C (00095)
10-20-2010	1300	Surface water	728	11.5	65	219	10.2	7.7	271
10-25-2010	0900	Surface water	719	8.5	45	-39	10.7	7.9	291
04-12-2011	1000	Surface water	730	--	2,130	2,200	10.7	7.6	203
04-13-2011	1030	Surface water	--	--	1,730	1,710	10.3	7.6	186
04-14-2011	1030	Surface water	745	--	1,400	--	11.2	7.6	180
04-18-2011	1630	Surface water	735	--	739	--	11.9	7.8	176
04-19-2011	1030	Surface water	735	-3.3	667	--	11.9	7.7	178
04-20-2011	0900	Surface water	737	2.2	606	--	11.5	7.7	179
04-21-2011	0930	Surface water	736	4.4	556	--	11.2	7.7	180

05140515 WARROAD RIVER NEAR HIGHWAY 11 AT WARROAD, MN—Continued

WATER-QUALITY DATA
WATER YEAR OCTOBER 2010 TO SEPTEMBER 2011

Part 2 of 4

[CaCO₃, calcium carbonate; FNU, Formazin nephelometric units; LED, light-emitting diode; N, nitrogen; P, phosphorus; SiO₂, silicon dioxide; ft, feet; ft³/s, cubic feet per second; ft³/s, cubic feet per second; mg/L, milligrams per liter; mm Hg, millimeters of mercury; nm, nanometers; °C, degrees Celsius; µS/cm, microsiemens per centimeter; µg/L, micrograms per liter; --, no data; <, less than; E, estimated]

Date	Sample start time	Temperature, water, °C (00010)	Turbidity, water, unfiltered, monochrome near infra-red LED light, 780-900 nm, detection angle 90 +/- 2.5 degrees, FNU (63680)	Gage height, ft (00065)	Sampler type (84164)	Loss on ignition of suspended solids, water, unfiltered, mg/L (00535)	Suspended solids, water, unfiltered, mg/L (00530)	Alkalinity, water, filtered, fixed endpoint titration, laboratory, mg/L as CaCO ₃ (29801)	Chloride, water, filtered, mg/L (00940)
10-20-2010	1300	7.2	3.6	4.84	Weighted-bottle	--	< 15	146	.83
10-25-2010	0900	6.8	3.7	4.83	Weighted-bottle	< 10	< 15	157	.91
04-12-2011	1000	5.2	24	--	US DH-95 plastic	< 20	78	99	1.77
04-13-2011	1030	6.0	15	--	US D-96-A1 Bag	< 20	< 30	95	1.31
04-14-2011	1030	4.0	10	--	US D-96-A1 Bag	20	30	93	.91
04-18-2011	1630	4.0	5.8	--	Weighted-bottle	< 20	< 30	92	.99
04-19-2011	1030	3.4	5.9	--	Weighted-bottle	< 20	< 30	93	1.03
04-20-2011	0900	4.3	5.8	--	Weighted-bottle	< 20	< 30	94	.97
04-21-2011	0930	4.9	5.6	--	Weighted-bottle	< 10	15	95	.98

WATER-QUALITY DATA
WATER YEAR OCTOBER 2010 TO SEPTEMBER 2011

Part 3 of 4

[CaCO₃, calcium carbonate; FNU, Formazin nephelometric units; LED, light-emitting diode; N, nitrogen; P, phosphorus; SiO₂, silicon dioxide; ft, feet; ft³/s, cubic feet per second; ft³/s, cubic feet per second; mg/L, milligrams per liter; mm Hg, millimeters of mercury; nm, nanometers; °C, degrees Celsius; µS/cm, microsiemens per centimeter; µg/L, micrograms per liter; --, no data; <, less than; E, estimated]

Date	Sample start time	Fluoride, water, filtered, mg/L (00950)	Silica, water, filtered, mg/L as SiO ₂ (00955)	Sulfate, water, filtered, mg/L (00945)	Ammonia plus organic nitrogen, water, filtered, mg/L as N (00623)	Ammonia plus organic nitrogen, water, unfiltered, mg/L as N (00625)	Ammonia, water, filtered, mg/L as N (00608)	Nitrate plus nitrite, water, filtered, mg/L as N (00631)	Nitrite, water, filtered, mg/L as N (00613)	Orthophosphate, water, filtered, mg/L as P (00671)
10-20-2010	1300	.10	12.2	1.21	.76	.84	.018	.016	.002	.011
10-25-2010	0900	.11	11.8	1.51	.71	.75	.014	.023	.001	.011
04-12-2011	1000	.08	8.2	7.45	.56	1.0	< .010	.234	.005	.017
04-13-2011	1030	.08	8.0	4.62	.56	.71	.013	.101	.004	.015
04-14-2011	1030	.09	8.0	3.28	.65	.76	< .010	.039	.004	.012
04-18-2011	1630	.07	8.0	2.70	.56	.54	.012	.030	.002	.010
04-19-2011	1030	.07	8.0	2.86	.58	.54	.012	.029	.002	.010
04-20-2011	0900	.07	7.8	2.94	.42	.60	< .010	.016	< .001	.007
04-21-2011	0930	.07	7.6	2.85	.52	.62	.011	.025	.002	.009

05140515 WARROAD RIVER NEAR HIGHWAY 11 AT WARROAD, MN—Continued

WATER-QUALITY DATA
WATER YEAR OCTOBER 2010 TO SEPTEMBER 2011

Part 4 of 4

[CaCO₃, calcium carbonate; FNU, Formazin nephelometric units; LED, light-emitting diode; N, nitrogen; P, phosphorus; SiO₂, silicon dioxide; ft, feet; ft³/s, cubic feet per second; mg/L, milligrams per liter; mm Hg, millimeters of mercury; nm, nanometers; °C, degrees Celsius; µS/cm, microsiemens per centimeter; µg/L, micrograms per liter; --, no data; <, less than; E, estimated]

Date	Sample start time	Phosphorus, water, filtered, mg/L as P (00666)	Phosphorus, water, unfiltered, mg/L as P (00665)	Chlorophyll a, phytoplankton, chromatographic-fluorometric method, µg/L (70953)	Pheophytin a, phytoplankton, µg/L (62360)
10-20-2010	1300	.013	.031	E 2.2	E 1.2
10-25-2010	0900	.010	.026	E 1.9	E 1.0
04-12-2011	1000	.023	.168	E .9	E 2.2
04-13-2011	1030	.019	.069	E .5	E .9
04-14-2011	1030	.017	.052	E .4	E .8
04-18-2011	1630	.012	.019	E .3	E .5
04-19-2011	1030	.012	.016	E .2	E .4
04-20-2011	0900	.011	.019	E .3	E .5
04-21-2011	0930	.012	.019	E .3	E .4