Interim Report on summer monitoring activities (1995) for the Red Cedar River Pilot Project [part of USEPA grant 104(B)(3)]

Erik Kampa
Wisconsin Department of Natural Resources
Western District
April 1996

Sample site location

A total of 27 sites in the Red Cedar watershed were sampled during the summer of 1995. Instantaneous grab samples were collected at all sites (Table 1). In addition, 7 sample sites were continuously monitored for varying periods of time. These included 4 sites on the Red Cedar River and one site each on the Chetek River, Yellow River, and Turtle Creek. Sample sites were coded with waterbody initials (Table 1) and a number.

Table 1. Waterbodies sampled, number of sites, and abbreviations used in sample site coding.

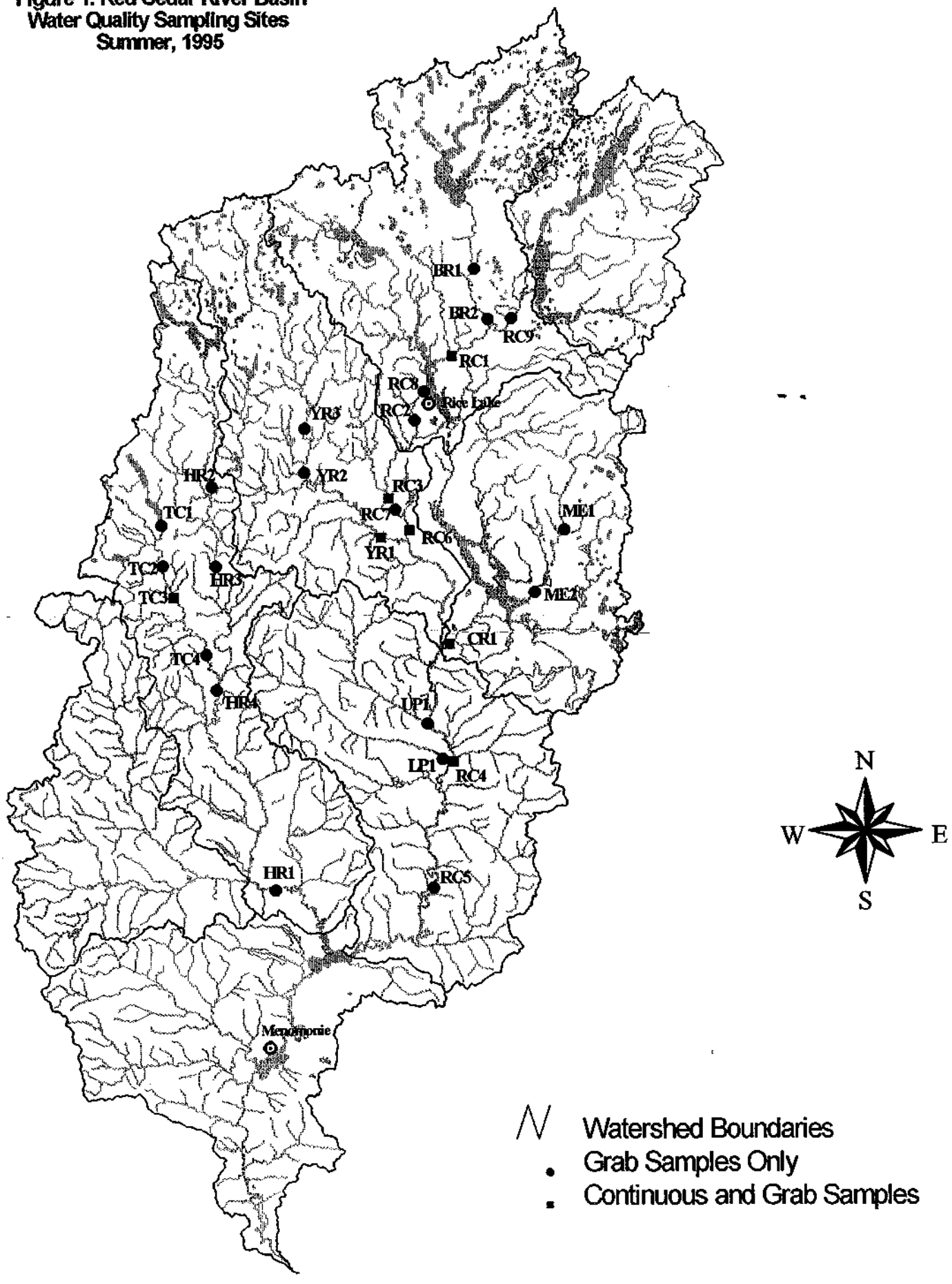
Waterbody	Number of sites	Abbreviation
Brill River	2	BR
Chetek River	1	CR
Hay River	4	HR
Lower Pine Creek	1	LP
Moose Ear Creek	2	ME
Red Cedar River	9	RC
Turtle Creek	4	TC
Upper Pine Creek	1	UP
Yellow River	3	YR

Most sample sites were at or near bridge crossings (Table 2, Figure 1). A Trimble GPS Pathfinder® Basic was also used to locate selected sample sites (Appendix A). However, the accuracy of these coordinates has a 100 meter margin of error.

Table 2. Description of sampling sites in the Red Cedar watershed.

Site	Description
RC-1	County Highway (CTH) M and State Highway (STH) 48, north of Rice Lake
RC-2	CTH O, south of Rice Lake
RC-3	CTH W, east of Cameron
RC-4	CTH V, in Sand Creek
RC-5	CTH W, north of Colfax
RC-6	19 3/4 Street, southeast of Barron (private access)
RC-7	12 3/4 Avenue, south of Cameron (private access)
RC-8	downstream of Rice Lake dam, in Rice Lake
RC-9	25th Avenue, northeast of Rice Lake
HR-1	Bridge Street, in Wheeler
HR-2	STH 8, east of Almena
HR-3	CTH D, east of Arland
HR-4	1st Avenue, south of Prairie Farm
YR-1	CTH O, southeast of Barron
YR-2	15th Avenue, northwest of Barron
YR-3	18th Avenue, north of Barron
TC-1	11 1/2 Avenue, south of Lower Turtle Lake
TC-2	9th Avenue, west of Arland
TC-3	CTH D, southwest of Arland
TC-4	CTH A, northwest of Prairie Farm
BR-1	CTH V, north of Brill
BR-2	25th Avenue, south of Brill
CR-1	Mud Lake Road, southwest of Chetek
ME-1	12th Avenue, northeast of Chetek
ME-2	CTH D, east of Chetek
UP-1	West River Road, northwest of Sand Creek
LP-1	CTH V, west of Sand Creek

Figure 1. Red Cedar River Basin
Water Quality Sampling Sites
Summer, 1995



Methods

Monitoring activities in the Red Cedar watershed were conducted from June through August of 1995. Grab samples were taken on at least one day at all locations. Continuous data was also collected at 7 sites.

Grab samples

Instantaneous grab samples were collected at various sites and dates (Appendix B). The sampling objective was to collect two samples at each site, one early in the morning and one late in the afternoon. The time interval was designed to capture daily low and high dissolved oxygen levels, respectively.

Dissolved oxygen (mg/l) and temperature (°C) were measured with a YSI 54A dissolved oxygen meter. These measurements were taken from a bridge, if possible, or from the streambank. The probe was lowered from the bridge into the area of the stream with the strongest flow. Data was collected to determine if dissolved oxygen or temperature readings were influenced by probe placement in the stream (i.e. left, center, or right of the stream). An analysis of variance indicated there were no significant differences in either temperature or dissolved oxygen across the stream (Appendix C).

Water chemistry samples were collected on selected monitoring dates. Grab samples were collected and sent, on ice, to the State Lab of Hygiene for analysis of nutrients and suspended solids (Appendix B). In the field, pH was measured in the collected samples with an Orion SA250 pH meter.

Continuous monitoring

Continuous monitoring was conducted at selected sites (Appendix D) with either YSI model 6000 continuous monitoring meters or with YSI dissolved oxygen meters equipped with LI-COR LI1000 dataloggers. The meters continuously logged temperature, dissolved, oxygen, pH, conductivity, and depth every 30 minutes. The meters were deployed for varying amounts of time, but were checked and re-calibrated weekly. Data files were downloaded in the field and imported into a spreadsheet for analysis.

Results

Grab sample and continuous monitoring data collected on the Red Cedar Watershed during the summer of 1995 are presented in Appendices B and D. Following are summaries of selected survey findings.

Stream flow

Stream discharge (in Cubic Feet per Second) was available for the Red Cedar River in Menomonie (USGS, 1989 and 1995). Mean discharge for 1995, 1989, and water years 1907-1994 is summarized in Figure 2. Discharge for 1989 was included so current conditions and previously collected data (Borman and Schreiber, 1992) could be compared. Discharge rates in 1995 were similar to 1989 for April through July. August 1995 was a period of unusually heavy rainfall and is reflected in a much higher discharge than normal.

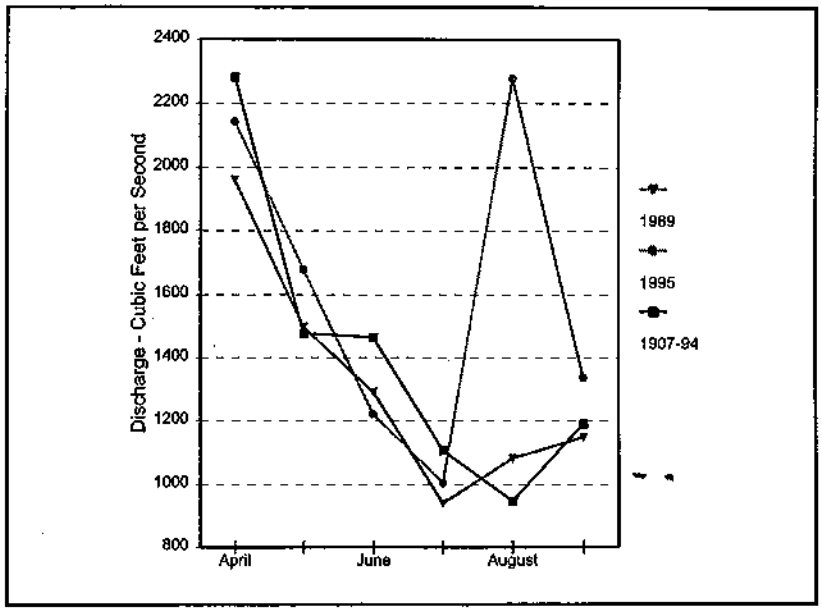


Figure 2. Mean discharge in CFS for the Red Cedar River at Menomonie, WI.

Dissolved oxygen

As previously mentioned, dissolved oxygen (D.O.) data was collected as both continuous and distinct grab samples. Direct comparison of the two data types is difficult. To prevent erroneous conclusions caused by lumping both data types together (e.g. a low D.O. measurement obtained from a continuous, several week record and one obtained from a single grab sample) the data is summarized separately (Appendices B and D).

An example of continuous D.O. data is given for the Red Cedar River site RC-3 (Figure 3). Note the unusual observations or "spiking" caused by equipment problems (see June 27th data, Figure 3). These data points were eliminated from further analysis.

The diurnal fluctuations evident in Figure 3 are typical of all sample sites in the Red Cedar study. D.O. levels rise during the heat of the day when aquatic plants (macrophytes) are photosynthesizing at high rates. There is usually a time lag between the time of highest stream D.O. and the time of highest ambient stream temperature. D.O. begins to decline as photosynthesis decreases. D.O. continues to decline and reaches a minimum as macrophytes respire during the nighttime hours.

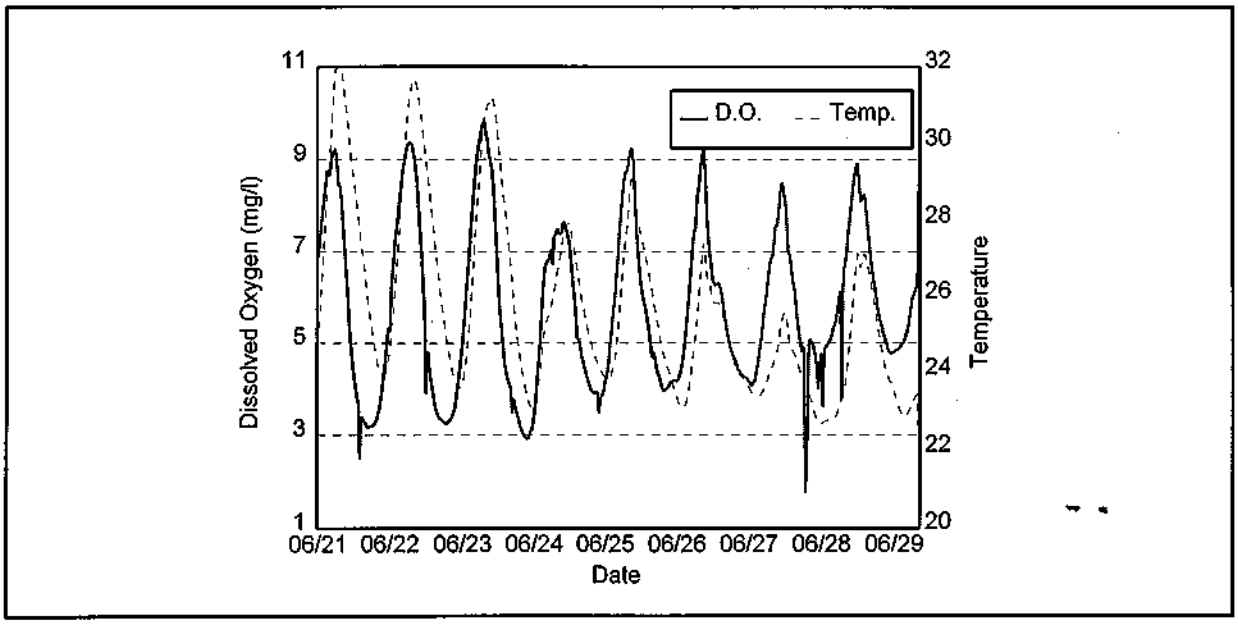


Figure 3. Dissolved oxygen and temperature at RC-3, 06/21/95 - 06/29/95.

The wide range of D.O. levels present in the Red Cedar system is also evidenced in Figure 3. From July 23rd to July 24th, D.O. levels dropped from over 9 mg/l to slightly below 3 mg/l. This range is fairly typical of sites on the main branch of the Red Cedar River and its larger tributaries.

D.O. levels in small tributaries to the Red Cedar River can be sensitive to storm events. D.O. levels in Turtle Creek "crashed" during a three day, four inch storm event (WI State Climatologist, 1996) in August (Figure 4). D.O. levels remained below the 5 mg/l level for nearly one week following the event. (The state minimum standard for cold-water sport fisheries is 6 mg/l.) While this storm event was unusually intense, it illustrates the sensitivity of the system to runoff and biochemical oxygen demamd (B.O.D.) inputs.

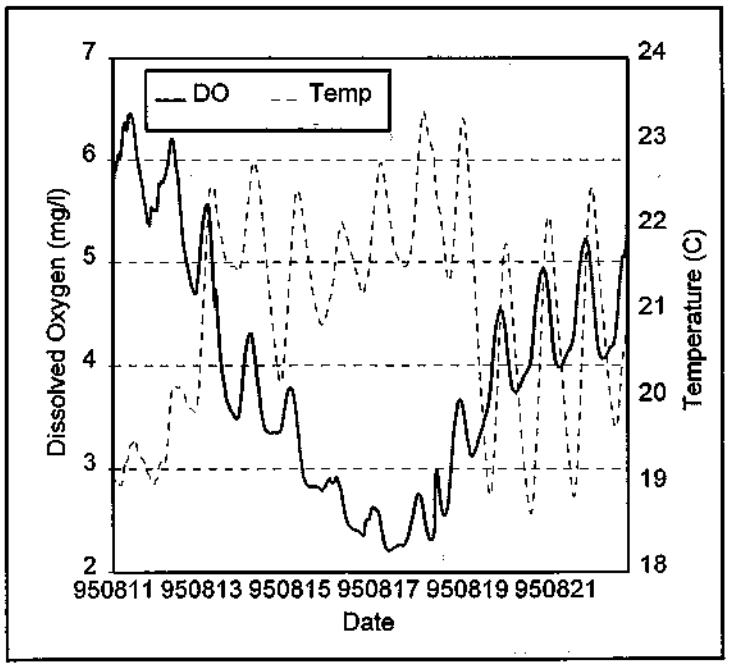


Figure 4. D. O. and temperature at TC-3 during August 11 -23,1995.

Low D.O. occurences were separated in an effort to compare large continuous DO data sets and grab samples. The lowest recorded D.O. was graphed, along with the highest D.O. recorded during the same diurnal cycle (either the previous or following 24 hours, whichever showed the highest D.O.) in Figure 5. This provides a means of comparing data collected over varying intervals and for various periods of time. It is important to remember that some of these ranges were obtained from several weeks of continuous data and some from a single pair of grab samples.

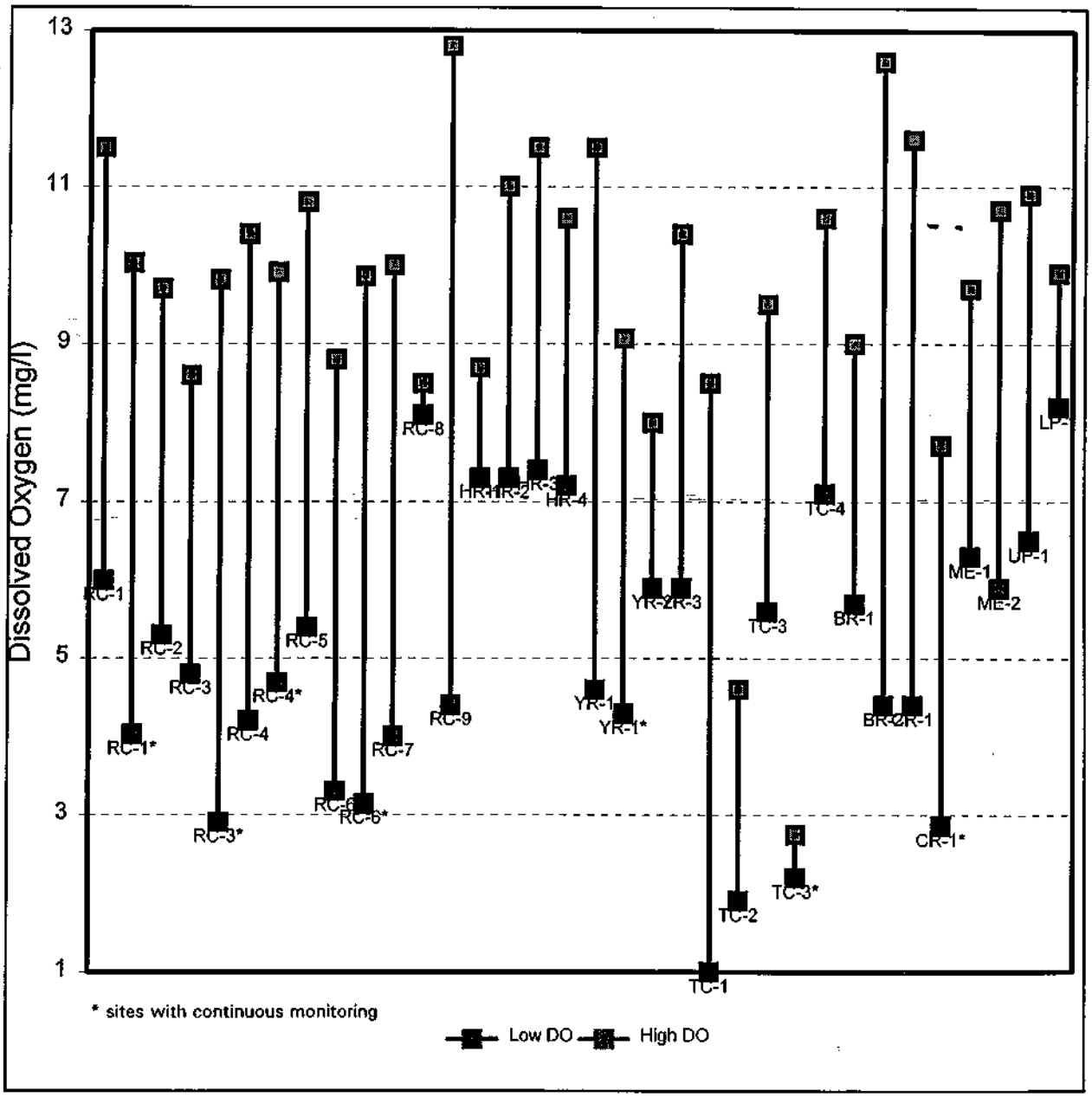


Figure 5. Lowest recorded D.O. and highest D.O. during same diurnal cycle.

There are no obvious upstream or downstream trends in Figure 5. One site on the main stem of the Red Cedar River, RC-8, appears to be an unusual data point. However, this site is immediately below the Rice Lake dam and is expected to have a higher minimum D.O. and a smaller range due to the mixing action caused by the dam.

At sites where both grab samples and continuous monitoring data were collected, minimum D.O. levels recorded during continuous monitoring were generally lower than those recorded during grab sampling. There does not appear to be any relationship between the size of the D.O. range and whether the data was collected continuously or as a grab sample.

The minimum recorded D.O. data was used to classify streams (US EPA, 1986). The daily minimum D.O. criteria differ for cold- and warm-water streams (Table 3). These

Table 3. D.O. classes based on daily minimum dissolved oxygen (US EPA, 1986).

	Warmwater streams	Coldwater streams
Poor	< 3 mg/l	< 4 mg/l
Fair	3 - 5 mg/l	4 -6 mg/l
Good	> 5 mg/l	> 6 mg/l

classes were then assigned an arbitrary descriptive title (i.e. poor, fair, good). The results of this classification exercise are presented in Table 4.

Most of the sample sites were ranked either good (13 sites) or fair (16 sites). Five sites were ranked poor: RC-3 (continuous), TC-1 (grab), TC-2 (grab), TC-3 (continuous), and CR-1 (continuous). There were rating discrepancies at sites which had both continuous monitoring and grab samples. This may primarily be due to the date on which samples were taken.

Overall, D.O. levels on the main branch of the Red Cedar River appear to be fair to good (with the exception of RC-3). D.O. levels in most of the tributaries appears to be acceptable. The main problem areas appear to be in the Chetek River and Turtle Creek. These problems may be exacerbated during drier years.

Minimum recorded D.O., monitoring type, temperature classification, and D.O. rank of streams in the Red Cedar watershed.

	Minimum D.O.	Monitoring	Cold or Warm	D.O. Class
RC-1	6.0	grab	warm	good
RC-1	4.0	continuous	warm	fair
RC-2	5.3	grab	warm	good
RC-3	4.8	grab	warm	fair
RC-3	2.9	continuous	warm	poor
RC-4	4.2	grab	warm	fair
RC-4	4.7	continuous	warm	fair
RC-5	5.4	grab	warm	good
RC-6	3.3	grab	warm	fair
RC-6	3.1	continuous	warm	fair
RC-7	4.0	grab	warm	fair
RC-8	8.1	grab	warm	good
RC-9	4.4	grab	warm	fair
HR-1	7.3	grab	warm	good
HR-2	7.3	grab	warm	good
HR-3	7.4	grab	warm	good
HR-4	7.2	grab	warm	good
YR-1	4.6	grab	warm	fair
YR-1	4.3	continuous	warm	fair
YR-2	5.9	grab	cold	fair
YR-3	5.9	grab	cold	fair
TC-1	1.0	grab	warm	poor
TC-2	1.9	grab	warm	poor
TC-3	5.6	grab	cold	fair
TC-3	2.2	continuous	cold	poor
TC-4	7.1	grab	cold	good
BR-1	5.7	grab	warm	good
BR-2	4.4	grab	cold	fair
CR-1	4.4	grab	warm	fair
CR-1	2.9	continuous	warm	poor
ME-1	6.3	grab	cold	good
ME-2	5.9	grab	cold	fair
UP-1	6.5	grab	warm	good
LP-1	8.2	grab	warm	good

Temperature

The temperature regime in the Red Cedar system closely parallels diurnal dissolved oxygen fluctuations (Figure 3). The time of peak stream temperature lags slightly behind the time of maximum D.O. Average and maximum recorded temperatures are presented for continuous monitoring sites (Table 5) and grab samples (Table 6).

Table 5. Average and maximum recorded temperatures at continuous monitoring sites.

Site	Average temperature (C)	Maximum temperature (C)
RC-1	22.9	28.8
RC-3	23.7	32.0
RC-4	23.2	29.8
RC-6	22.5	29.5
CR-1	23.7	26.1
YR-1	22.5	26.3
TC-3	21.0	23.4

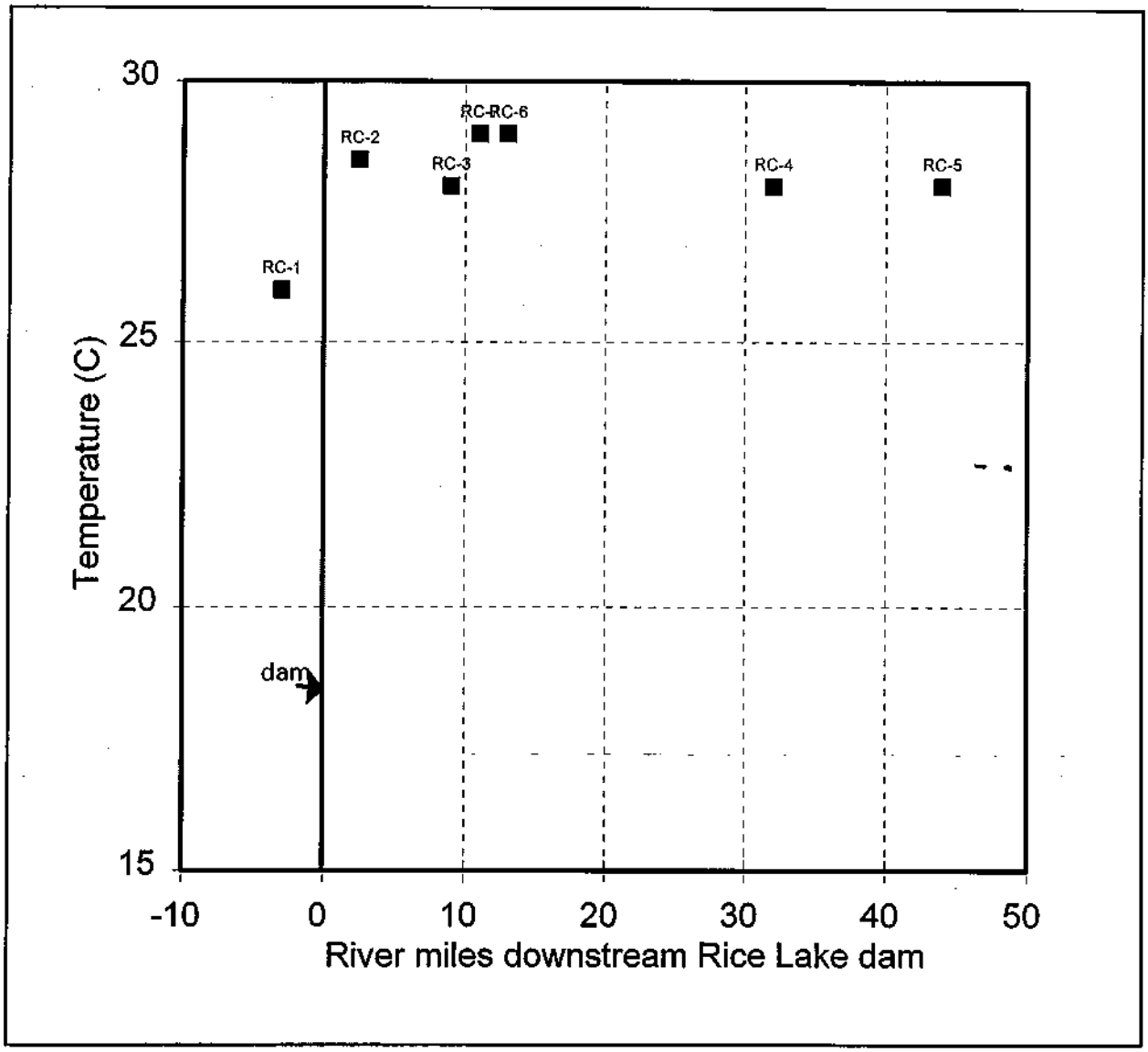
The most obvious trend in the continuous data is the thermal effect of Rice Lake. Site RC-1, just above Rice Lake, has a lower maximum temperature than any of the "main stem" sites below Rice Lake. The maximum temperature of main stem sites below the Rice Lake dam show a gradual decrease as distance downstream increases.

The grab data was edited by deleting sites which had only one temperature measurement (HR-3, HR-4, UP-1, and LP-1). For all sites where temperature was recorded on June 21st, the maximum temperature was recorded on that day. This is also true for the one continuous monitoring site that was deployed during June 21st (RC-3).

The thermal effect of Rice Lake and subsequent cooling trend is not as obvious in the grab sample data. RC-1 and RC-9 are cooler than all but one (RC-8) of the main stem sites downstream from the dam. RC-8 is immediately below the dam. However, this temperature measurement was taken on August 16th. (No measurements were taken at this site on June 21st.) The other downstream sites show a fairly consistent high temperature and do not show a cooling trend. Maximum temperatures on June 21st for the Red Cedar main stem are graphed in Figure 6.

Table 6. Average temperatures, maximum recorded temperatures, and date maximum temperature was recorded at grab sample sites.

Site	Average temperature (C)	Maximum temperature (C)	Date maximum temperature recorded
RC-1	22.0	26.0	06/21/95
RC-2	24.0	28.5	06/21/95
RC-3	22.3	28.0	06/21/95
RC-4	22.9	28.0	06/21/95
RC-5	23.0	28.0	06/21/95
RC-6	23.4	29.0	06/21/95
RC-7	23.1	29.0	06/21/95
RC-8	23.3	24.0	08/16/95
RC-9	25.3	27.0	07/26/95
HR-1	20.2	24.0	06/21/95
HR-2	18.0	18.0	08/02/95
YR-1	22.0	27.0	06/21/95
YR-2	20.0	21.0	07/26/95
YR-3	17.0	17.0	08/02/95
TC-1	24.0	25.0	08/10/95
TC-2	21.7	23.0	08/23/95
TC-3	20.8	22.0	08/23/95
TC-4	20.5	21.0	08/10/95
BR-1	22.3	23.5	07/26/95
BR-2	22.0	23.5	07/26/95
CR-1	25.3	26.5	07/26/95
ME-1	19.3	20.5	07/26/95
ME-2	24.3	26.0	07/26/95



pH

pH was also collected as both continuous monitoring data and as grab samples. pH was measured on ten sites in the project. Only two sites, RC-1 and RC-3, were continuously monitored for pH. This data is summarized in Figures 7 and 8.

All pH measurement are also summarized as ranges (Table 7). Sites where only one pH measurement was taken are reported as a single value instead of as a range. All sites in the Red Cedar watershed have slightly to moderately alkaline averages (pH > 7.00).

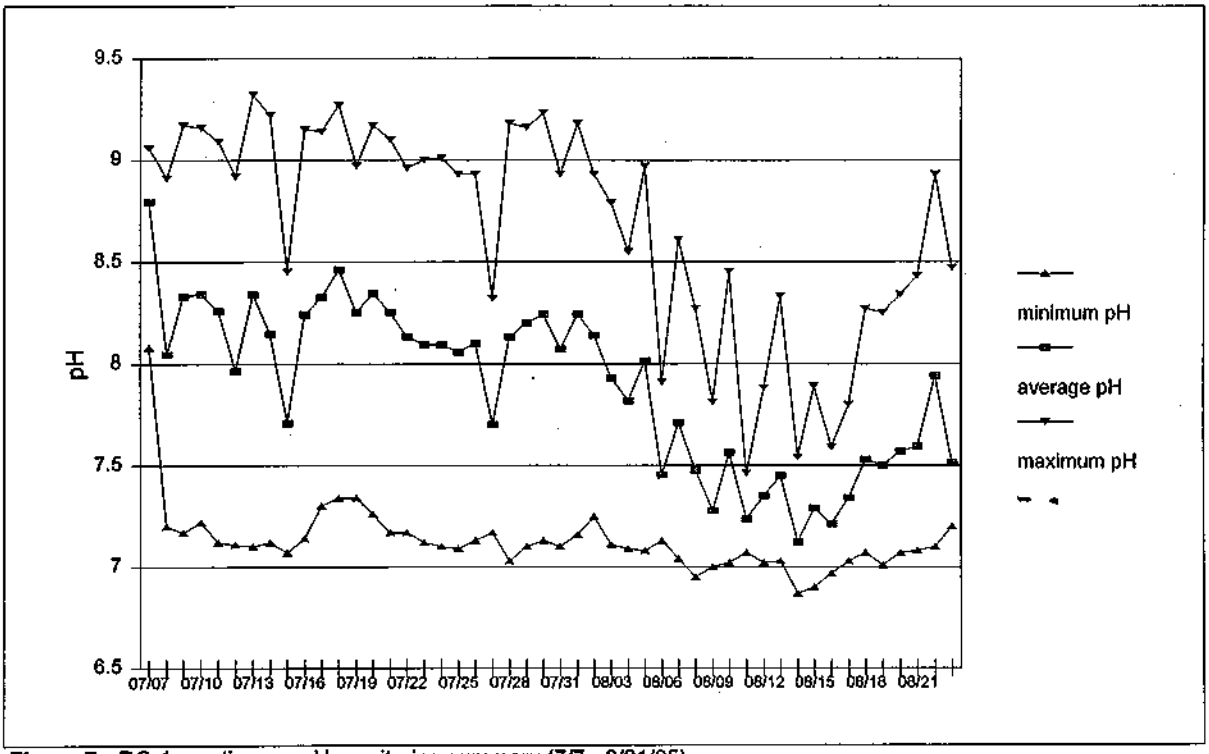


Figure 7. RC-1, continuous pH monitoring summary (7/7 - 8/21/95).

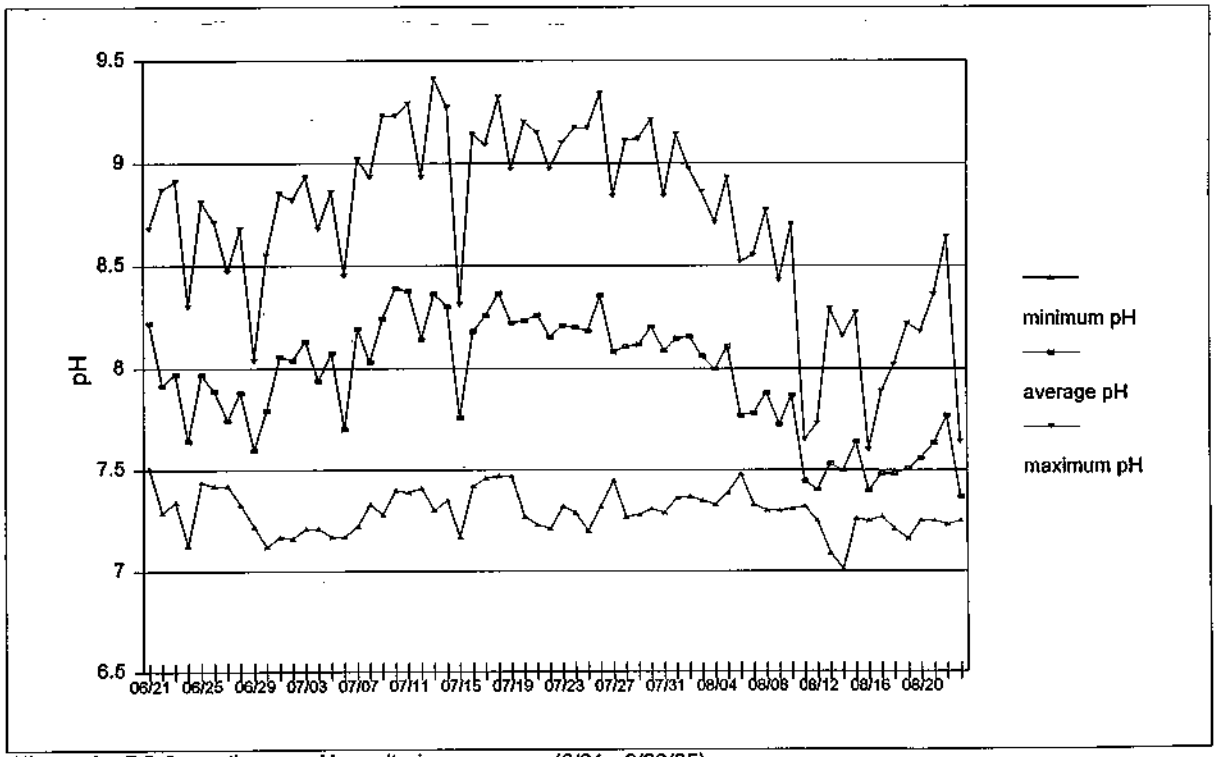


Figure 8. RC-3, continuous pH monitoring summary (6/21 - 8/20/95).

Table 7. pH ranges of grab sample and continuous monitoring sites.

Site	pH range
RC-1 (continuous)	6.87 - 9.32
RC-2	7.19 - 7.69
RC-3 (continuous)	7.01 - 9.41
RC-4	7.68*
RC-5	7.65*
HR-1	8.13*
YR-1	7.47 - 7.76
TC-1	7.81*
TC-2	7.23*
TC-3	7.53*

*sites with only one pH measurement

Literature Cited

Borman, S. and K. Schreiber. 1992. The distribution and biomass of aquatic macrophytes in the Red Cedar River near Barron, Wisconsin. Wisc. Dept. of Nat. Res., Eau Claire, WI.

U.S.G.S. 1989. Water resources data - Wisconsin - water year 1989. U.S. Geological Survey water -data report WI-89-1. Madison, WI.

U.S.G.S. 1995. Personal communication, provisional data. U.S. Geological Survey. Madison, WI.

WI State Climatologist, 1996. Personal communication. Madison, WI.

Appendix A

Selected sample site coordinates

Site	Latitude	Longitude
RC-1	45°31'48.7"N	91°42'6.4"W
RC-2	45°28'22.5"N	91°44'44.0"W
RC-3	45°24'5.1"N	91°46'42.4"W
RC-4	45°10'4.9"N	91°41'15.2"W
RC-5	45°3'6.8"N	91°42'36.1"W
RC-6	45°22'16.1"N	91°45'0.5"W
RC-7	45°23'32.1"N	91°46'6.3"W
HR-1	45°2'56.1"N	91°54'40.3"W
YR-1	45°21'57.3"N	91°47'12.1"W

Appendix B

Red Cedar River
Grab Sample Summary

Site	Date	Time	AMDO	PMDO	AMT	PMT	pH	NH3	NO3	TKN	TP	DP	SS
RC-1	06/21/95	08:05	6.5		21.5			0.055	0.462	* 0.42	* 0.053	0.018	6.0
	06/21/95	13:25		11.6		26.0							
	06/29/95	05:43	5.4		22.0								
	07/12/95	13:25		11.6		22.0							
	07/13/95	07:40	7.2		22.0								
	07/19/95	07:21	6.0		20.0								
	07/19/95	13:06		11.5		20.0							
	07/20/95	13:54		12.8		22.0	7.90	< 0.027	0.170	0.30	0.022	0.012	< 4.9
	08/16/95	12:50		7.0		22.5							
	08/23/95	13:27		11.8		22.0	8.11	< 0.027	0.485	0.30	0.028	0.014	< 4.9
RC-2	06/21/95	07:44	6.4		24.5			0.047	0.134	* 0.55	* 0.056	0.007	6.0
	06/21/95	13:38		11.4		28.5							
	06/29/95	05:28	6.5		23.5								
	06/29/95	16:22		8.4		24.0							
	07/12/95	13:49		10.6		24.0							
	07/13/95	07:08	6.1		23.0								
	07/19/95	07:00	5.3		21.0								
	07/19/95	13:36		9.7		23.0							
	07/20/95	12:55		10.7		24.5	7.19	0.145	0.177	0.80	0.076	0.029	7.0
	08/16/95	13:19		8.2		24.0							
	08/17/95	06:36	6.7		24.0								
	08/23/95	12:32		8.1		24.0	7.69	0.055	0.100	0.70	0.060	0.005	< 4.9
RC-3	06/21/95	07:25	4.8		21.5			0.150	0.949	0.80	** 0.126	0.051	6.0
	06/21/95	13:51		8.6		28.0							
	07/12/95	14:00	-	9.6		22.0							
	07/13/95	06:56	5.1		22.0								
	07/19/95	06:49	5.0		19.5								
	07/19/95	13:48		9.0		21.0							
	07/20/95	12:36		11.3		22.0	7.60	< 0.027	0.322	0.50	0.058	0.024	8.0
	08/16/95	13:33		5.9		23.0							
	08/23/95	12:00		6.6		22.5	7.55	0.028	0.683	0.70	0.114	0.041	< 4.9

Site	Date	Time	AMDO	PMDO	AMT	PMT	pH	NH3	NO3	TKN	TP	DP	SS
RC-4	06/21/95	06:06	4.2		24.5			0.085	0.847	* 0.60	* 0.205	0.140	8.0
	06/21/95	15:00		10.4		28.0							
	06/29/95	07:13	5.8		22.0								
	06/29/95	14:10		6.7		22.5							
	07/13/95	06:01	6.1		24.0								
	07/19/95	05:58	6.6		21.0								
	07/19/95	14:44		9.2		21.0							
	07/28/95	10:14	8.8		20.5		7.68	< 0.027	0.539	0.60	0.134	0.091	7.0
	08/03/95	05:20	6.2		23.0								
	08/16/95	14:40		6.4		23.0							
	08/17/95	05:32	5.8		23.0								
RC-5	06/21/95	05:45	5.4		24.0			0.038	0.936	# 0.48	+ 0.211	0.135	6.5
	06/21/95	15:17		10.8		28.0							
	06/29/95	07:29	6.4		22.0								
	06/29/95	15:23		6.9		23.0							
	07/12/95	14:53		9.3		24.0							
	07/13/95	05:46	7.0		24.0								
	07/19/95	05:43	7.1		21.0								
	07/19/95	15:00		9.1		21.0							
	07/20/95	09:48	8.3		20.0		7.65	< 0.027	0.628	0.50	0.146	0.099	9.0
	08/16/95	15:00		6.4		23.0							
	08/17/95	05:17	6.2		23.0								
RC-6	06/21/95	06:54	3.3		23.5								
	06/21/95	14:24		8.8		29.0							
	06/29/95	06:34	4.8		22.0								
	06/29/95	13:30		6.8		23.0							
	07/13/95	06:30	5.1		24.0								
	07/19/95	06:27	5.5		21.5								
	07/19/95	14:14		9.4		22.0							
	08/16/95	14:06		5.0		23.0							
	08/17/95	06:04	3.4		23.0								

Site	Date	Time	AMDO	PMDO	AMT	PMT	pH	NH3	NO3	TKN	TP	DP	SS
RC-7	06/21/95	07:13	4.0		22.5								
	06/21/95	14:00		10.0		29.0							
	06/29/95	06:22	5.9		22.0								
	06/29/95	16:05		8.4		24.0							
	07/12/95	14:07		10.2		22.0							
	07/13/95	06:49	5.5		23.0								
	07/19/95	06:43	5.5		21.0								
	07/19/95	13:55		10.7		21.5							
	08/16/95	13:42		6.1		23.0							
	08/17/95	06:23	4.5		23.0								
RC-8	06/29/95	05:57	8.4		24.0								
	06/29/95	16:30		7.9		23.5							
	07/12/95	13:40		9.8		23.0							
	07/13/95	07:28	9.1		23.0								
	07/19/95	07:10	8.1		22.5								
	07/19/95	13:27		8.5		22.5							
	08/16/95	13:04		8.4		24.0							
	08/17/95	06:48	8.6		24.0								
RC-9	07/26/95	13:34		12.8		27.0							
	07/27/95	06:35	4.4		23.5								

* Spike QC exceeded for matrix group
** Control Std Failed 3.5% over limit results appr
\# QC exceeded spike recovery 71.2%
\+ QC exceeded spike recovery 78.4%

Hay River
Grab Sample Summary

Site	Date	Time	AMDO	PMDO	AMT	PMT	pH	NH3	NO3	TKN	TP	DP	SS
HR-1	06/21/95	05:17	7.3		20.5			0.045	1.380	0.50	0.135	0.070	14.5
	06/21/95	15:41		8.7		24.0							
	06/29/95	08:00	7.3		19.5								
	06/29/95	15:00		7.4		20.0							
	07/12/95	15:14		9.0		22.0							
	07/13/95	05:23	8.0		21.0								
	07/14/95	05:22	8.2		18.0								
	07/14/95	15:21		8.8		19.0							
	07/20/95	09:13	8.3		18.0		8.13	< 0.027	1.150	0.60	0.166	0.099	19.0
HR-2	08/02/95	13:51		11.0		18.0							
	08/03/95	07:07	7.3		18.0								
HR-3	08/02/95	14:35		11.5		20.0							
	08/03/95	06:30	7.4										
HR-4	08/02/95	14:48		10.6		21.0							
	08/03/95	06:13	7.2										

Yellow River
Grab Sample Summary

Site	Date	Time	AMDO	PMDO	AMT	PMT	pH	NH3	NO3	TKN	TP	DP	SS
YR-1	06/21/95	06:40	4.6		22.5			0.071	1.570	0.50	0.264	0.191	8.0
	06/21/95	14:12		11.5		27.0							
	06/29/95	06:30	5.3		20.5								
	06/29/95	16:00		5.3		21.0							
	07/12/95	14:15		8.7		23.0							
	07/13/95	06:41	5.7		22.0								
	07/19/95	06:36	6.0		19.0								
	07/19/95	14:04		8.3		21.0							
	07/20/95	14:26		9.2		22.0	7.76	< 0.027	1.100	0.90	0.245	0.206	6.0
	08/16/95	13:55		6.3		22.0							
	08/17/95	06:14	5.9		21.5								
	08/23/95	11:11	7.2		22.0		7.47	< 0.027	1.330	1.00	0.316	0.171	6.0
YR-2	07/26/95	14:28		8.0		21.0							
	07/27/95	07:26	5.9		19.0								
YR-3	08/02/95	13:30		10.4		17.0							
	08/03/95	07:30	5.9		17.0								

a:\summary2.wb1:red_cedar

Turtle Creek
Grab Sample Summary

Site	Date	Time	AMDO	PMDO	AMT	PMT	pH	NH3	NO3	TKN	TP	DP	SS	BOD
TC-1	08/02/95	14:10		8.5		24.0								
	08/03/95	06:53	1.0		22.5									
	08/10/95	14:00		8.2		25.0								
	08/11/95	06:19	2.9		24.5									
	08/23/95	14:32		5.1		24.0	7.81	< 0.027	< 0.010	0.80	0.052	0.004	< 4.9	3.4
TC-2	08/02/95	14:22		6.4		21.5								
	08/03/95	06:41	2.7		20.0									
	08/10/95	14:11		4.6		22.5								
	08/11/95	06:07	1.9		21.5									
	08/23/95	14:48		2.4		23.0	7.23	0.064	0.083	0.90	0.533	0.226	6.0	1.6
TC-3	08/10/95	13:45		9.5		20.5								
	08/11/95	05:58	5.6		20.0									
	08/23/95	15:14		5.9		22.0	7.53	0.062	0.608	0.80	0.399	0.185	8.0	1.6
TC-4	08/10/95	14:29		10.6		21.0								
	08/11/95	05:43	7.1		20.0									

Other Streams sampled in the Red Cedar Watershed
Grab Sample Summary

Site	Date	Time	AMDO	PMDO	AMT	PMT
Brill River						
BR-1	07/26/95	13:53		9		23.5
	07/27/95	06:49	5.7		21	
BR-2	07/26/95	13:41		12.6		23.5
	07/27/95	06:40	4.4		20.5	
Chetek River						
CR-1	07/26/95	15:29		11.6		26.5
	07/27/95	05:24	4.4		24.0	
Moose Ear Creek						
ME-1	07/26/95	15:00		9.7		20.5
	07/27/95	05:56	6.3		18.0	
ME-2	07/26/95	15:12		10.7		26.0
	07/27/95	05:44	5.9		22.5	
Pine Creek (Upper and Lower)						
UP-1	08/02/95	15:23		10.9		
	08/03/95	05:45	6.5		18.0	
LP-1	08/02/95	15:30		9.9		
	08/03/95	05:32	8.2			

Appendix C

Red Cedar River
Dissolved Oxygen transect data
Analysis of Variance
July 20th, 1995

ANOVA: Two-way without replication TEMPERATURE

Summary	Count	Sum	Average	Variance	St. Dev.
HR-1	3	53.5	17.8	0.08	0.29
RC-5	3	60.0	20.0	0.00	0.00
RC-4	3	61.5	20.5	0.25	0.50
RC-6	3	65.0	21.7	0.08	0.29
RC-7	3	64.5	21.5	0.00	0.00
RC-3	3	65.5	21.8	0.08	0.29
RC-2	3	73.5	24.5	0.25	0.50
RC-8	3	69.0	23.0	0.00	0.00
RC-1	3	65.0	21.7	0.08	0.29
YR-1	3	66.0	22.0	0.00	0.00
Left	10	213	21.3	3.23	1.80
Center	10	215	21.6	3.08	1.76
Right	10	215	21.5	3.28	1.81

Analysis of Variance

Source	SS	df	MS	F	P-value
Site	85.0	9	9.4	129.1	0.00
L/C/R	0.3	2	0.2	2.4	0.12
Error	1.3	18	0.1		
Total	86.7	29			

ANOVA: Two-way without replication DISSOLVED OXYGEN

Summary	Count	Sum	Average	Variance	St. Dev.
HR-1	3	25.1	8.4	0.00	0.06
RC-5	3	25.1	8.4	0.00	0.06
RC-4	3	25.9	8.6	0.08	0.29
RC-6	3	29.4	9.8	0.12	0.35
RC-7	3	33.3	11.1	0.01	0.10
RC-3	3	31.7	10.6	1.40	1.18
RC-2	3	31.4	10.5	0.10	0.32
RC-8	3	27.4	9.1	0.08	0.29
RC-1	3	38.6	12.9	0.04	0.21
YR-1	3	27.0	9.0	0.12	0.35
Left	10	98.6	9.9	2.18	1.48
Center	10	99.9	10.0	2.20	1.48
Right	10	96.4	9.6	2.21	1.49

Analysis of Variance

Source	SS	df	MS	F	P-value
Site	56.0	9	6.2	33.7	0.00
L/C/R	0.6	2	0.3	1.7	0.21
Error	3.3	18	0.2		
Total	60.0	29			

Appendix D

Red Cedar River
Continuous Monitoring Summary

	/----over period----\		/---24 hr. avg. pH---\		Min. 24 hr	Max. 24 hr	/--------over period--------\			
Site/Date	Avg. D.O.	Ave. Temp.	Max	Min	Avg. D.O.	Avg. Temp.	Min. D.O.	Max. Temp.	Ave. Cond.	Filename
RC-1										
7/7 - 7/13	8.84	21.95	8.40	8.12	8.21	23.40	5.04	25.91	104	RC1_2
7/13 - 7/19	9.17	23.46	8.55	7.72	8.44	26.56	4.57	28.80	90	RC1_3
7/19 - 7/27	8.84	23.22	8.33	8.06	8.23	24.71	4.11	26.37	10	RC1_4
7/27 - 8/2	8.69	22.64	8.29	7.66	7.64	24.83	4.35	27.69	118	RC1_5
8/2 - 8/8	7.81	22.67	8.00	7.39	7.32	24.32	4.66	25.76	135	RC1_6
8/8 - 8/16	6.49	22.89	7.54	7.15	6.13	24.17	4.03	25.28	128	RC1_7
8/16 - 8/23	7.28	23.16	8.00	7.24	6.30	24.61	4.50	25.85	105	RC1_8
RC-4										
6/29 - 7/12	NA	21.07	NA	NA	NA	22.72	NA	25.26	NA	RC4_1
7/12 - 7/20	8.06	24.34	NA	NA	7.43	27.83	4.90	29.81	NA	RC4_2
7/20 - 7/26	7.23	23.48	NA	NA	6.77	24.61	4.78	25.62	NA	RC4_3
7/26 - 8/2	7.41	24.00	NA	NA	6.71	25.54	4.69	26.34	NA	RC4_4
RC-6										
6/29 - 7/12	7.53	20.89	NA	NA	6.47	23.54	4.43	25.85	NA	RC6_1
7/12 - 7/19	5.94	24.12	NA	NA	5.26	27.34	3.14	29.45	NA	RC6_2
RC-3										
6/21 - 6/29	5.83	25.80	7.96	7.71	5.69	27.55	2.91	32.00	99	RC3_1
6/29 - 7/7	6.81	20.02	8.07	7.48	6.10	22.46	4.62	23.99	107	RC3_2
7/7 -7/13	8.12	22.87	8.40	8.07	7.33	24.64	4.86	27.34	125	RC3_3
7/13 - 7/19	7.57	24.56	8.45	7.79	6.72	27.21	3.40	30.54	87	RC3_4
7/19 - 7/26	8.24	24.00	8.27	8.09	7.84	25.16	4.00	27.69	104	RC3_5
7/26 - 8/2	7.40	24.54	8.44	7.88	6.42	6.36	4.01	28.68	108	RC3_6
8/2 - 8/8	6.80	24.07	8.21	7.57	5.67	25.23	4.27	26.71	193	RC3_7
8/8 - 8/16	NA	23.81	7.84	7.38	NA	24.69	NA	26.44	116	RC3_8
8/16 - 8/23	NA	24.00	7.73	7.40	NA	24.52	NA	26.35	113	RC3_8
CR-1										
8/2 - 8/10	6.00	23.73	NA	NA	4.24	24.88	2.86	26.06	NA	CR1_1
YR-1										
7/20 - 7/27	6.73	22.50	NA	NA	6.65	23.88	4.29	26.26	NA	YR1_1
TC-3										
8/11 - 8/17	4.24	20.89	NA	NA	2.63	21.71	2.35	22.79	NA	TC3_1
8/17 - 8/23	3.05	21.19	NA	NA	2.37	22.38	2.20	23.37	NA	TC3_2