Department of Natural Resources
Madison, Wisconsin 53701

Fish Management Bureau
Management Report No. 49

Water Quality in the East Branch of the Rock River Associated with a Carp Chemical Eradication Project

by

Richard M. Johnson
John F. Sullivan

September, 1971

ABSTRACT

In August of 1971 the East Branch of the Rock River was chemically treated to remove the rough fish. Daily water samples were collected and tested for dissolved oxygen, carbon dioxide, pH, alkalinity, turbidity, color and conductivity. Little or no change was evident in five of the seven parameters. There was improved water clarity because of a continued decrease in turbidity and water color throughout the sampling period.

INTRODUCTION

In May of 1971 the Wisconsin Department of Natural Resources, fish management, began an extensive study of the East Branch of the Rock River in preparation for chemical treatment. By the end of July they were ready and plans were laid down for a target date of August tenth. The river above the Kekoskee dam was divided into four segments with scheduled treatments on the tenth, thirteenth, sixteenth and nineteenth. On August ninth final preparations were made and the chemical treatment of the East Branch of the Rock was ready to begin.

In conjunction with the treatment daily water samples were collected to measure certain parameters of the water quality. Tested were six water chemistries which might indicate the effect of the chemical treatment. Some of these tests had to be run in the field while others were run in the laboratory at Horicon. On August 9, one day prior to actual treatment, continuous daily water testing began and continued throughout the treatment program.

DESCRIPTION OF STUDY AREA

General Area

The area involved in the water chemistry study constitutes the head waters of the East Branch of the Rock River located in south central Wisconsin. A total of 350 miles of streams and rivers make up this area which begins in the Northwest corner of Washington county and winds westward through Dodge county to Horicon Marsh (refer to Figure 1 for a map of the treatment area). Of the 350 miles of streams and rivers in the east branch system 230 had to be treated in the chemical treatment project.

Individual Study Areas

To study the area, six water sampling stations were randomly chosen. Five of the stations were located on waters that would be treated with chemical. One station was on a control stream which would not be affected by the chemical treatment project. The following is a description of each station. It will include its location and physical properties of the water such as: flow, width, depth and an estimated percentage of the bottom materials.

Station number 1 is located south of Allenton on Hillcrest Road. Water samples were taken on the down stream side of a culvert which flows underneath the road at this location. The station is located just below the junction of Limestone Creek, Allenton Creek and an unnamed creek. Therefore, water samples collected at Hillcrest road originated in the three creeks mentioned.

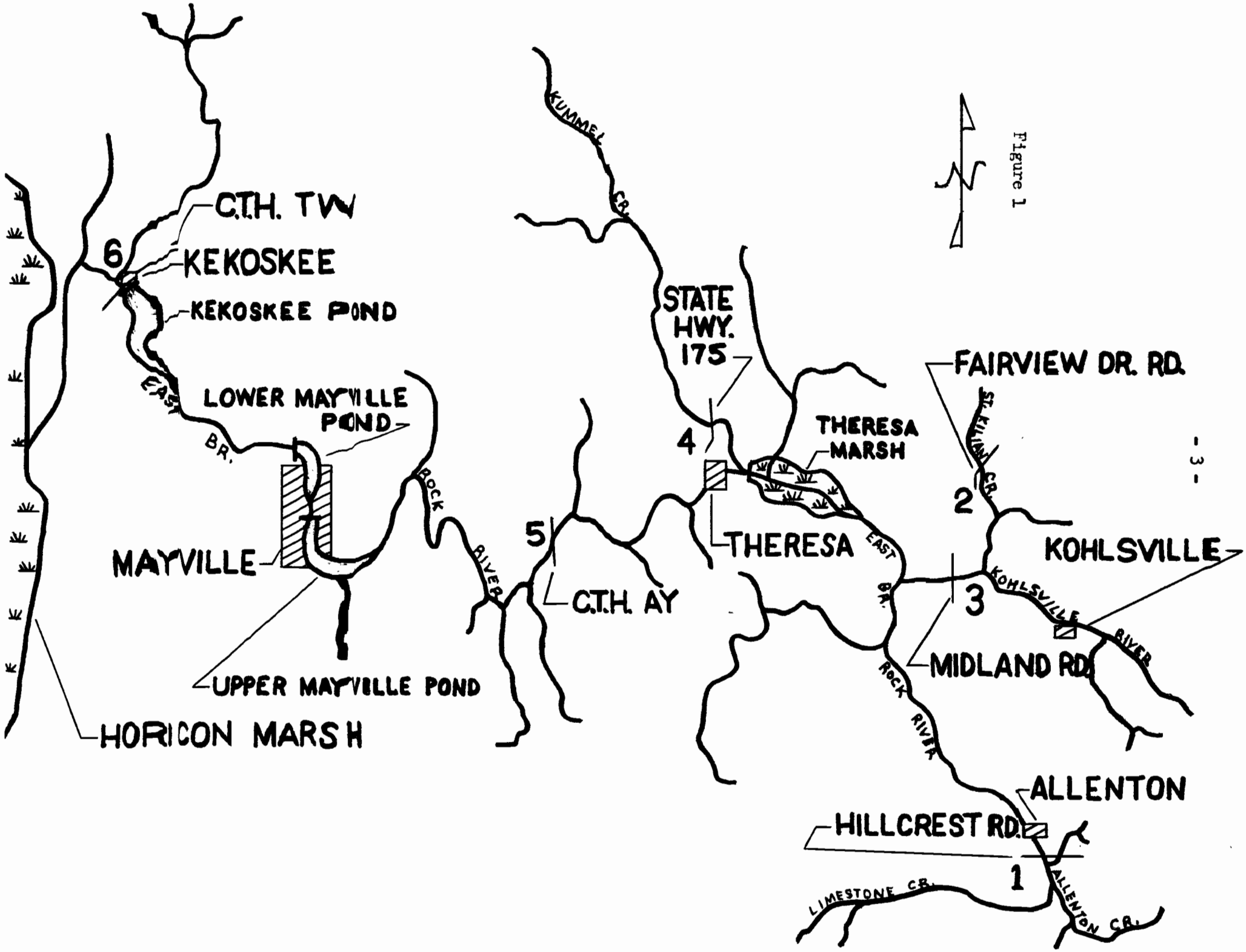

C.T.H. TW
6
KEKOSKEE
KEKOSKEE POND
EAST BR.
LOWER MAYVILLE POND
MAYVILLE
UPPER MAYVILLE POND
HORICON MARSH
ROCK RIVER
KUMMEL CR.
5
C.T.H. AY
STATE HWY. 175
4
THERESA
THERESA MARSH
EAST BR.
ROCK RIVER
FAIRVIEW DR. RD.
ST. PATRICK CR.
2
KOHLSVILLE
KOHLSVILLE RIVER
3
MIDLAND RD.
ALLENTON
HILLCREST RD.
1
LIMESTONE CR.
ALLENTON CR.

Figure 1

The flow at station one remained relatively constant for the entire project. Using a Gurley Pigmey flow meter (used for all flows) stream flow was calculated at 2 cubic feet per second (C.F.S.). The width of the river is about 15 feet with an average depth of 1½ feet. Bottom material is composed of 80% silt and 20% clay-mud with a gravel base below.

Station number 2 is located Northwest of Kohlsville on Fairview Drive Road. Water samples were taken from the bridge located on this road. Station number 2 was used as our control stream in the study. The stream known as St. Kilian Creek was not in need of chemical treatment.

The flow at station 2 was not calculated. However, it was estimated to be between 1 to 2 C.F.S. The width of the river at the sample site was 5 feet with an average depth of 1 foot. The bottom material consisted of 90% gravel with rocks making up the other portion.

Station number 3 is at a bridge west of Kohlsville on Midland Drive Road. This site on the Kohlsville River, is about a mile and a half south of station 2.

The flow at this station was calculated at 2 C.F.S. The width of the river was 10 feet with an average depth of one foot. Bottom material at this station consisted of 75% silt, 15% mud and 10% rock.

Station 4 was located at a bridge north of Theresa on Highway 175. The stream, Kummel Creek, flows into the Rock River to the west of Theresa Marsh.

Water flow at this site was calculated at 3 C.F.S. The width of the creek at the sample site was 10 feet with an average depth of 2 feet. Bottom material is made up of 60% silt and 40% rock.

Station 5 is located on the main river west of Theresa Marsh. The sampling site was a bridge on C.T.H. AY. Stream flows were constant at this station with an average flow of 10 C.F.S. However, stream flow increased the 18th of August due to the opening of Theresa Dam to facilitate the chemical treatment project. Flows increased rapidly to 27 C.F.S. on the 19th and gradually decreased thereafter. The river at this location has a width of 60 feet and an average depth of 2.5 feet. Even though volume of water increased sharply the 18th, the current was not fast due to the width and depth of the river at sample site. Bottom material is composed of 45% silt, 25% clay-mud and 30% rock and gravel.

Station 6 is located at the Kekoskee Dam, the end of the last segment of the chemical treatment project on the east branch. Station 6 also had a similar increase in flow with the opening of Theresa Dam. The average flow was calculated at 11 C.F.S., but increased to 19 C.F.S. with the opening of Theresa Dam. The width of the river at station 6 was about 10 feet up until the 19th. Thereafter the width increased due to the closing of Kekoskee dam on the 17th to prevent rough fish from moving upstream. The average depth was about 6", but increased the 17th and steadily afterwards.

TEST PROCEDURE

Water tests included: dissolved oxygen (water temperature was taken in conjunction with this), carbon dioxide, pH, phenolphthalein alkalinity and total alkalinity, conductivity, water color and turbidity. Previous experience had given us some idea of the time necessary to complete the sampling run. In order to reduce the effect of the time variable all samples were collected between 7:00 AM and 12:00 noon. All samples were collected beginning with station number 1 and finishing with station number six, except for one day. The day mentioned as the exception was August 12, and that day samples were run in the reverse order. A prior commitment to the chemical treatment crew necessitated this one day change.

Samples were collected with a Hach sampling bottle. Water temperature was obtained immediately before the collection of the sample. Dissolved oxygen and carbon dioxide were obtained immediately following the collection of the sample. The pH test was also run at this time with a Hach color comparator. This way we were able to utilize daylight which facilitates a much more accurate reading. The tests for dissolved oxygen, carbon dioxide, and alkalinity were done by the Hach method using premeasured dry chemicals.

The other tests run at the lab were alkalinity, color, turbidity and conductivity. Color and turbidity were measured with a Hach colorimeter and conductivity was measured with a meter manufactured by Industrial Instruments. The color reading is an apparent color reading and not a true color reading since the samples were only allowed to settle and not centrifuged prior to testing.

The Hach colorimeter, developed by the Hach Chemical Company, works on the principle of light penetration. A photo cell measures the amount of light which passes through the sample. A different light filter is used with each meter scale. Turbidity is measured in Jackson Turbidity Units and color is measured in units of color.

Testing began on August 9 and continued for a fourteen day period. The final samples were collected on August 22. The testing program was initiated one day prior to treatment and finished two days after the final treatment.

DATA SECTION

Presented on the following pages are the tabulated results of the testing program. Most of the data indicates little or no change due to the chemical treatment. However, some change is noted due to changes in weather patterns and manipulation of the dams. In order to show an association between test data and the weather, a section on weather was compiled from field notes and data that is collected daily at the Horicon headquarters.

Weather

For the most part the weather showed little variation during the sampling period. The skies were usually sunny with moderate wind speeds throughout the period. There was no precipitation during the time the samples were being collected. However, heavy thundershowers were experienced on the afternoon of the tenth and the evening of the thirteenth. A little rain fell on the morning of the nineteenth. Table 1 shows the weather patterns for the sample period.

Dissolved Oxygen

Dissolved oxygen showed daily fluctuations dependent on water temperature. The most erratic change was evident at station 5 while a more stable variation was evident at station 2. Figure 2 shows the comparison of dissolved oxygen to water temperature at the three stations away from the main river. These are stations 2, 3 and 4. Figure 3 shows a comparison of dissolved oxygen and water temperature on the three remaining main river stations.

The D.O. graph indicates a definite upward trend at all stations over the sample period. Figure 4 is a plot of the averages of 5 of the six stations with station 2 being plotted separately as a control. It is evident by fitting a line to the curve that there is a small increase in dissolved oxygen levels over the sample period. This increase is evident at all stations including station 2. Water temperature on the other hand shows a difference. The average water temperature for five of the six stations shows a small increase. However, station 2 shows a small decline over the sample period. The graph indicates that the rise in dissolved oxygen is directly related to the rise in temperature, station 2 being the exception to the rule. But station 2 is on a much more stable river system than the others. The authors believe the treatment and the removal of fish were not responsible for the increase in dissolved oxygen levels over the sampling period.

At this point there are a few extreme variations in the graphs which require an explanation. Water temperatures dropped sharply on the eleventh following a cold rain on the afternoon of the tenth. Temperatures dropped sharply again on the sixteenth following a very cold night on the fifteenth. Dissolved oxygen levels at stations 5 and 6 dropped sharply on the nineteenth due to the release of stagnant waters backed up behind the Theresa dam.

Carbon Dioxide

Carbon dioxide levels remained relatively stable throughout the sample period. In most cases CO_2 levels fell between 5 and 25 parts per million. The one exception being station one on the tenth where a high reading of 35 parts per million was observed. There were no erratic changes in levels on either treatment days or the days immediately following treatment.

Unlike dissolved oxygen levels, CO_2 levels did not follow water temperature changes. However, many stations showed a relationship of CO_2 levels to dissolved oxygen levels. The higher the level of dissolved oxygen the lower the level of CO_2. This relationship can be seen by comparing data in Table III to the graphs in figures 2 and 3.

Table I.

Date	* Temperature	Wind Speed	Wind Direction	Cloud Cover	Precipitation
8/9	Low 80's	25-30 mph	SW	Sunny	0
8/10	High 70's	10-30 mph	S-SW	Sunny	Thunder showers 1-6 pm .28 in.
8/11	Low 70's	5-10 mph	W-SW	Sunny	0
8/12	High 60's	5-15 mph	S-SW	Sunny	0
8/13	Low 80's	0-3 mph	SW	Sunny	Thunder showers 9-11 pm 1.13 in.
8/14	Mid 60's	5-10 mph	N-NW	Cloudy	0
8/15	Mid 70's	5-10 mph	W-SW	Sunny	0
8/16	Mid 70's	10-15 mph	S-SW	Partly Cloudy	0
8/17	High 70's	5-10 mph	S-SW	Cloudy	0
8/18	High 70's	5-10 mph	S-SW	Cloudy	0
8/19	High 60's	5-10 mph	S-SW	Sunny	Trace
8/20	Low 70's	5-10 mph	S-SW	Sunny	0
8/21	Low 70's	5-10 mph	S-SW	Sunny	0
8/22	High 70's	0-3 mph	S-SW	Sunny	0

* Since the sample time ran from 7 to 12 o'clock the temperature indicates air temp for that period in ^{o}F.

Table II.

	1		2		3		4		5		6	
	Temp*	D.O.	Temp*	D.O.	Temp*	D.O.	Temp*	D.O.	Temp*	D.O.	Temp*	D.O.
8/9	65°	6	62°	9	66°	8	66°	8	76°	14	76°	11
8/10	63°	5	61°	7	64°	5	65°	5	78°	10	78°	7
8/11	59°	7	61°	7	60°	7	62°	8	65°	7	65°	7
8/12	**	8	**	8	**	7	62°	5	66°	11	62°	5
8/13	64°	8	62°	8	66°	7	68°	7	74°	15	76°	11
8/14	63°	6	62°	7	67°	7	69°	5	74°	12	75°	6
8/15	64°	7	59°	7	63°	9	65°	8	72°	11	71°	8
8/16	58°	6	54°	9	58°	8	59°	6	63°	12	62°	8
8/17	59°	9	59°	10	60°	9	65°	10	73°	17	77°	11
8/18	60°	8	58°	9	62°	9	63°	9	74°	13	77°	11
8/19	64°	7	59°	7	65°	8	67°	7	74°	1	70°	7
8/20	63°	9	60°	10	63°	11	65°	11	78°	7	74°	6
8/21	66°	6	62°	9	66°	7	62°	9	78°	6	76°	18
8/22	64°	5	60°	9	64°	8	70°	8	76°	13	78°	18

* Temperatures taken 6 inches beneath surface in degrees Fahrenheit.

** No temperature was obtained because of the loss of the thermometer at Station 4.

Figure 2

Daily dissolved oxygen and water temperature variation for stations 2, 3 and 4

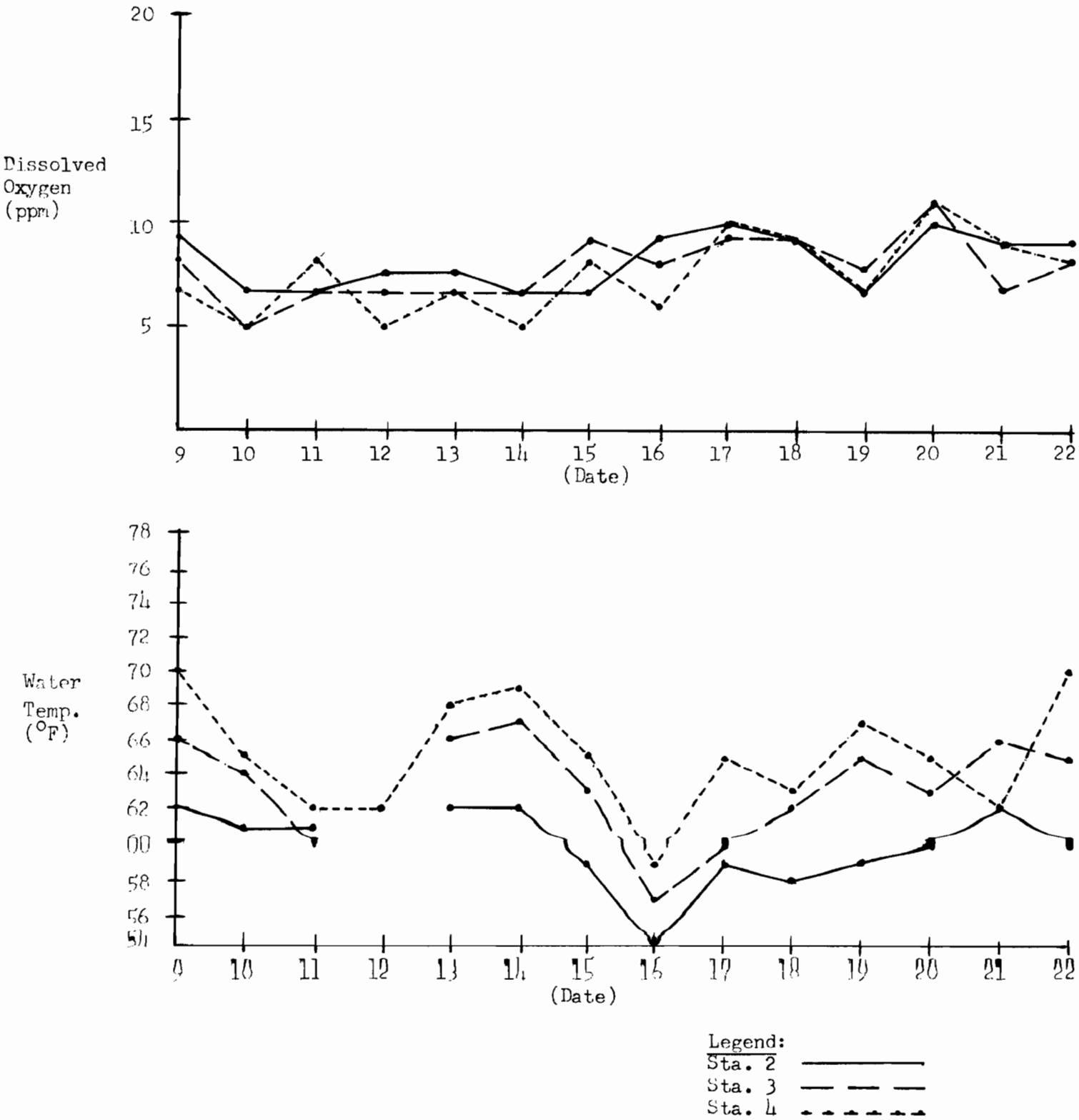


Figure 3

Daily dissolved oxygen and water temperature variation for stations 1, 5 and 6

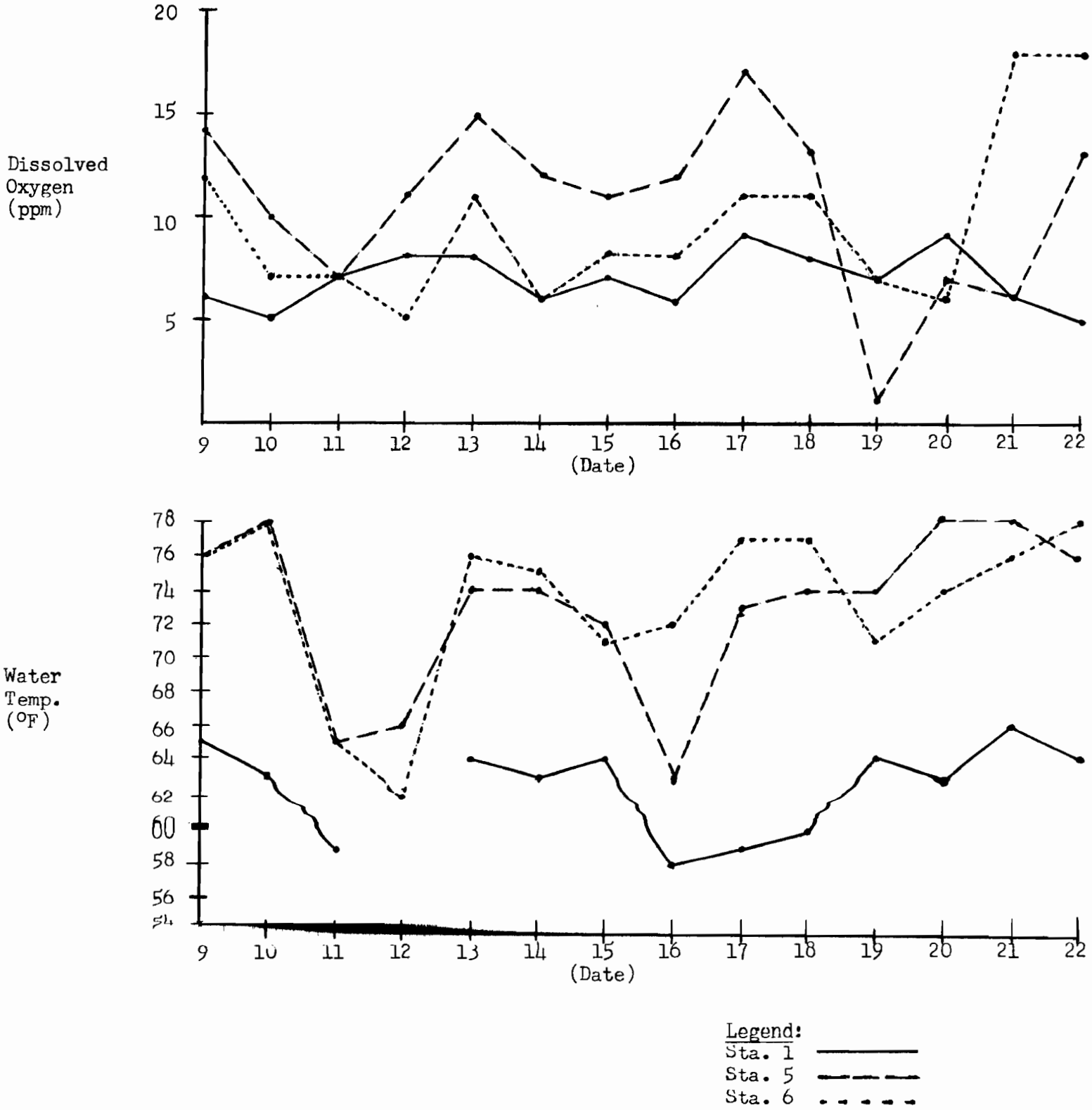


Figure 4

Average dissolved oxygen and water temperature for stations 1, 3, 4, 5 and 6 plotted against station 2, the control stream.

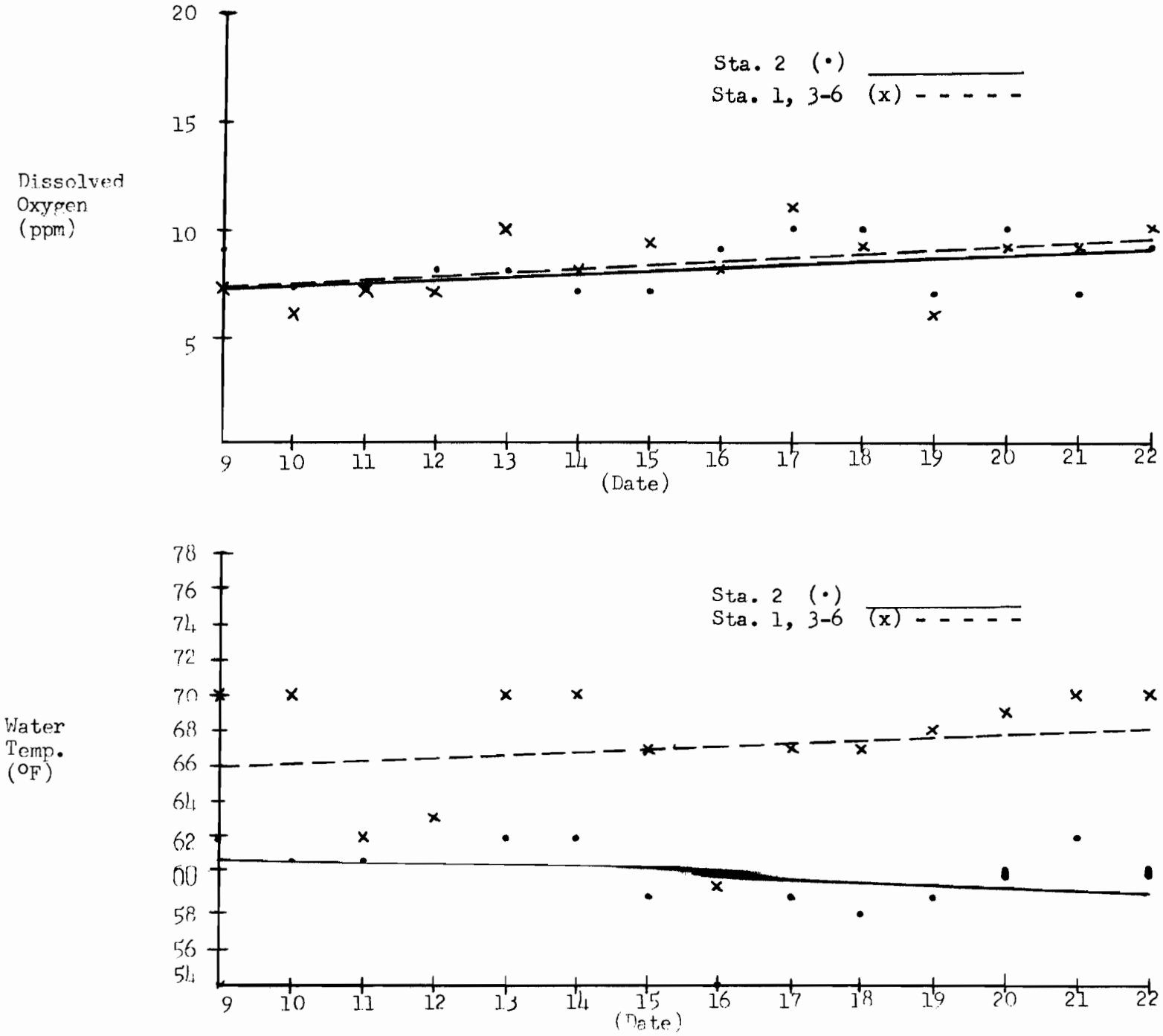


Table III.

CO_2 (ppm)

Sta. #	1	2	3	4	5	6
8/9	20	20	20	25	5	5
8/10	35	20	25	15	15	15
8/11	30	20	25	20	20	15
8/12	15	15	20	15	15	15
8/13	15	15	20	20	5	5
8/14	15	15	20	5	5	5
8/15	20	20	20	15	5	5
8/16	25	20	20	15	5	10
8/17	15	20	20	25	5	5
8/18	15	20	15	20	10	5
8/19	20	15	15	10	20	15
8/20	20	20	10	15	20	25
8/21	25	25	25	20	25	10
8/22	20	5	15	20	<5	<5
Range	15-35	5-25	10-25	5-25	5-25	5-25
$\bar{x}$	21	18	19	17	11	10

We feel there were no changes in CO_2 levels brought about by the chemical treatment and the elimination of fishes during the testing period.

Alkalinity

Fluctuations varied greatly from day to day but for the most part there were long periods of stability. There are periods when no change would take place for several days then a small change would take place. A pattern is evident at all stations up to the sixteenth. After this date large scale manipulations of the dams on the river system began. More erratic fluctuations took place during this period.

The alkalinity readings did show a reaction to the removal of the rough fish but this was associated with opening of the Theresa dam in downstream areas. There was no phenolphthalein alkalinity evident until three fourths of the river system had been treated. The phenolphthalein alkalinity was never very high and the readings were sporadic. Stations 5 and 6 showing the most consistant readings following the treatment of the area between the upper Mayville and Theresa dams. The Theresa dam had been opened on the seventeenth to facilitate the treatment. Station 3 did not show any trace of phenolphthalein alkalinity until 6 days after the treatment of the segment it is in. On the other hand, stations 4, 5 and 6 began to show traces of phenolphthalein alkalinity almost immediately after treatment.

We feel this is due to acid conditions caused by the release of stagnant waters behind the Theresa dam and in part by the dead fish remaining in the river. We feel this way because station one was treated in the same manner yet this station did not have the large numbers of rough fish that stations 3, 4, 5 and 6 had, and was not effected by dam openings. But, stations 3 and 4 were not effected by dam openings either. Also, station 2 which had no rough fish never showed any trace of phenolphthalein alkalinity throughout the period.

pH

pH readings for the duration of the testing period remained relatively stable (refer to Table V).

There were no great fluctuations evident from rain, chemical treatment, or removal of rough fish. Daily variations were the only apparent changes in pH readings. In most cases the average daily variations at all stations ranged from 2 to 4 tenths. By the end of the testing period the average pH at individual stations ranged from 7.8 to 8.5.

Turbidity

A general observation of the turbidity graph (Figure 5) indicates a decreasing trend in turbidity at all stations. There were three factors which had an affect on turbidity readings. These were heavy rains, which fell on the afternoon of the 10th and the evening of the 13th, the opening of Theresa dam the 19th of August and the removal of rough fish.

Table IV.

Total Alkalinity (ppm)

Sta. #	1	2	3	4	5	6
8/9	342	325	325	325	308	291
8/10	308	308	308	342	274	342
8/11	325	308	308	291	274	274
8/12	325	325	308	325	274	291
8/13	325	325	325	325	291	291
8/14	291	308	291	325	274	325
8/15	325	325	308	308	274	274
8/16	308	308	291	291	256	291
8/17	325	325	342	325	308	308 (2)
8/18	342	342	342	325	308 (2)	359 (2)
8/19	325	325	308 (2)	325	325	308
8/20	325	308	274 (2)	308 (2)	274 (2)	291
8/21	325	325	325	342	291 (1)	325 (3)
8/22	308	325	325	308	291 (2)	291 (3)
Range	291-342	308-342	274-342	291-342	256-325	274-359
$\bar{x}$	321	320	313	319	287	304

Numbers in ( ) indicate phenolphthalein alkalinity in grains per gallon of calcium carbonate.

Table V.

p.H.

Sta. #	1	2	3	4	5	6
8/9	7.8	8.5	7.9	7.8	8.3	7.8
8/10	7.7	8.0	7.9	7.9	8.3	8.0
8/11	8.0	7.9	7.8	7.8	8.1	8.0
8/12	8.0	8.0	8.0	8.0	8.6	8.0
8/13	7.9	8.0	8.0	7.9	8.8	8.6
8/14	7.3	7.8	8.2	7.8	8.6	7.9
8/15	8.0	8.2	8.0	8.0	8.7	8.0
8/16	7.9	8.0	8.1	7.9	8.7	8.0
8/17	7.9	8.0	8.0	8.1	8.7	8.7
8/18	7.7	7.8	7.9	7.9	8.8	8.7
8/19	7.9	8.0	8.5	8.2	8.0	8.0
8/20	7.9	8.1	8.4	8.1	8.5	8.2
8/21	7.9	8.0	8.3	8.0	8.6	8.8
8/22	8.0	8.0	8.0	8.0	8.9	8.9
Range	7.3-8.0	7.8-8.5	7.8-8.5	7.8-8.2	8.0-8.9	7.8-8.9
$\bar{X}$	7.8	8.0	8.1	8.0	8.5	8.2

Turbidity dropped sharply at stations 1, 3 and 4 on the 11th. This may be due to a dilution of these waters from rain the day before. However, by the 12th, stations 3 and 4 were rising again while the turbidity at station 1 was zero. Station 1, by that time, was in the second day after treatment and most if not all the rough fish, mainly carp, had been removed.

After the 13th, stations 1 and 3 had been treated. Both stations correspond with station 2 (the control stream) for the remainder of the testing period. A reminder that station 2 was not infested with rough fish and therefore wasn't treated.

Station 5 was not greatly affected by rain as were the other stations. A possible explanation of this is that river velocity at station 5 did not increase with heavy rain after the 10th and the 13th because of the great width and depth. Hence, the ability of the river to carry or dilute the silt load was great. Turbidity at stations 4 and 5 decrease sharply after the treatment on the 16th. Here again, is more evidence of the decrease in turbidity with rough fish removal.

Station 6 actually follows the same pattern as other stations. However, this station was affected greatly by rain on the 13th, and the opening of Theresa dam the 18th. With heavy rain and the opened dam, stream velocity increased at station 6. The factor affecting stream velocity at station 6 was the width of the stream (about 10 feet). Therefore, with increased stream velocity the silt load increased sharply. After the 19th station 6 showed the same trend due to the chemical treatment. The removal of rough fish leads to a decrease in stream or water turbidity.

Color

The color graph (Fig. 6) indicates a decrease in water color at all stations towards the end of the sampling period. The same factors that affected turbidity readings also affected color readings with one addition. They were; rain, the opening of the Theresa dam, the removal of rough fish and a bloom of phytoplankton. Color measurements parallel turbidity readings since both are measured by the total light passage through a sample.

It can be seen that the dye used in conjunction with the application of the poison had no apparent affect upon raising the color readings. In each case color measurements dropped on the day after treatment at all stations except station 3, which probably rose due to heavy rain the evening of the 13th.

Stations 1, 3 and 4 tend to follow the control stream after treatment days. By the 19th stations 1, 3 and 4 had color readings ranging from 0-20, a considerable drop from readings early in the testing period.

Stations 5 and 6 were very comparable during the testing period. The heavy rain the night of the 13th and the opening of the Theresa dam the 18th had a noticeable affect upon raising the color readings at both stations. The color graph indicates an increase on the fifth day after chemical treatment

Table VI.

Turbidity

Sta. #	1	2	3	4	5	6
8/9	55	<5	50	75	85	130
8/10	50	0	70	80	85	130
8/11	5	0	25	25	85	145
8/12	0	0	30	65	100	85
8/13	0	5	40	65	95	100
8/14	15	5	5	105	85	270
8/15	5	10	5	70	85	140
8/16	15	15	20	90	100	95
8/17	15	10	0	20	50	90
8/18	0	10	0	15	30	60
8/19	0	10	0	5	25	155
8/20	0	0	0	0	15	15
8/21	0	0	0	0	15	25
8/22	0	0	0	0	25	25
Range	0-55	0-15	0-70	0-105	15-100	15-270
$\bar{x}$	11	5	18	44	63	105

Figure 5

Daily turbidity readings for Stations 1 through 6

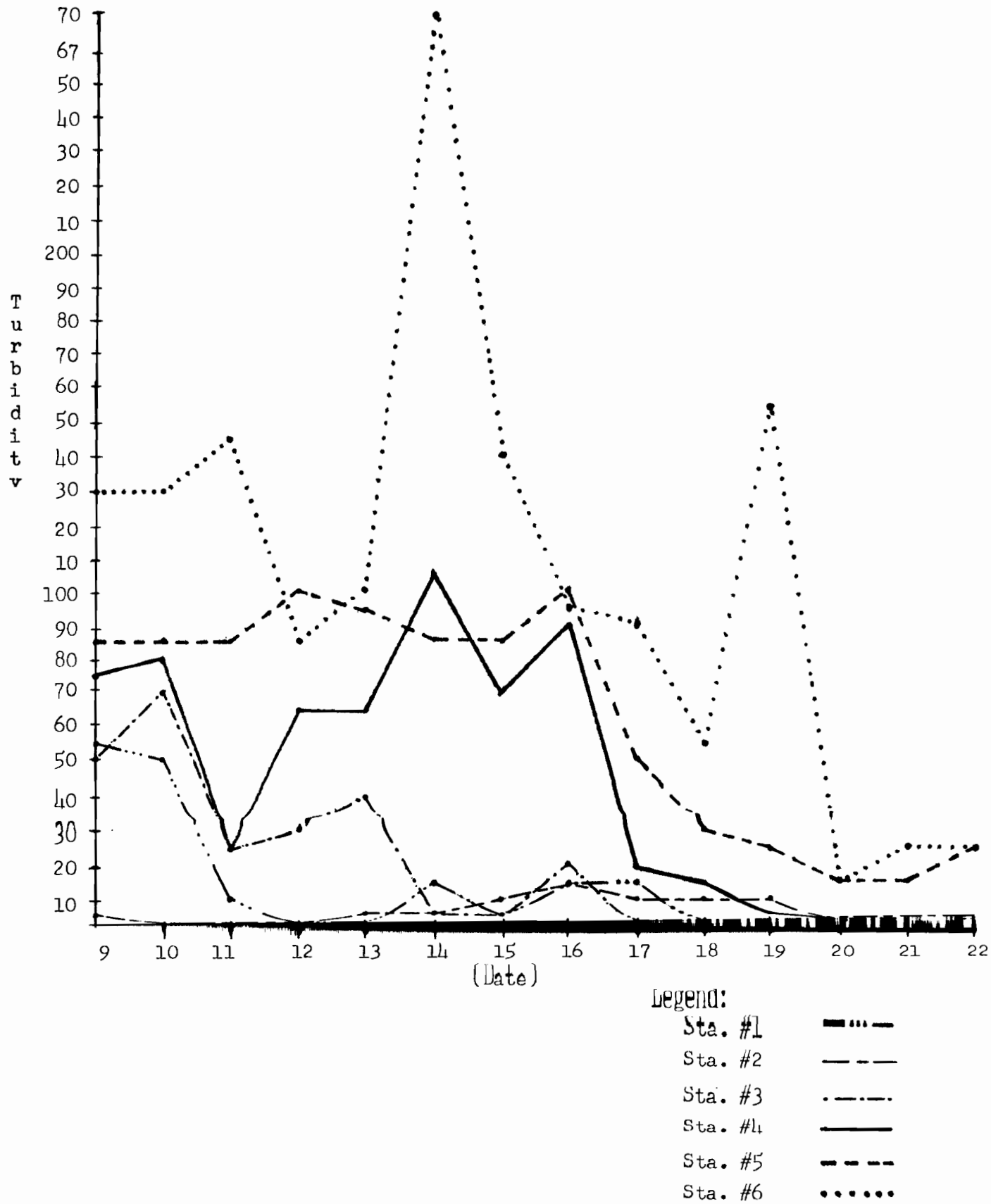


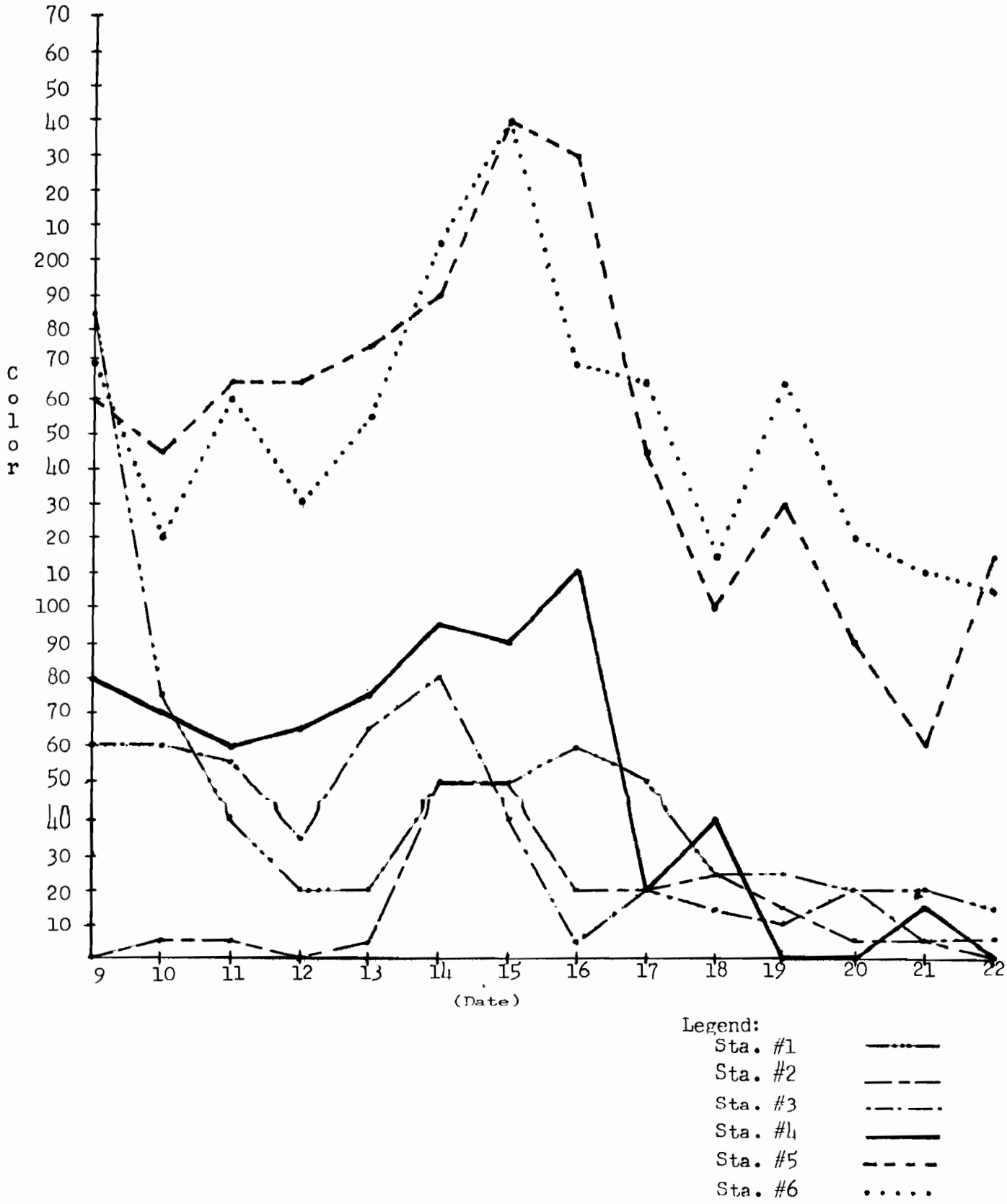
Table VII.

Color

Sta. #	1	2	3	4	5	6
8/9	185	0	60	80	160	170
8/10	75	5	60	70	145	120
8/11	40	5	55	60	165	160
8/12	20	0	35	65	165	130
8/13	20	5	65	75	175	155
8/14	50	50	80	95	190	205
8/15	50	50	40	90	240	240
8/16	60	20	5	110	230	170
8/17	50	20	20	20	145	165
8/18	25	25	15	40	100	115
8/19	25	15	10	0	130	165
8/20	20	5	20	0	90	120
8/21	20	5	5	15	60	110
8/22	15	0	5	0	115	105
Range	20-185	0-50	5-80	0-110	60-240	105-240
$\bar{x}$	47	15	34	51	151	152

Figure 6

Daily color readings for Stations 1 through 6



at station 5. The color of the water here increased while other stations remained steady or fell. A greenish tint to the water was quite evident. At first it was thought that the dye was causing this irregular reading. However, after studying the water more closely it was found that there was a bloom of phytoplankton, apparently due to the increase of nutrients from dead fish, absence of predator fish and the warmer water at this location. Stations 1, 3 and 4 may not have shown this bloom because of the much cooler waters at those stations (refer to Water Temp. graphs Fig. 2 and 3).

Conductivity

Conductivity varied greatly at certain stations while others remained more stable. Readings for the sample period are compiled in Table VIII.

Stations 1, 2, 4 and 6 show great change, all of which is not due to the chemical treatment and the removal of rough fish. There were no consistant changes at any station on treatment days or on the days immediately following the treatment. Conductivity at station 1 and 6 reflect the manipulation of the river system and the weather. Stations 2 and 4 mainly reflect the effects of the weather. All stations show a marked decrease on the fourteenth following the heavy thunderstorm on the night of the thirteenth. Station 4 showed a decrease on the eleventh and station 2 showed a decrease on the twelfth due to the rains on the tenth. Station 1 showed a decrease on the eighteenth. This was probably due to the effects of the manipulation of the Theresa dam downstream, on the seventeenth and eighteenth. Station 6 showed the most erratic change and, outside of the drop on the fourteenth, did not follow the pattern found at the other stations. An extremely rapid rise began on the seventeenth after the upper Mayville dam was closed on the sixteenth. This effectively reduced the flow which increased the dissolved solids in the remaining water which was mostly ground water influx.

On the twenty-second of August all stations experienced a rapid drop to the lowest point for the period. At the present time there is no logical explanation for this phenomena.

Discussion

The findings indicate there is no change in dissolved oxygen, carbon dioxide, pH or conductivity due to the chemical treatment or the removal of rough fish. Immediately following the removal of rough fish phenol alkalinity was detected at the sample stations on the lower reaches of the treatment segment. The big changes were found in the color and turbidity readings. There was a marked decrease in color levels and turbidity levels. Rough fish removal resulted in improved water clarity thus improving the habitat and making the river more desirable for stream organisms.

Table VIII.

Conductivity (77°)

Sta. #	1	2	3	4	5	6
8/9	663	770	638	816	702	768
8/10	688	771	573	844	688	813
8/11	688	771	630	785	688	844
8/12	692	621	762	846	648	929
8/13	692	773	649	851	667	817
8/14	556	649	589	767	584	614
8/15	677	748	544	809	613	970
8/16	692	801	648	787	588	785
8/17	678	726	661	833	610	873
8/18	587	784	664	810	696	1242
8/19	687	778	644	730	771	1269
8/20	678	766	642	748	573	1366
8/21	692	728	784	816	663	1214
8/22	533	548	480	644	526	604
Range	533-929	548-801	480-784	644-851	526-771	604-1366
$\bar{x}$	674	728	636	786	642	919

SUMMARY

On August 9, 1971, a water sampling program was initiated to coincide with the chemical treatment of the east branch of the Rock River. This was a series of daily samples taken at six stations spread over the entire system. The sampling continued for fourteen days and was concluded on August 22, 1971. Tests for dissolved oxygen, carbon dioxide, pH, alkalinity, water color, turbidity and conductivity were run in conjunction with the chemical treatment.

There was little or no change in dissolved oxygen, carbon dioxide, pH, alkalinity and conductivity. Major changes were evident in color and turbidity readings. This means there was an improvement in water clarity and in turn the river will be more desirable for stream organisms.