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Hydo. 340
Spring 99

Gauging Temperature at Lyman Lakes

There were three main objectives in this project. The first objectives was to try and ascertain if there was a difference in temperature between the water going into to the Lyman Lakes system verses the water coming out of the lakes. The second objective was seeing how the outside temperature effected the temperature gages in spring creek where it enters at the bridge and exits at the dam. The final objective was to look at the ground water to determine if there was any correlation to either the outside temperature or the gauges entering and exiting Lyman Lakes.

The area of Lyman Lakes begins at the bridge between Goodhue and Evans. It is at this point, where the water enters the Lyman Lakes system. Currently below this point, all the ground water is being drained so most of the area is deficient of ground water. However, there is a natural aquifer beneath this area which will still provide small amounts of ground water. In any case, there is quite a significant draw down effect as seen by the lack of water in the piezometeres. The ground water that has been removed is added back in the system in the middle of the Lyman Lakes area. The ground water that comes in to the system here has been measured to be at a temperature of 11 C. The Lyman Lakes area then continues on for another 1/2 mile before the dam. Under normal conditions, this dam is blocked; however, when this study occurred the dam is at this point is where spring creek leaves the Lyman Lakes system.

The Thermometers were approximately 6 in. long and recorded temperatures about ever five mins. A program called boxcar was used to activate the thermometers and also to down load the data. The thermometers can keep the data for fourteen days before it will record over the old data. Data was collected during two different periods of time. The first time period was between the 5/6-5/14 while the second was between 5/20-5/27. Four thermometers were installed. One was hanging below the center piling of the upper bridge by Goodhue. The second was put in two different piezometers during each test period. However, in both test periods it did not record any data either due to the fact that it cannot record the data in a piezometer or that the thermometer had problems down loading the data. However, in this situation it can be assumed that the ground water remained at a constant temperature. The third thermometer was installed in the weather station next to the Goodsell observatory in order to record the outside temperature. The final thermometer was installed in the dam where spring creek exited the system. Each thermometer was attached with a chain which held it in place at these locations. The thermometers recorded the data extremely well except for the one in the piezometer which failed both times. Because of the large quantity of data, this paper only looks at the data given every half an hour.

When examining the data some interesting trends can be observed. Both the upper bridge and the lower dam mimic the pattern of the outside temperature. For example, if the weather station temperature increases/ decreases so do both the upper bridge and lower dam.

Another trend that is observed is that the temperature in the upper bridge for the most part is above the lower dam (See Data charts 1 and 2). This could be for several reasons. One reason is that the addition of ground water might decrease the temperature in the dam because its temperature is much lower. However, the input from the ground water is fairly far away from the dam and it seems that the ground water should have increased in temperature by this point. Another possible explanation could be depth of the thermometers. During the coarse of the study the lower dam was blocked and water level rose. This caused an increase in the level of depth in the lower dam perhaps lowering the temperature. Perhaps it could be a combination of these two factors. In any case, it seems clear that where the water enters the Lyman Lake system it has a higher temperature.

The lower dam seems to be much more susceptible to the change in temperature. At times the lower dam seems fluctuate wildly and has brief periods when it crosses over the upper bridge's temperature. Such an example can be seen in day 5/9 and 5/8. The lower bridge fluctuates and the temperature increases so that it has a brief moment when it is higher than the upper bridge. Meanwhile, the upper bridge remains at a state where it is gradually but slowly rising to the change in temperature.

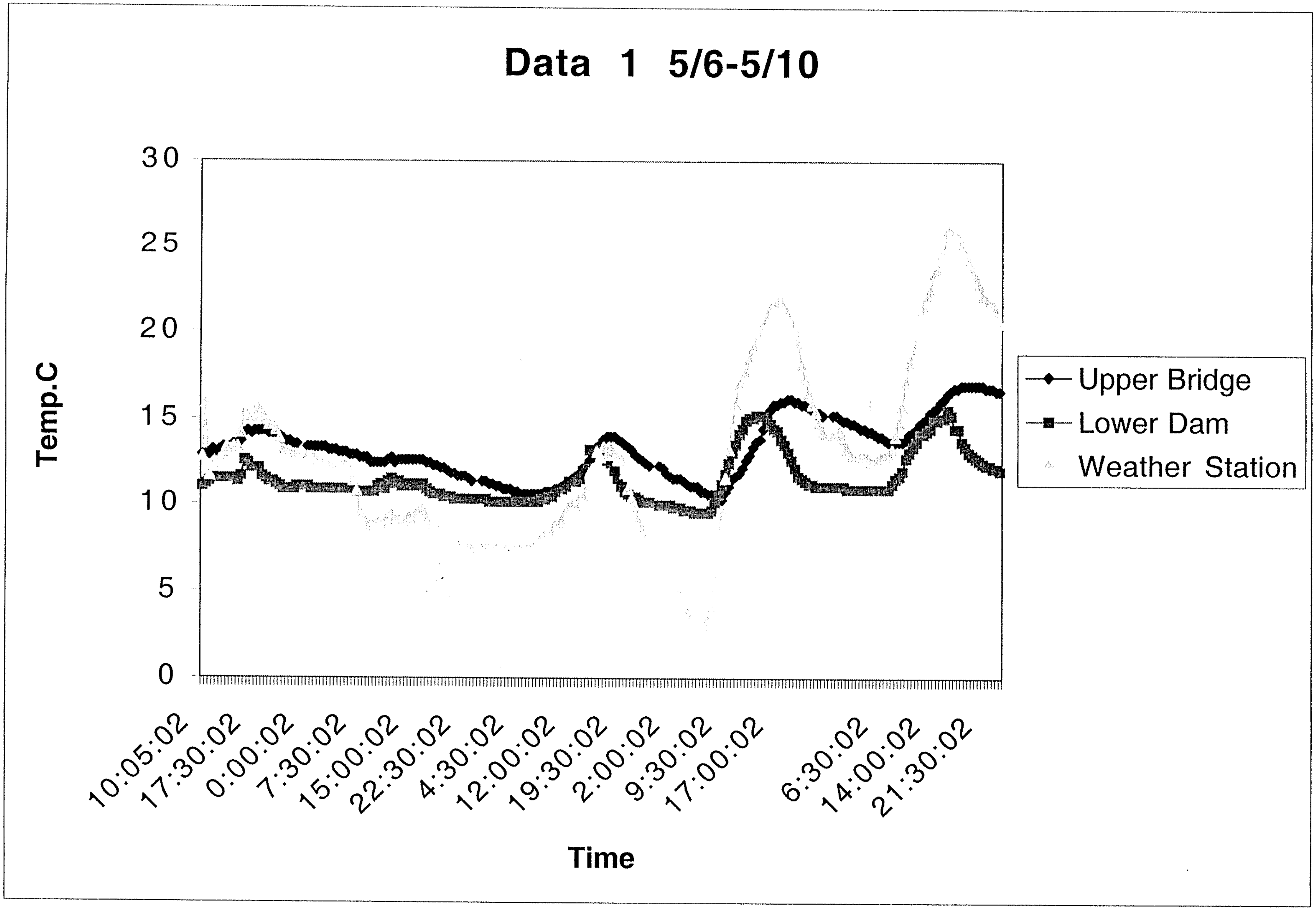
Another interesting occurrence that happened during this study is that one of the thermometers was buried about three feet deep in sand during the first test. It had gotten been buried after a few days of intense rainfall that occurred from the 11-13 of may. This observation can been seen quite accurately in the data for this time period. By looking at the Data 1 from 5/11 to 5/14 it is clear that the gage at lower bridge is following the outside temperature. However, the upper bridge appears to be in some what of a constant state. This is particularly apparent from the data on 5/14 when there was a clear sunny day.

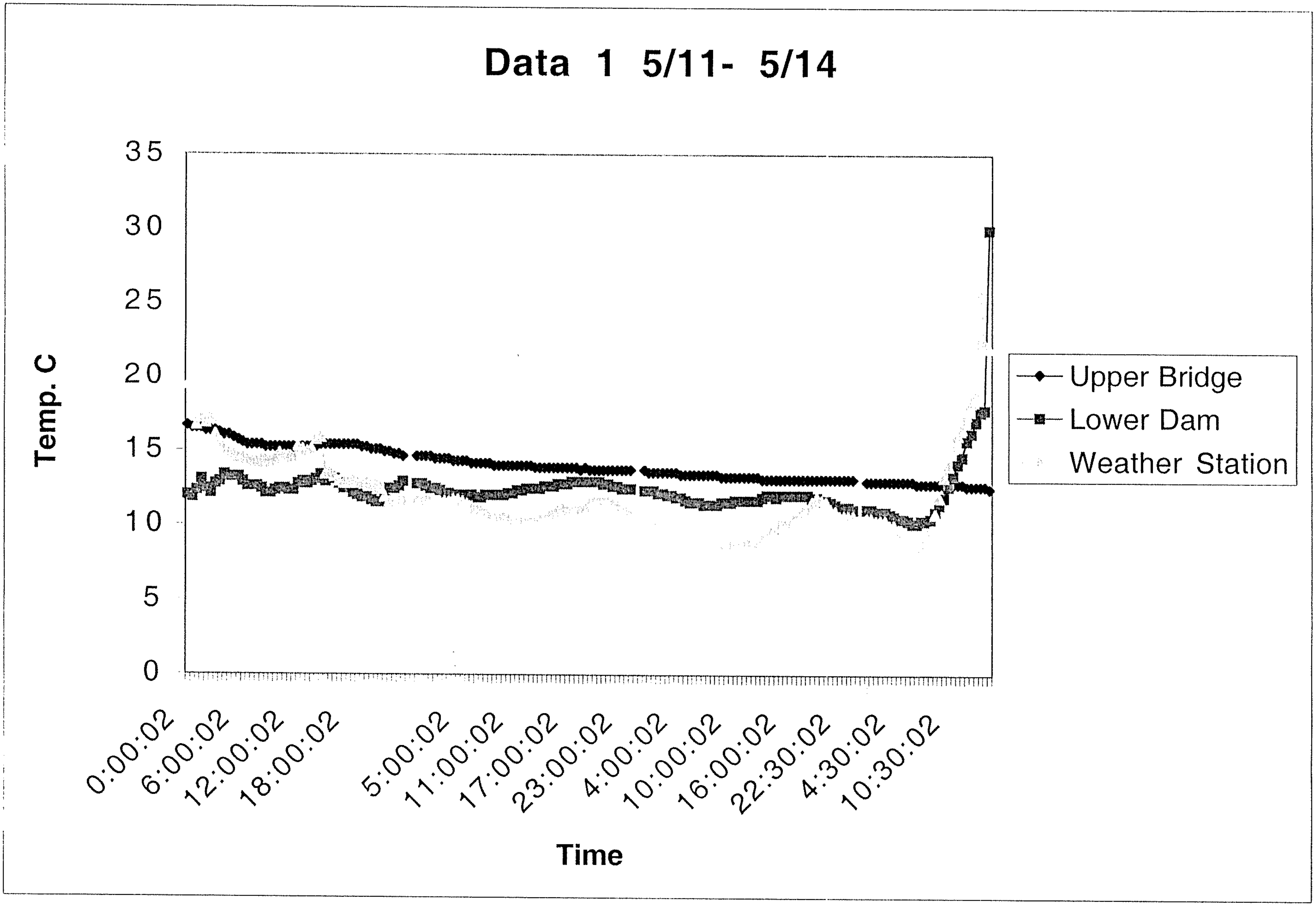
The outside temperature and the lower dam dramatically increased while the bridge remained at constant unchanging temperature. By observing the Data 1 chart from the days of 5/14-5/16 this factor become increasingly apparent because the upper bridge is now considerably lower in temperature than the dam.

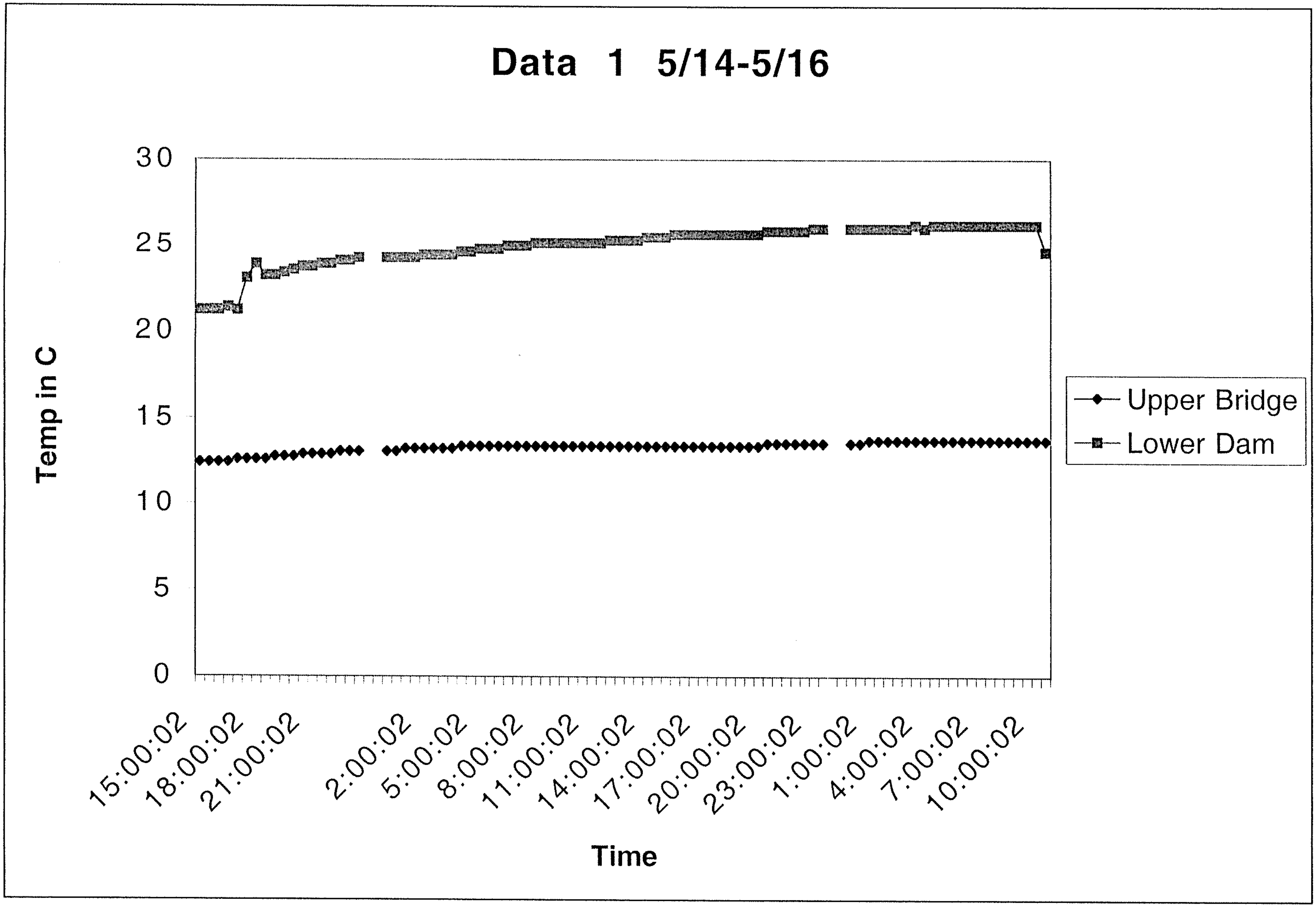
When looking at individual days it is interesting to note that on clear, sunny days (5/25/99) the temperature increases at about 9:00am peaks at about 3-4pm and decreases at about 7:00 pm. On a rainy days a steady decrease occurs at about 9:00am until the end of the day (5/7/99). These days seem to typify what occurs in temperature for the most part from day to day. Another interesting observation is the difference in temperature between Northfield and Rochester. Taking the mean that I got at Lyman Lakes and plotting it against the Rochester temperatures, Northfield is consistently higher. (Rochester Vs Northfield, Note that no data was taken in Rochester on 5/20 and that 5/6- 5/14 should be taken as a different graph then 5/20-5/27.)

While undertaking this study several problems arose. One such problem was the sediment burying the thermometer. Another was trying to find the chains which frequently got lost. I think one of the most important things that I learned from this study is that environmental conditions will change even over a very short time scale. This is one important factor to realize before installing any thermometers in the field. Also, when collecting data, keep in mind that more is not always better. I spend a lot of time editing out the large volume of data for the spread sheets.

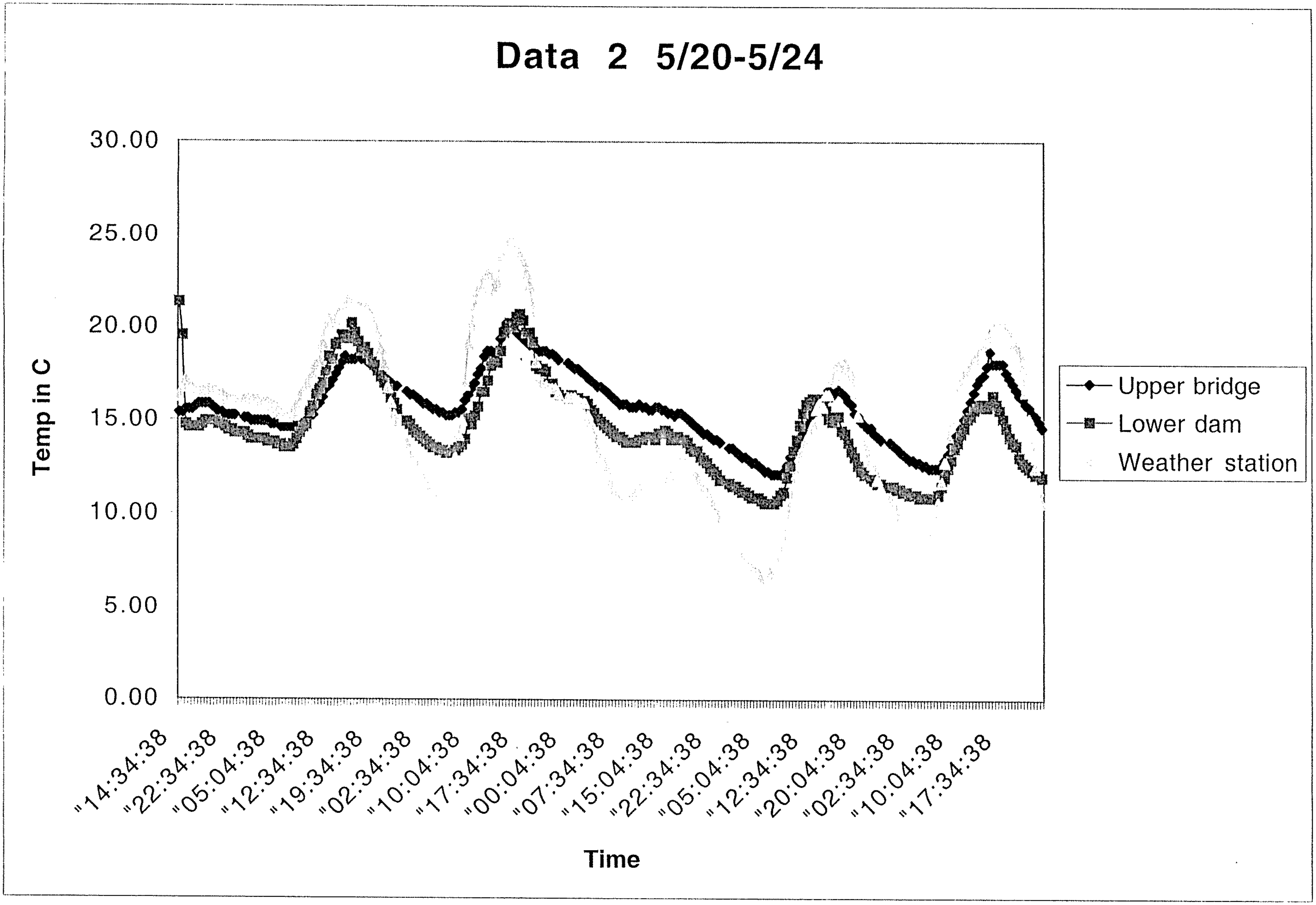
Overall the study went fairly well and some interesting observations were made about the incoming and exiting water in the Lyman Lakes area. For the future it might be interesting to redo this experiment seasonally so as to try and detect temperature patterns. Also, when the ground water is normalized it might be fascinating to see if it was the ground water that effected the lower dam or perhaps there might have been some other influence. In any case I think that this was a fun and exciting experiment.

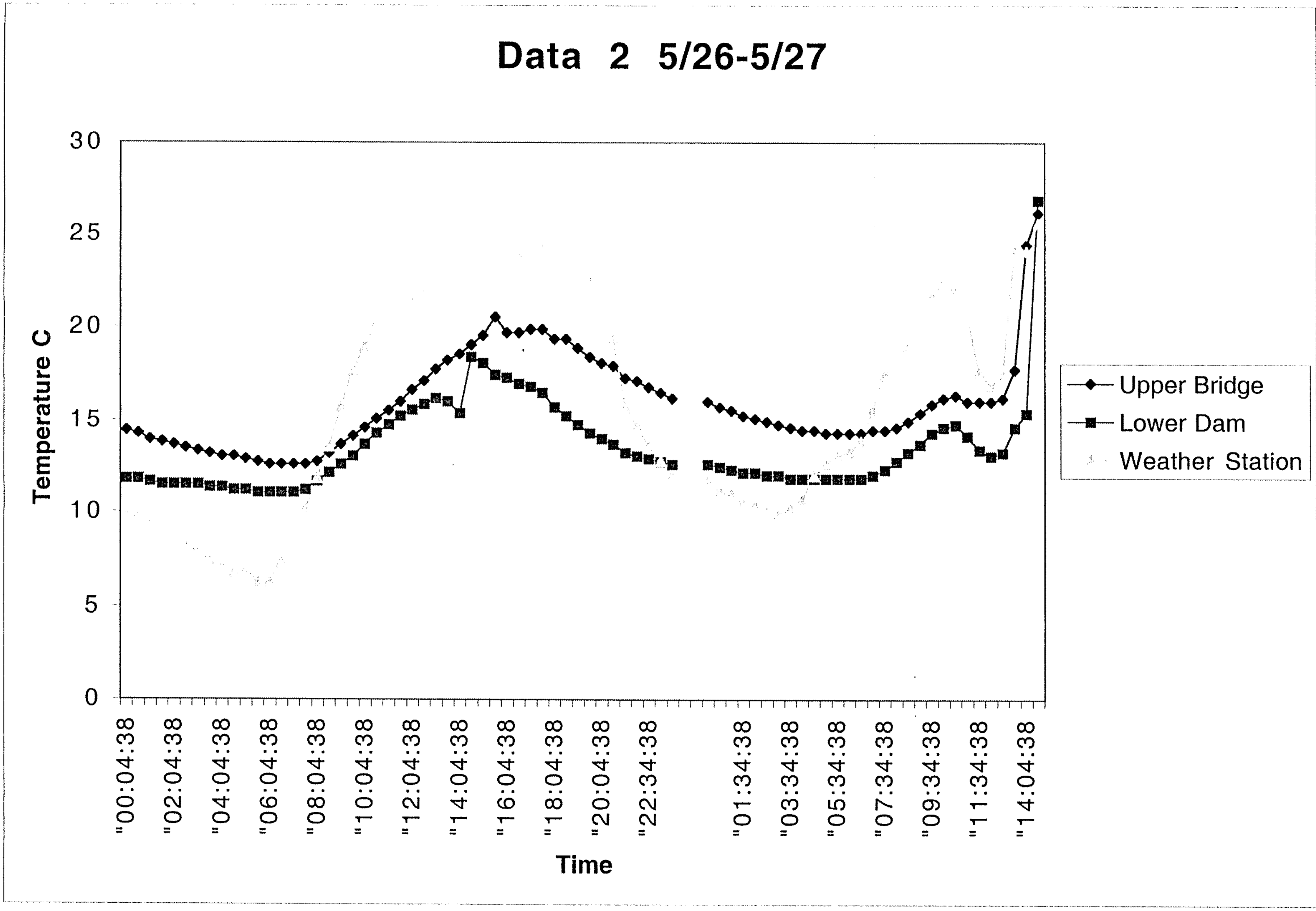

Data 1 5/6-5/10
Temp.C
30
25
20
15
10
5
0
10:05:02
17:30:02
0:00:02
7:30:02
15:00:02
22:30:02
4:30:02
12:00:02
19:30:02
2:00:02
9:30:02
17:00:02
6:30:02
14:00:02
21:30:02
Time
Upper Bridge
Lower Dam
Weather Station


Data 1 5/11- 5/14
Temp. C
35
30
25
20
15
10
5
0
0:00:02
6:00:02
12:00:02
18:00:02
5:00:02
11:00:02
17:00:02
23:00:02
4:00:02
10:00:02
16:00:02
22:30:02
4:30:02
10:30:02
Time
Upper Bridge
Lower Dam
Weather Station

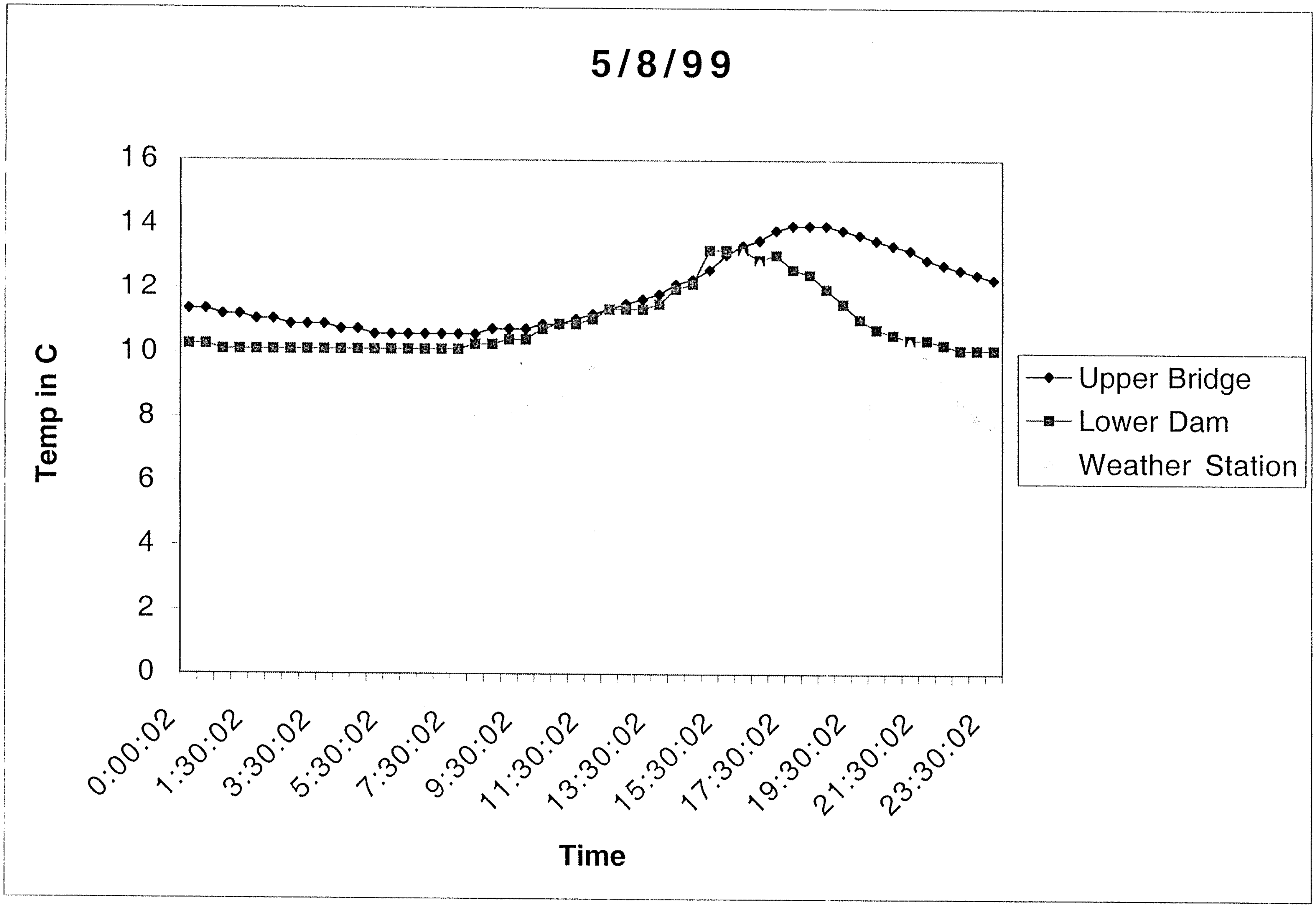


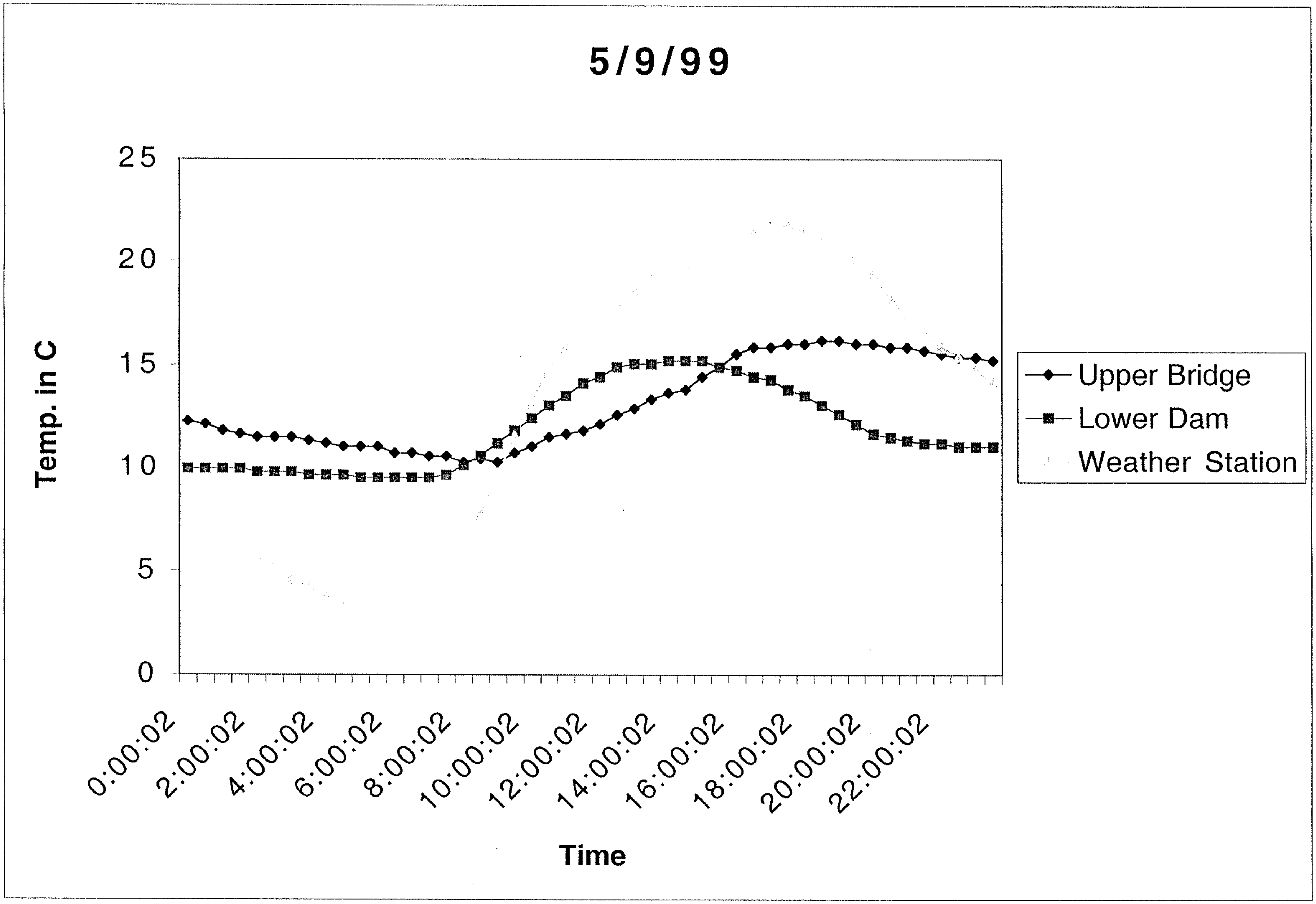
Data 1 5/14-5/16
Temp in C
30
25
20
15
10
5
0
15:00:02
18:00:02
21:00:02
2:00:02
5:00:02
8:00:02
11:00:02
14:00:02
17:00:02
20:00:02
23:00:02
1:00:02
4:00:02
7:00:02
10:00:02
Time
Upper Bridge
Lower Dam

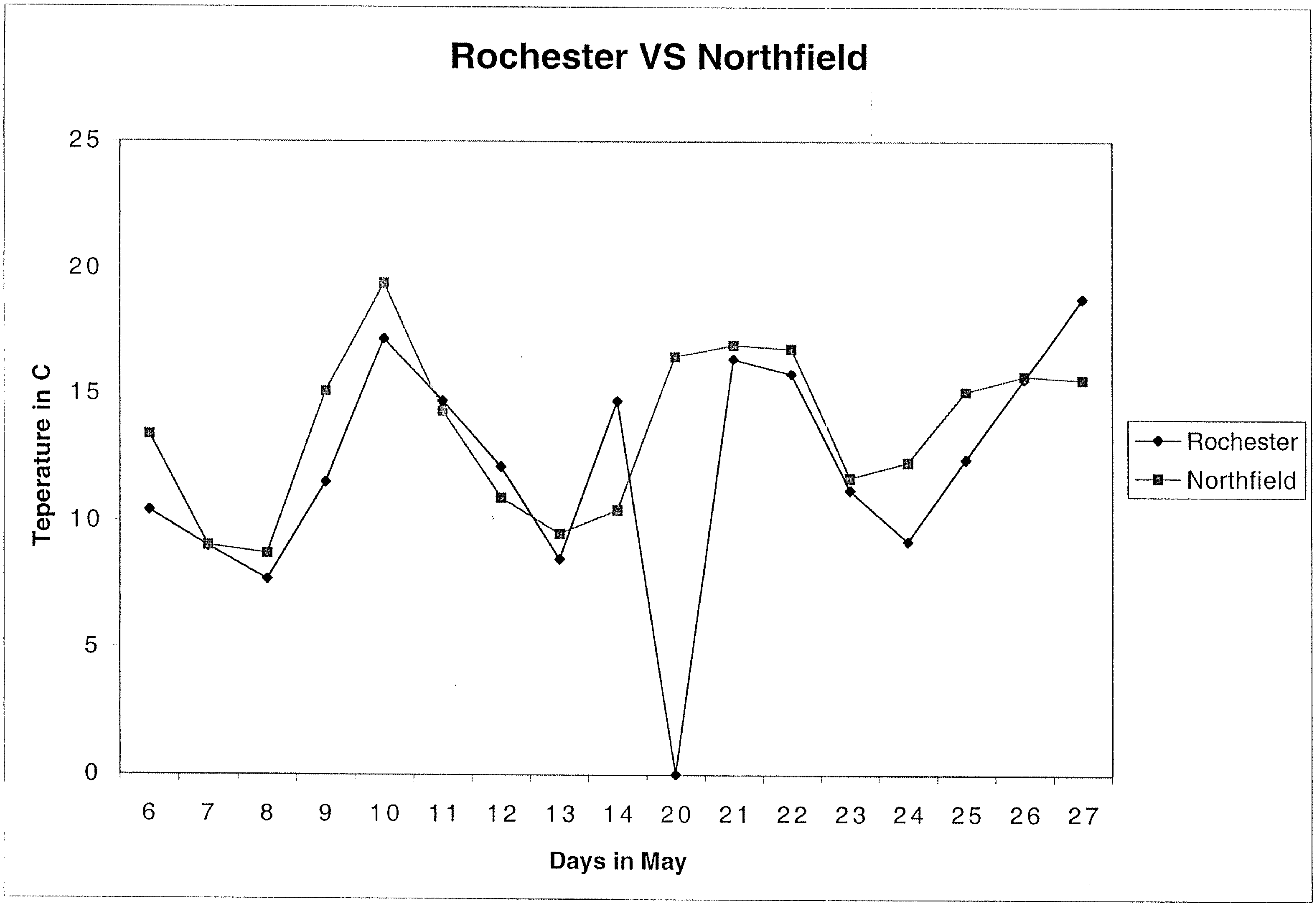

Data 2 5/20-5/24
Temp in C
30.00
25.00
20.00
15.00
10.00
5.00
0.00
"14:34:38
"22:34:38
"05:04:38
"12:34:38
"19:34:38
"02:34:38
"10:04:38
"17:34:38
"00:04:38
"07:34:38
"15:04:38
"22:34:38
"05:04:38
"12:34:38
"20:04:38
"02:34:38
"10:04:38
"17:34:38
Time
Upper bridge
Lower dam
Weather station

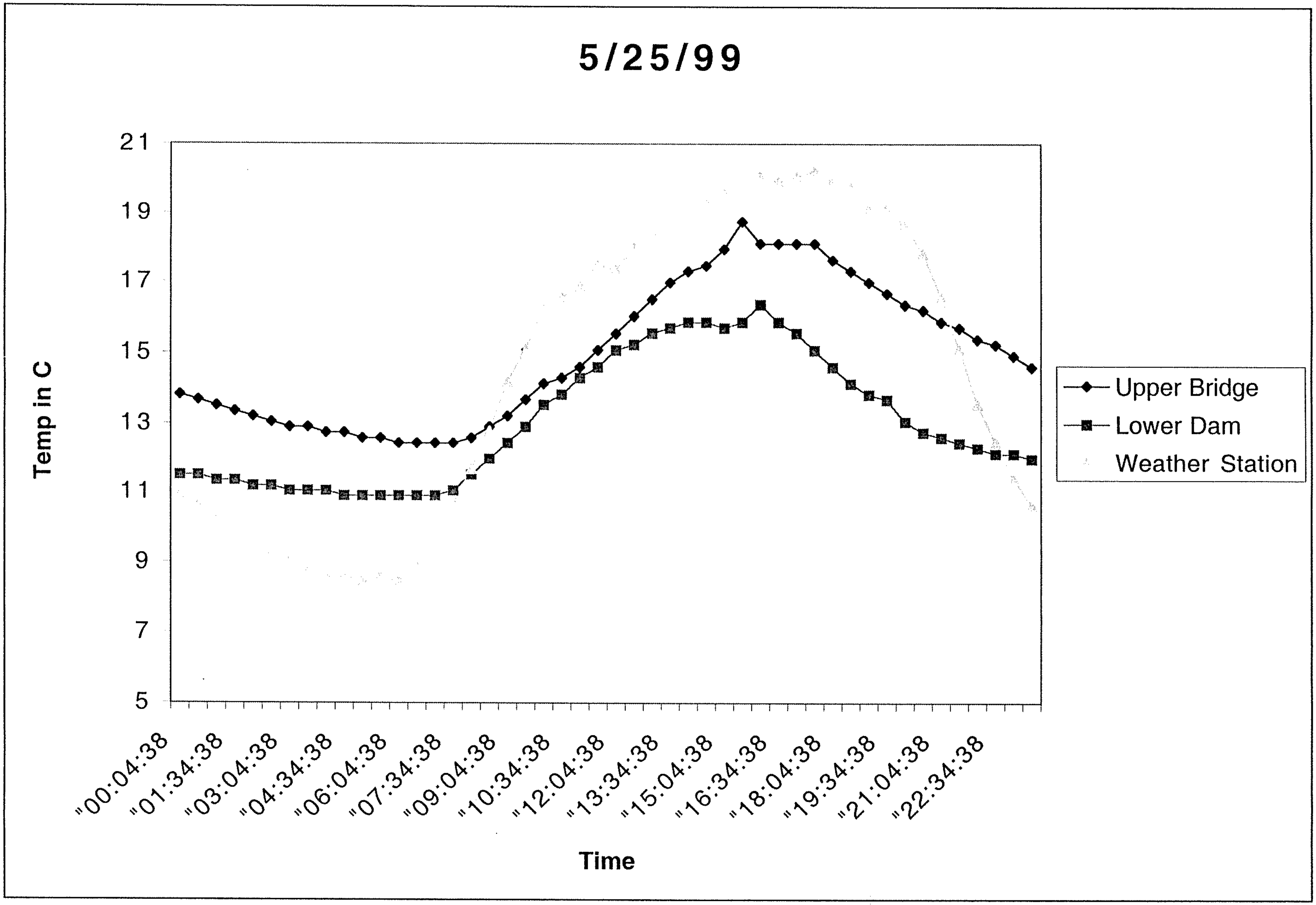


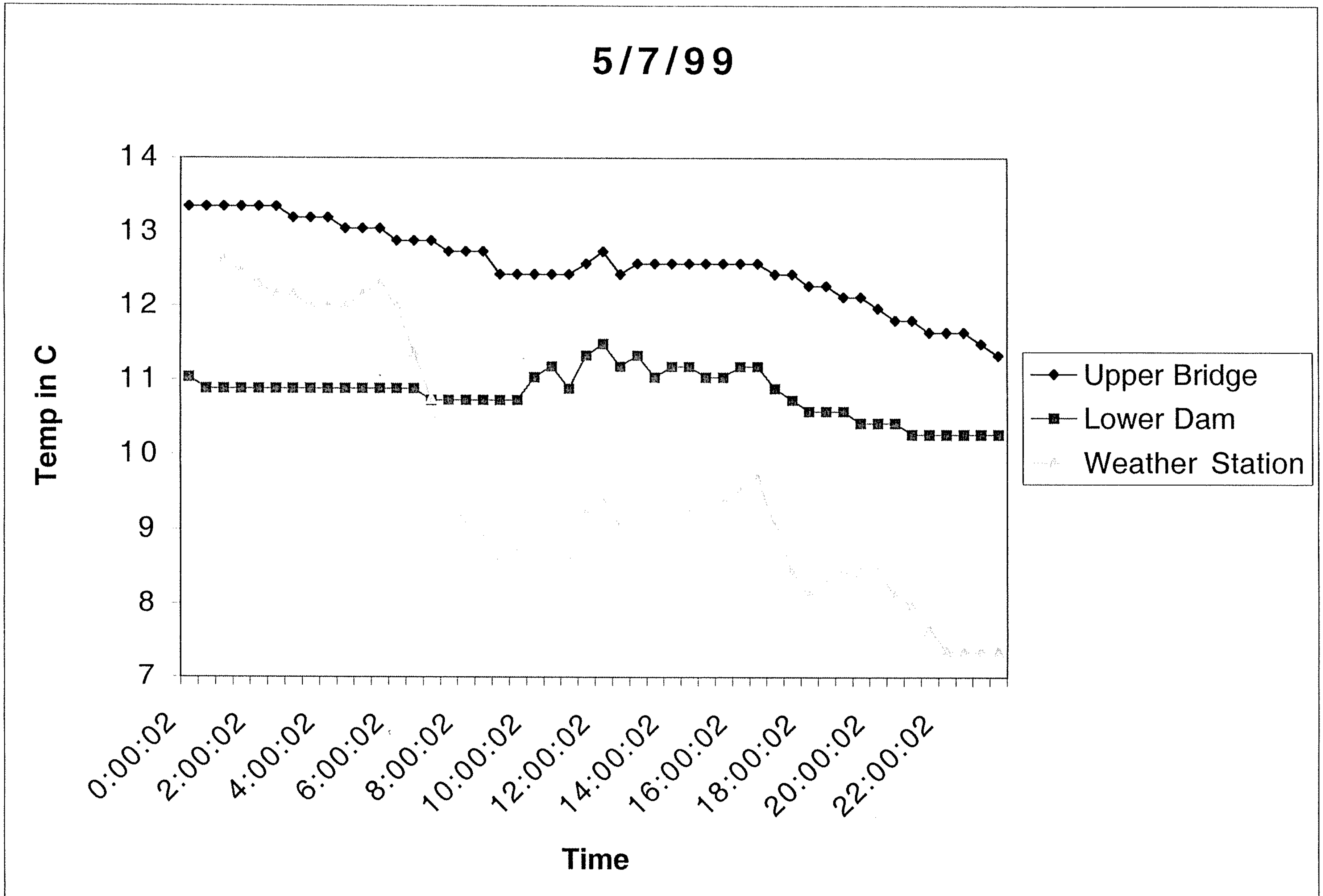
Data 2 5/26-5/27
Temperature C
30
25
20
15
10
5
0
"00:04:38
"02:04:38
"04:04:38
"06:04:38
"08:04:38
"10:04:38
"12:04:38
"14:04:38
"16:04:38
"18:04:38
"20:04:38
"22:34:38
"01:34:38
"03:34:38
"05:34:38
"07:34:38
"09:34:38
"11:34:38
"14:04:38
Time
Upper Bridge
Lower Dam
Weather Station


5/8/99
Temp in C
16
14
12
10
8
6
4
2
0
0:00:02
1:30:02
3:30:02
5:30:02
7:30:02
9:30:02
11:30:02
13:30:02
15:30:02
17:30:02
19:30:02
21:30:02
23:30:02
Time
Upper Bridge
Lower Dam
Weather Station


5/9/99
Temp. in C
25
20
15
10
5
0
0:00:02
2:00:02
4:00:02
6:00:02
8:00:02
10:00:02
12:00:02
14:00:02
16:00:02
18:00:02
20:00:02
22:00:02
Time
Upper Bridge
Lower Dam
Weather Station


Rochester VS Northfield
Teperature in C
25
20
15
10
5
0
6
7
8
9
10
11
12
13
14
20
21
22
23
24
25
26
27
Days in May
Rochester
Northfield


5/25/99
Temp in C
21
19
17
15
13
11
9
7
5
"00:04:38
"01:34:38
"03:04:38
"04:34:38
"06:04:38
"07:34:38
"09:04:38
"10:34:38
"12:04:38
"13:34:38
"15:04:38
"16:34:38
"18:04:38
"19:34:38
"21:04:38
"22:34:38
Time
Upper Bridge
Lower Dam
Weather Station



5/7/99
Temp in C
14
13
12
11
10
9
8
7
0:00:02
2:00:02
4:00:02
6:00:02
8:00:02
10:00:02
12:00:02
14:00:02
16:00:02
18:00:02
20:00:02
22:00:02
Time
Upper Bridge
Lower Dam
Weather Station

Weather						
6	7	8	9	10	11	12
Overcast	Rain	Overcast	Clear	Clear	Clear-TS	Rain
10.4	9	7.7	11.5	17.2	14.7	12.1
20	21	22	23	24	25	26
Rain	Clear	CL-TS	Overcast	Clear	Clear	Clear
	16.4	15.8	11.2	9.2	12.4	15.6

	Rochester	Northfield	Skies
6	10.4	13.38	Overcast
7	9	9.03	Rain
8	7.7	8.73	Overcast
9	11.5	15.09	Clear
10	17.2	19.41	Clear
11	14.7	14.31	Clear-TS
12	12.1	10.9	Rain
13	8.5	9.5	Rain
14	14.7	10.43	Clear
20	Na	16.52	Rain
21	16.4	16.99	Clear
22	15.8	16.83	CL-TS
23	11.2	11.675	Overcast
24	9.2	12.295	Clear
25	12.4	15.09	Clear
26	15.6	15.72	Clear
27	18.8	15.57	Cl-TS-CL