A Water Quality Study at the Congaree Swamp National Monument of Myers Creek, Reeves Creek and Toms Creek

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In 1976 the 15,135 acre Congaree Swamp National Monument was established "in order to preserve and protect for the education, inspiration, and enjoyment of present and future generations an outstanding example of a near-virgin southern hardwood forest" (P.L. 94-545, 1976). The name Congaree Swamp National Monument (hereinafter referred to as the "monument") may give one visions of a large inundated area with Spanish moss hanging from cypress trees, but this is not the case. The monument is actually a bottomland hardwood floodplain forest which encompasses a wide variety of tree species ranging from upland species such as pine to wetland species including cypress and tupelo. The monument is one of the last significant, near virgin tracts of bottomland hardwood forest in the Southeast United States. One of the main attractions is the number of record size trees in the monument.

The Congaree Swamp National Monument is largely within the floodplain of the Congaree River at an elevation of 80 to 110 feet above sea level (Fig. 1). On a yearly average, 90% of the park is covered by flood waters, providing nutrients from fertile upriver farmlands. Flooding usually occurs after frequent and abundant rains, but may also occur when water is released from an upriver dam. The frequently replenished soil supports a great diversity of plant and animal life. This flooding restricts the degree to which the monument may be developed for visitor use. Although the

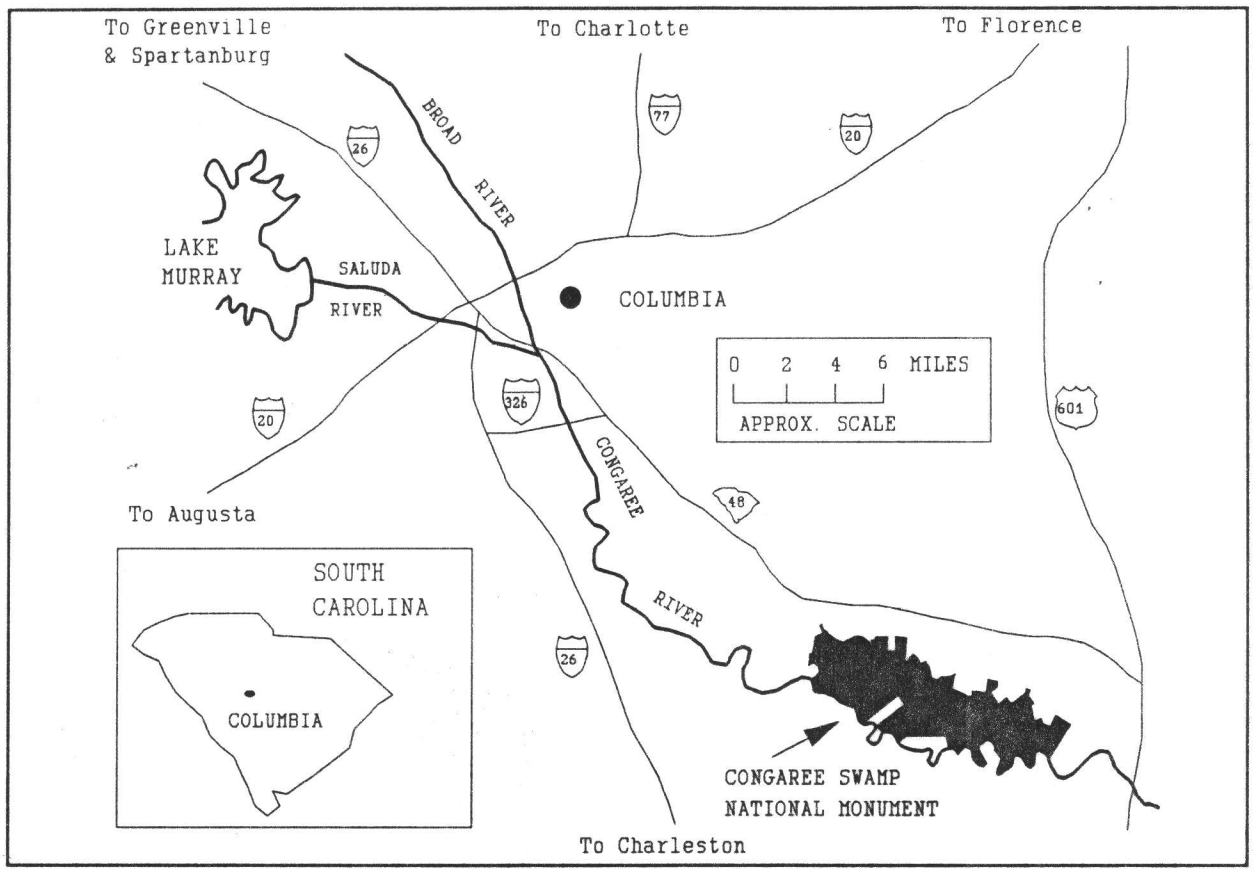


Figure 1. Map of the Congaree Swamp National Monument and surrounding area.

floodplain has an elevation change of only approximately 30 feet in over 13 miles, it has a surprisingly varied and complex pattern of vegetative communities. These vegetative communities exist in response to slight topographic gradients and the successional stages related to the sedimentation of old river channels. Because of this minimal relief, even slight elevation changes affect the duration and frequency of flooding and, therefore, the variety of plant communities. Flooding coupled with the near virgin state of the vegetation provides a unique ecosystem that has been all but lost in the Southeast. It is the major reason for including the

monument as an International Biosphere and on the National Registry of Natural Landmarks.

Objectives

The general purpose of this project was to develop and initiate a water quality monitoring program on Myers Creek, Reeves Creek, and Toms Creek. These are drainages that have their headwaters in the Coastal Plain of South Carolina and have industrial development upstream of the Congaree Swamp National Monument. This project collected and analyzed basic water quality parameters for these streams and conducted an analysis of the dissolved metals contained within these streams. The data was analyzed to determine if upstream industrial development has affected the quality of water entering the Congaree Swamp National Monument within the confines of the parameters being analyzed. The objectives of the study were as follows:

1. To collect and analyze basic water quality parameters for Myers Creek, Reeves Creek, Toms Creek as they enter the Congaree Swamp National Monument.
2. To collect and analyze any dissolved metals that may be contained in Reeves Creek, Myers Creek, and Toms Creek as they enter the Congaree Swamp National Monument.
3. To determine from the data collected if upstream industries are affecting the waters entering the Congaree Swamp National Monument.

Methods

Water sampling and field analysis was conducted by staff of the Congaree Swamp National Monument. Water samples were collected on Myers Creek, Reeves Creek and Toms Creek (Fig. 2). Samples for metals analysis were attempted to be collected on a bi-weekly

basis, however, because of the small park staff and the transfer of personnel the goal of bi-weekly sampling was not achieved. The water samples collected for metals analysis were preserved with nitric acid and mailed to the Chemical Analysis Laboratory, Institute of Ecology, University of Georgia. Dissolved metal concentrations were determined using a ICAP/plasma emission spectrometer. A list of the elements analyzed and their ranges and detection limits are given in Table 1.

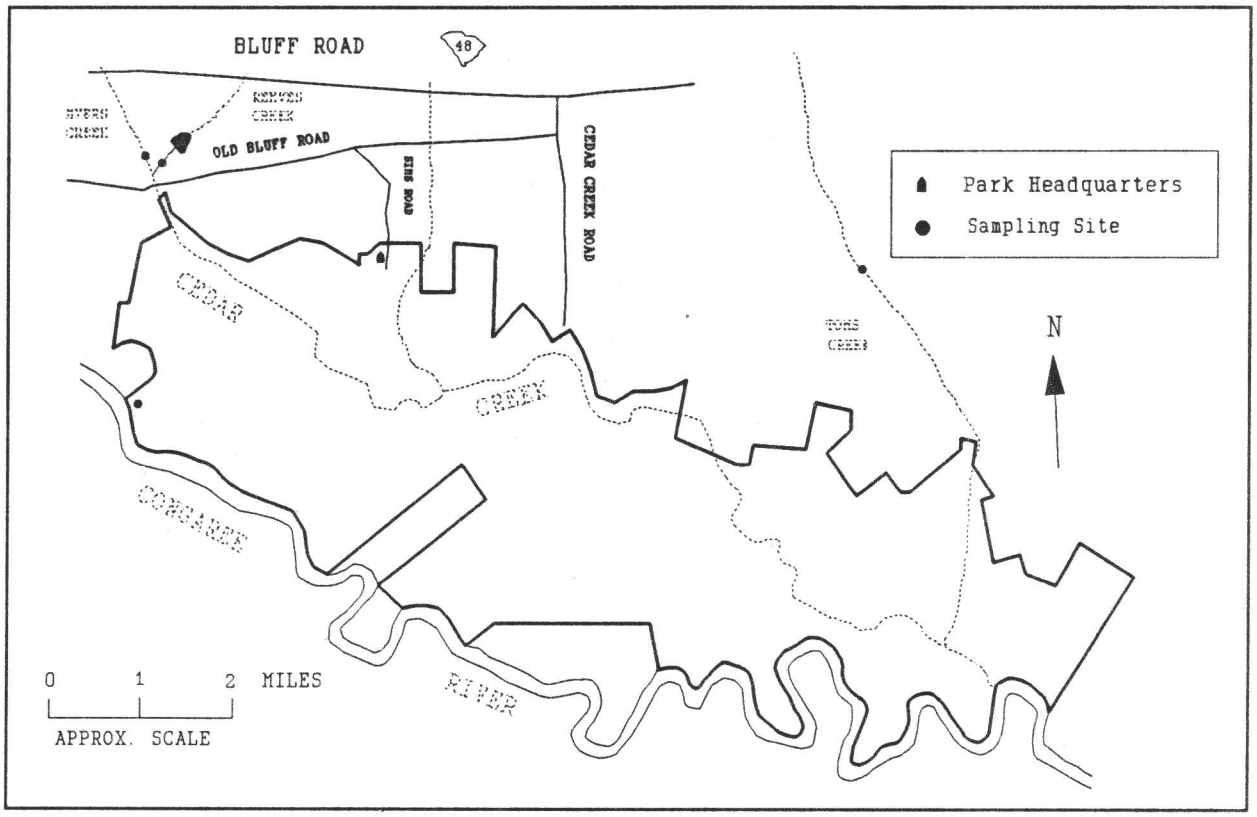


Figure 2. Map of the Congaree Swamp National Monument and the approximate location of the sampling sites.

Table 1. Elements analyzed by ICAP/plasma emission spectrometer.

Element	Symbol	Range (ppm)	%STD error
Aluminum	Al	0.05-400	1.60
Barium	Ba	0.05-400	1.15
Boron	B	1.00-600	2.59
Cadmium	Cd	0.50-200	0.23
Calcium	Ca	0.05-600	0.46
Chromium	Cr	0.10-400	0.90
Cobalt	Co	0.05-200	0.29
Copper	Cu	0.05-600	0.29
Iron	Fe	0.05-600	0.62
Lead	Pb	0.05-400	1.66
Magnesium	Mg	0.01-100	0.30
Manganese	Mn	0.10-300	0.28
Molybdenum	Mo	0.10-600	0.86
Nickel	Ni	0.10-600	0.54
Phosphorus	P	0.05-600	1.82
Potassium	K	5.00-600	2.61
Silicon	Si	1.00-600	2.05
Sodium	Na	1.00-600	0.79
Strontium	Sr	0.01-200	0.48
Zinc	Zn	0.50-100	0.40

Water samples were also analyzed at various intervals in the field for temperature, pH, conductivity, dissolved oxygen and iron. Temperature and conductivity were determined using a YSI Model 33 conductivity and temperature meter. A Bechman Altex 300 pH meter was used to measure pH. Dissolved oxygen was determined using a HACH digital titrator and dissolved iron was analyzed using a HACH DR-3000 spectrophotometer.

Analysis

Concentrations of the following elements were negligible or below the detectable range of the ICAP/plasma emission spectrometer: Boron, Barium, Cadmium, Cobalt, Chromium, Copper,

Molybdenum, Nickel, Lead, Strontium, and Zinc. All water quality data is given in Appendix I.

Aluminum appears in natural waters in a wide variety of forms, including organic complexes, fluoride complexes, and aluminum hydroxide. The toxicity of aluminum depends on how it is complexed. Generally higher aluminum toxicities occur at lower pH levels, but because of the many varieties of aluminum found in water, the precise relationships of aluminum concentrations to toxicity are not well understood (Flora et.al., 1984). Concentrations below 0.25 ppm are expected to protect most aquatic life (McKee and Wolf, 1963). Aluminum levels in Myers creek ranged from .36 to 4.62 ppm. Aluminum levels in Reeves creek and Toms creek ranged from 0 to .72 ppm and .06 to 1.27 ppm, respectively. Birch, 1982, also reported high aluminum concentrations with levels above 10 ppm.

Calcium salts and calcium ions are among the most commonly encountered substances in water. Calcium ions can result from the leaching of soil and other natural sources. Calcium is the primary constituent of limestone and agricultural lime. A direct relationship exists between calcium and water hardness, such that an increase in calcium ions will increase the hardness. Calcium in water decreases the toxicity of many chemicals to a variety of fish and in most cases, is considered beneficial (McKee and Wolf, 1963). Calcium concentrations were not particularly high at any of the three sampling sites with many samples being below the

detectable range of 0.05 ppm. The highest concentration of 1.59 ppm was recorded in Myers Creek.

Iron is an important constituent of many soils, especially clay soils, and may be present in water in varying quantities, depending upon the geology of the area and the chemical makeup of the water. Iron is an essential trace element required by plants and animals alike, and in all vertebrates and some invertebrates it is a critical transport mechanism in the blood. Iron concentrations in fresh water that exceed 1.0 ppm are considered toxic to aquatic life. Certain conditions (e.g. alkalinity, pH, hardness, temperature) in ambient natural waters can change the solubility of iron and thus affect its toxicity (US EPA, 1986). Iron concentrations for 3 sites were: Myers Creek with a range of 0.28 to 2.37 ppm and over 60% of the samples were higher than 1.0 ppm; Reeves Creek with a range of 0.12 to 2.02 ppm and 20% of the samples were above 1.0 ppm; Toms Creek with a range of 0.27 to 2.68 ppm and 55% of the samples were over 1.0 ppm.

Potassium is a common element and occurs in many minerals. Because it is one of the most active metals and readily reacts with oxygen and water, it is found only in the ionized ore molecular form in nature. Potassium and sodium share a number of the same properties, so that potassium salts can be substituted for sodium salts in many industrial applications; however, for some uses, such as fertilizers, potassium is indispensable. The toxicity of potassium to fish is reduced by calcium and to a lesser extent by sodium. Potassium is more toxic to fish and shellfish than

calcium, magnesium, or sodium. Potassium in chloride and nitrate forms has been found by several investigators to be toxic to fish in soft or distilled waters at concentrations of 50-200 ppm. The threshold concentration of potassium for fish in different kinds of water is about 400 ppm when potassium chloride, nitrate, or sulfate is used (McKee and Wolf, 1963). Potassium levels were well below this threshold level with the highest recorded value being 8.98 ppm in Myers Creek.

Magnesium is one of the most common elements found in the earth's crust and occurs in many ores and minerals. Due to its chemically active nature, it forms highly soluble salts and is not found in the elemental form. Because magnesium ions occur in significant concentrations in natural waters, they are an important factor in water quality and along with calcium form the major portion of the hardness reaction. At concentrations between 100 and 400 ppm, magnesium chloride and nitrate can be toxic to fish in distilled water or tap water. However, at concentrations between 1000 and 3000 ppm, magnesium chloride, nitrate, and sulfate have been tolerated for 2-11 days by aquatic life. Magnesium salts in water can also affect the toxicity of copper to fish. In short, the effects of different magnesium salts on different species can vary considerably (McKee and Wolf, 1963). In only one sample for all sites did magnesium exceed 1.0 ppm, this sample was in Myers Creek with a concentration of 1.24 ppm.

Manganese occurs in nature as a component of various salts and minerals and is often found in association with iron compounds.

The oxides of manganese are only slightly soluble, so that in natural surface waters, manganic or manganous ions are rarely found in concentrations greater than 1.0 ppm (McKee and Wolf, 1963). The US EPA (1986) established a criterion of 0.1 ppm manganese for the protection of consumers of marine mollusks. The American Fisheries Society task force (AFS, 1979) felt that the lack of knowledge on chronic toxicity made further research necessary before a realistic criterion could be established. The National Academy of Sciences (1973) suggests that manganese levels above 0.1 ppm constitute a hazard to marine life. The highest concentration of manganese in Myers Creek was 0.53 ppm with 95% of the samples being below 0.20 ppm. Manganese levels in Reeves creek were at or below 0.20 ppm except for two "spikes" of high manganese levels reaching 6.53 and 6.28 ppm during July, 1989, and December, 1989, respectively. Toms Creek manganese levels were also below 0.20 ppm except for one reading of 3.38 ppm during April, 1989.

A highly reactive metal, sodium does not occur in nature in its elemental form, but its compounds constitute 2.8 percent of the earth's crust. Sodium salts are extremely soluble in water; thus, any sodium that is leached from soil or discharge into streams with industrial waste will remain in solution. It was been reported that 500-1000 ppm of sodium was toxic to fish in distilled and soft waters when sodium chloride or nitrate was tested. Other data show variance in the effects of sodium on fish. It appears that the toxicity of sodium salts depends on the particular anion involved (e.g. the chromate is highly toxic and the sulfate is much

less so). It is possible that moderate amounts of sodium in water will reduce the toxic effects of potassium and ammonium salts on fish (McKee and Wolf, 1963). Sodium levels ranged from 1.01 to 5.65 ppm in Myers Creek, 1.34 to 4.57 ppm in Reeves Creek and 1.14 to 4.69 ppm in Toms Creek.

Phosphorus in water may occur in several forms, including soluble reactive phosphate and total phosphorus. Phosphates in wastes are the primary source of excess amounts of nutrients in water. Phosphorus is one of the three primary constituents of fertilizers. Artificially nutrient-enriched waters quite often are biologically altered, creating problems with algal blooms, stimulated growth of aquatic weeds, and the replacement of desirable fish species by less desirable ones. Standards for phosphorus are usually established according to the degree of protection an area wished to afford a particular water. The State of California has established mean annual concentrations of phosphorus ranging from 0.007 ppm to 0.1 ppm (NAS, 1973). The maximum allowable mean annual concentration for soluble phosphorus in the delivery water to Everglades National Park is 0.02 ppm (Rosendahl and Rose, 1979). Phosphorus levels in Myers Creek ranged from 0 to 0.7 ppm with 15% of the samples being over 0.2 ppm. Reeves Creek phosphorus levels ranged from 0 to 0.28 ppm with only 3% of the samples being over 0.2 ppm. Phosphorus levels ranged from 0 to 0.96 ppm in Toms Creek with 7% of the samples being over 0.2 ppm.

Field measurements of conductivity, pH and dissolved oxygen did not indicate anything unusual for streams of this geographic region. Conductivity, a measure of dissolved minerals and hardness, was low; the highest measurement was only 70 umhos/cm. Many naturally occurring waters may have conductivity readings of 200 umhos/cm or greater. Measurements of pH dropped below 6.0, but this is normal for slow moving waters with decaying organic matter that produces tannic acid. Also a pH of 5.4 is considered normal for unpolluted rain water. Dissolved oxygen levels remained above the minimum EPA criteria of 5.0 mg/l. Dissolved iron concentrations measured using the HACH DR-3000 spectrophotometer were found to be significantly different from the lab measurements at the 95% confidence interval. However, this instrument is useful in providing general indications of concentration levels for elements.

Summary

Aluminum is the only element, of the 20 analyzed, that reached levels that could harm aquatic life. Birch (1982) also reported abnormally high aluminum levels in the sediments. Iron was the only other metal that reached concentrations that could be of concern. It is recommended that monitoring be continued for these streams on a monthly basis. Considering the cost of analyzing a sample for these 20 elements, $6.50 per sample, this would provide inexpensive baseline water quality data. Annual analysis of the sediments should also be considered since these elements will accumulate in the sediments.

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Appendix I

Water Quality Data

MYERS CREEK (field measurements)

DATE	TEMP C	COND umhos/cm	pH	DO mg/l	Fe mg/l
05/06/88	14.0	30.0	7.3	8.3	
05/20/88	15.0	30.0	7.6	8.8	
06/02/88	18.0	30.0	6.9	8.6	
06/24/88	20.0	30.0	8.0	8.3	
07/15/88	20.0	30.0	8.1	6.5	
07/28/~~90~~ 88	23.0	40.0	8.3	8.0	
08/11/88	24.0	30.0	8.1	6.6	
08/25/88	24.0	30.0	8.2	7.0	1.0
09/19/88	23.0	45.0	8.0	5.4	1.3
11/07/88	12.0	30.0	8.3	6.5	1.1
12/07/~~88~~	4.0	30.0	7.4	11.0	0.7
01/11/89	10.0	30.0	8.5	9.0	1.0
02/12/89	13.0	30.0	7.6	10.7	0.9
03/14/89	12.0	30.0	5.6	9.1	0.6
04/11/89	13.0	20.0	6.6	8.1	0.5
05/15/89	18.0	30.0	5.7	6.8	1.2
06/08/89	22.0	30.0	6.0	7.6	1.2
07/18/89	23.0	40.0	6.5	6.1	1.7
10/11/89	18.0	40.0	7.1	9.1	2.0
11/21/89	14.0	30.0	7.1	10.4	1.1
12/19/89	5.0	20.0	7.4	12.1	0.5
01/25/90	10.0	25.0	6.7	9.3	1.1
12/24/90	12.0	25.0	7.8	6.9	1.7
13/22/90	14.0	29.0		6.5	

REEVES CREEK (field measurements)

DATE	TEMP C	COND umhos/cm	pH	DO mg/l	Fe mg/l
05/06/88	17.0	45.0	7.2	7.0	
05/20/88	20.0	20.0	7.6	7.0	
06/02/88	21.0	20.0	7.0	8.7	
06/24/88	25.0	20.0	8.0	8.9	
07/15/88	25.0	20.0	8.2	6.5	
07/27/88	25.0	40.0	8.7	9.0	
08/11/88	29.0	70.0	8.4	6.0	
08/25/88	28.0	30.0	8.5	6.5	
09/19/88	24.0	20.0	8.2	7.0	1.2
11/07/88	17.0	15.0	8.6	7.5	1.1
12/07/88	6.0	20.0	8.1	11.0	0.4
01/11/89	10.0	30.0	8.8	9.4	0.3
02/12/89	10.0	20.0	7.9	11.0	0.3
03/14/89	12.0	30.0	5.6	10.1	0.3
04/11/89	12.0	25.0	6.4	10.3	0.6
05/15/89	20.0	20.0	5.9	8.9	0.2
06/08/89	25.0	20.0	5.6	6.3	0.5
07/18/89	26.0	20.0	5.1	6.6	1.9
10/11/89	20.0	20.0	7.7	9.5	1.5
11/21/89	12.0	20.0	7.8	10.3	1.6
12/19/89	5.0	20.0	7.6	11.3	0.8
01/25/90	12.0	20.0	6.2	8.5	0.4
02/24/90	12.0	20.0	8.4	8.0	0.4
03/22/90	17.0	20.0		6.5	0.7

TOMS CREEK (field measurements)

DATE	TEMP C	COND umhos/cm	pH	DO mg/l	Fe mg/l
05/06/88	17.0	40.0	7.3	7.6	
05/20/88	18.0	20.0	7.5	7.9	
06/02/88	20.0	20.0	7.0	8.5	
06/24/88	23.0	25.0	7.9	8.5	
07/15/88	23.0	30.0	7.9	8.0	
07/27/88	22.0	55.0	8.7	7.9	
08/11/88	26.0	30.0	8.3	6.5	
08/25/88	25.0	30.0	8.5	6.0	1.1
09/19/88	22.0	30.0	8.0	6.0	1.0
11/07/88	12.0	25.0	8.2	8.4	0.9
12/07/88	5.0	20.0	8.3	11.0	0.6
01/11/89	10.0	20.0	8.7	9.4	1.0
02/12/89	13.0	25.0	6.2	8.9	0.5
03/14/89	12.0	30.0	5.6	9.1	0.5
04/11/89	16.0	20.0	6.8	9.3	0.4
05/15/89	20.0	20.0	5.7	9.1	1.2
06/08/89	23.0	30.0	5.8	7.9	1.4
07/18/89	24.0	30.0	5.2	6.1	1.2
10/11/89	18.0	30.0	7.8	8.0	3.3
11/21/89	13.0	20.0	7.7	9.5	1.5
12/19/89	5.0	20.0	6.9	12.2	0.8
01/25/90	10.0	20.0	6.2	7.9	1.1
02/24/90	12.0	20.0	7.5	8.4	1.4
03/22/90	15.0	21.0		7.8	

TOMS CREEK WATER QUALITY DATA (ppm)

DATE	Al	B	Ba	Ca	Cd	Co	Cr	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	Si	Sr	Zn
02/06/89	0.38	0.00	0.02	0.77	0.00	0.00	0.00	0.00	0.27	0.54	0.60	0.02	0.00	2.72	0.01	0.00	0.05	1.20	0.01	0.00
02/10/89	0.44	0.00	0.02	0.74	0.00	0.00	0.00	0.00	0.44	0.72	0.60	0.05	0.00	3.29	0.00	0.00	0.04	1.80	0.01	0.00
02/14/89	0.48	0.00	0.03	0.77	0.00	0.00	0.00	0.01	0.44	0.72	0.69	0.03	0.00	2.72	0.02	0.15	0.03	2.81	0.01	0.00
02/18/89	0.52	0.00	0.03	0.77	0.00	0.00	0.00	0.00	0.44	0.72	0.69	0.03	0.00	2.79	0.01	0.10	0.06	2.92	0.01	0.00
02/22/89	0.48	0.00	0.03	0.77	0.00	0.00	0.00	0.00	0.44	0.72	0.69	0.04	0.00	2.81	0.00	0.17	0.06	2.84	0.01	0.00
02/25/89	0.49	0.00	0.02	0.77	0.00	0.00	0.00	0.00	0.34	0.72	0.65	0.04	0.00	2.90	0.01	0.03	0.04	2.70	0.01	0.00
02/28/89	0.49	0.01	0.03	0.77	0.00	0.00	0.00	0.00	0.37	0.72	0.60	0.04	0.00	2.72	0.00	0.00	0.07	2.07	0.01	0.00
03/03/89	0.50	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.71	0.05	0.00	2.79	0.00	0.00	0.04	2.66	0.01	0.01
03/07/89	0.78	0.00	0.04	0.00	0.00	0.01	0.00	0.01	0.70	0.00	0.73	0.11	0.00	2.74	0.00	0.00	0.03	3.31	0.01	0.03
03/10/89	0.57	0.00	0.03	0.00	0.00	0.01	0.00	0.00	0.46	0.75	0.77	0.08	0.00	2.42	0.00	0.00	0.06	2.51	0.01	0.01
03/14 89	0.52	0.00	0.03	0.00	0.00	0.01	0.00	0.00	0.43	0.00	0.74	0.07	0.00	2.65	0.01	0.00	0.03	2.13	0.01	0.01
03/18/89	0.50	0.00	0.30	0.00	0.00	0.02	0.00	0.02	0.57	0.00	0.71	0.07	0.00	2.74	0.00	0.00	0.04	1.69	0.01	0.03
03/21/89	0.49	0.00	0.02	0.00	0.00	0.02	0.00	0.04	0.70	0.00	0.66	0.06	0.00	2.65	0.00	0.00	0.07	1.33	0.01	0.03
03/24/89	0.66	0.00	0.03	0.00	0.00	0.01	0.00	0.01	0.49	0.00	0.78	0.11	0.00	2.30	0.00	0.00	0.50	2.28	0.01	0.02
03/27/89	0.56	0.00	0.03	0.00	0.00	0.01	0.00	0.02	0.58	1.49	0.71	0.08	0.00	3.01	0.08	0.00	0.06	1.55	0.01	0.03
04/01/89	0.65	0.00	0.04	0.00	0.00	0.01	0.00	0.01	1.32	0.00	0.73	0.10	0.00	2.57	0.00	0.00	0.05	1.13	0.01	0.01
04/04/89	0.54	0.00	0.02	0.00	0.00	0.00	0.00	0.03	0.87	0.00	0.62	0.04	0.00	2.48	0.01	0.00	0.05	0.87	0.01	0.02
04/07/89	0.53	0.00	0.02	0.00	0.00	0.00	0.00	0.03	0.97	0.00	0.66	0.05	0.00	2.60	0.02	0.00	0.04	0.78	0.01	0.01
04/11/89	0.83	0.00	0.04	0.00	0.00	0.00	0.00	0.01	0.72	0.00	0.66	0.08	0.00	2.48	0.00	0.00	0.04	2.43	0.01	0.01
04/14/89	0.70	0.00	0.04	0.00	0.00	0.00	0.00	0.04	0.63	0.00	0.62	3.38	0.00	2.57	0.00	0.00	0.02	1.81	0.01	0.01
04/18/89	0.51	0.00	0.04	0.00	0.00	0.00	0.00	0.01	0.46	0.00	0.66	0.08	0.00	2.66	0.00	0.00	0.04	1.30	0.01	0.02
04/21/89	0.51	0.00	0.04	0.00	0.00	0.00	0.00	0.01	0.51	0.00	0.66	0.06	0.00	2.48	0.01	0.00	0.00	0.98	0.01	0.02
04/26/89	0.47	0.00	0.02	0.00	0.00	0.01	0.00	0.01	0.48	0.00	0.66	0.04	0.00	2.48	0.00	0.00	0.10	0.87	0.01	0.04
04/28/89	0.45	0.00	0.02	0.00	0.00	0.01	0.00	0.01	0.48	0.00	0.66	0.04	0.00	2.48	0.00	0.00	0.00	0.61	0.01	0.03
05/02/89	0.58	0.00	0.04	0.69	0.00	0.00	0.00	0.01	1.52	0.49	0.71	0.08	0.00	2.29	0.00	0.17	0.00	1.39	0.01	0.01
05/05/89	0.56	0.00	0.04	0.68	0.00	0.00	0.00	0.01	1.56	0.49	0.71	0.08	0.00	2.48	0.00	0.07	0.00	2.11	0.01	0.01
05/09/89	0.54	0.00	0.03	0.68	0.00	0.00	0.00	0.01	1.25	0.32	0.63	0.06	0.00	2.33	0.00	0.13	0.00	2.00	0.01	0.01
05/12/89	0.59	0.00	0.04	0.68	0.00	0.00	0.00	0.00	1.10	1.14	0.66	0.06	0.00	2.26	0.00	0.13	0.00	2.63	0.01	0.01
05/16/89	0.45	0.00	0.02	0.68	0.00	0.00	0.00	0.00	0.41	0.65	0.63	0.05	0.00	2.28	0.00	0.10	0.01	1.87	0.01	0.01
05/20/89	0.51	0.00	0.02	0.69	0.00	0.00	0.00	0.00	1.13	0.00	0.63	0.05	0.00	2.45	0.00	0.04	0.00	1.22	0.01	0.01
05/23/89	0.44	0.00	0.02	0.68	0.00	0.00	0.00	0.01	1.10	0.65	0.63	0.04	0.00	2.86	0.00	0.00	0.00	0.91	0.01	0.01
05/27/89	0.46	0.00	0.02	0.66	0.00	0.00	0.00	0.01	1.26	0.65	0.63	0.04	0.00	2.26	0.01	0.16	0.00	0.80	0.01	0.01
05/31/89	0.08	0.00	0.02	0.43	0.00	0.00	0.00	0.03	1.34	0.00	0.63	0.05	0.00	2.71	0.01	0.00	0.04	0.73	0.00	0.00
06/04/89	0.10	0.00	0.02	0.43	0.00	0.00	0.00	0.02	1.38	1.64	0.64	0.12	0.00	2.60	0.01	0.09	0.06	0.75	0.00	0.00
06/07/89	0.10	0.02	0.02	0.71	0.01	0.00	0.00	0.03	1.41	0.82	0.63	0.04	0.00	3.01	0.00	0.13	0.08	0.99	0.00	0.00
06/10/89	0.11	0.02	0.02	0.71	0.00	0.00	0.00	0.03	1.47	0.00	0.60	0.05	0.00	2.71	0.00	0.10	0.04	1.18	0.00	0.00
06/14/89	0.07	0.01	0.02	0.71	0.00	0.00	0.00	0.03	1.33	0.00	0.63	0.04	0.00	3.13	0.00	0.00	0.05	1.18	0.00	0.00
06/17/89	0.06	0.01	0.02	0.71	0.00	0.00	0.00	0.02	1.49	0.00	0.72	0.05	0.00	2.65	0.00	0.00	0.02	1.47	0.00	0.00
06/20/89	0.09	0.06	0.02	0.75	0.00	0.00	0.00	0.02	0.97	0.00	0.76	0.02	0.00	2.86	0.00	0.00	0.03	2.63	0.01	0.00
06/24/89	0.12	0.01	0.02	0.71	0.00	0.00	0.00	0.03	1.14	0.00	0.72	0.06	0.00	2.65	0.00	0.00	0.04	2.49	0.01	0.00
06/28/89	0.42	0.01	0.02	0.91	0.00	0.00	0.00	0.02	1.31	0.00	0.85	0.03	0.00	3.03	0.02	0.04	0.00	2.28	0.01	0.02
07/01/89	0.58	0.02	0.04	1.14	0.00	0.00	0.00	0.02	0.85	0.00	0.91	0.08	0.00	2.73	0.01	0.00	0.00	3.37	0.01	0.01
07/04/89	0.45	0.01	0.02	0.85	0.00	0.00	0.00	0.02	0.95	0.11	0.69	0.06	0.00	2.85	0.01	0.00	0.00	2.33	0.01	0.01
07/07/89	0.60	0.01	0.04	1.14	0.00	0.00	0.00	0.02	1.35	0.00	0.76	0.12	0.00	2.79	0.00	0.00	0.00	3.02	0.01	0.01
07/10/89	0.58	0.00	0.03	1.08	0.00	0.00	0.00	0.02	1.70	0.45	0.78	0.11	0.00	3.15	0.00	0.00	0.00	2.84	0.01	0.02
07/14/89	0.45	0.00	0.02	0.91	0.00	0.00	0.01	0.02	1.50	0.11	0.78	0.08	0.00	2.85	0.00	0.00	0.00	2.01	0.01	0.01
07/18/89	0.51	0.01	0.03	0.91	0.00	0.00	0.01	0.01	1.13	0.00	0.70	0.07	0.00	2.73	0.00	0.05	0.00	2.90	0.01	0.00
07/21/89	1.27	0.01	0.03	1.11	0.00	0.00	0.00	0.01	1.21	0.00	0.61	0.12	0.00	2.03	0.00	0.00	0.00	3.59	0.01	0.00
11/08/89	0.49	0.02	0.01	0.62	0.00	0.00	0.01	0.01	1.64	0.01	0.68	0.07	0.00	2.82	0.02	0.12	0.00	3.24	0.01	0.00
11/15/89	0.59	0.02	0.01	0.66	0.00	0.00	0.01	0.02	2.68	1.13	0.80	0.10	0.00	2.76	0.01	0.11	0.02	3.20	0.01	0.01
11/17/89	0.52	0.01	0.01	0.49	0.00	0.00	0.00	0.02	1.73	0.56	0.63	0.07	0.00	2.44	0.00	0.00	0.00	3.33	0.01	0.01
11/19/89	0.49	0.01	0.00	0.49	0.00	0.00	0.00	0.00	1.58	0.00	0.63	0.06	0.00	2.44	0.00	0.12	0.00	3.30	0.01	0.00
11/21/89	0.47	0.01	0.00	0.45	0.00	0.00	0.00	0.00	1.51	0.00	0.63	0.06	0.00	2.37	0.01	0.00	0.00	3.02	0.01	0.01
11/24/89	0.46	0.00	0.01	0.49	0.00	0.00	0.01	0.02	1.20	1.13	0.63	0.07	0.00	2.69	0.01	0.10	0.00	3.24	0.01	0.07
11/28/89	0.44	0.00	0.01	0.49	0.00	0.00	0.01	0.02	1.17	0.00	0.63	0.05	0.00	2.63	0.01	0.12	0.00	2.80	0.01	0.00
11/30/89	0.71	0.00	0.03	0.82	0.00	0.00	0.00	0.00	1.25	1.13	0.73	0.04	0.00	4.04	0.02	0.10	0.00	3.86	0.01	0.00
12/07/89	0.32	0.00	0.00	0.85	0.00	0.01	0.00	0.02	1.30	0.00	0.68	0.05	0.00	2.92	0.00	0.13	0.03	2.77	0.01	0.02
12/10/89	0.49	0.00	0.01	0.90	0.00	0.00	0.00	0.01	0.64	1.91	0.68	0.11	0.00	2.48	0.00	0.04	0.01	2.75	0.01	0.01
12/13/89	0.53	0.00	0.01	0.90	0.00	0.00	0.00	0.03	0.79	2.87	0.68	0.10	0.00	3.36	0.00	0.21	0.04	2.60	0.01	0.02
12/15/89	0.53	0.00	0.02	0.90	0.00	0.00	0.00	0.02	0.79	0.00	0.68	0.09	0.00	3.14	0.00	0.04	0.03	2.68	0.01	0.02
12/18/89	0.37	0.00	0.00	0.82	0.00	0.00	0.00	0.01	0.29	1.27	0.68	0.06	0.00	2.77	0.00	0.08	0.02	2.34	0.01	0.00
12/20/89	0.41	0.00	0.00	0.79	0.00	0.00	0.01	0.01	0.50	3.19	0.68	0.08	0.00	2.63	0.01	0.26	0.06	2.57	0.00	0.02

DATE	Al	B	Ba	Ca	Cd	Co	Cr	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	Si	Sr	Zn
12/26/89	0.39	0.00	0.00	0.90	0.00	0.00	0.00	0.03	0.50	3.18	0.68	0.03	0.00	3.07	0.00	0.04	0.03	2.51	0.01	0.02
12/29/89	0.36	0.00	0.00	0.73	0.04	0.01	0.00	0.01	0.47	0.64	0.64	0.02	0.00	2.85	0.00	0.03	0.03	2.42	0.00	0.03
01/06/90	0.46	0.06	0.00	0.51	0.00	0.01	0.01	0.06	0.75	0.00	0.64	0.04	0.00	2.16	0.00	0.04	0.04	1.66	0.01	0.03
01/11/90	0.45	0.01	0.00	0.51	0.01	0.00	0.02	0.04	0.67	0.00	0.64	0.02	0.00	3.07	0.01	0.32	0.00	1.27	0.00	0.03
01/16/90	0.40	0.03	0.00	0.43	0.00	0.00	0.01	0.00	0.32	0.00	0.54	0.04	0.00	1.14	0.00	0.12	0.01	1.13	0.00	0.01
01/19/90	0.51	0.03	0.00	0.43	0.00	0.00	0.01	0.01	0.82	0.00	0.54	0.04	0.00	1.36	0.00	0.16	0.01	0.71	0.00	0.02
01/25/90	0.46	0.01	0.00	0.43	0.00	0.00	0.00	0.00	1.01	0.86	0.54	0.03	0.00	2.05	0.00	0.28	0.02	0.56	0.00	0.03
01/27/90	0.56	0.01	0.00	0.56	0.01	0.00	0.01	0.08	1.10	0.86	0.65	0.19	0.00	2.50	0.03	0.11	0.09	1.20	0.00	0.04
01/29/90	0.51	0.02	0.00	0.58	0.00	0.00	0.02	0.04	0.98	1.72	0.65	0.06	0.00	2.87	0.00	0.96	0.06	0.85	0.00	0.01
01/31/90	0.49	0.04	0.00	0.58	0.01	0.00	0.01	0.11	0.96	1.72	0.59	0.04	0.00	2.96	0.02	0.15	0.04	0.55	0.00	0.08
02/06/90	0.65	0.00	0.02	0.88	0.01	0.00	0.00	0.00	1.40	1.90	0.67	0.03	0.00	3.36	0.00	0.15	0.06	0.43	0.02	0.08
02/09/90	0.65	0.00	0.02	0.88	0.00	0.00	0.00	0.00	1.32	0.00	0.64	0.05	0.00	2.70	0.00	0.09	0.04	0.46	0.02	0.09
02/15/90	0.64	0.04	0.02	0.77	0.00	0.00	0.00	0.00	1.36	0.00	0.71	0.05	0.00	2.72	0.00	0.00	0.03	0.68	0.02	0.01
02/20/90	0.76	0.19	0.02	0.83	0.02	0.00	0.00	0.05	1.25	3.16	0.64	0.06	0.00	3.04	0.00	0.03	0.04	1.43	0.02	0.08
02/25/90	0.72	0.33	0.02	0.77	0.00	0.00	0.00	0.00	1.35	0.00	0.64	0.06	0.00	2.72	0.00	0.18	0.02	1.54	0.02	0.01
02/28/90	0.66	0.33	0.02	0.77	0.00	0.00	0.00	0.00	1.02	0.00	0.57	0.06	0.00	3.52	0.00	0.10	0.04	1.34	0.02	0.01
03/01/90	0.47	0.07	0.02	0.63	0.00	0.00	0.00	0.04	0.91	1.93	0.60	0.06	0.00	3.95	0.00	0.06	0.02	0.95	0.01	0.02
03/03/90	0.46	0.08	0.02	0.63	0.00	0.00	0.00	0.02	1.00	1.15	0.60	0.04	0.00	3.53	0.01	0.02	0.02	0.72	0.01	0.05
03/17/90	0.52	0.06	0.02	0.88	0.00	0.00	0.00	0.02	2.14	0.00	0.77	0.12	0.00	3.95	0.00	0.02	0.01	0.85	0.01	0.03
03/20/90	0.55	0.04	0.02	0.94	0.00	0.00	0.00	0.01	2.06	0.77	0.72	0.08	0.00	3.74	0.00	0.03	0.01	1.66	0.01	0.02
03/22/90	0.40	0.03	0.02	0.82	0.00	0.00	0.00	0.01	1.77	0.00	0.60	0.10	0.00	4.69	0.00	0.68	0.00	1.35	0.01	0.02
03/28/90	0.44	0.03	0.02	0.69	0.00	0.00	0.00	0.01	1.55	1.93	0.68	0.06	0.00	4.00	0.00	0.06	0.01	1.04	0.01	0.02
03/30/90	0.42	0.01	0.02	0.76	0.00	0.00	0.00	0.01	1.45	0.00	0.60	0.06	0.00	3.63	0.00	0.00	0.00	1.40	0.01	0.03
05/15/90	0.57	0.00	0.03	0.71	0.00	0.00	0.00	0.03	1.61	0.59	0.65	0.08	0.00	4.64	0.01	0.00	0.00	1.91	0.01	0.07
05/23/90	0.57	0.00	0.03	0.71	0.01	0.00	0.00	0.02	2.08	0.47	0.65	0.13	0.00	3.73	0.00	0.00	0.00	2.59	0.01	0.04
05/26/90	0.49	0.00	0.03	0.71	0.00	0.00	0.00	0.00	1.54	0.59	0.65	0.12	0.00	3.49	0.00	0.00	0.00	1.20	0.01	0.03
05/30/90	0.50	0.00	0.03	0.71	0.00	0.00	0.00	0.00	1.24	0.00	0.65	0.07	0.00	3.24	0.01	0.00	0.00	2.00	0.01	0.02
06/21/90	0.51	0.00	0.03	0.83	0.00	0.00	0.00	0.00	1.57	0.00	0.79	0.04	0.00	3.90	0.01	0.00	0.05	1.57	0.01	0.00
06/23/90	0.50	0.00	0.03	0.83	0.00	0.00	0.00	0.00	1.51	0.00	0.77	0.33	0.00	4.40	0.02	0.00	0.02	1.36	0.01	0.00
06/26/90	0.46	0.00	0.03	0.83	0.00	0.00	0.00	0.00	1.46	0.00	0.69	0.03	0.00	3.34	0.01	0.00	0.00	1.30	0.01	0.00
06/28/90	0.48	0.00	0.03	0.83	0.00	0.00	0.00	0.00	1.42	0.00	0.69	0.03	0.00	3.47	0.01	0.00	0.02	1.19	0.01	0.00
06/30/90	0.45	0.00	0.02	0.83	0.00	0.00	0.00	0.00	1.16	0.00	0.77	0.01	0.00	3.04	0.01	0.00	0.00	1.35	0.01	0.00

MYERS CREEK WATER QUALITY DATA (ppm)

DATE	Al	B	Ba	Ca	Cd	Co	Cr	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	Si	Sr	Zn
02/06/89	0.60	0.01	0.04	0.83	0.00	0.00	0.01	0.00	0.71	0.74	0.52	0.06	0.00	5.65	0.00	0.07	0.00	2.61	0.01	0.00
02/10/89	0.63	0.00	0.04	0.76	0.00	0.00	0.00	0.00	0.68	0.74	0.52	0.29	0.00	5.28	0.00	0.00	0.02	4.05	0.01	0.00
02/14/89	0.81	0.01	0.04	1.02	0.00	0.00	0.00	0.01	0.64	0.74	0.60	0.11	0.00	3.89	0.00	0.02	0.01	3.92	0.01	0.00
02/18/89	0.73	0.02	0.04	1.02	0.00	0.00	0.00	0.01	0.61	2.22	0.60	0.11	0.00	3.89	0.00	0.00	0.00	3.87	0.01	0.00
02/22/89	1.36	0.01	0.04	1.02	0.00	0.00	0.00	0.01	0.80	2.03	0.60	0.11	0.00	3.89	0.00	0.00	0.00	4.74	0.01	0.00
02/25/89	0.70	0.01	0.04	1.02	0.00	0.00	0.00	0.01	0.45	0.74	0.60	0.23	0.00	5.07	0.00	0.00	0.00	4.33	0.01	0.01
02/28/89	0.82	0.00	0.04	1.02	0.00	0.00	0.00	0.00	0.52	0.74	0.60	0.08	0.00	4.91	0.00	0.00	0.05	3.97	0.01	0.00
03/03/89	1.11	0.00	0.03	0.00	0.00	0.01	0.00	0.00	0.67	0.56	0.63	0.08	0.00	4.37	0.00	0.00	0.06	4.04	0.01	0.01
03/07/89	1.13	0.00	0.04	0.00	0.00	0.01	0.00	0.01	0.66	0.09	0.77	0.10	0.00	3.81	0.00	0.00	0.03	3.85	0.02	0.02
03/10/89	0.78	0.00	0.03	0.00	0.00	0.01	0.00	0.00	0.44	0.00	0.63	0.06	0.00	4.35	0.00	0.00	0.06	3.63	0.01	0.03
03/14/89	0.70	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.58	0.05	0.00	4.65	0.00	0.00	0.05	2.76	0.01	0.02
03/18/89	0.83	0.00	0.03	0.00	0.00	0.01	0.00	0.01	1.04	0.00	0.63	0.07	0.00	4.92	0.00	0.00	0.05	2.49	0.01	0.02
03/21/89	0.88	0.00	0.03	0.00	0.00	0.01	0.00	0.02	1.15	0.75	0.63	0.08	0.00	4.56	0.00	0.00	0.06	3.16	0.01	0.02
03/24/89	1.03	0.00	0.03	0.60	0.00	0.02	0.00	0.01	0.58	0.37	0.77	0.03	0.00	2.74	0.00	0.00	0.04	3.33	0.02	0.01
03/27/89	1.01	0.00	0.03	0.00	0.00	0.01	0.00	0.00	0.85	0.75	0.63	0.08	0.00	4.08	0.01	0.00	0.04	2.73	0.01	0.02
04/01/89	1.07	0.00	0.04	0.00	0.00	0.00	0.00	0.03	1.53	0.88	0.63	0.11	0.00	4.03	0.03	0.00	0.02	2.71	0.01	0.01
04/04/89	0.77	0.00	0.04	0.00	0.00	0.00	0.00	0.03	1.27	0.18	0.63	0.08	0.00	4.68	0.00	0.00	0.00	2.66	0.01	0.03
04/07/89	0.51	0.00	0.02	0.00	0.00	0.01	0.00	0.01	0.74	0.00	0.54	0.03	0.00	2.57	0.02	0.00	0.00	0.97	0.01	0.01
04/11/89	1.13	0.00	0.04	0.00	0.00	0.00	0.00	0.01	0.82	0.00	0.59	0.08	0.00	3.37	0.02	0.00	0.00	3.71	0.01	0.02
04/14/89	1.01	0.00	0.04	0.00	0.00	0.01	0.00	0.03	0.80	0.88	0.59	0.48	0.00	3.85	0.01	0.00	0.00	3.41	0.01	0.01
04/18/89	0.59	0.00	0.04	0.00	0.00	0.01	0.00	0.01	0.51	0.88	0.59	0.06	0.00	3.92	0.04	0.00	0.00	2.71	0.01	0.02
04/21/89	0.56	0.00	0.04	0.00	0.00	0.00	0.00	0.02	0.53	0.17	0.59	0.05	0.00	3.85	0.02	0.00	0.00	3.01	0.01	0.02
04/26/89	0.54	0.00	0.04	0.00	0.00	0.00	0.00	0.01	0.60	0.18	0.63	0.06	0.00	4.27	0.00	0.00	0.00	3.45	0.01	0.01
04/28/89	0.52	0.00	0.04	0.00	0.00	0.00	0.00	0.01	0.56	0.00	0.59	0.06	0.00	4.11	0.03	0.00	0.00	3.66	0.01	0.02
05/02/89	0.91	0.00	0.04	0.98	0.00	0.00	0.00	0.01	1.44	2.13	0.66	0.07	0.00	4.32	0.01	0.00	0.00	4.56	0.01	0.00
05/05/89	0.75	0.00	0.04	0.98	0.00	0.00	0.00	0.01	1.24	0.71	0.58	0.05	0.00	4.33	0.00	0.00	0.00	4.48	0.01	0.00
05/09/89	0.79	0.00	0.04	0.98	0.00	0.00	0.00	0.01	1.05	0.71	0.58	0.06	0.00	4.13	0.01	0.00	0.03	4.41	0.01	0.00
05/12/89	0.82	0.00	0.04	0.98	0.00	0.00	0.00	0.00	1.07	0.71	0.58	0.05	0.00	4.04	0.00	0.07	0.03	4.44	0.01	0.00
05/16/89	0.54	0.00	0.04	0.96	0.00	0.00	0.00	0.01	0.51	1.42	0.58	0.53	0.00	3.99	0.01	0.00	0.01	4.14	0.01	0.01
05/20/89	0.54	0.00	0.04	0.98	0.01	0.00	0.00	0.01	0.54	1.42	0.58	0.07	0.00	4.13	0.01	0.00	0.01	4.41	0.01	0.03
05/23/89	0.68	0.00	0.04	0.98	0.00	0.00	0.00	0.01	1.24	1.42	0.58	0.03	0.00	4.13	0.01	0.70	0.00	4.71	0.01	0.00
05/27/89	0.75	0.00	0.04	0.98	0.00	0.00	0.00	0.03	1.21	0.71	0.58	0.04	0.00	3.94	0.00	0.03	0.00	5.01	0.01	0.01
05/31/89	1.21	0.02	0.04	0.70	0.01	0.00	0.00	0.03	1.24	3.19	0.59	0.05	0.00	3.23	0.01	0.11	0.05	5.75	0.01	0.00
06/04/89	1.17	0.01	0.02	0.93	0.00	0.00	0.00	0.02	1.27	3.19	0.59	0.04	0.00	3.32	0.00	0.29	0.03	5.44	0.01	0.00
06/07/89	1.06	0.00	0.02	1.01	0.00	0.00	0.00	0.02	1.30	1.60	0.62	0.06	0.00	3.21	0.02	0.13	0.00	5.84	0.01	0.00
06/10/89	2.22	0.01	0.06	1.94	0.01	0.00	0.00	0.03	1.12	3.18	1.24	0.22	0.00	4.56	0.03	0.13	0.01	7.19	0.02	0.00
06/14/89	1.14	0.01	0.04	1.01	0.00	0.00	0.00	0.03	1.20	2.00	0.62	0.07	0.00	4.05	0.02	0.24	0.01	6.12	0.01	0.00
06/17/89	0.94	0.00	0.04	1.01	0.00	0.00	0.00	0.03	1.21	3.19	0.66	0.07	0.00	3.94	0.00	0.26	0.06	5.91	0.01	0.00
06/20/89	0.74	0.01	0.04	1.01	0.00	0.00	0.00	0.02	0.97	3.19	0.71	0.02	0.00	4.05	0.00	0.28	0.00	5.61	0.01	0.00
06/24/89	0.96	0.01	0.04	1.32	0.00	0.00	0.00	0.02	1.14	2.99	0.87	0.13	0.00	4.90	0.02	0.37	0.00	6.18	0.01	0.00
06/28/89	0.58	0.02	0.04	1.14	0.01	0.00	0.02	0.02	1.22	1.80	0.65	0.03	0.00	5.41	0.01	0.07	0.00	5.43	0.02	0.02
07/01/89	0.62	0.03	0.06	1.59	0.01	0.00	0.02	0.02	0.81	0.56	0.87	0.17	0.00	4.80	0.01	0.00	0.00	5.54	0.03	0.02
07/04/89	0.67	0.02	0.05	1.14	0.01	0.00	0.01	0.02	1.06	0.56	0.73	0.15	0.00	5.30	0.00	0.00	0.00	5.72	0.02	0.01
07/07/89	0.85	0.02	0.06	1.36	0.00	0.00	0.00	0.02	1.38	0.00	0.73	0.18	0.00	3.64	0.01	0.06	0.00	4.55	0.02	0.01
07/10/89	0.83	0.02	0.05	1.36	0.00	0.00	0.01	0.02	1.90	0.11	0.70	0.15	0.00	4.36	0.02	0.00	0.00	5.01	0.02	0.01
07/14/89	0.66	0.02	0.04	1.36	0.01	0.00	0.01	0.01	1.76	0.34	0.70	0.09	0.00	4.59	0.01	0.03	0.00	5.21	0.02	0.02
07/18/89	0.68	0.02	0.05	1.14	0.00	0.00	0.00	0.01	1.54	0.00	0.70	0.12	0.00	4.55	0.01	0.00	0.00	5.69	0.02	0.01
07/21/89	0.86	0.02	0.04	1.14	0.00	0.00	0.00	0.02	1.41	1.13	0.61	0.10	0.00	4.12	0.01	0.07	0.00	5.29	0.01	0.01
11/08/89	0.51	0.00	0.03	1.00	0.00	0.00	0.01	0.03	1.52	1.73	0.65	0.03	0.00	4.10	0.02	0.00	0.01	5.04	0.01	0.00
11/15/89	0.92	0.01	0.03	0.92	0.00	0.00	0.01	0.04	2.13	0.00	0.65	0.11	0.00	4.03	0.01	0.25	0.02	5.45	0.01	0.01
11/17/89	0.92	0.01	0.03	0.79	0.00	0.00	0.01	0.02	1.88	0.00	0.62	0.10	0.00	3.96	0.03	0.20	0.01	5.62	0.01	0.00
11/19/89	0.79	0.02	0.03	0.83	0.00	0.00	0.00	0.01	1.49	0.00	0.60	0.09	0.00	4.29	0.03	0.06	0.04	5.59	0.01	0.00
11/21/89	0.69	0.01	0.03	0.75	0.00	0.00	0.01	0.01	1.29	0.00	0.57	0.07	0.00	4.55	0.03	0.00	0.02	5.33	0.01	0.01
11/24/89	0.67	0.01	0.01	0.67	0.00	0.00	0.01	0.02	1.12	0.00	0.55	0.06	0.00	3.83	0.04	0.08	0.02	4.91	0.01	0.12
11/28/89	0.64	0.01	0.03	0.75	0.00	0.00	0.00	0.02	1.25	1.73	0.55	0.05	0.00	4.03	0.01	0.14	0.05	4.45	0.01	0.01
11/30/89	0.46	0.01	0.01	0.58	0.00	0.00	0.01	0.02	1.65	0.58	0.65	0.06	0.00	2.47	0.07	0.06	0.06	3.20	0.01	0.00
12/07/89	0.50	0.00	0.03	0.89	0.00	0.00	0.00	0.04	1.13	2.47	0.57	0.05	0.07	1.24	0.00	0.09	0.07	3.76	0.02	0.03
12/10/89	0.40	0.04	0.03	1.22	0.00	0.00	0.00	0.00	0.46	1.85	0.67	0.19	0.03	2.54	0.00	0.02	0.07	3.92	0.02	0.01
12/13/89	0.82	0.02	0.03	1.11	0.00	0.00	0.00	0.01	0.74	3.09	0.67	0.10	0.00	3.48	0.00	0.00	0.08	3.73	0.02	0.01
12/15/89	0.56	0.03	0.03	1.17	0.00	0.00	0.00	0.02	0.61	3.70	0.67	0.08	0.00	1.01	0.01	0.07	0.07	3.48	0.02	0.03
12/18/89	0.38	0.00	0.03	1.00	0.00	0.00	0.00	0.01	0.37	2.47	0.64	0.06	0.00	3.87	0.00	0.45	0.04	3.49	0.01	0.01
12/20/89	0.36	0.01	0.01	0.94	0.00	0.00	0.00	0.04	0.28	4.32	0.64	0.04	0.00	3.75	0.00	0.00	0.05	3.40	0.01	0.01

REEVES CREEK WATER QUALITY DATA (ppm)

DATE	Al	B	Ba	Ca	Cd	Co	Cr	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	Si	Sr	Zn
02/06/89	0.38	0.01	0.02	0.51	0.00	0.00	0.00	0.00	0.12	0.00	0.40	0.00	0.00	1.73	0.00	0.22	0.03	0.67	0.00	0.00
02/10/89	0.40	0.00	0.02	0.51	0.00	0.00	0.00	0.00	0.31	0.73	0.42	0.06	0.00	1.62	0.01	0.19	0.02	0.41	0.00	0.00
02/14/89	0.54	0.00	0.02	0.73	0.00	0.00	0.00	0.00	0.29	0.00	0.48	0.03	0.00	1.81	0.00	0.16	0.02	0.90	0.00	0.00
02/18/89	0.55	0.00	0.02	0.70	0.00	0.00	0.00	0.00	0.28	0.00	0.48	0.02	0.00	1.81	0.00	0.06	0.00	0.90	0.00	0.00
02/22/89	0.55	0.00	0.02	0.73	0.00	0.00	0.00	0.00	0.29	0.00	0.48	0.03	0.00	1.81	0.00	0.08	0.00	0.98	0.01	0.00
02/25/89	0.47	0.01	0.02	0.76	0.00	0.00	0.00	0.00	0.23	0.00	0.59	0.02	0.00	1.79	0.00	0.09	0.00	1.64	0.01	0.00
02/28/89	0.47	0.00	0.02	0.76	0.00	0.00	0.00	0.00	0.21	0.00	0.59	0.01	0.00	1.88	0.00	0.11	0.02	1.77	0.01	0.00
03/03/89	0.38	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.15	0.00	0.55	0.02	0.00	1.75	0.00	0.00	0.06	1.36	0.01	0.01
03/07/89	0.40	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.16	0.37	0.56	0.02	0.00	1.75	0.01	0.00	0.04	1.26	0.01	0.01
03/10/89	0.37	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.21	0.00	0.55	0.20	0.00	1.84	0.02	0.00	0.04	1.21	0.01	0.01
03/14 89	0.39	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.21	0.00	0.63	0.01	0.00	1.93	0.00	0.00	0.04	1.19	0.01	0.01
03/18/89	0.34	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.20	0.00	0.47	0.02	0.00	1.93	0.00	0.00	0.05	0.51	0.01	0.01
03/21/89	0.36	0.00	0.01	0.00	0.01	0.01	0.00	0.02	0.35	0.75	0.47	0.02	0.00	1.93	0.00	0.00	0.05	0.13	0.01	0.02
03/24/89	0.46	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.30	0.00	0.55	0.05	0.00	1.66	0.00	0.00	0.02	0.70	0.01	0.01
03/27/89	0.44	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.30	0.00	0.63	0.02	0.00	2.02	0.00	0.00	0.05	0.87	0.01	0.04
04/01/89	0.39	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.54	0.01	0.00	1.70	0.00	0.00	0.03	0.21	0.01	0.01
04/04/89	0.40	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.52	0.00	0.48	0.01	0.00	1.61	0.00	0.00	0.03	0.01	0.01	0.01
04/07/89	0.40	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.53	0.00	0.48	0.02	0.00	1.50	0.00	0.00	0.00	0.00	0.01	0.01
04/11/89	0.46	0.00	0.02	0.00	0.00	0.10	0.00	0.00	0.38	0.00	0.48	0.01	0.00	1.61	0.00	0.00	0.00	0.41	0.01	0.01
04/14/89	0.45	0.00	0.02	0.00	0.00	0.01	0.00	0.02	0.35	0.67	0.48	0.07	0.00	1.57	0.01	0.00	0.00	0.65	0.01	0.01
04/18/89	0.38	0.00	0.02	0.00	0.00	0.01	0.00	0.01	0.21	1.34	0.48	0.01	0.00	1.79	0.00	0.00	0.03	0.34	0.01	0.02
04/21/89	0.37	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.15	0.00	0.48	0.01	0.00	1.88	0.00	0.00	0.00	0.80	0.01	0.01
04/26/89	0.36	0.00	0.02	0.00	0.00	0.01	0.00	0.01	0.23	0.00	0.45	0.01	0.00	1.79	0.00	0.00	0.01	0.00	0.01	0.01
04/28/89	0.38	0.00	0.02	0.00	0.00	0.01	0.00	0.01	0.50	0.50	0.40	0.01	0.00	1.61	0.00	0.00	0.00	0.00	0.01	0.01
05/02/89	0.39	0.00	0.02	0.71	0.00	0.00	0.00	0.01	1.02	0.00	0.48	0.07	0.00	1.55	0.00	0.00	0.00	0.05	0.01	0.00
05/05/89	0.41	0.00	0.02	0.71	0.01	0.00	0.00	0.00	0.92	0.34	0.48	0.03	0.00	1.60	0.01	0.14	0.01	0.04	0.01	0.01
05/09/89	0.43	0.00	0.02	0.47	0.00	0.00	0.00	0.01	0.81	0.33	0.40	0.02	0.00	1.51	0.00	0.10	0.04	0.10	0.00	0.01
05/12/89	0.40	0.00	0.02	0.47	0.00	0.00	0.00	0.00	0.52	0.00	0.46	0.01	0.00	1.51	0.00	0.14	0.00	0.19	0.00	0.00
05/16/89	0.39	0.00	0.02	0.59	0.00	0.00	0.00	0.00	0.14	1.34	0.45	0.02	0.00	1.51	0.02	0.00	0.07	0.42	0.01	0.00
05/20/89	0.38	0.00	0.02	0.47	0.00	0.00	0.00	0.01	0.18	0.84	0.40	0.01	0.00	2.05	0.00	0.00	0.01	0.22	0.00	0.02
05/23/89	0.39	0.00	0.02	0.47	0.00	0.00	0.00	0.00	0.52	1.01	0.45	0.02	0.00	2.01	0.02	0.02	0.04	0.04	0.00	0.00
05/27/89	0.40	0.00	0.02	0.47	0.00	0.00	0.00	0.01	0.58	1.34	0.43	0.02	0.00	1.60	0.00	0.00	0.02	0.09	0.00	0.00
05/31/89	0.01	0.01	0.02	0.24	0.01	0.00	0.00	0.02	0.88	1.25	0.38	0.04	0.00	1.63	0.01	0.06	0.02	0.00	0.00	0.00
06/04/89	0.05	0.02	0.01	0.55	0.00	0.00	0.00	0.02	1.16	0.00	0.38	0.06	0.00	2.01	0.02	0.00	0.00	0.13	0.00	0.00
06/07/89	0.02	0.01	0.02	0.51	0.00	0.00	0.00	0.03	1.74	0.00	0.38	0.08	0.00	1.92	0.00	0.00	0.00	0.24	0.00	0.00
06/10/89	0.12	0.01	0.02	0.75	0.00	0.00	0.00	0.06	2.02	0.42	0.50	0.13	0.00	2.01	0.01	0.07	0.00	0.51	0.00	0.02
06/14/89	0.04	0.02	0.01	0.51	0.00	0.00	0.00	0.03	1.05	0.00	0.38	0.05	0.00	2.04	0.00	0.18	0.00	0.37	0.00	0.00
06/17/89	0.01	0.01	0.02	0.55	0.00	0.00	0.00	0.03	1.11	0.42	0.47	0.08	0.00	1.69	0.00	0.15	0.00	0.32	0.00	0.00
06/20/89	0.00	0.01	0.02	0.24	0.00	0.00	0.00	0.01	0.88	0.00	0.38	0.02	0.00	1.60	0.01	0.10	0.00	0.06	0.00	0.00
06/24/89	0.01	0.02	0.02	0.20	0.00	0.00	0.00	0.00	0.98	0.00	0.38	0.04	0.00	1.75	0.01	0.17	0.03	0.25	0.00	0.00
06/28/89	0.38	0.02	0.03	0.67	0.01	0.00	0.01	0.01	1.02	0.00	0.43	0.03	0.00	1.83	0.03	0.05	0.00	0.17	0.01	0.00
07/01/89	0.43	0.01	0.03	0.67	0.00	0.00	0.01	0.01	1.19	0.00	0.43	0.05	0.00	1.95	0.01	0.00	0.01	0.24	0.01	0.01
07/04/89	0.43	0.01	0.02	0.67	0.01	0.00	0.01	0.02	1.04	0.00	0.43	0.04	0.00	2.01	0.02	0.00	0.01	0.10	0.01	0.03
07/07/89	0.44	0.01	0.02	0.84	0.01	0.00	0.02	0.02	0.86	0.00	0.52	0.04	0.00	1.82	0.03	0.06	0.01	0.73	0.01	0.01
07/10/89	0.44	0.02	0.02	0.90	0.01	0.00	0.01	0.02	0.81	0.00	0.52	0.05	0.00	2.00	0.02	0.00	0.01	0.88	0.01	0.01
07/14/89	0.43	0.02	0.03	0.90	0.00	0.00	0.01	0.02	1.00	0.00	0.52	0.06	0.00	1.98	0.02	0.00	0.00	0.83	0.01	0.00
07/18/89	0.45	0.01	0.03	0.90	0.00	0.00	0.01	0.01	1.35	0.00	0.52	3.54	0.00	2.00	0.01	0.00	0.01	0.61	0.01	0.00
07/21/89	0.52	0.01	0.03	0.90	0.00	0.00	0.01	0.01	1.07	0.00	0.50	6.53	0.00	3.22	0.01	0.08	0.00	1.08	0.01	0.00
11/08/89	0.28	0.01	0.00	0.52	0.00	0.00	0.01	0.00	0.76	0.00	0.48	0.01	0.00	1.59	0.00	0.08	0.02	1.35	0.01	0.00
11/15/89	0.48	0.02	0.00	0.73	0.00	0.00	0.01	0.02	0.91	0.54	0.48	0.03	0.00	1.85	0.00	0.01	0.05	1.74	0.00	0.01
11/17/89	0.36	0.00	0.00	0.56	0.00	0.00	0.01	0.00	0.74	0.16	0.48	0.01	0.00	1.34	0.00	0.14	0.01	1.34	0.00	0.00
11/19/89	0.39	0.02	0.00	0.56	0.00	0.00	0.00	0.00	0.75	0.00	0.48	0.02	0.00	1.53	0.00	0.28	0.01	1.59	0.00	0.00
11/21/89	0.42	0.02	0.00	0.56	0.00	0.00	0.01	0.01	0.76	0.00	0.48	0.02	0.00	1.78	0.00	0.04	0.03	1.88	0.00	0.01
11/24/89	0.39	0.01	0.00	0.56	0.00	0.00	0.00	0.01	0.63	0.54	0.48	0.01	0.00	1.47	0.00	0.00	0.01	1.99	0.00	0.12
11/28/89	0.38	0.01	0.00	0.68	0.00	0.00	0.00	0.01	0.51	0.00	0.48	0.01	0.00	1.66	0.00	0.00	0.06	1.89	0.00	0.00
11/30/89	0.37	0.00	0.00	0.56	0.00	0.00	0.01	0.01	0.48	0.00	0.48	0.01	0.00	1.53	0.00	0.03	0.03	1.80	0.00	0.00
12/07/89	0.36	0.00	0.00	0.71	0.01	0.00	0.01	0.11	0.51	0.00	0.39	0.02	0.00	2.73	0.00	0.10	0.00	1.48	0.00	0.05
12/10/89	0.37	0.00	0.00	0.65	0.00	0.01	0.00	0.01	0.17	1.25	0.39	0.12	0.00	1.58	0.00	0.10	0.03	1.64	0.00	0.00
12/13/89	0.62	0.00	0.00	0.87	0.00	0.00	0.00	0.02	0.40	0.62	0.57	0.13	0.00	2.16	0.00	0.13	0.00	2.18	0.00	0.01
12/15/89	0.51	0.00	0.01	0.98	0.00	0.01	0.01	0.01	0.32	1.88	0.66	0.04	0.00	2.59	0.00	0.01	0.04	2.39	0.01	0.01
12/18/89	0.37	0.00	0.00	0.87	0.00	0.01	0.00	0.01	0.18	4.38	0.52	0.02	0.00	2.01	0.00	0.12	0.01	2.11	0.00	0.00
12/20/89	0.39	0.00	0.00	1.09	0.00	0.01	0.00	0.08	0.22	3.13	0.56	6.28	0.00	3.52	0.00	0.04	0.03	2.14	0.00	0.04

DATE	Al	B	Ba	Ca	Cd	Co	Cr	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	Si	Sr	Zn
12/26/89	0.45	0.00	0.00	0.92	0.00	0.00	0.01	0.09	0.23	3.12	0.52	2.76	0.00	2.59	0.00	0.10	0.02	2.03	0.00	0.05
12/29/89	0.39	0.00	0.00	0.71	0.00	0.00	0.00	0.01	0.20	1.25	0.39	0.08	0.00	1.87	0.00	0.16	0.01	2.09	0.00	0.02
01/06/90	0.34	0.02	0.02	0.72	0.00	0.00	0.01	0.06	0.28	4.51	0.47	0.02	0.00	2.45	0.03	0.19	0.00	1.55	0.00	0.05
01/11/90	0.49	0.01	0.02	0.52	0.00	0.00	0.01	0.03	0.43	0.00	0.47	0.03	0.00	1.96	0.00	0.16	0.00	1.29	0.00	0.05
01/16/90	0.42	0.01	0.02	0.52	0.00	0.00	0.01	0.01	0.26	2.26	0.47	0.02	0.00	1.37	0.03	0.13	0.01	1.20	0.00	0.01
01/19/90	0.49	0.01	0.02	0.52	0.00	0.00	0.01	0.02	0.40	1.51	0.48	0.02	0.00	1.77	0.05	0.17	0.00	1.16	0.00	0.02
01/25/90	0.44	0.02	0.02	0.51	0.00	0.00	0.00	0.03	0.48	4.53	0.47	0.02	0.00	2.94	0.00	0.00	0.00	0.60	0.00	0.02
01/27/90	0.52	0.01	0.02	0.52	0.00	0.00	0.01	0.03	0.59	0.00	0.47	0.03	0.00	4.57	0.05	0.10	0.01	0.80	0.00	0.01
01/29/90	0.51	0.01	0.02	0.52	0.00	0.00	0.01	0.01	0.57	1.51	0.47	0.03	0.00	1.37	0.00	0.05	0.00	0.71	0.00	0.05
01/31/90	0.72	0.00	0.04	0.72	0.00	0.00	0.01	0.03	0.99	0.75	0.47	0.13	0.00	3.72	0.04	0.24	0.01	0.66	0.01	0.05
02/06/90	0.48	0.00	0.02	0.53	0.00	0.00	0.00	0.00	0.47	0.00	0.37	0.01	0.00	2.52	0.02	0.15	0.05	0.51	0.00	0.12
02/09/90	0.44	0.00	0.03	0.53	0.00	0.00	0.00	0.00	0.60	0.00	0.41	0.03	0.00	1.83	0.02	0.00	0.04	0.38	0.00	0.06
02/15/90	0.43	0.00	0.02	0.58	0.00	0.00	0.00	0.01	0.64	0.00	0.41	0.02	0.00	3.13	0.02	0.00	0.05	0.24	0.01	0.01
02/20/90	0.53	0.00	0.02	0.69	0.00	0.00	0.00	0.00	0.61	2.69	0.41	0.06	0.00	1.83	0.01	0.00	0.02	0.76	0.01	0.00
02/25/90	0.49	0.00	0.02	0.74	0.00	0.00	0.00	0.00	0.69	0.00	0.41	0.03	0.00	3.39	0.00	0.00	0.04	0.74	0.01	0.01
02/28/90	0.45	0.00	0.02	0.63	0.00	0.00	0.00	0.00	0.55	0.00	0.41	0.03	0.00	2.35	0.00	0.00	0.04	0.88	0.01	0.01
03/01/90	0.33	0.00	0.02	0.66	0.00	0.00	0.00	0.00	0.55	0.00	0.44	0.02	0.00	1.97	0.00	0.03	0.05	0.74	0.01	0.01
03/03/90	0.38	0.01	0.02	0.66	0.00	0.00	0.00	0.03	0.56	0.00	0.40	0.03	0.00	2.34	0.00	0.00	0.03	0.91	0.01	0.04
03/17/90	0.41	0.00	0.02	0.72	0.00	0.00	0.00	0.02	0.81	1.61	0.44	0.03	0.00	2.01	0.00	0.01	0.04	0.43	0.01	0.02
03/20/90	0.37	0.00	0.02	0.72	0.00	0.00	0.00	0.02	1.04	0.00	0.44	0.17	0.00	2.35	0.00	0.05	0.02	0.32	0.01	0.02
03/22/90	0.46	0.00	0.02	0.72	0.00	0.00	0.00	0.01	1.08	0.00	0.47	0.05	0.00	3.44	0.00	0.87	0.02	0.64	0.01	0.01
03/28/90	0.35	0.00	0.02	0.59	0.00	0.00	0.00	0.02	0.75	0.00	0.40	0.02	0.00	2.08	0.01	0.04	0.03	0.30	0.01	0.02
03/30/90	0.35	0.00	0.02	0.66	0.00	0.00	0.00	0.02	0.83	0.00	0.40	0.04	0.00	2.02	0.00	0.02	0.03	0.30	0.01	0.02
05/15/90	0.53	0.00	0.01	0.64	0.00	0.00	0.00	0.00	0.78	0.00	0.38	0.04	0.00	2.04	0.01	0.00	0.02	1.09	0.01	0.01
05/23/90	0.51	0.00	0.02	0.71	0.00	0.00	0.00	0.00	1.09	0.59	0.38	0.07	0.00	2.51	0.00	0.00	0.01	0.87	0.01	0.03
05/26/90	0.60	0.00	0.01	0.71	0.00	0.00	0.00	0.01	1.17	0.59	0.38	0.04	0.00	1.91	0.01	0.00	0.01	0.71	0.01	0.02
05/30/90	0.42	0.00	0.01	0.45	0.00	0.00	0.00	0.00	0.79	0.00	0.38	0.05	0.00	2.07	0.01	0.00	0.00	0.63	0.01	0.02
06/21/90	0.48	0.00	0.02	0.56	0.00	0.00	0.00	0.00	1.11	0.00	0.39	0.01	0.00	1.86	0.03	0.00	0.02	0.47	0.01	0.00
06/23/90	0.46	0.00	0.02	0.56	0.00	0.00	0.00	0.00	1.14	0.00	0.45	0.01	0.00	1.88	0.03	0.00	0.03	0.41	0.01	0.00
06/26/90	0.45	0.00	0.02	0.56	0.00	0.00	0.00	0.00	1.24	0.00	0.45	0.00	0.00	1.97	0.03	0.00	0.01	0.43	0.01	0.00
06/28/90	0.51	0.00	0.02	0.56	0.00	0.00	0.00	0.00	1.37	1.17	0.48	0.01	0.00	2.17	0.02	0.00	0.02	0.63	0.01	0.00
06/30/90	0.40	0.00	0.02	0.56	0.00	0.00	0.00	0.00	1.11	0.00	0.47	0.00	0.00	1.86	0.03	0.00	0.00	0.19	0.01	0.00