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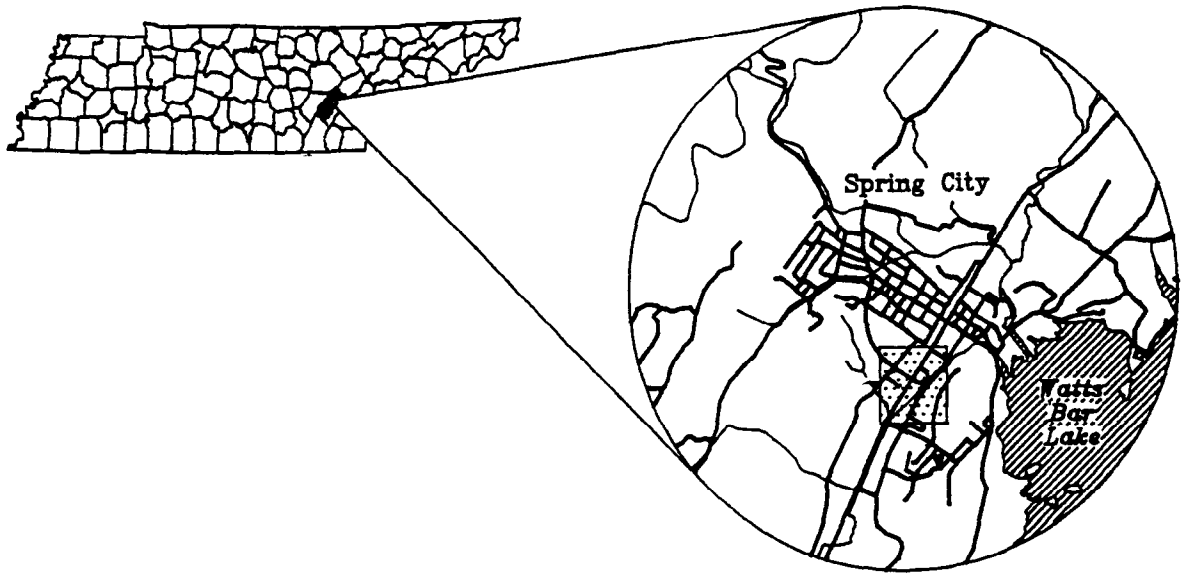
HYDROLOGIC DATA OF TWO WETLANDS AT SPRING CITY, TENNESSEE, DECEMBER 1991 THROUGH NOVEMBER 1992



Prepared by the
U.S. GEOLOGICAL SURVEY

in cooperation with the
TENNESSEE DEPARTMENT OF TRANSPORTATION

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By GREGORY C. JOHNSON and LAWRENCE M. BREDE

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Knoxville, Tennessee
1995

U.S. DEPARTMENT OF THE INTERIOR
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Multiply	By	To Obtain
inch (in.)	0.0254	meter
foot (ft)	0.3048	meter
acre	0.4047	hectare

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

Hydrologic Data of Two Wetlands at Spring City, Tennessee, December 1991 Through November 1992

By Gregory C. Johnson *and* Lawrence M. Brede

ABSTRACT

Hydrologic data for two small adjacent wetlands at Spring City, Tennessee, were collected from December 1991 through November 1992. One of the wetlands was natural and the other was constructed to replace a wetland disturbed by the construction of a road embankment.

Water levels were monitored in five 6-inch-diameter wells, approximately 5 feet deep. The casing in each well was slotted and screened from above land surface to a depth of about 4 feet. Water-level recorders provided continuous records of stage during periods of wetlands inundation, and of water-table depth during periods when the wetlands were not inundated. Water levels also were measured periodically in 20 smaller diameter, shallow wells installed in the wetlands. A recording rain gage was installed at the constructed wetland, and a continuous stage recorder was installed at Town Creek. Land surface at the wells was inundated from 0 to 75 percent of the study period. Additionally, water levels were not more than 1.5 feet below land surface for 57 to 85 percent of the study period.

INTRODUCTION

Part of a wetland in Spring City, Tennessee, was disturbed by construction of a highway ramp connecting State Route 29 to State Route 68 (fig. 1) in 1988. To compensate for the destroyed wetland, the Tennessee Department of Transportation (TDOT) excavated an adjacent area, south of the highway ramp, to create a constructed wetland. The remaining natural wetland located north of the highway ramp was not affected by the highway construction.

The 1987 Wetlands Delineation Manual (Sipple, 1987) defines wetlands as: "Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." According to the Federal Interagency Committee for Wetland Delineation (1989), wetlands are determined to possess three essential characteristics: (1) hydrophytic vegetation (plants that prefer or accept very wet conditions), (2) hydric soils (soil that is wet enough during the growing season to develop anaerobic conditions), and (3) wetland hydrology.

Primary criteria for regulatory wetland hydrology are the timing and duration of inundation or soil saturation (Federal Interagency Committee for Wetland Delineation, 1989). A site has regulatory wetland hydrology if it is flooded or saturated at the surface for 1 week or longer during the local growing season. This critical distance between the water table and the land surface varies with soil characteristics. The critical water-table depths for wetland hydrology for different soil-drainage classes are as follows: somewhat poorly drained, 0.5 foot; highly permeable, poorly drained, 1.0 foot; and low-permeability, poorly drained, 1.5 feet (Federal Interagency Committee for Wetland Delineation, 1989).

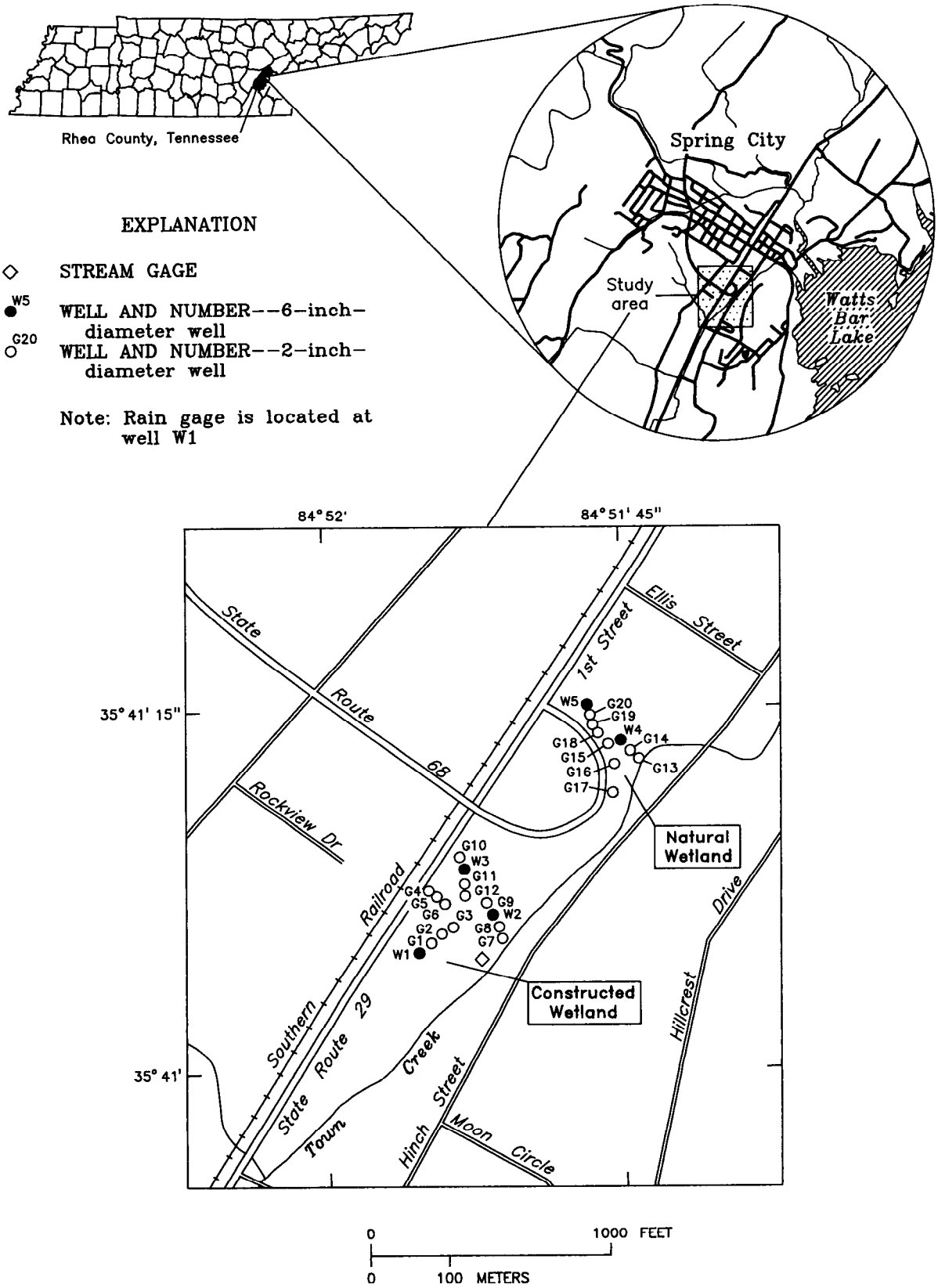

Figure 1. Location of the study area and location of stream gage and wells at Spring City, Rhea County, Tennessee.

In 1991, the U.S. Geological Survey (USGS), in cooperation with the TDOT, began a 1-year study to determine hydrologic characteristics of the constructed wetland and adjacent natural wetland. The USGS is participating in this and similar projects to establish sufficient data for interpretation of wetland hydrology in reference to mitigation efforts. The depth to the water table and depth of inundation were determined by periodic and continuous measurements of water levels. The stage of Town Creek was monitored to determine the effects of Town Creek on the hydrology of the wetlands. Rainfall also was recorded at the constructed wetland. The data from the two wetlands will be evaluated by the TDOT to determine if the constructed wetland has similar hydrologic properties to the natural wetland.

Purpose and Scope

The purpose of this report is to document hydrologic conditions in the Spring City wetlands from December 1991 through November 1992. Water-level data for 5 shallow continuous-record wells and periodic measurements of water levels in 20 observation wells are reported. Well-construction data for the two types of wells in this study are presented. Rainfall at the constructed wetland site and stage data for Town Creek also are presented.

Study Area

The study area is adjacent to the intersection of State Routes 68 and 29 in Spring City, Rhea County, Tennessee. The site extends along a 1,410-foot reach of Town Creek (fig. 1). The constructed wetland on the south side of the highway ramp covers 4.01 acres. The natural wetland on the north side of the highway ramp covers 2.07 acres.

Spring City is located in the Valley and Ridge physiographic province at the base of the Cumberland Escarpment. It is near the confluence of Town Creek and Watts Bar Lake. Soils in the wetlands are derived from alluvium of Recent age and are classified as Lindside silty clay loam and Philo fine sandy loam, both of which drain poorly (Hasty and others, 1948). The average growing season, defined as the average period between the last spring frost and the first autumn frost, is from April 15 to October 20 (D.D. Williams, Rhea County Extension Office, Dayton, Tennessee, oral commun., 1995).

Well-Construction Data and Instrumentation

The USGS constructed 25 wells in November 1991 to monitor water levels at the wetlands. A stream gage on Town Creek and a rain gage also were installed. Elevations for the datum of each well and the stream gage were determined by leveling from a nearby point of known elevation (table 1).

Five 6-inch-diameter wells (W1-W5) approximately 5 feet deep, were constructed and equipped with data loggers to record water levels at 15-minute intervals (fig. 2). Wells W1, W2, and W3 were located in the constructed wetland, and wells W4 and W5 were located in the natural wetland (fig. 1). At these sites, 1-foot-diameter holes were drilled with a portable two-man auger into the regolith to a depth of about 6 feet. The wells were cased with 6-inch-diameter schedule 80 polyvinylchloride (PVC) pipe. The pipes extended about 4 feet above land surface to provide sufficient elevation to prevent possible recorder submergence during flooding on Town Creek. The above-ground section of pipe was drilled with 1/2-inch-diameter holes throughout its length to allow water to enter the well during periods of inundation. The section of pipe below land surface was slotted and screened and set in a 1-foot-thick plug of concrete. The annulus was packed with sand to land surface; the well was then instrumented with a float and recorder.

Table 1. Station numbers and elevations of datums for wells and stream gage at Spring City, Tennessee

[Elevation, in feet, above sea level; gage datum of 0-foot gage height, in feet above sea level]

Wells			Stream gage		
Site	Land-surface elevation	Station number	Site	Gage datum	Station number
W1	758.30	354106084515501	Town Creek stream gage.	754.07	03542502
W2	757.30	354109084515201			
W3	757.70	354110084515301			
W4	756.60	354116084514501			
W5	756.80	354117084514701			
G1	758.24	354107084515401			
G2	757.77	354107084515301			
G3	757.12	354107084515301			
G4	757.90	354109084515301			
G5	758.06	354108084515301			
G6	758.79	354108084515302			
G7	758.15	354108084515201			
G8	757.63	354108084515202			
G9	757.90	354109084515202			
G10	758.72	354111084515301			
G11	758.06	354110084515302			
G12	757.75	354110084515201			
G13	756.66	354115084514401			
G14	756.72	354115084514501			
G15	756.52	354116084514601			
G16	755.49	354115084514601			
G17	757.69	354114084514501			
G18	756.40	354116084514602			
G19	756.12	354116084514603			
G20	755.88	354117084514702			

Twenty 2-inch-diameter wells (G1-G20) about 2.5 feet deep were installed to provide synoptic data and a more detailed profile of the water surface in the wetlands. Wells G1 through G12 were located in the constructed wetland; wells G13 through G20 were located in the natural wetland (fig. 1). A 4-inch diameter hole was drilled with a portable two-man auger into the regolith at these sites to a depth of about 2.5 feet. The wells were cased with 3-foot-long sections of 2-inch-diameter schedule 40 PVC pipe (fig. 2). The lower 2-foot section of the pipe was slotted. A sand pack was placed around the pipe to within 6 inches of land surface, and the remainder of the annulus was plugged with bentonite. The well was capped to prevent recharge from entering the top of the well, and the cap was vented to provide a pressure outlet. Water levels at these wells were measured manually at 4- to 6-week intervals.

A stream gage was located on Town Creek at a site adjacent to the constructed wetland area (fig. 1). The gage utilized a float attached to a digital recorder placed on a stilling well. Stage data for Town Creek were collected at 15-minute intervals.

A tipping-bucket rain gage and data logger were installed at the site of well W1 (fig. 1). Rainfall data were collected at 5-minute intervals to correlate rainfall with water-level changes.

HYDROLOGIC DATA

Hydrologic data for the wetlands and Town Creek were collected from December 1, 1991, through November 30, 1992. Three types of data were collected—water levels, stream stage, and rainfall (fig. 3).

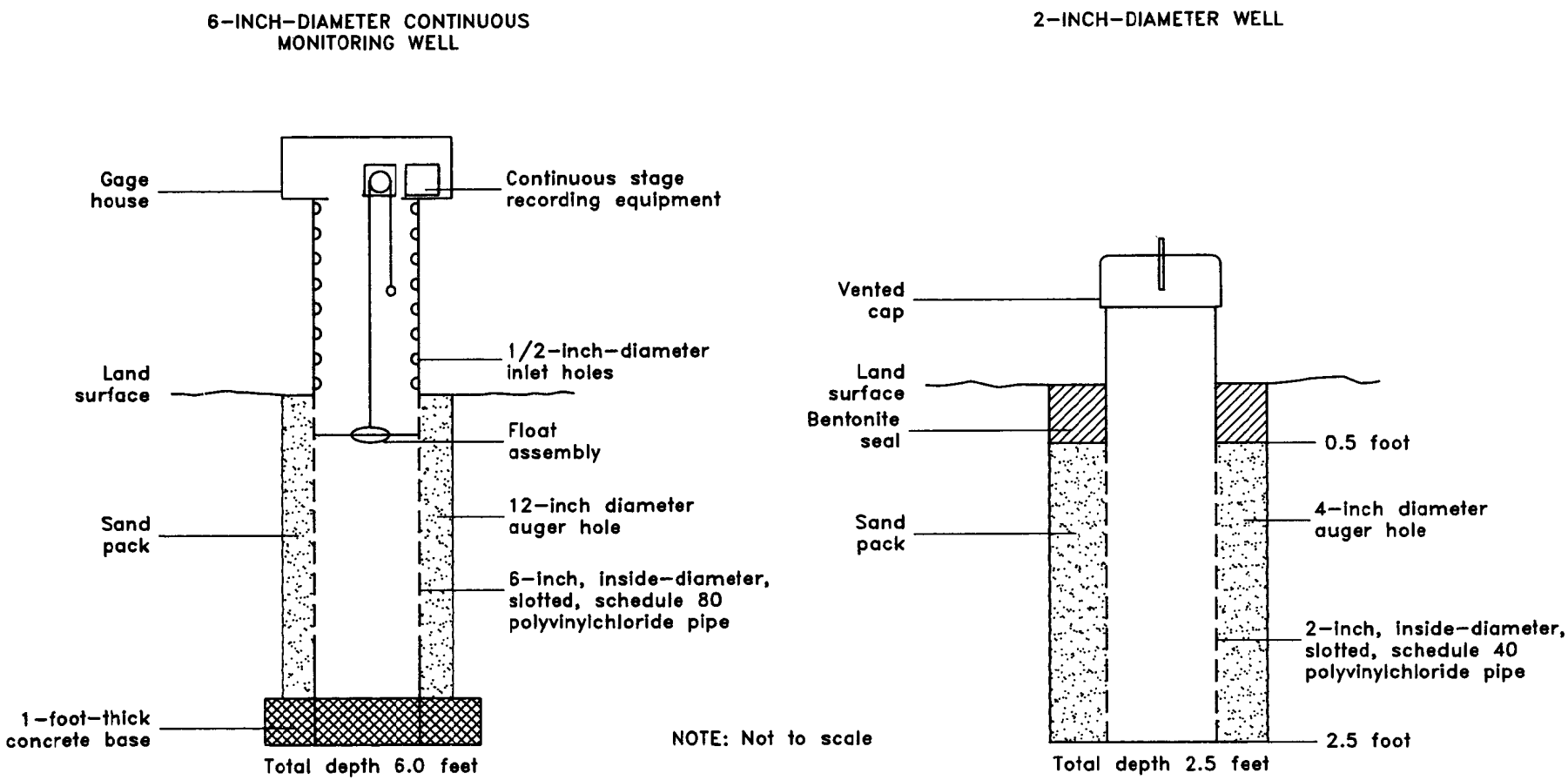

Figure 2. Construction diagrams for wells at Spring City, Tennessee.

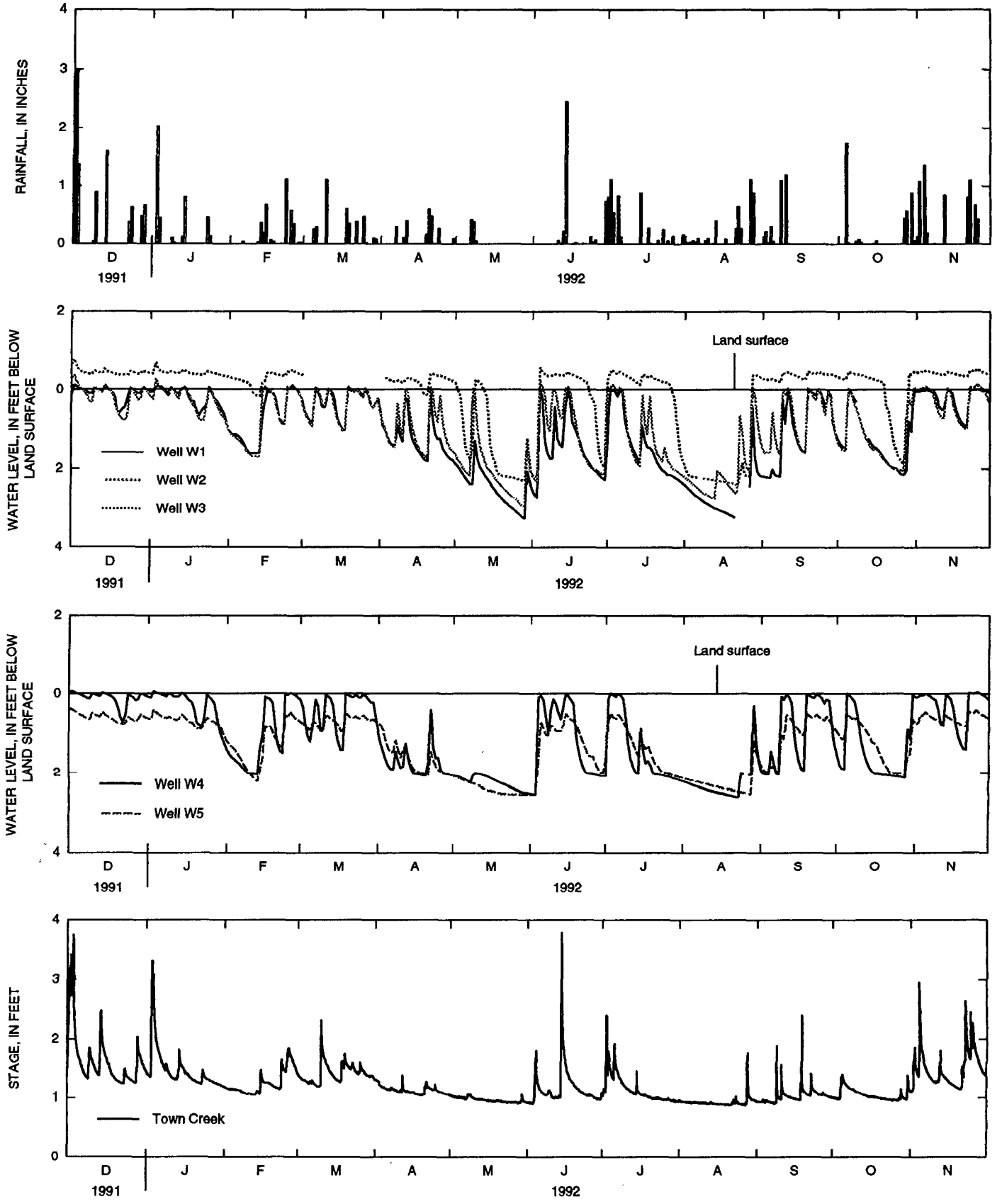

Figure 3. Daily rainfall; maximum daily water level below land surface for wells W1 through W3; maximum daily water level below land surface for wells W4 and W5; and daily mean stage for the Town Creek gage at Spring City, Tennessee, December 1, 1991 through November 30, 1992

Water-Level Data

Water levels were recorded at 15-minute intervals in five wells (W1 - W5) during the period of study. As a result of equipment failures, well W1 had 9 days of missing record, well W2 had 31 days of missing record, and well W4 had 1 day of missing record. Wells W3 and W5 had no missing record for the period of study (tables 2 - 6, at back of report).

An estimate of the total amount of time each well was inundated (table 7) can be made, based on maximum daily water levels (tables 2-6, at back of report). Land surface was inundated from 0 (well W5) to 75 percent of the study period (well W2). Additionally, water levels were not more than 1.5 feet below the land surface from 57 percent (well W4) to 85 percent of the study period (well W2).

Table 7. Summary of water-level data for wells W1 through W5 for Spring City, Tennessee, December 1, 1991 through November 30, 1992

Well number	Total days of record	Percentage of time maximum daily water level was above land surface	Percentage of time maximum daily water level was less than 1.5 feet below land surface
W1	357	7.0	68.9
W2	335	75.2	84.5
W3	366	17.8	70.8
W4	365	6.0	56.7
W5	366	0	63.3

All three continuously-monitored wells in the constructed wetland (W1, W2, and W3) were either inundated or had water-table depths of less than 0.5 foot for at least one period of 7 or more consecutive days between April 15 and October 20, 1992 (tables 2-4, at back of report). In the natural wetland, one continuously-monitored well, W4 was inundated or had a water-table depth of less than 0.5 foot for 7 consecutive days from July 2 through July 8, 1992, and for 10 consecutive days from September 19 through September 29, 1992 (table 5, at back of report). The second continuously monitored well, W5, had water-table depths of less than 1.0 foot for several periods of 7 or more consecutive days between April 15 and October 20, 1992 (table 6, at back of report).

Synoptic measurements of water levels were made at the 20 shallow observation wells (G1 through G20) at 4- to 6-week intervals during the study period (table 8, at back of report). Water-level measurements were made inside and outside of the casings at wells G3, G8, G15, G16, and G20 during ponded conditions.

Stream Stage and Rainfall Data

Stage data were recorded at 15-minute intervals at the Town Creek stream gage with no missing record for the period of study [table 9 (at back of report) and fig. 3]. Town Creek did not inundate the wetlands during the monitoring period.

Rainfall data were recorded at 5-minute intervals near well W1 for the study period. A total of 81 days of rainfall data between December 1991 and April 1992 was estimated because of equipment problems (table 10, at back of report). The monthly total rainfall at the gage was recorded, but the rainfall distribution during the month was estimated based upon the responses of the wells in the wetlands and data provided by the Tennessee Valley Authority for rain gages at Roddy and Dayton, Tennessee (Wayne Hamberger, Tennessee Valley Authority, written commun., 1992). Between May 1992 and November 1992, 42 days of data were lost because of equipment problems. This data could not be estimated because total rainfall was not recorded, and the spacial variability of summer storms prevented extrapolation from surrounding rain gages.

SUMMARY

Five continuous-record wells and 20 observation wells were installed by the U.S. Geological Survey at two adjacent wetlands in Spring City, Tennessee. These wells provided water-level data for the wetlands to aid in understanding the area hydrology. Rainfall and stream-stage information also were collected.

An estimate of the total amount of time that each of the five continuous-record wells was inundated was made based on maximum daily water levels. Land surface was inundated from 0 (well W5) to 75 percent of the study period (well W2). All five continuous-record wells had water levels of within 0.5 foot of land surface for at least 7 or more consecutive days during the growing season. Additionally, water levels were not more than 1.5 feet below land surface from 57 (well W4) to 85 percent of the study period (well W2).

REFERENCES CITED

Federal Interagency Committee for Wetland Delineation, 1989, Federal manual for identifying and delineating jurisdictional wetlands: Washington, D.C., U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and U.S. Department of Agriculture, Soil Conservation Service Cooperative technical publication, 76 p. plus appendixes.

Hasty, A.H., Mogen, C.A., Beadles, C.B., Sams, W.C., and Tyer, James, 1948, Soil survey, Rhea County, Tennessee: U.S. Department of Agriculture, Agricultural Research Administration, 87, 95 p.

Sipple, W.S., 1987, Wetland identification and delineation manual, v. 1, Rationale, wetland parameters, and overview of jurisdictional approach: Washington D.C., U.S. Environmental Protection Agency, Office of Wetlands Protection, 28 p. plus appendixes.

Table 2. Maximum daily water level at well W1 at Spring City, Tennessee, December 1, 1991 through November 30, 1992

[Water level in feet below land surface; --, missing data; MAX, maximum value for the month; negative values indicate ponded conditions]

	1991	1992										
DAY	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
1	0.1	0.05	1.04	0.30	0.50	1.87	2.53	1.35	2.41	2.18	1.26	0.03
2	-.12	.04	1.12	.56	.89	1.93	2.66	.02	2.47	2.20	1.36	.03
3	-.09	-.09	1.11	.69	1.00	2.02	2.74	-.01	2.53	2.21	1.44	.00
4	-.06	-.09	1.14	.79	1.19	2.12	-.01	.03	2.58	2.22	1.44	.01
5	-.03	-.09	1.19	.88	1.33	2.22	.25	.16	2.65	2.02	.01	-.02
6	.00	-.02	1.26	.04	1.38	2.31	1.26	-.01	2.70	2.15	.04	.01
7	.05	.04	1.38	.04	1.37	2.39	1.59	.05	2.75	2.18	.18	.02
8	.09	.07	1.52	.19	.89	2.39	1.74	.72	2.80	2.19	.29	.04
9	.09	-.06	1.60	.44	1.14	1.28	1.74	1.05	2.84	.25	--	.18
10	-.07	.02	1.62	.45	1.30	1.77	.43	1.26	2.88	.85	--	.42
11	-.02	.07	1.61	.02	.20	1.96	1.22	1.45	2.92	.03	--	.50
12	.00	.10	1.62	.02	.31	2.06	1.38	1.59	2.96	.26	--	.50
13	.03	.00	1.59	.09	1.00	2.17	1.43	1.75	3.00	.84	1.22	.00
14	-.10	-.09	.79	.33	1.26	2.26	.58	1.85	3.02	1.09	1.34	.02
15	-.03	.00	.33	.74	1.39	2.36	.02	.92	3.05	1.31	1.42	.07
16	.02	.20	.01	.89	1.51	2.46	.23	1.26	3.08	1.45	1.46	.33
17	.07	.30	.06	1.00	1.62	2.54	.82	1.44	3.10	1.56	1.52	.57
18	.19	.29	.05	1.00	1.72	2.62	.97	1.45	3.13	1.57	1.62	.73
19	.56	.50	.18	-.01	1.79	2.69	1.11	1.53	3.17	.01	1.73	.84
20	.58	.68	.43	.01	1.81	2.77	1.32	1.70	3.20	.04	1.81	.90
21	.50	.56	.75	.04	.07	2.83	1.53	1.85	3.24	.07	1.90	.89
22	.44	.48	.86	.04	.71	2.89	1.71	1.95	--	.12	1.95	.00
23	.16	.39	.86	.02	1.12	2.95	1.79	2.04	--	.01	1.98	.00
24	-.03	-.06	-.06	.07	1.24	3.00	1.88	2.07	--	.06	1.99	.00
25	.02	.08	-.06	.14	1.23	3.06	1.99	2.15	--	.26	2.06	-.03
26	.05	.21	-.06	.02	1.46	3.11	2.04	2.15	--	.53	2.14	.00
27	.08	.29	-.06	.08	1.58	3.17	2.10	2.18	2.46	.03	2.16	.01
28	.07	.36	.01	.31	1.69	3.22	2.17	2.21	.40	.12	2.06	.02
29	-.06	.50	.13	.44	1.75	3.26	2.23	2.25	1.74	.81	.79	.03
30	-.01	.62		.38	1.78	2.07	2.28	2.30	2.07	1.10	1.05	.07
31	.02	.85		.21		2.34		2.36	2.17		.02	
MAX	.58	.85	1.62	1.00	1.81	3.26	2.74	2.36	--	2.22	--	.90

Table 3. Maximum daily water level at well W2 at Spring City, Tennessee, December 1, 1991 through November 30, 1992

[Water level in feet below land surface; --, missing data; MAX, maximum value for the month; negative values indicate ponded conditions]

	1991	1992										
DAY	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
1	-0.61	-0.42	-0.32	-0.38	--	-0.19	2.17	-0.25	1.93	-0.29	-0.33	-0.45
2	-.78	-.41	-.30	-.36	--	-.01	2.18	-.44	2.08	-.27	-.31	-.45
3	-.61	-.68	-.29	--	-.31	.12	2.19	-.52	2.18	-.27	-.29	-.47
4	-.48	-.51	-.27	--	-.28	.65	-.57	-.43	2.19	-.27	-.29	-.47
5	-.45	-.46	-.25	--	-.25	1.34	-.44	-.42	2.20	-.29	-.47	-.51
6	-.43	-.44	-.23	--	-.22	1.63	-.40	-.47	2.21	-.26	-.44	-.47
7	-.41	-.43	-.21	--	-.22	1.77	-.36	-.42	2.22	-.23	-.42	-.45
8	-.40	-.42	-.19	--	-.24	1.41	-.35	-.38	2.23	-.21	-.41	-.44
9	-.39	-.46	-.15	--	-.21	-.26	-.37	-.35	2.24	-.44	-.40	-.42
10	-.48	-.44	.04	--	-.18	-.23	-.40	-.31	2.25	-.41	-.38	-.41
11	-.45	-.42	.11	--	-.25	-.19	-.38	-.27	2.26	-.46	-.37	-.39
12	-.43	-.42	.15	--	-.31	-.07	-.37	-.23	2.27	-.42	-.34	-.39
13	-.42	-.43	.15	--	-.29	.06	-.36	-.17	2.29	-.39	-.32	-.46
14	-.53	-.50	-.19	--	-.26	.30	-.39	-.14	2.30	-.37	-.30	-.45
15	-.46	-.46	-.23	--	-.24	1.35	-.46	-.40	2.31	-.34	-.28	-.43
16	-.44	-.42	-.43	--	-.20	1.68	-.41	-.36	2.32	-.31	-.27	-.41
17	-.42	-.39	-.42	--	-.16	1.84	-.38	-.33	2.33	-.28	-.24	-.40
18	-.40	-.40	-.42	--	.06	2.09	-.36	-.36	2.35	-.28	-.21	-.38
19	-.38	-.39	-.40	--	.12	2.17	-.33	-.33	2.36	-.47	-.17	-.37
20	-.37	-.37	-.38	--	.10	2.18	-.30	-.29	2.37	-.43	.39	-.35
21	-.37	-.37	-.36	--	-.40	2.19	-.26	-.26	2.39	-.42	.53	-.35
22	-.37	-.37	-.35	--	-.40	2.20	-.22	-.23	2.40	-.41	.90	-.48
23	-.37	-.45	-.34	--	-.37	2.22	-.17	-.21	2.16	-.46	1.32	-.49
24	-.46	-.45	-.46	--	-.35	2.23	.15	-.21	1.85	-.43	1.52	-.47
25	-.44	-.43	-.45	--	-.36	2.24	.23	-.18	2.16	-.41	1.70	-.54
26	-.43	-.42	-.51	--	-.34	2.26	.35	-.13	2.18	-.39	1.83	-.48
27	-.41	-.41	-.45	--	-.31	2.27	1.15	.06	2.18	-.41	1.86	-.46
28	-.41	-.38	-.42	--	-.28	2.29	1.66	.26	-.37	-.41	1.46	-.44
29	-.49	-.36	-.40	--	-.25	2.30	1.88	.87	-.40	-.39	-.41	-.42
30	-.45	-.35		--	-.23	1.20	1.99	1.49	-.36	-.36	-.40	-.41
31	-.43	-.34		--		1.94		1.75	-.33		-.47	
MAX	-.37	-.34	.15	--	--	2.30	2.19	1.75	2.40	-.21	1.86	-.35

Table 4. Maximum daily water level at well W3 at Spring City, Tennessee, December 1, 1991 through November 30, 1992

[Water level in feet below land surface; MAX, maximum value for the month; negative values indicate ponded conditions]

	1991	1992										
DAY	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
1	-0.28	0.18	1.04	0.35	0.56	1.64	2.14	-0.03	2.20	1.49	1.32	-0.02
2	-.37	.23	1.14	.57	.84	1.75	2.27	-.07	2.26	1.60	1.46	-.02
3	-.21	-.28	1.19	.73	.98	1.85	2.34	-.14	2.32	1.56	1.52	-.06
4	-.07	-.10	1.22	.84	1.19	1.96	-.22	-.04	2.38	1.60	1.52	-.06
5	-.03	-.05	1.27	.92	1.37	2.03	-.06	.05	2.43	.56	-.06	-.10
6	.04	.00	1.33	-.06	1.43	2.11	.15	-.08	2.49	1.17	.01	-.05
7	.14	.08	1.43	-.02	1.43	2.18	.87	.02	2.54	1.51	.26	.01
8	.28	.17	1.56	.15	.35	-.07	1.06	.40	2.59	1.66	.42	.19
9	.30	-.04	1.65	.39	.91	.20	-.01	1.01	2.62	-.02	.61	.44
10	-.07	.02	1.69	.40	1.21	.98	.03	1.32	2.66	.10	.80	.63
11	-.02	.14	1.70	-.04	.01	1.41	.32	1.56	2.70	-.05	1.02	.70
12	.03	.22	1.71	.04	.08	1.64	.66	1.73	2.73	.12	1.19	.70
13	.06	-.02	1.69	.24	.63	1.82	.74	1.89	2.76	.52	1.33	-.06
14	-.13	-.09	.06	.48	.99	1.99	-.04	1.95	2.04	.96	1.44	.01
15	-.05	-.03	-.10	.76	1.21	2.05	-.09	.11	2.10	1.24	1.50	.22
16	.01	.10	-.03	.91	1.41	2.15	.03	.80	2.19	1.46	1.51	.48
17	.09	.25	.02	1.02	1.54	2.23	.42	1.16	2.28	1.58	1.56	.67
18	.32	.41	.06	1.03	1.64	2.32	.68	.14	2.37	1.59	1.66	.81
19	.55	.55	.23	-.09	1.73	2.40	1.05	.95	2.45	-.06	1.75	.91
20	.68	.74	.50	-.05	1.68	2.48	1.37	1.38	2.53	.01	1.84	.97
21	.75	.77	.73	.04	-.07	2.55	1.58	1.63	2.61	.16	1.92	.97
22	.77	.77	.84	.06	.08	2.59	1.73	1.74	2.62	.25	1.97	-.09
23	.61	.45	.85	-.03	.62	2.65	1.83	1.81	.65	-.04	2.00	-.09
24	-.05	-.04	-.07	.13	.83	2.70	1.95	1.45	1.09	.09	2.01	-.08
25	.02	.04	-.07	.21	.15	2.74	2.00	1.76	1.79	.40	2.03	-.14
26	.12	.20	-.12	-.06	.79	2.80	2.02	1.89	2.02	.63	2.04	-.08
27	.26	.37	-.06	.05	1.12	2.87	2.04	1.98	2.03	.00	2.04	-.04
28	.21	.51	.00	.29	1.34	2.93	2.08	2.03	-.07	.19	.72	.02
29	-.08	.64	.12	.46	1.48	2.96	2.12	2.06	.18	.73	.23	.21
30	-.02	.71		.40	1.52	1.27	2.14	2.10	.78	1.11	.39	.37
31	.06	.86		.22		2.02		2.15	1.22		-.07	
MAX	.77	.86	1.71	1.03	1.73	2.96	2.34	2.15	2.76	1.66	2.04	.97

Table 5. Maximum daily water level at well W4 at Spring City, Tennessee, December 1, 1991 through November 30, 1992

[Water level in feet below land surface; --, missing data; MAX, maximum value for the month; negative values indicate ponded conditions]

	1991	1992										
DAY	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
1	-0.04	0.08	1.42	0.15	0.97	2.07	2.53	2.08	2.22	1.97	1.52	0.08
2	-.06	.10	1.53	.33	1.26	2.08	2.54	.12	2.25	2.02	1.78	.08
3	-.04	-.06	1.61	.79	1.47	2.10	2.54	-.02	2.27	2.03	1.89	.03
4	-.01	-.03	1.66	1.06	1.67	2.12	.09	.03	2.30	2.03	1.90	.03
5	.01	-.01	1.72	1.21	1.81	2.16	.05	.07	2.33	1.46	-.02	-.01
6	.04	.01	1.77	.72	1.90	2.19	.15	-.01	2.35	1.74	.04	.02
7	.08	.04	1.85	.14	1.91	2.23	.58	.04	2.37	2.02	.11	.07
8	.11	.07	1.92	.30	1.47	2.24	.99	.14	2.39	2.03	.19	.12
9	.12	-.01	2.00	.88	1.70	2.06	.38	.62	2.41	.06	.49	.16
10	.00	.02	2.02	.90	1.87	2.02	.13	1.25	2.43	.14	.92	.40
11	.02	.07	2.03	.03	1.84	2.03	.25	1.66	2.45	.01	1.27	.76
12	.04	.08	2.04	.07	1.25	2.04	.47	1.85	2.47	.08	1.54	.78
13	.06	.07	2.05	.13	1.64	2.06	.63	1.99	2.48	.23	1.73	.02
14	-.03	-.02	1.40	.31	1.87	2.08	.30	2.02	2.49	.92	1.88	.07
15	-.01	.01	1.06	.86	2.02	2.11	.00	.87	2.51	1.39	1.97	.15
16	.02	.09	.08	1.19	2.03	2.14	.06	1.46	2.52	1.71	2.02	.38
17	.05	.17	.11	1.42	2.04	2.18	.16	1.75	2.53	1.91	2.02	.82
18	.09	.20	.14	1.42	2.05	2.21	.24	1.70	2.55	1.94	2.03	1.08
19	.17	.39	.24	-.02	2.07	2.25	.95	1.81	2.56	-.01	2.04	1.26
20	.33	.73	.84	.03	2.08	2.28	1.38	2.02	2.57	.04	2.04	1.40
21	.59	.78	1.25	.08	1.75	2.31	1.67	2.03	2.59	.08	2.05	1.41
22	.70	.84	1.46	.09	.39	2.33	1.86	2.04	2.60	.10	2.06	-.03
23	.52	.58	1.50	.02	1.36	2.36	1.99	2.05	2.60	.00	2.07	-.02
24	.01	.04	.01	.09	1.63	2.39	2.02	2.06	2.02	.05	2.08	-.01
25	.06	.09	.02	.10	1.62	2.41	2.03	2.08	2.03	.11	2.09	-.04
26	.10	.15	-.02	.01	1.91	2.44	2.04	2.09	--	.23	2.10	-.03
27	.16	.24	.00	.06	2.02	2.46	2.04	2.11	2.04	.13	2.11	.00
28	.13	.59	.04	.14	2.03	2.48	2.05	2.13	2.04	.18	2.11	.04
29	-.01	.91	.09	.21	2.04	2.50	2.07	2.15	.29	.77	.88	.09
30	.01	1.08		.21	2.05	2.51	2.08	2.17	1.17	1.23	1.13	.15
31	.05	1.26		.58		2.52		2.20	1.66		.03	
MAX	.70	1.26	2.05	1.42	2.08	2.52	2.54	2.20	--	2.03	2.11	1.41

Table 6. Maximum daily water level at well W5 at Spring City, Tennessee, December 1, 1991 through November 30, 1992

[Water level in feet below land surface; MAX, maximum value for the month]

	1991	1992										
DAY	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
1	0.37	0.62	1.19	0.70	0.73	2.08	2.54	1.63	2.13	1.81	0.94	0.74
2	.38	.64	1.28	.75	.79	2.11	2.54	.69	2.15	1.93	1.04	.74
3	.43	.39	1.35	.81	.92	2.13	2.54	.48	2.17	1.97	1.13	.53
4	.48	.46	1.41	.87	1.17	2.16	1.78	.58	2.19	1.99	1.13	.53
5	.51	.52	1.49	.92	1.37	2.19	.72	.62	2.20	1.85	.49	.45
6	.54	.56	1.60	.68	1.48	2.22	.85	.51	2.22	1.83	.56	.51
7	.59	.59	1.70	.73	1.48	2.25	1.02	.59	2.24	1.97	.61	.56
8	.63	.61	1.82	.84	1.16	2.27	1.04	.72	2.26	2.00	.60	.60
9	.63	.56	1.93	.93	1.42	2.29	.79	.82	2.28	1.01	.67	.64
10	.48	.61	2.01	.93	1.62	2.31	.84	.94	2.29	1.14	.72	.69
11	.51	.64	2.11	.54	1.42	2.34	.94	1.08	2.31	.52	.79	.70
12	.55	.66	2.20	.56	1.32	2.36	.93	1.24	2.33	.59	.88	.70
13	.57	.64	2.25	.63	1.59	2.41	.93	1.45	2.35	.66	.96	.54
14	.45	.52	1.93	.67	1.77	2.44	.78	1.56	2.36	.77	1.05	.59
15	.52	.57	1.66	.73	1.90	2.46	.49	1.06	2.37	.84	1.21	.63
16	.56	.65	.81	.79	1.96	2.47	.57	1.27	2.39	.93	1.24	.67
17	.59	.71	.85	.93	1.98	2.48	.65	1.40	2.41	1.02	1.34	.71
18	.65	.71	.82	.93	2.00	2.49	.66	1.31	2.42	1.02	1.51	.74
19	.70	.79	.95	.48	2.03	2.52	.79	1.48	2.43	.49	1.65	.77
20	.73	.88	1.09	.54	2.06	2.53	.91	1.65	2.44	.54	1.79	.81
21	.75	.88	1.21	.59	2.06	2.53	1.06	1.79	2.46	.58	1.88	.81
22	.76	.87	1.33	.59	1.47	2.53	1.22	1.83	2.47	.59	1.99	.44
23	.73	.73	1.34	.56	1.68	2.54	1.39	1.96	2.49	.51	2.00	.47
24	.58	.61	.55	.61	1.83	2.54	1.57	1.96	2.50	.57	2.01	.47
25	.63	.64	.56	.61	1.92	2.54	1.58	2.00	2.51	.63	2.02	.40
26	.66	.68	.45	.53	1.97	2.54	1.60	2.02	2.53	.66	2.02	.47
27	.70	.71	.54	.60	1.99	2.54	1.75	2.03	2.53	.55	2.03	.51
28	.64	.77	.61	.65	2.01	2.54	1.90	2.05	2.53	.65	2.03	.54
29	.50	.83	.65	.66	2.04	2.54	1.99	2.07	1.18	.77	1.55	.58
30	.55	.91		.63	2.05	2.54	2.01	2.09	1.46	.86	1.53	.60
31	.59	1.05		.69		2.54		2.11	1.64		.63	
MAX	.76	1.05	2.25	.93	2.06	2.54	2.54	2.11	2.53	2.00	2.03	.81

Table 8. Water levels, in feet below land surface, at 2-inch-diameter wells at Spring City, Tennessee

[U/W, Well cap under water; --, Missing data; data in parentheses are water levels outside of the well casing; negative values indicate ponded conditions]

	Constructed wetland Well number												Natural wetland Well number							
Date	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G16	G17	G18	G19	G20
12/03/91	-0.14	-0.86	U/W	-0.56	-0.37	-0.53	-0.06	-0.36	-0.29	0.47	-0.10	-0.48	0.10	-0.15	0.03	-1.19	0.15	-0.15	-0.27	-0.10
12/30/91	-.02	-.38	-0.62	-.09	.18	-.09	.48	-.08	.26	1.72	.34	.04	.20	.71	.10	-.94	.32	.88	.05	-.40
01/28/92	.34	-.02	-.65	.24	.42	.04	1.13	.30	.50	Dry	.73	.33	.87	1.38	1.21	-.75 (-.95)	.48	1.58	.58	-.25 (-.25)
02/03/92	1.28	.54	-.16	1.00	1.18	.58	1.59	.60	1.10	Dry	1.45	1.02	1.37	1.87	Dry (.56)	-.35	.81	Dry	1.33 (-.06)	-.06
02/04/92	1.05	.55	-.13	1.01	1.18	.67	1.60	.80	1.12	Dry	1.48	1.04	1.21	1.86	Dry	-.34	.59	Dry	1.33	-.06
03/02/92	.11	.03	-.52 (-.57)	.29	.67	.18	1.22	.45	.66	Dry	.82	.41	.93	1.26	1.02	-.80 (-.97)	-.33	1.47	.61	.33 (.33)
04/02/92	.87	.23	-.46 (-.55)	.44	.93	.50	1.40	.53 (.01)	.83	1.82	1.01	.64	1.14	1.66	1.51	-.57 (.01)	.60	1.75	1.01	-.29 (-.29)
04/17/92	Dry	1.15	.28 (-.37)	1.35	1.60	1.21	2.03	0.86	1.59	Dry	1.84	1.45	1.81	Dry	Dry	.20 (-.20)	1.55	Dry	1.79	0-.01
05/13/92	1.80	1.78	.87 (-.23)	1.71	1.91	1.61	Dry	1.87	Dry	Dry	Dry	1.86	1.94	Dry	Dry	Dry	Dry	Dry	1.66	1.35
06/10/92	.33	.25	-.57 (-.61)	.02	.31	.03	1.24	.54	.57	1.80	.47	.21	.30	1.35	.69 (-.04)	-.97 (-.97)	.61	.97	.37	-.21 (-.21)
07/14/92	Dry	1.57	.72 (-.33)	1.84	Dry	1.69	Dry	1.75	Dry	Dry	Dry	1.89	Dry	2.06	Dry	-.28 (-.39)	Dry	Dry	Dry	-.12 (-.15)
08/05/92	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	.65
08/26/92	Dry	Dry	1.72	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	1.65	.96
09/24/92	.05	-.07	-.68 (-.63)	.19	.46	.11	.87	.26	.47	1.72	.39	.22	.45	.87	.27	-1.05 (-1.09)	2.61	.64	.34	-.47 (-.47)
10/07/92	.24	-.03	--	.20	.46	.11	1.17	.36	.62	Dry	.57	.23	.88	1.20	.47	-1.01 (-1.04)	1.01	.98	.42	-.44 (-.43)

Table 9. Daily mean stage at the stream gage on Town Creek at Spring City, Tennessee, December 1, 1991 through November 30, 1992

[Stage in feet above gage datum; MEAN, monthly mean of daily mean values; MAX, maximum mean daily value for the month; MIN, minimum mean daily value for the month]

	1991	1992										
DAY	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
1	3.06	1.41	1.1	1.38	1.30	1.03	0.92	1.08	0.94	0.94	1.00	1.11
2	3.12	1.43	1.15	1.33	1.25	1.02	.91	1.48	.93	.93	.99	1.58
3	2.92	3.01	1.14	1.30	1.19	1.01	.98	1.56	.93	.94	.98	1.44
4	1.94	2.22	1.14	1.28	1.17	1.01	1.45	1.44	.93	.94	1.20	2.11
5	1.67	1.85	1.13	1.25	1.15	1.00	1.20	1.46	.92	.93	1.30	1.76
6	1.54	1.69	1.12	1.27	1.14	.99	1.11	1.55	.93	.93	1.22	1.56
7	1.44	1.56	1.11	1.24	1.15	.99	1.07	1.40	.92	.91	1.18	1.45
8	1.36	1.49	1.08	1.20	1.13	1.05	1.05	1.30	.92	1.08	1.15	1.36
9	1.59	1.48	1.07	1.19	1.12	1.02	1.09	1.23	.91	1.02	1.13	1.30
10	1.65	1.39	1.07	1.80	1.10	.99	1.06	1.18	.91	1.09	1.10	1.27
11	1.53	1.34	1.06	1.67	1.14	.98	1.00	1.14	.91	1.09	1.08	1.27
12	1.45	1.32	1.05	1.56	1.13	.98	1.00	1.10	.90	1.04	1.07	1.47
13	1.55	1.39	1.08	1.47	1.10	.97	1.01	1.08	.91	1.02	1.05	1.41
14	2.18	1.61	1.08	1.41	1.09	.97	2.28	1.11	.91	1.00	1.03	1.35
15	1.79	1.50	1.31	1.36	1.09	.96	1.82	1.10	.90	.99	1.02	1.30
16	1.62	1.43	1.28	1.31	1.08	.95	1.53	1.06	.89	.98	1.02	1.25
17	1.52	1.39	1.26	1.28	1.06	.95	1.38	1.04	.89	.97	1.01	1.22
18	1.41	1.35	1.25	1.45	1.05	.94	1.29	1.04	.89	1.22	1.00	1.19
19	1.35	1.31	1.22	1.58	1.05	.95	1.23	1.01	.89	1.13	.99	1.16
20	1.30	1.28	1.19	1.57	1.08	.94	1.18	1.00	.88	1.07	.98	1.14
21	1.27	1.26	1.17	1.50	1.21	.94	1.13	.98	.88	1.04	.98	1.35
22	1.24	1.24	1.15	1.51	1.16	.93	1.09	.99	.93	1.13	.97	1.97
23	1.37	1.38	1.38	1.50	1.14	.93	1.07	.99	.93	1.13	.97	1.81
24	1.37	1.34	1.48	1.43	1.13	.93	1.05	.98	.90	1.09	.96	1.91
25	1.32	1.32	1.54	1.44	1.13	.92	1.04	.97	.89	1.06	.96	2.00
26	1.29	1.29	1.78	1.50	1.10	.92	1.04	.97	.89	1.05	.96	1.79
27	1.26	1.27	1.67	1.44	1.09	.92	1.01	.97	.90	1.06	.97	1.64
28	1.66	1.25	1.56	1.39	1.07	.92	.99	.96	1.26	1.04	1.04	1.53
29	1.71	1.23	1.46	1.37	1.06	.96	.98	.96	.99	1.02	.99	1.44
30	1.58	1.21		1.38	1.05	.96	1.01	.94	.96	1.01	1.08	1.38
31	1.48	1.19		1.34		.93		.94	.95		1.15	
MEAN	1.66	1.47	1.25	1.41	1.12	.97	1.17	1.13	.93	1.03	1.05	1.48
MAX	3.12	3.01	1.78	1.80	1.30	1.05	2.28	1.56	1.26	1.22	1.30	2.11
MIN	1.24	1.19	1.05	1.19	1.05	.92	.91	.94	.88	.91	.96	1.11

Table 10. Daily rainfall at Spring City, Tennessee, December 1, 1991 through November 30, 1992

[Rainfall in inches; --, missing data; e, estimated value]

	1991	1992										
DAY	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
1	e2.10	e0.00	e0.00	0.00	0.00	0.00	--	0.81	0.04	0.00	0.00	0.03
2	e3.00	e.00	e.00	.00	e.00	.00	--	1.11	.02	.21	.00	1.08
3	e1.37	e2.03	e.00	.00	e.00	.00	--	.55	.04	.03	.00	.00
4	e.00	e.46	.00	.00	e.00	.00	--	.00	.06	.30	1.74	1.36
5	e.00	e.00	.00	.25	e.00	.00	--	.83	.04	.05	.02	.18
6	e.00	e.00	.04	.29	e.00	.00	--	.12	.10	.00	.00	.00
7	e.00	e.00	.00	.00	e.29	.43	--	.00	.01	.00	.01	.00
8	e.00	e.00	.00	.00	e.00	.39	--	.00	.00	1.10	.05	.01
9	e.04	e.11	.00	.00	e.00	.05	--	.00	.06	.00	.08	e.00
10	e.89	e.02	.00	1.11	e.11	.00	--	.00	.10	1.20	.03	e.00
11	e.00	e.00	.00	.00	e.40	.00	0.06	.00	.00	.01	.00	.00
12	e.00	e.00	.03	.00	e.00	.00	.01	.00	.01	.00	.00	.84
13	e.00	e.12	.37	.00	e.00	--	.21	.00	.40	.00	.00	.00
14	e1.60	e.81	.19	.00	e.00	--	2.45	.88	.00	.00	.00	.00
15	e.00	e.00	.68	.00	e.00	--	.00	.00	.00	.00	.01	.00
16	e.00	e.00	.00	.00	e.00	--	.00	.00	.00	.00	.05	.00
17	e.00	e.00	.07	.00	e.00	--	.00	.27	.08	--	.00	.00
18	e.00	e.00	.04	.61	.00	--	.02	.01	.00	--	.00	.00
19	e.00	e.00	.00	.36	.16	--	.00	.00	.00	--	.00	.00
20	e.00	e.00	.00	.00	.60	--	.00	.00	.00	--	.00	.00
21	e.00	e.00	.00	.00	.48	--	.01	.06	.26	--	.00	.80
22	e.00	e.00	.00	.39	.00	--	.00	.00	.65	--	.00	1.10
23	e.38	e.46	1.11	.00	.00	--	.00	.24	.26	--	.00	.00
24	e.63	e.13	.00	.00	.26	--	.12	.00	.00	--	.00	.67
25	e.00	e.00	.58	.47	.00	--	.03	.05	.00	--	.00	.43
26	e.00	e.00	.35	.02	.00	--	.07	.00	.00	--	.00	.00
27	e.00	e.00	.00	.00	.00	--	.00	.13	1.11	--	.44	.00
28	e.49	e.00	.02	.00	.00	--	.00	.00	.88	--	.57	.00
29	e.67	e.00	.02	.10	.00	--	.00	.00	.00	--	.00	.00
30	e.00	e.00		.08	.09	--	.74	.00	.00	.00	.88	.00
31	e.00	e.00		.00		--		.16	.00		.06	
TOTAL	11.17	4.14	3.50	3.68	2.39	--	--	5.22	4.12	--	3.94	6.50