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A Reconnaissance of the Winyah Bay Estuarine Zone South Carolina

By

F. A. Johnson

Prepared by
U. S. Geological Survey, Water Resources Division
in cooperation with
South Carolina Water Resources Commission
Columbia, South Carolina
1970

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ABSTRACT

The Winyah Bay estuarine zone in this report consists of Winyah Bay, the Black River estuary, the Pee Dee River estuary and the Waccamaw River estuary. The specific conductance of the Winyah Bay estuarine zone is related to tides and fresh-water inflow. A specific conductance of 800 micromhos has been set as the boundary or interface between fresh and salt water. The fresh water upstream from the salt-water interface is of suitable chemical quality for most purposes, as shown in the tables of the chemical and physical characteristics of the fresh-water inflow.

The location of the salt-water interface normally varies about 4 miles between high and low tides. At high tide during periods when fresh-water inflow is 3000 cfs (cubic feet per second) or less, the front moves about 16 miles upstream from mile 0.0 of the Waccamaw and Pee Dee Rivers. The interface penetrates to about 5 miles above mile 0.0 of those rivers under average conditions of fresh-water inflow (15,000 cfs) and tide.

INTRODUCTION

Purpose and Scope of the Investigation

This report summarizes the results of a reconnaissance of the hydrology of the Winyah Bay estuarine zone made during December 1969 to May 1971. The principal purpose of the investigation was to determine the chemical and physical characteristics of the water and to relate, if possible, the specific conductance to tidal conditions and fresh-water inflow.

Cooperation

The investigation was part of a cooperative program between the U.S. Geological Survey and the South Carolina Water Resources Commission, Mr. Clair P. Guess, Executive Director.

CHARACTERISTICS OF ESTUARINE WATERS

An estuary has been defined by Pritchard (1967) as a semi-enclosed coastal body of water that has a free connection with the open sea and within which sea water is measurably diluted with fresh water derived from land drainage. An estuary is generally considered to extend from the river mouth upstream to that point at which tidal fluctuations no longer affect the water-surface elevation of the river.

Many factors determine the nature of an estuary: tides, currents, fresh-water inflow, sea level, wind, depth, temperature of both sea water and river water, evaporation, and amount of rainfall are some of the important factors. Because of the large number of factors, conditions are highly variable throughout an estuary.

The body of salt water in an estuary has a composition that reflects the quantity and quality of the waters that mix. Because salt water has a greater density than fresh water, it is often found to be moving inland as a more dense current along the bottom of a channel, while the less dense fresh water moves seaward at the surface. This temporary condition usually occurs just before or right after slack-tidal periods.

The amount of fresh-water inflow to an estuary has a limiting effect on the salt-water intrusion; for any given tidal stage, the greater the fresh-water inflow, the farther downstream the salt will be found. If there is appreciable fresh-water inflow to an estuary, the salt-water interface becomes a salt-water wedge caused by the less-dense fresh water overriding the salt water until they mix completely. The wedge is positioned so that its greatest upstream advance is along the bottom of the channel. In this stratified condition, the water in a vertical section has the least salt content at the surface and becomes progressively more salty with depth. When fresh-water inflow is high (40,000 cfs, for example), the trailing edge of the wedge at the water surface may be a mile or more downstream from the leading edge. During periods of low fresh-water inflow (2000 cfs, for example), the wedge is almost non-existant, and the salt-water interface is nearly vertical, exhibiting little or no stratification. In general, a higher fresh-water inflow causes greater stratification; also, it requires less distance in the downstream direction for complete mixing. Figure 1 illustrates typical positions of the salt-water wedge for three fresh-water inflow conditions.

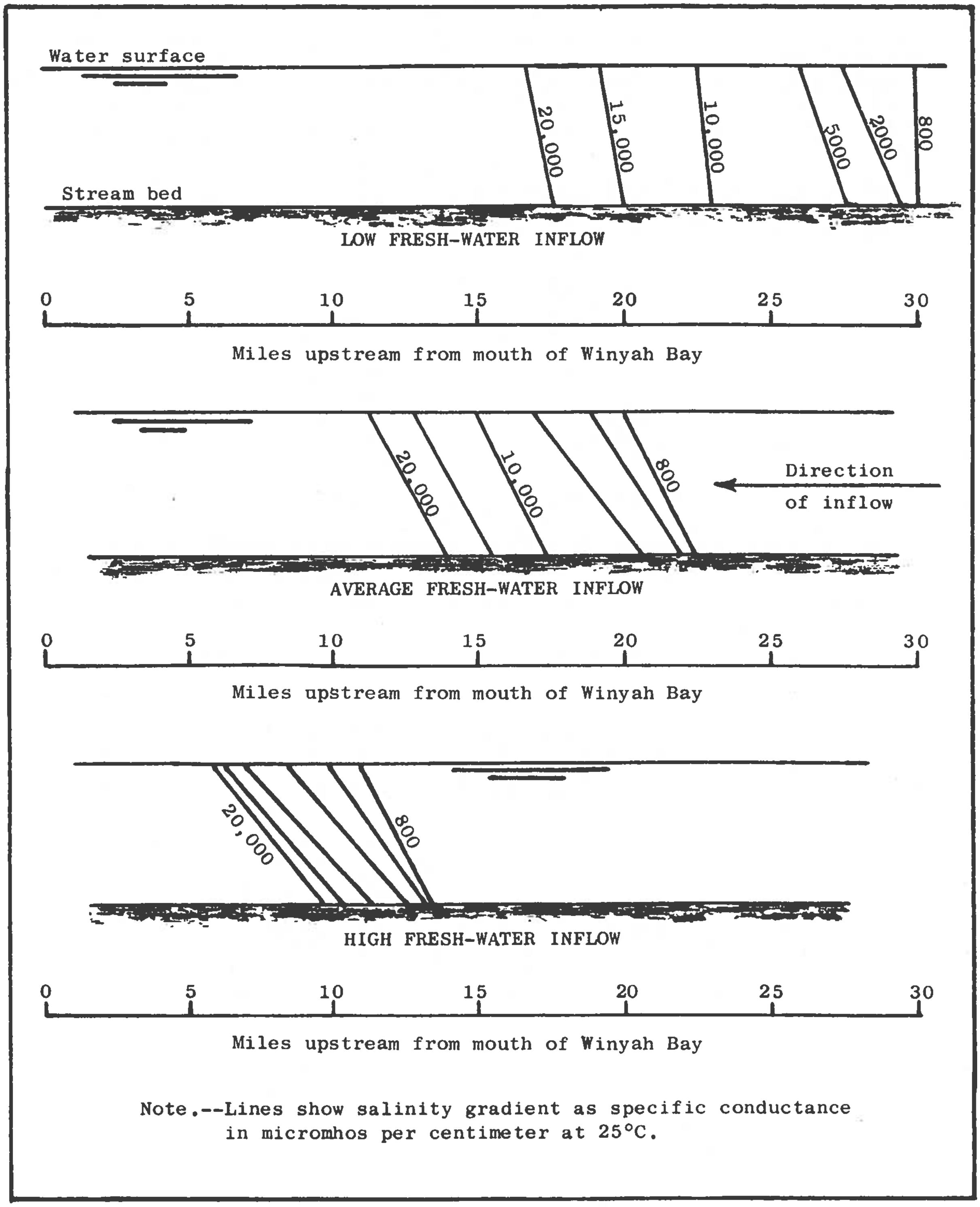


Figure 1. Effect of fresh-water inflow at high-slack tide in Winyah Bay estuarine zone.

DESCRIPTION OF THE WINYAH BAY ESTUARINE ZONE

Location

Figure 2 is a map of the Winyah Bay estuarine zone showing its drainage in South Carolina and the location of the study area. This zone includes the estuarine parts of the Black River basin, the Pee Dee River basin, the Waccamaw River basin, and Winyah Bay. These basins lie between the Cape Fear River basin, N.C. to the north, and the Santee River basin to the south. The 14 South Carolina counties that are drained totally or in part by this stream system are as follows:

Chesterfield	Kershaw
Clarendon	Lancaster
Darlington	Lee
Dillon	Marion
Florence	Marlboro
Georgetown	Sumter
Horry	Williamsburg

The Black River estuary extends inland to the vicinity of Andrews; the Pee Dee estuary extends inland about 5 miles upstream from the mouth of the Little Pee Dee River; and the Waccamaw River estuary extends about 12 miles upstream from Hammond, S.C. In river miles, the maximum upstream point at which there is a tidal effect has been estimated to be mile 46 for the Black River, mile 38 for the Pee Dee River, and mile 82 for the Waccamaw River (Col. Robert E. Rich, Corps of Engineers, U.S. Army, Charleston, S.C., written commun., 1966).

Swamps border much of these estuaries. Numerous tributaries enter and many of them may be connected with the estuary at more than one location. These tributaries have small drainage areas and yield only local runoff to the estuary.

Bathymetry

On December 1-3, 1969, bottom profiles through mile 20.0 of the main channels of the Black, Pee Dee, and Waccamaw River estuaries were mapped by a recording fathometer. Most profiles for Winyah Bay were based on U.S. Coast and Geodetic Survey Chart No. 787, except the profile for Winyah Bay at mile 10.0 (Frazier Point), which was obtained during a tidal-discharge measurement February 4, 1971.

Figure 3 is a map of the estuarine zone showing mile points and water-quality stations. Mile 0.0 of the Waccamaw and Pee Dee Rivers corresponds to mile 14.0 of Winyah Bay, and mile 0.0 of the Black River corresponds to mile 3.0 of the Pee Dee River.

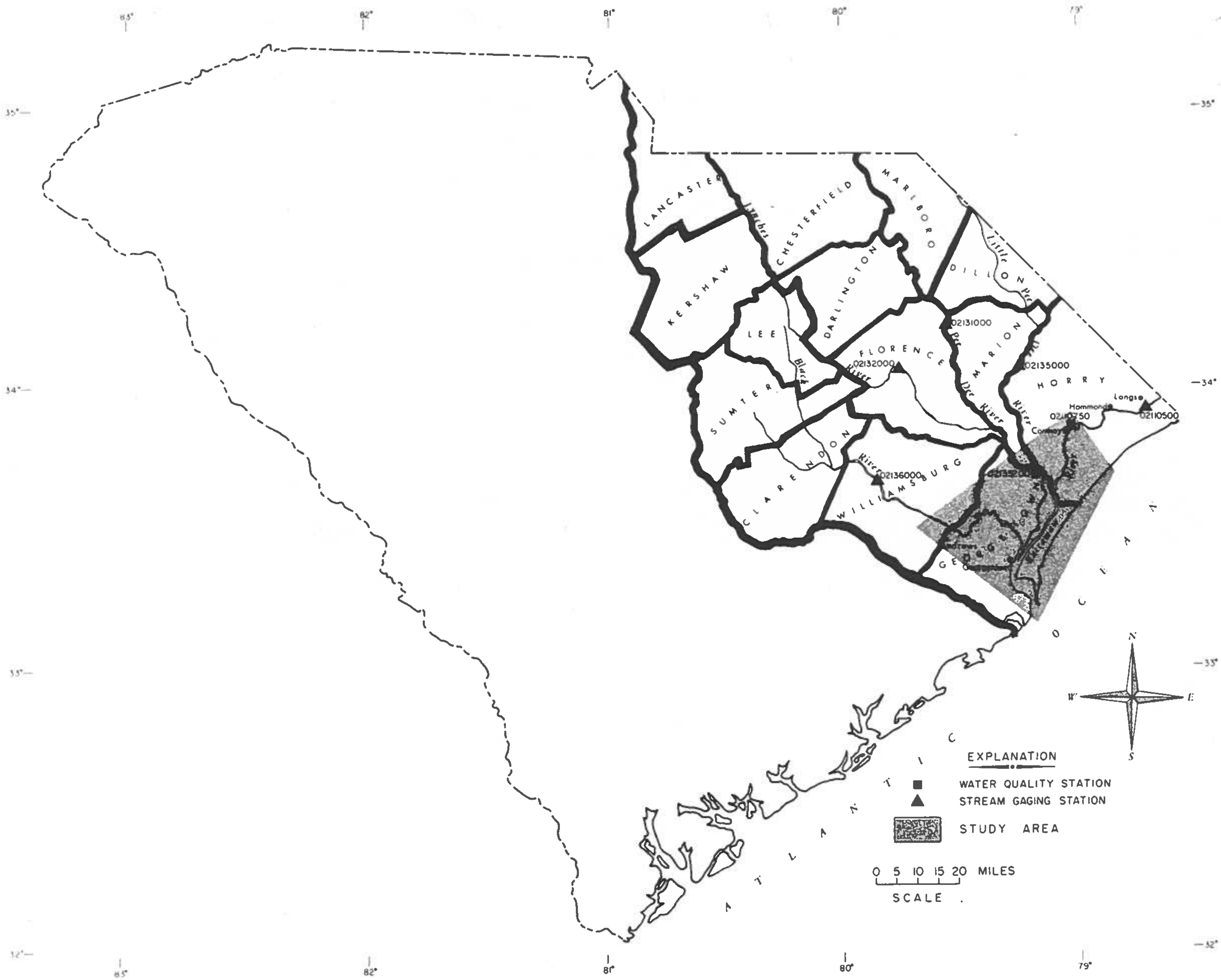
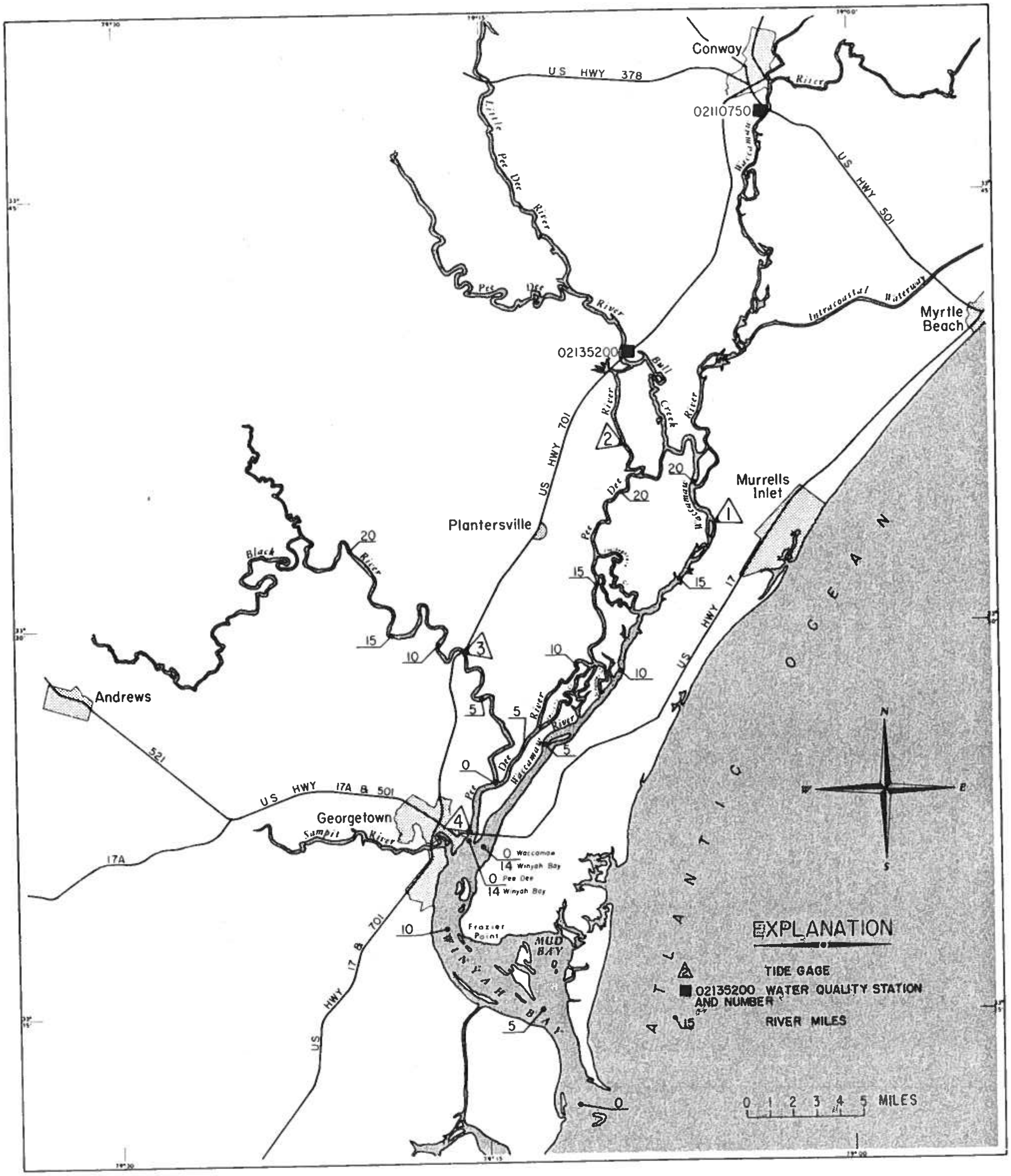


Figure 2. Winyah Bay Estuarine Zone and its drainage in South Carolina.


Conway
US HWY 378
02110750
US HWY 501
Little Pee Dee River
Pee Dee River
Waccamaw River
Intracoastal Waterway
Myrtle Beach
02135200
Bull Creek
US HWY 701
Murrells Inlet
Plantersville
Black River
US HWY 17
ATLANTIC OCEAN
Andrews
521
US HWY 17A & 501
Georgetown
Sampit River
17A
0 Waccamaw
14 Winyah Bay
0 Pee Dee
14 Winyah Bay
Frazier Point
MUD BAY
WINYAH BAY
US HWY 17 & 701
EXPLANATION
TIDE GAGE
02135200 WATER QUALITY STATION AND NUMBER
RIVER MILES
0 1 2 3 4 5 MILES

Figures 4-7 are selected cross-sections as viewed if looking downstream; the water surface elevations are those at mean high tide at each location. The sections show the Waccamaw channel to be wider than the Pee Dee channel and generally deeper; the Waccamaw channel from mile 0.0 to mile 28.0 is a section of the Intracoastal Waterway. Most of the fresh-water discharge of the Pee Dee River moves through Bull Creek (at Pee Dee mile 27.8), Thoroughfare Creek (at Pee Dee mile 16.3), Schooner Creek (at Pee Dee mile 11.2), and other connecting channels into the Waccamaw channel instead of entering Winyah Bay directly.

The Black River channel in its lower reaches is also generally wider and deeper than that of the Pee Dee. The Black River channel frequently transports more fresh water toward Winyah Bay than the Pee Dee channel downstream from Schooner Creek. One of the National Aeronautics and Space Administration color infra-red photographs (frame 3793, experiment 50-65, Apollo 9) shows that the Black River, which has a high color caused by organic material, dominates after entering the Pee Dee channel. The photograph was taken at low tide from an altitude of 116 miles. The photograph also indicates that the waters of the Waccamaw and Pee Dee Rivers do not mix until reaching a point a mile or more below Frazier Point in Winyah Bay. A submerged ridge extending two-thirds the distance from Waccamaw Point (between Waccamaw and Pee Dee Rivers at mile 0.0) to Frazier Point probably restricts lateral movement within the channel.

TIDAL CONDITIONS

Tide gages were established at four locations (fig. 3) in the Winyah Bay estuarine zone in October 1969, which are listed below:

Site Number	Station Name	Location
1	Waccamaw River near Murrells Inlet, S.C.	Lat 33°33'37", long 79°05'07", Georgetown County, on left bank on wooden pier of marina at Wachasaw Landing, 2.5 miles east of Murrells Inlet, and at mile 18.
2	Pee Dee River near Plantersville, S.C.	Lat 33°36'37", long 79°09'10", Georgetown County, on right bank on wooden pier at Lower Topsaw Landing, 5.2 miles northeast of Plantersville, and at mile 23.7.
3	Black River near Plantersville, S.C.	Lat 33°28'45", long 79°16'18", Georgetown County, on left bank or wooden pier 100 yards downstream from U.S. Highway 701 bridge over Black River, 6.1 miles southeast of Plantersville, and at mile 8.1.

Figure 4. Cross-sections of Winyah Bay at mean high tide (facing downstream).

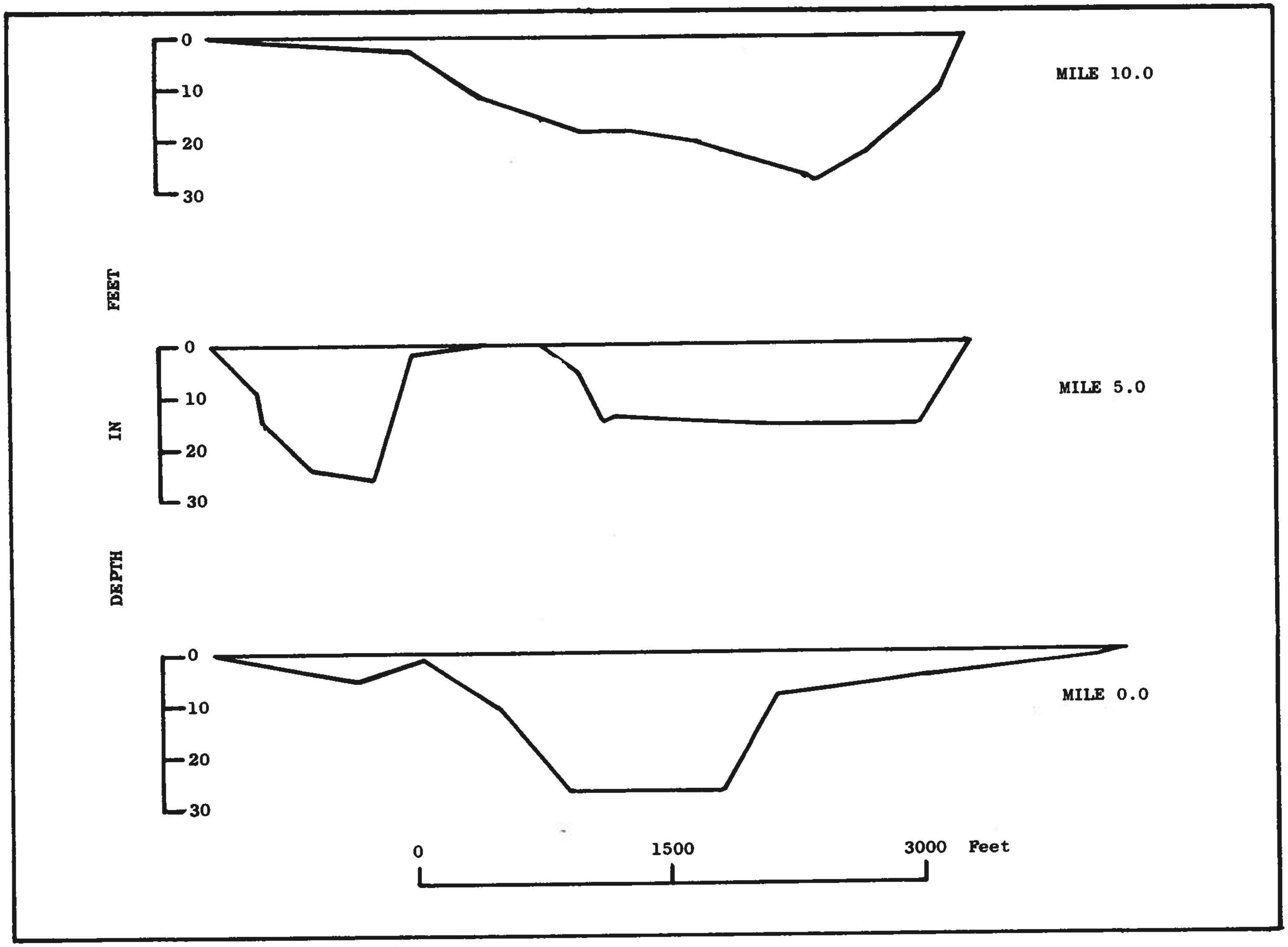


Figure 4. Cross-sections of Winyah Bay at mean high tide (facing downstream).

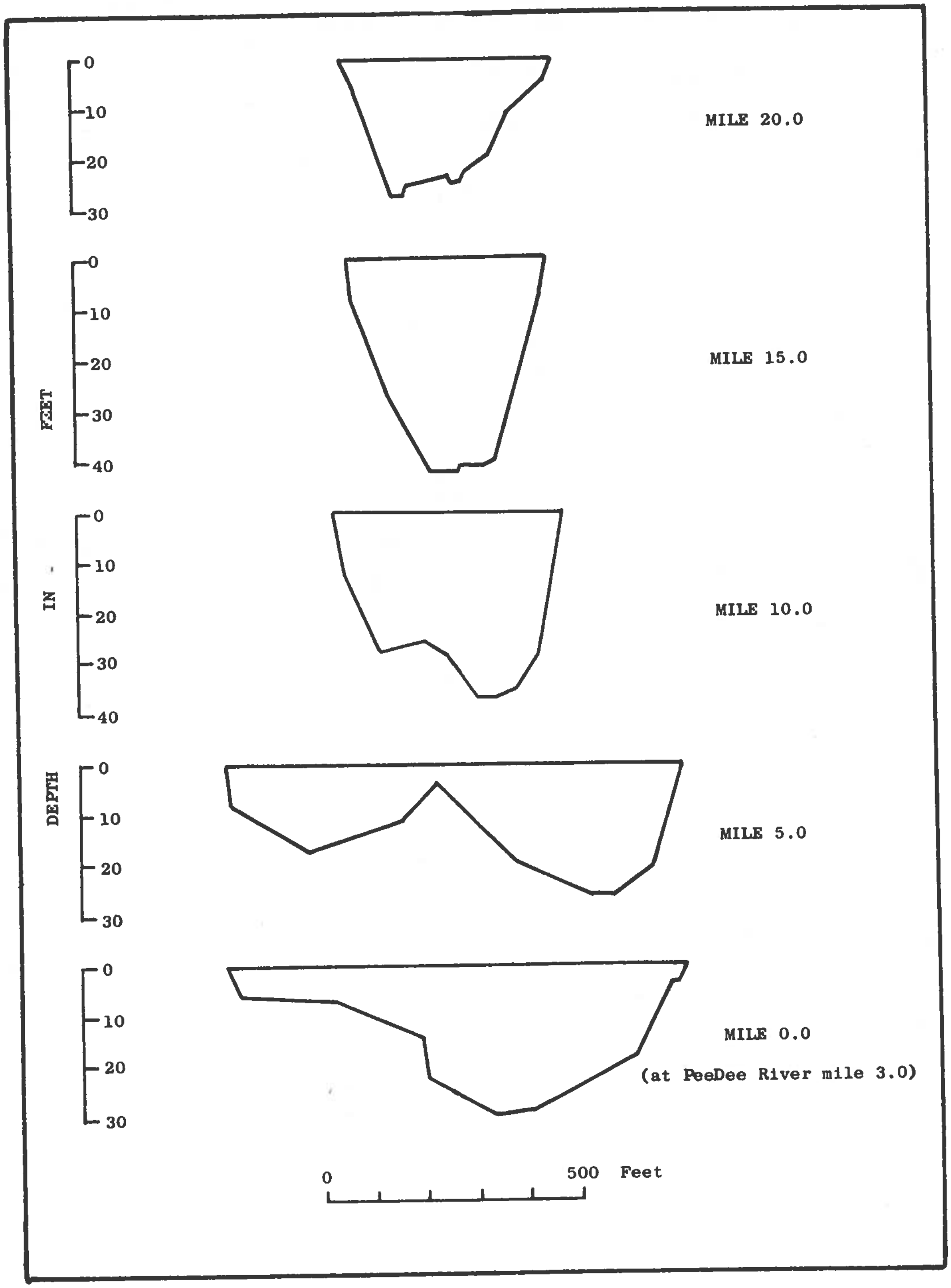


Figure 5. Cross-sections of Black River at mean high tide (facing downstream).

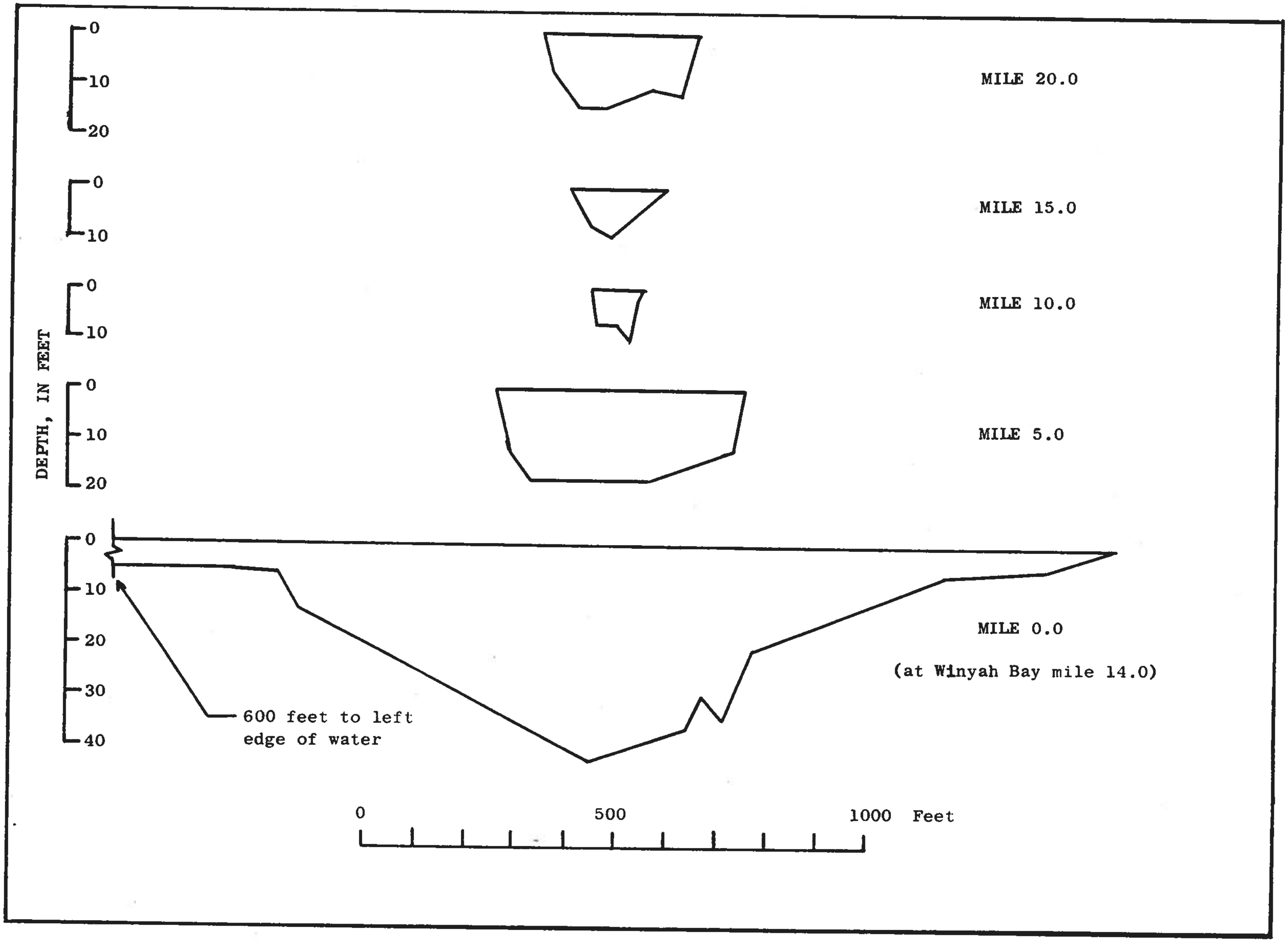


Figure 6. Cross-sections of PeeDee River at mean high tide (facing downstream).

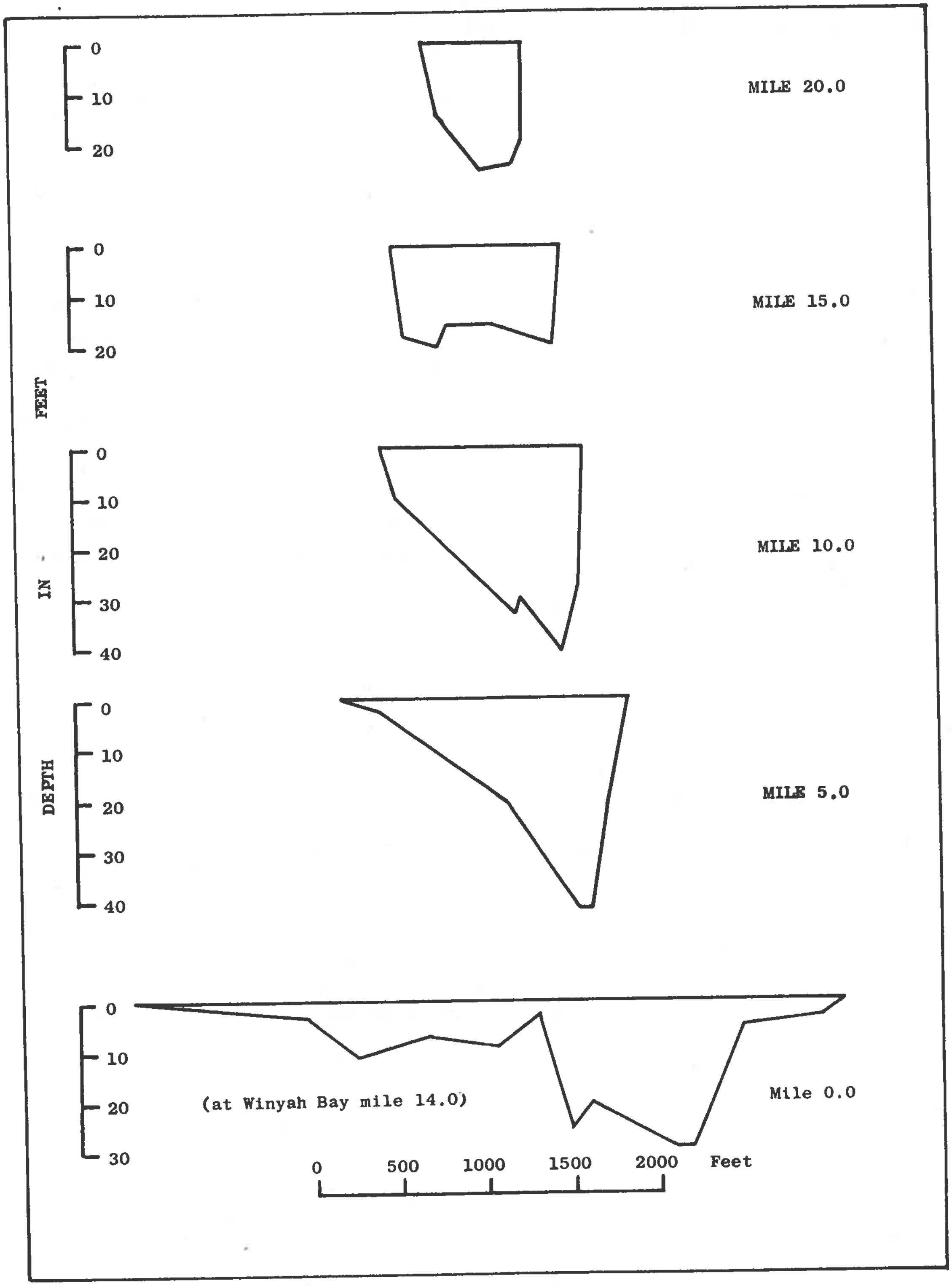


Figure 7. Cross-sections of Waccamaw River at mean high tide (facing downstream).

Figure 7. Cross-sections of Waccamaw River at mean high tide (facing downstream).

Site Number	Station Name	Location
4	Pee Dee River at Georgetown, S.C.	Lat 33°22"11', long 79°15'58", Georgetown County, near right bank on upstream side of discontinued bridge upstream from U.S. Highway 17 bridge over Pee Dee River at Georgetown, and at mile 0.6.

Pee Dee River at Georgetown, S.C., and Waccamaw River near Murells Inlet, S.C., are subordinate stations of the U.S. Coast and Geodetic Survey. A subordinate station is one where tide predictions can be obtained by applying established differences to the time and tide height given for a reference station. For these two subordinate stations, the reference station is located in Charleston Harbor. Although predicted times and heights are accurate under normal conditions, winds and variations in fresh-water discharge cause deviations in accuracy.

Tide heights for the Charleston reference station may be converted to tide heights for Pee Dee River at Georgetown (site 4) by applying a ratio of 0.63 to the predicted height of high and low tides for Charleston. The time conversion is made by adding 1 hour and 34 minutes to the predicted time of low tide in Charleston Harbor or by adding 2 hours and 35 minutes to the predicted time of high tide.

Tide heights and times for the Charleston reference station may be converted to heights and times for Waccamaw River near Murrells Inlet (site 1) by applying a ratio of 0.56 to the predicted height of high and low tides for Charleston, adding 3 hours and 6 minutes to the predicted time of high tide, and adding 4 hours and 8 minutes to the predicted time of low tide.

The times of high and low tides at the Black River station (site 3) lag those of the Pee Dee River at Georgetown station (site 4) by about 1 hour and the tidal amplitude is reduced by about 20 percent.

The times of high and low tides at the Pee Dee River near Plantersville station (site 2) lag those of the Georgetown station (site 4) by about 3 hours. The tidal height and amplitude at this site is governed largely by fresh-water inflow; therefore, no relationship in this respect has been made with the Georgetown gaging station. Generally, the tidal amplitude is only 1 or 2 feet, which is reduced to only a few tenths of a foot when the Pee Dee River is in flood.

SALINITY CONDITIONS

The U.S. Naval Oceanographic Office defines salinity as "a measure of the quantity of dissolved salts in sea water. It is formally defined as the total amount of dissolved solids in sea water in parts per thousand ($^0/_{00}$) by weight when all the carbonate has been converted to oxide, the bromide and iodide to chloride, and all organic matter is completely oxidized. These qualifications result from the chemical difficulty in drying the salts in sea water. In practice, salinity is not determined directly but is computed from chlorinity, electrical conductivity [specific conductance], refractive index, or some other property whose relationship to salinity is well established." In this reconnaissance, salinity was determined by measuring the specific conductance in micromhos per centimeter at 25°C. Specific conductance is a measure of the ability of water to conduct an electric current and is related to the amount of dissolved solids in solution.

Figure 8 shows the relation of salinity in parts per thousand to specific conductance in micromhos at 25°C. Data used in preparing figure 8 are those of Cox (1965). The mean monthly salinity of sea water off the Atlantic Coast at Myrtle Beach, S.C. has ranged from 32.5 $^0/_{00}$ to 35.5 $^0/_{00}$ (U.S. Coast and Geodetic Survey, 1965). This salinity range corresponds to a specific-conductance range of 50,000 to 54,000 micromhos. However, specific conductance ranging from 60,000 to 65,000 micromhos was determined from samples taken near the bottom of Winyah Bay from mile 5.2 to 6.0 January 28, 1971 (table 1).

During this reconnaissance, periodic measurements of specific conductance were made usually at 1-mile intervals in the Winyah Bay estuarine zone. The reach in which most of the measurements were made extended from water having a specific conductance of several thousand micromhos to water having a specific conductance of less than 100 micromhos. Most measurements were made at either high or low tide near the time of slack water. At each mile point where a measurement was made, specific conductance was determined from surface to bottom, usually at 2-foot intervals. Data obtained are given in tables 1-4.

An arbitrary specific conductance value of 800 micromhos has been selected to represent the salt-water interface because water having less specific conductance is generally suitable for most purposes.

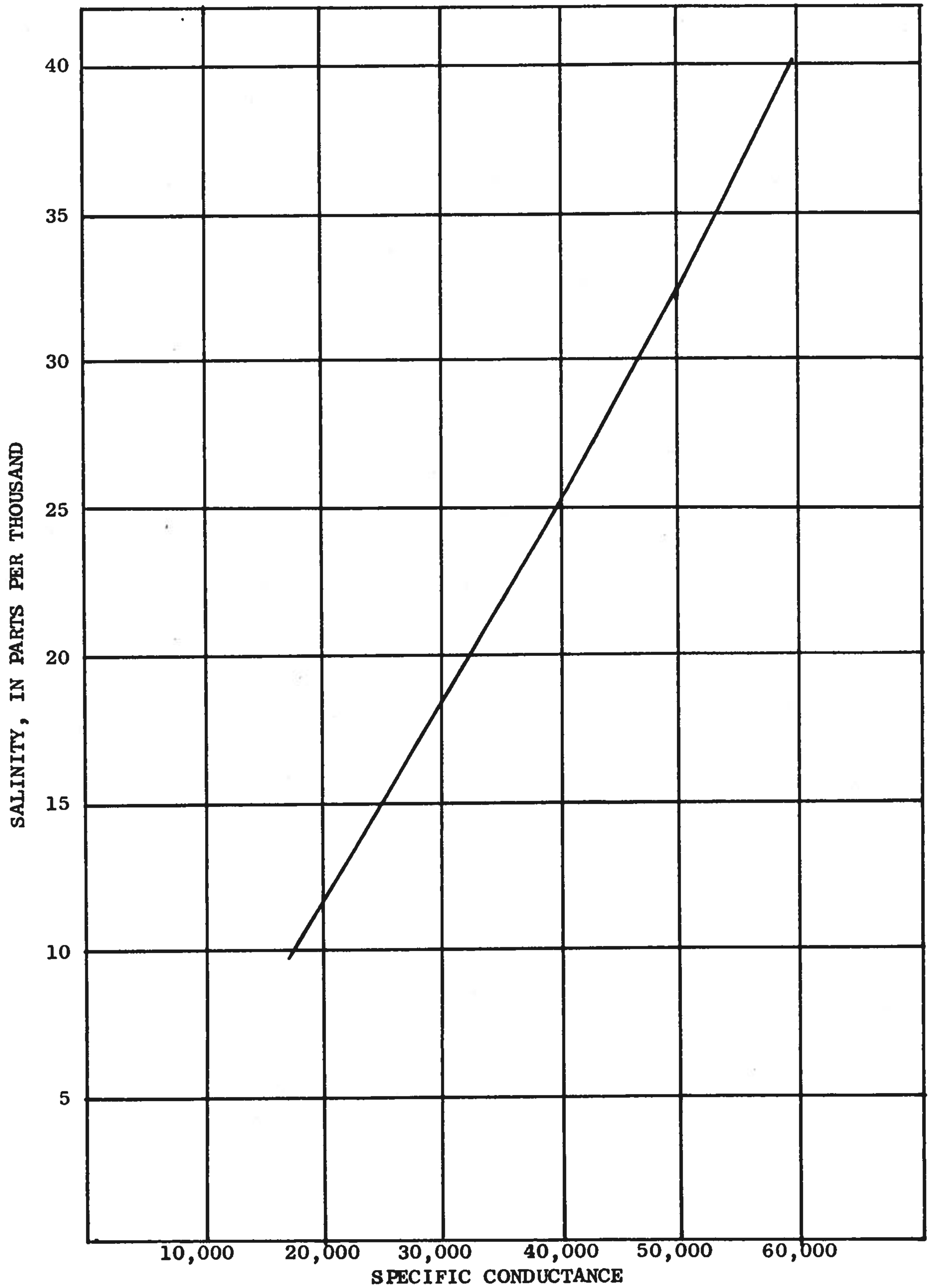


Figure 8. Relation between salinity and specific conductance at 25°C (Data from Cox, 1965).

Effect of the Tide on the Salt-water Interface

The location of the salt-water interface in an estuary is controlled principally by tides. On a semidiurnal basis, the interface moves up the estuary during flood (incoming) tide, and recedes during ebb (outgoing) tide. The distance travelled between high and low tides depends primarily on the height of the tide, the fresh-water inflow, and the estuary depth. Because of intertia, the mass of water will continue its upstream or downstream movement for a short time after high or low tides. For any given high tide, therefore, the maximum intrusion of the salt-water interface generally will occur at high-slack tide, and the minimum intrusion generally will occur at low-slack tide. Generally, the higher the tide, the farther upstream the interface will move if the fresh-water inflow remains fairly constant. The movement of the interface between high and low tides in the Winyah Bay estuarine zone is about 4 miles under average conditions.

Effect of Fresh-water Inflow on the Salt-water Interface

The U.S. Geological Survey operates five stream-gaging stations (fig. 2) on rivers whose combined discharge makes up nearly all the fresh-water inflow to Winyah Bay. In this report, the combined discharge at these gaging stations will be considered as total fresh-water inflow to Winyah Bay. Discharge records for these gaging stations may be found in the annual publications of the U.S. Geological Survey. The U.S. Geological Survey's downstream order number precedes the five gaging stations listed below:

02110500	Waccamaw River near Longs
02131000	Pee Dee River at Peedee
02132000	Lynches River at Effingham
02135000	Little Pee Dee River at Galivants Ferry
02136000	Black River at Kingstree

Fresh-water inflow to Winyah Bay ranges from about 2000 cfs during dry periods to about 100,000 cfs during major floods. The Pee Dee River at Peedee contributes about 60 percent of the average fresh-water inflow (15,000 cfs) to Winyah Bay. This does not take into account such unusual events as the flood of September 1945, when a discharge of 220,000 cfs was recorded at Pee Dee River at Peedee, or the minimum flow of 700 cfs that occurred at Peedee during the severe drought of 1954.

An estimate of total fresh-water inflow to Winyah Bay may be made by relating the average discharge of Pee Dee River at Peedee for a period of days to the average total discharge of the above stations for the same period of days. A relationship, based on monthly averages, is shown in figure 9. Figure 10 shows the relationship between Lynches River at Effingham and total inflow to Winyah Bay. These relationships may be used for estimating total inflow to Winyah Bay when averaging flow for as few as 4 consecutive days. An estimate based on only 1 or 2 days, however, would probably be unreliable because of variations in local conditions.

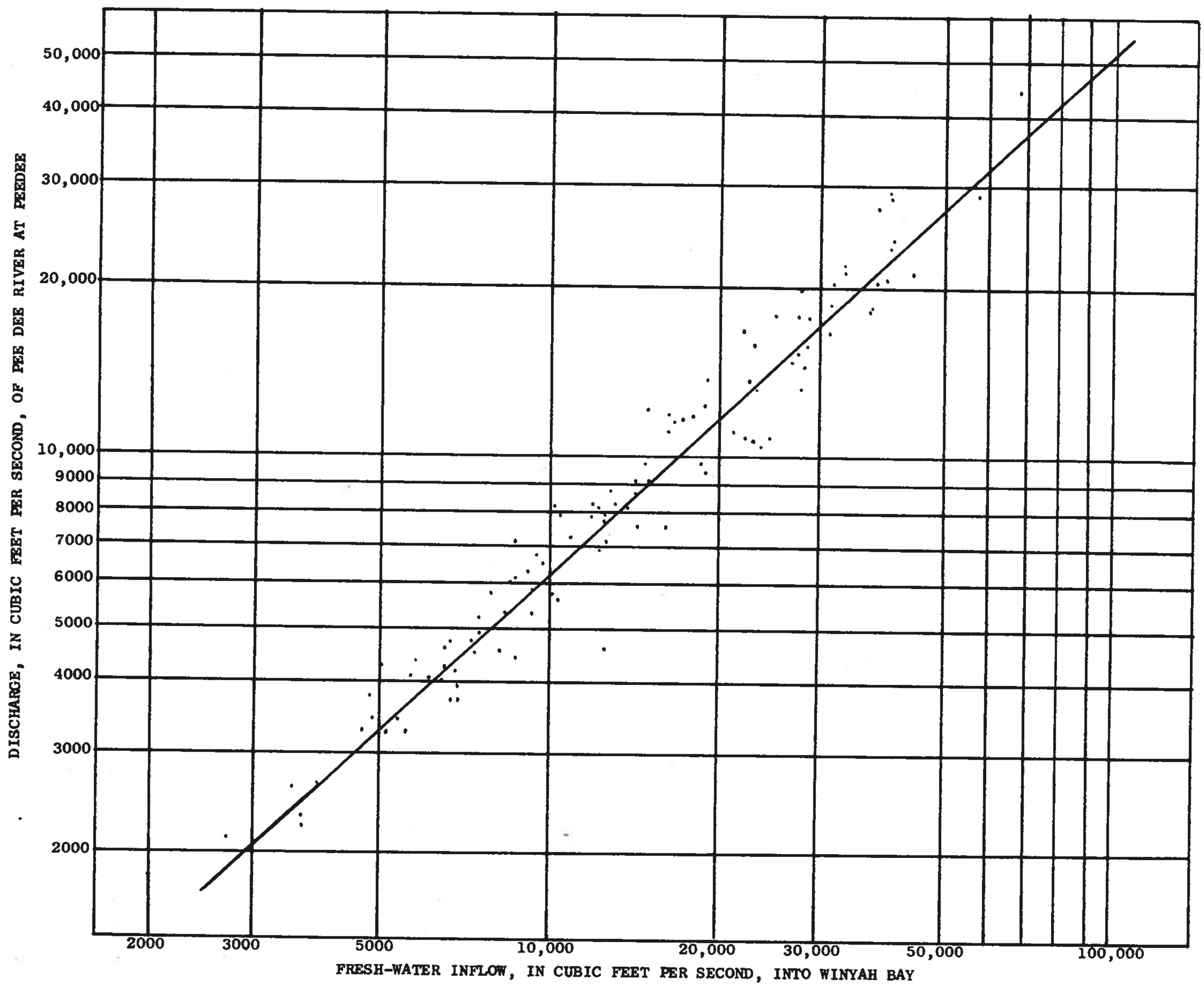


Figure 9. Relation of discharge of Pee Dee River at Peedee to fresh-water inflow into Winyah Bay.

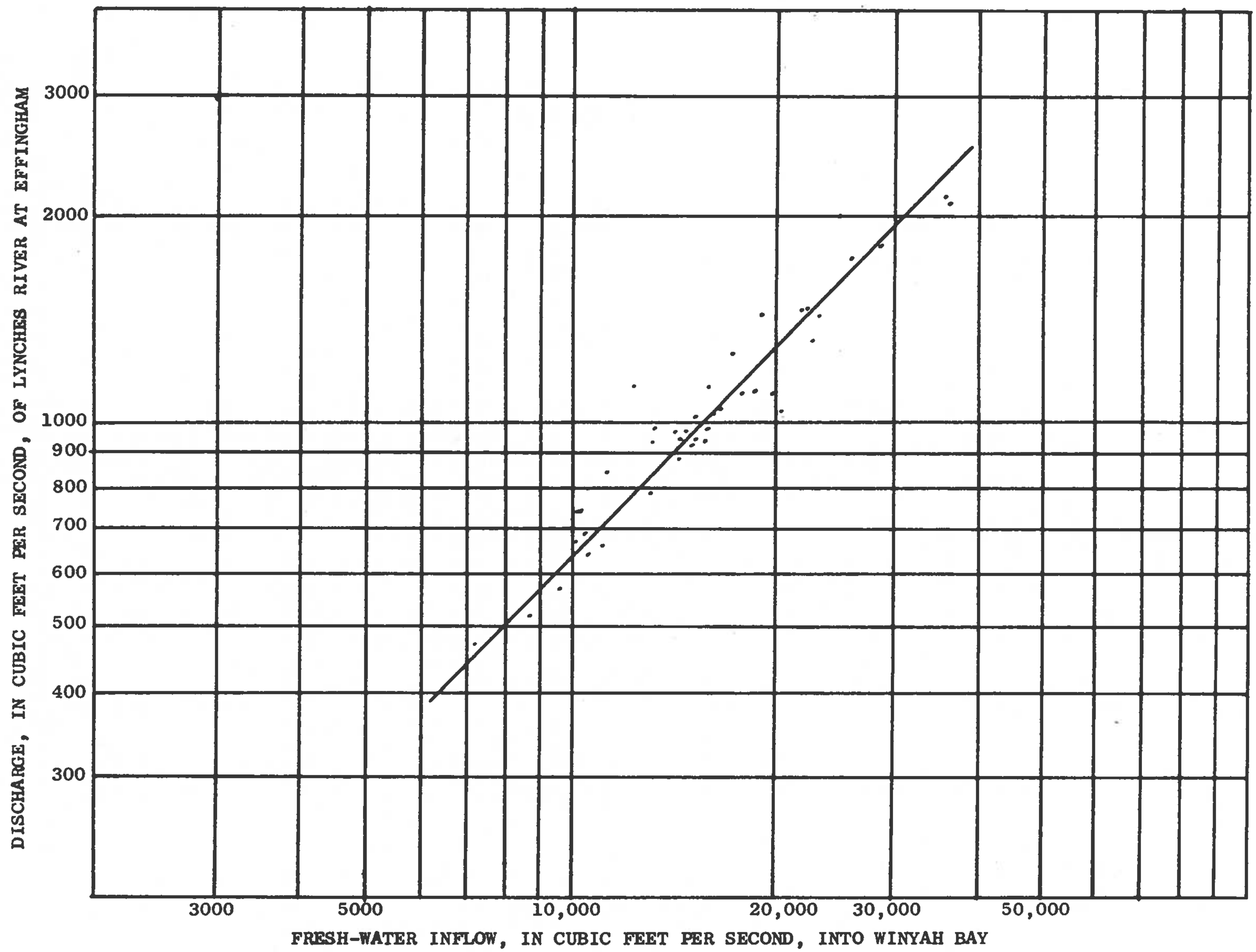


Figure 10. Relation of discharge of Lynches River at Effingham to fresh-water inflow into Winyah Bay.

Because the Pee Dee and Waccamaw Rivers are interconnected by numerous channels, the salt-water interface (800 micromhos) moves approximately the same distance into either river. It also moves into the Black River a distance corresponding to that on the Pee Dee and Waccamaw Rivers; i.e., when the interface is at mile 5.0 on the Pee Dee and Waccamaw Rivers at high tide, it is at mile 2.0 on the Black River. At mean high tide during low inflow of about 3000 cfs, the interface may penetrate as far as mile 16.0 on the Pee Dee and Waccamaw Rivers and mile 13.0 on the Black River; during a flood inflow of 35,000 cfs or more the interface will not advance beyond Winyah Bay river mile 14.0.

Figure 11 indicates the relationship between fresh-water inflow and location of the leading edge of selected specific conductances at mean high tide. Any two known variables in figure 11 may be used to estimate the third; however, the most significant use is in locating the salt-water interface. For example, if the inflow is estimated to be 15,000 cfs at mean high tide, a specific conductance of 800 micromhos is located at mile 19.6. Although figure 11 was constructed to represent conditions at mean high tide, it is also valid under other tidal conditions for determining the relative distance between differing specific conductances. That is, under other tidal conditions, the slope and separation of the specific-conductance curves should remain about the same, although their relationship to the location in miles above the mouth of Winyah Bay will vary (given equitable fresh-water inflow). Therefore, at other than mean high tide, if the location of any specific conductance is known and the inflow is known, the location of other specific conductances can be estimated. For example, estimate the location of 800 micromhos when, at other than mean high tide, a specific conductance of 10,000 micromhos is measured at mile 14.0 and the inflow is 15,000 cfs. The distance between the locations of 10,000 micromhos and 800 micromhos at 15,000 cfs is 4.0 miles; therefore, 800 micromhos would be located at mile 18.0.

CHEMICAL AND PHYSICAL CHARACTERISTICS

Vertical profiles of dissolved oxygen and temperature were measured in each river and in Winyah Bay. However, the dissolved-oxygen readings were obtained only during the winter. There was very little temperature or dissolved-oxygen variation in the vertical sections from 1 foot below the surface to 1 foot above the bottom. The dissolved oxygen content ranged from 8.5 to 11.8 mg/l (milligrams per liter), and the average was 10.0 mg/l. In no case was the range in excess of 1.0 mg/l from top to bottom; although, generally, the dissolved-oxygen content was higher near the surface. Dissolved-oxygen saturation ranged from 75 to 95 percent. Assuming the same range in percentage saturation, if the dissolved oxygen content had been measured during the summer, it would have ranged from 5.9 to 7.3 mg/l. The measured temperature ranged from 6.0°C in winter to 30.0°C in summer.

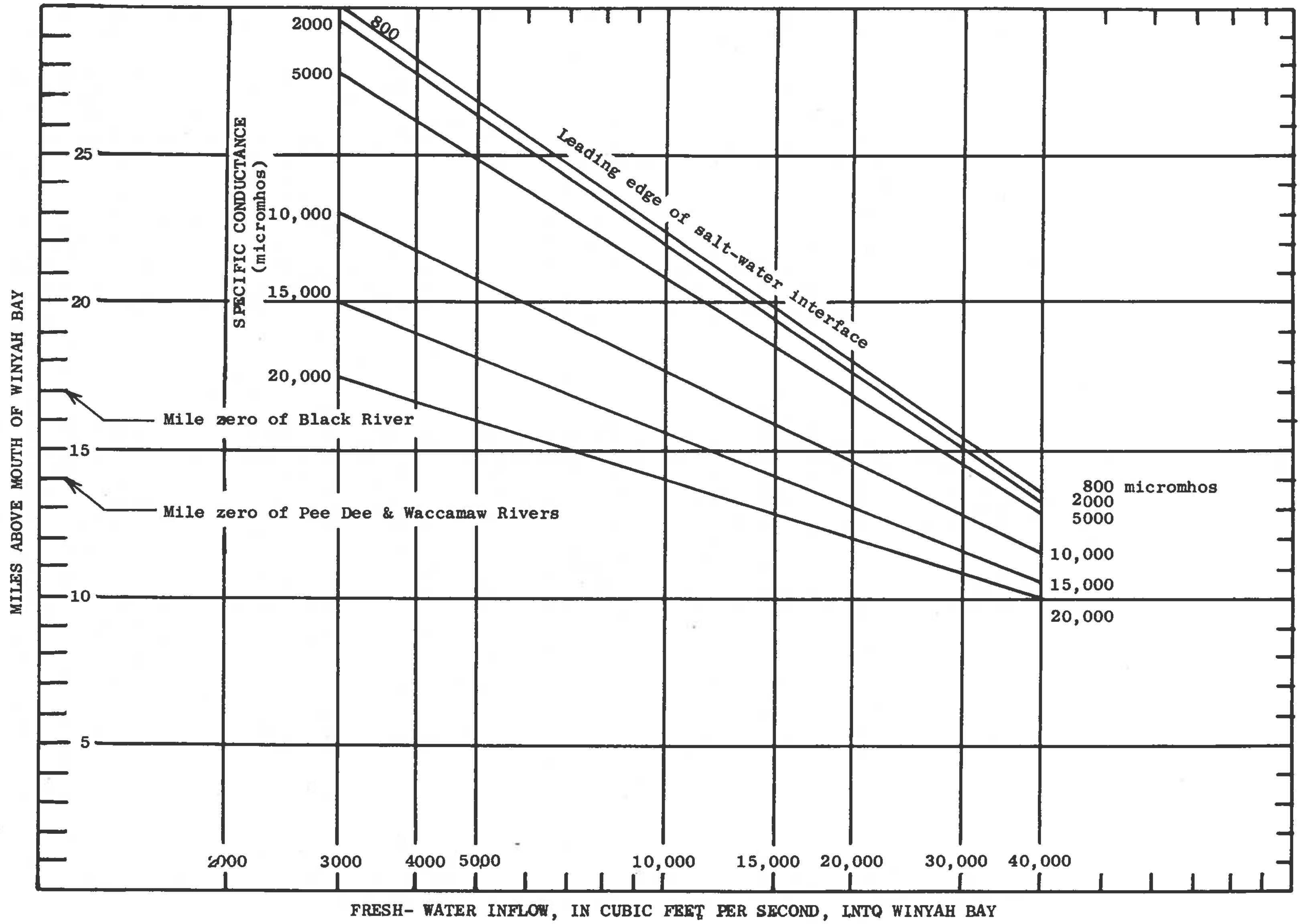


Figure 11. Bottom specific conductance values at high-slack tide in Winyah Bay estuarine zone.

Samples of bed sediments of Winyah Bay were collected at mile 9.3 May 4, 1971, and at mile 11.6 May 25, 1971. The results indicated low pesticide content at both sites; the lower values occurred at mile 9.3. These pesticide analyses are given in table 5. Samples of bed sediments were collected at mile 9.3 and at mile 11.6 May 25, 1971, for trace-metals analyses, which are given in table 6. One water sample collected for herbicide analyses at mile 9.3 May 25, 1971, indicated only a trace of 2,4-D and 2,4,5-T.

Other water samples were collected at upstream locations of the rivers (fig. 1) emptying directly or indirectly into Winyah Bay. Maximum and minimum values of dissolved substances and physical properties and the period during which the samples were collected for four of these sites are listed in table 7. Analyses for two other sites (fig. 2), including radiochemical data, are listed in tables 8 and 9.

The data indicates that the quality of fresh water entering Winyah Bay is suitable for most agricultural, industrial, and domestic purposes.

SUMMARY

Total fresh-water inflow into Winyah Bay from the Black, Pee Dee, and Waccamaw Rivers ranges from about 2000 cfs during dry weather to about 100,000 cfs during major floods. Average fresh-water inflow is about 15,000 cfs, with the Pee Dee River contributing the greatest proportion of this amount.

At high tide during periods of average fresh-water inflow, the salt-water interface (a specific conductance of 800 micromhos) reaches mile 2.0 on the Black River, mile 5.0 on the Pee Dee River, and mile 5.0 on the Waccamaw River. At low tide, the interface is about 4 miles farther downstream. When the inflow is 35,000 cfs or more, the salt-water interface does not advance beyond the mouths of Waccamaw and Pee Dee Rivers at high tide. During periods of low fresh-water inflow (about 3000 cfs), the front may move upstream as far as mile 16.0 on the Pee Dee and Waccamaw Rivers and as far as mile 13.0 on the Black River.

Chemical analyses indicate that the fresh-water inflow to the Winyah Bay estuarine zone is of good quality and suitable for most agricultural, industrial, and domestic uses. Bed sediments of Winyah Bay are relatively unpolluted by pesticides, although some trace metals were found.

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Table 1.--Field measurements of specific conductance (in micromhos at 25°C) of Winyah Bay at high tide

Date	Depth (feet)	mile 6.0	mile 7.0	mile 8.0	mile 9.0	mile 10.0	mile 11.0	mile 12.0
2-26-70	1	26,000	2,700	1,500	1,350	2,450	2,480	1,720
	3	27,000	2,800	1,500	2,650	-	-	1,800
	5	30,200	3,550	3,300	3,000	-	-	1,880
	7	35,000	16,800	18,000	4,600	-	-	1,950
	10	41,000	28,000	20,000	16,200	-	4,200	2,500
	12	44,500	31,500	25,000	17,600	-	-	2,800
	14	45,000	38,000	27,000	19,500	-	-	3,600
	16	45,000	39,000	32,000	22,000	-	-	8,800
	18	45,000	39,500	35,000	23,000	-	-	15,500
	20	45,000	39,500	36,000	27,500	-	15,800	16,500
	22	45,000	39,500	36,000	29,500	-	-	17,000
	24	45,000	40,000	37,000	30,000	-	-	18,000
	26	45,000	40,000	37,000	30,000	22,100	20,600	19,000
	30	45,000	40,000	37,000	-	-	-	19,600
	34	-	-	37,000	-	-	-	19,600

Date	Depth (feet)	mile 0.0	mile 6.0
1-28-71	1	47,000	34,000
	5	47,000	42,000
	10	47,000	42,000
	15	47,000	42,000
	20	47,000	42,000
	25	47,000	42,000
	30	47,000	-
	35	47,000	-
	40	47,000	-
	49	47,000	-

Date	Depth (feet)	mile 8.0	mile 10.0	mile 12.0
1-28-71 (cont.)	1	8,300	6,000	5,200
	3	8,500	7,000	5,500
	5	9,100	8,000	5,800
	7	17,000	8,400	6,100
	10	30,000	10,200	6,300
	12	-	-	-
	13	38,000	11,700	6,500
	15	38,000	-	-
	17	38,000	19,500	9,300
	20	38,000	28,000	9,400
	22	38,000	28,000	9,400
	24	38,000	-	9,400
	28	38,000	-	9,400
	36	38,000	-	-

Date	Depth (feet)	mile 5.2	mile 6.0	mile 6.6	mile 7.0	mile 7.5
3-12-71	1	150	83	81	65	58
	-	-	-	-		-
	5	1,100	100	84	68	58
	7	-	300	-		-
	10	22,000	8,900	650	70	59
	12	-	17,000	1,300		-
	14	-	28,000	-		-
	15	48,000	-	18,000	90	60
	16	-	40,000	-	400	-
	20	61,000	55,000	47,000	12,000	61
	22	-	58,000	-	13,000	-
	25	-	60,000	47,000	29,000	63
	29	-	60,000	-	30,000	
	30	65,000	-	-	30,000	-

Date	Depth (feet)	mile 9.3	mile 10.3	mile 13.8
5-25-71	1	1,200	1,000	180
	5	1,300	1,050	-
	10	2,200	1,100	185
	15	8,500	5,000	-
	20	17,500	13,000	185
	25	19,500	14,500	-
	30	20,000	14,000	-
	35	-	-	190

Table 2.--Field measurements of specific conductance (in micromhos at 25°C) of Pee Dee River at high tide

Date	Depth (feet)	mile 0.0	mile 1.0	mile 2.0	mile 3.0	mile 4.0	mile 6.0	mile 8.0	mile 10.0	mile 12.0	mile 14.0
12-10-69	1	19,500	19,000	17,000	16,000	13,400	7,600	2,200	600	116	66
	3	20,000	19,500	17,300	16,000	13,500	7,600	2,200	600	116	66
	5	21,000	19,500	17,300	16,000	13,900	7,700	2,450	600	116	66
	7	21,000	19,500	17,300	16,000	14,100	7,700	2,550	640	116	66
	10	21,000	19,500	18,000	17,000	14,200	7,800	2,600	640	-	-
	12	21,000	19,500	18,000	17,000	14,200	7,800	-	-	-	-
	14	21,000	19,500	18,000	17,000	14,200	7,800	-	-	-	-
	16	21,000	19,500	18,000	17,000	14,200	8,000	-	-	-	-
	18	21,000	19,500	18,000	17,000	14,200	8,000	-	-	-	-
	20	21,000	19,500	18,000	17,000	-	-	-	-	-	-
	22	21,000	-	18,000	-	-	-	-	-	-	-
	24	21,000	-	18,000	-	-	-	-	-	-	-
	26	21,000	-	18,000	-	-	-	-	-	-	-
	28	21,000	-	18,000	-	-	-	-	-	-	-
	42	21,000	-	-	-	-	-	-	-	-	-

Date	Depth (feet)	mile 1.0	mile 4.0
2-25-70	1	97	76
	3	97	77
	5	98	78
	7	102	79
	10	103	80
	12	103	81
	14	105	81
	16	105	-

Date	Depth (feet)	mile 1.0	mile 2.0	mile 3.0	mile 4.0	mile 5.0	mile 6.0	mile 7.0
7-22-70	1	12,500	11,000	11,000	10,200	9,400	8,200	6,200
	3	12,500	11,000	11,000	10,200	9,400	8,200	6,500
	5	12,500	11,000	11,000	10,200	9,400	8,200	6,500
	7	12,500	11,000	11,000	10,200	9,400	8,400	6,500
	10	12,500	11,000	11,000	10,200	9,400	8,400	6,500
	12	12,500	11,000	11,000	-	9,400	8,400	6,500
	14	12,500	11,000	11,000	-	9,400	8,400	6,500
	16	-	11,000	-	-	9,400	-	-
	18	-	11,000	-	-	-	-	-
	20	-	11,000	-	-	-	-	-
	22	-	11,000	-	-	-	-	-

Date	Depth (feet)	mile 8.0	mile 9.0	mile 10.0	mile 11.0	mile 12.0
7-22-70 (cont.)	1	2,400	1,800	500	135	88
	3	2,500	1,700	500	135	85
	5	2,800	1,700	500	135	85
	7	2,800	1,700	-	130	-
	10	-	-	-	135	-

Date	Depth (feet)	mile 1.0	mile 2.0	mile 3.0	mile 4.0
8-20-70	1	1,600	1,000	190	190
	3	3,000	950	250	200
	5	3,200	1,400	240	210
	7	3,400	1,750	240	220
	10	3,800	2,000	240	-
	12	-	-	240	-
	14	4,200	2,300	240	-
	16	-	2,550	-	-
	18	-	-	-	-
	20	-	2,900	-	-

Table 2.--Field measurements of specific conductance (in micromhos at 25°C) of Pee Dee River at high tide (cont.)

Date	Depth (feet)	mile 5.0	mile 6.0	mile 7.0	mile 8.0
8-20-70 (cont.)	1	180	130	110	100
	3	180	130	108	100
	5	175	128	106	100
	7	170	125	105	102
	10	170	120	105	-
	12	170	120	105	-
	14	-	120	105	-

Date	Depth (feet)	mile 0.0	mile 1.0	mile 2.0	mile 3.0	mile 4.0
1-26-71	1	4,000	3,800	2,300	230	120
	3	5,000	4,000	2,400	230	120
	5	5,500	4,000	2,500	240	120
	7	6,000	4,000	2,500	230	120
	10	6,200	4,000	2,600	230	120
	12	6,200	4,000	2,600	240	-
	14	6,200	4,000	2,700	240	-
	16	6,200	4,000	2,800	240	-
	18	6,200	4,000	2,800	240	-
	20	6,200	-	2,800	-	-

Date	Depth (feet)	mile 5.0	mile 6.0
1-26-71 (cont.)	1	95	83
	3	97	85
	5	100	85
	7	100	85
	10	100	86
	12	105	87
	14	-	87

Table 3.--Field measurements of specific conductance (in micromhos at 25°C) of Waccamaw River at high tide

Date	Depth (feet)	mile 0.0	mile 1.0	mile 2.0	mile 3.0	mile 4.0	mile 5.0	mile 6.0	mile 7.0	mile 8.0	mile 10.0	mile 15.0
12-9-69	1	10,000	6,600	7,200	6,500	5,100	2,250	820	154	132	86	75
	3	10,900	8,800	7,750	7,100	5,500	2,500	1,500	154	-	-	-
	5	12,200	9,500	8,100	8,300	5,800	3,200	2,000	144	140	86	-
	7	13,000	10,400	8,300	8,700	5,900	4,000	2,200	144	-	-	-
	10	13,100	10,600	8,600	8,900	6,000	4,800	2,450	143	150	86	78
	12	13,100	10,800	8,600	8,900	6,150	4,900	2,750	143	-	-	-
	14	12,900	10,900	8,700	9,000	6,150	5,900	2,800	161	155	87	-
	16	12,700	10,900	8,700	9,000	6,200	5,900	2,800	180	-	-	-
	18	12,800	10,900	9,100	9,000	6,250	5,900	2,800	205	165	88	82
	20	13,000	10,900	9,100	9,000	7,000	5,900	2,900	205	-	-	-
	22	13,000	10,900	9,300	9,000	7,000	5,900	2,900	230	170	88	82
	24	13,100	10,900	9,500	9,000	7,000	5,900	2,900	240	-	-	-
	26	13,300	10,900	9,500	-	7,000	5,900	3,000	240	170	88	-
	28	13,400	10,900	9,500	-	7,400	5,900	3,000	240	-	-	-
	30	13,400	11,000	9,500	-	7,500	5,900	3,000	280	170	88	-
	32	13,600	11,000	9,500	-	7,500	5,900	3,000	280	-	-	-
	34	13,700	11,000	9,500	-	7,500	6,100	-	300	170	88	-
	36	13,700	11,100	-	-	-	6,100	-	-	-	-	-
	38	-	11,100	-	-	-	6,100	-	-	-	88	-
	40	-	-	-	-	-	6,100	-	-	-	88	-

Date	Depth (feet)	mile 0.0	mile 1.0
2-26-70	1	140	67
	3	140	68
	5	132	69
	7	122	69
	10	122	70
	12	195	70
	14	260	70
	16	340	71
	18	470	71
	20	850	72
	22	1,000	73
	24	1,400	73
	26	1,460	73
	28	1,460	73
	30	-	73
	32	-	73

Date	Depth (feet)	mile 0.0	mile 1.0	mile 2.0	mile 3.0	mile 4.0	mile 5.0	mile 6.0
7-23-70	1	17,500	14,000	12,000	13,000	9,000	6,500	6,500
	3	17,500	15,000	14,000	13,000	10,500	9,000	8,500
	5	18,000	16,500	15,500	13,000	11,000	9,500	9,000
	7	18,500	17,000	15,500	14,000	11,000	10,000	9,000
	10	19,000	17,000	16,000	14,000	11,000	10,000	9,000
	12	-	17,000	16,000	14,500	11,500	10,000	9,000
	14	-	17,000	16,000	15,000	11,500	10,500	9,000
	16	-	17,000	16,000	15,000	12,500	11,000	9,000
	18	-	17,000	16,000	15,000	13,000	14,000	9,000
	20	-	17,000	16,000	15,000	13,000	14,000	9,000
	22	-	17,000	16,000	15,000	13,500	14,000	9,000
	24	-	17,000	16,000	15,000	13,500	14,000	9,000
	26	-	17,000	-	-	13,500	14,000	-
	28	-	17,000	-	-	13,500	14,000	-
	30	-	17,000	-	-	-	14,000	-
	32	-	17,000	-	-	-	14,000	-
	34	-	17,000	-	-	-	14,000	-
	36	-	-	-	-	-	14,000	-
	38	-	-	-	-	-	14,000	-
	40	-	-	-	-	-	14,000	-

Table 3.--Field measurements of specific conductance (in micromhos at 25°C) of Waccamaw River at high tide (cont.)

Date	Depth (feet)	mile 7.0	mile 8.0	mile 9.0	mile 10.0	mile 11.0	mile 12.0	mile 13.0	mile 14.0
7-23-70 (cont.)	1	5,800	4,400	750	290	220	100	100	95
	3	5,800	4,400	700	290	220	100	100	95
	5	5,600	4,400	700	290	220	100	100	95
	7	5,600	4,400	650	290	220	110	100	95
	10	5,600	4,400	600	300	230	110	100	95
	12	5,600	4,500	550	300	230	110	100	95
	14	5,600	4,500	550	300	230	110	100	95
	16	5,600	4,500	550	300	230	110	100	95
	18	5,600	4,500	550	300	230	110	100	95
	20	5,600	4,800	550	300	230	120	100	95
	22	5,600	4,800	550	300	-	120	100	95
	24	5,600	4,800	-	300	-	120	105	95
	26	5,600	5,000	-	300	-	120	100	95
	28	5,600	5,000	-	300	-	120	100	95
	30	5,600	5,000	-	300	-	120	100	-
	32	-	5,000	-	300	-	120	100	-
	34	-	-	-	-	-	120	-	-

Date	Depth (feet)	mile 0.0	mile 1.0	mile 2.0	mile 3.0	mile 4.0
1-26-71	1	4,000	510	400	180	75
	3	4,000	510	420	190	77
	5	4,000	700	440	200	78
	7	4,200	900	440	200	78
	10	4,200	1,100	440	200	78
	12	4,700	1,100	440	210	78
	15	5,800	1,180	450	220	78
	18	5,800	1,200	450	240	78
	20	5,800	1,200	450	250	78
	22	5,800	1,250	450	250	78
	24	5,800	-	450	-	78
	26	-	-	450	-	78
	30	-	-	-	-	78

Table 4.--Field measurements of specific conductance (in micromhos at 25°C) of Black River at high tide

Date	Depth (feet)	mile 0.0	mile 1.0	mile 2.0	mile 3.0	mile 4.0	mile 5.0	mile 6.0	mile 7.0	mile 8.0	mile 9.0
12-11-69	1	6,300	5,100	5,400	5,000	3,200	1,080	700	450	128	97
	3	6,400	5,100	5,400	5,000	3,300	1,080	710	450	130	97
	5	7,200	5,200	5,400	5,000	3,300	1,100	710	450	130	97
	7	7,300	5,200	5,400	5,000	3,300	1,250	710	450	130	97
	10	7,500	5,200	5,400	5,000	3,300	1,310	720	450	130	97
	12	7,700	5,200	5,400	5,000	3,300	1,380	730	450	130	97
	14	7,800	5,300	5,400	4,900	3,300	1,400	730	450	130	97
	16	7,800	5,300	5,400	4,900	3,300	1,400	730	450	130	97
	18	7,800	5,300	5,400	4,900	3,300	1,400	730	450	130	97
	20	7,800	5,300	5,600	-	3,300	1,360	750	-	130	97
	22	7,800	5,300	5,600	-	3,300	1,360	750	-	130	97
	24	7,800	5,400	5,700	-	3,300	1,360	750	-	126	98
	26	7,800	5,400	5,700	-	3,300	1,360	750	-	126	97
	28	-	-	-	-	-	-	-	-		

Date	Depth (feet)	mile 0.0	mile 1.0	mile 2.0	mile 3.0	mile 4.0	mile 5.0	mile 6.0	mile 7.0	mile 8.0	mile 9.0	mile 10.0
7-22-70	1	11,000	12,000	11,500	11,000	9,200	6,500	5,400	4,000	1,200	550	340
	3	11,500	12,000	11,500	11,000	9,000	6,700	5,400	4,000	1,200	580	340
	5	12,000	12,000	11,500	11,000	9,000	7,000	5,400	4,000	1,200	580	340
	7	12,000	12,000	11,500	11,000	9,000	7,000	5,600	4,000	1,200	600	340
	10	12,000	12,000	11,500	11,000	9,000	7,000	5,600	4,000	1,200	600	340
	12	12,000	12,000	11,500	11,000	9,000	7,000	5,600	4,000	1,200	600	340
	14	12,000	12,000	11,500	11,000	9,000	7,000	5,600	4,000	1,200	600	330
	16	12,000	12,000	11,500	11,000	9,000	7,000	5,800	4,000	1,200	600	300
	18	12,000	12,000	11,500	11,000	9,000	7,000	5,800	-	1,200	600	300
	20	-	12,000	11,500	-	9,000	7,000	5,800	-	1,200	600	300
	22	-	-	11,500	-	9,000	-	5,800	-	1,200	600	300
	24	-	-	-	-	-	-	-	-	1,200	600	300
	26	-	-	-	-	-	-	-	-	1,200	600	300
	28	-	-	-	-	-	-	-	-	-	600	300

Date	Depth (feet)	mile 11.0	mile 12.0	mile 13.0	mile 14.0	mile 15.0
7-22-70 (cont.)	1	210	140	110	95	85
	3	200	140	110	95	85
	5	190	140	110	95	85
	7	190	140	110	95	85
	10	190	140	110	95	85
	12	190	140	110	95	85
	14	190	140	110	95	85
	16	190	140	110	95	85
	18	190	140	110	95	85
	20	190	140	110	95	-
	22	190	140	110	95	-
	24	190	140	110	95	-
	26	190	140		95	-

Date	Depth (feet)	mile 0.0	mile 1.0	mile 2.0
1-28-71	1	138	110	80
	3	138	110	80
	5	140	110	80
	7	148	110	80
	10	150	113	86
	12	150	-	86
	14	150	-	86
	16	150	115	86
	18	150	-	86
	20	148	108	89
	22	148	110	-
	24	143	110	-
	26	143	110	-

Table 5.--Pesticide analyses of Winyah Bay bottom sediments
(Results in micrograms per kilogram. Analyses by U.S. Geological Survey.)

Sampling Site	Date and Time	Aldrin	DDD	DDE	DDT	Dieldrin	Endrin	Heptachlor	Lindane
Winyah Bay at mile 11.6	5-25-71 1030	0.0	4.2	3.4	0.0	9.1	0.0	0.0	0.0
Winyah Bay at mile 9.3	5-4-71 1100	0.0	0.4	0.0	0.0	1.1	0.0	0.0	0.0

Table 6.--Trace metals analyses of Winyah Bay bottom sediments (May 25, 1971)
(Results in micrograms per kilogram. Analyses by U.S. Geological Survey.)

Sampling Site	Copper (Cu)	Manganese (Mn)	Zinc (Zn)	Iron (Fe)	Arsenic (As)	Cadmium (Cd)	Chromium (Cr^{+6})	Lead (Pb)	Mercury (Hg)
Winyah Bay at mile 11.6	7.6×10^4	2.7×10^5	9.2×10^4	3.8×10^7	8.0×10^3	0	0	1.6×10^4	6.3×10^1
Winyah Bay at mile 9.3	4.8×10^4	7.2×10^5	9.2×10^4	4.8×10^7	1.2×10^4	0	0	4.0×10^3	8.8×10^1

Table 7.--Maximum and minimum values of dissolved substances and physical properties of selected surface waters of South Carolina
(Results in milligrams per liter except as indicated. Analyses by U.S. Geological Survey)

Period of Record	Maximum or Minimum	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids: Calculated	Dissolved Solids: Residue on evaporation at 120°C	Hardness as $CaCO_3$: Calcium Magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific Conductance (micromhos at 25°C)	pH units	Color (platinum-cobalt units)
					02131000 Pee Dee River at Peedee, S.C.														
1948-71	Maximum	12	0.45	6.1	2.5	20	3.5	46	10	12	0.4	2.2	81	84	22	4	124	7.3	90
	Minimum	3.0	.00	2.9	.8	2.4	.6	15	.8	2.3	.0	.0	31	38	12	0	47	5.9	2
					02132000 Lynches River at Effingham, S.C.														
1946-71	Maximum	10	0.78	5.0	2.4	19	2.7	28	12	33	0.3	2.7	79	102	20	12	150	7.7	110
	Minimum	2.3	.00	1.4	.0	2.7	.4	6	.8	3.0	.0	.0	23	28	6	0	30	5.8	5
					02135000 Little Pee Dee River at Galivants Ferry, S.C.														
1946-71	Maximum	13	0.45	3.2	1.3	6.1	1.2	9	7.7	8.5	0.3	2.9	38	67	11	6	60	6.3	200
	Minimum	.7	.01	1.0	.2	2.4	.4	4	.0	1.5	.0	.1	12	32	5	0	34	5.3	45
					3 Black River near Planterville, S.C.														
1962-66	Maximum	11	0.52	6.6	3.2	28	2.7	29	9.4	45	0.2	2.7	110	133	28	16	490	9.3	200
	Minimum	2.4	.05	3.0	.5	3.7	.7	10	1.2	4.9	.0	.0	29	48	11	0	40	5.9	40

Table 8.--Dissolved substances and physical properties of Pee Dee River near Conway, S.C.

Date	Type*	Temperature (°C)	Dissolved Iron (Fe)(mg/l)	Bicarbonate (HCO_3)(mg/l)	Sulfate (SO_4)(mg/l)	Chloride (Cl)(mg/l)	Fluoride (F)(mg/l)	Nitrate (NO_3)(mg/l)	Dissolved Solids (residue at 180°C) (mg/l)	Specific Conductance (micromhos)	pH (units)	Color(platinum-cobalt units)	Hardness(Ca,Mg) (mg/l)	Noncarbonate Hardness (mg/l)
7-24-69	L	-	-	-	-	-	-	1.6	-	-	-	-	-	-
	F	27.9	-	-	-	-	-	-	-	60	6.6	-	-	-
8-27-69	L	-	-	-	-	-	-	.7	-	-	-	-	-	-
	F	24.0	-	-	-	-	-	-	-	50	6.1	-	-	-
9-30-69	L	-	-	-	-	-	-	1.1	-	-	-	-	-	-
	F	21.5	-	-	-	-	-	-	-	83	6.7	-	-	-
10-29-69	L	16.7	-	20	6.8	9.4	0.2	1.6	66	73	6.5	100	18	2
	F	16.7	-	-	-	-	-	-	-	75	7.0	-	-	-
11-20-69	L	10.7	-	-	-	-	-	1.7	-	-	-	-	-	-
	F	10.7	-	-	-	-	-	-	-	75	7.0	-	-	-
12-18-69	L	6.5	-	-	-	-	-	1.1	-	-	-	-	-	-
	F	6.5	-	-	-	-	-	-	-	95	7.1	-	-	-
1-23-70	L	2.8	-	-	-	-	-	1.2	-	-	-	-	-	-
	F	2.8	-	-	-	-	-	-	-	68	7.0	-	-	-

Date	Type*	Carbonate (CO_3)(mg/l)	Dissolved Oxygen (mg/l)	Total Phosphorus (P)(mg/l)	Dissolved Manganese (Mn)(µg/l)	Total Chromium (Cr)(µg/l)	Copper (Cu)(µg/l)	Lead (Pb) (µg/l)	Nickel (Ni)(µg/l)	Radiochemicals				Methylene Blue Active Substance (mg/l)
										Dissolved Alpha(pc/l)	Suspended Alpha(pc/l)	Dissolved Beta(pc/l)	Suspended Beta(pc/l)	
7-24-69	L	-	-	0.040	-	-	-	-	-	-	-	-	-	-
	F	-	4.7	-	-	-	-	-	-	-	-	-	-	-
8-27-69	L	-	-	.040	-	-	-	-	-	-	-	-	-	-
	F	-	4.3	-	-	-	-	-	-	-	-	-	-	-
9-30-69	L	-	-	.030	-	-	-	-	-	-	-	-	-	-
	F	-	8.0	-	-	-	-	-	-	-	-	-	-	-
10-29-69	L	-	-	.060	0	0	0	14	3	0.3	0.7	4.3	1.8	0.03
	F	-	8.0	-	-	-	-	-	-	-	-	-	-	-
11-20-69	L	-	-	.050	-	-	-	-	-	-	-	-	-	-
	F	-	10.0	-	-	-	-	-	-	-	-	-	-	-
12-18-69	L	-	-	.110	-	-	-	-	-	-	-	-	-	-
	F	-	10.3	-	-	-	-	-	-	-	-	-	-	-
1-23-70	L	-	-	.030	-	-	-	-	-	-	-	-	-	-
	F	-	10.7	-	-	-	-	-	-	-	-	-	-	-

* L: laboratory; F: field

Table 8.--Dissolved substances and physical properties of Pee Dee River near Conway, S.C. (cont.)

Date	Type*	Temperature (°C)	Dissolved Iron (Fe)(mg/l)	Bicarbonate (HCO_3) (mg/l)	Sulfate (SO_4)(mg/l)	Chloride (Cl)(mg/l)	Fluoride (F) (mg/l)	Nitrate (NO_3)(mg/l)	Dissolved Solids (residue at 180°C) (mg/l)	Specific Conductance (micromhos)	pH (units)	Color(platinum-cobalt units)	Hardness(Ca,Mg) (mg/l)	Noncarbonate Hardness (mg/l)
2-17-70	L	7.8	-	-	-	-	-	0.7	-	-	-	-	-	-
	F	7.8	-	-	-	-	-	-	-	71	7.8	-	-	-
3-23-70	L	13.8	-	-	-	-	-	.7	-	-	-	-	-	-
	F	13.8	-	-	-	-	-	-	-	71	7.2	-	-	-
4-22-70	L	20.3	-	-	-	-	-	.6	-	-	-	-	-	-
	F	20.3	-	-	-	-	-	-	-	74	6.2	-	-	-
5-19-70	L	22.6	-	-	-	-	-	.3	-	-	-	-	-	-
	F	22.6	-	-	-	-	-	-	-	80	6.8	-	-	-
6-19-70	L	27.6	-	-	+	-	-	.1	-	-	-	-	-	-
	F	27.6	-	-	-	-	-	-	-	102	7.4	-	-	-
8-05-70	L	28.6	-	-	-	-	-	1.8	-	-	-	-	-	-
	F	28.6	-	-	-	-	-	-	-	105	7.3	-	-	-
8-25-70	L	24.8	-	-	-	-	-	1.4	-	-	-	-	-	-
	F	24.8	-	-	-	-	-	-	-	80	6.5	-	-	-

Date	Type*	Carbonate (CO_3)(mg/l)	Dissolved Oxygen (mg/l)	Total Phosphorus (P) (mg/l)	Dissolved Manganese (Mn) (μg/l)	Total Chromium (Cr)(μg/l)	Copper (Cu)(μg/l)	Lead (Pb) (μg/l)	Nickel (Ni)(μg/l)	Radiochemicals: Dissolved Alpha(pc/l)	Radiochemicals: Suspended Alpha(pc/l)	Radiochemicals: Dissolved Beta(pc/l)	Radiochemicals: Suspended Beta(pc/l)	Methylene Blue Active Substance (mg/l)
2-17-70	L	-	-	0.030	-	-	-	-	-	-	-	-	-	-
	F	-	13.1	-	-	-	-	-	-	-	-	-	-	-
2-23-70	L	-	-	.050	-	-	-	-	-	-	-	-	-	-
	F	-	10.4	-	-	-	-	-	-	-	-	-	-	-
4-22-70	L	-	-	.060	-	-	-	-	-	-	-	-	-	-
	F	-	7.4	-	-	-	-	-	-	-	-	-	-	-
5-19-70	L	-	-	.020	-	-	-	-	-	-	-	-	-	-
	F	-	7.8	-	-	-	-	-	-	-	-	-	-	-
6-19-70	L	-	-	.030	-	-	-	-	-	-	-	-	-	-
	F	-	7.5	-	-	-	-	-	-	-	-	-	-	-
8-05-70	L	-	-	.090	-	-	-	-	-	-	-	-	-	-
	F	-	6.0	-	-	-	-	-	-	-	-	-	-	-
8-25-70	L	-	-	.050	-	-	-	-	-	-	-	-	-	-
	F	-	6.2	-	-	-	-	-	-	-	-	-	-	-

* L: laboratory; F: field

Table 8.--Dissolved substances and physical properties of Pee Dee River near Conway, S.C. (cont.)

Date	Type*	Temperature (°C)	Dissolved Iron (Fe)(mg/l)	Bicarbonate (HCO_3) (mg/l)	Sulfate (SO_4)(mg/l)	Chloride (Cl)(mg/l)	Fluoride (F) (mg/l)	Nitrate (NO_3)(mg/l)	Dissolved Solids (residue at 180°C) (mg/l)	Specific Conductance (micromhos)	pH (units)	Color(platinum-cobalt units)	Hardness(Ca,Mg) (mg/l)	Noncarbonate Hardness(mg/l)
9-23-70	L	26.5	-	-	-	-	-	0.0	-	-	-	120	-	-
	F	26.5	-	-	-	-	-	-	-	69	6.5	-	-	-
10-22-70	L	19.0	357	25	6.8	9.8	0.2	1.3	65	90	6.7	40	15	0
	F	19.0	-	-	-	-	-	-	-	88	6.8	-	-	-
11-18-70	L	13.0	-	-	-	-	-	2.6	-	-	-	70	-	-
	F	13.0	-	-	-	-	-	-	-	80	6.9	-	-	-
12-18-70	L	10.1	-	-	-	-	-	.7	-	-	-	30	-	-
	F	10.0	-	-	-	-	-	-	-	94	7.0	-	-	-
1-12-71	F	9.0	-	-	-	-	-	-	-	72	6.9	-	-	-

Date	Type*	Carbonate (CO_3)(mg/l)	Dissolved Oxygen (mg/l)	Total Phosphorus (P) (mg/l)	Dissolved Manganese (Mn) (µg/l)	Total Chromium (Cr)(µg/l)	Copper (Cu)(µg/l)	Lead (Pb) (µg/l)	Nickel (Ni)(ug/l)	Radiochemicals: Dissolved Alpha(pc/l)	Radiochemicals: Suspended Alpha(pc/l)	Radiochemicals: Dissolved Beta(pc/l)	Radiochemicals: Suspended Beta(pc/l)	Methylene Blue Active Substance (mg/l)
9-23-70	L	-	-	0.080	-	-	-	-	-	-	-	-	-	-
	F	-	6.0	-	-	-	-	-	-	-	-	-	-	-
10-22-70	L	0	-	.030	0	0	5	0	0	0	0	5	3	0.05
	F	-	7.4	-	-	-	-	-	-	-	-	-	-	-
11-18-70	L	-	-	.030	-	-	-	-	-	-	-	-	-	-
	F	-	8.1	-	-	-	-	-	-	-	-	-	-	-
12-18-70	L	-	-	.030	-	-	-	-	-	-	-	-	-	-
	F	-	9.8	-	-	-	-	-	-	-	-	-	-	-
1-12-71	F	-	9.7	-	-	-	-	-	-	-	-	-	-	-

* L: laboratory; F: field

Table 9.--Dissolved substances and physical properties of Waccamaw River at Conway, S.C.

Date	Type*	Temperature (°C)	Dissolved Iron (Fe)(mg/l)	Bicarbonate (HCO_3) (mg/l)	Sulfate (SO_4)(mg/l)	Chloride (Cl)(mg/l)	Fluoride (F) (mg/l)	Nitrate (NO_3)(mg/l)	Dissolved Solids (residue at 180°C) (mg/l)	Specific Conductance (micromhos)	pH (units)	Color(platinum-cobalt units)	Hardness(Ca,Mg) (mg/l)	Noncarbonate Hardness(mg/l)
2-17-70	L	8.2	-	-	-	-	-	0.3	-	-	-	-	-	-
	F	8.2	-	-	-	-	-	-	-	54	6.8	-	-	-
3-23-70	L	14.0	-	-	-	-	-	.4	-	-	-	-	-	-
	F	14.0	-	-	-	-	-	-	-	56	6.5	-	-	-
4-22-70	L	20.3	-	-	-	-	-	.7	-	-	-	-	-	-
	F	20.3	-	-	-	-	-	-	-	55	6.1	-	-	-
5-19-70	L	24.4	-	-	-	-	-	.9	-	-	-	-	-	-
	F	24.4	-	-	-	-	-	-	-	86	6.8	-	-	-
6-18-70	L	29.1	-	-	-	-	-	.5	-	-	-	-	-	-
	F	29.1	-	-	-	-	-	-	-	110	7.3	-	-	-
7-09-70	L	29.3	-	-	-	-	-	1.8	-	-	-	-	-	-
	F	29.3	-	-	-	-	-	-	-	125	7.3	-	-	-
8-24-70	L	28.3	-	-	-	-	-	2.0	-	-	-	-	-	-
	F	28.3	-	-	-	-	-	-	-	126	7.2	-	-	-

Date	Type*	Carbonate (CO_3)(mg/l)	Dissolved Oxygen (mg/l)	Total Phosphorus (P) (mg/l)	Dissolved Manganese (Mn) (µg/l)	Total Chromium (Cr)(µg/l)	Copper (Cu)(µg/l)	Lead (Pb) (µg/l)	Nickel (Ni)(µg/l)	Radiochemicals: Dissolved Alph(pc/l)	Radiochemicals: Suspended Alpha(pc/l)	Radiochemicals: Dissolved Beta(pc/l)	Radiochemicals: Suspended Beta(pc/l)	Methylene Blue Active Substance (mg/l)
2-17-70	L	-	-	0.020	-	-	-	-	-	-	-	-	-	-
	F	-	10.5	-	-	-	-	-	-	-	-	-	-	-
3-23-70	L	-	-	.020	-	-	-	-	-	-	-	-	-	-
	F	-	9.7	-	-	-	-	-	-	-	-	-	-	-
4-22-70	L	-	-	.020	-	-	-	-	-	-	-	-	-	-
	F	-	8.3	-	-	-	-	-	-	-	-	-	-	-
5-19-70	L	-	-	.010	-	-	-	-	-	-	-	-	-	-
	F	-	7.3	-	-	-	-	-	-	-	-	-	-	-
6-18-70	L	-	-	.040	-	-	-	-	-	-	-	-	-	-
	F	-	7.2	-	-	-	-	-	-	-	-	-	-	-
7-09-70	L	-	-	.040	-	-	-	-	-	-	-	-	-	-
	F	-	6.6	-	-	-	-	-	-	-	-	-	-	-
8-24-70	L	-	-	.010	-	-	-	-	-	-	-	-	-	-
	F	-	6.0	-	-	-	-	-	-	-	-	-	-	-

* L: laboratory; F: field

Table 9.--Dissolved substances and physical properties of Waccamaw River at Conway, S.C. (cont.)

Date	Type*	Temperature (°C)	Dissolved Iron (Fe)(mg/l)	Bicarbonate (HCO_3) (mg/l)	Sulfate (SO_4)(mg/l)	Chloride (Cl)(mg/l)	Fluoride (F) (mg/l)	Nitrate (NO_3)(mg/l)	Dissolved Solids (residue at 180°C) (mg/l)	Specific Conductance (micromhos)	pH (units)	Color(platinum-cobalt units)	Hardness(Ca,Mg) (mg/l)	Noncarbonate Hardness(mg/l)
7-25-69	L	-	-	-	-	-	-	2.1	-	-	-	-	-	-
	F	29.0	-	-	-	-	-	-	-	77	6.3	-	-	-
8-25-69	L	-	-	-	-	-	-	.7	-	-	-	-	-	-
	F	23.6	-	-	-	-	-	-	-	44	5.5	-	-	-
9-29-69	L	-	-	-	-	-	-	2.0	-	-	-	-	-	-
	F	22.8	-	-	-	-	-	-	-	95	6.7	-	-	-
10-29-69	L	17.8	-	31	15	11	0.3	2.5	110	97	6.7	180	31	6
	F	17.8	-	-	-	-	-	-	-	100	7.1	-	-	-
11-19-69	L	11.5	-	-	-	-	-	2.9	-	-	-	-	-	-
	F	11.5	-	-	-	-	-	-	-	64	5.5	-	-	-
12-17-69	L	7.3	-	-	-	-	-	2.5	-	-	-	-	-	-
	F	7.3	-	-	-	-	-	-	-	75	6.5	-	-	-
1-22-70	L	4.4	-	-	-	-	-	.8	-	-	-	-	-	-
	F	4.4	-	-	-	-	-	-	-	60	6.2	-	-	-

Date	Type*	Carbonate (CO_3)(mg/l)	Dissolved Oxygen (mg/l)	Total Phosphorus (P) (mg/l)	Dissolved Manganese (Mn) (µg/l)	Total Chromium (Cr)(µg/l)	Copper (Cu)(µg/l)	Lead (Pb) (µg/l)	Nickel (Ni)(µg/l)	Radiochemicals: Dissolved Alpha(pc/l)	Radiochemicals: Suspended Alpha(pc/l)	Radiochemicals: Dissolved Beta(pc/l)	Radiochemicals: Suspended Beta(pc/l)	Methylene Blue Active Substance (mg/l)
7-25-69	L	-	-	0.030	-	-	-	-	-	-	-	-	-	-
	F	-	4.4	-	-	-	-	-	-	-	-	-	-	-
8-25-69	L	-	-	.030	-	-	-	-	-	-	-	-	-	-
	F	-	2.7	-	-	-	-	-	-	-	-	-	-	-
9-29-69	L	-	-	.020	-	-	-	-	-	-	-	-	-	-
	F	-	5.5	-	-	-	-	-	-	-	-	-	-	-
10-29-69	L	-	-	.080	0	0	5	3	0	0.5	0.2	5.1	1.2	0.04
	F	-	9.2	-	-	-	-	-	-	-	-	-	-	-
11-19-69	L	-	-	.040	-	-	-	-	-	-	-	-	-	-
	F	-	7.7	-	-	-	-	-	-	-	-	-	-	-
12-17-69	L	-	-	.060	-	-	-	-	-	-	-	-	-	-
	F	-	9.2	-	-	-	-	-	-	-	-	-	-	-
1-22-70	L	-	-	.010	-	-	-	-	-	-	-	-	-	-
	F	-	10.5	-	-	-	-	-	-	-	-	-	-	-

* L: laboratory; F: field

Table 9.--Dissolved substances and physical properties of Waccamaw River at Conway, S.C. (cont.)

Date	Type*	Temperature (°C)	Dissolved Iron (Fe)(mg/l)	Bicarbonate (HCO_3) (mg/l)	Sulfate (SO_4)(mg/l)	Chloride (Cl)(mg/l)	Fluoride (F) (mg/l)	Nitrate (NO_3)(mg/l)	Dissolved Solids (residue at 180°C) (mg/l)	Specific Conductance (micromhos)	pH (units)	Color(platinum-cobalt units)	Hardness(Ca,Mg) (mg/l)	Noncarbonate Hardness(mg/l)
9-23-70	L	25.5	-	-	-	-	-	0.1	-	-	-	200	-	-
	F	25.5	-	-	-	-	-	-	-	54	5.9	-	-	-
10-22-70	L	19.6	410	14	6.4	9.2	0.2	3.3	97	70	6.6	200	21	9
	F	19.6	-	-	-	-	-	-	-	70	6.3	-	-	-
11-17-70	L	13.5	-	-	-	-	-	1.2	-	-	-	150	-	-
	F	13.5	-	-	-	-	-	-	-	70	6.2	-	-	-
12-18-70	L	9.5	-	-	-	-	-	.9	-	-	-	150	-	-
	F	9.5	-	-	-	-	-	-	-	75	6.5	-	-	-
1-11-71	F	8.0	-	-	-	-	-	-	-	73	6.5	-	-	-

Date	Type*	Carbonate (CO_3)(mg/l)	Dissolved Oxygen (mg/l)	Total Phosphorus (P) (mg/l)	Dissolved Manganese (Mn) (µg/l)	Total Chromium (Cr)(µg/l)	Copper (Cu)(µg/l)	Lead (Pb) (µg/l)	Nickel (Ni)(µg/l)	Radiochemicals: Dissolved Alpha(pc/l)	Radiochemicals: Suspended Alpha(pc/l)	Radiochemicals: Dissolved Beta(pc/l)	Radiochemicals: Suspended Beta(pc/l)	Methylene Blue Active Substance (mg/l)
9-23-70	L	-	-	0.010	-	-	-	-	-	-	-	-	-	-
	F	-	6.0	-	-	-	-	-	-	-	-	-	-	-
10-22-70	L	0	-	.030	10	0	5	0	0	0	0	5	1	0.11
	F	-	6.5	-	-	-	-	-	-	-	-	-	-	-
11-17-70	L	-	-	.000	-	-	-	-	-	-	-	-	-	-
	F	-	7.0	-	-	-	-	-	-	-	-	-	-	-
12-18-70	L	-	-	.030	-	-	-	-	-	-	-	-	-	-
	F	-	9.1	-	-	-	-	-	-	-	-	-	-	-
1-11-71	F	-	10.4	-	-	-	-	-	-	-	-	-	-	-

* L: laboratory; F: field

UNITS OF MEASURE

1 cubic foot per second =	26,930 gallons per hour
=	646,323 gallons per day
1 milligram per kilogram =	.032 ounces per ton
=	1 part per million (by weight)
1 microgram per kilogram =	3.2×10^{-5} ounces per ton
=	0.001 part per million (by weight)
1 milligram per liter (mg/l) =	1.335×10^{-4} ounces per gallon
1 microgram per liter (µg/l) =	1.335×10^{-7} ounces per gallon

Salinity

1 part per thousand (by weight) =	0.137 lb (salt) per gallon (water)
picocuries per liter (pc/l) =	3.7×10^{-2} disintegrations per second of any radioactive nuclide.