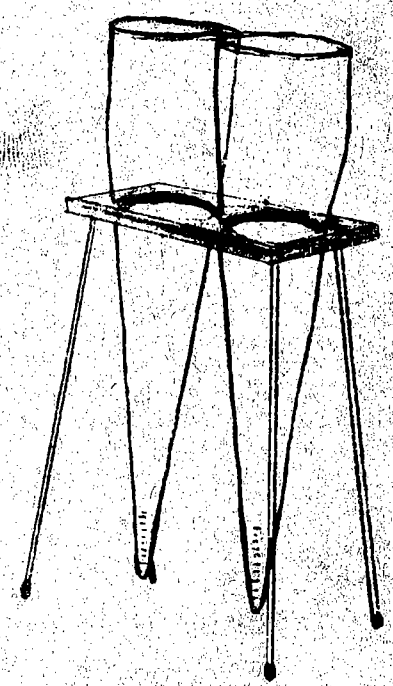
BACK BAY-CURRITUCK SOUND DATA REPORT



Environmental Factors

COOPERATIVE STUDIES 1958 - 1964

BY: BUREAU OF SPORT FISHERIES AND WILDLIFE
NORTH CAROLINA WILDLIFE RESOURCES COMMISSION
VIRGINIA COMMISSION OF GAME AND INLAND FISHERIES

BACK BAY - CLJRRITUCK SOUND DATA REPORT

Environmental Factors, Volume 3.

This data report is, the third of four volumes of data and preliminary analysis data on the cooperative study of the ecology of Back Bay,. Virginia, and Currituck Sound, North Carolina, from 1958 through 1964. Volume 1,' dated December 1965,was entitled "Introduction and Vegetation Studies" and Volume 2, dated March 1966, was entitled "Waterfowl Studies." The last volume, soon to be released, presents data on fish studies.

This report is not a publication. Subsequent publication will be made of a condensation of these four volumes in the U.S. Fish and Wildlife Service Special Scientific Report Series.

May'1966

Back Bay-Currituck Sound Data Report-Environment Facotors - Volume III'

Table of Contents

	Page
INTRODUCTION	1
Historical Accounts of Water Salinity	1
Discussion of Water Salinities, 1920-1950	3
CLIMATOLOGICAL DATA	4
WATER DEPTHS AND FLUCTUATION	7
WATERCHEMISTRY	8
Water Chemistry at Periodic Intervals, 1958-1963	8
Procedures	8
Results	8
P H	10
Alkalinity	11
Turbidity	11
Chloride	12
Conclusions	13
Conversion of Salinity	13
LIGHT PENETRATION OF WATER	15
Light Penetration of Back Bay	15
Light Penetration at Stations from Back Bay to Oregon Inlet	18
Laboratory Test of Flocculation of Turbidity from Soils by Saltwater	19
Methods and Procedures	19
General Observations	21
Silt - Table 1, Figure 1	21
Clay - Tables 3 through 5, Figures 3 through 5	21
Loam - Table 2, Figure 2	21
Comparative Settling Out Rates Between Silt, Loam, and Clay in Various Known Salinities	22
Available Nutrient Evaluation of Back Bay Soils after Treatment with Various Percentages of Sea Strength	23

Table of Contents (cont'd)

	Page
RELATIONSHIPS OF THE CHEMICAL CONTENT OF WATER, SOILS, AND AQUATIC PLANTS	25
Laboratory Chemical Analyses of Water, 1959.	25
Calcium.	25
Magnesium.	26
Sodium	26
Potassium.	27
Nitrate	27
Phosphate.	28
Chloride	28
Bicarbonates	29
Sulfate	30
Silica	30
Aluminum	31
Iron	31
Lithium	31
Fluoride	32
Manganese.	32
Zinc	32
Chromium	33
Copper	33
Boron	34
Nickel	35
Bromide	35
Iodide	35
Dissolved Solids	36
Summary of Laboratory Analyses of Water Chemistry, 1959.	36
Quarterly Water Analysis from 17 Station in Back Bay and Currituck Sound.	37
Spectrochemical Analysis of Sago Pondweed Collected from Representative Field Locations	38
Calcium..	38
Magnesium.	41
Sodium	42
Manganese.	42
Potassium.	42
Aluminum	43
Iron	43
Boron	43
Phosphorus	44

Table of Contents (cont'd)

Page

Spectrochemical Analysis of Aquatic Plants from the Bioassay in Water Salinities of 0 to 40 Percent Sea Strengths. 46
Content of Elements in Sago Pondweed Grown in Water of 0 to 40% SS 46
Water Chemistry During the Bioassay. 48
Chemistry of Soils in the 1960 Bioassay 48
Yield of Sago Pondweed in Relation to Content of Elements in the Plant 50
Discussion of Nutrient Content of Sago Pondweed. 50
Content of Elements in Other Aquatics Grown in Water of 0 to 40% SS 52
Widgeongrass 52
Najas 52
Wildcelery 52
Redheadgrass 52
Discussion of Nutrient Content of Other Aquatics Grown in 0 to 40% SS 53

SOIL CHEMISTRY TYPES AND DISTRIBUTION 54

Quarterly Chemical Analyses of Soils 54
Procedures 54
Results 54
pH 54
Iron 55
Phosphorus 55
Potassium. 56
Calcium. 56
Magnesium. 57
Nitrate and Ammonia. 57
Sulfate 58
Chloride 58
Conclusions. 58
Laboratory Soil Classification and Analyses. 60
Soil Type Distribution in Back Bay and Currituck Sound 62
Relationships of Aquatic Vegetation to Soil Types. 63
Discussion of Silt Deposition in Back Bay and the North Landing River. 64
Summary of Silt-Turbidity Problems 65

APPENDIX 68

INTRODUCTION

Measurement of environmental factors possibly affecting aquatic vegetation of Back Bay and Currituck Sound was an important aspect of the cooperative study of that area from 1958-64. Reference to the major environmental changes that occurred in the area was made in Volume I, "Introduction and Vegetation Studies," of this data report. The ecology cannot be understood unless attention is called to the juxtaposition of the area-to the ocean, the history of ocean water intrusion, the history of extensive dredging activities, the relationship of water salinity and turbidity, and the significance of these and other environmental factors.

Back Bay-Currituck Sound is the northernmost body of a series of large inland waters located along the coast of North Carolina and Virginia. It is separated from the Atlantic Ocean by a narrow barrier beach varying in width from one-fourth mile to one mile. The north-south length of the area is 45 miles; it varies in east-west width from 2 to 12 miles, averaging 5 miles. There are approximately 27,000 acres of open water and marsh ponds in Back Bay and 98,000 acres in Currituck Sound, comprising 125,000 acres of water in the total area. The maximum recorded-depth is 20 feet with an average depth of 5 feet.

Lunar tides are negligible, but wind tides cause marked fluctuation in water levels with extremes rarely exceeding 4 feet. The area receives water from surrounding swamps, Northwest River, North Landing River, and numerous farm drainage ditches. Back Bay-Currituck Sound discharges into the North River through the Intracoastal Waterway at Coinjock, North Carolina, and into Albemarle Sound at the sound end of the area.

Historical Accounts of Water Salinity

Historically., of the variable environmental factors determining plant community type of Back Bay and Currituck Sound, the dominant factor was salinity.

Although there are a few early references to the salinity of the water based on taste or known ocean water intrusions, the first quantitative records were made in March 1925. The Game Preservation Association arranged for the Norfolk Testing Laboratories in Norfolk, Virginia, to analyze monthly water samples collected from nine locations around. Knotts Island (see map). Monthly samples were collected from March 23, 1925, to March 5, 1938. Original data expressed in grains of NaCl per gallon were converted to ppm (parts per million) NaCl -and percent of full sea strength.

I am compelled, once again, to remind the reader that many people cannotdetect salt in water when it is much less than 7% SS (percent of full sea strength). This point has bearing on. the authenticity of references to water salinity as determined by taste, and can well.

explain statements that the area was fresh even when the records prove that ecologically significant concentrations of salt were present.

The average salinity from 1925 through October 31, 1930, only once slightly exceeded 10% SS; but from November 29, 1930, through August 27, 1934, the average monthly salinity exceeded 10% SS, with a peak average of 32.6% SS on August 31, 1933. Presumably, the increases in salinity in 1931 through August 1932 resulted from intrusion across thebarrier beach and also down the A & C Canal in the North Landing River. The locks in the canal were not in operation between April 1, 1917, and August 10, 1932. Salinities in 1931 and 1932 were fairly constant at about 20% SS; some freshening occurred by October 22, 1932, and by July 28, 1933, the salinities averaged 13% SS. This freshening may have reflected the influence of the lock.

A hurricane in August 1933 increased the salinity to 36.6% SS, but by May 1934 the waters freshened to 10.4% SS. By April 20, 1936, the average w.as 2.1% SS but a hurricane increased it to 18.7% SS in October 1936. The sand fences completed in 1933-35 probably ameliorated the effect of the 1936 hurricane.

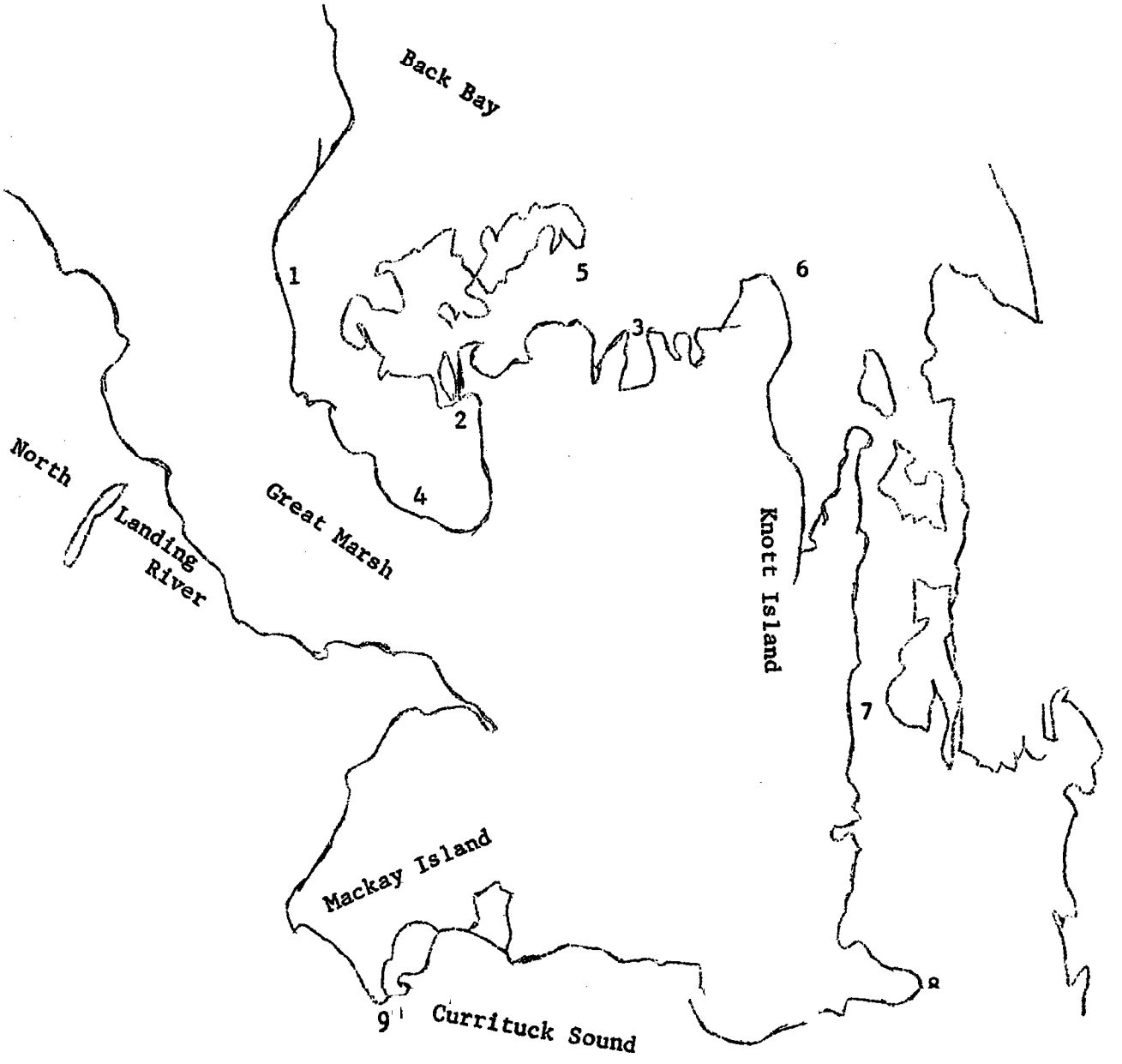
Hall, Bourn, and Cottam cite a study by the Army Engineers (see Volume I, p. 18 this data report) on the control of the locks (presumably the opening of the locks at ebb tide from July 1934 to January 1935). They concluded it was in some wayharmful to some 'undesignated' portion of the area. The salinity records, however, indicate only further freshening of the area from 10.7% SS on July 28, 1934, to 8.2% SS by February 15, 1935. Lacking further information I question the magnitude of the study and the authenticity of the conclusion.

By the spring of 1937 and on to March 1938, the waters were apparently quite fresh at only 3 to 5% SS.

Few records exist for the 1940's and early 50's, but Chamberlain stated that in 1946 Back Bay averaged 2.3-4% SS, Currituck Sound averaged 7.5% SS, and Albemarle Sound was 21.4% SS. One sample collected on September 24, 1946, at Currituck Courthouse was reported as 16.7% SS by the Norfolk Testing Laboratories. In general, the consensus was that the area, particularly Back Bay, was freshening during the 1940's.

A slight increase in salinities occurred in Currituck Sound and Back Bay from 1951-55 because of a break in the sand dunes near Monkey Island.

The first large influx of ocean water after 1937 occurred on March 7, 1962; this will be discussed in detail.



Salinity Stations of Game Preservation Association Taken Monthly 1925 to 1938 and Tested by Norfolk Testing Laboratories

1. Waterfield's Boat House
2. Entrance to Corey's Pond
3. Near Dredger
4. Buzzard Bay end of Canal
5. Serviss? (southwest) cove end of canal
6. North end Knott Island
7. Cason Point
8. Knott Landing
9. Halfway Point

Table continued. Salinity Determinations in Parts Per Million of Waters from Back Bay Area, Virginia, made by Norfolk Testing Laboratories for Game Preservation Association - March 23, 1925 to March 5, 1938. (Expressed as ppm NaCl.)*

Date	Stations 1	2	3	4	5	6	Average ppm NaCl	Av. % sea Strength	Stations 7	8	9	Av. ppm NaCl 1 to 9	Av. % sea Strength 1 to 9
Feb. 28, 1927	2,279	2,319	2,739	3,539	2,859	2,658	2,732	8.5		2,219	2,999	2,701	8.4
Feb. 2, 1927	2,358	2,478	2,339	2,459	2,439	2,449	2,420	7.5		2,468	2,418	2,426	7.5
Jan. 3, 1927	2,279	2,559	2,418	2,538	2,549	3,318	2,610	8.1		2,439	2,459	2,570	8.0
Nov. 29, 1926	2,579	2,619	2,559	2,958	2,758	3,658	2,855	8.9		2,699	2,969	2,850	8.8
Oct. 29, 1926	2,699	2,759	2,658	3,759	2,919	4,398	3,199	9.9		2,838	3,598	3,204	9.9
Sept. 28, 1926	2,739	2,598	2,619	2,833	2,633	4,527	2,992	9.3		2,653	2,927	2,941	9.1
Aug. 31, 1926	2,418	2,538	2,648	2,859	2,588	2,499	2,592	8.0		2,519	2,989	2,632	8.2
Aug. 14, 1926	2,718	2,693	2,619	2,658	2,499	2,598	2,631	8.2		2,519	2,759	2,633	8.2
July 10, 1926	2,139	2,339	2,178	2,379	2,259	2,279	2,262	7.0		2,298	2,319	2,274	7.0
June 14, 1926	1,890	2,159	2,099	2,262	2,139	2,238	2,131	6.6		2,259	2,358	2,176	6.7
May 14, 1926	1,479	1,959	1,899	2,199	1,919	2,079	1,922	6.0		1,859	2,319	1,964	6.1
April 19, 1926	1,458	1,938	1,698	2,039	1,959	1,578	1,778	5.5		1,259	1,998	1,141	5.4
March 15, 1926	1,839	2,159	1,719	2,039	2,259	2,168	2,031	6.3		2,178	1,979	2,043	6.3
Feb. 19, 1926	2,219	2,339	2,118	2,859	2,459	1,659	2,276	7.1			3,159		
Feb. 3, 1926	1,679	2,238	2,039	2,559	2,639	2,046	2,200	6.8			2,651		
Jan. 11, 1926	2,279	2,639	2,399	2,819	2,838	2,970	2,657	8.2			2,900		
Dec. 12, 1925	2,408	2,478	3,358	5,147	2,648	3,757	3,299	10.2		6,898	4,818	3,939	12.2
Nov. 21, 1925	2,144	2,401	2,499	3,438	2,507	4,158	2,858	8.9		4,638	3,279	3,133	9.7
Oct. 19, 1925	2,559	2,478	2,639	2,619	2,519	3,018	2,639	8.2		4,338	2,759	2,866	8.9
Sept. 21, 1925	2,019	2,238	2,437	2,199	2,139	2,619	2,275	7.1		3,318	2,238	2,401	7.4
Aug. 24, 1925	1,921	2,039	2,058	2,156	2,043	1,878	2,016	6.2		2,163	2,199	2,057	6.4
July 27, 1925	1,799	2,110	2,279	2,106	1,998	2,010	2,050	6.4		2,089	2,127	2,065	6.4
June 16, 1925	1,379	1,818	1,998	2,139	1,638	2,003	1,829	5.7	2,238	2,279	2,118	1,922	6.0
May 16, 1925	1,179	1,458	1,578	1,659	1,498	1,998	1,562	4.8					
April 20, 1925	1,059	1,299	1,379	1,638	1,374	1,458	1,368	4.2					
March 23, 1925	954	1,398	1,450	1,410	1,424	1,451	1,348	4.2					

* Original data expressed as salt, NaCl grains per gallon was converted to ppm NaCl.

Table continued. Salinity Determinations in Parts Per Million of Waters from Back Bay Area, Virginia, made by Norfolk Testing Laboratories for Game Preservation Association - March 23, 1925 to March 5, 1938. (Expressed as ppm NaCl.)*

Date	Stations 1	2	3	4	5	6	Average ppm NaCl	Av. % sea Strength	Stations 7	8	9	Av. ppm NaCl 1 to 9	Av. % sea Strength 1 to 9
May 30, 1929	1,799	1,998	1,839	2,399	1,679	1,919	1,939	6.Q		1,479	2,118	1,904	5.9
May 7, 1929	1,218	1,578	2,058	2,159	1,799	2,339	1,856	5.8		1,698	2,238	1,886	5.8
March 29, 1929	803	1,319	1,299	1,549	1,599	1,518	1,348	4.2		1,378	1,679	1,393	4.3
March 2, 1929	879	1,040	898	1,158	1,439	1,319	1,122	3.5		1,119	2,559	1,301	4.0
Feb. 2, 1929	1,040	1,158	879	999	1,059	1,179	1,052	3.3		1,079	899	1,037	3.2
Dec. 29, 1928	959	1,079	920	1,158	999	1,179	1,049	3.3		1,018	1,098	1,051	3.3
Nov. 28, 1928	1,189	1,199	1,098	1,278	1,203	1,218	1,197	3.7		1,194	1,283	1,208	3.7
Oct. 26, 1928	839	1,158	1,199	1,359	1,278	1,439	1,212	3.8		1,199	1,398	1,234	3.8
Sept. 28, 1928	1,199	1,040	1,359	1,479	1,519	1,239	1,306	4.0		1,278	1,398	1,314	4.1
Aug. 29, 1928	1,359	1,781	1,818	1,781	1,698	1,719	1,693	5.2		1,450	1,799	1,676	5.2
July 27, 1928	1,359	1,739	1,782	1,619	1,659	1,479	1,606	5.0		1,519	1,698	1,617	5.0
June 27, 1928	1,698	1,719	1,758	1,998	1,638	1,679	1,748	5.4		1,559	1,979	1,754	5.4
May 31, 1928	1,458	1,518	1,539	1,638	1,498	1,559	1,535	4.8		1,469	1,739	1,552	4.8
April 24, 1928	1,040	1,299	1,289	1,638	1,518	1,479	1,377	4.3		1,458	1,599	1,415	4.4
March 31, 1928	1,378	1,532	1,385	1,534	1,583	1,566	1,496	4.6		1,569	1,578	1,516	4.7
Feb. 18, 1928	1,179	1,518	1,539	1,799	1,758	1,698	1,582	4.9		1,719	1,784	1,624	5.0
Feb. 1,1928	1,059	1,799	1,518	1,859	1,839	1,959	1,672	5.2		1,837	1,847	1,715	5.3
Dec. 31, 1927	1,299	1,938	1,359	1,878	2,058	2,139	1,779	5.5		2,039	1,919	1,829	5.7
Dec. 5, 1927	2,298	2,598	2,499	2,739	2,679	2,759	2,595	8.0		2,639	2,718	2,616	8.1
Oct. 21, 1957	2,300	2,598	2,699	2,919	2,619	2,718	2,642	8.2		2,099	2,958	2,614	8.1
Sept. 30, 1957	2,045	2,718	2,701	2,979	2,708	2,458	2,602	8.1		2,559	2,979	2,643	8.2
Aug. 26, 1927	2,159	2,610	2,799	3,059	2,819	2,898	2,724	8.4		2,619	3,219	2,773	8.6
July 27, 1927	1,739	2,519	2,718	2,898	2,559	2,619	2,508	7.8		1,899	2,819	2,471	7.7
June 23, 1927	1,799	2,399	2,238	2,658	2,898	2,559	2,425	7.5		2,298	2,699	2,444	7.6
May 31, 1927	2,399	2,633	2,418	3,059	3,039	2,939	2,748	8.5		2,598	3,059	2,768	8.6
April 30, 1927	1,559	2,598	2,238	2,819	2,778	2,538	2,422	7.5		2,679	2,898	2,514	7.8
March 29, 1927	2,759	2,859	2,559	3,279	3,159	3,119	2,956	9.2		2,799	3,378	2,989	9.3

* Original data expressed as salt, NaCl grains per gallon was converted to ppm NaCl.

Table . continued. Salinity Determinations in Parts Per Million of Waters from Back Bay Area, Virginia, made by Norfolk Testing Laboratories for Game Preservation Association - March 23, 1925 to March 5, 1938. (Expressed as ppm NaCl.)*

Date	Stations 1	2	3	4	5	6	Average ppm NaCl	Av. % sea Strength	Stations 7	8	9	Av. ppm NaCl 1 to 9	Av. % sea Strength 1 to 9
June 27, 1931	3,858	6,457	6,718	8,197	6,997	7,156	6,564	20.3		3,752	7,997	6,392	19.8
May 25, 1931	3,747	5,731	5,432	8,206	6,548	6,598	6,044	18.7		5,714	7,708	6,211	19.3
April 24, 1931	3,742	5,828	5,965	6,757	5,585	5,618	5,583	17.3		4,999	6,382	5,610	17.4
March 28, 1931	5,262	5,060	3,572	6,123	5,140	5,495	5,109	15.8		4,774	5,299	5,091	15.8
Feb. 28, 1931	3,598	4,458	3,242	4,138	4,398	4,218	4,009	12.4		3,502	3,838	3,924	12.2
Jan. 31, 1931	2,958	3,639	4,738	4,518	3,958	3,999	3,968	12.3		3,500	4,558	3,984	12.4
Jan. 3, 1931	3,478	3,488	3,099	3,678	3,498	3,463	3,451	10.7		3,469	3,929	3,513	10.9
Nov. 29, 1930	2,645	2,732	2,328	6,192	2,799	2,993	3,282	10.2		2,717	3,399	3,226	10.0
Nov. 8, 1930					2,499								
Oct. 31, 1930	2,045	1,921	1,925	2,873	3,395	2,892	2,509	7.8		2,779	2,794	2,578	8.0
Oct. 11, 1930	1,679	1,919	2,239	2,859	2,179	2,220	2,183	6.8		1,968	2,179	2,155	6.7
Sept. 20, 1930	1,810	1,822	1,949	2,823	1,776	2,225	2,068	6.4		1,745	2,660	2,101	6.5
Aug. 30, 1930	1,299	1,599	1,799	1,669	1,674	1,704	1,624	5.0		1,575	1,697	1,627	5.0
July 26, 1930	929	1,534	1,598	1,503	1,515	1,505	1,431	4.4		1,542	1,551	1,460	4.5
June 28, 1930	950	1,359	1,419	1,489	1,210	1,439	1,311.	4.1		1,278	1,518	1,333	4.1
May 27, 1930	1,179	1,338	1,898	1,719	1,518	1,479	1,439	4.5		1,359	1,739	1,466	4.5
April 26, 1930	1,200	1,279	1,059	1,390	1,409	1,419	1,293	4.0		1,328	1,409	1,312	4.1
March 29, 1930	1,087	924	1,218	1,651	1,242	1,335	1,243	3.9		1,179	1,315	1,244	3.9
March 1, 1930	1,218	1,279	939	1,319	1,259	1,270	1,214	3.8		1,289	1,238	1,227	3.8
Feb. 1, 1930	1,218	1,278	1,158	1,229	1,258	1,078	1,203	3.7		1,098	1,249	1,196	3.7
Dec. 28, 1929	1,199	1,239	1,218	1,479	1,398	1,439	1,329	4.1		1,359	1,499	1,354	4.2
Nov. 26, 1929	1,040	1,458	1,319	1,599	1,620	1,659	1,449	4.5		1,639	1,649	1,473	4.6
Nov. 3, 1929	1,398	1,559	1,479	2,199	1,659	1,839	1,689	5.2		1,499	1,781	1,677	5.2
Sept. 27, 1929	1,679	1,758	1,739	1,750	1,479	1,745	1,692	5.2		1,799	1,779	1,716	5.3
Aug. 27, 1929	1,899	1,878	2,019	1,998	1,839	1,969	1,934,	6.0		1,739	1,959	1,913	5.9
July 26, 1929	1,719	1,690	1,930	1,998	1,759	1,859	1,826	5.7		1,518	1,919	1,799	5.6
June 29, 1929	1,698	1,679	1,859	1,959	1,619	1,949	1,794	5.6		1,409	1,719	1,736	5.4

* Original data expressed as salt, NaCl grains per gallon was converted to ppm NaCl.

Table continued. Salinity Determinations in Parts Per Million of Waters from Back Bay *Area,* Virginia, made by Norfolk **Testing** Laboratories for Game Preservation Association - March 23, 1925 *to* March 5, 1938. (Expressed as ppm **NaCl.)***

Date	Stations 1	2	3	4	5	6	Average ppm NaCl	Av. % sea Strength	Stations 7	8	9	Av. ppm NaCl 1 to 9	Av. % sea Strength 1 to 9
Sept.28, 1933	5,969	10,104	10,902	10,105	9,906	6,346	*8,889*	27.6					
Aug. 31, 1933	11,009	10,086	11,024	9,985	10,054	**11,014**	10,529	32.6					
July 28, 1933	4,420	4,207	4,027	4,179	4,218	4,150	4,200	13.0					
June 24, 1933	4,563	4,490	4,498	4,254	6,386	4,330	4,420	13.7					
May 27, 1933	4,207	4,256	4,130	4,111	4,114	4,203	4,170	12.9					
April 29, 1933	3,963	4,047	3,951	3,667	3,987	3,891	3,918	12.1					
Mar. 25, 1933	4,251	4,114	4,050	3,963	4,378	4,275	4,172	12.9					
Feb. 25, 1933	4,426	4,531	4,231	4,963	4,591	4,606	4,558	14.1					
Jan. 21, 1933	5,486	5,546	5,563	4,610	5,475	5,615	5,383	16.7					
Dec. 24, 1932	6,130	5,966	5,910	6,121	6,265	4,179	5,762	17.9	2,571				
Nov. 26, 1932	6,774	6,846	6,742	6,862	6,949	6,966	6,857	21.3					
Oct. 22, 1932	7,006	7,390	7,165	7,366	7,422	7,297	7,274	22.5					
Sept. 24, 1932	7,126	7,534	7,141	7,558	7,285	7,446	7,348	22.8					
Aug. 26, 1932	6,534	6,966	6,990	6,925	7,078	6,982	6,913	21.4					
July 27, 1932	6,181	6,814	6,646	6,910	6,775	6,742	6,678	20.7					
June 27, 1932	5,854	6,063	6,294	6,210	6,046	6,342	6,135	19.0					
May 28, 1932	5,266	5,910	5,878	6,085	6,157	6,102	*5,900*	18.3					
April 23, 1932	5,214	5,478	6,006	6,181	6,118	5,989	5,831	18.1		6,037	6,061	5,886	18.2
Mar. 26, 1932	6,514	5,854	5,822	6,366	6,006	5,654	6,036	18.7		5,802	6,214	*6,029*	18.7
Feb. 27, 1932	5,827	6,006	5,346	5,835	5,790	6,034	5,806	18.0		**6,169**	5,821	5,854	18.2
Jan. 26, 1932	6,325	6,022	5,974	6,460	6,766	6,198	6,291	19.5		6,541	6,589	*6,359*	19.7
Dec. 29, 1931	7,045	7,134	6,030	7,494	6,997	7,254	6,992	21.7		7,285	7,318	7,070	21.9
Nov. 23, 1931	7,093	7,006	7,366	7,381	7,206	7,270	7,220	22.4		7,285	7,301	7,239	22.4
Oct. 23, 1931	5,518	6,358	6,598	6,997	6,698	7,018	6,531	20.2		6,277	7,038	6,563	20.3
Sept. 23, 1931	3,219	6,291	7,915	6,882	6,265	6,846	6,236	19.3		5,991	**7,052**	6,908	19.6
Aug. 25, 1931	4,086	5,509	6,769	6,888	6,721	6,226	6,033	18.7		4,930	6,966	6,012	18.6
July 25, 1931	3,932	6,608	7,033	7,261	**6,534**	6,677	6,341	19.7		6,331	7,887	6,533	20.3

***** Original data expressed as salt, **NaCl** grains per gallon was converted to ppm **NaCl.**

Table . Salinity Determination in Parts Per Million of Waters from Back Bay Area, Virginia, made by Norfolk Testing Laboratories for Game Preservation Association - March 23, 1925 to March 5, 1938. (Expressed as PPM NaCl.)*

Date	Stations 1	2	3	4	5	6	Average ppm NaCl	Av. % sea Strength - 7 stations	Av. ppm NaCl 1 to 9	Av. % sea Strength 1 to 9
March 5, 1938					1,090					
Oct. 30, 1937					1,490					
June 26, 1937					1,851					
Feb. 19, 1937	2,967	2,931	2,995	2,971	2,819	2,925	2,934	9.1		
Dec. 29, 1936	3,883	3,927	3,971	4,207	4,008	4,018	4,002	12.4		
Oct. 17, 1936	8,485	5,690	5,310	5,283	5,362	5,998	6,021	18.7		
July 16, 1936	884	874	812	828	836	5.64	800	2.5		
April 20, 1936	680	720	640	800	760	440	673	2.1		
Nov. 16, 1935	1,623	1,587	1,516	1,463	1,528	1,547	1,544	4.8		
Aug. 16, 1935	1,367	1,644	1,619	1,625	1,671	665	1,432	4.4		
June 15, 1935	1,848	1,923	1,902	1,827	1,971	1,851	1,887	5.8		
March 30, 1935	2,307	2,435	2,511	2,547	2,555	2,468	2,471	7.7		
Feb. 15, 1935	2,671	2,731	2,643	2,627	2,555	2,631	2,643	8.2		
Dec. 1, 1934	2,883	2,747	2,955	2,715	2,928	2,763	2,832	8.8		
Oct. 27, 1934	2,611	2,927	2,807	2,954	2,930	2,843	2,845	8'8		
Sept. 29, 1934	2,751	2,927	2,811	3,019	2,739	2,951	2,866	8.9		
Aug. 27, 1934	3,459	3,627	3,800	3,600	3,608	3,279	3,562	11.0		
July 28, 1934	3,603	3,423	3,526	3,443	3,571	3,179	3,458	10.7		
June 29, 1934	3,411	3,787	3,754	3,826	3,711	3,691	3,697	11.5		
May 31, 1934	2,451	3,511	3,107	3,770	3,790	3,570	3,367	10.4		
April 28, 1934	3,019	4,311	3,967	3,915	4,690	3,855	3,960	12.3		
March 30, 1934	4,123	6,008	4,866	6,186	6,082	1,052	4,720	14.6		
Feb. 23, 1934	7,882	8,489	8,538	8,490	8,605	5,590	7,932	24.6		
Jan. 27, 1934	8,825	9,130	9,244	8,974	9,601	7,218	8,802	27.3	8,410	
Dec. 30,? 1933	9,284	9,705	9,560	9,405	9,493	7,930	9,230	28.6		
Nov. 25, 1933	9,709	9,675	9,484	9,600	9,683	9,961	9,685	30.0		
Oct. 27, 1933	10,040	10,080	10,240		10,280	8,160	9,760	30.3		

* Original data expressed as salt, NaCl grains per gallon was converted to ppm NaCl.

Table

Salinity Data Contained in Letter from C. J. Robin, Chief, Engineering Division, U. S. Army Corps of Engineers, Norfolk, Virginia, to Mr. Roland O. Halstead, Virginia Commission of Game and Inland Fisheries, Dated August 2, 1955.

"From January 1949 to September 1950, prior to a break in the beach approximately 1½ miles north of Currituck Beach Light caused by a storm which brought in considerable sea water, the average salinity content of the waters was as follows:

Wright Memorial Bridge	Water Lily	South End Knotts Island	North End Knotts Island	North Bay
4.76%	2.15%	1.86%	1.93%	1.37%

"Between September 1950 and August 1951, following the break in the beach, the average salinity content of the water at the same stations was as follows:

Wright Memorial Bridge	Water Lily	South End Knotts Island	North End Knotts Island	North Bay
12.87%	4.42%	3.61%	3.3%	2.76%

"The average yearly salinity content since 1951 has been as follows:

	Wright Memorial Bridge	Water Lily	South End Knotts Island	North End Knotts Island	North Bay
1952	6.5%	4.3%	3.2%	3.0%	2.3%
1953	11.6%	4.1%	3.3%	2.9%	1.7%
1954	12.2%	4.1%	3.2%	2.8%	2.1%
1955*	14.9%	7.6%	6.5%	5.6%	2.3#

* Average between January and approximately June 1955."

Table . Analysis of Water Samples from North Landing River, Back Bay, Virginia, and Currituck Sound, North Carolina, (Data Expressed in Parts Per Million Except for pH and Secchi Disc). August 1953 to August 1956.

Analysis for:	Date	Station: Warden's Headquarters	Munden	Pungo Ferry	North Landing River	Knott's Island	West Neck Creek
NaCl	August 1953	647	631	492	1,125	806	42
	September 1953	838	675	492	259	1,092	0
	July 1956	1,266	934	862	575	*	403
	August 1956	1,384	966	*	450	*	516
pH	August 1953	7.3	7.3	6.7	6.5	7.3	5.9
	September 1953	7.9	7.2	6.8	6.5	7.6	6.1
	July 1956	6.4	7.1	6.7	6.8	*	6.2
	August 1956	7.3	7.1	*	*	*	*
Secchi Disc (Inches)	August 1953	32	21	18	22	*	13
	September 1953	33	21	16	14	24	15
	July 1956	55	*	22	14.5	*	19.5
	August 1956	62	50	*	25	*	23
Methyl-orange Alkalinity	August 1953	19	23	28	23	1	6
	September 1953	14	17	15	14	20	14
	July 1956	46	41	30	25	*	0.0
	August 1956	53	78	*	40	*	40

* No data available.

Discussion of Water Salinity, 1920-1950

Frequent fluctuations in salinity in Back Bay and Currituck Sound permitted observers to infer just about whatever they wished as to its effect on the habitat, laymen and professionals alike.

Salt water is neither the panacea nor the bane that it has frequently been portrayed. Many complaints emanated from the area in the 1920's when water salinities averaged less than 10% SS, but they continued in the 1930's when salinities, over a broad expanse, ranged from 2% to 32% SS.

Salinity ha's had important effects on the environment that will be clarified in this report; however, the primary factors adversely affecting aquatic plant-production have been turbidity and siltation. This does not imply that further consideration of salinity is not needed, for salinity is related to turbidity in a manner-suggesting management possibilities. Also, salinity determines plant community types and influences certain plant growth and production,

CLIMATOLOGICAL DATA

Data are presented on air and water temperature, precipitation, wind speed, and direction that are applicable to the Back Bay and Currituck Sound Area. Data were obtained from the Monthly Summaries of the United States Weather Bureau for the conditions at Norfolk Municipal Airport and from the records of the Back Bay National Wildlife Refuge.

Ideally, all the interrelationships of climatological data, water levels, turbidity, water chemistry, and yields of aquatic vegetation would be considered in this section. Unfortunately, the construction of mathematical models of all these factors to ferret out the relationships of interest must await final publication. In construction of models relating weather to turbidity and vegetation yield, it may be necessary to exclude 1962 because of the prevailing influence of the ocean water intrusion, and 1963 for Back Bay because dredging activities had commenced; the, inclusion of these two years could obscure the subtle relationship during the period 1958-61. The data necessary to attempt comparisons are included in Volumes I and III; attention was called to the major environmental changes of salinity, turbidity, and dredging and noticeable changes in vegetation yield are apparent. It is likely that yields of major aquatics from each August transect survey will be compared to the May, June, and July monthly averages of air and water temperature, wind speed, water turbidity, and salinity when appropriate for Back Bay and Currituck Sound individually.

Annual yield of vegetation probably cannot be considered as an independent variable; it most likely bears some-relationship to the previous year, at least. Competition between species is another variable that should be considered.

No one could deny that climatological factors affect annual yields of vegetation; however, annual yields of aquatic plants, unlike upland plants, are less directly the product of climatic factors than they are of physical and chemical variations in the environment. The water ameliorates the effects of climatic factors, often relegating them to secondary importance compared to turbidity, siltation, water level fluctuation, salinity, and other chemical, physical, and biological factors. The direct effect of climatic variation is thus obscured, and except for extreme conditions, is seldom considered of direct influence.

Generally, high winds, low spring and summer temperatures, and excessive rainfall would adversely affect aquatic vegetation yield in the Back Bay-Currituck Sound Area by the direct effect on physical, chemical, and biological factors.

The average annual temperature from 1906 through 1963 was 60.2°F; the lowest annual average was 57.2 in 1917, and the highest was 62.7 in 1949. January has the lowest average temperature of

42.4°F, and July has the highest average temperature of 78.5°F. The lowest monthly average temperature was 31.0°F in January 1940, and the highest was 82.0°F in July of both 1942 and 1952.

Water temperatures have direct influence on the beginning of the bass spawning (62°-65°F), and, as seen in the maximum and minimum, water temperatures at weekly intervals'would be limiting on spawning activity until mid-April to early May. Turbidity is also correlated with water temperature, but this relationship is only slightly cause and effect of water temperature-density-settling rates; the coincidental relationships of temperature to wind speed and direction, drainage, erosion from cropland, aquatic vegetation, etc., that affect turbidity are of greater importance.

Annual precipitation averaged 42.8 inches between 1906 and 1963. Heaviest rainfall normally occurs in June, July, and August with the maximum average of 5.67 inches in July. Least rainfall normally occurs in November, averaging 2.47 inches. Monthly extremes were 0.26 inches in February 1918 and 14.51 inches in August 1949.

Wind speed is least in July and August, averaging 9.5 and 9.4 mph, respectively. March has the highest average wind speed of 12.8 mph. During the period 1958-65 the highest monthly average wind speed was 14.4 mph in February 1958. The lowest monthly average wind speed was 8.1 mph in June 1959.

During the study, spring and early summer wind conditions were generally favorable compared to the 1921-50 averages.

Table _____. Average Wind Speed in MPH, Prevailing Direction, and Fastest Mile at the Norfolk Municipal Airport.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1958	12.3 NNW 44	14.4 W 46	12.5 N 34	12.9 S 43	9.7 SSW 35	9.3 SSW 40	9.8 SW 39	8.7 SW 48	8.2 N 41	10.7 NE 46	10.0 S W 35	9.8 NNE 38
1959	11.5 SW 56	10.7 NNE 40	11.6 SSW 47	11.5 SW 45	9.2 SW 29	8.1 SW 48	8.3 SW 45	7.5 SW 30	8.5 ENE 36	10.4 SW 32	11.5 NNE 33	10.7 NNE 41
1960	10.8 NNE 42	13.6 WNW '49	12.9 N 52	12.7 SW' 39	10.2 ENE 36	10.4 SW 31	8.8 SW 37	10.5 SW 30	9.9 ENE 73	10.3 NNE 34	9.5 SW 27,	10.0 SW 48
19'61	10.7 SW 40	12.2 SW 45	12.5 SW 34	13.1 SW 42	9.6 SW 26	8.9 SW 38	7.9 SW 34	8.1 SW 34	9.9 NE 35	8.6 SW 39	10.7 NNW 31	9.9 SW 30
1962	12.2 SW 43	10.8 N 31	12.2 NNE 41	12.3 SSW 44	9.4 ENE •	10.5 SW 40	9.2 SW 26	8.6 ENE 27	9.9 SW 35	10.3 SW 35	13.6 NNE 52	14.1 NNE 45
1963	11.3 N 36	13.1 N 40	13.6 SW 57	13.3 SW 38	11.1 S 30	9.1 S 39	8.9 SSW 29	9.0 S 51	10.8 NNE 35	11.1 NN-E 34	11.2 S 38	11.8 NW 46
1964	13.9 S 45	13.9 WSW 59	13.8 S 52	11.2 ENE 45	11.5 NE 39	9.0 SSW 30	10.3 S 32	9.4 SSW 34	12.2 SSW 63	11.2 NNE 50	10.7 SSW 36	11.4 S 36
1965	13.5 NW 34	13.2 WSW 66	12.5 NNW 35	13.1 NNE 33	11.2 SSE 53	12.7 S 34	10.8 S 28	9.8 S 28	10.7 ESE 26	12.2 W 34	11.3 W 34	11.1 WSW 34

Table Climatological Normals Recorded, from Data at the Norfolk Municipal Airport. (Based on 1921-1950 Values.)

Month	Average Air Temperature	Degree Days	Precipitation	Avg. Speed Wind (mph)	Prevailing Direction	% *Sunshine
January	41.5	729	3.17	11.9	SW	50
February	42.0	644	3.06	12.1	N	57
March	49.1	500	3.27	12.8	NE	60
April	56.3	265	3.16	12.1	SW	63
May	65.9	59	3.45	10.8	SW	66
June	74.7	0	4.16	10.0	SW	66
July	77.5	0	6.05	9.5	SW	66
August	76.4	0	5.08	9.4	NE	66
September	72.0	9	3.86	10.0	NE	63
October	61.2	152	2.45	10.8	NE	64
November	51.4	408	2.67	11.3	SW	60
December	42.8	688	2.88	11.3	SW	52
Totals & Average:	59.2	3454	43.26	11.0	SW	62

* Percent possible sunshine.

WATER DEPTHS AND FLUCTUATION

Daily water level data were obtained from the Back Bay National Wildlife Refuge records for the period 1958-63. Monthly summary of the means, maximum and minimum water levels, show no relationship to yields of aquatic vegetation. However, observation indicates that increasing water depths in midsummer can be harmful to plant production and seeding. This was not true in 1962 when water levels increased from May through July, but the clearer water that summer probably offset the detrimental effects.

No tidal effect occurs in Back Bay or most of Currituck Sound. Wind direction and velocity are the principal factors controlling water levels ; of course, heavy rainfalls affect water levels for short periods. Average monthly water levels are normally highest from April through September, but daily maximums equalling, or exceeding, average summer levels can occur in all months. The highest level recorded was 1.90 ft. above mean sea level in February 1961 and April 1962. The lowest level was 3.1 ft. below mean sea level during the March 7, 1962, storm.

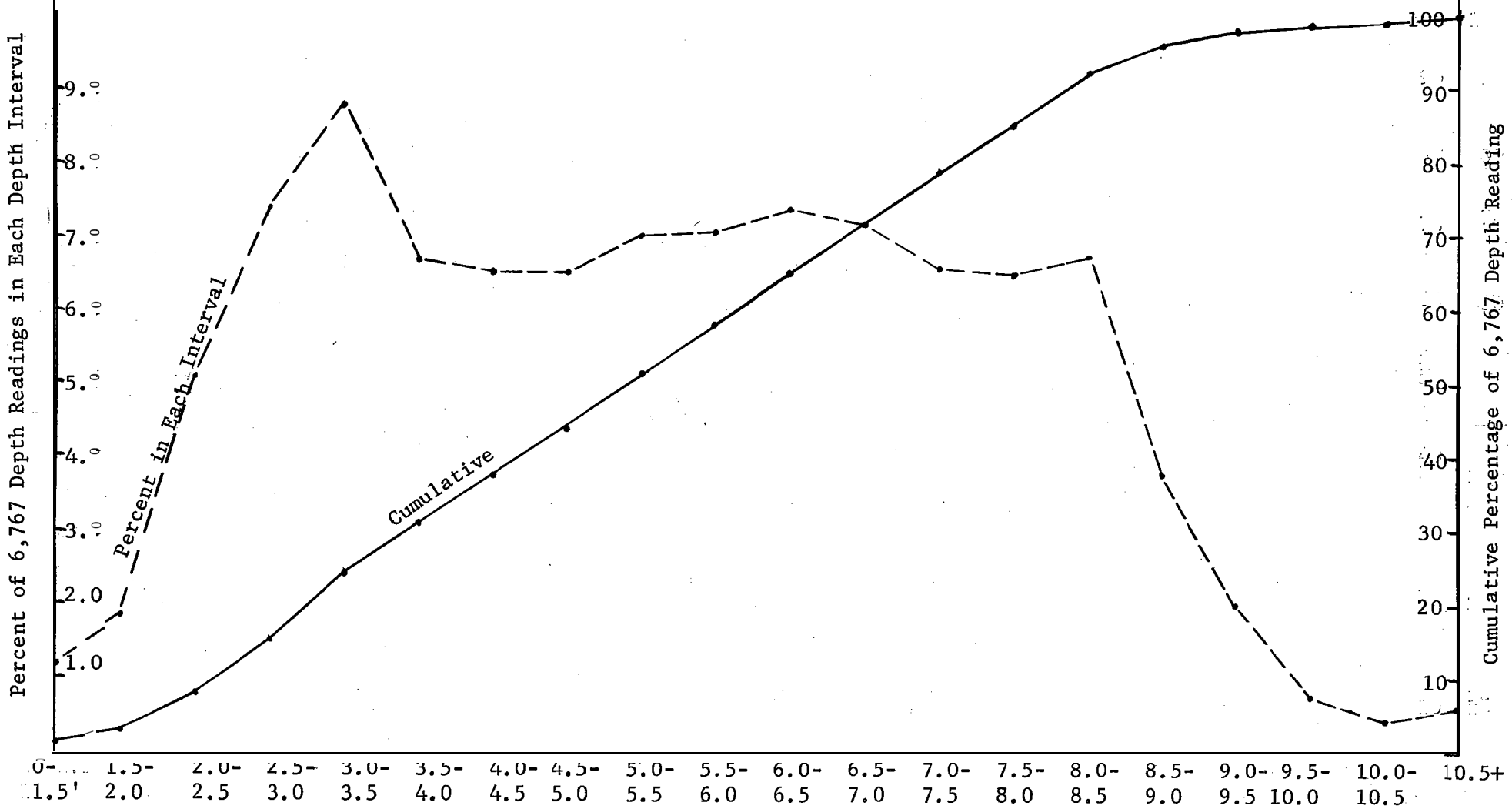
Maps are presented for four subdivisions of the Back Bay-Currituck Sound Area (A, B, C, and D) that show the average depth of quadrates 1,000 yards square. These depth readings were taken in conjunction with the master surveys and each average is based on ten depth readings.

In August 1959 when the average water level reading was 0.43 ft. msl, the average depths were 6.06, 4.78, 4.94, and 4.56 ft. in Sections A, B, C, and D, respectively. The overall average was 5.04 feet. Sections A through D, respectively, represent south Currituck, mid-Currituck, north Currituck, and Back Bay.

The distribution of 6,767 depth readings taken in 1959 by half-foot intervals is shown in the following graph;

The relationship of aquatic plant yield to water depth is discussed in Volume 1; as mentioned there, all species of plants declined in production with increased depth of water. This was principally due to lesser light penetration, but was aggravated in several areas because the deeper areas also were sites for collection of soft silts that formed poor substratum for aquatic plant' attachment.

Figure _____ Percentages of 6,767 Depth Readings in Each One-half Foot Interval and the Cumulative Percentages, from the 1959 Master Survey of Back Bay and Currituck Sound.



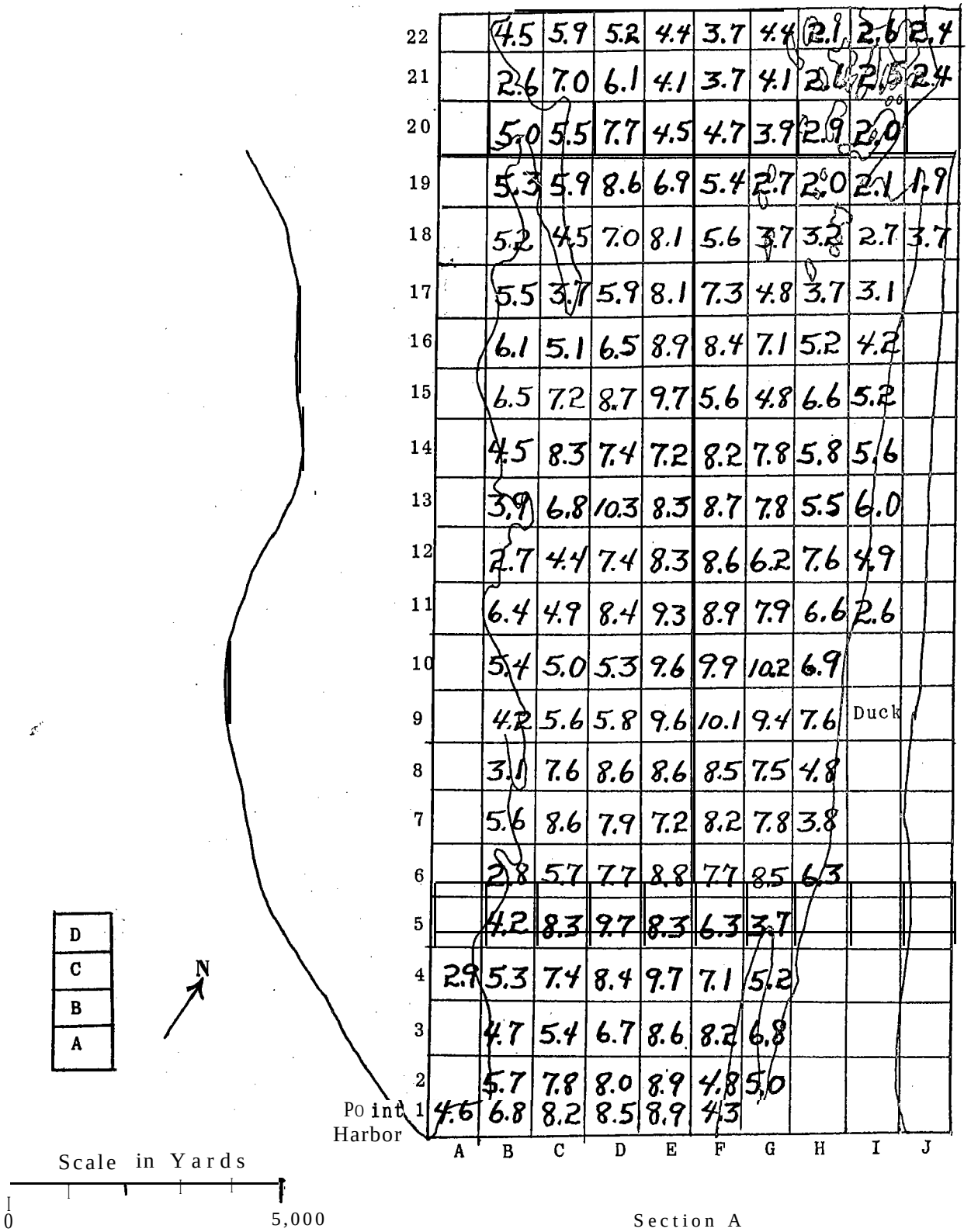


Figure ___. Average Depth of Each Quadrate (in feet) from the Master Survey, August, 1962, when the Average Water Level was 0.4 ft. above Mean Sea Level.

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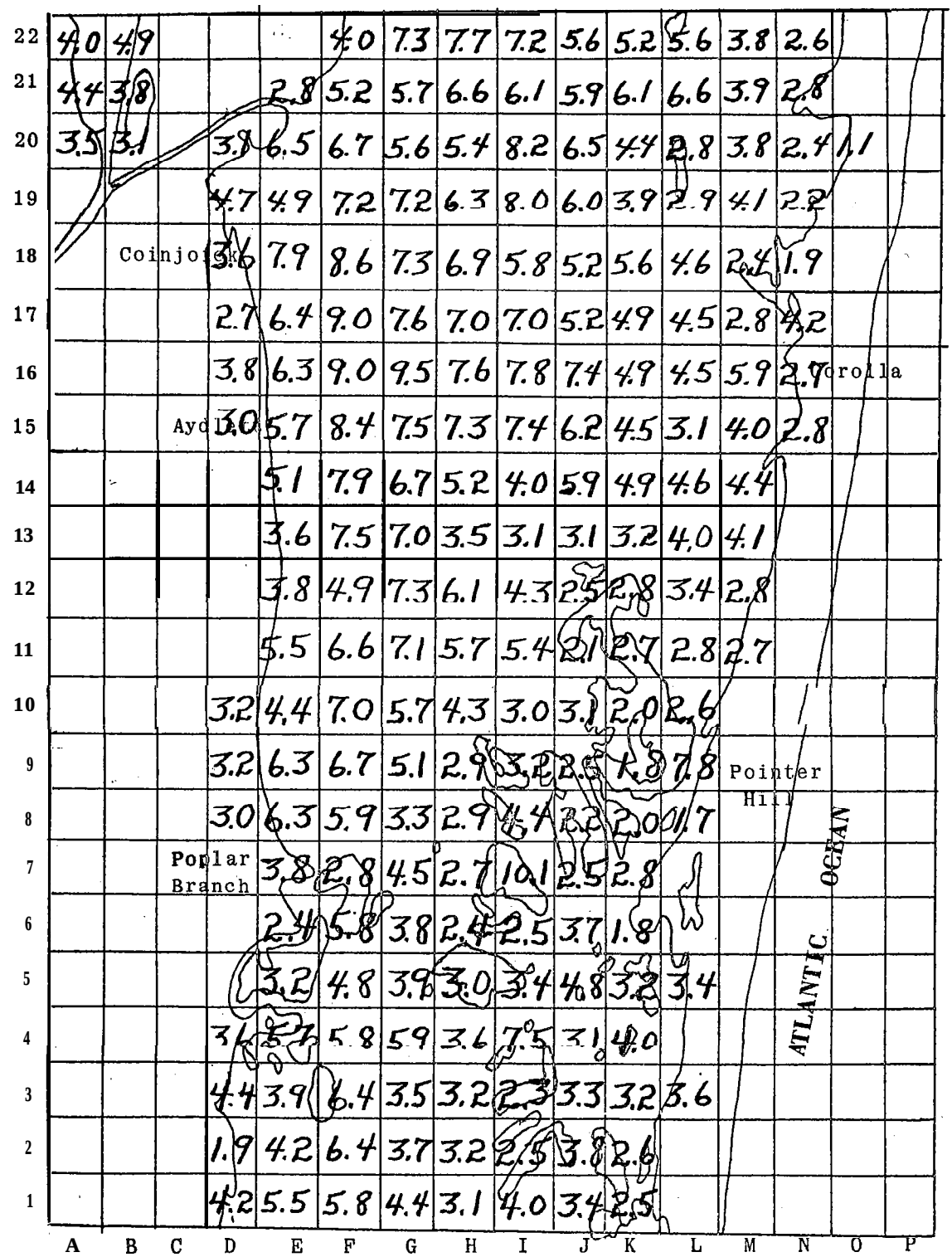


Section B

Figure_____. Average Depth of Each Quadrate (in feet) from the Master Survey, August, 1962, when the Average Water Level was 0.4 ft. above Mean Sea Level.

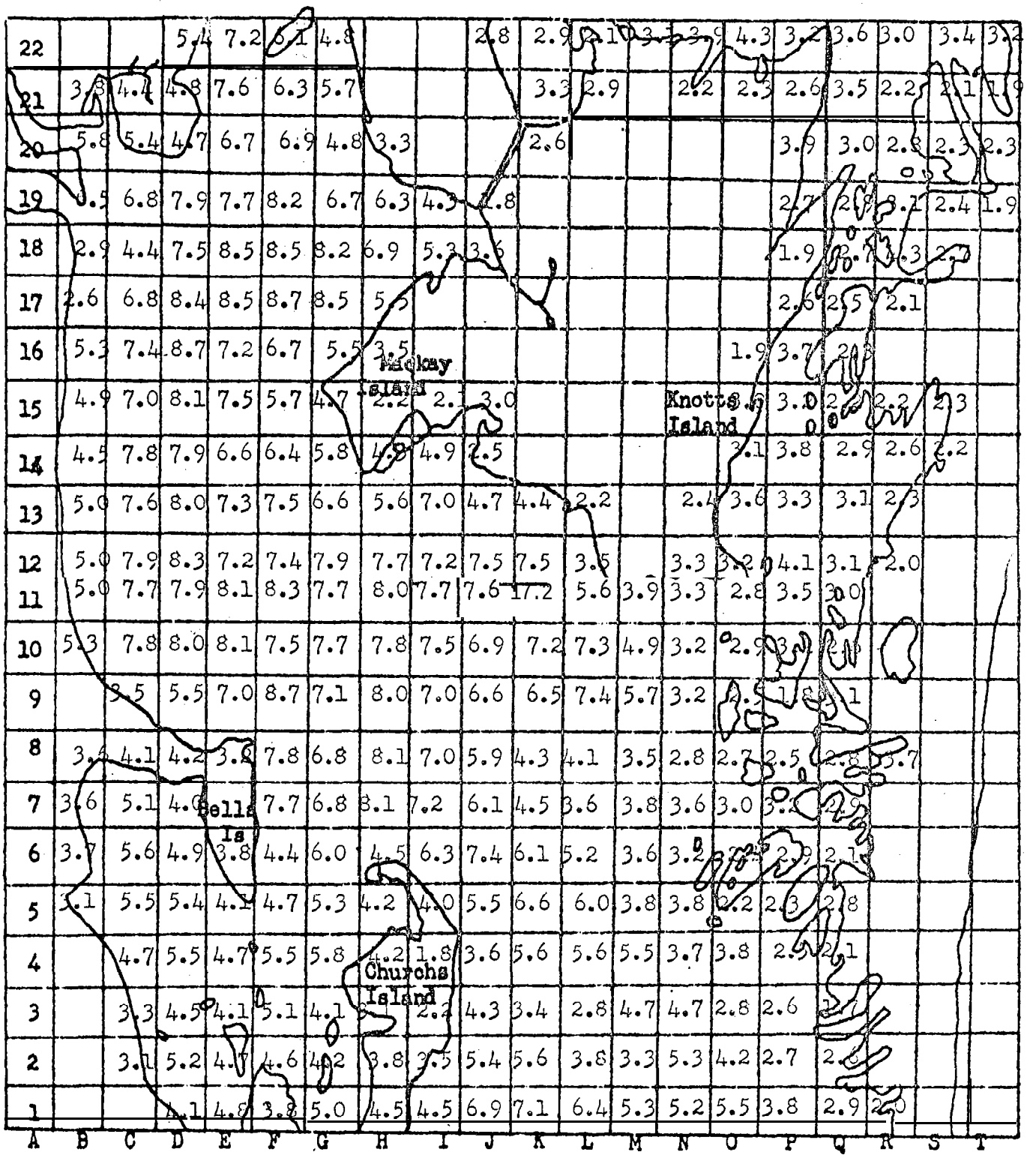
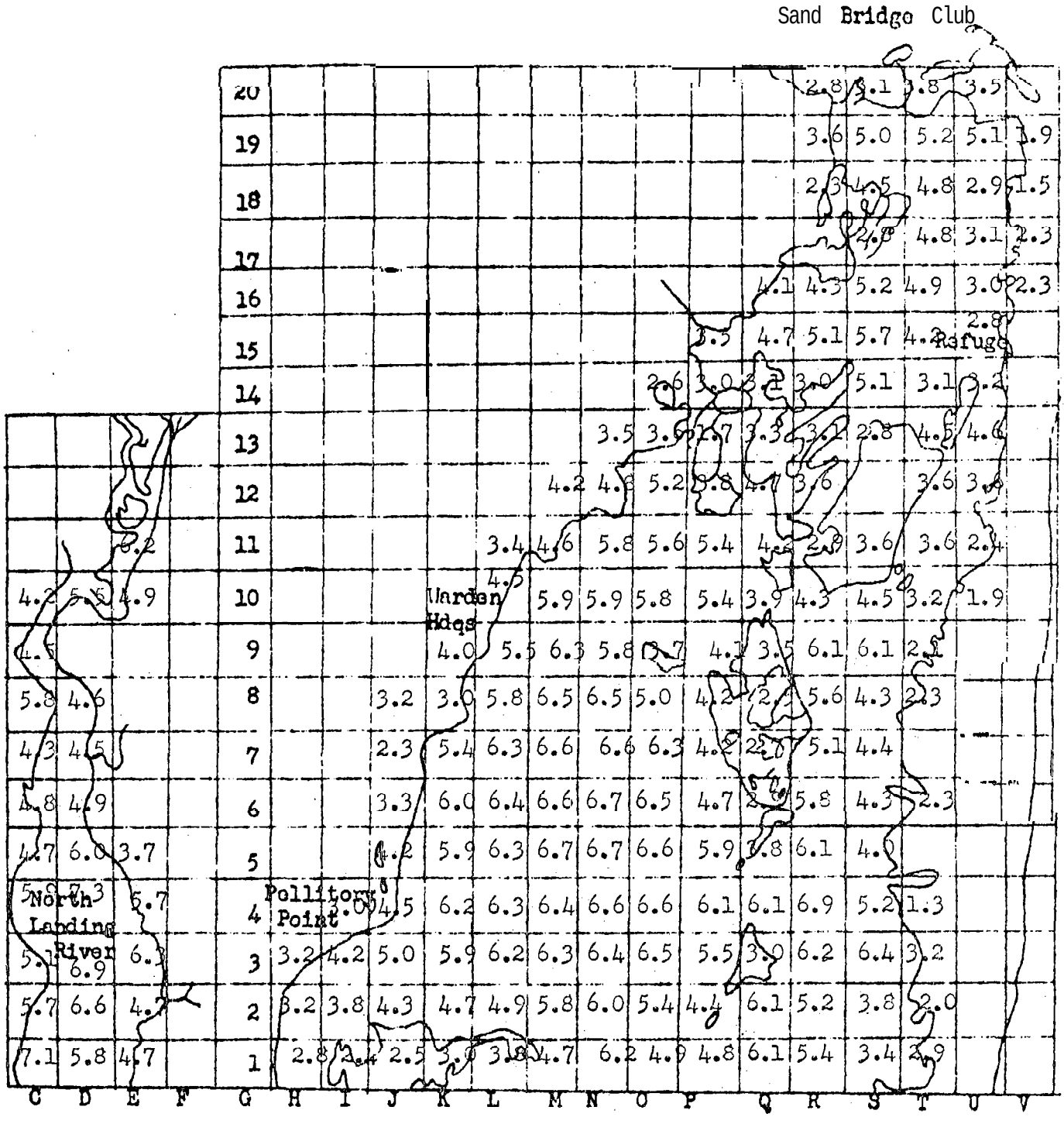


Figure_____. Average Depth of Each Quadrate (in feet) from the Master Survey, August, 1962, when the Average Water Level was 0.4 ft. above Mean Sea Level.



Section D

Figure_____. Average Depth of Each Quadrate (in feet) from the Master Survey, August, 1962, when the Average Water Level was 0.4 ft. above Mean Sea Level.

Table . Water Level Data - Back Bay National Wildlife Refuge, Back Bay, Virginia. January 1958 through July 1963.

Date	Maximum	Minimum	Deviation	Average
1958				
January	.70	- .90	1.60	- .01
February	.90	- .70	1.60	- .01
March	.50	- 1.00	1.50	- .20
April	1.30	- .40	1.70	.60
May	1.30	.20	1.10	.77
June	1.18	.00	1.18	.49
July	1.10	.26	.84	.74
August	1.02	.00	1.02	.53
September	.80	- .70	1.50	.19
October	.74	- 2.00	2.74	.05
November	.90	- .60	1.50	.39
December	.10	- 1.20	1.30	- .48
Annual Average:	.88	- .59	1.47	.26
1959				
January	.60	- .70	1.30	.00
February	.30	- 1.30	1.60	- .35
March	1.50	- 1.10	2.60	- .04
April	1.10	- .40	1.50	.34
May	1.04	.32	.72	.67
June	.68	- .10	.78	.25
July	1.38	.04	1.34	.77
August	.76	- .04	.80	.43
September	.76	.48	1.24	.17
October	1.64	.06	1.58	.84
November	.80	- 1.22	2.02	.01
December	.52	- 1.10	1.62	- .18
Annual Average:	.92	- .50	1.43	.24
1960				
January	.70	- 1.50	2.20	.15
February	1.54	- 1.50	3.04	.34
March	1.16	- 1.42	2.58	- .34
April	1.30	.00	1.30	.77
May	1.08	- .30	1.38	.54
June	1.42	- .02	1.44	.80
July	.86	.16	.70	.49
August	1.30	.34	.96	.84
September	1.46	- .02	1.48	.64

(Cont'd)

Table . Water Level Data - Back Bay National Wildlife Refuge, Back Bay, Virginia. January 1958 through July 1963. (Cont'd)

Date	Maximum	Minimum	Deviation	Average
1960 (Cont'd)				
October	.82	- .32	1.14	.44
November	.42	- .60	1.02	.06
December	.28	- .82	1.10	- .40
Annual Average:	1.03	- .50	1.53	.36
1961				
January	.38	.68	1.06	- .23
February	1.90	- .90	2.80	.12
March	1.00	- .10	1.10	.53
April	1.50	.20	1.30	.94
May	1.42	.24	1.18	.76
June	1.10	.00	1.10	.67
July	1.10	.20	.90	.64
August	1.00	- .10	1.10	.60
September	.80	- .70	1.50	.12
October	.86	.28	1.14	.14
November	.80	- .42	1.22	.01
December	.60	- .40	1.00	.11
Annual Average:	1.04	- .25	1.28	.37
1962				
January	1.00	- .50	1.50	- .04
February	.64	- 1.20	1.84	- .15
March	1.10	- 3.10	4.20	.10
April	1.90	- .20	2.10	.52
May	.90	- .20	1.10	.29
June	.92	- .56	1.48	.60
July	1.20	- .14	1.34	.73
August	.76	0.00	.76	.41
September	.80	- .22	1.02	.40
October	.94	- .50	1.44	.35
November	.94	- 2.50	3.44	- .20
December	.36	- 2.00	2.36	- .28
Annual Average:	.96	- .93	-1.88	0.20

(Cont'd)

Table . Water Level Data - Back Bay National Wildlife Refuge, Back Bay, Virginia. January 1958 through July 1963. (Cont'd)

Date	Maximum	Minimum	Deviation	Average
1963				
January	.46	- .94	1.10	- .27
February	- .10	- 2.20	2.10	- .76
March	.70	- .54	1.24	.15
April	.54	.60	1.14	.02
May	.70	- .60	1.30	.08
June	1.10	- .04	1.14	.55
July	.78	- .22	1.00	.28

WATER CHEMISTRY

Water Chemistry at Periodic Intervals, 1958-1963

The quality of the water in an aquatic habitat affects, directly or indirectly, all forms of life which live in or use that habitat. The analyses from the transect lines were to determine certain basic characteristics of water chemistry that can affect habitat conditions; to monitor these characteristics; to investigate their interrlationships; and to interpret their environmental significance.

Procedures

During the summer of 1958, 20 transects were established across the Back Bay-Currituck Sound Area, for vegetation and water chemistry studies, according to a systematic sampling plan. Water sample stations were selected at approximately 100 yards offshore on each transect end, and in the middle of each transect. During stable conditions, water samples were collected at approximately monthly intervals from each of the sample stations. During unstable conditions, the frequency of sampling, to obtain adequate data on the chemical changes occurring in the study area, was left to the judgment of the investigator. One additional transect (Kl, -Currituck Courthouse to Mackeys Island) was established following the March 7, 1962, sea-water intrusion to provide information on the movement of the saline water in the northern portion of Currituck Sound.

The surface water samples were collected at approximately one foot depths and the bottom water samples, collected occasionally in.deeper water areas and during the influx of sea water, were collected on, or near, the bottom with the use of a Kemmerer water bottle or a modified Irwin sampler. Samples were collected in, or placed into, labeled containers and returned to the laboratory for analysis. Water depth and secchi disc reading were recorded at each sample site.

All chemical determinations were made by the methods outlined in Standard Methods for the Examination of Water and Sewage, 1955. Chloride determinations were made by the Mohr method and the results expressed as ppm chloride (NaCl) and percent sea water. Determinations for pH were made with a Taylor color comparator or an electric pH meter. The electric pH meter provided quick pH determinations of the water samples upon arrival at the laboratory. It also eliminated the common errors experienced with color comparators. However, some difficulty was experienced in keeping the electric pH meters operating properly and in cases of questionable meter operation, the pH determinations were made with the color comparator.

Results

The periodic water sampling at established stations was initiated in May. 1958, and was conducted at bimonthly or monthly intervals until December 1961. Some portions of the study were being terminated at this time in preparation for completing the study in 1962.

The severe March 7, 1962, storm, which battered most of the Atlantic coast, created eight major breaks, plus numerous small ones, through the protective sand dunes on the barrier beach along the study area and introduced large quantities of sea water into Back Bay-Currituck Sound. A major portion of the dunes was either washed flat or seriously eroded. The barrier beach was eroded to the extent that sea water continued to enter the area for several days following the storm during above normal post-storm tides. The study was continued following the intrusion of sea water to evaluate the effects of the sea water. Sea-water concentrations as strong as 75 percent were recorded in Back Bay and 94 percent in Currituck Sound on March 8, 1962. The sea-water intrusions increased the average salinity in Currituck Sound from 3.26 percent sea water, just prior to the storm, to approximately 28 percent and raised the average salinity in Back Bay to approximately 15 percent.

The sea water did not immediately mix and dilute with the fresh to brackish water in the study area. A stratified layer containing high concentrations of sea water developed in the deeper waters. Differences as great as 34 percent sea water were found between surface and bottom samples. Subsequent wave action and wind tides mixed and diluted these stratified concentrations so by March 23, 1962, the salinity was fairly uniform from the surface to the bottom in most areas. There was a considerable movement of saline waters before they finally dispersed and diluted with the Sound water with a gradul decrease in the average area-wide chloride content being apparent during the mixing process. After mixing, the average chloride content remained fairly constant around 10-12 percent sea water through the summer months of 1962. The major portion of the sea water, which entered the study area in March, still remained in the area after a period of 7 months. The higher concentrations of sea water entered the central portions of the area and continued to remain in this general area until November 25, 1962, at which time another northeastern strom blew most of the water out of the study area.

The severe northeastern storm which began on November 25, 1962, with winds up to 76 miles per hour, heavy seas, and tides 3 to 5 feet above normal, caused extensive beach erosion along the study area barrier beach. Approximately 40 percent of the dune repairs, which were made along the Currituck coast following the March 7, 1962, storm, were completely destroyed; and approximately 25 percent of the remaining 60 percent were seriously eroded. The most severe erosion occurred from Sandbridge, Virginia, south to about 5 miles below Corolla, North Carolina. The storm lashed the study area coast for a period of 9 days.

The volume of sea water which entered the study area during the November 25, 1962, storm was small compared to that which entered on March 7, 1962. Concentrations of 27 percent sea water were located just south of Corolla, North Carolina, during the storm, but the. overall effect of the storm was a reduction in average chloride content.. This reduction resulted from the steady and strong northerly winds which blew most of the water out of the study area. A staff gauge reading of 1.1 feet below mean sea level was recorded at Coinjock, North Carolina, the lowest water level recorded during the study period.

Sea-water concentrations up to 27 percent entered the study area from the south via Albemarle Sound upon the cessation of the strong northerly winds and the return of normal water levels. This body of saline water was probably the same 27 percent sea-water concentration that was located just south of Corolla during the storm, and was pushed just out of the study area and returned following the cessation of the strong northerly winds. The 27 percent sea water did not penetrate north of Poplar Branch, North Carolina, and was pushed out of the study area again, within a few days, by less severe northerly winds which occurred shortly after the November 25, 1962, storm.

The Back.Bay-Currituck Sound Area was still influenced by the March 7,. '1962, sea-water intrusion in August 1963, 17 months later, with an average chloride content of 6 percent sea water. Prior to the sea-water intrusion, the average chloride content varied from 2 to 3 percent sea water.

pH

The pH values in the study area prior to the March 7, 1962, storm ranged from 6.4 to 9.2 in Back Bay and 6.2 to 9.3 in Currituck Sound, with an average of 7.7 and 7.5 for Back Bay and Currituck Sound, respectively. Some lower pH values were recorded in Currituck Sound during August, September, and November 1958, but were in error due to faulty procedure of prolonged holding of the samples.

After the ocean water intrusion, the pH values ranged from 5.7 to 9.7 in Back Bay and 7.1 to 8.7 in Currituck Sound, with an average of 7.4 in Back Bay and 7.8 in Currituck Sound.

Generally, slightly higher pH values occurred in the summer months, and also in the shallow cove areas.

The lowest series of pH determinations in the summer months on Back Bay was the last taken on July 29, 1963, when the average dropped to 6.6. It is unfortunate that further determinations were not made, for a sudden and severe deterioration of aquatic plants, occurred in July and August 1963, on Back Bay. Dredging activities at Sandbridge Marsh and/or heavy rains in June may have contributed to lower pH values and the plant destruction.

The pH of the study waters, with the exception of a few individual samples, falls within the range of tolerance for fish and plant life which occur in the area.

Bourn found the waters of Back Bay and Currituck Sound to range from pH 6.2 to 6.8 in 1929 and 1930. Chamberlain in 1947 recorded a pH range of 6.0 to 8.7 for the waters of Back Bay; his determinations were very similar to those of the present study. Neither Bourn nor Chamberlain attributed any adverse effects to the pH values.

Alkalinity

The pH of the water in the study area is generally less than 8.3 and the alkalinity consists of bicarbonates. The alkalinity ranged from 16 to 66 ppm in Back Bay and 10 to 210 ppm in Currituck Sound, during pre-storm conditions, with an average of 30 ppm in Back Bay and 41 ppm in Currituck Sound. A slight overall increase in alkalinity occurred in Back Bay after the introduction of sea water with an average of 39 ppm for all Back Bay samples. The greatest increase was noted at the east stations where the average alkalinity was 42 ppm after the storm. The introduction of sea water did not alter the overall alkalinity in Currituck Sound with the average remaining at 41 ppm.

The waters within the study area would, by some standards, be classified as medium hard to hard water with the average alkalinity of 30 to 41 ppm (Lagler, 1952). Waters of this hardness are generally considered productive for both fish and aquatic plants. Moyle (1945) states sago pondweed, *Najas*, and wildcelery make their best growth, and are more abundant, in hard waters, and that they occur infrequently and make poor growth in waters with total alkalinity of less than 20 ppm. In general, the water in the study area had total alkalinity levels which were capable of supporting growth of the major species of aquatic vegetation in the area; but the alkalinity was less than optimum for sago pondweed and widgeongrass.

Turbidity

A complete analysis of the turbidity, water depths, and light penetration is presented in another section of this report, so only a few general observations will be made at this point.

In general, the water is progressively clearer from north to south in the study area. This is also the pattern of the chloride content in the study area and although there are other factors which affect the turbidity within the area, there is a direct correlation between the two.

Light penetration increased throughout the study area following the introduction of sea water. The sediment became resuspended during periods of excessive wind action, but the sedimentation rate of the suspended material was greater following the increase in chloride content. The light penetration continued to be greater in Currituck Sound, under similar chloride content, pointing out the possibility of a different type of material which causes the turbidity in Back Bay, In general, the greater turbidity occurred during the period November through April. The prevailing wind during this period is from the north and northeast. These winds have the greatest fetch on the water in the area and, in general, are of greater velocity than other winds. The excessive turbidity occurs during the beginning of the growing season, and in amounts great enough to cause deleterious effects on the aquatic vegetation in the deeper water areas of the study area.

Chloride

Prior to the March 7, 1962, storm, the chloride content in Back Bay ranged from 200 to 1050 ppm (1-3 percent sea water) with an average of 485 ppm, and Currituck Sound ranged from 250 to 7950 ppm (l-25 percent sea water) with an average of 1640 ppm (5 percent sea water). The large quantities of sea water which entered the study area during the March 7, 1962, storm increased the average chloride content in Back Bay to 15 percent sea water and 28 percent sea water in Currituck Sound.

Concentrations of 75 percent sea water in Back Bay and 94 percent sea water in Currituck Sound were recorded in the study area on March 8. The more dense, heavier sea water did not readily mix with the water in the study area. The sea water ran under and displaced the area water and became stratified in the deeper water areas. It was not until March 23 that the chloride content became fairly uniform from the surface to the bottom.

A fish kill resulted from the sea-water intrusion. The kill was confined to the eastern shore area from Swan Island to Duck, North Carolina. The sea water affected all species, but was fairly light due to the few number of fish in the area along the shore at this time of year. The chloride content remained high enough through the spawning season, in some portions of the study area, to reduce the spawning success of largemouth bass and bluegill and completely eliminate largemouth bass and bluegill spawning success in other portions of the study area.

The full sea strength (94 percent) sea water which entered the area near Corolla, North Carolina, killed all species of vegetation in the immediate vicinity of the entrance and damaged the vegetation in the adjoining area where concentrations remained above 40 percent sea water for several days. The vegetation in the full strength sea water turned black and broke off at bottom level. The vegetation in the 40 to 60 percent sea water (for several days) experienced cell destruction by the excessive -salt content. The denuded areas revegetated within a short time and by August 1962, good growths of all species were present.

The more dense, higher concentrations of sea water did not readily mix throughout the study area even after concentrations became fairly uniform from the surface to the bottom. The body of saline water moves up and down the middle portion of Currituck Sound for a period of 7 months, slowly mixing and spreading in size. The-majority of the sea water remained in the middle portion of Currituck Sound until a severe storm, on November 25, 1962, blew most of the water out of the study area and dispensed the body of saline water. The sea water which entered the Back Bay portion of the study area dispersed and diluted the area water within a short period. The tendency of the Currituck body of water to remain intact was probably due to the bowl-shaped area and to the restricted outlet at the Narrows near Poplar Branch.

The chloride content still was influenced by the March 7, 1962, intrusion in August 1963, with an average of 1695 ppm in Back Bay and 2615 ppm in Currituck Sound.

For those who may wish to express the chloride content by other means than chloride and percent sea water, a conversion chart is included.

Conclusions

1. The pH of the study area water, with the exception of a few individual samples, falls within the range of tolerance for the fish and plant life which occur in the Back Bay-Currituck Sound Area.

2. In general, the water in the study area has total alkalinity levels which are within those that are considered satisfactory for growth of some species of aquatic vegetation in the area, but marginal for sago pondweed and widgeongrass.

3. The March 7, 1962, sea-water intrusion did not alter the pH and alkalinity levels in Currituck Sound. A slight increase in alkalinity was noted in Back Bay following the sea-water introduction.

4. Light penetration increased throughout the Back Bay-Currituck Sound Area following the sea-water intrusion.

5. The sediment became resuspended during periods of excessive wind action, but the sedimentation rate was greater after the increase in chloride content.

6. Uncontrolled introductions of sea water into the area may result in extensive damage to the existing fish and plant life in the area, but the intrusions in 1962 did not cause apparent harm.

7. The heavier, more dense sea water does not readily mix with the area water, rather it tends to displace the area water and may become stratified in the deeper water areas.

Conversion of Salinity

Salinity is defined as the total amount of solid material in grams contained in 1 kilogram of sea water when all the carbonate has been converted to oxide, the bromine and iodine replaced by chlorine, and all organic matter completely oxidized. This normally is reported in grams per kilogram (parts per thousand).

Chlorinity is defined as the number of grams of "atomic weight silver" necessary to precipitate the halogens in 0.3285230 kilograms of sea water. This is reported in grams per kilogram (parts per thousand).

The generally accepted empirical relationship between salinity and chlorinity is: Salinity = 0.03 + 1.805 x chlorinity.

A third method of expressing the saltiness of water is in the amount of chloride present, assuming that all chlorides are in the form of sodium chloride. This is usually presented as parts per million NaCl. The method for calculation of chlorides as sodium chloride is outlined in "Standard Methods for the Examination of Water and Sewage," Ninth' Edition, (1946) as published by the American Public Health Association and the American Water Works Association.

A number of standards have been used to form a basis for calculations of salinity or chlorinity. Van Nostrand's Chemical Annual, Seventh Edition, 1948 states that normal-sea water from the North Atlantic contains 32,210 ppm Cl as NaCl. The reference for this is questionable. Using this figure, the chlorinity would be 19.538 parts per thousand and the salinity 35.296 parts per thousand. The accepted standard sea water (normal sea water) used in oceanographicwork (Sverdrup, Johnson, and Fleming, "The Oceans," 1946) has a chlorinity of 19.381 parts per thousand, a salinity of 35.013 parts per thousand or 31,950 ppm Cl^- as NaCl. Both references have merits and the use of either or both would depend on preference.

For much work, especially in brackish water work, it is convenient to express salt content in percent sea water strength.' This can easily be computed from any method of presentation of data. It is most important to state which basis is used for full strength sea water.

Table

CONVERSION TABLE FOR VARIOUS SYSTEMS OF COMPUTING SALT CONTENT

Chlorinity parts per thousand (‰)		Salinity parts per thousand (‰)		Chloride parts per million (ppm) as NaCl		% Sea Water
Normal[1] Sea Water	North Atlantic[2] Sea Water	Normal Sea Water	North Atlantic Sea Water	Normal Sea Water	North Atlantic Sea Water	
.006	.006	.041	0041	49.6	50	.003
.030	.030	.083	.084			.15
.060	.061	.138	.140	99.2	100	.31
.090	.091	.192	0194	148.8	150	.47
,120	.121	.246	.248	198.3	200	.62
.150	.151	.353	.302	248.0	250	.78
.179	.181	.409	.356	297.6	300	.93
.210	.212		.412	347.1	350	1.09
,241	.243	.464	.468	396.8	400	1.24
,271	.303	.519	.577	446.4	450	1.40
.301	.334	.572	.632	545.6	500	1.55
.331		.627		605.1	550	1.71
.361	.364	.681	.687		600	1.87
.391	.394	.735	.741	644.7	650	2.02
.422	.425	.790	.797	694.3	700	2.18
.451	.455	.844	.905	793.5	750	2.33
.481	.485	.898	.961	843.1	800	2.48
.512	.516	.953			850	2.64
.542	.546	1.007	1.015	892.7	900	2.80
.571						
.602	.607	1.060 1.116	1.069 1.125	991.9 942.3	1,000 950	2.95 3.11
						3.26
.662	.667	1.170	1.280	1,091.1	1,100	3.42
.692	.698	1.280	1.290	1,140.7	1,150	3.57
.722	0728	1.333	1.344	1,190.3	1,200	3.73
.752	.758	1.387	1.398	1,239.9	1,250	3.88
.782	.788	1.440	1.452	1,289.5	1,300	4.04
.812	.819	1.496	1.508	1,339.1	1,350	4.19
.842	.849	1.549	1.562	1,388.7	1,400	4.35
.873	.880	1.605	1.618	1,438.3	1,450	4.50
.903	.910	1.658	1.672	1,487.9	1,500	4.66
.932	.940	1.713	1.727	1,537.5	1,550	4.82
.962	.970	1.767	1.781	1,587.1	1,600	4.97
.993	1.001	1.822	1.837	1,636.7	1,650	5.13
1.023	1.031	1.876	1.891	1,686.3	1,700	5.28
1.052	1.061	1.929	1.945	1,735.9	1,750	5.44
1.083	1.092	1.985	2.001	1,785.5	1,800	5.59
						5.75
1.143	1.152	2.092	2.109	1,894.6	1,900	5.90
1.173	1.183	2.147	2.165	1,934.2	1,950	6.06
1.203	1.213	2.201	2.21.9	1.983.8	2,000	6.21
1.233	1.243	2.256	2.274	2,033.4	2,050	6.36

Chlorinity parts per thousand (‰)		Salinity parts per thousand (‰)		Chloride parts per million (ppm) as NaCl		% Sea Water
Normal Sea Water	North Atlantic Sea Water	Normal Sea Water	North Atlantic Sea Water	Normal. Sea Water	North Atlantic Sea Water	
1.264	1.274	2.310	2.329	2,083.0	2,100	6.52
1.293	1.304	2.365	2.384	2,132.6	2,150	6.68
1.323	1.334	2.418	2.438	2,182.2	2,200	6.84
1.354	1.365	2.474	2.494	2,231.8	2,250	6.99
1.384	1.395	2.527	2.548	2,281.4	2,300	7.15
1,414	1.425	2.58::	2.602	2,331.0	2,350	7.39
1,444	1.456	2.636	2.658	2,380.6	2,400	7.45
1.474	1.486	2.690	2.712	2,430.2	2,450	7.61
1,504	1.516	2.744	2.766	2,479.8	2,500	7.76
1.535	1.547	2.799	2.822	2,529.4	2,550	7.92
1,564	1.577	2.853	2.876	29579.0	2,600	8.07
1.594	1.607	2.907	2.931	2,628.6	2,650	8.24
1.625	1.638	2.962	2.986	2,678.2	2,700	8.38
1.655	1.668	3.016	3.041	2,727.8	2,750	8.54
1.684	1.698	3.070	3.095	29777.4	2,800	8.70
1.715	1.729	3.125	3.151	2,827.0	2,850	8.85
1.745	1.759	3.179	3.205	2,878.6	2,900	9.01
1.775	1.789	3.233	3.259	2,926.2	2,950	9.16
1.805	1.820	3.288	3.315	2,974.8	3,000	9.32
1.835	1.850	3.342	3.369	3,025.4	3,050	9.46
1.865	1.880	3.395	3.423	3,075.0	3,100	9.63
1.896	1.311.	3.451	3.479	3,124.6	3,150	9.78
1.925	1.941	3.504	3.533	3,174.2	3,200	9.95
1.955	1.971	3.559	3.588	3,223.8	3,250	10.11.
1.986	2.002	3.614	3.644	3,273.4	3,300	10.25
2.016	2.032	3.668	3.698	3,323.0	3,350	10.41
2,045	2,062	3,722	3.752	3,372.5	3,400	10.58
2.076	2.093	3.777	3,808	3,422.1	3,450	10.62
2.106	2.. 1.23	3.831	3,362	3,471.7	3,500	10.88
2.136	2.153	3.884	3.916	3,521.3	3,550	11.03
2.166	2.184	3.940	3.972	3,570.9	3,600	11.19
2.196	2.214	3.993	4.026	3,620.5	3,650	11.36
2.226	2.244	4.047	4.080	3,670.1	3,700	11.50
2.257	2.275	4.102	4.136	3,719.7	39750	11.65
2.286	2.305	4.157	4.191	3,769.3	3,800	11.80
2.316	2.335	4.211	4.245	3,818.9	3,850	11.96
2.347	2.366	4.266	4.301	3,868.5	3,900	12.11
2.377	2.396	4.320	4.355	3,918.1	3,950	12.28
2.406	2.426	4.373	4.409	3,967.7	4,000	12.42
3.009	3.033	5.406	5.450	4,959.6	5,000	15.52
3.611	3.640	6.547	6.600	5,951.6	6,000	18.63
4.212	4.246	7.632	7.694	6,943.5	7,000	21.73

Chlorinity parts per thousand (‰)		Salinity parts per thousand (‰)		Chloride parts per million (ppm) as NaCl		% Sea Water
Normal Sea Water	North Atlantic Sea Water	Normal Sea Water	North Atlantic Sea Water	Normal. Sea Water	North Atlantic Sea Water	
4.814	4.853	8.719	8.790	7,935.4	8,000	24.84
5.415	5.459	9.803	9.883	8,927.3	9,000	27.94
6.017	6.066	10.890	10.979	9,919.3	10,000	31.05
12.034	12.132	21.750	21.928	19,838.6	20,000	62.09
18.052	18.198	32.611	32.877	29,757.8	30,000	93.14
19.381	19.538	350010	35.296	31,950.0	32,210	100.00

[1] From Sverdrup, Johnson and Fleming, "The Oceans", 1942.
[2] Based on Van Nostrand's Chemical Annual, Seventh Editic ,1948.

LIGHT PENETRATION OF WATER

Light Penetration of Back Bay

Light penetration of Back Bay was determined at 23 stations monthly from July 1, 1960, through August 21, 1963, with a submarine photometer. The photometer was made by the Fred Schueler Company, Waltham, Massachusetts. Measurements were taken at locations on the transects used for vegetation sampling and water quality determinations. At each station the incident light at the water's surface was determined and the single cell photometer was then immediately lowered to depths of 1 inch, 1 foot, 2 feet, etc.., to the bottom of the bay. The light intensity at each depth was recorded in foot-candles and converted to the percent of the light at the surface. Sampling was generally conducted between 10 a.m. and 2 p.m. on the same day, so that the sun was near its apex and the sky conditions were as uniform as possible.

Because of an unfortunate mislabeling on the submarine photometer of read-out units in microamperes, rather than proper labeling of foot-candles, initial readings were multiplied by a factor of 4; consequently some early quarterly reports were in error. The data herein have been corrected.

Plant growth was slightly reduced in those areas where less than 15 percent of the surface light reached the bottom. It was further inhibited in areas where less than 10 percent of the light reached the bottom, and virtually non-existent where less than 5 percent of the light reached the bottom during the growing season.

The water was clearer during the warm summer months because of favorable weather and wind, lesser density of warm water, and some reduction of wave action by vegetation.

Although the intensity of sampling was minimal for such a variable characteristic as turbidity, the data indicate that relatively favorable quantities of light were recorded at a 4-foot depth in the summer of 1962. These data conform to observations of all study investigators. In some protected locations the bay bottom in both Back Bay and Currituck Sound was observed in the summer of 1962, when the salinity was above 10% SS, that were not seen in the 4 previous years or since that time.

During the summer of 1962 the waters of Back Bay became just as turbid as in other years; the important difference was that suspended silts did not remain in suspension for as long a period, and after a day or two of calm weather, sunlight penetration would increase. This observation was the consensus of many observers on the bay. It conforms closely with the results of the controlled laboratory study which showed that increasing the water salinity increased the rate of settling of suspended silts.

Bearing in mind that 10 percent of the sunlight represents a critical point, whereby plant growth was retarded below that intensity, quickly scan the summary data for 1960, 1961, 1962, and 1963. It is apparent that a greater quantity of sunlight reached depths of 4 feet for a longer period of time in the summer of 1962 than in other years. Plant growth could have started as early as May and continued through September at the 4-foot depth.

Paired comparison of the percentage of sunlight at the 3-foot depth at stations on Back Bay in May 1961, 1962, and 1963 reveals the following:

Station	May 19, 1961	May 18, 1962	May 22, 1963
1	Tr.	20	3
2	1	22	5
3	5	20	19
4	0	10	21
5	4	18	6
6	3	30	
7	10	16	5
9	1	19	Tr.
10	10	15	4
12	1	24	2
13	10	10	5
15	Tr.	17	8
16	Tr.	3	6
18	2	19	14
19	13	26	18
20		30	18
22	6	36	4
23	5	48	2
Average	4.2	21.3	8.2

The average percent of sea strength was 1.14 in May 1961, 11.90 in May 1962, and 4.99 in May 1963. Graphically the relationship is as follows:

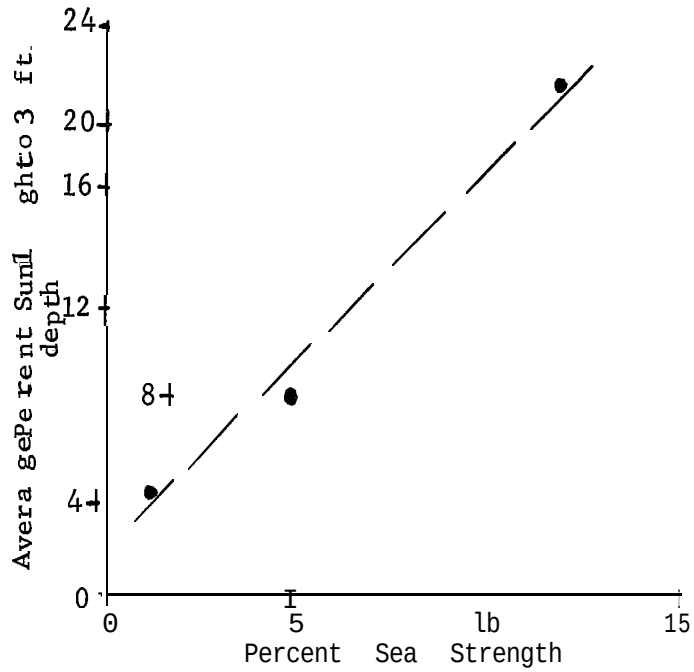


Table . Percent of Average Light Transmission to Indicated Depth Below Water Surface on Back Bay from July 1, 1960, to August 17, 1961 -- Each Monthly. Value Based on 23 Submarine Photometer Readings.

Date	Average Light at Surface (f.c.)	1 inch	1 foot	2 feet	3 feet	4 feet	5 feet	6 feet
1960								
'uly 1	3,272	74	41	24	12	7	5	3
August 1	3,352	78	53	33	19	9	6	
'eptember 1	4,324	78	55	35	20	12	7	7
October 4	3,208	71	39	19	11	7	5	3
December 22	3,176	64	PO	2	Tr.	0	0	
1961								
'anuary 13	2,166	67	18	4	1	Tr.	0	
February 7	1,794	46	3	Tr.***	0	0	0	
March 27	4,507	55	6	Tr.	Tr.	0	0	0
April 20	4,083	59	8	1	Tr.	Tr.		
May 19	4,339	67	27	12	4	2	2	.44
'une 26	3 , 5 9 7	71	47	28	13	7	3	3*
Iuly 19	4,481	78	51	29	15	7	5	
August 17	4,066	72	50	34	19	16	9	
October 5	3,776	79	50	28	16	9	7	2**

a% at 7 feet 2%

** at 7 feet Ir.

*** Trace equals less than 0.5%

Table . Percent of Average Light Transmission to Indicated Depth Below Water Surface on Back Bay, Virginia from April 6, 1962 to August 21, 1963 - Each Monthly Value Based on 23 Submarine Photometer Readings.

Date	Average Light at Surface (f.c.)	1 inch	1 foot	2 feet	3 feet	4 feet	5 feet	6 feet
1962								
April 6	3,297	63	27	12	6	3	2	2
April 19	4,053	68	33	15	9	1	1	0
April 26	4,220	70	37	19	9	3	Tr.	0
May 10	1,790	59	59	11	5	2	Tr.	0
May 18	3,775	80	55	35	21	7	1	Tr.
June 1	3,496	76	49	31	19	9	5	2
June 15	3,290	72	44	30	17	9	1	1
July 20	3,952	81	60	38	25	12	5	1
August 1	4,243	71	48	31	17	11	4	5
August 31	4,174	72	53	35	23	12	4	2
September 25	3,463	66	37	23	9	6	0	0
October 30	1,925	71	39	18	8	3	1	0
1963								
January 17	1,419	66	19	4	1	Tr.	0	0
March 4	3,250	56	6	Tr.	Tr.	0	0	0
March 29	3,469	80	36	12	6	2	Tr.	Tr.
May 22	3,949	81	44	22	10	5	1	Tr.
June 19	3,629	81	50	30	19	7	5	1
August 21	2,693	76	42	22	12	4	3	1

Trace equals less than 0.5 percent.

Quantitative categorization of weather conditions for interpretation of effect on plant life is a difficult task at best and observations and impressions must be relied on for evaluation. My impression is that cold, windy weather in May and June has decided effect on the annual crop of aquatics. An early start seems particularly important for sago pondweed, whereas muskgrass can produce well with favorable late summer conditions.

Water temperatures reached a high of 85°F as early as May 20, 1962. Comparable temperatures were not reached in 1960 until June 21, in 1961 until June 12, and in 1963 until June 2. The increased sunlight penetration may have contributed to earlier warming of the water in 1962. Air temperature averaged 68°F in May 1962 which was considerably higher than the average of 63.6°F in May 1961 and 64.6°F in May 1963; it was slightly lower, however, than the average of 68.3°F in May 1960.

Light Penetration at Stations from Back Bay to Oregon Inlet

It is best to obtain submarine photumeter readings from different stations under as nearly identical conditions of wind, cloud cover, haze, angle of the sun, time lag after storms, wave height, etc., as possible. This made it necessary to restrict the one available submarine photometer to the Back Bay Area, where turbidity was more critical.

However, some comparable readings from Currituck Sound and south to Oregon Inlet, where salinity was greater, were desired. From March 27, 1961, to August 28, 1961, the seaplane was used to quickly fly to 18 stations from Back Bay to Oregon Inlet at monthly intervals. Both salinity and photometer determinations were obtained. Normally all samples were collected in about 2 hours, which minimized weather variables.

Comparison of the relationship of salinity and turbidity must be done judiciously for bottom soils, water depth, site exposure, etc.; all serve to hinder direct comparison.

These data are useful to depict site conditions, for comparison of individual stations in time, for comparison of one factor, e.g. light penetration between stations, and for comparison of salinity-turbidity relationships where stations are reasonably comparable.

Comparison solely of light penetration to a 3-foot depth reveals that in all months stations 1 through 5, at the north end of the area, were more turbid than stations 6 through 10, at the south end of the area. The drainage pattern, soil types, and prevalence of dredging and ditching in the northern part of the area are responsible for the greater turbidity.

The North Landing River Stations, #2 (near Munden Point) and #3 (near Tulls Bay), were with few exceptions the most turbid stations sampled. Periodic dredging is one source of turbidity in that area, but large tug boats and yachts almost daily stir up tremendous amounts of silt that billows out in a easily observed manner.

If recent proposals to dredge a boat canal through the entire length of Back Bay to the North Landing River are ever carried out, these same conditions will prevail there.

Although there is no specific evidence to substantiate it, I believe that siltation and turbidity affect plants in ways other than just the physical exclusion of sunlight and the weighting down of the plants to the bottom; the fine silts normally involved in turbidity have high cation-exchange capacity that could possibly absorb essential elements from plant tissue.

Laboratory Test of Flocculation of Turbidity from Soils by Salt Water

The potential for controlling the turbidity of the waters of Back Bay and Currituck Sound by ocean water introduction has long been recognized, and was initiated by a large-scale pumping operation in May 1964 by the City of Virginia Beach.

Our laboratory tests in 1960 of the flocculation of suspended soils were designed to determine the effects of various concentrations of ocean water on the turbidity of Back Bay water induced by known amounts of soils from Back Bay.

The dominant soil types, silt, clay, and Loam;, were used in this controlled experiment for they all can contribute to turbidity of the water; however, a textural analysis conducted for us by the U.S. Department of-Agriculture indicated the texture of suspended silts when settled from Back Bay water averaged 68.1 percent clay (< 0.002 mm), 31.3 percent silt (0.05-0.002 mm), and 0.6 percent sand (0.1-0.05 mm). Organic carbon content averaged 7.77 percent. Clay particles were the principal cause of turbidity.

Methods and Procedures

Five 2 liter jars were placed in a compartmented light-tight box that had a rheostat controlled light bulb behind each compartment. The light passed through a hole in the partition between the light bulb and the jar, through the jar, and was measured with a foot candle light meter as it passed through a hole in the side of the light-tight box. The meter fit tightly in the hole and measured only emitted light that passed through the center of the square jar.

Water from Back Bay was collected and mixed with ocean water in the following concentrations:

1. Bay water - 1.87% SS or 600 ppm as NaCl
2. 5.13% SS or 1,650 ppm
3. 9.93% SS or 3,200 ppm
4. 14.90% SS or 4,800 ppm
5. 20.05% SS or 6,450 ppm

Normal sea strength considered as 32,210 ppm as NaCl

Two liters of Back Bay water were poured into one jar and the light intensity in each of the five compartments was adjusted by the rheostat so 50 F.C.(foot candles) passed through the jar.

The five concentrations of bay and ocean water were then poured into the respective jars. Ten grams of soft, surface silt, that had been collected from Back Bay, were then added to each jar.

Each jar was stirred vigorously for 1 minute with 1/4", 2,000 rpm drill to which a shaft and paddle had been attached. One more minute elapsed before the meter readings were started, making a total of 6 minutes before the first light meter reading. The light meter reading was 0 in each jar immediately after stirring was completed.

Thereafter foot candle meter readings were made at 10 minute intervals for 6 hours. Meter readings were 1 minuteapart on each jar. Water temperature was also determined. On completion of each test the accuracy of the instrument was checked twice against the standard bay water and the rheostat settings were found to be satisfactorily constant.

Identical procedure was followed throughout figures 1 through 5 and tables 1 through 5 with only the following exception: experiment number one represented by figure 1 and table 1 was run with the salinity reading of Back Bay water of 1.87 percent sea strength; whereas, in experiments 2 through 5, represented by their respective tables and figures, the Back Bay water used was 1.40 percent sea strength. The temperature differences should also be noted on each experiment. This set of experiments is designed only to show the differences that the addition of various percentages of sea water make on silt, loam, and clay taken from Back Bay under the conditions stated on each table and graph.

Figures 6 through 10 with their accompanying tables are designed to demonstrate how loam, silt, and clay react in comparison to each other when exposed to various degrees of sea strength up to 20 percent and under the same conditions.

The same procedure that was followed in the above experiments was used here except the solution was stirred only 15 seconds with a 15 second lapse between each reading and each soil type was tested against the other in a solution to the same percent of sea strength.

It should be noted that it is not wise to attempt to compare one graph with another. Each figure represents a complete experiment within itself with the temperature of the solution remaining constant within one degree of the temperature indicated. The water taken from Back Bay, from which the original solutions were mixed, was not all taken at the same time and was, therefore, not of the same turbidity, when collected. This means that the original setting of 50 F.C. on the dark box would vary according to the turbidity of the Back Bay water used in each experiment. The only instance in which one graph can be reliably compared with another is when comparing the effect of the various percentages of sea strength upon clay (figures 3 through 5). In this instance the same solution was used throughout all three experiments and the only variable was the temperature. It can be seen by close examination of these graphs that some variation in the rate of settling out occurred with variations in temperature.

General Observations

Silt - Table 1, Figure 1

The rate of settling out of silt appears to be proportional to the amount of salt water in the solution during the first 6 hours after stirring; the higher the salinity the more rapid the settling out process. After 72 hours the 20 and 15 percent gave exactly the same reading with the 10 and 5 percent solutions only one-and three foot candles less, respectively. Back Bay water appeared to fall gradually behind at the end of the 72 hour period. It seems then, that nearly as much can be accomplished with settling out of silt in 72 hours under still water conditions with a 10 and 15 percent addition of sea water as with a 20 percent addition. This gradual convergence of lines on figure 1 appears to begin around 24 hours.

Clay - Tables 3 through 5, Figures 3 through-5

It can be readily seen that clay particles settle out very slowly in Back Bay water in the three temperatures in which this series of tests, was conducted. Any addition of sea water from 5 to 20 percent had a very obvious effect in speeding,-up the fallout of induced turbidity. Generally speaking, the 10, 15, and 20 percent solutions ran very close to each other throughout all three experiments. This is especially true at the end of 6 hours, running on through 72 hours at 81°. As was true with silt, there seems to be a greater comparative rate of settling out between 5 and 10 percent sea strength, than between 10 and 20 percent. Comparatively speaking then, there is more to be gained by raising a solution from 5 to 10 percent than from 10 to 20 percent of sea strength. It should be noted that at 72 hours (figure 3) the readings on the 10, 15, and 20 percent solutions were above 50 F.C.; higher than the original settling of the light meter. This indicates that the original Back Bay water from which the meter was set, already had some turbidity in it which was also settled out. While running the experiment with clay, it was decided to run the same solutions under three different temperatures, 39°, 59°, and 81°F. to see what differences might occur in the settling out rate. Although the colder the solution, the slower the rate of settling out, this difference appears only slight in this experiment. It will also be noted that. the behaviors of the settling out appears somewhat different at each different temperature.

Loam - Table 2, Figure 2

The relationships between Back Bay water and the 5 percent solution and between the 10 and 15 percent solution showed a very erratic behavior-- during the first 6 hours of the experiment. The 20 percent solution, however, showed a comparatively steady fallout rate. This peculiar reaction of the turbidity induced by loam was recognized after the experiment had been going for about 3 hours. By turning on the light switches and observing the particles settling out through the holes cut for the light meter, it was observed that the particles did not

appear to settle out at a steady rate as previously thought they would. The only reason this observation was made, was to see if anything was wrong with the dark box, or if the material was actually settling out in a peculiar fashion as the data seemed to indicate. The turbidity seemed to fall out momentarily (especially the larger particles that could be easily observed) then stop, then fall out some more, and pause once again. It is not known how long this type of action continued. The first 6 hours showed very little difference in the rate of settling out between Back Bay water and 15 percent, but the 20 percent solution settled out kery rapidly from the very beginning and stayed far ahead of the rest throughout the 6 hour period. At the end of 72 hours the 5 and 20 percent solutions had settled out all the induced turbidity plus the turbidity that was originally in the water.

Comparative Settling Out Rates Between Silt, Loam, and Clay in Various Known Salinities.- Tables 6 through 10 and Figures 6 through 10..

By carefully observing figures 6 through 10 it is readily observed that the most dramatic effect of the addition of sea water to Back Bay is on clay when compared to silt and loam. Clay settled out much slower than the other two soil types in Back Bay water. Upon the addition of sea water, at the end of 6 hours, clay has settled out, approximately the same as silt and ahead of loam in the 5 and 10 percent solutions but is well ahead of both silt and loam in the 15 and 20 percent solutions. However, it is always behind the other two soil types at the end of 30 minutes. In all cases where salt water is added, silt settles out more rapidly at first than does clay or loam, but later on may surpass the one or both, depending on the increase of sea strength. The addition of salt water seems to have less effect on the settling out of loam particles than on silt or clay.

A slight discrepancy may be noted between clay and silt at the end of the 6 hour period in 5 and 10 percent solutions (figures 7 and 8). It would seem from the graphs that clay was slightly ahead of silt in the 5 percent solution but was only even with silt in the 10 percent solution. No explanation is offered for this except the possible difference in temperature of 3°F. Regardless of the reasons for this, it is clear that silt, loam, and clay do not react the same to the addition of sea water to Back Bay water.

It should be noted that an attempt was made to compare sand with silt, loam, and clay, and also to establish a rate of settling out under various degrees of sea strength, but the sand particles fell out so fast, even after the 1 minute after stirring that no rate could be established.

Table 1. Effect of Various Percentages of Sea Water on Silt Taken from Back Bay--10 Grams of Soil, Temperature 84°F.

Reading taken after stirring	Back Bay Water	5%	10%	15%	2.0%
Immediately	0	0	0	0	0
6 Minutes	0	0	1	1	1.5
30 Minutes	1.5	3	4	5.	6
1 Hour	3	5	6	8	10
1½ Hours	4	6	8	10	13
2 Hours	5	8	10	12	15
2½ Hours	6	9	11	14	16
3 Hours	7	10	13	15	17
3½ Hours	7	10	13	16	18
4 Hours	8	11	15	18	20
4½ Hours	8	12	15	19	22
5 Hours	9	13	16	20	22
5½ Hours	10	14	16	20	24
6 Hours	10	15	17	21	25
24 Hours	13	20	25	27	32
48 Hours	2 3	32	36	39	40
72 Hours	35	42	45	46	46

Table 2. Effect of Various Percentages of Sea Water on Loam Taken from Back Bay-010 Grams of Soil, Temperature 620F.

Reading. taken after stirring	Back Bay Water	5%	10%	15%	20%
Immediately	0	0	0	0	0
6 Minutes	0	0	0	0	0
30 Minutes	0	1	3	3	6
1 Hour	2	2	4	4	8
1½ Hours	3	3	6	6	10
2 Hours	5	5	7	7	12
2½ Hours	6	7	8	8	15
3 Hours	7	8	9	9	16
3½ Hours	8	8	10	10	17
4 Hours	9	9	11	11	18
4½ Hours	9	10	11	12	20
5 Hours	10	10	11	12	21
5½ Hours	11	11	12	13	22
6 Hours	12	12	12	14	23
24 Hours	21	26	26	30	61
48 Hours	26	39	39	50	77
72 Hours	35	50	50	70	77

1 minute stirring and 1 minute lapse between each reading,
Light meter set on 50 foot candles, before addition of soil.

Table 3. Effect of Various Percentages of Sea Water on Clay Taken from Back Bay--10 Grams of Soil, Temperature 59°F.

Reading taken after stirring	Back Bay Water	5%	10%	15%	20%
Immediately	0	0	0	0	0
6 Minutes	0	0	0	0	0
30 Minutes	0	4	5	10	10
1 Hour	0	7	9	14	15
1½ Hours	0	10	15	18	20
2 Hours	0	11	18	20	24
2½ Hours	0	13	20	23	26
3 Hours	0	15	24	25	28
3½ Hours	0	17	26	27	30
4 Hours	0	19	29	30	31
4½ Hours	0	20	30	32	34
5 Hours	0	21	31	33	35
5½ Hours	0	22	32	35	36
6 Hours	.5	23	34	35	37
24 Hours	5	37	46	47	48
48 Hours	9	43	52	53	55
72 Hours	14	45	52	54	55

Table 4. Effect of Various Percentages of Sea Water on Clay Taken from Back Bay--10 Grams of Soil, Temperature 81°F.

Reading taken after stirring	Back Bay Water	5%	10%	15%	20%
Immediately	0	0	0	0	0
6 Minutes	0	0	0	0	0
30 Minutes	0	6	6	9	10
1 Hour	0	9	10	14	15
1½ Hours	0	12	15	18	20
2 Hours	0	15	19	21	24
2½ Hours	0	17	23	23	27
3 Hours	0	19	25	26	30
3½ Hours	.5	21	28	28	32
4 Hours	.5	23	30	30	34
4½ Hours	.5	24	31	32	35
5 Hours	1	25	32	33	36
5½ Hours	1	26	32	33	36
6 Hours	1	27	34	34	37

1 minute stirring and 1 minute lapse between each reading.
Light meter set on 50 foot candles, before addition of soil.

Table 5. Effect of Various Percentages of Sea Water on Clay Taken from Back Bay--10 Grams of Soil, Temperature 39°F.

Reading taken after stirring	Back Bay Water	5%	10%	15%	20%
Immediately	0	0	0	0	0
6 Minutes	0	0	0	0	0
30 Minutes	0	3	4	6	9
1 Hour	0	7	9	16	16
1½ Hours	0	11	12	17	18
2 Hours	0	13	14	20	20
2½ Hours	0	15	16	21	23
3 Hours	0	17	19	24	25
3½ Hours	0	19	21	26	27
4 Hours	0	19	23	27	30
4½ Hours	0	20	26	29	32
5 Hours	0	21	28	31	34
5½ Hours	0	23	30	32	36
6 Hours	0	25	32	34	38

1 minute stirring and 1 minute lapse between each reading.
Light meter set on 50 foot candles, before addition of soil.

Table 6. Comparison of Rate of Settling Out Between Silt, Loam, and Clay in Back Bay Water--PO Grams of Soil, Temperature 63°F.

Reading taken after stirrin	Soil Type Used		
	Silt	Clay	Loam
Immediately	0	0	0
1 Minute	0	0	0
30 Minutes	17	0	5
1 Hour	23	0	7
1½ Hours	27	0	9
2 Hours	30	0	12
2½ Hours	31	0	13
3 Hours	34	0	14
3½ Hours	36	0	15
4 Hours	36	0	15
4½ Hours	36	0	16
5 Hours	37	0	17
5½ Hours	38	0	18
6 Hours	40	.5	19

15 second stirring and 15 second lapse between each reading.
Light meter set on 50 foot candles, before addition of soil.

Table 7. Comparison of Rate of Settling Out Between Silt, Loam, and Clay in Back Bay Water. Raised to 5 Percent Sea Strength--l0 Grams of Soil, Temperature 630F.

Reading taken after stirring	Soil Type Used		
	Silt	Clay	Loam
Immediately	0	0	0
1 Minute	0	0	0
30 Minutes	21	0	4
1 Hour	28	7	7
1½ Hours	32	11	8
2 Hours	35	22	9
2½ Hours	35	25	10
3 Hours	36	30	12
3½ Hours	39	35	13
4 Hours	40	36	14
4½ Hours	40	38	15
5 Hours	40	40	15
5½ Hours	40	41	15
6 Hours	40	43	16

Table 8. Comparison of Rate of Settling Out Between Silt, Loam, and Clay in Back Bay Water, Raised to 10 Percent Sea Strength--lo Grams of Soil, Temperature 50°F.

Reading taken after stirring	Soil Type Used		
	Silt	Clay	Loam
Immediately	0	0	0
1 Minute	0	0	0
30 Minutes	20	0	5
1 Hour'	26	3	7
1½ Hours	29	9	10
2 Hours	31	15	10
2½ Hours	33	20	12
3 Hours	35	25	13
3½ Hours	35	29	14
4 Hours	35	30	15
4½ Hours	37	34	16
5 Hours	39	35	16
5½ Hours	39	37	17
6 Hours	40	40	19

15 second stirring and 15 second lapse between each reading.
Light meter set on 50 foot candles, before addition of soil.

Table "9' . Comparison of Rate of Settling Out Between Silt, Loam, and Clay in Back Bay Water. Raised to 15 Percent Sea Strength--10 Grams of Soil, Temperature 65°F.

Reading taken after stirring	Soil Type Used		
	Silt	Clay	Loam
Immediately	0	0	0
1 Minute	0	0	0
30 Minutes	21	3	5
1 Hour	28	20	8
1½ Hours	31	27	10
2 Hours	34	34	12
2½ Hours	36	40	14
3 Hours	38	44	15
3½ Hours	40	48	17
4 Hours	41	50'	19
4½ Hours	42	53	20
5 'Hours	43	55	21
5½ Hours	43	55	22
6 Hours	44	56	24

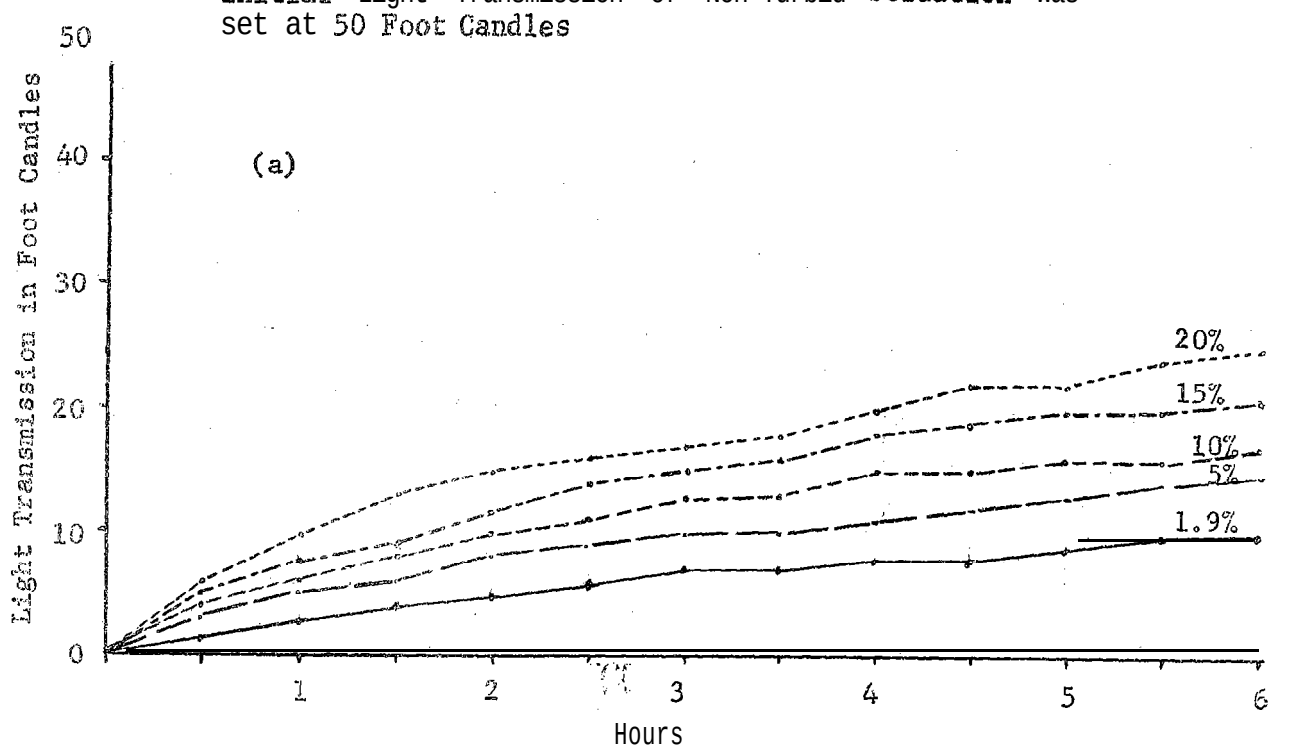
Table 10 . Comparison of Rate of Settling Out Between Silt, Loam, and Clay in Back Bay Water. Raised to 20 Percent Sea Strength--10 Grams of Soil, Temperature 60°F.

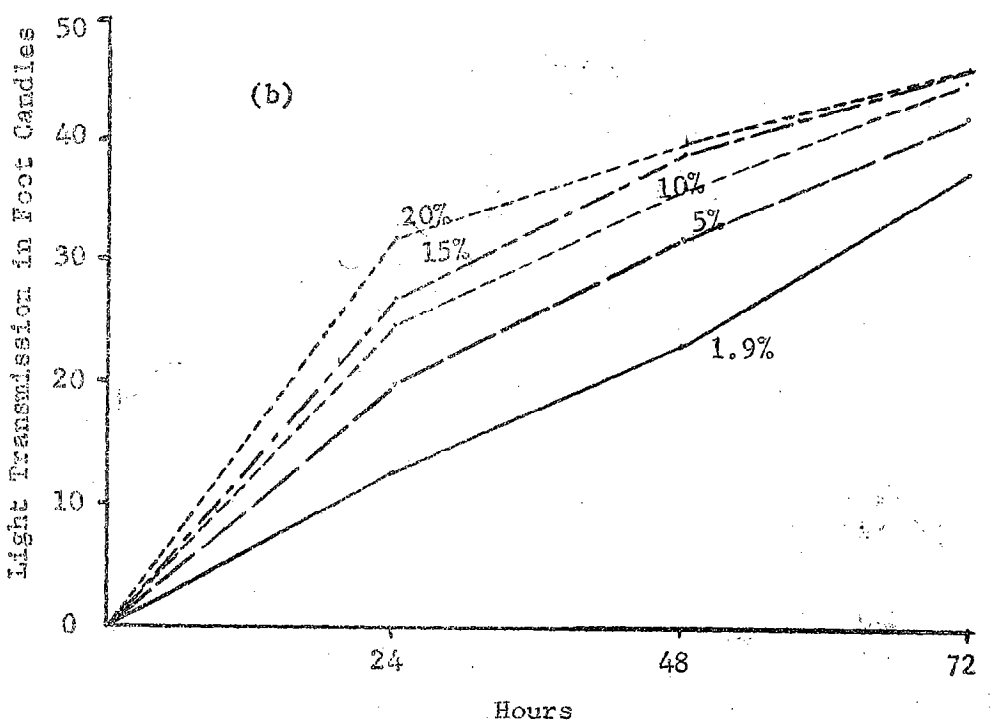
Reading taken after stirring	Soil Type Used		
	Silt	Clay	Loam
Immediately	0	0	0
1 Minute	0	0	0
30 Minutes	21	2	5
1 Hours	27	15	8
1½ Hours	31	25	10
2. Hours	33	31	13
2½ Hours	35	36	15
3 Hours	35	40	16
3½ Hours	38	43	18
4 Hours	40	45	20
4½ Hours	40	47	21
5 Hours	41	50	23
5½ Hours	44	52	24
6 Hours	45	53	25

15 second stirring and 15 second lapse between each reading.
Light meter set on 50 foot candles, before addition of soil.

Figure 1. Light Transmission through Water Solution of Different Percentages of Sea Strength, and Initial Equal Turbidity Induced by 10 Grams of Silt. Temperature 84°F. (a) Readings at 30 Minute Intervals for a 6 Hour Period. (b) Readings at 24, 48, and 72 Hours.'

Initial Light Transmission of Non-Turbid Soluation was set at 50 Foot Candles





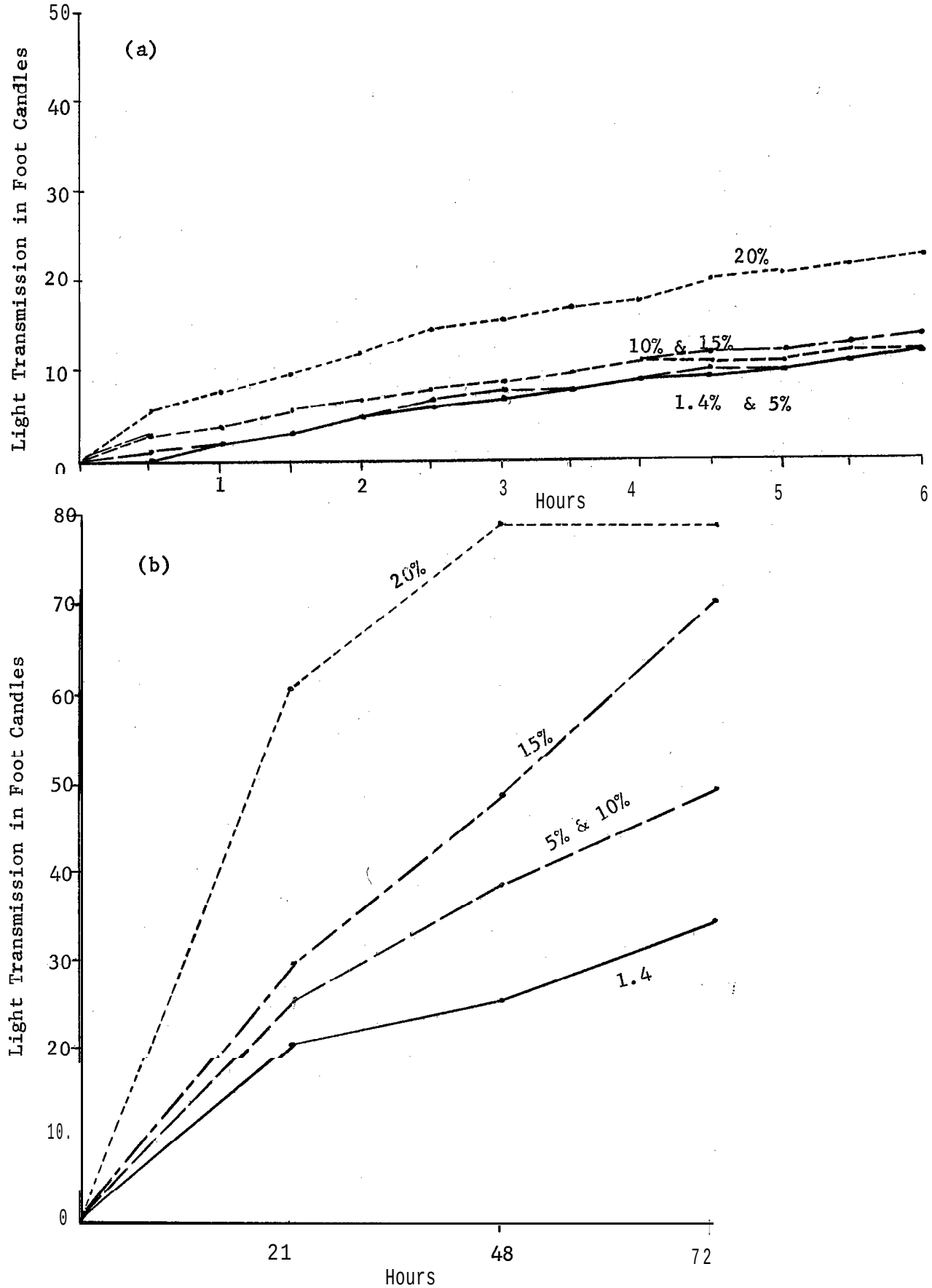


Figure 2. Light Transmission through Water Solutions of Different Percentages of Sea Strength, and Initial Equal Turbidity Induced by 10 Grams of Loam. Temperature 62°F. (a) Readings at 30 Minute Intervals for a 6 Hour Period. (b) Readings at 24, 48, and 72 Hours.

Initial Light Transmission of Non-Turbid Solution was set at 50 Foot Candles.

Figure 3. Light Transmission through Water Solutions of Different 'Percentages of Sea Strength, and Initial 'Equal Turbidity Induced by 10 Grams of Clay.' Temperature 59°F. (a) Readings at 30 Minute Intervals for a 6 Hours Period. (b) Readings at 24, 48, and 72 Hours.

Initial Light Transmission of NonTurbid Solution was set at 50 Foot Candles.

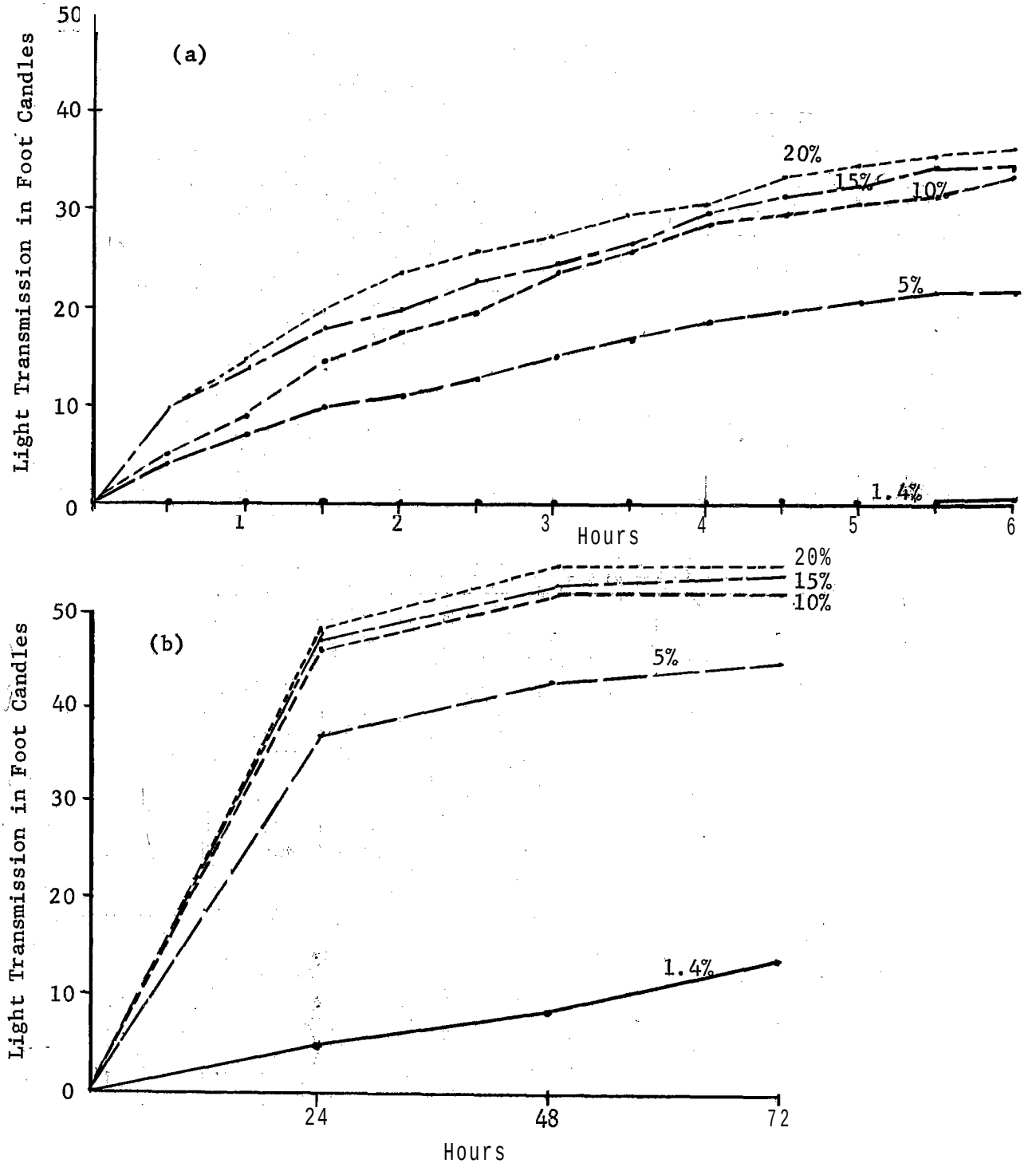


Figure 4. Light Transmission through Water Solutions of Different Percentages of Sea Strength, and Initial Equal Turbidity Induced by 10 Grams of Clay. Temperature 81°F.

Initial Light Transmission of Non-Turbid Solution was set at 50 Foot Candles.

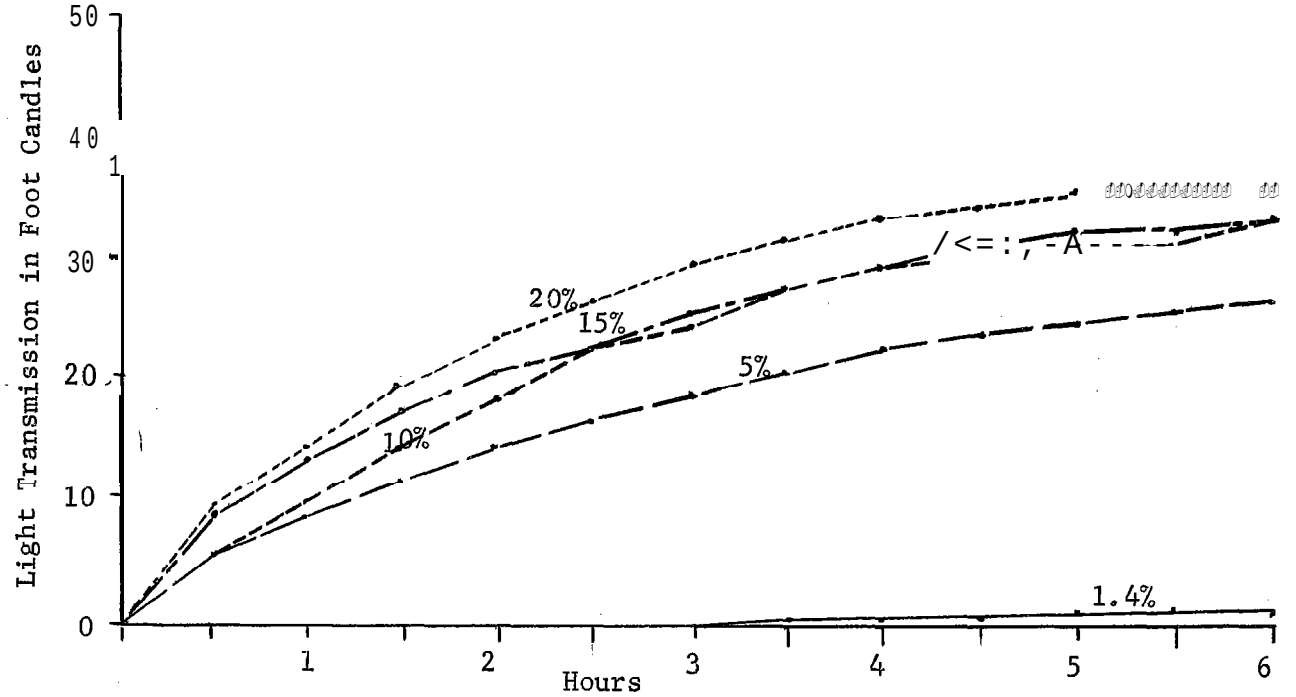


Figure 5. Light Transmission through Water Solutions of Different Percentages of Sea Strength, and Initial Equal Turbidity Induced by 10 Grams of Ciay. Temperature 39°F.

Initial Light Transmission of Non-Turbid Solution was set at 50 Foot Candles.

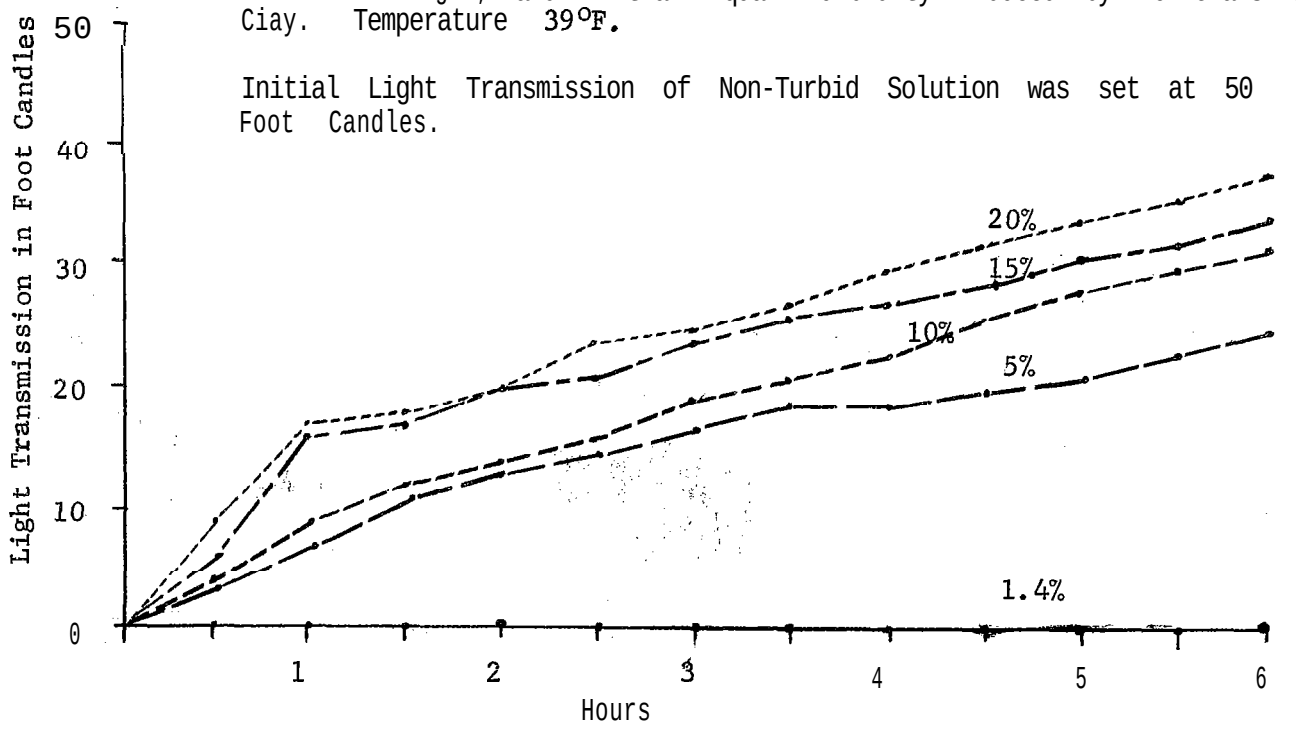
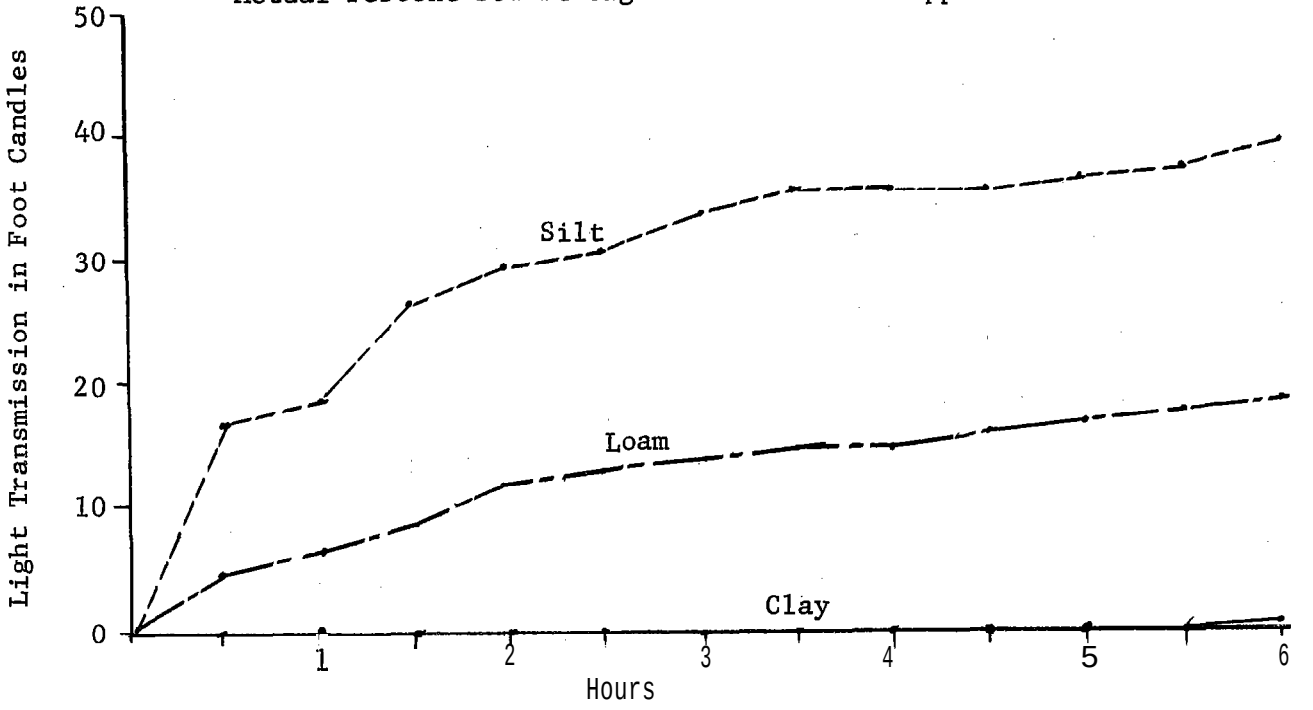


Figure 6. Comparison of Rate of Settling Out Between Silt, Loam, and Clay, in Back Bay Water, using 10 Grams of Soil at 63°F. Recordings at 30 Minute Intervals for a 6 Hour Period.

Initial Light Transmission on Non-Turbid Solution was set at 50 Foot Candles.

Actual Percent Sea Strength = 1.40% or 450 ppm.



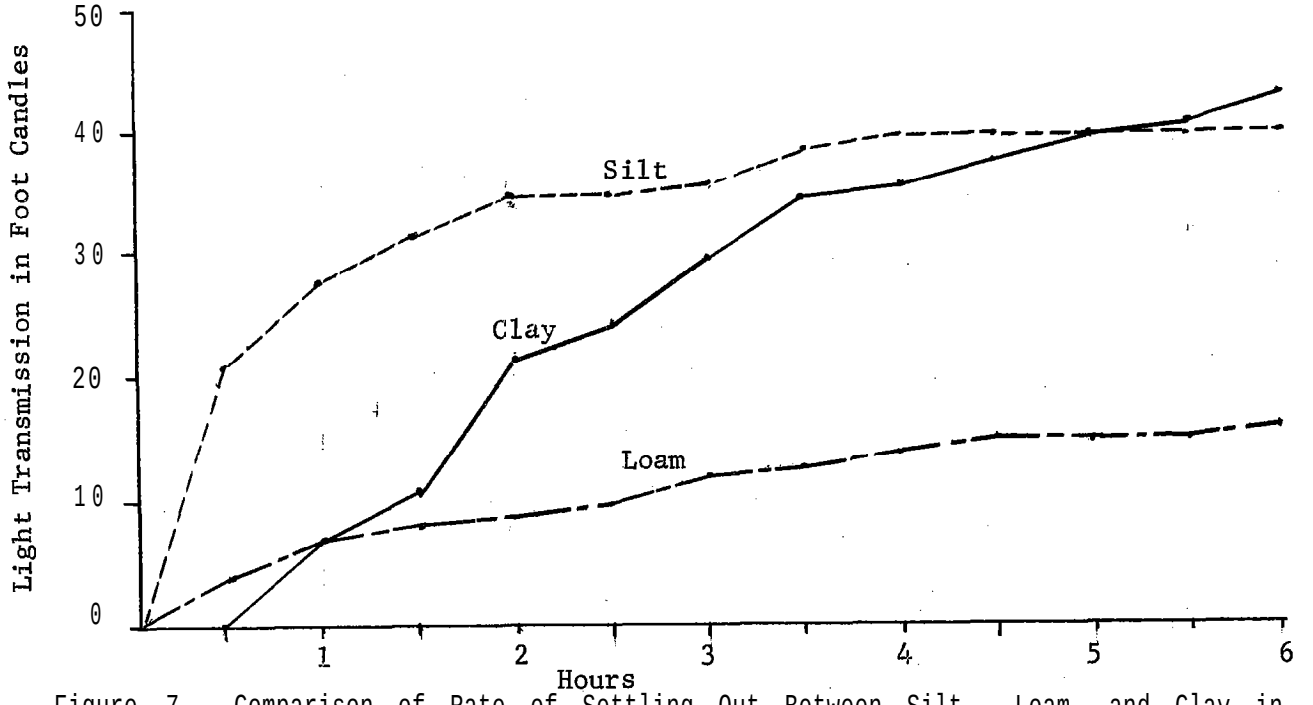


Figure 7. Comparison of Rate of Settling Out Between Silt,. Loam, and Clay in Back Bay Water raised to 5 Percent Sea Strength, Using 10 Grams of Soil at 630F.

Initial Light Transmission of Non-Turbid Soultion was set at 50 Foot Candles.

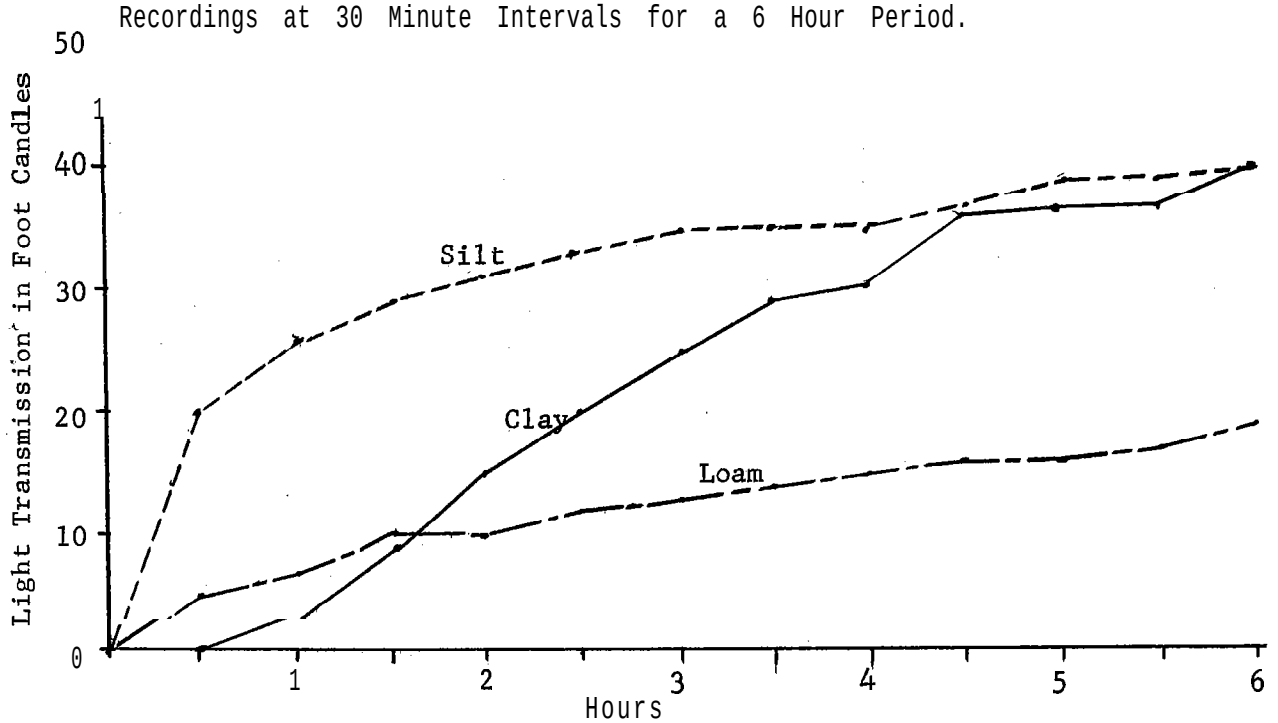
Actual Percent Sea Strength = 5.13% or 1650 ppm.

Figure 8. Comparison of Rate of Settling Out Between Silt, Loam, and Clay in Back Bay Water Raised to 10 Percent Sea Strength, Using 10 Grams of Soil at 60°F.

Initial Light Transmission of Non-Turbid Solution was set at 50 Foot Candles.

Actual Percent Sea Strength = 9.93% or 3200 ppm.

Recordings at 30 Minute Intervals for a 6 Hour Period.



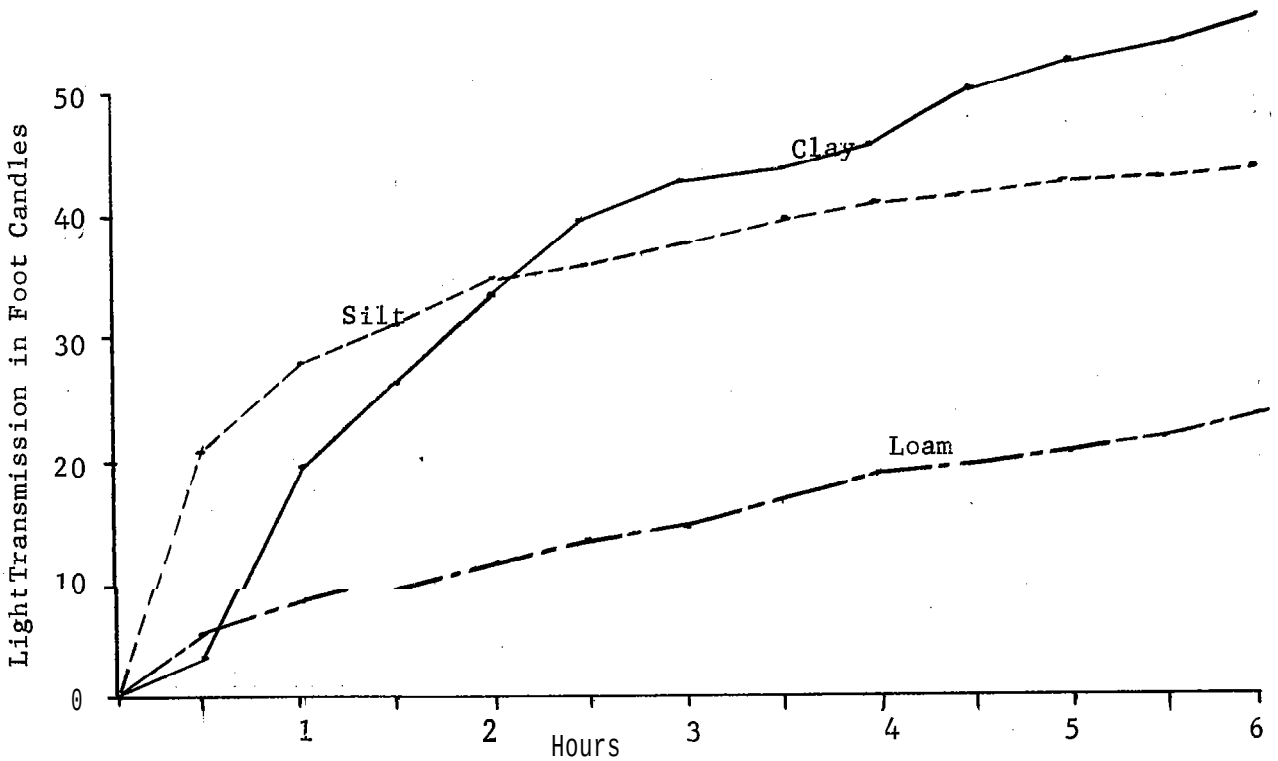


Figure 9. -Comparison of Rate of Settling out Between Silt, Loam, and Clay in Back Bay Water Raised to 15 Percent Sea Strength, Using 10 Grams of Soil at 650F.

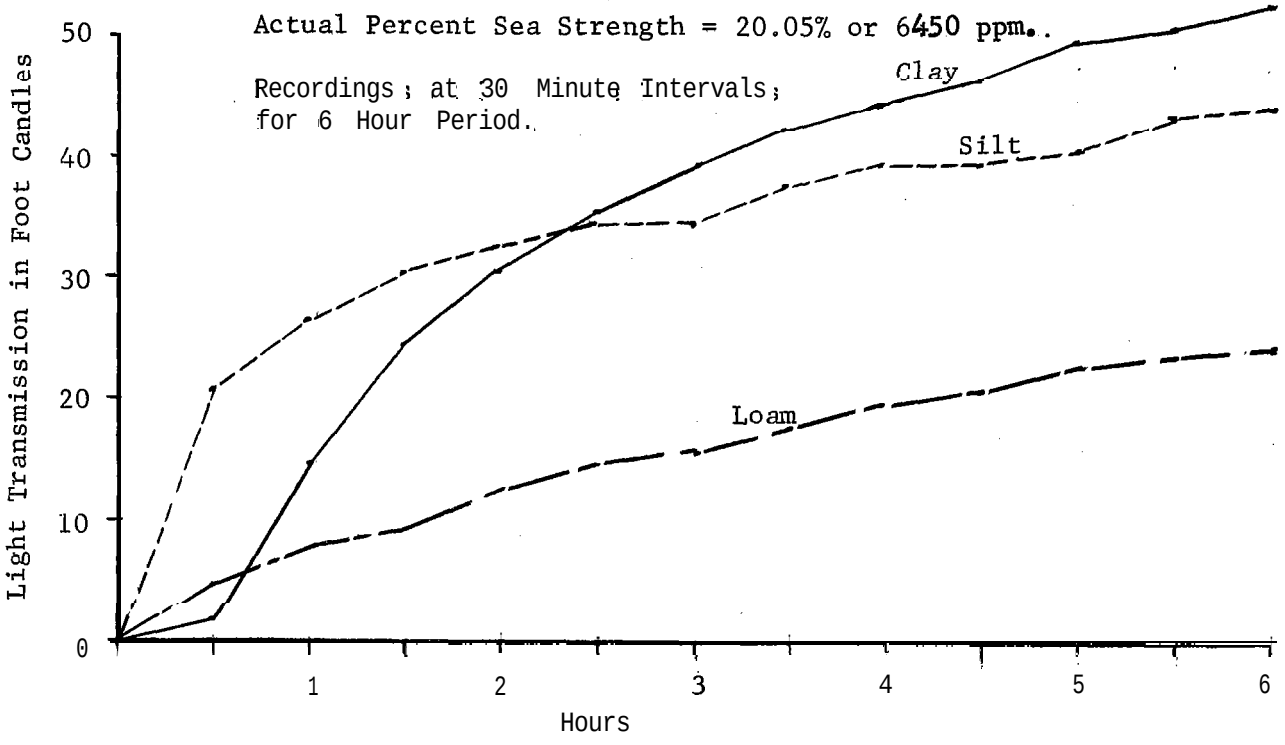
Initial Light Transmission of NonTurbid Solution was set at 50 Foot Candles.

Actual Percent Sea Strength = 14.90% or 4800 ppm.

Recordings at 30 Minute Intervals for a 6 Hour Period.

Figure 10. Comparison of Rate of Settling out Between Silt, Loam, and Clay in Back Bay Water Raised to 20 Percent Sea Strength, using 10 Grams of Soil at 60°F.

Initial Light Transmission of NonTurbid Solution was set at 50 Foot Candles.



Available Nutrient Evaluation of Back Bay Soils after Treatment with Various Percentages of Sea Strength

The soils that were used to check the effect of sea water on'turbidity were analyzed to determine the amount of available nutrients that might be added to the various types of Back Bay soils when treated with 5, 10, 15, and 20 percent sea strength.

The soils used were clay, silt, loam, and sand.

Results

Clay

1. The pH appeared to drop as the salinity went up but no change was noted under 15 percent sea strength.

2. Phosphorus, potassium, calcium, magnesium, nitrates, and iron remained the same at the salinities used.

3. Ammonia and sulfate showed a slight increase, with increasing salinities.

4. Chloride showed a greater increase, ranging from low to high,+ with increasing salinity.

Silt

1. pH showed no appreciable change with increasing salinity.

2. Calcium, magnesium, nitrate, and ammonia remained the same at the various salinities used.

3. Phosphorus and sulfate showed a slight increase with increasing salinity.

4. Potassium and chloride showed a gradual increase as the salinity increased.

5. Iron showed a progressive decrease as the salinity increased.

Loam

1. pH showed no appreciable change at the different salinity levels.

2. Magnesium and nitrates remained the same at the various salinity levels.

3. Phosphorus, calcium, sulfate, and chloride showed a slight increase as salinity increased. No explanation is offered for the drop in chloride at the 10 percent level.

4. Potassium and ammonia showed a rather sharp increase as salinity increased.

5. Iron showed a gradual decrease as the salinity increased.

Sand

1. pH showed no significant change with different salinities.

2. Phosphorus, calcium, nitrates, ammonia, and sulfate showed no change with the various salinities used.

3. Magnesium and chloride showed a slight increase with increasing salinities.

4. Iron showed a slight decrease as the salinity increased.

Generally speaking the addition of the various percentages of sea water to Back Bay water did not result in any significant changes in pH, nitrates, magnesium, and calcium. Only slight increases were usually observed in potassium, sulfates, ammonia, and phosphorus, whereas. chlorides increased rather sharply, as the salinity increased. In all cases except with clay, ferric iron showed a decrease as the salinity increased, but clay showed a very low amount of iron, even in Back Bay water.

It seems noteworthy that the various soils tested do not react the same way to the addition of sea water. This was also true with the turbidity tests.

Table _____. Nutrient Evaluation of Soils after Treatment with Various Percentages of Sea Strength

Soil Type	Available** Nutrient	Back Bay 1.4%	5%.	10%.	15%	20%
Clay	pH (wet).	8.0	8.0	8.0	7.5	6.5
	pH (dry)	8.0	8.0	8.0	8.0	7.0
	Phosphorus	High+	High+	High+	High+	High+
	Potassium	V.High	V.High	V.High	V.High	V.High
	Calcium	Med.	Med.	Med.	Med.	Med.
	Magnesium	High	High	High	High	High
	Nitrate	None	None	None	None	None
	Ammonia	High+	High+	High+	V.High	V.High
	Sulfate	V.Low+	V.Low+	V.Low+	V.Low+	Low
	Choride	Low+	Med.+	Med.+	High+	High+
	Ferric Iron	V.Low	V.Low	V.Low	V.Low	V.Low
Silt	pH (wet)	6.5	6.5	6.5	6.5	6.5
	pH (dry)	6.5	6.5	6.0	6.5	6.0
	Phosphorus	Med.	Med.	Med.	Med.+	Med.+
	Potassium	Med.	High+	High+	V.High	V.High
	Calcium	Low	Low	Low	Low	Low
	Magnesium	Med.+	Med.+	Med.+	Med.+	Med..+.
	Nitrate	None	None	None	None	None
	Ammonia	High+	High+	High+	High+	High+
	Sulfate	V.Low+	V.Low+	V.Low+	V.Low+	Low
	Chloride	Low+	Med.+	High	V.High	V.High
	Ferric Iron*	Med.	Med.	Med.	Low	Low
Loam	pH (wet)	6.5	6.5	6.0	6.0	6.0
	pH (dry)	6.0	6.5	6.0	6.0	6.0
	Phosphorus	Med.	Med.+	Med.+	Med.+	Med.+
	Potassium	Med.	High	V.High	V.High	V.High
	Calcium	Low	Low	Med.	Med.	Med.
	Magnesium	Med.+	Med.+	Med.+	Med.+	Med.+
	Nitrate	None	None	None	None	None
	Ammonia	High	High+	High+	High+	V.High
	Sulfate	V.Low	V.Low	V.Low	V.Low+	V.Low+
	Chloride	Med.+	Med.+	Low+	High	High%
	Ferric Iron*:	Med.	Med.	Low	Low	Low
Sand	pH (wet)	6.0	6.0	6.0	6.0	6.0
	pH (dry)	6.0	6.0	6.0	6.0	6.5
	Phosphorus	V.Low-	V.Low-	V.Low-	V.Low-	V.Low-
	Potassium	Low+	Low+	Low+	V.High+	V.High+
	Calcium	V.Low-	V.Low-	V.Low-	V.Low-	V.Low-
	Magnesium	V.Low-	V.Low-	V.Low-	V.Low+	V.Low+
	Nitrate	None	None	None	None	None
	Ammonia	V.Low-	V.Low-	V.Low-	V.Low-	V.Low-
	Chloride	Med.	Med.	Med.+	High	High
	Ferric Iron	Low	Low	Low	V.Low	V.Low

* Actually appears to be progressive from medium to low as percent of sea strength increases.

** Analyses made with a Hellige-Truog combination soil tester, Model 697.

RELATIONSHIPS OF THE CHEMICAL CONTENT OF WATER, SOILS, AND AQUATIC PLANTS

Several individual studies were undertaken to determine the chemical make up of the water, soils, and plants, and to interpret the significance of the values. Namely, these studies consisted of an extensive analyses of the water by the U. S. Geological Survey; periodic water and soil analyses from 17 test plots; and spectrochemical analyses of aquatic plants from field locations and controlled bioassays.

Considerable relationship exists between these studies and, while each will be considered as an entity, interspersion of data and its implications will be considered as appropriate.

Laboratory Chemical Analyses of Water, 1959..

The U. S. Geological Survey at Raleigh, North Carolina; analyzed eight water samples from Back Bay and Currituck Sound collected on August 19, 1959, and four samples collected between November 23 and December 12, 1959. The accompanying table presents the results of these analyses, the location from which the samples were collected, and the dates of collection. All samples were depth integrated samples. Sample station number eight was taken from the ocean near the Virginia-North Carolina Stateline; the significance of this sample is that it indicates the proportions of elements that have been introduced into the study area when ocean water had access to the area, and also what would be introduced by management with ocean water introductions. The ocean water near Sandbridge at the time of analyses contained only 16,900 ppm (parts per million) chlorides which is only 86.5 percent of the 19,538 ppm Cl given by John C. Olsen in the 7th Edition of Van Nostrand's Chemical Annual. This abnormality had been noticed in March 1959 when the ocean water at Sandbridge, Virginia, was only 78 percent of the normally accepted ocean salinity. This is probably explained by the southward movement of diluted ocean water, moving along the shore, from the Chesapeake Bay Area. This is a fact of considerable importance in relation to controlled ocean water introduction.

Calcium

The Geological Survey analyses in 1959 showed only 10 to 20 ppm calcium in the northern part of the study area, 38 to 40 ppm in the southern part, and 409 ppm in the ocean water.

Ellis, et al.. in review of literature state that Ohle (1934) found the biota of the lakes in north Germany to be poor if the calcium were less than 10 ppm, good when the calcium ranged between 10 and 25 ppm, and very good when the calcium exceeded 25 ppm.

Calcium salts are known to be toxic in high concentrations but specific toxicity of the calcium ion varies with the plant species and references are lacking for its effect on the species with which

we are concerned. The waters of the study area varying as they do between 10 and 40 ppm are probably well below any toxic level, and are likely to be somewhat low for maximum biotic production. Pearse (1939) presents the calcium content of typical ocean water, hard fresh water,and soft fresh water as 420 ppm, 65 ppm, and 10 ppm, respectively.

McKee and Wolf (1963) state that "calcium in the water reduces the toxicity of many compounds to fish and other aquatic fauna," and cite examples where increased concentrations of calcium cancelled the toxic effect of lead, zinc, and aluminum. Hart et al. (1945) cite a reference that, of the U. S. waters supporting a good mixed fish fauna, about 5 percent have less than 15 ppm of calcium; 50 percent have less than 28 ppm, and 95 percent have less than 52 ppm. Thus the waters of Back Bay during the fresh water conditions of 1959 were in the lower percentile group.

Magnesium

The water sample taken in November 1959 from the North Landing River contained 14 ppm and was the lowest recorded, and the highest content recorded was 110 ppm from south Currituck in August 1959. The ocean water sample contained 1,160 ppm. Pearse (1939) lists the content of magnesium in typical sea water, hard fresh water,and soft fresh water as 1,310 ppm, 65 ppm, and 10 ppm, respectively. According to Welch (1935) magnesium is a component of chlorophyll, and in some instances, acts as a carrier of phosphorus.

Hart et al. (1945) cite a report that, of U. S. Waters supporting a good fish fauna, about 5 percent have less than 3.5 ppm of magnesium; 50 percent have less than 7 ppm; and 95 percent have less than 14 ppm. Since 14 ppm was the lowest recorded for the study area, it is obviously in the upper percentile group.

McKee and Wolf (1963) quote Hedgepeth (1943): "The relative concentration of magnesium and calcium in water may be one factor controlling the distribution of certain crustacean fishfood organisms, such as copepods, in streams."

Doudoroff et al. (1953) point out that some fresh-water fish have been found in very saline lake water containing over 1,000 ppm of magnesium as well as additional sodium and calciumsalts. It is not considered here that the higher magnesium concentrations, of 110 ppm, were limiting to fish life.

Sodium

Sodium increased in direct proportion to the chloride content. The range in the study area waters was from 99 ppm to 850 ppm in the August and November 1959 analyses by the Geological Survey; the ocean water sample contained 9,460 ppm.

Hart et al. (1945) report that of the U. S. waters supporting a good fish fauna [fresh water], ordinarily the concentration of sodium plus potassium is less than 6 ppm in about 5 percent, less than 10 ppm in about 50 percent, and less than 85 ppm in about 95 percent.

McKee and Wolf (1963) mention that several investigators reported that 500-1,000 ppm of sodium was toxic to fish in distilled and soft waters when sodium chloride or nitrate was tested, They also mention that toxicity of sodium salts depends largely on the anion involved, the chromate being exceedingly toxic and the sulfate least so.

Potassium

The Yearbook of Agriculture (1953) states "A deficiency of potassium makes many diseases more severe, presumably because plant sugars accumulate in the cells in the absence of potassium instead of building into new tissue.. A deficiency of potassium eventually retards photosynthesis and production of new tissues."

Pearse (1939) lists the composition of "typical" sea water, hard fresh water, and soft fresh water as containing 390 ppm, 16 ppm, and 0 ppm of potassium, respectively.

In the waters of the study area the concentration of potassium ranged from 7.5 ppm to 35 ppm and generally increased toward the south end of the study area in proportion to the salinity; however, other variables than salinity are obviously affecting the concentration of potassium in the water. With the exception of the North Landing River, the potassium content of the waters was higher in the November samples than in the August samples. Surber (1947) considered that plants act as a storehouse for nutrient elements. The subsequent breakdown of these plants in the late fall and early winter may have released sufficient potassium for the detected rise in the potassium content of the water. The water from North Bay increased in potassium content from 6.8 ppm in August to 12.0 ppm in November, but the rise in chloride content was only 20 ppm between those two dates. At the south end of Currituck Sound the potassium content increased from 23.0 ppm in August to 35.0 ppm in November, and there was actually a decrease in chloride content in these waters from 1,520 ppm in August to 1,400 ppm in November. Potassium has a most favorable influence in peat, sand, and hard-bottomed ponds; in mud ponds, it inhibits hard water-flora and favors soft water-flora (Schaeperclaus, 1933).

Nitrate

The supply of nitrates in the water generally tended to decrease from north to south in the study area, as shown by both the Geological Survey and our own analyses from the plots. The range from the GS analyses was 0.2 to 1.0 ppm, whereas the range from our plot water analyses was 0.00 to 1.26 ppm. The ocean water sample contained no nitrates. Our quarterly analyses indicated highest concentrations in the winter and lower concentrations in the summer.

Table . (Cont'd) Quarterly Water Analysis of Water Samples from Back Bay, Virginia, and Currituck Sound, North Carolina, Test Plots. (Data Expressed in Parts Per Million Except for pH). July 1959 - January 1963. Back Bay-Currituck Sound Cooperative Investigations.

Analysis for:	Date	Plot: Back Bay 1	2	3	4	5	6	7	8	Currituck Sound 9	10	11	12	13	14	15	16	17
Meta Phosphate	July 1959	0.30	0.17	0.15	0.10	0.20	0.16	0.07	0.04	*	*	*	*	*	*	*	*	*
	Dec. 1959	0.26	0.26	0.31	0.29	0.32	0.28	0.43	0.38	*	*	*	*	*	*	*	*	*
	April 1960	*	*	*	*	*	*	*	*	0.78	0.99	*	0.88	1.05	0.54	0.87	*	1.09
	June 1960	*	*	*	*	*	*	*	*	*	*	*	0.03	0.04	0.07	0.01	0.04	0.00
	Oct. 1960	0.00	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.02	0.08	0.06	0.03	0.05	0.08	0.11	0.09	0.04
	Feb. 1961	0.13	0.06	0.14	0.02	0.05	0.08	0.08	0.06	0.01	0.00	0.05	0.18	0.02	0.00	0.03	0.06	0.09
	April 1962	1.14	0.13	0.08	0.82	0.23	0.04	0.00	0.00	0.07	0.13	0.08	0.09	0.18	0.11	0.17	0.12	0.14
	July 1962	0.34	0.72	0.63	0.46	0.37	0.68	0.55	1.00	0.21	0.14	0.12	0.24	0.16	0.16	0.07	0.28	0.06
	Oct. 1962	0.85	1.16	0.10	*	*	1.06	0.45	0.33	0.23	0.22	0.20	0.26	0.24	0.24	0.35	0.37	0.18
	Jan. 1963	0.51	0.07	0.64	1.84	1.32	4.60	0.38	2.72	0.05	0.11	0.06	0.19	0.14	0.17	0.22	0.18	0.09
NaCl	July 1959	35°	80°	550	600	55°	55°	550	750	*	*	*	*	*	*	*	*	*
	Dec. 1959	70°	70°	700	700	70°	70°	650	400	*	*	*	*	*	*	*	*	*
	April 1960	45°	50°	450	450	45°	50°	450	450	*	*	*	*	*	*	*	*	*
	June 1960	45°	65°	550	500	60°	50°	850	200	*	*	*	*	*	*	*	*	*
	Oct. 1960	55°	60°	550	600	50°	40°	350	250	*	*	*	*	*	*	*	*	*
	Feb. 1961	35°	65°	600	450	50°	40°	250	200	*	*	*	*	*	*	*	*	*
	April 1962	300°	390°	3350	3500	320°	415°	4750	4400	3600	2950	3700	4550	4950	5400	5250	5150	3600
	July 1962	340°	395°	3800	3650	420°	420°	3900	3750	4150	2800	3050	3650	3750	2800	3250	3000	2250
	Oct. 1962	250°	455°	3650	3350	400°	320°	2400	1800	2850	2400	3100	3550	4000	4100	4000	3750	4000
	Jan. 1963	2300	2300	2650	2500	2900	2350	2650	1900	2450	2250	2400	2700	2650	3050	2750	3200	3956
Sulfate	July 1959	85	84	85	60	85	55	55	50	*	*	*	*	*	*	*	*	*
	Dec. 1959	63	60	63	63	60	63	41	46	*	*	*	*	*	*	*	*	*
	April 1960	55	45	45	40	48	41	42	50	64	57	*	63	56	64	64	*	65
	June 1960	85	60	85	80	80	80	75	70	80	90	130	105	130	75	145	140	105
	Oct. 1960	41	55	56	51	46	30	26	21	57	46	59	59	98	135	135	155	130
	Feb. 1961	31	86	50	44	45	46	35	26	37	63	55	66	56	68	73	65	75
	April 1962	155	110	130	340	98	113	135	71	420	325	410	465	525	550	525	475	355
	July 1962	247	284	271	284	247	225	234	234	430	280	330	390	355	280	325	285	250
	Oct. 1962	210	280	280	270	270	226	196	156	350	255	330	390	410	410	410	400	410
	Jan. 1963	205	195	275	250	265	245	230	210	265	210	240	280	280	310	265	295	410

* No data available.

Table . (Cont'd) Quarterly Water Analysis of Water Samples from Back Bay, Virginia, and Currituck Sound, North Carolina, Test Plots. (Data Expressed in Parts Per Million Except for pH). July 1959 - January 1963. Back Bay-Currituck Sound Cooperative Investigations.

Analys-is for:		Plot																
		Back Bay								Currituck Sound								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	155	16	17
Nitrite	July 1959	*	0.03	0.05	0.05	0.04	0.04	0.04	0.08	*	*	*	*	*	*	*	*	
	April 1960	*	*	*	*	*	*	*	*	0.00	0.00	*	0.05	0.00	0.00	0.00	0.00	0.0
	June 1960	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.0
	Oct. 1960	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
	Feb. 1961	0.00	0.00	0.02	0.00.	0.02	0.02	0.00	0.00	0.06	0.06	0.08	0.04	0.04	0.05	0.03	0.04	0.0
	April 1962	0.03	0.02	0.04	0.00	0.03	0.00	0.00	0.00	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.0
	July 1962	0.04	0.04	0.03	0.06	0.04	0.05	0.05	0.06	0.00	0.00	0.00	0.00	0.04	0.00	0.05	0.00	0.0
	Oct. 1962	0.06	0.05	0.06	0.04	0.06	0.03	0.04	0.06	0.05	0.05	0.05	0.05	0.04	0.05	0.04	0.04	0.0
	Jan. 1963	0.05	0.02	0.04	0.04	0.04	0.02	0.04	0.05	0.06	0.05	0.06	0.04	0.04	0.05	0.05	0.04	0.0
Nitrate	April 1960	*	*	*	*	*	*	*	*	0.57	0.37	*	0.30	0.77	0.81	0.58	*	0.2
	June 1960	*	*	*	*	*	*	*	*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
	Oct. 1960	1.1;	1.00	0.89	0.97	0.84	0.00	0.73	0.53	0.42	0.44	0.30	0.52	0.47	0.67	0.39	0.46	0.2
	Feb. 1961	1.26	0.50	0.52	0.50	0.37	0.50	0.50	0.43	0.55	0.89	0.57	0.79	0.82	0.89	0.69	0.84	0.1
	April 1962	0.04	0.02	0.00	0.20	0.07	0.04	0.10	0.05	0.09	0.04	0.02	0.03	0.03	0.04	0.03	0.02	0.0
	July 1962	0.42	0.31	0.30	0.36	0.35	0.42	0.28	0.35	0.05	0.20	0.22	0.18	0.16	0.19	0.12	0.02	0.0
	Oct. 1962	0.60	0.67	0.67	0.58	0.77	0.63	0.63	0.77	0.44	0.57	0.50	0.60	0.48	0.60	0.50	0.46	0.4
	Jan. 1962	0.75	0.92	0.63	0.82	0.57	0.84	0.75	0.77	0.42	0.77	0.53	0.75	0.73	0.62	0.57	0.75	0.1
Methyl-' orange Alkalinity	July 1959	.22	.24	.24	.22	.24	24	.22	32	*	*	*	*	*	*	*	*	
	Dec. 1959	26	32	26	28	26	'26	30	'24	*	*	*	*	*	*	*	*	
	April 1960	22	24	24	22	24	22	22	24	*	*	*	*	*	*	*	*	
	June 1960	26	28	24	26	24	26	28	28	*	*	*	*	*	*	*	*	
	Oct. 1960	44	44	46	38	42	42	40	38	*	*	*	*	*	*	*	*	
	Feb. 1961	36	56	'36	32	28	30	30	28	*	*	*	*	*	*	*	*	

* No data available.

Table . (Cont'd) Quarterly Water Analysis of Water Samples from Back Bay, Virginia, and Currituck Sound, North Carolina, Test Plots. (Data Expressed in Parts Per Million Except for pH). July 1959 - January 1963. Back Bay-Currituck Sound Cooperative Investigations.

Analysis for:	Date	Plot: Back Bay 1	2	3	4	5	6	7	8	Currituck Sound 9	10	11	12	13	14	15	16	17
pH	July 1959	8.0	8.2	8.4	8.2	8.2	8.4	8.8	8.0	*	*	*	*	*	*	*	*	
	Dec. 1959	7.8	7.6	7.6	7.8	7.6	7.6	7.5	7.8	*	*	*	*	*	*	*	*	
	April 1960	7.0	7.3	7.4	7.4	7.7	7.5	7.7	7.6	*	*	*	*	*	*	*	*	
	June 1960	8.0	7.9	7.9	8.0	8.2	8.5	8.6	8.0	*	*	*	*	*	*	*	*	
	Oct. 1960	7.8	7.8	7.8	7.7	7.8	7.9	8.0	8.0	*	*	*	*	*	*	*	*	
	Feb. 1961	8.4	8.0	8.1	8.2	8.1	8.1	8.1	8.4	*	*	*	*	*	*	*	*	
	April 1962 1/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	July 1962	7.9	8.6	7.4	7.8	7.6	8.1	8.2	7.5	7.8	8.0	8.0	8.0	8.2	7.8	8.0	8.1	8.
	Oct. 1962	7.4	7.5	7.6	7.6	7.6	7.5	7.6	7.7	7.4	7.1	7.2	7.3	7.6	7.8	7.5	7.5	7.
	Jan. 1963	7.1	7.3	7.1	7.1	7.1	7.1	7.1	7.1	7.4	7.3	7.4	7.9	7.3	7.6	7.2	7.7	7.
Turbidity	April 1960	11	21	11	23	11	14	7	12	*	*	*	*	*	*	*	*	
	June 1960	8	17	13	30	19	19	13	23	28	29	21	17	12	25	24	23	3
	Oct. 1960	4	7	10	8	4	7	8	13	12	34	21	32	32	34	39	14	1
	Feb. 1961	26	14	21	24	24	26	37	34	37	63	55	66	56	68	73	65	7
	April 1962	40	45	37	70	52	30	29	36	28	25	32	20	26	25	28	24	2
Secchi Disc (Inches)	July 1959	32	36	32	32	43	40	40	26	*	*	*	*	*	*	*	*	
	Dec. 1959	16	22	19	18	14	19	29	25	*	*	*	*	*	*	*	*	
	April 1960	8	14	8	8	8	12	13	12	*	*	*	*	*	*	*	*	
	June 1960	39	36	37	29	20	30	32	30	*	*	*	*	*	*	*	*	
	Oct. 1960	31	29	24	23	38	33	31	33	*	*	*	*	*	*	*	*	
	Feb. 1961	7	13	11	7	8	7	7	7	*	*	*	*	*	*	*	*	
Ammonia Nitrogen	April 1960	*	*	*	*	*	*	*	*	0.75	0.99	*	0.67	0.44	1.30	0.61	*	0.9
	June 1960	*	*	*	*	*	*	*	*	0.00	0.02	0.00	0.02	0.01	0.02	0.01	0.13	0.1
	Oct. 1960	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
	Feb. 1961	1.23	0.80	0.84	0.94	0.99	0.82	1.17	1.30	13.40	9.75	2.60	1.55	3.35	21.80	5.55	1.14	8.2
	April 1962	1.02	1.34	0.97	1.27	0.99	1.23	1.82	1.30	1.30	1.60	1.60	1.51	1.95	2.18	2.18	2.50	1.3
	July 1962	1.30	2.37	1.88	1.95	2.50	3.02	2.02	1.65	0.62	5.00	3.64	3.20	2.22	1.72	4.04	1.60	2.2
	Oct. 1962	1.14	1.88	1.51	1.95	1.47	1.27	1.11	1.14	1.60	1.70	1.08	1.05	1.60	2.18	3.00	1.82	1.7
	Jan. 1963	1.70	2.27	1.23	2.85	2.85	2.85	1.55	1.82	1.17	2.85	2.85	0.89	1.14	1.47	0.94	1.60	1.0

* No data available.

1/ pH range 7.1 to 7.9.

Spectrochemical Analysis of Sago Pondweed Collected from Representative:. Field Locations

Samples of sago pondweed and redheadgrass leaves and stems were collected on August 29, 1959, from several sites throughout the length of Back Ray and Currituck Sound for spectrochemical analysis. The Spectrochemical Laboratory, Plant Industry Station, Beltsville, Maryland, subsequently made the determinations. At each site soil samples were also taken for laboratory analyses; the aforementioned Geological Survey water samples were taken the same month.

Field ratings of excellent, good, fair, or poor were assigned to the vegetation samples at time of collection and later compared by rank order to the quantity of each major element in the plant. In this rough comparison, it appeared that there were greater concentrations of aluminum, copper, manganese, iron, calcium, and boron in the poorer quality sago pondweed plants. In general, there were higher quantities of sodium, potassium, and magnesium in the sago pondweed plants of better condition. The condition of the plants did not appear to be related to the content of phosphorus in the plant.

The elements in the waters and plants will be considered individually.

Calcium

The calcium content of these waters did not vary much north of mid-Currituck Sound at station # 6. From that station southward the waters contained approximately twice the quantity of calcium that they did to the north, and the quantity was generally proportional to the salinity.

The anomaly of higher calcium content in the sago pondweed plants and redheadgrass plant samples from the more northerly portions of the area, as shown by the spectrochemical analyses, could possibly result from several things. It might be explained by the generally higher content of calcium in the soils from the northern portion of the study area, or from the suggested tendency mentioned in Agricultural Handbook No. 60 (1954) "of high sulfate concentrations (in this instance in the southern portion of the study area) to limit the uptake of calcium by plants." Another explanation may be the calcium suppression by potassium which will shortly be discussed.

In the Agricultural Yearbook (1938) it is stated "that calcium is seldom if ever found in the soil solution in concentrations high enough to be injurious to crop plants. This is because it is usually associated in the solution with sulphate and bicarbonate, with which it forms salts of such low solubility that it is precipitated from solution before it reaches injurious concentrations."

The anomaly of decreased calcium content in the plants in waters with higher calcium content is somewhat parallel to data in a report by Alston W. Specht, et. al. (1956) in which they report on the uptake of elements in the leaves of Trifolium hirtum raised in sand cultures with

Table Comparison of Field Rating, of Sago Pondweed Condition with the Content of Elements in the Plant Sample as Determined by Spectro-Chemical Analyses*.

Samples from Back Bay, Virginia, and Currituck Sound, North Carolina
Collection dates: August 29-30, 1959

Aluminum

Sample No.	ppm ppm	Rating Rating
11	420	Excellent
13	460	Good
2	490	Poor
1	520	Fair
9	800	Fair
6	1700	Poor
5	1900	Good
4	1900	Poor

copper

Sample No.	ppm	Rat
13	6.2	Good
11	8.6	Excellent
9	9.1	Fair
2	14.0	Poor
4	20.0	Poor
5	21.0	Good
6	21.0	Poor
1	25.0	Fair

Manganese

Sample NO.	ppm	Rating
11	120	Excellent
13	180	Good
2	200	Poor
1	210	Fair
5	230	Good
9	240	Fair
4	260	Poor
6	450	Poor

Iron

Sample No.	ppm	Rating
11	300	Excellent
2	320	Poor
13	360	Good
9	460	Fair
1	590	Fair
6	720	Poor
4	840	Poor
5	1000	Good

Calcium

Sample No.	ppm	Rating
11	9700	Excellent
13	11000	Good-
5	11000	Good
6	13000	Poor
9	14000	Fair
1	15080	Fair
4	15000	Poor
2	17000	Poor

Boron

Sample No.	ppm	'Rating
13	540	Good
5	590	Good
1	560	Fair
11	680	Excellent
9	680	Fair
4	770	Poor
6	800	Poor
2	840	Poor

In general it appears that there are increasing amounts of the above listed elements in the sago plant specimens of poorer condition. With the exception of phosphorus it appears that increasing amounts of the elements listed below are found in sago plant specimens of better condition.

Sodium

Sample No.	ppm	Rating
6	3800	Poor
2	4700	Poor
4	5200	Poor
9	6000	Fair
1	6700	Fair
5	6700	Good
13	7200	Good
11	8200	Excellent

Potassium

Sample No.	ppm	Rating
6	12000	Poor
4	15000	Poor
2	17000	Poor
11	20000	Excellent
13	22000	Good
1	25000	Fair
9	25000	Fair
5	25000	Good

Ma nesium

Sample No.	ppm	Rating
6	6900	Poor
4	7000	Poor
2	7800	Poor
13	8500	Good
5.	8.500	Good
9	9300	Fair
1	10000	Fair
11	11000	Excellent

Phosphorus

Sample No.	ppm	Rating	Sample No.	ppm	Rating
2	1400	Poor	9	1900	Fair
13	1600	Good	1	2000	Fair
11	1700	Excellent	4	2400	Poor
6	1800	Poor	5	2800	Good

Table Exploratory Analytical Study of the Content of Elements in Two Aquatic Plants from Back Bay, Virginia, and Currituck Sound, North Carolina, 1959.

Date Sampled	Species of Veg.	Location of Sample	Vis. Est. of Quality	Soil Type	Soil Lab#	Plant Lab #	Water Depth	Other Spec. present	K %	Ca %	Mg %	P %	Na %	B ppm	Fe ppm	Mn ppm	Cn ppm	Al ppm
8/29	Sago Pond-Weed	N.Bay St8	Fair	Silt	1	1	5'	Najas-Celery	2.5	1.5	1.0	.20	.67	660	590	210	25	520
8/29		Shipps Bay St. 7	Poor	Sand	2	2	3'	Widgeon-Cel. Nitella-Chara	1.7	1.7	.78	.14	.47	840	320	200	14	590
8/29	"	Redhead Cove St. 5	Poor	Mucky	3	4	3'	~~Najas~~-Celery	1.5	1.5	.70	.24	.52	770	840	260	20	1900
8/30	"	Cedar Is. 4 (Back Bay)	Good	Muck-St	5	5	7'	Najas	2.5	1.1	.85	.28	.67	590	1000	230	21	1900
8/30	"	Buzzard Bay St. 1	Poor	Muck-St	7	6	3'	Najas-Celery	1.2	1.3	.69	.18	.38	890	720	450	21	1700
8/29	"	Church Is.	F-Good	Mucky	10	9	4½'	Najas-Celery	2.5	1.4	.97	.19	.60	680	460	240	9.1	800
8/29	"	N.Mossey Is.	Excel. (good seed crop)	Mucky	11	11	5'	Najas-Celery	2.0	.97	1.1	.17	.82	680	300	120	8.6	420
8/30	"	S.Mossey	Good	Muck Sd.	12	13	4½'	Najas-Celery Widgeongrass	2.2	1.1	.85	.16	.72	540	360	180	6.2	460
8/29	Red-head Grass	Shipps Bay St. 7	Fair	Sand	2	3	3'	Widgeongrass Nitella-Chara	2.0	.93	1.3	.18	.65	55	300	120	35	570
8/30		Buzzard Bay St. 1	F-Poor	Muck-St	7	7	3'	Najas-Celery Chara-Eleo.	1.5	.73	1.2	.18	.41	40	250	160	15	290
8/30	"	Knotts Is. Channel	F-Poor	Muck-St	8	8	2'	Najas-Celery	1.8	1.1	.96	.17	.51	70	620	460	11	1000
8/29	"	Church's Is.	F-Good	Muck-St	10	10	4½'	Najas-Celery	1.7	.73	1.1	.17	.54	60	340	190	6.3	520
8/30	"	S.Mossey Is.	Good	Muck-Sd	12	12	4½'	Najas-Celery Widgeongrass	1.5	.61	1.1	.17	.74	65	240	95	7.2	350

Analyses made by Spectrochemical Laboratory, Eastern Soil and Water Management Research Branch, Plant Industry Station, Beltsville, Maryland, in cooperation with the Bureau of Sport Fisheries and Wildlife.

Samples listed from North to South for each species.

various nutrient supplies. It is stated in that report that "The accumulations of calcium and magnesium in the tops were in general in inverse relation to their supplies and to the accumulation of potassium. The cause of these inverse relations was probably an imbalance in the nutrient solution between calcium and magnesium on the one hand and potassium on the other. This interpretation is supported by the fact that the equivalent potassium concentration was roughly 3 and 3½ times as great as that of calcium and magnesium,respectively. Under this condition, potassium uptake dominated uptakes of calcium and magnesium so that their accumulations.not only did not increase with increased concentrations in their supplies but actually tended to decrease. This competitive relationship of potassium with calcium and magnesium has been frequently demonstrated."

At the risk of taking some facts out of context from this paper by Specht, some other principles involved in that study were: "increased concentrations in the nutrient supply did not cause increases in accumulations of copper, iron, sodium, and aluminum in the tops of plants which were limited to symbiotically fixed nitrogen only. The accumulation of these elements--except aluminum--tended to increase, however, with increased concentrations in the nutrient supply when the plants were supplied with supplementary nitrogen. This indicates that the source of nitrogen can influence the accumulation of certain other elements. The data show that an increase in the supply of either potassium or magnesium produced a significant increase in yeild,.... The high level of calcium and the interactions of the elements produced no significant differences in yield. Increasing the potassium supply resulted in increases in the accumulation of potassium, nitrogen, phosphorus, and boron in the tops, but calcium, magnesium, and manganese uptakes were decreased.

"The accumulation of boron wasmarkedlyincreased by the over-all effect of increased potassium supply. The potassium and calcium effects on boron accumulations are almost equal and are additive. The high level of calcium supply caused increased concentrations of calcium and boron and decreased concentrations of magnesium and copper. The increase in the supply of magnesium caused increased accumulations in the tops of magnesium, nitrogen, and phosphorus, but produced decreased concentrations of calcium, boron, manganese, and copper.

"It is unlikely that an application of calcium would result in any nutritional benefit under cultural conditions which permit 2.5% or more of this element to accumulate in the tops. In fact, excess liming with a low magnesium material would probably prove detrimental because of the depressing effect of a high calcium level on magnesium accumulation. Also, what is probably more important, it was found that the high level of calcium supply decreased the efficiency of nitrogen fixation through its interaction with potassium. The data indicate that, within the levels of supply used in experiment 2, potassium and magnesium tend to supplement each other for inducing growth and nitrogen fixation. Since magnesium accumulation is readily depressed, however, by the high level of potassium, too high or too frequent applications of potassium could limit growth.

"It is entirely possible that the beneficial effect of adequate magnesium supply on nitrogen fixation and yield is a stimulation of root and nodule growth."

This lengthy presentation of excerpts from Specht's publication is necessary here because the sources to be drawn from in interpretation of water chemistry - plant ash element content are limited and probably nonexistent for the aquatic vegetation with which we are here concerned. The comparability of nutrient relationships for Trifolium and the aquatic vegetation is not known but the limited. data suggest, some relationships.

As previously mentioned one of the principles of nutrient relationship of Trifolium that may apply here is the high content of calcium in the aquatics from the areas of relatively low calcium content of the water and low potassium and magnesium content. Also sulphate was relatively low in areas where the plants had a higher uptake of calcium. Conversely, the calcium uptake of aquatics appears to be lower in the areas where the water contained a higher level of calcium, potassium, magnesium, and sulphate.

Lyon and Buckman (1950) "too much calcium may interfere with phosphorus and boron nutrition or may encourage chlorosis due to a reduction in the availability of the soil iron, zinc, or manganese. An undersupply of calcium may retard both nitrogen and phosphorus availability."

There is a progressive increase in salinity from north to south through the study area that is characteristic. Associated with the increasing salinity the calcium/magnesium ratio. decreases in the water. Expressed in equivalents the ratio of calcium/magnesium of the waters of the Back Bay Area is 1.01 or 1.02; in upper Currituck Sound the ratio in equivalents is about 0.97; and in lower Currituck Sound the ratio is 0.60. In the ocean water sample,the ratio. in equivalents of calcium/ magnesium was 0.58.

This relationship of calcium/magnesium appears to follow the same pattern in the soils and in element content in the sago pondweed specimens, although it is somewhat erratic. In the Back Bay Area, the average ratio of calcium/magnesium as equivalents in the soil is 0.88; in the soils of north Currituck the ratio is 0.76; and in south Currituck the ratio is 0.56. In the sago pondweed samples from the Back Bay Area,the calcium/ magnesium ratio as equivalents averaged 2.96; in north Currituck the average ratio is 1.91 (an average of 2.37 and 1.45); and in south Currituck the ratio of the only sample was 2.13.

Based on weight the calcium/magnesium ratios calculated from data by Pearse (1939) for typical ocean water, hard fresh water, and soft fresh water were 0.32, 4.64, and 18.8, respectively. The ratios of calcium/ magnesium by weight in the Back Bay Areawereabout 0.62; in north and mid-Currituck it was 0.59; in south Currituck, 0.36; and in the ocean water, 0.35. It would seem therefore, that while calcium is depauperated relative

to magnesium, in its deviation from the "typical," actually the trends in the ratios of calcium to magnesium in the waters, soils, and plants are the same. Based on equivalents the calcium/magnesium ratios of the soils', waters, and plants and the field rating of the condition of sago pondweed were:

Location	Soil	Water	Plants	Plant Condition
North Bay	0.98	1.01	2.47	Fair
Shipps Bay	0.80	(1.01)*	3.59	Poor
Redhead Bay	0.86	(1.02)*	3.53	Poor
Back Bay	0.76	1.02	2.13	Good
Buzzard Bay	1.00	(1.02)*	3.10	Poor
N. Currituck	0.76	0.97	2.37	Fair-Good
Mid-Currituck	0.76	0.98	1.45	Excellent
S. Currituck	0.56	0.60	2.13	Good

*Values from contiguous areas used.

In-association with the above relationships potassium and sulfate increase fairly progressively from North Bay to south Currituck. It will be noted that the field rating of condition of the sago pondweed samples varies in relation to the calcium/magnesium ratio- in the plants.

Magnesium

Magnesium has been considered in the above discussion of calcium; as implied there,it increases with increasing salinity and the uptake by sago pondweed is greater in the better quality plants.

The Yearbook of Agriculture (1938) states that "as a rule healthy plant leaves contain about 0.5 percent of magnesia."

On the exchange capacity of the soils of the study area there is an apparently strong correlation between milliequivalents of magnesium per 100 grams of soil and the percentage of clay particles (0.002 mm) in the soil; e.g., with increasing clay particles in the soil there is an increase in the exchangeable magnesium. A less pronounced relationship exists between exchangeable magnesium and the percentage silt sized particles (0.05-.002 mm). Lyon and Buckman (1950) state: "While all, sorts of cations may thus be loosely held by the adsorptive power of the clay nuclei, certain ones are especially prominent. For a humid-region clay, these in the order of their numbers are H^+ and Ca^{++} first, Mg^{++} second, and K^+ and Na^+ 'third." They consider this humid-region clay as having a calium-hydrogen complex; The condition on the study area, however, is a hydrogen-magnesium complex.

The Agricultural Handbook No. 60 (1954) states: "High concentrations of magnesium in the substrate are frequently more toxic to plants than isosmotic concentrations of other neutral salts. This toxicity of magnesium may be alleviated by the presence of relatively high concentrations of calcium ions in the substrate." It is not here postulated that magnesium occurs in excess in the soils or waters of the study area, and even more certainly it is unlikely that there is a deficiency, but the conditions influencing the uptake of magnesium, potassium, and calcium apparently have caused an imbalance, which is evidenced in the plant by a white or yellowish chlorosis of sago pondweed.

Sodium

In the sago pondweed plants analyzed, sodium content tended to be greater in the plants of better condition, whichwerefrom the southern part of the area. As previously mentioned this may have resulted from suppression of calcium uptake by sulphate and potassium with concomitant increase in sodium.

The Agricultural Yearbook (1953) states that "some experiments show that the addition of salt has increased the growth of crops. The phenomenon of base exchange enters here, and the salt addition may have released other elements of more direct use to the plant." Miller (1931) considered the role of sodium as follows: (1) a conserver of potassium, since less is absorbed when sodium is present, (2) replaces potassium to a limited extent as a plant-nutritive element, (3) renders soil-adsorbed potassium more available to plants, and (4) to be an antidoting agent against certain toxic salts in the medium.

Manganese

The Agricultural Yearbook (1938) states: "Manganese is a common constituent of soils and plants, the quantities present in both varying greatly. There is no correlation between the manganese in the soils and in the plants growing on the soils. The availability of manganese is governed rather by the acidity and the reducing action in the soil than by the quantity present. The manganese in soils containing organic matter becomes very soluble when these soils are submerged for relatively short periods. Under these conditions the concentrations of soluble manganese greatly exceeds the limits that have been found toxic to plants." (Chlorosis and sometimes necrotic spotting characterizes a deficiency.) "Some plant leaves contain as little as a few thousands of 1 percent, and a number of tree leaves growing on very acid soils contain nearly 0.5% (5000 ppm)."

The manganese content in the sago pondweed and redheadgrass samples tended to be greatest in those given a field rating of poor and least in the plants of better condition, but the differences are possibly insignificant. The Agricultural Yearbook (1953) states: "Manganese when present in excess may bring about iron deficiency." The uptake of manganese in the sago pondweed and redheadgrass appears to bear some relationship to exchangeable H in the soils.

Potassium

In the soils of the study area it is found in far less supply than the other major cations. The milliequivalents per100 g. of soil indicate that the concentration of potassium is highest in Back Bay and North Bay soils where the cation exchange capacity is highest. However, proportionally the sandy soils of Shipps Bay have the highest percent of exchangeable potassium. This percentage increase in potassium appears to be at the expense of hydrogen on the cation exchange complex.

The content of potassium in the sago pondweed plants from field samples has been considered already; it was indicated that greater amounts were found in the plants of better condition and that possibly it effected a better balance between calcium and magnesium by lowering the uptake of calcium.

Aluminum

The aluminum content in the sago pondweed and redheadgrass samples was lowest in the plants of apparent best condition and highest in those of apparently poorest condition. The aluminum content in the plants does not appear to vary in relation to that in the water. A fairly positive relationship, however, exists between the percent of exchangeable hydrogen in the soils and the uptake of aluminum by sago pondweed as will be witnessed in the following rank comparison:

Exchangeable hydrogen % in soil:	22	31	36	38	39	40	41	46
ppm aluminum in plant:	490	460	420	800	1700	520	1900	1900

Although. somewhat erratic,at higher percentages of exchangeable hydrogen in the soil, uptake of aluminum was greater by sago pondweed. Aluminum will be considered in greater detail in later. analyses.

Iron

The quantity of iron in the samples of sago pondweed and redheadgrass was erratic in relation to the condition of the plants at the time of collection. Deposits on the roots of aquatics of the area which are apparently iron are commonly observed. Increased uptake of iron in sago pondweed occurs with increasing percentages of exchangeable hydrogen in the soil, and is correlated, therefore, with the uptake of phosphorus.

There is some indication of higher nitrate content in the waters of the northern part of the area during the summer, which might increase the uptake of iron and copper by the plants.

Boron

From the Agricultural Yearbook (1938): "Small amounts of boron are required for plant growth and slightly higher concentrations cause injury. Boron is present in quantities up to 200 ppm in all normal, healthy plants; Orchard grown citrus leaves suffering from boron injury may contain in excess of five times as much. Irrigation water occasionally contains boron in amounts toxic to plants. Considerable damage to citrus crops in California was caused by irrigation water containing more than one-half part per million." The Agricultural Handbook No. 60 states: "Foliar analysis is useful in the diagnosis of boron injury of many plant species. The boron content of normal mature leaves of such plants as citrus, avocados, walnuts, figs, grapes, cotton, and alfalfa tops is about 50 ppm. Boron contents of 20 ppm or less indicates deficiency, while values above 250 ppm are usually associated with boron toxicity. If due allowance is made for varietal specificity in boron accumulation foliar analysis may provide a readier basis for diagnosis than analysis of soil or water."

In the analysis for boron in sago pondweed and redheadgrass the most striking characteristic is that the boron content in sago pondweed averages 12 times the amount in redheadgrass from the same waters and soils. Little if any, relationship, exists between the boron content of the water and that of the uptake by these plants. Controlling factors of uptake are not readily apparent. The sago pondweed samples of poorer condition contained larger quantities of boron than the samples in better condition.

Phosphorus

The content of phosphorus in sago pondweed and redheadgrass, as shown by the spectrochemical analyses, tends to decrease from north to south through the study *area.* This appears to be associated with soil characteristics; and most particularly the percentage of hydrogen on the cation exchange complex. In rank comparison of the percent phosphorus in the sago pondweed plants and the exchangeable hydrogen percentage from the soils from which the samples were taken, it will be noticed that as exchangeable hydrogen increases in the soils that the uptake of phosphorus was greater:

Percent phosphorus in plants:	.14	.16	.17	.18	.19	.20	.24	.28
Percent ex. hydrogen in soil:	22	31	36	39	38	40	41	46

Also the greater amount of hydrogen on the exchangeable cation complex is most closely associated with decreasing percentages of sodium on the cation exchange complex. Robinson (1949) lists the order of absorption of the principal ions as H>Ca>Mg>K>Na. "The replacement of exchangeable sodium by exchangeable hydrogen is, thus more rapid than the replacement of exchangeable hydrogen by exchangeable sodium."

If this relationship is as simple as it seems when the percent of exchangeable sodium increases, the hydrogen that is exchangeable decreases and the uptake of phosphorus by the plants decreases. While this relationship is factual, there *are* many facets *as* to the reasons for it and variation in particle size, the presence of sesquioxides, fluorides, chlorides, and bicarbonates serve further to complicate it. While the strongest relationship is that of sodium displacing hydrogen in the exchange complex, there is a positive trend indicating that magnesium also serves to displace hydrogen. The fact that sodium replaces hydrogen to a greater extent than magnesium, and magnesium does so to a greater extent than calcium is because of the relative proportions in the water, e.g., Na>Mg> Ca> K. (See Table).

A relationship also exists between the pH of the saturated paste (1:1) of the soil and the uptake of phosphorus by sago pondweed:

Percent phosphorus in plant:	.14	.16	.17	.18	.19	.20	.24	.28
pH of saturated paste:	4.9	4.8	4.2	5.0	4.9	4.6	4.2	4.0

The trend here is not as apparent as that of the percent of exchangeable hydrogen and phosphorus uptake, because the first three values are somewhat erratic. Basically all this means is that phosphorus uptake was enhanced by increasing soil acidity, but sodium and to some extent magnesium and possibly calcium by decreasing soil acidity limited phosphorus uptake by the sago pondweed plants. The significance of this would be further explored were it not for the fact that there is no apparent relationship between the uptake of phosphorus by the plant and the quality or condition of the plant. If such a relationship does exist, it would seem that those sago pondweed samples with greater uptake of phosphorus come from areas where the plants are of relatively poor quality and seed production is limited. This question remains for further consideration. It is likely that the greater accumulations of phosphorus are luxury consumption for sago pondweed.

The 1957 Yearbook of Agriculture in discussion of plant diseases states: "That may be due partly to the occurrence of more turgid and thinner walled plant cells after nitrogen application and their greater susceptibility to parasitic invasion. Also involved is a disturbance of the normal nitrogen and phosphorus ratio in the plant. The nitrogen fertility of the soil needs to be kept in balance with that of phosphorus, at least as far as the Pythium root rots are concerned." This reference is recorded here because Pvthium and Rhizoctonia were recorded on aquatic vegetation from the study area.'

The Yearbook of-Agriculture (1953) in discussion of phosphorus deficiency states: "Shortages of phosphorus lower plant growth markedly. The symptoms are not always clearly defined. Usually the leaves are small-and erect, the lateral buds are few, and the roots may be sparsely branched. But most of the effects of phosphorus deficiency apparently are more general. The leaves are usually dark green, but in later stages or in extreme cases they may be dull green and may show purplish tints. Sometimes necrosis is evident. When the older leaves dry up or shed they are dark brown to almost black. The cereals often show purpling on older leaves."

Spectrochemical Analysis of Aquatic Plants from the Bioassay in Water Salinities of 0 to 40 Percent Sea Strength

The design and results of the 1960 bioassay of aquatic plants grown in water of 0 to 40% SS a'represented on pages 71-76, Volume 1 of this data report.

Spectrochemical analysis of plants and knowledge of interpretation of the data are still in its infancy; this is particularly true for aquatic plants. Plant specificity for uptake of nutrients varies with the plant species, as well as the physical and chemical environment. Uptake of elements is not necessarily related to the supply or availability of an element in the environment, and may actually be inversely related to supply. In some instances, an excess of one element may control uptake of one. or more other elements. The acidity or alkalinity of the soil and water, partly by controlling availability of elements, also controls uptake by plants. Quite possibly there may be some phenological implications and competition among plant species that affect uptake of nutrients. If our discussion here, at times, contradicts certain earlier assumptions it is primarily because of the conjectural topic of plant nutrients. It is an exceedingly complex problem particularly as applied to aquatic plants, and field studies and laboratory studies, beyond the scope of this work, will be required for better clarification.

Content of Elements in Sago Pondweed Grown in Water of 0 to 40% SS

Earlier discussion of relationships of concomitant.. increases of certain elements and salts in water with increases in salinity should be referred to. Potassium, sulfates, calcium, magnesium, sodium, chlorides, and boron are enrichments in ocean water and considered here to be increased in-general proportion to the salinities used. Aluminum, iron, copper, phosphorus, manganese, nitrates, and bicarbonates cannot be considered as increasing in proportion to salinity.

Graphs and tables present the content of major elements in each of the plant species grown on silt soils in water salinities of.0 to 40% SS in.5 percent increments..

As surmised from the analyses from the field samples, the calcium content in sago pondweed decreases with increasing water salinity; this is believed to be the result of suppression of calcium uptake by higher sulfate content in the higher salinities.

The potassium content did not increase, as anticipated, in the higher salinities. It was highest in the sago pondweed from the 10% SS tank; which had a very poor yield of chlorotic plants and no tubers. This is contrary to field samples that tended to have greater quantities of potassium in those of better condition.

The content of 2.8 percent (or 28,000 ppm) in the plant from 10% SS, however, was in excess of that in any of the field samples.

Magnesium tended to increase in sago pondweed in proportion to salinity. At 0, 5, and 10% SS the potassium uptake increased in general proportion to the ratio of calcium to magnesium. This relationship seems to also exist at 25, 30, and 35% SS, but to a different degree than at the lower salinity.

Sodium content of sago pondweed tended to increase in general proportion to potassium content of the plants, but not in direct proportion to the water salinity. The sodium content appears to be inversely related to the calcium content.

Phosphorus content in sago pondweed appears to be postively correlated with the content of iron and aluminum in the plant; as discussed this appears to be related to soil acidity, for in the field samples all three elements increased in the plant as the exchangeable hydrogen increased.

No positive relationship of copper content to other elements in sago pondweed is apparent. As in the field samples there was a tendency for higher concentrations in those of lowest yield and poorest condition.

The ranges in element uptake in the bioassay and the field samples compares as follows:

	Bioassay		Field	
Ca	10,000-27,000	ppm	9,700-17,000	ppm
Mg	6,100-19,000		6,900-11,000	
K	8,000-28,000		12,000-25,000	
Na	5,300-12,000		3,800- 8,200	
P	3,000- 9,200		1,400- 2,800	
B	850- 2,500		540- 840	
Fe	900- 4,800		300- 1,000	
Mn	440- 1,100		120- 450	
cu	8.2- 28.0		6.2- 25.0	
Al	1,300- 8,000		420- 1,900	

Of course, if a greater number of field samples had been sampled the ranges in element content would probably have been greater; however, in the bioassay the generally higher and broader range of phosphorus, boron, iron, manganese, and copper content in sago pondweed plants all tend to make one suspect a lowering of the pH to a range of 5.5 to 7.0; lower pH values would probably have decreased phosphorus availability because of formation of aluminum and iron phosphates.

Water Chemistry During the Bioassay

Certain chemical characteristics of the water are presented in tabular form. In the sago pondweed tanks, the pH tended to remain higher in the waters of the silt tanks, generally exceeding 8.0; occasionally pH's as high as 9.5 were reached during July and August. The greatest range occurred on December 5, when the waters of the loam soil tanks varied from 4.5 to 9.3, generally being more acid in the higher salinities. The range of pH values of the waters of the silt soils was only from 7.6 to 8.7 at that time.

In the sago pondweed tanks with silt, the iron content of the water on June 7 ranged from 0.00 ppm to 0.05 ppm; on December 5 it ranged from 0.09 to 0.16 ppm. Sulfates increased in general proportion to the salinity and ranged from 78 ppm in fresh water to 4,200 ppm in 40% SS. The. total methyl orange alkalinity of the sago pondweed water in the silt series ranged from 28 to 98 ppm; it generally increased with higher salinities, but was not dependent on it.

Chemistry of Soils in the 1960 Bioassay

Availability of nutrients was determined for each of the three types of soil (soft surface silt, subsurface silt, and loam) with a Truog-Hellige Soil Testing Kit on April 22, when the test tanks were established.

Six random samples were taken of each soil type; as mentioned in Volume 1, 3 gallons of loam soil from an area normally productive of aquatic vegetation were placed in 60 test tanks; to the other 60 test tanks 2½ gallons of subsurface silt, from the nonproductive area of Back Bay, were added, and 1 week later 2 quarts of soft surface silt were added so that it could settle to the bottom of the water and duplicate natural conditions in the bay.

Although certain water chemistry aspects were monitored during the summer, it was not possible with the work load of other duties to monitor the soil chemistry during the summer. However, on July 25, 1960, when unusually low pH values developed in certain waters of the loam series of tanks for redheadgrass, soil chemical characteristics were determined from all water salinities in that series.

The tanks were taken up on December 5, 1960, and we determined the soil chemical characteristics from the loam soils, and the aggregate silt soils in all water salinities in the sago pondweed series.

Spectrochemical analyses of plantsweremade on those from the silt series for each species.

The original pH (wet) of the surface and subsurface soils was alkaline with a range of 7.5 to 8.0, and a mode of 8.0. The loam soils originally had a pH (wet) range of 6.5 to 7.5, with a mode of 6.5. The lower pH of the air-dried samples will be discussed later; it is typical of these soils and becomes more pronounced with successive wetting and drying.

Initially, calcium availability was generally low on the surface silt, but very low on subsurface silt; magnesium was medium-plus on both silts; phosphorus was uniformly high on both silts; potassium was high to-high-plus on the subsurface silts but only meditum to medium-plus on the surface silts; no nitrates were present and ammonia was very high on both silt types; sulfates were low on both silt types; chlorides were generally medium-plus on both silt types; ferric iron was low on-surface silts, but very low on subsurface silts.

At the pH value of 8.0 the nutrient levels were in accord with expected values for a submerged coastal silt soil. The lower availability of potassium on the surface silt may be related to the slightly greater calcium availability on the surface silt.

The soils were submerged in tanks with water salinities ranging from 0 to 40% SS in 5 percent increments until December 5.

The initial uniformly high phosphorus availability on the silt soils was slightly reduced in one fresh tank and in the 10% SS tank; it remained high in one fresh tank, 5, 15, and 20% SS; and increased to high-plus in 25, 30, and 35% SS and very high in 40% SS.

Potassium availability increased to very high levels in all salinities except 10% SS which increased to high-plus. It is interesting to note that potassium uptake by sago pondweed was highest in the 10% SS tank.

On the silt soils calcium remained very low from fresh to 10% SS, and tended to increase slightly from 15 through 40% SS; magnesium remained medium-plus from 0 through 10% SS, but increased to high-plus from 15 through 40% SS. Nitrates were still absent in all tanks, and ammonia remained very high at all salinities. Sulfates decreased slightly in 0 and 5% SS, remained low in 10% SS, and increased slightly in all higher salinities. Chlorides remained about the same at 0 and 5% SS but increased to very high levels from 10% SS to 40% SS. Ferric iron increased in 0, 15, and 30% SS to medium levels, and remained low in the other salinities.

Spectrochemical analyses were not made on plants from the loam soils but it should be noted that the initial slightly acid soils remained about the same in the salinities of 20% SS or more, but became less acid in the fresher water. Phosphorus remained about the same; potassium availability increased to very high levels in general proportion to salinity; calcium remained relatively unchanged; magnesium tended to increase with increased salinity; nitrates remained absent; ammonia remained high but increased to very high levels in the fresh water tanks and in 10% SS; sulfates increased significantly to medium levels only in 35 and 40% SS; chlorides tended to increase appreciably in higher salinities; ferric iron decreased to low levels in all tanks except the 20, 25, and 30% SS.

The major differences between the loam and silt soil before and after the bioassay were the greater acidity of the loam; higher phosphorus, potassium, calcium, magnesium, ammonia, of the silt soils; and slightly higher sulfate initially in loam, but greater sulfate increases in silt at higher salinity levels. Iron availability tended to decrease in loam, but increased in silt during the study.

Yield of Sago Pondweed in Relation to Content of Elements in the Plant

When the content of magnesium, calcium, and potassium was approximately the same, as it was in the sago pondweed from 20 to 40% SS, vegetative and tuber production was enhanced. Tuber production was absent, or lowest when the plant content of potassium and calcium exceeded the content of magnesium. Actual values of yields are presented in Volume 1.

Discussion of Nutrient Content of Sago Pondweed

The nutrient content of sago pondweed grown in the 1960 bioassay differed considerably from the nutrient content in wildcelery tubers, redheadgrass vegetation, widgeongrass vegetation, and najas vegetation; the potassium content was the dominant nutrient in these other plants, regardless of the salinities 'in which they were grown. Potassium was the dominant nutrient only in the exceedingly poor yield of chlorotic sago pondweed grown in 10% SS. However, in the field samples potassium was generally the dominant element.

The general increase in the ratio of magnesium to calcium in the sago pondweed plants grown in progressively higher salinities in part reflects the relatively greater enrichment of magnesium than calcium in ocean water; probably more important, however, the enrichment of sulfates in the ocean water served to suppress the uptake of calcium. The resultant favorable balance of calcium, magnesium, and potassium resulted in greater yields of vegetation and tubers in higher salinities. Probably cation and anion exchange of sodium and chloride is involved in this balance.

No readily apparent relationship of the content of phosphorus, boron, iron, manganese, copper, or aluminum to yeild or condition exists in the bioassay data; although most of these elements, except phosphorus, generally occurred in greater quantity in the poorer quality field samples. Soil acidity is probably one of the principal regulators of uptake of these elements.

It was aptly stated at one committee meeting that our rather cursory investigation of disease of sago pondweed, with limited funds and manpower, would "Only plumb the depths of our ignorance." I doubt that we even achieved that! That study did reveal that 44 percent plus or minus 2 percent of the sago pondweed plants had lesions and that Pythium spp. fungi were frequently associated with the lesions. Wet organic and clay soils with imbalance of nutrients, frequently excess nitrogen and deficiencies of phosphorus, are often conducive to growth of Pythium root rot; but balance of potassium and other nutrients, temperature, and other factors are also important.

Clearly, I am stating nothing more than a thesis by suggesting that the apparent imbalances noted in nutrient uptake by sago pondweed in both the bioassay and the field samples may have increased the severity of the root rot by one or more pathogenic fungi. From the field survey, root rot appeared to occur most severely in loam soils; it is noteworthy that the ratio of ammonia to phosphorus availability increased in the

loam tanks of 0 and 10% SS in the bioassay, and these were the least productive tanks. The ratio of available ammonia to phosphorus remained about the same on the soils in the other water salinities. The sago pondweed plants were dead or chlorotic and similar in appearance to those believed to be diseased by root rot.

In the bioassays of both 1960 and 1961, yields of sago pondweed vegetation and tubers were increased in higher salinities. We believe that these yields were increased because of more favorable nutrient balance. It is suspected that when calcium and magnesium uptake is more nearly equal, or magnesium uptake exceeds that of calcium, the balance of other nutrients is most favorable. Further it is conjectured that sulfates serve to suppress the calcium uptake and create the better nutrient balance. Sulfates, of course, are relatively enriched in the ocean water and could provide a means of managing nutrient availability and uptake by aquatic plants.

This preoccupation with sago pondweed and nutrient balance was because it was the aquatic plant in greatest distress.

Although nutrient imbalance apparently predisposed sago pondweed to fungus disease and nutrient deficiency, that probably limited production of vegetation and tubers, it is still considered a secondary limiting factor to turbidity and excessive siltation.

Content of Elements in Other Aquatics Grown in Water of 0 to 40% SS -

Widgeongrass

The calcium/magnesium ratio in widgeongrass decreased with increasing salinity. Highest yields were in salinities from 15 to 40% SS. There was greater consistency of relative uptake of elements in widgeongrass in various salinities than there was for sego pondweed. The content of aluminum, iron, boron, and manganese was considerably lower in widgeongrass than in sago pondweed,

Potassium uptake was lowest in 5, 30, 35, and 40% SS.

Najas

Najas did not survive salinities of 25% SS or more; yield was progressively reduced at 10, 15, and 20% SS. No imbalance of nutrients was apparent.

Wildcelery

Practically all the leaves disintegrated prior to the time the tanks were taken up, so the tubers were submitted for spectrochemical analyses. Uptake of elements by tubers is probably much different than that by foliage.

As mentioned on page 73, Volume 1, a red coloration of the leaves was noticed by mid-summer, and it was most pronounced on those from 20 and 25% ss. It was conjectured that a nutrient imbalance or deficiency of phosphorus might be the cause. 'A slightly lesser quantity of phosphorus occurred in the wildcelery tubers from the 20 and 25% SS.

The number and volume of tubers tended to increase in higher-salinities, There was a slight indication that yields were better when the magnesium/calcium uptake ratio was lower, Magnesium uptake exceeded calcium in all instances and this was believed to be a characteristic of roots and tubers; uptake in foliage would likely have been different,

Uptake of copper was generally higher in the tubers from fresher water.

Redheadgrass

Good yields of redheadgrass occurred in all salinities; however, the yield of leaves and stems was reduced above 25% SS, but the ratio of the yield of roots to vegetation increased at those salinities. The 20% SS tank was destroyed by decomposition of a rodent.

No apparent relationship of nutrient uptake to yield or condition was obvious.

The yield from 0 through 15% SS was rated as excellent to good; whereas the yield in the higher salinities rated as only fair at the time of measurement. The content of phosphorus was highest in the plants from 0 through 15% SS, ranging from 0.36 to 0.63 ppm; the range was 0.31 to 0.34 ppm for the plants rated as fair in the higher salinities.

Discussion of Nutrient Content of Other Aquatics 'Grown in 0 to 40% SS

Potassium was the dominant nutrient in all plants except sago pondweed. The greatest variation in the calcium/magnesium ratio occurred in sago pondweed; the least variation of this ratio was in Najas. Boron content was highest in sago pondweed, ranging from 850 to 2,500 ppm; it was not detected'in Najas vegetation or wildcelery tubers. The range in redheadgrass was only 36 to 55 ppm, and in widgeongrass it ranged from 210 to 510 ppm.

Aluminum and iron were generally much lower in the other aquatics than in sago pondweed.

There was some indication that red coloration of wildcelery was caused by phosphorus deficiency; also phosphorus may have limited vegetative yield of redheadgrass in higher salinities. Red coloration was frequently observed *on* patches of Najas in the area; quite possibly this represents localized phosphorus deficiency.

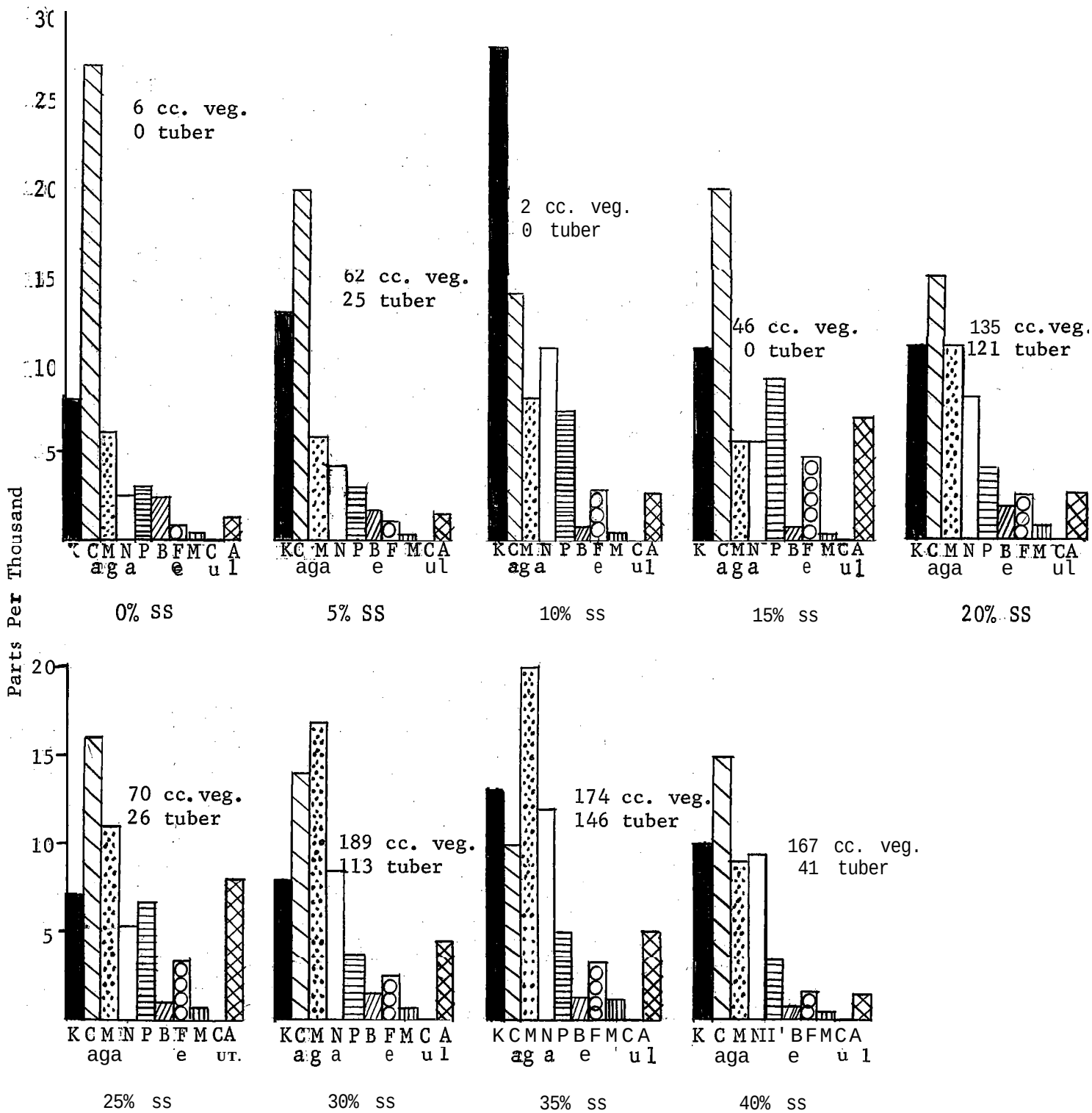


Figure _____. Nutrient Content of Sago Pondweed Grown in 0 to 40 Percent Sea Strength Water in the 1959 Bioassay, with Indicated Yields of Vegetation and Tubers.

P determined in different kinds of aquatic plants[1]

Percent of sea strength	Sago Pond-Weed (Lab. Nos. 1-9)	Najas (Lab. Nos. 20-25)	Celery tubers (Lab. Nos. 10-19)	Widgeon grass (Lab. Nos. 26-34)	Redhead grass (Lab. Nos. 35-43)
	%	%	%	%	%
0		1.10	0.65	0.75	0.63
0	0.31	0.45	0.49	0.54	0.38
5	0.30	0.65	0.50	0.58	0.60
lo	0.73	0.83	0.49	no sample	0.36
15	0.92	0.55	0.52	0.63	0.39
20	0.40	0.59	0.31	0.68	no sample
25	0.66		0.37	0.71	0.31
30	0.37		0.38	0.40	0.33
35	0.49		0.46	0.50	0.34
40	0.33		0.39	0.35	0.34

1/ Analyses made by Spectrochemical Laboratory, U. S. Soils Laboratory, Soil and Water Conservation Research Division, Northeast Branch, Agricultural Research Service, United States Department of Agriculture, Beltsville, Maryland. Cooperative work with Fish and Wildlife Service, United States Department of Interior, Patuxent Research Refuge, Laurel, Maryland.

K determined in different kinds of aquatic plants[1]

Percent of sea strength	Sago Pond-Weed (Lab. Nos. 1-9)	Najas (Lab. Nos. 20-25)	Celery tubers (Lab. Nos. 10-19)	Widgeon grass (Lab. Nos. 26-34)	Redhead grass (Lab. Nos. 35-43)
	%	%	%	%	%
0		2.90	1.30	3.00	3.20
0	0.80	2.80	1.00	2.90	3.10
5	1.30	3.00	1.00	1.60	2.80
10	2.80	2.00	1.30	no sample	2.40
15	1.10	2.40	1.00	2.60	2.40
20	1.10	2.20	1.00	2.90	no sample
25	0.70		1.00	2.50	2.50
30	0.80		1.00	1.30	2.50
35	1.30		1.20	1.80	2.20
40	1.00		1.10	1.30	2.90

1/ Analyses made by Spectrochemical Laboratory, U. S. Soils Laboratory, Soil and Water Conservation Research Division, Northeast Branch, Agricultural Research Service, United States Department of Agriculture, Beltsville, Maryland. Cooperative work with Fish and Wildlife Service, United States Department of Interior, Patuxent Research Refuge, Laurel, Maryland.

Ca determined in different kinds of aquatic plants[1]

Percent of sea strength	Sago Pond-Weed (Lab. Nos. 1-9)	Najas (Lab. Nos. 20-25)	Celery tubers (Lab. Nos. 10-19)	Widgeon grass (Lab. Nos. 26-34)	Redhead grass (Lab. Nos. 35-43)
	%	%	%	%	%
0		0.74	0.18	1.30	1.50
0	2.70	0.79	0.18	1.20	1.30
5	2.00	0.78	0.12	0.94	1.30
10	1.40	0.91	0.19	no sample	1.20
15	2.00	0.82	0.11	1.10	1.10
20	1.50	0.72	0.12	0.94	no sample
25	1.60		0.18	0.83	1.50
30	1.40		0.11	0.74	1.20
35	1.00		0.16	0.76	1.40
40	1.50		0.12	0.62	1.10

1/ Analyses made by Spectrochemical Laboratory, U. S. Soils Laboratory, Soil and Water Conservation Research Division, Northeast Branch, Agricultural Research Service, United States Department of Agriculture, Beltsville, Maryland. Cooperative work with Fish and Wildlife Service, United States Department of Interior, Patuxent Research Refuge, Laurel, Maryland.

Hem (1959) states that nitrate content in surface waters not subject to extensive pollution from sewage or other sources seldom is as high as 5 ppm, and oftenless than 1 ppm.

Maciolek (1954) in a literature review quotes the following: "Chu (1943) concluded from laboratory results that nitrogen and phosphorus occur naturally in quantities far below the upper limit for optimal growth and do not reach lower optimal concentrations. These elements," he added,"may limit growth at certain times of the year and may exert a selective influence on different species of algae when concentrations are below the lower limit (nitrogen 0.3 to 1.3 ppm, phosphorus 0.018 to 0.090 ppm). Such concentration limits may not apply to natural situations."

Riffenburg (1925) states that nitrate averages 0.2 ppm in rainwater.

Phosphates

In 1959 low concentrations of phosphorus occurred in most of the Geological Survey water samples in November but none was found in the water samples collected in August. The uptake by plankton and aquatic plants probably accounts in part for the summer absence of phosphorus. Hutchinson (1957) states that "Most relatively uncontaminated lake districts have surface waters containing 0.010 to 0.030 ppm (total phosphate), but in some waters that are not obviously grossly polluted, higher values appear to be normal. The soluble phosphate usually is but a small fraction, of the order of 10 per cent of the total." Maciolek (1954) in a literature review states that"Barrett (1953) indicates that the rate of disappearance for added phosphorus from epilimnial water was related to alkalinity (theoretical lower limit of alkalitrophy seemed to be between 120 and 160 ppm methyl orange alkalinity), and also that the amount of exchangeable'phosphate in bottom sediments was inversely related to the ratio of marl to organic matter."

Phosphates are seldom toxic to fish at levels of normally encountered concentrations and are generally beneficial because of stimulation of algae. and zooplankton.

Chloride

Chloride naturally increased towards the southern part of the study area in the waters of greater salinity. The lowest chloride content in the laboratory analyses of water samples was 178 ppm in the November sample from the North Landing River; the highest concentration was 1,520 ppm in the August sample from the southern part of Currituck Sound. A review of the literature reveals that apparently little is known of the specific toxicity of the chloride ion to plants. The Yearbook of Agriculture (1938) mentions that chlorine is not retained by soil colloids and is easily leached out by rainwater. "This element seems to act as a vehicle to carry various bases in solution into the plant."

Hem (1959) states that "Chloride is present in all natural water." McKee and Wolf (1963) cited references that stated "4,000 ppm chloride was harmful to bass, pike, and perch; 8,100-10,500 ppm was harmful to small bluegills; and 4,500-6,000 ppm was harmful to carp eggs." They state further that 'the Aquatic Life Advisory Commission concluded that it is impossible to generalize on the effects of chloride concentrations on aquatic life, for each mixture of chlorides with other salts must be evaluated separately."

Bicarbonates

It will be seen in the accompanying table that bicarbonates varied but little throughout the study area, being highest in the August 1959 sample from North Bay (34 ppm) and lowest 'in the November sample from the North Landing River (19 ppm). Although the ocean water sample concentration of bicarbonates was 129 ppm, bicarbonates within the study area do not vary in proportion to salinity. Except for the samples from North Currituck, the bicarbonate content was lower in the November samples than in the August samples, as might be expected.

The writer has been somewhat surprised at the relatively low bicarbonate content of the water and. perhaps somewhat enlightened by the following discussion by Hutchinson (1957). "Some unpublished observations on Linsley Pond indicated that oxidized mud suspended in water actually caused a loss of bicarbonate. It is probable, in general, that oxidized mud binds Ca^{++} as might be expected, but that on reduction the bases are liberated into the aqueous phase, converting CO_2 in the aqueous phase of the mud to bicarbonate. The base-exchange material obviously cannot be clay. Mortimer suggests reasonably, but without as yet very critical evidence, that it is a ferric-organic complex. On reduction the complex is supposedly dissociated, or at least loses its base-exchange properties." Uhler (1956) discusses the effect of increasing the carbonic acid content of the water, through the submergence and decay of herbaceous vegetation, on decreasing turbidity from colloidal types of clay. Ellis, et al. (1948) state that "Carbonates and bicarbonates in natural unpolluted waters supporting good fish fauna,,.ran ge from 0 to 350 ppm (expressed as calcium carbonate), with the usual ly expected values lying between 45 and 200 ppm.'

The pH of the water from the study area is below 8.3 in most instances and the alkalinity is assumed to be primarily attributable to bicarbonates. McKee and Wolf (1963) state that at a pH of 7, the ratio of bicarbonates to carbonates will be 2,270 to 1. If Hutchinson's reference to oxidized mud causing loss of bicarbonate is correct and applicable here, this may serve to explain relatively low bicarbonate content in the turbid waters of Back Bay and Currituck Sound.

Hart et al. (1945) state that "in U.S. waters that support a good fish fauna, 5 percent of such waters have less than 40 ppm of bicarbonates, 50 percent have less than 90 ppm, and 95 percent have less than 180 ppm."

It has been the observation of several waterfowl biologists in different locations in the U.S. that the more desirable aquatic plants for waterfowl grow better in waters with high bicarbonate. content.

Sulfate

The ocean water sample indicates the enrichment of sulfates in ocean water (2,350 ppm). Within the study area it varies in almost direct 'proportion to the salinity. Sulfate concentration during fresh water periods was somewhat low for optimum growth of widgeongrass, redhead-grass, and possibly sago pondweed. The relationships of sulfate to calcium in the uptake by plants will be considered in later discussion.

Of the various elements listed, the data on sulphates seem of particular importance in regard to the distribution and condition of some species of aquatic vegetation. John B. Moyle (1956) states "There is a noticeable biological relationship between the concentration of sulphates and distribution of aquatic plants in Minnesota. Ruppia occidentalis, and Scirpus paludosus, are generally limited to waters with a sulphate ion concentration greater than 50 ppm, and make their best growth in waters where sulphates exceed 200 ppm. Some species typical of hard carbonate waters such as Potamogeton pectinatus (sago pondweed) and Potamogeton richardsonii, also grow well in high-sulphate waters, but many of the typical hard water species do not thrive in them."

Moyle (1945) lists Potamogeton pectinatus with the hard-water flora in a subgroup (2) in which the included species seldom occurred in waters with a total alkalinity of less than 30 ppm, and which commonly occurred in waters with a sulphate ion concentration greater than 50 ppm. He included Najas flexilis and Vallisneria americana in hardwater group 3 which includes plants which make their best growth and are most abundant in hard waters but which range into both soft and alkali waters. He states that they are usually infrequent and make poor growth in waters with a total alkalinity of less than 20 ppm or in waters with a sulphate ion concentration greater than 300 ppm.

Silica

Silica in waters is somewhat cyclic and the erratic content of silica in the waters of the study area is not likely to be atypical of an aquatic habitat such as this; also it is doubtful that silica is a limiting factor to production of higher aquatic plants of the area. The theories on the role of silica in higher plants are conflicting. The Yearbook of Agriculture (1938) states "Plants, particularly the grasses, grown in the absence of silica are especially susceptible to fungus- diseases, and from this it is supposed that the normal plant is able to ward off such diseases because of the mechanical protection afforded by the silica in the outside walls of the plant. Normally silica is quite insoluble.

Table _____. Soil Settled Out of Back Bay Water. Taken from Center of Back Bay, Shipp's Bay, and North Bay.

Available Nutrient	Back Bay	North Bay	Shipp's Bay
pH (wet)	7.0	8.0	8.0
pH (dry)	6.0	7.0	7.5
Phosphorus	Low	Low	Low
Potassium	Very High	Very High	Very High
Calcium	Low	Low	Medium
Magnesium	Medium+	Medium+	Medium
Nitrate	None	None	None
Ammonia	Very High	High+	Very High
Sulfate	Very Low	Very Low	Very Low
Chloride	Medium	Low	Low
Ferric Iron	Low	Low	Low

Its solubility is increased in the presence of alkalies and by high temperatures. Silicon in its more active forms in the soil increases the availability of phosphorus." The Yearbook of Agriculture (1953) mentions that silicon affects the availability of potassium. Hutchinson (1957) presents the content of silica in surface waters of Wisconsin (from Juday, Birge, and Melohe, 1938) as ranging from 0.2 to 25.6 mg/l; the mean was 2.05 mg/l, and the mode 0.0 to 0.9 mg/l.

Aluminum

It is apparently not known if aluminum is required by plants. Aluminum is known to be relatively insoluble, but is increasingly soluble in acid soils. The Yearbook of Agriculture (1938) mentions that on acid soils aluminum is sometimes considered toxic; and further "The element is toxic at low concentrations in water cultures." No deficiency diseases are reported due to lack of the element. On the other hand, some root rots are ascribed to the presence of excessive quantities.

In the Geological Survey analyses of aluminum content of the waters, the variations were small with the exception of the November sample from the North Landing River. Aluminum content at this location increased from 0.3 ppm in August to 0.9 ppm in November. Hutchinson (1957) presents several average values of aluminum in water that are so much qualified that it will suffice here merely to say that 0.9 ppm appears somewhat higher than the average for surface water. The sea water sample from this area contained about 10 times the amount in the waters of the study area, but the concentration of aluminum in the study area waters does not appear to be proportional to salinity.

Iron

Iron functions in the formation of chlorophyll. Welch (1952) states "Most algae grow best when water has a ferric oxide content of 0.2 to 2 mg/l, but distinct toxicity occurs when the available iron exceeds 5 mg/l (ppm). However, many natural waters may contain more than 5 mg/l of iron without being toxic owing to the buffer action of organic compounds or of calcium salts'! (from Smith, 1933). In upland crops it is known that overliming can produce iron deficiency symptoms characterized by chlorosis. The Yearbook of Agriculture (1938) states "In the leaves of healthy plants iron will average a few hundredths of one percent, the amount never varying greatly."

It would not seem that excessive concentrations of iron occurred in the waters analyzed by the Geological Survey. As with aluminum, iron appeared in greatest quantity (0.43 ppm) in the November sample from the North Landing River. It may also be significant that the pH of 6.6 for that sample was the lowest of the series.

Lithium

Lithium salts in small quantities are known to stimulate upland crops; excessive concentrations can be toxic. It will be noticed that lithium increases fairly progressively from north to south

through the study area. <Determinations of lithium were not made on the ocean water sample but it is here supposed that the increase in the southerly areas is related to the salinity. Lithium has apparently been seldom sought for.

Fluoride

Fluorine is apparently not known to be needed for the growth and development of any form of plant life. Lyon and Buckman (1950) in discussing the possible use of calcium silicate as a lime source, state "One thing, however, must be guarded against --impurities that might be detrimental. If, for instance, the by-product silicate should contain fluorine, even in small amounts, the influence on superphosph-ate when the two come in contact with the soil would be very undesirable. This is because a reversion of the available phosphoric acid to the very insoluble and unavailable fluorapatite would occur. The effectiveness of the phosphate might thus be markedly reduced if not entirely negated." Fluoride varies but little throughout the waters of the study area; the mode is 0.1 ppm. The ocean water sample contained 1.3 ppm. McKee and Wolf (1963) concluded that 1.5 ppm would not interfere with aquatic life.

Manganese

Manganese was absent from all water samples except the August sample from south Currituck, which contained 0.01 ppm in solution. Hutchinson in literature review states "Later Pirson (1937) and Emerson and Lewis (1939) demonstrated that manganese deficiency greatly reduced the rate of photosynthesis in a dim light and less markedly in a bright light.' The addition of manganese to a manganese-starved culture may raise the photosynthetic rate with great rapidity" (Pirson, 1937; Noack & Pirson, 1939).

McKee and Wolf (1963) concluded that 1.0 ppm would not be deleterious to fish and aquatic life.

Zinc

Zinc deficiency is known to cause bronzing of the leaves of tung trees. The significance of zinc as a plant nutrient in agriculture and particularly in limnological studies is obscure. The small quantities (0.01-0.03 ppm) detected in the study area waters do not have any seasonal or area of distribution pattern.

McKee and Wolf(1963) stated "It is toward fish and aquatic organisms that zinc exhibits its greatest toxicity. In soft water, concentrations of zinc ranging from 0.1 to 1 ppm have been reported to be lethal, but calcium is antagonistic toward such toxicity. The presence of copper appears to have a synergistic effect on the toxicity of zinc."

No adverse effects from zinc would be anticipated in waters of the study area.

Chromium

Chromium or chromates-were not detected in the samples analyzed by the Geological Survey. Quarterly analysis by. field personnel has revealed the presence of some chromates. The Yearbook of Agriculture (1938) states "Chromium salts, in very small concentrations, have been found toxic to plant growth, and chromium in the form of chromates is particularly toxic. When applied to high lime soils (e.g. the spent liquors from chrome tanning of leather) or used in conjunction with much lime the toxic effect was largely nullified.' Chromite is very inactive except on very acid soils and should have no deleterious effect unless in these soils. The other form, which appears in the colloidal matter or clay, probably is isomorphous with the oxides of aluminum and iron, and becomes soluble in the same soil conditions that dissolve alumina and iron oxide." Hutchinson, in presenting data by Braidech and Emery (1935) for chromium content of North American waters, gives the range as 0.0 to 0.040 ppm, the mean as 0.005 ppm.

Hem (1959) states that "0.05 ppm Cr in the hexavalent form constitutes grounds for rejection of water for domestic use by the standards of the U. S. Public Health Service." Chromates were generally detected in our quarterly analyses; maximum concentrations were 0.30 ppm. Slightly higher concentrations occurred after the March 7, 1962, storm.

At these concentrations no direct toxicity to fish would be expected, but lower forms of aquatic life are extremely sensitive and some deleterious effect may have occurred to diatoms, etc.

Copper

The Geological Survey samples of 1959 indicated copper only in one sample in November from the northern part of Currituck Sound. Our quarterly analyses with the Bausch and Lomb Spectronic 20 indicated absence or fairly small quantities from July 1959 through February 1961. However, relatively high quantities, ranging from 0.12 to 1.06 ppm, of copper were reported at all 17 stations in April, July, and October 1962 and January 1963. This, of course, is after the ocean water intrusion of March 7, 1962, but sea water only averages 0.001 to 0.09 ppm copper and the apparently large increases cannot be attributed to the ocean water intrusion. Whether nickel, cobalt, or bismuth interfered with our determinations is not known, but it seems unlikely because of their small quantities in ocean water. One oddity of the October 1962 and January 1963 data is that the Back Bay samples showed a decrease, whereas the Currituck Sound samples generally showed a continued increase between those two periods. Another oddity was the general tendency for increasing quantities of copper in the progression from north to south (samples l-17 approximately aligned in that manner).

Attention is called to the somewhat corresponding increase in hexavalent chromium (chromates) during the same period in question.

McKee and Wolf (1963) concluded from their literature review that the following threshold concentrations of copper are indicated for specific beneficial uses: domestic supply, 1.0 ppm; irrigation, 0.1 ppm; fish and aquatic life, 0.02 ppm in fresh water and 0.05 ppm in sea water. The reader is referred to "Water Quality Criteria" by these authors for more detailed review.

The concentrations of copper indicated by our analyses between February 1961 and January 1963 are well above the criteria mentioned for all use except domestic supply and warrant further inquiry. Ellis, et al. (1948) state "Copper is a frequent pollutant in streams receiving run-off waters or wastes from mining and industrial areas. It is precipitated by carbon dioxide and carbonates and is removed rather rapidly from hard waters."

While faulty equipment, aging reagents, etc., might be suspect in causing erroneous readings, it would seem that the increasing pattern from stations 1 to 17 would not have occurred if those factors were the cause. Of course, each sample was checked against a blank.

If in fact the determinations are accurate, it indicates pollution probably entered the area either through the intracoastal canal, the south end of the area, or via the intrusion across the beach in March 1962.

Certainly no observable or known effect on the biota occurred that might be attributed to copper.

Boron

In the chemical analysis of water from the study area it is of particular interest that the November series of samples contained about twice the boron content of that in the August samples. Boron content in the water erratically tended to increase toward the southern part of the area. Eaton (1944) found that many plants made normal growth in sand cultures with a trace of boron (0.03 to 0.04 ppm) and that injury often occurred in cultures containing 1 ppm. In the study area the boron content of the water ranged from a low of 0.17 ppm in the North Landing River in August to a high of 0.69 ppm in the south end of Currituck Sound in December. Ocean water is enriched and the samples from this area contained 4.1 ppm.

The boron content of the waters from the study area are of interest because of the potential use of these waters for irrigation and the possible conflict that could arise by agricultural interests on the one hand, and wildlife interests on the other, as to the chemical nature of the water that is most desirable for raising their respective crops.

In view of the fact that sago pondweed, redheadgrass,,widgeongrass, and to some extent wild celery can tolerate moderate amounts to large amounts of salinity, depending on the species, it is likely that specific tolerance* to boron is relatively high compared to upland crops.

Possibly the upsurge of boron in the November water samples could be explained by the breakdown and decomposition of some marsh and aquatic vegetation at that time of the year with the release of boron. It is not here considered that boron occurs in excessive amounts for aquatic plants of the area, and whether a deficiency exists is not known, but it seems unlikely. But this is merely speculative.

Fish and lower forms of aquatic life can tolerate many times the quantities found in the study area waters.

Nickel

Hutchinson lists the normal range of nickel in water as 0 to 0.01 ppm. Only three water samples from the study area contained detectable nickel and they were the August samples from the North Landing River, south Gurrituck, and the ocean. Its influence on aquatic plants is considered as probably being negligible.

Bromide

The bromide content of the waters of the study area varied from a low of 0.1 in North Bay and the North Landing River to a high of 4.1 ppm at the south end of Currituck Sound. Hutchinson (1957) states that "in a number of Russian lakes and rivers (Selivanov 1939, 1944, 1946), who found a range of from 0.0005 to 0.14 ppm in river water...." (of bromine). The Yearbook of Agriculture (1938) states "Bromine appears to be generally present in quantities of the order of a few parts per million in plants and soils. Raw German potash salts contain considerable bromine. This element supplied to plants in the form of sodium bromide shows no immediate ill effects, but later in the life of the plant the effect is quite serious. The clay of ordinary soils does not retain bromine and it would be quickly leached from the soil."

Hem (1959) states that sea water contains 65 ppm bromide.

Iodide

The iodide content of the North Landing River sample on November 24, 1959, was 0.6 ppm and for all other stations there was an increase in iodide in the waters over level in the waters in August. Hutchinson lists the iodine content range of fresh water from 0.01 $mg\text{-}m^3$ (.00001 ppm) in some Finish lakes to supposedly over 1 $mg.m^{-3}$ (.001 ppm) in some samples from Lake Superior. Attention was called to the relatively high iodide content by the Geological Survey. The Yearbook of Agriculture (1957) states "Suggestions that iodine is a plant nutrient have never been confirmed. Iodine is toxic to plants in concentrations of 0.1 ppm in culture solutions. The fact that plant toxicity is produced from such low amounts suggests high reactivity of iodine in some plant biochemical systems."

Hem (1959) states that iodide occurs in sea water to the extent of less than 1 ppm.

Dissolved Solids

The Geological Survey water analyses in 1959 showed a range of 424 ppm to 2,930 ppm dissolved solids in waters of the study area. The ocean water sample contained 31,900 ppm.

The blood of fresh-water fishes has an osmotic pressure approximately equal to 6 atmospheres, or about 7,000 ppm as sodium chloride (McKee and Wolf 1963). Osmotic pressureain excess of six atmospheres may be expected to be deleterious to fresh-water fish. (See Section on bioassays in Volume 4 of this data report;)

Oysters formerly occurred in Back Bay and Currituck Sound. The optimum salinity for Ostrea virginica is 25 to 29 percent sea strength, (8,750 to 10,150 ppm). Lunz (1938) found that oysters could tolerate a salinity as low as 5,000 ppm for only 20 days. McConnell (1932) found that oysters can tolerate salinities between 20 and 50 percent of sea water (7,000 to 17,500 ppm).

Summary of Laboratory Analyses of Water Chemistry - 1959

In general, only chromates, copper, and iodide occurred in concentrations in either the Geological Survey analyses or our quarterly analysis to warrant possible concern from industrial pollution.

Sulfates , potassium, bicarbonates, calcium, and manganese may be somewhat limiting to optimum growth of the best hard water aquatic plants during fresh water periods in Back Bay and northern Currituck Sound.

Table . Analytical Results of Water Samples from Back Bay, Virginia, and Currituck Sound, North Carolina. (Values in parts per million).

	1. North Bay	2. Sand Bay	3. Back Bay	4. N. Landing R.		5. N. Currituck		6. Mid-Currituck		7. S. Currituck		8. Sea water
Date (1959)	8/19	11/23	8/19	8/19	11/24	8/19	11/24	8/19	11/24	8/19	12/12	8/19
Calcium	16	17	8/19	8/19	8/19	16	10	20	16	38	40	38
Magnesium	26	23	33	29	27	1	4	34	32	64	110	99
Sodium	192	209	255	220	205	99	265	237	485	850	800'	1,160
Potassium	6.8	12.0	9.2	8.0	8.0	7.5	10.0	12.0	10.0	23.0'	35.0	9,460
Nitrate	0.3	0.6	0.4	0.3	0.6	0.2	0.3	0.2	0.2	0.2	1.0	279.0
Phosphate	0.0	0.1	0.0	0.0	0.0	0.4	0.0	0.1	0.0	0.0	0.1	0.0
Chloride	340	360	460	396	374	178	484	424	910	1,520	1,400	16,900
Bicarbonate	34	33	31	29	26	19	26	28	36	31	29	'129
Sulfate	54	67	75	69	64	33	77	63	142	219	187	2,350
Silica	1.2	0.6	1.1	0.9	2.1	7.1	1.2	0.8	1.6	5.3	4.9	1.0
Aluminum	0.2	0.1	0.1	0.1	0.3	0.9	0.2	0.2	0.2	0.3	0.2	-2.2
Iron*	0.03	0.01	0.03	0.03	0.06	0.43	0.01	0.03	0.09	0.05	0.00	0.00
Lithium	0.8	--	1.0	0.9	0.9	--	1.0	--	1.6	2.2	--	--
Fluoride	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	1.3
Manganese*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Zinc	0.02	0.00	0.01	0.00	0.01	0.02	0.01	0.02	0.01	0.03	0.01	--
Chromium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--
Copper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	--
Boron	0.18	0.35	0.20	0.18	0.17	0.29	0.20	0.33	0.42	0.30	0.69	4.1
Nickel	0.00	--	0.00	0.00	0.01	--	0.00	--	0.00	0.01	--	0.01
Bromide	0.1	0.9	0.7	0.5	0.4	0.1	1.1	1.7	0.2	4.1	2.2	60
Iodide	0.1	0.3	0.1	0.2	0.2	0.6	0.1	0.5	0.2	0.2	0.4	0.3
Specific conductance	1,240	1,450	1,620	1,410	1,320	731	1,720	1,650	3,060	4,850	4,950	38,780
pH	7.4	6.7	6.9	6.7	6.8	6.6	6.7	6.7	6.9	6.9	6.8	7.8
Total Hardness**	146	138	185	162	154	89	192	171	360	554	504	5,800
Color	15	30	15	15	45	200	20	30	10	15	15	1
Dissolved solids	691	778	917	814	790	424	994	877	1,800	2,930	2,780	31,900
Sun	654	707	871	757	712	360	907	802	1,670	2,790	2,580	30,700
Temperature	84	--	84	85	85	--	85	--	--	--	—	—
Appearance	Clear	Turbid	Clear	Clear	Clear	Turbid	Clear	Turbid	Clear	Clear	Turbid	Clear

* In solution when analyzed

** Includes hardness of all polyvalent cations reported.

Analyses made by the Quality of Water Branch of the U.S. Geological Survey, at Raleigh, North Carolina, in cooperation with the North Carolina Wildlife Resources Commission for the Back Bay-Currituck Sound Cooperative Study.

Quarterly Water Analysis from 17 Stations in Back Bay and Currituck Sound

To explore the possible effect of changes in aluminum, iron, copper, pH, turbidity, ammonical nitrogen, nitrite, nitrate, alkalinity, chromate, total phosphate, ortho phosphate, meta phosphate, salinity, and sulfate on the aquatic biota chemical determination was made from 17 stations in the area. Stations were selected on a representative basis of the various environmental conditions, and were the stations employed for detailed observation of the aquatic plants. A Bausch Lomb Spectronic 20 spectrophotometer was used following the methods of the Hach Co. Samples taken for determination of phosphates and nitrogen were fixed with choroform and sulphuric acid, respectively. No means were available for determination of potassium.

The major chemical change was the increase in salinity that occurred on March 7, 1962, which was first indicated in April 1962 data. As would be.expected the sulfate concentrations increased with the increased salinity levels; undoubtedly the potassium concentrations and other constituents of ocean water increased in general proportion. The sulfate determinations are less accurate in the higher salinites because the need for further dilufion'increases the Tyndall effect.

The significance of all these determinations is not known and we can only attempt to look for extremes in any set of data and conjecture as to its meaning. Minor differences can be ignored for the methods were not considered that sensitive and we could not interpret their significance.

The extremes worthy of note are the high readings of aluminum in February 1961 (stations 1-8), peak readings of iron at several stations in April 1960, increases in copper at most stations accompanying increased salinity in April 1962, low pH readings at most stations in January 1963, extreme readings of ammonia nitrogen in February 1961 (stations 9, 10, 14, 15, 17 [sound frozen]), an apparent increase in nitrites February 1961 or April 1962 and thereafter at several stations, and increases in chromates particularly after April 1962.

The extreme concentrations 8 to 21.8 ppm ammonical nitrogen in February 1961, are believed to have resulted from large concentrations of waterfowl using a few isolated openings when most of the sound was frozen for an extended period.

The increasing concentrations of copper and chromates are'dicussed in the foregoing section on the Geological Survey analyses.

In general, there is no evidence of domestic, agricultural or industrial pollution by these chemical constituents that would adversely affect the aquatic biota.

Separate consideration of turbidity and salinity is presented elsewhere in this report.

Table . Quarterly Water Analysis of Water Samples from Back Bay, Virginia, and Currituck Sound, North Carolina, Test Plots. (Data Expressed in Parts Per Million Except for pH). July 1959 - January 1963. Back Bay-Currituck Sound Cooperative Investigations.

Analysis for:,	Date	Plot																
		Back Bay								Currituck Sound								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Aluminum	July;1959	0.04	0.07	0.00	0.00	0.03	0.02	0.01	0.10	*	*	*	*	*	*	*	*	*
	Dec. 1959	0.00	0.07	0.01	0.01	0.02	0.02	0.02	0.03	*	*	*	*	*	*	*	*	*
	April 1960	0.04	0.04	0.02	0.04	0.02	0.02	0.01	0.04	0.21	0.08	*	0.04	0.10	0.13	0.13	*	0.09
	June 1960	0.02	0.05	0.00	0.12	0.01	0.02	0.01	0.05	0.00	0.02	0.00	0.02	0.01	0.02	0.01	0.13	0.03
	Oct. 1960	0.03	0.02	0.04	0.05	0.03	0.05	0.07	0.04	0.00	0.01	0.00	0.00	0.00	0.03	0.00	0.00	0.00
	Feb. 1961	0.33	0.02	0.35	0.21	0.33	0.26	0.26	0.71	0.02	0.12	0.09	0.07	0.05	0.03	0.03	0.02	0.02
	April 1962	0.01	0.00	0.00	0.00	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.15	0.10	0.11	0.02	0.02
	July 1962	0.04	0.06	0.01	0.02	0.02	0.05	0.11	0.05	0.01	0.01	0.04	0.17	0.08	0.07	0.05	0.06	0.05
	Oct. 1962	0.01	0.03	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01
	Jan. 1963	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Iron	July 1959	0.28	0.07	0.02	0.06	0.10	0.07	0.06	0.04	*	*	*	*	*	*	*	*	*
	Dec. 1959	0.15	0.09	0.12	0.15	0.08	0.15	0.06	0.15	*	*	*	*	*	*	*	*	*
	April 1960	0.39	0.44	0.39	0.50	0.30	0.44	0.34	0.44	0.86	0.64	*	0.58	0.44	0.50	0.26	*	0.34
	June 1960	0.11	0.24	0.11	0.18	0.16	0.24	0.26	0.39	0.18	0.36	0.14	0.16	0.14	0.11	0.16	0.14	0.14
	Oct. 1960	0.11	0.11	0.18	0.20	0.16	0.11	0.24	0.36	0.00	0.01	0.00	0.00	0.09	0.00	0.00	0.24	0.24
	Feb. 1961	0.41	0.18	0.26	0.26	0.26	0.30	0.50	0.50	0.09	0.34	0.30	0.29	0.24	0.14	0.55	0.20	0.11
	April 1962	0.11	0.00	0.55	0.00	0.00	0.11	0.00	0.16	0.04	0.11	0.09	0.24	0.52	0.30	0.29	0.29	0.14
	July 1962	0.04	0.04	0.01	0.04	0.07	0.07	0.04	0.07	0.14	0.09	0.29	0.36	0.34	0.34	0.26	0.36	0.20
	Oct. 1962	0.14	0.18	0.14	0.14	0.14	0.14	0.14	0.20	0.11	0.14	0.09	0.11	0.16	0.18	0.20	0.14	0.20
	Jan. 1963	0.07	0.07	0.04	0.04	0.09	0.04	0.09	0.07	0.09	0.16	0.16	0.11	0.16	0.09	0.09	0.09	0.14
Copper	July 1959	0.08	0.03	0.00	0.00	0.00	0.00	0.00	0.00	*	*	*	*	*	*	*	*	*
	Dec. 1959	0.00	0.08	0.07	0.00	0.00	0.00	0.00	0.00	*	*	*	*	*	*	*	*	*
	April 1960	0.17	0.15	0.15	0.12	0.12	0.15	0.15	0.15	0.03	0.03	*	0.06	0.03	0.06	0.06	*	0.08
	June 1960	0.22	0.17	0.08	0.22	0.15	0.03	0.08	0.35	0.08	0.06	0.06	0.06	0.03	0.12	0.06	0.06	0.06
	Oct. 1960	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Feb. 1961	0.15	0.00	0.12	0.15	0.17	0.15	0.12	0.17	0.20	0.17	0.17	0.17	0.20	0.17	0.22	0.20	0.22
	April 1962	0.15	0.15	0.15	0.22	0.31	0.28	0.50	0.37	0.40	0.46	0.72	0.68	0.83	0.90	0.86	0.86	0.80
	July 1962	0.12	0.75	0.62	0.75	0.68	0.86	0.72	0.68	0.72	0.64	0.68	0.62	0.53	0.90	0.95	0.90	0.68
	Oct. 1962	0.86	0.95	0.95	0.90	0.86	0.83	0.95	0.83	0.58	0.64	0.58	0.72	0.75	0.99	0.72	0.95	0.64
	Jan. 1963	0.34	0.64	0.72	0.75	0.50	0.40	0.25	0.72	0.68	0.80	0.99	0.86	0.99	0.95	0.95	1.06	0.99

* No data available.

Table . (Cont'd) Quarterly Water Analysis of Water Samples from Back Bay, Virginia, and Currituck Sound, North Carolina, Test Plots. (Data Expressed in Parts Per Million Except for pH). July 1959 - January 1963. Back Bay-Currituck Sound Cooperative Investigations.

Analysis for:	Date	Plot: Back Bay 1	2	3	4	5	6	7	8	Currituck Sound 9	10	11	12	13	14	15	16	17
Chromate	July 1959	0.04	0.02	0.03	0.02	0.02	0.03	0.02	0.02	*	*	*	*	*	*	*	*	*
	Dec. 1959	0.06	0.06	0.06	0.06	0.05	0.05	0.04	0.03	*	*	*	*	*	*	*	*	*
	April 1960	0.14	0.11	0.17	0.18	0.11	0.13	0.18	0.14	0.18	0.14	*	0.18	0.15	0.15	0.21	*	0.14
	June 1960	0.14	0.15	0.14	0.11	0.15	0.15	0.17	0.15	0.15	0.15	0.15	0.13	0.15	0.08	0.10	0.06	0.14
	Oct. 1960	0.18	0.10	0.00	0.04	0.02	0.00	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Feb. 1961	0.00	0.01	0.18	0.14	0.13	0.19	0.21	0.19	0.24	0.17	0.14	0.23	0.18	0.21	0.13	0.18	0.14
	April 1962	0.19	0.19	0.26	0.19	0.19	0.29	0.27	0.19	0.24	0.19	0.24	0.21	0.29	0.17	0.24	0.21	0.18
	July 1962	0.19	0.29	0.21	0.27	0.30	0.18	0.23	0.27	0.23	0.19	0.23	0.29	0.19	0.24	0.13	0.21	0.21
	Oct. 1962	0.23	0.17	0.24	0.24	0.24	0.14	0.26	0.19	0.30	0.26	0.26	0.19	0.27	0.18	0.15	0.21	0.15
	Jan. 1963	0.23	0.24	0.26	0.27	0.19	0.26	0.17	0.23	0.30	0.29	0.30	0.26	0.24	0.26	0.26	0.23	0.19
Total Phosphate	July 1959	0.40	0.20	0.16	0.11	0.23	0.22	0.10	0.06	*	*	*	*	*	*	*	*	*
	Dec. 1959	0.28	0.28	0.32	0.30	0.34	0.30	0.45	0.40	*	*	*	*	*	*	*	*	*
	April 1960	*	*	*	*	*	*	*	*	0.84	1.02	*	0.92	1.10	0.59	0.91	*	1.10
	June 1960	0.16	0.06	0.06	0.06	4.80	0.16	0.06	0.06	0.01	0.05	*	0.06	0.05	0.09	0.02	0.05	0.00
	Oct. 1960	0.00	0.00	0.00	0.00	1.16	0.00	0.01	0.00	0.02	0.08	0.06	0.03	0.05	0.10	0.11	0.10	0.06
	Feb. 1961	0.20	0.09	0.15	0.13	0.06	0.09	0.09	0.07	0.16	0.26	0.21	0.25	0.09	0.11	0.26	0.07	0.15
	April 1962	1.16	0.18	0.11	0.84	0.25	0.06	0.00	0.02	0.10	0.16	0.10	0.11	0.18	0.16	0.18	0.15	0.16
	July 1962	0.37	0.74	0.64	0.49	0.42	0.71	0.61	1.06	-0.28	0.16	0.13	0.25	0.21	0.16	0.07	0.28	0.06
	Oct. 1962	1.36	1.50	2.00	1.70	0.90	1.16	0.56	0.5.9	0.34	0.37	0.30	0.42	0.34	0.40	0.45	0.46	0.32
	Jan. 1963	0.69	0.23	0.79	2.00	1.50	4.80	0.56	2.90	0.28	0.37	0.40	0.37	0.32	0.42	0.40	0.36	0.37
Ortho Phosphate	July 1959	0.10	0.03	0.01	0.01	0.03	0.06	0.03	0.02	*	*	*	*	*	*	*	*	*
	Dec. 1959	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02	*	*	*	*	*	*	*	*	*
	April 1960	*	*	*	*	*	*	*	*	0.06	0.03	*	0.04	0.05	0.05	0.04	*	0.01
	June 1960	*	*	*	*	*	*	*	*	0.02	0.06	*	0.03	0.01	0.02	0.01	0.01	0.00
	Oct. 1960	0.00	0.00	0.00	0.00	0.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.01	0.02
	Feb. 1961	0.07	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.15	0.26	0.16	0.07	0.07	0.11	0.23	0.01	0.06
	April 1962	0.02	0.05	0.03	0.02	0.02	0.02	0.00	0.02	0.03	0.03	0.02	0.02	0.00	0.05	0.01	0.03	0.02
	July 1962	0.03	0.02	0.01	0.03	0.05	0.03	0.06	0.06	0.07	0.02	0.01	0.01	0.05	0.00	0.00	0.00	0.00
	Oct. 1962	0.51	0.34	1.90	*	*	0.10	0.11	0.26	0.11	0.15	0.10	0.16	0.10	0.16	0.10	0.09	0.13
	Jan. 1963	0.18	0.16	0.15	0.16	0.18	0.20	0.18	0.18	0.23	0.26	0.34	0.18	0.17	0.25	0.18	0.18	0.28

* No data available.

Mg determined in different kinds of aquatic plants[1]

Percent of sea strength	Sago Pond-Weed (Lab. Nos. 1-9)	Najas (Lab. Nos. 20-25)	Celery tubers (Lab. Nos. 10-19)	Widgeon grass (Lab. Nos. 26-34)	Redhead grass (Lab. Nos. 35-43)
	%	%	%	%	%
0	[illegible]	0.70	0.91	0.62	0.71
0	0.61	0.61	0.77	0.83	0.50
5	0.59	0.66	0.67	0.56	0.81
10	0.81	0.82	0.76	no sample	1.30
15	0.57	1.10	0.62	0.67	1.10
20	1.u)	0.70	0.45	0.81	no sample
25	1.10		0.64	0.74	0.67
30	1.70		0.42	0.65	0.66
35	1.90		1.10	0.73	0.49
40	0.90		0.46	0.58	0.44

1/ Analyses made by Spectrochemical Laboratory, U. S. Soils Laboratory, Soil and Water Conservation Research Division, Northeast Branch, Agricultural Research Service, United States Department of Agriculture, Beltsville, Maryland. Cooperative work with Fish and Wildlife Service, United States Department of Interior, Patuxent Research Refuge, Laurel, Maryland.

Na determined in different kinds of aquatic plant&

Percent of sea strength	Sago Pond-Weed (Lab. Nos. 1-9)	Najas (Lab. Nos. 20-25)	Celery tubers (Lab. Nos. 10-19)	Widgeon grass (Lab. Nos. 26-34)	Redhead grass (Lab. Nos. 35-43)
	ppm	ppm	ppm	ppm	ppm
0		3400	1400	5900	7800
0	2600	3700	1000	6100	5900
5	4200	4900	1300	6300	8000
10	11000	4500	1500	no sample	9500
15	5700	6300	1200	9400	11000
20	8000	3900	1200	10000	no sample
25	5300		1600	9100	10000
30	8500		1600	4300	11000
35	12000		3200	5100	7600
40	9300q		1700	3300	10000

1/ Analyses mule by Spectrochemical Laboratory, U. 8. Boils Laboratory, Soil and Water Conservation Research Division, Northeast Branch, Agricultural Research Service, United States Department of Agriculture, Beltsville, Maryland. Cooperative work with Fish and Wildlife Service, United States Department of Interior, Patuxent Research Refuge, Laurel, Maryland.

B determined in different kinds of aquatic plants[1]

Percent of sea strength	Sago Pond-Weed (Lab. Nos. 1-9)	Najas (Lab. Nos. 20-25)	Celery tubers (Lab. Nos. 10-19)	Widgeon grass (Lab. Nos. 26-34)	Redhead grass (Lab. Nos. 35-43)
	ppm	ppm	ppm	ppm	ppm
0		2/	2/	235	45
0	2500	2/	2/	355	42
5	1800	2/	2/	410	44
lo	860	2/	2/	no sample	50
15	880	2/	2/	350	42
20	1900	2/	2/	510	no sample
25	990		2/	330	50
30	1600		2/	330	41
35	1200		2/	410	55
40	850		2/	210	36

1/ Analyses made by Spectrochemical Laboratory, U. S. Soils Laboratory, Soil and Water Conservation Research Division, Northeast Branch, Agricultural Research Service, United States Department of Agriculture, Beltsville, Maryland. Cooperative work with Msh and Wildlife Service, United states Department of Interior, Patuxent Research Refuge, Laurel, Maryland.

2/ Not detected.

Al determined in different kinds of aquatic plants[1]

Percent of sea strength	Sago Pond-Weed (Lab. Nos. 1-9)	Najas (Lab. Nos. 20-25)	Celery tubers (Lab. Nos. 10-19)	Widgeon grass (Lab. Nos. 26-34)	Redhead grass (Lab. Nos. 35-43)
	ppm	ppm	ppm	ppm	ppm
0		1400	1200	385	480
0	1300	380	1900	220	190
5	1600	290	540	90	180
10	2700	1300	460	no sample	490
15	7000	1300	380	220	270
20	2600	1000	250	160	no sample
25	8000		460	130	380
30	4600		220	70	180
35	5000		840	120	240
40	1600		270	90	250

1/ Analyses made by Spectrochemical Laboratory, U. S. Soils Laboratory, Soil and Water Conservation Research Division, Northeast Branch, Agricultural Research Service, United States Department of Agriculture, Beltsville, Maryland. Cooperative work with Fish and Wildlife Service, United States Department of Interior, Patuxent Research Refuge, Laurel, Maryland.

Fe determined in different kinds of aquatic plants[1]

Percent of sea strength	Sago Pond-Weed (Lab. Nos. 1-9)	Najas (Lab. Nos. 20-25)	Celery tubers (Lab. Nos. 10-19)	Widgeon grass (Lab. Nos. 26-34)	Redhead grass (Lab. Nos. 35-43)
	ppm	ppm	ppm	ppm	ppm
ϕ		3500	2200	865	600
0	900	1100	1900	420	510
5	1300	980	1900	240	450
10	2900	3300	1400	no sample	680
15	4800	1300	1500	350	480
20	2400	1100	990	390	no sample
25	3200		1300	610	640
30	2600		970	220	520
35	3100		1900	230	440
40	1700		1200	380	1100

1/ Analyses made by Spectrochemical Laboratory, U. S. Soils Laboratory, Soil and Water Conservation Research Division, Northeast Branch, Agricultural Research Service, United States Department of Agriculture, Beltsville, Maryland. Cooperative work with Fish and Wildlife Service, United States Department of Interior, Patuxent Research Refuge, Laurel, Maryland.

Cu determined in different kinds of aquatic plants[1]

Percent of sea strength	Sago Pond-Weed (Lab. Nos. 1-9)	Najas (Lab. Nos. 20-25)	Celery tubers (Lab. Nos. 10-19)	Widgeon grass (Lab. Nos. 26-34)	Redhead grass (Lab. Nos. 35-43)
	ppm	ppm	ppm	ppm	ppm
0		13	65	23	9.2
0	18	6.3	33	18	6.8
5	8.9	11.0	25	8.7	8.9
10	8.2	16	21	no sample	11
15	28	13	11	9.2	30
20	6.7	6.0	6.7	8.4	no sample
25	23		6.5	6.5	18
30	14		25	6.8	18
35	10		15	7.1	9.3
40	9.9		17	6.6	8.5

1/ Analyses made by Spectrochemical Laboratory, U. S. Soils Laboratory, Soil and Water Conservation Research Division, Northeast Branch, Agricultural Research Service, United States Department of Agriculture, Beltsville, Maryland. Cooperative work with Fish and Wildlife Service, United States Department of Interior, Patuxent Research Refuge, Laurel, Maryland.

Mn determined in different kinds of aquatic plants[1/]

Percent of sea strength	Sago Pond-Weed (Lab. Nos. 1-9)	Najas (Lab. Nos. 20-25)	Celery tubers (Lab. Nos. 10-19)	Widgeon grass (Lab. Nos. 26-34)	Redhead grass (Lab. Nos. 35-43)
	ppm	ppm	ppm	ppm	ppm
0		700	410	485	170
0	500	330	440	210	140
5	450	410	390	160	140
10	440	2200	410	no sample	325
15	460	1500	330	180	190
20	730	460	250	390	no sample
25	820		230	410	340
30	840		240	130	130
35	lloo		570	190	180
40	440		350	170	450

1/ Analyses made by Spectrochemical Laboratory, U. S. Soils Laboratory, Soil and Water Conservation Research Division, Northeast Branch, Agricultural Research Service, United States Department of Agriculture, Beltsville, Maryland. Cooperative work with Fish and Wildlife Service, United States Department of Interior, Patuxent Research Refuge, Laurel, Maryland.

SOIL CHEMISTRY, TYPES, AND DISTRIBUTION

Quarterly Chemical Analyses of Soils

The bottom soils within an aquatid habitat provide the primary source of nutrients from which the aquatic plants within an area must receive the necessary nutrients for growth, seed production, tuber production, and general condition. A shortage of any basic nutrient, or excess of certain available elements, could prevent or retard plant growth and the formation of plant reproduction structures, thereby limiting the wildlife utilization of the area. Various soils throughout the Back Bay-Currituck Sound study area were analyzed to determine the seasonal variation of the available soil nutrients in the area. The study was repeated following the March 7, 1962, sea-water intrusion to determine possible changes in the available soil nutrients resulting from the sea introduction.

Procedures

Soil samples were collected at quarterly intervals from the 17 vegetation plot study sites located throughout the Back Bay-Curs-ituck Sound Area. One pint of bottom soil was obtained at each sample site, placed into ice cream cartons and delivered to the laboratory at Coinjock, North Carolina, for analysis. The soil samples were analyzed for pH (wet), pH (air dried), phosphorus, potassium, calcium, magnesium, nitrate, sulfate, chloride, ammonia, and ferric iron. Ferric iron was determined with a LaMotte Soil Test Kit and the other nutrient determinations were made with a Hellige-Truog Combination Soil Testing Kit.

The (wet) pH determinations were made immediately upon arrival at the laboratory. The soil samples were then air dried in the laboratory in preparation for testing. Series of samples which were not analyzed immediately following drying were prepared for permanent storage and analysis was conducted at a later date. All analyses were conducted in accordance with instructions contained with the soil test kits.

Results

Five series of soil samples were collected and analyzed from the eight stations in Back Bay during the period May 1959 to February 1961. Three series of soil samples were collected and analyzed from nine station. in Currituck Sound during the period March 1960 to February 1961. Following the March 7, 1962, storm, four series of samples were collected and analyzed from the established stations in Back Bay and Currituck Sound.

pH

The pH (air dried) of the soils tested during the pre-storm period ranged from 4.0 to 7.0 in Back Bay, and from 4.5 to. 6.0 for the Currituck Sound soils. The only seasonal variation noted during this period was in the May 1959, Back Bay series of samples. The pH ranged from 4.0 to 4.5 for all soils in this series of samples as compared to the range of 5.0 to 7.0 for the other Back Bay series.

As Neely (1962) explains, sulfates are reduced to sulfides which combine with iron in-the clays forming iron pokysulfides which upon drying oxidize and produce sulphuric acid; hence lowering the pH. If soils remain wet, no such reaction occurs.

The pH (air dried) values of the soils tested following the sea-water introductions of March 7, 1962, ranged from 4.0 to 6.5 for the Back Bay soil samples and 4.5 to 7.0 for the Currituck Sound soils. Although the range of the pH value does not indicate a great change in the soil reaction following the sea-water intrusion, there was a general decrease in the overall pH values in both Back Bay and Currituck Sound following the intrusion of sea water.

The soil pH (wet) values obtained during the entire study were' similar to the pH of the water at the sample site, and are probably of greater significance in regard to availability of nutrients.

Iron

Iron is needed only in limited amounts but is essential as it is directly connected with the functioning of chlorophyll in plants. Most soils contain sufficient amounts of iron to satisfy the-needs of plants, but a deficiency of iron sometimes occurs in alkaline soils. This should not be a problem within most of the study area as the bottom soils in Back Bay-Currituck Sound are generally acidic. The wet silt deposits are frequently alkaline in a reaction which could limit availability of iron, but availability of aluminum is increased at high and low pH, being least in the intermediate pH scale. At high pH's insoluble aluminum phosphates could be formed, and at low pH's insoluble phosphates of iron and aluminum could limit phosphorus for plants.

The results were too erratic to establish definite trends in seasonal variations. Also, no appreciable change was noted in the iron content following the sea-water intrusions. The results indicate that there is sufficient iron in the soils in the area to satisfy plant needs, and generally no major indications of toxic concentrations.

Phosphorus

Phosphorus is necessary for cell development and the amount of available phosphorus present in soils influences plant growth, root development, condition; and seed production. Plants require large amounts of phosphorus for satisfactory growth and even higher levels are required for maximum growth and yield. Some indications of insufficient phosphorus for wild-celery and najas in localized areas and in tank studies were discussed;

Twenty-three.percenf of the Back Bay soil samples, and 40 percent of the Currituck samples tested prior to the sea-water intrusion did not contain sufficient phosphorus for satisfactory growth. Following the sea-water intrusion, 78 percent of the Back Bay samples and 64 percent of the Currituck samples contained insufficient phosphorus for optimum plant growth, The decrease in available phosphorus was probably due to the increased plant growth which occurred following the sea-water introduction.., All of the total phosphorus in the soil is not in available forms., A major portionof the phosphorus is tied up in various phosphates which, especially in acid soils, becomes available

to the plants at a rather slow rate. The increased demand for phosphorus resulting from the increased plant growth following the sea-water intrusion possibly surpassed the conversion rate of the phosphates. A similar decrease was noted between the various seasons of the year. The higher phosphorus levels occurred during periods of low plant growth. The . . majority of the soils in the area do not apparently contain sufficient amounts of phosphorus to support maximum plant growth during the spring and summer months.

Potassium

Potassium is essential for starch formation in plants and the development of chlorophyll. It encourages the development of healthy root systems and exerts a balancing effect on both nitrogen and phosphorus. Potassium does not become part of the plant, but rather acts as a catalyst, encouraging beneficial reactions within the plant processes.. Plants require large amounts of potassium for proper growth. Most soils contain large amounts of potassium, but most of it is in an insoluble form which becomes available to plants at a very slow rate.

Approximately 47 percent of the pre-storm soil samples in Back Bay contained insufficient potassium for average plant growth and 80 percent of the Currituck pre-storm soil samples were deficient in potassium. Greater quantities of available potassium were noted during the June series of samples for the pre-storm Back Bay area. The potassium content was greater in February in Currituck pre-storm soil samples.

Following the sea-water introductions of March 7, 1962, potassium was deficient in 61 percent of the Back Bay samples and 75 percent of the Currituck Sound soil samples. Seasonal increases were noted in both Back Bay and Currituck Sound soils during January and October. Most of: the soils tested did not contain satisfactory amounts of potassium for good plant growth.

Calcium

Calcium becomes a structural part of the cell walls of plants. It also acts a a neutralizer for excess acids which may be formed during plant processes. Calcium stimulates micro-organism activity, thereby indirectly increasing the availability of other soil nutrients.

All study area soil samples tested during pre-storm conditions contained from low to very low quantities of available calcium with no definite seasonal variations, This level of available calcium is not considered sufficient for good plant growth.

Under post-storm conditions, one sample each in Back Bay and Currituck Sound, of the total 67 tested, contained sufficient calcium for good plant growth. Eight samples contained no available calcium. Variations were too erratic to establish seasonal trends. Calcium content of the soils within the study is very low and the March 7, 1962, introduction of sea water did not appreciably increase the calcium levels.

Magnesium

Magnesium in soils usually occurs along with calcium and calcium salts. The ratio between calcium and magnesium is very important as a high -calcium content in conjunction with low magnesium levels will restrict the availability of the magnesium. A ratio of two to three parts of calcium to one part magnesium is considered acceptable in most soils. The calcium-magnesium ratio:; usually becomes a problem in alkaline soils. This should not be a problem within the study area as the soils in Back Bay-Currituck Sound have a low calcium content and are slightly acid to slightly alkaline when wet.

Magnesium is an important soil nutrient as it stimulates the assimilation of phosphorus in plants and is essential in the formation of chlorophyll. A deficiency of magnesium may cause chlorosis in plants, (a white, leached-out appearance).

Approximately. 35 percent of the Back Bay samples and 40 percent of the Currituck Sound samples tested during the pre-storm-sampling did not contain sufficient amounts of available magnesium for -maximum plant growth. An overall increase in magnesium content was noted following the sea-water intrusion, with only 13 percent of the Back Bay samples and 8 percent of the Currituck Sound samples indicating insufficient quantities. Seasonal trends were not appreciable in the pre-storm samples, but a slight seasonal increase was noted during the July sampling following the sea-water intrusion.

Nitrate and Ammonia

Nitrogen is essential in the development of all plants. In order that plants may build proteins, it is necessary that they have a source of ready available nitrogen. Nitrogen exists in available forms in soils as nitrates and ammonia. Nitrates are very soluble and in an aquatic habitat they are lost as a result of leaching. Ammonia is less soluble and may be retained in the soils of an aquatic habitat without great losses due to leaching. Continued cropping and leaching, which occurs under aquatic conditions, rapidly deplete the nitrates in the bottom soils. The nitrate levels in the soils in':the study area were zero under pre-strom conditions and zero to very low following the sea-water intrusion. The slight increase in nitrate levels following the storm remained stable throughout the year.

Ammonia content in the study area soils, prior to the storm, ranged from low to very high with only 9 percent of the samples testing low. Seasonal variations in the ammonia content were noted with the highest levels occurring during February and the low levels in June., A decrease in ammonia occurred following the sea-water intrusion. Ammonia levels ranged from very low to high with 44 percent of the samples testing low. This decrease was probably due to the increased demand for nitrogen resulting from the increase in 'aquatic vegetation growth which occurred following the eea-water intrusion. The seasonal low occurred during July and the highest level was noted during Octover during the post-storm conditions. Although the nitrate levels were very low, the ammonia content was sufficient, in most cases, to provide the necessary nitrogen for good plant growth in the area.

Sulfate

Sulphur is an important plant nutrient which is essential in the development of various organic compounds within the plant. It is not required in great quantities as usually the amount of sulfate contained in the noraml rainfall over most of the United States is sufficient to supply the quantities needed for proper plant growth. Sulphur, in the form of sulfate salts, may reach levels high enough to become harmful to some plants, and even at lower levels, they may contribute to a harmful condition when they occur in conjunction with a high chloride content.

The sulfate content of the pre-storm soils in both Back Bay and Currituck Sound ranged, except for a few individual samples, from very low to low. A slight overall increase occurred following the sea-water intrusion. Variations were too erratic to develop seasonal trends. The soil., analyses revealed sufficient quantities of sulphur in the study area soils to satisfy plant needs, but possibly minimal amounts are causing nutrient imbalance in some areas.

Chloride

Chloride is not considered an essential plant nutrient although it has a stabilizing effect on some of the plant processes. There is evidence that chloride also acts as a stimulant to the growth of various aquatic plants, similar to its function as a stimulant for various body functions in animals, The primary consideration applied to the chloride content of soils is its harmful effect on plants when present in high concentrations.

The chloride content of the study area soils prior to the sea-water intrusion ranged from very low to high with only a few individual samples containing high levels of chloride. Following the sea-water intrusion the chloride content of the study area soils ranged from medium to very high. This increase occurred throughout the study area. No seasonal -trend was established although the chloride levels were slightly higher in some areas during the January and April test. The chloride content of the study area soils reached levels following the sea-water intrusion which would be a limiting factor for some of the fresh-water forms of aquatic plants; however, the increase, in turn, provides more favorable levels for some of the more desirable brackish-water species of aquatic. vegetation.

Conclusions

1. Soil nutrient deficiencies of phosphorus, potassium, calcium, and -magnesium could possibly be below optimum for best plant growth in some soils within the study area.

2. The decrease in the amounts of ammonia, potassium, and phosphorus following the March 7, 1962, storm was probably due to the increased demand for soil nutrients resulting from the stimulated plant growth which followed:; the sea-water intrusion.

3. The chloride content of the study area soils reached levels following the sea-water intrusion which would limit the growth of some of the fresh-water species of aquatic plants; however, the increase, in turn, provided more favorable conditions for some of the more desirable brackish-water species.

Laboratory Soil Classification and Analyses

Soil classification was based on particle size analyses conducted by the U.S. Soil Conservation Service, Beltsville, Md., on 12 representative samples taken at the same stations as the plants collected for spectrochemical analyses. As mentioned, the use of prefixes in describing soils from the bays lead to so many classifications that analyses of the data seemed impossible. Dominant soil types, and the method of classifying them in the laboratory and field were:

1. Loam - Loam soils contain 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. Field identification of loam soil in aquatic habitat--Moderatecohesion of soil particles, sand can be detected when soil is worked between fingers.

2. Silt - Particle sizes range in diameter between the upper size of clay, 0.002 mm., and the lower size of very fine sand, 0.05 mm. A silt soil contains 80 percent or more of silt (as described) and less than 12 percent of clay. Field identification--A fine, light soil without the cohesive characteristics of clay and without detectable sand.

3. Sand - Particle size 0.5 mm to 2.0 mm. A sand soil contains 85 percent or more of sand particles and not more than 10 percent of clay. Field identification--Coarse particle size apparent by touch and vision; virtually no cohesion of particles; relatively heavy soil.

4. Clay Particle size less than 0.002 mm. in diameter. As a soil textural class, clay contains 40 percent or more of clay, less than 45 percent of sand, and less than 40 percent of silt. Field identification--Great cohesion of particles; greasy feeling when rubbed between the fingers, and easily recognized by blue-gray coloration; in addition it characteristically clouds water when put into suspension.

5. Shell - Identifiable particles of shell apparent. Field classification--=50 percent of matter in sample contains shell.

6. Muck - A highly decomposed organic soil. Plant parts not identifiable. Field identification--Resembles a loam soil but identified by lighter weight, dark brown to black coloration, and only moderate cohesion.

7. Peat - Unconsolidated soil material consisting largely of undecomposed or only slightly decomposed organic matter. Field identification--Over 50 percent undecomposed organic matter present.

In the soil table presenting the percent of exchangeable cations, it will be noticed that there is a general increase in sodium toward the south end of the study area where water salinities are higher. Shipps Bay, however, in the northern part of the study area, has sandy soils, a relatively low sodium content in the water, and a high percentage of sodium on the cation exchange capacity. This is interesting in that the

sandy bottoms of Shipps Bay supported one of the 'best stands of the brackish-preferring Ruppia maritima in the northern part of the study area in 1959. The high percentage of potassium in this soil is also interesting, although the proportional amounts of sodium and potassium do not seem to be reflected in the uptake of the elements by the poor quality sago pondweed sample collected from that area.

In the waters of the study area sodium increases proportionally to the chloride content. Greater quantities of sodium occurred in the sago pondweed plants of better condition. In the soils there is a greater concentration of sodium as milliequivalents per 100 grams of soil in the soils of finer particle size; however, in the percent of exchangeable cations the percentage of sodium on the cation exchange capacity is greater on the sandy soils, This implies that sodium, which is in much greater supply in the water than either calcium or magnesium, is far less active in becoming a part of the cation exchange capacity than calcium or magnesium,, but when it does enter into the exchange capacity it is more pronounced on coarse textured soils than on fine textured soils. Sand having a low cation exchange capacity, is more directly influenced by the constitutents of the water over it than are the silts, clays, or loams.

In Back Bay Proper there are about 8,000 acres where an undesirable physical condition of loose?, soft silts are dominant and vegetation is virtually absent, The total cation exchange capacity of this soil was 25.2 milliequivalents per 100 grams of soil, which was the highest of all samples taken from the study area. Again, this is a reflection fine particle size in the soil. However, the Agriculture Handbook No. 60 states that "In general, the physical properties of fine-textured soils are affected more adversely at a given exchangeable sodium -percentage than coarse-textured soils,"' The milliequivalent of sodium per 100 grams of soil from Back Bay was 4.0, the highest of any of the 12 samples.

These soils are virtually nonvegetated, but the chemical factors are not the primary limiting factor and the reason for lack of vegetation is turbidity of the water to some extent and highly dispersed, semi-liquid state of fine sedimentary particles which prevents adequate rooting. This is the fundamental problem of Back Bay Proper and the North Landing River causing lack of vegetation.

Table . Textural Class of Twelve Representative Soil Samples from Back Bay, Virginia, and Currituck Sound, North Carolina as Determined by the Soil Survey Laboratory, Soil Conservation Service, Beltsville Maryland.

Lab. Nos. 59824 - 59838 correspond to Field Nos. l-12. Collection Dates: August- 29-30, 1959.

Field No.	Area: (Section) & Quadrat	Particle Size Distribution (in mm.) (percent) Very Coarse Sand 2-1	Coarse Sand 1-.5	Medium Sand 0.5-.25	Fine Sand 0.25-.10	Very Fine Sand .10-.05	Silt 0.05-.002	Clay 0.002	0.2-0.02	0.02-.002	Total Sand	Textural Class
1	North Bay (D) S-19	0.3	0.4	0.4	2.0	6.9	72.0	18.0	47.9	32.3	10.0	Silt Loam
2	Shipps Bay (D) T-15	0.0	0.1	0.5	84.1	13.4	1.4	0.5	88.0	0.9	98.1	Fine Sand
3	Salinger's Cove Red Head Bay (D) P-12	0.2	0.6	0.9	3.0	10.7	73.6	11.0	61.9	24.2	15.4	Silt Loam
4	Back Bay (D) L-7	0.0	0.2	0.5	8.4	4.7	62.8	23.4	26.8	47.3	13.8	Silt Loam
5	Back Bay west of Little Cedar Is. (D) O-2	0.0	0.2	0.4	9.7	34.9	45.7	9.1	72.1	16.8	45.2	Loam
6	South Back Bay (D) L-3	0.0	0.1	0.2	17.9	31.4	41.6	8.8	74.4	15.0	49.6	Loam/very fine sand loam
7	Buzzard's Bay (D) N-l	0.0	0.2	0.2	4.2	41.5	48.5	5.4	83.1	10.6	46.1	Loam
8	Knott's Is. Channel (C)P-17	0.0	0.3	3.1	34.8	26.1	27.8	7.9	62.1	9.8	64.3	Fine Sand Loam
9	North Landing River (C)G-19	0.4	2.9	9.1	27.2	20.6	30.7	9.1	53.2	11.3	60.2	Very fine Sand Loam
10	East of Church's Is (C) J-3	0.0	0.1	0.2	11.0	51.5	28.4	8.8	83.3	6.5	62.8	Very fine Sand
11	NW Sanders Bay (B) K-13	0.1	0.6	0.8	12.0	45.5	32.2	8.8	77.9	10.4	59.0	Very fine Sand Loam
12	W. Caffey Inlet (A) G-17	0.0	0.1	0.2	42.1	26.5	24.6	6.5	82.0	7.1	68.9	Fine Sand Loam

Table . Continuation of Soil Analyses for Back Bay, Virginia, and Currituck Sound, North Carolina. pH of Saturated Paste 1:1; Percent Organic Matter; pH of Water from Soils and of Soils

Collection Date: August 29-30, 1959

Field No.	Area: (Section) & Quadrat	pH of Saturated Paste 1:1	Percent Organic Carbon*	Water from Soils: Millimhos/cm	Ohms	N.eq./liter	Solution pH	pH of Soils: Original pH	** pH(1)	pH(2)	pH(3)	Remarks
1.	North Bay (D) S-19	4.6	3.27	2.34	220	25	5.5	6.2	4.4	3.1	2.6	yellow salt on beaker
2.	Shipps Bay (D) T-15	4.9	0.24	1.95	260	20	3.9	6.6	4.6	3.4	3.1	
3.	Salinger's Cove Red Head Bay (D) P-12	4.2	2.49	2.46	200	26	4.3	6.6	4.2	2.9	2.5	yellow salt on beaker
4.	Back Bay (D) L-7	5.0	3.74	1.85	265	20	7.5	7.0	6.0	4.5	4.1	
5.	Back Bay west of Little Cedar Island (D) O-2	4.0	1.68	1.98	245	20	7.2	6.7	5.0	3.7	2.9	
6.	South Back Bay (D) L-3	4.0	1.48	2.67	190	29	4.6	5.9	4.0	2.9	2.6	
7.	Buzzard's Bay (D) H-l	5.0	1.26	1.56	320	16	7.3	6.9	4.8	3.7	2.9	
8.	Knott's Is. Channel (C) P-17	4.2	1.50	2.02	240	21	7.6	6.5	4.6	3.9	2.5	
9.	North Landing River (C) G-19	5.4	1.26	1.85	265	20	7.5	6.9	5.5	4.7	4.2	
10.	East of Church's Is. (C)J-3	4.9	0.98	2.40	220	26	6.7	6.2	4.5	3.6	3.2	
11.	NW of Sanders Bay (B) K-13	4.2	2.09	3.90	125	44	6.7	6.8	4.6	2.8	2.4	yellow salt on beaker
12.	w of Caffey Inlet (A) C-17	4.8	1.26	4.10	120	46	3.8	6.4	4.2	2.8	2.4	yellow salt on beaker

* Organic Carbon X 1.724 equals approximate amount of organic matter present

** pH(1) Soils air dried, rewet and pH determined.
pH(2) Soils are dried second time, rewet and pH determined.
pH(3) Soils are dried third time, rewet and pH determined.

Table . Continuation of Soil Analyses for Back Bay, Virginia, and Currituck Sound, North Carolina. Cation Exchange Capacity; Extractable Cations; Percentage Base Saturation; Calcium/Magnesium Ratios.

Collection Date: August 29-30, 1959

Field No.		Area: (Section)& Quadrat	Cation Exchange Capacity	milliequivalents per 100 g. soil Ca	Mg	H	Na	K	Percent Base Saturation	Ca/Mg Ratio
1.		North Bay (D) S-19	23.0	4.9	5.0	9.2	3.1	0.8	60	0.9
2.	Sh	Shipps Bay (D) T-15	1.8	0.4	0.5	0.4	0.4	0.1	78	0.8
3.		Salinger's Cove Red Bead Bay (D) P-12	17.6	3.6	4.2	7.2	2.1	0.5	59	0.8
4.		Back Bay (D) L-7	25.2'	5.6	6.0	8.8	4.0	0.8	65	0.9
5.		Back Bay west of Little Cedar Island (D) O-2	14.8	2.5	3.3	6.8	1.8	0.4	54	0.8
6.	S	South Back Bay (D) L-3	12.0	2.1	2.9	5.0	1.6	0.4	58	0.7
7.		Buzzard's Bay (D) H-l	8.2	1.9	1.9	3.2	1.0	0.2	61	1.0
8.		Knott's Is. Channel (C) P-17	10.9	1.8	2.3	5.2	1.2	0.4	52	0.8
9.		North Landing River (C) G-19	9.4	1.8	2.4	3.9	1.0	0.3	58	0.8
10.		East of Church's Is. (C) J-3	8.4	1.6	2.1	3.2	1.2	0.3	62	0.8
11.		NW of Sanders Bay (B) K-13	17.9	3.2:	4.2	6.5	3.4	0.6	64	0.8
12.		W of Caffey Inlet (A) G-17	9.6	1.4	2.5	3.0	2.3	0.4	69	0.6

Table . Percentages of Exchangeable Cations and Miscellaneous Cation Ratios.

Field NO.	Area: (Section) & Quadrat	Percent Exchangeable Cations Ca	Mg	H	Na	K	Ca/Na	Ca/Na+K	Ca + Mg / Na + K
1.	North Bay (D) S-l.9	21	22	40	13	3	1.6	1.3	2.5
2.	Shipps Bag (D) T-15	22	28	22	22	5	1.0	1.3	1.8
3.	Salinger's Cove Red Head Bay (D) P-1.2	20	24	41	12	3	1.7	1.4	3.0
4.	Back Bay (D) L-7	22	24	35	16	3	1.4	1.2	2.4
5.	Back Bay west of Little Cedar Island (D) O-2	17	22	46	12	3	1.4	1.1	2.6
6.	South Back Bay (D) L-3	17	24	42	13	3	1.3	1.1	2.5
7.	Buzzard's Bay (D) N-l	23	23	39	12	2	1.9	1.6	3.2
8.	Knott's Is. Channel (C) P-17	17	21	48	11	4	1.5	1.1	2.6
9.	North Landing River (C) G-19	19	26	41	11	3	1.8	1.4	3.2
10.	East of Church's Is. (C) J-3	19	25	38	14	4	1.4	1.1	2.5
11.	NW of Sanders Bay (B) K-13	18	23	36	19	3	0.9	0.8	1.9
12.	W of Caffey Inlet (A) G-17	15	26	31	24	4	0.6	0.6	1.4

Table . Physical Conditions at Collection Site of Soil Samples; Frequency of Each Species of Vegetation in Quadrat from Master Survey; Estimate of Crop Condition and Observations; and Correspondence of Soil Sample Number to Plant Sample Number used in Spectrochemical Analyses.

Soil Field No.	Area: (Section) & Quadrat	Plant Field No.	Av. Water Depth	General amount of vegetation in area	Sa	Ce	Na	Re	Wi	Ni	Ch	Sg	El	No	Remarks
1	North Bay (D) S-19	1(Sa)*	5.2'	Abundant		90	90							10	Waters stained, veg. normal, few seed on Sa.
2	Shipps Bay (D) T-15	2Sa, 3Re	3.6'	Common, but small	30	70	20		80	70	90				Best local Wi*
3	Salinger's Cove Red Head Bay (D) P-12	4(Sa)	3.6'	Abundant	20	40	80							20	August Chlorosis of Sago, Few Sa.-Seeds
4	Back Bay (D) L-7	-	6.2'	None over large area										100	Problem area; no vegetation
5	Back Bay west of Little Cedar Island (D) O-2	5(Sa)	4.1'	Scattered Sa. Rare Na.	2°	60	7°		10		10				Sample from 7' water. Few Sa. Seeds
6	South Back Bay (D) L-3	-	6.4'	Scattered Sa.										100	Very Black Soil. Almost no vegetation.
7	Buzzard's Bay (D) H-1	6Sa, 7Re	4.3'	Abundant		70	100	20		20	40	30	40		Chlomsis & fungi on Sago; Fungi & dark leaves on Redhe
8	Knott's Is. Channel (C) P-17	8(Re)	3.2'	Abundant	100	100	100	100		20					Heaviest stand Redhead but f softening of leaves.
9	North Landing River (C) G-19	-	8.0'	Absent over large area										100	Large area devoid of vegetat Generally turbid water.
10	East of Church's Is. (C) J-3	9Sa,	3.7'	Common	30	80	70	50	10	40	50				Normal vegetation
11	NW of Sanders Bay (B) K-13	11Sa	4.0'	Abundant		50	80		20						Normal vegetation, good seed prod. on Sago in area.
12	West of Caffey Inlet (A) G-17	12Re, 13Sa	4.3'	Abundant	100	80	40	60	100	10	10				Normal veg.; good seed on Sa more widgeongrass in general area.

* Sa-Sago pondweed, Ce-Wildcelery, Na-Southern naiad, Re-Redheadgrass, Wi-Widgeon grass, Ni-Nitella sp.

% Frequency from master survey August 1959, based on 10 one-half figure ft. samples per quadrat (1000 yds. on each side)

Soil Type Distribution in Sack Bay and Currituck Sound

Soil type abundance is discussed on page 57 of Volume 1. The maps of soil type frequency are presented in this volume on environmental factors. As with the maps of vegetation frequency, each dot represents a 10 percent frequency of occurrence of the designated soil type in each quadrate. The dominant soil type only was recorded, for in 1959 when we attempted to define the many combinations of silty sand, sandy loam, silty clay, etc., over 38 combinations were encountered that defied analysis in relation to vegetation or easy depiction of the data.

Certain differences in soil type distribution were recorded between 1.960 and 1962, e. g. the lesser quantity of loam and the higher quantity of silt in the North Landing River in 1962; while some differences may have been real, in the majority of instances, most of them resulted from different classification by the different field crews. We became increasingly aware of this difficulty of accurately assigning a field classification and made all efforts to standardize it by all field crews in 1962. The best representation of soil type distribution was from 1962. Other factors affecting good portrayal of soil distribution are the method of sampling and the extent of the turbidity. For example, samples taken rapidly or while the boat was still moving invariably would wash away surface silt and, consequently, the observer would identify only the heavier or more compact subsurface soil. This was probably the major error. Possibly after severe wave action enough silt was suspended in the water that observation of the dominant surface soil at the time of sampling misrepresented "average" conditions.

Relationships of Aquatic, Vegetation Occurrence to Soil Types

The frequency of each species of aquatic vegetation on each soil type is discussed in Volume I and tables are presented from the Master Survey data on the relationship of vegetation to depth and soil type in the Appendix to that volume.

Additional data are presented in the accompanying tables detailing prevalence of soil types and occurrence of each species of aquatic on each soil type. The percent of each soil type supporting each species, and the percent of each species occurrence on each soil type, are the respective columns in the tables. As an example, 13.2 percent of 3,616 samples of sand soil supported sago pondweed, whereas 55.9 percent of the total occurrences of sago pondweed occurred on sand soil.

With exception of *Potamogeton berchtoldi* and *Anacharis* sp., all other species preferred sand soil. *Nitella* sp., *Chara* sp., and widgeongrass displayed the strongest affinity for sand soil for 81.6, 79.3, and 73.4 percent of their respective occurrences were on sand soil and sand comprised only 51.0 percent of all soil occurrences.

Other relationships of vegetation occurrence to soil type abundance are readily discerned from the table; silt was generally used relative to abundance; however, *Nitella* sp., *Chara* sp., *Eleocharis* sp., and widgeongrass were infrequent on silt soil.

Table . Percent of Samples of 'Each Soil Type Supporting Each Species of Vegetation and the Percent of Total Occurrences of Each Species of Vegetation on Each Soil Type from the August 1960 Master Survey of Back Bay, V-irginia, and Currituck Sound, North Carolina.

			Sago		Celery		Redheadgrass	
	No. Samples	Soil Type Percent	% Soil Type Supporting&/	% Total Occurrence Each Soil21	% Soil Type Supporting	% Total Occurrence Each Soil	% Soil Type Supporting	% Total Occurrence Each Soil
Non-Record	8	Tr.	--	--	--	--	--	--
Loam	1596	22.5	11.7	21.8	34.3	19.6	13.8	24.8
Silt	1466	20.7	11.6	19.9	36.1	18.9	14.4	23.8
Sand	3616	51.0	13.2	55.9	45.7	59.1	12.2	49.8
Clay	170	2.4	4.1	0.8	21.2	1.3	5.3	1.0
Shell	134	1.9	5.2	0.8	9.0	0.4	2.2	0.3
Muck	62	0.9	8.1	0.6	22.6	0.5	3.2	0.2
Peat	41	0.6	2.4	0.1	12.2	0.2	0	0
	7093	100.0		99.9		100.0		99.9

			Nitella spp.		Chara		Najas	
Samples	No.	Soil Type Percent	% Soil Type Supporting	% Total Occurrence Each Soil	% Soil Type Supporting	% Total Occurrence Each Soil	% Soil Type Supporting	% Total Occurrence Each Soil
Non-Record	8	Tr.	--	--	--	--	--	--
Loam	1596	22.5	3.4	12.0	9.3	14.0	57.5.	24.1
Silt	1466	20.7	1.0	3.2	2.0	2.8	'60.6	23.3
Sand	3616	51.0	10.2	81.6	23.2	79.3	52.0	49.3
Clay	170	2.4	6.5	2.4	12.9	2.1	40.6	1.8
Shell	134	1.9	0.7	0.2	9.7	1.2	23.9	0.8
Muck	62	0.9	0	0	3.2	0.2	35.5	0.6
Peat	7093	100.0	4.9	99.9	9.8	100.0	2.4	99.9

1/ Column 3 = % soil type with sago = $\frac{\text{no. each soil type with sago}}{\text{total no. each soil type}}$

2/ Column 4 = % total sago occurrences by each soil type = $\frac{\text{column 2 x column 3}}{\text{sum (column 2 x column 3}}$

Table . Percent of Samples of, Each Soil Type Supporting Each Species of Vegetation and the Percent of Total Occurrences of Each Species of Vegetation on Each Soil Type from the August 1960 Master Survey of Back Bay, Virginia, and Currituck Sound, North Carolina, continued.

			Widgeongrass		Eleocharis		Sagittaria	
	No. Samples	Soil Type Percent	% Soil Type Supporting 1/	% Total Occurrence Each Soil 2/	% Soil Type Supporting	% Total Occurrence Each Soil	% Soil Type Supporting	% Total Occurrence Each Soil
Non-Record	8	Tr.	--	--	--	--	--	--
Loam	1596	22.5	14.1	15.6	2.9	28.3	2.3	36.2
Silt	1466	20.7	9.3	9.5	0.9	8.1	1.1	15.9
Sand	3616	51.0	29.3	73.4	2.4	53.2	1.2	42.8
Clay	170	2.4	1.8	0.2	7.6	7.9	1.8	3.0
Shell	134	1.9	10.4	1.0	0	0	0	0
Muck	62	0.9	4.8	0 . 2	4.8	1.9	3.2	2.0
Peat	41	0.6	4.9	0.1	2.4	0.6	0	0
	7093	100.0		100.0		100.0		99.9

			P. berchtoldi		Anacharis		Total Vegetation	
	No. Samples	Soil Type Percent	% Soil Type Supporting	% Total Occurrence Each Soil	% Soil Type Supporting	% Total Occurrence Each Soil	% Soil Type Supporting	% Total Occurrence Each Soil
Non-Record	8	Tr.	--	--			--	--
Loam	1596	22.5	1.6	46.1	0.2	42.0	59.7	21.3
Silt	1466	20.7	0.8	21.2	0.3	58.0	62.3	20.5
Sand	3616	51.0	0.5	32.7	0	0	67.8	54.9
Clay	170	2.4	0	0	0	0	44.7	1.7
Shell	134	1.9	0	0	0	0	29.1	0.9
Muck	62	0.9	0	0	0	0	37.1	0.5
Peat	41	0.6	0	0	0	0	17.1	0.2
	7093	100.0		100.0		100.0		100.0

1/ Column 3 = % soil type with sago = $\frac{\text{no. each soil type with sago}}{\text{total no. each soil type}}$

2/ Column 4 = % total sago occurrences by each soil type = $\frac{\text{column 2 x column 3}}{\text{sum (column 2 x column 3)}}$

Discussion of Silt Deposition in Back Bay and the North Landing River

The deeper waters on the west side of the Back Bay Area and in the North Landing River form sump areas for silt deposition. The true nature of these soft, semiliquid silts can only truly be observed by using SCUBA equipment to go down and see them in situ; no sampling device could do the same.

These semiliquid silt deposits were crudely measured by gently lowering a rule into the bottoms until the slightest light resistance was felt; the depth of silt was measured at 50 random stations in each area. The maps for 1960 and 1962 indicate the areas sampled and the average depth of semiliquid silt in each area; silt depth ranged from 0.4 inches to 3.5 inches.

There is no doubt that these semiliquid silts are quickly resuspended after sufficient intensity and duration of wind. Once resuspended, many factors determine the duration of suspension. The frequency, direction, velocity, and duration of the wind, water temperature, CC2 content, water salinity, rainfall, exposure of the site, depth of the water, currents, vegetation abundance, etc., all interact to determine degree and duration of turbidity.

Academic inquiry into the degree of influence of each of the many factors contributing to resuspension of bottom silts and duration of turbidity seems superfluous, except in relation to those factors possibly subject to control. Of the above-named factors, possibly only water salinity and vegetation abundance would seem to fall into the realm of control in a 200-sq. mile area.

Aside from the problems that turbidity causes in limiting sunlight, thus retarding photosynthesis by the plants, the deep silt deposits themselves are a principal limiting factor on aquatic growth. A seedling plant rooted in 2 to 3 inches of semiliquid silt has a very tenuous anchorage and the frequent winds rarely enable any plants to secure their roots in the firmer subsoils beneath the silt in the large open water areas. The soil chemistry of these semiliquid silts is such that plants are produced in abundance in test tanks with still water but the physical nature of the silts in the bay definitely limits aquatic growth. Based on the records of wind velocity it would, indeed, be a rare occasion when the waters were sufficiently calm for a sufficient duration to permit ecesis of aquatic plants into the deeper, silt-laden sump areas of Back Bay and the North Landing River.

The effect of salt water in flocculating suspended silts has been discussed and no doubt salt water would tend to coagulate the deposited silts to a slight degree; however, it is unlikely that the silts would be sufficiently coagulated so that they would not be resuspended by heavy wave action. In essence, salt water

would limit turbidity, thereby permitting increased plant growth' in areas where silt deposition is not a major problem.

Can anything benefit these silt-laden, nonvegetated sump areas in Back Bay and the North Landing River? Certainly increased light penetration resulting from increased salinity combined with extremely favorable weather conditions will result in some ephemeral increases in aquatic plant growth, but the problem would still exist when weather conditions returned to normal.

Severe winter storms have the potential of suspending the silts and north winds can flush the waters and suspended silts out of their present locations; however, the beneficial effects are offset when this same water soon seeks its level and deposits much of the silt in the same locations. Exactly what ideal combination of storm, wind, rainfall, and calm periods it would require to truly flush an area free of silt is' a matter of conjecture.

Certainly one positive action could be, and should be, taken by those concerned with the welfare of the Bay and Sound--opposition to all activities contributing to further siltation of the bay bottoms.

It was occasionally suggested that carp might be of considerable importance in causing the turbidity in Back Bay and Currituck Sound. In small, closed pond systems carp can cause considerable turbidity. Observable turbidity from carp action was occasionally seen in small marsh ponds and, in a few instances, in the larger open bays. However, the magnitude of the turbidity from carp action was insignificant in relation to wind-caused turbidity. Carp were so scarce in some recent years that commercial fishermen would not fish for them intentionally.-

Summary of Silt-Turbidity Problems

There is no doubt, in 'my-opinion, that major dredging activities in the Back Bay-Currituck Sound *Area* were instrumental in starting the chain of events resulting in excessive turbidities, silt deposits) and large, nonvegetated areas. The problem is complicated by the history of salt water, plant disease, and other factors; however, it seems likely that the end result would have been the same even if the area had always been fresh and plant disease had never been a factor. Plant disease, in this instance, is considered more as a reflection of an adverse habitat condition--turbidity and fresh water-- than as the cause of the present condition.

Initially the plant problems resulted from turbidity caused by dredging, and this was followed by plant destruction and heavy siltation. With the disappearance of aquatics in some areas, wave action increased and shoreline erosion became more severe, further contributing to turbidity and siltation. This process

occasionally was interrupted by favorable weather conditions and water salinities, and possibly some flushing of silts from the area.

The cosmopolitan fungi, which apparently cause the plant disease, probably become more important at times when the plants have a marginal , or sub-optimum, existence in relation to light intensity and favorable water salinities. Logically, one would assume this was equally true for fresh-water plants in excessive salinities, as well as for brackish-water plants in sub-optimum salinities.

Definition of the problem is only the first step towards its correction. Reduction of turbidity and siltation and maintenance of favorable salinity levels for the most desirable plants is the goal. The methods by which the goals might be achieved include:

1. Opposition to all unnecessary dredging, to reduce turbidity and siltation. When possible, all dredging and filling that are"essential" should be confined to dormant periods of vegetative growth. and when the greatest chance for flushing action from the area would occur; because of prevailing wind direction from the north, February and March would appear to be the best time.

2. Encouraging farming practices, e.g. cover cropping, proper timing of plowing, etc., that would cause the least soil erosion.

3. Diversion of silt-laden waters, particularly from Back Bay where the problem is the worst.

4. Maintenance of water salinities that would favor sago pondweed and widgeongrass, thereby decreasing shoreline erosion.

5. Prevent fluctuations in salinity, which favors neither fresh nor brackish water vegetation.

6. Maintenance of water salinities adequate to ameliorate turbidity, but not in excess of those harmful to bass reproduction.

Reticence, on possible recommendations to alleviate these problems, might be the wiser course to one who wishes not to bare his ignorance or daydreams, but often things that were impractical yesterday are commonplace today. Duly qualified, then, further methods possibly worthy of consideration are:

1. Diversion of stream and runoff water that enters Back Bay to the North Landing River via a canal along the perimeter of the marsh and the treeline, from Muddy Creek south. This no doubt could only be accomplished if North Carolina were to concede that the North Landing River already was irrevocably destroyed.

2. Bulkheading from the north end of Church's Island to Mackay Island to prevent movement of turbid water into Currituck Sound.

3. Rutting flap gates on Corey's ditch which would only permit southward flow out of Back Bay and preventing egress of North Landing River water northward in the canal.

4. Experimentally attempting flocculation of suspended silts in the critical spring and early summer months with commercial flocculants. The entire Back Bay Area should. be involved, for small-scale studies would be obscured.

5. A causeway and road from Knotts Island to the beach across Knotts Island Channel near the Stateline have occasionally been proposed; although it might provide some degree of independent management by Virginia, I cannot visualize direct benefit, and some harm by further preventing flushing of silt might occur. Water level control, particularly during the summer when the rainfall is greatest, could possibly become a severe problem.

6. Bulkheads, judiciously placed across wide, open water expanses to break wave action, might alleviate some turbidity and agitation of bottom silts, but would not be economically feasible. Bulkheading smaller cove units to minimize silt deposition and turbidity would be beneficial.

7. Even more extreme, impractical suggestions might be creation of a series of parallel subsurface sand fills across the deep, silt-laden sump areas by means of hydraulic dredge moving sand from the beach area. These might be 3 feet in height and 20 yards or more in width. They would serve two purposes: (1) establishment of vegetation on firmer, shallow strips that would serve as breakwaters, and (2) disruption of wave action by their physical presence alone across an otherwise flat bottom.

Certain European countries have successfully used "artificial vegetation" of plastic strips attached to submerged, anchored cables to break wave action on coastal areas and prevent beach erosion. No cost evaluation of that method is presently available, but it deserves further consideration.

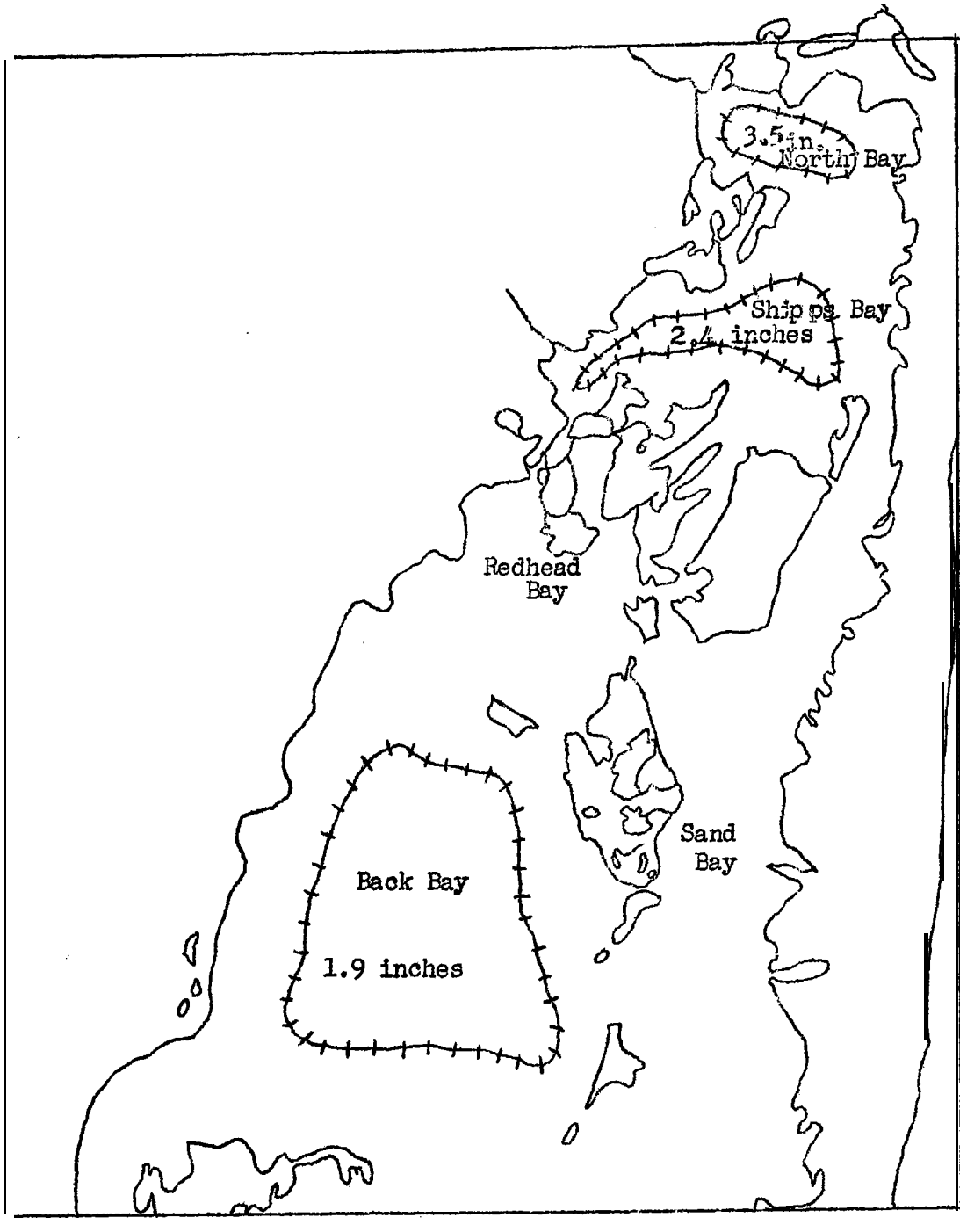
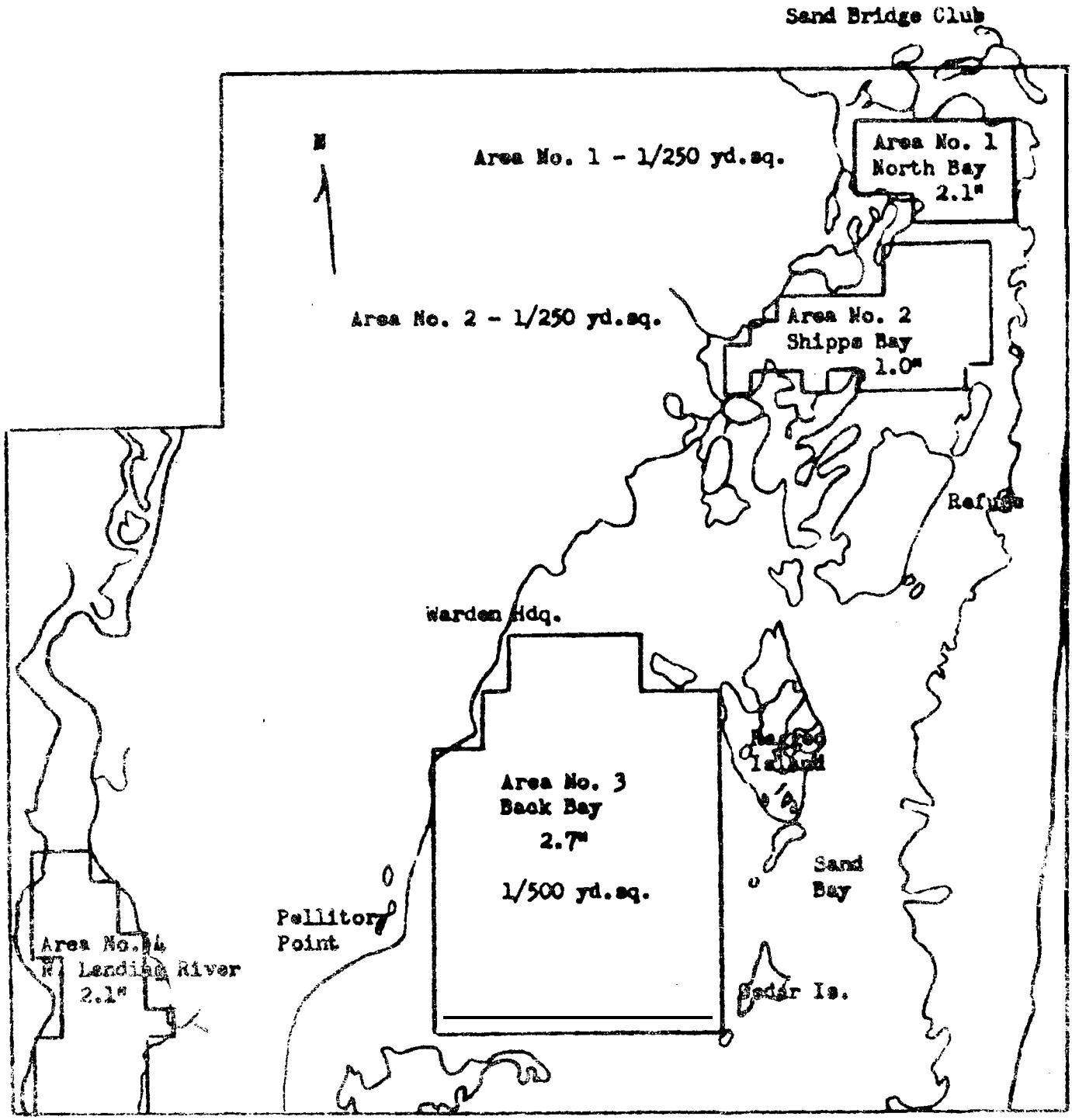


Figure___. Average Depth of Silt in Three Areas of Back Bay, July 22, 1960, Each Area Based on 50 Samples.

Table ____. Average Depth of Silt in Three Areas of Back Bay - July 22, 1960- Each Area Based on 50 Samples*.

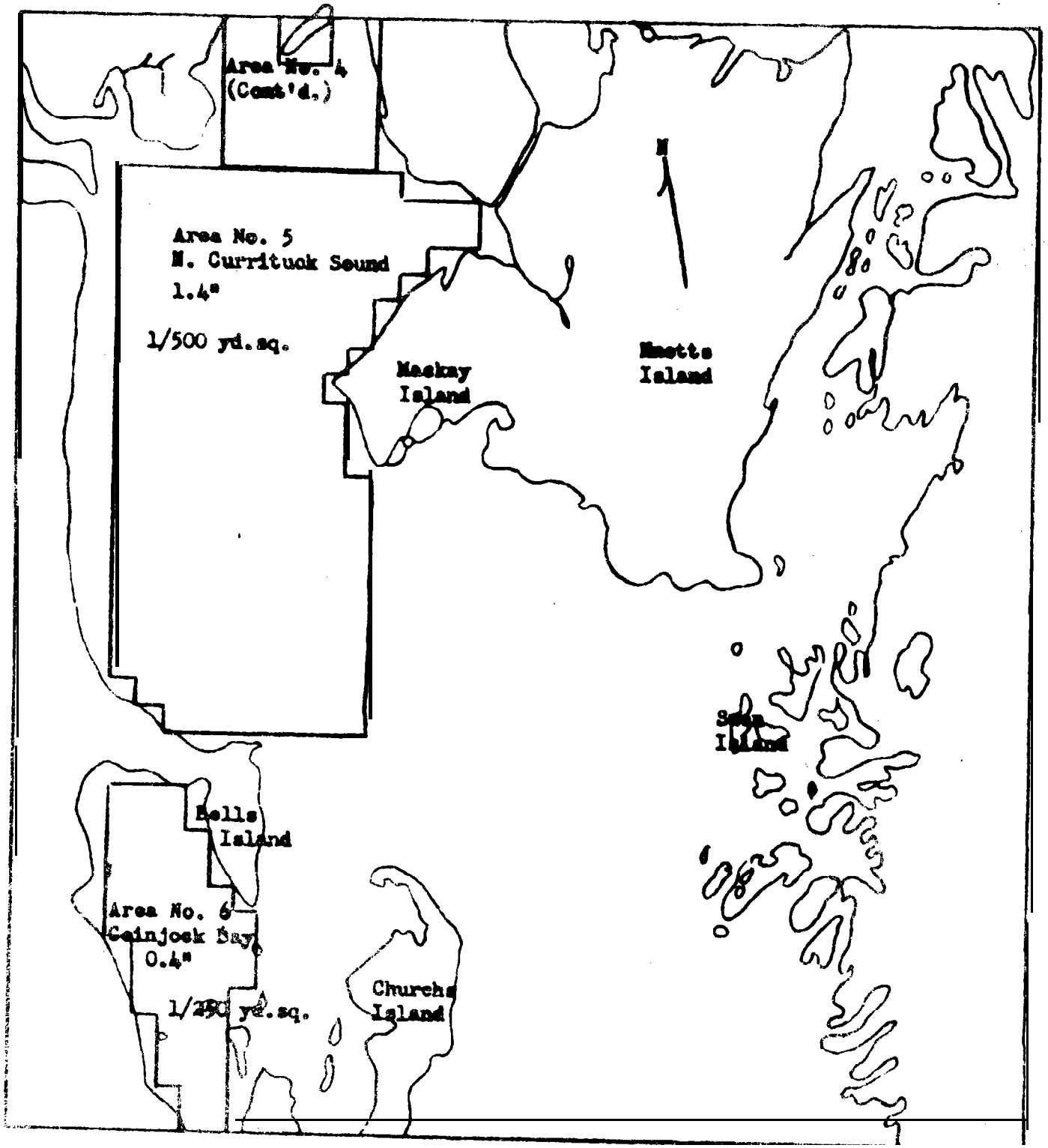
Area	Average Depth (inches)	Range in Depth (inches)
1, North Bay	3.5	0.25 - 7.0
2. Shipps Bay	2.4	0.75 - 4.0
3. Back Bay	1.9	0.5 - 3.0

*Readings were taken by observer diving to bottom with SCUBA equipment and lightly pressing a triangular engineer's rule through top layer of soft silt.



Section D

Figure_____. Average Depth of Silt in Areas 1-4 of Back Bay, Virginia. July 26-27, 1962. Each Area Based on Fifty Randomly Selected Samples. Back Bay - Currituck Sound Cooperative Investigation.



Section C

Figure_____. Average Depth of Silt in Areas 5-6 of Currituck Sound, N. C. September 13, 1962 and July 23, 1962. Each Area Based on Fifty Randomly Selected Samples. Back Bay - Currituck Sound Cooperative Investigation.

Table . Average Depth of Silt in Six Areas of Back Bay, Virginia, and Currituck Sound, North Carolina - July-September 1962. Each Area Based on Fifty Randomly Selected Samples.*

Area	Avg. Silt Depth (Inches)	Range in Silt Depth (Inches)	Average Secchi Disc (Inches)	Average Water Depth (Feet)	% Samples With Silt
1. North Bay	2.1	0.0-5.8	30	4.8	82
2. Shipps Bay	1.0	0.0-3.5	45	4.7	72
3. Back Bay	2.7	0.0-4.5	24	6.5	92
4. N. Landing River	2.1	0.0-8.0	26	6.2	92
5. N. Currituck Sound	1.4	0.1-3.5	44	6.7	100
6. Coinjock Bay	0.4	0.1-1.0	--	5.0	100

* Readings were taken by observer skin diving to the bottom and lightly pressing a triangular engineering ruler through the top layer of semi-liquid silt.

Comments: The average secchi disc readings include bottom readings.

APPENDIX

Table . Average Air Temperatures from Norfolk, Virginia Municipal Airport. 1906 - 1963

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	An'l.
1906	46.2	40.6	44.8	58.7	67.0	75.6	76.6	79.6	75.8	61.5	51.7	43.7	60.2
1907	46.0	37.1	52.4	51.0	63.2	69.3	78.9	76.9	75.0	57.6	50.6	45.1	58.6
1908	41.5	39.0	53.3	60.6	67.6	72.8	79.2	76.1	69.6	62.6	53.0	45.4	60.1
1909	46.1	50.3	48.1	59.0	66.0	75.8	76.4	74.6	69.7	58.4	55.0	38.8	59.8
1910	41.6	43.2	55.0	60.0	65.2	72.0	78.4	76.4	73.4	63.8	45.4	37.2	59.3
1911	45.0	43.9	47.0	54.6	69.2	75.6	79.2	78.8	74.4	62.6	49.8	47.6	60.6
1912	33.5	38.0	47.2	61.0	68.5	73.0	77.8	76.8	74.2	63.6	51.6	47.7	59.4
1913	51.2	43.0	54.7	58.6	67.6	73.2	78.2	75.9	70.8	62.2	52.5	45.5	61.1
1914	44.1	38.6	42.4	55.8	68.3	75.0	76.7	78.2	69.4	63.9	51.0	40.0	58.6
1915	42.2	45.4	42.4	60.2	66.0	71.3	77.4	78.0	74.2	64.4	52.4	40.5	59.5
1916	47.0	41.1	44.1	56.4	69.2	72.1	77.4	76.9	70.3	63.0	52.4	42.7	59.4
1917	42.8	38.8	47.2	57.6	62.4	74.2	77.2	77.8	68.2	58.2	47.8	33.8	57.2
1918	31.6	43.7	52.6	56.4	70.5	72.6	75.0	79.6	69.1	65.2	52.0	47.4	59.6
1919	43.8	42.6	50.4	56.9	67.9	73.4	77.8	76.6	72.6	70.0	53.0	40.5	60.5
1920	37.4	38.0	50.0	57.3	61.4	74.3	76.4	76.8	73.9	64.6	52.6	45.6	59.0
1921	43.6	45.0	58.1	61.2	63.0	74.8	79.8	76.4	77.8	62.0	55.8	44.2	61.8
1922	39.2	44.8	51.2	59.7	67.9	75.9	78.0	75.0	73.6	64.3	51.8	46.6	60.7
1923	43.9	39.2	49.6	57.2	65.6	77.2	77.0	77.4	73.6	61.0	50.6	51.1	60.3
1924	42.2	40.5	46.8	55.4	65.2	73.9	76.6	77.6	68.8	62.0	51.6	44.4	58.8
1925	41.0	49.2	51.4	59.2	64.4	77.8	79.6	76.2	75.4	58.7	50.2	40.8	60.3
1926	41.6	44.2	44.2	55.3	65.6	72.6	78.9	79.6	73.2	63.0	51.4	41.4	59.2
1927	40.2	48.3	51.6	54.8	66.7	70.1	76.8	73.7	73.2	64.6	55.6	44.5	60.0
1928	41.2	43.6	48.6	56.6	64.8	73.8	79.0	79.4	69.8	64.6	52.3	44.6	59.9
1929	42.2	41.3	54.4	61.6	66.6	73.4	77.0	76.7	72.0	61.1	53.1	45.4	60.4
1930	44.0	48.2	48.2	57.0	69.0	75.0	79.8	77.4	77.7	59.7	51.0	40.4	60.6
1931	42.4	43.8	44.2	56.0	66.0	73.8	80.6	77.8	76.4	65.2	59.0	51.9	61.4
1932	52.8	49.4	46.4	56.3	65.2	75.4	79.2	78.8	72.8	63.4	51.6	47.4	61.6
1933	49.3	44.6	49.0	58.6	71.1	76.8	76.8	78.4	77.2	63.4	50.0	47.0	61.8
1934	45.6	32.0	46.0	57.6	67.0	78.8	79.8	77.6	74.6	61.4	54.7	43.0	59.8
1935	39.9	42.8	54.3	54.7	65.0	75.9	78.2	77.4	71.4	62.0	55.6	37.2	59.5
1936	37.4	37.0	53.8	55.9	67.9	74.0	79.1	79.6	73.6	65.0	50.4	46.2	60.0
1937	51.8	41.8	46.5	57.0	67.6	76.8	79.4	79.6	69.9	59.6	51.2	42.1	60.3
1938	41.2	46.8	54.6	60.8	67.2	74.5	79.0	80.4	71.8	61.2	55.6	45.2	61.5
1939	45.2	49.8	52.4	58.8	67.8	77.2	77.3	79.2	74.8	64.3	50.0	44.4	61.8
1940	31.0	42.4	46.8	55.2	66.4	77.0	78.6	76.8	70.4	59.8	52.8	48.4	58.8

(Cont'd)

Table . Average Air Temperatures from Norfolk, Virginia Municipal Airport. 1906 - 1963

Year	Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	An'l.
1941	40.4	38.0	44.0	60.6	69.6	74.8	79.1	78.2	75.0	68.8	55.9	47.4	61.0
1942	41.1	38.8	51.1	60.2	70.9	77.3	82.0	77.6	74.6	64.6	54.8	42.4	61.3
1943	43.3	44.6	49.0	55.5	70.3	80.0	79.1	78.6	70.8	60.2	51.5	42.8	60.4
1944	41.7	43.4	47.9	57.8	72.4	77.4	79.2	77.4	74.0	62.4	51.1	39.8	60.4
1945	37.8	44.0	59.5	62.1	66.4	77.1	78.4	77.1	76.2	62.9	54.2	38.6	61.2
1946	43.0	44.9	56.4	58.1	68.4	73.7	76.8	75.4	72.7	64.8	57.5	48.4	61.7
1947	49.0	37.0	42.6	59.0	68.8	73.7	77.0	78.8	74.5	67.4	51.4	43.3	60.2
1948	36.0	43.1	52.9	58.8	68.1	75.7	79.8	78.0	72.2	60.1	58.2	47.2	60.8
1949	49.8	50.0	50.9	58.8	67.2	75.8	81.7	78.8	71.9	66.7	52.8	47.5	62.7
1950	53.9	45.4	47.8	56.3	65.7	75.3	78.1	76.5	71.8	65.6	52.1	40.4	60.7
1951	45.5	44.7	48.8	58.8	66.6	75.4	79.6	78.3	73.2	65.3	49.7	48.2	61.2
1952	46.8	45.3	49.1	60.6	68.2	79.8	82.0	79.2	73.5	60.1	53.5	44.7	61.9
1953	46.1	46.2	51.2	58.7	71.4	73.9	79.7	77.1	71.8	63.0	51.4	45.6	61.4
1954	41.7	46.7	48.7	60.8	64.0	75.6	78.0	77.9	73.8	64.6	50.0	41.3	60.3
1955	38.4	41.2	52.4	60.5	67.7	71.9	81.4	79.9	72.2	62.5	50.6	37.8	59.7
1956	37.2	45.9	48.1	56.6	64.3	75.3	78.7	77.3	70.8	63.5	51.1	52.2	60.1
1957	39.7	44.6	48.4	62.3	68.1	77.7	78.6	75.7	74.8	58.2	53.9	46.7	60.7
1958	37.3	36.4	43.6	57.8	66.7	71.8	81.7	77.8	70.7	61.4	55.6	37.2	58.2
1959	39.7	43.7	49.4	60.2	69.7	76.4	78.7	79.4	73.6	64.7	51.1	44.8	60.9
1960	41.7	41.4	39.2	63.7	68.3	75.5	77.8	80.0	72.8	61.8	52.7	36.5	59.3
1961	35.0	43.6	53.1	55.5	63.6	72.4	80.6	77.7	75.3	60.6	53.2	41.5	59.4
1962	38.9	41.0	43.7	56.4	68.0	73.4	75.2	76.0	69.1	61.8	49.8	37.2	57.6
1963	37.1	35.7	53.4	60.3	64.6	73.2							
*Grand Avg.	42.4	42.8	49.3	58.1	67.1	74.8	78.5	77.7	72.9	62.8	52.4	43.7	60.2

* Fifty-eight year average.

Table . Total Precipitation from Norfolk, Virginia Municipal Airport.
January 1906 - June 1963

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1906	2.57	4.35	3.97	1.54	4.99	2.48	8.90	11.20	.66	4.69	.91	2.97	49.23
1907	1.03	4.01	3.37	3.21	3.20	3.56	4.46	3.89	3.01	1.19	4.52	3.27	38.72
1908	2.92	2.79	4.50	3.26	3.99	4.56	5.78	8.00	2.28	2.36	.83	2.98	44.25
1909	1.49	2.99	1.35	3.11	4.20	6.00	4.41	5.81	.56	1.43	.52	1.91	33.78
1910	2.53	2.10	3.43	2.46	3.48	7.07	6.16	4.05	.89	3.33	1.02	3.83	40.35
1911	2.39	2.18	3.70	3.30	.56	3.65	5.10	5.93	.63	2.77	4.12	4.62	38.95
1912	3.39	2.66	5.18	2.78	1.75	4.63	1.86	2.12	2.61	.78	1.96	4.65	34.37
1913	3.39	1.97	1.99	.79	4.31	5.70	10.24	4.14	5.23	2.63	1.30	1.68	43.37
1914	2.32	3.67	3.77	1.88	2.53	3.20	3.91	1.10	2.97	2.39	2.62	4.69	35.05
1915	5.66	1.71	1.14	.91	4.82	6.52	5.72	2.46	1.76	2.29	.87	2.26	36.12
1916	2.07	4.03	1.68	1.95	5.48	1.98	3.05	2.99	3.53	2.62	1.34	3.11	33.83
1917	2.28	1.88	4.60	2.61	1.98	4.65	11.73	4.54	5.26	2.89	.59	2.62	45.63
1918	2.77	.26	3.68	4.81	2.97	3.25	3.06	2.48	3.12	.79	.77	2.94	30.90
1919	3.10	2.15	3.36	1.61	3.63	3.48	7.21	3.47	.70	2.27	.20	1.71	32.89
1920	2.14	6.33	2.39	4.25	1.99	5.05	4.33	3.83	3.11	.94	3.64	4.91	42.91
1921	1.55	3.02	1.50	3.02	4.72	1.05	3.27	3.13	2.43	1.28	1.70	3.69	30.36
1922	3.49	4.85	4.95	1.88	3.42	9.78	11.92	8.04	.53	2.85	.44	2.93	54.98
1923	1.74	2.01	5.12	3.59	1.90	1.43	4.14	4.47	3.23	1.70	1.95	.93	32.21
1924	1.96	3.15	3.16	2.89	7.47	6.46	4.45	4.27	6.59	.11	2.00	2.85	45.36
1925	6.22	1.31	3.29	1.74	1.72	2.60	5.52	1.05	2.66	2.22	1.97	4.20	34.50
1926	4.52	2.50	3.11	2.45	1.89	2.69	1.03	5.73	2.17	1.65	2.59	4.52	34.85
1927	.61	3.24	2.18	4.87	3.57	4.68	6.72	3.85	1.68	5.14	2.36	5.99	44.89
1928	1.51	2.85	2.73	4.24	2.14	7.84	4.41	2.05	9.79	1.24	1.92	3.85	44.57
1929	1.81	4.24	2.80	1.06	7.90	3.35	4.09	2.64	3.87	5.66	3.66	1.83	42.91
1930	4.09	1.24	1.68	2.38	1.63	5.90	2.50	.64	.57	2.00	1.26	3.02	26.91
1931	1.57	1.70	2.74	3.24	4.62	5.13	4.56	4.25	1.45	.74	.29	1.71	32.00
1932	4.53	2.15	3.13	1.63	2.48	3.26	3.21	1.60	1.51	3.96	2.34	3.70	33.50
1933	2.99	2.52	1.98	2.13	1.76	2.05	5.26	13.13	2.07	.39	.99	.66	35.93
1934	1.88	5.68	6.31	2.04	6.96	1.68	8.19	4.37	6.80	.20	2.35	1.83	48.29
1935	3.10	3.53	4.17	5.22	2.89	1.81	7.80	3.63	5.29	.78	3.64	2.23	44.09
1936	6.60	4.16	3.83	4.71	.98	3.95	9.30	1.77	4.95	5.31	1.87	4.88	52.31
1937	8.46	2.53	3.08	6.44	3.35	7.49	5.69	6.77	4.47	3.98	5.57	1.87	59.70
1938	2.80	1.10	3.73	5.78	5.06	7.25	5.28	2.78	7.76	2.09	3.19	2.45	49.27
1939	3.93	5.52	2.40	4.26	1.53	6.51	12.40	9.20	.56	5.04	3.14	1.15	55.64
1940	2.35	2.38	2.05	3.37	3.64	2.31	3.44	10.14	4.10	1.10	4.45	1.16	40.49

Table . Total Precipitation from Norfolk, Virginia Municipal Airport. January 1906 - June 1963.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1941	2.12	2.58	2.50	3.24	.94	4.31	4.52	4.99	2.80	2.37	1.57	2.87	34.81
1942	2.76	2.63	5.52	.73	2.70	1.23	1.61	15.61	2.83	5.87	.96	5.15	47.60
1943	2.80	1.81	4.18	2.77	3.83	4.26	10.27	1.00	6.08	3.90	1.36	2.01	44.27
1944	4.47	5.90	6.97	2.57	.85	1.24	1.43	6.25	9.61	3.45	4.08	2.43	49.25
1945	1.72	5.16	1.30	2.12	2.64	7.72	12.92	3.32	5.74	1.32	4.02	5.87	53.85
1946	3.27	3.70	1.60	3.42	6.50	4.56	7.24	3.51	5.94	1.26	3.55	1.31	45.86
1947	4.18	1.26	3.54	2.92	1.86	3.89	8.28	2.17	4.01	1.47	6.25	2.35	42.18
1948	4.36	3.65	2.82	4.86	6.98	4.66	4.86	5.15	2.24	2.41	5.51	4.09	51.59
1949	1.62	4.27	2.85	1.71	5.42	2.57	6.35	14.51	2.06	2.29	3.51	2.10	49.26
1950	2.11	1.09	2.79	3.55	2.27	3.07	10.79	2.35	2.05	1.95	1.53	2.84	36.39
1951	1.61	1.59	2.99	2.29	3.68	4.86	2.78	8.68	.53	3.63	6.34	2.67	41.65
1952	4.31	5.52	4.41	2.16	1.97	2.29	4.14	4.73	2.36	2.75	4.83	3.23	42.70
1953	1.72	3.48	2.67	5.80	3.16	2.92	3.56	9.14	4.17	1.05	2.74	2.69	43.10
1954	6.40	1.59	4.14	2.46	5.78	.37	4.96	7.27	2.77	1.70	2.13	3.62	43.19
1955	2.41	2.71	3.96	1.73	1.58	2.47	2.34	8.16	9.26	1.48	2.05	2.14	40.29
1956	2.49	5.72	3.09	3.81	2.57	2.07	6.63	5.04	3.70	8.06	1.51	2.76	47.45
1957	4.11	4.74	4.06	1.86	1.94	3.56	2.18	5.96	7.18	3.44	4.81	4.53	48.37
1958	4.16	3.55	6.41	3.28	6.23	4.99	6.27	10.48	.36	4.88	3.07	4.10	57.78
1959	1.52	1.84	3.96	5.03	1.98	2.49	7.49	2.81	10.73	8.78	1.85	2.65	51.13
1960	3.85	3.57	2.54	1.40	4.43	2.57	4.78	6.49	5.88	2.76	1.10	2.37	41.74
1961	3.52	4.56	3.59	2.74	7.77	6.70	1.69	7.42	1.62	4.12	1.20	3.74	48.67
1962	5.56	2.50	4.32	4.49	3.68	3.03	9.05	4.09	3.07	4.48	4.06	3.80	52.13
1963	3.36	3.75	2.98	1.29	1.55	9.72							
*Grand Avg.	3.11	3.10	3.37	2.96	3.45	4.11	5.67	5.24	3.58	2.70	2.47	3.03	42.79

* 58 year average.

Table . Climatological Data - Back Bay National Wildlife Refuge, January 1958 through July 1963.

Date	Temperature (Air-Fahrenheit) Avg. Max.	Avg. Min.	Monthly Avg.	* Degree Days	Precipitation (Inches)
1958					
January	45.7	30.9	38.3	822	4.43
February	45.7	28.9	37.3	772	2.72
March	48.1	37.7	42.9	679	4.12
April	64.5	47.7	56.1	271	2.93
May	73.2	58.4	65.8	45	5.55
June	77.9	63.8	70.9	11	4.74
July	87.3	73.3	80.3	0	5.13
August	83.0	71.8	77.4	0	9.46
September	77.1	64.7	70.9	2	1.00
October	68.3	55.7	62.0	117	6.67
November	63.8	47.9	55.9	272	1.86
December	45.5	30.9	38.2	821	2.57
Average & Totals :	65.0	51.0	58.0	3,812	51.18
1959					
January	47.5	30.6	39.1	797	1.95
February	54.0	34.8	44.4	570	2.92
March	57.8	39.4	48.6	501	6.00
April	67.4	50.1	58.8	208	4.65
May	75.1	61.0	68.1	46	1.11
June	80.7	67.1	73.9	4	1.57
July	82.9	72.0	77.5	0	7.02
August	85.2	72.6	78.9	0	1.35
September	79.4	68.5	74.0	4	3.32
October	72.5	59.8	66.2	100	5.98
November	61.8	45.8	53.8	339	2.38
December	53.2	38.5	45.9	587	2.46
Average & Totals :	68.1	53.4	60.8	3,156	40.71
1960					
January	50.2	36.6	43.4	663	5.09
February	49.6	35.3	42.5	646	4.43
March	45.6	32.2	38.9	801	2.31
April	70.6	52.5	61.6	175	1.32
May	72.6	58.9	65.8	58	5.25
June	80.3	67.8	74.1	0	5.20
July	82.3	70.8	76.6	0	6.30
August	84.5	72.4	78.5	0	7.29
September	77.9	69.0	73.5	0	4.05
October	69.1	56.7	62.9	107	5.78
November	61.8	46.9	54.4	314	1.75
December	47.2	29.9	38.6	809	2.60

(Cont'd)

Table . Climatological Data - Back Bay National Wildlife Refuge, January 1958 through July 1963. (Cont'd)

Date	Temperature (Air-Fahrenheit) Avg. Max.	Avg. Min.	Monthly Avg.	*Degree Days	Precipitation (Inches)
1960					
Average & Totals:	66.0	52.4	59.2	3,573	51.37
1961					
January	44.9	29.8	37.4	848	3.47
February	52.0	36.7	44.4	573	5.82
March	61.4	42.6	52.0	407	-
April	-	-	-	-	3.41
May	-	-	-	-	4.65
June	80.9	62.2	71.6	12	5.15
July	88.6	70.0	79.3	0	4.62
August	90.3	66.5	78.4	0	5.19
September	84.3	-	-	-	3.53
October	70.3	-	-	-	6.23
November	62.0	46.9	54.5	334	2.11
December	51.4	34.5	43.0	676	3.33
Average & Totals:	-	-	-	-	51.44
1962					
January	50.6	32.6	41.6	717	6.53
February	51.1	33.0	42.1	638	3.21
March	55.3	39.4	47.4	541	4.23
April	65.3	47.4	56.4	283	3.08
May	77.0	58.7	67.9	35	3.09
June	79.9	66.6	73.3	0	4.28
July	81.7	69.4	75.6	0	6.81
August	82.4	70.8	76.6	0	3.31
September	78.0	64.0	71.0	11	2.93
October	71.9	57.4	64.7	94	5.72
November	57.9	44.4	51.2	407	4.92
December	47.4	32.6	40.0	767	2.53
Average & Totals:	66.5	51.4	59.0	3,493	50.64
1963					
January	44.8	30.3	37.6	843	3.56
February	45.5	28.1	36.8	795	3.48

(Cont'd)

Table . Climatological Data - Back Bay National Wildlife Refuge, January 1958 through July 1963. (Cont'd)

Date	Temperature (Air-Fahrenheit) Avg. Max.	Avg. Min.	Monthly Avg.	*Degree Days	Precipitation (Inches)
1963 (Cont'd)					
March	63.3	42.5	52.9	375	3.05
April	68.2	50.1	59.2	232	1.23
May	72.0	54.8	63.4	118	1.78
June	80.8	66.1	73.5	2	8.77
July	84.8	70.1	77.5	0	4.32

* Degree day base equals 65 degree Fahrenheit.

Table . Weekly Maximum-Minimum Water Temperatures at Three Foot Depth, Warden Headquarters, Back Bay, Virginia. (Fahrenheit)

Date	Max.	Min.
1959		
August 8	86	79
August 15	90	86
August 22	90	82
August 30	90	78
September 5	90	82
September 13	85	73
September 20	79	65
September 25	80	77
October 4	84	72
October 25	72	60
October 31	72	62
November 10	66	50
November 16	62	55
November 25	63	46
December 6	56	46
December 15	54	40
December 29	54	46
1960		
January 5	54	42
January 12	49	44
January 18	55	42
January 24	50	34
February 16	58	37
February 24	48	37
March 1	56	40
March 7	49	34
March 15	51	33
March 21	54	40
March 28	54	42
April 4	66	52
April 11	68	50
April 18	74	54
May 2	80	58
May 9	78	58
May 16	73	72
May 23	82	69
May 31	79	78
June 6	78	76
June 13	82	65
June 21	87	77
June 27	86	74
July 4	93	82
July 11	87	79
July 19	88	84
July 25	91	81
August 1	87	76
August 8	91	81
August 15	92	82
August 22	96	75
August 30	90	72
1960 continued		
September 9	90	73
September 19	80	72
September 27	84	76
October 5	73	68
October 14	75	65
October 17	76	71
October 25	72	54
November 1	60	58
November 11	52	50
November 14	65	48
November 29	(Broken)	
December 21	(Temp. 42)	
December 29	45	34
1961		
January 4	41	38
January 10	46	34
January 16	45	35
January 23	47	34
February 4	40	33
February 6	45	36
February 13	50	35
February 18	55	42
February 27	60	46
March 6	62	50
March 13	65	47
March 20	62	44
March 27	57	47
April 24	63	57
May 2	70	54
May 8	73	60
May 15	76	70
May 22	78	63
May 29	73	59
June 6	79	67
June 12	85	78
July 3	(Broken - Temp. 84)	
August 1	(Temp. 83)	
August 10	87	77
August 21	86	74
August 28	87	78
September 8	89	81
September 18	87	66
October 3	85	68
October 9	72	62

Table . Weekly Maximum-Minimum Water Temperatures at Three Foot Depth, Warden Headquarters, Back Bay, Virginia. Fahrenheit Temperatures - April 1962 through July 1963.

Date	Weekly Max.	Weekly Min.	Average Temperature	Average Max.	Average Min.
April 1	67	51	60	66	53
April 8	69	48	63	67	58
April 15	64	47	57	62	51
April 22	77	52	66	71	60
April 29	80	63	72	77	67
May 6	77	68	73	76	69
May 13	79	64	72	78	65
May 20	85	70	80	85	75
May 27	85	70	78	82	74
June 3	86	73	79	83	75
June 10	83	69	77	81	72
June 17	87	76	81	84	78
June 24	89	74	83	86	79
July 1	83	70	75	78	72
July 8	86	74	81	85	77
July 15	88	78	83	86	80
July 22	86	78	82	85	79
July 29	85	76	81	83	79
August 5	88	78	83	86	80
August 12	88	76	81	84	77
August 19	88	76	81	84	78
August 26	88	74	80	82	77
September 2	86	70	76	78	74
September 9	85	70	79	81	76
September 16	78	62	74	77	70
September 23	72	61	67	70	64
September 30	76	66	71	73	69
October 7	77	70	73	74	71
October 14	75	62	71	72	70
October 21	67	52	61	63	59
October 28	59	50	55	57	53
November 4	57	48	53	54	51
November 11	55	48	53	54	51
November 18	57	51	54	55	52
November 25	57	46	51	52	50
December 2	58	45	53	55	51
December 9	Surface Frozen				
December 16	-	-	-	-	-
December 23	-	-	-	-	-
December 30	-	-	-	-	-
1963					
January 6	48	34	41	42	39
January 13	54	37	44	46	41
January 20	53	36	45	47	43
January 27	41	35	39	40	37

(Cont'd)

Table . Weekly Maximum-Minimum Water Temperatures at Three Foot Depth, Warden Headquarters, Back Bay, Virginia. Fahrenheit Temperatures - April 1962 through July 1963. (Cont'd)

Date	Weekly Max.	Weekly Min.	Average Temperature	Average Max.	Average Min.
1963					
February 3	53	35	41	44	37
February 10	55	48	53	54	51
February 17	57	51	54	55	52
February 24	48	36	42	43	40
March 3	59	43	52	54	49
March 10	62	47	56	58	53
March 17	64	44	54	56	51
March 24	66	49	59	61	56
March 31	69	55	63	66	60
April 7	64	53	58	62	54
April 14	70	54	62	65	58
April 21	73	56	66	69	62
April 28	68	53	61	64	58
May 5	76	63	69	72	66
May 12	74	58	66	69	62
May 19	78	62	71	74	68
May 26	74	61	69	71	67
June 2	86	67	77	80	74
June 9	86	72	79	82	76
June 16	80	68	75	78	72
June 23	90	72	80	84	76
June 30	89	72	84	87	79
July 7	88	70	78	83	73
July 14	88	75	81	84	78
July 21	90	78	84	87	80
July 28-31	90	80	85	88	81

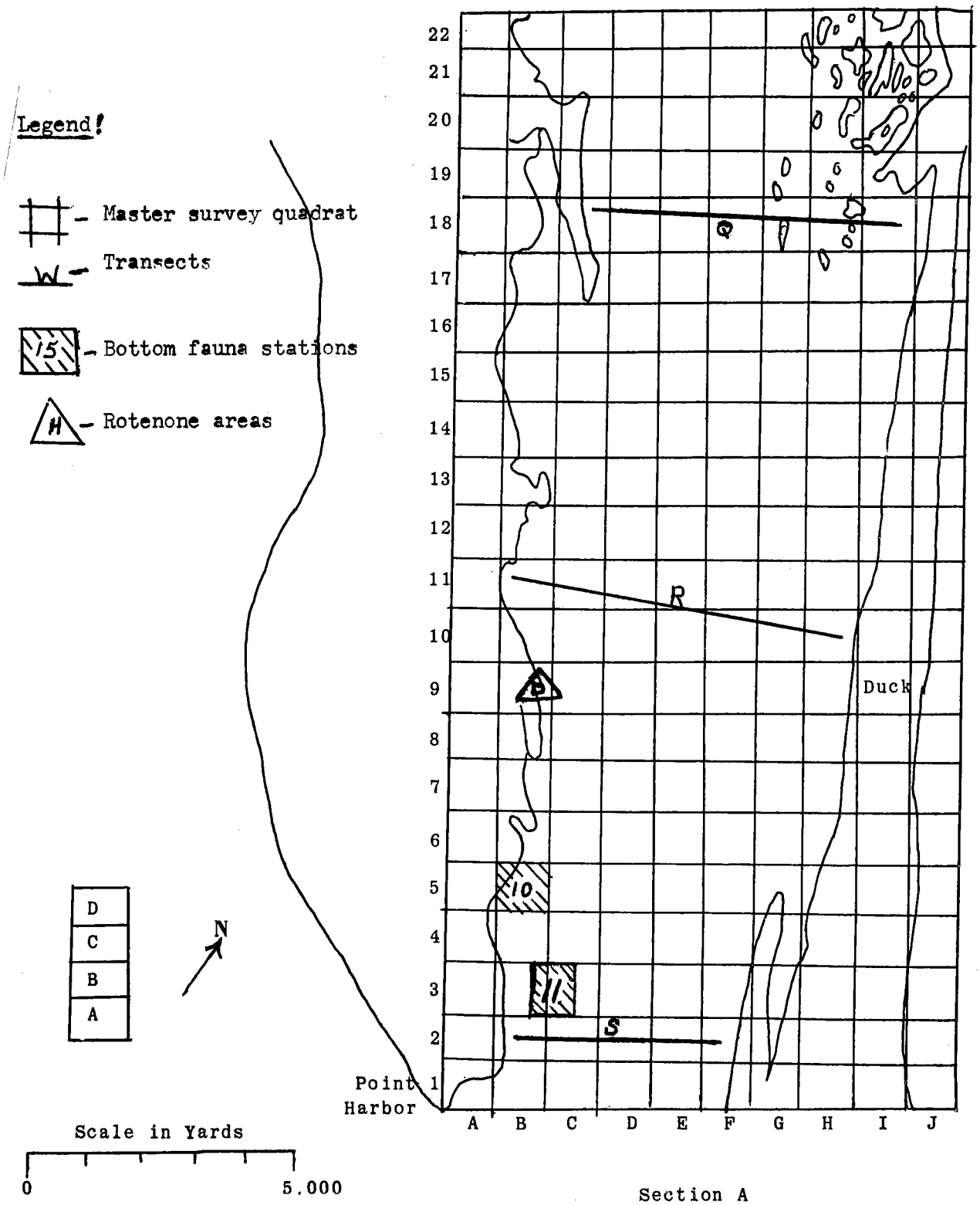
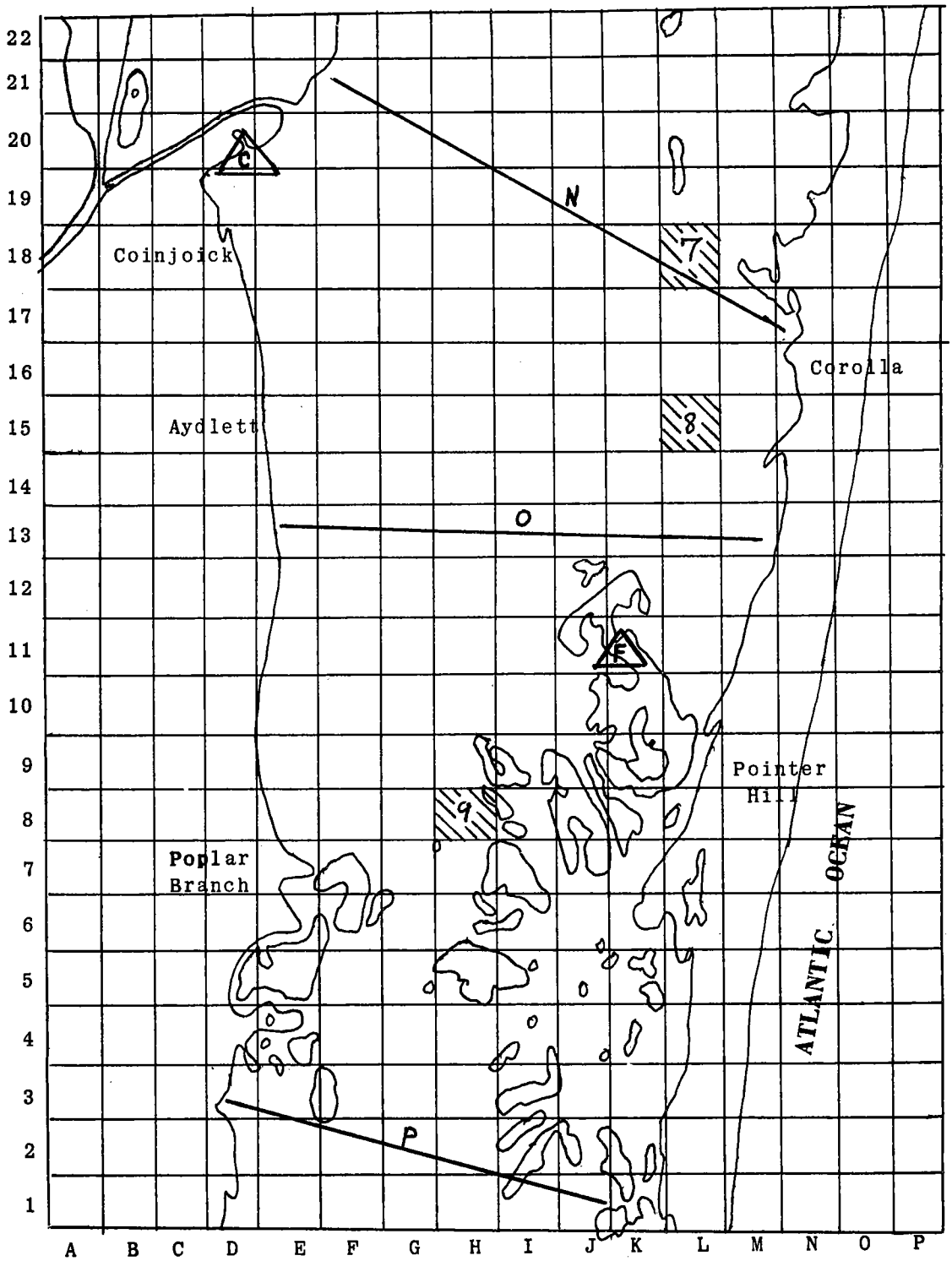
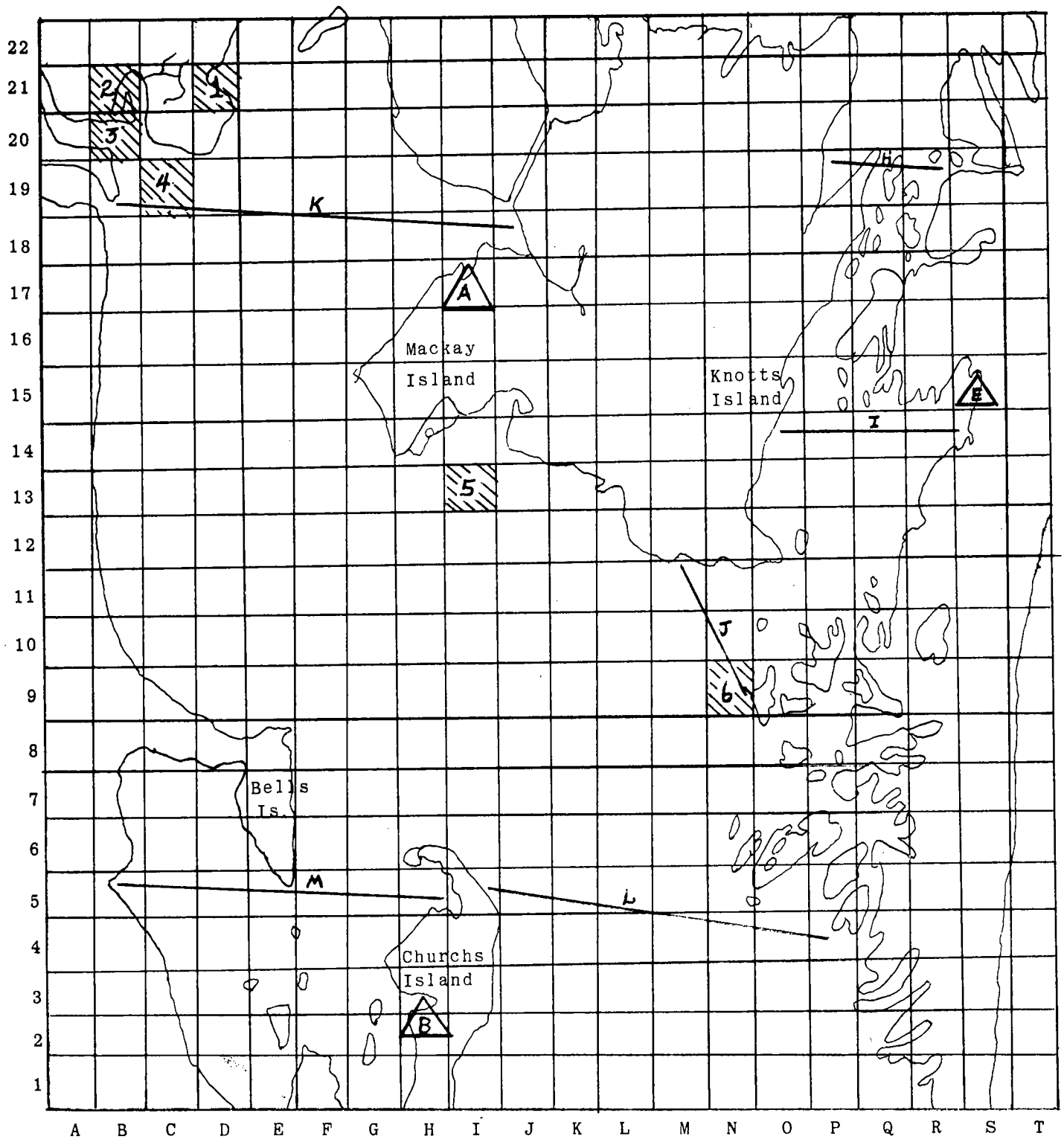


Figure ____. Location of Transects, Master Survey Quadrats, Bottom Fauna Stations and Rotenone Areas.



Section B

Figure ___. Location of Transects, Master Survey Quadrats, Bottom Fauna Stations and Rotenone Areas.



Section C

Figure _____ Location of Transects, Master Survey Quadrats, Bottom Fauna Stations and Rotenone Areas.

TABLE

WATER QUALITY **BACK BAY AREA**

WEST STATION pH MAY 1958 TO DECEMBER 1961

DATE	A	B	C	D	E	F	G	G_1	AVG. A-G_1
5/20/58	7.1	7.2	-	7.4	7.4	7.3	7.2	-	7.3
6/3	7.4	8.0	8.0	7.0	7.3	7.2	7.4	-	7.5
6/16	7.3	6.9	8.2	7.6	7.6	8.1	8.2	7.9	7.7
6/30	7.6	7.5	8.2	7.5	7.4	7.4	8.0	7.4	7.6
7/14	6.8	6.8	6.8	7.4	7.0	7.4	7.6	7.3	7.1
7/28	7.6	7.6	7.6	7.6	7.6	7.6	8.0	7.5	7.6
8/11	8.4	8.4	8.2	7.6	7.4	7.6	8.0	8.4	8.0
8/26	7.6	6.4	7.3	7.3	7.4	7.4	7.4	7.4	7.3
9/9	7.4	7.6	7.9	7.4	7.6	7.6	8.0	7.7	7.7
9/22	7.3	7.6	7.4	7.5	7.9	7.6	8.0	8.2	7.7
10/5	7.6	7.8	7.6	7.2	7.2	7.4	7.4	7.5	7.5
10/24	6.8	7.0	7.3	6.4	7.4	7.5	7.7	7.4	7.2
11/10	7.0	7.2	7.2	7.4	7.4	7.4	7.4	7.4	7.3
11/24	7.2	7.4	7.2	7.4	7.2	7.2	7.4	7.3	7.3
12/8	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
12/23	7.6	7.2	-	7.2	7.2	7.2	7.2	7.2	7.2
1/21/59	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.1	7.2
2/12	7.2	7.3	7.4	7.5	7.3	7.3	7.2	7.2	7.3
3/3	7.2	7.2	7.1	7.2	7.3	7.3	7.3	7.3	7.2
3/24	7.4	7.2	7.3	7.2	7.3	7.3	7.3	7.3	7.3
4/15	7.0	7.0	7.4	7.2	7.4	7.4	7.4	7.2	7.3
5/3	7.4	7.1	7.2	7.2	7.3	7.2	7.4	6.8	7.2
6/4	7.4	7.5	7.8	7.2	7.8	7.4	8.0	7.2	7.5
7/6	8.4	8.9	8.7	7.7	7.4	7.4	7.6	7.6	8.0
8/5	8.4	8.6	9.2	7.8	7.8	8.0	8.5	8.6	8.4
9/9	8.0	7.0	8.1	7.7	7.8	7.8	8.5	7.2	7.8
10/2	7.3	7.0	7.4	7.4	7.0	6.8	7.5	7.2	7.2
11/10	7.2	6.8	7.0	7.3	7.4	7.2	7.6	7.0	7.2
12/2	7.4	7.3	7.3	7.2	7.2	7.2	7.3	7.1	7.2
1/5/60	7.2	7.3	7.7	7.8	7.8	7.7	7.6	7.6	7.6
2/9	8.0	8.0	7.9	7.8	7.8	7.9	7.8	7.8	7.9
3/24	8.0	7.8	7.8	7.4	7.5	7.2	7.8	7.2	7.6
4/6	7.8	7.5	7.4	7.4	7.3	7.3	7.2	7.2	7.4
5/3	7.8	7.7	7.8	7.8	8.0	8.1	8.2	8.0	7.9
6/14	7.6	7.7	8.4	7.9	7.8	7.8	8.2	8.7	8.0
7/1	7.4	7.2	8.0	7.4	7.2	7.2	7.4	8.0	7.5
8/1	7.0	7.2	7.6	8.2	7.8	8.1	7.4	8.5	7.7
9/1	7.0	8.0	8.6	7.5	8.2	8.6	8.2	8.3	8.1
9/14	7.0	6.5	7.2	7.0	7.3	7.6	7.6	8.0	7.3
10/4	7.4	7.4	7.2	7.2	7.4	7.4	7.4	7.8	7.4
11/2	7.8	8.0	7.6	7.6	7.7	7.8	7.7	7.7	7.7
12/22	7.7	7.9	7.5	7.5	7.4	7.4	7.2	7.4	7.5
1/13/61	7.6	7.5	7.4	7.6	7.5	7.6	7.6	7.6	7.6
2/7	8.0	8.0	7.9	7.8	8.2	8.4	8.2	8.3	8.1
3/27	8.1	7.8	7.8	7.8	7.8	7.8	7.7	7.7	7.8
4/20	8.1	7.9	7.8	8.1	7.8	7.8	7.8	7.9	7.9
5/19	8.0	8.1	8.0	8.0	7.9	7.9	7.7	7.7	7.9
6/26	8.4	8.2	8.2	8.2	8.2	8.0	8.1	8.2	8.2
7/19	7.1	8.1	8.8	8.3	8.1	7.9	8.5	8.8	8.2
8/17	7.6	8.0	8.2	8.3	8.2	8.1	8.2	8.4	8.1
AVG.	7.5	7.5	7.7	7.5	7.5	7.6	7.7	7.7	7.6

TABLE NO. ___

WATER QUALITY — Back Bay Area

Middle Station — pH — May 1958 to December 1961

	A	B	C	D	E	F	G	G1	Avg. A-G
5/20/58	7.3	7.2	-	7.4	7.4	7.4	7.2	-	7.3
6/3	7.5	8.0	8.2	7.5	7.2	7.2	7.4	-	7.6
6/16	8.0	7.4	8.4	8.0	8.1	8.0	7.8	6.8	7.8
6/30	8.2	8.2	8.2	8.2	7.4	7.6	8.2	8.4	8.1
7/14	7.6	7.6	7.6	7.6	7.5	7.5	7.6	7.6	7.6
7/28	7.6	7.6	7.6	8.0	7.8	7.4	7.8	8.4	7.8
8/11	8.1	8.2	8.2	7.8	7.9	7.7	7.9	8.2	8.0
8/26	7.4	7.5	7.3	7.4	7.4	7.4	8.1	8.0	7.6
9/9	7.4	7.6	8.4	7.6	7.8	8.0	8.4	8.4	8.0
9/22	7.3	8.4	7.6	7.4	7.8	8.0	8.4	7.9	7.8
10/5	7.5	7.5	8.1	7.6	7.6	7.4	7.6	8.1	7.7
10/24	7.0	7.7	7.6	7.7	7.5	7.4	7.8	7.5	7.5
11/10	7.2	7.2	7.3	7.4	7.5	7.4	7.3	7.3	7.3
11/24	7.0	7.4	7.2	7.3	7.4	7.4	7.4	7.2	7.3
12/8	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
12/23	7.4	7.4	-	7.4	7.2	7.2	7.2	7.2	7.3
1/21/59	7.1	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
2/12	7.2	7.4	7.3	7.3	7.2	7.4	7.2	7.2	7.3
3/3	7.2	7.2	7.2	7.4	7.2	7.2	7.2	7.2	7.2
3/24	7.2	7.2	7.3	7.3	7.2	7.2	7.3	7.2	7.2
4/15	7.3	7.4	7.4	7.4	7.3	7.4	7.3	7.3	7.4
5/3	7.4	7.4	7.1	7.4	7.3	7.3	7.4	6.8	7.3
6/4	7.6	7.6	7.8	7.4	7.4	7.4	7.6	7.0	7.3
7/6	8.6	8.6	8.5	7.6	7.8	7.8	7.6	8.0	8.1
8/5	9.2	9.2	9.6	7.8	7.8	7.8	8.6	8.2	8.5
9/9	8.6	8.5	8.6	8.4	6.8	7.3	8.3	7.0	7.9
10/2	7.6	7.6	7.4	7.2	7.2	6.8	7.3	7.2	7.3
11/10	7.5	7.8	7.3	7.4	7.2	7.0	7.8	7.2	7.4
12/2	7.4	7.2	7.2	7.6	7.8	7.7	7.8	7.2	7.5
1/5/60	7.2	7.6	7.8	7.6	7.5	7.6	7.6	7.8	7.6
2/9	8.2	7.8	7.8	7.8	7.8	7.8	7.8	7.6	7.8
3/24	7.8	7.7	7.6	7.5	7.4	7.4	7.2	7.4	7.5
4/6	7.8	7.5	7.4	7.4	7.3	7.2	7.2	7.2	7.4
5/3	7.6	7.6	7.8	7.8	8.0	8.1	8.1	7.9	7.9
6/14	7.5	7.6	8.0	7.9	7.7	7.8	8.5	8.2	7.9
7/1	7.4	7.8	8.0	7.4	7.4	7.4	7.6	7.6	7.6
8/1	7.4	8.0	8.3	8.4	8.3	7.8	7.5	8.0	8.0
9/1	7.1	8.5	8.2	8.5	8.6	8.5	8.5	7.9	8.2
9/14	7.1	7.0	7.2	7.0	7.4	7.6	7.6	8.0	7.4
10/4	7.6	7.4	7.4	7.4	7.4	7.4	7.4	7.2	7.4
11/2	7.8	7.6	7.7	7.6	7.7	7.8	7.7	7.7	7.7
12/22	7.5	7.5	7.5	7.4	7.5	7.4	7.2	7.5	7.4
1/13/61	7.6	7.5	7.6	7.5	7.5	7.6	7.6	7.6	7.6
2/7	7.8	7.9	8.2	7.6	8.2	8.4	8.1	8.3	8.1
3/27	8.0	7.6	7.8	7.7	7.8	7.8	7.7	7.6	7.8
4/20	7.9	7.9	7.8	7.7	7.7	7.8	7.9	7.8	7.8
5/17	8.0	8.1	8.0	7.8	7.8	7.8	7.8	7.8	7.9
6/26	8.4	8.4	8.2	8.2	8.1	8.0	8.0	8.2	8.2
7/19	7.2	8.4	9.0	8.2	8.1	8.9	8.6	8.7	8.4
8/17	7.8	8.0	8.3	8.2	8.2	8.1	8.2	8.4	8.2
11/6	7.6	7.6	7.5	7.5	7.4	7.0	7.0	7.5	7.4
12/27	7.3	7.2	7.3	7.3	7.2	7.1	7.1	7.0	7.2
Avg.	7.6	7.7	7.8	7.6	7.6	7.6	7.7	7.6	7.7

TABLE

WATER QUALITY **BACK BAY AREA**

EAST STATION pH MAY 1958 TO DECEMBER 1961

DATE	A	B	C	D	E	F	G	G_1	AVG. A-G_1
5/20/58	7.2	7.4	-	7.2	7.4	7.4	7.4	-	7.3
6/3	7.8	8.0	-	7.4	7.4	7.2	7.4	-	7.5
6/16	8.3	7.6	-	8.2	8.4	8.2	8.2	6.8	8.0
6/30	8.2	8.2	-	8.2	8.1	7.8	8.4	8.4	8.2
7/14	6.8	6.8	-	7.6	7.6	7.6	7.6	7.6	7.4
7/28	7.6	7.6	-	7.8	7.8	8.0	8.2	8.2	7.9
8/11	8.3	8.4	-	7.7	7.8	7.9	8.4	7.2	8.0
8/26	7.6	7.6	-	7.4	7.3	8.4	8.4	7.3	7.7
7/9	8.2	8.4	-	8.4	8.0	8.4	8.4	8.0	8.2
9/22	8.0	7.8	-	8.2	8.0	8.4	8.4	7.3	8.0
10/5	7.6	7.8	-	7.6	7.6	7.8	8.0	7.6	7.7
10/24	7.3	7.5	-	7.7	7.5	7.6	8.1	7.2	7.6
11/10	7.2	7.2	-	7.5	7.5	7.3	7.4	7.0	7.3
11/24	7.3	7.4	-	7.3	7.3	7.4	7.6	7.2	7.4
12/8	7.2	7.2	-	7.2	7.2	7.2	7.2	7.2	7.2
12/23	7.4	7.4	-	7.4	7.3	7.3	7.2	7.0	7.3
1/21/59	7.2	7.2	-	7.2	7.2	7.2	7.2	7.0	7.2
2/12	7.2	7.3	-	7.4	7.3	7.3	7.4	7.2	7.3
3/3	7.2	7.2	-	7.2	7.3	7.2	7.3	7.2	7.2
3/24	7.2	7.2	-	7.2	7.2	7.2	7.2	7.2	7.2
4/15	7.2	7.2	-	7.2	7.4	7.4	7.4	7.2	7.3
5/3	7.4	7.4	-	7.3	7.3	7.2	7.4	7.2	7.3
6/4	7.4	8.4	-	8.0	8.0	8.0	8.4	7.6	8.0
7/6	8.8	8.5	-	7.8	7.6	8.2	8.4	7.6	8.1
8/5	9.2	9.2	-	8.2	8.6	9.2	8.6	8.8	8.8
9/9	8.6	8.5	-	8.4	8.8	8.6	8.2	7.6	8.4
10/2	7.8	7.6	-	7.0	7.2	7.2	8.0	7.0	7.4
11/10	7.3	7.6	-	7.3	8.1	7.9	8.0	7.7	7.7
12/2	7.3	7.2	-	7.8	7.8	7.7	7.8	7.4	7.6
1/5/60	7.0	7.2	-	7.8	7.6	7.6	7.6	7.8	7.5
2/9	7.9	7.9	-	7.8	7.8	7.8	7.8	8.0	7.9
3/24	7.8	7.8	-	7.4	7.4	7.4	7.4	7.4	7.5
4/6	7.6	7.4	-	7.3	7.3	7.2	7.2	7.3	7.3
5/3	7.6	7.8	-	7.8	8.0	8.1	8.0	7.6	7.8
6/14	7.5	7.5	-	8.2	7.8	8.5	9.0	8.1	8.1
7/1	7.8	8.0	-	7.4	7.4	8.0	8.4	7.4	7.8
8/1	8.1	8.1	-	8.2	8.7	9.4	9.0	7.7	8.5
9/1	8.7	8.6	-	8.5	8.9	8.8	9.0	7.7	8.6
9/14	7.2	7.2	-	7.2	7.4	7.6	7.8	7.8	7.5
10/4	7.2	7.4	-	7.4	8.2	7.8	7.8	7.2	7.6
11/2	7.8	7.8	-	7.8	7.9	7.8	7.7	7.8	7.8
12/22	7.5	7.6	-	7.5	7.4	7.4	7.2	7.4	7.4
1/13/61	7.6	7.6	-	7.5	7.6	7.6	7.6	7.7	7.6
2/7	7.9	7.8	-	7.8	8.3	8.2	8.1	8.3	8.1
3/27	8.0	8.0	-	7.8	7.8	7.7	7.6	7.9	7.8
4/20	8.0	8.0	-	7.8	7.8	7.9	7.8	8.1	7.9
5/19	8.0	8.0	-	7.9	8.0	7.8	7.7	7.8	7.9
6/26	8.2	8.2	-	8.2	8.0	8.0	8.4	8.2	8.2
7/19	7.3	8.8	-	8.1	8.0	8.8	8.8	8.5	8.3
8/17	7.8	8.2	-	8.2	8.1	8.0	8.1	8.3	8.1
AVG.	7.7	7.8	-	7.7	7.7	7.8	7.9	7.6	7.7

TABLE

WATER QUALITY **BACK BAY AREA**

WEST STATION pH JANUARY 1962 TO AUGUST 1963

DATE	A	B	C	D	E	F	G	G_1	AVG. A-G_1
4/6/62	6.7	6.0	5.9	6.0	6.1	6.1	6.1	6.5	6.2
4/14	6.5	6.4	6.0	6.0	6.2	6.2	6.3	6.5	6.3
4/19	7.2	7.2	7.1	7.2	7.5	7.5	7.5	7.5	7.3
4/26	7.1	7.1	7.3	7.4	7.6	7.6	7.7	7.6	7.4
5/4	7.1	7.1	7.3	7.4	7.5	7.5	7.6	7.7	7.4
5/11	8.2	9.3	8.7	7.9	7.8	7.4	7.0	6.6	7.9
5/18	7.1	7.2	7.6	7.7	7.6	7.6	7.5	7.7	7.5
7/3	7.3	8.3	7.7	7.4	7.6	7.3	7.5	8.0	7.6
7/20	7.4	8.4	7.8	7.3	7.8	7.2	7.5	7.9	7.7
8/26	7.1	7.9	8.7	7.8	8.0	8.2	8.7	9.0	8.2
9/25	7.6	7.3	7.7	7.8	7.8	7.8	8.0	8.0	7.7
10/17	7.4	7.2	7.4	7.4	7.7	8.2	8.0	8.1	7.7
10/30	7.6	7.3	7.3	7.2	7.4	7.5	7.6	7.9	7.5
12/4	7.2	7.2	7.2	7.5	7.6	7.6	7.6	7.7	7.5
1/17/63	7.8	7.8	7.7	8.1	7.7	7.6	7.6	7.6	7.7
3/4	7.6	7.3	7.4	7.7	7.6	7.6	7.5	7.7	7.5
3/29	7.2	7.2	7.2	7.1	7.0	7.2	7.1	7.1	7.1
5/22	7.1	7.1	7.0	6.9	7.0	7.0	7.0	7.1	7.0
6/19	7.4	7.1	7.1	7.1	6.9	7.1	7.1	7.1	7.1
7/29	6.6	6.5	6.8	6.5	6.5	6.5	6.5	6.6	6.6
AVG.	7.3	7.3	7.3	7.3	7.3	7.3	7.4	7.5	7.3

TABLE

WATER QUALITY **BACK BAY AREA**

MIDDLE STATION pH JANUARY 1962 TO AUGUST 1963

DATE	A	B	C	D	E	F	G	G_1	AVG. A-G_1
4/6/62	6.6	5.9	5.8	5.9	6.1	6.1	6.4	6.5	6.2
4/14	6.5	6.0	5.8	5.8	6.2	6.2	6.3	6.4	6.2
4/19	7.2	7.1	7.1	7.2	7.4	7.4	7.4	7.4	7.3
4/26	7.1	7.2	7.3	7.4	7.6	7.6	7.6	7.9	7.5
5/4	7.0	7.2	7.3	7.4	7.4	7.6	7.5	7.8	7.4
5/11	9.1	9.7	8.8	8.1	8.0	7.2	7.1	5.2	7.9
5/18	7.1	7.4	7.7	7.7	7.6	7.6	7.6	7.7	7.6
7/3	7.3	8.3	8.1	7.5	7.6	7.6	8.1	7.8	7.8
7/20	7.5	8.5	8.1	7.6	7.4	7.4	8.2	7.9	7.8
8/26	7.2	8.0	8.1	8.2	8.2	8.3	8.8	9.1	8.2
9/25	7.6	7.8	7.7	7.7	8.0	7.8	7.3	7.9	7.7
10/17	7.3	7.3	7.4	7.4	8.2	8.3	8.3	8.1	7.8
10/30	7.5	7.3	7.3	7.3	7.5	7.5	7.7	8.0	7.5
12/4	7.1	7.2	7.2	7.5	7.5	7.6	7.6	-	7.4
1/17/63	7.8	7.9	7.4	7.6	7.6	7.6	7.6	7.7	7.6
3/4	7.6	7.4	7.4	7.6	7.5	7.5	7.6	7.8	7.6
3/29	7.2	7.2	7.1	7.1	7.2	7.1	7.1	7.2	7.2
5/22	7.0	7.1	7.0	6.9	7.0	7.0	7.0	7.0	7.0
6/19	7.2	7.1	7.1	6.9	7.0	7.1	7.0	7.2	7.1
7/29	6.8	6.5	6.7	6.6	6.6	6.6	6.5	6.5	6.6
AVG.	7.3	7.4	7.3	7.3	7.4	7.4	7.4	7.4	7.4

TABLE

WATER QUALITY **BACK BAY AREA**

EAST STATION pH JANUARY 1962 TO AUGUST 1963

DATE	A	B	C	D	E	F	G	G_1	AVG. A-G_1
4/6/62	6.7	5.8	-	5.9	5.9	6.0	6.4	6.8	6.2
4/14	6.6	5.7	-	6.0	6.0	6.1	6.2	6.8	6.2
4/19	7.2	7.2	-	7.2	7.3	7.4	7.4	7.4	7.3
4/26	7.1	7.2	-	7.4	7.5	7.5	7.6	7.9	7.3
5/4	7.1	7.3	-	7.4	7.5	7.5	7.6	7.8	7.5
5/11	9.2	9.3	-	7.6	7.0	7.4	7.2	4.6	7.5
5/18	7.1	7.5	-	7.7	7.6	7.6	7.6	7.9	7.6
7/3	7.5	8.1	-	7.9	8.3	-	8.4	7.6	8.0
7/20	7.5	8.2	-	7.7	8.4	8.3	8.6	8.0	8.1
8/26	7.4	8.4	-	8.7	9.0	8.9	9.4	8.5	8.6
9/25	7.6	7.7	-	8.2	8.3	8.1	8.3	7.0	7.9
10/17	7.2	7.4	-	7.5	8.0	8.1	8.4	8.1	7.8
10/30	7.5	7.4	-	7.4	7.5	7.6	7.7	8.1	7.6
12/4	7.1	7.2	-	7.6	7.5	7.6	7.6	-	7.4
1/17/63	7.8	7.2	-	7.8	7.7	7.7	7.6	7.7	7.6
3/4	7.4	7.4	-	7.7	7.6	7.5	7.5	7.8	7.6
3/29	7.2	7.2	-	7.0	7.2	7.1	7.1	7.3	7.2
5/22	7.1	6.9	-	7.0	6.9	7.0	7.0	7.1	7.0
6/19	7.0	7.0	-	7.0	7.1	7.1	7.1	7.3	7.1
7/29	6.8	6.7	-	6.5	6.7	6.9	6.8	6.5	6.7
AVG.	7.3	7.3	-	7.4	7.5	7.4	7.6	7.4	7.4

TABLE

WATER QUALITY **CURRITUCK SOUND AREA**

WEST STATION pH MAY 1958 TO DECEMBER 1961

DATE	H	I	J	K	L	M	N	O	AVG. H-O	P	Q	R	S	AVG. P-S
5/20/58	-	-	-	-	-	7.2	7.5	7.4	7.4	7.3	7.4	7.7	7.7	7.5
6/30	7.3	7.5	7.8	7.0	7.4	7.2	6.7	6.8	7.2	7.2	6.9	6.7	6.7	6.9
7/14	6.2	6.6	6.4	6.3	6.3	6.2	6.7	7.1	6.5	7.0	6.9	6.7	6.4	6.8
7/28	6.9	7.0	7.0	6.9	6.8	7.2	7.1	7.9	7.1	7.9	7.5	7.5	7.5	7.6
8/11*	6.9	7.5	7.3	6.9	7.1	7.3	7.1	6.1	7.0	6.2	6.3	5.7	6.1	6.1
8/25*	6.9	6.7	6.3	6.4	6.3	6.9	7.0	6.9	6.7	7.3	7.1	6.9	7.3	7.2
9/9*	6.2	6.0	6.1	5.8	5.8	6.0	6.2	6.0	6.0	6.4	6.2	5.8	5.9	6.1
10/6*	6.3	6.5	6.3	5.7	6.0	5.6	6.0	6.2	6.1	8.6	8.0	8.4	6.1	7.8
10/14	8.5	8.4	8.0	8.4	8.4	8.8	7.2	8.4	8.3	8.1	8.2	8.0	7.7	8.0
10/30	7.3	7.4	7.4	7.5	7.5	7.1	7.8	7.9	7.5	7.3	7.2	7.6	7.6	7.4
11/11	6.9	7.4	7.8	7.0	7.2	6.8	6.8	9.4	7.4	6.6	6.7	7.4	7.1	7.0
11/26	7.3	7.8	8.0	7.2	7.0	6.8	7.7	7.8	7.4	7.4	7.9	7.4	7.4	7.5
12/19	-	7.0	6.7	7.2	6.9	6.7	-	7.4	7.0	7.2	7.3	7.2	7.0	7.2
12/30	7.1	7.1	7.1	7.2	7.8	6.7	6.9	7.2	7.1	7.6	7.6	7.2	7.2	7.4
1/21/59	-	6.7	6.7	6.6	6.9	6.8	6.9	7.0	6.8	7.1	8.0	7.7	7.5	7.6
2/13	7.2	7.2	7.1	7.0	7.2	6.5	7.2	7.5	7.1	7.5	7.7	7.2	7.2	7.4
3/5	6.9	7.1	6.6	6.9	6.3	7.1	6.7	6.6	6.8	7.1	7.2	7.3	7.3	7.2
4/15	7.0	7.4	7.1	7.1	7.5	6.6	8.4	7.8	7.4	7.6	7.6	7.6	7.5	7.5
5/7	8.3	8.4	8.4	7.6	7.4	7.2	7.5	8.8	8.0	8.0	8.4	7.4	7.4	7.8
6/9	8.6	7.2	8.6	7.7	8.2	7.2	7.6	8.7	8.0	8.5	8.3	8.0	7.7	8.1
7/9	8.8	9.0	9.0	8.0	8.3	7.8	8.6	8.7	8.5	7.9	8.0	7.6	7.8	7.8
9/23	9.1	9.2	8.8	8.9	8.8	-	8.8	8.8	8.9	8.5	8.9	-	7.7	8.4
10/7	8.2	8.4	8.8	7.6	8.6	7.1	-	-	8.1	-	-	8.1	7.6	7.8
11/24	7.3	7.5	7.3	7.2	7.4	7.6	7.8	7.7	7.5	8.0	8.0	8.1	7.7	8.0
12/10	7.3	7.3	7.3	7.2	7.5	7.5	7.7	7.9	7.5	7.9	8.0	7.9	7.9	7.9
1/14/60	7.3	7.4	7.3	7.5	7.4	7.1	7.7	7.7	7.4	7.7	7.7	7.7	7.7	7.7
2/9	7.3	7.3	7.3	7.2	7.3	7.3	7.5	7.3	7.3	7.5	7.5	7.5	7.5	7.5
3/28	7.5	7.6	7.6	7.4	7.8	7.4	7.8	7.6	7.6	7.7	7.7	7.5	7.5	7.6
4/13	7.8	7.8	7.7	7.6	7.8	7.8	7.8	8.0	7.8	7.8	7.8	8.0	7.9	7.9
5/10	7.1	7.1	7.3	7.5	7.5	7.1	7.9	7.3	7.4	7.5	7.7	7.7	7.7	7.6
6/14	7.1	7.2	7.0	7.4	7.0	7.0	7.6	7.6	7.2	7.9	7.7	7.6	7.0	7.6
7/8	7.9	8.3	8.1	7.3	7.9	7.5	7.9	8.3	7.9	7.7	7.5	7.7	7.6	7.6
8/3	7.9	8.1	8.5	7.1	8.3	7.5	8.2	8.4	8.0	8.1	7.6	7.5	7.6	7.7
9/29	7.9	8.1	7.3	7.3	7.5	7.3	7.7	7.3	7.6	7.5	7.4	7.6	7.3	7.4
10/26	7.9	8.0	8.0	8.1	8.0	7.8	7.8	7.5	7.9	7.7	7.7	7.7	7.5	7.6
11/11	7.4	7.4	7.9	7.9	7.6	7.4	7.6	7.5	7.6	7.4	7.5	7.2	7.2	7.3
12/21	7.8	7.8	7.9	8.2	7.9	7.8	7.8	7.5	7.8	7.4	7.7	7.6	7.3	7.5
1/24/61	-	-	-	7.8	-	7.5	-	-	7.6	-	-	-	-	-
2/10	7.5	7.5	7.6	7.7	7.8	7.4	7.8	7.4	7.6	7.4	7.4	7.4	7.3	7.4
3/24	7.4	7.8	7.4	7.6	7.4	7.3	7.6	7.5	7.5	7.6	7.5	7.4	7.3	7.4
4/19	7.6	7.6	7.4	7.4	7.4	7.4	7.4	7.2	7.4	7.1	7.1	6.9	6.9	7.0
5/19	7.2	7.2	7.3	7.5	7.3	7.2	8.1	8.1	7.5	8.0	8.0	7.9	7.9	8.0
6/12	7.6	7.4	7.5	7.7	7.6	7.6	7.6	7.5	7.6	7.3	7.3	7.4	7.3	7.3
7/12	7.4	7.3	7.0	7.3	7.4	7.5	8.2	8.1	7.5	7.5	8.0	7.5	7.6	7.6
8/7	7.6	7.7	7.5	7.6	7.7	7.4	7.8	7.8	7.6	7.7	7.3	7.2	7.2	7.4
AVG.	7.5	7.5	7.5	7.3	7.4	7.2	7.5	7.6	7.4	7.6	7.6	7.4	7.3	7.5

*Questionable data.

TABLE

WATER QUALITY **CURRITUCK SOUND AREA**

MIDDLE STATION pH MAY 1958 TO DECEMBER 1961

DATE	H	I	J	K	L	M	N	O	AVG. H-O	P	Q	R	S	AVG. P-S
5/20/58	-	-	-	-	-	7.3	7.4	7.4	7.4	7.3	7.5	7.7	7.7	7.6
6/30	7.3	7.4	7.7	7.2	7.5	7.1	6.9	6.7	7.2	6.9	6.7	6.8	6.5	6.7
7/14	6.3	6.6	6.7	6.2	6.2	6.3	7.1	7.1	6.6	7.1	7.0	6.8	6.2	6.8
7/28	7.3	7.2	7.5	6.9	6.9	7.0	6.8	7.5	7.1	7.5	7.7	7.5	7.7	7.6
8/11*	7.5	7.5	7.1	7.1	7.1	7.3	7.1	6.1	7.1	5.6	6.2	6.3	5.9	6.0
8/25*	6.9	6.7	6.3	6.8	6.3	6.4	7.2	7.1	6.7	7.1	7.3	7.1	6.9	7.1
9/9*	6.1	6.0	6.1	-	6.1	5.8	5.4	6.0	5.9	6.2	5.9	5.9	6.2	6.0
10/6*	6.4	6.5	6.6	5.5	5.8	5.7	5.9	6.1	6.1	8.5	8.2	8.2	6.0	7.7
10/14	8.4	8.1	8.4	8.2	8.0	8.6	7.2	8.4	8.2	7.9	7.3	7.8	7.7	7.7
10/30	7.2	7.5	7.8	7.2	7.2	7.3	7.7	8.1	7.5	7.9	8.0	7.9	7.9	7.9
11/11	7.0	7.4	7.9	7.0	7.3	6.9	7.0	7.7	7.3	6.5	6.6	7.4	7.4	7.0
11/26	7.6	7.9	8.2	-	7.2	7.1	7.2	7.6	7.5	7.6	7.5	7.3	7.3	7.4
12/19	-	7.4	7.0	6.8	6.8	6.6	6.9	7.0	6.9	7.0	7.0	7.0	7.3	7.1
12/30	8.0	8.1	7.3	7.6	7.1	6.8	6.9	7.3	7.4	7.0	6.9	7.0	7.4	7.1
1/21/59	-	6.5	6.7	6.6	7.0	7.0	6.9	7.0	6.8	7.6	7.6	7.6	7.6	7.6
2/13	7.2	7.1	7.0	6.8	7.2	6.8	7.6	7.5	7.2	7.3	7.4	7.3	7.3	7.3
3/5	6.9	6.9	7.2	6.8	6.7	6.9	6.9	6.6	6.9	7.3	7.2	7.4	7.1	7.2
4/15	8.6	7.8	6.2	7.3	7.2	7.3	8.2	7.8	7.6	7.5	7.8	7.9	7.4	7.6
5/7	8.1	8.7	8.5	7.5	7.6	7.5	7.7	8.8	8.0	8.0	8.2	7.6	7.6	7.8
6/9	8.6	7.2	8.8	7.5	-	7.8	7.8	8.7	8.1	8.5	8.7	7.9	7.5	8.2
7/9	8.9	9.0	8.8	7.8	8.5	7.6	8.9	8.4	8.5	7.8	7.8	8.0	7.9	7.9
9/23	9.3	9.0	8.9	8.7	8.8	-	8.8	8.8	8.9	8.5	8.5	8.2	7.8	8.2
10/7	8.3	8.4	8.0	7.7	8.6	7.3	-	-	8.0	-	-	8.0	7.6	7.8
11/24	7.5	7.5	7.2	7.5	7.7	7.5	7.8	7.9	7.6	8.9	8.0	8.1	7.9	8.2
12/10	7.3	7.4	7.5	7.2	7.3	7.2	7.9	7.8	7.4	7.8	8.0	7.9	7.8	7.9
1/14/60	7.3	7.5	7.5	7.2	7.8	7.3	7.5	7.5	7.4	7.7	7.8	7.7	7.7	7.7
2/9	7.3	7.1	7.3	7.2	7.3	7.1	7.5	7.3	7.3	7.4	7.5	7.6	7.6	7.5
3/28	7.5	7.8	7.6	7.8	7.8	7.4	7.8	7.8	7.7	7.7	7.6	7.4	7.4	7.5
4/13	7.7	7.6	7.8	8.1	8.0	7.8	7.8	7.9	7.8	7.9	7.9	8.0	7.9	7.9
5/10	7.1	7.3	7.5	7.7	7.7	7.3	7.9	7.7	7.5	7.8	7.5	7.5	7.5	7.6
6/14	7.1	7.0	7.1	7.4	7.4	7.4	8.2	7.5	7.4	7.8	7.6	7.2	7.1	7.4
7/8	8.3	8.3	8.3	7.5	8.3	8.3	8.1	8.3	8.2	8.3	7.9	7.9	7.7	8.0
8/3	8.2	8.1	8.7	7.2	8.3	7.5	7.5	8.4	8.0	8.3	7.7	7.5	7.3	7.7
9/29	7.9	8.1	7.9	7.4	7.6	7.5	7.9	8.0	7.8	7.5	7.5	7.5	7.4	7.5
10/26	7.9	8.0	7.9	8.0	7.9	8.0	8.0	7.5	7.9	7.5	7.7	7.5	7.5	7.6
11/11	7.4	7.4	7.4	7.8	7.7	7.5	7.7	7.7	7.6	7.5	7.6	7.3	7.3	7.4
12/21	7.9	7.7	7.8	8.1	8.1	7.8	8.0	7.5	7.9	7.4	7.6	7.3	7.2	7.6
1/24/61	-	-	-	7.6	-	7.4	-	-	7.5	-	-	-	-	-
2/10	7.4	7.5	7.4	7.5	7.7	7.3	7.6	7.5	7.5	7.4	7.3	7.4	7.2	7.3
3/24	7.7	7.4	7.5	7.7	7.3	7.4	7.5	7.5	7.5	7.6	7.5	7.2	7.3	7.4
4/19	7.4	7.5	7.6	7.6	7.3	7.5	7.3	7.3	7.4	7.2	7.2	6.9	7.0	7.1
5/19	7.4	7.3	7.4	7.5	7.2	7.2	8.1	7.9	7.5	8.0	7.9	7.9	7.8	7.9
6/12	7.5	7.3	7.4	7.6	7.4	7.5	7.4	7.4	7.4	7.4	7.3	7.2	7.2	7.3
7/12	7.6	7.4	7.6	7.2	7.0	7.2	7.8	8.1	7.5	8.2	7.6	7.4	7.9	7.8
8/7	7.6	7.5	7.4	7.7	7.6	7.4	7.8	7.6	7.6	7.5	7.2	7.2	7.3	7.3
AVG.	7.6	7.5	7.5	7.4	7.4	7.2	7.5	7.6	7.5	7.6	7.5	7.5	7.3	7.5

*Questionable data.

TABLE

WATER QUALITY — **CURRITUCK SOUND AREA**

EAST STATION — pH — MAY 1958 TO DECEMBER 1961

DATE	H	I	J	K	L	M	N	O	AVG. H-O	P	Q	R	S	AVG. P-S
5/20/58	-	-	-	-	-	7.6	7.2	7.4	7.4	7.3	7.5	7.6	7.7	7.5
6/30	7.4	7.6	8.0	7.3	7.7	7.5	6.9	6.7	7.4	6.6	6.4	6.9	6.7	6.6
7/14	6.8	6.7	6.4	6.3	6.8	6.6	7.1	6.9	6.7	7.3	7.1	6.8	6.7	7.0
7/28	7.6	7.8	8.3	7.3	8.1	6.9	7.6	8.1	7.7	7.3	7.7	7.7	7.7	7.6
8/11*	7.5	8.3	7.9	-	7.7	7.3	7.7	-	7.7	6.1	6.4	6.1	6.1	6.2
8/25*	6.3	6.4	6.6	6.5	6.3	6.6	7.0	7.3	6.6	7.1	6.9	7.1	6.9	7.0
9/9*	5.9	6.1	6.1	-	5.9	6.0	-	6.0	6.0	6.2	5.9	6.1	5.8	6.0
10/6*	5.8	6.1	6.7	6.0	6.0	5.6	6.2	6.0	6.0	9.0	7.9	8.1	6.0	7.8
10/14	8.9	8.4	8.3	8.2	8.2	8.4	8.4	8.2	8.4	8.1	7.8	7.8	8.0	7.9
10/30	7.4	7.8	7.9	6.5	7.3	7.4	7.7	8.6	7.6	8.0	8.3	8.2	7.9	8.1
11/11	7.1	7.6	7.9	6.9	7.4	7.2	7.1	-	7.3	6.7	6.6	7.4	7.4	7.0
11/26	7.4	8.0	8.2	-	7.1	6.8	7.2	7.4	7.4	7.3	7.3	7.4	7.2	7.3
12/19	-	6.8	6.9	6.7	6.9	6.6	7.0	7.0	6.8	6.9	7.1	7.0	6.8	7.0
12/30	7.1	7.0	7.8	7.3	7.3	6.9	7.0	7.5	7.2	7.3	7.0	7.0	6.8	7.0
1/21/59	-	6.6	6.9	6.7	6.9	6.9	6.9	7.0	6.8	7.8	7.6	7.6	7.5	7.6
2/13	7.2	7.4	7.2	6.8	7.2	6.8	7.4	7.2	7.2	7.2	7.4	7.3	7.3	7.3
3/5	-	7.3	7.0	7.0	7.2	6.9	6.5	6.6	6.9	7.0	7.4	7.4	7.4	7.3
4/15	-	7.2	8.4	7.1	-	7.6	8.0	7.8	7.7	7.6	7.9	7.8	7.8	7.8
5/7	8.2	8.6	8.2	7.5	7.6	7.9	8.4	9.2	8.2	7.6	7.0	7.2	7.8	7.4
6/9	9.2	7.2	8.6	8.1	8.7	7.8	8.9	8.8	8.4	8.7	8.4	8.3	7.6	8.2
7/9	9.0	9.0	9.2	8.2	9.1	7.7	8.6	8.4	8.6	8.2	8.0	7.9	7.8	8.0
9/23	9.0	9.0	9.0	8.8	8.8	-	8.8	9.0	8.9	8.7	8.4	8.2	7.8	8.3
10/7	8.1	8.5	8.7	7.5	8.7	7.5	-	-	8.2	-	-	7.9	8.1	8.0
11/24	7.5	7.5	7.4	7.6	7.6	7.6	7.8	7.8	7.6	7.8	8.0	8.0	7.7	7.9
12/10	7.2	7.4	7.3	7.4	7.4	7.5	8.0	7.8	7.5	7.8	7.9	7.9	7.9	7.9
1/14/60	7.3	7.6	7.3	7.5	7.2	7.1	7.5	7.8	7.4	7.6	7.6	7.5	7.8	7.6
2/9	7.5	7.3	7.4	7.1	7.5	7.1	7.5	7.3	7.3	7.5	7.5	7.6	7.5	7.5
3/28	7.6	7.6	7.6	7.7	7.8	7.4	7.8	7.8	7.7	7.8	7.7	7.4	7.2	7.5
4/13	7.7	7.6	7.6	7.9	7.9	7.9	7.6	7.8	7.8	7.8	7.8	8.0	8.0	7.9
5/10	7.3	7.3	7.5	7.5	7.7	7.3	7.7	7.7	7.5	7.7	7.5	7.5	7.5	7.6
6/14	7.1	6.8	6.9	7.5	8.0	6.8	7.8	7.9	7.4	7.4	7.9	7.7	8.3	7.8
7/8	8.5	8.1	8.3	7.3	8.3	7.3	8.1	7.3	7.9	8.3	8.1	8.1	7.9	8.1
8/3	8.6	8.3	8.6	7.1	8.8	7.3	8.2	8.3	8.2	8.5	7.7	7.7	7.7	7.9
9/29	8.1	7.7	8.1	7.3	7.7	7.3	8.1	7.9	7.8	7.9	7.7	7.6	7.3	7.6
10/26	8.0	7.9	7.9	8.0	8.1	7.8	7.9	7.9	7.9	7.7	7.7	7.7	7.5	7.6
11/11	7.3	7.4	7.4	7.8	7.8	7.6	7.6	7.6	7.6	7.5	7.5	7.4	7.4	7.4
12/21	7.8	7.9	7.8	8.1	8.1	7.8	8.0	7.8	7.9	7.7	7.5	7.5	7.1	7.4
1/24/61	-	-	-	7.6	-	7.6	-	-	7.6	-	-	-	-	-
2/10	7.5	7.5	7.4	7.6	7.7	7.3	7.7	7.5	7.5	7.4	7.4	7.3	7.4	7.4
3/24	7.4	7.3	7.4	7.7	7.4	7.6	7.5	7.5	7.5	7.5	7.6	7.5	7.3	7.5
4/19	7.6	7.6	7.6	7.5	7.5	7.5	7.4	7.4	7.5	7.2	7.1	7.0	7.0	7.1
5/19	7.2	7.4	7.2	7.4	7.3	7.3	8.0	7.9	7.5	7.9	7.9	7.9	7.8	7.9
6/12	7.4	7.5	7.3	7.5	7.4	7.6	7.5	7.5	7.5	7.3	7.3	7.2	7.1	7.2
7/12	7.2	7.4	7.5	7.2	7.3	7.3	7.7	8.2	7.5	8.2	8.0	8.0	7.6	8.0
8/7	7.7	7.7	7.5	7.5	7.6	7.5	7.6	7.8	7.6	7.8	7.4	7.2	7.2	7.4
AVG.	7.6	7.5	7.7	7.4	7.6	7.3	7.6	7.6	7.5	7.6	7.5	7.5	7.4	7.5

*Questionable data.

WATER QUALITY

CURRITUCK SOUND AREA

JANUARY 1962 TO AUGUST 1963

TABLE

WEST STATION

pH

DATE	H	I	J	K	K_1	L	M	N	O	AVG. H-O	P	Q	R	S	AVG. P-S
5/31/62	7.1	8.0	8.0	8.2	7.8	8.1	7.5	7.8	7.9	7.8	7.8	7.9	7.9	7.7	7.8
6/15	-	7.4	7.2	7.4	7.2	7.4	7.1	7.7	7.9	7.4	7.4	7.9	8.0	7.4	7.7
7/5	8.4	7.6	7.2	7.3	7.1	7.8	7.6	7.8	7.7	7.6	7.6	7.8	8.0	7.8	7.8
8/2	7.8	7.4	7.8	-	7.9	7.1	7.8	8.0	7.7	7.7	8.0	7.7	7.9	7.9	7.9
9/25	8.1	-	-	-	-	-	-	-	-	8.1	-	-	-	-	-
10/30	7.6	-	-	-	-	-	-	-	-	7.6	-	-	-	-	-
1/17/63	7.6	7.4	7.4	7.6	-	7.4	7.3	7.8	7.8	7.5	7.8	7.8	-	7.7	7.8
3/4	7.5	-	-	-	-	-	-	-	-	7.5	-	-	-	-	-
AVG.	7.7	7.6	7.5	7.6	7.5	7.6	7.5	7.8	7.8	7.6	7.7	7.8	8.0	7.7	7.8

TABLE

MIDDLE STATION

5/31/62	7.5	7.9	8.1	7.6	8.1	8.0	7.5	7.9	7.9	7.8	8.0	8.0	7.9	7.6	7.9
6/15	-	7.4	7.4	7.4	7.2	7.3	7.2	7.9	7.9	7.5	7.9	7.7	7.7	8.0	7.8
7/5	8.5	7.8	7.7	7.4	7.5	7.8	7.5	7.7	7.6	7.7	7.8	7.5	7.7	7.7	7.7
8/2	7.8	7.8	7.8	7.9	7.4	7.1	7.8	7.8	7.6	7.7	7.7	7.6	7.8	7.6	7.7
9/25	8.0	-	-	-	-	-	-	-	-	8.0	-	-	-	-	-
10/30	7.7	-	-	-	-	-	-	-	-	7.7	-	-	-	-	-
1/17/63	7.5	7.4	7.4	7.6	7.4	7.4	7.3	7.9	8.0	7.5	7.9	7.9	-	7.6	7.8
3/4	7.5	-	-	-	-	-	-	-	-	7.5	-	-	-	-	-
AVG.	7.8	7.7	7.7	7.6	7.5	7.5	7.5	7.8	7.8	7.7	7.9	7.7	7.8	7.7	7.8

TABLE

EAST STATION

5/31/62	7.7	7.6	7.4	8.2	8.0	7.5	7.5	7.8	7.9	7.7	7.8	8.0	7.8	7.9	7.9
6/15	-	7.2	7.4	7.5	7.6	7.5	7.1	7.8	7.8	7.5	7.6	7.9	7.7	7.8	7.7
7/5	8.2	7.4	7.8	7.4	7.8	7.4	7.5	7.7	7.7	7.7	7.7	7.9	7.7	7.6	7.7
8/2	8.1	7.6	7.7	7.5	7.9	7.2	7.8	7.5	7.9	7.7	7.8	8.0	7.8	8.0	7.9
9/25	8.7	-	-	-	-	-	-	-	-	8.7	-	-	-	-	-
10/30	7.7	-	-	-	-	-	-	-	-	7.7	-	-	-	-	-
1/17/63	-	7.4	7.4	7.4	7.4	7.4	7.4	7.9	7.8	7.5	7.9	7.8	-	7.6	7.8
3/4	7.4	-	-	-	-	-	-	-	-	7.4	-	-	-	-	-
AVG.	8.0	7.4	7.5	7.6	7.7	7.4	7.5	7.7	7.8	7.7	7.8	7.9	7.8	7.8	7.8

WATER QUALITY TABLE NO. Back Bay Area

West Station M. O. Alkalinity (ppm) May 1958 to December 1961

	A	B	C	D	E	F	G	G1	Avg. A-G1
11/24/58	24	26	22	26	24	28	26	24	25
12/8*									
12/23*									
1/21/59	24	30	28	28	30	30	30	30	29
2/12	22	22	24	24	24	24	26	24	24
3/3	20	24	22	22	24	26	22	20	22
3/24	20	24	20	20	22	18	20	20	20
4/15	18	18	18	20	20	18	20	20	19
5/3	20	22	22	22	22	20	22	22	22
6/4	28	26	26	22	26	22	22	22	24
7/6	30	28	28	28	30	26	30	20	28
8/5	34	34	28	30	30	30	26	22	29
9/9	34	30	30	30	30	30	32	22	30
10/2	38	32	36	32	30	32	38	30	34
11/2	24	22	28	28	28	26	32	26	27
12/2	28	26	26	26	26	28	28	26	27
1/5/60	28	26	26	28	26	26	26	28	27
2/9	20	20	22	24	22	22	22	22	22
3/24	18	24	22	20	18	18	18	22	20
4/6	18	20	20	18	20	24	26	24	21
5/3	26	30	28	34	30	30	32	36	31
6/14	28	28	30	26	26	30	26	26	28
7/1	34	38	32	32	32	32	32	30	33
8/1	38	38	40	34	32	32	28	36	35
9/1	32	38	48	48	52	44	44	48	44
9/14	28	22	28	26	28	28	28	32	28
10/4	34	40	38	38	44	40	42	46	40
11/2	30	40	32	32	36	30	36	32	34
12/22	28	32	34	36	30	32	38	32	33
1/13/61	20	32	34	40	36	28	30	30	31
2/7/61	28	30	38	38	34	30	30	34	33
3/27	22	28	38	38	44	52	50	54	41
4/20	34	36	30	48	40	40	42	66	42
5/19	40	34	46	48	52	48	50	48	46
6/26	36	36	34	32	30	28	34	32	33
7/19	35	25	36	38	38	33	40	38	35
Avg.	28	29	30	30	30	30	31	31	30

* See Middle Station Data.

WATER QUALITY TABLE NO. Back Bay Area

Middle Station M. O. Alkalinity (ppm) May 1958 to December 1961

	A	B	C	D	E	F	G	G_1	Avg. A-G
11/24/58	26	26	24	24	26	28	26	26	26
12/8	28	28	30	32	28	30	30	28	29
12/23	32	30	-	26	26	24	26	20	26
1/21/59	24	28	28	32	30	30	30	28	29
2/12	22	22	24	24	24	22	24	20	23
3/3	22	20	22	22	22	22	22	22	22
3/24	20	24	20	18	18	20	20	20	20
4/15	16	18	18	20	20	18	22	18	19
5/3	20	22	18	24	20	22	24	24	22
6/4	26	26	26	26	22	22	22	24	24
7/6	34	28	28	26	30	30	30	18	28
8/5	28	26	26	30	26	26	26	24	26
9/9	34	30	26	34	30	28	28	20	29
10/2	38	34	36	34	32	32	36	32	34
11/2	26	26	28	28	28	22	30	24	26
12/2	28	28	30	30	30	28	28	26	28
1/5/60	26	24	30	26	26	28	28	24	26
2/9	16	22	22	24	26	24	22	22	22
3/24	16	24	20	22	20	20	20	20	20
4/6	18	22	20	22	18	24	28	22	22
5/3	28	32	30	36	32	34	34	34	32
6/14	24	26	26	24	28	24	24	24	25
7/1	34	32	28	30	28	30	28	28	30
8/1	36	34	36	34	36	26	28	34	33
9/1	34	40	50	50	40	40	46	46	43
9/14	22	28	28	26	26	30	34	36	29
10/4	34	38	42	40	36	38	46	38	39
11/2	30	34	34	36	34	34	34	34	34
12/22	32	32	30	32	32	32	38	28	32
1/13/61	28	30	32	34	34	34	34	32	32
2/7	38	32	30	38	34	32	30	40	34
3/27	24	32	38	30	30	42	52	50	37
4/20	30	34	34	38	36	38	38	40	36
5/19	44	42	38	44	48	54	56	58	48
6/26	36	34	36	34	34	30	38	36	35
7/19	26	30	34	36	38	39	45	35	35
Avg.	28	29	29	30	29	29	31	29	29

WATER QUALITY
East Station

TABLE NO.
M. O. Alkalinity (ppm)

Back Bay Area
May 1958 to December 1961

	A	B	C	D	E	F	G	G_1	Avg. A - G
11/24/58	26	24	-	26	26	28	28	22	26
12/8*									
12/23*									
1/21/59	26	34	-	30	30	30	32	30	30
2/12	18	22	-	24	24	26	40	22	25
3/3	20	20	-	22	26	24	24	24	23
3/24	22	20	-	20	18	20	20	18	20
4/15	18	18	-	20	22	20	18	22	20
5/3	24	24	-	22	22	26	28	22	24
6/4	26	26	-	26	26	24	32	20	26
7/6	30	28	-	30	34	34	36	20	30
8/5	34	30	-	32	30	28	26	22	29
9/9	32	30	-	40	32	30	32	22	31
10/2	40	34	-	40	36	36	34	34	36
11/2	28	26	-	22	32	30	40	28	29
12/2	26	32	-	28	30	32	30	28	29
1/5/60	24	30	-	28	28	30	36	24	29
2/9	22	22	-	24	24	24	28	22	24
3/24	18	20	-	20	22	22	22	18	20
4/6	20	18	-	20	22	30	22	24	22
5/3	26	32	-	34	30	36	32	34	32
6/14	30	28	-	30	28	26	28	26	28
7/1	30	34	-	34	34	34	32	30	33
8/1	34	32	-	36	32	30	36	34	33
9/1	40	46	-	54	50	44	48	46	47
9/14	30	32	-	28	30	34	32	30	32
10/4	36	40	-	48	48	50	50	40	46
11/2	30	36	-	36	20	38	48	30	34
12/22	30	30	-	36	34	34	42	24	33
1/13/61	30	34	-	34	34	32	38	26	33
2/7	34	32	-	34	32	32	32	30	32
3/27	26	36	-	36	26	48	54	60	41
4/20	34	32	-	34	36	42	52	60	41
5/19	42	46	-	50	52	54	56	28	47
6/26	38	32	-	36	40	42	40	30	37
7/19	31	34	-	36	42	44	40	30	37
Avg.	29	30	-	32	31	33	35	29	31

* See Middle Station data.

TABLE

WATER QUALITY **BACK BAY AREA**

WEST STATION M. O. ALKALINITY (ppm) JANUARY 1962 TO AUGUST 1963

DATE	A	B	C	D	E	F	G	G_1	AVG. A-G_1
4/19/62	36	36	40	44	40	40	42	42	40
4/26	20	32	36	38	34	36	54	48	37
5/4	-	-	34	38	32	30	32	24	32
5/11	30	24	26	26	24	22	24	24	25
5/18	32	26	28	28	26	24	28	28	27
6/1	28	26	28	30	24	26	26	34	28
6/15	36	32	36	32	36	34	34	34	34
7/3	50	70	70	66	70	62	58	64	64
7/20	64	40	44	56	44	56	44	46	49
8/26	32	40	60	48	34	36	32	30	39
9/25	40	48	38	36	44	40	50	38	42
10/17	36	48	44	52	50	50	64	56	50
10/30	34	42	46	56	60	64	60	48	51
12/4	40	50	36	40	46	42	46	46	43
1/17/63	44	56	50	66	42	50	46	50	50
3/4	32	30	38	40	36	38	44	40	37
3/29	24	34	28	32	30	34	30	38	31
5/22	22	22	24	20	26	22	26	30	24
6/19	36	28	24	32	20	18	20	22	25
7/29	22	32	24	26	22	28	22	18	24
8/21	20	26	24	24	22	24	32	22	24
AVG.	34	37	37	40	36	37	39	37	37

TABLE

WATER QUALITY **BACK BAY AREA**

MIDDLE STATION M. O. ALKALINITY (ppm) JANUARY 1962 TO AUGUST 1963

DATE	A	B	C	D	E	F	G	G_1	AVG. A-G_1
4/19/62	36	34	40	38	38	40	44	44	39
4/26	28	34	38	38	40	54	50	52	42
5/4	-	40	32	38	-	30	34	22	33
5/11	32	26	26	26	28	22	28	22	26
5/18	34	28	28	24	30	26	30	26	28
6/1	30	30	30	32	30	28	36	36	31
6/15	36	36	34	36	38	36	32	30	35
7/3	48	62	68	64	72	68	62	88	66
7/20	46	196	44	46	60	44	46	38	65
8/26	36	40	54	44	38	32	30	32	38
9/25	40	40	48	38	54	56	40	44	45
10/17	28	36	46	48	62	60	70	48	50
10/30	34	48	48	52	62	74	64	44	53
12/4	32	40	40	46	50	44	48	-	43
1/17/63	38	60	44	44	42	42	42	48	45
3/4	26	32	42	34	44	42	36	38	37
3/29	32	34	22	32	28	40	32	42	33
5/22	22	18	26	26	30	28	30	34	27
6/19	34	20	22	22	18	18	20	20	22
7/29	26	24	24	22	30	26	18	22	24
8/21	22	20	26	22	26	22	32	26	24
AVG.	33	43	37	37	41	40	39	38	38

TABLE

WATER QUALITY **BACK BAY AREA**

EAST STATION M. O. ALKALINITY (ppm) JANUARY 1962 TO AUGUST 1963

DATE	A	B	C	D	E	F	G	G_1	AVG. A-G_1
4/19/62	40	38	-	40	46	44	48	48	43
4/26	32	34	-	40	50	56	50	42	43
5/4	30	50	-	34	38	28	38	26	35
5/11	26	28	-	30	30	32	30	26	29
5/18	24	30	-	32	30	30	34	26	29
6/1	32	36	-	34	36	32	36	28	33
6/15	34	36	-	36	38	38	36	28	35
7/3	64	66	-	68	64	-	64	82	68
7/20	50	42	-	64	52	64	66	32	53
8/26	34	38	-	58	62	74	70	28	52
9/25	46	38	-	40	40	56	58	40	45
10/17	42	46	-	72	68	74	76	44	60
10/30	42	46	-	58	78	76	90	50	63
12/4	36	32	-	36	40	48	40	-	39
1/17/63	42	62	-	40	60	56	80	44	55
3/4	28	34	-	38	42	44	80	40	44
3/29	30	28	-	38	40	42	44	38	37
5/22	22	30	-	38	44	42	40	30	35
6/19	22	26	-	26	24	28	30	30	27
7/29	24	30	-	24	22	30	28	18	25
8/21	30	32	-	26	24	32	38	24	29
AVG.	35	38	-	42	44	46	51	36	42

WATER QUALITY TABLE NO. **Currituck Sound Area**

West Station M. O. Alkalinity (ppm) May 1958 to December 1961

	H	I	J	K	L	M	N	O	Avg. H-O	P	Q	R	S	Avg. P-S
10/29/58	35	35	-	25	-	30	40	35	33	55	55	55	40	51
11/11	40	50	30	30	50	30	50	50	41	60	50	60	40	52
11/26	40	50	80	30	50	40	60	30	48	60	100	60	40	65
12/19	-	80	40	40	160	30	60	80	70	220	30	50	80	95
12/30	80	90	80	90	30	80	60	70	72	80	100	110	100	98
1/21/59	-	60	30	40	30	50	70	60	49	50	60	30	60	50
2/13	30	20	50	40	30	30	20	40	32	30	50	30	40	38
3/5	30	20	10	50	50	20	30	30	30	40	40	50	50	45
4/15	30	50	30	40	30	30	70	40	40	40	50	60	50	50
5/7	50	40	40	40	40	30	40	40	40	40	40	40	40	40
6/9	50	50	50	50	60	40	40	50	49	50	50	50	60	52
7/9	30	40	40	20	50	30	50	60	40	50	50	50	60	52
8/11	30	40	40	30	30	20	30	20	30	50	30	40	30	38
9/23	40	50	50	30	60	40	40	30	42	40	50	40	20	38
10/7	60	30	60	30	-	40	60	50	47	50	50	50	40	48
11/24	30	30	30	50	30	30	40	40	35	30	40	40	40	38
12/10	40	30	30	30	20	40	50	40	35	40	40	30	40	38
1/14/60	25	25	20	20	30	20	25	25	24	30	25	25	30	28
2/9	15	35	20	15	20	20	25	30	22	20	20	15	20	19
3/28	10	15	10	15	10	15	15	15	13	20	20	20	20	20
4/13	20	10	25	25	20	20	15	15	16	15	15	20	20	18
5/10	15	20	15	10	15	15	15	20	16	15	20	15	25	19
6/14	25	25	25	25	25	20	30	30	26	30	35	30	35	32
7/8	25	25	30	40	25	25	30	35	29	30	25	35	25	29
8/3	35	35	35	25	35	25	40	35	33	40	40	40	25	36
9/29	30	30	30	20	30	30	40	40	31	50	45	50	35	45
10/26	35	35	30	20	25	40	40	40	33	45	50	40	25	40
11/11	35	35	30	40	25	30	40	35	34	45	40	40	40	41
12/21	25	20	20	20	30	30	30	35	26	40	35	40	35	38
1/24/61	-	-	-	35	-	20	-	-	28	-	-	-	-	-
2/10	25	20	20	25	20	20	20	20	21	25	25	30	30	28
3/24	25	30	25	20	20	20	25	25	24	25	25	30	25	26
4/19	25	30	25	25	20	20	30	25	25	30	30	25	35	28
5/19	25	25	20	20	25	20	20	20	22	20	30	30	30	28
6/12	25	30	25	25	20	30	25	30	26	30	35	30	25	30
7/12	25	25	30	25	25	10	25	30	24	35	35	30	25	31
8/7	30	25	30	25	25	30	35	40	30	35	35	35	40	36
Avg.	32	35	33	31	34	29	37	36	33	43	41	40	38	41

WATER QUALITY TABLE NO. Currituck Sound Area

Middle Station M. O. Alkalinity (ppm) May 1958 to December 1961

	H	I	J	K	L	M	N	O	Avg. H - O	P	Q	R	S	Avg. P - S
10/29/58	35	35	-	30	40	-	45	45	38	40	45	55	55	49
11/11	30	30	50	30	40	40	50	70	42	50	50	50	60	52
11/26	50	50	50	-	40	40	50	60	49	60	60	90	60	68
12/19	-	30	30	100	30	30	150	140	73	200	100	60	40	100
12/30	80	110	80	130	-	40	50	50	77	50	70	70	70	65
1/21/59	-	50	30	30	50	50	70	70	50	50	50	50	60	52
2/13	30	30	30	30	20	20	40	40	30	30	30	30	40	32
3/5	20	40	10	10	20	40	20	40	25	40	30	40	50	40
4/15	40	20	40	40	30	40	30	40	35	50	50	40	40	45
5/7	40	40	50	40	50	40	40	40	42	40	50	30	50	42
6/9	50	60	50	50	60	40	50	40	50	50	60	40	50	50
7/9	50	40	40	30	50	40	50	60	45	50	50	50	50	50
8/11	30	40	30	60	30	20	20	30	32	20	40	30	-	30
9/23	40	30	40	30	40	40	40	50	39	40	50	50	20	40
10/7	30	50	-	50	40	40	50	50	44	60	50	40	50	50
11/24	50	40	50	20	30	30	20	50	36	40	40	30	40	38
12/10	30	30	30	30	30	50	30	30	32	30	40	40	50	40
1/14/60	25	35	20	15	15	35	30	25	25	30	30	30	30	30
2/9	25	15	20	20	20	10	20	20	19	20	20	20	20	20
3/28	10	10	20	10	15	15	15	15	14	15	15	15	20	16
4/13	15	15	15	15	15	20	15	20	16	20	20	20	25	21
5/10	20	15	15	15	15	10	25	20	17	15	20	20	30	21
6/14	25	25	25	25	30	35	30	30	28	30	30	40	35	34
7/8	25	25	30	30	25	25	35	35	29	40	35	30	25	32
8/3	35	35	35	25	45	30	30	35	34	40	40	35	35	38
9/29	30	30	30	30	30	35	35	50	34	45	50	50	55	50
10/26	40	40	30	25	30	40	35	45	36	50	55	50	35	48
11/11	35	40	35	30	30	25	35	25	32	45	40	35	35	39
12/21	30	25	30	25	20	25	25	30	26	40	40	40	40	40
1/24/61	-	-	-	25	-	30	-	-	28	-	-	-	-	-
2/10	20	25	20	25	20	20	20	20	21	25	25	30	30	28
3/24	25	25	25	20	25	20	25	25	24	25	30	30	30	29
4/19	20	30	25	25	25	25	25	30	26	30	35	25	30	30
5/19	25	20	20	25	25	25	25	25	24	25	25	25	35	28
6/12	25	30	30	25	25	25	30	30	28	35	30	35	30	32
7/12	25	30	3[illegible]	25	35	35	30	30	30	35	30	35	30	32
8/7	30	30	35	30	35	25	35	35	32	35	40	40	40	39
Avg.	32	34	32	33	31	31	37	40	34	42	41	39	40	40

WATER QUALITY TABLE NO. Currituck Sound Area

East Station M. O. Alkalinity (ppm) May 1958 to December 1961

	H	I	J	K	L	M	N	O	H-O(Avg.)	P	Q	R	S	P-S (Avg.)
10/29/58	35	50	35	30	35	40	45	-	39	50	35	45	45	44
11/11	40	40	50	40	50	30	50	60	45	70	70	50	50	60
11/26	40	60	50	-	50	30	60	60	50	50	100	90	70	78
12/19	-	100	30	20	80	20	50	-	50	100	150	200	210	185
12/30	80	190	-	50	70	60	70	70	84	40	40	40	60	45
1/21/59	-	40	50	50	50	30	50	60	47	80	50	20	60	52
2/13	40	40	40	40	30	20	30	50	36	20	40	40	40	35
3/5	-	30	-	10	30	30	50	30	30	30	40	40	40	38
4/15	-	30	50	30	-	30	60	90	48	40	30	50	50	42
5/7	30	40	50	40	40	40	50	40	41	40	40	40	40	40
6/9	50	40	50	60	50	60	50	50	51	40	50	60	50	50
7/9	40	110	40	30	40	40	40	60	50	40	50	60	40	48
8/11	50	20	30	30	30	20	60	40	35	30	30	30	30	30
9/23	30	50	40	40	50	50	80	40	48	50	40	70	40	50
10/7	40	40	30	60	30	50	60	30	42	80	40	40	40	50
11/24	40	50	40	40	30	40	30	50	40	30	30	50	30	35
12/10	20	20	30	40	30	50	30	40	32	40	40	50	50	45
1/14/60	30	35	20	15	25	20	30	30	26	30	30	30	30	30
2/9	30	20	15	15	20	15	20	20	19	20	15	20	20	19
3/28	15	15	15	10	15	15	10	15	14	15	15	20	20	18
4/13	15	15	15	15	15	15	15	20	16	20	20	20	20	20
5/10	25	25	20	15	20	15	30	15	20	20	20	25	30	24
6/14	35	25	30	25	30	35	35	30	31	25	25	35	40	31
7/8	25	30	35	25	30	25	30	35	29	35	35	35	35	35
8/3	30	40	40	35	45	105	50	40	48	45	35	40	25	36
9/29	30	30	35	25	30	35	50	45	35	50	45	55	50	50
10/26	40	30	40	25	25	25	45	45	34	45	40	40	50	44
11/11	35	40	40	25	30	25	35	40	34	50	40	45	45	45
12/21	30	20	35	25	35	25	35	30	29	40	35	40	40	39
1/24/61	-	-	-	30	-	30	-	-	30	-	-	-	-	-
2/10	30	30	35	25	35	20	35	25	29	30	20	30	25	26
3/24	25	25	25	20	25	20	30	25	24	25	30	30	30	29
4/19	25	30	25	20	25	25	25	25	25	20	30	25	25	25
5/19	25	25	25	25	25	10	30	25	24	30	30	25	25	28
6/12	30	30	30	30	30	25	30	25	29	30	35	35	25	31
7/12	30	30	30	30	25	25	30	35	29	30	35	30	35	32
8/7	30	35	35	25	15	30	45	30	31	40	35	40	35	38
Avg.	33	41	34	30	34	32	41	39	36	42	40	44	43	42

TABLE

WATER QUALITY

WEST STATION

M. O. ALKALINITY (ppm)

CURRITUCK SOUND AREA

JANUARY 1962 TO AUGUST 1963

DATE	H	I	J	K	K_1	L	M	N	O	AVG. H-O	P	Q	R	S	AVG. P-S
5/18/62	30	40	40	30	25	45	30	30	45	35	40	50	45	40	44
5/31	30	35	35	25	25	35	30	40	50	34	45	50	35	40	42
6/15	35	40	45	15	35	35	35	50	50	38	50	45	35	45	44
7/5	60	35	30	20	45	30	25	30	40	35	35	35	20	35	31
7/20	30	25	30	20	35	50	30	35	145	44	35	45	55	50	46
8/2	35	35	35	-	25	30	35	45	50	36	35	35	40	30	35
8/27	35	35	35	20	30	35	25	50	60	36	55	50	50	30	46
10/15	70	45	40	30	25	35	40	45	50	42	55	50	50	40	49
11/21	70	35	30	30	-	40	35	45	50	42	40	-	-	-	40
12/9	-	-	-	-	-	-	-	25	30	27	30	45	50	-	42
1/17/63	45	30	35	25	-	25	30	30	30	31	35	35	-	35	35
3/4	45	-	--	30	-	30	25	5	20	26	25	25	30	25	26
4/22	-	-	-	-	-	-	-	45	35	40	-	-	-	-	-
5/3	-	40	35	35	30	30	30	-	-	33	-	35	45	30	37
5/27	35	40	40	40	35	50	40	40	40	40	45	40	40	50	44
6/24	20	25	25	30	25	25	25	25	30	26	40	35	40	40	39
8/21	35	30	35	30	30	30	50	60	50	39	45	40	50	35	42
AVG.	41	35	35	27	30	35	32	37	48	36	41	41	42	37	40

TABLE

WATER QUALITY
MIDDLE STATION

M. O. ALKALINITY (ppm)

CURRITUCK SOUND AREA
JANUARY 1962 TO AUGUST 1963

DATE	H	I	J	K	K_1	L	M	N	O	AVG. H-O	P	Q	R	S	AVG. P-S
5/18/62	40	45	50	30	40	45	35	40	45	41	35	50	35	30	37
5/31	35	45	35	25	30	50	25	50	50	38	40	40	40	45	41
6/15	40	25	35	25	35	30	30	50	25	33	45	50	40	35	42
7/5	60	35	30	25	25	40	20	35	35	34	25	25	35	25	27
7/20	30	30	40	25	30	25	40	80	45	38	55	35	45	55	47
8/2	50	25	45	25	25	65	45	35	45	40	40	40	50	35	41
8/27	35	35	35	25	25	35	25	50	55	36	50	50	50	50	50
10/15	70	35	45	30	-	30	30	45	50	42	55	60	50	40	51
11/21	70	35	30	40	-	50	35	40	40	42	50	-	-	-	50
12/9	-	--	- -	- -	-	-	-	-	30	30	35	40	45	-	40
1/17/63	50	30	30	25	25	25	20	25	25	28	30	35	-	40	35
3/4	40	-	-	25	-	15	25	15	25	24	25	25	25	25	25
4/22	-	-	-	-	-	-	-	45	25	35	-	-	-	-	-
5/3	-	30	35	30	-	35	30	-	-	32	40	35	40	45	40
5/27	35	50	35	45	35	45	40	35	35	39	45	50	40	40	44
6/24	20	20	25	25	25	20	25	25	40	25	35	40	40	40	39
8/21	35	45	40	40	45	35	-	40	50	41	45	50	45	35	44
AVG.	44	35	37	29	31	37	30	41	39	35	41	42	41	39	41

TABLE

WATER QUALITY
EAST STATION

M. O. ALKALINITY (ppm)

CURRITUCK SOUND AREA
JANUARY 1962 TO AUGUST 1963

DATE	H	I	J	K	K_1	L	M	N	O	AVG. H-O	P	Q	R	S	AVG. P-S
5/18/62	25	40	40	25	40	45	35	50	45	38	45	-	45	40	43
5/31	40	50	40	30	35	50	35	55	45	42	40	40	35	40	39
6/15	40	35	40	25	40	35	25	55	45	38	45	25	35	35	35
7/5	65	40	35	20	30	40	20	40	35	36	30	30	25	35	30
7/20	40	45	40	35	30	30	20	60	50	39	55	45	55	40	49
8/2	40	45	40	35	30	45	40	40	50	41	40	40	45	40	41
8/27	30	35	30	20	30	55	30	55	65	39	45	60	55	55	54
10/25	85	45	45	30	35	40	35	55	60	48	55	50	45	40	47
11/21	75	40	35	-	-	40	35	50	45	46	45	50	-	-	47
12/9	-	-	-	-	-	-	-	-	-	-	30	40	-	40	37
1/17/63	-	35	35	25	20	25	25	45	25	29	30	30	-	-	30
3/4	40	-	-	25	-	20	20	40	35	30	35	25	30	30	30
4/22	-	-	-	-	-	-	-	45	45	45	-	-	-	-	-
5/3	-	40	35	25	35	35	25	-	-	32	40	45	45	35	41
5/27	40	40	45	-	35	45	30	40	45	40	50	50	50	40	47
6/24	25	25	25	25	20	25	30	30	35	27	30	40	40	30	35
8/21	40	30	45	40	25	50	40	45	50	41	50	50	50	35	46
AVG.	45	39	38	28	31	39	30	47	45	38	42	41	43	38	41

TABLE NO. _____

WATER QUALITY — Back Bay Area

West Station — Secchi Disc/ Depth — May 1958 to December 1961

	A	%	B	%	C	%	D	%	E	%	F	%	G	%	G1	%	Avg. %
5/20/58	23/48	48	27/40	56	22/48	46	15/54	28	16/48	33	13/42	31	22/30	73	-	-	45
6/3	33/43	77	33/42	79	28/48	58	11/54	20	8/48	17	8/54	15	9/48	19	-	-	41
6/16	21/21	100	20/36	56	27/43	63	23/48	48	23/30	77	28/36	78	23/36	64	23/36	64	69
6/30	30/36	83	30/42	71	26/36	72	22/42	52	23/48	48	28/48	58	31/54	57	24/36	67	64
7/14	41/42	97	30/42	71	37/54	69	22/48	46	20/48	42	26/54	48	31/48	64	24/42	57	62
7/28	39/42	93	40/42	95	42/48	88	24/54	44	23/48	48	28/54	52	23/48	48	29/30	97	71
8/11	30/30	100	39/39	100	43/43	100	23/48	48	23/42	55	24/48	50	31/42	74	35/35	100	78
8/26	42/42	100	9/48	19	44/48	92	24/60	40	24/54	44	26/54	48	28/48	58	29/42	69	70
9/9	25/36	69	47/47	100	40/40	100	21/54	39	22/42	52	29/42	69	22/36	61	32/32	100	74
9/22	34/34	100	38/38	100	40/40	100	22/54	41	25/42	60	29/48	60	30/42	71	31/36	86	77
10/5	19/24	79	25/36	69	23/42	55	8/54	15	7/42	17	7/48	15	7/42	17	7/36	19	36
10/24	12/22	54	11/34	32	13/40	33	10/52	19	9/42	21	14/30	47	14/36	39	21/30	70	39
11/10	28/38	65	30/41	71	29/37	60	14/54	26	14/35	29	16/38	30	16/46	33	18/36	43	45
11/24	21/21	100	38/38	100	41/41	100	24/54	44	23/42	55	17/48	35	26/42	62	25/36	69	71
12/8	39/39	100	17/40	43	14/36	39	14/48	29	14/36	39	15/24	63	15/30	50	18/28	64	53
12/23	13/39	33	14/40	35	-	-	10/48	21	10/36	28	11/24	46	10/30	33	12/28	43	34
1/21/59	15/42	36	14/42	33	12/36	33	8/48	17	12/48	25	10/48	21	10/36	28	10/30	33	28
2/12	7/30	23	9/36	25	8/36	22	5/48	10	5/36	14	5/30	17	7/36	19	6/30	20	19
3/3	7/36	19	6/24	25	7/18	39	7/36	19	6/30	20	7/48	15	7/30	23	6/18	33	24
3/24	11/36	31	8/24	33	8/24	33	5/42	12	5/36	14	6/30	20	6/36	17	8/24	33	24
4/15	6/24	25	5/36	14	5/30	17	8/42	19	7/36	19	7/24	29	6/36	17	9/24	38	22
5/3	23/55	42	18/50	36	25/49	51	11/54	20	12/56	21	10/44	23	14/48	29	20/42	47	34
6/4	34/48	71	48/48	100	36/36	100	20/36	56	23/48	48	26/36	72	28/42	67	34/34	100	77
7/6	40/49	82	39/44	89	37/37	100	15/47	32	15/40	38	26/36	72	32/40	80	25/32	78	71
8/5	36/48	75	30/45	89	40/40	100	25/46	54	27/27	100	30/30	100	33/39	85	30/30	100	88
9/9	35/35	100	43/43	100	41/41	100	21/42	50	19/42	45	20/41	49	30/44	68	36/36	100	77
10/2	55/55	100	42/42	100	35/47	74	23/57	40	18/54	33	18/46	39	24/52	46	40/45	89	65
11/1	30/30	100	32/42	76	35/35	100	14/36	39	13/43	30	13/31	42	14/37	38	18/27	67	62
12/2	43/43	100	32/38	84	26/41	63	24/48	50	22/46	48	21/35	60	25/43	58	9/34	26	61
1/5/60	28/53	53	17/45	38	14/47	30	14/51	27	14/53	26	14/42	33	20/48	42	13/38	34	35
2/9	10/56	18	8/54	15	7/48	15	7/51	14	8/50	16	9/40	23	8/49	16	9/39	23	18
3/24	12/36	33	8/42	19	7/42	17	6/45	13	6/48	13	6/25	24	6/42	14	7/31	23	20
4/6	12/28	43	12/48	25	12/36	33	11/54	20	11/48	23	10/48	21	7/48	15	10/36	28	26
5/3	12/36	33	12/48	25	13/36	36	6/48	13	7/36	19	7/42	17	6/43	14	6/36	17	22
6/14	19/34	56	33/44	75	42/42	100	18/48	38	19/44	43	13/37	35	21/40	53	32/32	100	63
7/1	44/44	100	40/40	100	43/43	100	32/50	64	22/49	45	25/43	58	36/44	82	30/37	81	79
8/1	32/45	71	40/40	100	46/46	100	28/54	52	26/50	52	25/41	61	26/42	62	36/36	100	75
9/1	21/48	44	47/47	100	45/45	100	35/50	70	29/49	59	30/39	77	25/46	54	39/39	100	76
9/14	13/60	22	9/50	18	18/56	32	15/62	24	19/61	31	19/57	33	14/50	28	48/48	100	36
10/4	22/38	58	37/37	100	36/46	78	25/50	50	26/49	53	21/40	53	23/38	61	34/34	100	69
11/2	29/29	100	13/34	35	37/37	100	22/43	51	23/40	58	25/29	86	21/35	60	26/26	100	74
12/22	13/31	42	12/28	43	11/36	31	11/41	27	12/42	29	11/31	35	8/35	23	11/28	39	34
1/13/61	13/41	32	14/37	38	12/23	52	15/39	38	12/32	38	10/24	42	13/30	43	13/24	54	42
2/7	9/34	26	5/24	21	9/28	32	6/40	15	6/40	15	4/35	11	6/34	18	5/23	22	20
3/27	6/52	12	8/37	22	11/43	26	7/53	13	6/50	12	6/45	13	8/41	20	8/33	24	18
4/20	7/44	16	10/45	22	10/50	20	10/36	28	6/47	13	6/53	11	6/47	13	7/44	16	17
5/19	15/47	32	12/41	29	32/43	74	23/43	53	17/44	39	12/38	32	9/41	22	21/37	57	42
6/26	26/56	46	26/44	59	30/47	64	17/56	30	17/53	32	25/40	63	29/47	62	35/39	90	56
7/19	21/43	49	34/36	94	36/48	75	18/66	27	20/48	42	27/48	56	38/48	79	40/40	100	65
8/17	32/36	89	37/37	100	39/39	100	28/46	61	28/36	78	28/35	80	29/43	67	34/34	100	84
10/5																	
11/6	38/38	100	45/45	100	30/30	100	18/44	41	24/24	100	34/34	100	28/36	78	30/30	100	90
AVG.		62		60		64		34		38		44		46		64	51

WATER QUALITY: TABLE NO. ___

Middle Station — Secchi Disc/Depth — Back Bay Area, May 1958 to December 1961

	A	%	B	%	C	%	D	%	E	%	F	%	G	%	G1	%	% Avg.
5/20/58	35/35	64	25/60	42	24/24	100	16/72	22	20/84	25	21/72	29	23/48	48	-	-	47
6/3	30/		30/		24/		15/		22/		7/		12/		-	-	-
6/16	39/60	65	25/60	42	21/30	70	25/53	47	35/66	53	28/60	47	33/36	92	27/27	100	64
6/30	42/60	70	23/60	38	24/30	80	26/60	43	36/72	50	38/66	56	40/40	100	35/35	100	67
7/14	53/66	80	37/66	56	34/36	94	27/54	50	21/78	27	33/72	46	32/48	67	32/36	89	64
7/28	58/60	97	43/66	65	33/36	92	29/60	48	27/72	38	33/60	55	33/42	78	33/36	92	71
8/11	60/60	100	44/60	73	30/30	100	28/60	47	35/72	49	30/60	50	41/42	98	33/33	100	77
8/26	68/68	100	69/69	100	38/38	100	29/66	44	33/84	39	34/72	47	48/48	100	40/42	95	78
9/9	64/66	94	58/58	100	27/27	100	31/48	65	31/72	43	25/60	42	32/36	89	31/31	100	79
9/22	58/58	100	58/58	100	30/30	100	29/60	48	32/72	44	27/66	41	40/40	100	34/34	100	79
10/5	17/60	28	13/60	22	23/23	100	11/60	18	11/72	15	9/53	17	12/36	33	35/35	100	42
10/24	7/		13/		13/		12/		12/60	20	15/53	28	15/36	42	17/30	57	37
11/10	17/61	28	24/56	43	32/36	89	14/58	24	12/72	17	15/82	18	15/38	39	30/40	75	42
11/24	33/		39/		31/31	100	25/		31/		31/		31/		17/		-
12/8	17/		16/		15/		15/		15/		14/		21/		16/		-
12/23	8/		11/		-		8/		10/		9/		9/		14/		-
1/21/59	9/60	15	13/60	22	13/36	36	9/53	17	8/66	12	10/72	14	9/36	25	10/30	33	22
2/12	9/60	15	8/60	13	8/24	33	9/60	15	8/60	13	6/36	17	7/30	23	9/24	38	21
3/3	7/48	14	7/48	14	7/12	58	7/42	17	6/48	12	8/36	22	6/24	25	6/24	25	23
3/24	7/48	14	8/48	17	7/12	58	7/48	14	6/48	12	7/36	19	8/30	27	8/24	33	24
4/15	7/48	14	5/48	10	6/12	50	6/48	17	5/52	10	5/42	12	4/24	17	8/30	27	20
5/3	26/65	40	24/67	36	22/42	52	20/77	26	15/81	18	14/82	17	17/39	44	18/42	43	34
6/4	32/60	53	52/66	79	30/36	83	33/72	46	35/78	45	32/48	67	30/42	71	36/36	100	68
7/6	36/63	57	39/65	60	26/26	100	31/62	50	36/64	56	35/46	76	34/34	100	32/32	100	75
8/5	42/56	75	47/59	80	32/32	100	27/66	41	31/72	43	30/72	42	33/33	100	30/30	100	73
9/9	62/62	100	62/62	100	30/30	100	37/60	62	35/72	49	36/51	70	35/63	55	37/37	100	80
10/2	62/62	100	68/68	100	40/40	100	33/63	52	30/66	45	27/54	50	30/48	62	37/46	80	74
11/1	23/54	42	26/55	47	22/24	92	19/55	34	18/70	26	13/61	21	14/45	31	26/32	81	47
12/2	35/58	60	31/61	51	19/29	66	18/59	30	18/66	27	23/44	52	21/37	57	22/34	65	51
1/5/60	21/69	30	18/70	26	20/39	51	12/70	17	16/85	19	20/76	26	20/41	49	14/38	37	32
2/9	6/72	8	8/78	10	10/42	24	7/72	10	9/84	11	12/49	24	13/36	36	10/32	31	19
3/24	6/36	17	6/52	12	7/39	18	5/54	9	5/63	8	7/48	15	7/60	12	7/24	29	15
4/6	11/46	24	8/48	17	12/36	33	6/66	9	8/72	11	7/72	10	8/42	19	8/36	22	18
5/3	12/36	33	12/54	22	13/42	31	12/60	20	12/60	20	7/78	9	10/36	28	14/26	54	27
6/14	32/56	57	40/62	64	34/34	100	21/62	34	21/68	31	19/67	28	35/35	100	29/36	81	62
7/1	40/60	67	44/64	69	44/44	100	32/68	47	38/72	53	38/56	68	34/38	89	41/41	100	74
8/1	36/62	58	64/68	94	44/44	100	25/63	40	30/60	50	35/70	50	30/58	52	36/36	100	68
9/1	32/60	53	67/67	100	38/38	100	49/65	75	28/79	35	36/53	68	41/41	100	41/41	100	79
9/14	15/72	21	40/73	55	37/48	77	16/72	22	17/81	21	14/63	22	32/45	71	50/50	100	49
10/4	27/58	46	53/62	85	36/36	100	27/72	38	28/68	41	24/49	49	36/44	82	35/40	88	66
11/2	51/51	100	43/54	80	23/23	100	24/59	41	20/59	34	23/68	34	21/33	64	30/30	100	70
12/22	10/52	19	12/56	21	6/19	32	9/57	16	10/56	18	8/40	20	10/34	29	10/29	34	24
1/13/61	12/50	24	14/54	26	12/25	48	12/47	26	12/60	20	12/51	24	19/33	58	16/28	57	35
2/7	9/46	20	8/48	17	7/25	28	9/44	20	5/65	8	4/63	6	6/30	20	4/23	17	17
3/27	8/62	13	11/63	17	9/33	27	9/57	16	7/72	10	12/56	21	10/42	24	14/35	40	21
4/20	6/58	10	8/71	11	9/42	21	10/70	14	8/72	11	8/58	14	7/50	14	9/43	21	15
5/19	19/52	36	21/53	40	24/35	69	31/58	53	28/73	38	14/52	27	18/42	43	32/38	84	49
6/26	29/65	45	29/68	43	24/39	62	35/62	56	32/80	40	30/60	50	32/46	70	38/44	86	57
7/19	24/55	44	51/70	73	38/38	100	20/65	31	20/73	27	18/85	21	35/43	81	42/42	100	60
8/17	37/59	63	66/66	100	33/33	100	60/60	100	36/72	50	32/47	68	35/35	100	35/35	100	85
10/5																	
11/6	60/60	100	53/64	83	36/36	100	42/78	54	24/69	35	41/72	57	37/46	80	20/20	100	76
12/27	21/65	32	20/66	30	17/74	23	10/64	16	7/74	9	16/68	24	23/31	74	18/46	39	31
Avg.		50		51		73		35		29		35		59		71	50

WATER QUALITY: TABLE NO. Back Bay Area

East Station Secchi Disc/Depth May 1958 to December 1961

	A	%	B	%	C	%	D	%	E	%	F	%	G	%	G_T	%	Avg. %
5/20/58	25/54	46	19/42	45	-	-	24/24	100	21/30	70	17/36	47	23/36	64	-	-	62
6/3	25/		26/		-	-	16/	-	21/	-	15/	-	27/	-	-	-	-
6/16	36/42	86	36/36	100	-	-	22/22	100	26/26	100	27/27	100	29/29	100	33/36	93	97
6/30	40/54	74	33/33	100	-	-	24/24	100	31/31	100	31/31	100	33/33	100	40/40	100	96
7/14	34/	-	36/48	75	-	-	25/	-	24/	-	37/	-	36/36	100	44/44	100	92
7/28	51/60	85	44/44	100	-	-	27/27	100	33/33	100	33/33	100	36/36	100	37/37	100	98
8/11	49/49	100	39/39	100	-	-	22/22	100	32/32	100	30/30	100	32/32	100	36/36	100	100
8/26	59/59	100	48/48	100	-	-	29/29	100	38/42	90	37/37	100	41/41	100	33/42	79	96
9/9	48/48	100	35/35	100	-	-	20/20	100	29/29	100	25/25	100	30/30	100	33/33	100	100
9/22	48/48	100	39/39	100	-	-	20/20	100	32/32	100	30/30	100	33/33	100	30/30	100	100
10/5	24/42	57	23/36	64	-	-	15/18	83	16/24	67	19/24	79	26/30	87	31/36	86	75
10/24	11/	-	18/	-	-	-	15/	-	16/24	67	24/24	100	25/25	100	29/29	100	92
11/10	22/30	73	24/41	59	-	-	18/18	100	14/27	100	23/31	74	24/35	69	28/37	76	72
11/24	34/34	100	38/38	100	-	-	18/	-	22/22	100	26/26	100	31/31	100	34/34	100	100
12/8	17/	-	20/	-	-	-	15/	-	15/	-	17/	-	22/	-	21/	-	-
12/23	13/	-	12/	-	-	-	10/	-	10/	-	11/	-	12/	-	12/	-	-
1/21/59	13/48	27	15/36	42	-	-	10/18	56	11/18	61	11/30	37	12/24	50	9/30	30	43
2/12	8/36	22	9/24	37	-	-	8/18	44	8/48	17	9/24	37	11/24	46	11/30	37	34
3/3	5/18	28	6/18	33	-	-	6/12	50	7/24	29	9/18	50	8/18	44	6/24	25	37
3/24	8/24	33	8/18	44	-	-	8/18	44	6/18	33	8/18	44	8/24	33	8/18	44	39
4/15	6/24	25	6/24	25	-	-	9/12	75	9/24	37	11/18	61	6/24	25	8/24	33	40
5/3	26/26	100	25/51	49	-	-	27/27	100	30/36	83	27/36	75	36/36	100	18/41	44	79
6/4	22/22	100	42/48	88	-	-	24/24	100	28/28	100	31/31	100	32/32	100	35/35	100	98
7/6	48/48	100	43/43	100	-	-	23/23	100	26/26	100	30/30	100	29/29	100	34/34	100	100
8/5	20/20	100	43/43	100	-	-	14/14	100	26/26	100	30/30	100	26/26	100	31/31	100	100
9/9	30/30	100	46/46	100	-	-	18/18	100	30/30	100	32/32	100	33/33	100	37/37	100	100
10/2	24/24	100	48/48	100	-	-	28/28	100	30/36	83	35/35	100	42/42	100	31/44	70	93
11/1	20/20	100	34/39	87	-	-	13/16	81	13/19	68	22/22	100	26/26	100	30/30	100	91
12/2	23/29	79	20/46	43	-	-	19/19	100	19/29	66	31/31	100	32/34	94	18/35	51	76
1/5/60	11/26	42	26/40	65	-	-	21/26	81	15/33	45	17/35	49	23/36	64	16/41	39	55
2/9	9/43	21	14/47	30	-	-	7/22	32	6/32	19	11/34	32	17/35	49	11/40	28	30
3/24	6/24	25	7/38	18	-	-	6/14	43	5/24	21	6/24	25	7/30	23	9/27	33	27
4/6	10/26	38	12/26	46	-	-	10/24	42	6/26	23	11/26	42	11/36	31	12/36	33	36
5/3	12/24	50	14/36	39	-	-	12/18	67	12/24	50	18/24	75	12/30	40	18/18	100	60
6/14	32/32	100	35/35	100	-	-	17/17	100	30/30	100	28/28	100	29/29	100	27/27	100	100
7/1	32/32	100	34/34	100	-	-	18/18	100	27/27	100	28/28	100	34/34	100	32/32	100	100
8/1	30/30	100	36/36	100	-	-	23/23	100	24/24	100	28/28	100	31/31	100	34/34	100	100
9/1	32/32	100	36/36	100	-	-	23/23	100	29/29	100	31/31	100	36/36	100	33/33	100	100
9/14	32/38	84	52/54	96	-	-	30/30	100	19/45	42	18/48	38	47/47	100	23/48	48	73
10/14	33/33	100	38/38	100	-	-	17/17	100	29/29	100	28/28	100	32/32	100	18/30	60	94
11/2	22/22	100	26/26	100	-	-	17/17	100	23/23	100	19/19	100	25/25	100	24/24	100	100
12/22	12/27	44	17/29	59	-	-	11/25	44	10/23	43	11/22	50	12/25	48	10/24	42	47
1/13/61	15/38	39	12/24	50	-	-	14/48	29	14/20	70	15/22	68	20/24	83	15/24	62	57
2/7	10/40	25	7/29	24	-	-	8/15	53	6/21	29	6/25	24	7/20	35	4/25	16	29
3/27	5/41	12	8/35	23	-	-	11/10	58	8/30	27	10/29	34	11/31	35	9/34	26	31
4/20	10/36	28	8/40	20	-	-	15/24	62	17/36	47	15/36	42	8/38	21	11/37	30	36
5/19	27/42	64	40/40	100	-	-	24/24	100	28/33	85	25/32	78	27/34	79	34/38	89	85
6/26	42/42	100	38/46	83	-	-	24/24	100	31/31	100	35/35	100	37/37	100	29/40	72	94
7/19	44/44	100	51/60	85	-	-	29/34	85	24/65	37	38/38	100	36/36	100	32/36	89	85
8/17	37/37	100	32/32	100	-	-	21/21	100	22/22	100	29/29	100	31/31	100	34/34	100	100
10/5																	
11/6	47/47	100	36/36	100	-	-	36/36	100	26/26	100	24/24	100	21/21	100	27/27	100	100
Avg.		72		72		-		83		72		78		80		73	76

TABLE

WATER QUALITY **BACK BAY AREA**

MIDDLE STATION SECCHI DISC/DEPTH JANUARY 1962 TO AUGUST 1963

DATE	A	%	B	%	C	%	D	%	E	%	F	%	G	%	G_1	%	AVG. %
3/22/62	8/60	13	6/48	12	7/34	21	8/78	10	3/74	4	3/67	4	5/44	11	6/38	16	11
3/29	38/62	61	34/66	52	33/33	100	18/62	29	13/74	18	24/73	33	30/32	94	20/37	54	55
4/2	26/72	36	19/76	25	25/42	60	15/73	21	12/90	13	11/86	13	13/48	27	14/47	30	28
4/4	24/62	39	18/61	30	29/33	88	24/70	34	-	-	-	-	-	-	-	-	48
4/6	32/60	53	25/60	42	32/36	89	25/62	40	6/68	9	6/66	9	23/36	64	8/32	25	41
4/14	33/60	55	24/58	41	30/37	81	8/64	12	6/69	9	7/72	10	10/38	26	30/33	91	41
4/19	27/54	50	31/51	61	30/30	100	28/63	44	12/63	19	12/58	21	18/24	75	18/22	82	56
4/26	20/56	36	25/55	45	19/32	59	15/66	23	18/75	24	19/66	29	24/33	73	25/36	69	45
5/4	27/71	38	29/54	34	13/39	33	26/58	45	12/78	15	7/79	9	12/36	33	28/42	67	34
5/11	28/59	47	33/49	67	19/38	50	30/59	51	17/63	27	12/66	18	30/32	94	38/38	100	57
5/18	31/52	60	33/50	66	13/17	76	30/61	49	20/68	29	20/59	34	28/40	70	31/31	100	60
6/1	38/54	70	54/54	100	29/36	81	25/70	36	21/73	29	24/55	44	31/31	100	39/39	100	70
6/15	24/63	38	35/58	60	20/39	51	22/61	36	21/74	28	19/55	35	41/41	100	45/45	100	56
7/3	13/47	28	47/47	100	22/22	100	13/49	27	13/55	24	12/59	20	25/38	66	23/23	100	58
7/20	28/60	47	39/60	65	29/33	88	37/61	61	38/72	53	21/60	35	31/36	86	41/41	100	67
8/2	24/60	40	46/54	85	24/38	63	32/60	53	25/81	31	-	-	-	-	-	-	54
8/26	22/58	38	42/54	78	30/35	86	41/72	57	28/52	54	21/66	32	29/45	64	37/37	100	64
9/25	20/49	41	34/51	67	19/19	100	15/46	33	17/59	29	15/59	25	20/32	62	31/31	100	57
10/17	33/63	52	50/69	72	38/38	100	33/62	53	23/55	42	23/48	48	25/45	56	42/42	100	65
10/30	24/62	39	27/60	45	32/32	100	18/59	30	13/72	18	23/45	51	40/40	100	34/34	100	60
12/4	3/31	10	4/39	10	4/21	19	5/32	16	4/40	10	4/26	15	5/28	18	-	-	14
1/17/63	4/48	8	11/29	38	13/27	48	15/53	28	15/44	34	15/44	34	9/37	24	14/33	42	32
3/4	5/60	8	6/50	12	6/32	19	6/56	11	5/60	8	6/46	13	7/37	19	5/32	16	13
3/29	15/65	23	21/68	31	14/45	31	18/68	26	13/82	16	14/70	20	18/50	36	12/41	29	26
4/18	12/60	20	13/60	22	11/36	31	12/66	18	12/72	17	12/72	17	18/42	43	12/30	40	26
5/22	24/60	40	16/63	25	15/30	50	17/60	28	18/75	24	18/68	26	26/40	65	24/38	63	40
6/19	18/53	34	43/54	80	34/35	97	54/57	95	27/78	35	12/74	16	37/37	100	36/36	100	70
7/29	18/70	26	23/68	34	14/30	47	17/56	30	23/70	33	23/60	38	23/37	62	24/34	71	43
8/21	24/68	35	26/73	36	11/33	33	16/60	27	25/72	35	28/46	61	31/35	89	38/38	100	52
AVG.		37		49		66		35		25		26		61		73	46

TABLE

WATER QUALITY
WEST STATION

SECCHI DISC/DEPTH

BACK BAY AREA
JANUARY 1962 TO AUGUST 1963

DATE	A	%	B	%	C	%	D	%	E	%	F	%	G	%	G_1	%	AVG. %
3/22/62	7/50	14	6/44	14	6/42	14	3/58	5	4/48	8	4/37	11	4/67	6	7/37	19	11
3/29	38/38	100	25/53	47	33/41	80	9/54	17	10/54	19	13/34	38	26/60	43	19/33	58	50
4/2	24/56	43	17/61	28	23/52	44	14/67	21	18/67	27	13/60	22	12/54	22	13/53	25	29
4/4	26/42	62	18/46	39	25/38	66	15/62	24	-	-	-	-	-	-	-	-	48
4/6	24/44	55	32/44	73	32/42	76	6/48	12	6/54	11	7/48	15	29/40	72	9/33	27	43
4/14	26/46	57	34/43	79	32/45	71	7/52	13	9/57	16	10/47	21	9/42	21	31/32	97	47
4/19	28/42	67	25/39	64	30/30	100	17/48	35	11/42	26	14/36	39	20/34	59	33/33	100	61
4/26	25/42	60	26/43	60	24/41	59	13/54	24	14/58	24	18/42	43	21/48	44	19/48	40	44
5/4	25/51	49	24/42	57	28/48	58	19/54	35	13/61	21	7/47	15	9/50	18	37/37	100	44
5/11	20/37	54	25/44	57	34/42	81	13/55	24	10/54	19	9/39	23	28/57	49	36/36	100	51
5/18	20/31	65	23/36	64	24/33	73	31/53	58	24/32	75	21/32	66	21/37	57	25/25	100	70
6/1	37/49	76	39/47	83	29/40	72	23/63	36	25/47	53	24/49	49	23/50	46	32/32	100	64
6/15	12/49	24	35/47	74	33/46	72	21/49	43	20/46	43	15/49	31	20/46	43	39/39	100	54
7/3	16/39	41	39/39	100	34/34	100	9/52	17	12/49	24	15/38	39	17/35	49	22/22	100	59
7/20	25/48	52	41/48	85	43/43	100	23/54	43	30/60	50	21/36	58	26/60	43	36/36	100	66
8/2	11/48	23	48/54	89	47/47	100	24/60	40	21/47	45	-	-	-	-	-	-	59
8/26	13/35	37	35/35	100	42/42	100	11/44	25	13/50	26	11/40	28	28/42	67	25/33	76	57
9/25	18/36	50	37/37	100	35/35	100	17/48	35	16/27	59	13/26	50	19/38	50	17/24	71	64
10/17	23/40	58	41/41	100	46/46	100	20/47	43	20/46	43	22/45	49	24/45	53	29/35	83	66
10/30	20/34	59	33/33	100	39/39	100	13/36	36	17/36	47	13/36	36	17/41	41	31/31	100	65
12/4	3/19	16	4/26	15	5/16	31	9/24	38	4/28	14	5/25	20	4/33	12	5/23	22	21
1/17/63	15/38	39	13/54	24	17/36	47	11/41	27	10/46	22	9/29	31	9/38	24	10/25	40	32
3/4	7/32	22	7/36	19	7/39	18	4/36	11	5/46	11	6/38	16	7/46	15	5/27	19	16
3/29	14/32	44	16/40	40	15/46	33	15/37	41	15/53	28	20/38	53	17/45	38	23/36	64	43
5/22	12/50	24	33/48	69	18/43	42	12/48	25	15/45	33	23/48	48	25/48	52	32/38	84	47
6/19	12/47	26	30/45	67	40/47	85	24/44	55	23/49	47	26/44	59	26/46	57	37/37	100	62
7/29	16/40	40	18/50	36	15/43	35	18/43	42	11/38	29	17/37	46	18/50	36	26/35	74	42
8/21	25/39	64	22/44	50	16/46	35	13/48	27	12/40	30	14/42	33	19/42	45	24/35	69	44
AVG.		47		62		68		30		31		36		41		72	49

TABLE

WATER QUALITY **BACK BAY AREA**

EAST STATION SECCHI DISC/DEPTH JANUARY 1962 to AUGUST 1963

DATE	A	%	B	%	C	%	D	%	E	%	F	%	G	%	G_1	%	AVG. %
3/22/62	20/55	36	18/33	55	-		20/57	35	10/66	15	25/27	93	19/42	45	5/44	11	41
3/29	42/60	70	42/42	100	-		38/42	90	33/33	100	32/32	100	46/46	100	18/33	55	88
4/2	30/71	42	23/53	43	-		22/40	55	12/72	17	19/40	48	22/41	54	18/52	35	42
4/4	28/65	43	28/42	67	-		-	-	-	-	-	-	-	-	-	-	55
4/6	34/66	52	26/48	54	-		22/22	100	30/30	100	33/33	100	27/38	71	28/30	93	81
4/14	36/64	56	26/48	54	-		20/20	100	28/29	97	34/34	100	27/27	100	28/28	100	87
4/19	30/59	51	24/42	57	-		30/46	65	23/25	92	26/33	79	24/33	73	14/20	70	70
4/26	24/60	40	20/41	49	-		18/27	67	30/30	100	29/29	100	25/30	83	35/35	100	77
5/4	37/52	71	39/43	91	-		27/27	100	31/31	100	29/29	100	28/28	100	24/42	57	88
5/11	27/72	38	39/39	100	-		28/28	100	31/31	100	34/34	100	41/41	100	34/34	100	91
5/18	30/52	58	32/32	100	-		19/19	100	26/26	100	24/24	100	34/34	100	27/27	100	94
6/1	35/59	59	34/44	77	-		24/24	100	30/30	100	35/35	100	42/47	89	34/34	100	89
6/15	28/59	47	29/39	74	-		28/28	100	36/36	100	38/38	100	41/44	93	42/42	100	88
7/3	12/49	24	37/37	100	-		16/16	100	29/29	100	-	-	39/39	100	27/27	100	87
7/20	35/48	73	41/41	100	-		28/28	100	33/33	100	35/35	100	47/47	100	40/40	100	96
8/2	49/66	74	48/48	100	-		25/25	100	42/52	81	38/38	100	-	-	-	-	91
8/26	24/24	100	44/44	100	-		17/17	100	27/27	100	26/26	100	27/27	100	28/28	100	100
9/25	23/51	45	46/46	100	-		29/29	100	25/25	100	24/24	100	33/33	100	30/30	100	92
10/27	33/33	100	47/53	89	-		22/22	100	33/33	100	30/30	100	34/34	100	28/28	100	98
10/30	26/26	100	40/47	85	-		14/14	100	29/29	100	25/25	100	26/26	100	26/26	100	98
12/4	3/26	12	3/15	20	-		4/35	11	4/53	8	5/21	24	6/21	29	-	-	17
1/17/63	17/26	65	13/43	30	-		15/18	83	17/22	77	18/21	86	22/22	100	18/28	64	72
3/4	9/33	27	7/47	15	-		7/21	33	6/24	25	6/22	27	11/25	44	5/24	21	27
3/29	13/36	36	17/52	33	-		16/22	73	14/32	44	15/29	52	15/34	44	8/26	31	45
5/22	31/44	70	25/25	100	-		21/21	100	22/28	79	32/32	100	30/32	94	19/38	50	85
6/19	36/49	73	24/24	100	-		24/24	100	30/30	100	32/32	100	32/32	100	36/36	100	96
7/29	31/31	100	23/24	96	-		25/25	100	23/30	77	31/31	100	30/30	100	35/35	100	96
8/21	25/31	81	24/24	100	-		21/21	100	25/25	100	30/30	100	31/31	100	36/36	100	97
AVG.		59		75				86		82		89		85		79	78

WATER QUALITY TABLE NO.____ Currituck Sound Area

West Station Secchi Disc/Depth May, 1958 to December, 1961

	H	%	I	%	J	%	K	%	L	%	M	%	N	%	O	%	Avg.% H-O	P	%	Q	%	R	%	S	%	Avg.% P-S
5/26/58	-	-	13/	-	20/	-	10/	-	16/	-	26/	-	18/	-	16/	-	-	27/	-	35/	-	35/	-	32/	-	-
6/10	-	-	21/	-	15/	-	12/	-	18/	-	23/	-	24/	-	30/	-	-	34/	-	37/	-	36/	-	35/	-	-
6/30	31/48	65	30/30	100	28/28	100	19/48	40	20/20	100	24/30	80	24/36	67	24/24	100	82	32/32	100	32/36	89	30/30	100	31/60	52	85
7/14	36/	-	31/	-	23/	-	21/	-	22/	-	32/	-	35/	-	40/40	100	100	31/	-	30/	-	23/	-	33/	-	-
7/28	36/	-	36/	-	30/	-	25/	-	32/	-	32/	-	33/	-	41/	-	-	36/	-	32/	-	37/	-	32/	-	-
8/11	31/31	100	36/36	100	22/22	100	16/38	42	25/25	100	30/30	100	34/36	94	33/33	100	92	35/35	100	34/36	94	34/42	81	39/48	81	89
8/25	31/	-	27/	-	36/	-	13/	-	15/	-	34/	-	38/	-	-	-	-	41/	-	34/	-	34/	-	36/	-	-
9/9	34/	-	31/31	100	22/	-	17/	-	18/18	100	41/	-	28/	-	32/32	100	100	38/	-	28/	-	28/	-	30/	-	-
10/6	18/24	75	20/20	100	20/20	100	14/48	29	8/18	44	30/30	100	22/22	100	24/30	80	78	36/42	86	35/45	78	34/34	100	25/60	42	76
10/14	25/25	100	32/32	100	29/	-	25/	-	28/	-	24/	-	25/	-	34/	-	100	35/	-	30/	-	30/	-	40/	-	-
10/30	30/	-	32/32	100	25/	-	15/	-	26/	-	20/	-	40/	-	31/	-	100	62/	-	53/	-	55/	-	44/	-	-
11/11	29/66	44	30/36	83	34/34	100	21/66	32	15/	-	24/24	100	36/36	100	32/36	89	78	36/36	100	58/60	97	54/60	90	42/42	100	97
11/26	26/	-	22/	-	22/	-	24/	-	24/24	100	31/	-	40/	-	32/	-	100	34/	-	32/	-	40/40	100	55/	-	100
12/19	-	-	15/	-	18/	-	15/	-	18/	-	22/	-	-	-	25/	-	-	25/	-	22/	-	23/	-	9/	-	-
12/30	13/	-	19/	-	18/	-	11/	-	11/	-	11/	-	19/	-	25/	-	-	25/	-	21/	-	30/	-	35/	-	-
1/21/59	-	-	17/24	71	12/30	40	15/30	50	15/24	62	22/48	46	23/48	48	28/36	78	56	27/60	45	33/48	69	33/36	92	30/48	62	67
2/13	13/27	48	15/31	48	11/30	37	10/62	16	17/23	74	21/50	42	18/72	25	19/30	63	44	17/50	34	19/65	29	28/72	39	30/50	60	40
3/5	13/40	32	10/26	38	14/29	48	13/40	32	13/25	52	17/60	28	14/60	23	13/30	43	37	17/72	24	17/70	24	20/72	28	18/54	33	27
4/15	6/38	16	6/18	33	6/14	43	10/30	33	8/36	22	13/35	37	20/35	29	20/24	83	37	20/43	46	22/72	31	34/72	47	21/38	55	45
5/7	36/48	75	32/36	89	36/36	100	19/66	29	22/36	61	24/30	80	23/48	48	24/24	100	73	34/60	57	40/48	83	40/66	61	60/60	100	75
6/9	48/48	100	30/30	100	36/36	100	26/72	36	32/72	44	45/60	75	36/36	100	40/40	100	82	57/72	79	47/72	65	45/60	75	49/60	82	75
7/9	46/46	100	30/30	100	35/35	100	28/51	55	35/70	50	35/72	49	38/38	100	40/40	100	82	46/72	64	40/72	56	40/62	65	48/	-	62
8/11	52/52	100	36/36	100	38/38	100	21/38	55	33/33	100	35/35	100	41/41	100	30/30	100	94	35/72	49	33/45	73	30/36	83	33/33	100	76
9/23	46/46	100	28/28	100	35/35	100	21/72	29	36/44	82	45/60	75	41/41	100	40/40	100	86	46/72	64	35/35	100	39/72	54	50/50	100	80
10/7	60/60	100	40/40	100	32/46	70	29/50	58	35/65	54	55/72	76	36/36	100	36/36	100	82	48/60	80	41/60	68	43/60	72	46/46	100	80
11/24	9/40	22	27/48	56	9/38	24	19/48	40	16/48	33	21/48	44	22/22	100	21/21	100	52	40/60	66	30/72	42	30/40	75	60/72	83	66
12/10	16/40	40	18/30	60	20/36	55	16/50	32	29/36	81	22/40	55	36/72	50	36/36	100	59	36/36	100	44/78	56	55/55	100	62/72	86	85
1/14/60	16/46	35	15/30	50	15/31	48	16/40	40	21/50	42	30/72	43	34/35	97	30/45	67	53	36/60	60	41/46	89	15/72	21	40/72	56	56
2/9	16/50	32	15/45	33	15/42	36	12/36	33	15/54	28	16/50	32	16/66	24	20/37	54	34	20/66	30	22/48	46	29/36	81	20/66	30	47
3/28	14/48	29	11/34	32	14/36	39	15/40	38	12/40	30	12/60	20	14/70	20	18/30	60	34	20/75	27	15/60	25	10/78	13	10/72	14	20
4/13	15/48	31	14/40	35	14/35	40	14/32	44	15/45	33	15/45	33	20/55	36	25/32	78	41	30/72	42	22/68	32	20/45	44	14/72	19	34
5/10	23/40	58	28/40	70	15/40	38	25/44	57	25/54	46	30/48	62	28/42	67	21/36	58	57	33/72	46	27/54	50	30/54	56	55/84	65	54
6/14	30/30	100	28/28	100	36/36	100	20/60	33	41/52	79	28/60	47	36/42	86	40/45	89	79	45/72	62	45/60	75	48/60	80	45/60	75	73
7/8	40/45	89	45/45	100	35/36	97	20/48	42	34/34	100	50/55	91	20/36	56	42/42	100	84	43/84	51	40/54	74	39/55	71	53/60	88	71
8/3	55/55	100	36/36	100	30/42	71	20/48	42	37/54	69	41/60	68	36/36	100	42/42	100	81	40/78	51	30/66	45	36/72	50	50/72	69	54
9/29	44/44	100	36/36	100	30/36	83	20/30	67	36/40	90	30/60	50	36/36	100	36/36	100	86	30/50	60	20/60	33	22/45	49	38/60	63	51
10/26	45/50	90	40/40	100	35/35	100	20/40	50	34/34	100	37/60	62	35/35	100	21/21	100	88	50/60	83	35/65	54	33/55	60	50/60	83	70
11/11	27/48	56	25/25	100	17/30	57	25/60	42	25/36	69	44/48	92	36/36	100	25/25	100	77	45/60	75	41/48	85	34/36	94	34/54	63	79
12/21	24/48	50	20/20	100	15/35	43	15/48	31	23/36	64	22/48	46	25/60	42	20/36	56	54	22/48	46	21/54	39	36/60	60	30/48	62	52
1/24/61	-	-	-	-	-	-	10/66	15	-	-	25/60	42	-	-	-	-	28	-	-	-	-	-	-	-	-	-
2/10	11/42	26	12/30	40	11/36	31	13/42	31	12/24	50	15/54	28	21/60	35	14/30	47	36	18/72	25	14/48	29	17/36	47	20/60	33	34
3/24	15/54	28	10/42	24	12/36	33	11/66	17	16/60	27	15/60	25	15/48	31	15/48	31	27	21/54	39	16/60	27	16/36	44	21/42	50	40
4/19	8/48	17	12/36	33	13/48	27	12/72	17	14/54	26	18/54	46	25/54	46	15/48	31	29	25/60	42	36/54	67	30/60	50	28/48	58	54
5/19	41/50	82	29/36	81	21/36	58	21/60	35	26/40	65	28/48	58	15/48	31	20/48	42	56	23/54	43	22/60	37	22/54	41	25/60	42	41
6/12	41/54	76	31/36	86	24/36	67	20/48	42	32/42	76	33/72	46	30/30	100	30/48	62	69	32/60	53	30/48	62	25/54	46	27/36	75	59
7/12	45/54	83	36/36	100	30/30	100	15/72	21	35/48	73	36/54	67	20/54	37	30/48	62	68	30/66	45	25/60	42	24/66	36	30/32	94	54
8/7	36/36	100	42/42	100	42/42	100	32/84	38	30/66	83	36/60	60	50/66	76	48/48	100	82	45/66	68	36/54	67	36/36	100	45/60	75	78
11/14	22/22	100	24/30	80	30/30	100	39/84	46	36/36	100	60/60	100	43/54	80	24/24	100	88	55/66	83	42/42	100	30/30	100	66/66	100	96
Avg.		67		78		69		38		65		59		68		81	68		59		59		65		67	63

WATER QUALITY TABLE NO.____ Currituck Sound Area

Middle Station Secchi Disc/Depth May 1958 to December 1961

	H	%	I	%	J	%	K.	%	L	%	M	%	N	%	O	%	Avg. H-O	P	%	Q	%	R	%	S	%	Avg. P-S
5/26/58	-	-	15/	-	20/	-	13/	-	24/	-	18/	-	15/	-	19/	-	-	14/	-	32/	-	30/	-	31/	-	-
6/10	-	-	25/	-	13/	-	16/	-	18/	-	10/	-	19/	-	27/	-	-	34/	-	39/	-	36/	-	34/	-	-
6/30	30/30	100	35/35	100	38/38	100	21/90	23	32/54	59	24/48	50	30/96	31	38/60	63	66	36/48	75	30/66	45	42/96	44	32/90	36	50
7/14	32/	-	34/	-	29/	-	20/	-	25/	-	22/	-	34/	-	36/	-	-	36/36	100	31/	-	32/	-	31/	-	100
7/28	34/	-	30/30	100	34/	-	24/	-	31/	-	29/	-	38/	-	42/	-	100	45/	-	47/	-	40/	-	41/	-	-
8/11	24/24	100	36/36	100	34/34	100	25/84	30	38/82	46	26/30	87	38/84	45	45/60	75	73	42/46	91	45/54	83	39/120	32	36/102	35	60
8/25	28/	-	29/	-	31/	-	25/	-	34/	-	19/	-	42/	-	57/	-	-	39/	-	36/	-	32/	-	40/	-	-
9/9	16/16	100	35/35	100	29/	-	-	-	20/	-	24/	-	33/	-	33/	-	100	42/	-	28/	-	26/	-	33/	-	-
10/6	18/18	100	25/25	100	27/27	100	13/72	18	20/72	28	18/48	38	23/96	24	24/60	40	61	34/36	94	36/56	64	28/90	31	25/108	23	53
10/14	15/15	100	32/32	100	31/31	100	31/	-	32/	-	25/	-	33/	-	36/	-	100	36/	-	31/	-	29/	-	36/	-	-
10/30	27/	-	31/	-	30/	-	20/	-	21/	-	20/	-	41/	-	22/	-	-	31/	-	44/	-	45/	-	43/	-	-
11/11	16/24	67	34/48	71	30/30	100	17/90	19	26/66	39	23/60	38	40/96	42	36/48	75	56	54/78	69	56/66	85	63/120	52	49/90	54	65
11/26	25/	-	28/	-	23/23	100	-	-	28/	-	30/	-	27/	-	30/	-	100	30/	-	24/	-	32/	-	40/	-	-
12/19	-	-	15/	-	17/	-	12/	-	20/	-	12/	-	19/	-	19/	-	-	20/	-	18/	-	16/	-	24/	-	-
12/30	10/	-	8/	-	12/	-	12/	-	12/	-	12/	-	24/	-	19/	-	-	25/	-	30/	-	25/	-	34/	-	-
1/21/59	-	-	14/36	39	16/36	44	10/	-	17/84	20	12/36	33	19/84	23	16/36	44	34	17/36	47	19/48	40	28/60	47	32/108	30	41
2/13	13/28	46	16/20	80	15/32	47	12/92	13	13/30	43	10/34	29	19/65	29	13/50	26	39	15/55	27	11/51	22	21/72	29	28/	-	26
3/5	10/50	20	13/23	57	15/34	44	8/72	11	11/72	15	15/45	33	16/72	22	14/36	39	30	12/72	17	15/60	25	19/72	26	18/72	25	23
4/15	6/12	50	7/28	25	7/35	20	6/72	8	6/22	27	11/30	37	10/72	14	11/42	26	26	16/36	44	14/50	28	21/72	29	25/72	35	34
5/7	30/72	42	40/48	83	34/34	100	22/84	26	22/84	26	23/30	77	30/96	31	38/48	79	58	40/66	61	41/54	76	54/108	50	48/108	44	58
6/9	50/50	100	40/40	100	30/30	100	26/72	36	35/45	78	35/48	73	56/72	78	56/72	78	80	41/41	100	52/72	72	51/72	71	43/72	60	76
7/9	45/45	100	32/32	100	28/28	100	25/72	35	37/64	58	32/50	64	39/72	54	42/70	60	71	43/43	100	40/72	56	40/	-	55/	-	78
8/11	32/32	100	41/41	100	34/34	100	25/72	35	33/90	37	24/24	100	37/108	34	36/45	80	73	36/36	100	39/72	54	30/108	28	42/108	39	55
9/23	21/21	100	34/34	100	42/42	100	24/84	29	49/72	68	35/35	100	41/72	57	50/72	69	78	41/41	100	45/66	68	35/120	29	62/108	57	64
10/7	40/40	100	41/41	100	45/45	100	36/72	50	36/72	50	38/62	61	40/72	56	45/72	62	72	42/42	100	46/72	64	39/72	54	61/72	85	76
11/24	20/35	57	15/48	31	8/48	17	17/	-	19/84	23	32/48	67	21/60	35	36/96	38	38	34/84	40	41/55	75	33/108	31	41/120	34	45
12/10	18/32	56	20/50	40	16/30	53	18/72	25	23/84	27	18/42	43	34/72	47	39/72	54	43	39/72	54	46/72	64	44/72	61	60/72	83	66
1/14/60	15/20	75	19/35	54	12/35	34	15/72	21	23/72	32	16/48	33	25/72	35	21/72	29	39	30/72	42	31/72	43	27/72	38	25/72	35	40
2/9	16/36	44	12/45	27	14/42	33	15/78	19	15/96	16	14/72	19	19/96	20	17/90	19	25	15/84	18	18/54	33	20/96	21	20/96	21	23
3/28	15/36	42	11/45	24	11/40	28	12/78	15	12/72	17	14/50	28	14/78	18	15/38	39	26	18/50	36	17/90	19	12/78	15	12/108	11	20
4/13	16/30	53	16/44	36	16/34	47	15/96	16	12/50	24	13/50	26	11/76	14	10/60	17	29	14/84	17	10/84	12	20/108	19	13/102	13	15
5/10	20/24	83	24/44	57	15/42	36	16/108	15	23/60	38	22/54	41	23/102	23	28/78	36	41	25/96	26	36/54	67	31/90	34	55/102	54	45
6/14	28/28	100	40/40	100	35/45	78	20/120	17	30/60	50	24/50	48	45/118	38	50/114	44	59	44/60	73	42/84	50	47/96	49	45/108	42	54
7/8	25/25	100	40/48	83	45/55	82	25/108	23	36/60	60	36/45	80	36/90	40	42/72	58	66	40/48	83	42/90	47	38/102	37	40/108	37	51
8/3	30/30	100	44/44	100	36/36	100	25/78	32	41/84	49	42/60	70	36/102	35	45/72	62	68	35/78	45	30/84	36	36/114	32	55/108	51	41
9/29	23/23	100	35/35	100	30/30	100	18/72	25	45/72	62	30/34	88	60/72	83	45/72	62	78	35/72	49	30/72	42	20/72	28	25/72	35	38
10/26	30/30	100	30/30	100	33/33	100	20/72	28	44/60	73	51/51	100	47/108	44	55/72	76	78	45/84	54	35/72	49	35/72	49	45/72	62	54
11/11	24/24	100	35/35	100	30/30	100	15/66	23	34/72	47	18/18	100	48/90	53	52/72	72	74	45/84	54	37/72	51	38/102	37	34/96	35	44
12/21	21/36	58	17/35	49	13/30	43	14/84	17	18/72	25	20/55	36	25/72	35	24/72	33	37	18/78	23	25/72	35	28/72	39	32/72	44	35
1/24/61	-	-	-	-	-	-	12/60	20	-	-	15/40	38	-	-	-	-	29	-	-	-	-	-	-	-	-	-
2/10	9/18	50	12/42	29	12/30	40	11/84	13	14/78	18	15/48	31	16/84	19	10/66	15	27	14/72	19	17/72	24	19/96	20	15/102	15	20
3/24	13/36	36	12/48	25	16/36	44	13/72	18	17/72	24	14/72	19	12/72	17	10/72	14	25	25/72	35	32/72	44	30/72	42	35/72	49	42
4/19	10/42	24	12/54	22	15/60	25	12/84	14	15/72	21	14/60	23	20/108	19	18/96	19	21	18/72	25	26/96	27	40/102	39	38/114	33	31
5/19	31/31	100	39/45	87	28/36	78	26/72	36	31/72	43	20/42	48	21/102	21	26/84	31	56	35/78	45	34/90	38	35/96	36	36/102	35	38
6/12	33/33	100	36/40	90	34/34	100	25/72	35	38/84	45	29/54	54	37/84	44	30/90	33	63	32/96	33	34/84	40	34/96	35	36/114	32	35
7/12	36/36	100	40/40	100	36/36	100	23/114	20	36/72	50	25/54	46	20/90	22	25/96	26	58	22/72	31	23/96	24	28/108	26	30/120	40	30
8/7	42/42	100	48/48	100	40/40	100	36/96	38	40/54	74	40/40	100	52/90	58	46/46	100	84	51/78	65	38/54	70	40/108	37	42/96	44	54
11/14	18/26	69	30/40	75	30/30	100	30/72	42	51/78	65	42/42	100	48/78	62	46/60	77	74	50/60	83	50/90	56	60/108	56	65/96	68	66
Avg.		78		74		74		24		41		56		37		49	57		56		48		37		41	47

WATER QUALITY TABLE NO.____ Currituck Sound Area

East Station Secchi Disc/Depth May, 1958 to December, 1961

	H	%	I	%	J	%	K	%	L	%	M	%	N	%	O	%	Avg. H-O	P	%	Q		R	%	S	%	Avg. P-S
5/26/58	-	-	20/	-	21/	-	13/	-	29/	-	23/	-	26/	-	28	-	-	24/	-	32/32	100	25/	-	25/	-	100
6/10/58	-	-	27/	-	26/	-	12/	-	15/	-	15/	-	31/	-	25/	-	-	26/	-	30/30	100	38/	-	29/	-	100
6/30	26/48	54	34/34	100	29/29	100	15/36	42	20/20	100	25/36	69	24/24	100	36/36	100	83	28/28	100	20/20	100	20/20	100	15/15	100	100
7/14	32/32	100	38/38	100	30/30	100	21/21	100	33/33	100	22/	-	28/	-	41/41	100	100	30/30	100	26/26	100	36/	-	30/	-	100
7/28	20/20	100	38/38	100	30/30	100	23/	-	34/	-	29/	-	37/	-	37/37	100	100	34/	-	20/20	100	41/	-	41/	-	100
8/11	24/24	100	34/34	100	27/27	100	27/60	45	20/20	100	27/48	56	16/16	100	38/38	100	88	40/48	83	18/18	100	30/39	77	19/19	100	90
8/25	25/25	100	25/	-	25/25	100	26/	-	20/20	100	31/	-	31/	-	40/40	100	100	42/	-	37/37	100	38/	-	42/	-	100
9/9	25/	-	36/36	100	22/22	100	-	-	21/21	100	19/	-	33/	-	24/24	100	100	45/45	100	12/12	100	25/	-	29/	-	100
10/6	30/41	73	20/20	100	12/12	100	21/21	100	22/22	100	18/48	38	22/22	100	40/60	67	85	17/17	100	24/24	100	24/24	100	20/20	100	100
10/14	21/21	100	30/30	100	26/26	100	28/	-	20/20	100	23/	-	48/	-	30/30	100	100	45/45	100	34/34	100	29/	-	28/	-	100
10/30	22/22	100	32/32	100	26/	-	17/	-	26/	-	32/	-	27/27	100	48/	-	100	35/35	100	34/34	100	35/	-	19/	-	100
11/11	25/25	100	35/35	100	24/24	100	20/36	56	24/24	100	26/	-	41/48	85	36/36	100	92	18/18	100	20/20	100	41/42	98	29/29	100	99
11/26	25/	-	25/25	100	20/20	100	-	-	26/	-	18/	-	30/	-	33/	-	100	30/30	100	28/28	100	26/	-	29/	-	100
12/19	-	-	19/	-	14/14	100	13/	-	18/	-	16/	-	15/	-	21/	-	100	21/	-	17/	-	16/	-	16/	-	-
12/30	8/	-	11/	-	10/	-	13/	-	13/	-	15/	-	29/	-	20/	-	-	22/	-	22/	-	30/	-	24/	-	-
1/21/59	-	-	18/30	60	15/24	62	7/30	23	10/10	100	11/36	31	18/36	50	16/36	44	53	18/36	50	17/24	71	24/36	67	20/20	100	72
2/13	11/21	52	20/26	77	13/22	59	10/53	19	13/27	48	20/60	33	15/29	52	23/53	43	48	20/42	48	13/28	46	19/60	32	26/42	62	47
3/5	-	-	14/25	56	11/25	44	10/72	14	11/30	37	12/43	28	13/56	27	15/40	38	35	16/36	44	13/25	52	19/36	53	20/26	77	56
4/15	-	-	10/40	25	10/12	83	7/40	18	-	-	9/35	26	19/40	48	36/40	90	48	17/30	57	20/20	100	20/20	100	23/70	33	72
5/7	24/24	100	38/38	100	33/33	100	27/36	75	27/36	75	25/60	42	30/66	45	40/40	100	80	20/24	83	25/25	100	37/37	100	16/16	100	96
6/9	20/20	100	40/40	100	28/28	100	32/60	53	30/30	100	27/60	45	45/60	75	35/35	100	84	21/21	100	24/24	100	44/46	96	21/21	100	99
7/9	39/39	100	38/38	100	26/26	100	35/55	64	30/30	100	30/55	55	51/51	100	42/42	100	90	34/34	100	38/38	100	43/	-	40/	-	100
8/11	20/20	100	44/44	100	30/30	100	30/50	60	25/25	100	23/60	38	52/72	72	50/55	91	83	39/39	100	18/18	100	36/36	100	25/25	100	100
9/23	41/41	100	42/42	100	29/29	100	28/58	48	32/32	100	39/39	100	49/49	100	42/42	100	94	33/33	100	40/50	80	28/28	100	35/35	100	95
10/7	36/36	100	48/48	100	35/35	100	23/72	32	34/38	89	45/60	75	55/72	76	38/38	100	84	37/50	74	30/30	100	46/55	84	56/72	78	84
11/24	11/21	52	20/48	42	8/24	33	26/60	43	22/28	79	35/44	80	40/40	100	34/34	100	66	27/27	100	30/30	100	29/36	81	25/25	100	95
12/10	18/24	75	22/40	55	21/30	70	12/38	32	22/36	61	24/36	67	37/37	100	33/33	100	70	41/46	89	49/55	89	42/42	100	34/34	100	94
1/14/60	13/20	65	23/41	56	12/35	34	12/72	17	15/20	75	10/48	21	20/80	25	20/36	56	44	25/25	100	26/52	50	20/20	100	27/38	71	80
2/9	18/24	75	15/47	32	12/42	29	10/60	17	11/24	46	13/55	24	15/72	21	15/42	36	35	20/30	67	21/24	88	21/48	44	21/66	32	58
3/28	12/30	40	12/42	29	13/30	43	11/78	14	13/25	52	15/70	21	15/60	25	14/45	40	33	17/48	35	15/33	45	13/78	17	14/44	32	32
4/13	17/19	89	18/36	50	14/18	78	13/72	18	13/24	54	12/55	22	15/66	23	18/30	60	49	11/52	21	11/52	21	18/84	21	16/84	19	20
5/10	23/24	96	24/48	50	16/30	53	17/78	22	20/30	67	25/66	38	22/66	33	30/48	62	53	34/42	81	30/30	100	35/54	65	42/42	100	86
6/14	36/36	100	30/48	62	40/40	100	26/60	43	30/36	83	30/48	62	30/84	36	40/48	83	71	48/50	96	45/45	100	50/58	86	46/60	77	90
7/8	27/27	100	45/45	100	24/24	100	42/60	70	27/27	100	30/50	60	30/30	100	36/36	100	91	25/25	100	28/28	100	42/48	88	40/40	100	97
8/3	24/24	100	40/40	100	36/36	100	35/78	45	30/30	100	36/72	50	40/66	61	42/42	100	82	25/36	69	36/36	100	32/66	48	48/54	89	76
9/29	30/30	100	40/40	100	30/30	100	25/66	38	24/24	100	30/60	50	35/66	53	35/60	58	75	35/60	58	30/40	75	30/48	62	30/55	55	62
10/26	28/28	100	41/41	100	31/31	100	17/72	24	24/24	100	30/60	50	40/72	56	30/36	83	77	48/48	100	34/34	100	35/44	80	25/45	56	84
11/11	24/24	100	36/36	100	24/24	100	28/60	47	24/24	100	36/48	75	45/60	75	40/48	83	85	42/42	100	36/36	100	30/36	83	30/48	62	86
12/21	22/	-	22/25	88	15/27	56	17/60	28	23/36	64	20/55	36	34/60	57	18/42	43	53	20/36	56	20/36	56	24/48	50	25/54	46	52
1/24/61	-	-	-	-	-	-	9/66	14	-	-	15/60	25	-	-	-	-	20	-	-	-	-	-	-	-	-	-
2/10	13/24	54	11/36	31	11/24	46	10/60	17	14/18	78	13/54	24	16/66	24	8/42	19	37	16/48	33	15/36	42	14/54	26	18/42	43	36
3/24	16/36	44	18/36	50	18/36	50	14/66	21	16/30	53	17/60	28	18/60	30	16/42	38	39	25/54	46	20/36	56	35/60	58	36/36	100	65
4/19	10/36	28	15/42	36	14/36	39	12/72	17	15/36	42	15/48	31	18/72	25	19/42	45	33	15/42	36	28/42	67	36/54	67	38/54	70	60
5/19	25/25	100	46/46	100	32/34	94	28/60	47	28/28	100	24/54	44	30/54	56	25/42	60	75	25/36	69	34/36	94	42/60	70	40/48	83	79
6/12	30/30	100	45/45	100	30/30	100	27/60	45	31/31	100	25/60	42	43/43	100	25/36	69	82	30/42	71	41/48	85	28/60	47	30/36	83	72
7/12	36/36	100	48/48	100	33/36	92	30/66	45	27/27	100	27/54	50	20/60	33	20/48	42	70	22/54	41	25/42	60	27/60	45	27/42	64	52
8/7	30/30	100	36/36	100	36/36	100	37/72	51	36/36	100	35/66	53	36/54	67	34/42	81	82	48/66	73	36/36	100	34/48	71	36/36	100	86
11/14	16/16	100	29/29	100	32/32	100	15/60	25	30/30	100	48/60	80	43/60	72	42/42	100	85	36/36	100	42/42	100	48/48	100	48/48	100	100
Avg.		86		81		83		39		85		46		62		76	72		78		86		72		78	82

TABLE

WATER QUALITY **CURRITUCK SOUND AREA**

WEST STATION SECCHI DISC/DEPTH JANUARY 1962 TO AUGUST 1963

DATE	H	%	I	%	J	%	K	%	K_1	%	L	%	M	%	N	%	O	%	AVG. % H-O	P	%	Q	%	R	%	S	%	AVG. % P-S
4/26/62	25/36	69	26/36	72	27/36	75	23/48	48	36/60	60	35/48	73	35/60	58	20/48	42	30/36	83	64	36/48	75	36/54	67	30/60	50	24/24	100	73
5/18	30/48	62	30/30	100	24/30	80	24/60	40	30/36	83	24/24	100	35/60	58	36/60	60	36/36	100	76	46/54	85	48/48	100	30/30	100	55/60	92	94
5/31	34/42	81	31/42	74	35/36	97	30/60	50	40/40	100	33/48	69	62/62	100	45/48	94	45/48	94	84	48/54	89	52/60	87	36/36	100	59/60	98	94
6/15	34/34	100	30/30	100	36/36	100	11/52	21	32/54	59	36/36	100	66/66	100	36/60	60	30/30	100	82	36/72	50	36/48	75	48/60	80	48/60	80	71
7/5	35/35	100	36/36	100	36/48	75	36/60	60	42/48	88	36/48	75	42/60	70	30/78	38	36/36	100	78	36/72	50	30/60	50	36/36	100	30/48	62	66
7/20	24/24	100	36/36	100	32/32	100	29/60	48	36/48	75	33/36	92	53/53	100	40/60	67	36/36	100	87	49/54	91	47/47	100	41/41	100	62/72	86	94
8/2	36/36	100	42/42	100	36/36	100	-	-	30/30	100	36/36	100	50/60	83	40/66	61	30/30	100	93	42/60	70	40/48	83	40/54	74	48/60	80	77
8/27	36/36	100	24/24	100	36/36	100	30/48	62	14/30	47	36/36	100	60/60	100	36/54	67	42/42	100	86	40/66	61	48/48	100	36/36	100	36/36	100	90
10/15	30/30	100	34/34	100	36/36	100	30/60	50	24/48	50	42/42	100	60/60	100	57/66	86	34/34	100	87	48/72	67	46/60	77	41/41	100	51/60	85	82
11/21	30/30	100	32/34	94	24/36	67	19/66	29	-	-	18/36	50	45/54	83	30/57	53	30/36	83	70	42/54	78	-	-	-	-	-	-	78
12/9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34/48	71	31/31	100	86	42/72	58	42/66	64	42/48	88	-	-	70
1/17/63	10/23	43	13/24	54	12/26	46	18/60	30	-	-	24/52	46	33/48	69	27/27	100	15/15	100	61	23/42	55	24/36	67	-	-	33/60	55	59
3/4	7/25	28	-	-	-	-	11/36	31	-	-	13/42	31	24/54	44	17/48	35	13/36	36	34	20/60	33	18/54	33	28/54	52	20/36	56	44
4/22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40/60	67	36/36	100	83	-	-	-	-	-	-	-	-	-
5/3	-	-	24/34	71	19/19	100	20/29	69	18/24	75	24/30	80	40/54	74	-	-	-	-	78	60/64	94	46/48	96	42/42	100	60/63	95	96
5/27	31/42	74	34/36	94	33/33	100	35/78	45	35/48	73	36/36	100	57/57	100	48/60	80	33/33	100	85	63/63	100	49/49	100	54/54	100	60/66	91	98
6/24	34/34	100	35/35	100	25/25	100	24/64	38	40/40	100	26/26	100	56/56	100	59/59	100	33/33	100	93	57/57	100	38/38	100	36/36	100	45/45	100	100
8/21	30/30	100	34/34	100	24/24	100	32/32	100	41/41	100	36/36	100	52/52	100	54/54	100	31/31	100	100	46/46	100	48/48	100	36/36	100	41/54	76	94
AVG.		84		91		89		48		78		82		84		69		94	79		74		81		90		84	81

TABLE

WATER QUALITY **CURRITUCK SOUND**

MIDDLE STATION SECCHI DISC/DEPTH JANUARY 1962 TO AUGUST 1963

DATE	H	%	I	%	J	%	K	%	K_1	%	L	%	M	%	N	%	O	%	AVG. % H-O	P	%	Q	%	R	%	S	%	AVG. % P-S
4/26/62	18/18	100	28/54	52	25/36	69	26/84	31	30/96	31	28/84	33	27/60	45	24/90	27	30/72	42	48	34/60	57	36/84	43	36/90	40	36/96	38	44
5/18	20/20	100	30/30	100	24/24	100	30/48	62	36/84	43	30/84	36	24/24	100	36/84	43	36/42	86	74	47/78	60	58/90	64	57/84	68	63/96	66	64
5/31	27/27	100	41/60	68	34/42	81	34/84	40	33/96	34	31/84	37	37/48	77	36/96	38	42/90	47	58	52/72	72	55/84	65	54/96	56	55/108	51	61
6/15	32/32	100	36/42	86	36/36	100	36/84	43	38/96	40	42/84	50	39/60	65	36/96	38	36/84	43	63	36/72	50	40/72	56	48/96	50	48/108	44	50
7/5	18/18	100	36/36	100	36/36	100	36/84	43	36/96	38	36/90	40	42/66	64	40/108	37	40/96	42	63	48/72	67	50/84	60	30/96	31	30/108	28	46
7/20	40/40	100	39/39	100	30/30	100	40/78	51	38/96	40	38/78	49	32/54	59	33/96	34	44/84	52	65	54/78	69	62/78	79	54/102	53	57/108	53	64
8/2	30/30	100	36/36	100	30/30	100	40/78	51	36/96	38	36/78	46	42/60	70	40/96	42	36/36	100	72	52/78	67	48/78	62	50/108	46	50/102	49	56
8/27	42/42	100	30/30	100	24/24	100	30/84	36	24/90	27	36/84	43	36/48	75	40/96	42	48/78	62	65	50/72	69	38/84	45	48/96	50	52/96	54	54
10/15	28/28	100	35/35	100	36/36	100	36/84	43	-	-	56/84	67	45/54	83	50/96	52	49/84	58	75	49/78	63	51/84	61	53/102	52	59/114	52	57
11/21	19/19	100	33/39	85	24/42	57	18/96	19	-	-	30/69	43	19/48	40	24/78	31	24/72	33	51	34/78	44	-	-	-	-	-	-	44
12/9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26/84	31	36/90	40	18/108	17	-	-	29
1/17/63	11/14	79	12/24	50	18/22	82	14/84	17	19/84	23	24/66	36	18/68	26	36/96	38	12/24	50	45	38/72	53	30/84	36	36/120	30	24/108	22	35
3/4	7/28	25	-	-	-	-	10/88	11	-	-	13/78	17	12/48	25	14/75	19	13/42	31	21	24/78	31	18/78	23	27/96	28	22/102	22	26
4/18	17/36	47	16/48	33	13/27	48	13/96	14	-	-	18/84	21	19/72	26	17/90	19	36/90	40	31	36/84	43	42/96	44	36/120	30	26/132	20	34
4/22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24/90	27	48/75	53	40	-	-	-	-	-	-	-	-	-
5/3	-	-	29/29	100	28/28	100	17/96	18	-	-	33/72	46	20/48	42	-	-	-	-	61	36/36	100	54/74	73	64/100	64	50/108	46	71
5/27	25/25	100	38/38	100	34/34	100	23/72	32	32/90	36	42/84	50	48/54	89	42/90	47	37/37	100	73	72/72	100	60/90	67	69/108	64	69/96	72	76
6/24	21/21	100	36/36	100	30/30	100	34/96	35	48/96	50	56/67	84	48/48	100	84/88	95	72/72	100	85	72/72	100	88/88	100	78/108	72	66/102	65	84
8/21	25/25	100	42/42	100	46/46	100	46/62	74	46/92	50	64/64	100	46/46	100	63/97	65	79/90	88	86	72/79	91	45/77	58	49/88	56	42/102	41	62
AVG.		97		86		90		36		38		47		64		41		60	60		65		57		47		45	53

TABLE NO. ___

WATER QUALITY

Currituck Sound Area

East Station

Secchi Disc/Depth

January, 1962 to August, 1963

	H	%	I	%	J	%	K	%	K1	%	L	%	M	%	N	%	O	%	%Avg. H-O	P	%	Q	%	R	%	S	%	Avg.% P-S
4/2/62	18/36	50	28/36	78	26/36	72	30/48	62	19/72	26	15/24	62	20/25	80	18/54	33	24/42	57	58	24/30	80	30/42	71	30/60	50	24/48	50	63
5/18	30/36	83	30/36	83	24/24	100	36/60	60	36/72	50	24/30	80	42/54	78	42/54	78	38/48	79	77	36/36	100	42/42	100	54/54	100	42/42	100	100
5/31	27/27	100	38/48	79	35/42	83	35/60	58	32/60	53	32/32	100	28/48	58	40/60	67	36/48	75	75	48/48	100	36/36	100	40/48	83	36/36	100	96
6/15	41/41	100	42/48	88	36/36	100	36/66	55	36/72	50	24/24	100	45/48	94	36/66	56	36/36	100	83	36/60	60	42/42	100	42/42	100	42/42	100	90
7/5	18/21	86	36/36	100	36/36	100	36/78	46	40/54	74	36/36	100	42/66	64	36/36	100	42/66	64	82	48/60	80	30/30	100	30/60	50	36/36	100	82
7/20	36/36	100	36/36	100	26/26	100	48/60	80	42/72	58	36/36	100	36/60	60	45/60	75	42/42	100	86	36/36	100	48/48	100	36/36	100	42/42	100	100
8/2	24/24	100	24/24	100	30/30	100	48/72	67	40/60	67	30/30	100	40/54	74	40/60	67	36/48	75	83	42/60	70	30/30	100	42/42	100	36/36	100	92
8/27	24/24	100	30/30	100	24/24	100	30/84	36	24/42	57	24/24	100	24/72	33	30/60	50	36/36	100	75	46/48	96	36/48	75	50/54	93	48/48	100	91
10/15	20/20	100	41/41	100	34/34	100	38/72	53	42/72	58	30/30	100	48/60	80	42/66	64	41/60	68	80	46/60	77	47/48	98	48/48	100	60/72	83	90
11/21	17/17	100	36/42	86	26/36	72	-	-	-	-	30/30	100	27/54	50	36/36	100	36/54	67	82	30/72	42	37/38	97	-	-	-	-	70
12/9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8/36	22	30/42	71	18/54	33	-	-	42
1/17/63	-	-	32/32	100	24/24	100	30/60	50	30/54	56	25/26	96	23/48	48	48/48	100	34/34	100	81	37/54	69	29/42	69	-	-	23/36	64	67
3/4	6/15	40	-	-	-	-	9/72	12	-	-	12/36	33	10/42	24	17/54	31	15/34	44	31	15/66	23	19/48	40	20/42	48	24/60	40	38
4/22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32/64	50	38/38	100	75	-	-	-	-	-	-	-	-	-
5/3	-	-	35/35	100	26/26	100	14/64	22	20/48	42	25/25	100	24/72	33	-	-	-	-	66	30/30	100	42/42	100	42/42	100	41/41	100	100
5/27	24/36	67	40/40	100	33/33	100	25/72	35	26/66	39	24/24	100	42/66	64	53/53	100	20/20	100	78	42/42	100	50/50	100	48/48	100	46/46	100	100
6/24	33/33	100	37/37	100	30/30	100	38/72	54	49/72	68	41/41	100	64/64	100	56/56	100	36/36	100	91	29/29	100	45/45	100	46/46	100	61/61	100	100
8/21	36/36	100	37/37	100	34/34	100	46/70	66	60/68	88	25/25	100	46/46	100	58/58	100	41/41	100	95	46/46	100	38/41	100	48/55	87	50/57	88	94
Avg.		88		44		95		50		56		92		65		73		83	76		78		89		83		88	83

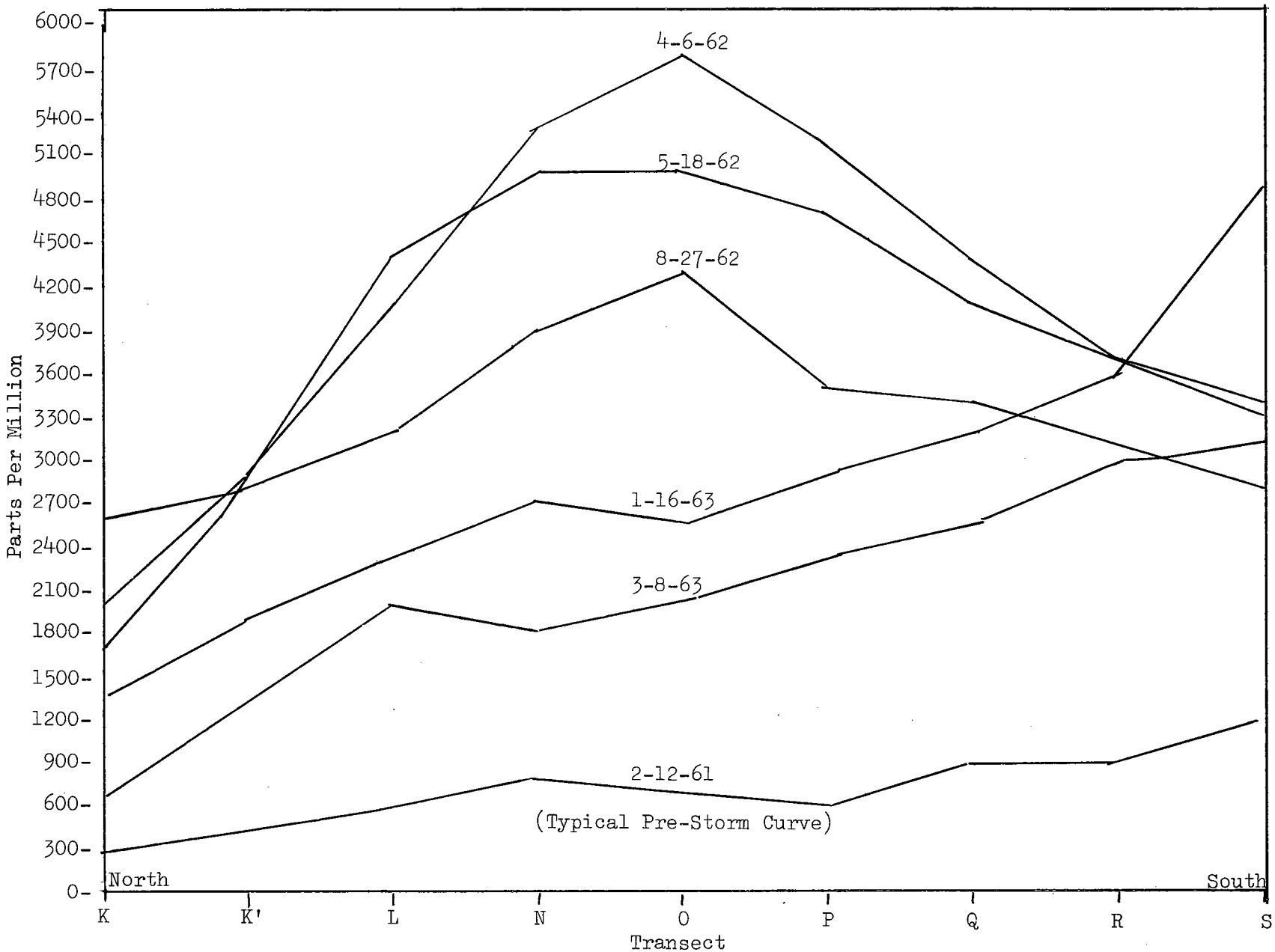


Figure___. Salinity Variations in Currituck Sound after the March 7, 1962 Storm.

TABLE NO. _____

WATER QUALITY

Back Bay Area

West Station

Salinity (ppm NaCl) May 1958 to December 1961

	A	B	C	D	E	F	G	G1	AVG.** A-G1
5/20/58	200	350	-	400	450	450	450	-	385
6/3	350	400	450	400	450	450	450	-	420
6/16	300	350	400	450	500	450	450	500	425
6/30	300	350	450	450	450	450	450	400	410
7/14	450	450	450	450	450	500	500	450	460
7/28	450	450	450	500	500	500	500	500	480
8/11	400	400	500	500	500	500	550	550	490
8/26	400	200	450	500	500	500	500	500	445
9/9	200	250	450	450	500	450	500	450	405
9/22	350	400	450	500	500	500	500	500	460
10/5	400	300	400	400	400	450	500	450	410
10/24	400	300	450	200	450	500	500	450	405
11/10	300	300	450	450	450	500	500	500	430
11/24	250	400	450	450	450	450	500	450	425
12/8	300	350	450	450	500	500	500	500	445
12/23	400	450	-	500	500	450	500	500	470
1/21/59	250	400	400	450	450	450	450	450	410
2/12	300	350	400	450	400	450	450	450	405
3/3	200	250	450	400	400	450	450	450	380
3/24	250	300	400	450	450	450	450	450	400
4/15	200	250	400	350	450	400	450	350	355
5/3	300	400	450	500	500	450	500	500	450
6/4	350	400	450	500	500	500	500	500	460
7/6	550	550	550	600	550	600	650	550	575
8/5	450	350	500	650	600	650	600	600	550
9/9	600	600	650	650	650	700	700	700	655
10/2	650	650	700	700	700	700	700	800	700
11/10	350	550	650	700	700	700	750	700	640
12/2	500	600	700	650	650	650	650	650	630
1/5/60	600	650	650	700	650	700	700	600	655
2/9	300	400	500	500	550	450	500	550	470
3/24	250	400	500	500	450	500	400	450	430
4/6	350	400	400	450	450	500	450	450	430
5/3	300	450	450	450	450	500	500	500	450
6/14	200	350	900	500	500	500	600	500	505
7/1	250	450	500	550	600	550	550	550	500
8/1	400	450	550	600	550	650	750	550	560
9/1	150	450	500	550	550	550	600	550	490
9/14	350	100	500	400	600	600	550	600	460
10/4	250	300	450	550	600	600	650	500	490
11/2	350	250	400	550	550	600	600	550	480
12/22	300	200	550	500	550	550	550	550	470
1/13/61	250	450	500	450	550	500	550	500	470
2/7	150	200	400	400	450	450	450	450	370
3/27	200	300	500	400	500	400	550	550	425
4/20	250	350	400	300	450	500	500	500	405
5/19	300	150	300	350	450	300	400	400	330
6/26	350	300	400	400	450	450	450	450	405
7/19	400	400	500	550	650	450	550	600	510
8/17	450	350	300	450	500	500	500	500	445
10/5*									
11/6*									
12/27*									
AVERAGE:	335	375	480	485	510	510	530	515	465

* See middle station data.

** Averages rounded off to nearest 5.

TABLE NO. _____

WATER QUALITY — Back Bay Area

Middle Station — Salinity (ppm NaCl) May 1958 to December 1961

	A	B	C	D	E	F	G	G_1	Avg. ** A-G_1
5/20/58	350	400	400	500	500	400	500	-	435
6/3	400	350	450	400	450	450	500	-	430
6/16	350	400	400	450	500	450	450	500	435
6/30	350	400	450	500	450	450	450	400	430
7/14	500	450	500	500	500	500	500	500	495
7/28	450	450	500	500	500	500	500	500	490
8/11	450	500	500	500	550	500	550	550	510
8/26	500	450	500	500	500	500	550	500	500
9/9	200	500	500	500	500	500	550	500	470
9/22	300	500	500	500	500	550	550	450	480
10/5	300	450	400	450	450	500	500	450	435
10/24	350	400	450	500	500	500	500	450	455
11/10	300	450	450	500	500	500	500	450	455
11/24	200	400	450	450	450	500	500	500	430
12/8	350	350	400	500	500	450	500	500	445
12/23	400	450	-	500	500	500	500	450	470
1/21/59	250	400	400	450	450	450	450	450	410
2/12	300	350	400	450	400	450	500	450	415
3/3	250	350	400	450	450	450	450	400	400
3/24	250	400	400	450	400	450	450	450	405
4/15	350	350	400	450	450	500	450	450	425
5/3	450	400	400	500	500	500	500	450	460
6/4	450	450	450	500	550	500	550	500	495
7/6	550	550	550	600	600	650	700	550	595
8/5	550	550	600	650	650	600	650	550	600
9/9	650	700	650	800	750	700	700	650	700
10/2	700	700	700	700	700	750	1,050	700	750
11/10	350	650	700	700	700	700	700	650	645
12/2	500	650	650	700	700	700	700	600	650
1/5/60	500	600	650	650	700	700	750	500	630
2/9	250	500	550	550	550	500	500	500	490
3/24	250	450	500	500	500	500	450	500	455
4/6	350	400	450	450	500	500	450	450	445
5/3	450	400	450	450	450	500	500	500	465
6/14	200	500	500	600	550	550	650	450	500
7/1	300	450	600	600	600	600	650	550	545
8/1	500	450	500	600	500	650	600	550	545
9/1	250	500	550	600	600	550	600	550	525
9/14	250	450	500	550	550	600	650	500	505
10/4	250	450	500	550	600	600	550	400	485
11/2	350	450	350	600	600	550	600	500	500
12/22	300	450	500	550	550	550	500	450	480
1/13/61	300	450	450	500	500	550	500	600	480
2/7	250	350	450	500	450	450	500	400	420
3/27	300	300	350	500	400	500	550	400	415
4/20	300	400	500	600	450	500	500	500	470
5/19	200	300	250	400	450	450	450	450	370
6/26	300	300	450	500	450	450	450	400	410
7/19	350	350	500	500	550	550	650	450	490
8/17	450	400	450	450	450	450	550	550	470
10/5	450	-	-	-	-	-	-	500	475
11/6	450	450	500	500	550	600	600	550	525
12/27	400	500	500	550	500	600	650	1,000	585
AVERAGE:	365	445	480	525	520	530	555	505	490

** Averages rounded off to nearest 5.

TABLE NO. _____

WATER QUALITY

Back Bay Area

East Station

Salinity (ppm NaCl) May 1958 to December 1961

	A	B	C	D	E	F	G	G_1	AVG.** A-G_1
5/20/58	550	550	-	550	550	500	550	-	540
6/3	450	450	-	450	450	500	550	-	475
6/16	450	500	-	500	500	500	550	450	495
6/30	450	450	-	450	450	450	500	350	445
7/14	550	550	-	500	500	500	550	500	520
7/28	500	500	-	500	550	550	550	500	520
8/11	500	450	-	550	550	500	600	450	515
8/26	500	500	-	500	550	550	600	500	530
9/9	400	500	-	550	550	550	550	450	505
9/22	500	500	-	500	550	550	600	400	515
10/5	350	400	-	450	450	500	500	400	435
10/24	350	350	-	500	500	500	500	400	445
11/10	300	450	-	500	550	500	500	400	455
11/24	400	400	-	500	500	500	500	450	465
12/8	300	450	-	400	450	500	500	400	430
12/23	350	450	-	700	500	550	500	400	495
1/21/59	300	400	-	450	450	450	500	450	430
2/12	200	300	-	400	450	500	600	450	415
3/3	350	350	-	350	400	450	450	450	400
3/24	300	400	-	500	450	500	500	450	445
4/15	350	350	-	450	500	500	450	450	435
5/3	500	450	-	500	500	600	600	400	505
6/4	550	600	-	600	550	650	800	500	605
7/6	600	650	-	650	700	800	800	500	670
8/5	600	600	-	800	800	750	800	550	700
9/9	650	850	-	950	800	750	850	700	795
10/2	700	700	-	800	700	750	800	700	735
11/10	500	400	-	450	650	700	800	650	595
12/2	550	600	-	700	700	750	700	450	635
1/5/60	400	550	-	650	650	700	800	500	605
2/9	400	500	-	550	500	550	550	350	485
3/24	300	350	-	450	450	450	500	300	400
4/6	350	400	-	450	500	550	500	350	445
5/3	450	450	-	500	500	500	500	550	495
6/14	400	850	-	600	550	600	650	400	580
7/1	550	600	-	600	600	650	650	550	600
8/1	600	550	-	600	600	600	700	650	615
9/1	500	600	-	650	650	650	700	500	605
9/14	550	450	-	600	600	650	650	450	565
10/4	300	450	-	( )	650	650	650	400	530
11/2	400	300	-	500	400	500	600	450	450
12/22	350	400	-	500	550	500	550	500	480
1/13/61	350	350	-	450	500	500	550	450	450
2/7	250	300	-	400	300	500	500	350	370
3/27	300	600	-	450	450	550	550	250	450
4/20	350	350	-	350	500	550	550	400	435
5/19	300	300	-	400	450	450	450	400	395
6/26	450	400	-	500	500	500	550	400	470
7/19	400	500	-	600	600	650	600	400	535
8/17	450	400	-	450	500	500	600	500	485
10/5	450	-	-	-	-	-	500	-	475
11/6*									
12/27*									
AVERAGE:	430	475	-	530	535	560	590	455	510

* See middle station data.

** Averages rounded off to nearest 5.

WATER QUALITY TABLE NO. Back Bay Area

West Station Salinity (ppm NaCl) January 1962 to August 1963

	A	B	C	D	E	F	G	G_1	Avg.** A-G
3/8/62	6,950	350	-	-	600	550	550	400	1,560
3/10	10,950	3,300	(5600-UN)	550	650	500	550	450	2,820
3/11	7,000	2,000	750 (1650-UN)	600	750	-	900	-	1,950
3/13	-	6,150	1,100 (1800-UN)	700	900	900	1,850	650	1,755
3/15	-	-	-	1,500 *1,500	1,900 *2,250	1,900	2,300	600	1,705
3/22	4,750	3,950	4,900	3,050	2,850	2,750	3,000	2,750	3,500
3/29	6,000	5,450	4,000	2,800	2,800	2,450	3,350	2,050	3,610
4/2	6,000	6,100	5,200	3,100	3,000	3,050	2,750	3,000	4,025
4/4	4,800	6,000	5,700	2,950	-	-	-	-	4,860
4/6	5,250	5,200	5,500	3,150	2,900	3,000	3,200	2,600	3,850
4/14	5,200	5,250	5,350	3,150	3,000	2,900	3,200	2,600	3,830
4/19	4,200	4,700	4,350	2,750	3,000	3,000	3,100	3,050	3,520
4/26	4,300	4,800	3,700	3,450	3,400	3,450	3,450	3,450	3,745
5/4	4,200	4,550	4,600	3,500	3,500	3,300	3,500	3,250	3,800
5/11	4,100	4,650	4,350	3,950	3,500	3,700	3,500	3,300	3,880
5/18	4,200	4,750	-	4,050	3,900	3,900	3,650	3,700	4,020
6/1	4,800	4,700	4,000	3,950	3,900	3,700	3,650	2,600	3,910
6/15	3,700	4,750	4,300	3,900	3,900	3,800	3,700	2,900	3,870
7/3	3,900	4,500	4,650	4,050	4,150	3,950	3,850	3,650	4,090
7/20	3,550	3,700	4,100	3,600	3,650	3,700	4,000	3,650	3,745
8/2	2,650	4,000	4,550	3,500	3,550	4,150	3,850	3,150	3,675
8/26	3,100	3,550	3,900	3,850	3,700	3,700	3,750	3,800	3,670
9/25	3,500	3,600	3,900	3,400	3,550	3,400	4,350	3,750	3,680
10/17	1,650	2,600	2,500	2,950	3,050	3,250	3,300	3,000	2,790
10/30	1,900	2,450	3,250	3,200	3,450	3,200	3,550	2,400	2,925
12/4	1,250	1,850	2,300	2,750	2,800	2,800	2,850	2,500	2,390
1/17/63	1,650	2,150	2,400	2,350	2,400	2,400	2,450	2,100	2,240
3/4	800	1,500	1,700	1,600	1,650	1,500	1,550	1,250	1,445
3/29	850	1,300	1,450	1,900	1,600	1,750	1,700	1,650	1,525
5/22	1,400	1,650	1,700	1,750	1,750	1,700	1,650	1,450	1,630
6/19	400	950	1,200	1,250	1,500	1,500	1,600	1,500	1,240
7/29	1,200	1,100	1,400	1,650	1,650	1,650	1,650	1,650	1,495
8/21	1,350	1,150	1,450	1,750	1,800	1,750	1,800	1,800	1,605
Avg. **	3,725	3,520	3,355	2,670	2,635	2,680	2,750	2,410	2,980

* Bottom water sample.
** Averages rounded off to nearest 5.
UN Upper Narrows.

WATER QUALITY TABLE NO. Back Bay Area

Middle Station Salinity (ppm NaCl) January 1962 to Aug. 1963

	A	B	C	D	E	F	G	G1	Avg. ** A-G
3/8/62	10,400	8,750	23,550	500	2,250	550	550	500	5,880
3/10	12,700	6,750	(1000-LN)	600	850	1,400	4,350	-	3,950
3/11	13,400	10,750	7,800 (550-LN)	800	1,100	850	4,800	-	5,005
3/13	-	5,050	2,300 (700-LN)	1,000	2,150	2,750	4,000	400	2,295
3/15	14,000	-	-	1,200	2,550	3,950	2,850	-	4,255
				*2,000	*2,800		*4,700		
3/22	7,750	7,250	6,550	3,350	3,000	3,750	3,050	1,000	4,295
	*7,000	*7,050		*3,350	*3,000	*3,550	*3,250	*1,500	
3/29	7,000	6,450	5,100	3,100	3,500	3,750	3,650	1,500	4,255
4/2	5,550	5,500	5,000	4,050	3,200	3,050	3,000	3,000	4,045
4/4	5,550	5,550	5,500	3,500	-	-	-	-	5,025
4/6	5,500	5,850	5,600	4,650	3,200	3,050	3,200	2,600	4,165
		*5,750		*5,300	*3,200	*3,100	*3,150		
4/14	5,600	5,750	5,350	2,900	3,150	3,050	3,150	2,850	3,985
	*5,600	*5,750		*3,200	*3,150	*3,100	*3,200		
4/19	4,200	5,000	5,150	3,500	3,350	3,400	3,250	2,700	3,820
	*4,200	*5,050		*3,500	*3,350	*3,550	*3,300		
4/26	4,400	5,250	4,050	3,750	3,450	3,300	3,650	1,600	3,680
5/4	4,550	4,950	4,800	3,900	3,600	3,550	3,500	2,900	3,970
5/11	4,550	4,850	4,400	4,050	3,550	3,600	3,550	2,600	3,895
5/18	4,250	4,850	4,950	4,200	3,650	3,700	3,650	3,550	4,100
6/1	4,600	4,850	4,400	3,900	3,800	3,950	3,400	2,500	3,925
6/15	4,350	4,600	4,500	3,900	3,750	3,550	3,650	2,250	3,820
7/3	4,250	4,400	4,500	4,150	4,200	3,900	4,000	3,700	4,140
7/20	3,750	3,650	4,200	4,250	3,800	3,800	3,750	3,400	3,840
8/2	3,250	4,100	4,600	3,900	3,700	3,650	3,500	3,600	3,790
8/26	3,550	4,150	4,050	3,750	3,650	3,700	3,750	3,500	3,760
9/25	3,200	3,600	3,550	3,700	3,600	3,650	4,000	4,000	3,660
10/17	1,350	2,800	3,000	3,150	3,300	3,400	3,450	2,850	2,910
10/30	2,000	2,800	3,050	3,500	3,350	3,500	2,950	1,650	2,850
12/4	1,250	2,000	2,450	2,850	2,950	3,250	3,150	-	2,560
1/17/63	1,600	2,200	2,300	2,650	2,350	2,450	2,400	2,000	2,245
3/4	800	1,500	1,750	1,900	1,850	1,750	1,600	650	1,475
3/29	850	1,250	1,550	1,600	1,900	1,600	1,600	1,200	1,445
4/18	1,250	1,500	1,900	1,600	1,600	1,850	1,550	750	1,500
5/22	1,750	1,400	1,700	1,650	1,700	1,650	1,650	1,000	1,560
6/11	800	950	1,200	1,350	1,550	1,600	1,550	1,450	1,305
6/19	500	1,000	1,250	1,350	1,550	1,450	1,500	1,550	1,270
7/29	1,300	1,150	1,500	1,750	1,650	1,700	1,650	1,500	1,525
8/21	1,450	1,300	1,500	1,800	1,850	1,800	1,900	1,800	1,675
8/27	1,450	1,450	1,400	1,850	1,850	1,850	1,850	1,850	1,695
Avg. **	4,460	4,275	3,965	2,850	2,800	2,875	3,050	2,105	3,265

* Bottom water sample.

** Averages rounded off to nearest 5.

LN Lower Narrows.

WATER QUALITY TABLE NO. Back Bay Area

East Station Salinity (ppm NaCl) January 1962 to August 1963

	A	B	C	D	E	F	G	G1	Avg. * A-G
3/8/62	22,100	24,300	-	10,500	400	700	1,550	500	8,580
3/10	13,850	12,950	-	9,850	2,600	900	2,250	250	6,095
3/11	18,800	14,000	-	7,600	5,750	1,800	2,500	-	8,410
3/13	-	6,550	-	2,800	3,250	6,200	-	550	3,870
3/15	-	-	-	-	6,000	6,250	6,600	750	4,900
3/22	8,000	7,000	-	3,900	3,750	4,200	4,900	1,100	4,695
3/29	7,000	6,950	-	4,300	3,900	3,350	4,800	1,350	4,520
4/2	4,500	5,250	-	4,050	4,250	4,500	4,750	2,050	4,195
4/4	5,250	4,900	-	-	-	-	-	-	5,075
4/6	5,350	6,000	-	4,250	3,950	4,350	4,250	2,250	4,340
4/14	6,000	5,350	-	3,950	4,350	4,350	4,450	2,550	4,430
4/19	4,600	4,650	-	4,450	4,000	3,700	3,600	2,000	3,855
4/26	4,700	5,000	-	4,050	3,850	3,850	3,850	1,450	3,820
5/4	4,600	4,350	-	3,800	3,600	3,550	3,750	2,350	3,715
5/11	4,600	4,650	-	3,800	3,500	3,700	3,600	2,300	3,735
6/18	4,600	4,850	-	4,100	3,750	3,700	3,750	3,950	4,100
6/1	4,650	4,450	-	3,800	3,700	3,700	3,550	2,400	3,750
6/15	4,450	3,800	-	3,700	3,650	3,650	3,700	2,400	3,620
7/3	4,300	4,200	-	4,100	4,100	[illegible]	3,650	3,550	3,985
7/20	4,150	3,900	-	4,000	3,600	4,000	3,950	3,550	3,880
8/2	4,050	4,050	-	3,350	3,750	3,500	3,350	3,850	3,700
8/26	3,650	4,200	-	3,600	3,650	3,700	3,700	2,600	3,585
9/25	4,000	3,900	-	3,650	3,650	4,050	4,550	3,900	3,960
10/17	2,200	2,800	-	3,150	3,300	3,150	3,100	2,100	2,830
10/30	1,750	2,350	-	3,350	3,550	3,450	3,450	1,100	2,715
12/4	1,500	1,950	-	2,400	2,800	2,950	2,750	-	2,390
1/17/63	1,500	1,500	-	1,800	2,150	2,250	2,450	2,000	1,950
3/4	1,100	1,500	-	1,600	1,600	1,750	1,800	650	1,428
3/29	1,200	1,250	-	1,600	1,500	1,400	1,450	600	1,285
5/22	1,750	1,750	-	1,700	1,650	1,800	1,800	1,000	1,635
6/19	1,050	1,300	-	1,500	1,500	1,550	1,400	1,250	1,365
7/29	1,500	1,650	-	1,700	1,800	1,850	1,750	1,250	1,645
8/21	1,600	1,750	-	2,150	1,850	1,850	2,000	1,350	1,795
Avg. *	5,110	5,095	-	3,825	3,270	3,215	3,225	1,900	3,755

* Averages rounded off to nearest 5.

WATER QUALITY

West Station

TABLE NO.

Salinity (ppm NaCl)

Currituck Sound Area

May 1958 to December 1961

	H	I	J	K	L	M	N	O	Avg.* H-O	P	Q	R	S	Avg.* P-S
6/10/58	-	550	500	250	400	500	500	550	465	750	-	400	450	535
6/30	400	500	500	250	350	400	500	850	470	950	700	650	750	765
7/14	550	550	850	400	850	500	600	750	630	750	650	650	550	650
7/28	550	550	650	450	650	450	750	750	600	650	600	650	700	650
8/11	600	500	550	400	500	500	700	600	545	800	800	550	1,100	810
8/25	550	550	500	250	500	500	1,000	750	575	800	650	950	1,750	1,040
9/9	500	550	550	200	500	450	700	650	515	700	700	700	650	685
10/6	450	450	450	350	500	400	600	600	475	650	600	650	350	565
10/14	500	450	450	350	450	300	550	600	455	650	750	800	1,400	900
10/30	450	450	450	350	700	950	800	850	625	7,550	6,400	9,300	6,700	7,490
11/11	450	450	500	350	500	900	850	850	605	3,550	4,900	5,960	4,800	4,800
11/26	650	650	550	350	750	950	800	700	675	[illegible]	1,400	3,850	3,700	2,440
12/19	-	600	600	550	600	1,500	700	750	755	950	1,500	2,400	2,900	1,940
12/30	550	550	550	250	1,250	1,400	1,050	600	775	1,000	1,250	5,350	4,550	3,035
1/21/59	-	800	800	700	850	1,750	700	850	920	900	1,300	2,250	2,750	1,800
2/13	650	650	750	750	900	1,400	900	800	850	950	950	1,700	2,800	1,600
3/5	850	500	650	300	850	1,450	700	850	770	1,250	1,250	2,650	2,700	1,965
4/15	700	650	300	250	700	950	600	800	620	850	1,000	1,750	2,200	1,450
5/7	700	800	750	450	750	700	850	850	730	850	1,300	2,050	2,550	1,685
6/9	700	750	850	500	850	700	1,050	1,050	805	1,900	1,750	2,500	2,050	2,050
7/9	850	1,050	850	800	1,050	800	1,200	1,900	1,065	2,000	2,050	2,750	3,600	2,600
8/11	750	750	1,050	650	1,050	700	1,300	1,450	960	1,800	1,900	2,050	2,700	2,115
9/23	1,100	1,250	1,200	1,250	1,300	1,100	1,400	1,500	1,260	2,150	3,250	2,950	2,050	2,600
10/7	1,200	1,500	1,500	950	-	1,100	1,100	1,200	1,220	1,950	1,850	4,450	7,600	3,965
11/24	950	850	850	700	1,100	1,400	1,300	1,100	1,030	1,400	1,550	1,800	4,100	2,210
12/10	550	550	850	500	1,000	1,800	950	750	870	750	1,000	1,900	1,750	1,350
1/14/60	700	650	600	300	750	1,150	900	800	730	950	1,150	1,550	2,300	1,490
2/9	550	550	700	100	600	1,350	600	950	655	750	900	1,400	1,800	1,210
3/28	450	400	500	450	700	850	500	550	550	650	700	700	650	675
4/13	450	450	450	350	500	700	600	500	500	650	550	600	950	690
5/10	600	600	650	450	600	750	700	700	630	700	550	750	750	685
6/14/60	600	550	700	500	600	650	650	850	640	1,000	1,400	1,500	5,450	2,335
7/8	600	650	850	400	700	600	950	950	715	1,450	650	2,400	3,000	1,875
8/3	750	800	800	550	850	700	750	850	755	1,900	2,650	3,250	2,800	2,650
9/29	600	650	550	400	450	600	700	1,000	620	1,250	1,400	1,850	3,700	2,050
10/26	650	550	650	350	700	700	800	900	660	1,400	1,950	2,100	3,000	2,115
11/11	700	900	600	550	900	1,650	1,000	1,200	935	1,450	1,650	3,900	3,900	2,725
12/21	700	600	650	450	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,000	1,350	1,300	3,650	1,825
1/24/61	-	Frozen	-	200		1,600	-	-	900	-	-	-	-	-
2/10	500	500	500	200	700	1,050	650	750	605	750	850	900	1,150	915
3/24	500	400	450	300	600	650	650	700	530	800	750	1,000	1,550	1,025
4/19	500	450	450	400	500	950	700	650	575	700	950	1,200	1,300	1,035
5/19	450	450	350	150	450	450	400	600	415	600	750	1,200	1,200	940
6/12	500	500	400	250	350	500	600	600	460	900	1,000	1,100	1,100	1,025
7/12	500	550	600	250	500	450	500	650	500	750	850	950	1,000	860
8/7	450	500	500	350	450	450	1,050	850	575	1,050	1,150	1,250	1,300	1,190
Avg.	620	625	645	425	695	875	790	840	695	1,245	1,390	2,010	2,395	1,755

WATER QUALITY

TABLE NO.

Currituck Sound Area

Middle Station

Salinity (ppm NaCl)

May 1958 to December 1961

	H	I	J	K	L	M	N	O	Avg.* H - O	P	Q	R	S	Avg.* P - S
6/10/58	-	550	550	400	550	400	500	850	545	850	1,000	800	550	800
6/30	350	400	450	250	450	350	700	700	455	850	700	950	500	750
7/14	550	700	700	400	900	400	750	800	650	550	750	650	650	650
7/28	650	650	650	450	650	500	750	750	630	800	650	650	700	700
8/11	500	600	700	1,000	650	600	750	850	705	800	450	500	800	635
8/25	600	650	550	550	900	450	750	800	655	850	650	1,650	2,450	1,400
9/9	500	550	550	-	550	450	600	650	550	700	750	700	750	725
10/6	500	450	550	400	500	400	600	600	500	700	650	650	1,550	890
10/14	500	450	400	450	500	300	600	650	480	750	700	700	1,450	900
10/30	550	450	550	400	450	550	850	650	555	1,200	5,800	7,050	6,150	5,050
11/11	550	550	500	350	500	700	750	650	570	2,000	2,600	5,700	4,300	3,650
11/26	650	750	600	-	550	850	550	650	650	750	750	1,750	4,750	2,000
12/19	-	650	750	450	700	1,400	650	550	735	900	1,050	1,500	2,900	1,580
12/30	550	650	750	450	-	850	600	650	645	950	1,450	1,700	4,500	2,150
1/21/59	-	550	650	600	850	1,600	800	750	830	750	700	1,000	1,350	950
2/13	550	650	750	550	700	1,150	900	800	755	750	1,150	1,300	2,300	1,375
3/5	550	750	700	500	600	1,450	700	800	755	1,100	900	1,550	1,950	1,375
4/15	600	600	650	450	650	750	800	850	670	950	1,100	1,300	1,650	1,250
5/7	550	850	750	450	500	550	1,000	1,000	705	1,050	1,150	1,750	1,950	1,475
6/9	800	700	1,100	550	950	600	1,150	1,250	885	1,900	1,900	2,400	2,250	2,115
7/9	800	1,000	900	800	1,000	550	2,050	2,200	1,160	2,050	2,100	2,150	3,250	2,390
8/11	900	1,000	1,150	650	1,250	750	1,150	1,800	1,080	1,850	2,200	2,100	3,000	2,290
9/23	1,150	1,250	1,150	950	1,450	1,350	1,800	2,600	1,460	2,500	3,050	2,850	2,050	2,615
10/7	1,650	1,650	-	1,250	1,400	1,200	1,250	1,500	1,415	1,900	2,250	3,100	6,350	3,400
11/24	850	900	1,250	600	1,150	1,650	1,100	1,250	1,095	1,250	1,850	2,250	3,550	2,175
12/10	850	700	900	900	850	1,200	750	750	865	750	1,150	1,050	1,700	1,160
1/14/60	700	650	550	500	800	1,100	800	850	745	900	1,000	1,500	2,000	1,350
2/9	550	700	600	250	600	1,150	700	1,200	720	700	900	1,100	1,700	1,100
3/28	450	450	550	400	550	800	500	500	525	600	700	750	750	700
4/13	500	550	500	400	500	550	600	600	525	700	700	600	1,050	765
5/10	600	600	550	550	650	600	800	800	645	550	800	800	700	710
6/14/60	650	600	600	500	850	600	950	1,000	720	1,550	1,800	5,900	6,400	3,915
7/8	600	700	950	550	950	650	950	900	780	1,250	1,650	1,750	3,600	2,060
8/3	850	900	1,150	700	750	650	850	1,100	870	1,800	2,650	3,050	2,800	2,575
9/29	600	650	450	400	600	550	700	1,150	640	1,350	1,700	1,800	3,650	2,125
10/26	750	700	550	500	600	700	800	800	675	1,100	2,100	2,350	3,000	2,135
11/11	750	850	750	550	700	950	750	700	750	1,300	1,150	2,800	2,800	2,015
12/21	600	600	650	500	600	1,100	550	750	670	950	950	2,150	4,950	2,250
1/24/61	-	-	Frozen	450	-	1,650	-	-	1,050	-	-	-	-	-
2/10	600	450	600	400	500	1,100	850	700	650	600	1,000	1,100	1,250	985
3/24	400	500	450	250	750	800	600	600	545	750	950	1,300	1,600	1,150
4/19	450	400	500	350	600	650	600	700	530	700	850	1,300	1,300	1,040
5/19	450	450	400	350	500	450	500	650	470	700	700	900	1,200	875
6/12	500	550	550	250	600	400	700	750	540	850	1,050	1,100	1,100	1,025
7/12	550	600	700	300	400	400	700	800	555	750	950	1,050	1,150	975
8/7	500	550	500	350	750	450	850	1,000	620	1,100	1,250	1,150	1,300	1,200
Avg.	635	670	675	505	715	790	815	910	720	1,060	1,340	1,780	2,335	1,630

WATER QUALITY | TABLE NO. | Currituck Sound Area

East Station | Salinity (ppm NaCl) | May 1958 to December 1961

	H	I	J	K	L	M	N	O	AVG. H - O	P	Q	R	S	AVG. P - S
6/10/58	-	650	550	400	600	900	550	950	655	1,000	500	750	850	775
6/30	550	550	550	350	500	350	850	950	580	850	800	850	500	750
7/14	600	700	800	500	850	400	1,100	850	725	750	750	750	850	775
7/28	650	850	750	450	800	700	900	750	730	650	750	750	700	710
8/11	600	800	850	-	750	500	850	-	725	650	750	700	1,500	900
8/25	600	500	600	800	750	550	900	800	690	650	650	2,150	2,950	1,600
9/9	500	550	600	-	650	450	750	750	605	750	750	700	800	750
10/6	450	500	500	450	650	350	800	750	555	650	650	700	750	685
10/14	550	500	500	400	450	350	700	650	515	700	700	800	750	735
10/30	550	500	550	500	450	700	700	650	575	1,650	1,250	3,550	4,150	2,650
11/11	500	550	550	450	450	500	550	650	525	950	1,700	4,750	3,550	2,740
11/26	600	550	650	-	600	800	700	550	635	750	750	1,450	3,450	1,600
12/19	-	700	650	750	600	1,300	650	-	775	850	650	950	2,100	1,135
12/30	550	600	-	500	950	1,500	650	550	755	1,000	1,600	1,750	3,800	2,040
1/21/59	-	700	850	600	800	1,000	750	750	780	750	650	1,500	1,350	1,060
2/13	600	800	600	550	750	1,150	600	800	730	850	1,150	1,450	800	1,065
3/5	-	650	-	500	850	1,100	750	750	765	750	850	1,750	2,350	1,425
4/15	-	55-	750	300	-	600	850	700	625	1,000	1,100	1,250	1,100	1,125
5/7	400	800	850	500	800	550	950	1,200	755	1,050	1,750	1,850	2,350	1,750
6/9	750	800	1,300	700	800	650	1,700	1,850	1,070	1,950	2,300	2,450	2,200	2,225
7/9	900	900	1,100	700	1,250	850	1,750	2,150	1,200	1,950	1,950	2,250	2,450	2,150
8/11	950	1,000	1,050	900	1,200	950	2,100	1,950	1,260	1,950	2,400	2,400	3,500	2,565
9/23	1,150	1,200	1,100	1,100	1,400	1,200	2,500	2,250	1,485	2,500	2,150	3,450	2,650	2,690
10/7	1,550	1,800	1,700	1,000	2,200	1,150	1,600	950	1,495	1,850	2,650	4,800	6,550	3,960
11/24	800	550	1,150	700	1,050	1,900	1,350	1,500	1,125	1,050	1,950	2,100	3,150	2,065
12/10	900	850	850	800	800	950	600	800	820	800	950	1,250	1,850	1,210
1/14/60	650	700	600	400	700	1,100	800	800	720	850	850	1,000	1,550	1,065
2/9	600	700	650	250	600	950	700	700	645	700	850	1,000	1,550	1,025
3/28	500	500	500	400	450	850	450	500	520	600	700	850	850	750
4/13	550	450	450	350	500	550	500	650	500	650	650	750	1,200	810
5/10	650	650	650	500	700	600	300	750	600	800	800	850	700	790
6/14/60	750	550	750	500	850	600	900	1,100	750	1,200	1,200	4,250	7,950	3,650
7/8	650	700	800	600	1,100	750	1,100	1,300	875	1,450	2,750	1,850	3,750	2,450
8/3	800	1,000	900	550	1,200	850	1,150	1,200	955	2,300	2,400	2,650	3,300	2,660
9/29	600	900	900	350	650	600	1,200	1,200	800	1,450	2,000	2,500	3,550	2,375
10/26	850	700	650	400	550	900	900	1,050	750	1,100	2,150	2,350	2,900	2,125
11/11	750	600	950	550	750	950	750	900	775	900	1,100	1,550	1,550	1,275
12/21	650	550	550	550	550	1,500	700	800	720	800	800	1,450	5,150	2,050
1/24/61	-	-	-	450	-	1,200	-	-	825	-	-	-	-	-
2/10	500	550	650	350	550	800	800	750	620	650	800	800	750	750
3/24	500	500	500	250	600	700	650	650	545	750	700	1,000	1,450	975
4/19	550	550	500	300	600	650	600	700	555	650	800	1,200	1,200	965
5/19	500	500	550	250	550	450	750	700	530	700	850	1,150	1,200	975
6/12	500	600	700	450	750	400	800	800	625	650	1,100	1,200	1,400	1,085
7/12	550	550	500	350	350	350	950	1,000	575	750	1,050	1,150	1,100	1,015
8/7	500	700	650	450	550	500	1,100	1,100	695	1,100	1,200	1,350	1,500	1,285
Avg.	655	690	740	515	760	795	915	955	755	1,030	1,220	1,690	2,215	1,540

TABLE NO.

WATER QUALITY

Currituck Sound Area

West Station — Salinity (ppm NaCl) — January 1962 to August 1963

	H	I	J	K	K1	L	M	N	O	Avg. ** H-O	P	Q	R	S	Avg. * P-S
3/8/62	600	-	700	-	-	9,850	-	950	800	2,580	1,150	-	-	-	1,150
3/9	-	-	-	-	-	3,150	-	750	1,000	1,635	1,900	1,100	1,050	1,600	1,410
3/10	4,100	3,800	6,450	230	-	7,550	1,450	-	-	3,930	1,750	1,200	1,200	1,100	1,310
3/11	3,100	6,400	5,300	-	100	7,700	1,450	4,750	2,250	3,890	1,600	1,500	-	-	1,550
3/12	-	-	-	-	-	-	-	4,700	1,550	3,125	1,350	-	-	7,500	4,425
3/13	7,800	5,400	4,950	-	3,450	3,500	1,500	4,100	1,750	4,065	2,550	4,150	3,750	-	3,485
3/14	-	-	-	-	-	6,000	-	3,000	-	6,600	-	-	-	-	-
						* 10,150		*7,250							
3/15	4,000	5,150	6,450	850	1,600	4,100	1,450	3,500	2,800	3,650	1,850	-	3,500	5,300	3,550
					*3,150	*4,500		*6,250							
3/19	3,750	4,150	3,300	1,700	2,400	4,400	2,400	4,450	5,850	3,610	4,150	3,150	3,300	4,050	3,660
3/23	-	-	4,650	900	2,500	3,500	2,500	5,350	6,000	3,640	3,850	-	2,900	2,900	3,215
3/29	3,650	4,000	2,850	1,200	1,200	3,450	2,250	4,900	5,850	3,270	4,800	4,250	3,050	2,850	3,740
4/6	3,650	4,000	3,750	1,000	2,500	3,500	2,300	4,750	5,900	3,490	5,400	4,850	3,450	2,950	4,160
4/12	3,350	3,350	3,850	-	2,500	3,050	2,600	5,000	5,250	3,630	5,500	4,900	3,400	2,950	4,190
4/26	3,550	2,750	2,950	1,500	2,350	3,550	2,550	4,300	4,500	3,120	4,900	4,750	3,350	2,300	3,825
5/18	3,550	3,700	3,750	1,150	2,600	3,750	2,600	2,950	4,700	3,195	4,600	4,600	4,200	3,650	4,260
5/31	3,400	3,450	3,750	2,150	2,950	4,050	2,700	4,800	4,700	3,560	4,000	4,000	3,600	4,500	4,025
6/15	3,550	3,800	3,350	2,500	2,450	3,350	2,650	4,350	4,650	3,415	4,100	3,700	3,350	3,700	3,710
7/5	3,650	3,150	3,350	2,350	3,050	3,400	2,200	3,800	4,000	3,225	4,050	3,450	2,050	2,500	3,010
7/20	3,400	3,100	3,550	1,500	2,900	3,300	2,450	3,900	4,100	3,140	3,600	3,250	3,250	2,300	3,010
8/2	3,800	3,750	3,750	-	3,050	3,400	3,250	4,100	3,800	3,620	4,050	3,750	3,200	2,300	3,325
8/27	3,900	3,800	3,500	2,100	3,100	3,250	3,850	3,400	3,850	3,415	3,700	3,550	3,250	2,850	3,340
9/25	3,800	-	-	-	-	-	-	-	-	3,800	-	-	-	-	-
10/15	3,300	3,400	3,000	2,200	2,250	2,850	2,450	3,650	4,050	3,025	3,650	3,350	3,500	3,800	3,575
11/21	3,250	2,600	2,400	1,800	-	2,850	2,450	3,250	3,550	2,780	3,600	-	-	-	3,600
12/5	-	-	-	-	-	1,900	-	2,350	2,950	2,400	3,000	2,700	2,400	3,650	2,940
12/9	-	-	-	-	-	-	-	2,850	3,600	3,225	4,000	6,750	9,250	7,850	6,960
12/11	-	-	-	-	-	-	-	3,600	3,600	3,600	3,800	6,450	9,500	-	6,585
1/17/63	2,400	2,250	2,250	1,000	-	2,450	2,750	2,700	2,700	2,320	3,100	3,300	-	4,700	3,700
2/1	-	-	-	-	-	1,650	-	1,800	1,800	1,750	-	-	-	-	-
3/4	1,500	-	-	500	-	2,200	2,400	1,750	2,000	1,725	2,450	2,450	2,850	2,950	2,675
4/22	-	-	-	-	-	-	-	2,000	2,000	2,000	-	-	-	-	-
5/3	-	1,700	1,600	1,050	1,300	1,650	1,900	-	-	1,535	2,300	2,800	2,400	2,150	2,410
5/27	1,500	1,600	1,750	1,000	1,150	1,750	3,300	1,900	2,100	1,790	2,200	2,250	2,250	3,250	2,490
6/24	1,500	1,550	1,250	350	850	1,300	1,400	1,500	1,800	1,785	1,700	2,000	2,150	2,300	2,040
8/21	1,850	1,750	1,600	750	1,000	1,350	1,050	2,100	2,100	1,515	2,400	2,200	2,150	2,450	2,300
Avg. **	3,275	3,415	3,360	1,325	2,200	3,825	2,315	3,550	3,405	3,060	3,260	3,475	3,405	3,410	3,345

* Bottom water sample.

** Averages rounded off to nearest 5.

WATER QUALITY TABLE NO. Currituck Sound Area

Middle Station Salinity (ppm NaCl) January 1962 to August 1963

	H	I	J	K	K_1	L	M	N	O	Avg. H-O	P	Q	R	S	Avg. P - S
2/23/62***	-	-	850	250	-	700	1,000	700	1,150	775	1,400	1,450	1,450	1,550	1,460
3/8	500	16,650	-	-	-	-	6,600	800	-	6,140	3,450	-	-	-	3,450
3/9	-	-	2,150	-	-	1,650	1,300	2,450	4,800	2,470	3,250	2,500	2,000	1,750	2,375
3/10	-	4,850	4,050	230	-	4,850	1,800	7,950	12,000	5,105	2,100	-	-	-	2,100
3/11	4,700	5,500	3,800	1,300	-	4,050	1,550	4,750	9,400	4,380	1,950	1,400	-	-	1,675
3/12	-	-	-	-	-	-	-	-	-	-	-	-	-	4,700	4,700
3/13	7,000	8,600	5,000	-	3,700	5,250	1,600	2,050	2,800	5,465	2,600	5,100	3,750	-	5,960
								*13,100				*5,850	*12,500		
3/14	-	-	-	-	-	5,000	-	3,000	-	6,910	-	-	-	-	-
						*9,500		*10,150							
3/15	4,100	6,600	7,000	1,250	2,350	5,200	3,400	5,000	3,800	4,895	2,500	2,800	3,300	5,950	4,535
				*1,350	*3,650	*5,500	*4,800	*10,750	*8,700		*2,550	*3,050	*10,050	*6,000	
3/19	5,000	5,150	4,050	2,050	2,800	4,550	2,900	5,700	6,350	4,440	4,450	3,650	3,550	3,750	4,015
	*5,050	*5,150		*2,200	*3,350	*4,500	*3,050	*6,250	*7,200		*4,500	*3,650	*3,650	*4,850	
3/23	-	-	4,350	2,100	1,950	3,550	2,550	5,700	6,600	3,955	4,350	-	3,500	3,750	4,125
				*2,300	*3,300	*4,750		*6,350			*4,900		*3,750	*4,450	
3/29	3,600	4,300	3,600	1,700	-	3,350	2,550	5,950	6,300	3,925	5,450	3,600	3,250	2,450	3,590
				*1,650		*3,250	*2,550	*5,900	*6,300			*3,600	*3,300	*3,400	
4/6	4,100	4,700	5,250	2,250	2,800	3,250	3,100	5,150	6,150	4,015	5,750	4,600	4,100	3,500	4,515
		*4,800		*2,250	*2,800	*3,300	*3,000	*5,100	*6,250		*5,550	*4,800	*4,100	*3,650	
4/12	3,500	3,500	3,750	-	3,750	4,200	2,400	4,700	5,650	4,205	5,250	4,300	4,200	5,250	4,580
						*4,000		*5,100	*5,700		*5,300	*4,650	*4,150	*3,550	
4/26	3,100	3,000	3,200	1,500	2,800	3,650	2,550	3,750	4,500	3,180	5,200	4,300	3,900	2,500	3,930
				*1,500	*2,800	*3,600		*4,000	*4,600			*4,700	*4,300	*2,550	
5/18	3,650	3,700	3,700	2,300	2,800	4,050	3,100	4,500	4,800	3,400	4,750	3,750	3,700	3,000	3,800
5/31	3,700	4,100	3,900	2,250	3,150	4,450	2,750	4,750	4,300	3,715	3,700	3,800	2,900	4,900	3,825
6/15	3,800	4,000	3,850	2,600	2,900	3,500	3,050	4,800	4,250	3,705	3,950	3,500	3,500	3,800	3,640
				*2,600				*4,700	*4,400		*3,900	*3,400	*3,500	*3,500	
7/5	4,050	4,100	3,400	2,750	2,950	3,850	2,400	4,100	3,800	3,500	3,200	2,950	2,000	5,000	3,290
7/20	3,400	3,850	3,650	3,150	2,600	3,150	3,000	4,550	3,750	3,455	3,900	3,300	3,500	2,250	3,240
8/2	3,650	3,800	3,750	3,050	2,950	3,900	4,150	4,150	3,950	3,715	3,700	3,450	3,700	4,250	3,775
8/27	3,900	3,700	3,700	2,650	2,400	3,200	3,100	3,750	4,000	3,385	3,400	3,200	3,000	2,500	3,025
9/25	3,650	-	-	-	-	-	-	-	-	3,650	-	-	-	-	-
10/15	3,400	3,400	3,300	1,750	-	3,050	2,600	3,350	4,100	3,120	3,750	3,450	3,050	3,700	3,490
11/21	2,600	2,350	2,500	2,250	-	2,600	2,350	3,050	3,350	2,630	3,600	-	-	-	3,600
11/30	-	-	-	-	-	-	-	-	8,800	8,800	-	-	-	-	-
12/5	-	2,700	2,800	-	-	2,800	2,500	2,800	2,800	2,735	2,650	2,750	2,950	3,700	3,010
12/9	-	-	-	-	-	-	-	-	3,800	3,800	4,450	5,500	7,350	7,700	6,250
12/11	-	-	-	-	-	-	-		-	-	-	-	8,650	-	8,650
1/17/63	2,300	2,250	2,300	1,550	1,900	2,200	2,700	2,650	2,350	2,255	2,750	3,150	-	5,050	3,650
2/1	-	-	-	-	-	1,850	-	2,250	2,000	2,035	-	-	-	-	-
3/4	1,650	-	-	700	-	2,000	1,750	2,000	2,000	1,685	2,250	2,500	3,200	2,950	2,725
4/18	1,450	1,350	1,350	650	-	1,850	1,650	1,900	2,000	1,525	2,300	2,550	2,250	1,450	2,140
4/22	-	-	-	-	-	-	-	1,850	1,850	1,850	-	-	-	-	-
5/3	-	1,650	1,800	950	-	1,900	1,400	-	-	1,540	2,250	2,600	2,450	2,250	2,390
5/27	1,550	1,850	1,850	1,200	1,200	2,000	1,650	1,850	2,350	1,730	2,350	2,200	2,900	3,200	2,390
6/11	1,550	1,450	1,500	600	-	1,250	1,250	1,800	1,850	1,405	2,100	2,100	2,550	2,850	2,400
6/24	1,500	1,600	1,500	600	1,000	1,250	1,250	1,800	2,050	1,390	1,950	2,100	2,150	2,550	2,190
8/21	2,000	[illegible]	1,600	1,100	1,300	1,450	1,200	1,950	2,100	1,620	2,300	2,200	2,300	2,400	2,300
8/27	1,950	2,000	2,150	1,350	-	2,200	-	2,550	2,450	2,095	2,500	2,550	2,500	2,950	2,625
Avg. **	3,230	4,080	3,280	1,750	2,660	3,486	2,575	4,390	4,605	3,455	3,545	3,430	3,915	3,675	3,595

* Bottom water sample.
* * Averages rounded off to nearest 5.
* * * 2/23/62 Data not included in the transect averages.

WATER QUALITY TABLE NO. Currituck Sound Area

EAST STATION Salinity (ppm NaCl) January 1962 to August 1963

	H	I	J	K	K_1	L	M	N	O	Avg. ** H-O	P	Q	R	S	Avg.** P-S
3/8/62	-	-	-	-	700	27,400	-	30,200	14,350	18,160	9,650	3,550	-	-	6,600
3/9	-	-	-	-	2,000	8,000	-	18,450	13,250	10,425	6,750	2,950	3,000	1,350	3,510
3/10	6,350	19,400	4,350	500	2,700	14,450	1,850	15,150	11,050	8,420	3,450	1,750	1,800	3,450	2,610
3/11	6,550	10,750	4,450	-	-	13,150	1,550	9,700	12,750	8,415	6,850	2,950	-	-	4,900
3/13	10,150	10,750	7,100	-	3,700	6,750	2,100	3,550	3,150	5,905	4,600	5,500	5,600	-	5,235
3/14	-	-	-	-	-	5,550	-	4,750	-	5,590	-	-	-	-	-
						*7,300		*4,750							
3/15	6,650	7,350	7,200	1,150	-	8,200	3,800	5,700	-	6,705	4,550	3,600	5,550	6,850	5,270
						*8,850	*4,250	*13,900							
3/19	5,550	5,300	5,400	1,500	2,950	4,800	3,250	7,900	1,550	5,005	5,000	3,550	3,750	4,250	4,140
					*2,950										
3/23	-	-	4,750	1,800	3,550	4,600	3,050	6,250	5,800	4,250	5,100	-	3,350	3,450	3,965
3/29	3,850	4,400	4,400	2,050	2,700	3,500	2,600	6,150	6,700	4,040	5,600	4,400	3,600	2,650	4,060
4/6	4,300	4,850	6,000	2,050	3,250	5,800	-	5,950	5,600	4,725	4,400	3,700	3,450	3,700	3,810
4/12	3,750	3,750	4,600	-	3,900	5,250	3,100	5,250	5,250	4,355	5,300	3,500	3,250	3,250	3,825
4/26	3,550	3,450	3,400	1,450	2,350	3,500	2,900	5,000	4,200	3,310	5,150	4,900	3,500	2,700	4,060
5/18	3,750	3,750	4,050	2,350	2,950	5,100	3,000	5,000	5,050	3,890	4,850	3,800	3,400	3,250	3,825
5/31	3,650	4,650	4,200	2,450	3,100	4,500	3,200	5,350	4,750	3,985	3,500	3,450	3,000	4,750	3,675
6/15	3,800	3,850	4,300	2,500	3,100	4,100	2,700	3,750	4,300	3,600	3,950	3,400	3,550	3,600	3,625
7/5	4,000	4,150	3,850	2,600	3,000	3,900	2,400	4,250	3,750	3,545	3,550	3,100	2,450	3,100	3,050
7/20	3,700	3,400	3,550	2,500	2,650	3,500	3,050	4,100	3,900	3,370	3,950	3,800	2,950	3,200	3,475
8/2	3,850	3,950	3,800	3,250	3,300	4,000	3,250	4,200	3,900	3,720	3,800	3,100	3,150	3,000	3,260
8/27	3,900	3,850	4,050	2,650	2,750	3,300	2,850	4,150	3,950	3,495	3,500	3,350	3,000	2,700	3,140
9/25	4,000	-	-	-	-	-	-	-	-	4,000	-	-	-	-	-
10/15	3,000	3,300	3,200	2,150	2,250	3,150	2,600	3,900	4,150	3,080	3,800	3,050	3,150	4,000	3,500
11/21	3,200	2,950	2,450	-	-	2,500	2,850	3,000	3,150	2,870	3,300	3,550	-	-	3,425
11/30	-	-	-	-	-	2,850	-	7,850	2,750	4,485	2,500	2,600	-	-	2,550
12/5	-	-	-	-	-	2,700	-	4,200	3,550	3,485	2,750	2,950	3,000	3,250	2,990
12/9	-	-	-	-	-	-	-	-	-	-	4,350	5,500	-	8,400	6,085
12/11	-	-	-	-	-	-	-	-	-	-	4,000	5,000	5,500	-	4,835
1/17/63	-	2,400	2,300	1,800	1,950	2,450	2,700	2,800	2,600	2,375	2,900	3,100	-	4,900	3,635
2/1	-	-	-	-	-	2,000	-	2,050	1,950	2,000	-	-	-	-	-
3/4	1,400	-	-	700	-	1,850	2,000	1,750	2,050	1,670	2,150	2, 150	2,950	3,550	2,700
4/22	-	-	-	-	-	-	-	2,100	2,250	2,175	-	-	-	-	-
5/3	-	1,800	1,850	800	1,250	1,850	1,550	-	-	1,515	2,350	2,750	2,650	2,350	2,525
5/27	1,700	2,000	1,900	-	1,400	2,050	1,550	2,300	2,500	1,925	2,550	2,250	2,550	3,650	2,750
6/24	1,500	1,600	1,600	850	900	1,800	1,350	2,100	2,100	1,535	2,050	2,100	2,300	2,450	2,225
8/21	2,100	2,350	1,800	1,150	1,400	2,000	1,250	2,300	2,400	1,860	2,150	2,100	2,050	2,950	2,310
Avg. **	4,100	4,955	3,940	1,810	2,530	5,475	2,590	6,295	4,920	4,480	4,140	3,380	3,395	3,630	3,730

* Bottom water sample
** Averages rounded off to nearest 5.

Table . Food Candles of Light at Surface and Percent at Each Indicated Depth; Secchi Disc Readings, and Percent of Sea Strength at Stations on the Back Bay Transects on July 1, 1960. Back Bay-Currituck Cooperative Investigations.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	0.78	44/44	100	2,700	61	17	11	2	1		
	2 mid.	0.93	40/60	67	2,250	67	27	13	5	2	2	
	3 east	1.71	32/32	100	2,250	80	47	27	20			
B	4 west	1.40	40/40	100	2,550	76	29	12	2			
	5 mid.	1.40	44/64	69	3,000	75	45	30	20	15	10	
	6 east	1.87	34/34	100	2,850	58	37	21	11			
C	7 west	1.55	43/43	100	3,900	81	54	19	8	4		
	8 mid.	1.87	44/44	100	3,150	67	47	29	14	6		
D	9 west	1.71	32/50	64	2,550	65	41	24	18	6		
	10 mid.	1.87	32/68	47	2,700	72	28	22	9	6	3	1
	11 east	1.87	18/18	100	3,900	76	49	38				
E	12 west	1.87	22/49	45	2,250	73	40	20	13	6		
	13 mid.	1.87	38/72	53	4,200	75	46	29	18	11	7	3
	14 east	1.87	27/27	100	2,850	68	36	26				
F	15 west	1.71	25/43	58	3,300	72	36	18	9			
	16 mid	1.87	38/56	68	4,200	82	50	29	18	11	5	4
	17 east	2.02	28/28	100	3,600	79	54	37				
G	18 west	1.71	36/44	82	4,050	81	48	22	11			
	19 mid.	2.02	34/38	89	4,050	78	48	26	15			
	20 east	2.02	34/34	100	3,900	73	42	23	19			
G_1	21 west	1.71	30/37	81	3,000	75	40	20	5			
	22 mid.	1.71	41/41	100	4,050	85	56	33	19			
	23 east	1.71	32/32	100	4,050	74	30	15	11	7	5	3
Average	(west)	1.55		79								
	(mid.)	1.70		74								
	(east)	1.87		100								
Average of all samples					3,272	74	41	24	12	7	5	3

Table . Foot Candles of Light at Surface and Percent at Each Indicated Depth; Secchi Disc Readings, and Percent of Sea Strength at Stations on the Back Bay Transects on August 1, 1960. Back Bay-Currituck Cooperative Investigations.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	1.24	32/45	71	4,500	77	43	20	2	3		
	2 mid.	1.55	36/62	58	4,800	84	59	38	19	8	3	
	3 east	1.87	30/30	100	4,200	79	68	50	39			
B	4 west	1.40	40/40	100	2,400	69	44	31	14			
	5 mid.	1.40	64/68	94	3,000	70	50	35	25	20	11	
	6 east	1.71	36/36	100	3,450	83	65	52	39			
C	7 west	1.71	46/46	100	2,250	73	47	22	19	16		
	8 mid.	1.55	44/44	100	4,200	86	75	57	43			
D	9 west	1.87	28/54	52	3,000	70	40	13	7	2		
	10 mid.	1.87	25/63	40	2,400	63	31	15	9	5	3	
	11 east	1.87	23/23	100	3,900	88	58	42				
E	12 west	1.71	26/50	52	2,550	76	35	12	6	4		
	13 mid.	1.55	30/60	50	2,100	71	50	21	14	9	5	
	14 east	1.87	24/24	100	3,300	82	59	45				
F	15 west	2.02	25/41	61	3,450	74	52	22	9			
	16 mid.	2.02	35/70	50	4,800	88	63	38	22	10	6	
	17 east	1.87	28/28	100	3,300	68	50	41				
G	18 west	2.33	26/42	62	4,800	78	50	25	9			
	19 mid.	1.87	38/58	52	4,800	88	56	31	16	9	6	
	20 east	2.18	31/31	100	4,500	83	67	47				
G_1	21 west	1.71	36/36	100	1,050	86	41	30	19			
	22 mid.	1.71	36/36	100	1,800	75	50	33	21			
	23 east	2.02	34/34	100	3,450	87	57	35	30			
Average	(west)	1.74		75								
	(mid.)	1.69		68								
	(east)	1.92		100								
Average of all samples					3,352	78	53	33	19	9	6	

Trace equals less than 1

Table . Foot Candles of Light at Surface and Percent at Each Indicated Depth; Secchi Disc Readings, and Percent of Sea Strength at Stations on the Back Bay Transects on September 1, 1960. Back Bay-Currituck Cooperative Investigations.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	0.47	21/48	44	4,350	31	3	2	Tr.	0		
	2 mid.	0.78	32/60	53	4,650	68	32	6	4	1	0	
	3 east	1.55	32/32	100	4,650	81	65	45	39			
B	4 west	1.40	47/47	100	4,800	78	63	38	28			
	5 mid.	1.55	67/67	100	4,650	83	67	51	42	26	6	
	6 east	1.87	36/36	100	4,650	81	65	52	35			
C	7 west	1.55	45/45	100	4,500	83	67	50	13			
	8 mid.	1.71	38/38	100	4,500	80	60	20				
D	9 west	1.71	35/50	70	3,600	67	38	13	4			
	10 mid.	1.87	49/65	75	4,650	84	65	48	32	23	16	10
	11 east	2.02	23/23	100	4,650	87	68	55				
E	12 west	1.71	29/49	59	4,500	97	53	27	13	8		
	13 mid.	1.87	28/79	35	4,500	80	57	37	23	17	7	4
	14 east	2.02	29/29	100	4,500	97	67	50				
F	15 west	1.71	30/39	77	4,500	80	50	27	20			
	16 mid.	1.71	36/53	68	4,650	77	54	35	23	16		
	17 east	2.02	31/31	100	4,200	82	61	43				
G	18 west	1.87	25/46	54	4,200	90	46	29	14	7		
	19 mid.	1.87	41/41	100	4,050	88	67	44	30			
	20 east	2.18	36/36	100	4,050	85	67	48	33			
G_1	21 west	1.71	39/39	100	3,450	74	48	30	1			
	22 mid.	1.71	41/41	100	3,450	33	48	26	13			
	23 east	1.55	33/33	100	3,750	80	48	24				
Average	(west)	1.52		76								
	(mid.)	1.63		79								
	(east)	1.88		100								
Average of all samples					4,324	78	55	35	20	12	7	7

Trace equals less than 1

Table . Foot Candles of Light at Surface and Percent at Each Indicated Depth; Secchi Disc Readings, and Percent of Sea Strength at Stations on the Back Bay Transects on October 4, 1960. Back Bay-Currituck Cooperative Investigations.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	0.78	22/38	58	1,350	55	14	4	2			
	2 mid.	0.78	27/58	46	1,950	46	14	5	2	1		
	3 east	0.93	33/33	100	2,850	58	26	6				
B	4 west	0.93	37/37	100	2,700	61	28	10	3			
	5 mid.	1.40	53/62	85	2,700	67	33	16	12	9	7	
	6 east	1.40	38/38	100	3,900	73	58	38	27			
C	7 west	1.40	36/46	78	4,050	78	52	37	19			
	8 mid.	1.55	36/36	100	3,300	86	64	32	18			
D	9 west	1.71	25/50	50	2,550	58	29	10	6	4		
	10 mid.	1.71	27/72	38	3,450	70	30	10	7	4	3	2
	11 east	-	17/17	100	3,450	78	65					
E	12 west	1.87	26/49	53	2,550	70	35	11	5	4		
	13 mid.	1.87	28/68	41	4,050	81	52	26	15	9	6	3
	14 east	2.02	29/29	100	3,750	80	60	28				
F	15 west	1.87	21/40	53	2,100	57	29	10	4			
	16 mid.	1.87	24/49	49	4,350	83	52	31	21	14		
	17 east	2.02	28/28	100	4,200	86	61	39				
G	18 west	2.02	23/38	61	4,500	83	50	27	13			
	19 mid.	1.71	36/44	82	2,850	79	47	32	26	8		
	20 east	2.02	32/32	100	4,650	81	52	29	19			
G_1	21 west	1.55	34/34	100	2,250	60	20	9	4			
	22 mid.	1.24	35/40	88	2,850	74	26	9	3			
	23 east	1.24	18/30	60	3,450	70	17	4				
Average	(west)	1.52		69								
	(mid.)	1.50		66								
	(east)	1.65		94								
Average of all samples					3,208	71	39	19	11	7	5	3

Table . Foot Candles of Light at Surface and Percent at Each Indicated Depth; Secchi Disc Readings, and Percent of Sea Strength at Stations on the Back Bay Transects on December 22, 1960. Back Bay-Currituck Cooperative Investigations.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	0.93	13/31	42	2,550	65	6	1				
	2 mid.	0.93	10/52	19	2,700	61	11	Tr.	Tr.	0		
	3 east	1.09	12/27	44	3,600	67	8	1				
B	4 west	0.62	12/28	43	3,150	81	14	2				
	5 mid.	1.40	12/56	21	3,300	73	14	3	Tr.	0		
	6 east	1.24	17/29	59	3,450	78	26	6				
C	7 west	1.71	11/36	31	3,450	65	13	1	0			
	8 mid.	1.55	6/19	32	3,450	61	6	1				
D	9 west	1.55	11/41	27	3,600	75	13	3	Tr.	0		
	10 mid.	1.71	9/57	16	3,150	67	10	2	Tr.	0		
	11 east	1.55	11/25	44	3,150	67	14	3				
E	12 west	1.71	12/42	29	2,850	63	11	2	Tr.	0		
	13 mid.	1.71	10/56	18	3,600	63	13	1	Tr.	0	0	
	14 east	1.71	10/23	43	3,000	65	15	5				
F	15 west	1.71	11/31	35	3,150	62	10	1	1			
	16 mid.	1.71	8/40	20	3,600	50	3	0				
	17 east	1.55	11/22	50	2,700	78	17	5				
G	18 west	1.71	8/35	23	3,150	62	4	0	0			
	19 mid.	1.55	10/34	29	3,300	59	9	1	Tr.			
	20 east	1.71	12/25	48	3,600	63	8	1				
G_1	21 west	1.71	11/28	39	3,150	71	7	1	0	0		
	22 mid.	1.40	10/29	34	2,700	50	6					
	23 east	1.55	10/24	42	2,700	39	1					
Average	(west)	1.46		34								
	(mid.)	1.49		24								
	(east)	1.49		47								
Average of all samples					3,176	64	10	2	Tr.	0	0	

Trace equals less than 1

Table . Foot Candles of Light at Surface and Percent at Each Indicated Depth; Secchi Disc Readings, and Percent of Sea Strength at Stations on the Back Back Transects on January 13, 1961. Back Bay-Currituck Cooperative Investigations.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	0.78	13/41	32	1,650	64	18	2	1	0		
	2 mid.	0.93	12/50	24	3,750	68	12	1	Tr.	0		
	3 east	1.09	15/38	39	1,350	61	10	2	1			
B	4 west	1.40	14/37	38	3,450	48	39	9	1			
	5 mid.	1.40	14/54	26	1,500	75	20	3	1	1		
	6 east	1.09	12/24	50	1,650	64	18	4				
C	7 west	1.55	12/23	52	3,525	77	17	4				
	8 mid.	1.40	12/25	48	2,025	51	15	3				
D	9 west	1.40	15/39	38	4,500	72	22	7				
	10 mid.	1.55	12/47	26	3,150	62	14	10	1	Tr.		
	11 east	1.40	14/48	29	2,100	70	22	6	2	Tr.		
E	12 west	1.71	12/32	38	2,250	57	17	Tr.				
	13 mid.	1.55	12/60	20	1,275	71	12	2	Tr.	0	0	
	14 east	1.55	14/20	70	900	67	11	6				
F	15 west	1.55	10/24	42	1,500	60	8	1				
	16 mid.	1.71	12/51	24	2,700	72	17	3	1	0		
	17 east	1.55	15/22	68	900	58	11	5				
G	18 west	1.71	13/30	43	2,400	75	25	3	0			
	19 mid.	1.55	19/33	58	1,500	85	30	10	6			
	20 east	1.71	20/24	83	1,650	82	27	9				
G_1	21 west	1.55	13/24	54	975	62	14	3				
	22 mid.	1.87	16/28	57	2,250	80	27	1				
	23 east	1.40	15/24	62	2,925	67	10	2				
Average	(west)	1.46		42								
	mid.)	1.49		35								
	(east)	1.40		57								
Average of all samples					2,166	67	18	4	1	Tr.	0	

Trace equals less than 1

Table . Foot Candles of Light at Surface and Percent at Each Indicated Depth; Secchi Disc Readings, and Percent of Sea Strength at Stations on the Back Bay Transects on February 7, 1961. Back Bay-Currituck Cooperative Investigations.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	0.47	9/34	26	900	50	6	1	0			
	2 mid.	0.78	9/46	20	1,050	43	6	1	0	0		
	3 east	0.78	10/40	25	900	25	2	1	0			
B	4 west	0.62	5/24	21	1,650	64	5	1				
	5 mid.	1.09	8/48	17	1,050	71	4	1	0	0		
	6 east	0.93	7/29	24	900	50	8	1				
C	7 west	1.24	9/28	32	750	60	5	0				
	8 mid.	1.40	7/25	28	2,850	63	3	0				
D	9 west	1.24	6/40	15	900	44	1	0	0			
	10 mid.	1.55	9/44	20	1,350	44	9	1	0	0		
	11 east	1.24	8/15	53	1,500	50	10					
E	12 west	1.40	6/40	15	2,250	53	2	0	0	0		
	13 mid.	1.40	5/65	8	2,250	47	1	0	0	0	0	
	14 east	0.93	6/21	29	2,850	53	1	Tr.				
F	15 west	1.40	4/35	11	3,000	35	0	0	0			
	16 mid.	1.40	4/63	6	2,550	76	6	0	0	0	0	
	17 east	1.55	6/25	24	2,400	43	Tr.	0				
G	18 west	1.40	6/34	18	750	32	0	0	0			
	19 mid.	1.55	6/30	20	1,050	29	1	0				
	20 east	1.55	7/20	35	2,100	64	5	1				
G_1	21 west	1.40	5/23	22	2,550	53	0	0				
	22 mid.	1.24	4/23	17	2,700	22	0	0				
	23 east	1.09	4/25	16	3,000	30	0	0				
Average	(west)	1.15		20								
	(mid.)	1.30		17								
	(east)	1.15		29								
Average of all samples					1,794	46	3	Tr.	0	0	0	

Trace equals less than 1

Table . Foot Candles of Light at Surface and Percent at Each Indicated Depth; Secchi Disc Readings, and Percent of Sea Strength at Stations on the Back Bay Transects on March 27, 1961. Back Bay-Currituck Cooperative Investigations.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	0.62	6/52	12	4,725	32	5	Tr.	Tr.	0	0	
	2 mid.	0.93	8/62	13	4,725	35	6	1	Tr.	0	0	
	3 east	0.93	5/41	12	4,725	35	2	0	0	0		
B	4 west	0.93	8/37	22	4,725	63	5	Tr.	0			
	5 mid.	0.93	11/63	17	4,725	54	6	1	Tr.	0	0	
	6 east	1.87	8/35	23	4,650	61	10	Tr.	0			
C	7 west	1.55	11/43	26	4,650	68	13	2	Tr.	0		
	8 mid.	1.09	9/33	27	4,725	67	6	0				
D	9 west	1.24	7/53	13	4,125	40	2	0	0			
	10 mid	1.55	9/57	16	4,650	65	1	0	0	0	0	
	11 east	1.40	11/20	58	4,650	61	13	0				
E	12 west	1.55	6/50	12	3,825	43	1	0	0	0		
	13 mid.	1.24	7/72	10	4,800	56	Tr.	0	0	0	0	0
	14 east	1.40	8/30	27	4,650	58	4	1	0			
F	15 west	1.24	6/45	13	3,900	63	2	0	0	0		
	16 mid.	1.55	12/56	21	4,800	53	1	Tr.	Tr.	0	0	
	17 east	1.71	10/29	34	4,650	55	1	0	0			
G	18 west	1.71	8/41	20	4,350	62	5	1	Tr.			
	19 mid.	1.71	10/42	24	4,650	61	15	2	Tr.	0		
	20 east	1.71	11/31	35	4,500	70	12	1				
G_1	21 west	1.71	8/33	24	3,900	46	4	Tr.	0			
	22 mid.	1.24	14/35	40	4,350	63	14	Tr.	0			
	23 east	0.78	9/34	26	4,200	61	4	Tr.	0			
Average (west)		1.32		18								
(mid.)		1.29		21								
(east)		1.40		31								
Average of all samples					4,507	55	6	Tr.	Tr.	0	0	0

Trace equals less than 1

Table . Foot Candles of Light at Surface and Percent at Each Indicated Depth; Secchi Disc Readings, and Percent of Sea Strength at Stations on the Back Bay Transects on April 20, 1961. Back Bay-Currituck Cooperative Investigations.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	0.78	7/44	16	4,350	59	7	1	0			
	2 mid.	0.93	6/58	10	4,050	67	7	Tr.	0			
	3 east	1.09	10/36	28	4,350	49	17	2	Tr.			
B	4 west	1.09	10/45	22	4,500	67	4	Tr.	0			
	5 mid.	1.24	8/71	11	4,200	64	11	1				
	6 east	1.09	8/40	20	4,200	75	14	1	Tr.			
C	7 west	1.24	10/50	20	4,650	94	19	2	Tr.	Tr.		
	8 mid.	1.55	9/42	21	4,500	73	17	2	Tr.			
D	9 west	0.93	10/36	28	4,350	59	3	Tr.	0			
	10 mid.	1.87	10/70	14	2,700	61	11	1	Tr.	0		
	11 east	1.09	15/24	62	4,050	70	26	7				
E	12 west	1.40	6/47	13	2,100	29	1	0				
	13 mid.	1.40	8/72	11	3,000	50	5	Tr.	0			
	14 east	1.55	17/36	47	4,800	63	16	2	1			
F	15 west	1.55	6/53	11	4,650	45	2	0				
	16 mid.	1.55	8/58	14	3,000	30	1	0				
	17 east	1.71	15/36	42	4,200	50	11	1	Tr.			
G	18 west	1.55	6/47	13	4,500	43	Tr.	0	0			
	19 mid.	1.55	7/50	14	4,500	53	1	0				
	20 east	1.71	8/38	21	4,050	52	7	1	Tr.			
G_1	21 west	1.55	7/44	16	4,200	46	1	0				
	22 mid.	1.55	9/43	21	4,500	70	10	1	Tr.			
	23 east	1.24	11/37	30	4,500	63	7	1	Tr.			
Average	(west)	1.25		17								
	(mid.)	1.46		15								
	(east)	1.35		36								
Average of all samples					4,083	59	8	1	Tr.	Tr.		

Trace equals less than 1

Table. . Foot Candles of Light at Surface and Percent at Each Indicated Depth; Secchi Disc Readings, and Percent of Sea Strength at Stations on the Back Bay Transects on May 19, 1961. Back Bay-Currituck Cooperative Investigations.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	0.93	15/47	32	4,050	41	6	1	Tr.			
	2 mid.	0.62	19/52	36	4,800	38	19	6	1	Tr.		
	3 east	0.93	27/42	64	4,800	66	31	16	5			
B	4 west	0.47	12/41	29	4,650	32	4	Tr.	0			
	5 mid.	0.93	21/53	40	4,200	71	21	11	4	1	Tr.	
	6 east	0.93	40/40	100	4,800	69	38	9	3			
C	7 west	0.93	32/43	74	4,650	77	37	26	10			
	8 mid.	0.78	24/35	69	4,650	71	35	10	2			
D	9 west	1.09	23/43	53	4,050	78	26	3	1			
	10 mid.	1.24	31/58	53	4,650	74	40	24	10	5	2	
	11 east	1.24	24/24	100	4,650	74	39	23				
E	12 west	1.40	17/44	39	4,050	59	22	5	1			
	13 mid.	1.40	28/73	38	4,575	67	39	23	10	5	2	Tr.
	14 east	1.40	28/33	85	4,500	80	40	25				
F.	15 west	0.93	12/38	32	3,150	62	8	2	Tr.			
	16 mid.	1.40	14/52	27	4,350	69	14	3	Tr.	0		
	17 east	1.40	25/32	78	4,575	62	30	16				
G	18 west	1.24	9/41	22	4,425	71	7	1				
	19 mid.	1.40	18/42	43	4,350	79	28	10	2			
	20 east	1.40	27/34	79	4,500	73	40	20	13			
G_1	21 west	1.24	21/37	57	3,300	68	27	2				
	22 mid.	1.40	32/38	84	4,650	81	35	19	6			
	23 east	1.24	34/38	89	4,350	72	34	17	5			
Average	(west)	1.03		42								
	(mid.)	1.15		49								
	(east)	1.23		85								
Average of all samples					4,379	67	27	12	4	2	1	Tr.

Trace equals less than 1

Table . Foot Candles of Light at Surface and Percent at Each Indicated Depth; Secchi Disc Readings, and Percent of Sea Strength at Stations on the Back Bay Transects on June 26, 1961. Back Bay-Currituck Cooperative Investigations.

					Foot Candles of Light and Percent of Total at Each Depth								
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %	7 feet %
A	1 west	1.09	26/56	46	4,650	94	41	19	10	5	2		
	2 mid.	0.93	29/65	45	4,575	95	52	28	13	8	3		
	3 east	1.40	42/42	100	4,575	69	65	39	26	20			
B	4 west	0.93	26/44	59	4,575	85	39	20	10	6			
	5 mid.	0.93	29/68	43	2,850	74	34	16	11	10	5		
	6 east	1.24	38/46	83	2,400	75	56	25	6	3			
C	7 west	1.24	30/47	64	4,275	87	63	21	11				
	8 mid.	1.40	24/39	62	2,250	67	40	20	7				
D	9 west	1.24	17/56	30	2,325	52	13	4	1	Tr.	0		
	10 mid.	1.55	35/62	56	4,500	80	53	32	17	7	3		
	11 east	1.55	24/24	100	4,350	86	59	38					
E	12 west	1.40	17/53	32	3,600	38	8	3	1	Tr.	0		
	13 mid.	1.40	32/80	40	4,575	82	59	36	21	11	7	3	2
	14 east	1.55	31/31	100	4,350	84	59	38	28				
F	15 west	1.40	25/40	63	2,700	72	42	17	4	3			
	16 mid.	1.40	30/60	50	3,000	75	45	30	18	13	8		
	17 east	1.55	35/35	100	4,350	83	59	41	31				
G	18 west	1.40	29/47	62	1,650	82	45	27	18	14			
	19 mid.	1.40	32/46	70	4,500	87	53	37	22	13			
	20 east	1.71	37/37	100	4,200	75	50	34	7				
G_1	21 west	1.40	35/39	90	1,725	91	61	35	13				
	22 mid.	1.24	38/44	86	4,200	79	46	21	11	7			
	23 east	1.24	29/40	72	2,550	65	26	12	4				
Average	(west)	1.25		56									
	(mid.)	1.28		57									
	(east)	1.46		94									
Average of all samples					3,597	77	47	28	13	7	3	3	2

Trace equals less than 1

Table . Foot Candles of Light at Surface and Percent at Each Indicated Depth; Secchi Disc Readings, and Percent of Sea Strength at Stations on the Back Bay Transects on July 19, 1961. Back Bay-Currituck Cooperative Investigations.

					Foot Candles of Light and Percent of Total at Each Depth						
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %
A	1 west	1.24	21/43	49	4,725	79	46	19	13		
	2 mid.	1.09	24/55	44	4,575	66	33	16	5	2	
	3 east	1.24	44/44	100	4,800	88	63	25	14		
B	4 west	1.24	34/36	94	4,725	95	48	27	17		
	5 mid.	1.09	51/70	73	4,650	58	48	32	27	18	15
	6 east	1.55	51/60	85	1,875	76	40	28	20	4	
C	7 west	1.55	36/48	75	4,425	69	64	39	17	2	
	8 mid.	1.55	38/38	100	4,650	78	65	48	26		
D	9 west	1.71	18/66	27	3,750	96	90	32	6	3	
	10 mid.	1.55	20/65	31	4,575	41	16	5	2	1	Tr.
	11 east	1.87	29/34	85	4,725	87	57	30	21		
E	12 west	2.02	20/48	42	4,500	92	42	13	3		
	13 mid.	1.71	20/73	27	4,800	78	47	28	16	2	0
	14 east	1.87	24/65	37	4,650	48	32	15	2	1	
F	15 west	1.40	27/48	56	4,650	65	45	24	11	2	
	16 mid.	1.71	18/85	21	4,575	82	39	23	5	0	
	17 east	2.02	38/38	100	4,800	89	66	58	16		
G	18 west	1.71	38/48	79	4,650	81	58	32	24	16	
	19 mid.	2.02	35/43	81	4,800	88	59	31	16	6	
	20 east	1.87	36/36	100	4,200	71	41	27	18		
G_1	21 west	1.87	40/40	100	4,650	90	65	58	48	29	
	22 mid.	1.40	42/42	100	4,650	92	65	35	16		
	23 east	1.24	32/36	89	4,650	81	47	16	6		
Average	(west)	1.58		65							
	(mid.)	1.52		60							
	(east)	1.66		85							
Average of all samples					4,481	78	51	29	15	7	5

Trace equals less than 1.

Table . Foot Candles of Light at Surface and Percent at Each Indicated Depth; Secchi Disc Readings, and Percent of Sea Strength at Stations on the Back Bay Transects on August 17, 1961. Back Bay-Currituck Cooperative Investigations.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	1.40	32/36	89	4,050	70	44	19	11			
	2 mid.	1.40	37/59	63	4,200	75	54	32	18	11	5	
	3 east	1.40	37/37	100	4,200	71	54	39	29	18		
B	4 west	1.09	37/37	100	4,200	71	43	29	11			
	5 mid.	1.24	66/66	100	4,200	75	64	46	36	29	11	
	6 east	1.24	32/32	100	4,200	71	54	39	29			
C	7 west	0.93	39/39	100	4,200	68	55	39	30			
	8 mid.	1.40	33/33	100	4,200	89	71	53	30			
D	9 west	1.40	28/46	61	3,675	47	20	14	4			
	10 mid.	1.40	60/60	100	4,350	72	52	45	28	17	14	
	11 east	1.40	21/21	100	4,200	79	68	54				
E	12 west	1.55	28/36	78	3,825	73	44	22	13			
	13 mid.	1.40	36/72	50	3,750	80	52	20	12	8	6	
	14 east	1.55	22/22	100	4,200	71	54	43				
F	15 west	1.55	28/35	80	3,825	76	39	18	8			
	16 mid.	1.40	32/47	68	4,200	71	39	25	14	11		
	17 east	1.55	29/29	100	4,200	71	64	50	39			
G	18 west	1.55	29/43	67	4,200	68	39	25	11			
	19 mid.	1.71	35/35	100	4,200	64	43	29	14			
	20 east	1.87	31/31	100	4,200	68	54	36	29			
G_1	21 west	1.55	34/34	100	3,675	71	49	35	10			
	22 mid	1.71	35/35	100	3,825	73	49	35	12			
	23 east	1.55	34/34	100	4,200	89	48	36	7			
Average	(west)	1.39		84								
	(mid.)	1.46		85								
	(east)	1.50		100								
Average of all samples					4,066	72	50	34	19	16	9	

Table . Foot Candles of Light at Surface and Percent at Each Indicated Depth; Secchi Disc Readings, and Percent of Sea Strength at Stations on the Back Bay Transects on October 5, 1961. Back Bay-Currituck Cooperative Investigations.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	-	30/42	71	3,600	83	38	13	7	6		
	2 mid.	1.40	46/52	88	3,450	83	61	39	22	17	12	
	3 east	1.40	29/29	100	3,450	78	61	39	35			
B	4 west	-	-	-	3,300	77	18	6	2	1		
	5 mid.	-	58/61	95	3,750	80	60	40	28	20	9	
	6 east	-	38/38	100	3,750	80	60	40	28	20		
C	7 west	-	36/36	100	3,750	80	56	28	7			
	8 mid.	-	30/36	83	3,750	80	76	68				
D	9 west	-	28/50	56	3,750	80	28	8	3	1		
	10 mid.	-	39/60	65	3,900	77	58	35	19	10	6	
	11 east	-	50/60	83	3,750	80	56	44	32	20	4	
E	12 west	-	23/60	38	3,750	76	40	8	3	1	Tr.	
	13 mid.	-	26/78	33	4,050	81	37	19	7	3	1	Tr.
	14 east	-	36/36	100	3,900	85	62	38	27			
F	15 west	-	23/48	48	3,750	76	28	8	3	1		
	16 mid.	-	36/48	75	4,275	74	56	35	18	8		
	17 east	-	30/30	100	4,050	81	67	44	41			
G	18 west	-	24/28	86	3,750	80	36	11	4			
	19 mid.	-	33/67	49	3,900	77	42	23	12	7	4	3
	20 east	-	30/30	100	3,900	77	58	42	35			
G_1	21 west	-	26/30	87	3,825	78	43	5	2			
	22 mid.	1.55	32/32	100	3,750	80	48	12	9			
	23 east	1.55	36/36	100	3,750	80	56	28	12			
Average	(west)	-		69								
	(mid.)	1.47		74								
	(east)	1.47		98								
Average of all samples					3,776	79	50	28	16	9	7	2

Trace equals less than 1

Table . Foot Candles of Light at Each Indicated Depth; Secchi Disc Readings, and Percent of Sea Strength at Stations on the Back Bay Transects on April 6, 1962.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strenght	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	16.3	24/44	55	3,300	73	30	18	7	3		
	2 mid.	17.1	32/60	53	3,300	55	30	14	7	4	4	
	3 east	16.6	34/66	52	3,000	55	33	23	10	8	6	5
B	4 west	16.1	32/44	73	3,450	65	39	17	8	6		
	5 mid.	18.2	25/60	42	2,100	64	29	14	8	5	2	
	6 east	18.6	26/48	54	3,150	57	40	17	7	6		
C	7 west	17.1	32/42	76	1,800	50	33	17	13	7		
	8 mid.	17.4	32/36	89	1,875	52	28	12	8			
D	9 west	9.8	9/54	35	4,200	71	21	5	1	0	0	
	10 mid.	14.4	25/62	40	1,350	56	28	11	7	3	2	
	11 east	13.2	22/22	100	3,000	70	40	25	--	-	-	-
E	12 west	9.0	6/48	13	3,600	52	2	0	0	0		
	13 mid.	10.0	6/68	9	3,900	77	15	2	0	0	0	0
	14 east	12.3	30/30	100	3,750	80	40	20	14			
F	15 west	9.3	7/48	14	4,200	71	5	0	0	0		
	16 mid.	9.5	6/66	9	4,050	67	6	0	0	0	0	0
	17 east	13.5	33/33	100	3,900	77	38	17	10			
G	18 west	10.0	29/40	72	4,350	69	38	17	12	5		
	19 mid.	10.0	23/36	64	3,900	73	38	17	8			
	20 east	13.2	27/38	71	4,050	78	43	22	13			
G_1	21 west	8.1	9/33	27	2,925	23	7	1	0			
	22 mid.	8.1	8/32	25	2,925	51	5	0	0			
	23 east	7.0	28/30	93	3,750	60	32	4	2			
Average		12.8	22/45	55	3,300	63	27	12	6	3	2	1.7

Table . Foot Candles of Light at Each Indicated Depth; Secchi Disc Readings, and Percent of Sea Strength at Stations on the Back Bay Transects on April 19, 1962.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	13.1	26/39	67	4,350	69	38	21	9			
	2 mid.	13.1	30/51	59	4,350	72	40	21	9	0		
	3 east	14.3	28/54	52	4,275	74	39	18	11	4	3	
B	4 west	14.6	24/39	62	4,050	72	35	15	3			
	5 mid.	15.5	26/54	48	4,125	76	40	24	11	3		
	6 east	14.4	29/29	100	4,200	75	55	32	25			
C	7 west	13.5	38/38	100	4,500	75	42	25	17			
	8 mid.	16.0	29/29	100	4,125	78	47	22	18			
D	9 west	8.5	10/50	20	3,750	56	18	2	--	--		
	10 mid.	10.9	24/60	40	4,125	65	36	9	3	1	--	
	11 east	13.8	30/30	100	4,125	78	51	29	25			
E	12 west	9.3	14/42	33	3,750	64	16	2	1	--		
	13 mid.	10.4	13/71	18	3,750	60	14	2	--	0	0	0
	14 east	12.4	27/27	100	4,050	72	33	19				
F	15 west	9.3	13/34	38	3,750	60	16	4	1			
	16 mid.	10.6	13/66	20	3,900	65	15	4	1	0		0
	17 east	11.5	17/17	100	4,125	73	40	20				
G	18 west	9.6	20/42	48	3,900	58	19	4	1	1		
	19 mid.	10.1	19/32	60	4,200	66	34	13	7			
	20 east	11.2	25/39	64	4,125	64	22	5	3			
G_1	21 west	9.5	28/28	100	3,750	72	44	36	30			
	22 mid.	8.4	32/32	100	3,900	69	38	19	15			
	23 east	6.2	23/29	79	4,050	56	19	7	5			
Average		11.6	23/41	66	4,052	68	33	15	9	1	0.9	0

Table . Foot Candles of Light at Each Indicated Depth; Secchi Disc Readings and Percent of Sea Strength at Stations on the Back Bay Transects on April 26, 1962.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	13.4	25/42	60	4,125	69	44	25	13	9		
	2 mid.	13.7	20/56	36	3,700	73	35	17	8	2	0	
	3 east	14.6	24/60	40	4,200	71	36	18	7	2	1	
B	4 west	14.9	26/43	61	4,050	70	44	26	11	9		
	5 mid.	16.1	25/55	45	4,125	69	44	18	7	2		
	6 east	15.5	20/41	49	4,125	76	40	16	9			
C	7 west	11.5	24/41	59	4,050	63	35	19	7			
	8 mid.	12.5	19/32	60	4,050	46	20	7	1			
D	9 west	10.6	13/54	24	4,125	58	16	3	1	0	0	
	10 mid.	11.7	15/66	23	4,050	48	19	3	1	0	0	
	11 east	12.5	18/27	67	4,200	48	29	11	5			
E	12 west	10.6	14/59	24	4,350	69	26	14	7	3	1	
	13 mid.	10.6	18/72	25	4,350	76	29	17	10	1	1	0
	14 east	12.0	30/30	100	4,350	76	52	34	28			
F	15 west	10.6	18/42	43	4,275	74	39	21	11	5		
	16 mid.	10.3	19/66	29	4,275	79	35	21	5	1	0	0
	17 east	12.0	29/29	100	4,275	77	56	33	21			
G	18 west	10.6	21/48	44	4,500	70	43	18	7	3		
	19 mid.	11.3	24/33	73	4,500	77	53	27	13			
	20 east	12.0	25/30	83	4,275	98	35	21	9			
G_1	21 west	10.6	19/31	61	4,200	79	54	29	18			
	22 mid.	5.0	25/36	70	4,350	72	34	17	10			
	23 east	4.5	35/35	100	4,350	72	33	21	7			
Average		11.6	22/45	55	4,220	70	37	19	9	3	0.4	0

Table . Foot Candles of Light at Each Indicated Depth; Secchi Disc Readings and Percent of Sea Strength at Stations on the Back Bay Transects on May 10-11, 1962.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	12.7	20/37	54	825	55	18	6	2			
	2 mid.	14.1	28/59	44	900	58	33	13	6	3	0	
	3 east	14.3	27/72	38	1,050	43	24	10	3	1	0	0
B	4 west	14.4	25/44	57	1,425	47	26	16	4	3		
	5 mid.	15.0	33/49	67	1,500	50	35	10	7	6		
	6 east	14.4	39/39	100	1,425	53	32	14	7			
C	7 west	13.5	34/42	81	1,125	60	33	16	8	2		
	8 mid.	13.6	19/38	50	1,500	50	20	4	2			
D	9 west	12.3	13/55	24	4,200	61	18	3	1	0	0	
	10 mid.	12.5	30/59	51	1,200	56	23	13	7	3	1	
	11 east	11.9	28/28	100	1,275	53	24	12	9			
E	12 west	10.9	10/54	19	3,975	62	17	3	1	0		
	13 mid.	11.1	17/63	27	4,125	65	31	9	2	1	0	
	14 east	11.0	31/31	100	1,275	59	3	2				
F	15 west	11.5	9/39	23	3,600	42	5	0	0			
	16 mid.	11.3	12/66	18	4,050	74	37	9	2	1	0	
	17 east	11.5	34/34	100	---							
G	18 west	10.9	28/57	49	675	59	33	17	1	0	0	
	19 mid.	11.1	30/32	94	675	56	31	16	7			
	20 east	11.2	41/41	100	600	77	52	22				
G_1	21 west	10.2	36/36	100	---							
	22 mid.	8.1	38/38	100	375	99	60	29	16			
	23 east	7.1	34/34	100	---							
Average		11.9	27/46	65	1,790	59	59	11	5	2	0.1	0

Table . Foot Candles of Light at Each Indicated Depth; Secchi Disc Readings and Percent of Sea Strength at Stations on the Back Bay Transects on May 18, 1962.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	13.0	20/31	65	3,675	82	53	31	20			
	2 mid.	13.1	31/52	60	3,675	82	61	41	22	8		
	3 east	14.2	30/52	58	3,750	80	58	40	20	5		
B	4 west	14.6	23/36	64	3,600	71	46	23	10			
	5 mid.	14.9	33/50	66	3,675	73	53	37	18	12		
	6 east	14.9	32/32	100		84	60	40	30			
C	7 west	15.3	24/33	73	3,750	76	44	28	16			
	8 mid.	15.3	13/17	77	3,750	72	46	34				
D	9 west	12.6	31/53	59	3,900	79	71	33	19	15		
	10 mid.	12.9	30/61	49	3,600	71	42	25	15	6	3	
	11 east	12.6	19/19	100	3,750	80	46	40				
E	12 west	12.1	24/32	75	3,675	84	57	33	24			
	13 mid.	11.3	20/68	29	3,900	77	71	23	10	1	0	0
	14 east	11.6	26/26	100	3,750	84	64	44				
F	15 west	12.1	21/32	66	4,050	83	41	22	17			
	16 mid.	11.5	20/59	34	3,975	77	38	8	3	1	1	
	17 east	11.5	24/24	100	3,750	84	68	52				
G	18 west	11.4	21/37	57	3,900	77	54	34	19			
	19 mid.	11.4	28/40	70	3,750	86	63	44	26			
	20 east	11.7	34/34	100	3,750	82	64	46	30			
G_1	21 west	11.5	25/25	100	3,825	86	55	27				
	22 mid.	11.1	31/31	100	3,900	81	44	42	36			
	23 east	12.3	27/27	100	3,750	88	74	58	48			
Average		12.7	26/38	74	3,775	80	55	35	21	7	1.3	0.1

Table . Foot Candles of Light at Each Indicated Depth; Secchi Readings, and Percent of Sea Strength at Stations on the Back Bay Transect on June 1, 1962.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface c.f.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	14.9	37/49	76	4,200	75	57	36	21	11		
	2 mid.	14.3	38/54	70	4,350	84	69	45	29	19	16	
	3 east	14.4	35/59	59	4,500	80	62	37	22	10	8	
B	4 west	14.6	39/47	83	4,350	83	62	41	24	17		
	5 mid.	15.1	54/54	100	4,200	91	71	54	36	25		
	6 east	13.8	34/44	77	4,350	62	34	17	10	7		
C	7 west	12.4	29/40	73	4,200	86	54	36	14	13		
	8 mid.	13.7	29/36	81		85	55	12	15			
D	9 west	12.3	23/63	37	4,200	89	46	25	11	5	1	
	10 mid.	12.1	25/70	36	4,200	82	46	30	14	13	7	2
	11 east	11.8	24/24	100	4,125	89	59	41				
E	12 west	12.1	25/67	37	1,650	45	19	11	5	3	2	0
	13 mid.	11.8	21/73	29	1,050	71	30	17	7	4	2	0
	14 east	11.5	30/30	100	4,125	76	44	36	29			
F	15 west	11.5	21/49	49	1,650	55	36	13	5	2		
	16 mid.	12.6	24/58	41	1,500	50	20	13	7	3	1	
	17 east	11.5	35/35	100	2,700	78	53	33	25			
G	18 west	11.3	23/50	46	3,900	81	50	25	10	2		
	19 mid.	10.6	31/31	100	4,125	78	48	28	13			
	20 east	11.0	42/47	89	2,550	76	41	29	12	3		
G_1	21 west	8.1	32/32	100	3,450	78	70	65	57			
	22 mid.	7.8	39/39	100	3,450	78	70	43	30			
	23 east	7.5	34/34	100	3,600	75	33	25	13			
Average		12.0	32/47	73	3,495	76	49	31	19	9	5	2

Table . Foot Candles of Light at Each Indicated Depth; Secchi Disc Readings, and Percent of Sea Strength at Stations on the Back Bay Transects on June 15, 1962.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	11.5	12/49	24	2,700	56	28	8	2	1		
	2 mid.	13.5	24/63	38	3,300	68	36	18	6	2	0	
	3 east	13.8	28/59	47	2,700	64	22	15	8	4	1	
B	4 west	14.8	35/47	74	3,225	84	47	35	14	2		
	5 mid.	14.3	35/58	60	3,150	71	48	29	12	6	2	
	6 east	11.8	29/39	74	3,450	83	41	22	6			
C	7 west	13.4	33/46	72	3,150	76	48	29	10	3		
	8 mid.	14.0	20/39	51	2,850	74	21	9	1			
D	9 west	12.1	21/49	43	3,300	73	45	20	5	2		
	10 mid.	12.1	22/61	36	3,000	60	33	20	5	2		
	11 east	11.5	28/28	100	3,900	77	54	35				
E	12 west	12.1	20/46	43	3,150	71	29	19	5	1		
	13 mid.	11.7	21/74	28	3,000	75	35	20	10	3	2	1
	14 east	11.3	36/36	100	3,750	74	58	44	26			
F	15 west	11.8	15/49	31	1,950	62	35	12	3	0		
	16 mid.	11.0	19/55	35	2,400	31	5	4	2	1		
	17 east	11.3	38/38	100	3,900	77	54	42	27			
G	18 west	11.5	20/46	43	3,975	68	42	26	9	3		
	19 mid.	11.3	41/41	100	3,750	80	52	40	30			
	20 east	11.5	41/44	93	3,900	81	50	31	23	15		
G_1	21 west	9.0	39/39	100	3,900	92	85	69	54			
	22 mid.	7.0	45/45	100	3,900	85	77	71	54	50		
	23 east	7.5	42/42	100	3,375	76	71	64	60	53		
Average		11.7	29/48	65	3,290	72	44	30	17	9	1	1

Table . Foot Candles of Light at Each Indicated Depth; Secchi Disc Readings and Percent of Sea Strength at Stations on the Back Bay Transects on July 20, 1962.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strenght	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	11.0	25/48	52	4,050	83	48	22	15	2		
	2 mid.	11.7	28/60	47	3,975	83	51	26	15	11	2	
	3 east	12.9	35/48	73	4,125	84	60	44	22	11		
B	4 west	11.5	41/48	85	3,900	81	56	38	19	12		
	5 mid.	11.3	39/60	65	3,750	88	64	44	24	16	12	
	6 east	12.1	41/41	100	4,200	86	68	46	36			
C	7 west	12.7	43/43	100	3,900	81	67	46	15	12		
	8 mid.	13.1	29/33	88	3,750	84	56	30	14			
D	9 west	11.2	23/54	43	3,750	72	42	24	14	4	2	
	10 mid.	13.1	37/61	61	3,900	81	58	38	23	17	12	
	11 east	12.4	28/28	100	4,050	85	67	41	37			
E	12 west	11.3	30/60	50	3,900	83	58	27	13	8	1	
	13 mid.	11.8	28/72	39	4,125	73	58	29	15	11	7	1
	14 east	11.2	33/33	100	4,050	85	63	44	37			
F	15 west	10.6	21/36	58	3,900	73	50	21	12			
	16 mid.	11.8	20/60	35	3,900	73	50	23	13	6	1	
	17 east	12.4	35/35	100	4,050	85	67	52	44			
G	18 west	12.4	26/60	43	3,900	77	54	27	15	8	1	
	19 mid.	11.7	31/36	86	3,900	81	56	27	15			
	20 east	12.3	47/47	100	4,125	85	71	53	40	36		
G_1	21 west	11.3	36/36	100	3,750	76	58	48	40			
	22 mid.	10.6	41/41	100	3,975	83	74	57	42			
	23 east	11.0	40/40	100	3,975	87	75	57	49			
Average		11.8	33/47	75	3,952	81	60	38	25	12	5	1

Table . Foot Candles of Light at Each Indicated Depth; Secchi Disc Readings and Percent of Sea Strength at Stations on the Back Bay Transects on August 1, 1962.

					Foot Candles of Light and Percent of Total at Each Depth								
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface c.f.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %	7 feet %
A	1 west	8.2	11/48	23	4,200	61	21	11	1				
	1a	--	15/54	28	4,200	54	18	4	1				
	1b	--	24/60	40	4,200	66	32	11	2	1	x		
	2 mid.	10.1	24/72	33	4,200	68	41	18	9	4	1		
	2a	--	30/66	45	4,350	66	43	22	9	5	1		
	2b	--	49/66	74	4,275	67	46	35	18	9	2		
	3 east	12.6	33/38	87	4,425	68	51	37	17				
B	*4 west	12.4	5/38	13	4,200	54	2	0	0				
	4a	--	48/54	89	4,350	83	62	45	29	17	5		
	4b	--	47/66	71	4,350	83	66	45	31	12	6		
	4c	--	49/66	74	4,425	75	61	46	27	17	12		
	4d	--	46/72	64	4,350	66	60	40	17	9	3		
	5 mid.	12.7	40/72	56	4,350	69	53	38	17	12	3		
	5a	--	38/72	53	4,200	77	57	39	21	16	5		
	5b	--	46/54	85	4,350	74	62	38	24	10			
	5c	--	38/38	100	4,350	79	62	45	21				
	6 east	12.6	48/48	100	4,125	76	67	49	25	18			
C	7 west	13.2	47/47	100	4,275	82	70	53	35	21			
	8 mid.	14.3	24/38	63	4,125	69	47	18	13				
D	9 west	11.8	24/60	40	4,500	73	57	23	13	10	0		
	10 mid.	12.1	32/60	53	4,275	75	53	35	21	14	11		
	11 east	10.4	25/25	100	4,350	76	59	48					
E	12 west	11.0	21/47	45	3,900	69	42	23	10	6			
	13 mid.	11.5	25/81	31	4,125	76	42	27	18	13	9	5	2
	14 east	11.7	42/52	81	3,900	65	42	35	21	6			
F	17 east	10.9	38/38	100	3,975	64	43	32	21				
Average		11.7	33/55	63	4,243	71	48	31	17	11	4	5	2

Samples 15-16 and 18-23 incomplete due to motor failure.

X = less than 0.5 percent.
* = very muddy after heavy rain.

Table . Foot Candles of Light at Each Indicated Depth; Secchi Disc Readings and Percent of Sea Strength at Stations on the Back Bay Transects on August 31, 1962.

					Foot Candles of Light and Percent of Total at Each Depth								
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %	7 feet %
A	1 west	9.7	29/36	81	4,200	82	54	32	9				
	2 mid.	11.0	30/60	50	4,200	82	57	36	21	10	7		
	3 east	11.3	28/28	100	4,275	79	60	42	35				
B	4 west	11.0	37/37	100	4,350	79	66	59	34				
	5 mid.	12.9	46/66	70	4,275	81	67	49	32	18	5	3	
	6 east	13.0	45/45	100	4,275	81	63	53	49	32			
C	7 west	12.1	43/43	100	4,200	79	64	46	11				
	8 mid.	12.6	28/28	100	4,200	79	64	29					
D	9 west	12.0	23/48	48	4,350	66	41	24	8	7			
	10 mid.	11.7	31/48	65	4,500	73	47	37	23	7			
	11 east	11.2	36/36	100	4,275	77	70	56	42				
E	12 west	11.5	17/30	57	4,200	68	30	13	9				
	13 mid.	11.3	31/73	42	4,200	68	46	21	14	7	2	1	
	14 east	11.3	32/32	100	4,275	70	60						
F	15 west	11.5	19/41	46	4,200	64	29	14	11	7			
	16 mid.	11.5	21/80	26	4,200	68	29	11	7	4	1	1	
	17 east	11.5	32/32	100	4,275	70	63	35	23				
G	18 west	11.7	23/37	62	3,900	54	31	19	15				
	19 mid.	11.7	38/38	100	4,050	67	56	37	28				
	20 east	11.5	31/31	100	3,750	88	80	60	52				
G_1	21 west	11.8	37/37	100	3,900	62	42	29	19				
	22 mid.	10.9	41/41	100	4,050	67	56	37	26				
	23 east	8.1	34/34	100	3,900	58	35	27	19				
Average		11.4	32/43	80	4,174	72	53	35	23	12	4	2	

Table . Foot Canles of Light at Each Indicated Depth; Secchi Disc Readings, and Percent of Sea Strength at Stations on the Back Bay Transects on September 25, 1962.

					Food Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	10.9	18/36	50	3,600	75	33	10	6			
	2 mid.	9.9	20/49	41	3,450	70	39	13	3	0		
	3 east	12.4	23/51	45	4,050	78	37	22	11	7		
B	4 west	11.2	37/37	100	3,150	71	52	29	14			
	5 mid.	11.2	34/51	67	3,900	73	54	35	23	15		
	6 east	12.1	46/46	100	2,850	74	47	32	26	21		
C	7 west	12.1	35/35	100	2,700	67	44	22	14			
	8 mid.	11.0	19/19	100	3,300	77	64	36				
D	9 west	10.6	17/48	35	3,150	57	29	10	1	0		
	10 mid.	11.5	15/46	33	3,750	60	24	8	1	1		
	11 east	11.3	29/29	100	3,150	62	29	19				
E	12 west	11.0	16/27	59	3,600	58	21	8				
	13 mid.	11.2	17/59	29	4,050	59	26	7	1	0		
	14 east	11.3	25/25	100	3,150	62	33	24				
F	15 west	10.6	13/26	50	3,600	50	17	2				
	16 mid.	11.3	15/59	25	3,750	60	20	8	1	1		
	17 east	12.6	24/24	100	3,525	68	43	30				
G	18 west	13.5	19/38	50	2,400	44	19	81	3			
	19 mid.	12.4	20/32	63	3,150	67	29	14				
	20 east	14.1	33/33	100	3,600	77	63	29	19			
G_1	21 west	11.7	17/24	71	3,300	68	23	9				
	22 mid.	12.4	31/31	100	4,350	72	48	28				
	23 east	12.1	30/30	100	4,125	76	62	47				
Average		11.7	24/37	70	3,463	66	37	23	9	6		

Table . Foot Candles of Light at Each Indicated Depth; Secchi Disc Readings, and Percent of Sea Strength at Stations on the Back Bay Transects on October 30, 1962.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	5.9	20/34	59	350	64	21	3	1			
	2 mid.	6.2	24/62	39	445	67	35	12	3	2	1	
	3 east	5.4	26/26	100	1,125	60	27	5				
B	4 west	7.6	33/33	100	1,050	71	50	29	21			
	5 mid.	8.7	27/60	45	900	75	50	25	8	4	2	
	6 east	7.3	40/47	85	975	77	46	23	9	6		
C	7 west	10.1	39/39	100	1,725	65	43	22	9			
	8 mid.	9.5	32/32	100	1,650	77	55	32	14			
D	9 west	9.9	13/36	36	3,300	73	32	11	4			
	10 mid.	10.9	18/59	31	2,025	74	37	15	5	2	0	
	11 east	10.4	14/14	100	1,800	71	33					
E	12 west	10.7	17/36	47	3,225	77	30	12	5			
	13 mid.	10.4	13/72	18	3,225	65	30	9	2	0	0	0
	14 east	11.0	29/29	100	2,775	70	43	22				
F	15 west	9.9	13/36	36	1,425	58	26	4	2			
	16 mid.	10.9	23/45	51	2,400	78	38	19	7	3		
	17 east	10.7	25/25	100	3,300	75	57	45				
G	18 west	11.0	17/41	41	1,950	77	31	15	5	4		
	19 mid.	9.2	40/40	100	2,850	84	68	47	32			
	20 east	10.7	26/26	100	1,875	72	44	12				
G_1	21 west	7.5	31/31	100	1,425	68	42	19	11			
	22 mid.	5.1	34/34	100	2,100	64	36	14	3			
	23 east	3.4	18/26	69	2,400	69	25	4				
Average		8.8	25/38	72	1,925	71	39	18	8	3	1	0

Note: Survey made under very cloudy sky conditions.

Table . Foot Candles of Light at Each Indicated Depth; Secchi Disc Readings, and Percent of Sea Strength at Stations on the Back Bay Transects on January 17, 1963. Back Bay-Currituck Cooperative Investigation.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	5.1	15/38	39	900	43	18	3	2	--	--	--
	2 mid.	5.0	14/48	29	420	76	26	5	2	1	--	--
	3 east	4.7	17/26	65	390	77	21	5	--	--	--	--
B	4 west	6.7	11/29	38	420	71	17	4	--	--	--	--
	5 mid.	6.8	13/54	24	370	70	30	5	3	0	0	--
	6 east	4.7	13/43	30	750	52	17	4	1	1	--	--
C	7 west	7.5	17/36	47	900	47	21	7	3	--	--	--
	8 mid.	7.1	13/27	48	900	40	12	2	--	--	--	--
D	9 west	7.3	11/41	27	2,250	60	3	0	0	0	--	--
	10 mid.	8.2	15/53	28	1,500	80	20	9	4	1	--	--
	11 east	5.6	15/18	83	1,200	63	17	8	--	--	--	--
E	12 west	7.5	10/46	22	450	72	13	2	0	0	--	--
	13 mid.	7.3	15/68	22	1,950	85	38	8	1	0	0	0
	14 east	6.7	17/22	77	1,200	63	25	9	--	--	--	--
F	15 west	7.5	9/29	31	1,500	50	3	0	0	--	--	--
	16 mid.	7.6	15/44	34	2,250	67	13	5	1	Tr.	--	--
	17 east	7.0	18/21	86	1,500	80	30	1	--	--	--	--
G	18 west	7.6	9/38	24	2,550	59	5	Tr.	0	--	--	--
	19 mid.	7.5	9/37	24	1,800	83	17	2	0	--	--	--
	20 east	7.6	22/22	100	3,300	73	36	14	--	--	--	--
G_1	21 west	6.5	10/25	40	1,500	60	9	1	--	--	--	--
	22 mid.	6.2	14/33	42	1,950	77	15	3	1	--	--	--
	23 east	6.2	18/28	64	2,700	61	28	5	--	--	--	--
Average		6.7	14/36	45	1,419	66	19	4	1	Tr.	0	0

Note: Trace = Less than 1.

Table . Foot Candles of Light at Each Indicated Depth; Secchi Disc Readings, and Percent of Sea Strength at Stations on the Back Bay Transects on March 4, 1963. Back Bay-Currituck Cooperative Investigations

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 fee %
A	1 west	2.5	9/32	28	3,150	67	12	5	Tr.	--	--	--
	2 mid.	2.5	5/60	8	3,150	57	2	Tr.	0	0	0	0
	3 east	3.4	9/33	27	3,000	55	8	Tr.	0	--	--	--
B	4 west	4.7	7/36	19	3,225	74	7	Tr.	0	--	--	--
	5 mid.	4.7	6/50	12	3,225	56	9	Tr.	Tr.	0	--	--
	6 east	4.7	7/47	15	1,875	64	12	Tr.	0	0	--	--
C	7 west	5.3	7/39	18	3,450	57	3	0	0	--	--	--
	8 mid.	5.4	6/32	19	2,850	63	8	Tr.	0	--	--	--
D	9 west	5.0	4/36	11	3,300	41	2	0	0	--	--	--
	10 mid.	5.9	6/56	11	3,600	54	5	0	0	0	0	--
	11 east	5.0	7/21	33	3,450	57	6	1	--	--	--	--
E	12 west	5.1	5/36	14	2,700	50	3	Tr.	0	--	--	--
	13 mid.	5.7	5/60	8	3,300	55	11	Tr.	0	0	0	--
	14 east	5.0	6/24	25	3,600	54	3	0	--	--	--	--
F	15 west	4.7	6/38	16	3,150	52	3	Tr.	Tr.	--	--	--
	16 mid.	5.4	6/46	13	3,450	65	9	Tr.	Tr.	0	--	--
	17 east	5.4	6/22	27	3,600	42	2	0	--	--	--	--
G	18 west	4.8	7/46	15	3,450	61	3	0	--	--	--	--
	19 mid.	5.0	7/37	19	3,675	53	5	Tr.	0	--	--	--
	20 east	5.6	11/25	44	3,675	57	10	1	--	--	--	--
G_1	21 west	3.9	5/27	19	3,150	48	1	0	--	--	--	--
	22 mid.	2.0	5/32	16	3,450	39	1	0	0	--	--	--
	23 east	2.0	5/24	21	3,300	64	2	0	--	--	--	--
Average		4.5	6/37	19	3,250	56	6	Tr.	Tr.	0	0	--

Note: Trace = Less than 1.

Table . Foot Candles of Light at Each Indicated Depth; Secchi Readings and Percent of Sea Strength at Stations on the Back Bay Transects on March 29, 1963.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	2.6	14/32	44	2,699	78	22	6	1			
	2 mid.	2.6	15/65	23	3,450	78	30	9	2	Tr.		
	3 east	3.7	13/36	36	3,450	78	39	13	9			
B	4 west	4.0	16/40	40	3,300	86	32	9	2			
	5 mid.	3.9	21/68	31	2,100	79	36	14	7	3	Tr.	Tr.
	6 east	3.9	17/52	33	3,350	84	31	13	9	4		
C	7 west	4.5	15/46	33	3,300	82	45	18	11	7		
	8 mid.	4.8	14/45	31	3,600	75	33	10	3	1		
D	9 west	5.3	15/37	41	3,600	79	42	10	4			
	10 mid.	5.0	18/68	26	3,625	82	43	16	5	2	1	Tr.
	11 east	5.0	16/22	73	3,525	85	40	15				
E	12 west	5.0	15/40	38	3,600	83	38	13	2			
	13 mid.	5.3	13/82	16	3,625	91	42	16	1	Tr.		
	14 east	4.7	14/32	44	3,525	72	20	6	2			
F	15 west	5.4	20/38	53	3,750	80	44	18	8			
	16 mid.	5.0	14/70	20	3,600	75	42	13	4	1	Tr.	Tr.
	17 east	4.4	15/29	52	3,600	83	33	10	8			
G	18 west	5.3	17/45	38	3,825	82	47	18	8	4		
	19 mid.	5.0	18/50	36	3,750	84	52	16	12	2		
	20 east	4.5	15/34	44	3,600	79	27	8	4			
G_1	21 west	5.1	23/36	64	3,525	81	51	26	13			
	22 mid.	3.7	12/41	29	3,600	83	21	4	1	1		
	23 east	1.9	8/26	31	3,900	58	10	6				
Average		4.4	16/45	38	3,469	80	36	12	6	2	Tr.	Tr.

Table . Foot Candles of Light at Each Indicated Depth; Secchi Disc Readings and Percent of Sea Strength at Stations on the Back Bay Transects on May 22, 1963.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	4.35	12/38	32	3,900	81	35	15	3			
	2 mid.	5.44	24/60	40	3,900	81	46	19	5	1		
	3 east	5.44	31/42	78	3,900	85	54	35	19			
B	4 west	5.13	23/45	51	4,200	89	61	39	21	18		
	5 mid.	4.35	16/63	25	4,125	84	40	18	6	3	1	
	6 east	5.28	25/25	100	3,750	76	52	28				
C	7 west	5.28	18/42	43	4,200	80	41	18	5	5		
	8 mid.	5.28	13/25	52	3,600	75	27	7				
D	9 west	5.44	12/48	25	3,450	70	15	2	Tr.			
	10 mid.	5.13	17/56	30	4,350	76	38	14	4	1		
	11 east	5.28	21/21	100	3,450	76	48	35				
E	12 west	5.44	15/45	33	3,900	85	38	15	2			
	13 mid.	5.28	25/72	35	3,750	84	48	16	5	2	1	Tr.
	14 east	5.13	22/28	79	4,125	91	53	25				
F	15 west	5.28	23/48	48	4,200	89	50	25	8	5		
	16 mid.	5.13	18/68	26	3,750	80	44	20	6	3	1	
	17 east	5.59	32/32	100	4,500	88	58	42	40			
G	18 west	5.13	25/48	52	4,200	86	57	29	14	8		
	19 mid.	5.13	26/40	65	4,200	89	54	32	18			
	20 east	5.59	30/32	94	4,125	84	47	33	18			
G_1	21 west	4.50	32/38	84	4,350	73	55	28	9			
	22 mid.	3.11	24/38	63	4,350	83	34	16	4			
	23 east	3.11	19/38	50	2,550	65	24	4	2			
Average		4.99	21/43	57	3,949	81	44	22	10	5	1	Tr.

Note: Trace = Less than 0.5

Table . Foot Candles of Light at Each Indicated Depth; Secchi Readings and Percent of Sea Strength at Stations on the Back Bay Transects on June 19 and 20, 1963.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	1.24	12/38	32	3,900	81	35	15	3			
	2 mid.	1.55	18/53	34	3,300	69	18	5	1			
	3 east	3.62	36/49	73	3,300	80	41	23	7	3		
B	4 west	2.95	30/45	67	4,125	73	36	18	4	1		
	5 mid.	3.11	43/54	80	4,350	86	55	34	17	6	4	
	6 east	4.04	24/24	100	3,300	86	33	27				
C	7 west	3.73	40/47	85	4,350	76	52	43	21	10		
	8 mid.	3.88	34/35	97	2,550	74	35	14	10			
D	9 west	3.88	24/44	55	2,700	83	39	17	5	2		
	10 mid.	4.19	54/57	95	4,350	90	69	55	34	21	5	
	11 east	4.66	24/24	100	900	67	50	22				
E	12 west	4.66	23/49	47	2,250	83	40	20	7			
	13 mid.	4.82	18/75	24	2,850	84	63	37	21	8	7	1
	14 east	4.66	30/30	100	4,500	87	67	47	40			
F	15 west	4.66	26/44	59	3,900	67	38	19	10			
	16 mid.	4.50	12/74	16	2,850	66	21	4	1			
	17 east	4.82	32/32	100	4,500	92	75	60	53			
G	18 west	4.97	26/46	57	5,100	88	65	32	15			
	19 mid.	4.66	37/37	100	4,875	85	69	46	38			
	20 east	4.35	32/32	100	4,200	80	63	45	36			
G_1	21 west	4.66	37/37	100	3,600	79	58	31	13			
	22 mid.	4.82	36/36	100	2,625	91	71	46	34			
	23 east	3.88	36/36	100	5,100	85	59	37	24			
Average		4.01	30/43	75	3,629	81	50	30	19	7	5	1

Table . Foot Candles of Light at Each Indicated Depth; Secchi Readings and Percent of Sea Strength at Stations on the Back Bay Transects, August 21, 1963.

					Foot Candles of Light and Percent of Total at Each Depth							
Tran.	Stat.	% Sea Strength	S.D./Depth Inches	- %	Surface f.c.	1 inch %	1 foot %	2 feet %	3 feet %	4 feet %	5 feet %	6 feet %
A	1 west	4.19	25/39	64	1,500	80	35	16	9			
	2 mid.	4.50	24/68	35	1,875	60	40	15	9	5	3	
	3 east	4.97	25/31	81	2,025	81	37	22	15			
B	4 west	3.57	22/44	50	1,500	80	25	13	5	2		
	5 mid.	4.04	26/72	36	2,400	69	38	19	10	6	3	1
	6 east	5.44	24/24	100	2,250	67	33	17				
C	7 west	4.50	16/46	35	2,250	67	23	8	3	1		
	8 mid.	4.66	11/33	33	2,250	67	13	3	2			
D	9 west	5.44	13/48	27	3,000	75	25	6	1			
	10 mid.	5.59	16/60	27	3,450	76	39	9	4	1		
	11 east	6.68	21/21	100	3,300	86	64	45				
E	12 west	5.59	12/40	30	3,000	75	25	8	3	1		
	13 mid.	5.75	25/72	35	3,375	84	56	22	10	6	4	1
	14 east	5.75	25/25	100	2,100	71	54	36				
F	15 west	5.44	14/42	33	3,000	65	20	5	1			
	16 mid.	5.59	25/46	54	3,300	77	57	34	18	11		
	17 east	5.75	30/30	100	2,625	71	57	43	34			
G	18 west	5.59	19/42	45	3,450	78	35	13	5	3		
	19 mid.	5.90	31/35	89	3,375	80	62	40	31			
	20 east	6.21	31/31	100	3,150	90	71	43	33			
G_1	21 west	5.59	24/35	69	2,700	83	50	28	9			
	22 mid.	5.59	38/38	100	2,700	83	61	39	22			
	23 east	4.19	36/36	100	3,375	78	49	27	11			
Average		5.24	23/42	63	2,693	76	42	22	12	4	3	1

Table . Foot Candles of Light at Water Surface and Percent Transmission to Indicated Depth; Salinities; at Stations from Back Bay to Oregon Inlet - March 27, 1961.

Station	% Sea Strength	Surface f.c.	Foot Candles of Light and Percent of Total at Each Depth										
			1 in. %	1 ft. %	2 ft. %	3 ft. %	4 ft. %	5 ft. %	6 ft. %	7 ft. %	8 ft. %	9 ft. %	10 ft. %
1. Back Bay - Middle	0.93	4,350	76	8	1	Tr.	0	0	0	0*			
2. North Landing River	0.78	4,050	63	4	Tr.	0	0	0	0	0*			
3. N.L.R. near Tulls Bay	0.78	4,050	70	48	11	2	0	0*					
4. N. of Church's Island	1.87	4,050	70	19	4	1	Tr.	0	0	0*			
5. E. of Church's Island	2.02	4,050	63	11	2	Tr.	Tr.	0*					
6. S. of Waterlily	2.02	3,750	76	20	6	2	Tr.	Tr.	Tr.*				
7. N. of Poplar Branch	2.18	3,750	76	28	12	3	1	Tr.	Tr.*				
8. E. of Dews Quarter Is.	2.64	3,750	76	36	12	5	3	1	Tr.	Tr.	0*		
9. W. of Powell's Point	3.26	3,750	76	40	24	12	6	4*					
10. Wright Memorial Bridge	4.66	3,450	65	22	4	1	1	0	0*				
11. S. of W. M. Bridge	4.97	3,450	70	26	7	2	1	0	0	0*			
12. Colington	5.90	3,300	64	27	14	4	2	1	Tr.	Tr.*			
13. S. of Colington	6.84	3,300	59	27	14	5	2	1	1	Tr.	Tr.	0*	
14. N. of Manteo	12.74	3,000	75	40	25	10	6	5	3	2*			
15. S. of Manteo	-	3,000	70	35	20	9*							
16. E. of Broad Creek	29.05	-	-										
17. W. of Cedar Island	-	-	-										
18. N. of Oregon Inlet	35.26	2,700	72	44	28	17	10	7	4	3	2	2	1*

Readings from 1:00 p.m. to 3:20 p.m.; taken from seaplane.

Tr. = 0.5% or less
* = Bottom

Table . Foot Candles of Light at Water Surface and Percent Transmission to Indicated Depth; Salinities; at Stations from Back Bay to Oregon Inlet - April 28, 1961.

Station	% Sea Strength	Surface f.c.	Foot Candles of Light and Percent of Total at Each Depth											
			1 in.	1 ft.	2 ft.	3 ft.	4 ft.	5 ft.	6 ft.	7 ft.	8 ft.	9 ft.	10 ft.	11 ft.
			%	%	%	%	%	%	%	%	%	%	%	%
1. Back Bay - Middle	1.24	4,350	79	4	Tr.	0*								
2. North Landing River	0.93	4,350	76	9	1	Tr.	0*							
3. N.L.R. near Tulls Bay	0.93	4,350	72	7	1	Tr.	0*							
4. N. of Church's Island	1.24	4,350	76	7	1	0*								
5. E. of Church's Island	1.55	4,500	73	10	2	1*								
6. S. of Waterlily	2.02	4,500	80	22	4	1	Tr.	0*						
7. N. of Poplar Branch	2.02	4,650	74	23	4	1	Tr.*							
8. E. of Dews Quarter Is.	2.48	4,650	84	40	23	11	4	2	1	Tr.	Tr.*			
9. W. of Powell's Point	3.11	4,500	83	43	20	7	3	1*						
10. Wright Memorial Bridge	4.04	4,500	83	50	30	17	7	4	2	1*				
11. S. of W.M. Bridge	2.80	4,650	71	16	3	Tr.	Tr.	0*						
12. Colington	3.88	4,725	86	51	32	13	4	2	1	Tr.	Tr.*			
13. S. of Colington	2.95	4,650	87	19	4	1	Tr.	Tr.	0*					
14. N. of Manteo	6.68	4,650	87	35	13	4	2	1*						
15. S. of Manteo	10.58	4,650	87	39	19	8	3	1	Tr.	Tr.	0*			
16. E. of Broad Creek	12.89	4,800	84	44	22	13	5	3	2	1	1	Tr.	Tr.	0*
17. W. of Cedar Island	-	-	-											
18. N. of Oregon Inlet	26.57	4,650	81	48	26	11	6	4	2	2	1	1	1	Tr.*

Readings from 10:00 a.m. to 12:00 p.m.; taken from seaplane.

Tr. = 0.5% or less
* = Bottom

Table . Foot Candles of Light at Water Surface and Percent Transmission to Indicated Depth; Salinities; at Stations from Back Bay to Oregon Inlet - May 22, 1961.

Station	% Sea Strength	Surface f.c.	Foot Candles of Light and Percent of Total at Each Depth											
			1 in.	1 ft.	2 ft.	3 ft.	4 ft.	5 ft.	6 ft.	7 ft.	8 ft.	9 ft.	10 ft.	11 ft.
			%	%	%	%	%	%	%	%	%	%	%	%
1. Back Bay - Middle	1.40	4,200	82	46	21	8	4	2	1*					
2. North Landing River	0.62	4,200	75	14	3	1	0	0	0	0*				
3. N.L.R. near Tulls Bay	0.78	4,200	64	11	1	0	0	0	0	0*				
4. N. of Church's Island	0.93	3,750	72	16	3	1	Tr.	0	0	0	0*			
5. E. of Church's Island	1.40	4,350	79	31	14	7*								
6. S. of Waterlily	1.40	4,350	72	31	10	4	1	1	Tr.	0	0*			
7. N. of Poplar Branch	1.87	4,350	83	48	28	14	7	4	1*					
8. E. of Dews Quarter Is.	2.48	4,500	80	53	30	16	10	5	2	2	1*			
9. W. of Powell's Point	3.11	4,500	77	47	33	20	10	6	4	3*				
10. Wright Memorial Bridge	3.42	4,350	79	48	31	21	14	7	4	3	2	1*		
11. S. of W.M. Bridge	2.80	4,500	77	27	10	2	1	Tr.	0	0*				
12. Colington	3.57	4,500	80	40	20	8	3	2	1	Tr.*				
13. S. of Colington	4.04	4,650	81	45	19	10	3	2	1	Tr.	Tr.*			
14. N. of Manteo	5.90	4,650	90	52	26	13	6	3	2*					
15. S. of Manteo	7.30	4,650	84	58	29	19	10	6	3	2	1	1	Tr.	Tr.*
16. E. of Broad Creek	13.05	4,500	90	53	33	20	12	7	5	3	2*			
17. W. of Cedar Island	20.50	4,650	84	58	39	23	13	5*						
18. N. of Oregon Inlet	34.00	4,500	83	60	43	33	23	17	13	10	7*			

Readings from 10:00 a.m. to 12:00 p.m.; taken from seaplane

Tr. = 0.5% or less
* = Bottom

Table . Foot Candles of Light at Water Surface and Percent Transmission to Indicated Depths; Salinities; at Stations from Back Bay to Oregon Inlet - June 26, 1961.

Station	% Sea Strength	Surface f.c.	Foot Candles of Light and Percent of Total at Each Depth												
			1" %	1' %	2' %	3' %	4' %	5' %	6' %	7' %	8' %	9' %	10' %	11' %	14' %
1. Back Bay - Middle	1.24	4,500	83	47	30	17	7	3	3	2*					
2. North Landing River	1.24	4,500	83	23	10	3	1	Tr.	Tr.	Tr.*					
3. N.L.R. near Tulls Bay	1.40	4,500	73	23	10	3	1	1	Tr.	Tr.*					
4. N. of Church's Island	3.26	4,500	80	30	13	7	2	1	Tr.	Tr.	Tr.	Tr.	0*		
5. E. of Church's Island	2.33	4,500	83	43	23	13	7	3	2*						
6. S. of Waterlily	2.80	4,500	83	50	33	20	13	10	7	3	2	2*			
7. N. of Poplar Branch	2.43	4,500	76	53	33	20	13	7*							
8. E. of Dews Quarter Is.	2.95	4,200	82	57	36	25	14	11	7	4*					
9. W. of Powell's Point	3.26	4,200	79	57	36	25	18	11	7	4*					
10. Wright Memorial Bridge	3.11	4,200	82	54	36	18	11	7	4	2	1	1*			
11. S. of W. M. Bridge	4.04	4,050	74	56	33	19	11	7	4*						
12. Colington	4.97	3,900	77	50	31	15	8	4	2	1*					
13. S. of Colington	7.30	3,750	84	60	36	20	12	8	4	2	2	1	1*		
14. N. of Manteo	10.62	3,750	84	60	40	28	20	12	8	4*					
15. S. of Manteo	13.36	3,900	77	54	38	23	15	12	8	5	3	2	1	1	Tr.*
16. E. of Broad Creek	22.68	3,750	84	60	36	24	16	12	8	5	3	2*			
17. W. of Cedar Island	27.65	3,750	84	56	36	24	16	8*							
18. N. of Oregon Inlet	21.90	3,450	74	48	26	17	9	4	4*						

Readings from 12:00 p.m. to 2:30 p.m.; taken from seaplane

Tr. = 0.5% or less
* = Bottom

Table . Foot Candles of Light at Water Surface and Percent Transmission to Indicated Depth; Salinities; at Stations from Back Bay to Oregon Inlet - July 22, 1961.

Station	% Sea Strength	Surface f.c.	Foot Candles of Light and Percent of Total at Each Depth										
			1 in. %	1 ft. %	2 ft. %	3 ft. %	4 ft. %	5 ft. %	6 ft. %	7 ft. %	8 ft. %	9 ft. %	10 ft. %
1. Back Bay - Middle	1.24	4,650	87	58	29	13	9	5	3	Tr.*			
2. North Landing River	1.09	4,800	78	34	13	4	2	1	Tr.	Tr.*			
3. N.L.R. near Tulls Bay	1.09	4,650	74	23	8	2	1	Tr.	Tr.	0*			
4. N. of Church's Island	1.87	4,650	84	35	19	10	3	2	1	Tr.	Tr.*		
5. E. of Church's Island	1.87	4,500	83	53	33	13*							
6. S. of Waterlily	2.18	4,800	84	53	41	25	14	8	3	1	1	Tr.*	
7. N. of Poplar Branch	3.11	1,950	77	31	15	5*							
8. E. of Dews Quarter Is.	3.11	4,350	79	55	31	17	10	3	1	1	1*		
9. W. of Powell's Point	3.26	5,400	72	33	22	10	6	4	2	1	Tr.*		
10. Wright Memorial Bridge	3.57	4,200	82	57	36	20	13	6	4	2	1	1	1*
11. S. of W. M. Bridge	3.57	4,350	83	52	28	17	9	4	3	2	2*		
12. Colington	3.42	4,050	81	59	33	22	13	7	4	2*			
13. S. of Colington	4.19	4,350	83	52	34	19	12	6	5	3	2*		
14. N. of Manteo	15.38	4,200	79	54	36	21	14	7	4*				
15. S. of Manteo	18.00	3,600	75	46	29	17	8	6	4*				
16. E. of Broad Creek	21.90	3,000	70	45	25	13	6	3	2	1	Tr.	Tr.*	
17. W. of Cedar Island	27.65	2,250	73	30	13	4	3*						
18. N. of Oregon Inlet	45.05	1,500	60	30	20	9	5	3	2	1	1	Tr.	0*

Readings from 12:00 p.m. to 2:40 p.m.; taken from seaplane

Tr. = 0.5% or less
* = Bottom

Table . Foot Candles of Light at Water Surface and Percent Transmission to Indicated Depth; Salinities; at Stations from Back Bay to Oregon Inlet - August 28, 1961.

Station	% Sea Strength	Surface f.c.	Foot Candles of Light and Percent of Total at Each Depth											
			1 in. %	1 ft. %	2 ft. %	3 ft. %	4 ft. %	5 ft. %	6 ft. %	7 ft. %	8 ft. %	9 ft. %	10 ft. %	11 ft. %
1. Back Bay - Middle	1.55	2,775	78	46	24	16	14	11	5*					
2. North Landing River	1.09	2,850	58	21	13	8	1	1	Tr.	Tr.*				
3. N.L.R. near Tulls Bay	1.24	1,800	75	29	17	13	3	2	1	1	1*			
4. N. of Church's Island	1.24	3,600	67	42	21	10	6	2	1	1	Tr.	Tr.*		
5. E. of Church's Island	1.87	3,600	79	54	33	21	6*							
6. S. of Waterlily	2.80	4,050	89	59	33	30	22	15	11	7	6*			
7. N. of Poplar Branch	2.80	4,350	86	62	48	31	21	14	10	3*				
8. E. of Dews Quarter Is.	3.11	4,200	79	53	36	21	14	7	5	2	1*			
9. W. of Powell's Point	6.21	4,500	80	53	30	20	13	12*						
10. Wright Memorial Bridge	11.19	4,275	88	70	56	32	21	14	11	7*				
11. S. of W. M. Bridge	-	-												
12. Colington	-	-												
13. S. of Colington	-	-												
14. N. of Manteo	26.72	4,500	87	77	50	43	33	23	20	15	10*			
15. S. of Manteo	35.11	4,500	80	63	43	27	17	12	8	7	5	2	1	1*
16. E. of Broad Creek	38.67	4,500	83	67	47	33	23	17	13	8	7	5*		
17. W. of Cedar Island	-	-												
18. N. of Oregon Inlet	83.86	4,500	83	67	53	47	40	30	23	18	15*			

Readings from 10:00 a.m. to 1:00 p.m.; taken from seaplane

Tr. = 0.5% or less
* = Bottom

Table _____. pH of Water in the 1960 Bioassay of Aquatic Plants in Water of 1 to 40 Percent Sea Strength.

		Sago Pondweed Tanks**									
Soil	Salinity	5/30	6/7	7/7	7/22	7/25	8/2	8/6	10/11	11/4	12/5
Loam	1% SS	8.0	8.2	8.0	9.0	9.3	8.7	9.1	8.3	7.3	9.3
	1	8.1	8.4	8.4	9.4	9.4	9.0	8.9	8.4	7.3	9.1
	5	8.1	8.0	8.4	9.3	9.2	8.7	8.8	8.2	7.5	8.7
	10	7.6	7.6	7.0	8.1	8.0	5.8	6.9	8.2	7.7	5.7
	15	7.4	7.4	6.8	8.2	8.7	8.2	8.8	8.4	7.4	6.3
	20	7.4	7.3	7.0	8.2	7.5	6.7	7.6	6.8	7.4	5.0
	25	7.5	7.4	8.2	9.1	8.9	8.4	8.6	8.4	8.2	5.1
	30	7.7	7.4	8.0	8.6	8.4	7.6	8.2	6.6	7.0	4.5
	35	8.0	7.7	8.4	9.0	8.8	8.7	9.0	8.8	8.3	5.0
	40	8.0	7.9	8.2	8.8	8.8	8.8	9.0	8.6	8.2	5.6
Silt	1	8.0	7.6	7.4	8.5	9.0	7.5	8.3	8.3	7.3	8.5
	1	8.1	7.8	7.4	8.9	9.1	9.0	9.0	8.6	7.8	8.7
	5	8.1	7.8	8.4	9.5	9.5	9.4	9.6	8.8	8.2	8.3
	10	7.6	7.8	7.8	7.6	6.8	6.2	6.9	8.0	7.6	8.0
	15	7.7	7.8	8.2	9.3	9.2	8.9	9.2	8.6	7.8	8.5
	20	7.4	7.7	8.2	9.2	9.1	8.6	8.8	9.2	8.8	8.4
	25	8.1	8.1	8.4	9.3	9.0	8.6	9.0	8.0	8.0	7.6
	30	7.8	8.0	8.4	9.5	9.3	9.2	9.4	9.2	8.5	8.6
	35	7.8	7.8	8.4	8.5	8.4	8.5	8.8	9.1	8.6	8.1
	40	8.0	7.9	8.4	8.8	8.7	9.0	9.4	9.2	8.8	7.6

** pH's of sago pondweed tanks reasonably similar to tanks of widgeongrass, wildcelery, Najas, and *Chara* and data not presented for those.

Table _____. Chemical Analyses of Water in Redheadgrass Tanks with Loam Soil on July 22, 1960, at time of Low pH's* in Three Tanks.

Salinity	pH	Aluminum	Ferric Iron	Ammonia Nitrogen	Nitrites	Copper	Total Phosphate	Ortho Phosphate	Turbidity	CO_2	Methyl Orange Alkalinity
1% SS	9.8	0	.07	0	0	.15	.37	.06	4	0	32
1	9.8	0	.23	0	0	.15	.11	.00	4	0	34
5	9.3	0	.30	0	.02	.08	.06	.02	11	0	38
10	9.4	.05	.28	0	.02	.12	.15	.02	19	0	36
15	4.4*	.21	.47	.33	.01	.06	.05	.02	9	8.0	6
20	4.7*	.06	.33	.59	.02	.06	.06	.02	7	4.0	8
25	8.8	0	.32	.82	.02	.06	.13	.02	7	0	18
30	8.9	.01	.35	1.14	.03	.06	.11	.03	11	0	24
35	4.4*	.22	.91	1.76	.02	.06	.07	.01	8	7.0	6
40	8.7	.04	.30	1.51	.02	.12	.13	.02	26	0	40

* Loam soil tanks of 15, 20, and 35 percent sea strength developed low pH's, low alkalinity, and increased CO_2 content.

Table _____. (cont'd) pH of Water in the 1960 Bioassay of Aquatic Plants in Water of 1 to 40 Percent Sea Strength.

		Redheadgrass											
Soil	Salinity	5/30	6/7	7/12	7/22	7/23	7/25	7/26	8/2	8/6	10/11	11/4	12/5
Loam	1% SS	8.6	9.2	8.2	9.8	9.0	9.6	8.8	9.5	9.2	9.6	8.9	6.2
	1	8.7	9.2	8.4	9.8	9.3	9.8	9.2	9.5	9.4	9.7	9.1	7.4
	5	7.6	8.6	8.2	9.3	9.0	9.2	9.0	9.0	8.9	9.2	8.6	6.9
	10	7.6	8.4	8.2	9.4	9.1	9.4	8.9	9.1	9.0	9.5	8.8	7.8
	15	7.3	8.2	6.8*	4.4*	4.2*	4.2*	4.0*	4.3*	4.4*	8.8	8.4	5.9
	20	7.2	8.3	6.8*	4.7*	4.7*	4.4*	4.4*	4.6*	5.5*	8.4	8.1	7.4
	25	7.3	8.2	8.2	8.8	8.5	8.7	8.5	8.4	8.5	9.0	8.0	7.6
	30	8.2	8.0	8.2	8.9	8.6	8.6	8.5	8.3	8.6	8.5	7.8	6.7
	35	7.5	8.0	6.8*	4.4*	4.2*	4.2*	4.0*	4.2*	5.2*	8.5	7.9	4.1
	40	7.8	8.0	8.2	8.7	8.4	8.6	8.1	9.4	9.5	9.0	8.2	7.8
Silt	1	9.1	9.4	8.4	9.6	9.3	9.5	-	8.9	8.9	9.9	9.2	8.8
	1	8.9	9.4	8.2	9.5	9.3	9.4	-	9.2	9.1	9.6	9.0	8.3
	5	7.8	9.0	8.4	9.5	9.1	9.4	-	9.0	8.9	9.2	8.5	8.3
	10	7.5	8.8	8.2	9.2	8.9	9.2	-	8.7	8.7	9.4	8.8	8.3
	15	7.3	8.2	8.2	8.8	8.3	8.6	-	7.4	8.0	8.8	8.4	8.3
	20	7.2	8.3	8.2	9.2	9.0	9.1	-	8.9	9.0	8.8	7.9	8.0
	25	7.4	8.4	7.8	8.2	7.0	8.0	-	7.6	6.6	8.8	8.0	7.2
	30	8.2	8.2	8.2	8.4	8.1	8.4	-	8.5	8.9	8.9	8.1	6.9
	35	7.9	8.0	8.2	8.6	8.5	8.6	-	8.6	9.0	9.1	8.2	8.0
	40	8.0	8.0	8.4	9.2	9.1	9.2	-	9.1	9.6	8.7	8.4	8.0

* Redheadgrass - Loam soil tanks of 15, 20, and 35 percent sea strength developed low pH's, low alkalinity, and increased CO_2 content.

Table _____. Total Methyl Orange Alkalinity (ppm) of Water in the 1960 Bioassay of Aquatic Plants in Water of 1 to 40 Percent Sea Strength.

Soil	Salinity	Sago Pondweed				Redheadgrass				Widgeongrass				Wildcelery				Najas			
		6/1	7/7	7/27	10/11	5/31	7/12	7/25	10/11	5/31	7/8	7/27	10/11	5/31	7/8	7/27	10/11	5/31	7/8	7/27	10/11
Loam	1% SS	34	42	46	42	50	46	32	40	50	54	48	38	74	74	55	24	58	66	54	68
	1	40	38	36	24	52	54	34	64	60	68	52	40	46	54	42	88	58	64	60	58
	5	32	36	24	34	42	52	38	44	44	64	48	48	52	66	40	30	40	40	30	26
	10	28	20	18	24	48	46	36	82	42	44	40	28	52	70	70	96	30	42	28	26
	15	20	24	24	36	22	18*	6*	22*	72	76	60	106	62	82	80	90	42	68	50	54
	20	24	22	22	26	32	22*	8*	24*	68	90	70	104	52	66	50	62	42	68	74	104
	25	50	48	30	20	58	36	18	46	46	70	48	30	36	46	42	40	48	56	54	82
	30	42	34	20	18	68	42	24	24	54	68	70	20	44	64	70	66	52	66	68	86
	35	70	78	70	50	20	20*	6*	44	62	74	54	54	62	66	52	52	56	76	74	114
	40	80	92	90	44	52	52	40	84	66	62	40	30	60	84	76	56	66	80	90	118
Silt	1	36	50	48	38	34	50	30	62	40	50	40	22	44	68	48	22	46	50	40	60
	1	40	42	42	36	34	46	34	64	42	68	50	38	44	56	52	26	52	60	42	80
	5	36	54	30	58	28	46	28	56	42	74	50	70	34	60	40	20	32	46	40	38
	10	46	32	40	28	32	40	18	38	36	58	42	58	38	46	40	40	34	38	34	62
	15	38	48	42	46	36	38	14	34	34	62	54	62	38	54	46	46	38	42	40	26
	20	40	52	58	84	36	40	28	400**	40	74	64	104	40	58	50	62	40	62	56	60
	25	52	58	40	30	38	40	16	26	54	62	68	66	38	54	84	70	40	64	96	108
	30	60	68	60	60	36	34	18	64	46	82	66	106	52	86	76	30	58	90	105	114
	35	54	76	80	78	50	48	20	80	60	84	80	74	56	82	90	40	48	72	80	90
	40	60	84	90	98	58	82	54	98	64	80	70	72	56	80	80	76	56	90	90	112

* Redheadgrass - Loam soil tanks of 15, 20, and 35 percent sea strength developed low pH's, low alkalinity, and increased CO_2 content.

** No known explanation.

Table_____. Tests Involving Soils, Salinity, and Aqutic Plants.

Tank Study Soil Analysis - Silt — December 5, 1960

Available Nutrient	1%	2%	5%	10%	15%	20%	25%	30%	35%	40%
pH (dry)	6.0	6.0	6.5	6.0	6.0	6.0	6.5	6.0	6.0	6.0
Phosphorus	Med.+	High	High	Med.+	High	High	High+	High+	High+	V.High
Potassium	V.High	V.High	V.High	High+	V.High	V.High	V.High	V.High	V.High	V.High
Calcium	V.Low	V.Low	V.Low	V.Low	Low	Low	Low+	Med.	Med.	Med.
Magnesium	Med.+	Med.+	Med.+	Med.+	High+	High+	High+	High+	High+	High+
Nitrate	None	None	None	None	None	None	None	None	None	None
Ammonia	V.High	V.High	V.High	V.High	V.High	V.High	V.High	V.High	V.High	V.High
Sulfate	V.Low	V.Low	V.Low	Low	Med.	Med.	Med.	Low+	Med.	Med.
Chloride	Med.+	Med.	Med.+	V.High	V.High	V.High	V.High	V.High	V.High	V.High
Iron	Med.	Med.	Low	Low	Med.	Low	Low	Med.	Low	Low

Loam

pH (dry)	6.0	6.0	6.0	6.0	6.0	5.0	5.0	5.0	6.0	5.0
Phosphorus	Med.+	Med.+	High	High	Med.+	Med.+	Med.+	Med.+	Med.+	Med.+
Potassium	Low+	Low+	Med.+	V.High	High+	High+	V.High	V.High	V.High	V.High
Calcium	V.Low	V.Low	V.Low	Low	V.Low	V.Low	V.Low	Low	Low	V.Low
Magnesium	Med.	Med.	Med.+	Med.+	Med.+	Med.+	Med.+	High	High	High
Nitrate	None	None	None	None	None	None	None	None	None	None
Ammonia	V.High	V.High	High	V.High	High	High	High	High	High	High
Chloride	Med.	Med.	Med.+	Med.+	Med.+	High	V.High	V.High	V.High	V.High
Iron	Low	Low	Low	Low	Low	Med.	Med.	Med.	Low	Low
Sulfate	V.Low	V.Low	V.Low+	V.Low+	Low	Low	V.Low	Low	Med.	Med.

Table _____. Soil Nutrient Evaluation of Tank Study of Redheadgrass - Loam, July 25, 1960.

	Control	5%	10%	15%	20%	25%	30%	35%	40%
pH (wet)	7.0	6.5	7.0	6.0	7.5	6.0	6.0	8.0	8.0
pH (dry)	6.0	6.0	6.0	6.0	5.0	5.0	5.5	5.0	5.0
Phosphorus	High	High+	High+	High+	High+	High+	High+	High+	V.High
Potassium	Med.+	Med.	Med.	High	High+	Low+	V.High	V.High	High+
Calcium	V.Low	V.Low	Low	Low	Low	V.Low	Low	V.Low	Med.
Magnesium	Med.	Med.	Med.	Med.+	Med.+	High	High	High	High
Ammonia	High	High	High	V.High	V.High	High	High	V.High	High
Nitrate	None	None	None	None	None	None	None	None	None
Sulfate	Low	V.Low+	Low	Med.	Med.	Low+	Low	Med.	Low
Chloride	Med.+	Med.+	Med.+	High	High+	V.High	High+	High+	High
Iron	Low	Low	Low	Med.	High	High	Low	High	Med.

Table____. Quarterly Chemical Analyses of Soils

May 19, 1959	Back Bay							
Available Nutrient	Plot Number							
	1	2	3	4	5	6	7	8
pH (Air dried)	4.5	4.0	4.5	4.5	4.0	4.0	4.5	*
Phosphorus	Med.	Med.	Med.	Low.+	Low	Low+	V.Low+	
Potassium	Low	Low	Low	High	High	High	V.High	
Calcium	V.Low	V.Low	V.Low	Low	V.Low	V.Low	V.Low	
Magnesium	V.Low	V.Low	Low	Med.	Med.	Med.	Med.	
Nitrate	None	None	None	None	None	None	None	
Ammonia	High	Med.	High	High+	Med.	High	V.High	
Sulfate	Low	Low	Low	V.High	V.High	V.High	V.High	
Chloride	Med.	Med.	High	Med.	Med.	Med.	Med.	
Ferric Iron	Med.	Low	Med.	High	High	High	High	

December 17, 1959	Back Bay							
pH (Air dried)	6.0	6.0	6.0	7.0	5.5	6.0	5.5	6.0
Phosphorus	Med.	Low	V.Low	V.High	High	V.Low	Low	Med.
Potassium	Med.	Low	Low	Med.	Low	Low	Low	Low
Calcium	Low	V.Low	V.Low	Low	V.Low	V.Low	V.Low	V.Low
Magnesium	Med.	V.Low	V.Low	High	High	Low	Low	Med.
Nitrate	None	None	None	None	None	None	None	None
Ammonia	High	Med.	Med.	V.High	Med.	Med.	Med.	V.High
Sulfate	V.Low	V.Low	V.Low	V.Low	Low	V.Low	V.Low	Low
Chloride	High	Med.	High+	Med.	Med.+	Low	Low	Med.

*Sample not collected.
+Quantity slightly above that indicated.

Table____. Quarterly Chemical Analyses of Soils

April 13, 1960 — Back Bay

Available Nutrient	Plot Number 1	2	3	4	5	6	7	8
pH (wet)	8.0	8.0	6.0	8.5	8.0	7.0	8.0	8.0
pH (aid dried)	6.0	5.0	6.0	6.0	5.0	5.0	6.0	5.5
Phosphorus	Med.	Low+	Low	Med.+	Med.	Med.+	V.Low+	Med.+
Potassium	Low	Med.	Low	High	Med.	V.High	Low	Med.
Calcium	V.Low	V.Low+	V.Low	V.Low	V.Low	V.Low+	V.Low	V.Low+
Magnesium	V.Low	Low+	V.Low	High	Low	Med.+	V.Low	Med.+
Nitrate	None	None	None	None	None	None	None	None
Ammonia	Med.	High	Low	V.High	Med.	V.High	Low	Med.
Sulfate	V.Low	V.Low	V.Low	Low+	V.Low+	V.Low+	V.Low	High
Chloride	Low	Med.	Low	Med.+	Low+	Low+	V.Low+	Med.
Ferric Iron	V.Low	Med.	V.Low	Low	Med.	Med.	V.Low	Med.

March 31, 1960 — Currituck Sound

Available Nutrient	Plot Number T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9
pH (wet)	6.0	6.0	*	6.0	7.0	5.0	6.0	*	6.0
pH (air dried)	5.0	5.5		5.5	5.0	4.5	5.0		5.0
Phosphorus	V.High	V.High		High	High	Med.	High+		Low
Potassium	Low+	Med		Low+	Low+	Low+	Low+		Low+
Calcium	V.Low	V.Low		V.Low	V.Low	V.Low	V.Low		V.Low
Magnesium	Med.+	Low		Low+	Low+	V.Low+	High+		Med.
Nitrate	None	None		None	None	None	None		None
Ammonia	High	Med.		Med.	Med.	Med.	Med.		Med.
Sulfate	Low+	V.Low		V.Low+	V.Low+	Low+	Med.+		Med.+
Chloride	High	Med.+		Med.+	Med.+	Low+	Med.+		Med.+
Ferric Iron	Med.	Low		Low+	Med.	Med.+	Med.		Low

*Sample not collected.
+Quantity slighly above that indicated.

Table____. Quarterly Chemical Analyses of Soils

June 16, 1960 — Back Bay

Available Nutrient	Plot Number 1	2	3	4	5	6	7	8
pH (wet)	8.0	6.0	7.0	8.0	8.0	8.0	7.0	8.0
pH (air dried)	5.0	5.5	5.5	6.0	5.5	6.0	5.5	7.0
Phosphorus	Med.+	High	V.High	Med.+	Med.+	Med.+	High+	High+
Potassium	Med.	Med.	Low+	Med.	Med.	High	Low+	High+
Calcium	V.Low	V.Low+	V.Low	V.Low+	V.Low+	Low+	V.Low	Low+
Magnesium	V.Low	Low	V.Low	Low+	V.Low	High	Med.	High+
Nitrate	None	None	None	None	None	None	None	None
Ammonia	High	High	High	High+	High+	High	Med.	V.High
Sulfate	V.Low	V.Low	V.Low	V.Low	V.Low	Low	V.Low	Low
Chloride	Low	Med.	Med.	Med.+	High	Med.+	Med.+	High
Ferric Iron	Low	Med.	Low	Low	Med.	Low	Low	Med.

June 14, 1960 — Currituck Sound

Available Nutrient	Plot Number T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9
pH (wet)	6.0	6.0	6.0	6.0	6.0	5.5	6.0	5.5	6.0
pH (air dried)	6.0	6.0	6.0	6.0	6.0	5.5	5.5	5.5	6.0
Phosphorus	V.High	High+	Low	V.Low	High	Med.	High	V.High	Low
Potassium	Low+	Med.	Low+	V.Low+	Low+	Low	Low	Low+	Low+
Calcium	V.Low+	Low	V.Low	V.Low	V.Low	V.Low	V.Low	Low	V.Low
Magnesium	Med.	V.Low	V.Low	V.Low	V.Low	V.Low	Med.+	Med.	Med.
Nitrate	None	None	None	None	None	None	None	None	None
Ammonia	Med.	High+	Med.	Low	Low	Med.	Med.	Low	Med.+
Sulfate	V.Low+	V.Low	V.Low	V.Low	V.Low	V.Low	Low	V.Low+	V.Low+
Chloride	Med.	Low	V.Low+	Low+	Med.	High	Med.	Low+	Med.
Ferric Iron	Low	High	Low	Low	Low	Med.	Med.	Med.	Med.

+Quantity slightly above that indicated.

Table _____. Nutrient Analysis for Plot Study.

September 9, 1960

	Back Bay							
	1	2	3	4	5	6	7	8
pH	5.0	5.0	5.0	5.0	4.5	5.0	5.0	4.5
Iron	High	Med.	Low	Med.	High	High	Low	High
Phosphorus	Med.+	Med.	Low	High+	Med.+	Med.	Low	Med.+
Potassium	Med.	Med.	Low	V.High	Low+	Low+	V.Low+	High
Calcium	V.Low	V.Low	V.Low	Low	V.Low	V.Low	V.Low	V.Low
Magnesium	V.Low	V.Low	V.Low	Med.	V.Low	V.Low	Med.+	Med.+
Nitrate	None	None	V.Low	None	None	None	None	None
Ammonia	High	High	Med.	V.High	Med.	High	Med.	V.High
Sulfate	Low	V.Low	V.Low	Med.+	V.Low	V.Low	V.Low	Med.
Chloride	Low+	V.Low	V.Low+	Low+	Low	V.Low	V.Low	Low

November 3, 1960

	Currituck Sound								
	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9
pH	5.0	5.0	4.5	5.0	4.5	6.0	5.0	5.0	4.5
Iron	High	Med.	Low	Low	High	Low	High	High	Low
Phosphorus	High	High	V.Low	V.Low	High	High	High	Med.+	V.Low
Potassium	Med.+	Low+	Low+	Low	Low	Low	Med.	Low+	Low
Calcium	V.Low	V.Low+	V.Low	V.Low	V.Low	V.Low	V.Low	Low	V.Low
Magnesium	Low	V.Low	V.Low	V.Low-	Med.	Low	Med.+	Med.+	Low
Nitrate	None	None	None	None	None	None	None	None	None
Ammonia	High	High	High	Med.	Med.	Med.	Med.	V.High	Low
Sulfate	Low	V.Low	V.Low	V.Low	Low	V.Low	Low+	Med.+	V.Low+
Chloride	Med.+	Med.+	Med.+	Low	High	Med.+	High	High	Med.

Table____. Quarterly Chemical Analyses of Soils

February 15, 1961 — Back Bay

Available Nutrient	Plot Number 1	2	3	4	5	6	7	8
pH (air dried)	5.0	6.0	6.0	5.0	5.0	5.5	6.0	5.0
Iron	High	Med.	Low	High	High	Med.	Low	High
Phosphorus	Med.	Low	Low	High	Med.	Med.	Low	Low
Potassium	High	Low	Med.	Low+	Med.	Low+	V.Low	V.High
Calcium	V.Low	V.Low	V.Low	V.Low+	Low	Low	V.Low	Low
Magnesium	Low	V.Low	V.Low	Med.	Low	Med.	V.Low	Med.+
Nitrate	None	None	None	None	None	None	None	None
Ammonia	V.High	High	Med.	V.High	High	High	Med.	V.High
Sulfate	V.Low+	V.Low	V.Low	Med.	V.Low	Low+	V.Low	Low
Chloride	Med.	V.Low	V.Low	Med.	Low	V.Low	V.Low	Med.

February 16, 1961 — Currituck Sound

Available Nutrient	Plot Number T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9
pH (air dried)	5.5	5.0	5.0	6.0	5.0	5.0	5.0	5.0	5.0
Phosphorus	V.High	V.High	V.Low	V.Low	V.Low+	High	High	High	Low
Potassium	V.High	Low+	V.Low	V.Low+	Low+	Low+	High	Low+	Med.
Calcium	V.Low	V.Low	V.Low	V.Low	V.Low	V.Low+	Low+	V.Low+	V.Low+
Magnesium	Low	V.Low	V.Low	V.Low	V.Low	Low+	High	Med.+	High
Nitrate	None	None	None	None	None	None	None	None	None
Ammonia	High	High	High	Low	High	High	V.High	V.High	High
Sulfate	V.Low+	V.Low+	V.Low	V.Low	V.Low	V.Low+	Med.	Low.	Low+
Chloride	Low	Low	V.Low+	V.Low+	V.Low+	V.Low+	Med.+	Low	Med

+Quantity slightly above that indicated.

Table____. Quarterly Chemical Analyses of Soils

April 26, 1962 — Back Bay

Available Nutrient	Plot Number 1	2	3	4	5	6	7	8
pH (wet)	7.0	8.0	6.5	7.0	6.0	6.5	8.0	7.0
pH (air dried)	5.0	6.0	6.5	5.5	4.5	5.0	6.0	5.0
Iron	High	Med.	Low	Med.	High	Low	Low	High
Phosphorus	Low+	Low+	V.Low	Med.+	Low+	Low	Low	High
Potassium	High+	Med.	Low+	Med.	V.High	Med.	Low	Low
Calcium	V.Low	V.Low	V.Low	V.Low	V.Low	V.Low	V.Low	V.Low
Magnesium	Low	Med.	V.Low+	Med.	Low	Low	Med.	High
Nitrate	V.Low	None	None	V.Low	V.Low	None	None	V.Low
Ammonia	High+	Med.	Low	High	Med.	Low	Low	High
Sulfate	Low	V.Low	None	Med.	Med.	Low	V.Low	High
Chloride	Med.+	Med.+	High	High	High	High	V.High	High

April 26, 1962 — Currituck Sound

Available Nutrient	Plot Number 1	2	3	4	5	6	7	8	9
pH (wet)	7.0	5.5	7.0	6.5	8.5	6.5	6.0	8.0	7.5
pH (air dried)	6.0	5.5	7.0	6.0	6.0	6.0	4.5	5.0	5.0
Iron	Low	Med.	Low	Low	Low	Low	Med.	Low	Med.
Phosphorus	Med.+	Med.+	V.Low+	V.Low	Med.	Med.+	High	Low+	V.Low
Potassium	Low+	Low+	Low+	Low+	Low+	Med.	High	High	V.High
Calcium	Low	V.Low+	V.Low	V.Low	V.Low	V.Low+	Low	V.Low	Low
Magnesium	Low	Low	Low	Med.	Med.	Med.	Low	Low	Low+
Nitrate	V.Low	None	None	None	V.Low	None	None	None	None
Ammonia	High	High+	Med.	Low	Low	Low	Med.	Low	Low
Sulfate	V.Low	V.Low	V.Low	V.Low	V.Low	V.Low	Med.	Low	Med.
Chloride	V.High	High	High	Med.	High	High	High	High	Med.

+Quantity slightly above that indicated.

Table____. Quarterly Chemical Analyses of Soils

July 23, 1962 — Back Bay

Available Nutrient	Plot Number 1	2	3	4	5	6	7	8
pH (air dried)	4.0	4.5	5.0	4.5	5.0	4.5	6.0	4.0
Iron	Med.	Low	Low	Low	Med.+	Med.	Low	High
Phosphorus	V.Low+	Low	V.Low	V.Low	Med.	V.Low+	V.Low+	V.Low
Potassium	V.High	Low+	Low+	Low	Med.	Low	V.Low	Low+
Calcium	V.Low+	V.Low	None	V.Low	Med.	Low	Low+	V.Low
Magnesium	Med.	Low+	V.Low	Low	High+	High	High+	Low+
Nitrate	V.Low	V.Low	V.Low	None	None	V.Low	None	V.Low
Ammonia	Med.	Low	Low	Low	Med.	Med.	High	Low
Sulfate	Med.+	Low	V.Low	Low	V.High	Med.+	Low+	High
Chloride	Med.+	Med.+	Med.+	Med.+	Med.+	Med.+	Med.+	Med.+

July 23, 1962 — Currituck Sound

Available Nutrient	Plot Number T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9
pH (air dried)	4.5	6.0	4.5	5.0	5.0	4.5	4.5	4.5	5.5
Iron	Low	Med.	Low	Med.	Low	Low	Med.	Low	Low
Phosphorus	V.Low	Med.	V.Low	V.Low	V.Low	V.Low	Low+	Low	V.Low
Potassium	Low	Low+	Low+	Low	Low	Med.+	Low+	Low	Low
Calcium	V.Low	Low	V.Low	V.Low+	Low	V.Low	Low	V.Low	V.Low
Magnesium	Med.+	High	Med.	Med.+	Med.+	Med.+	High+	High	Low
Nitrate	V.Low	None	V.Low	V.Low	None	None	None	V.Low	V.Low
Ammonia	Low	Low	Low	Low	Low	Low	Med.	Low	Low
Sulfate	Med.	Med.	Low+	Med.+	Med.	Med.	Med.+	Low	Med.+
Chloride	Med.+	Med.+	Med.+	Med.	Med.+	Med.+	Med.	Med.	Med.+

+Quantity slightly above that indicated.

Table____. Quarterly Chemical Analyses of Soils

October 30, 1962 — Back Bay

Available Nutrient	Plot Number 1	2	3	4	5	6	7	8
pH (air dried)	4.0	5.3	4.5	4.5	4.5	5.8	5.0	4.0
Iron	High	Low	Med.+	Med.	Med.	Low	Low	Med.
Phosphorus	Low	V.Low+	Med.	Low	Low	V.High	Low	Med.
Potassium	Med.	Med.	Low+	Low+	V.High	Low+	Low	Med.+
Calcium	None	None	Low	Low	Low+	V.Low+	None	Low+
Magnesium	Med.+	V.Low+	Med.+	Med.+	High	Med.	Low+	Med.+
Nitrate	None	V.Low	V.Low	V.Low	None	V.Low	V.Low	V.Low
Ammonia	High	Med.+	High	Med.	Med.	Med.+	Low	Med.
Sulfate	Med.+	V.Low	Med.+	Med.+	Med.	V.Low+	Low	Med.
Chloride	High	V.High	Med.+	Med.+	High	Med.+	Med.+	Med.+

October 30, 1962 — Currituck Sound

Available Nutrient	Plot Number T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9
pH (air dried)	5.5	6.0	5.0	6.0	5.0	4.5	4.5	6.0	4.5
Iron	Low	Low	Low	V.Low	Med.	High	Med.	Med.	Low
Phosphorus	High	Med.+	Low+	V.Low	Low	Low+	Med.+	V.Low+	V.Low
Potassium	Low+	Med.	High	Low+	High	Low+	Med.+	Low+	Low+
Calcium	V.Low	Low	V.Low	None	Low	Low+	Low	V.Low	Low+
Magnesium	Low+	Low+	V.Low+	V.Low+	Med.+	Med.+	Med.+	Low+	Med.+
Nitrate	V.Low	V.Low	V.Low	V.Low	None	None	None	V.Low	None
Ammonia	Med.	Med.	Low	Low	Med.	Med.	Med.	Low	Med.
Sulfate	Low	V.Low	V.Low	V.Low	Med.	Med.	Med.+	V.Low	Med.+
Chloride	Med.+	Med.+	Med.+	Low+	Med.+	Med.+	Med.+	Med.+	Med.+

+Quantity slightly greater than that indicated.

Table ____. Quarterly Chemical Analyses of Soils

January 16, 1963 — Back Bay

Available Nutrient	Plot Number 1	2	3	4	5	6	7	8
pH (air dried)	4.5	5.0	5.5	4.5	5.0	4.5	6.0	*
Iron	Med.	Low	Low	High	Med.	Med.	Low	
Phosphorus	V.Low+	V.Low	V.Low	Med.+	V.Low+	V.Low+	V.Low	
Potassium	Low+	Low+	High	Low+	Low+	Low	Low+	
Calcium	Low	V.Low	V.Low	Low+	Low	Low+	V.Low	
Magnesium	Med.+	Low	V.Low	High+	Med.+	Med.+	Low+	
Nitrate	None	None	V.Low	None	V.Low	None	None	
Ammonia	High	Med.	Low	Med.	Med.	Med.	Low	
Sulfate	Med.+	V.Low	V.Low	Med.+	Med.	Med.	Low	
Chloride	Med.+	Med.	Med.+	Med.+	Med.+	Med.+	Med.	

January 16, 1963 — Currituck Sound

Available Nutrient	Plot Number T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9
pH (air dried)	5.5	6.0	4.5	5.5	5.0	4.0	4.5	4.5	4.5
Iron	Low	Low	Low	Low	Low	Med.	Med.	Low	Low
Phosphorus	Med.	Med.+	Med.+	V.Low	V.Low	Low	Med.+	V.Low	V.Low
Potassium	Low+	Low+	Low+	Low	Low+	V.Low	Low+	V.Low+	Low+
Calcium	V.Low	Low	V.Low+	None	None	Low	Med.+	None	V.Low
Magnesium	Med.	Med.+	Low+	V.Low+	Low+	High +	Med.+	Low+	Med.+
Nitrate	None	None	V.Low	V.Low	V.Low	None	None	None	V.Low
Ammonia	Med.	Med.	Med.	Low	V.Low	Med.	Med.	V.Low	Low
Sulfate	Low	V.Low	Med.	V.Low+	V.Low	Med.+	Med.+	Low	Med.
Chloride	Med.+	High+	High	Med.+	Med.+	High	High	Med.+	Med.+

*Sample not taken.
+Quantity slightly higher than that indicated.

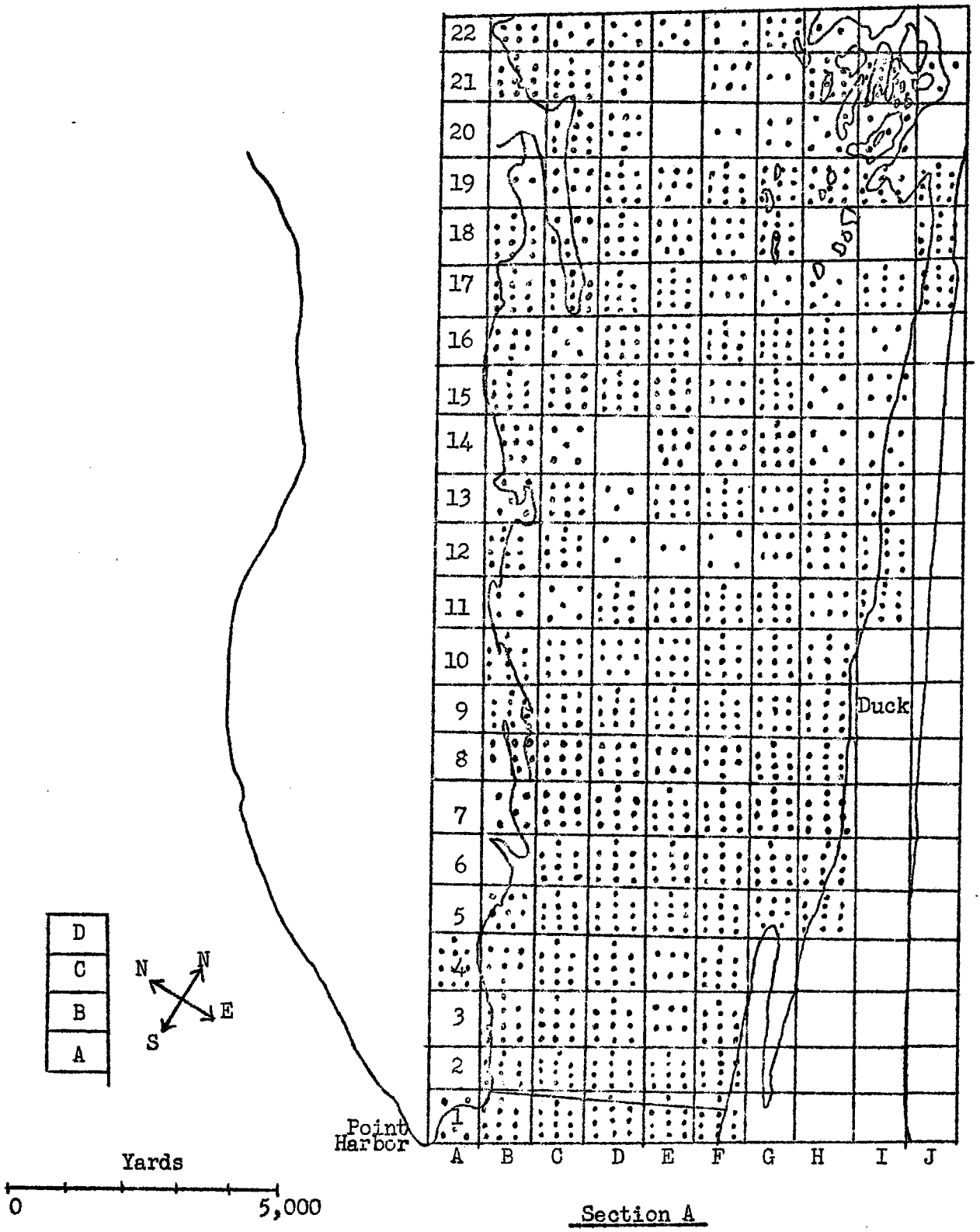
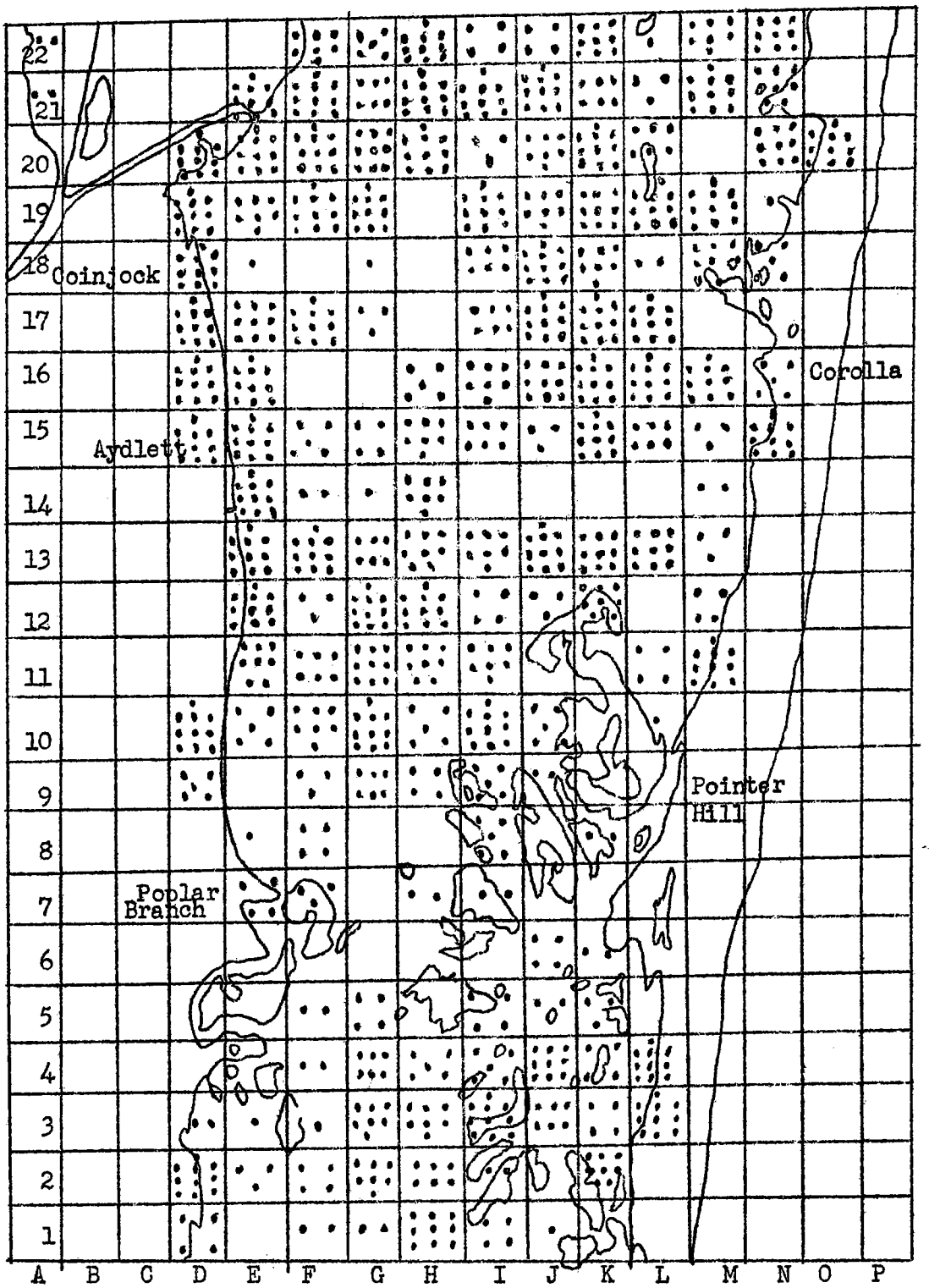
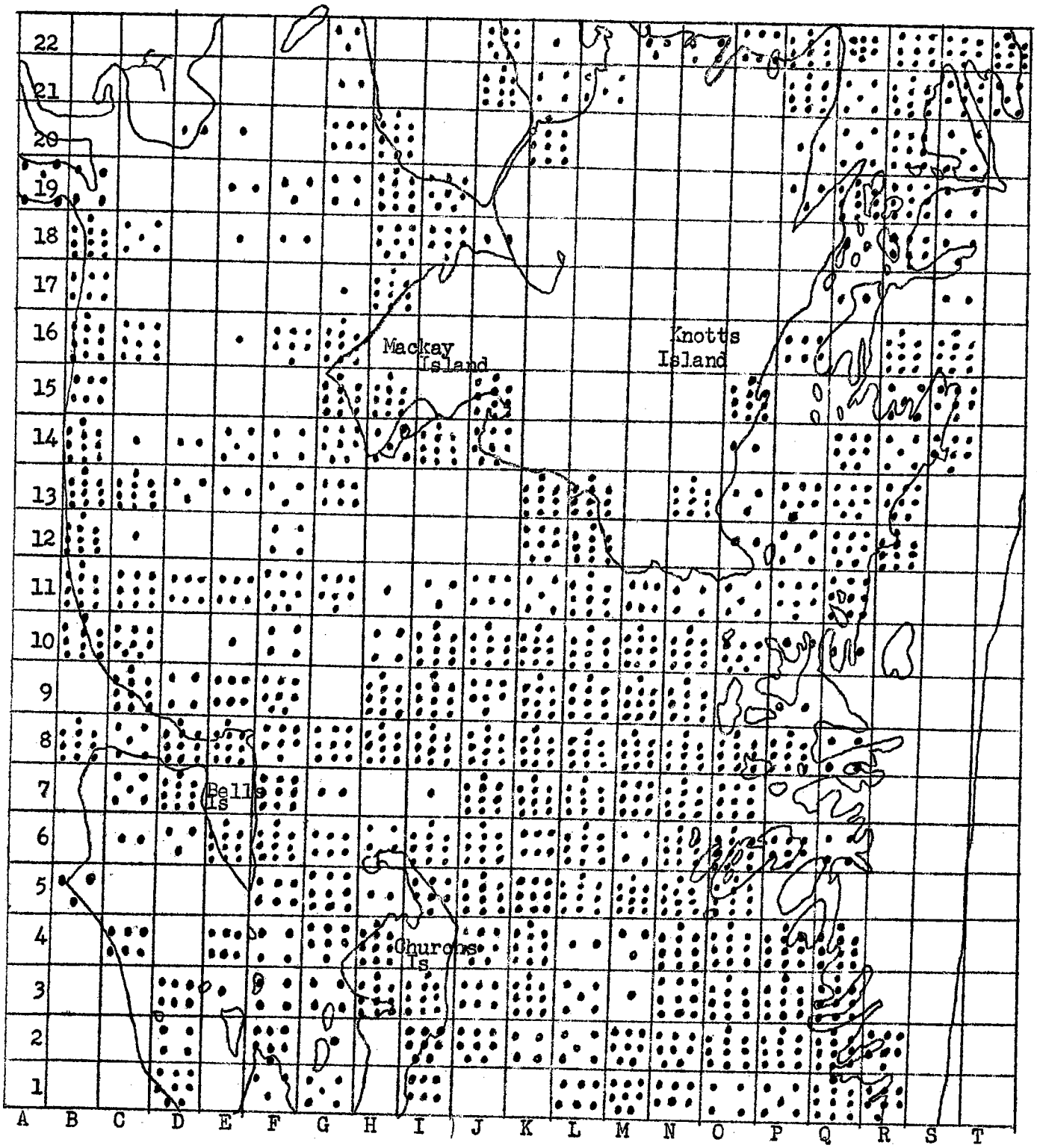


Figure _____. Distribution of Sand, Master Survey, August-September 1960.



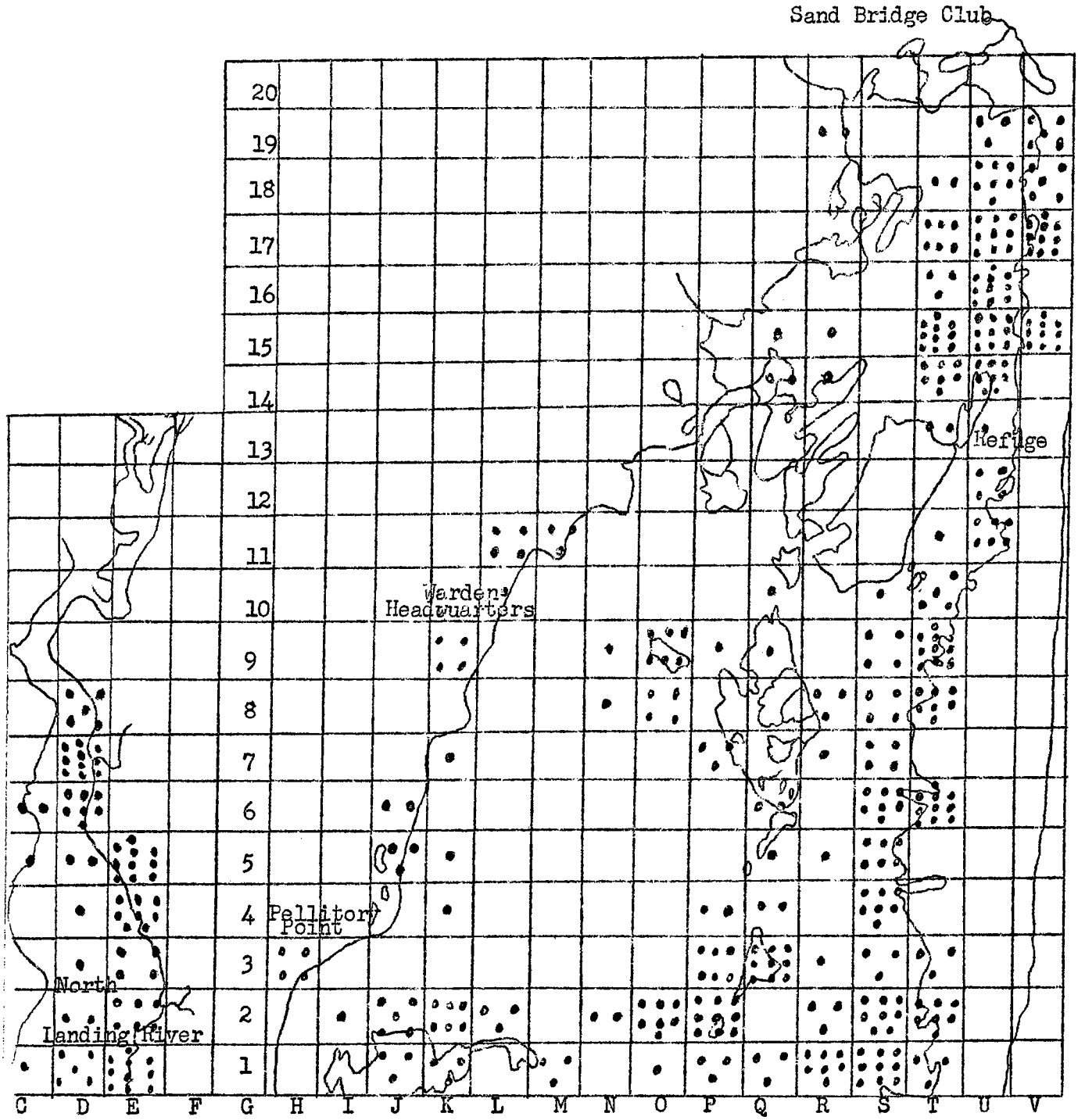
Section B

Figure _____. Distribution of Sand, Master Survey, August-September 1960.



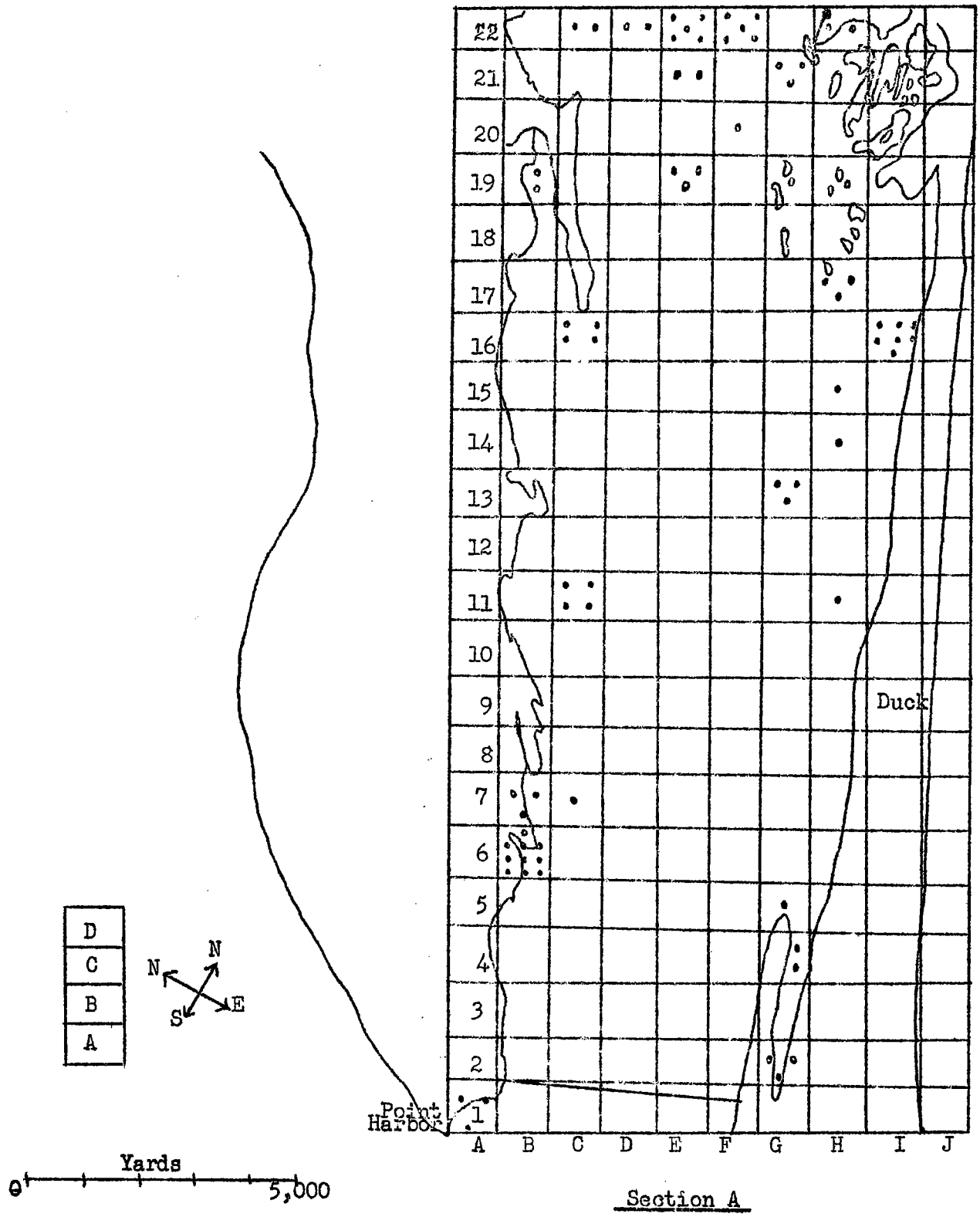
Section C

Figure _____. Distribution of Sand, Master Survey, August-September 1960.



Section D

Figure _____. Distribution of Sand, Master Survey, August-September, 1960.



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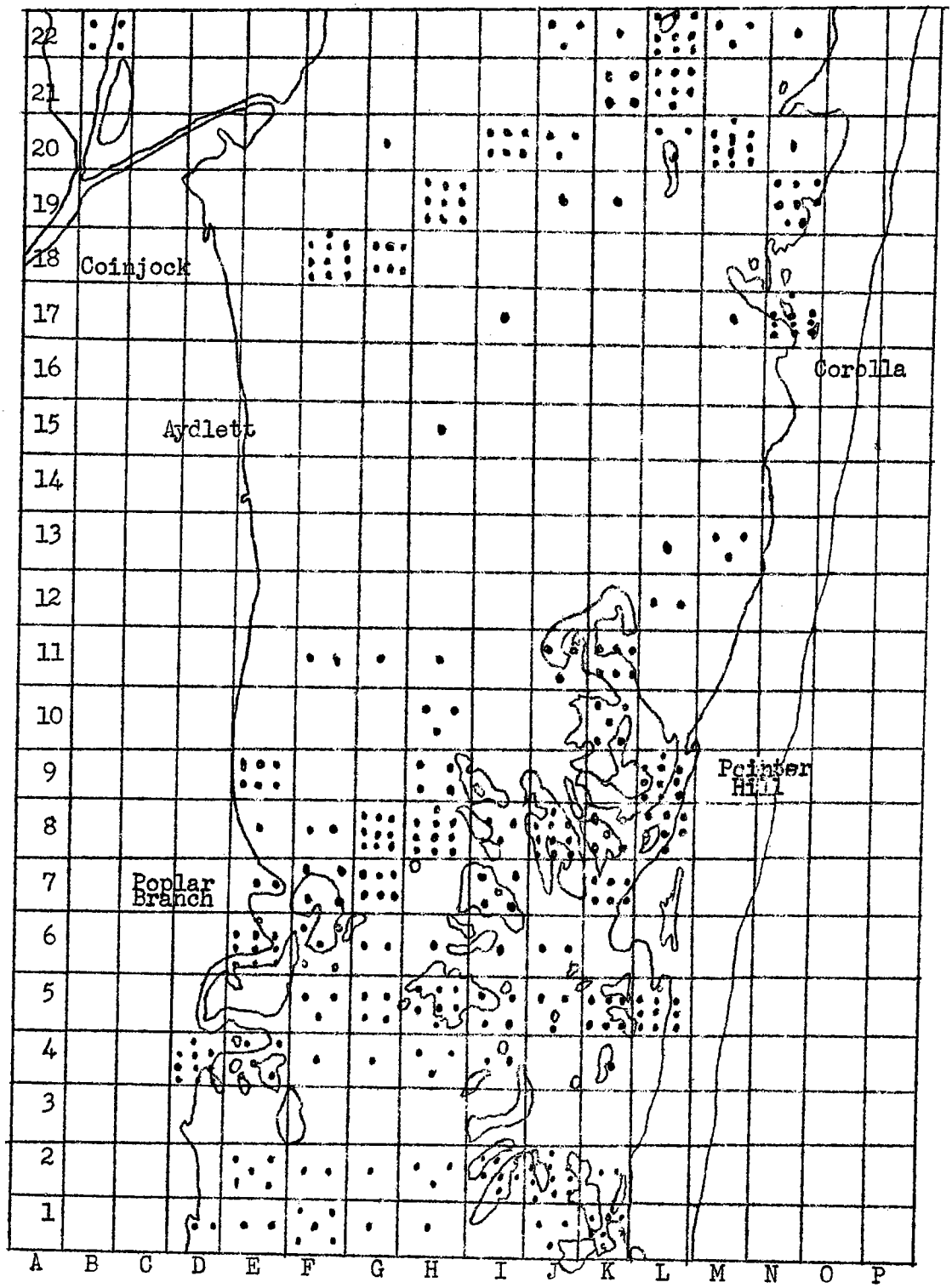

Section B

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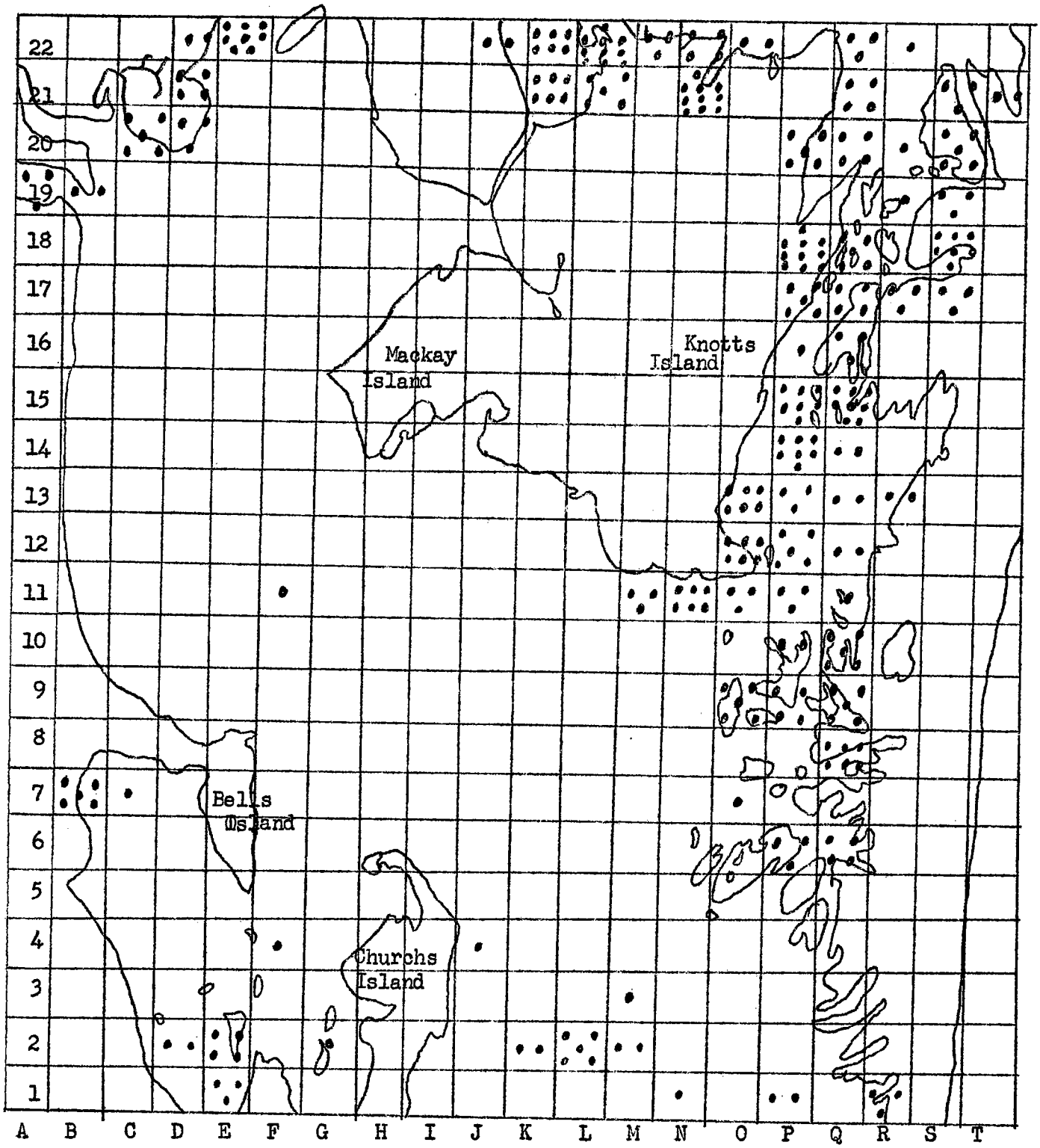

Section C

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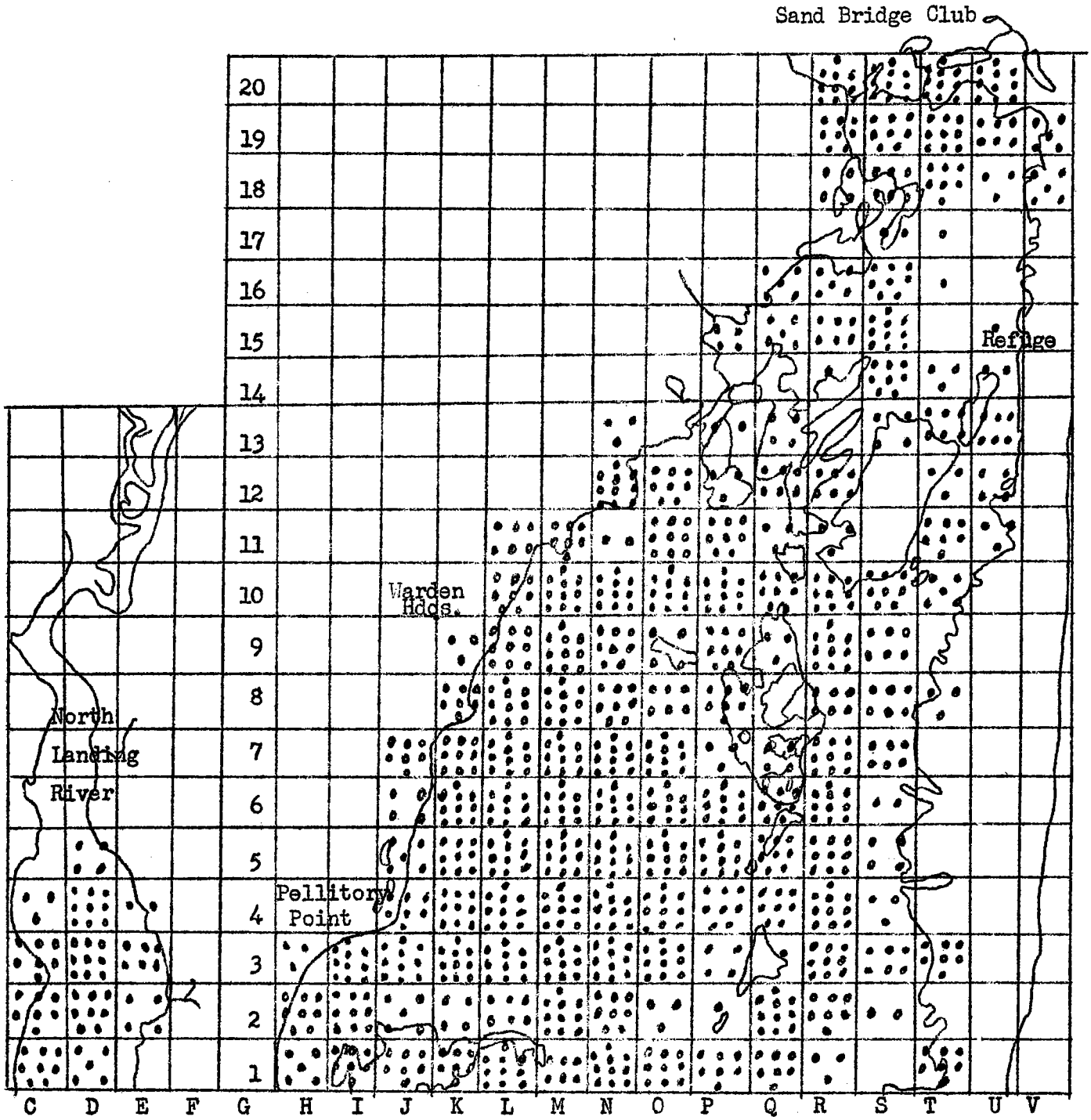

Section D

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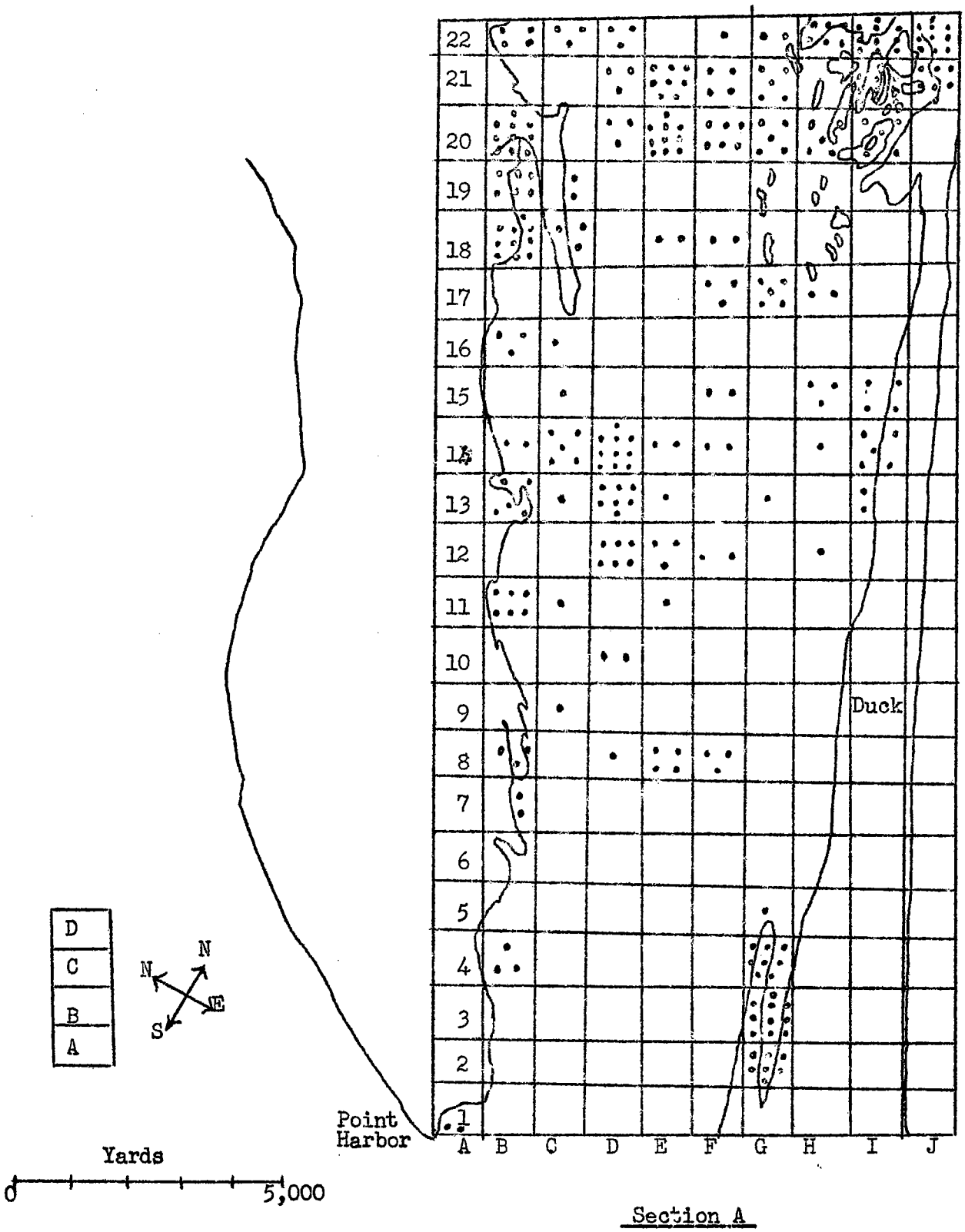

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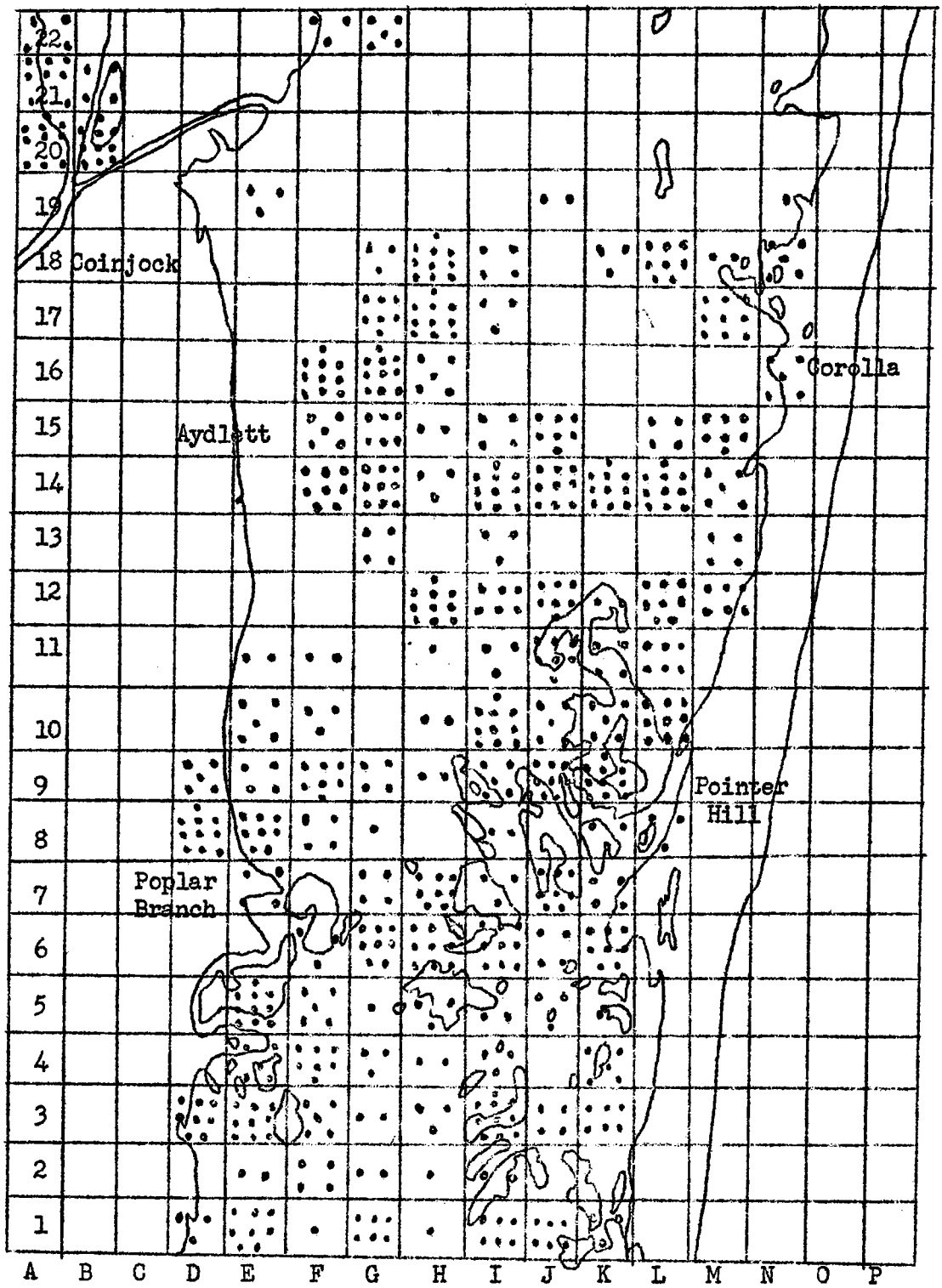

Section B

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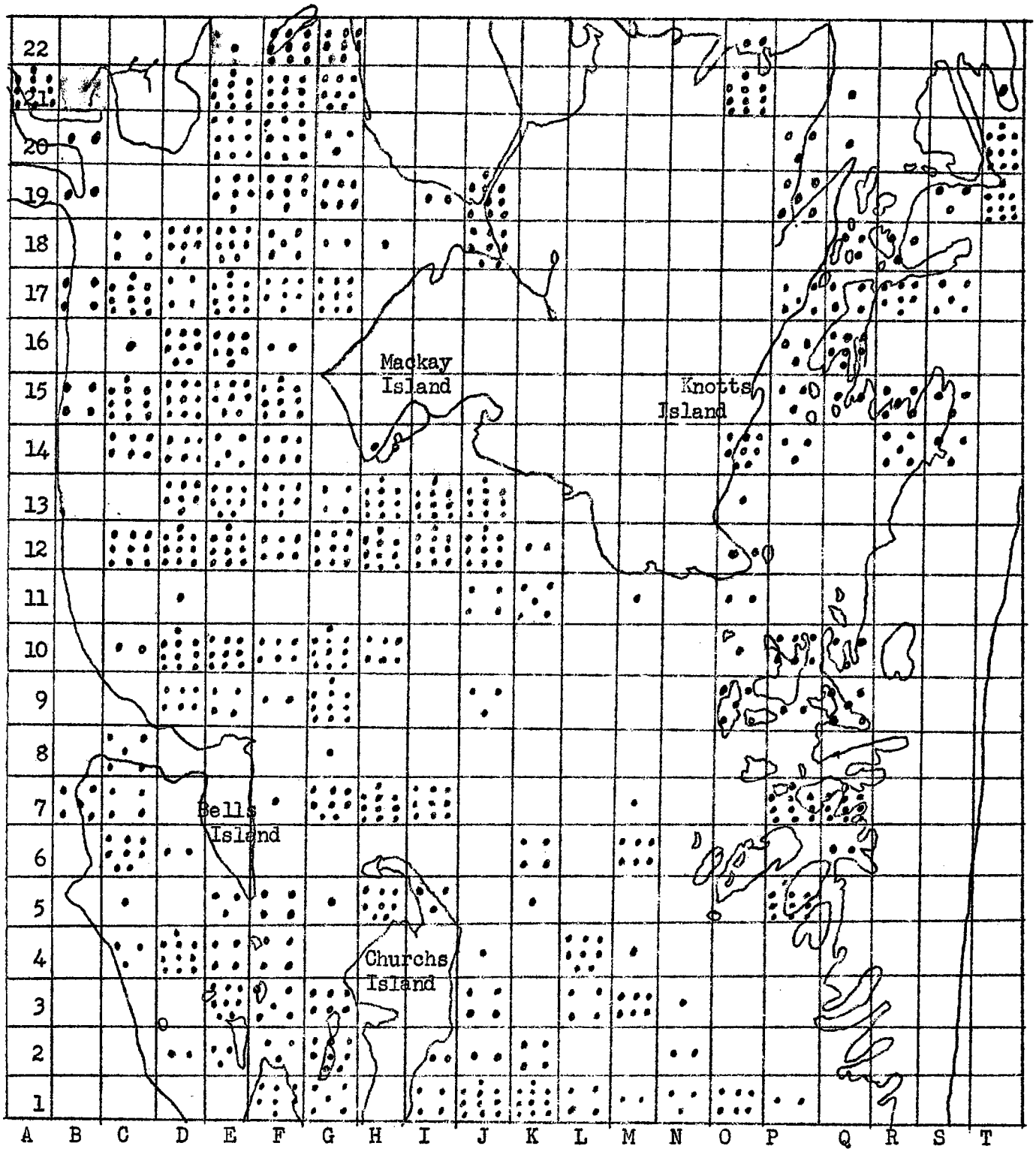

Section C

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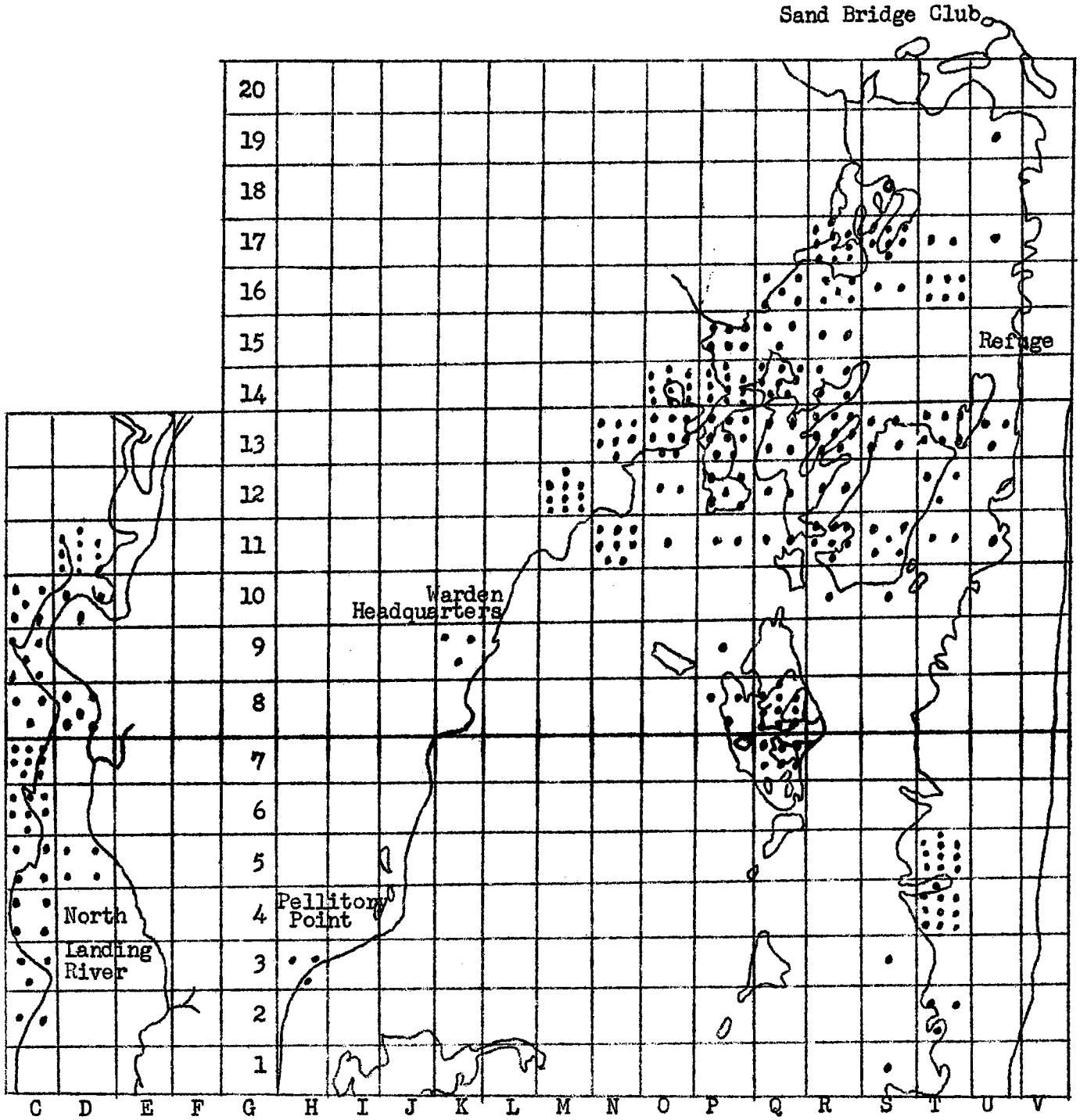

Section D

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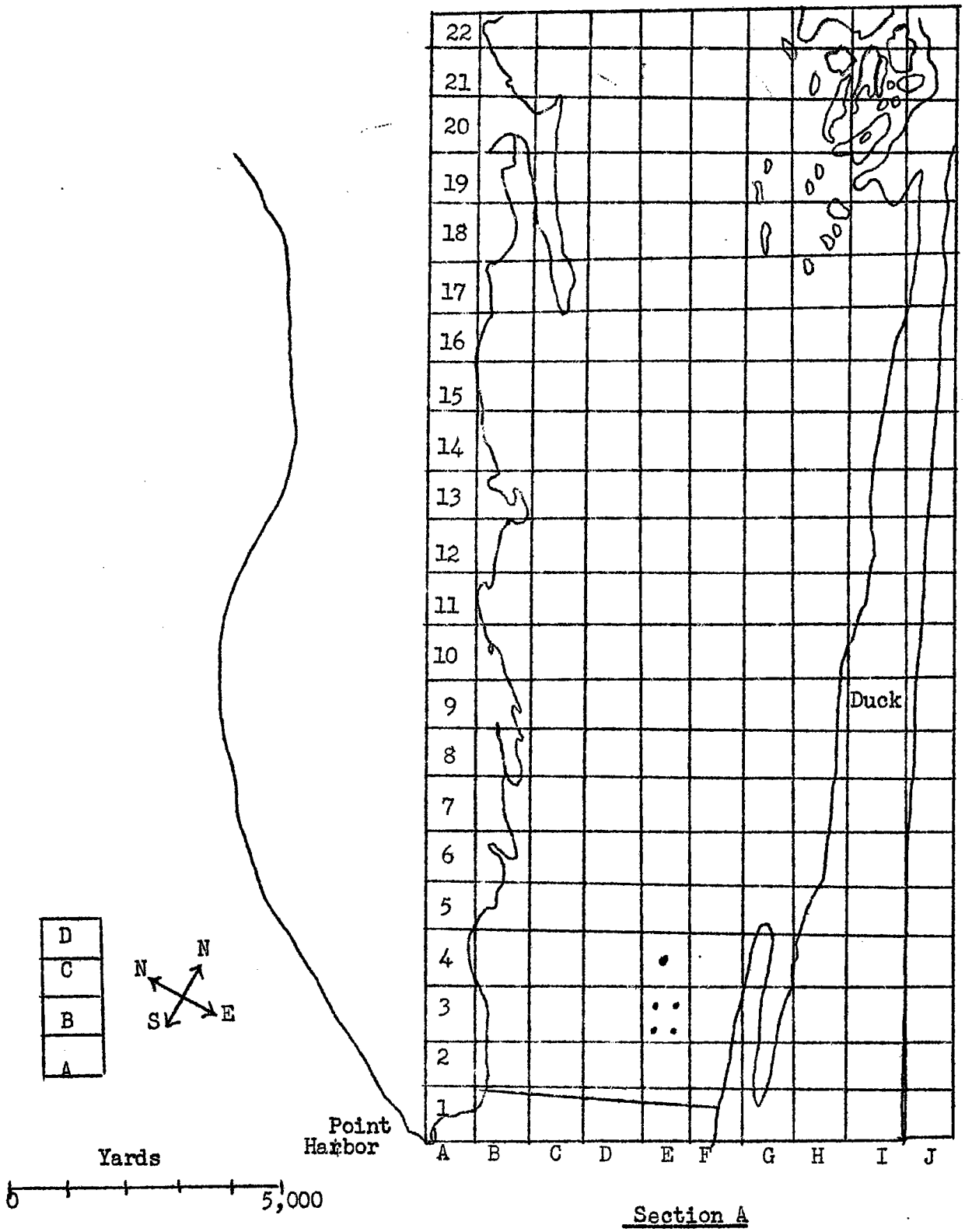

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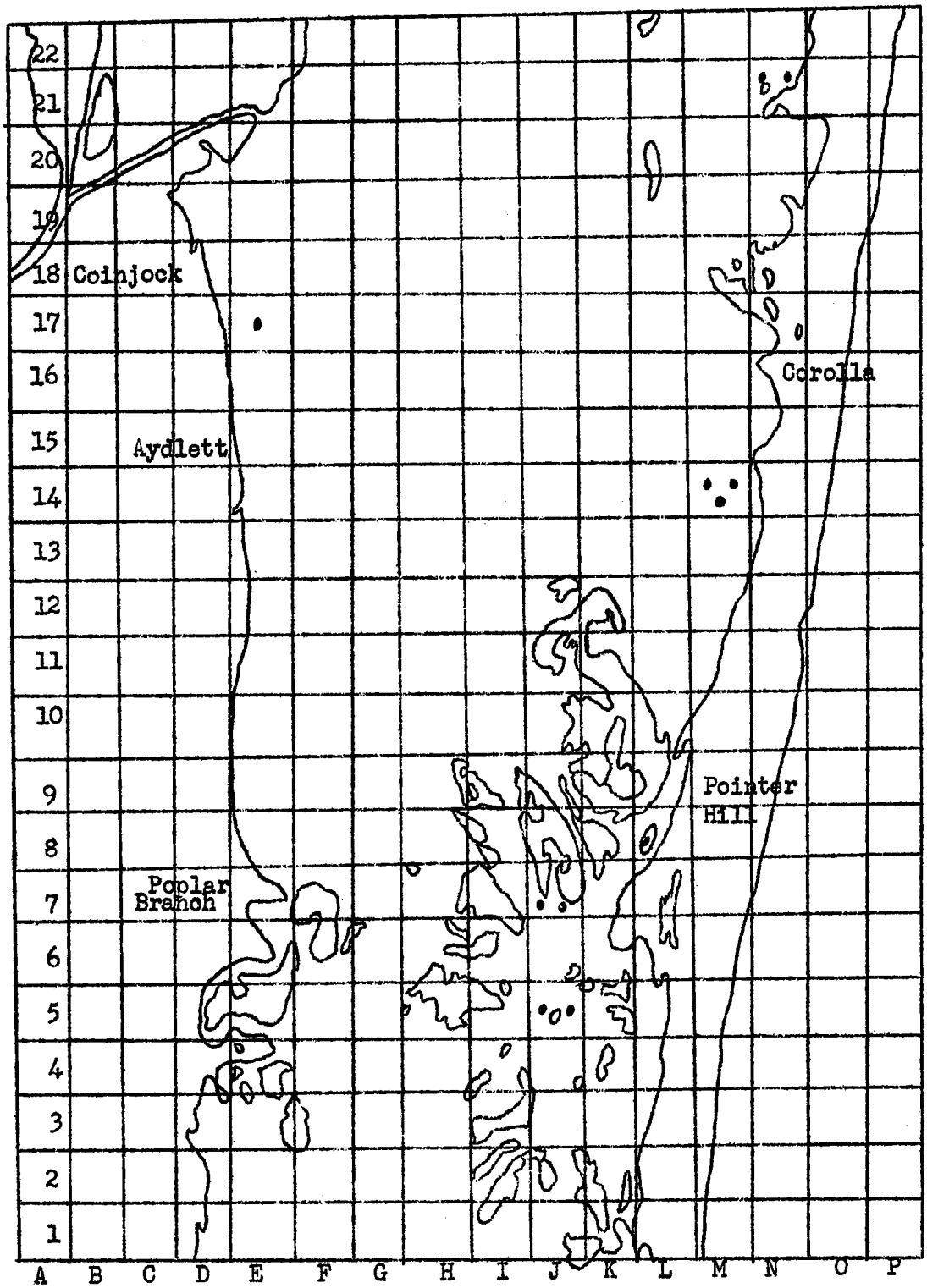
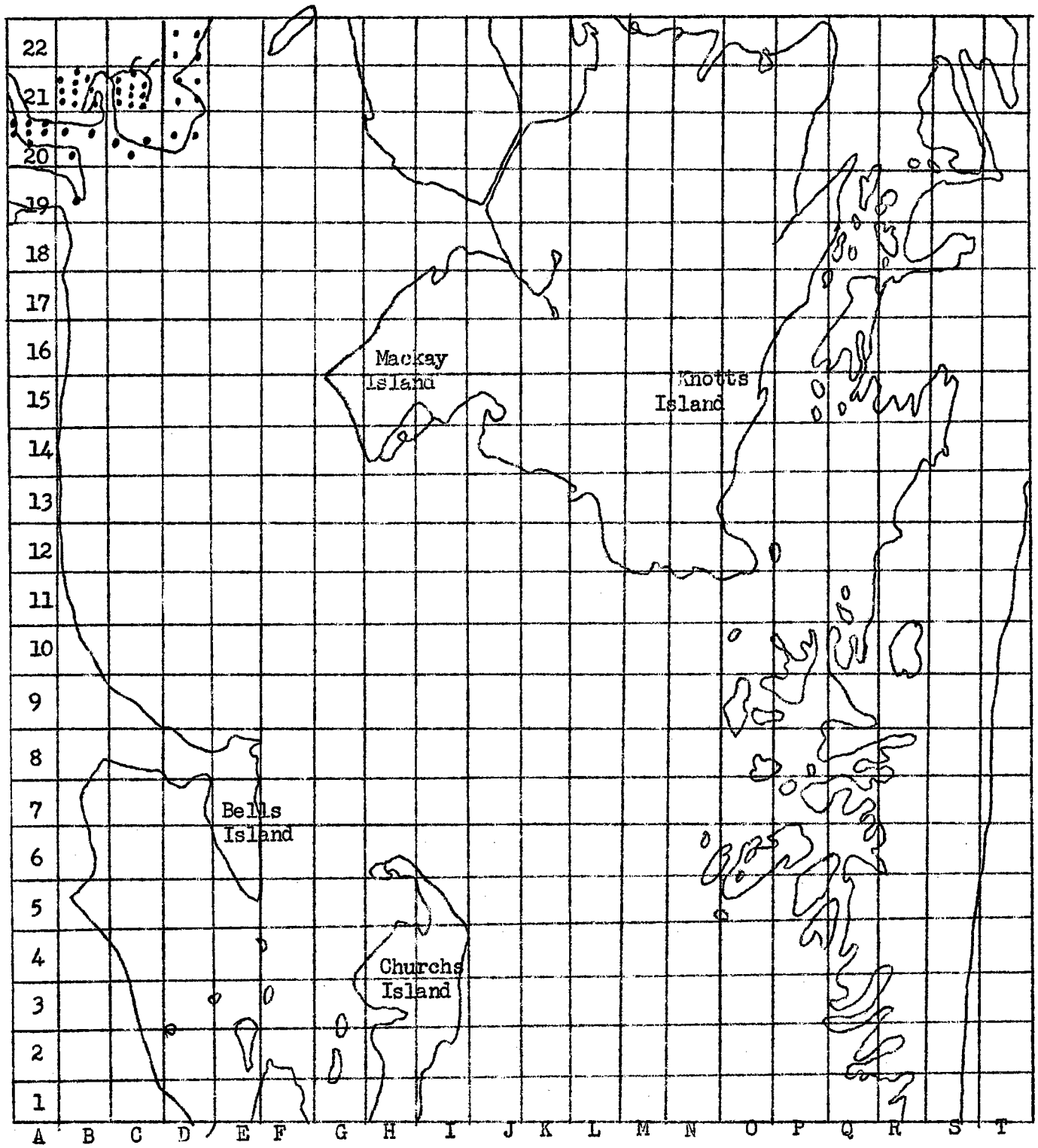


Section B

Figure_____. Distribution of Muck, Master Survey, August-September 1960.



Section C

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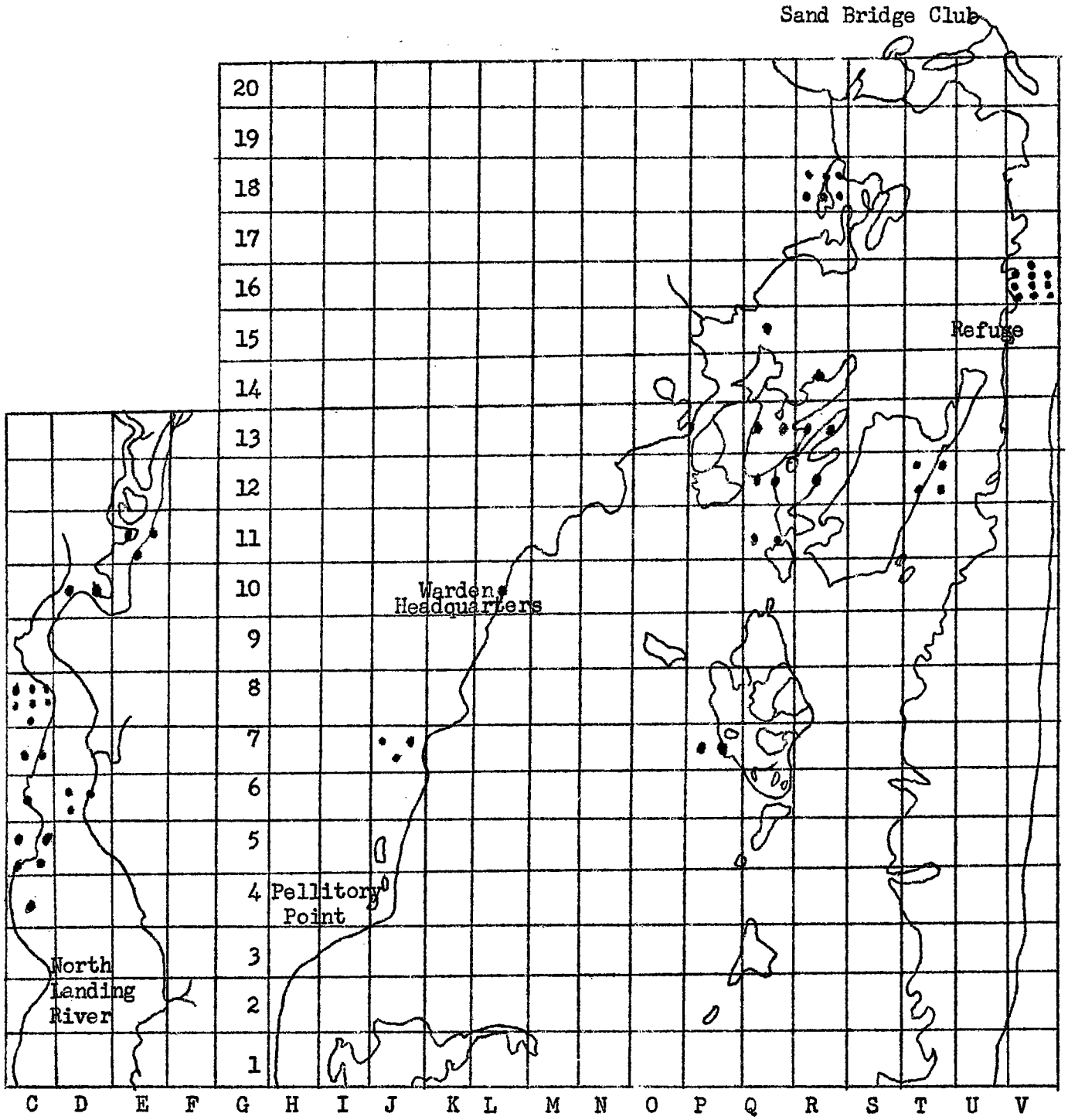

Section D

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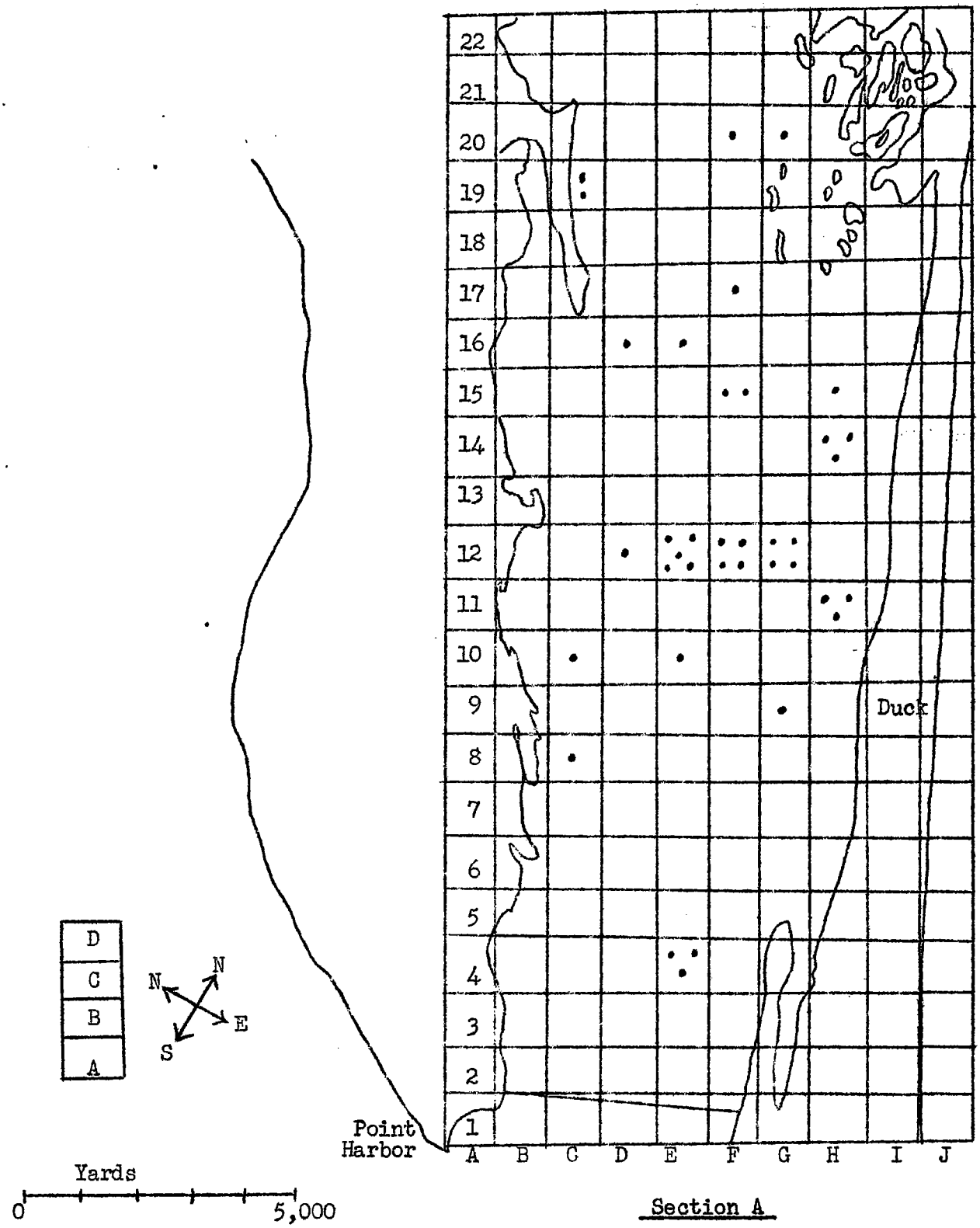

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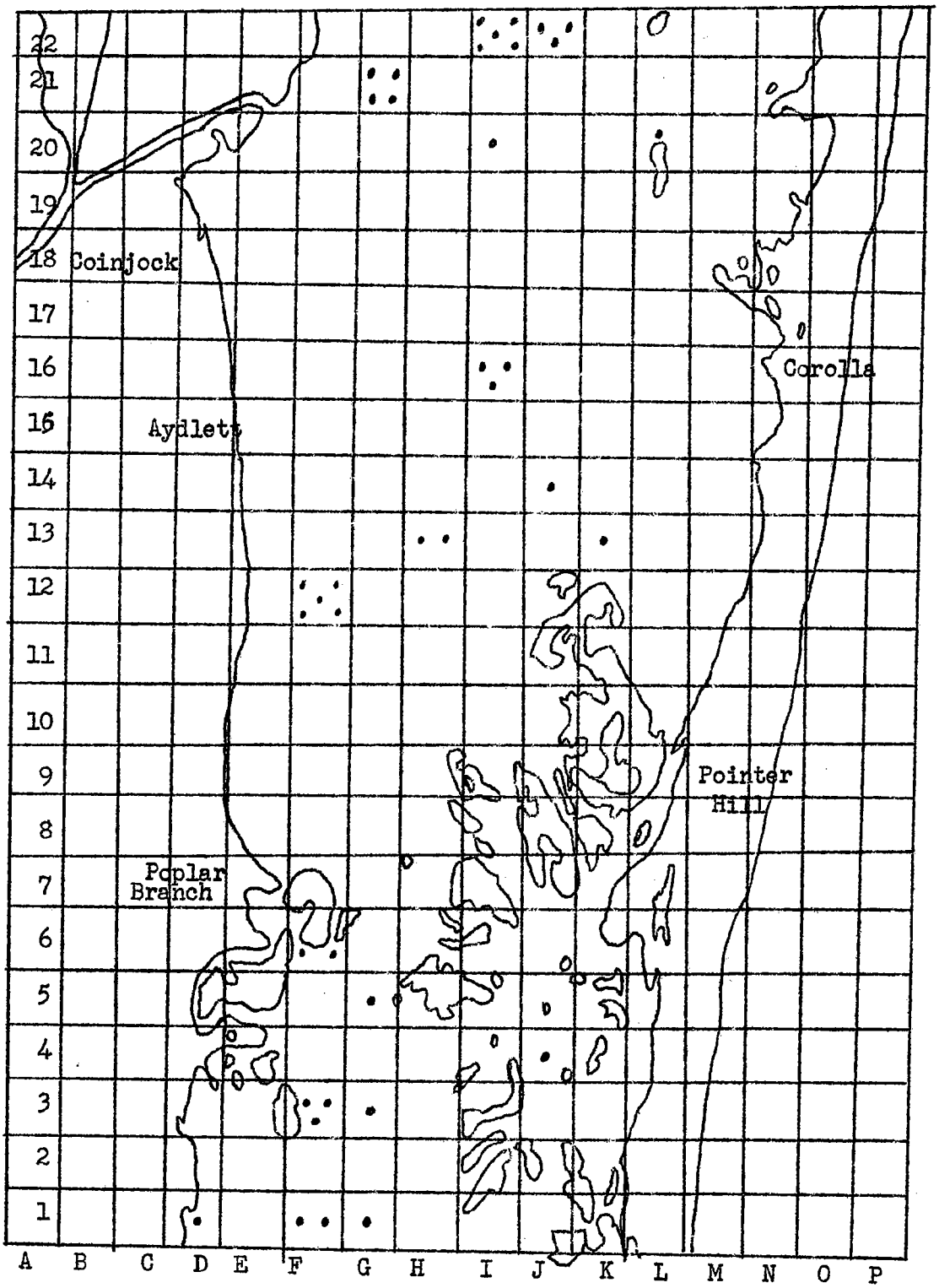
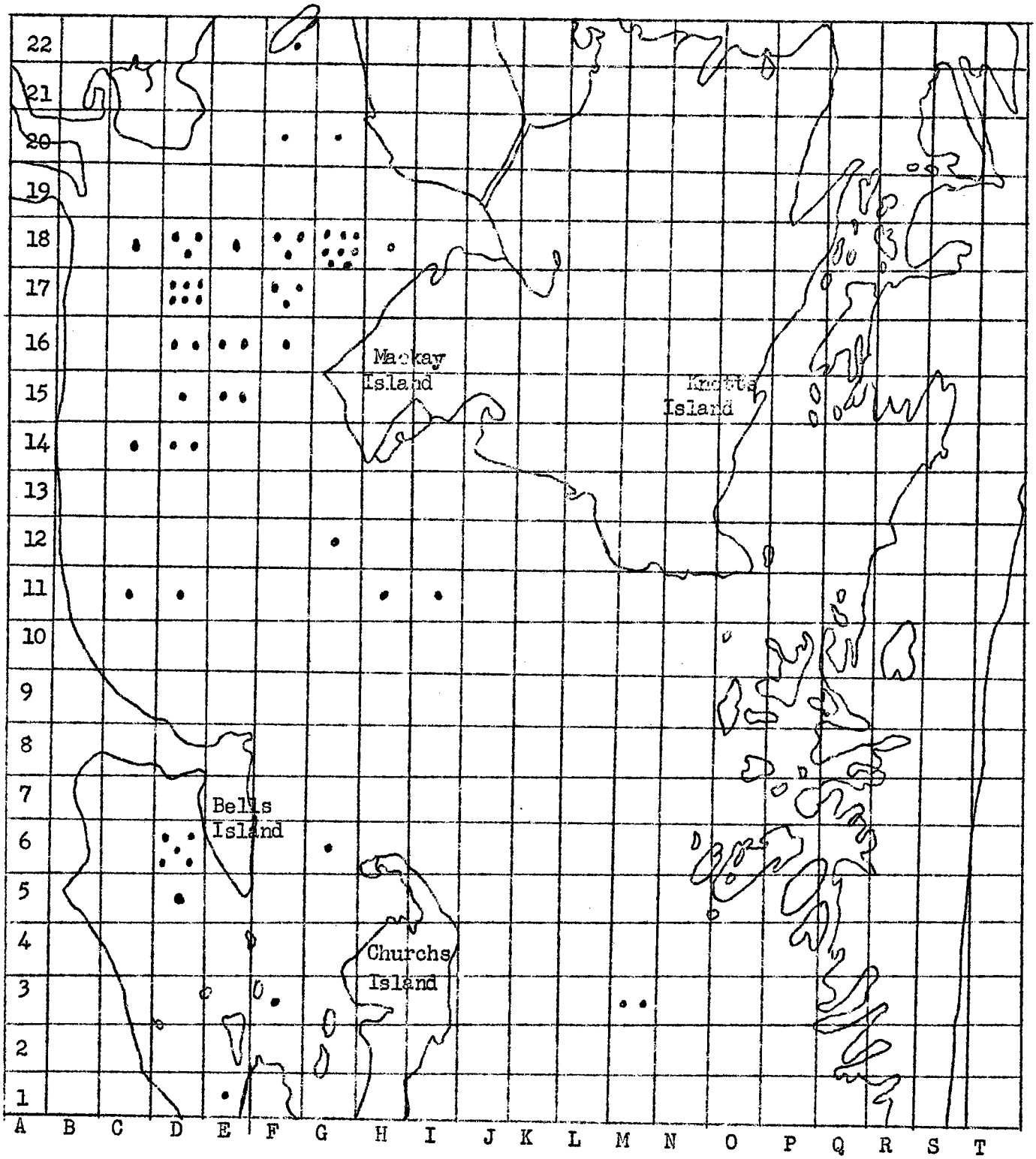


Section B

Figure _____. Distribution of Shell, Master Survey, August-September 1960.



Section C

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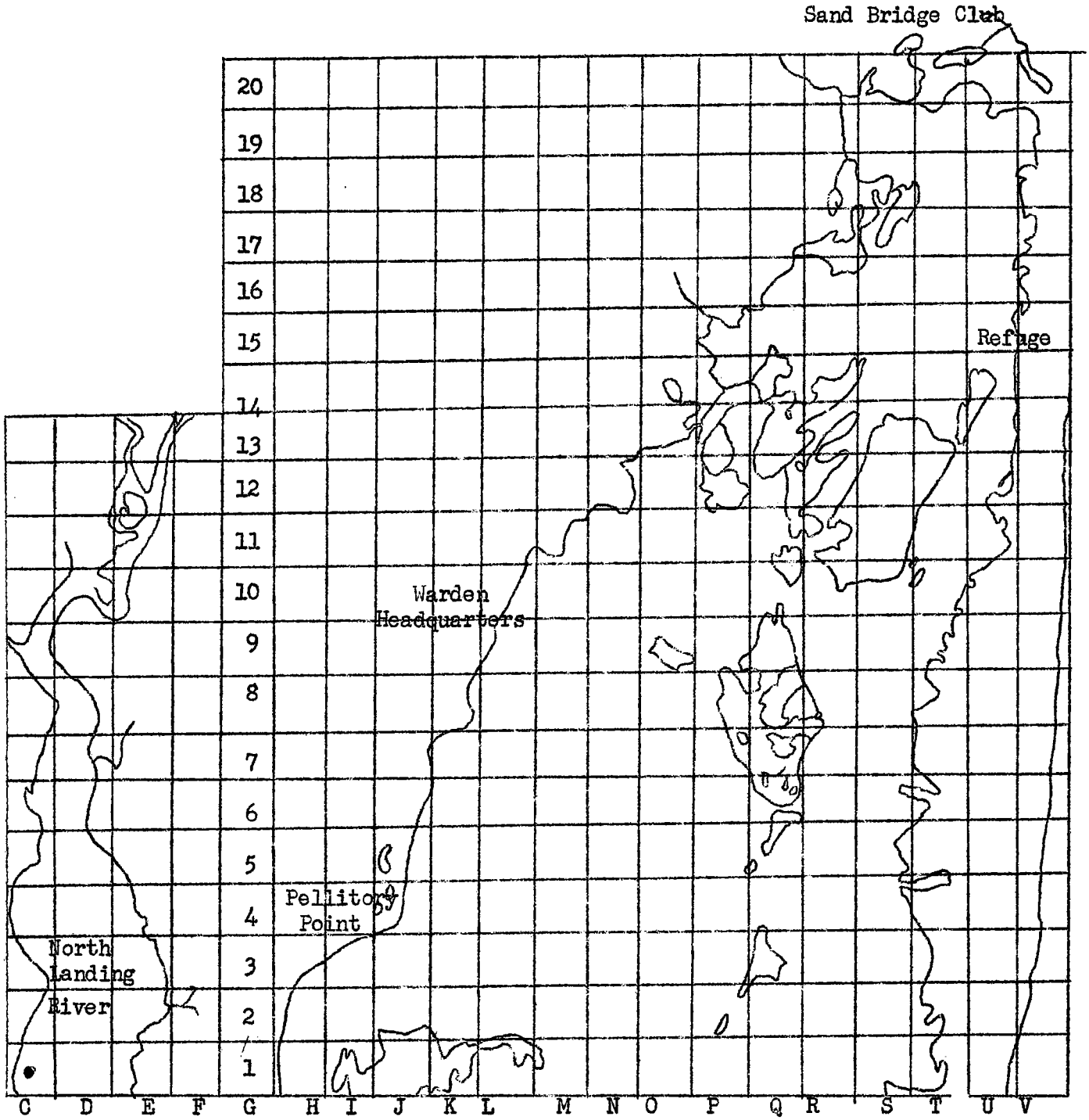

Section D

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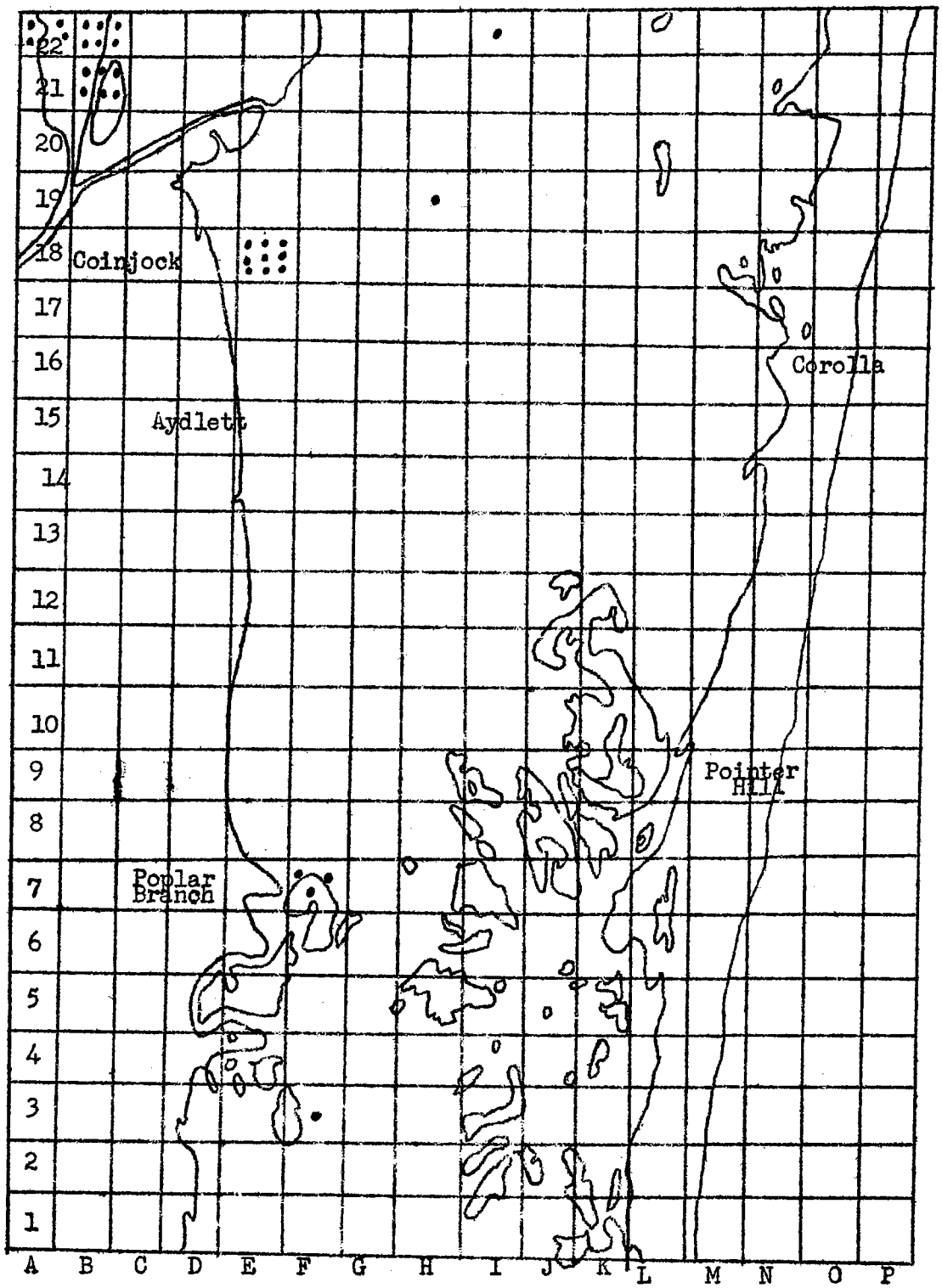

Section B

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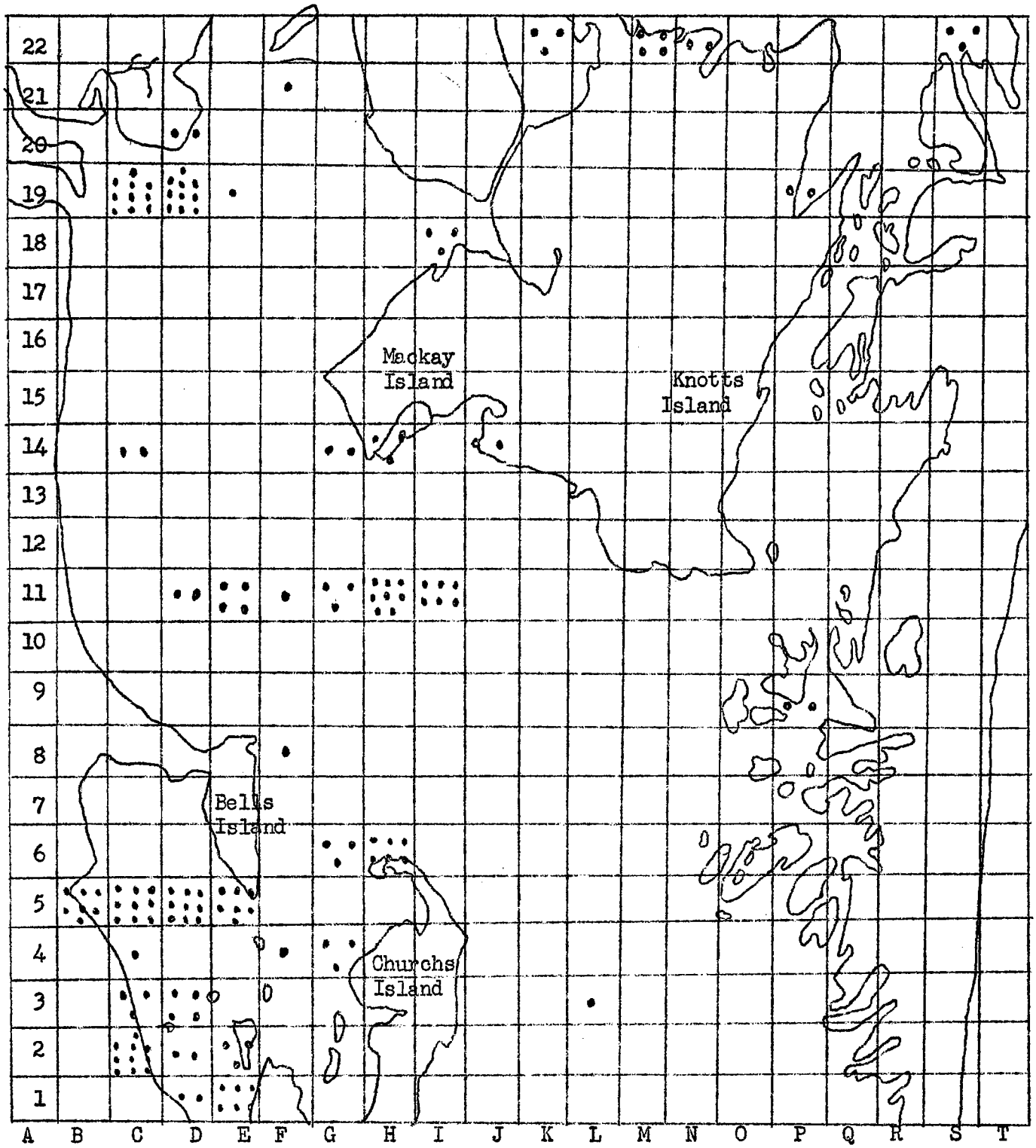

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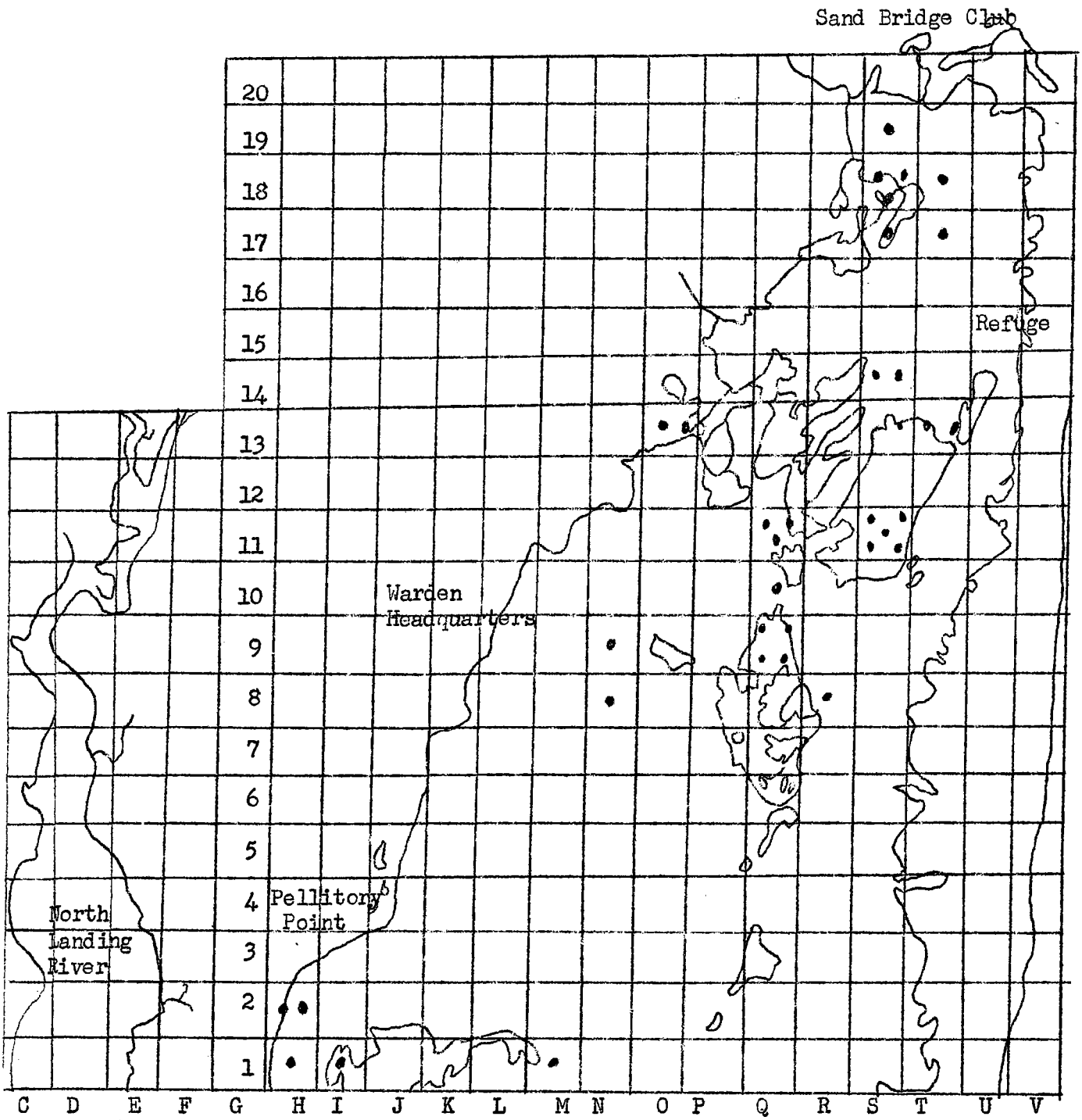

Section D

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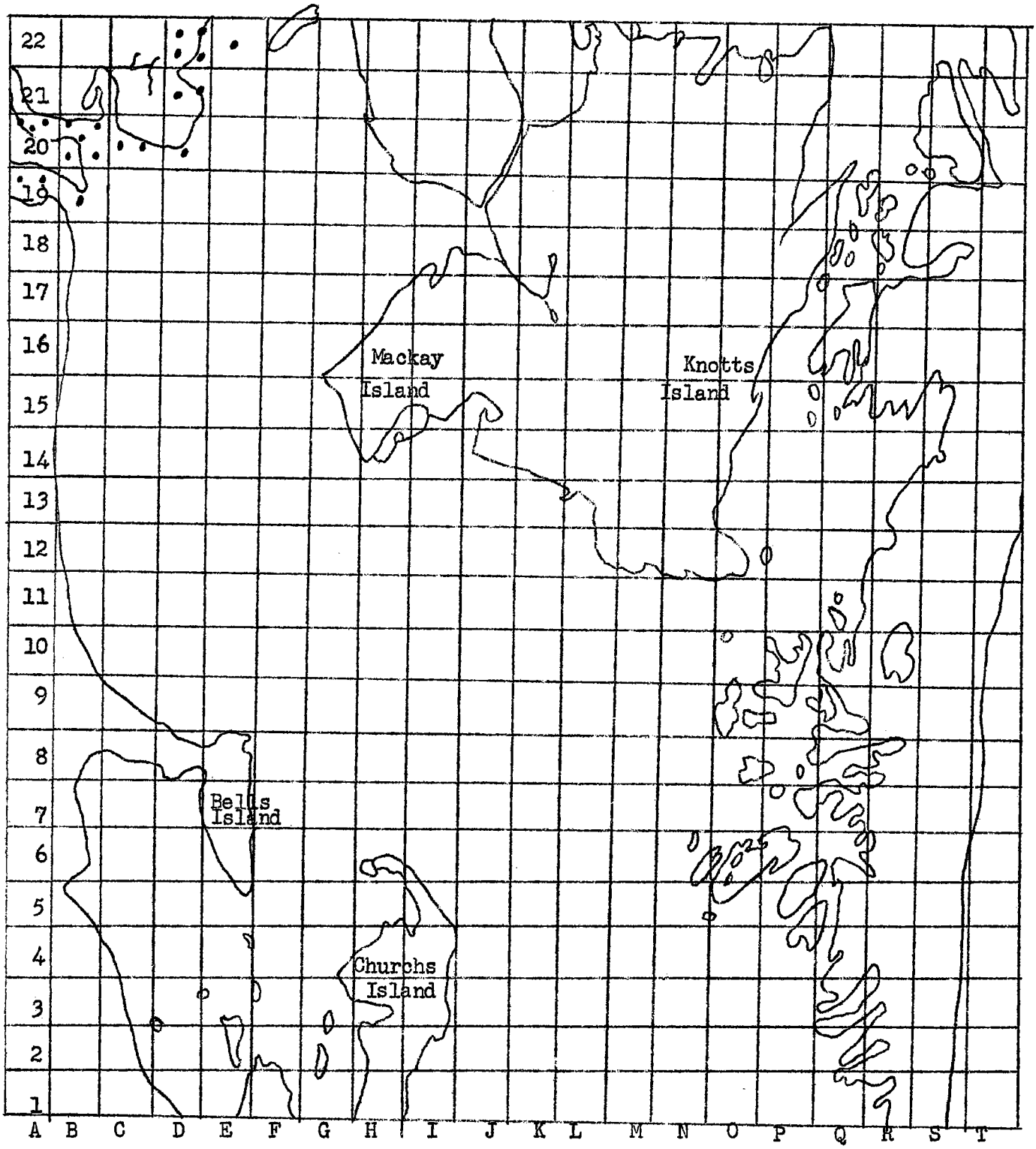
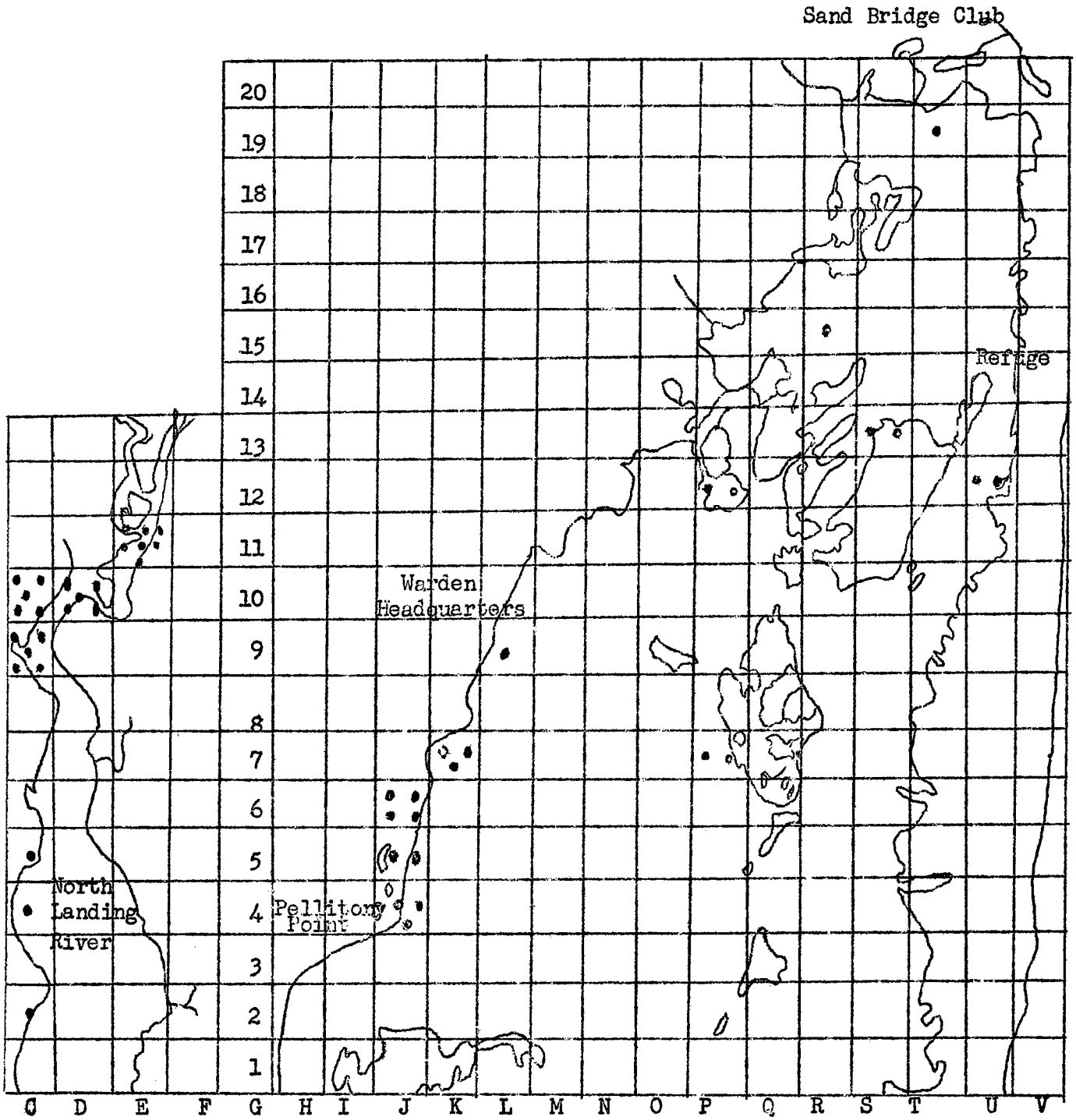


Section C

Figure _____. Distribution of Peat, Master Survey, August-September 1960.



Section D

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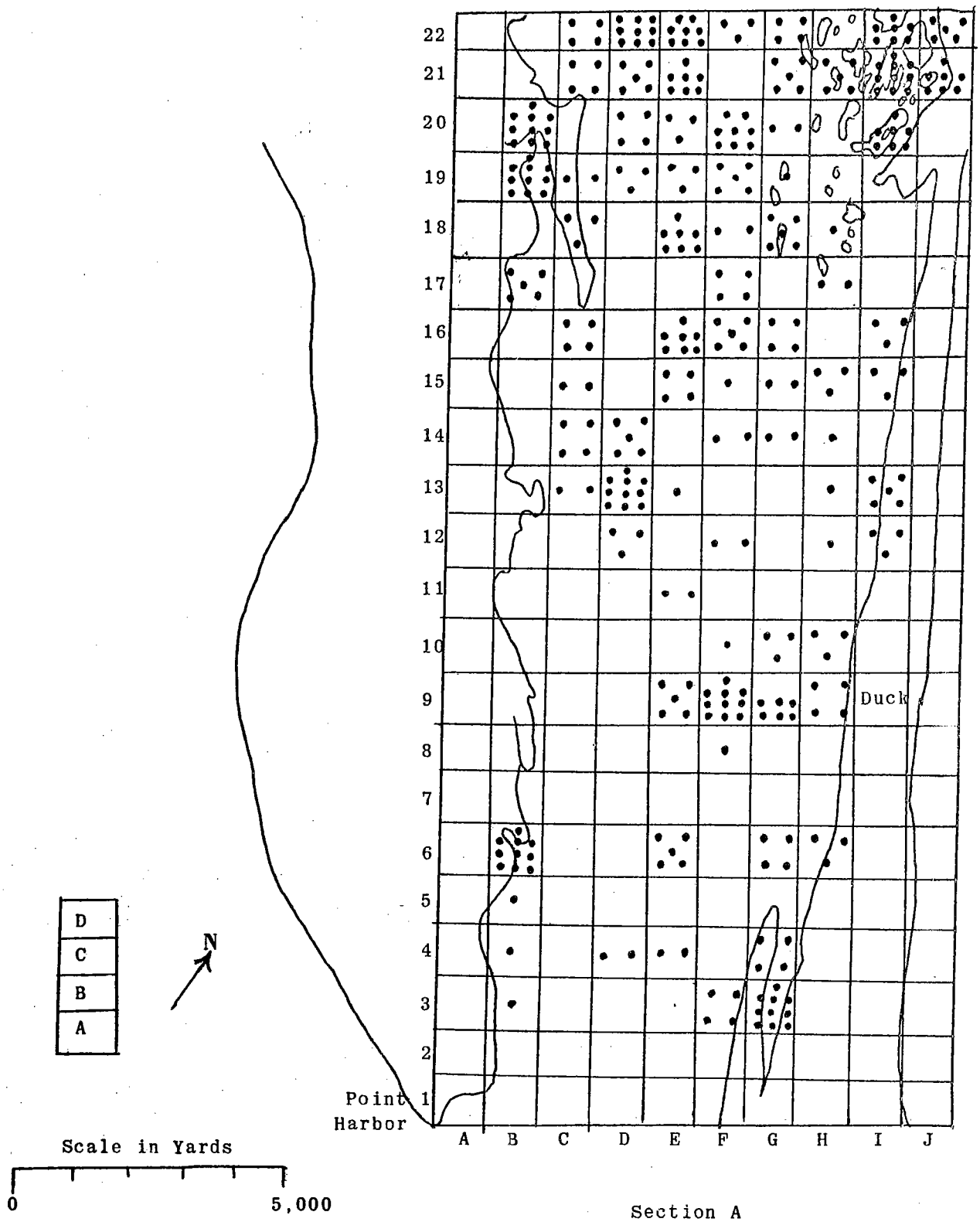
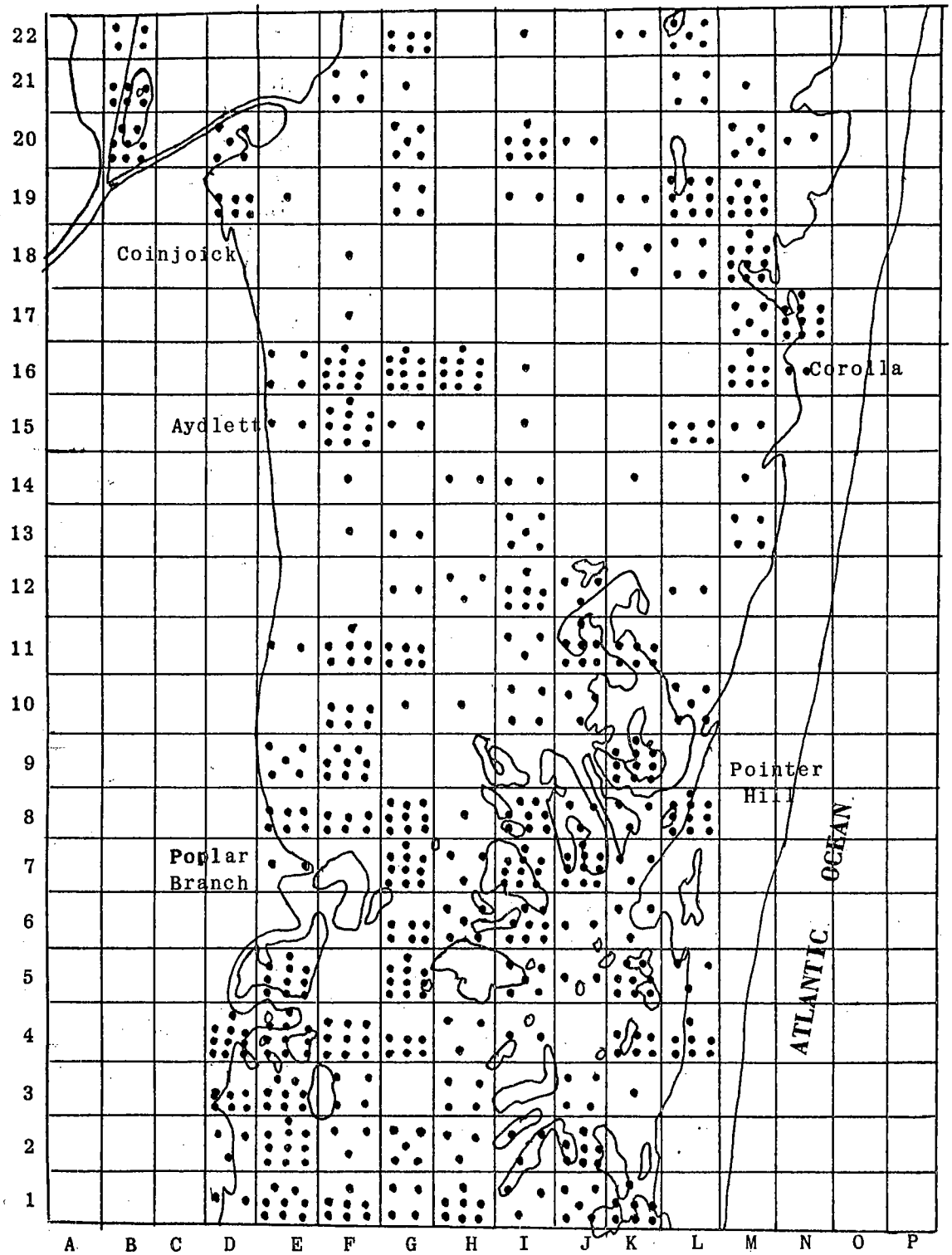
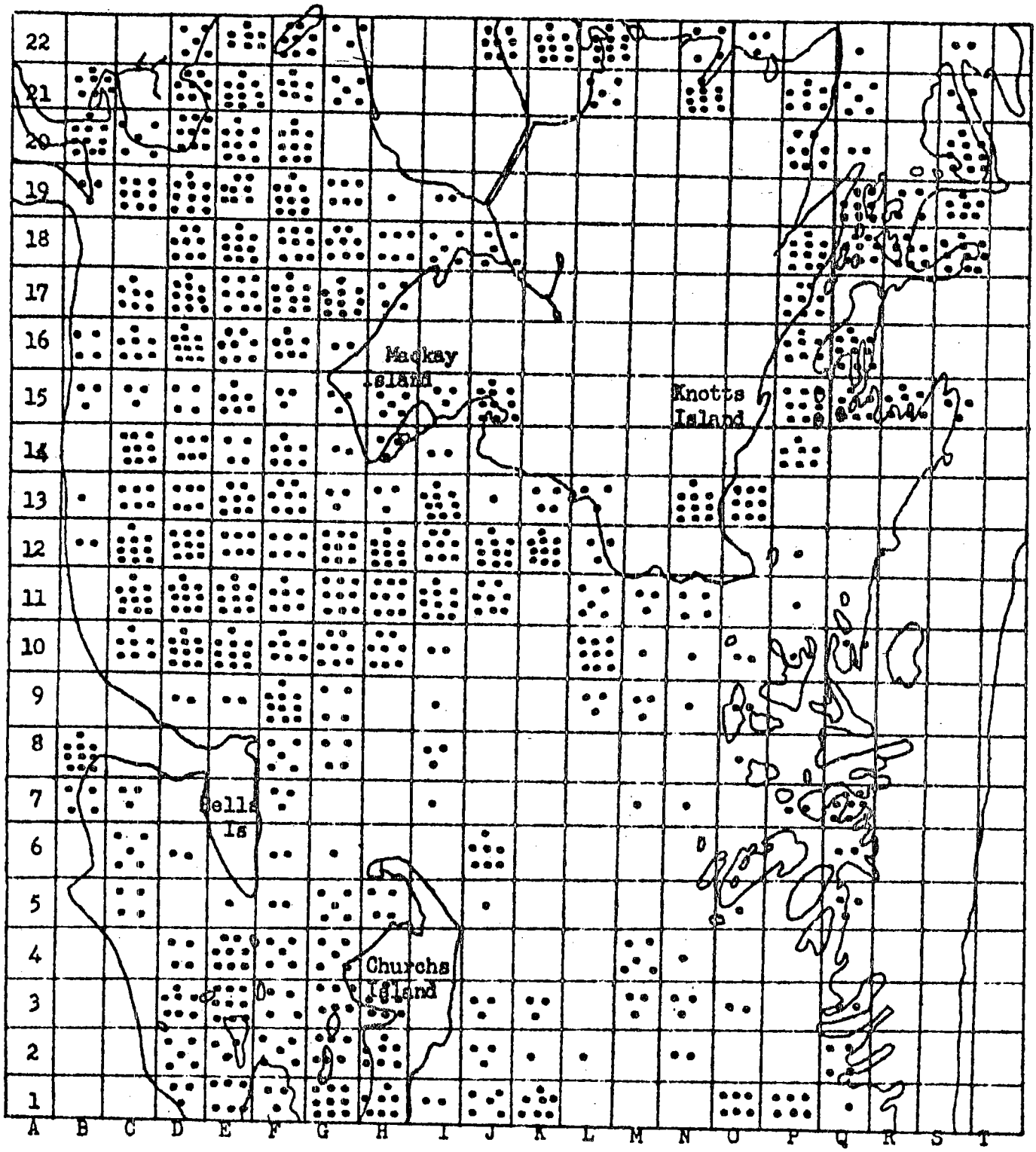


Figure Distribution of Silt, Master Survey, August 1962.



Section B

Figure Distribution of Silt, Master Survey, August 1962.



Section C

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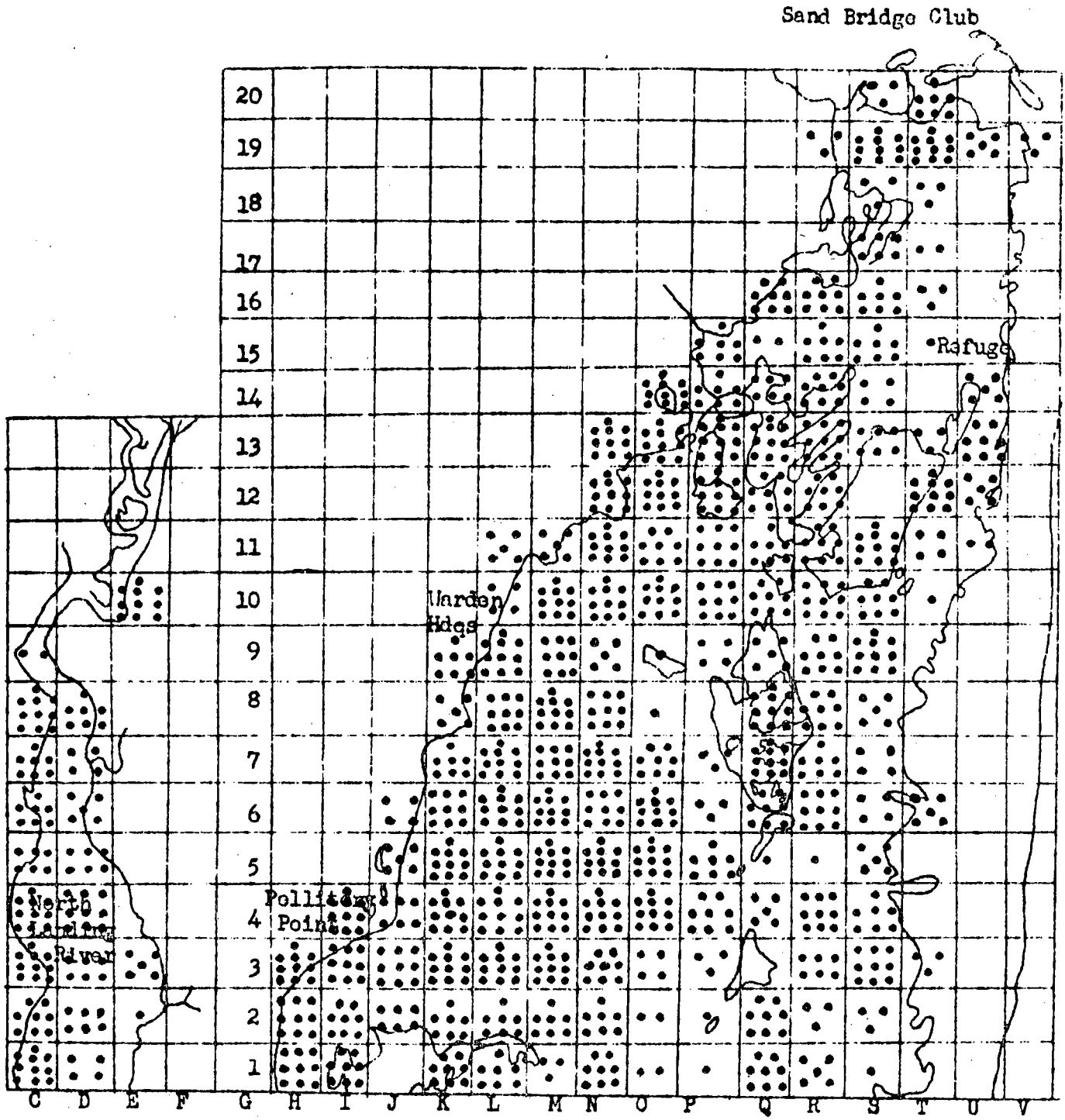
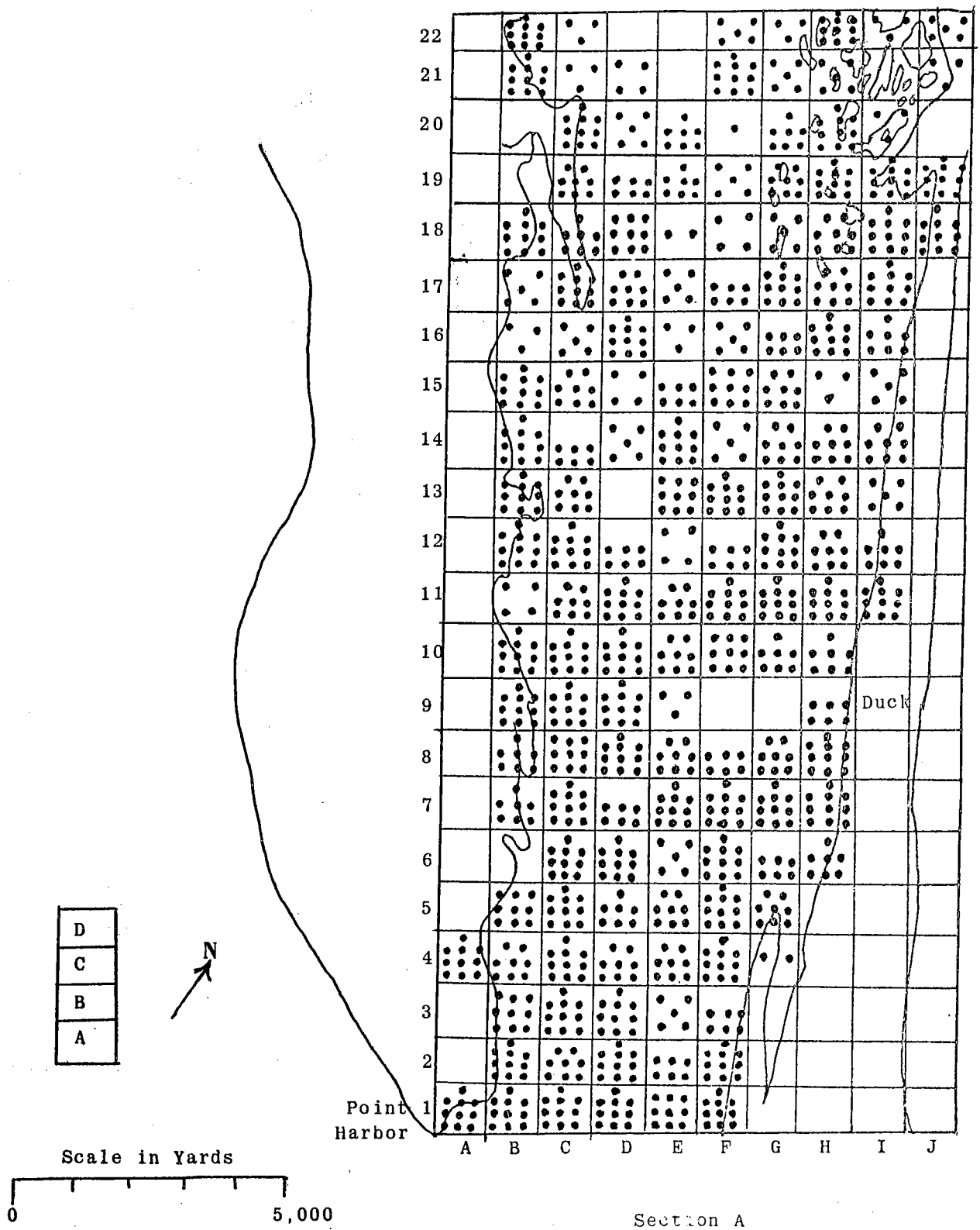


Section D

Figure_____. Distribution of Silt Bottom, Master Survey, August 1962.



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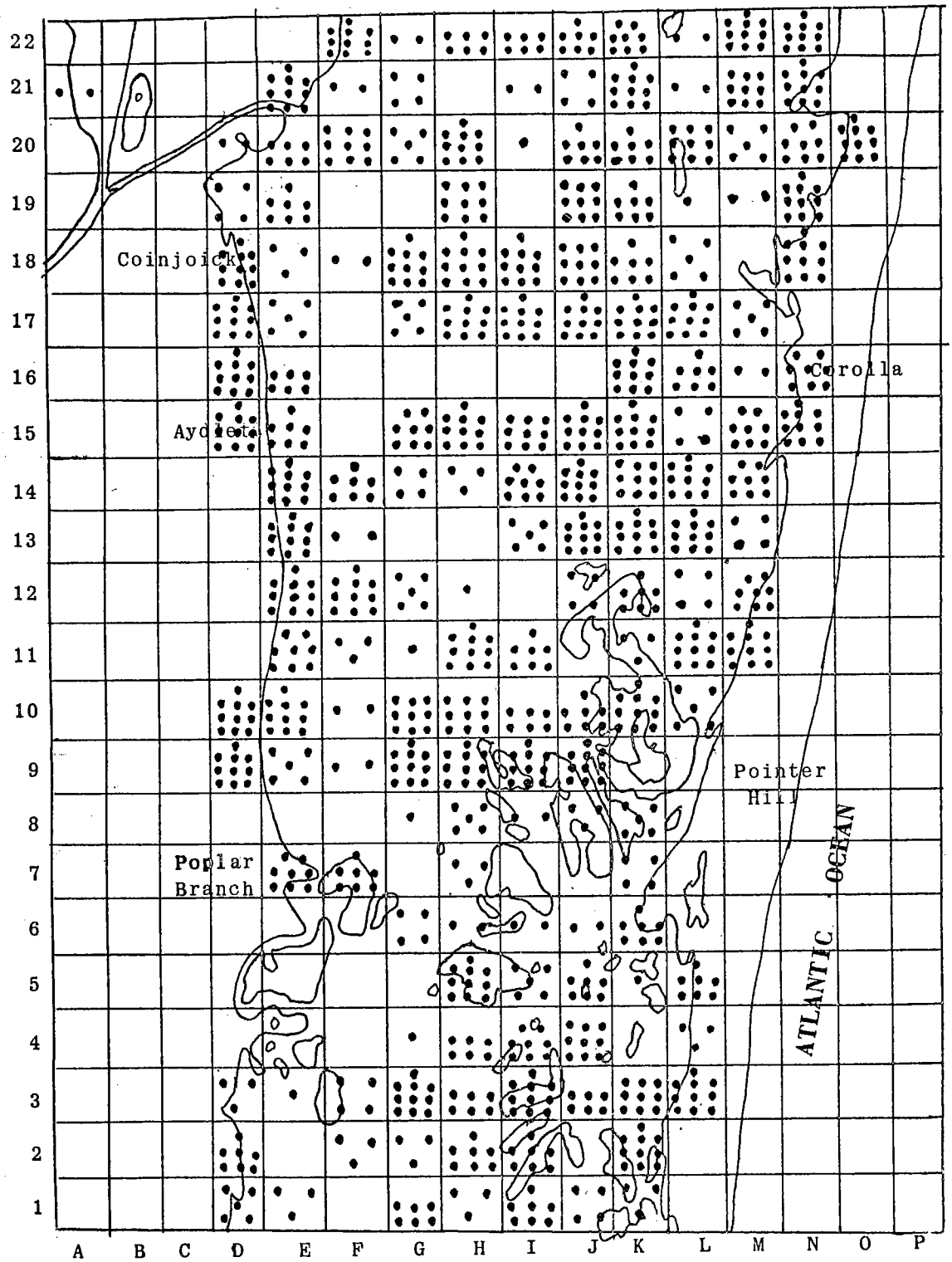
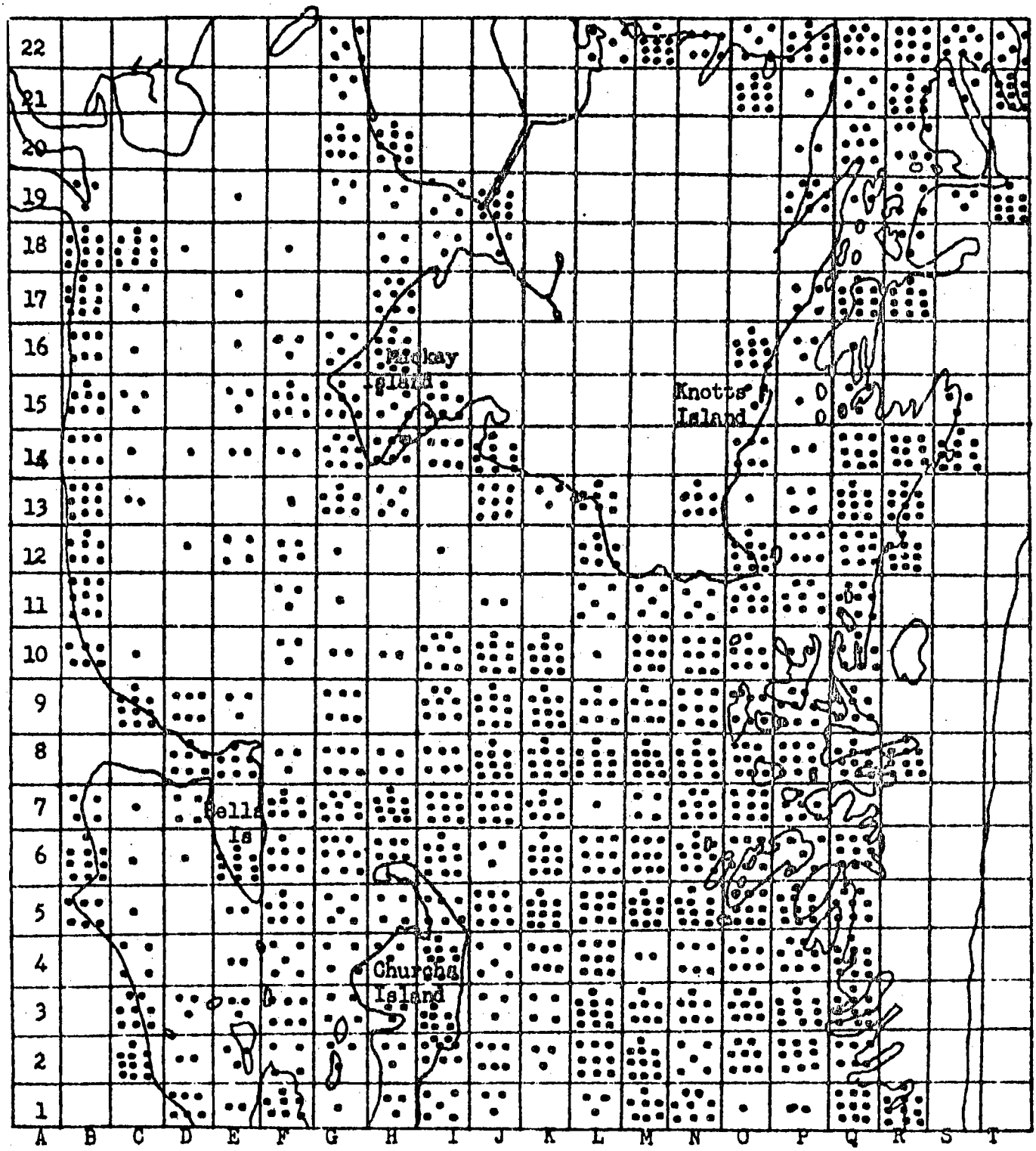


Section B

Figure Distribution of Sand, Master Survey, August 1962.



Section C

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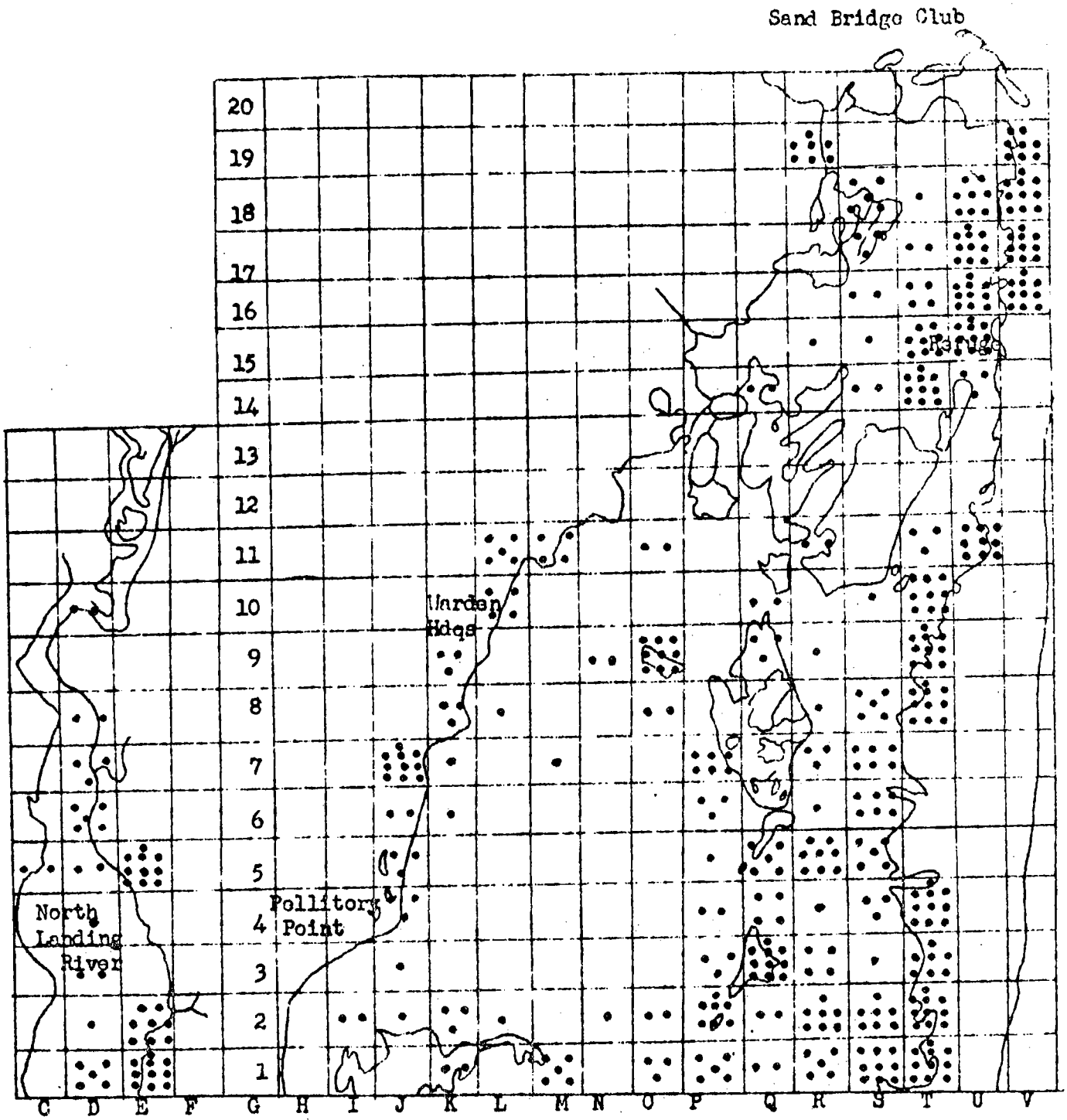

Section D

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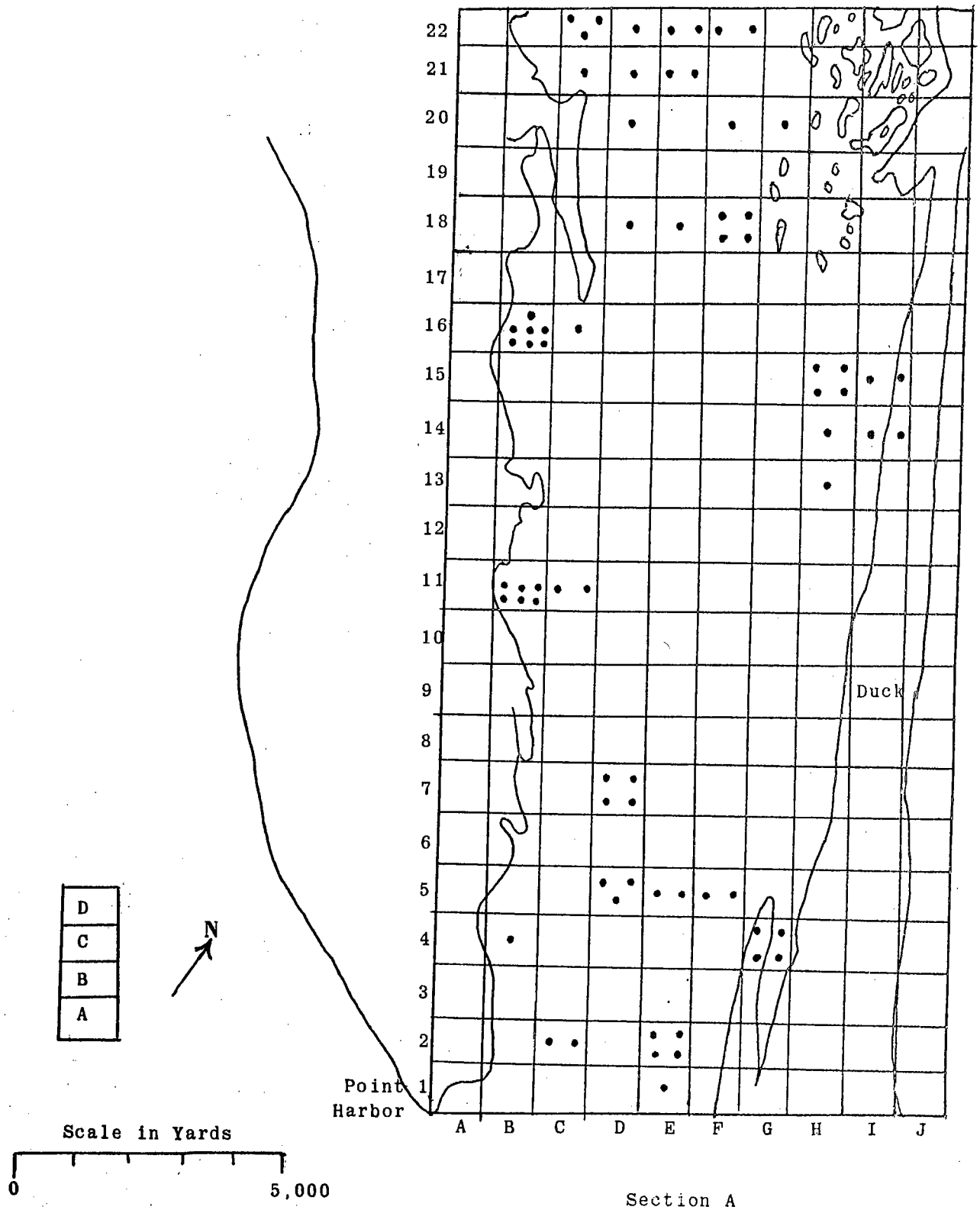

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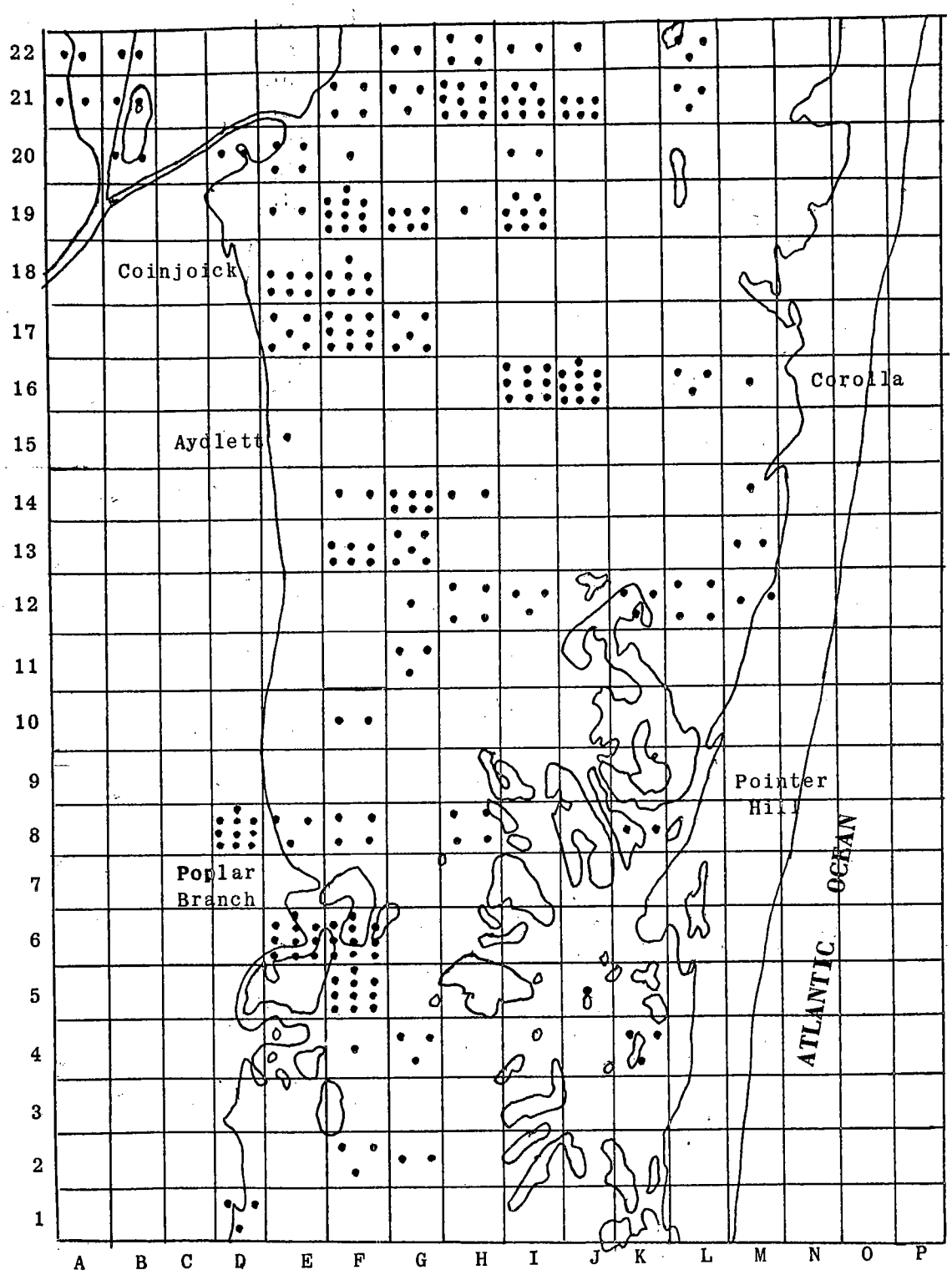

Section B

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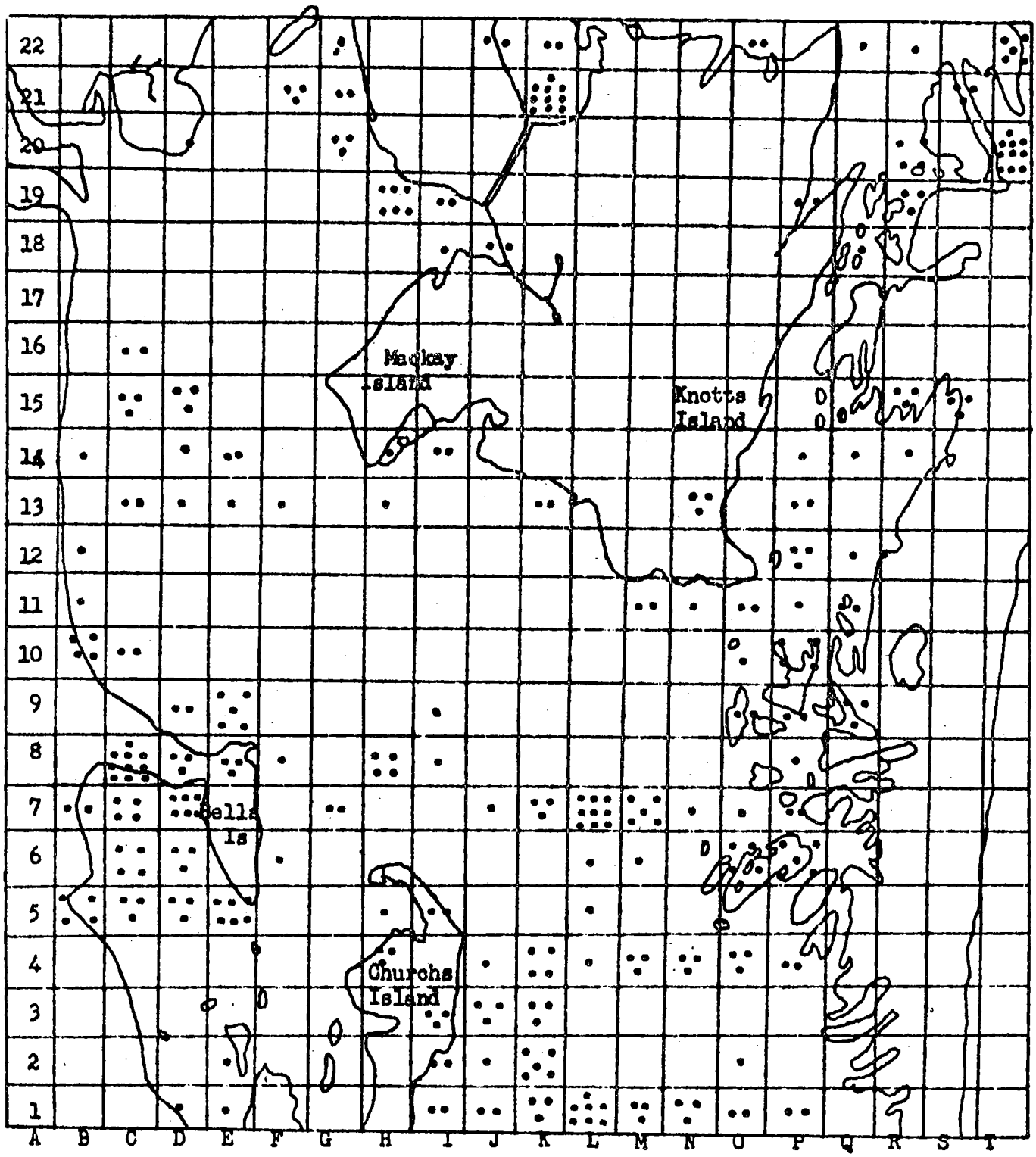

Section C

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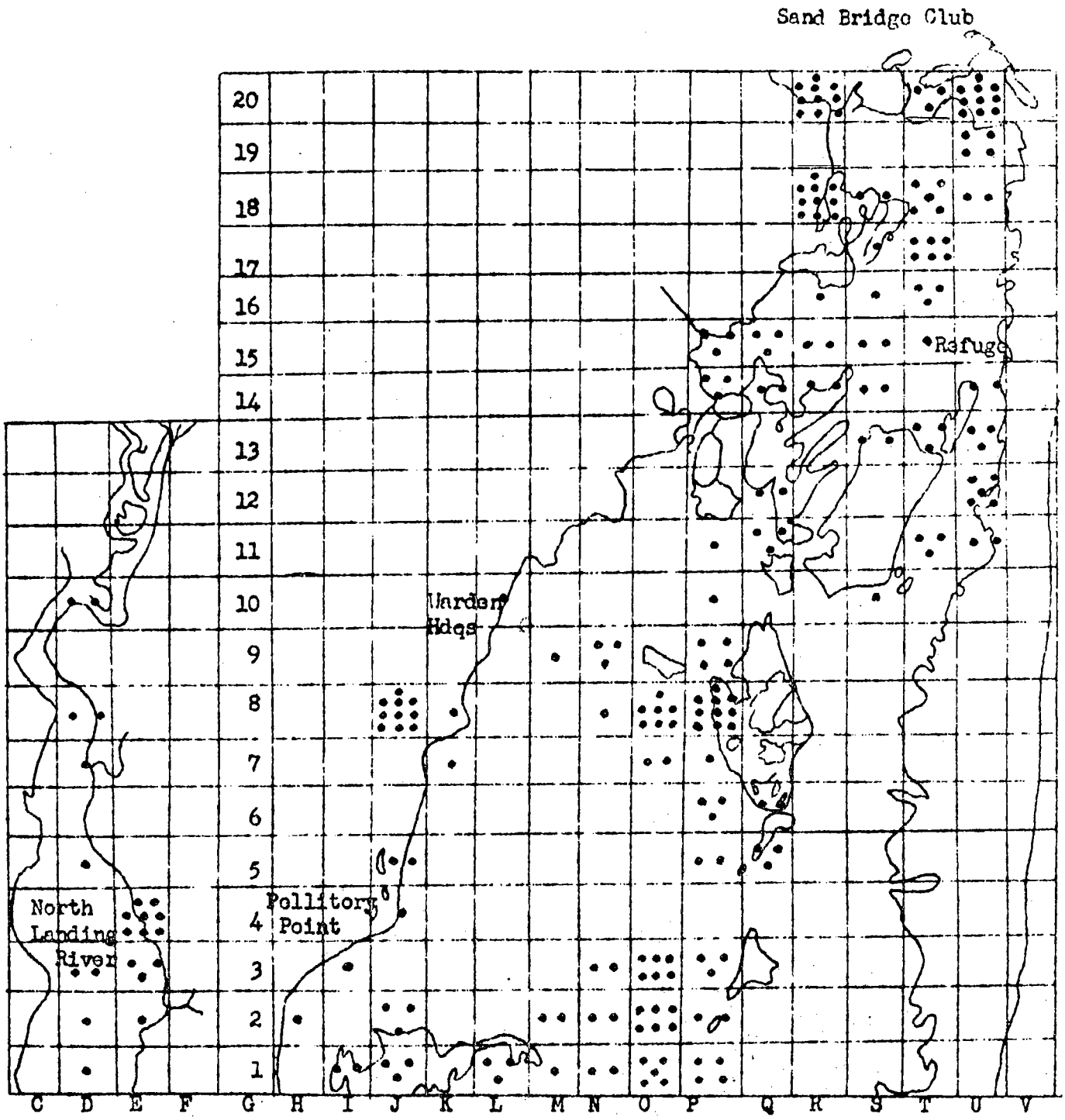

Section D

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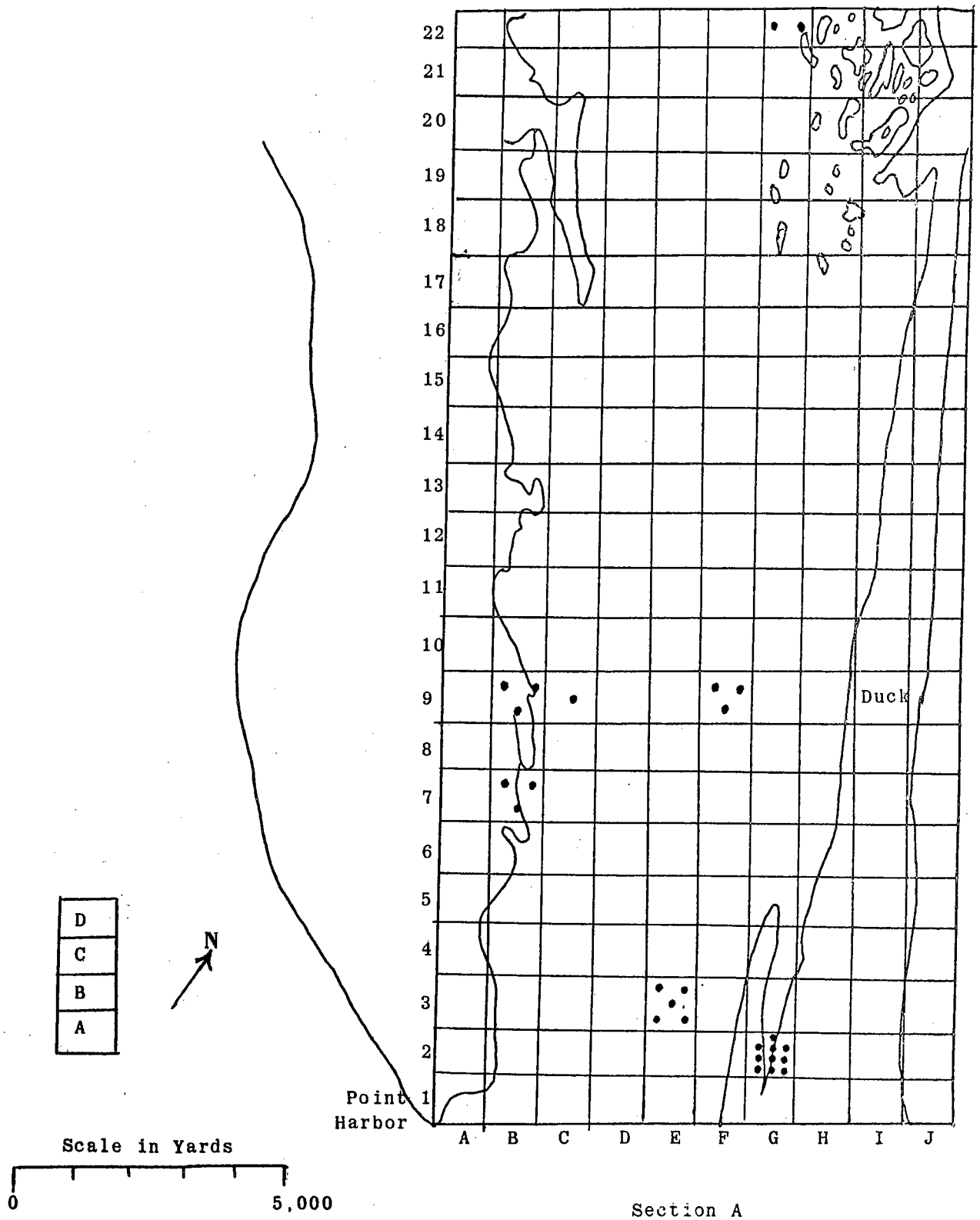

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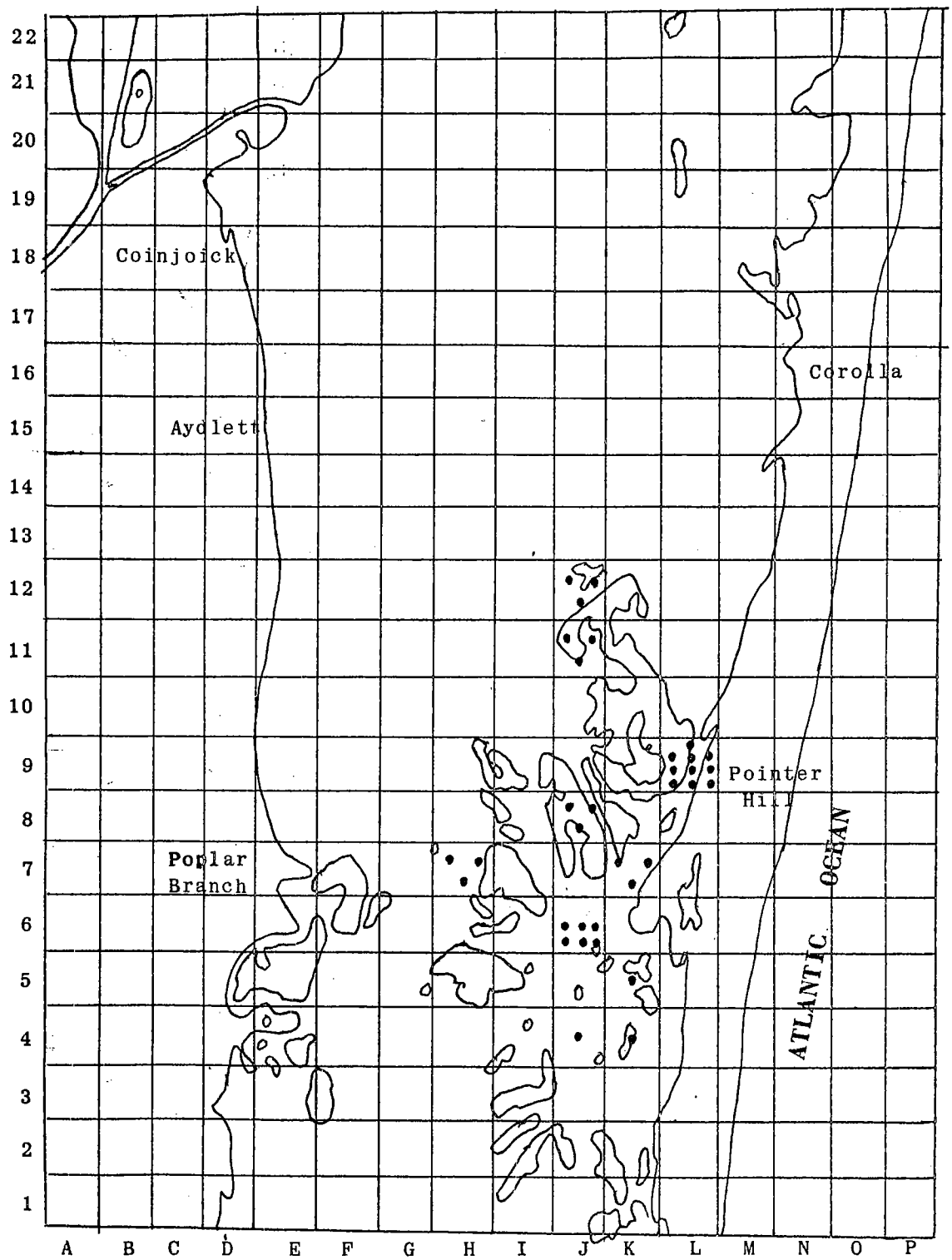

Section B

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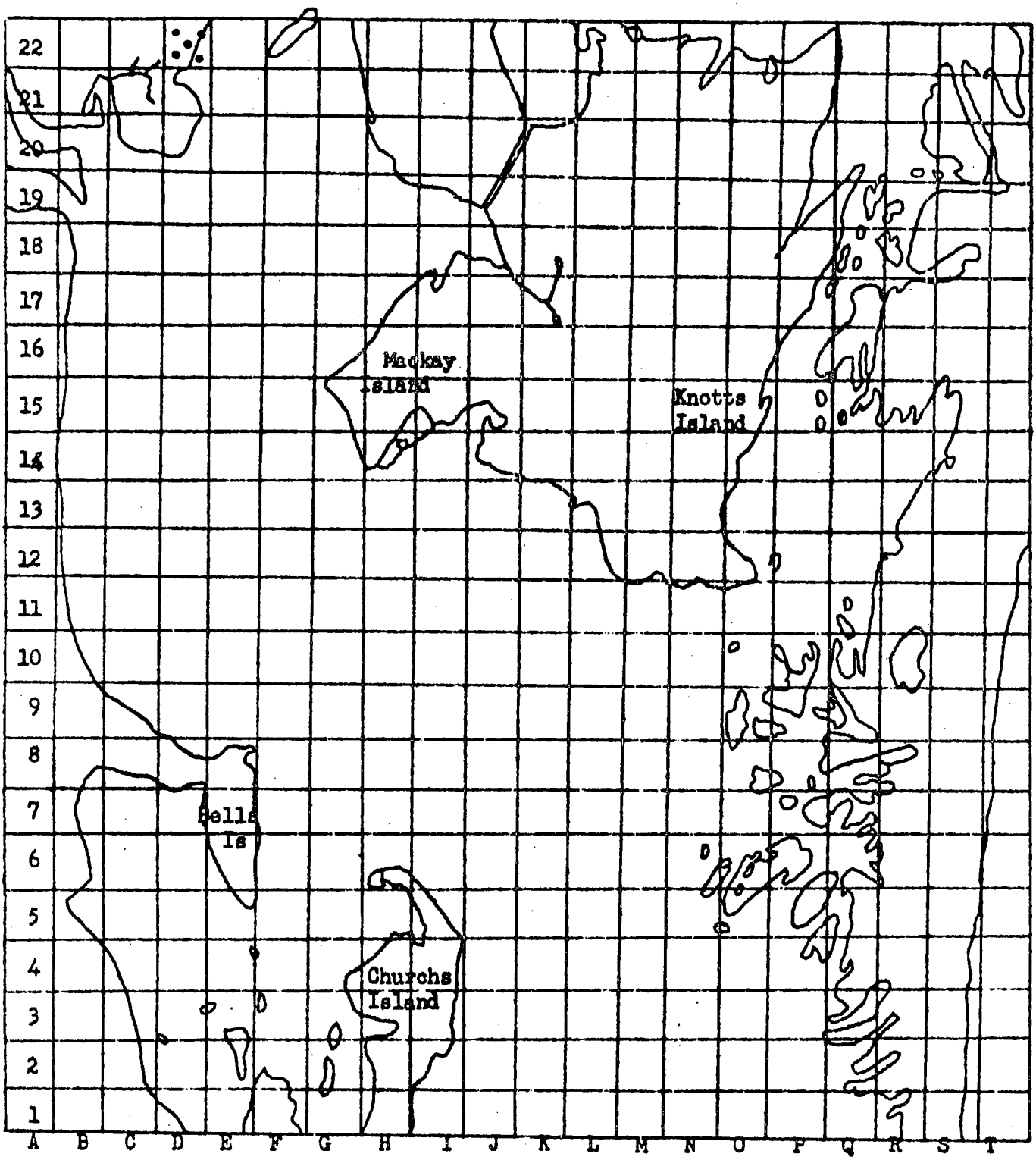

Section C

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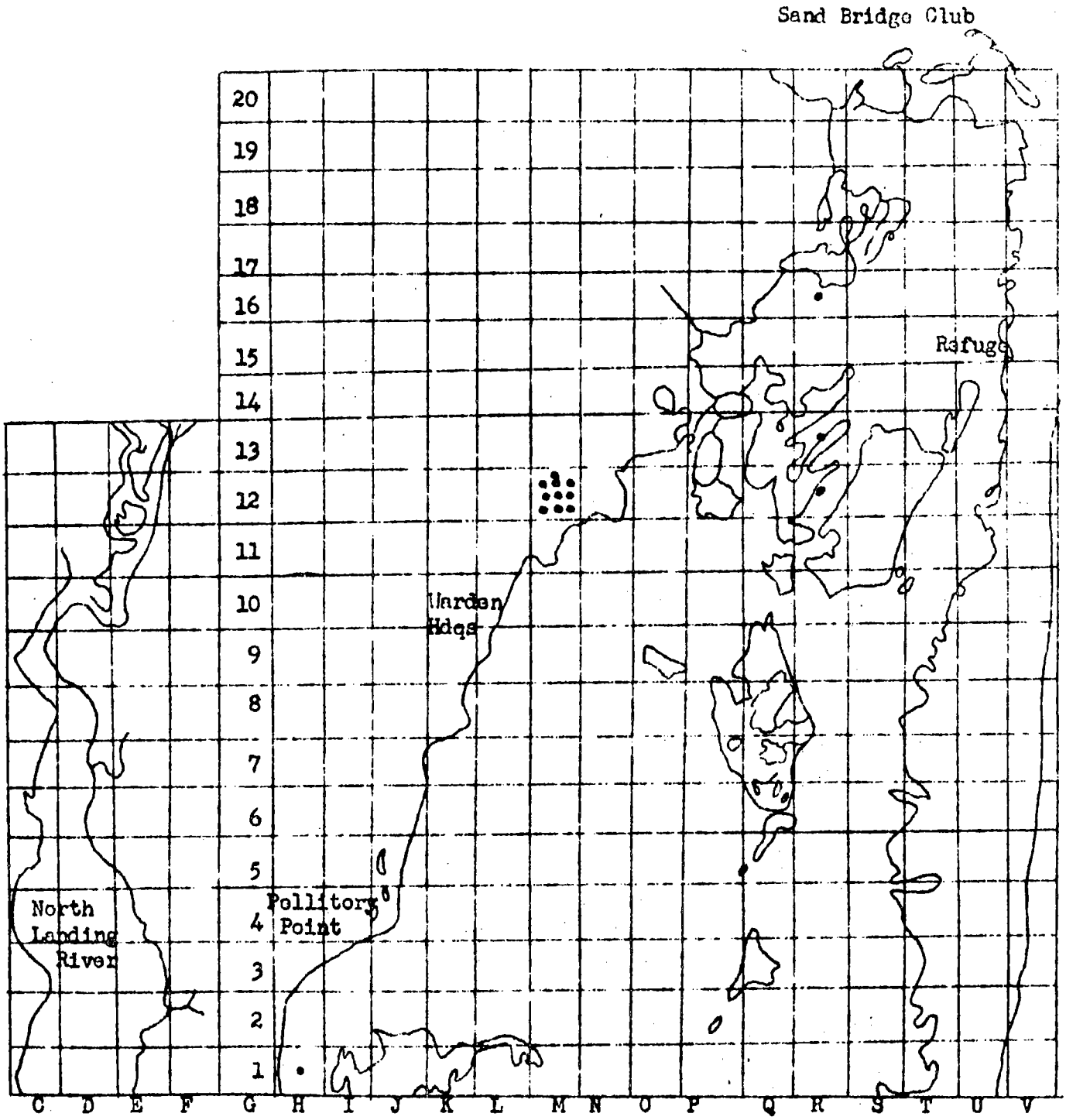
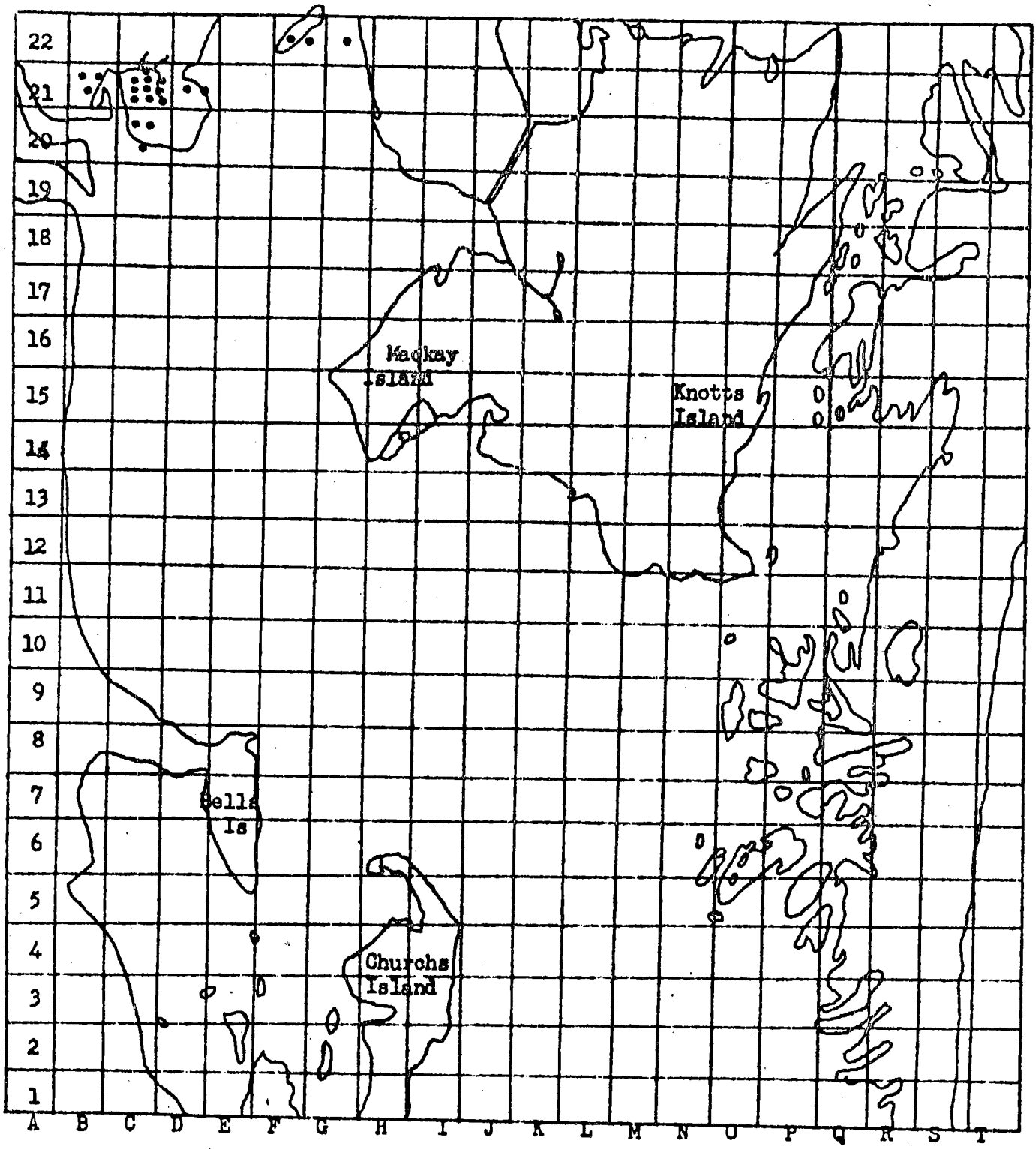


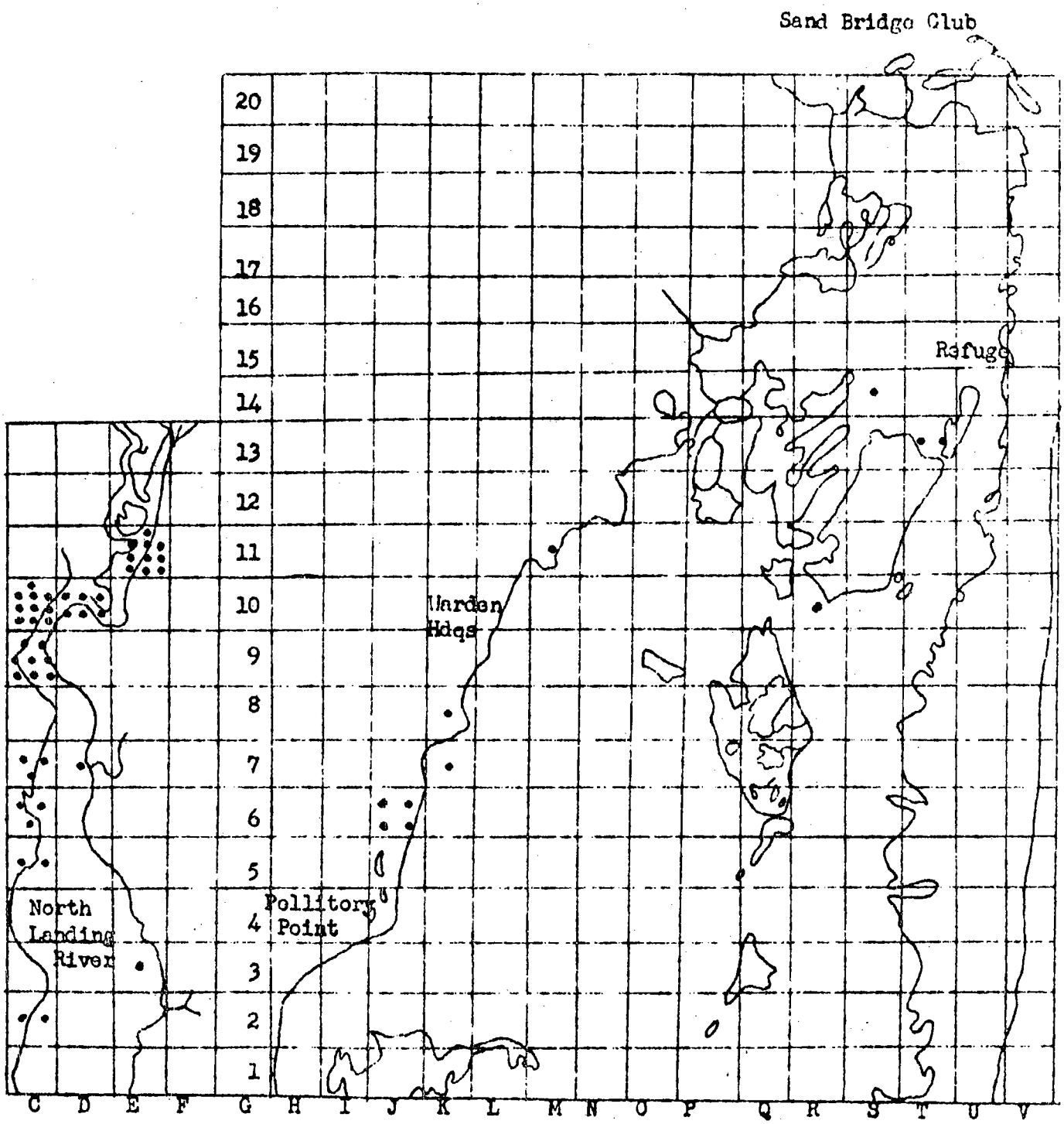
Section D

Figure_____. Distribution of Muck Bottom, Master Survey, August 1962.



Section C

Figure_____. Distribution of Peat, Master Survey, August 1962.



Section D

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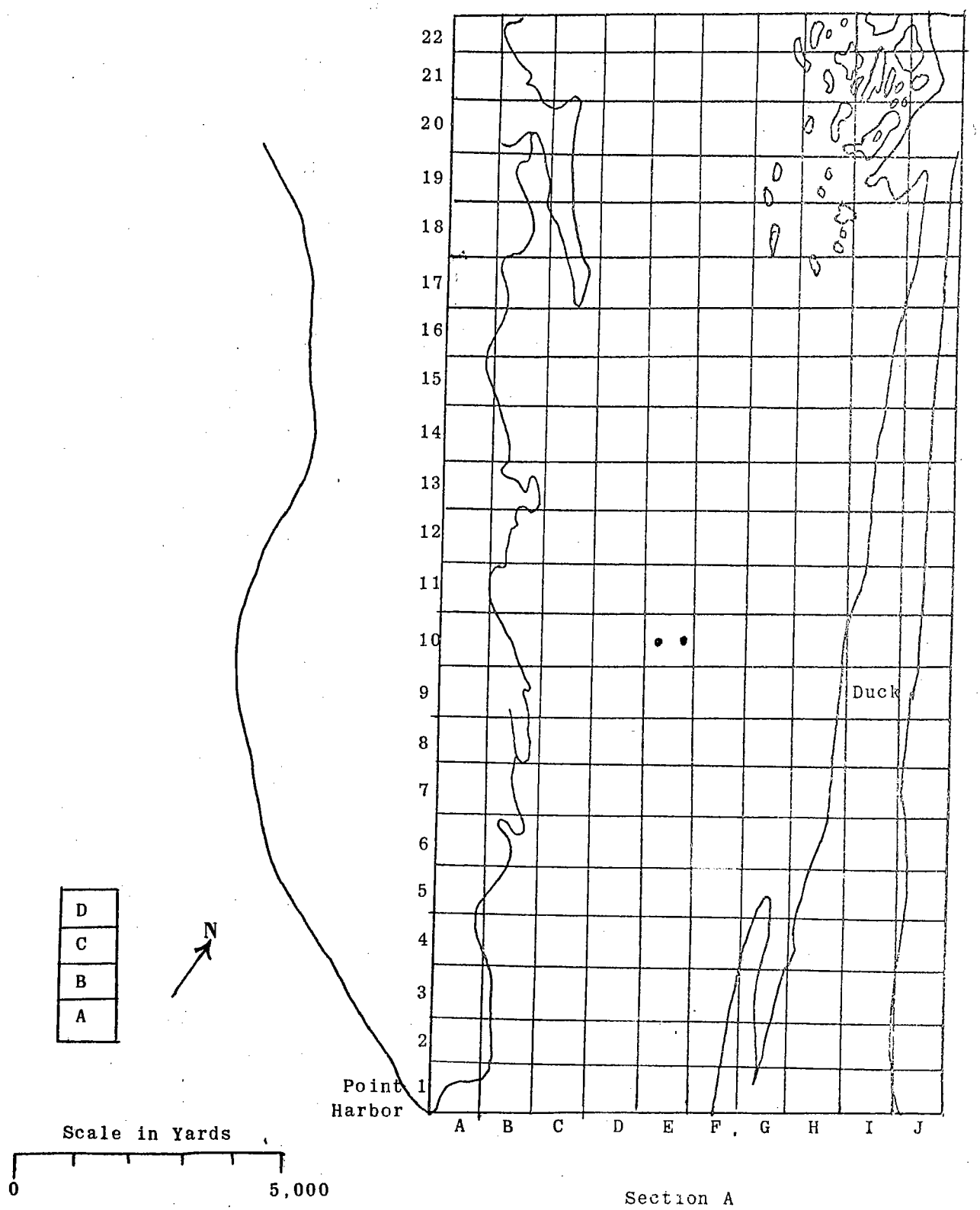

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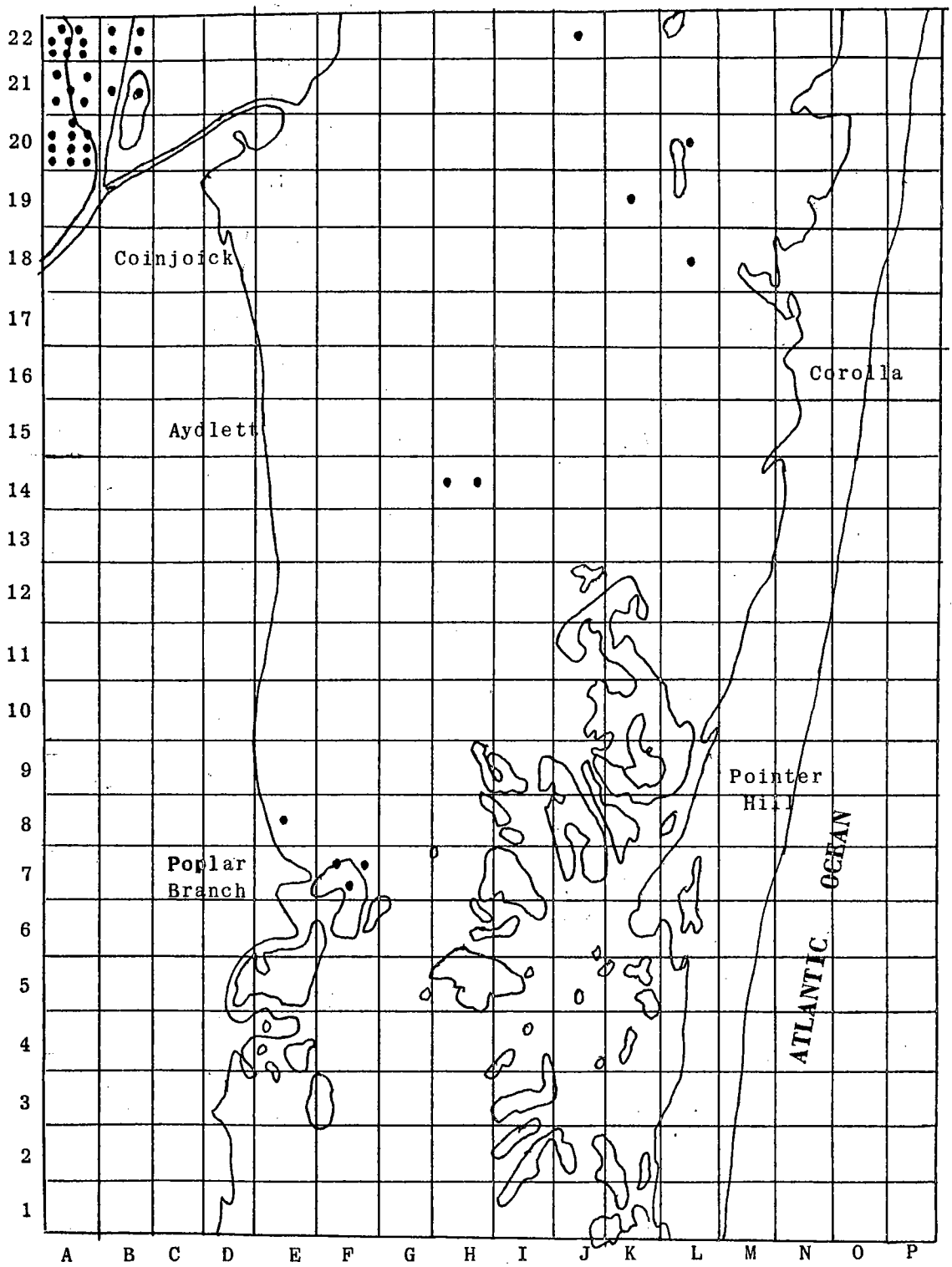

Section B

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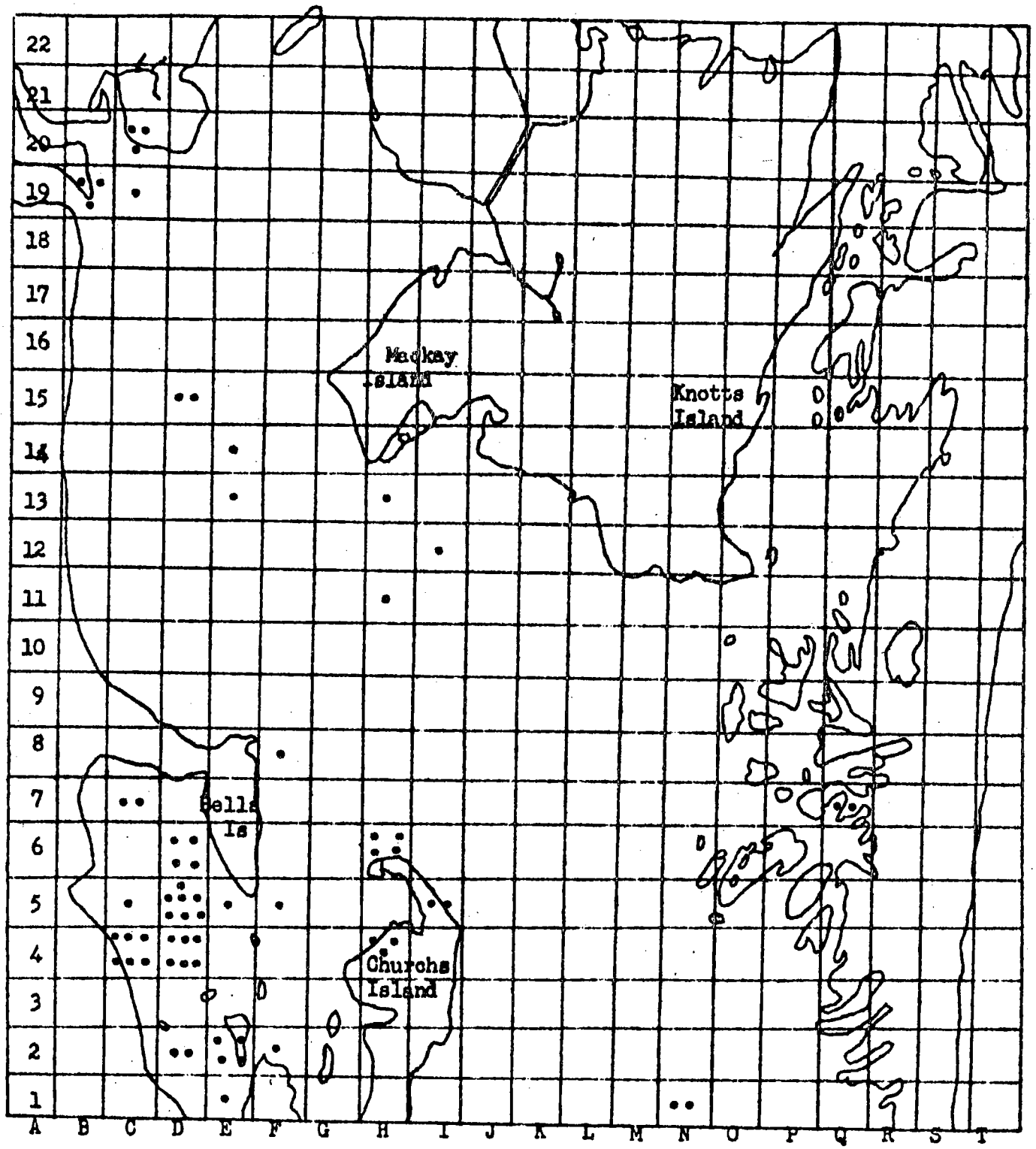

Section C

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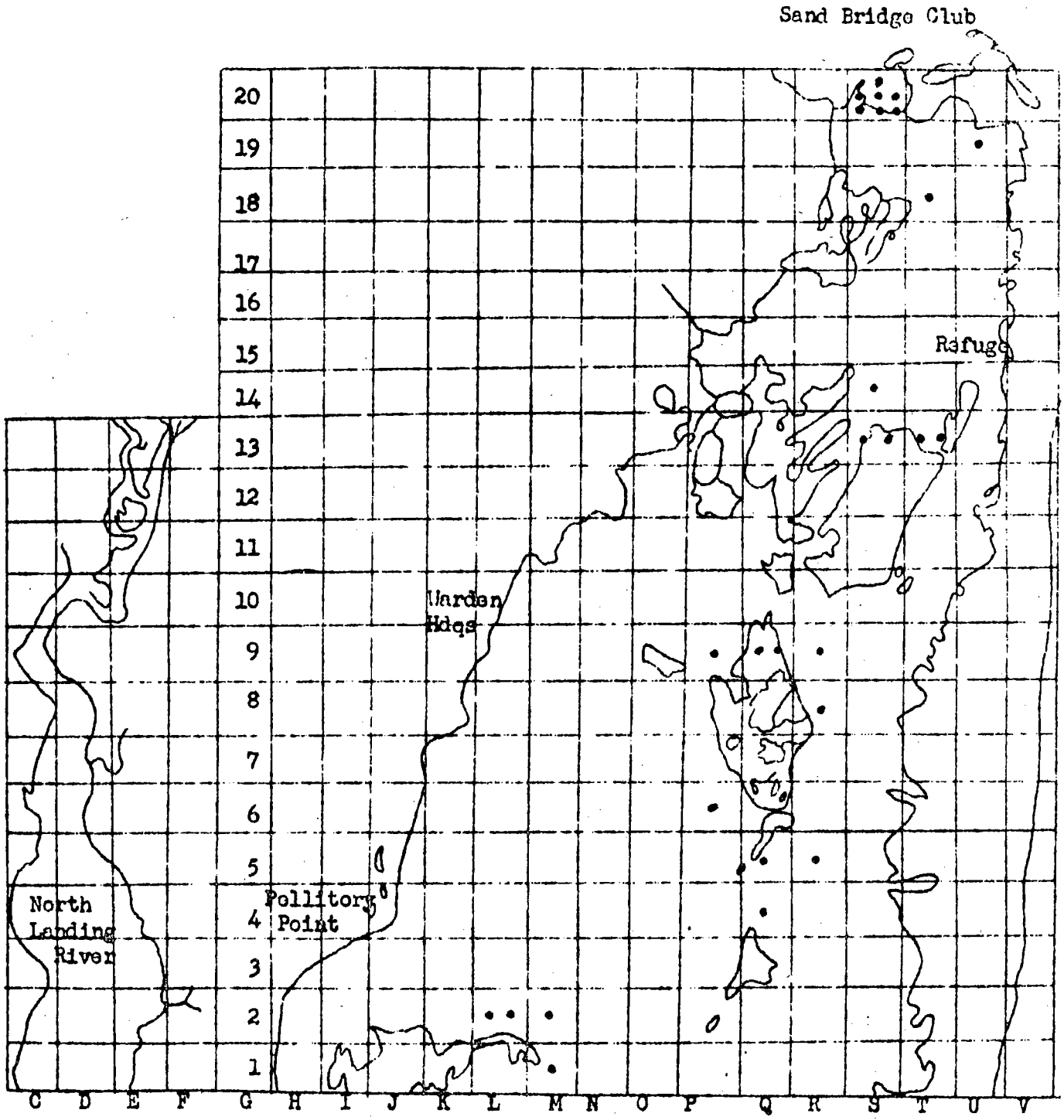
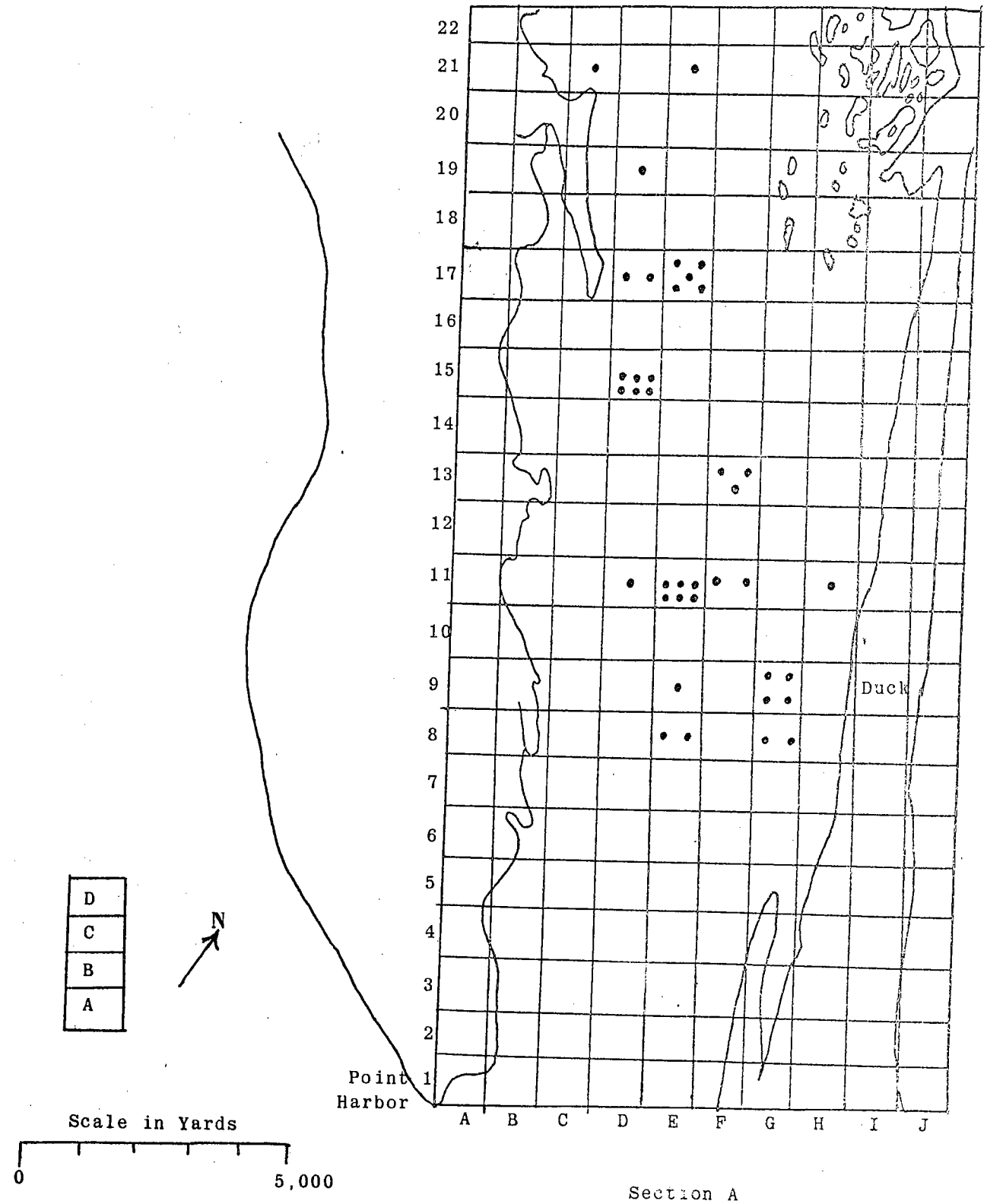


Section D

Figure_____. Distribution of Clay Bottom, Master Survey, August 1962



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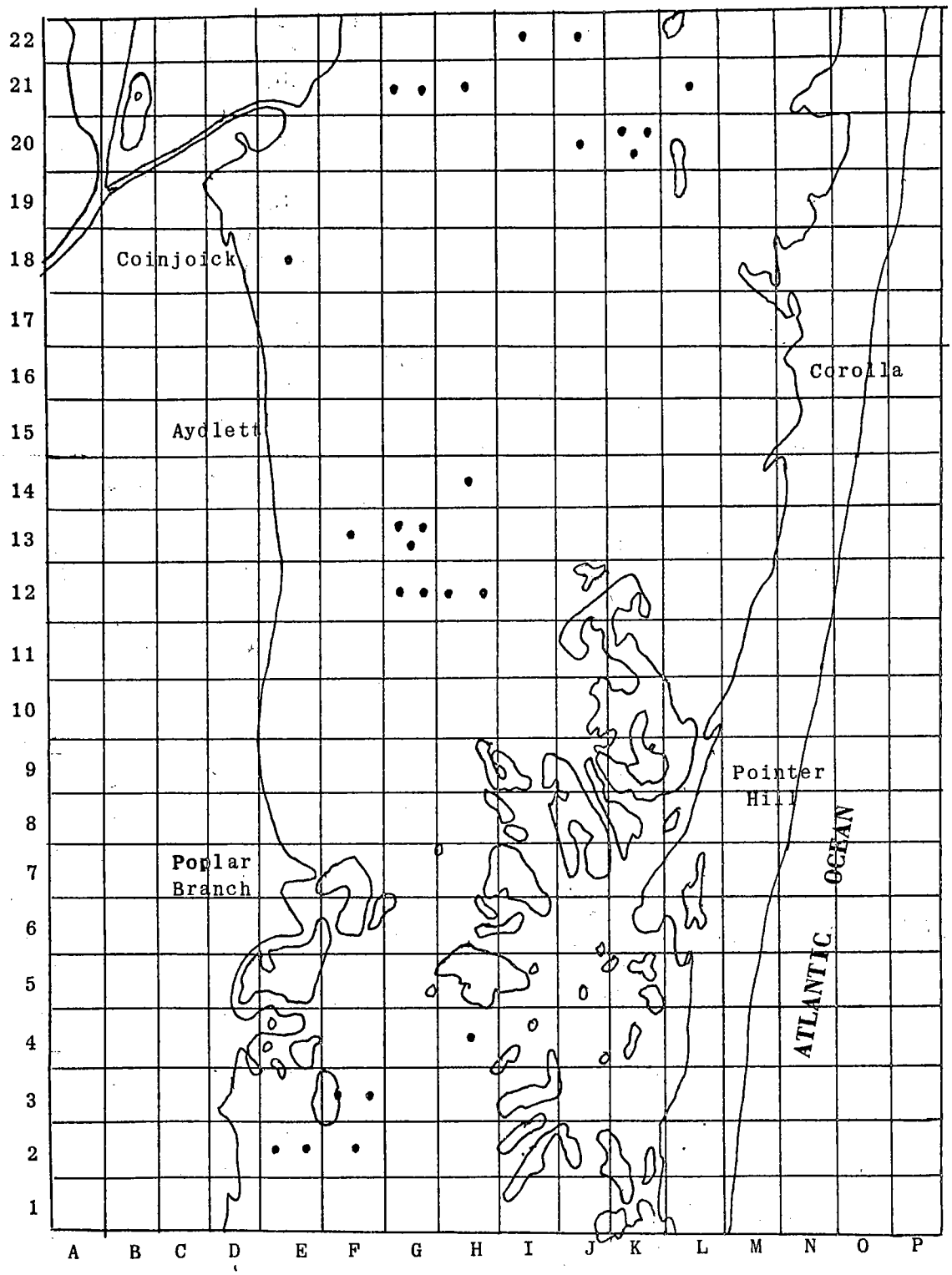

Section B

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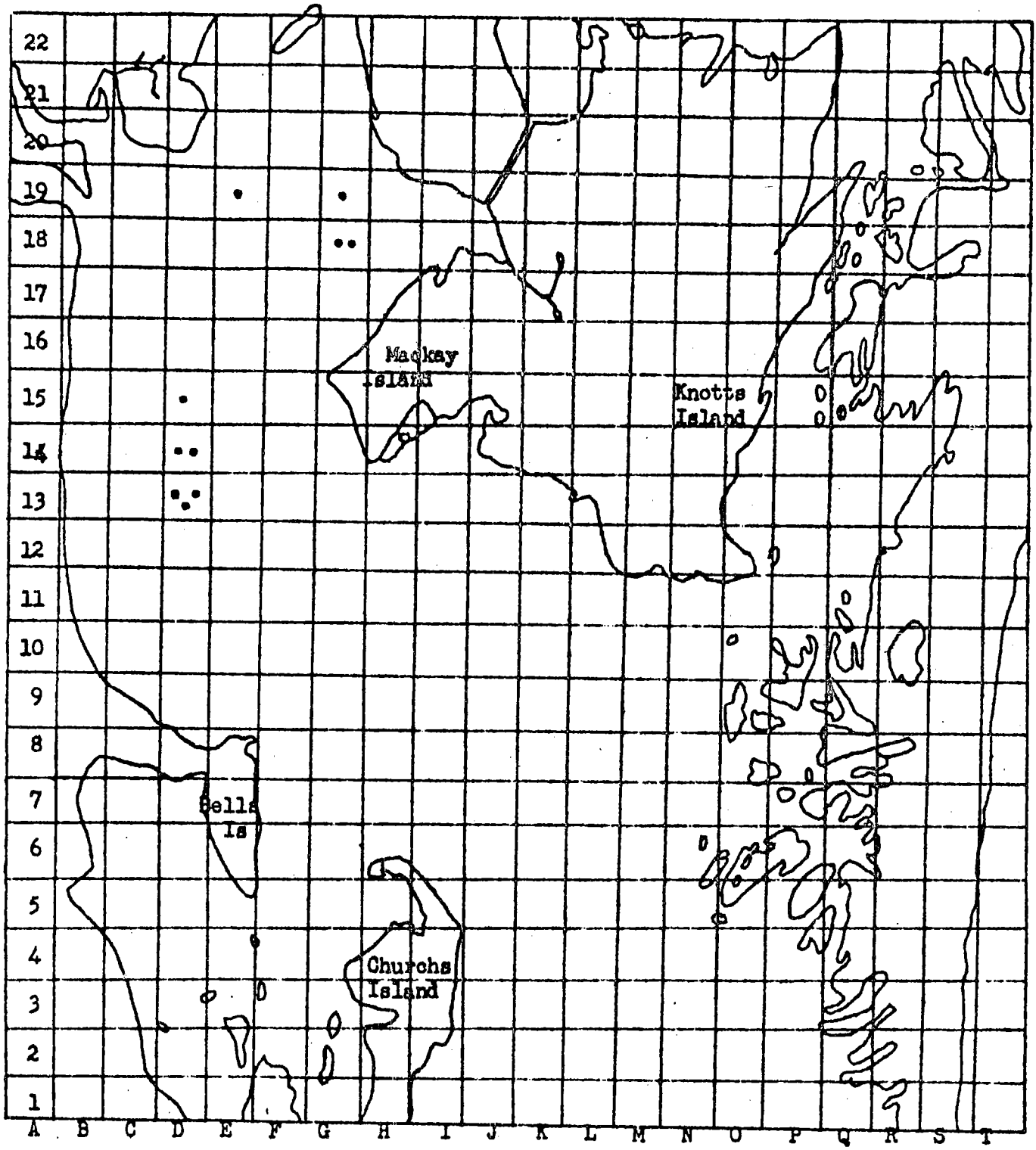

Section C

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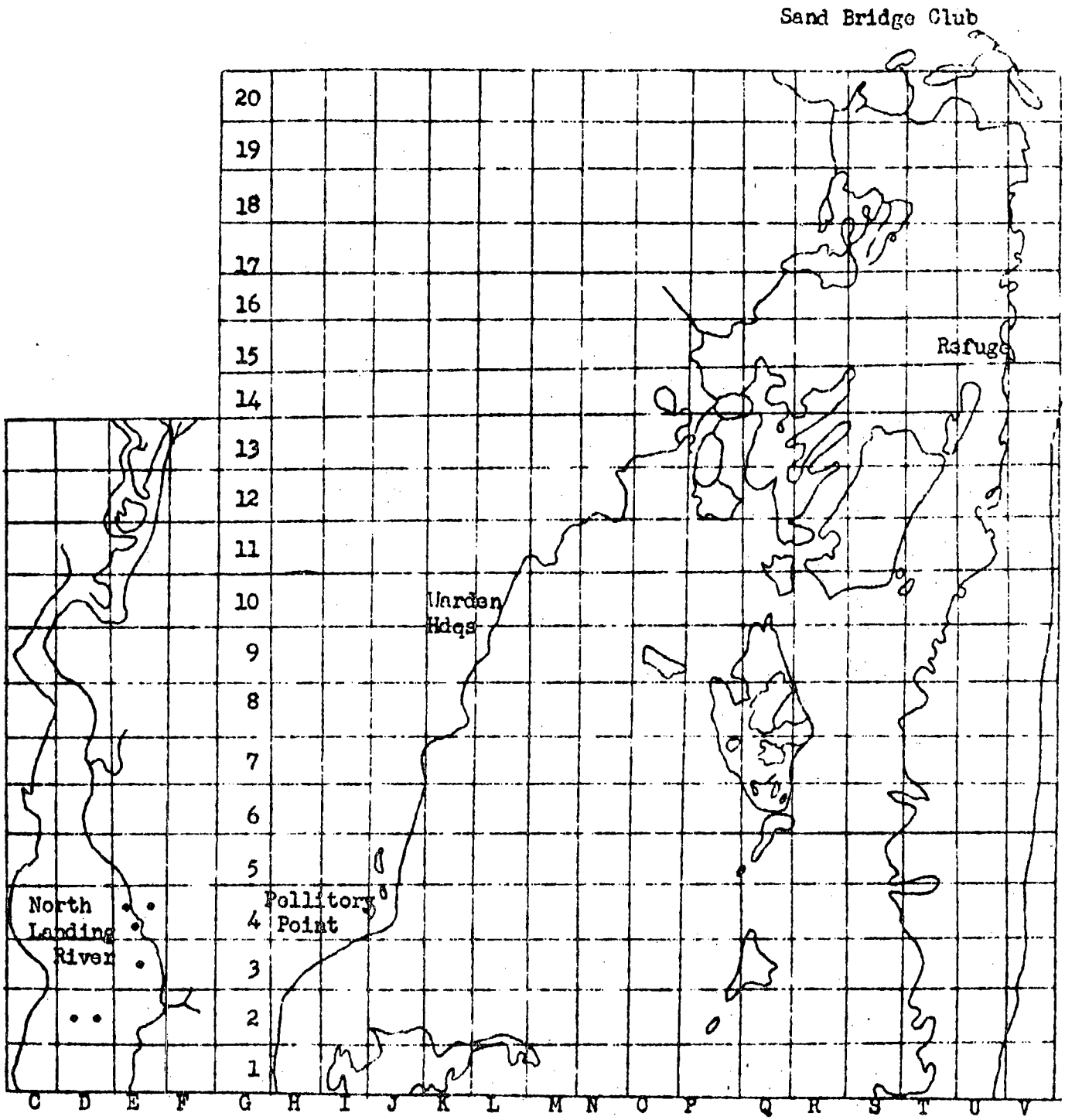

Section D

Figure_____. Distribution of Shell Bottom, Master Survey, August 1962.