SECOND REPORT (unpublished document)

STUDIES OF SANDY TROUBLE SPOTS IN DUG WATER CONTROL CHANNELS, HIGHLANDS AND OKEECHOBEE COUNTIES, FLORIDA

by

Donald A. Parsons

USDA Sedimentation Laboratory
Southern Branch
Soil and Water Conservation Research Division
Agricultural Research Service
US Department of Agriculture

June, 1963

1964 - 2 page up-date attached.

TABLE OF CONTENTS

SECOND REPORT

STUDIES OF SANDY TROUBLE SPOTS IN DUG WATER CONTROL CHANNELS, HIGHLANDS AND OKEECHOBEE COUNTIES, FLORIDA

by

Donald A. Parsons [1]

INTRODUCTION

This is the second report on the studies of sandy trouble spots in dug water control channels -- specifically, Fisheating and Taylor Creeks, Florida. An attempt is made to avoid repetition of the material of the first report, dated June 19, 1961. Reference to that report may be desirable for continuity. This is not a concluding document; but is to collect and summarize most of the observations at hand.

The soil classifications by the Soil Conservation Service people, along with the laboratory results on densities, soil moisture, and texture, are reproduced in the Appendix. Graphical representations of much of the data are given in the text.

Messrs. Stewart, Speir, and Luke visited three of the study reaches on Fisheating Creek on May 24, 1962. J. Luke, G. Moore, W. McCall, and D. Parsons observed conditions along Fisheating

---

1/ Hydraulic Engineer (Research), USDA Sedimentation Laboratory, Southern Branch, Soil and Water Conservation Research Division, Agricultural Research Service, US Department of Agriculture, Oxford, Mississippi.

and Taylor Creeks in January, 1963. Color pictures were taken at both times.

MECHANICAL ANALYSES

Figures 1 and 2 show by different methods the size distributions of the large quantity of sand that was taken to Oxford, from reach D on the north lateral extension of Fisheating Creek. This sand has been used in laboratory observations of the flowing sand phenomenon.

References to the data in the Appendix will show that all of the many samples taken from the banks and bed of the stream have very small proportions of material in the silt size range, even when the clay sizes are appreciable.

The sand portions of the samples have about the same size distributions in all the sampled reaches of Fisheating Creek. The range in size is quite narrow as indicated by the standard deviation for Krumbein's phi values 2/.

BULK DENSITIES

The bulk density, sometimes called volume-weight, is compared with the silt and clay percentages in Figure 3. Mean values of the bulk density generally increased with increasing percentages of silt and clay.

2/ Rouse, H.
"Fluid Mechanics for Hydraulic Engineers", First Edition, McGraw-Hill Book Company, 1938, p. 348. (For a description of Krumbein's phi scale.)

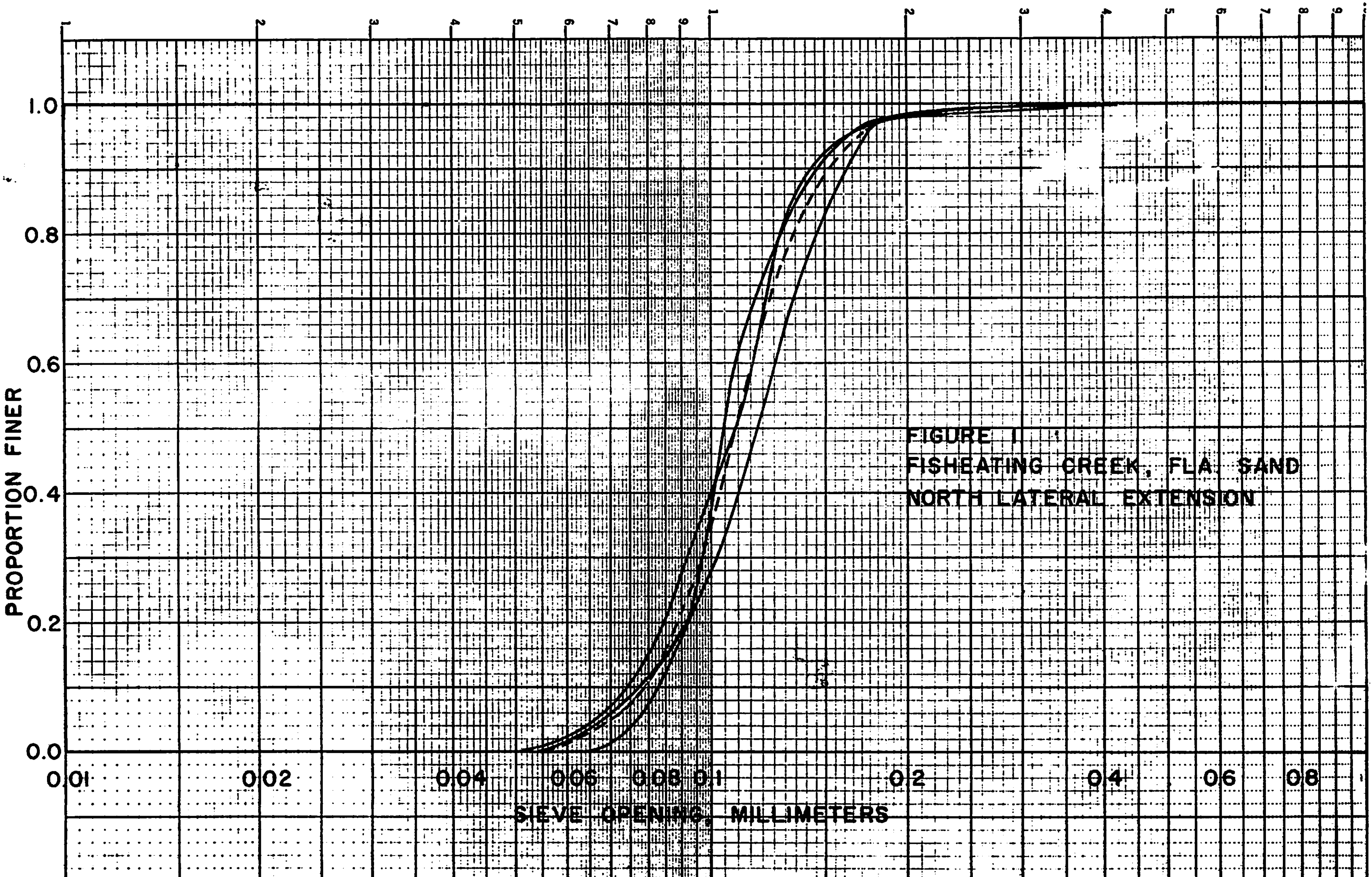


FIGURE 1
FISHEATING CREEK, FLA. SAND
NORTH LATERAL EXTENSION

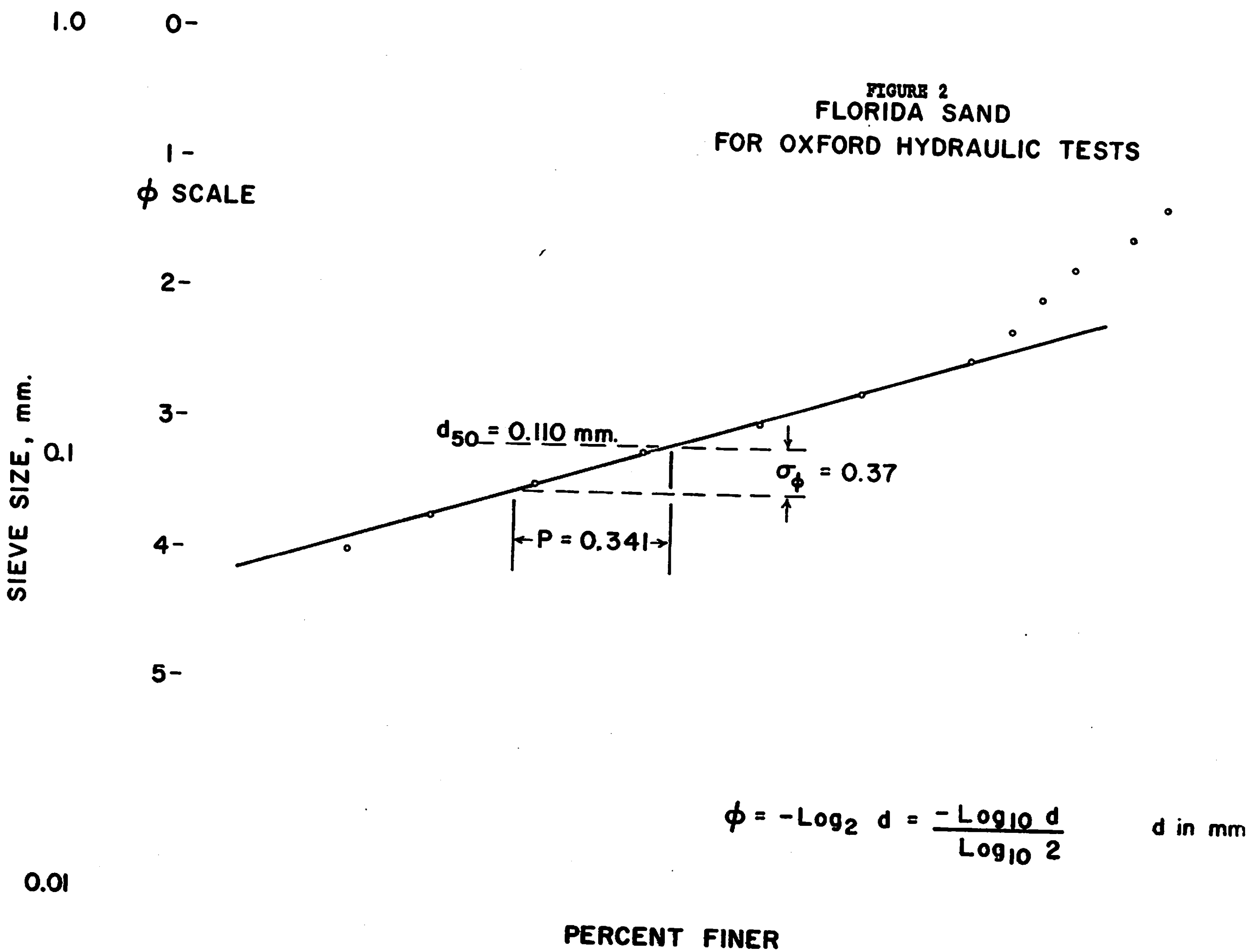


FIGURE 2
FLORIDA SAND
FOR OXFORD HYDRAULIC TESTS

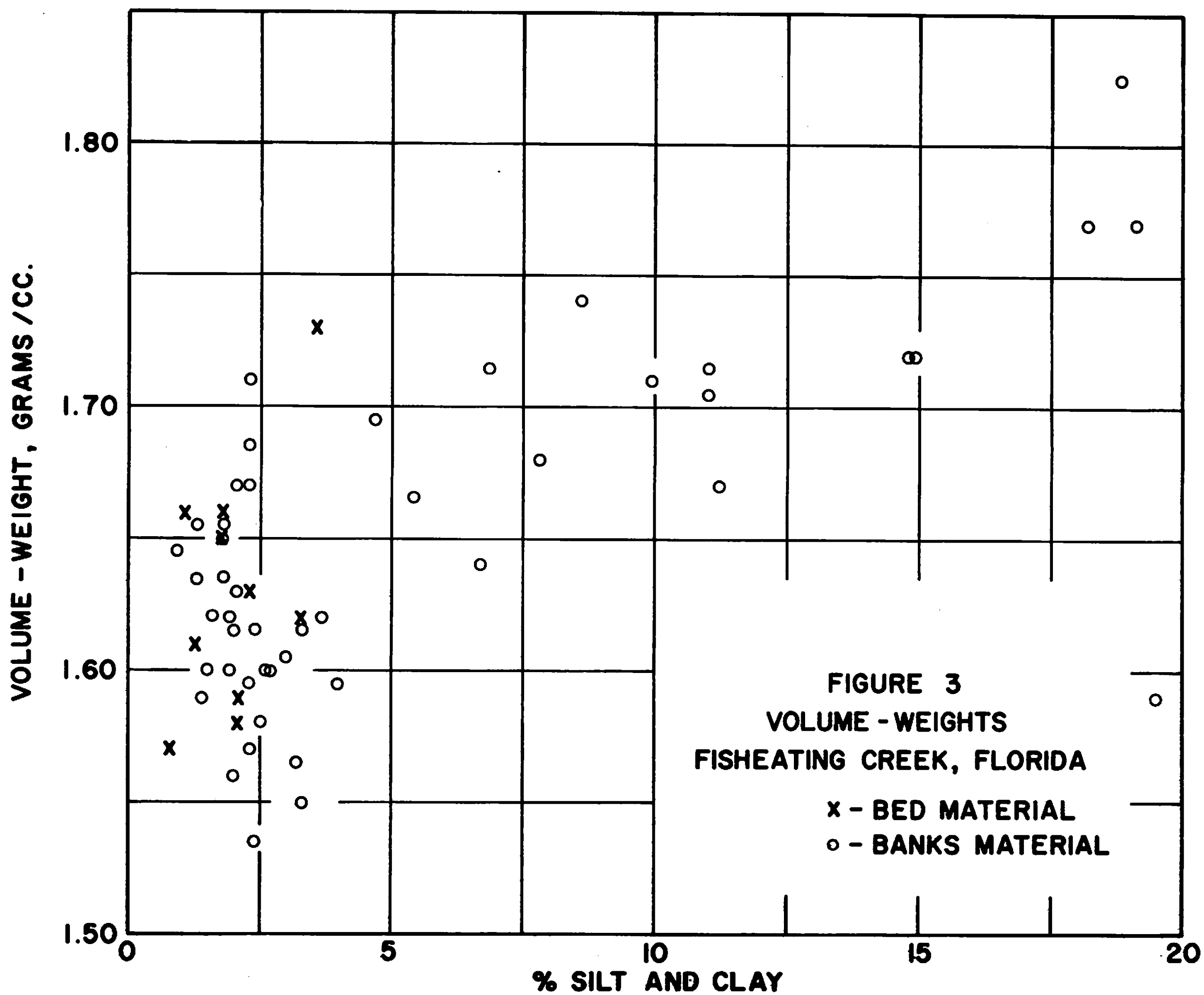


FIGURE 3
VOLUME - WEIGHTS
FISHEATING CREEK, FLORIDA

A comparison of the bulk density values determined at Oxford with those obtained at Fort Lauderdale is made in Figure 4. These determinations were made on twin samples. Although the Oxford-tested samples were taken in the same soil horizon and presumably from the same kind of material as were those measured at Fort Lauderdale, the sampling equipment and crews were different. Also, horizontal variations in texture did exist.

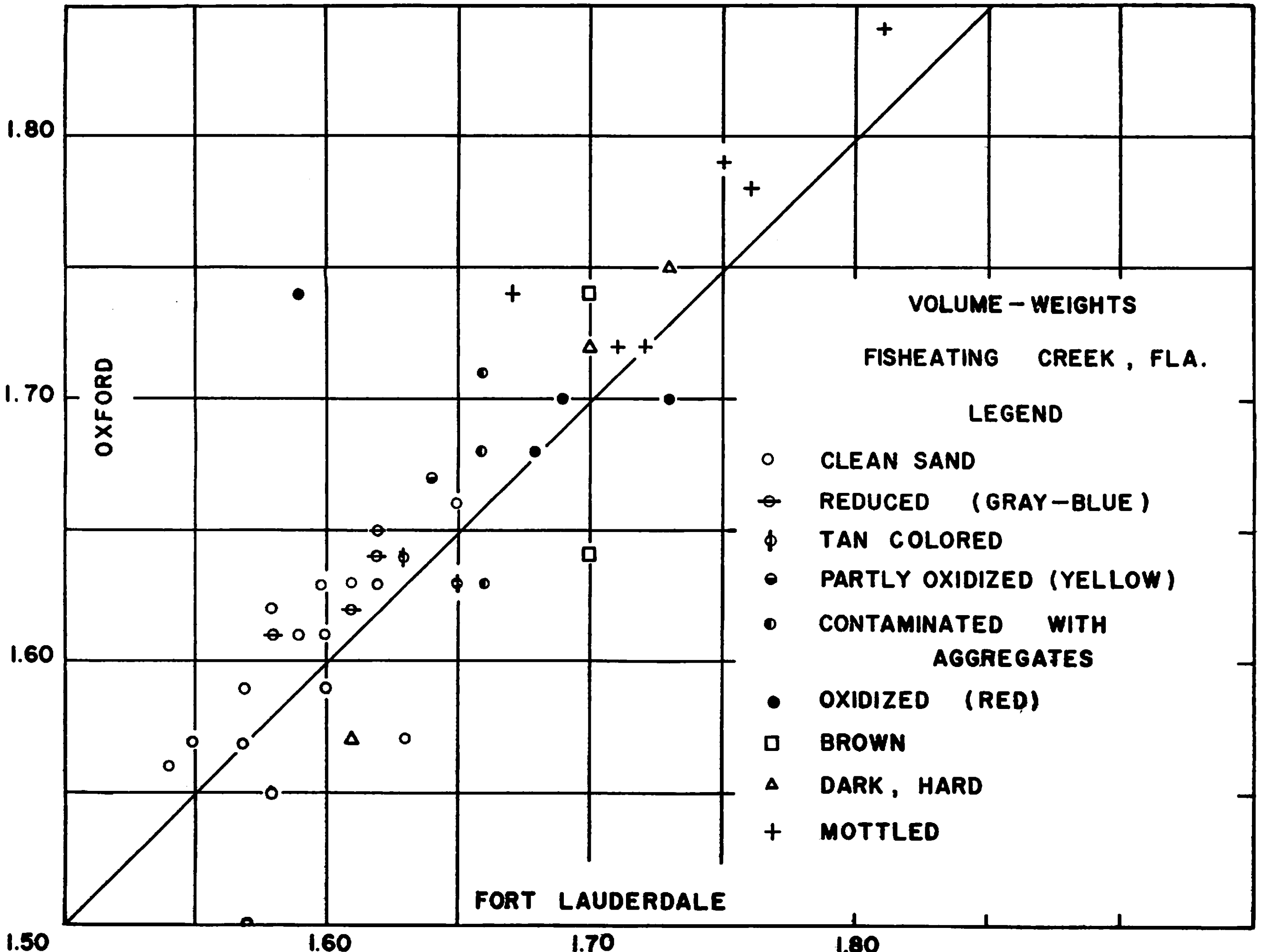
It may be noted that bulk density generally increases in a progression from clean sand through tinted to dark-colored and mottled materials.

PERMEABILITY

The permeabilities or hydraulic conductivities of the undisturbed samples are shown in Figure 5 as they varied with the silt and clay content. Permeability generally decreased with increasing silt and clay percentages.

MOISTURE CONTENT - TENSION RELATIONS

The low tension moisture characteristics of undisturbed samples from Fisheating Creek banks are shown in Figure 6. The desorption characteristics of disturbed samples are shown in Figure 7. Figures 6 and 7 were furnished by Mr. Ernie Stewart of the Fort Lauderdale station.



1.80
1.70
1.60
1.50
1.60
1.70
1.80
OXFORD
FORT LAUDERDALE
VOLUME – WEIGHTS
FISHEATING CREEK, FLA.
LEGEND
CLEAN SAND
REDUCED (GRAY–BLUE)
TAN COLORED
PARTLY OXIDIZED (YELLOW)
CONTAMINATED WITH AGGREGATES
OXIDIZED (RED)
BROWN
DARK, HARD
MOTTLED

FIGURE 4

FIGURE 5

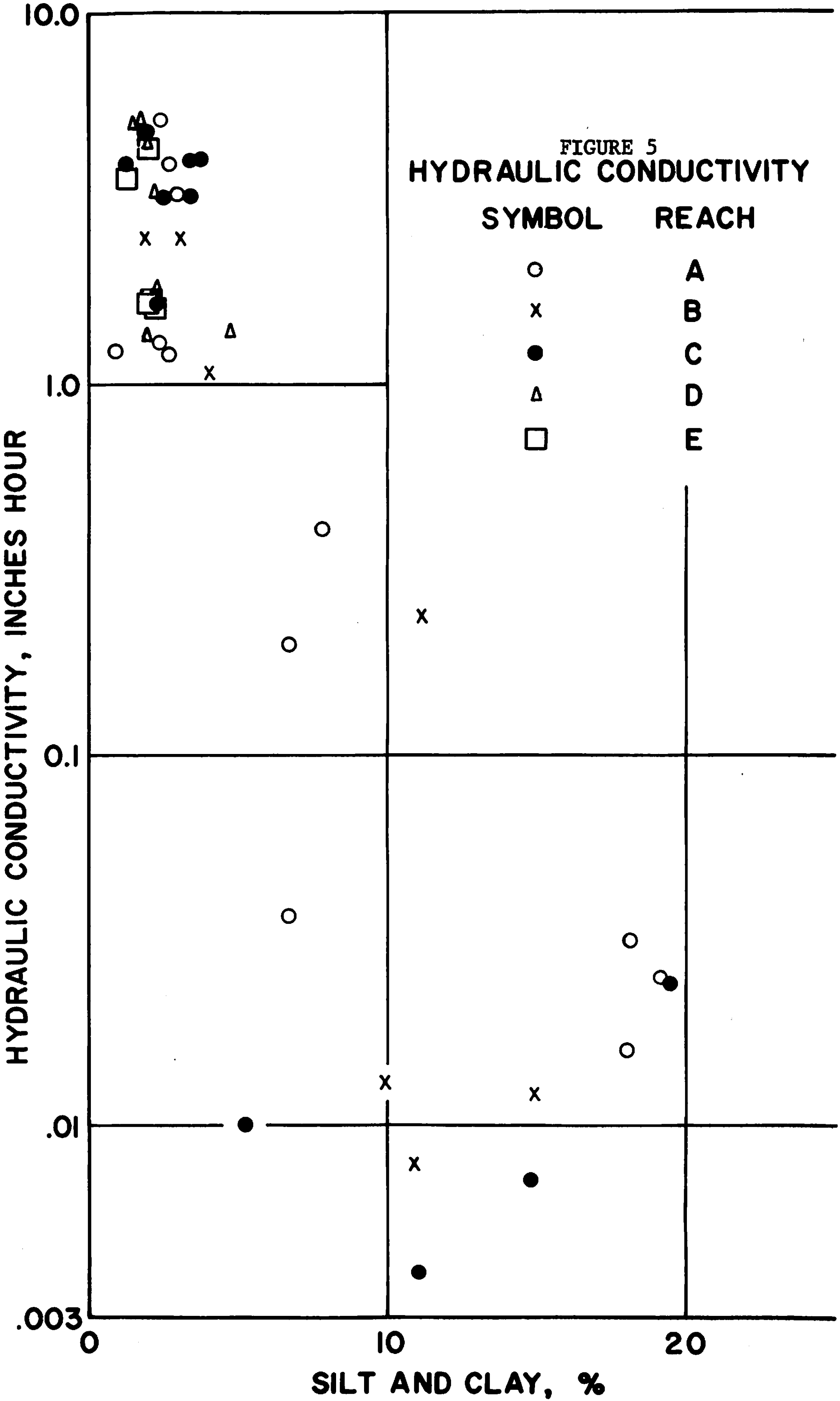

HYDRAULIC CONDUCTIVITY
SYMBOL REACH
○ A
x B
● C
Δ D
□ E
10.0
1.0
0.1
.01
.003
0
10
20
HYDRAULIC CONDUCTIVITY, INCHES HOUR
SILT AND CLAY, %

FIGURE 6. LOW TENSION MOISTURE CHARACTERISTICS OF UNDISTURBED SOIL SAMPLES FROM FISHEATING CREEK CHANNEL BANKS.

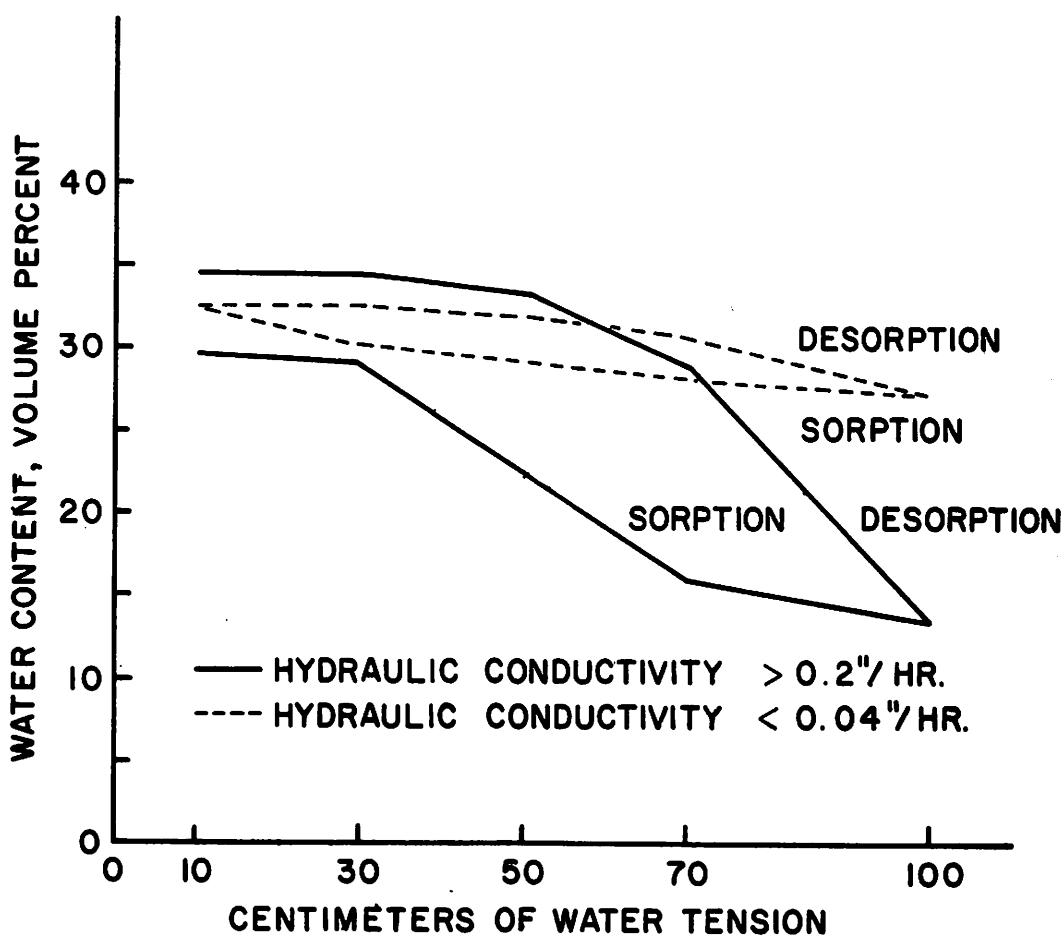
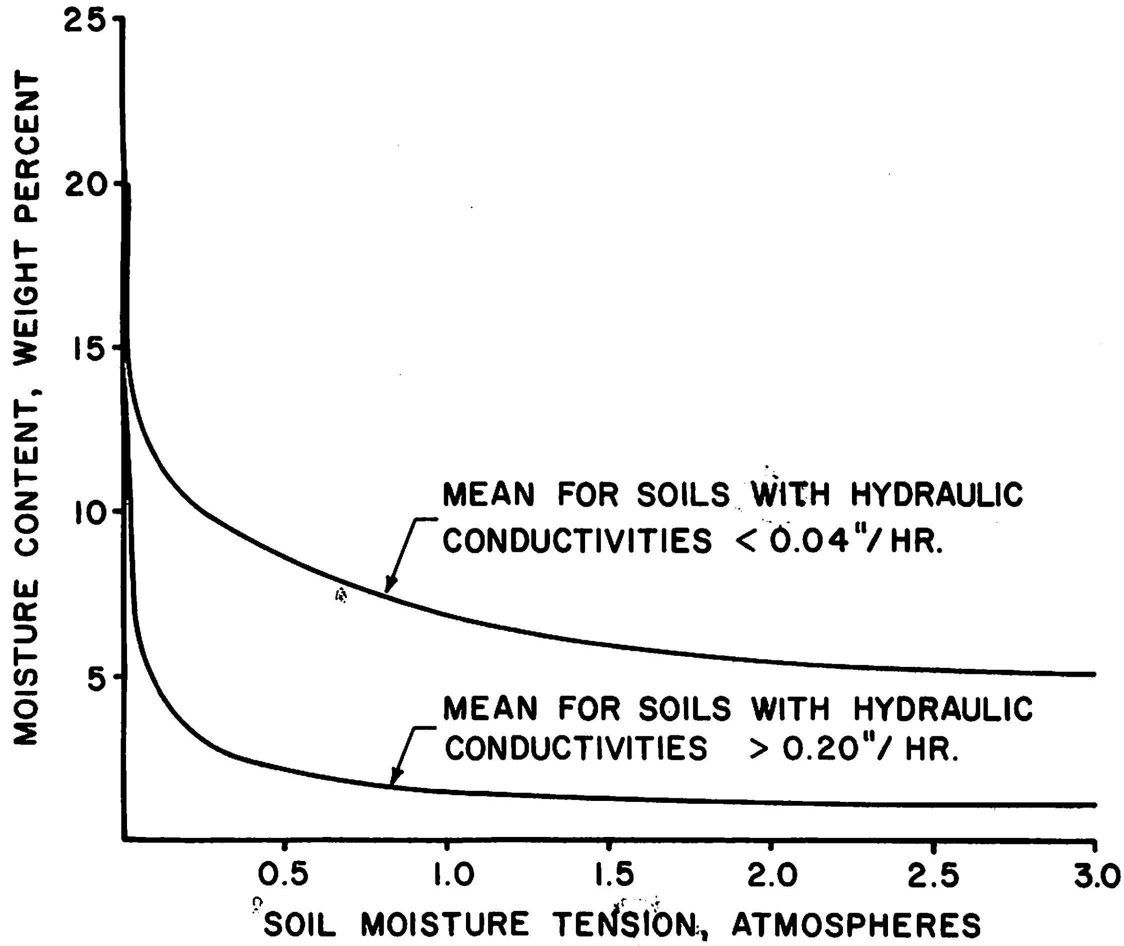


FIGURE 7. DESORPTION MOISTURE CHARACTERISTICS OF DISTURBED SOIL SAMPLES FROM FISHEATING CREEK CHANNEL BANKS.



WATER TABLE MEASUREMENTS

Two lines of ground water observation wells were established across the Taylor Creek valley and periodically read by the Fort Lauderdale station personnel. A description of the installations and a record of the ground water levels may be found in the Fort Lauderdale annual report for 1962.

FERTILIZER TRIALS

Comparisons between the fertilized and unfertilized reaches of the banks of Fisheating Creek revealed no positively detectable difference in vegetative cover. Observations were made in May 1962 and January 1963. This simply means that for the conditions in May 1961 when the fertilizer was put down, it is ineffective. All, of course, know that the results would have been different for different conditions.

CLAY vs. BANK STABILITY

Many days of digging, sampling and observing along Fisheating Creek, along with the surveyed cross sections of the channel, created some ability to recognize bank stability for the conditions or environment experienced by the channels. The mechanical analyses of the bank samples revealed that a clay content of as little as 5 percent was sufficient for stability under the hydraulic conditions involved.

VIBRATIONS

Speculation, expressed under the heading "Erosional Patterns" in the first report, about the reasons for the serrated condition of the upper edge of Fisheating Creek, included the thought that vibrations due to operation of the excavation equipment could be partially responsible. A recently received publication 3/ from Finland gives support to this notion. Bank failure in test pits were much more likely when dug by machine than when dug with hand shovels. Computed requisite factors of safety differed by 19 percent and 42 percent, depending upon the method of computation.

CROSS SECTIONS

Several channel cross sections in each of the five study reaches, A to E, inclusive, on Fisheating Creek are included in the Appendix. Shown are the channel conditions as planned, as built, and as found in May, 1961. A study of these helps to obtain a better knowledge of the processes involved in the channel changes.

Except for reach B, which in May 1961 was judged to have the most stable bank materials of the selected study reaches, there was obviously some difficulty with bank sloughing during construction. The "as built" cross sections show materially greater widths than

3/ "On Failures of Draining Channels by Sliding and on the Methods Employed for their Prevention". Soil and Hydrotechnical Investigations, No. 10. (Written in Finnish with English abstract.)

specified. Changes in channel size and shape between the final cross section survey following construction and those of May 1961 suggest several processes in operation.

Beginning with reach E on the south lateral, mid-channel bed elevations had increased from one-half to two feet. The banks had sloughed considerably but the cross sectional area of the sloughed bank was less than the area of deposits. Some erosion from the spoil banks plus wind-transported materials would account for the difference.

In reach D on the north lateral extension, there was very little bank sloughing between surveys. It may be remembered, incidentally, that no restricting layer was found in the bank within this reach. A considerable amount of deposition has occurred, however, which can be attributed principally to wind deposits and sediment contributions from an eroding tributary spur channel.

A material amount of bank sloughing occurred along reach C on the north lateral near Henscratch. The deposits within the channel appear to exceed the sloughed amounts considerably. Slopes of the berms suggest that some erosion of the spoil banks has gotten back into the channel.

Bed elevations within reach B were only slightly higher in May, 1961. The excess of the erosion due to a small amount of increase in width, along with a small amount of eroded material from the berm and spoil pile, was undoubtedly transported downstream by the flows in the channel.

Since in reach A of the main channel the bed elevations remained substantially the same, the large amounts of bank materials that sloughed into the channel, plus some from the spoil banks, had obviously been transported downstream by the flow.

HYDRAULIC LABORATORY STUDIES

Both visual and quantitative exploratory observations of the flowing sand phenomenon were made in the facility shown in Figures 8 and 9. A schematic representation of the apparatus and test conditions are presented in Figure 10. The window view in Figures 8 and 9 and the right end of the diagram of Figure 10 depict a cross section of one ditch bank and a portion of the channel.

Piezometers are placed within the sand of the bank at various distances from the channel, and are connected by tubing to the glass wells. The wells were temporarily filled with colored liquid for the photography of Figure 8. The elevation of the water in the wells corresponds with the water table position at the point of the piezometer in the sand. The position and slope of the phreatic surface, along with an analysis technique to eliminate the effect of the flow of water in the capillary fringe above the water table, were used in a determination of the sand permeability. It was determined to be about 0.01 cm. per sec. (14 ins. per hr.).

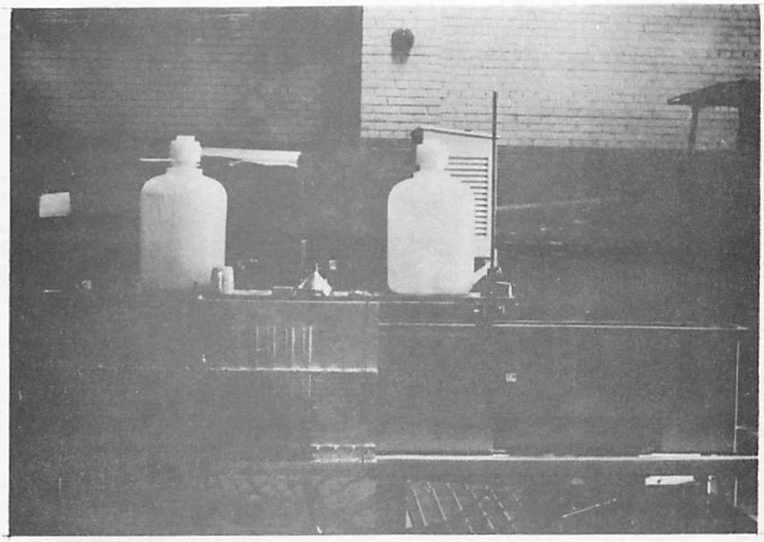


Figure 8.--29 Aug. '62, Time 28 hr. 45 min.

Florida Sand

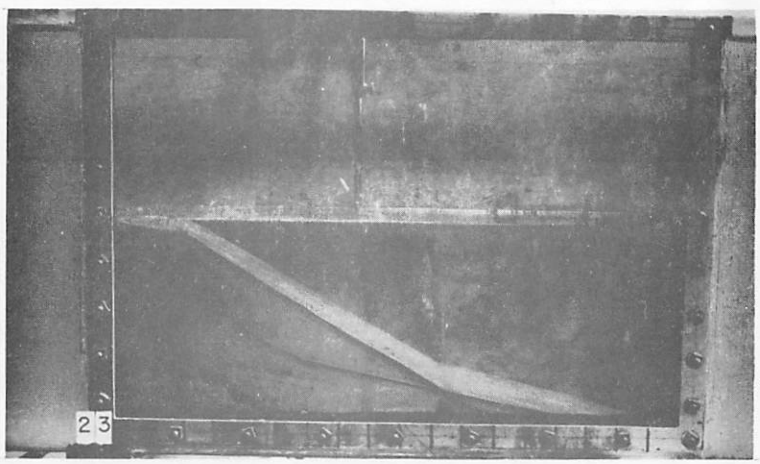
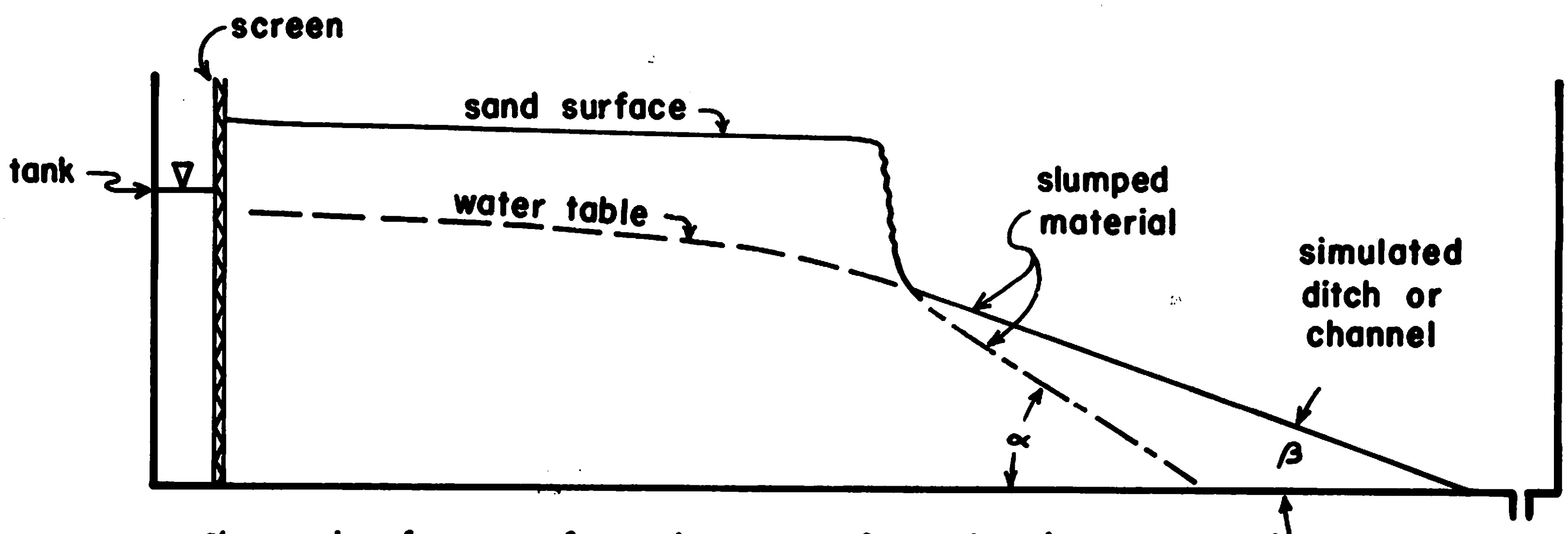


Figure 9.--30 Aug. '62, Time 49 hr. 45 min.

Florida Sand

FIGURE 10.-

LABORATORY REPRODUCTION OF FLOWING SAND PHENOMENON
(Schematic representation)



α = angle of repose for under water formation (mean = 29°)

β = angle of repose for formation in air (mean = 9°)

Vigorous vibration of the sand and water mass by repeated tapping on the tank produced in this model a rise in the water table just as treading a wet sand mass in the field had done. These vibrations presumably reorient many of the sand grains in a manner to reduce the voids within the mass.

Several series of observations were made of the sloughing and flowing sand into the "channel". Beginning with a dry ~~vertical~~ "ditch bank", a high water table was created at the left end of the tank. Water flowed through the sand to the "channel". In some cases, water was maintained at an appreciable depth in the channel. In other instances, the channel was kept drained down.

A watery mixture formed at the face of the bank below the intercept of the water table. This progressively forming layer of material flowed down the face to the bottom of the channel, forming a cavity in the ditch bank. The weight of the overhanging material in time caused failure of the upper part of the bank along a vertical plane, and slumping of a large mass of bank material into the hole below. This sequence is illustrated in Figures 11 to 16, inclusive. The flow of sand from the bank continued until the top of the wedge of slumped material, along the landward edge of the mass, was at about the elevation of the water table in the undisturbed bank.

This phenomenon required several days to occur in the laboratory tank. It is undoubtedly dependent upon the unavoidable vibrations that

Figure 11.--10 July @ 8:30 am. Start of run.

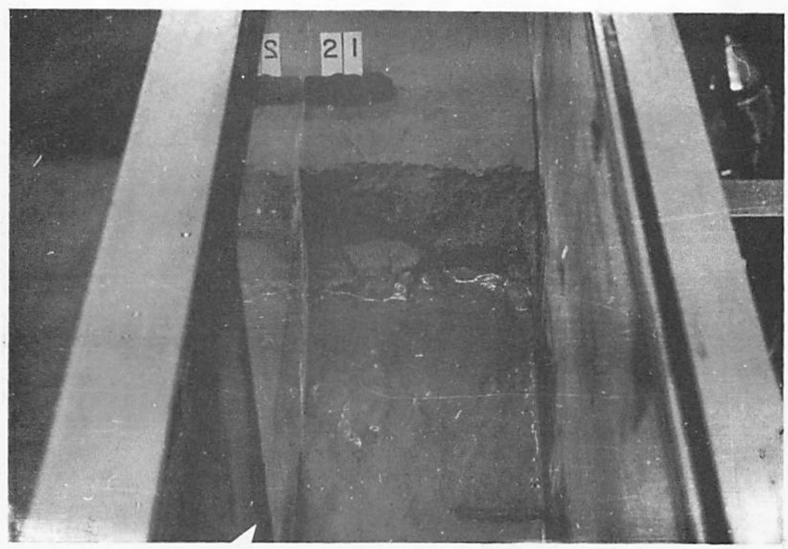


Figure 12.--12 July @ 5:00 pm. Time elapsed
56 hr. 30 min.

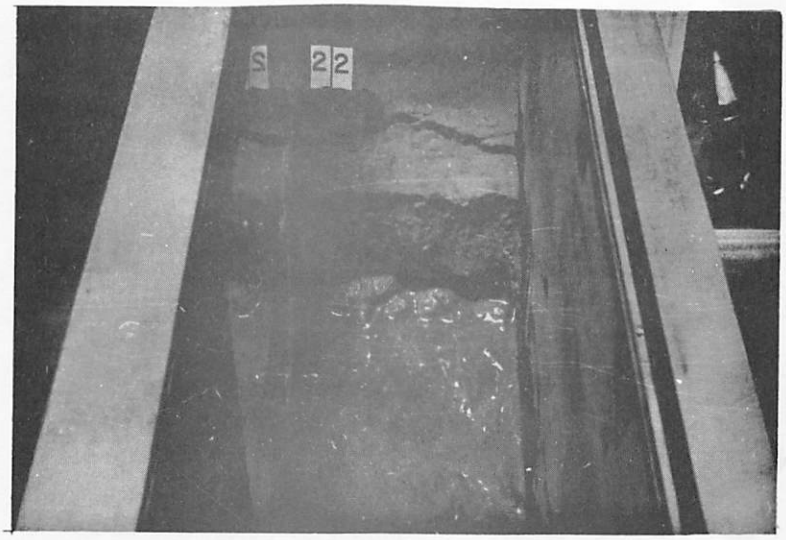


Figure 13.--12 July @ 8:00 pm. Time elapsed 59 hr. 30 min.

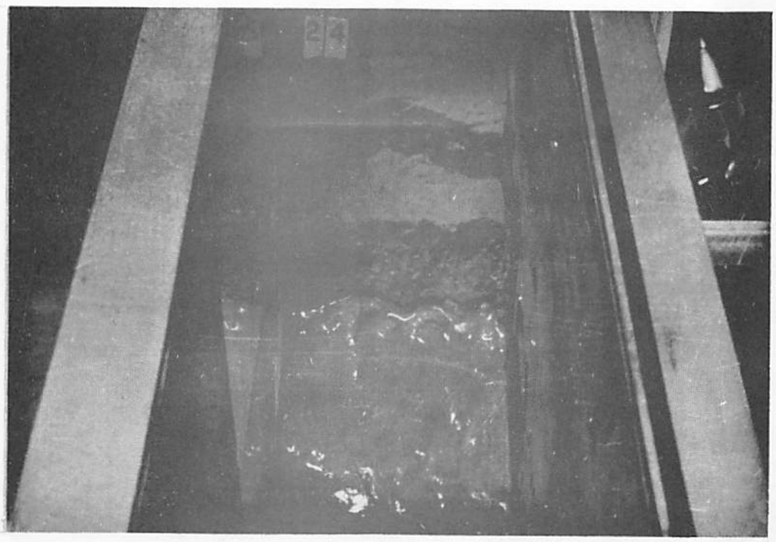


Figure 14.--13 July @ 9:30 am. Time elapsed 73 hr.

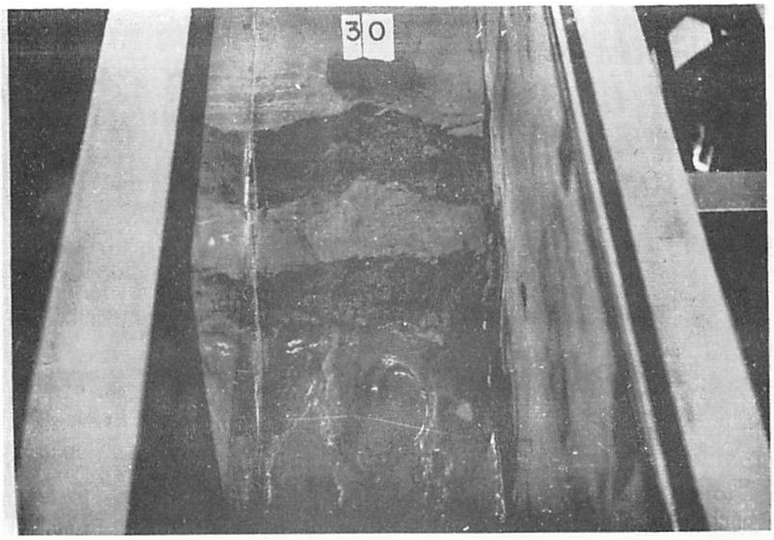


Figure 15.--17 July @ 8:00 pm. Time elapsed

116 hr. 30 min.

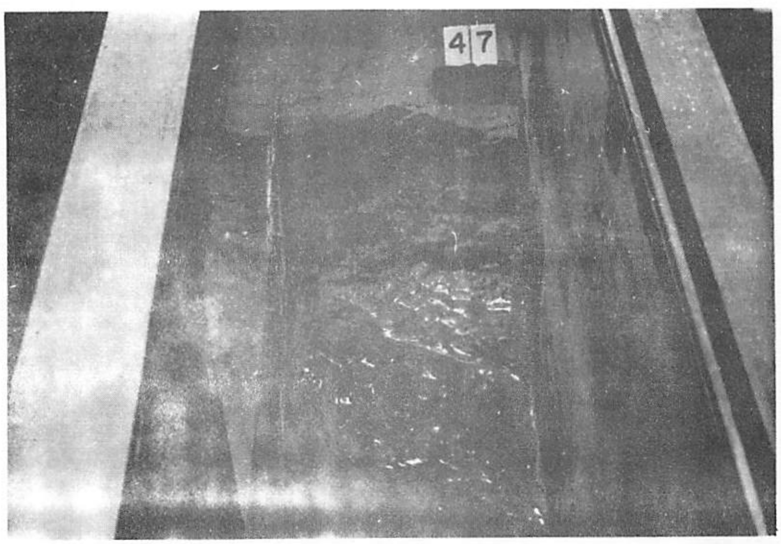


Figure 16.--25 July @ 4:00 pm. Time elapsed

266 hr.

occur in the building. Direct applicability to field channels is questionable because of this. On the other hand, we know that similar processes do occur in the field. The angles of repose of the slumped materials should be similar. Average values in the laboratory tests were 29° when the wedge of slumped material was formed under water; but only about 9° when it formed in air with the channel kept drained of water.

WORK TO BE DONE

Present thoughts about work yet to be done include:

(1) Observations of channel construction in Taylor Creek, north of Potter Road, where some difficulties have been anticipated;

(2) continuation of hydraulic laboratory studies of the flowing sand phenomenon;

(3) recross-sectioning of Fisheating Creek, if changes in cross section become apparent;

(4) completion of measurements on samples already obtained to determine particle shapes and clay mineral identifications;

(5) continue observations of dug channels with specific interest in all sedimentation and hydraulic problems involved.

APPENDIX

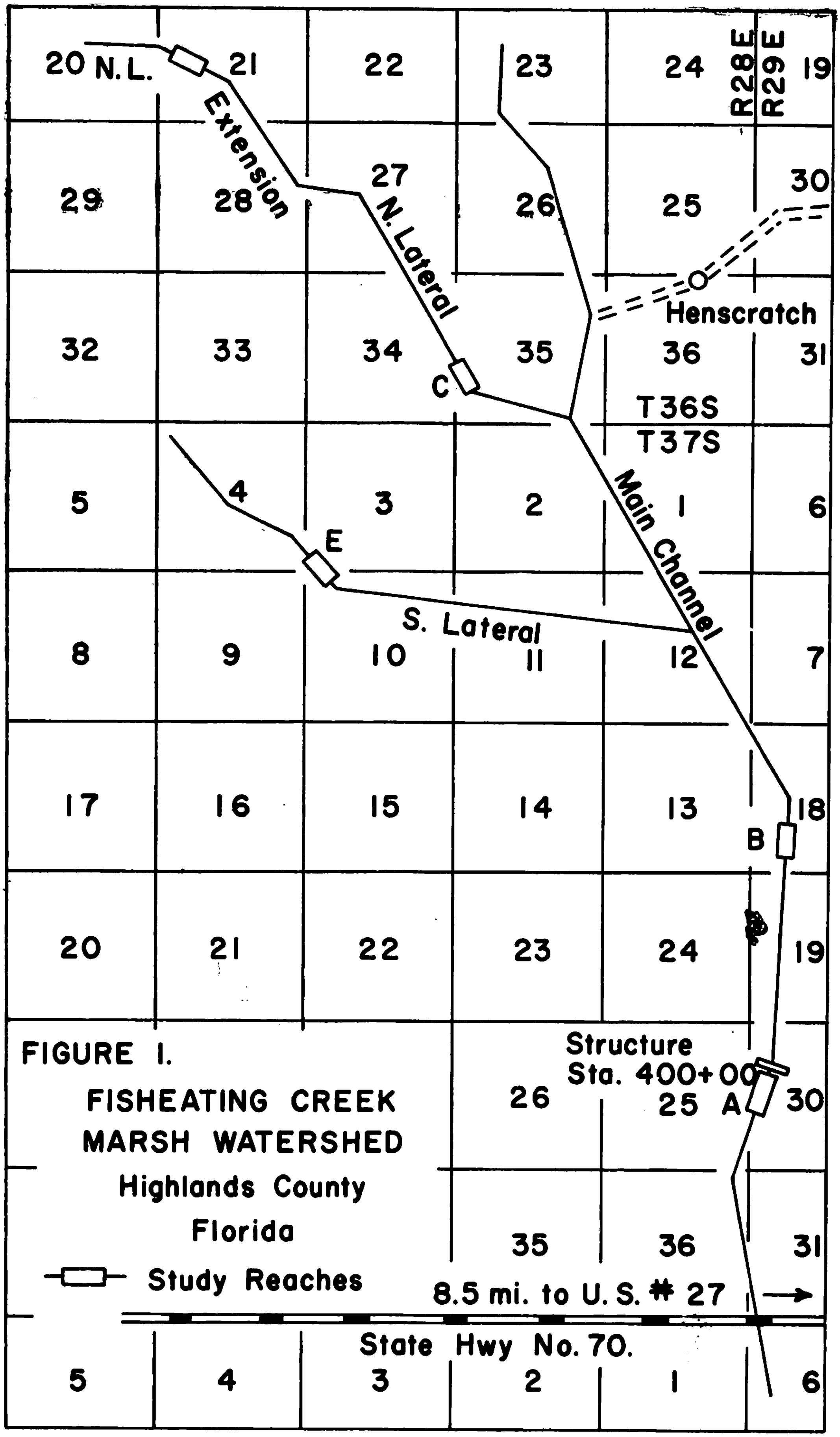


FIGURE I.

FISHEATING CREEK MARSH WATERSHED

Highlands County

Florida

SOIL PROFILE DESCRIPTIONS

Made by the Soil Conservation Service
and furnished by L. A. Jacobson
Area Conservationist, Sebring, Florida

CHANNEL REACH A (MAIN CHANNEL, BELOW STRUCTURE)

No. 1 SOUTH OF STRUCTURE

0- 4"	Dark gray (10YR4/1) fine sand; single grain; loose; boundary abrupt and smooth.
4-12"	Light gray (10YR6/1) fine sand; single grain; loose; medium acid; boundary gradual and smooth.
12-20"	Pale brown (10YR6/3) fine sand; single grain; loose; slightly acid; boundary gradual and smooth.
20-28"	Yellow (10YR7/6) fine sand; single grain; loose; neutral; many, distinct, medium, yellowish brown (10YR5/6) mottles; boundary gradual and smooth,
28-60"+	Light gray (10YR7/2) fine sand; single grain; very friable; neutral; many, distinct, medium, yellowish brown (10YR5/6) mottles.

CHANNEL REACH A (MAIN CHANNEL, BELOW STRUCTURE)

No. 2 SOUTH OF STRUCTURE

0- 2"	Very dark gray (10YR3/1) fine sand; single grain; very friable; very strongly acid; boundary clear and smooth.
2- 7"	Light gray (10YR7/2) fine sand; single grain; loose; medium acid; few, distinct, medium, dark yellowish brown (10YR4/4) mottlings; boundary gradual and smooth.
7-13"	Gray (10YR6/1) fine sand; single grain; loose; medium acid; boundary gradual and smooth.
13-18"	Pale brown (10YR6/3) fine sand; single grain; loose; slightly acid; boundary gradual and smooth.
18-46"	Yellow (10YR8/6) fine sand; single grain; loose; slightly acid to neutral; few, prominent, coarse, yellowish red (5YR4/6) mottles; boundary gradual and smooth.
46-60"	White (10YR7/1) fine sand; single grain; loose; slightly acid to neutral; few, prominent, coarse, brownish yellow (10YR6/6) mottles; boundary diffuse and wavy.
60"+	Light grayish brown (10YR6/2) fine sandy clay loam; massive; friable; neutral; common, prominent, medium, dark brown (7.5YR4/4) mottles.

No. 3 SOUTH OF STRUCTURE

0- 2"	Gray 10YR4/1) fine sand; single grain; loose; very strongly acid; boundary clear and smooth.
2- 8"	Light gray (10YR7/2) fine sand; single grain; loose; medium acid; boundary gradual and smooth.
8-16"	Pale brown (10YR7/3) fine sand; single grain; loose; medium acid; boundary clear and smooth.
16-27"	Yellow (10YR8/6) fine sand; single grain; loose; neutral; few, prominent, coarse, strong brown (7.5YR5/6) mottles; boundary gradual and smooth.
27-34"	Strong brown (7.5 YR5/6) fine sand; single grain; very friable; few iron concretions; boundary gradual and smooth.
34-45"+	Very pale brown (10YR8/3) fine sand; single grain; loose; neutral.

CHANNEL REACH B (MAIN CHANNEL, ABOVE STRUCTURE)

No. 1 NORTH OF STRUCTURE

0- 3"	Black (10YR2/1) fine sand; single grain; loose; high organic material; strongly acid; boundary clear and smooth.
3- 6"	Gray (10YR5/1) fine sand; single grain; loose; strongly acid; boundary gradual and wavy.
6-12"	Light gray (10YR6/1) fine sand; single grain; loose; medium acid; boundary gradual and smooth.
12-30"	Very pale brown (10YR7/4) fine sand; single grain; loose; slightly acid; few, prominent, medium, yellowish brown (10YR5/6) mottles; boundary abrupt and smooth.
30-49"	Grayish brown (10YR5/2) fine sandy loam; massive; very friable; strongly acid; many, distinct, medium, dark brown (7.5YR4/4) mottles; boundary diffuse and smooth.
49-60"+	Gray (10YR5/1) fine sandy loam; massive; very friable; many, distinct, medium, yellowish brown (10YR5/6) mottles.

No. 2. NORTH OF STRUCTURE

0- 3"	Black (10YR2/1) fine sand; single grain; very friable; high organic content; boundary clear and smooth.
3-12"	Gray (10YR5/1) fine sand; single grain; loose; strongly acid; boundary gradual and smooth.
12-16"	Grayish brown (10YR5/2) fine sand; single grain; loose; neutral; boundary gradual and smooth.
16-25"	Light yellowish brown (10YR6/4) fine sand; single grain; loose; neutral; boundary clear and smooth.
25-49"	Grayish brown (10YR5/2) fine sandy loam; massive; very friable; medium acid; many, prominent, fine, dark yellowish brown (10YR3/4) mottles; boundary gradual and wavy.
49-60"+	Very dark gray (10YR3/1) fine sandy loam; massive; very friable; strongly acid; many, distinct, medium, grayish brown (10YR5/2) mottles.

CHANNEL REACH C (NORTH LATERAL NEAR HENSCRATCH)

No. 1 SOUTH OF LOG BRIDGE

0- 2"	Grayish brown (10YR5/2) fine sand; single grain; loose; medium acid; boundary abrupt and smooth.
2- 7"	Gray (10YR6/1) fine sand; single grain; loose; medium acid; boundary gradual and smooth.
7-15"	Light brownish gray (10YR6/2) fine sand; single grain; loose; slightly acid; boundary gradual and smooth.
15-27"	Very pale brown (10YR7/3) fine sand; single grain; loose; slightly acid; boundary gradual and smooth.
27-35"	Yellowish brown (10YR5/8) fine sand; single grain; loose; neutral; boundary gradual and smooth.
35-44"	Grayish brown (10YR5/2) fine sandy clay loam; massive; very friable; neutral; common, distinct, medium, strong brown (7.5 YR5/8) mottles; boundary diffuse and smooth.
44-60"+	Very dark gray (10YR3/1) fine sandy clay loam; massive; very friable; neutral; common, distinct, coarse, dark brown (10YR3/4) mottles.

No. 2 SOUTH OF LOG BRIDGE

0- 1"	Grayish brown (10YR5/2) fine sand; single grain; loose; medium acid; boundary abrupt and smooth.
1-18"	Pale brown (10YR6/3) fine sand; single grain; loose; medium acid; boundary diffuse and smooth.
18-26"	Yellow (10YR7/6) fine sand; single grain; loose; neutral; boundary abrupt and smooth.
26-33"	Brownish yellow (10YR5/8) fine sand; single grain; loose; neutral; boundary abrupt and smooth.
33-43"	Dark gray (10YR4/1) fine sandy loam; massive; very friable; boundary diffuse and smooth.
43-60"+	Very dark gray (10YR3/1) fine sandy clay loam; massive; very friable; neutral; few, distinct, medium, dark yellowish brown (10YR4/4) mottles.

CHANNEL REACH D (NORTH LATERAL EXTENSION)

STATION 19 + 72

0--2"	Gray (10YR5/1) fine sand; single grain; loose; medium acid; boundary clear and smooth.
2- 6"	Light gray (10YR7/1) fine sand; single grain; loose; slightly acid; boundary gradual and smooth.
6-18"	Very pale brown (10YR7/3) fine sand; single grain; loose; slightly acid to neutral; boundary gradual and smooth.
18-35"	Yellow (10YR7/8) fine sand; single grain; loose; slightly acid to neutral; boundary gradual and wavy.
35-48"+	Light brownish gray (10YR6/2) fine sand; single grain; loose; neutral.

STATION 20 + 21

0- 4"	Light gray (10 YR7/2) fine sand; single grain; loose; slightly acid to neutral; boundary gradual and smooth.
4-20"	Pinkish white (7.5YR8/2) fine sand; single grain; loose; neutral; boundary gradual and smooth.
20-25"	Yellowish brown (10YR5/8) fine sand; single grain; very friable; neutral; boundary gradual and smooth.
25-40"+	Pale brown (10YR6/3) fine sand; single grain; loose; neutral.

CHANNEL REACH E (SOUTH LATERAL)

STATION 167 + 19

0- 3"	Black (10YR2/1) fine sand; single grain; loose; slightly acid; high organic content; boundary clear and smooth.
3- 8"	Gray (10YR5/1) fine sand; single grain; loose; slightly acid; boundary clear and smooth.
8-22"	Light gray (10YR7/1) fine sand; single grain; loose; slightly acid to neutral; boundary gradual and smooth.
22-36"	Grayish brown (10YR5/2) fine sand; few, distinct, medium, very dark grayish brown (10YR3/2) mottles; single grain; loose; neutral; boundary diffuse and smooth.
36-48"	Dark grayish brown (10YR4/2) fine sand; many, distinct, coarse, very dark brown (10YR2/2) mottles; single grain; loose; neutral.

STATION 166 + 36

0- 3"	Black (N 2/0) muck; boundary abrupt and smooth.
3- 7"	Light brownish gray (10YR6/2) fine sand; single grain; loose; slightly acid; boundary clear and smooth.
7-25"	Light gray (10YR7/1) fine sand; single grain; loose; slightly acid; boundary diffuse and smooth.
25-40"+	Grayish brown (10YR5/2) fine sand; single grain; loose; slightly acid.

Table 1.--Some Physical and Moisture Data of Undisturbed Soil Core Samples from Fisheating Creek Channel Banks.

Station	Station Sample No.	Sample Elev.	Bulk Density	Hydraulic Conduc.	Total Pores	Water Content at Respective Tensions				
						Desorption			Sorption	
						10 cm.	50 cm.	100 cm.	50 cm.	10 cm.
		Ft.MSL	Gm/cm^3	In./hr.	Vol.%	Vol.%	Vol.%	Vol.%	Vol.%	Vol.%
					Channel A					
400+85	4	83.40	1.63	3.92	38.5	33.9	31.6	9.5	19.3	32.2
	3	82.76	1.73	0.037	34.7	30.5	29.6	20.1	25.3	30.8
	2	80.98	1.57	1.30	40.8	32.8	31.6	12.9	22.2	30.2
	1	79.82	1.81	0.016	31.7	28.5	27.6	26.5	27.0	29.9
403+50	4	83.31	1.60	3.26	39.6	35.1	31.9	10.6	19.9	32.5
	3	81.86	1.65	0.20	37.7	31.4	29.6	14.4	21.9	30.8
	2	79.58	1.76	0.025	33.6	29.9	29.3	27.6	28.8	31.4
	1	77.87	1.58	1.21	40.4	37.7	36.8	11.2	22.7	34.2
406+90	4	84.11	1.60	5.18	39.6	36.0	33.7	10.1	18.7	31.6
	3	81.85	1.68	0.41	36.6	33.4	30.8	13.2	21.0	31.4
	2	79.14	1.75	0.032	34.0	31.4	31.1	25.9	27.9	31.1
	1	76.97	1.66	1.22	37.4	34.8	30.5	10.9	14.7	30.8
					Channel B					
322+77	4	83.29	1.58	2.50	40.4	34.5	32.5	10.4	19.9	32.5
	3	82.62	1.70	0.024	35.8	29.3	29.3	23.6	26.5	29.3
	2	81.67	1.67	0.008	37.0	33.4	32.2	21.3	26.2	31.6
	1	80.08	1.73	0	34.7	31.6	31.4	27.9	29.1	30.5
324+03	4	83.72	1.63	2.50	38.5	32.5	31.4	8.9	17.8	29.3
	3	81.82	1.70	0.012	35.8	31.6	31.1	24.7	27.6	30.8
	2	81.15	1.60	1.06	39.6	33.1	32.2	14.1	21.3	31.9
	1	79.52	1.70	0.013	35.8	32.8	32.5	29.6	30.8	32.8
					Channel C					
192+68	3	84.62	1.59	4.79	40.0	34.5	34.2	12.7	25.6	31.9
	2	83.81	1.61	4.08	39.2	35.7	35.7	10.4	23.3	32.2
	1	82.88	1.72	0.007	35.1	30.5	29.9	28.5	29.1	30.5
197+30	4	85.16	1.54	4.02	41.9	33.7	32.8	10.4	21.9	31.4
	3	83.90	1.59	0.010	40.0	43.7	43.7	33.1	38.0	42.9
	2	83.05	1.71	0.004	35.5	31.9	31.6	30.8	31.6	33.1
	1	81.56	1.61	0.024	39.2	37.4	37.1	35.1	36.5	38.0

Table 1.--(Continued)

Station	Station Sample No.	Sample Elev.	Bulk Density	Hydraulic Conduc.	Total Pores	Water Content at Respective Tensions: Desorption 10 cm.	Desorption 50 cm.	Desorption 100 cm.	Sorption 50 cm.	Sorption 10 cm.
		Ft.MSL	Gm/cm^3	In./hr.	Vol.%	Vol.%	Vol.%	Vol.%	Vol.%	Vol.%
				Channel C (Cont'd)						
197+89	4	85.02	1.57	3.21	40.8	36.3	35.4	14.7	25.0	33.1
	3	84.14	1.62	3.32	38.9	35.1	34.2	13.2	23.0	33.1
	2	83.17	1.57	1.62	40.8	37.1	36.2	17.5	27.0	33.4
	1	81.36	1.65	3.99	37.7	35.7	35.1	10.6	23.6	32.8
				Channel D						
19+72	4	87.28	1.55	4.53	41.5	34.2	33.1	11.8	22.7	32.5
	3	86.49	1.64	5.18	38.1	34.8	34.5	12.9	25.9	31.6
	2	85.50	1.66	3.26	37.4	34.8	34.5	16.4	26.2	31.6
	1	84.72	No sample	-	-	-	-	-	-	-
20+21	4	87.46	1.60	5.01	39.6	35.1	34.5	13.2	23.9	33.1
	3	86.56	1.69	1.37	36.2	33.9	33.9	17.8	27.3	31.4
	2	86.12	1.66	1.34	37.4	34.2	33.9	19.0	26.8	31.4
	1	85.30	1.66	1.83	37.4	34.2	33.7	15.0	26.2	31.4
				Channel E						
166+36	3	86.31	1.62	3.58	38.9	31.9	31.9	21.0	24.7	30.8
	2	84.96	1.62	1.64	38.9	36.3	36.0	13.8	20.4	31.6
	1	83.32	No sample	-	-	-	-	-	-	-
167+19	3	86.72	1.61	4.42	39.2	33.4	33.4	11.8	22.4	31.6
	2	85.40	1.61	1.62	39.2	33.9	33.7	16.7	20.7	29.9
	1	83.60	1.58	1.64	40.4	38.0	37.7	13.2	22.9	31.9

Table 2.--Moisture Characteristic Data of Disturbed and Undisturbed Soil Samples from Fisheating Creek Channel Banks.

Station	Station Sample No.	Sample Elevation	Water Content at Respective Tensions 1/				
			30 cm.	70 cm.	100 cm.	300 cm.	3100 cm.
				Channel A			
400+85	4	83.40	20.5	14.3	5.83	1.95	1.12
	3	82.76	17.6	14.8	11.6	4.04	1.63
	2	80.98	20.5	18.5	8.24	2.32	0.92
	1	79.82	15.8	15.3	14.6	11.5	6.56
403+50	4	83.31	21.4	14.2	6.64	2.29	0.75
	3	81.86	19.0	14.8	8.71	4.70	1.32
	2	79.58	17.0	16.5	15.7	14.8	7.12
	1	77.87	23.4	20.5	7.07	11.2	2.85
406+90	4	84.11	22.3	14.7	6.29	2.45	1.48
	3	81.85	19.6	14.6	7.89	3.11	1.25
	2	79.14	17.9	16.9	14.8	8.50	5.08
	1	76.97	19.4	13.8	5.36	2.68	1.22
				Channel B			
322+77	4	83.29	21.5	14.4	6.54	2.15	1.18
	3	82.62	17.2	16.6	13.8	9.32	5.60
	2	81.67	19.9	16.8	12.7	5.25	2.88
	1	80.08	18.3	17.6	16.1	9.50	5.11
324+03	4	83.72	19.8	14.1	5.47	2.51	1.12
	3	81.82	18.6	17.3	14.6	8.95	5.28
	2	81.15	20.6	16.3	8.80	2.77	1.00
	1	79.52	19.3	19.1	17.4	9.65	4.52
				Channel C			
192+68	3	84.62	21.7	20.2	7.96	2.68	1.54
	2	83.81	21.7	21.0	6.42	2.38	1.37
	1	82.88	17.7	17.2	16.6	13.5	7.16
197+30	4	85.16	21.9	16.4	6.73	2.66	1.92
	3	83.90	27.5	25.9	20.8	5.27	2.16
	2	83.05	18.7	18.7	18.0	11.5	6.17
	1	81.56	23.2	23.0	21.7	13.1	6.68

1/ Soil samples with 30, 70 and 100 cm. tensions were undisturbed; 300 and 3100 cm. tension samples were disturbed.

Table 2.--(Continued)

Station	Station Sample No.	Sample Elevation	Water Content at Respective Tensions 1/ 30 cm.	70 cm.	100 cm.	300 cm.	3100 cm.
			Channel C (Cont'd.)				
197+89	4	85.02	22.9	20.3	9.34	3.32	0.62
	3	84.14	21.7	18.0	8.18	4.14	0.78
	2	83.17	23.5	22.2	11.2	3.47	0.82
	1	81.36	21.5	20.6	6.47	1.84	0.71
			Channel D				
19+72	4	87.28	22.0	17.2	7.59	2.61	1.42
	3	86.49	21.2	20.5	7.88	2.11	0.67
	2	85.50	21.0	20.5	9.90	2.18	0.57
	1	84.72	No sample				
20+21	4	87.46	21.8	18.7	8.28	2.10	1.03
	3	86.56	20.1	19.4	10.6	4.78	1.28
	2	86.12	20.6	20.2	11.4	2.39	0.63
	1	85.30	20.7	20.1	9.03	2.50	0.69
			Channel E				
166+36	3	86.31	19.7	17.2	13.0	2.32	0.95
	2	84.96	22.3	21.1	8.51	2.86	1.10
	1	83.32	No sample				
167+19	3	86.72	20.7	17.1	7.32	2.21	1.31
	2	85.40	21.0	18.9	10.3	2.58	1.33
	1	83.60	24.0	22.8	8.38	2.45	1.14

1/ Soil samples with 30, 70 and 100 cm. tensions were undisturbed; 300 and 3100 cm. tension samples were disturbed.

Table 3.--Volume-Weight Determinations

Station		Volume Wgt. (gms. cc)
400 + 85	Bed	1.59
	1	1.84
	2	1.50
	3	1.70
	4	1.57
403 + 50	Bed	1.58
	1	1.62
	2	1.78
	3	1.63
	4	1.61
406 + 90	Bed	1.63
	1	1.63
	2	1.79
	3	1.68
	4	1.63
322 + 77	Bed	1.62
	1	1.75
	2	1.74
	3	1.64
	4	1.55
324 + 03	Bed	1.73
	1	1.72
	2	1.59
	3	1.74
	4	1.64
192 + 68	Bed	1.65
	1	1.72
	2	1.63
	3	1.61
197 + 30	Bed	1.66
	1	1.57
	2	1.72
	3	1.74
	4	1.56

Station		Volume Wgt. (gms. cc)
197 + 89	Bed	1.62
	1	1.66
	2	1.57
	3	1.63
	4	1.59
19 + 72	Bed	1.66
	1	1.71
	2	1.71
	3	1.67
	4	1.57
20 + 21	Bed	1.61
	1	1.68
	2	1.68
	3	1.70
	4	1.61
166 + 36	Bed	1.59
	1	1.65
	2	1.64
	3	1.65
167 + 19	Bed	1.57
	1	1.61
	2	1.63
	3	1.62

Table 4.--Mechanical Analysis of Channel Bank Materials, Fisheating Creek, Florida, May, 1961.

Station	Sample No.	% Sand Larger .500mm	% Sand .500mm to .250mm	% Sand .250mm to .177mm	% Sand 0.177mm to 0.125mm	% Sand 0.125mm to 0.105mm	% Sand 0.105mm to 0.088mm	% Sand 0.088mm to 0.062mm	% Sand 0.062mm to 0.050mm	% Sand	% Silt 0.050mm to 0.002mm	% Clay Less than 0.002mm
						CHANNEL REACH A (BELOW STRUCTURE)						
400 + 85	Bed	0.2	4.7	5.4	35.9	19.7	18.6	11.4	1.3	97.2	0.7	1.4
Rt. Bank	1	0.3	4.9	7.4	26.6	17.6	15.5	8.3	1.2	81.8	4.1	14.7
	2	0.5	8.1	6.9	34.7	19.9	16.5	9.4	1.4	97.4	0.5	1.9
	3	0.6	9.9	7.0	27.8	19.5	17.9	10.8	1.2	94.9	2.8	3.9
	4	0.4	6.9	6.2	31.8	20.7	20.1	10.8	1.4	98.6	1.0	1.6
403 + 50	Bed	0.1	2.6	3.7	37.9	19.7	21.1	11.1	1.4	97.6	0.9	1.2
Rt. Bank	1	0.5	6.2	6.7	34.8	21.1	19.0	9.3	0.8	98.3	1.6	1.1
	2	0.4	4.9	6.2	31.9	16.6	15.8	5.9	0.5	82.1	1.5	17.6
	3	0.4	8.1	6.2	31.9	18.1	18.6	9.7	1.4	94.4	1.2	5.5
	4	0.5	7.6	6.4	37.0	16.5	19.0	9.8	1.3	98.3	1.2	1.8
406 + 90	Bed	0.3	3.3	3.4	31.2	13.4	26.7	15.1	1.9	97.9	0.4	1.9
Rt. Bank	1	0.1	6.0	11.3	45.5	17.0	12.5	5.1	0.3	98.0	0.3	0.6
	2	0.1	3.9	4.6	24.9	19.5	18.8	9.1	1.1	82.5	2.4	15.8
	3	0.5	7.7	6.0	29.8	18.9	18.5	10.9	1.5	93.8	2.6	5.2
	4	0.4	6.2	5.8	30.7	20.9	20.6	12.9	1.5	99.1	0.5	1.9
						CHANNEL REACH B (MAIN CHANNEL, ABOVE STRUCTURE)						
322 + 77	Bed	0.5	7.3	5.1	25.0	24.6	21.9	12.3	1.5	98.4	0.6	1.0
Rt. Bank	1	0.2	3.4	3.5	20.2	23.2	22.3	14.9	2.4	90.2	0.9	7.7
	2	0.2	5.1	4.3	21.7	21.2	18.8	12.4	1.8	85.8	2.8	8.2
	3	0.2	6.5	5.1	21.6	20.6	20.0	12.7	1.6	88.4	1.8	9.4
	4	0.3	6.8	5.1	28.2	20.8	21.3	12.8	1.8	97.2	1.6	1.6
324 + 03	Bed	0.1	3.7	4.2	29.6	23.2	22.7	12.5	1.4	97.6	2.0	1.6
Rt. Bank	1	0.1	1.8	2.5	19.5	23.1	23.8	14.9	2.4	98.3	2.3	7.4
	2	0.3	5.6	4.5	32.5	18.1	21.9	11.9	1.3	96.1	1.8	2.2
	3	0.4	5.9	4.5	19.6	19.8	19.4	12.7	2.0	84.5	1.4	13.5
	4	0.3	6.9	5.2	30.2	21.2	19.9	13.2	1.3	98.2	0.1	6.0

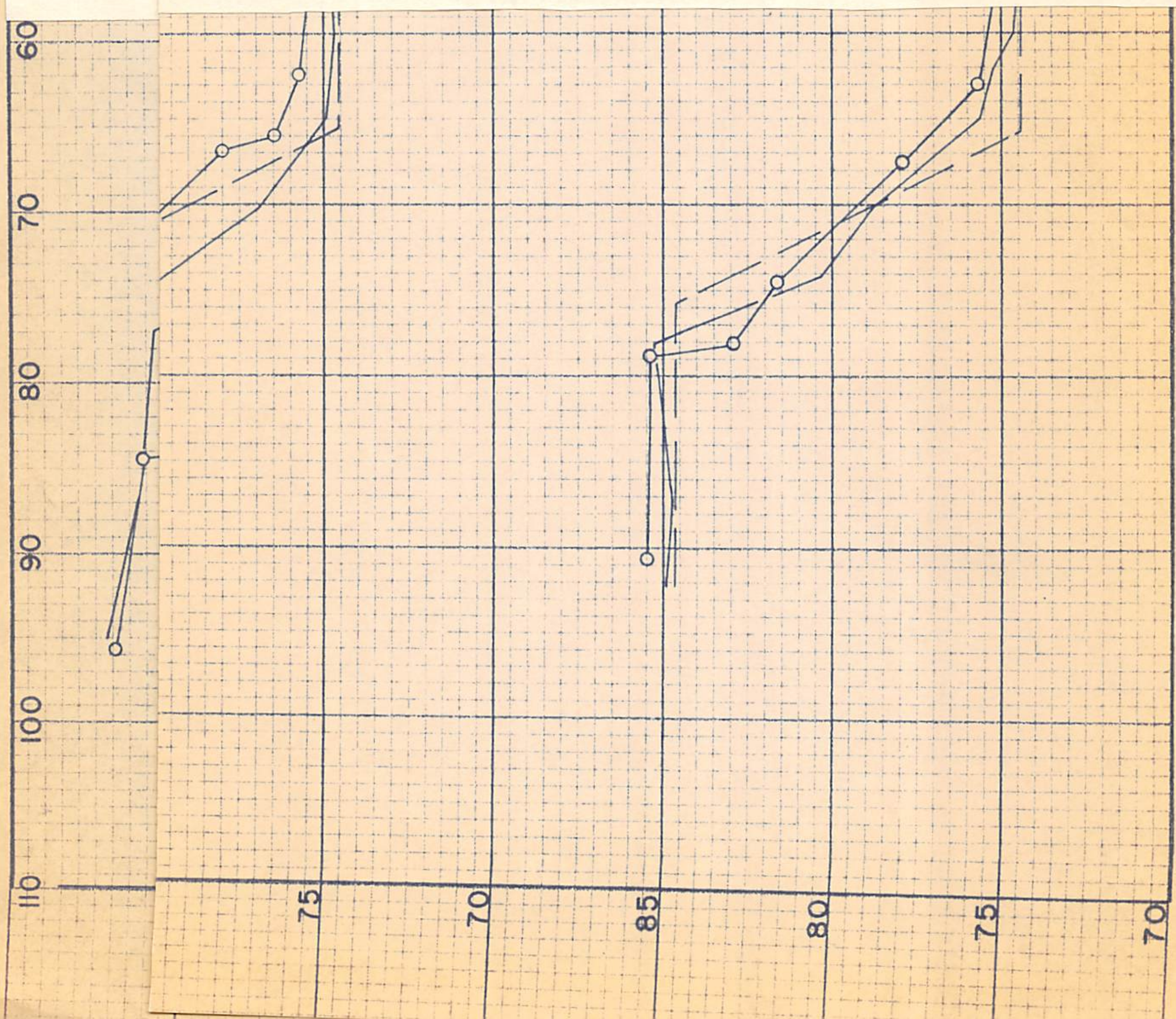
Table 4.--(Continued)

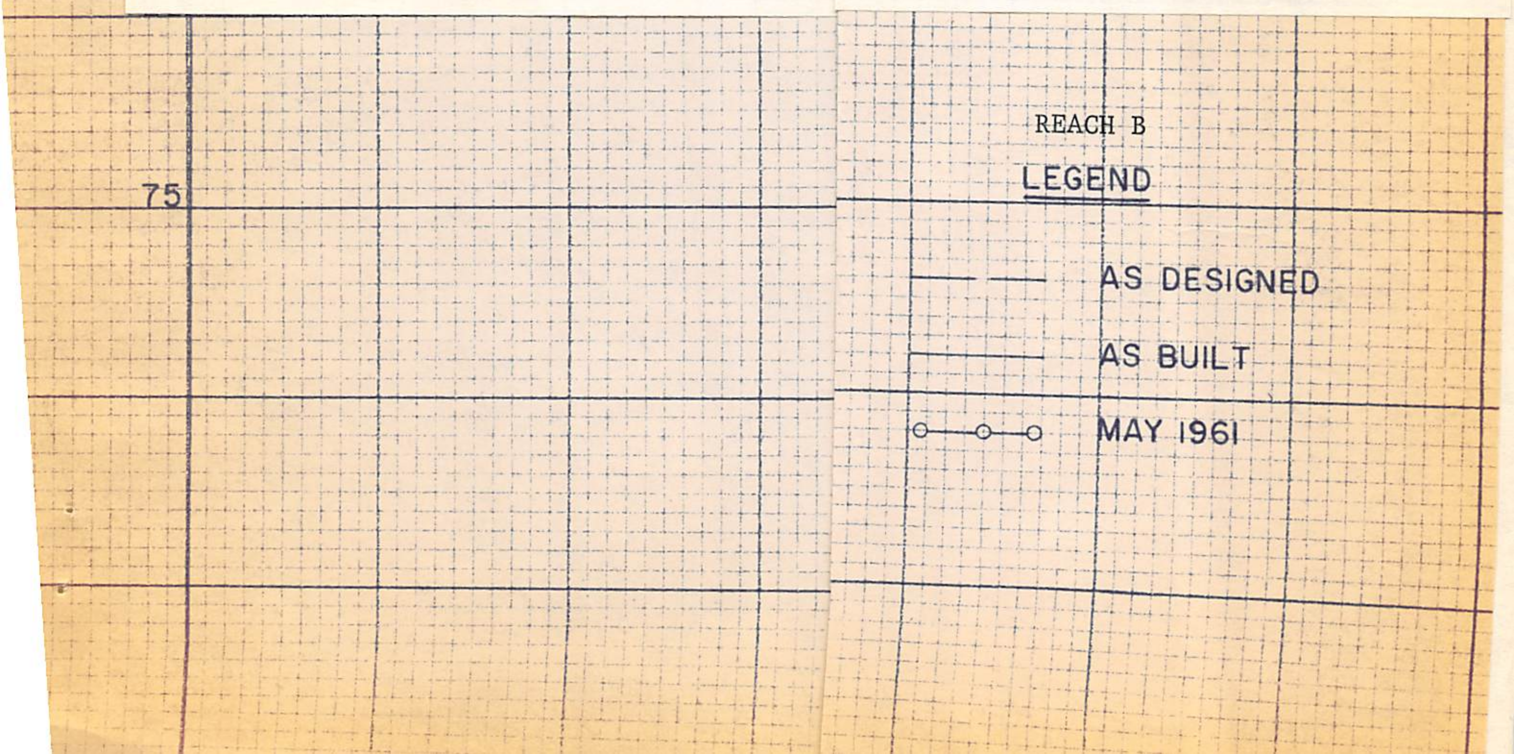
Station	Sample No.	% Sand Larger .500mm	% Sand .500mm to .250mm	% Sand .250mm to .177mm	%Sand 0.177mm to 0.125mm	% Sand 0.125mm to 0.105mm	% Sand 0.105mm to 0.088mm	% Sand 0.088mm to 0.062mm	% Sand 0.062mm to 0.050mm	% Sand	% Silt 0.050mm to 0.002mm	% Clay Less than 0.002mm
CHANNEL REACH C (NORTH LATERAL)												
192 + 68	Bed	0.2	2.8	2.7	25.4	23.8	25.8	14.1	2.0	96.9	1.1	0.7
Rt. Bank	1	0.3	4.6	3.1	19.4	22.3	21.1	12.6	2.3	85.8	3.2	11.6
	2	0.4	6.5	4.2	25.2	20.1	25.3	14.3	2.0	97.9	3.2	0.5
	3	0.4	6.4	4.3	32.1	20.0	20.6	12.6	1.5	98.2	1.1	0.8
197 + 30	Bed	0.7	12.6	8.6	25.5	23.3	17.3	9.4	1.3	98.7	0.9	0.9
Lt. Bank	1	0.2	2.7	2.3	14.9	19.4	24.8	15.2	2.5	81.9	7.2	12.3
	2	0.2	3.9	2.8	15.1	20.6	26.0	16.4	3.1	88.2	1.3	9.7
	3	0.3	5.2	3.5	22.7	22.0	23.3	14.3	1.8	93.1	2.2	3.0
	4	0.4	4.8	3.7	28.6	18.9	24.6	13.7	1.8	96.4	1.9	1.4
197 + 89	Bed	0.1	0.3	0.3	20.6	20.6	34.6	18.4	2.5	97.4	2.0	1.3
Rt. Bank	1	0.2	4.4	3.8	23.8	24.2	26.4	13.6	1.9	98.6	1.0	0.3
	2	0.4	4.8	3.7	24.4	23.3	24.3	14.0	2.4	97.6	1.4	0.9
	3	0.4	10.8	30.0	21.0	21.7	12.0	0.8	0.9	97.5	1.3	2.0
	4	0.5	6.1	4.8	33.7	19.9	21.5	12.1	1.6	97.9	1.0	1.5
CHANNEL REACH D (NORTH LATERAL EXTENSION)												
19 + 72	Bed	0.2	1.1	1.7	25.4	24.0	27.6	16.3	2.7	99.0	0.3	0.8
Lt. Bank	1	0.2	2.6	2.8	24.2	24.0	24.9	15.8	2.5	97.5	1.9	0.4
	2	0.3	3.7	3.3	31.0	19.6	24.3	13.3	1.9	97.7	1.3	1.0
	3	0.3	3.1	2.9	26.6	23.5	24.6	14.5	2.5	98.1	1.7	0.1
	4	0.3	7.4	27.3	24.5	23.3	13.6	0.3	1.7	98.5	0.9	1.1
20 + 21	Bed	0.1	0.7	1.0	30.0	26.6	24.1	14.4	1.8	98.8	1.1	0.2
Rt. Bank	1	0.3	3.1	3.1	24.7	27.0	22.0	14.7	2.6	97.4	2.1	0.2
	2	0.2	3.1	3.1	28.2	21.3	24.6	14.6	2.4	97.5	1.2	0.9
	3	0.2	4.6	4.3	36.5	12.5	23.7	14.1	1.5	95.4	2.2	2.5
	4	0.2	3.8	3.5	32.1	19.4	23.7	13.2	2.6	98.7	0.9	0.6

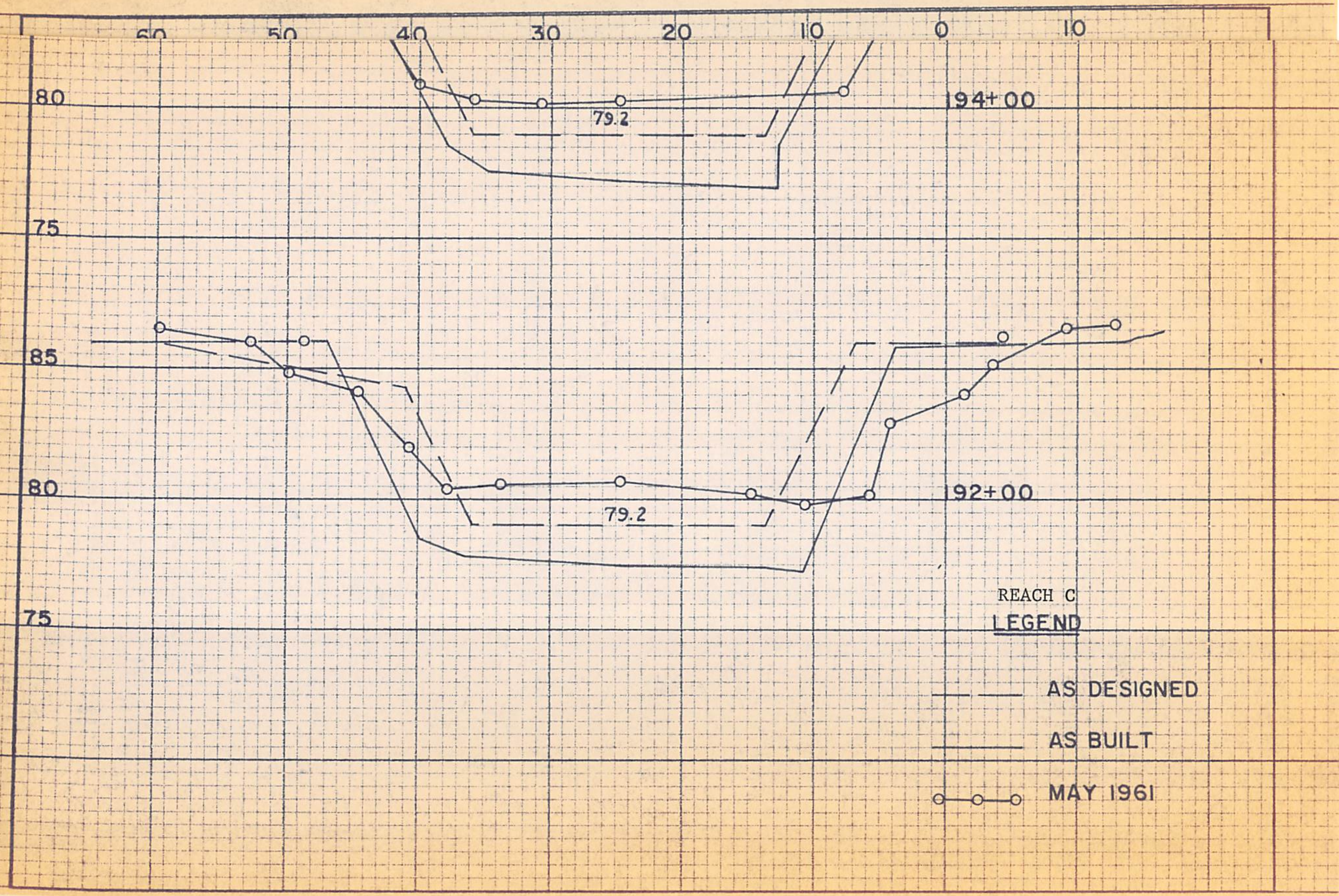
Table 4.--(Continued)

Station	Sample No.	% Sand Larger .500mm.	% Sand .500mm to .250mm	% Sand .250mm to .177mm	% Sand 0.177mm to 0.125mm	% Sand 0.125mm to 0.105mm	% Sand 0.105mm to 0.088mm	% Sand 0.088mm to 0.062mm	% Sand 0.062mm to 0.050mm	% Sand	% Silt 0.050mm to 0.002mm	% Clay Less than 0.002mm
CHANNEL REACH E (SOUTH LATERAL)												
166 + 36	Bed	0.0	0.2	0.5	13.9	26.3	34.3	20.9	2.8	99.0	0.6	0.8
Lt. Bank	1	0.4	4.0	3.5	30.4	20.9	23.3	13.5	1.5	97.7	1.5	0.3
	2	0.3	3.4	3.4	26.3	24.4	23.2	14.5	2.3	97.7	1.9	0.2
	3	0.3	3.6	3.6	29.1	22.7	22.9	13.4	2.4	98.1	1.0	0.3
167 + 19	Bed	0.2	3.6	4.2	41.0	17.2	21.6	9.8	1.2	99.3	0.1	0.7
Lt. Bank	1	0.1	2.2	2.5	33.2	20.2	24.0	13.2	2.2	97.7	1.2	1.1
	2	0.3	3.8	3.4	33.0	20.6	22.3	12.4	1.8	97.7	1.5	0.4
	3	0.3	3.8	3.5	30.3	22.7	24.0	11.9	1.7	98.1	1.5	0.5

REACH A

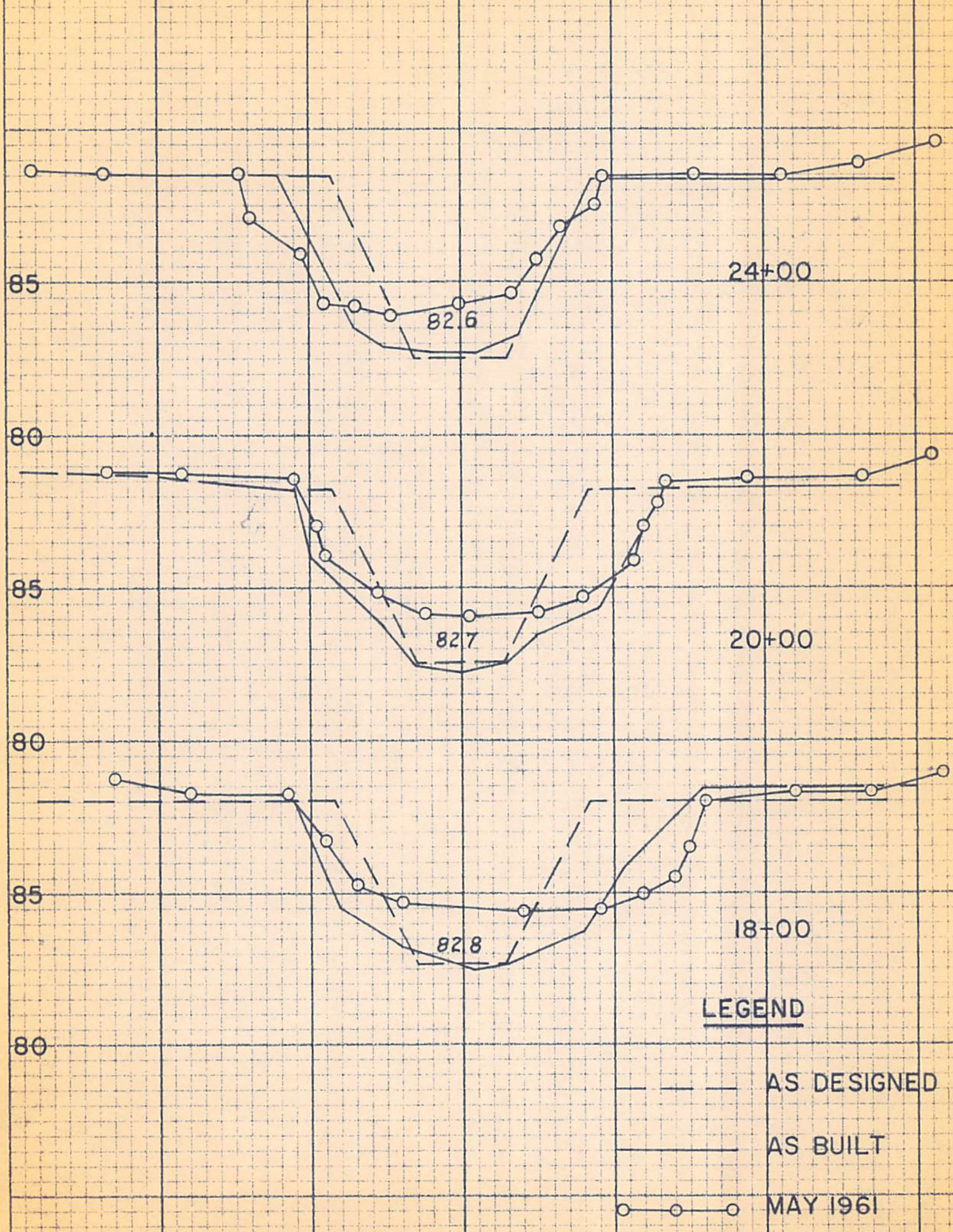


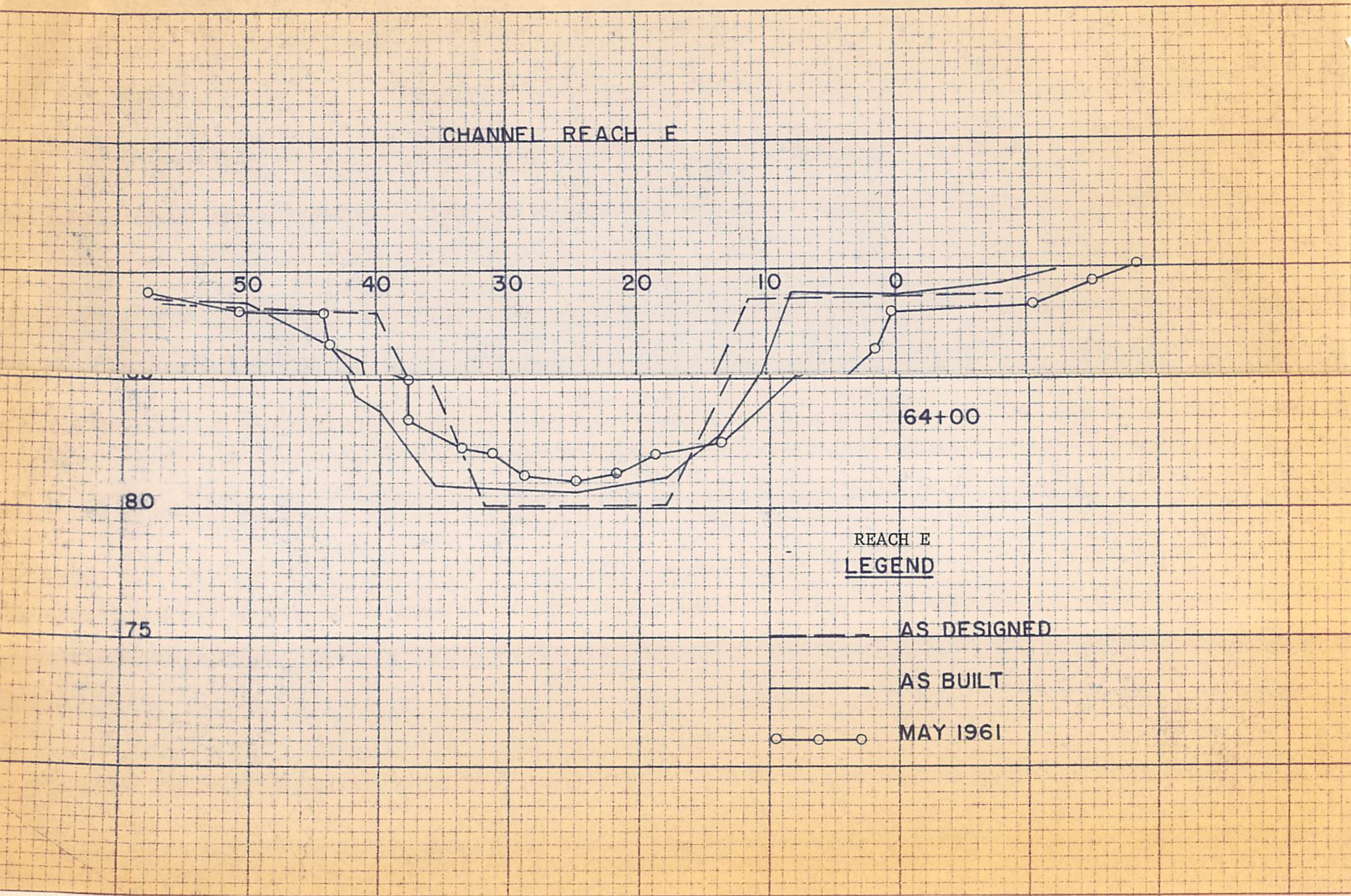

75
REACH B
LEGEND
AS DESIGNED
AS BUILT
MAY 1961



60
50
40
30
20
10
0
10
80
194+00
79.2
75
85
80
192+00
79.2
75
REACH C
LEGEND
AS DESIGNED
AS BUILT
MAY 1961

CHANNEL REACH D




CHANNEL REACH E
50
40
30
20
10
0
164+00
80
75
REACH E
LEGEND
AS DESIGNED
AS BUILT
MAY 1961