SILT BARRIERS AS EROSION POLLUTION CONTROL IN A LARGE RECREATIONAL LAKE

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Soil erosion from urban development and Interstate highway construction during the winter and spring of 1972 and 1973 resulted in extensive runoff pollution of Lake Jackson, a large recreational lake in northern Florida. Turbidity levels in mid-lake reached levels of 180 Jackson turbidity units, and portions of the lake reached turbidity levels exceeding 500 Jackson turbidity units. Floating silt barriers were deployed in 2 arms of the lake by the Florida Department of Transportation to abate the movement of turbid waters into the main body of the lake. Sediment core analyses were performed to determine the extent of sedimentation that had occurred, and water turbidity was monitered to determine the effectiveness of the silt barriers. Clay and silt fines were found to be the major factor in creating turbid conditions in the lake. Erosion controls were effective in controlling movement of sand-size sediments, but they were ineffective in controlling clays and silts. The silt barriers were up to 93 percent effective in preventing the movement of suspended silt and clay into the main body of the lake.

•THE PROBLEM of soil erosion during highway construction has been a major concern for several years. Of more recent concern has been the pollution effect of sedimentation and concentrations of suspended solids on biotic communities of natural aquatic habitats resulting from construction. Ellis (7) reported that erosion silts can destroy mussel populations in various streams by the direct smothering of mud deposits. Zeibell (15) and Cordone and Pennoyer (6) showed that silt from gravel washing operations in Washington and California could reduce benthic communities by 75 to 85 percent from 1 to 10 miles (1.6 to 16 km) downstream of the washing facilities. Hess (10) made a study during moderately heavy rainfall in the first winter after road construction during a logging operation near a small stream in California. He noted that turbidities reached as high as 3,000 ppm (3000 mg/dm^3) and that sediment had accumulated up to 2 ft (0.6 m) where erosion and slippage had occurred from the road. Immediate detriment was noted to most aquatic invertebrates in South Fork Caspar Creek. However, the loss of invertebrates was offset by an increase of diptera and plecoptera, which may or may not have been a direct result of road construction.

The direct effect of sediments and suspended solids on fish is not well documented. Kemp (11) stated that mud or silt in suspension can clog or cut the gills of fish and mollusks. He believed that suspensions of 3,000 ppm (3000 mg/dm^3) were dangerous when they remained for 10 or more days. Wallen (14) could not detect behavioral differences in warm water fishes until concentrations of turbidity neared 20,000 ppm (20 000 mg/dm^3) in controlled aquarium studies.

Bennett, Thompson, and Parr (4) determined that turbidity could reduce fishing success. It was found that the number of fish caught per person hour decreased from 6.53 to 2.04 when Secchi disk transparency was reduced from 4.0 ft (1.2 m) to 1.3 ft (0.4 m) in Fork Lake, Illinois.

Numerous erosion control techniques have been developed to prevent the transport of soil by water erosion from highway construction sites. Most of these controls involve energy dissipation to reduce the load-carrying capacity of runoff, or they involve chemical soil stabilizers, herbaceous ground cover, or artificial cover to reduce the erodibility of exposed soils from rain, runoff, and wind action (3). Often these controls are not effective enough to prevent the transport of silt and clay fines into natural bodies of water. Such suspensions can cause serious pollution problems as well as create adverse public reaction to highway construction.

Little information has been documented on the use of floating turbidity screens or silt barriers in natural waters to control suspended fines resulting from erosion during highway construction. Such silt barriers can be an invaluable tool in preventing the dispersion of suspended solids in storm-water runoff that are largely beyond the abatement capabilities of conventional erosion controls. This paper documents the effects that can be achieved by use of temporary floating silt barriers to prevent turbid conditions in a large recreational lake.

BACKGROUND

Lake Jackson is a relatively large freshwater lake occupying a surface area of approximately 4,000 acres (1619 hm^2) located in rolling terrain characteristic of the northern panhandle region of the state (Figure 1).

Two of the southern drainage subbasins of the lake, the Meginnis Arm watershed and the Fords Arm watershed, are located in areas of rapid urban expansion in Tallahassee. The subbasins occupy about 5,000 acres (2024 hm^2) of which the Meginnis Arm watershed is approximately 80 percent urban. Because of the rapid urbanization within its watershed, Meginnis Arm has been the recipient of increasingly large quantities of highly polluted storm-water runoff since the early 1960s. The Fords Arm watershed is largely single family residences. It has not been subjected to intense commercial development as has the Meginnis Arm watershed. Although comparable in size to the Fords Arm watershed, storm-water discharge from the Meginnis Arm watershed is 7 times greater than that of the Fords Arm watershed for similar rainfall events (5). Mean total discharge per storm into Meginnis Arm for 20 storms from September 1973 to March 1974 was measured at 730,868 ft^3 (20 696 m^3). Discharge measured into Fords Arm for 18 storms during the same period was 100,328 ft^3 (2841 m^3). Meginnis Arm has shown acute symptoms of cultural eutrophication in recent years in the form of high concentrations of green and blue-green algae that are not characteristic of other portions of Lake Jackson.

Interstate 10 in Florida, when it is completed, will extend west from Jacksonville, its easternmost terminus, through Pensacola to the Florida-Alabama state line. The Interstate facility traverses northern Leon County through portions of both the Fords and Meginnis Arms watersheds involving about 120 acres (49 hm^2) in those drainage subbasins (Figure 2).

Clearing for Interstate construction began in the 2 southern watersheds in May 1972. It was apparent that earth-moving operations and exposed clay soils posed a potential erosion problem because of the relief of the local terrain and the close proximity of the construction site to the southern portion of Lake Jackson. Various erosion controls were employed on the project site to forestall the possibility of transportation of sediments to the lake during rainfall periods. These controls included

1. An 8,000-ft^2 (743.2-m^2) sediment detention basin located in the path of Meginnis Arm tributary with a storage capacity for 600 yd^3 (458.4 m^3) of sediment,
2. Temporary Visqueen slope drains,
3. Earth berms,
4. Brush or hay-bale sediment checks,
5. Temporary grassing and mulching, and
6. Placement of sod on fill slopes after each 5 ft (1.5 m) of fill reached and use of plastic sheet covering at intermediate levels.

Antecedent precipitation for the 2 southern watersheds was extremely sparse during the fall of 1972. Total precipitation for the months of July through October registered at the Tallahassee municipal airport was recorded at 11.22 in. (28.5 cm). The normal

Figure 1. Lake Jackson area.

Figure 2. Interstate 10 alignment through Fords and Meginnis Arms watersheds.

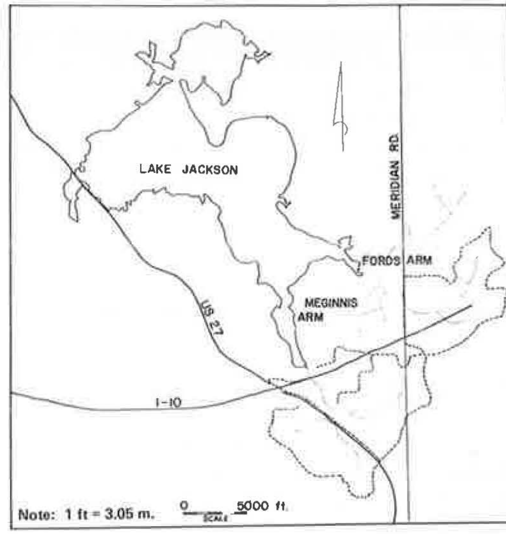
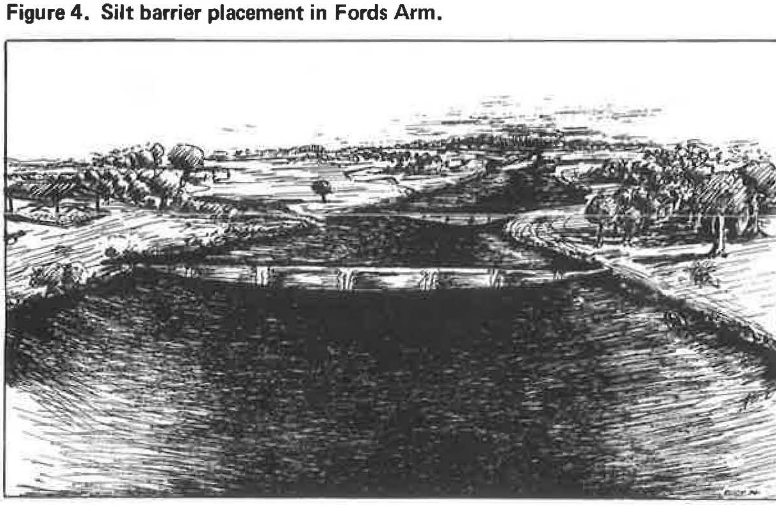


Figure 3. Silt barrier placement in Meginnis Arm.

Figure 4. Silt barrier placement in Fords Arm.



rainfall total for the same period is 22.9 in. (58.2 cm). Lake levels during this period reached a low elevation of 83.4 ft (26.2 m) above sea level.

Beginning in November 1972 and following through May 1973, record rainfall was recorded at 61.76 in. (156.9 cm) for the 7 months. This exceeded normal rainfall by 34.5 in. (87.6 cm) for the same period. Normal yearly rainfall for the Tallahassee area is 56.86 in. (144.4 cm). Lake elevations rose above 87 ft (26.5 m) during this period.

Turbidity and suspended solids reached levels of 1,200 Jackson turbidity units (JTU) and 2,830 ppm (2830 mg/dm^3) respectively where I-10 crosses Meginnis Arm tributary. Turbidity levels in Meginnis and Fords Arms reached as high as 520 JTU, and a noticeable plume of highly turbid, very discolored water had extended from Meginnis and Fords Arms to a point in mid-lake. Its area was equal to about a third of the lake surface. Mid-lake turbidities of up to 180 JTU were recorded. Florida's allowable pollution standard for turbidity is 50 JTU above background. The mean mid-lake turbidity level for the previous year (July 1971 to June 1972) was 7.2 JTU (8).

It became readily apparent that the erosion controls employed were ineffective in preventing the transport of sediments into the lake. An additional sediment detention basin with a capacity of 600 yd^3 (458.4 m^3) was constructed upstream of the project on Meginnis Arm tributary to help control sediment transport from urban Tallahassee as well as provide additional retention for runoff from the highway construction area. Additional ponding on the project site within median and interchange areas further prevented runoff from carrying away erodible materials.

To prevent further degradation of the water quality of the main body of the lake, the builders installed temporary silt barriers (diapers) in the 2 southern arms of the lake. The barriers were placed in such a way as to confine the uncontrolled suspended materials to the 2 arms rather than allow them to spread farther into the lake proper. These diapers originally were developed by the Florida Department of Transportation to control the spread of suspended silts during dredging operations (2). But they had never been applied to the containment of suspended fines from storm-water runoff from upland construction activity. Their effectiveness could only be speculated on because of the volume of runoff encountered and the colloidal nature of the clay fines that were suspected of creating most of the turbidity problems within the lake.

SILT BARRIER APPLICATION AND DESCRIPTION

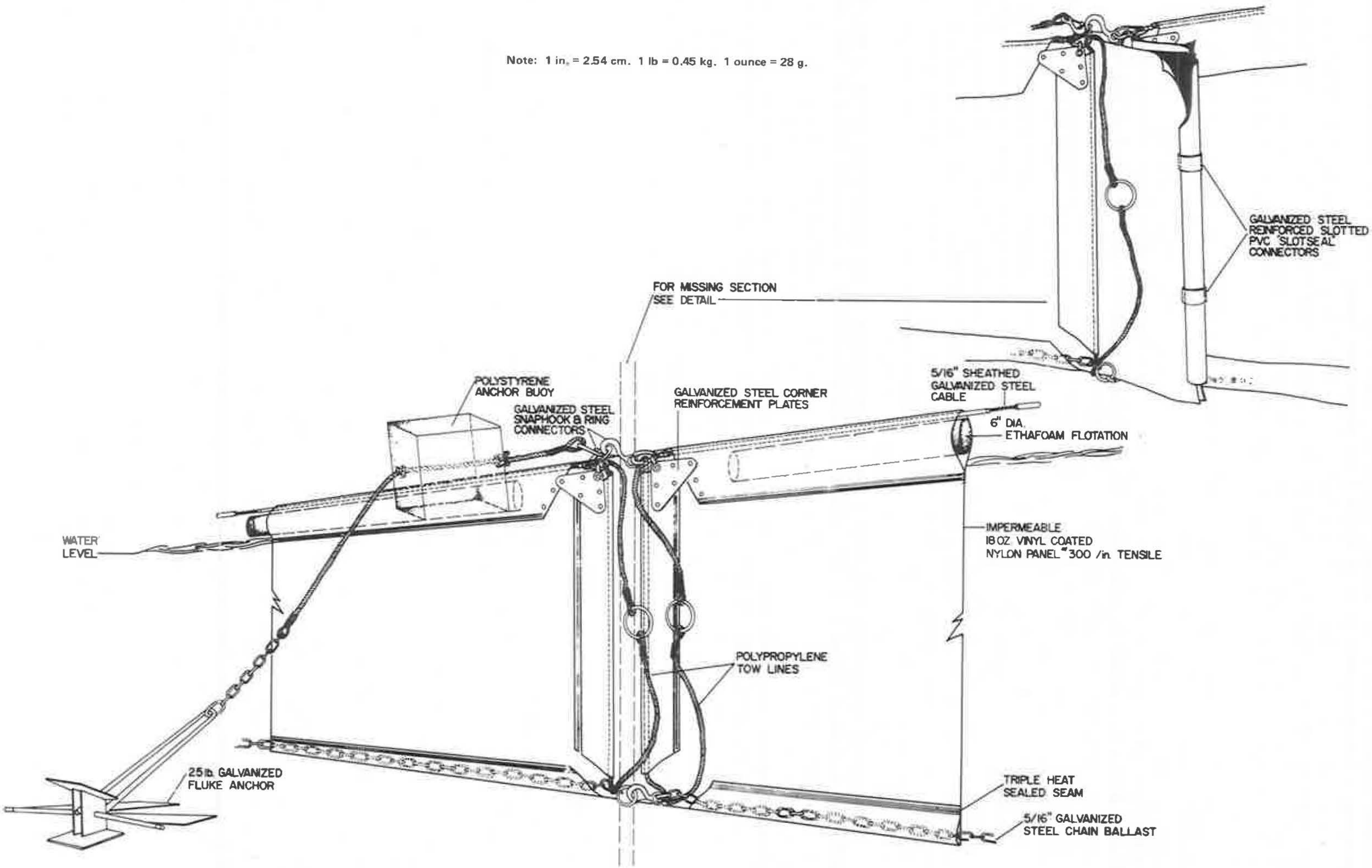
Cross-sectional profiles along selected transects in the 2 arms were measured to determine lake bottom configuration where the silt screens were to be located. Water depths varied in the 2 arms from 2 to 10 ft (0.61 to 3.05 m); widths from shoreline to shoreline varied from 400 to 1,000 ft (121.9 to 304.8 m). Locations were selected that represented areas of low flow where possible to ensure maximum use of low energy currents during high runoff conditions. It was decided that 2 barriers would be deployed in each of the 2 arms of the lake. Figures 3 and 4 show barrier positions in Fords and Meginnis Arms.

The silt barriers cost about $23 thousand. Barriers were constructed of impermeable 18-ounce (504-g) vinyl-coated nylon-fabric material with a tensile strength of 300 lb/in.^{2} (207 kPa/m^2). Flotation was provided with 6-in. (15.2-cm) diameter, 11-lb/ft (16.3-kg/m) buoyancy ethafoam in Meginnis Arm and 6-in. (15.2-cm) diameter, 11-lb/ft (16.3-kg/m) buoyancy styrofoam chip flotation in Fords Arm. The main load line supporting the curtain consisted of $^5/_{16}$-in. (0.79-cm) sheathed galvanized steel cable with a 9,800-lb (4445.25-kg) break strength. Ballast was provided by $^5/_{16}$-in. (0.79-cm) galvanized chain that was heat-sealed into a bottom seam extending the length of each barrier panel (Figure 5).

The barriers were formed by joining 100-ft (33.5-m) panels that were connected end to end by slotted tubes of galvanized-steel-reinforced polyvinylchloride pipe. To keep currents and winds from displacing the barriers from their respective desired positions, 25-lb (11.3-kg) galvanized steel fluke anchors were attached to both sides of the barriers and spaced equally apart at selected points along each curtain. Anchor lines were

Figure 5. Details of silt barriers installed in Fords and Meginnis Arms.

Note: 1 in. = 2.54 cm. 1 lb = 0.45 kg. 1 ounce = 28 g.



buoyed to prevent sagging of the barriers where anchor lines were attached to the main load line.

EVALUATION OF SILT BARRIER PERFORMANCE

The Florida State University Marine Laboratory was employed to monitor the effects of the silt barriers in conjunction with other water quality evaluations in the lake watersheds. Turbidity data were compiled biweekly beginning in May 1973.

Surface water samples were taken at 3 stations on each side of each barrier (Figures 6 and 7). Turbidities were determined by use of a Hach Model 2100A turbidimeter calibrated with formazine standard suspension (1). Readings obtained on each side of the barriers were averaged, and reduction in turbidity percentage was calculated across each barrier. Table 1 gives the results of mean turbidity analyses from May 1973 to June 1974.

Turbidity reductions were consistently lower across the inner (M1) and outer (M2) Meginnis Arm barriers than they were across the inner (F1) and outer (F2) Fords Arm barriers. Reduction across M1 ranged from a low of 3.6 percent to a high of 60.9 percent. Across M2, reduction ranged from 1.7 to 29.4 percent. Reduction across F1 ranged from a low of 5.1 percent to a high of 77.7 percent. Across F2, reduction ranged from 5.1 to 74.8 percent.

The overall objective of installing the silt screens was to prevent turbid waters from encroaching on the main body of Lake Jackson. A more realistic evaluation of their effectiveness can be seen by comparing the overall turbidity reductions from inside the inner barriers of the 2 arms with those from the outside of the outer barriers. When this comparison is made, a much more dramatic representation of turbidity reductions is evident. Figures 8 and 9 show the overall reductions achieved. When calculated as an overall percentage reduction, the range in Meginnis Arm was from a low of 44 percent on October 4, 1973, to a high of 90 percent on April 8, 1974. Fords Arm turbidity reductions ranged from a low of 45 percent on August 17, 1973, to a high of 93 percent in August 1973 and January 1974. The calculated overall mean effectiveness for turbidity reductions in the 2 arms of the lake was 72.3 percent in Meginnis Arm and 68.2 percent in Fords Arm.

These reductions appear somewhat anomalous because turbidity reductions immediately across the 2 barriers in Meginnis Arm were consistently lower than they were for those in Fords Arm. This situation can be explained by comparing the geomorphologic configurations of the 2 arms. Bottom profiles within Fords Arm form a shallow trough-like depression that gradually and uniformly increases in depth from its easternmost shoreward end toward the main body of the lake. There are no flow constrictions as the arm fans outward toward its mouth. This results in an evenly dispersed westerly movement of storm runoff into the lake during heavy rainfall. Although storm runoff discharge is of smaller magnitude in Fords Arm than in Meginnis Arm for comparable rain, the only significant physical obstruction to the transport of suspended materials was the presence of the 2 silt curtains.

Meginnis Arm depth and width vary considerably along its northerly course to the main body of the lake. The arm at its southern end widens drastically where Meginnis Creek empties its storm-water load into the arm. Depths to 15 ft (4.6 m) during high water conditions are achieved because a karst depression is located to the north and west of the mouth of the creek. As the arm progresses toward the lake, depths decrease to about 5 ft (1.5 m) at a narrow constriction about 800 ft (243.8 m) long by 300 ft (91.44 m) wide. This constriction is blocked partially by an earth mound across the channel at a point just south of where the arm again begins to widen along its approach to the lake. A gas pipeline traverses the mouth of the arm and forms an additional earth mound blockage where water depths would normally average about 5 to 6 ft (1.5 to 1.8 m). Thus the flow velocity in this arm is checked by the physical variance of the geomorphology of the arm as well as the placement of the 2 silt barriers. The inability of the silt barriers to completely check turbidity in this arm was obviously offset by the restrictive configuration of the arm during high runoff conditions.

Figure 6. Silt barriers and turbidity sampling sites in Meginnis Arm.

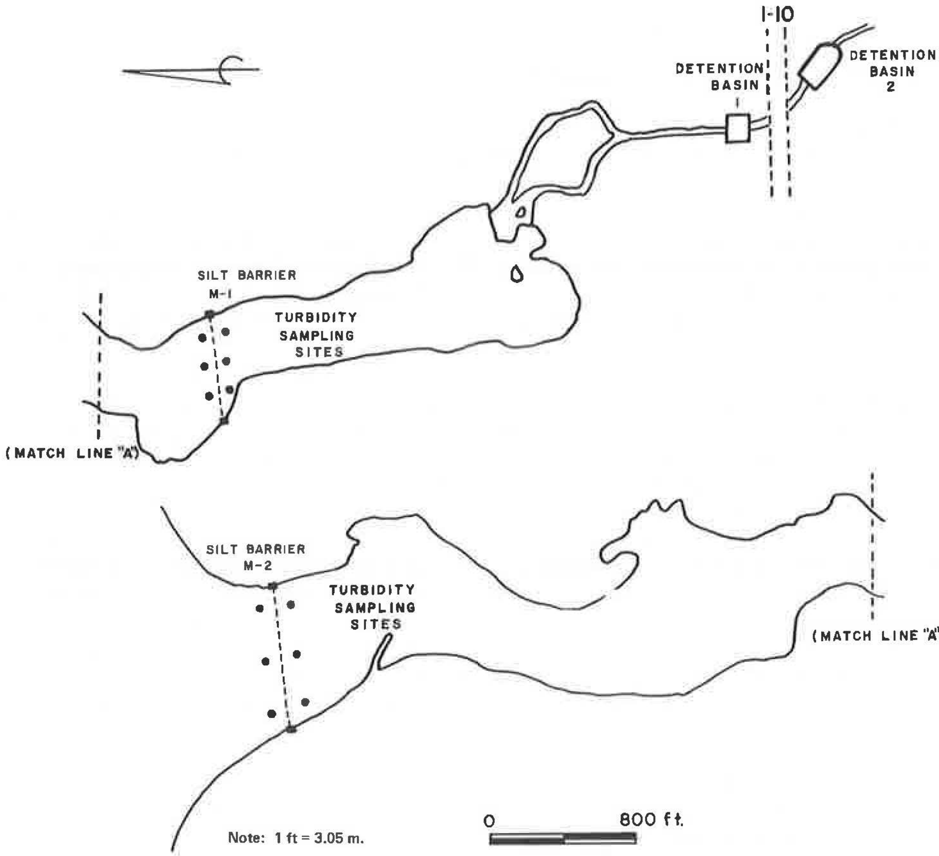


Figure 7. Silt barriers and turbidity sampling sites in Fords Arm.

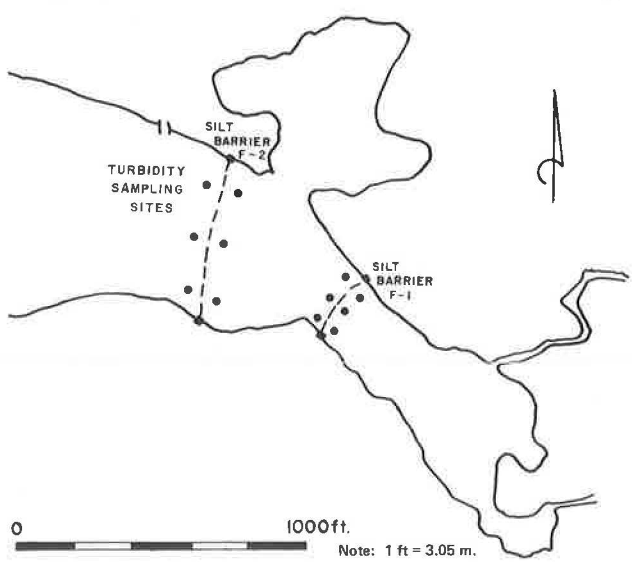


Table 1. Turbidity reductions across silt barriers in Lake Jackson.

		Meginnis Arm Barrier				Fords Arm Barrier			
		Inner		Outer		Inner		Outer	
Date	Turbidity	In	Out	In	Out	In	Out	In	Out
May 30, 1973	Observed, JTUs	92	86	38	37	57	43	32	14
		—	—	—	—	56	44	30	13
		—	—	—	—	—	—	—	—
	Average, JTUs	—	—	—	—	56.5	43.5	31	13.5
	Percent reduction	6.5		2.6		23		56	
June 18, 1973	Observed, JTUs	29	18	3.5	3.0	18	8.5	12	7.6
		30	17	3.7	3.5	18	8.8	11	7.4
		28	18	3.4	3.0	20	11	11	6.2
	Average, JTUs	29	17.7	3.5	3.2	18.7	9.4	11.3	7.1
	Percent reduction	39.1		10.2		49.5		37.6	
July 5, 1973	Observed, JTUs	16	9.5	6.0	6.2	8.1	2.2	3.2	2.9
		14	10	5.7	5.6	9.8	2.4	3.1	2.9
		13	9.9	6.4	6.0	13	2.2	3.2	2.9
	Average, JTUs	14	9.8	6.0	5.9	10.3	2.3	3.2	2.9
	Percent reduction	30.0		1.7		77.7		9.4	
August 6, 1973	Observed, JTUs	40	22	2.9	5.4	85	27.5	21	6.1
		36	32	6.1	5.1	82	22	21	6.3
		40	30	5.8	5.2	81	27	26	4.9
	Average, JTUs	39	28	4.9	5.2	83	26	23	5.8
	Percent reduction	28.2		+6.1[a]		68.7		74.8	
August 17, 1973	Observed, JTUs	27	16	2.3	3.1	3.8	2.4	2.1	2.1
		25	14	2.4	2.8	3.7	2.1	2.2	2.0
		28	15	2.2	2.9	3.9	2.1	2.7	2.2
	Average, JTUs	27	15	2.3	2.9	3.8	2.2	2.3	2.1
	Percent reduction	44.4		+26[a]		42		8.7	
October 14, 1973	Observed, JTUs	5.3	5.9	2.5	3.8	5.1	2.9	1.7	1.8
		5.6	5.6	2.2	2.7	5.6	2.9	1.9	1.4
		5.6	7.1	2.1	2.7	5.3	2.8	1.7	1.5
	Average, JTUs	5.5	6.2	2.3	3.1	5.3	2.9	1.8	1.6
	Percent reduction	+11.3[a]		+25.8[a]		45.3		11.1	
November 13, 1973	Observed, JTUs	9.6	8.7	2.4	1.8	4.9	4.3	2.3	2.1
		9.4	8.4	2.7	1.7	4.3	3.7	2.7	2.4
		11	8.0	1.6	1.8	4.4	3.9	3.4	2.5
	Average, JTUs	10	8.4	2.2	1.8	4.5	4.0	2.8	2.3
	Percent reduction	16		18.2		11.1		17.9	
December 4, 1973	Observed, JTUs	18	15	3.8	3.2	8.2	11	3.7	3.6
		13	13	3.4	3.7	9.1	8.5	3.7	3.6
		18	14	3.9	3.4	11	10	4.2	3.8
	Average, JTUs	16.3	14	3.7	3.4	9.4	9.8	3.9	3.7
	Percent reduction	14.1		8.1		+4.1[a]		5.1	
December 19, 1973	Observed, JTUs	31	32	5.8	5.8	—	—	—	—
		30	25	6.1	5.0	—	—	—	—
		19	18	3.6	6.3	—	—	—	—
	Average, JTUs	26.7	25	5.2	5.7	—	—	—	—
	Percent reduction	6.3		+8.8[a]		—	—	—	—
January 7, 1974	Observed, JTUs	18	14	5.0	4.5	22	19	17	8.0
		18	14	4.4	4.4	22	19	17	8.0
		19	14	5.4	4.4	22	19	18	9.0
	Average, JTUs	18.3	14	4.16	4.4	22	19	17.3	8.3
	Percent reduction	23.5		4.3		13.6		52.0	
January 13, 1974	Observed, JTUs	—[b]	—[b]	6.3	6.3	58	22	10	4.0
		—[b]	—[b]	7.5	7.2	55	26	18	4.0
		—[b]	—[b]	6.2	5.4	41	28	6.8	3.3
	Average, JTUs			6.7	6.3	51.3	25.3	11.6	3.8
	Percent reduction			6.0		50.7		67.2	
March 4, 1974	Observed, JTUs	6.9	5.7	2.6	3.0	9.6	8.7	7.2	3.6
		6.1	5.2	3.0	3.2	9.8	9.5	7.3	5.1
		6.0	5.6	3.7	2.7	10	9.6	7.0	4.0
	Average, JTUs	6.3	5.5	3.1	3.0	9.8	9.3	7.2	4.2
	Percent reduction	12.7		3.2		5.1		41.7	
March 20, 1974	Observed, JTUs	6.8	7.3	2.9	2.7	7.3	4.9	3.8	2.1
		6.1	7.7	2.7	2.3	7.5	4.7	3.8	2.2
		6.8	8.8	3.4	3.4	7.2	4.8	4.4	2.1
	Average, JTUs	6.6	7.9	3.0	2.8	7.3	4.8	4.0	2.1
	Percent reduction	+16.5[a]		6.7		34.2		47.2	
April 8, 1974	Observed, JTUs	28	29	1.7	2.3	49	38	28	12
		24	18	2.2	1.9	48	40	27	9.4
		31	33	3.6	3.8	51	43	23	12
	Average, JTUs	27.2	26.7	2.5	2.7	49.3	40.3	26.0	11.1
	Percent reduction	3.6		+7.4[a]		18.3		57.3	
April 25,1974	Observed, JTUs	6.1	4.2	2.5	1.4	4.7	3.1	2.7	2.0
		6.7	4.3	2.1	1.5	4.6	3.3	2.5	2.6
		5.4	3.7	2.5	2.3	4.9	3.0	2.2	1.9
	Average, JTUs	6.1	4.1	2.4	1.7	4.7	3.1	2.5	2.2
	Percent reduction	32.8		29.2		44.0		12.0	
May 9, 1974	Observed, JTUs	7.0	3.1	1.7	1.3	4.4	1.4	1.6	1.1
		6.8	2.6	1.5	1.2	4.3	1.9	1.7	1.0
		6.8	2.5	1.5	1.4	3.8	1.7	1.5	1.0
	Average, JTUs	6.9	2.7	1.6	1.3	4.2	1.7	1.6	1.0
	Percent reduction	60.9		18.7		59.5		37.5	
May 24, 1974	Observed, JTUs					13	4.1	3.7	2.8
						13	4.1	3.9	3.4
						13	4.1	3.8	4.0
	Average, JTUs					13	4.1	3.8	3.4
	Percent reduction					68		11	
June 4, 1974	Observed, JTUs					5.8	3.0	3.1	1.7
						5.8	3.2	3.2	1.8
						5.4	3.3	4.3	1.9
	Average, JTUs					5.67	3.17	3.53	1.8
	Percent reduction					44		49	

[a]Higher turbidity on lake side of barrier was due to turbulence.

[b]Barrier loose.

Figure 8. Average turbidity reductions in Meginnis Arm.

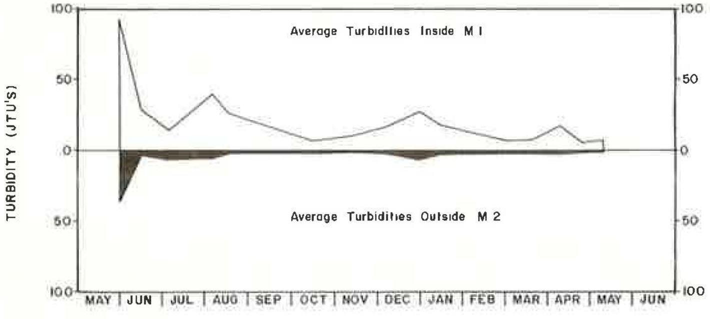


Figure 9. Average turbidity reductions in Fords Arm.

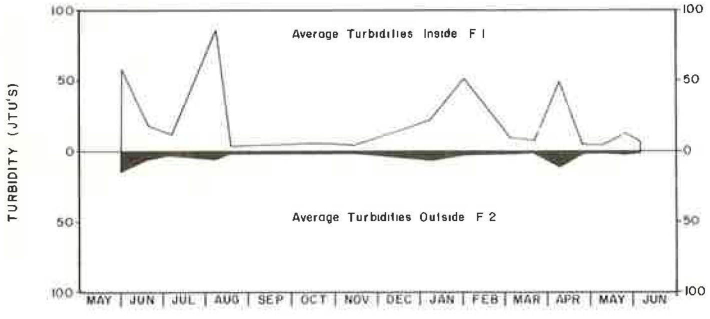


Table 2. Particle size analyses on sediments from I-10 detention basins.

Sediment	Percent in Basin 1	Percent in Basin 2	Size (mm)	Frequency (percent) Basin 1	Frequency (percent) Basin 2
Gravel	0.49	0.01	More than 2.000	0.49	0.01
Sand	71.60	65.47	1.000 to 2.000	0.42	0.02
			0.500 to 1.000	3.12	0.05
			0.250 to 0.500	22.10	1.10
			0.125 to 0.250	38.13	36.82
			0.062 to 0.125	9.83	27.48
Silt	10.06	20.51	0.031 to 0.062	4.95	13.94
			0.016 to 0.031	1.91	2.60
			0.008 to 0.016	1.81	2.08
			0.004 to 0.008	1.39	1.89
Clay	17.85	14.01	0.002 to 0.004	1.50	2.02
			0.001 to 0.001	1.50	2.14
Volatile	2.50	4.06			
Colloid			Less than 0.001	12.83	9.85

This resulted in the overall high reduction percentage in turbid waters outside barrier M2 compared with that outside barrier F2.

DEPOSITION OF SEDIMENTS

To determine the extent of sedimentation within the 2 arms that occurred during the time Interstate 10 was under construction, researchers from the Department of Geology of Florida State University gathered and analyzed a series of core samples. Weekly cross sections of sediment deposition within the 2 detention basins (Figure 6) were performed to assess the sediment contribution from urban runoff draining to the Interstate facility as well as that deposited from erosion from the highway construction site. Sediment-size distribution was determined to evaluate what particle-size fractions were being retained within the detention basins compared to what suspended materials were being transported into the lake after passing through the basins.

SEDIMENTS IN DETENTION BASINS

Sediments from the 2 basins were removed when cross section data indicated a 600-yd^3 (458.4-m^3) accumulation. From June 1972 to February 22, 1974, a total of 9,600 yd^3 (7296 m^3) of sediments had been removed from the 2 detention basins of which an estimated 75 to 80 percent were deposited from urban runoff not affected by highway construction.

In August 1973, sediments were sampled for grain-size distribution from the 2 detention basins adjacent to the I-10 construction site in the Meginnis Arm watershed. Sediment sizes and classifications were based on the Wentworth scale (9).

Table 2 data indicate that 79 percent of the sediments impounded in basin 1 and 81 percent of the sediments impounded in basin 2 fall within the mid-range of silt-size particles and larger. The majority of materials found within this size distribution can be classified as very fine sand to coarse sand. It would be logical that the majority of those sediments deposited in Meginnis Arm following the construction of the sediment traps would fall below the size distribution classed as fine sands and heavy silts. The data given in Table 2 are modified from the data given by Turner (13).

LAKE SEDIMENTATION

Thirty-nine cores were taken in southern Meginnis Arm and 10 cores were taken in Fords Arm to determine the extent of sedimentation that had occurred before and during the construction of the Interstate highway (12). Those sediments considered most recently deposited (1970 to 1973) were characterized as urban sediments because stormwater runoff was received from urban areas of Tallahassee as well as from highway construction. No distinction could be made between sediments deposited from highway construction and sediments transported from upland private construction activity. Therefore, all sediments attributed to upland soil disturbance from construction activity, regardless of source, will be referred to as urban sediments in this paper unless otherwise specifically stated. Figures 10 and 11 show the locations of the core sample sites (12).

Core analyses indicated that distinctly urban sediments were restricted to the southern half of Meginnis Arm. Those sediments had formed a sandy delta complex on the southeastern shore of the arm, and a thick layer of homogenous clay and silt-clay mud extended northward to core site 15. The deltaic sediments reached a thickness of about 8 ft (2.4 m) where the northern fringe is next to the karst depression in the southern end of the arm. The urban clay and silts in the deepest portion reached thicknesses of up to 29.9 in. (76 cm) at core 13 and 3.9 in. (10 cm) at core 15. Figure shows the deposition of clay sediments for the 1970-1973 period. Sediment volumes

Figure 10. Core sites in Meginnis Arm.

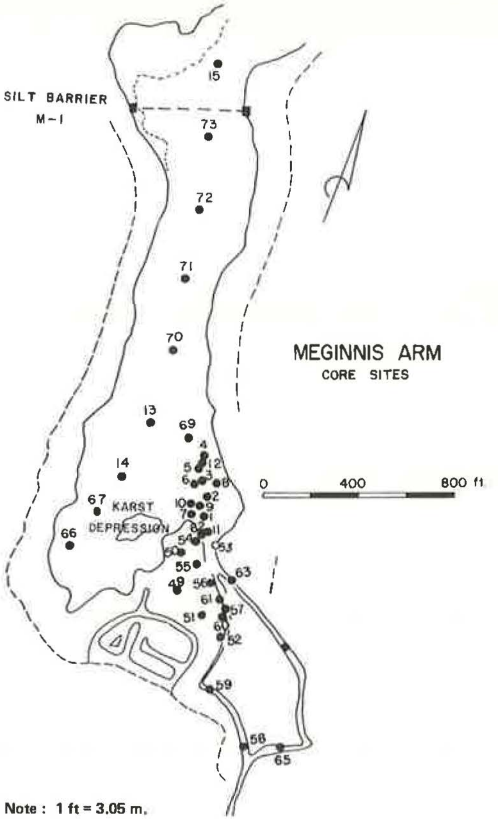


Figure 11. Core sites in Fords Arm.

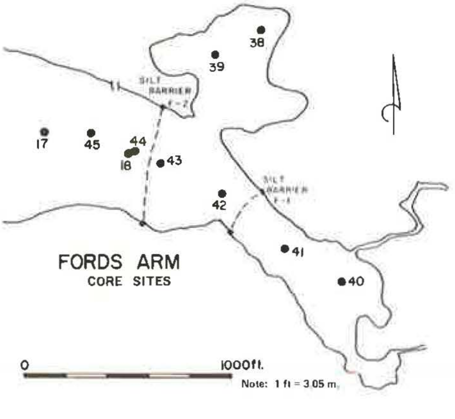
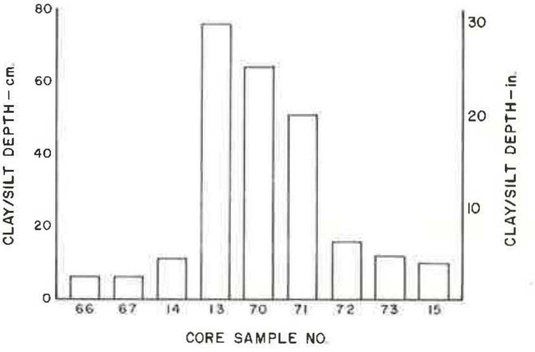


Figure 12. Silt-clay deposition in southern Meginnis Arm.



were estimated to be 15,990 yd³ (12 152.4 m³) for deltaic deposits and 32,850 yd³ (24 996 m³) for nondeltaic clays and silts.

Fords Arm core samples did not indicate any appreciable urban sediment deposition except at core site 40 where a clay-silt fraction of 0.6 ft (18.28 cm) was intermixed with natural organic muck deposits. This is evidence that volumetrically small contributions of suspended fines can create extreme turbidities (up to 500 JTU) with no significant contribution to bottom sedimentation. The noticeable lack of urban sediments was probably a result of the deposition of eroded sediments upland from the arm before runoff entered the lake.

CONCLUSIONS

The high volume of accumulated clay-silt sediments in Meginnis Arm was primarily responsible for the turbidity problems experienced in Lake Jackson. Although little urban sedimentation was detected in Fords Arm, high turbidities on occasion indicated that small volumes of suspended fines can create excessive murkiness under extreme climatic conditions. Extensive erosion controls on the highway construction site were capable of retaining heavier sand-size sediments but were insufficient in removing suspended silts and clays from runoff from either the construction site or the greater portion of the Meginnis Arm watershed not affected by highway construction.

Floating silt barriers can be a significant tool in confining suspended solids to localized areas in aquatic environs. However, silt barriers should not be relied on as a sole means to control erosion pollution. Properly planned on-site erosion controls and construction phasing should take into account worst case conditions where potential sensitive pollution problems may result from erosion during highway construction.

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