IV
OBSERVED CHANGES IN THE SHORELINE PROFILES FROM OCTOBER 1978 TO OCTOBER 1979

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A. Introduction

The five study sites listed in the previous chapter were surveyed on a monthly basis for a one-year period to determine whether there were marked differences in the rate of fastland retreat during the recreational boating season and during other times of the year. The results presented in this chapter show few effects are able to be attributed to the recreational boating activity in a single season. The greatest changes were noted after the passage of Tropical Storm David, which occurred on September 5-6, 1979. Other changes in the surveyed profiles were also measured through the year at three of the sites. But only one site showed any important change in the shoreline profile during the boating season.

These shoreline sites could be resurveyed on a continuing seasonal basis with the landowners' continued permission to see whether trends appear in the profiles during successive seasons when boats, wind-waves, and other factors affect the erosion and transport of sediments.

B. Methods

At each of the sites, three profiling locations were selected with a separation distance of 30 feet. Each

profile was established by inserting two reference pipes or stakes several feet apart on a line perpendicular to the beach or shoreline. The position of the six reference pipes was then surveyed with a transit and rod from a fixed bronze survey marker set in concrete.

When the shoreline profiles were surveyed each month, the ground elevations along each profile were referenced to that of the benchmark using a precision level and rod. The rear reference pipe was considered to be the origin for each profile. The ground elevations were surveyed at 3-foot intervals, and at all additional intermediate points where a slope change occurred. At the two sites with bluffs (Sites B and D) the profiles were extended up the bluff face from the rear stakes, and elevations were surveyed at intervals up to the instrument height.

In order to test the precision of the profiling technique, replications were made at Sites A and B (Figures 4.1, 4.2). Site A was replicated on 11/25/78 with a mean deviation of 0.020 ft. The maximum deviation was 0.075 ft. at the step of the foreshore. This difference could represent a real change in the position and elevation of the step since about one hour elapsed between successive profiles.

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opposite: Figure 4.1 (top) Plot of duplicate surveys at Site A on 11/25/78.

Figure 4.2 (bottom) Plot of duplicate surveys at Site B on 11/4/78.

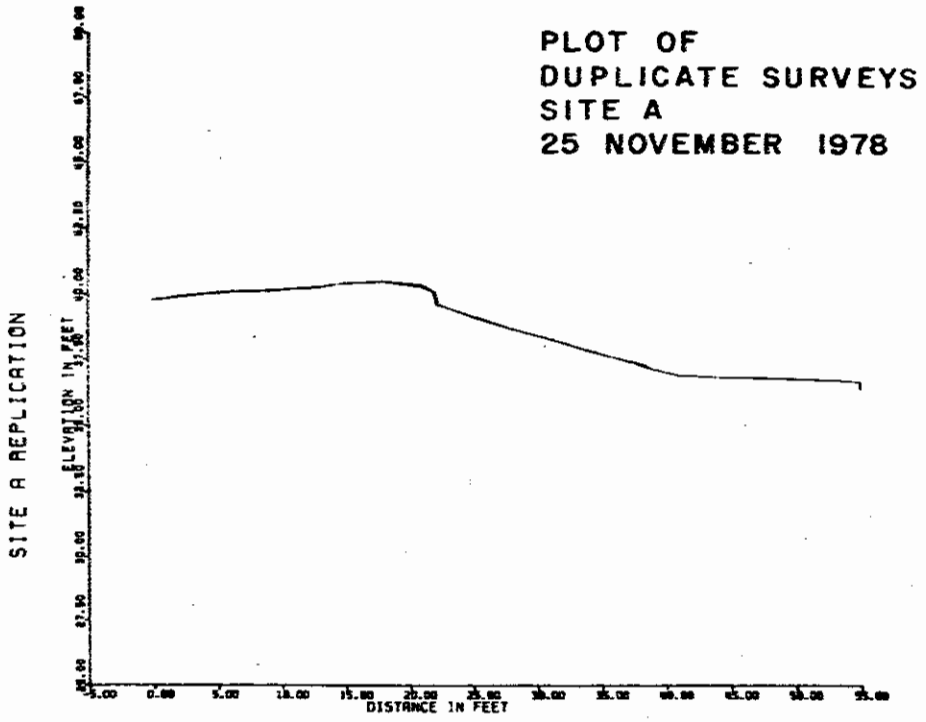

Figure 4.1

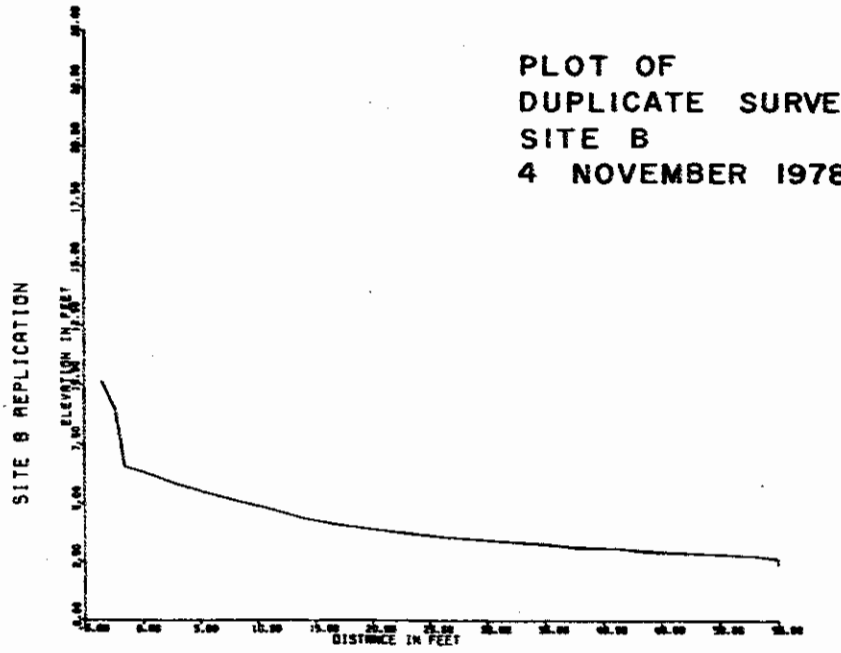

Figure 4.2

The maximum deviation outside of the step zone was 0.052 ft. The comparative plot is shown in Figure 4.1. Site B was replicated on 11/4/78 with a mean deviation of 0.016 ft. The maximum deviation was 0.069 ft. which occurred in the nearshore zone. The mean deviation of elevation within the bluff and beach zone was 0.003 ft. with a maximum deviation of 0.005 ft. The comparative plot is shown in Figure 4.2 The replications indicate that the profiling method is precise enough to discriminate changes in elevation as small as 0.1 foot. The dates when profiles were acquired at all the study sites are shown in Table 4.1.

C. Results

For the year-long period of observations, fastland retreat was measured at three sites (B.C.D). There were changes in the shoreline profile amounting to a reduction in the amount of slumped material at the toe of the bluffs at sites B and D. At site D, some bluff retreat was also measured after Tropical Storm David in early September, 1979. Only at Site C on Broad Creek did significant fastland retreat occur during the boating season.

At all the sites except Site E, there were variations measured in the beach elevations on the shoreline profiles from month to month. These variations were largely restricted to the intertidal zone. Only at

TABLE 4.1

DATES OF PROFILES

Month	SITE A	B	C	D	E
Oct, 1978	29	-	29	29	29
Nov	25	24	25	26	26
Dec	20	20	20	21	21
Jan, 1979	-	-	-	-	-
Feb	3	3	3	3	4
Mar	10	11	10	10	11
Apr	16	16	16	17	17
May	25	26	26	25	26
June	23	23	23	24	24
July	28	28	29	29	29
Aug	-	18	18	18	18
Sep	15	15	15	16	16
Oct, 1979	20	20	20	21	21

Site D was there any significant change in bottom elevations at points seaward of the low-tide line. A detailed description of the shore zone response to boat wakes and wind waves at each site follows.

SITE DESCRIPTIONS

Site A. A vegetated sand spit on the lower South River, at the entrance to Harness Creek

This site is located in the region known as Hillsmere Shores (Figures 4.3, 4.4, 4.5). The beach segment chosen for monitoring is located on a spit which trends north-south along the shoreline. The sediments which form the spit were derived from erosion of an adjacent bluff which forms a headland slightly downstream on the South River. This headland bluff is about 30 feet in elevation, and is composed of interbedded sand, silt and clay deposits of the Talbot Formation (Pleistocene Age), with a thin lower horizon of pebbly sand and gravel exposed (Glaser, 1976).

The spit begins about 500 feet upstream from the zone of active bluff erosion, and is connected to the bluff by a sandy terrace of approximately 3 feet elevation which broadens from the base of the bluff to a width of about 30 feet upstream at the point of spit attachment. This sandy terrace is also experiencing retreat due to frontal erosion

along the South River shoreline. The entire portion of the South River shoreline near the spit is littered with fallen trees.

The mean tide range in the area is approximately 1.0 foot, and there were no shoreline structures present along the reach during the period of study.

The spit itself is about 400 feet in length, and the distal end exhibits a strong recurve. Earlier episodes of sand transport and deposition along the spit have led to the formation of a lagoon on the back side of the spit, and subsequent marsh growth has separated this lagoon from Harness Creek. Downstream from the study site on the spit, there is a frontal scarp which is evidence of active erosion. At the top of this scarp, the ground surface slopes towards the land instead of the water (Figure 4.5); this suggests that erosion and shoreline recession in this portion of the shoreline have already devoured the "spine" of the spit, which was the crest of the earlier natural beach or berm line formed when the spit was growing. Older marsh sediments are exposed on this scarp near the point of spit attachment to the adjacent bluff, and a shell bed up to

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next pages: Figure 4.3 (left) Location map showing Site A.

Figure 4.4 (upper right) Aerial view of Site A.

Figure 4.5 (lower right) Typical profile of Site A in October 1978.

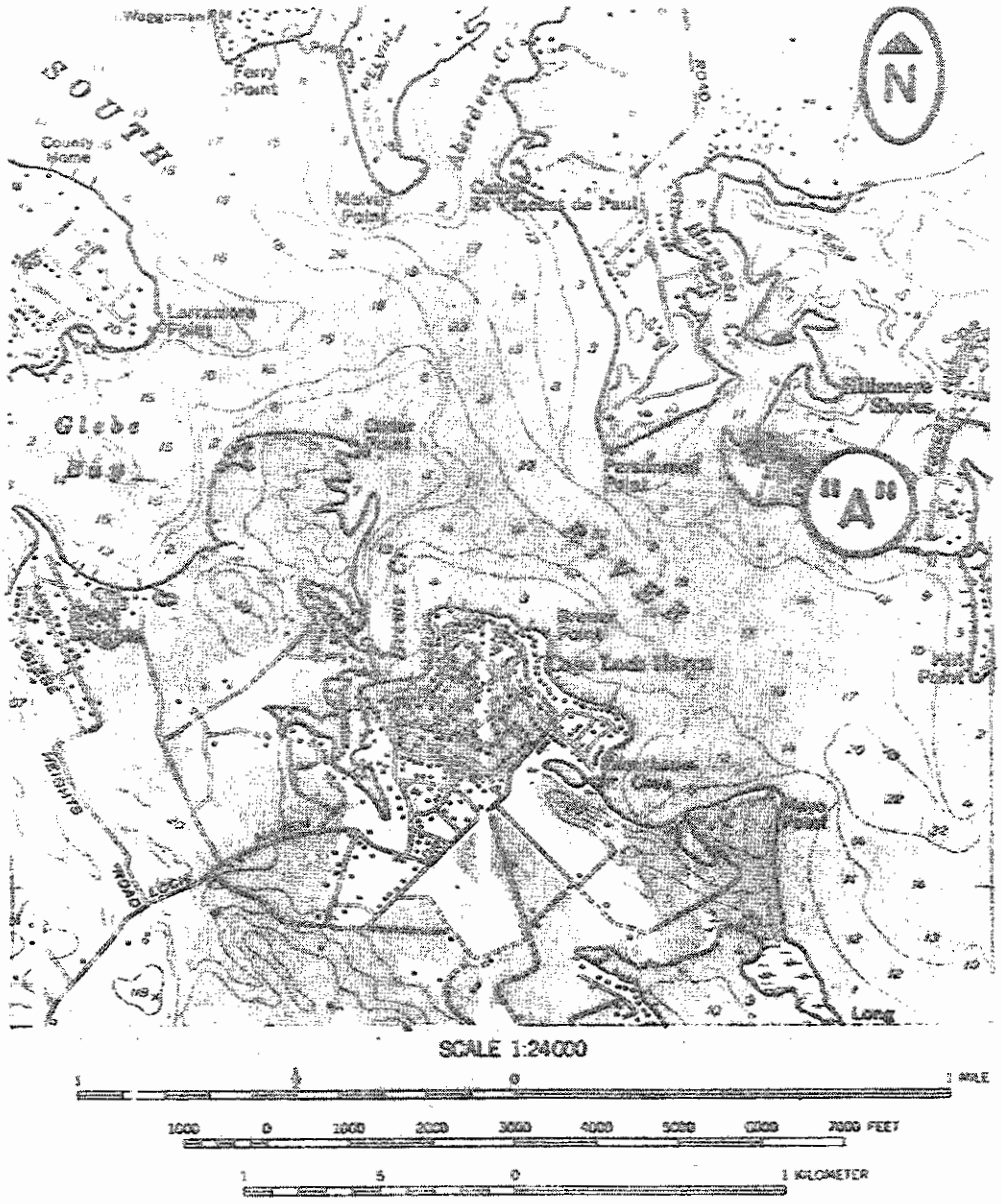

SOUTH
Ferry Point
County Home
Glebe
Point "A"
SCALE 1:24000
1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 KILOMETER

Figure 4.3

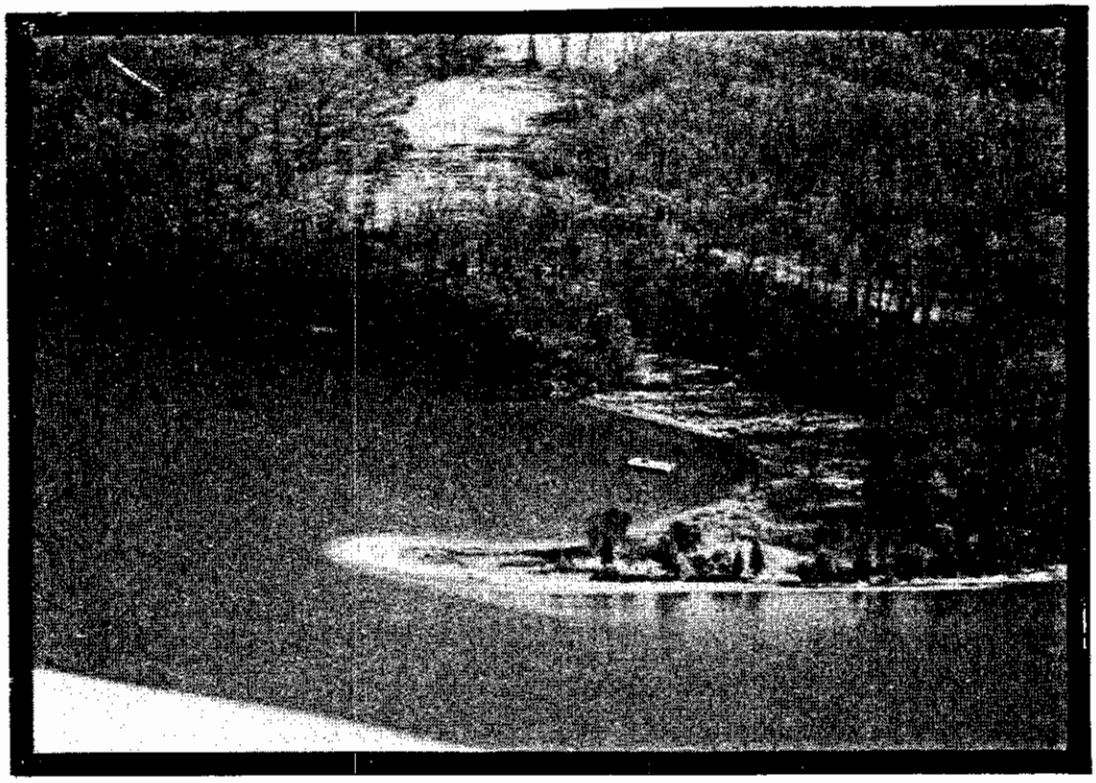


Figure 4.4

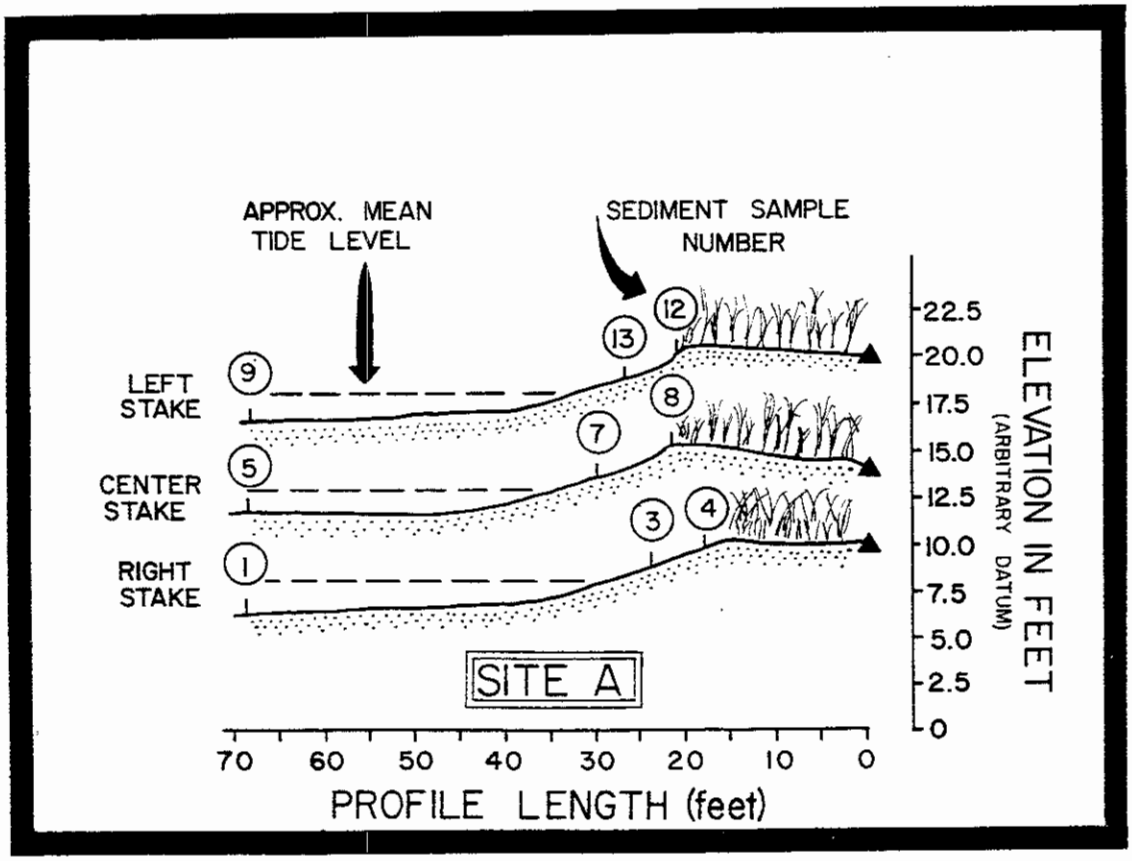


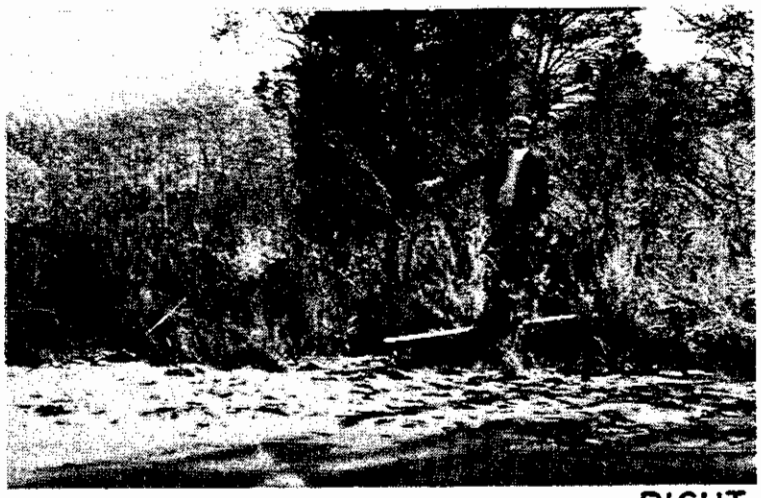
Figure 4.5

1.5 feet thick is also exposed in the scarp. The shells have been eroded and carried all along the beach to form a pavement over the lower foreshore and the immediate nearshore (Figure 4.6a). The eroding shell bed is composed solely of the shells of the oyster Crassostrea virginica, and it apparently represents a shell dump left by earlier inhabitants of the area.

The spit is densely vegetated with shrubs, grasses, and small cedar trees. Sand deposits on the shoreline profiles are very narrow with as little as six feet between the shoreface and the fringe of the vegetation. The profile locations are midway along the length of the spit, with the center profile situated 200 feet from the point of spit attachment.

The profile layout consists of three transects spaced 30 feet apart. Typical profiles (October 1978) are shown in Figure 4.5. In April 1979, the sediments were sampled from the beach in the upper 1-2 inches of the shoreline profiles and the textural characteristics of the sediments are shown in Table 4.2. The offshore zone is represented by samples taken 69 feet from the profile origins, and Table 4.2 shows sediments in this portion of the profile are sandy muds. In contrast, the beach materials represented by the foreshore samples Nos. 3, 7, and 11 are sand containing up to 20%

Next pages: Figure 4.6a-c Photographic view of the three profile locations at Site A in October 1978, May 1979, October 1979.



RIGHT

CENTER

LEFT

SITE "A" OCT. 1978

Figure 4.6a

RIGHT

CENTER

LEFT

SITE "A" MAY 1979

Figure 4.6 b

RIGHT CENTER LEFT

SITE "A" OCT. 1979

Figure 4.6c

TABLE 4.2

SEDIMENT CHARACTERISTICS; SITE A

Sample No.	Profile	Distance From Origin	Zone	*Gravel (>2.0 mm)		Sand (0.062mm to 2mm)		Silt (0.0039 to 0.062mm)		Clay (<0.0039 mm)	
				Mineral	Organic	Mineral	Organic	Mineral	Organic	Mineral	Organic
1	Right	69.0 ft.	Offshore	0.06 gm	-	42.49 gm	0.39 gm	35.91 gm	0.26 gm	17.20 gm	3.68 gm
3	Right	24.0	Foreshore	6.81	-	91.12	0.37	0.29	<0.01	0.30	1.11
4	Right	18.2	Fastland	2.90	-	93.75	0.57	0.57	<0.01	1.29	0.91
5	Center	69.0	Offshore	0.20	-	47.87	0.39	28.71	0.03	19.22	3.58
7	Center	30.0	Foreshore	20.46	-	76.34	0.46	0.33	<0.01	1.31	1.09
8	Center	22.3	Fastland	0.77	-	93.63	0.76	1.04	<0.01	2.74	1.05
9	Left	69.0	Offshore	0.96	-	36.85	0.26	38.05	0.04	20.04	3.80
11	Left	27.0	Foreshore	12.63	-	84.09	0.34	0.04	0.02	1.43	1.45
12	Left	21.7	Fastland	0.72	-	93.53	0.66	1.54	0.04	1.86	1.66

*The numerical values shown represent the fractional weight, in grams, of 100 grams of sample, thus the results may also be interpreted as percentage values.

gravel-size material. The boundary zone between the predominance of sand and mud in the nearshore occurs between 30 and 50 feet on the profiles. The fastland samples taken from the erosion scarp show a composition of sand with minor amounts of gravel; but, this scarp is not considered to be the principal source of the gravels in the beach sediments at the study site. The enrichment of gravels in the beach is probably due principally to the erosion of the downstream bluff, and movement of these materials along the shoreline onto the spit.

The shoreface of the spit receives boat-wake energy from boats entering and exiting Harness Creek, and from boats travelling up and down the South River. Since the width of Harness Creek is only about 500 feet in the vicinity of the profile stations, boats entering or leaving the creek pass relatively close to the shore where the study site is located. On the other hand, boats travelling on the South River commonly pass at distances greater than 1,000 feet from the study site. The boating characteristics at this site are discussed in Chapter VI.

The spit also receives wind waves which approach with the longest fetches from the east, south, and northwest. The wind-wave climate at this site is discussed in Appendix B, and the wind waves and boat wakes are compared in Chapter VII for their relative importance in causing any changes in the shoreline profiles.

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opposite: Table 4.2 Sediment characteristics at Site A. The locations of the samples listed in the table are shown on the profiles in Figure 4.5.

The fastland boundary at Site A was defined as the edge of vegetation. This boundary coincides with a pronounced break in slope formed by the upper foreshore of the beach. On some spring high tides during the year of observation, the wave uprush would reach the limit of vegetation to form a scarp. Photographic views of the three profiles which are shown in Figures 4.6 a,b,c for the months of October 1978, May 1979, and October 1979, respectively, were selected from all the monthly photographs to illustrate the conditions at the beginning and end of the "non-boating season" (October 1978 - May 1979), and at the end of the "boating season" (May 1979 October 1979). The complete monthly photographic coverage is on file at the Coastal Resources Division of the Maryland Department of Natural Resources.

Profile comparisons between successive months are shown in Figure 4.7. The envelope of total change is shown in Figures 4.8a and b. The combined profile overlay for the period October 1978 - May 1979 (Figure 4.8a) clearly shows the modulation of beach foreshore elevations from month to month, and the virtual absence of any change in the nearshore bottom. The greatest total vertical change within the envelope was at the upper foreshore adjacent to the fastland boundary.

The combined profile overlay for the period May-October 1979 (Figure 4.8b) shows that some modulation of foreshore elevation occurs during the boating season. There was also measurable retreat of about 0.5 feet in the fastland boundary on the left and right profiles during the boating

season, but this is due principally to a fastland retreat solely in the profiles of 07/28/79 and 09/15/79. The changes in the shoreline profiles during this time period can be reasonably attributed to the influence of the passage of Tropical Storm David on September 5-6, 1979. During the passage of David, a storm surge of about 2.5 feet was generated in the vicinity of the study area along with strong winds from the southeast. Under these conditions, the entire spit was awash and subjected to wave and current energy.

It is important to note that during the boating season (the profile period 05/25/79 to 07/28/79), no retreat of the fastland occurred at any of the three profile stations. In fact, very little difference in foreshore elevation is evidenced in the profiles for those months. In order to emphasize the changes in the zone of the fastland boundary, segments of the monthly profiles which were collected through time are shown "stacked" in Figure 4.7. The vertical reference lines represent the position of the fastland boundary (edge of vegetation) in October, 1978. Again, note the absence of scarp retreat between the May and July surveys.

Next pages: Figure 4.7 (left) Profile comparisons between successive months at Site A.

Figure 4.8a (upper right) Profile overlay for Site A from October 1978 to May 1979.

Figure 4.8b (lower right) Profile overlay for Site A from May 1979 to October 1979.

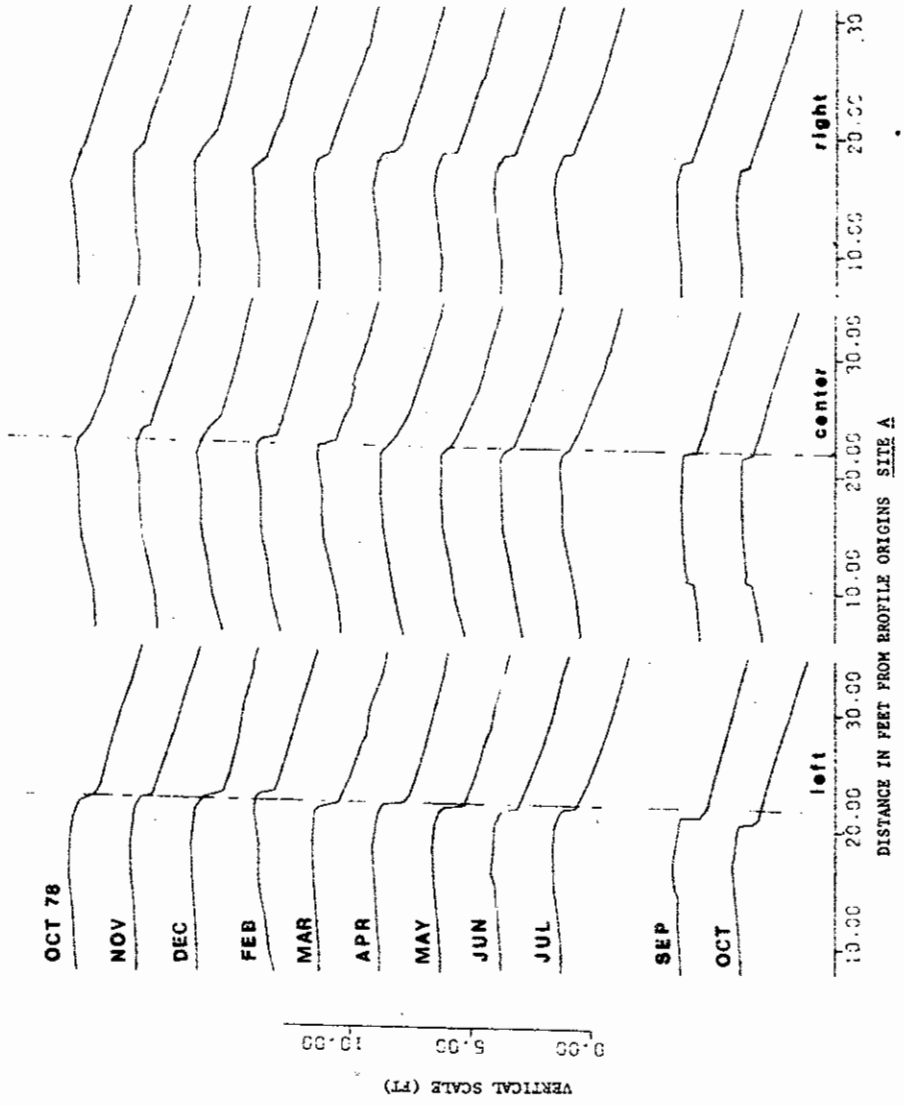
OCT 78
NOV
DEC
FEB
MAR
APR
MAY
JUN
JUL
SEP
OCT
left
center
right
10.00
20.00
30.00
DISTANCE IN FEET FROM PROFILE ORIGINS SITE A
VERTICAL SCALE (FT)
0.00
5.00
10.00

Figure 4.7

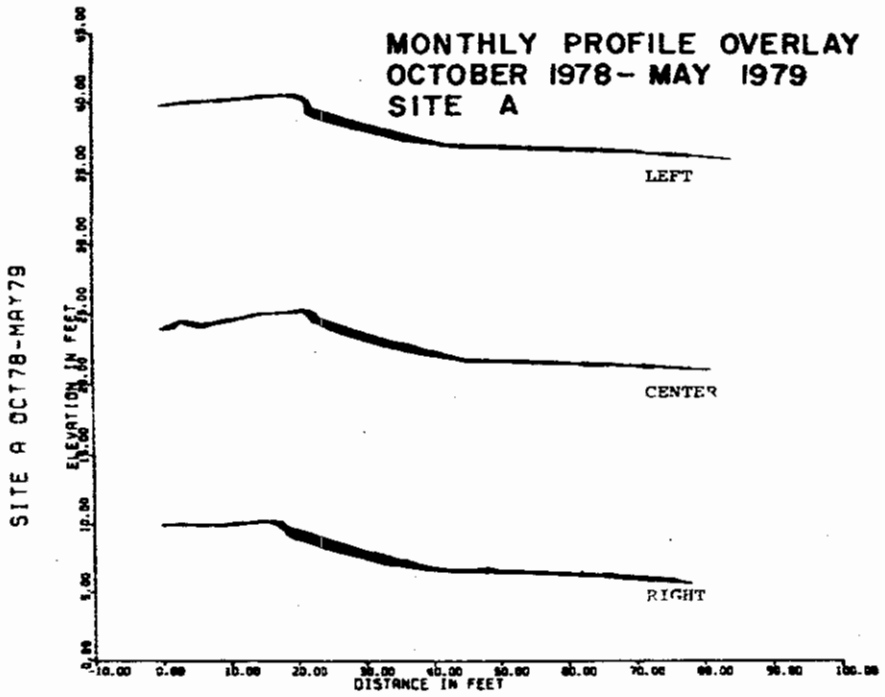

Figure 4.8 a

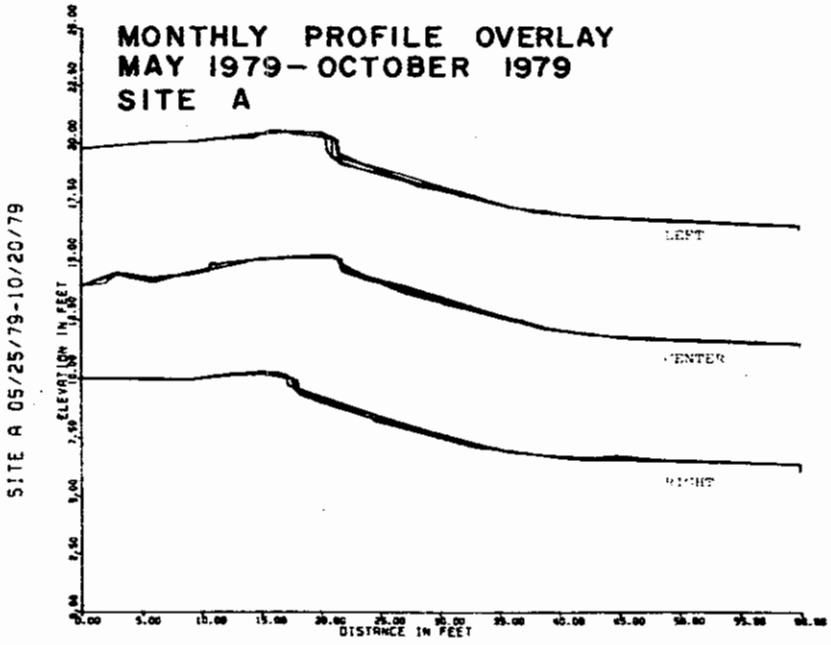

Figure 4.8 b

The evidence from the monthly surveys and photographs indicates there was very little change in the position of the fastland boundary during the year of observations. The scarp between the edge of the active vegetation and the beach foreshore varied in elevation and steepness through the course of the year along with a variation in the volume of foreshore sand at the shoreline site. This modulation in beach sand occurred in response to varying wave conditions and water levels. The profiles collected during the "boating season" on 05/25/79, 06/23/79, and 07/28/29 are virtually identical. Thus, boat wake activity did not cause measurable monthly changes at Site A during that period. The fastland retreat which was observed in the survey of 09/15/79 at two of the profiles is attributed to the wave and water level conditions during Tropical Storm David.

Site B. A steep bank on the upper South River near Goose Island.

This site is located near the subdivision known as Glen Isle (Figures 4.9, 4.10, 4.11). The beach segment chosen for monitoring is located in a bluff section on the south shore of the upper South River, about 700 feet downstream from the mouth of Flat Creek. The sediments on the beach at the study site are derived principally from the bluff, but the finer-grained sediments in the nearshore may be derived principally from the sediment discharge of Flat Creek. The bluff has a maximum height of about 30 feet, and a frontal slope of about 45 degrees. It is composed of semi-consolidated clayey sands of the Aquia Formation (Eocene Age) that contain impermeable lenses of sediment cemented into a sandstone-type material. As the bluff has eroded, these limonitic deposits have fallen onto the beach at the base on the bluff and form a rubble pavement on the shoreline profile.

The bluff extends for about 500 feet along the upper South River shoreline, from the mouth of Flat Creek to a marsh which has formed at the mouth of a ravine. There

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Next pages: Figure 4.9 (left) Location map showing Site B.

Figure 4.10 (upper right) Aerial view of Site B.

Figure 4.11 (lower right) Typical profile of Site B in November 1978.

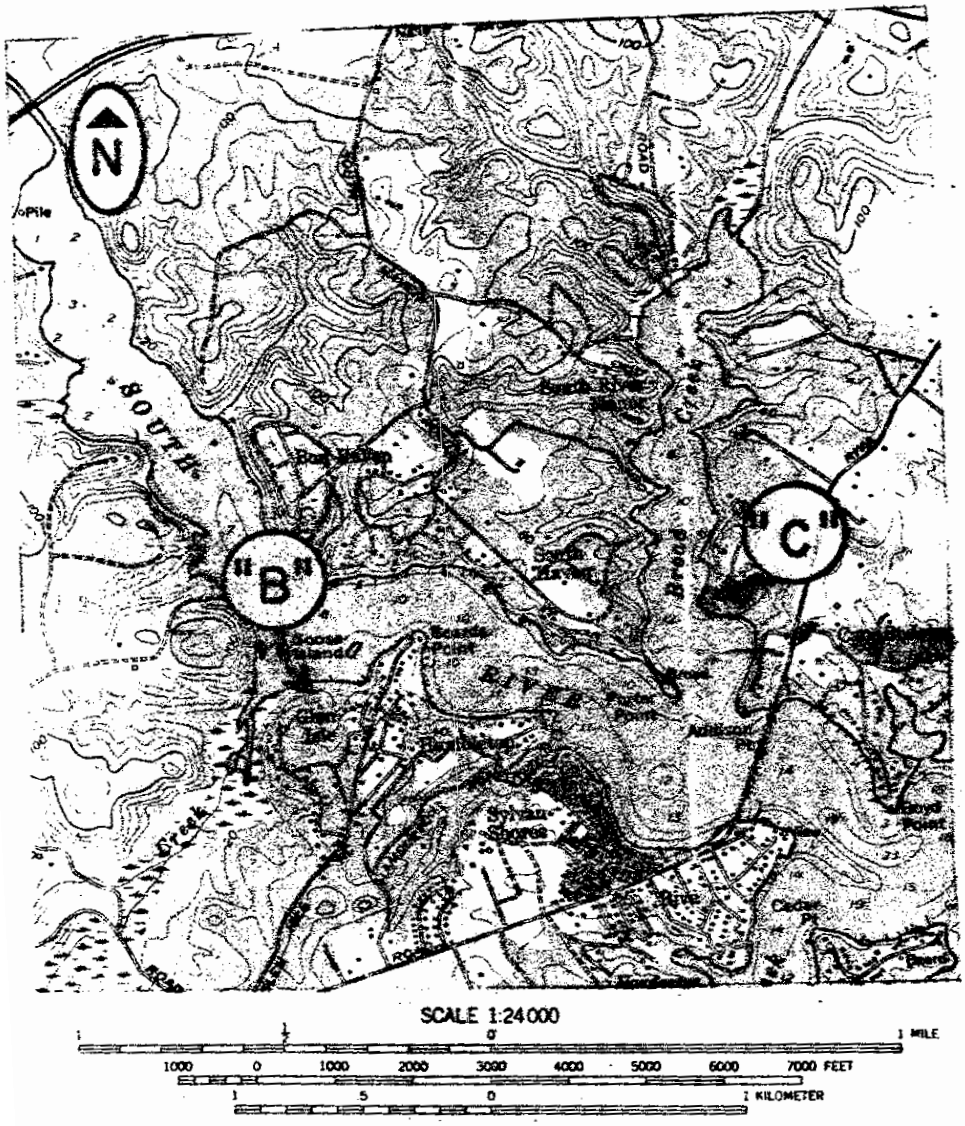
N
"B"
"C"
SCALE 1:24000
1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 KILOMETER

Figure 4.9

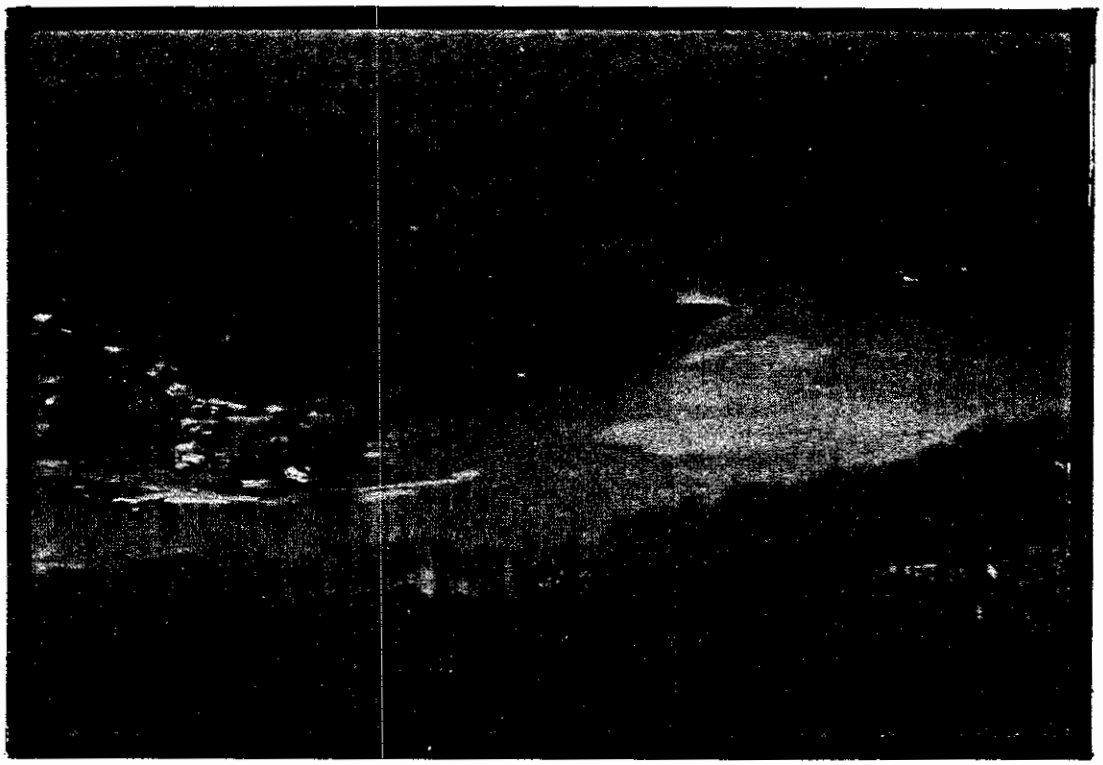

Figure 4.10

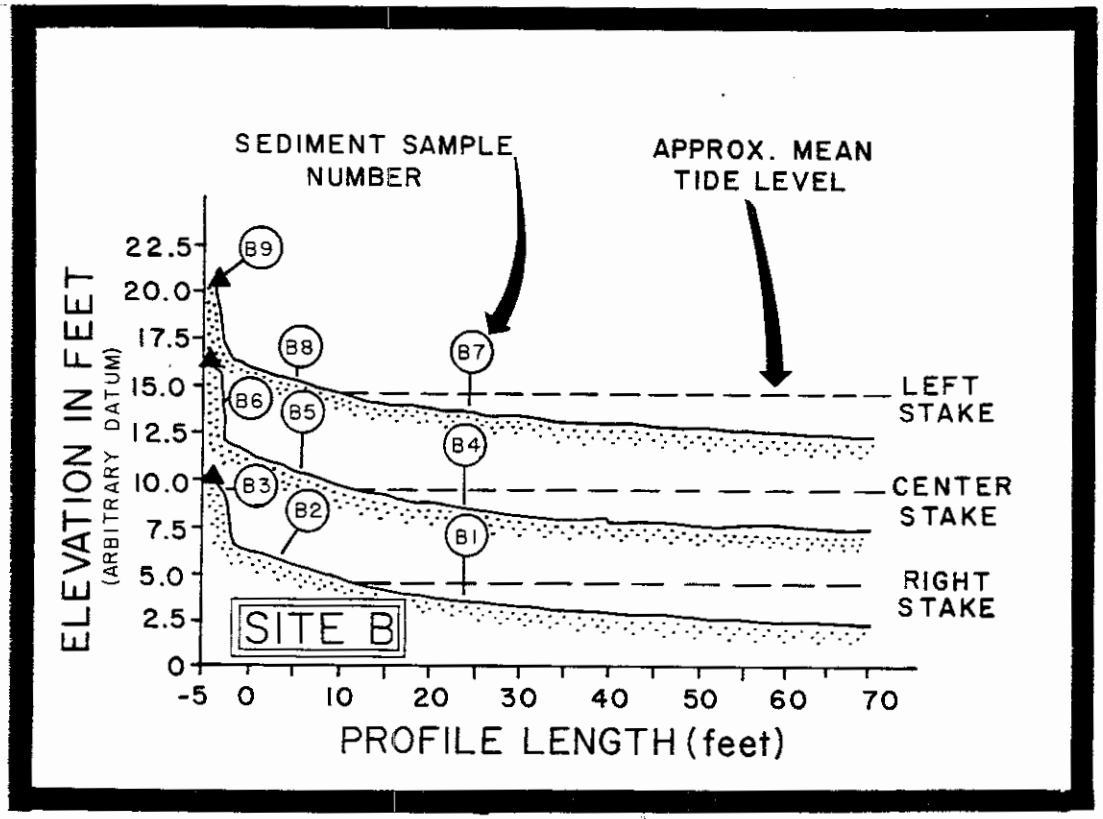

Figure 4.11

TABLE 4.3

SEDIMENT CHARACTERISTICS; SITE B

Sample No.	Profile	Distance From Origin	Zone	*Gravel (>2.0 mm)		Sand (0.062mm to 2mm)		Silt (0.0039 to 0.062mm)		Clay (<0.0039 mm)	
				Mineral	Organic	Mineral	Organic	Mineral	Organic	Mineral	Organic
B1	Right	24.0 ft.	Nearshore	18.71 gm	-	66.11 gm	1.60 gm	4.23 gm	1.04 gm	6.15 gm	2.15 gm
B2	Right	3.0	Foreshore	5.04	-	83.81	0.76	1.34	0.05	7.13	1.87
B3	Right	-3.1	Bluff	1.48	-	68.44	3.00	14.26	0.75	11.54	3.52
B4	Center	24.0	Nearshore	22.17	-	65.08	0.86	4.43	0.30	4.84	2.32
B5	Center	5.0	Foreshore	11.92	-	82.26	0.41	0.82	<0.01	2.72	1.86
B6	Center	-2.4	Bluff	1.51	-	77.40	0.86	3.89	0.09	13.67	2.58
B7	Left	24.0	Nearshore	44.28	-	43.70	0.53	4.60	0.03	5.06	1.80
B8	Left	5.0	Foreshore	2.84	-	85.91	0.87	1.62	0.30	6.72	1.74
B9	Left	-4.2	Bluff	6.48	-	78.71	0.80	0.42	<0.01	11.83	2.26

*The numerical values shown represent the component weight, in grams, of 100 grams of sample, thus the results may also be interpreted as percentage values.

are mature trees and shrubs located on the top of the bluff, and the upper portions of the bluff face are covered with a slumped and hanging mass of soil and roots.

The mean tide range at the site is about 1.0 foot, and there were no shoreline structures present along the reach during the period of study.

Sand deposits on shoreline profiles at this site are narrow, with as little as 10 feet between the shoreface and the toe of the bluff. The profile locations for the study are located at the downstream end of the bluff, where the land surface slopes into the ravine, and just before the beach joins with the marsh. The profile layout consists of three transects spaced 30 feet apart. Typical profiles (November 1978) are shown in Figure 4.11. In April 1979, the sediments were sampled from the beach in the upper 1-2 inches of the shoreline profiles, and the textural characteristics of the sediments are shown in Table 4.3. The offshore zone is composed of soft, fine-grained muds which blend into a relatively firm sandy bottom about 30 feet from the shoreline. These sands on the beach and in the nearshore possess a significant gravel content which represents the lag deposit left on the shoreline profile as the bluff recedes. Sediment samples from the bluff are composed predominantly of sand, but with a significant

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Opposite: Table 4.3 Sediment characteristics at Site B. The locations of the samples listed in the Table are shown on the profiles in Figure 4.11.

fine-grained component. As the bluff sediments erode, the finer-grained sediments are winnowed from the talus deposits at the base of the bluff by wave action and transported into deeper water.

The shoreface of the bluff receives boat-wake energy mostly from boats travelling the South River at distances of more than 1,000 feet. Some localized boat activity is generated from a smaller number of boats which circle Goose Island and pass within 100-200 feet of the study site. The boating characteristics at the site are discussed in Chapter VI.

The bluff site also receives wind waves which approach with the longest fetches from the north-northwest. Regional winds from this direction can generate appreciable wave energy which would focus on the site; but, these winds also tend to drive water out of the rivers on the western shore so that the erosive power of the waves tends to be expended at low levels on the beach and in the nearshore, rather than on the toe of the bluff. The wind-wave climate at this site is discussed in Appendix B, and the wind waves and boat wakes are compared in Chapter VII for their relative importance in causing any changes in the shoreline profiles.

The fastland boundary at Site B was defined as either the in-place semi-consolidated sediments forming the bluff, or the material which slumped from the bluff face. The reason for considering the slumped material as "fastland" is that were it not for the removal of this material by wave

action, the bluff slope would ultimately be reduced and become stabilized with vegetation.

The initial condition of the profile sites is shown in the photographs of October, 1978 (Figure 4.12a). The Right profile is at a position where the bluff elevation is low and the semi-consolidated sediments were covered with a soil horizon. At the Center profile, the fastland is slumped material with limonitic fragments at the base, along with a notch about 0.75 feet deep cut into the sediment. The Left profile is a near-vertical cut of the native bluff sediments with a toe of limonitic fragments.

Figures 4.12b, b, and d show the condition at the profiles in May, August, and October, 1979 respectively. Profile comparisons between successive months are shown in Figure 4.13. The envelope of total change is shown in Figures 4.14a and b for the periods October 1978 - May 1979 respectively. The combined profile overlay shows there was no change in the fastland throughout the entire year at the Right profile, simply a modulation of the sand elevation in the beach at the toe of the bluff. During the period October 1978 - May 1979, the Left and Center profiles show an episode of slumping and reduction of the slump by wave action. During the period May-October, 1979, there was some further modification of the slumped material at the Center

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Next pages: Figure 4.12 a-d. Photographic views of the three profile locations at Site B in October 1978, May 1979, August 1979, October 1979.

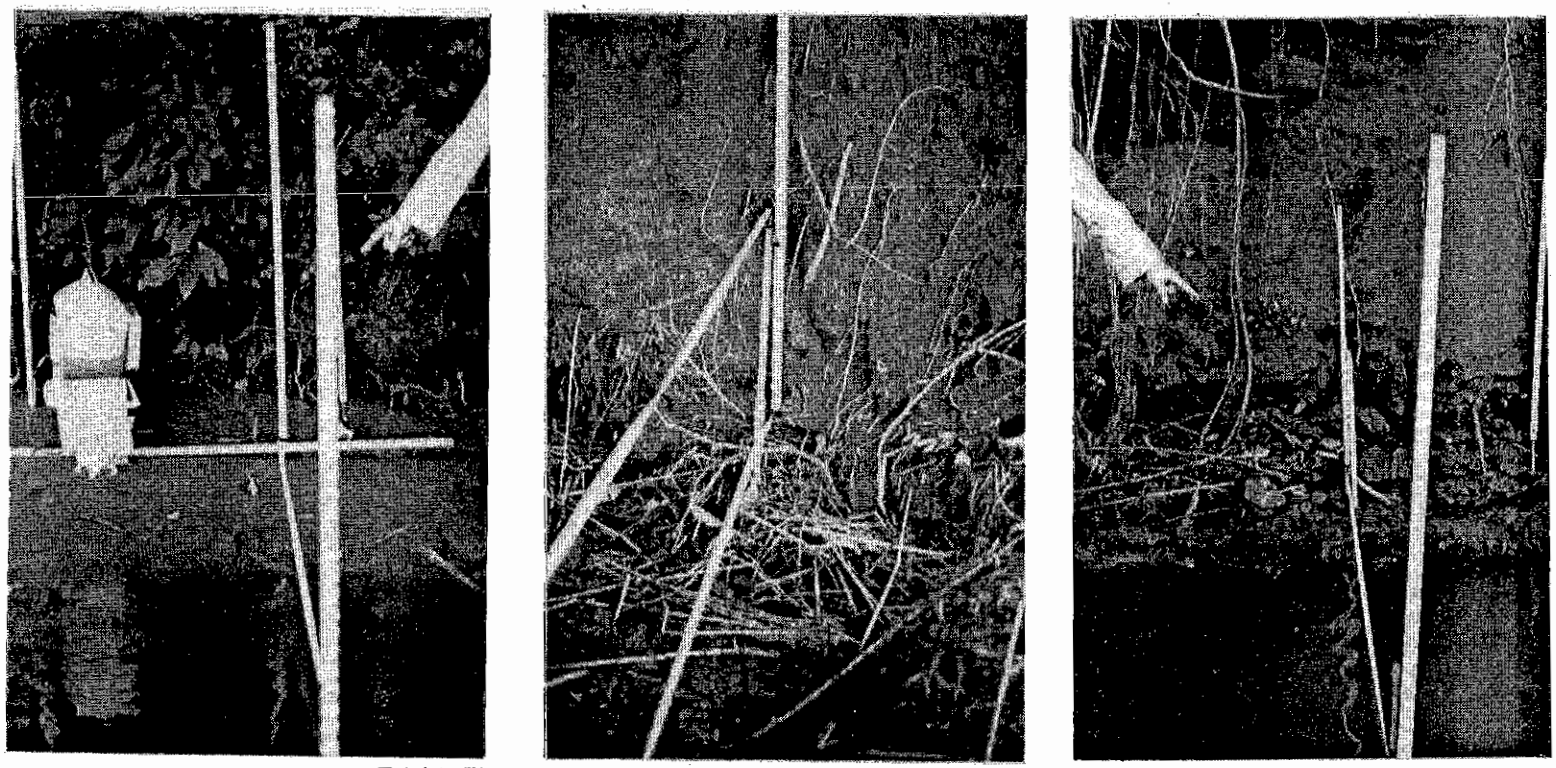
RIGHT

CENTER

LEFT

SITE "B" OCT. 1978

Figure 4.12a

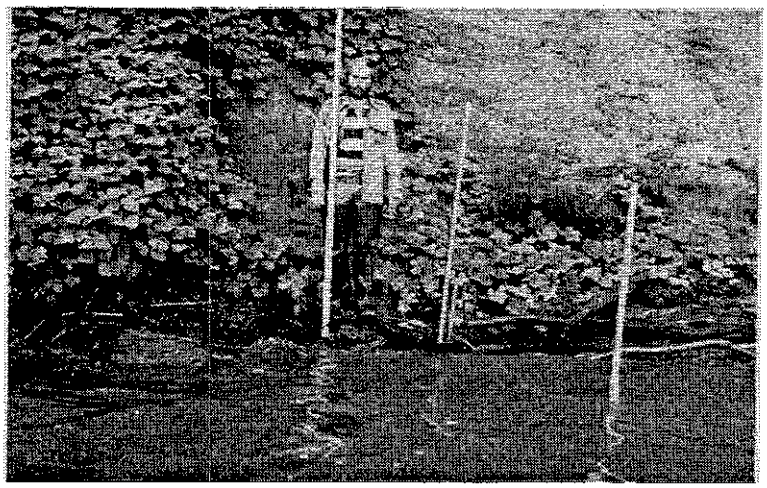


RIGHT CENTER LEFT

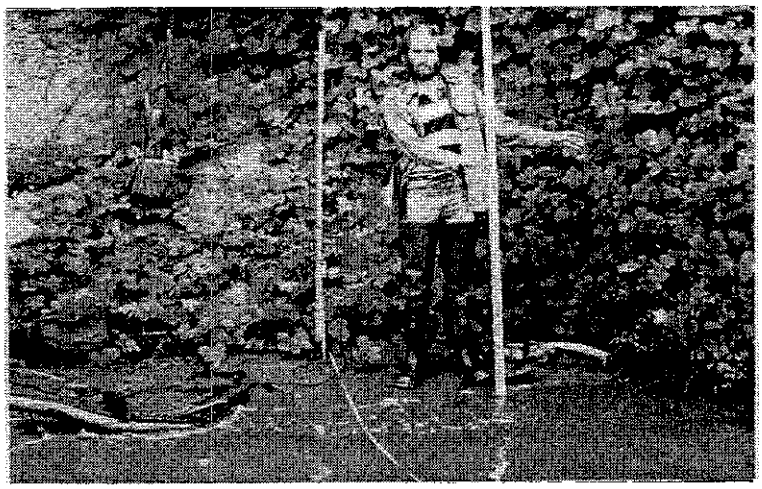
SITE "B" MAY 1979

Figure 4.12 b

RIGHT



CENTER



LEFT

SITE "B" AUG. 1979

Figure 4.12c

RIGHT CENTER LEFT

SITE "B" OCT. 1979

Figure 4.12d

and Left profiles, and again no change in fastland at the Right profile.

A different view of the fastland boundary changes is provided in Figure 4.13. This figure shows that no change in the Right profile occurred throughout the entire year, while the Center profile showed no change in fastland until sometime between the February and March 1979 surveys, when a massive slump occurred. The slumped material underwent some reduction by wave action until April-May 1979, and then only very minor modification until the passage of Tropical Storm David in September 1979. The Left profile shows minor slumping between October-December 1978, and a massive slump between December 1978 and early February 1979. The slumped material was again reduced by wave action in February, March, and April. However between the late May and late August surveys in 1979, there was little modification. Tropical Storm David in September was accompanied by a substantial reduction of the slumped material, and Figure 4.12d shows the native bluff material was again exposed after David.

All the evidence indicates there was little modification of the fastland at this site during the boating season. However, there was significant modification of two of the three profile locations with the passage of Tropical Storm David. Figure 4.13 shows the approximate level of the storm tidal surge during the David episode. This site was apparently not exposed to much high wave action since the

wind was predominantly from the southeast and south. Even so, the shoreline profiles collected after David show the slumped material at the Center and Left profiles was reduced. The Right profile showed no change.

In summary, it should be noted that very minor changes occurred during the boating season of 1979. Comparison of the month-to-month surveys shows this was the period of least response in the shoreline profiles to wave activity during the year of observations.

Next pages: Figure 4.13 (left) Profile comparisons between successive months at Site B.

Figure 4.14a (upper right) Profile overlay for Site B from October 1978 to May 1979.

Figure 4.14b (lower right) Profile overlay for Site B from May 1979 to October 1979.

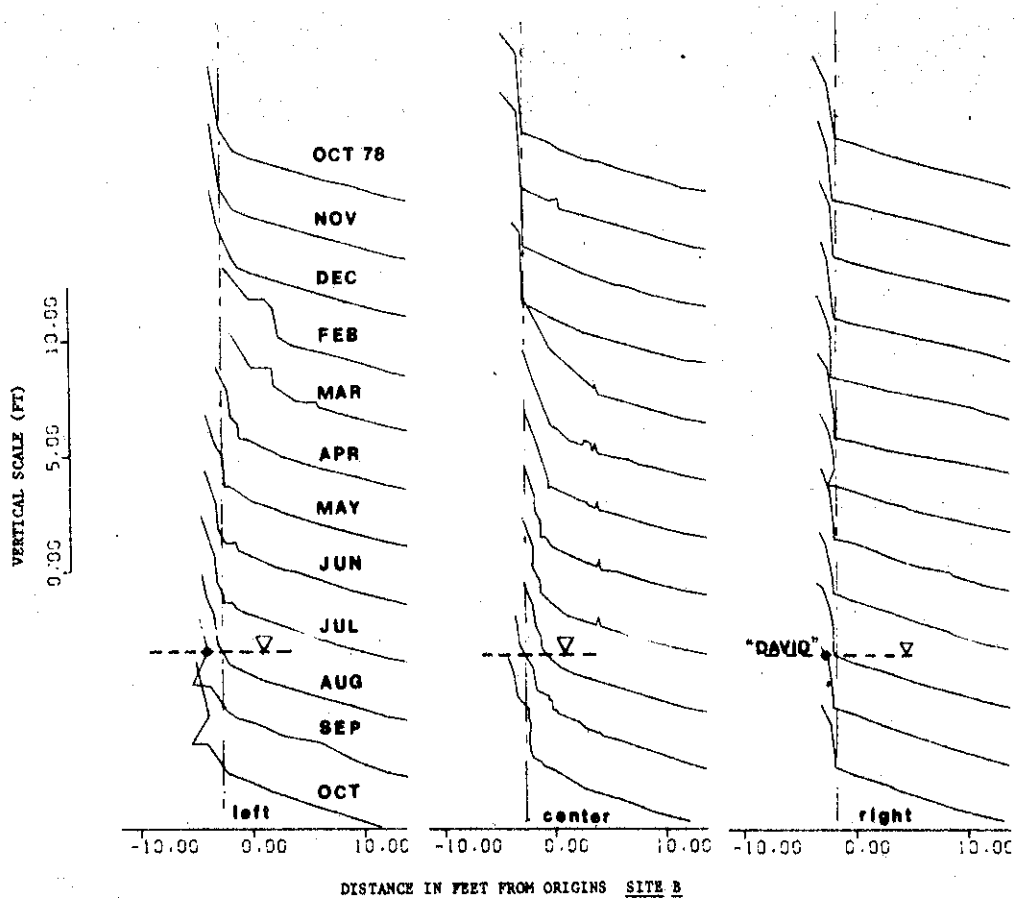

OCT 78
NOV
DEC
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
"DAVID"
left
center
right
VERTICAL SCALE (FT)
0.00
5.00
10.00
-10.00
0.00
10.00
DISTANCE IN FEET FROM ORIGINS SITE B

Figure 4.13

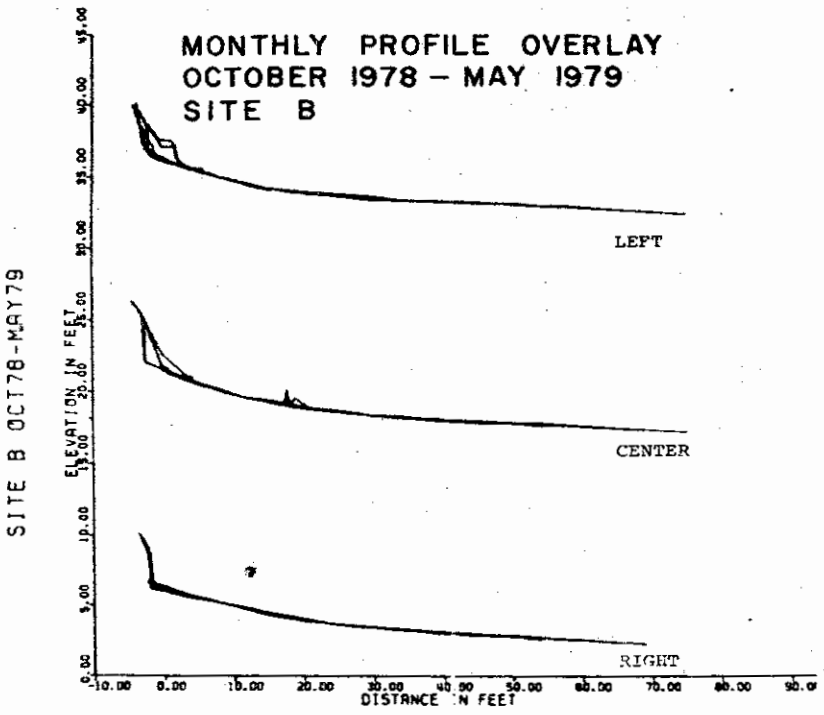


Figure 4.14 a

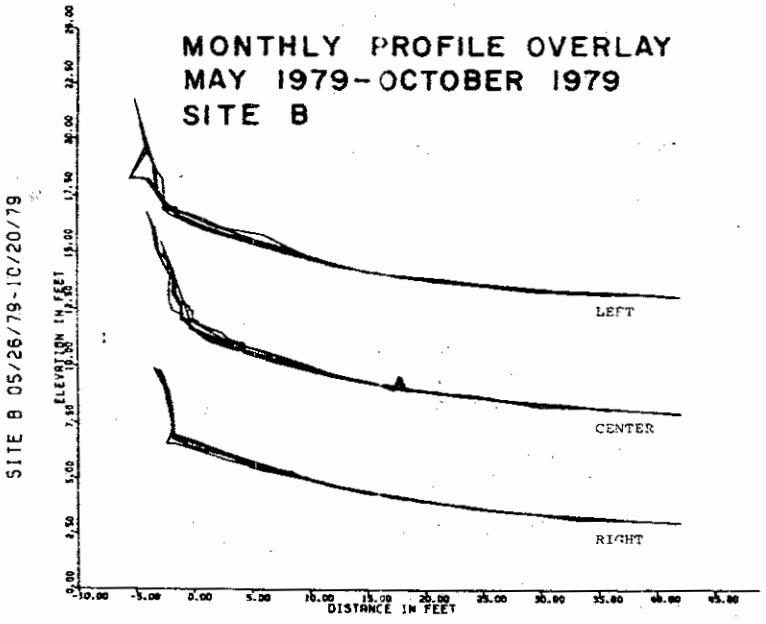


Figure 4.14 b

Site C. A broad, marshy promontory on Broad Creek off the upper South River.

This site is located approximately 1200 feet north of the mouth of Broad Creek (Figure 4.15, 4.16, 4.17). The shoreline segment chosen for monitoring is located on a promontory at the junction of a north-south shoreline reach and another trending east-west. The promontory is composed of a low, marsh-capped, alluvial platform which is surrounded by hills attaining elevations of up to 60 feet within 500 feet of the study site. This adjacent topography is sculptured from sandy deposits of the Aquia Formation (Eocene Age).

The sediments at the study site were derived partially from the erosion of these adjacent landforms. Various exhumed debris from along the shoreline near the study site indicates that the site may also be partially composed of artificial fill. Upstream of the promontory for a distance of about 100 feet along the shoreline are the remains of a concrete wall which are columnar in section, and about one-foot-square. These remains no longer provide an effective barrier to shoreline erosion as they lay on the bottom of Broad Creek several feet from the fastland at the study site.

In the area where the profiles were located, the promontory forms a portion of the Broad Creek shoreline about 130 feet in length. The fastland at the study site is

relatively flat, with an overwash "levee" present on the marsh surface (Figure 4.17). The marsh itself is flooded at higher tidal stages, and is composed of Spartina patens, Scirpus, and Distichlis grass species.

The mean tide range in the area is about 1.0 foot, and there were no shoreline structures present along the reach during the period of study.

Sand deposits on the shoreline profiles are narrow with as little as 10 feet between the shoreface and edge of the marsh. The profile locations are situated on the promontory along the east side of Broad Creek facing the west. The profile layout consists of three transects spaced 30 feet apart. Typical profiles (October, 1978) are shown in Figure 4.17. In April 1979, sediments were sampled from the beach in the upper 1-2 inches of the shoreline profiles, and the textural characteristics of the sediments are shown in Table 4.4. The sediments in the foreshore, nearshore, and offshore (up to 69 feet from the profile origins) are all predominantly sand size with small contributions of organics. The composition of the terrace sediments is shown in a boring sample M1. The upper 2-3 inches of the boring are an organic soil with an abrupt transition below to a sandy gravel.

Next pages: Figure 4.15 (left) Location map showing Site C.

Figure 4.16 (upper right) Aerial view of Site C.

Figure 4.17 (lower right) Typical profile of Site C in October 1978.

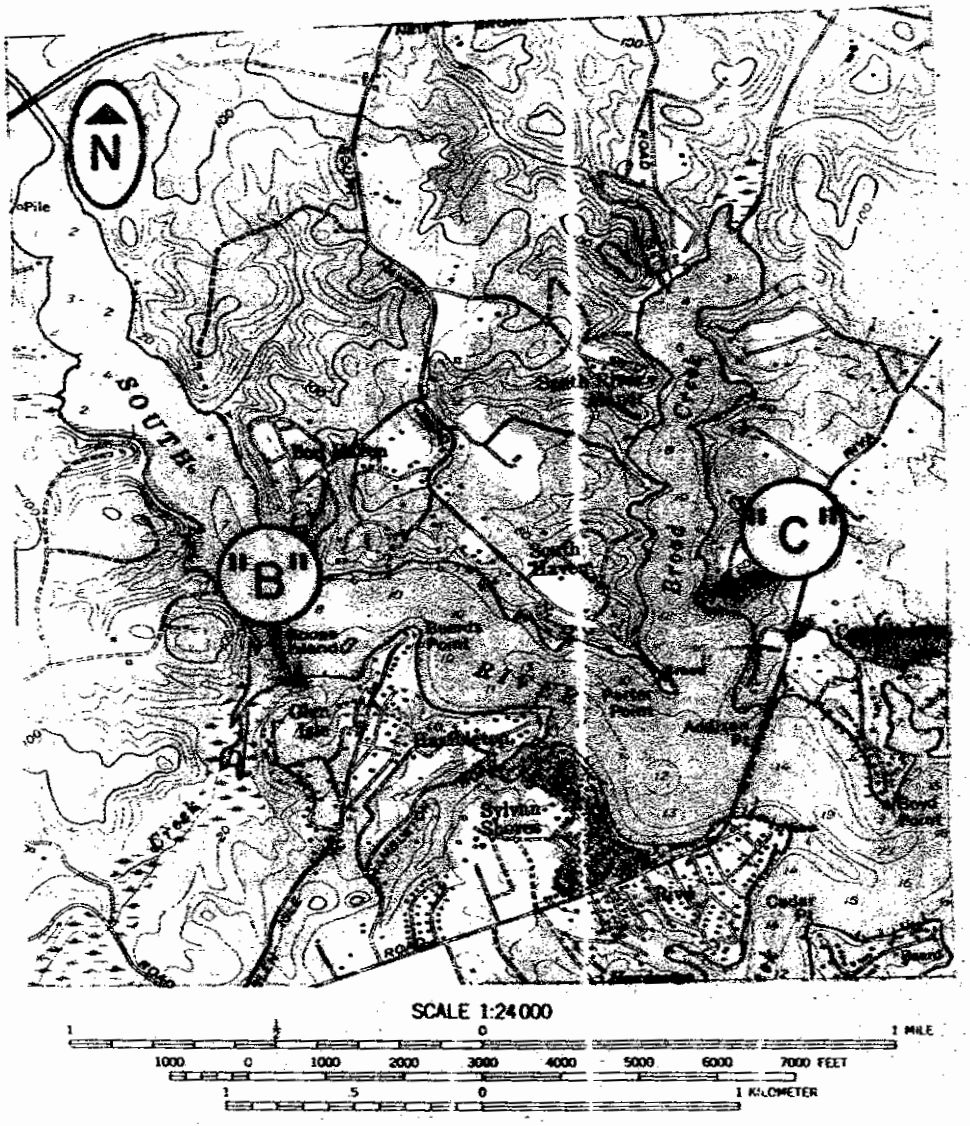

N
"B"
"C"
SOUTH
Creek
Broad
SCALE 1:24000
1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 KILOMETER

Figure 4.15

Figure 4.16

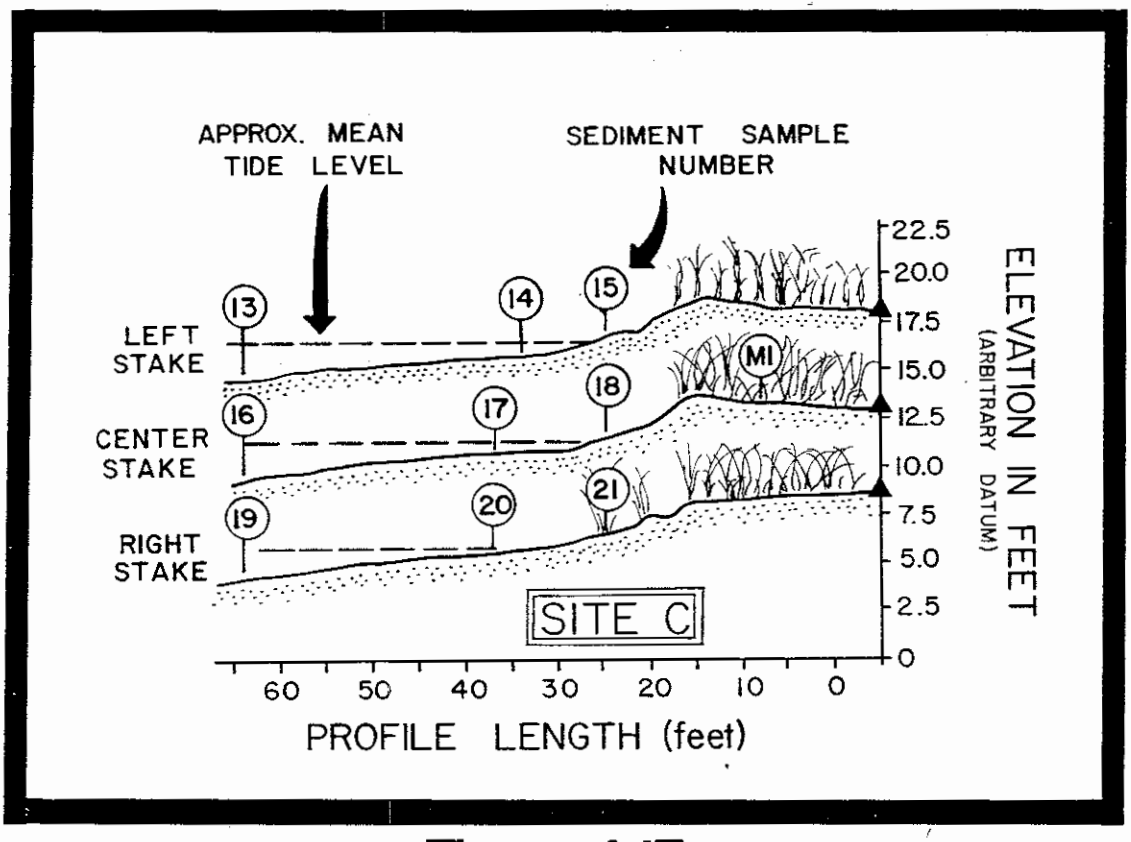


Figure 4.17

TABLE 4.4

SEDIMENT CHARACTERISTICS; SITE C

Sample No.	Profile	Distance From Origin	Zone	*Gravel (<2.0 mm)		Sand (0.062mm to 2mm)		Silt (0.0039 to 0.062mm)		Clay (<0.0039 mm)	
				Mineral	Organic	Mineral	Organic	Mineral	Organic	Mineral	Organic
19	Right	69.0 ft.	Offshore	3.58	-	89.79	0.54	1.25	0.12	3.01	1.70
20	Right	42.0	Nearshore	2.20	-	90.90	0.36	1.57	0.08	2.98	1.91
21	Right	30.0	Foreshore	7.49	-	87.92	0.26	0.75	0.13	1.51	1.94
16	Center	69.0	Offshore	2.10	-	91.26	0.55	1.85	0.19	2.48	1.57
17	Center	42.0	Nearshore	0.84	-	93.66	0.28	1.00	0.38	2.14	1.71
18	Center	30.0	Foreshore	15.60	-	80.90	0.24	0.67	<0.01	1.00	1.59
M1	Center	13.0	Marsh Terrace	47.49	-	46.94	0.19	2.14	0.40	0.88	1.98
13	Left	69.0	Offshore	1.02	-	93.84	0.38	0.96	0.10	1.74	1.96
14	Left	39.0	Nearshore	1.59	-	89.90	0.45	1.94	1.04	3.13	1.94
15	Left	30.0	Foreshore	0.78	-	94.82	0.48	0.57	0.33	1.40	1.63

*The numerical values shown represent the fractional weight, in grams, of 100 grams of sample, thus the results may also be interpreted as percentage values.

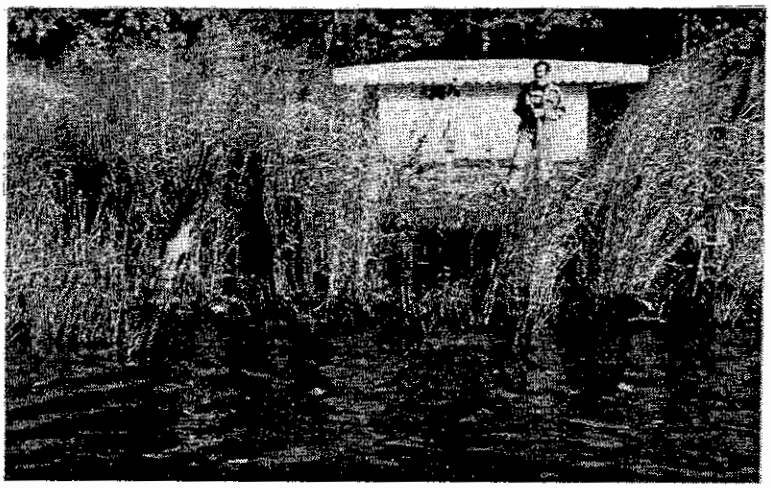
The shoreface of the promontory receives boat-wake energy from boats travelling up and down Broad Creek. The site is downstream from a posted speed-control zone, and both high- and low-speed boat passes are encountered. Due to the relatively narrow width of the creek in the area, the study site is positioned particularly close to boats generating wake. The boating characteristics at this site are discussed in Chapter VI.

The site also receives wind waves which approach with the longest fetches from the north. But waves generated by these northern winds have to undergo considerable refraction to approach the study site from directly offshore, so the wind-wave energy at this site is considered to be small relative to sites with similar fetches on the South River. The wind-wave climate at this site is discussed in Appendix B and the wind waves and boat wakes are compared in Chapter VII for their relative importance in causing any changes in the shoreline profiles.

The initial condition of the profile sites is shown in the photographs of October, 1978 (Figure 4.18a). The fast-land boundary was defined as the edge of the marsh vegetation capping the sand and gravel terrace. At all three profile locations, collapsed patches of the cap marsh were growing on the intertidal foreshore of the narrow beach.

Opposite: Table 4.4 Sediment characteristics at Site C. The locations of the samples listed in the Table are shown on the profiles in Figure 4.17.

Next pages: Figure 4.18 a-d Photographic view of the three profile locations at Site C in October 1978, May 1979, August 1979, and October 1979.



RIGHT

CENTER

LEFT

SITE "C" OCT. 1978

Figure 4.18a

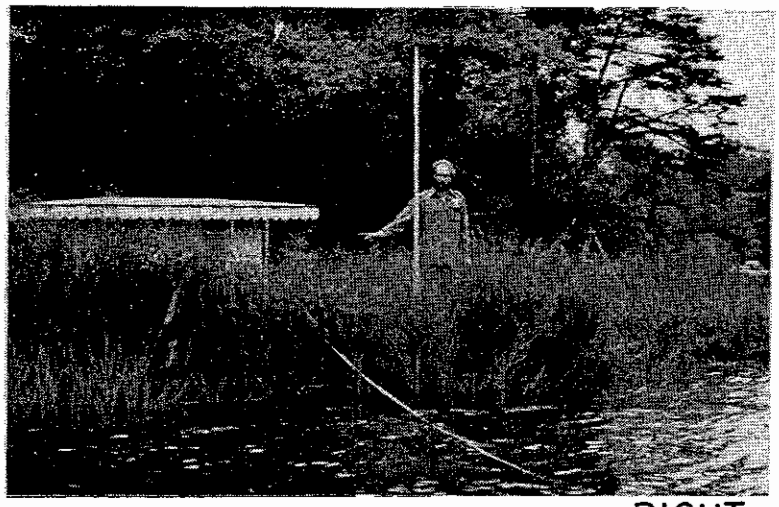
RIGHT

CENTER

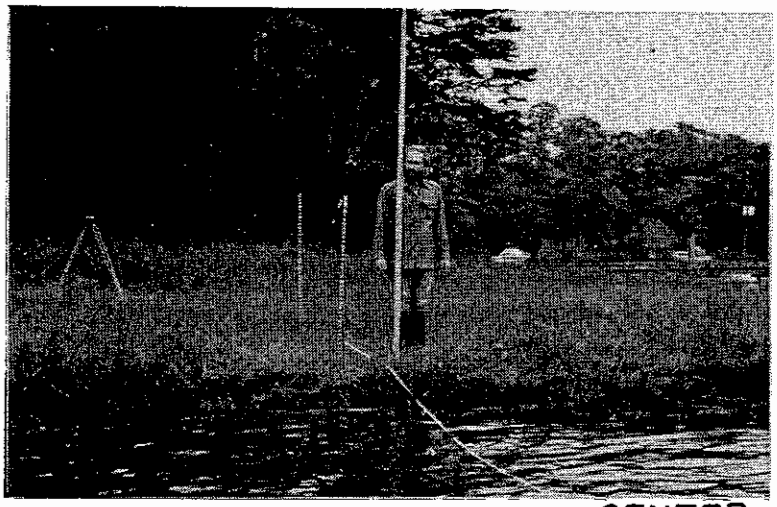
LEFT

SITE "C" MAY 1979

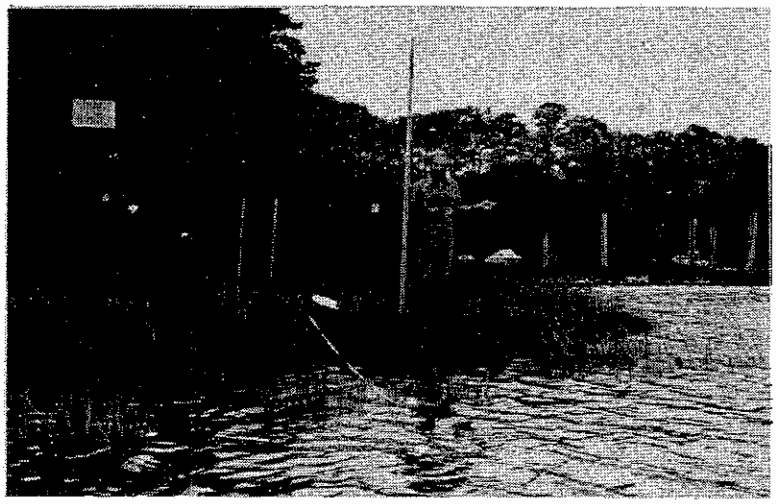
Figure 4.18b



RIGHT



CENTER

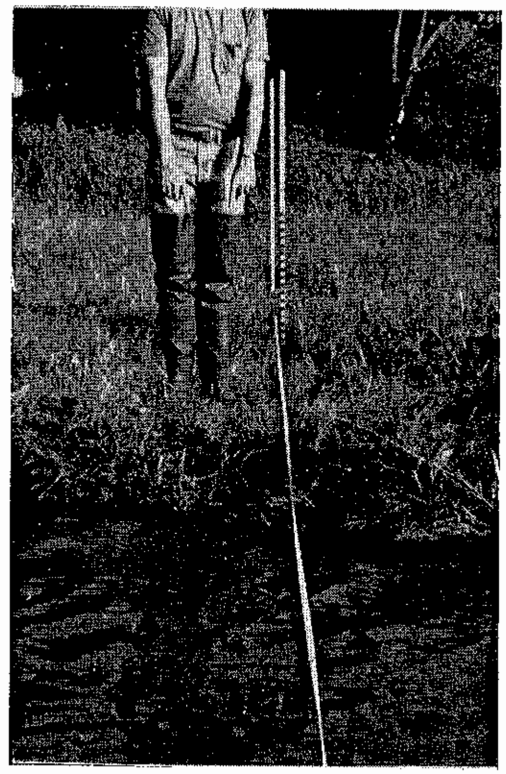


LEFT

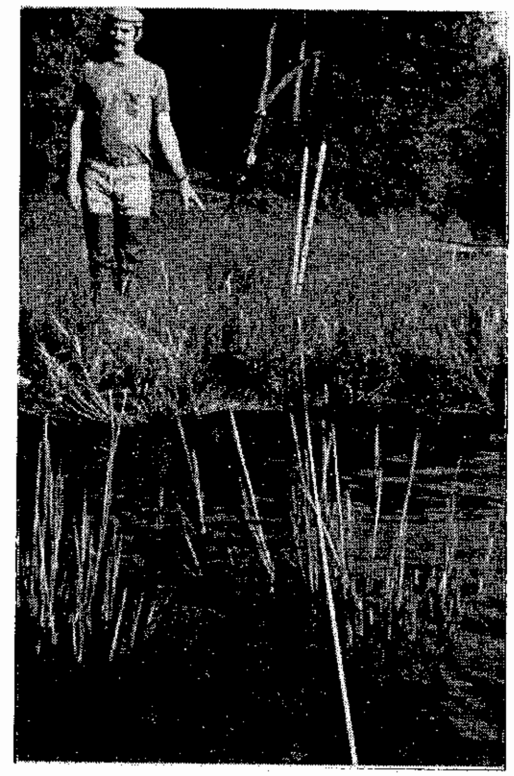
SITE "C" AUG. 1979

Figure 4.18c

RIGHT



CENTER



LEFT

SITE "C" OCT. 1979

Figure 4.18d

The overlays of monthly profiles for the periods October 1978-May 1979 and May - October 1979 are shown in Figures 4.20a and b. Both the Left and Center profiles reflect the existence of the slight positive relief on the terrace due to an overwash deposit formed by wave action awashing foreshore sand onto the marsh surface during times of high water. In addition, the different geometry of the profiles near the fastland should be noted. Comparison of Figs. 4.20a and b shows a rather dramatic difference in the fastland response between the boating and non-boating seasons. During the boating season a pronounced retreating scarp formed at the Left profile. At the Center profile the preexisting scarp continued to retreat. The Right profile exhibited no fastland retreat throughout the year. The details of the observed fastland boundary retreat are shown in Figure 4.19. The Left profile, within 15 feet of the downstream end of the marsh terrace, had a slight scarp at the edge of vegetation which was stable in position until after the February 1979 survey. Between February and May 1979, the edge of vegetation retreated 3.7 feet but with only slight scarp formation. By the time of the June survey, a pronounced scarp had formed. By the time of the survey of 18 August 1979, the fastland scarp retreated an additional 2.6 feet. Finally, between 18 August and 20 October 1979, an additional 0.5 feet of retreat occurred. This loss includes the effects of Tropical Storm David. In total, about 6.8 feet of fastland retreat occurred during the one year period.

The Center profile had a pronounced scarp at the fastland boundary throughout the period. The scarp position was stable until after the March 1979 survey, and between that time and the survey of 26 May 1979 the scarp retreated 1.6 feet. Between the May survey and that of 18 August, the scarp retreated an additional 2.6 feet, most of which occurred between the May and June surveys. Between the June and July surveys, fallen bulkhead sheeting was exposed in the foreshore. Finally, between August and October 20, 1979, an additional 1.0 foot of retreat was measured. The total fastland retreat was 5.2 feet during the course of the year.

In summary, the pattern of fastland erosion at Site C appears to be that of a smoothing process which is tending to round the exposed corner of the marsh terrace (see Fig. 4.16). An important factor in this process may be the physical setting of the site. It is important to note that there is very little sand supplied to the site from the more erosion-resistant upstream banks. Were there sand available from this upstream source it would tend to maintain a beach in front of the marsh. Instead, the local intertidal beach is composed of materials eroded from the terrace, which is itself composed of a highly erodible, loose sand and gravel.

Next pages: Figure 4.19 (left) Profile comparisons between successive months at Site C.

Figure 4.20a (upper right) Profile overlay for Site C from October 1978 to May 1979.

Figure 4.20b (lower right) Profile overlay for Site C from May 1979 to October 1979.

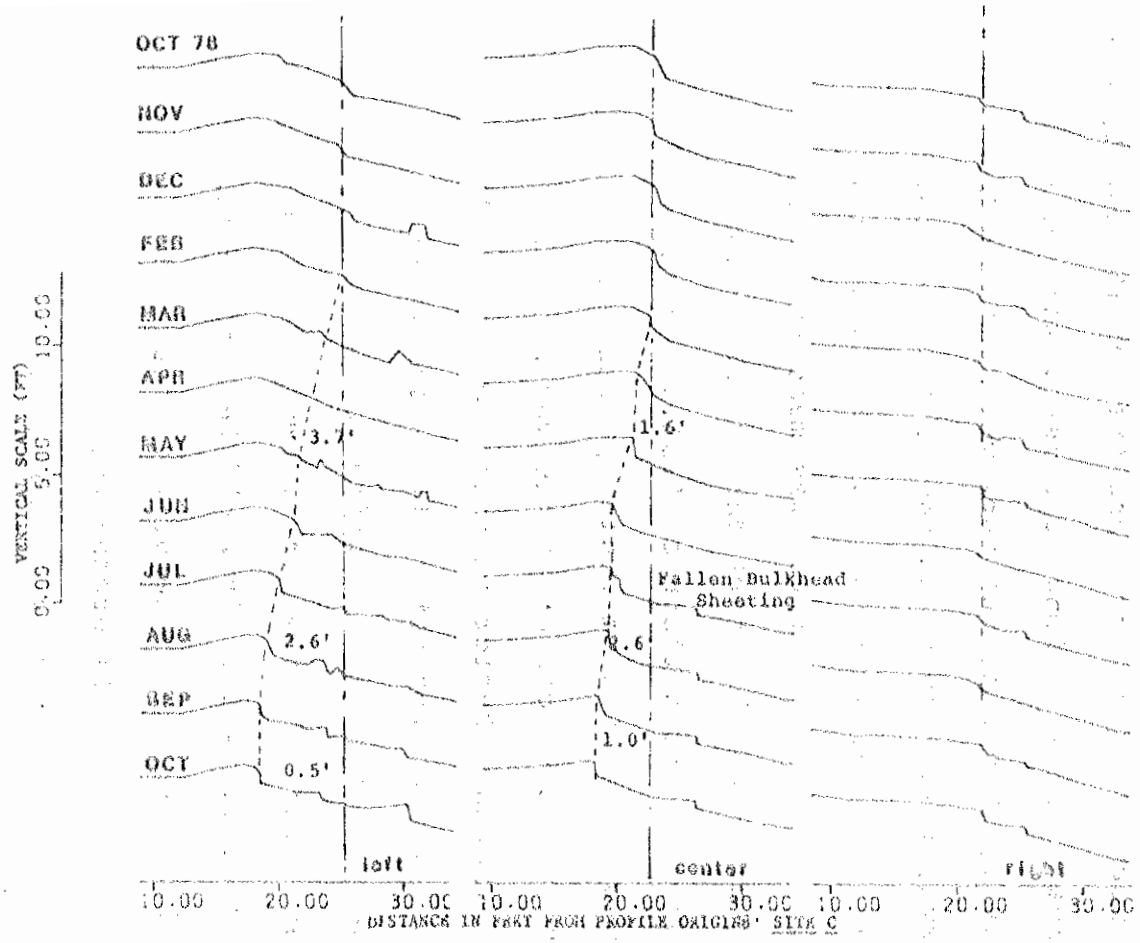

OCT 78
NOV
DEC
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
VERTICAL SCALE (FT)
0.00
5.00
10.00
3.7'
2.6'
0.5'
1.6'
1.6'
1.0'
Fallen Bulkhead Sheeting
left
center
right
10.00
20.00
30.00
DISTANCE IN FEET FROM PROFILE ORIGIN: SITE C

Figure 4.19

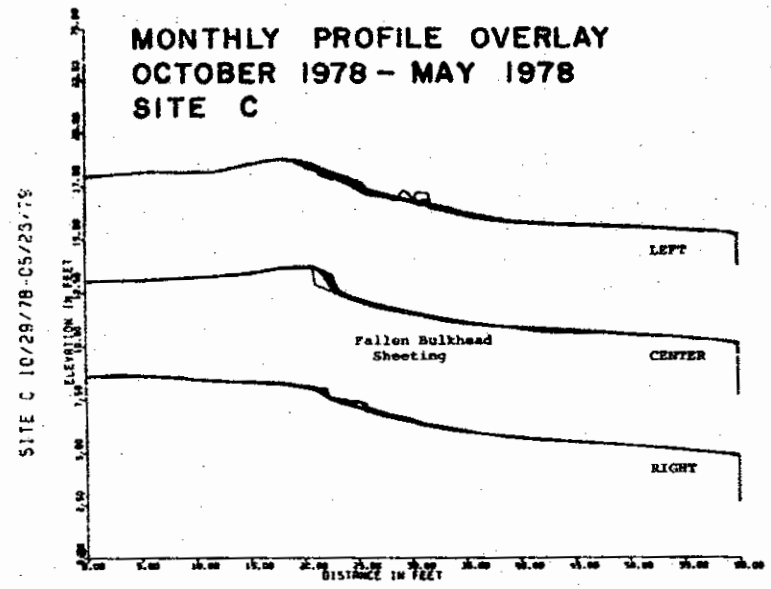


Figure 4.20a

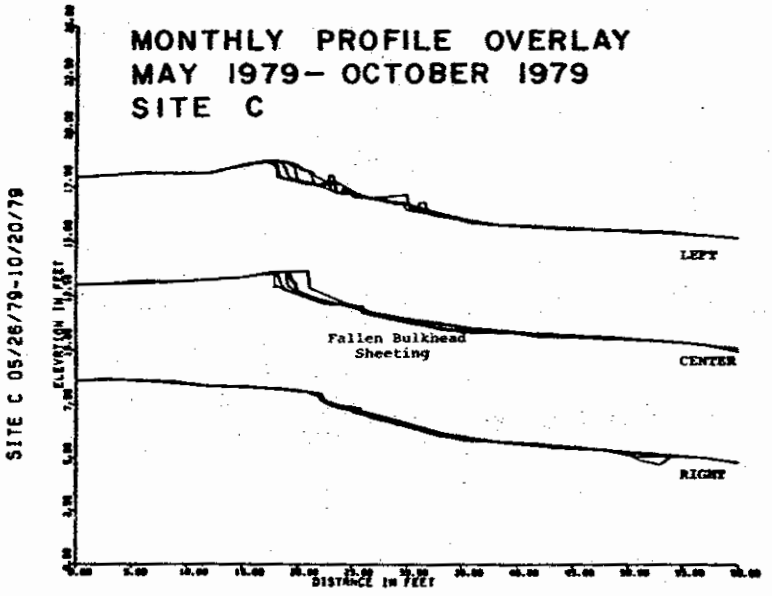


Figure 4.20b

Since materials including bricks and old bulkhead sheeting were exhumed from this site during the course of the year of study, it appears that at least part of the site is constructed of fill material.

Site D. A bluff on the lower Severn River at Severnside.

This site is located on the north shore of the Severn River approximately 4,000 feet southeast of the Route 50-301 Severn River Bridge (Figures 4.21, 4.22 and 4.23), at the region called Severnside. The shoreline reach in which the site is situated is about 4,500 feet in length extending from Brice Point in the southeast to a terminal spit in the northwest. With the exception of the vicinity of Brice Point and a ravine drainage, the entire reach is composed of bluffs as high as 80 feet in elevation. The bluffs are composed of semiconsolidated clayey sand (Aquia Formation) which in places stands at the near vertical.

Trees and shrubs are present on the top of the bluff, and vines and shrubs cover some potions of the bluff face. Some fallen trees and driftwood litter the shoreline near the study site, and the only shore protection structure in the immediate vicinity is a short 20-foot, cement-block-rubble groin about 230 feet southeast of the profiles. This short groin has no influence on the shore behavior at the profile area.

The mean tide range in the area is about 0.9 feet.

The profile monitor sites are at a bluff section about 50 feet in elevation, which intersects the shoreline about 150 feet northwest of the ravine cut. At the base of the ravine itself there is a low, wave-sculptured terrace. The profile layout consists of three transects spaced 30 feet apart. Typical profiles (October 1978) are shown in Figure 4.23 which also indicates the sites where sediment samples were acquired in April, 1979. Sediments were sampled from the beach in the upper 1-2 inches of the shoreline profiles and textural characteristics of the sediments are shown in Table 4.5. All the sediments at the study site are predominantly sand size, but the bluff and talus slopes contain a significant fraction of silt and clay. These fine-grained materials get winnowed out in the sorting process under wave action and are deposited in deeper waters offshore. As in the case of the bluff at Site B (on the upper South River near Goose Island), fragments of limonitic sandstone-type material litter the toe of the bluff on the shoreline profile. These fragments represent the lag material from successive slumps of the bluff face which remain after the sand and mud are redistributed by wave action.

Next pages: Figure 4.21 (left) Location Map showing Site D.

Figure 4.22 (upper right) Aerial view of Site D.

Figure 4.23 (lower right) Typical profile of Site D in October 1978.

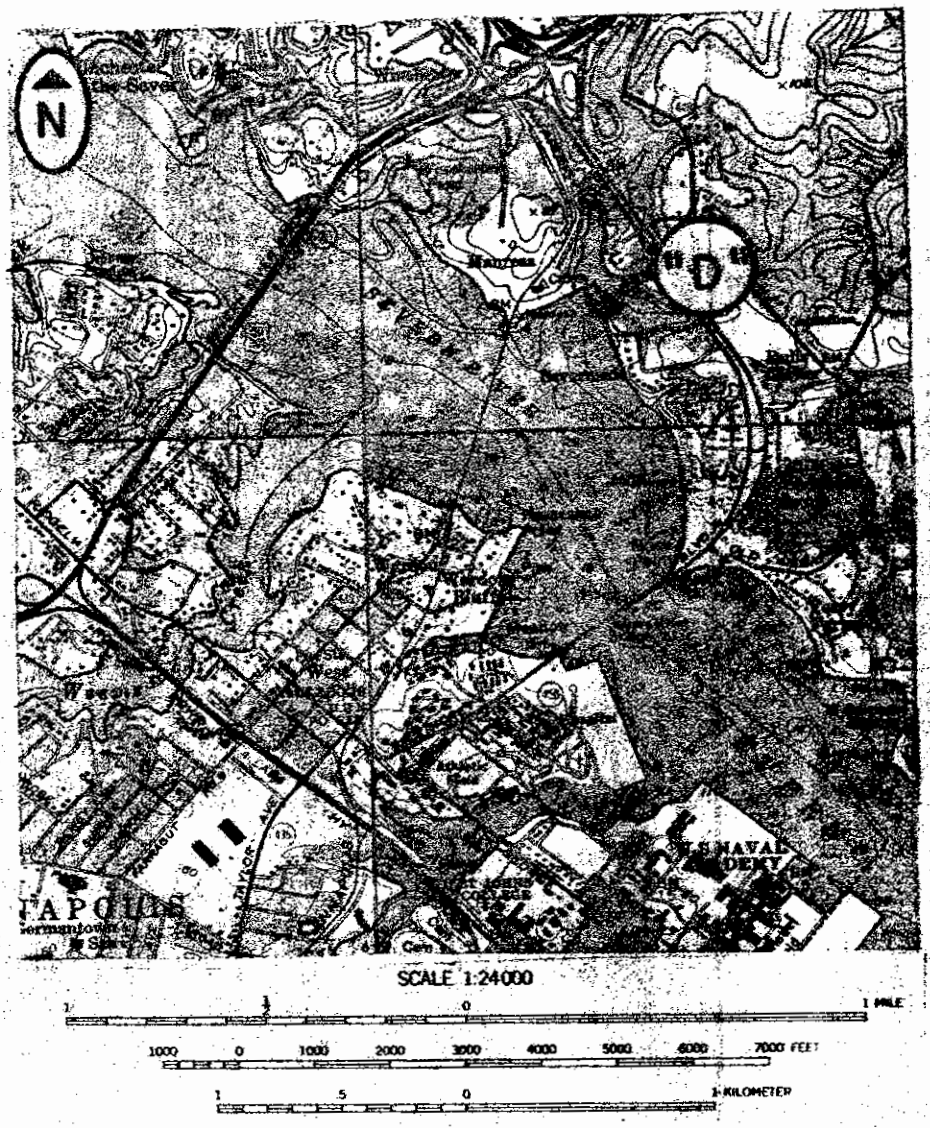

N
SCALE 1:24000
1 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER

Figure 4.2l

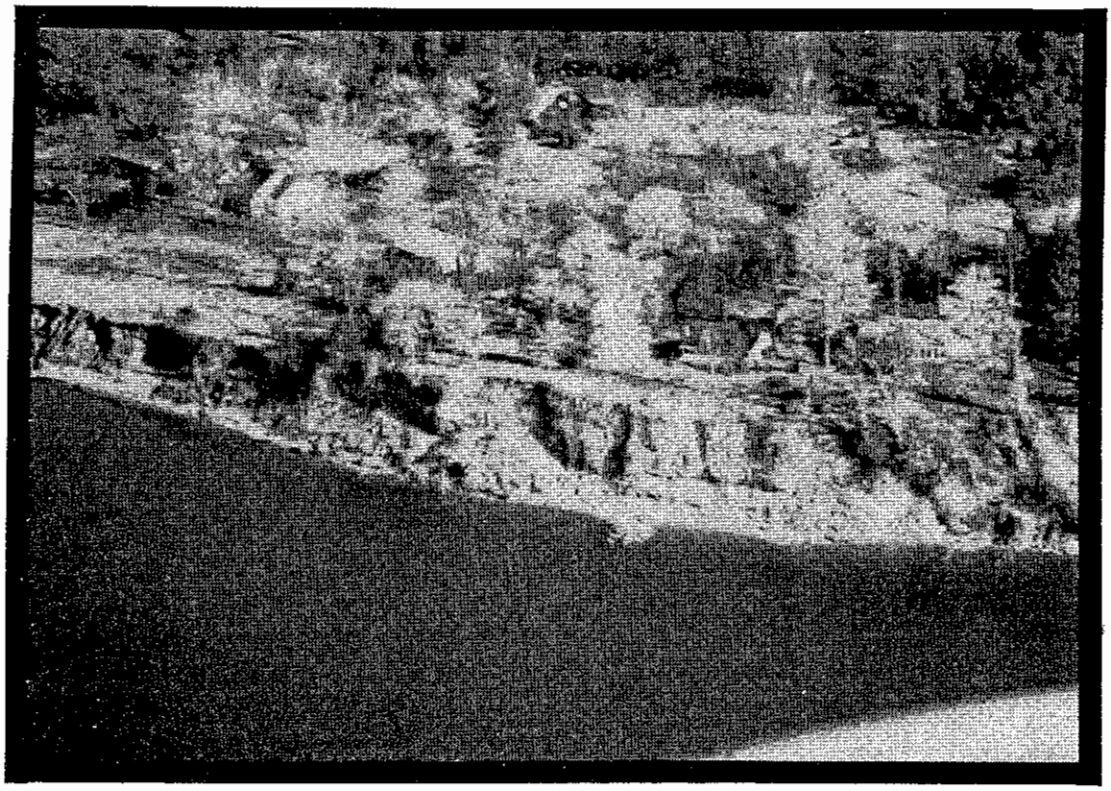


Figure 4.22

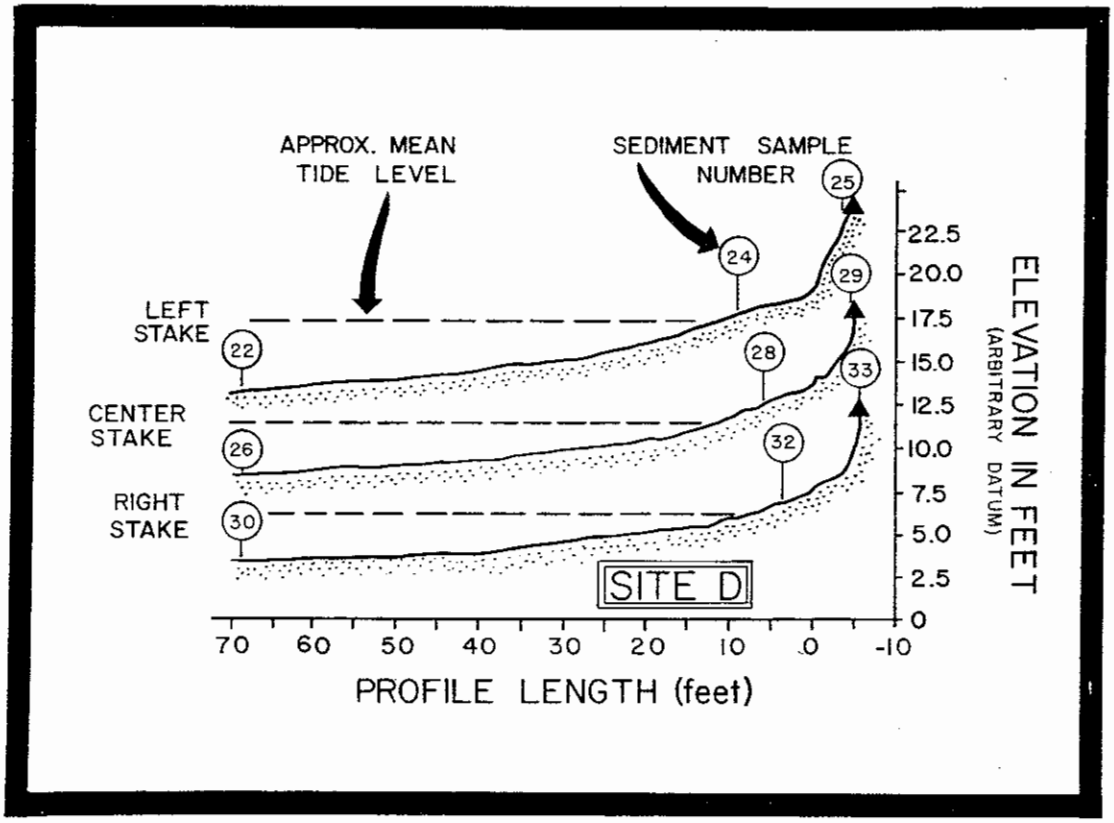


Figure 4.23

TABLE 4.5

SEDIMENT CHARACTERISTICS; SITE D

Sample No.	Profile	Distance From Origin	Zone	*Gravel (<2.0 mm)		Sand (0.062mm to 2mm)		Silt (0.0039 to 0.062mm)		Clay (<0.0039 mm)	
				Mineral	Organic	Mineral	Organic	Mineral	Organic	Mineral	Organic
33	Right	-4.8	Bluff Talus	9.74	-	61.95	1.65	9.26	0.53	14.04	2.83
32	Right	3.0	Foreshore	1.73	-	92.39	0.93	0.70	<0.01	2.63	1.62
30	Right	69.0	Offshore	1.86	-	91.42	0.92	0.88	0.09	2.91	1.92
29	Center	-5.7	Bluff Talus	7.66	-	80.31	0.57	2.10	0.12	7.41	1.83
28	Center	6.0	Foreshore	0.13	-	93.75	0.76	0.20	<0.01	3.45	1.71
26	Center	69.0	Offshore	0.67	-	89.53	0.90	0.46	0.42	5.89	2.12
25	Left	-3.0	Bluff Talus	1.62	-	86.59	1.05	2.59	0.03	6.01	2.11
24	Left	9.0	Foreshore	11.00	-	81.92	0.83	0.62	<0.01	4.12	1.51
22	Left	69.0	Offshore	3.61	-	86.61	0.87	0.97	0.31	5.77	1.85

*The numerical values shown represent the fractional weight, in grams, of 100 grams of sample, thus the results may also be interpreted as percentage values.

The beach at the study site receives boat-wake energy from boats travelling up and down the Severn River. Most of the boat traffic passes at distances greater than 1000 feet from the shoreline, but some localized boat traffic does pass closer to the shore and generates wakes which attack the shoreline profile. The boating characteristics at this site are discussed in Chapter VI.

This portion of the Severn River shoreline also receives wind waves which approach with the longest fetches from the northwest, south, and southeast. The wind-wave climate at this site is discussed in Appendix B and the wind waves and boat wakes are compared in Chapter VII for their relative importance in causing any changes in the shoreline profiles.

As in the case of the other bluff site (Site B), the fastland boundary was defined as either the consolidated sediments of the bluff or the loose material slumped from the bluff. The sequence of photographs shown in Figure 4.24 indicates that until some time after the July survey (07/29/79) the modifications of the fastland were, in fact, due to removal of slumped material. However the passage of Tropical Storm David in early September resulted in complete removal of the slumped material as well as erosion of the

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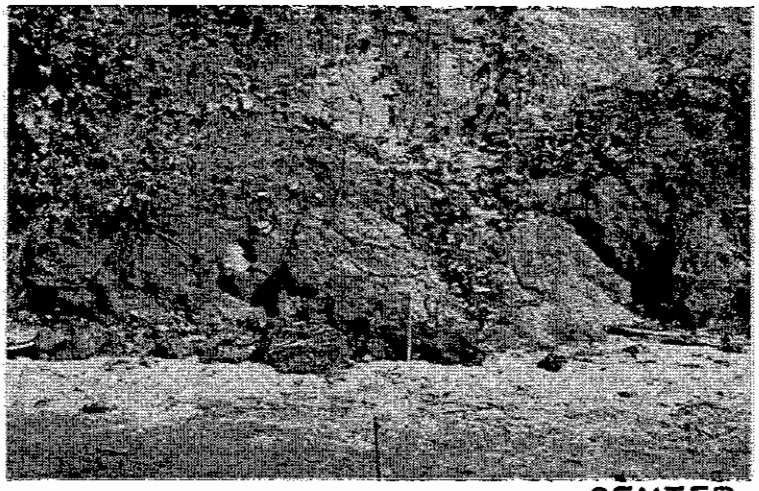
Opposite: Table 4.5 Sediment characteristics at Site D. The locations of the samples listed in the Table are shown on the profiles in Figure 4.23.

Next pages: Figures 4.24 a-d Photographic view of the three profile locations at Site D in October 1978, May 1979, July 1979, and October 1979.

RIGHT

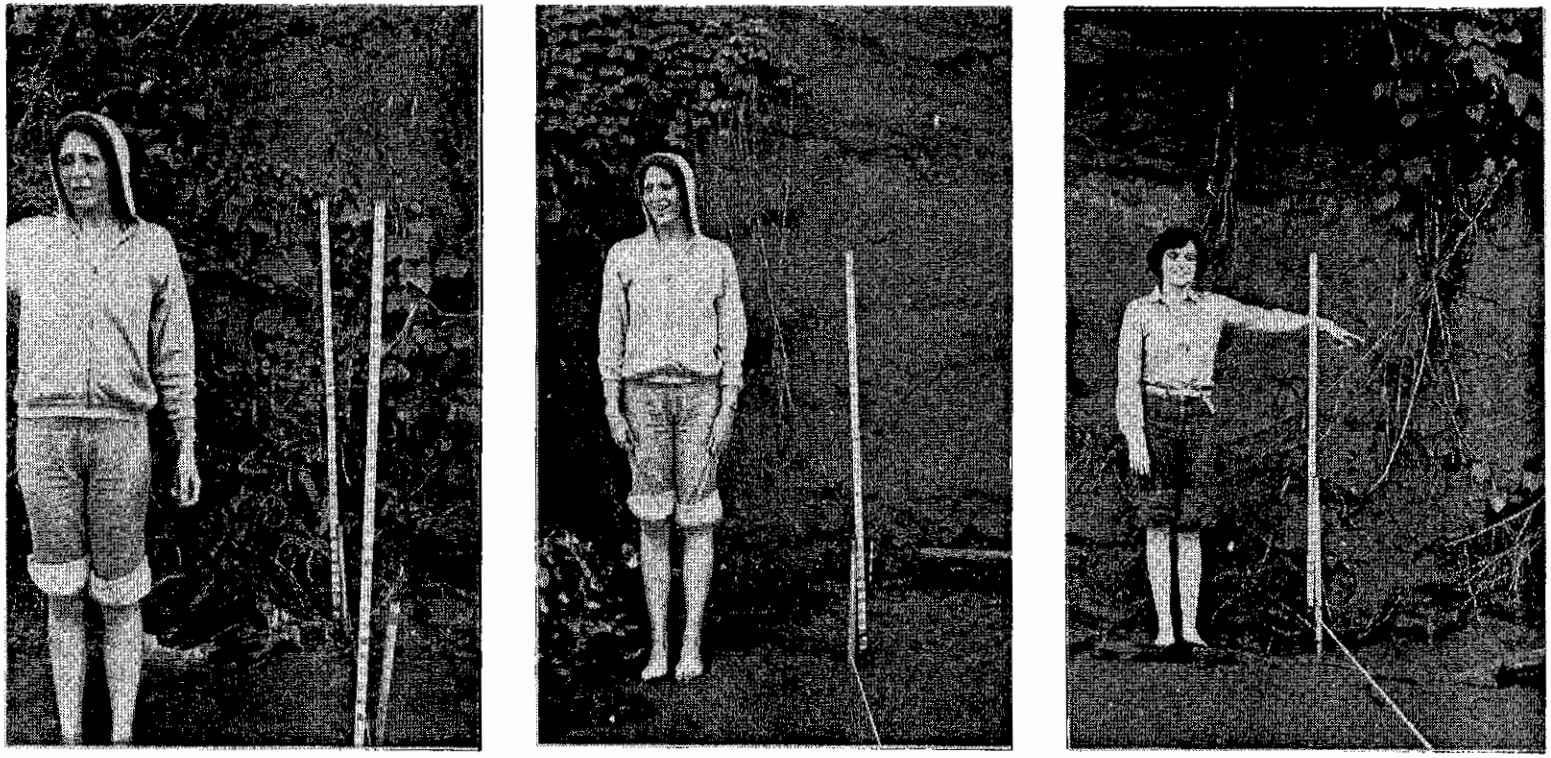


CENTER

LEFT

SITE "D" OCT. 1978

Figure 4.24 a

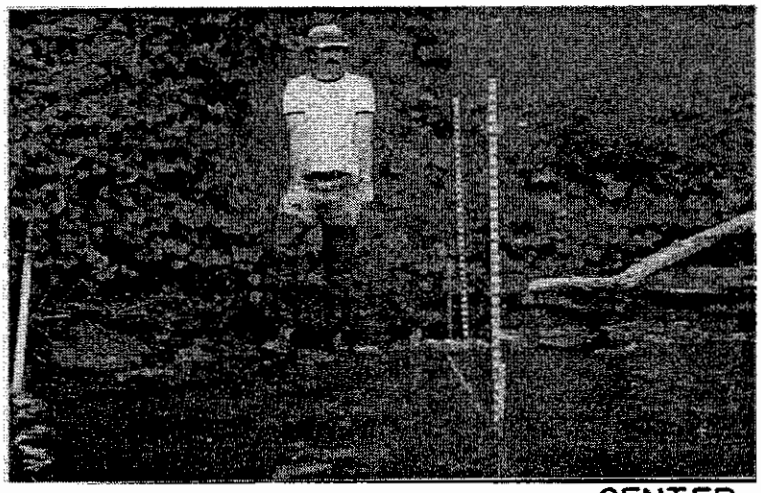


RIGHT CENTER LEFT

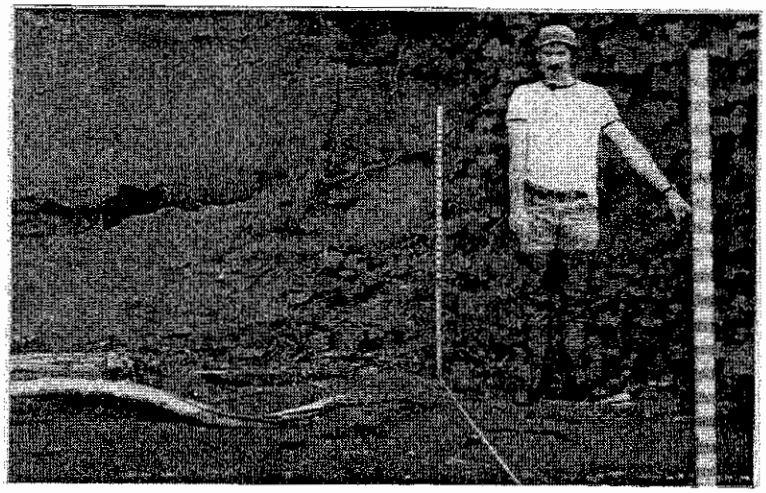
SITE "D" MAY 1979

Figure 4.24b

RIGHT



CENTER



LEFT

SITE "D" JULY 1979

Figure 4.24c

RIGHT

CENTER

LEFT

SITE "D" OCT. 1979

Figure 4.24d

consolidated bluff sediments. Thus in Figure 4.24d (October 1979) we see an exposed bluff (Left & Center) with a scarped terrace of sand in the backshore rather than slumped material.

The comparative envelopes of change between the periods of October 1978-May 1979, and May-October 1979, are shown in Figures 4.26 a and b, respectively. Note in particular that the surveys in June, July, and August cluster very close to the post-Tropical Storm David profiles of September and October 1979. The profile comparisons between successive months offer additional illustration that there was little profile modification during the peak boating season of June, July and August.

The details of the fastland modifications are shown in Figure 4.25 where sequential profile segments are displayed. At least two episodes of slumping occurred at the Left profile between the surveys of November 1978 and that of May 1979. Intervening surveys show reduction of the slumped material. Between the May and June surveys some additional reduction of slumped material (talus) occurred, but during the period of June through August the profiles were virtually identical. While the close similarity in monthly profile positions on this dynamic shoreline does not necessarily mean there has been no significant change in the time between profiles, there is little likelihood that the slump surface angles would be similar if there had, in fact, been significant changes between profile dates. Thus, these profiles are interpreted as showing no significant changes.

The storm surge associated with the passage to Tropical Storm David was about 2.5 feet, as determined from strand lines at the sites. This elevation at Site D, along with large wave heights (estimated up to 2-3 ft. by local observers) was sufficient to cause direct attack on the bluff as well as to reduce the volume of earlier slumped material. The comparative profiles of August and September 1979 (Figure 4.25) show a displacement of the fastland of 2.5 feet, part of which is bluff-face retreat. These profiles also show that the sand beach following David was considerably higher in elevation, and both the photographic evidence and the post-David survey of September show a scarped beach backshore. Thus between the first and third week of September 1979, Tropical Storm David eroded the bluff which resulted in a pronounced thickening of the beach sands, and this, in turn, was followed by a reduction in beach elevation as evidenced by the backshore sand scarp shown in Figures 4.24d and 4.24b.

The profile histories at the Center and Right profiles exhibit essentially the same patterns of behavior as previously discussed at the left profile: slumps reduced by

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Next pages: Figure 4.25 (left) Profile comparisons between successive months at Site D.

Figure 4.26a (upper right) Profile overlay for Site D from October 1978 to May 1979.

Figure 4.26b (lower right) Profile overlay. for Site D from May 1979 to October 1979.

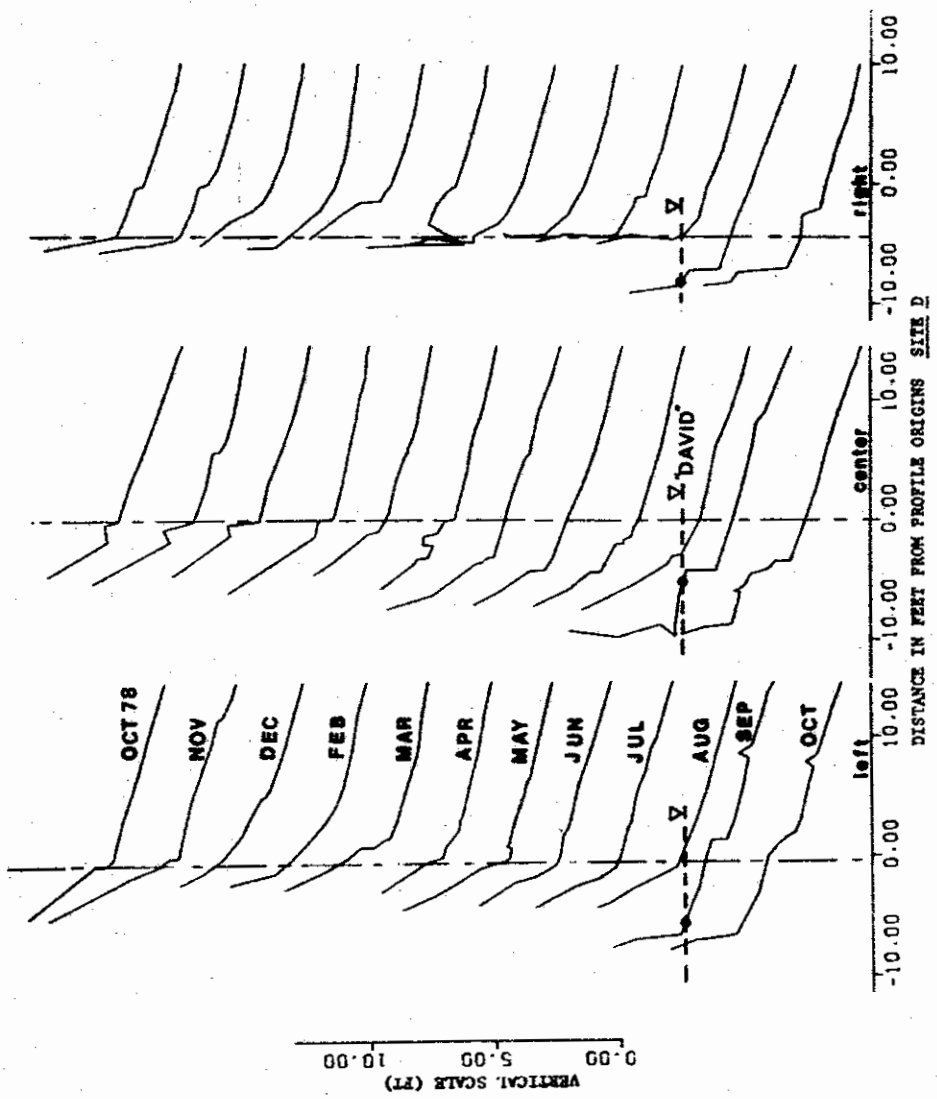
OCT 78
NOV
DEC
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
left
center
right
10.00
0.00
-10.00
DISTANCE IN FEET FROM PROFILE ORIGINS SITE D
VERTICAL SCALE (FT)
0.00
5.00
10.00

Figure 4.25

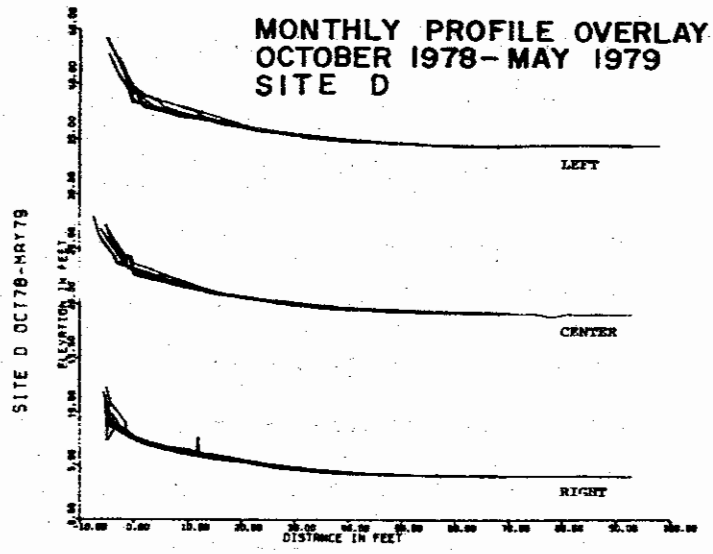

Figure 4.26a

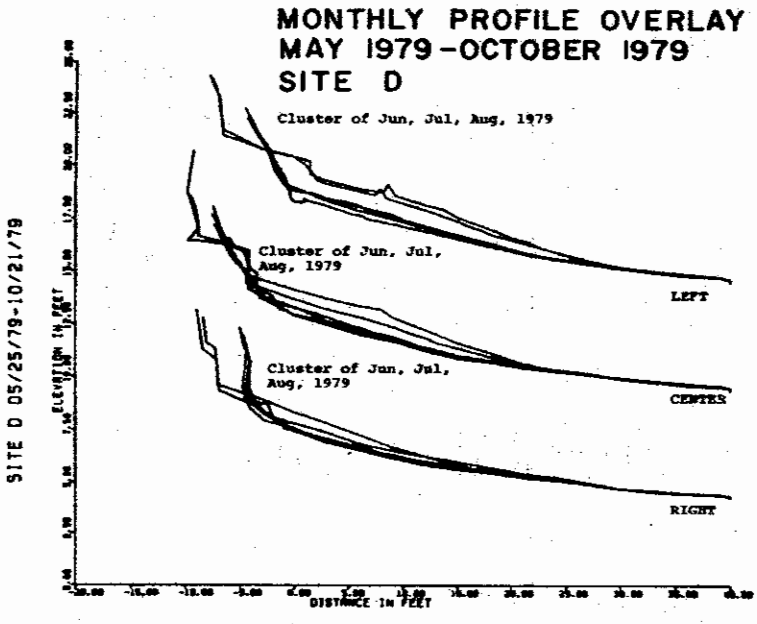

Figure 4.26b

wave action during the late fall, winter, and early spring; relative quiescence during the peak boating season of June, July, and August. The occurrence of Tropical Storm David with a large storm surge and large waves from the southeast dominated the profile response.

In summary, the observations over the one-year period demonstrated the role of wind waves in the reduction of the material eroded from face of the bluffs. But the most important effect was a single storm event, with a large storm surge and waves that dominated the fastland and shore zone response over an annual cycle. Finally, it should be noted that the profile modifications during the boating season, aside from the storm response, were very small relative to the changes during the non-boating season.

Site E. A pocket marsh near the entrance of Maynedier Creek off of the upper Severn River.

This site, located near the mouth of Maynedier Creek (Figs. 4.27, 4.28, 4.29) is a ravine-mouth marsh, approximately 175 ft. in width across the frontal margin. The marsh is predominantly clump growths of Spartina cynosuroides and Scirpus sp. which are tightly bound by root mass and soil, and virtually "float" on a substrate of very soft organic "mush". While a "shaky" "firm" footing may be found on the clumps, a misstep leaves the observer knee-high "in the mush". The shoreline on the flanks of the marsh intersects a thin veneer of sand overlying a plastic tan clay which also forms the steep banks with an elevation of about 4 feet. The nearshore (and offshore) fronting the marsh itself is a very soft substrate varying between sandy-silt to silty-clay The organic content of samples collected along the shoreline profiles is high (Table 4.6).

The mean tide range is about 0.8 feet. There are no shoreline protection structures influencing the area.

The marsh receives boat-wake wave energy from boats

Next pages: Figure 4.27 (left) Location map showing Site E.

Figure 4.28 (upper right) Aerial view of Site E.

Figure 4.29 (lower right) Typical profile of Site E in October 1978.


Herald Harbor
N
"E"
SCALE 1:24000
1 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER

Figure 4.27

Figure 4.28

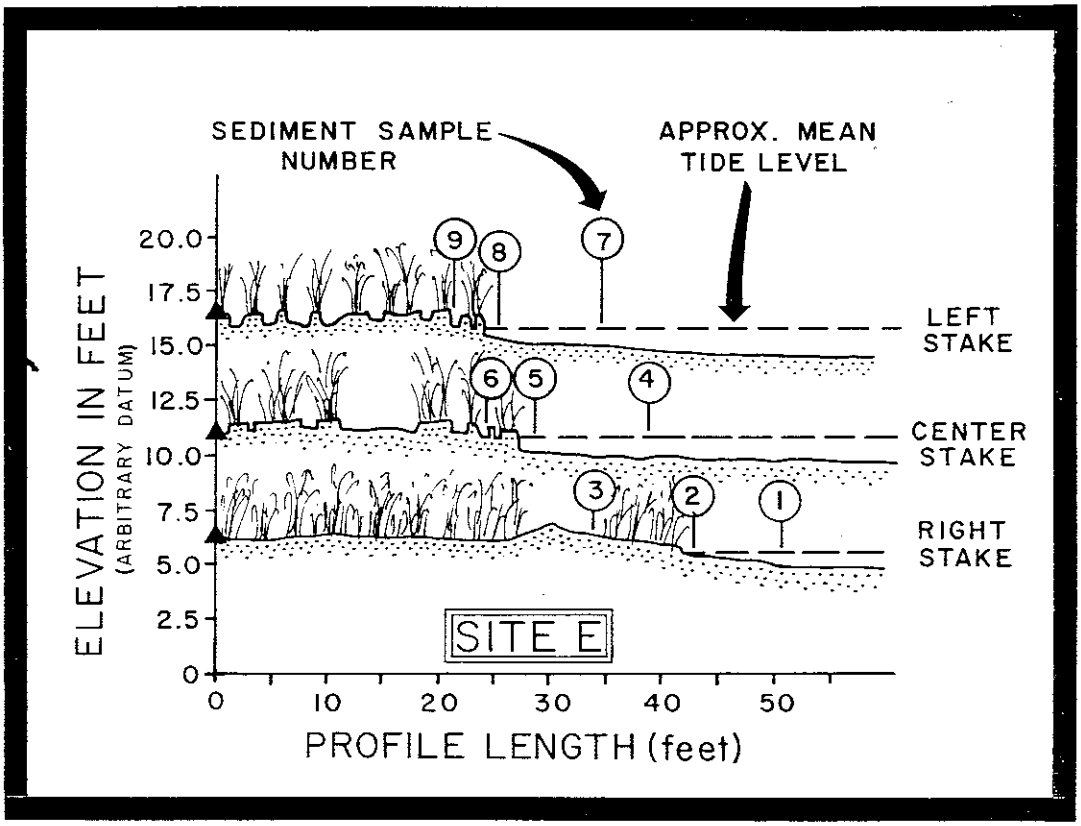

Figure 4.29

Table 4.6

SEDIMENT CHARACTERISTICS; SITE E

Sample No.	Profile	Distance From Origin	Zone	*Gravel (<2.0 mm)	Sand (0.062mm to 2mm)		Silt (0.0039 to 0.062mm)		Clay (<0.0039 mm)	
					Mineral	Organic	Mineral	Organic	Mineral	Organic
BD3	Right	34.0 ft.	Marsh	0.97	93.02	0.94	2.06	0.22	0.83	1.96
BD2	Right	36.0	Foreshore	1.00	96.04	0.19	0.06	0.87	0.37	1.47
BD1	Right	51.0	Nearshore	6.08	65.35	3.37	10.59	2.00	9.23	3.38
BD6	Center	25.0	Marsh	8.09	32.17	14.86	19.76	3.13	12.95	9.03
BD5	Center	28.0	Foreshore	7.41	34.50	12.96	19.80	1.88	12.92	10.52
BD4	Center	39.0	Nearshore	4.23	44.93	6.18	27.58	2.02	8.01	7.04
BD9	Left	19.0	Marsh	6.81	29.81	24.79	17.77	2.91	7.24	10.67
BD8	Left	26.0	Foreshore	10.71	41.52	15.28	14.87	1.99	7.74	7.89
BD7	Left	36.0	Nearshore	6.79	47.65	8.15	20.06	1.50	8.36	7.48

*The numerical values shown represent the fractional weight, in grams, of 100 grams of sample, thus the results may also be interpreted as percentage values.

entering and leaving Maynedier Creek. There is a posted speed-control zone in the creek on weekends. Boats travelling near the study site commonly pass within a few hundred feet from the shoreline. The boating characteristics at this site are discussed in more detail in Chapter VI.

The entrance to Maynedier Creek is relatively protected from heavy wave action by Mathiers Point and the shallow bathymetry of Round Bay to the east. The limited fetch within Maynedier Creek (maximum about 2,000 ft. to the south) precludes any significant wind-wave generation within the area.

The wind-wave climate at this site is discussed in Appendix B, and the wind waves and boat wakes are compared in Chapter VII for their relative importance in causing any changes in the shoreline profiles.

Three profile stations, 30 feet apart, are established on the frontal face of the marsh. Typical profiles (October 1978) are shown in Figure 4.29. Repetitive profiling and visual observation between October 1978-February 1979 indicated little or no change in the marsh behind the shore. After February, auxillary profile stakes were emplaced to

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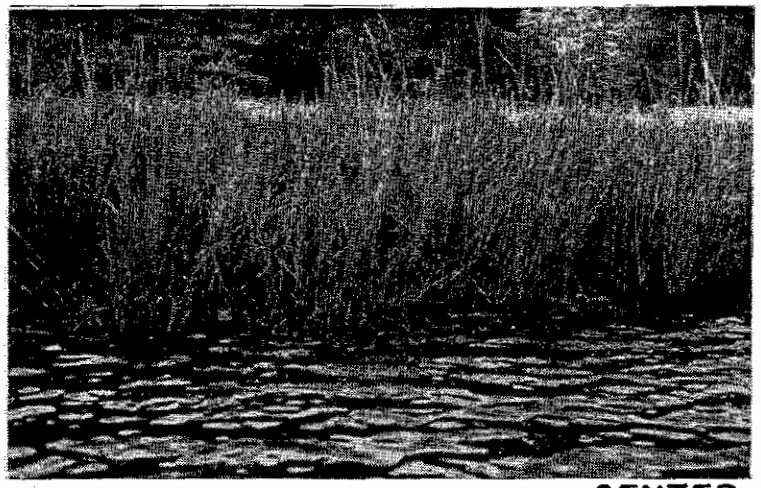
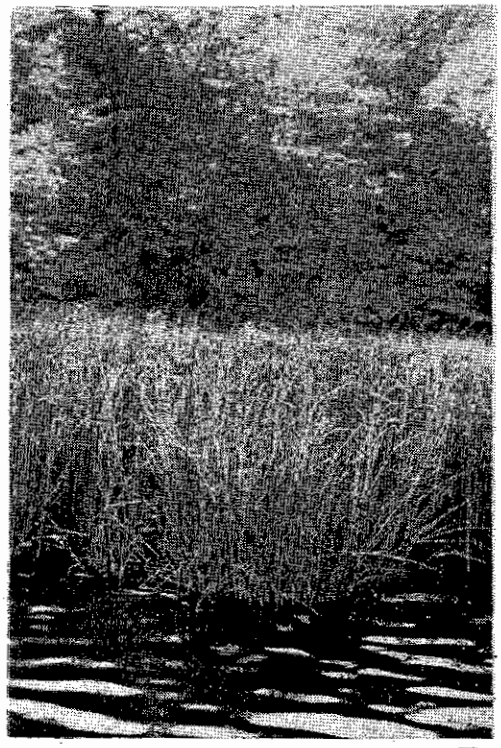
Opposite: Table 4.6 Sediment characteristics at Site E. The location of the samples listed in the Table are shown on the profiles in Figure 4.29.

Next pages: Figures 4.30 a-d Photographic view of the three profile locations at Site E in October 1978, May 1979, August 1979, and October 1979.



CENTER

RIGHT



LEFT

SITE "E" OCT. 1978

Figure 4.30 a

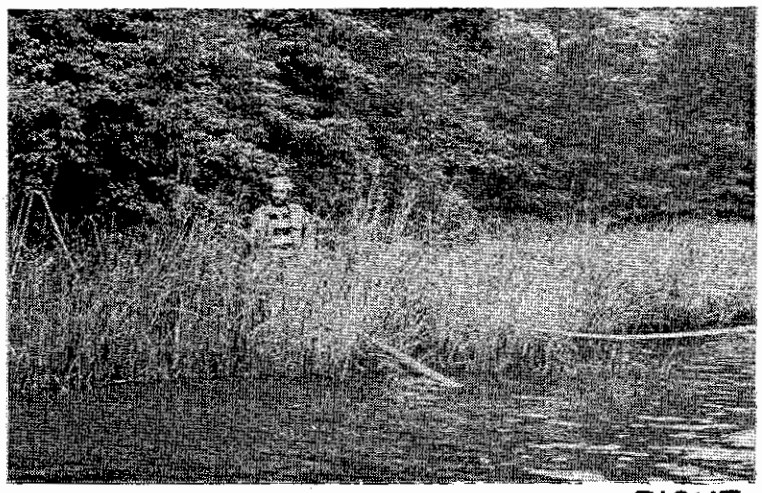
LEFT

CENTER

RIGHT

SITE "E" MAY 1979

Figure 4.30b



RIGHT

CENTER

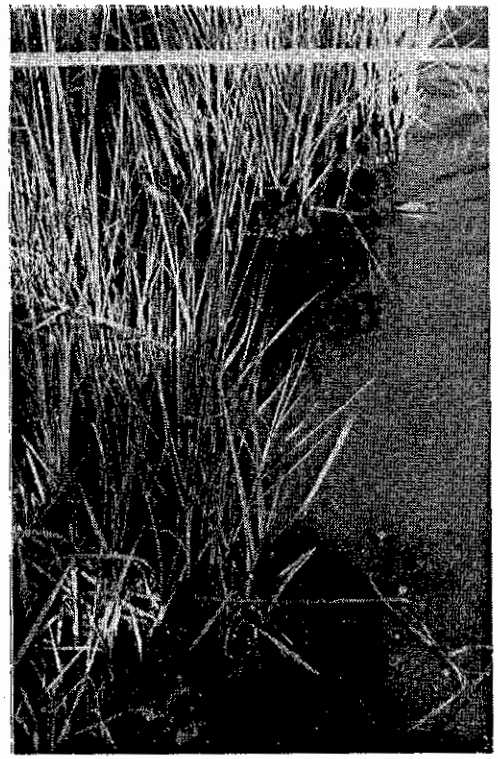
LEFT

SITE "E" AUG. 1979

Figure 4.30c

RIGHT

CENTER



LEFT

SITE "E" OCT. 1979

Figure 4.30d

minimize observer disturbance to the marsh system. The edge of the marsh vegetation was considered to be the fastland boundary. The series of photographic observations and the profile surveys shown below indicate there was no fastland retreat during the one year observation period. The photographic series (October 1978; May, August, October 1979) are shown in Figure 4.31 and the profile envelopes for October 1978-to-May 1979, and May-to-October 1979 are shown in Figure 4.32. The difficulties of surveying in a marsh composed of isolated, irregularly shaped clumps of vegetation are exemplified in the two sets of profile overlays. The measurement of the exact position of the fastland edge varied with the tightness of the measuring tape, and the precision of the rodman staying "on line". The tape tightness necessarily varied with the height and density of vegetation while straying off line could result in missing the edge of a marsh clump. This is best illustrated in Figure 4.30c (Left) where it is to be noted that the tape passes just to the side of a marsh segment. Positioning the tape slightly different would result in the inclusion of the marsh segment in the profile. In the Left profile sequence of Figure 4.31 this was the case in the surveys of February and October 1979.

In summary, the monthly photography provides unambiguous decumentation that there was no measurable

retreat of the marsh edge on the Left profile. The profile sequence in Figure 4.31 for the Center and Right profiles demonstrate that there was no change at these two profiles either.

Next pages: Figure 4.31 (left) Profile comparisons between successive months at Site E.

Figure 4.32a (upper right) Profile overlay for Site E from October 1978 to May 1979.

Figure 4-32b (lower right) Profile overlay for Site E from May 1979 to October 1979.

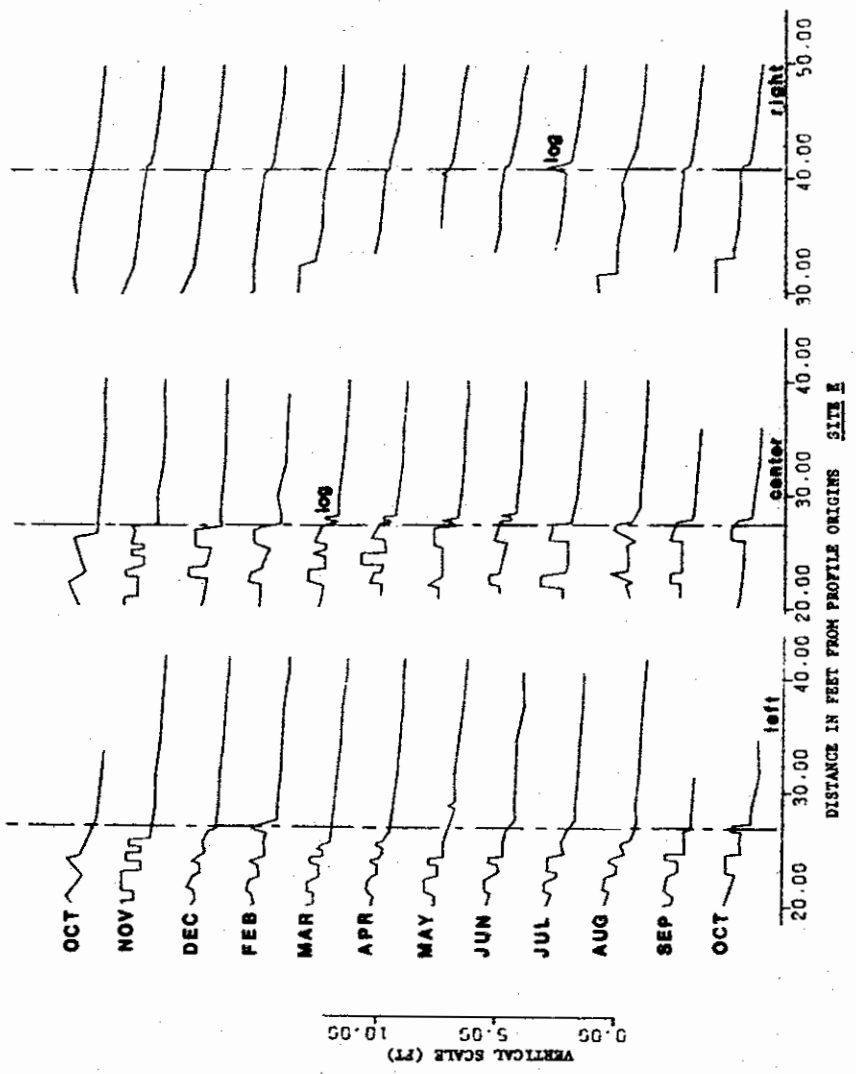

OCT
NOV
DEC
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
left
center
log
right
20.00
30.00
40.00
50.00
DISTANCE IN FEET FROM PROFILE ORIGINS SITE E
VERTICAL SCALE (FT)
0.00
5.00
10.00

Figure 4.31

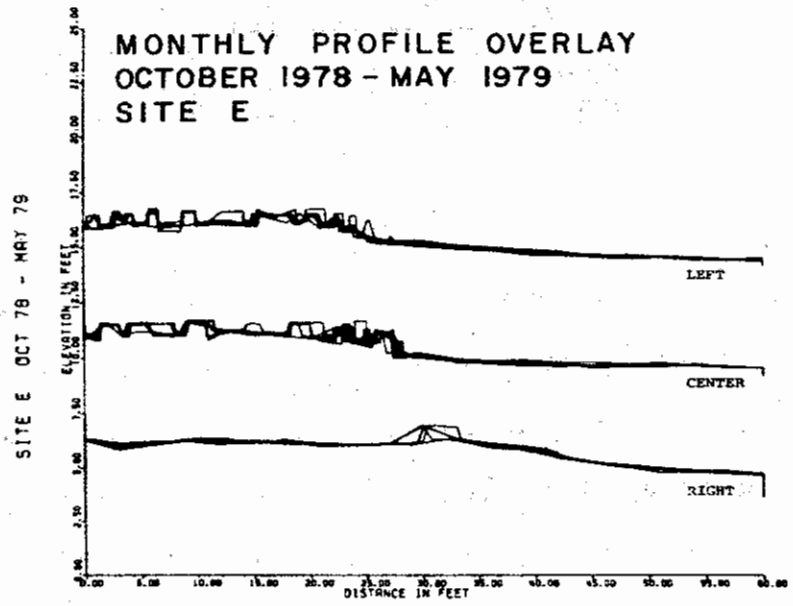


Figure 4.32a

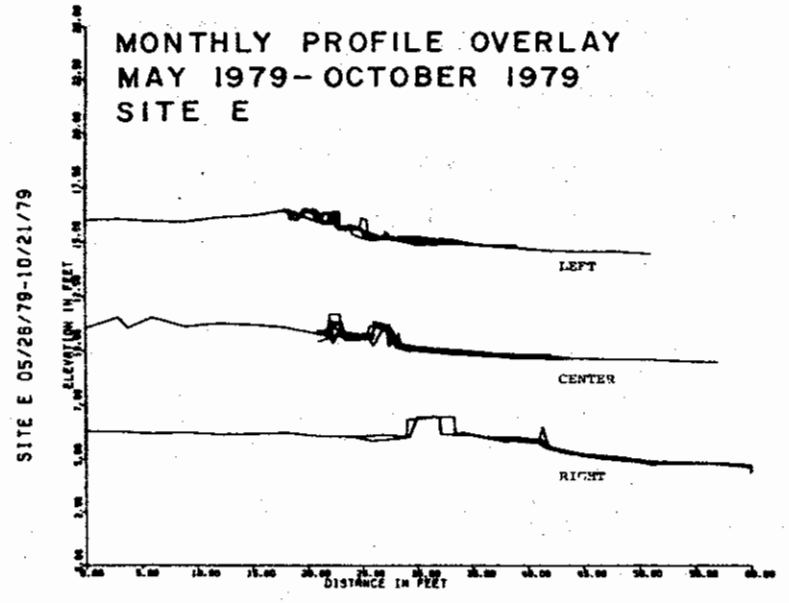


Figure 4.32b