V

BEHAVIOR OF SHORELINE PROFILES AT ADDITIONAL SITES

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A. Introduction

In addition to those sites described in the last chapter, additional sets of monthly profiles were collected by DNR student interns from the Environmental Studies Program at Anne Arundel Community College. Some of these supplemental sites were adjacent to the consultants' profiling locations and represented different shoreline types, (i.e. a marsh next to a bluff, or a bank next to a marsh). The supplemental sites also included two additional locations which were initially selected as "back-up" sites to the consultants' locations, and were to be used in the event that boating patterns at one of the principal sites turned out not to be as anticipated.

The results presented in this chapter show Tropical Storm David produced the greatest changes in shoreline profiles. Some other sediment movement was measured during the year of study, but no important changes at any of the sites took place during the boating season.

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 from a fixed bronze survey marker set in concrete with a transit and rod.

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 three sites with banks or bluffs (Sites AA, CC, EE), the profiles were extended up the bluff face from the rear stakes, and elevations were surveyed at intervals up to the instrument height.

Site AA: A pocket marsh and adjacent bluff in Harness Creek off the lower South River.

This site is located in an area known as Hillsmere Shores (Figure 5.1.) The beach segment chosen for

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Next pages: Figure 5.1 (left) Location map showing Site AA.

Figure 5.2 (upper right) Aerial view of Site AA.

Figure 5.3 (lower right) Typical profile of Site AA in October 1978.

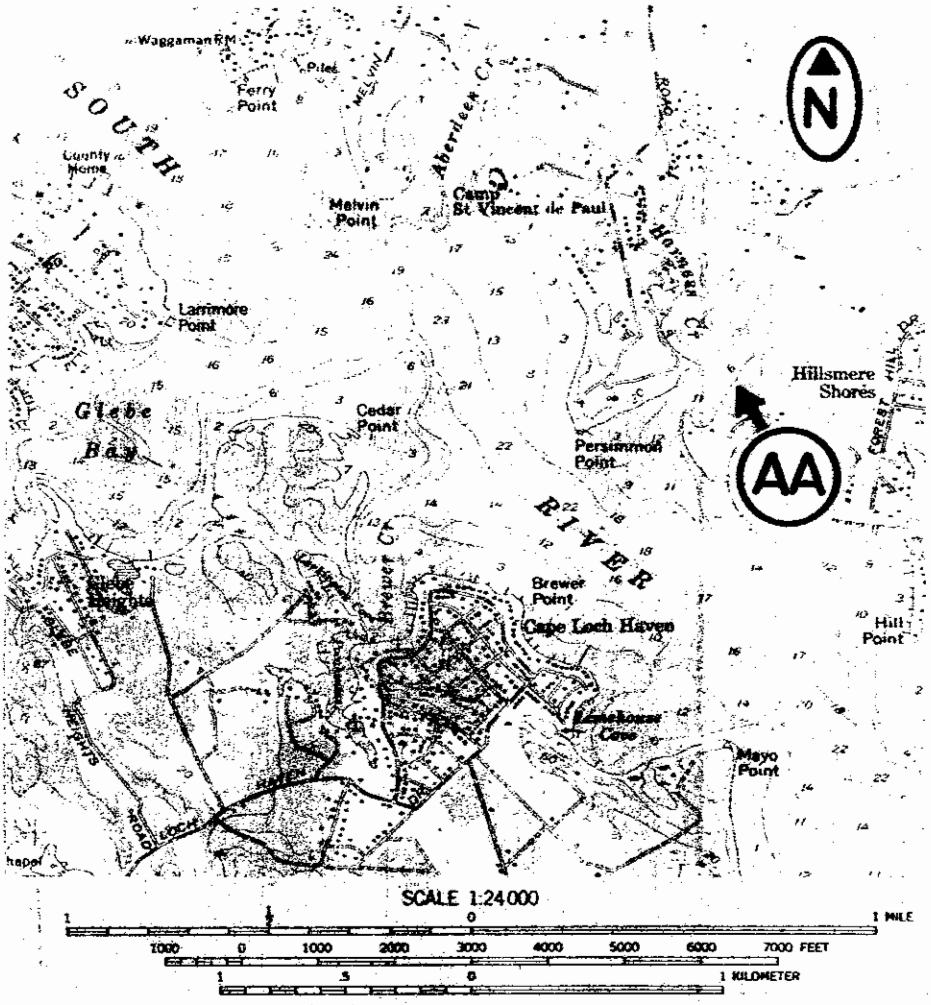
Waggaman RM
Ferry Point
Aberdeen Ct
SOUTH
County Home
Melvin Point
Camp St Vincent de Paul
Larrimore Point
Glebe Bay
Cedar Point
Persimmon Point
Hillsmere Shores
N
AA
RIVER
Brewer Point
Cape Loch Haven
Hill Point
Mayo Point
SCALE 1:24000
1 MILE
7000 FEET
1 KILOMETER

Figure 5.1

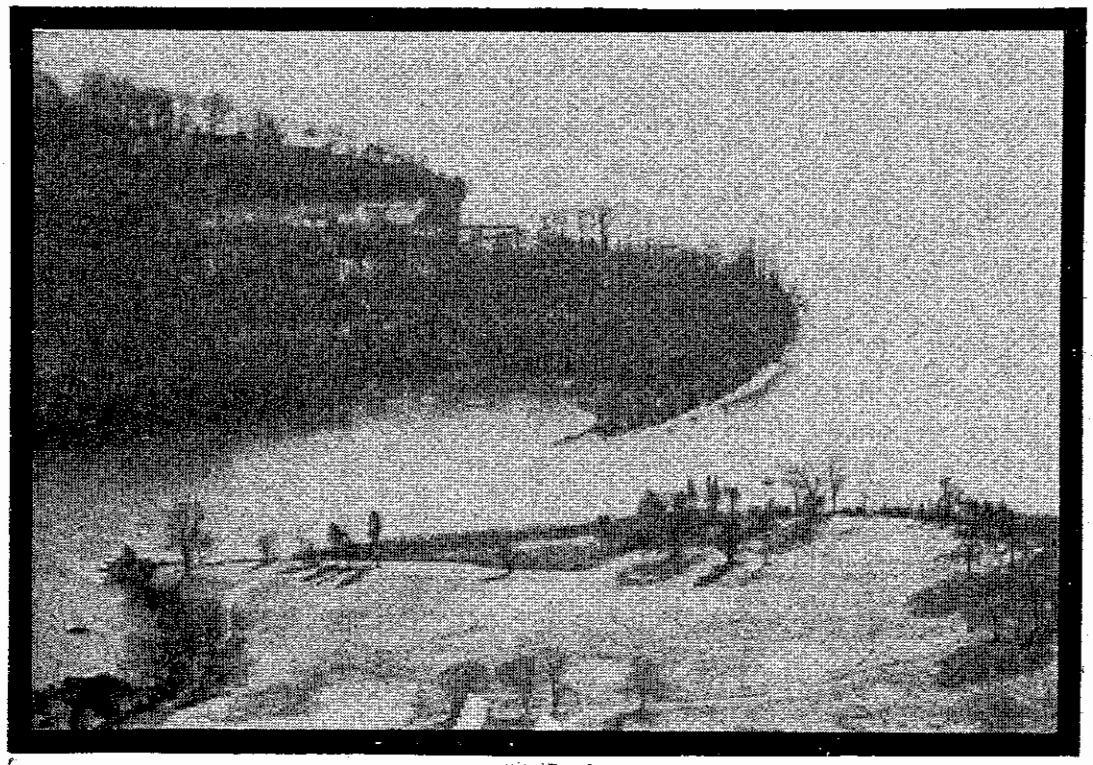

Figure 5.2

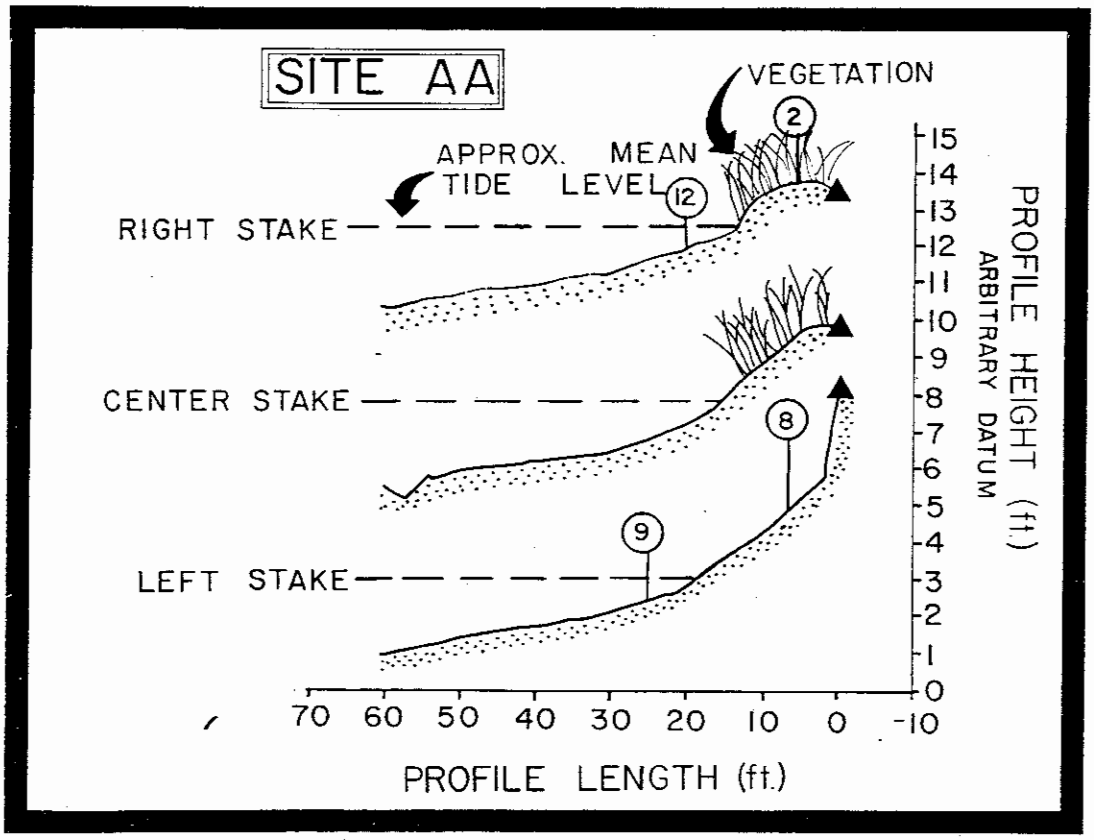

Figure 5.3

TABLE 5-1 SEDIMENT CHARACTERISTICS

SITE	PROFILE	SAMPLE	DISTANCE FROM ORIGIN	ZONE	% SAND	% SILT PLUS CLAY
AA	LEFT	2	0 ft.	BLUFF TALUS	70%	30%
AA	LEFT	12	20 ft.	OFFSHORE	80%	20%
AA	RIGHT	8	5 ft.	MARSH	98%	2%
AA	RIGHT	9	25 ft.	OFFSHORE	89%	11%
BB	RIGHT	6	3 ft.	MARSH	99%	1%
BB	LEFT	17	3 ft.	OFFSHORE	90%	10%
BB	LEFT	11	26 ft.	OFFSHORE	88%	12%
CC	LEFT	4	5 ft.	BLUFF	76%	24%
CC	LEFT	16	15 ft.	OFFSHORE	95%	5%
CC	RIGHT	13	8 ft.	NEARSHORE	99%	1%
CC	RIGHT	14	18 ft.	OFFSHORE	95%	5%
EE	RIGHT	1	12 ft.	BLUFF TALUS	70%	30%
EE	RIGHT	15	28 ft.	OFFSHORE	93%	7%
EE	RIGHT	5	17 ft.	NEARSHORE	98%	2%
FF	RIGHT	3	15 ft.	FORESHORE	97%	3%
FF	LEFT	10	10 ft.	MARSH	66%	34%
FF	LEFT	7	20 ft.	OFFSHORE	98%	2%

monitoring is on the southern shore of Harness Creek in an area where a bluff meets with a pocket marsh formed at the mouth of a ravine. Site AA is in the vicinity of the consultants' profile site Site A, which was discussed in the previous chapter.

The profile layout for site AA consisted of 3 transects spaced 30 feet apart. The right and center profiles are located on the marsh, which extends approximately 300 feet across its frontal margin and about 200 feet inland. The left profile is located at the base of the adjacent bluff which is approximately 10 feet high.

The vegetation at the right and center profiles consists of marsh grasses growing in thick compact clumps. The marsh grass ends at the shoreline in a sharp boundary. The bluff face on the left profile is largely exposed eroding sediments. At the top of the bluff are mature trees, shrubs, and vines which extend up to the bluff face. The bluff is nearly vertical in the upper portions and covered with exposed root masses. A number of trees have fallen over the bluff edge onto the beach; the entire shoreline surrounding the study site is littered with fallen trees and driftwood.

Opposite: Table 5.1 Sediment characteristics at the additional study sites. The locations of the samples listed in the Table are shown on the profiles in Figures 5.3, 5.7, 5.11, 5.15, and 5.19.

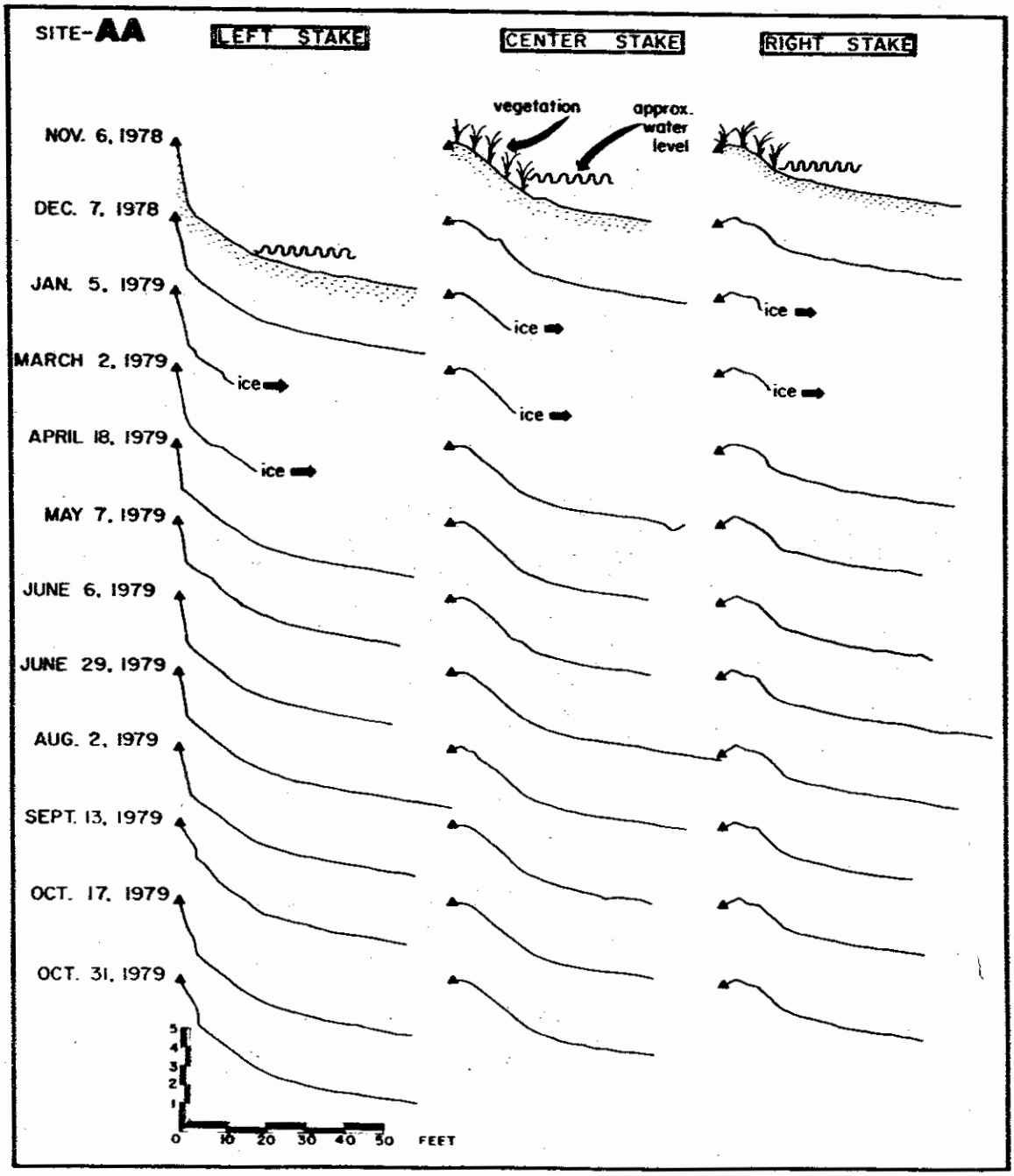
SITE-AA
LEFT STAKE
CENTER STAKE
RIGHT STAKE
vegetation
approx. water level
NOV. 6, 1978
DEC. 7, 1978
JAN. 5, 1979
MARCH 2, 1979
APRIL 18, 1979
MAY 7, 1979
JUNE 6, 1979
JUNE 29, 1979
AUG. 2, 1979
SEPT. 13, 1979
OCT. 17, 1979
OCT. 31, 1979
ice
ice
ice
ice
ice
0 10 20 30 40 50 FEET

Figure 5.4

Sediment samples were collected from the beach and nearshore in the upper 1-2 inches of the shoreline profiles (Table 5.1). The sediments in the nearshore at site AA are principally derived from the erosion of the bluff. Table 5.1 shows the bluff sediments contain about 30% silt and clay. The nearshore sample contains a similar portion of fine-grained material. The samples collected in front of the marsh and nearshore contained slightly less silt and clay than the offshore samples.

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 shoreline at site AA receives boat-wake energy mainly from boats entering and exiting Harness Creek. Much of the boat traffic near the study site stays within the main channel which is approximately 500-1000 feet from the profile locations.

The shoreline of site AA also receives wind-wave energy mainly from the northwest. Normal winds from any other direction produce small waves at the site.

The fastland boundary for the bluff at the left profile stake was defined as either the inplace 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

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Opposite: Figure 5.4 Comparison of monthly profiles collected at Site AA.

this material by wave action, the bluff slope would ultimately reduce and become stabilized with vegetation. The fastland boundaries for the center and right stakes were defined as the edge of vegetation. These boundaries are composed of the compact root masses of the marsh grass.

Profiles at site AA were collected monthly, and a comparison between successive months is illustrated in Figure 5.4. This comparison of successive profiles shows that the bluff located at the left stake experienced modulation of sediments and fastland retreat. The right and center stakes located in front of the marsh showed no important changes during the year of study, in either the boating or non-boating seasons.

There are noticeable changes in the amounts of material which have accumulated at the base of the bluff on profiles in January, April,and September of 1979 (Figure 5.4). This material is usually reduced by the next profile date. These modulations of sediments on the profiles are thought to be due to slumping and subsequent wave action washing out the slumped material. The boating season was considered to start in May of 1979, and some of the slumped material from the previous month's profile at the left stake is still noticeable at the base of the bluff. This material decreases slightly during the summer. In September of 1979, the storm surge during Tropical Storm David focused wave action directly on the bluff face at the left profile stake, and more material accumulated at the base of the bluff on

the shoreline profile taken after David. Some reduction of the talus deposit occurred between the September and October profiling dates, but the profile at the left stake was slightly built up again by the end of October. The near-shore portion of the profiles at the left stake show a slight accumulation of material until September 1979, when David came through the area.

In summary, Tropical Storm David was accompanied by the greatest change in shoreline profiles at this site. These changes occurred in front of the bluff, where the slumped material on the beach was eroded. Smaller changes in this portion of the shoreline profile also were observed earlier in the study period. The two adjacent profiles in the adjoining marsh showed no change in either the boating on non-boating seasons.

Site BB: A pocket marsh on the upper South River near Goose Island

This site is located near the Glen Isle subdivision on the southern shore of the upper South River (Figure 5.5). The shoreline segment chosen for monitoring is a small pocket marsh 750 feet downstream from the mouth of Flat

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Next pages: Figure 5.5 (left) Location map showing Site BB.

Figure 5.6 (upper right) Aerial view of Site BB.

Figure 5.7 (lower right) Typical profile of Site BB in October 1978.

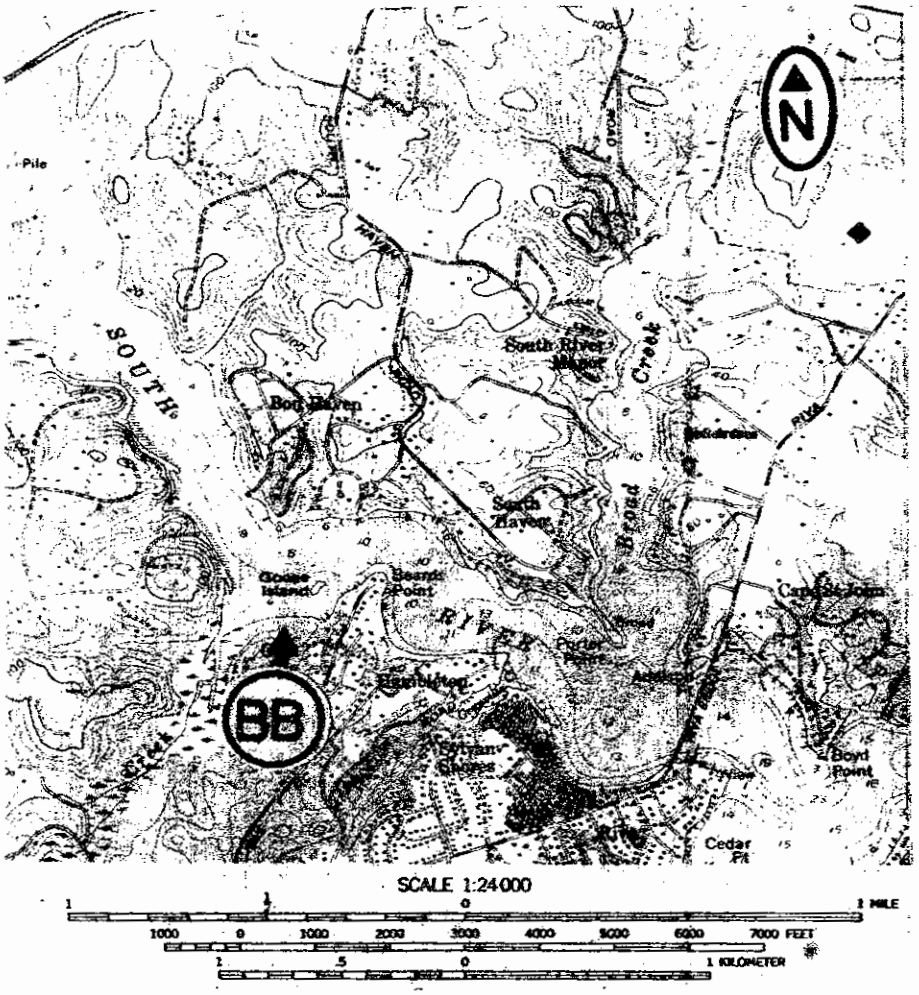

Figure 5.5

5-11

Figure 5.6

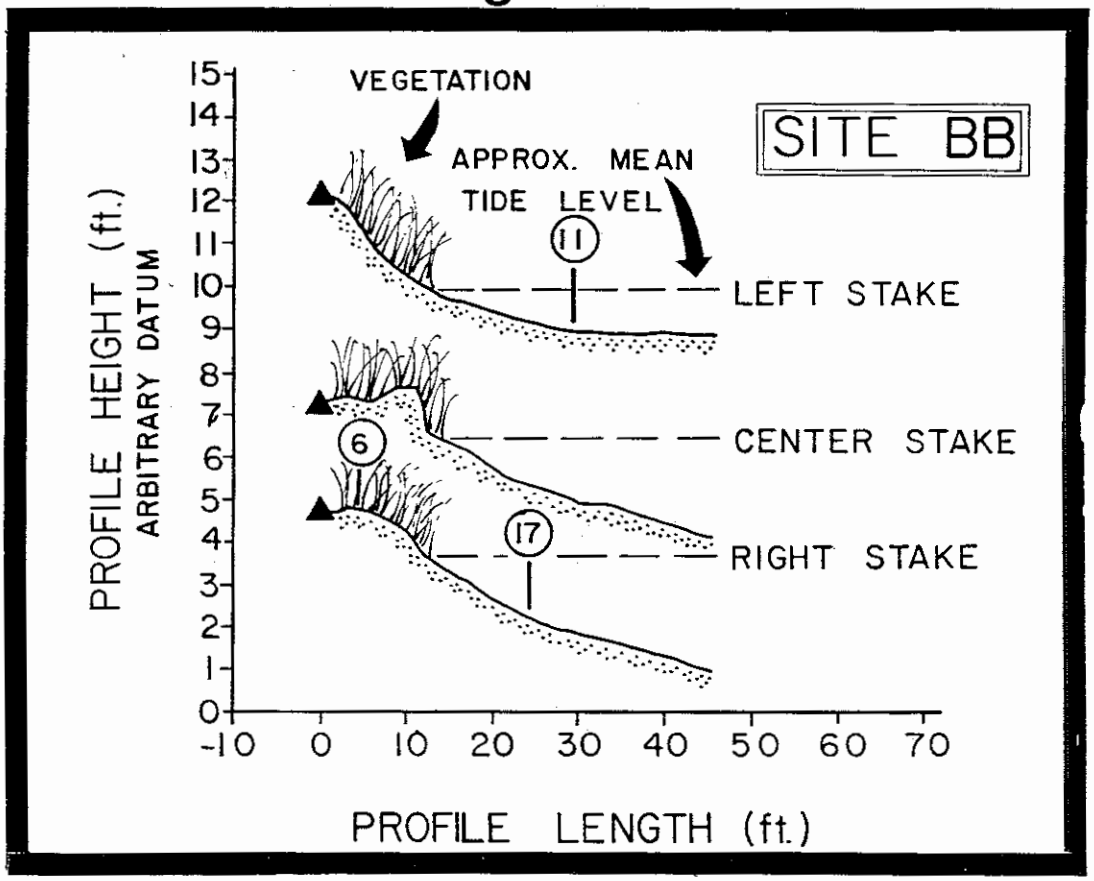

Figure 5.7

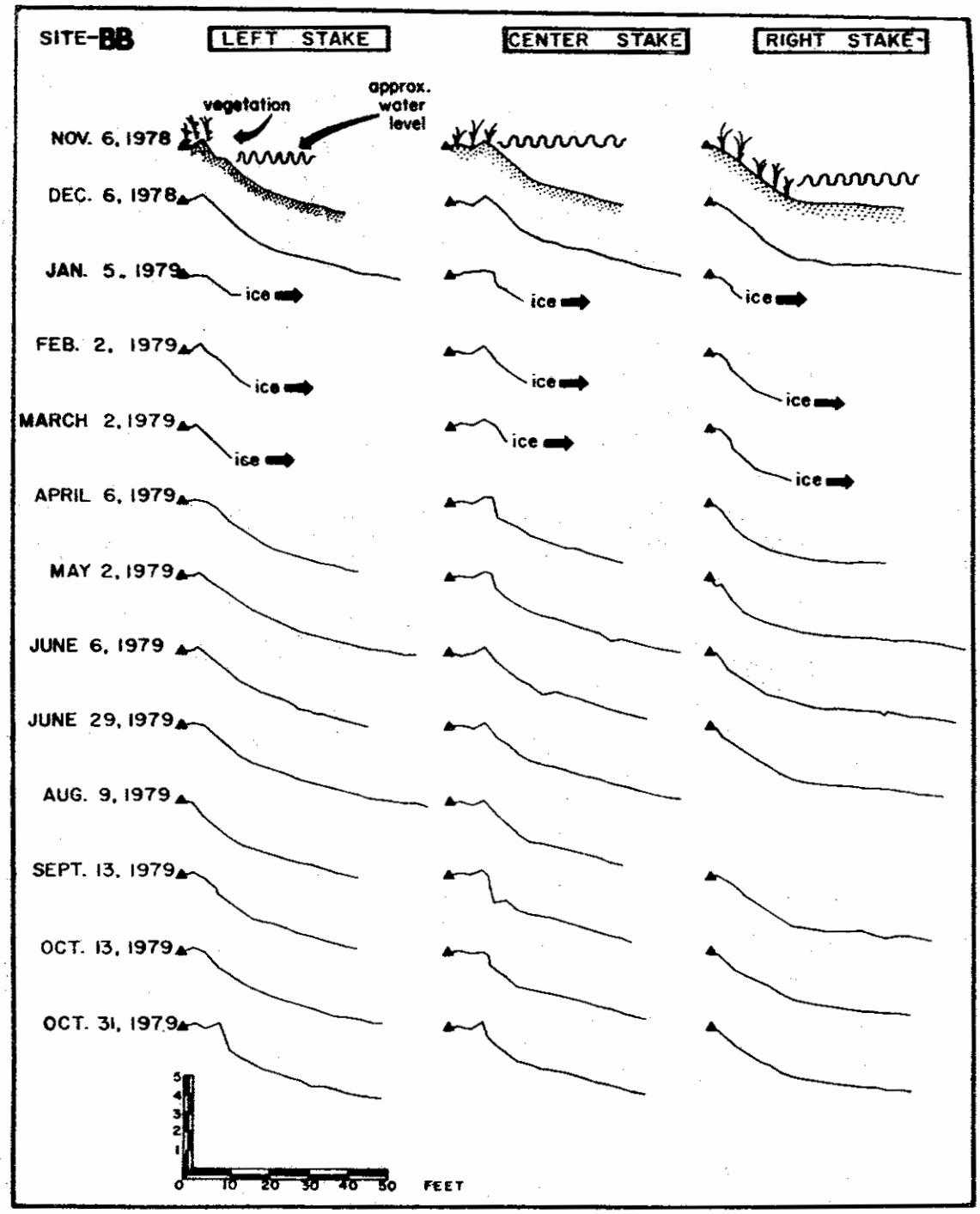
SITE-BB
LEFT STAKE
CENTER STAKE
RIGHT STAKE
vegetation
approx. water level
NOV. 6, 1978
DEC. 6, 1978
JAN. 5, 1979
FEB. 2, 1979
MARCH 2, 1979
APRIL 6, 1979
MAY 2, 1979
JUNE 6, 1979
JUNE 29, 1979
AUG. 9, 1979
SEPT. 13, 1979
OCT. 13, 1979
OCT. 31, 1979
ice
0 10 20 30 40 50
FEET

Figure 5.8

Creek. Immediately upstream is the bluff which is the location of the consultants' Site B discussed in the previous chapter.

The profile layout for site BB consisted of 3 transects spaced 30 feet apart along the entire section of the marsh. The vegetation at site BB consists of marsh grasses Phragmites communis and Scirpus olneyi, which extend from the water line landward to a zone of shrubs and small trees. Further landward, the marsh meets a ravine and the adjacent bluff which are full of mature trees, shrubs, vines and considerable undergrowth.

Sediment samples at site BB were collected from the beach, marsh, and nearshore zones within the upper 1-2 inches of the shoreline profiles. The sediments collected near the profile origins were composed of sand with a relatively minor silt and clay content (Table 5.1). The sample collected for analysis also contained well-sorted gravel. At the site, the relatively firm sand along the foreshore blends into finer-grained, less consolidated sediment offshore (Table 5.1). These nearshore sediments are considered to be derived partly from the erosion of the adjacent bluff and partly from finer-grained sediment carried into South River from Flat Creek.

The mean tidal range in the area of site BB is approximatley 1.0 foot, and there were no shoreline structures present along the reach that were considered to

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Opposite: Figure 5.8 Comparison of monthly profiles collected at Site BB.

interfere with sediment transport at the site during the year of study.

The shoreline of the marsh receives boat-wake energy from boats travelling on the South River generally at distances greater than 1000 feet. More localized boat traffic is generated from boats which circle Goose Island, and pass within 100-200 feet of the study site. A large percentage of these boats are towing waterskiers and tend to make multiple passages of the shoreline in a relatively short period of time. Boating traffic for the shoreline reach where sites B and BB are located is discussed further in chapters VI and VII.

The marsh 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 site BB, but these winds also tend to drive water out of the rivers on the western shore so the erosive power of the waves is expended at lower levels on the beach and in the nearshore, rather than on the fastland boundary of the marsh.

Monthly profiles collected at site BB are illustrated in Figure 5.8. The fastland boundary for site BB was defined as the edge of vegetation, and showed little or no retreat for all 3 profile stakes during the year of study. Comparative profiles in Figure 5.8 do clearly show modulation of beach face sediments, but the fastland boundary for all 3 stakes remained relatively unchanged.

One major instance of visible fastland retreat at site BB occurred after the passage of Tropical Storm David September 8-9, 1979. Figure 5.8 shows the beach profile at the center stake experienced a slight fastland loss and a substantial loss of nearshore sediments between the profile dates of August 9, 1979 and September 13, 1979 after the passage of David. These nearshore sediments were presumably lost during the storm and were partially replaced by erosion from the adjacent bluff within one month. In summary, some modulation of nearshore sediments occurred at all three stakes, but no notable fastland changes can be attributed to boating. The only notable fastland change at this site can be attributed to the passage of Tropical Storm David.

Site CC: A bluff in Broad Creek off the upper South River.

This site is located approximately 1200 feet north of the mouth of Broad Creek (Figure 5.9). The shoreline segment chosen for monitoring is located at the base of a bluff which has a maximum elevation of 60 feet. The profiles at this site are located approximately 50 feet downstream from the marshy promontory which is the location of the consultants' Site C discussed the previous chapter.

Next pages: Figure 5.9 (left) Location map showing Site CC.

Figure 5.10 (upper right) Aerial view of Site CC.

Figure 5.11 (lower right) Typical profile of Site CC in October 1978.

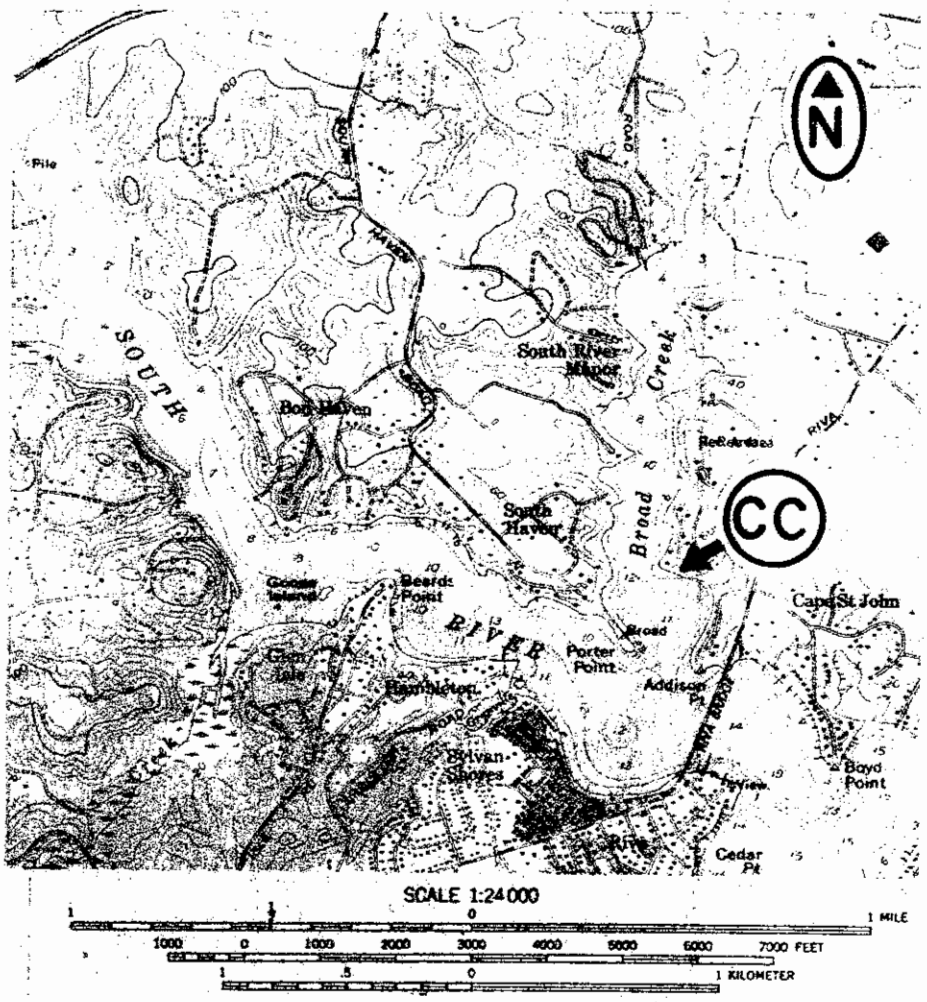
N
CC
SOUTH
RIVER
Broad Creek
South River Manor
South Haven
Beards Point
Porter Point
Addison Pt
Cape St John
Boyd Point
Cedar Pt
Bolvan Shores
SCALE 1:24000
1 MILE
7000 FEET
1 KILOMETER

Figure 5.9

Figure 5.10

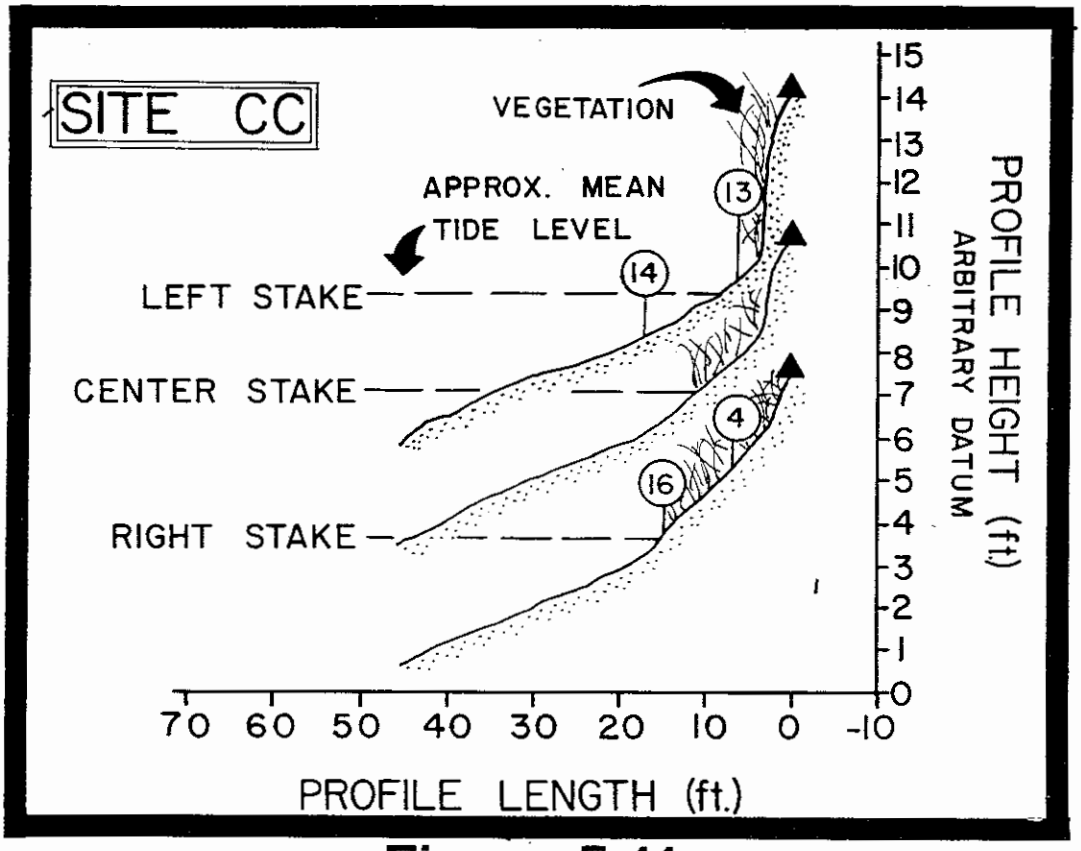

Figure 5.11

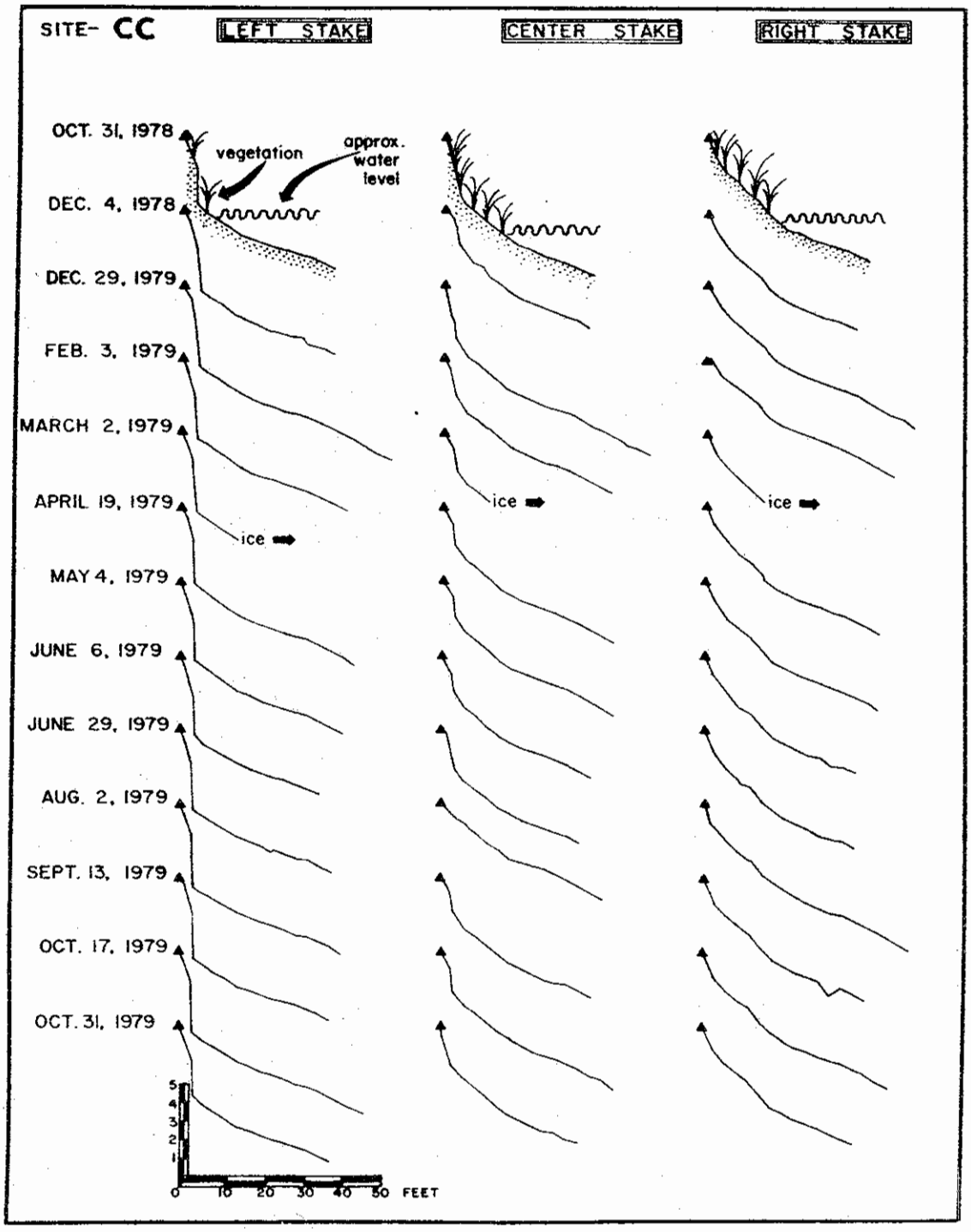
SITE- CC
LEFT STAKE
CENTER STAKE
RIGHT STAKE
OCT. 31, 1978
DEC. 4, 1978
DEC. 29, 1979
FEB. 3, 1979
MARCH 2, 1979
APRIL 19, 1979
MAY 4, 1979
JUNE 6, 1979
JUNE 29, 1979
AUG. 2, 1979
SEPT. 13, 1979
OCT. 17, 1979
OCT. 31, 1979
vegetation
approx. water level
ice
ice
ice
5
4
3
2
1
0
10
20
30
40
50
FEET

Figure 5.12

The profile layout for Site CC consists of 3 transects spaced 30 feet apart. The right profile is situated at the base of a bluff that meets the beach with an approximate 30 degree sloping face. The center profile is located 30 feet further upstream along the bluff and gradually steepens to a 50 degree sloping face. The bluff continues to steepen until it reaches a nearly - vertical section located at the left profile site.

The bluff face does not contain many areas of exposed sediments and its vegetation is composed of many trees, shrubs, thick vines, and small undergrowth. The beach grasses which grow at the base of the bluff along the shoreline consist of Scirpus olneyi and clump growths of Phragmites communis. In some areas of the shoreline between the center and right profiles, the grasses are isolated clumps tightly bound at the roots. Sediments in the near-shore contain submerged clumps of dead root material. The entire shoreline contains a 2-4 foot wide section of small grass growth that begins beyond the visible swash line.

Sediment samples at Site CC were collected from the bank, beach, and nearshore zones within the upper 1-2 inches of the shoreline profiles (Table 5.1). The sediments collected from the beach and nearshore zones are considered to be principally derived from the erosion of materials within the bluff. This bluff contains predominantly sand

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Opposite: Figure 5.12 Comparison of monthly profiles collected at Site CC.

and some well-sorted gravel between 20-50 mm. Sandy sediments comprise the beach within 3-5 feet of the base of the bluff. The strands of grass on the beach at the base of the bluff must play an important role in trapping these sandy sediments. This nearshore zone also contains well-sorted gravel which appears similar in character to the gravel collected from the bluff.

The mean tidal range at this site is approximately 1 foot, and there were no shoreline structures present along the reach which interferred with sediment movement during the period of study. There is a pier adjacent to the profiles, but this pier is not considered to have an effect on shore erosion.

The shoreface of the bluff at the study site receives boat-wake energy from boats entering and exiting Broad Creek, as well as from boats travelling up and down the South River. Boats entering and exiting Broad Creek pass at distances betweeen 400-500 feet, as compared to distances greater than 1500 feet on the South River. The inventory of boating activity collected at nearby Site C shows that 63% of the boat passages were waterskiers that were making multiple passes near that shoreline in a relatively short period of time. This site also experienced considerably more boating traffic on weekends as compared to weekdays.

The shoreface of this site, being situated some 500 feet from the main channel of the Creek, receives much lower levels of boat-wake energy than the adjacent promontory marsh. The pier adjacent to Site CC extends out 130 feet

and discourages most boats from making passes anywhere near the shoreface of the site. Even though the boating frequencies in this portion of Broad Creek are considered to be high, the boat-wake energy expended on the beach at site CC is relatively small.

The shoreface of Site CC also receives wind waves with the longest fetches between the south and southwest. Porter and Adison Points at the mouth of Broad Creek protect Site CC from many of the regional winds, except those focused directly into the creek. The wind roses illustrated in Appendix B show the bluff and marsh block any wind-waves when regional winds blow from the northern fetch areas, and the total wave energy expended on the beach at Site CC is negligible. Therefore the total wind-wave energy created at Site CC can be considered to be small.

The fastland boundary for Site CC was defined as the edge of vegetation for the right and center profiles. This vegetation line is also accompanied by a slight scarp which is composed of grass clumps tightly bound to the beach by root masses. The fastland boundary for the left profile was defined as either the in-place sediments forming the bluff, or the material which slumped from the bluff face.

Monthly profiles were collected at Site CC and a comparison between successive months is illustrated in Figure 5.12. Profile comparisons of successive months indicate that only very minor changes occurred at all three profile locations. The small vertical bluff face at the

left profile has a web of thick tree roots which has held the sediments tightly in place. The monthly profiles at the right and center stakes show some modulation of sediments on the beach and foreshore, but neither set shows any considerable fastland retreat. There was also a small slump between the inital profile in October 1978 and the next profile in December 1978. The profile on December 29, 1978 shows removal of much of the slumped sediment from the profile at the center stake, but the subsequent profiles do not show any additional change.

In summary, only minor changes were observed at all three profile locations during the period of the study. This site is sheltered from some of the strongest winds which blow from the north-northwest. The site is located in a popular boating area, but it is protected from close passages by boats due to a pier which extends out from the shore.

Site EE: A small bank and beach in Maynedier Creek off the upper Severn River.

This site is located inside the mouth of Maynedier Creek, off the upper Severn River (Figure 5.13). The beach segment chosen for monitoring consists of a small bank and beach which is adjacent to the ravine pocket marsh at the consultants' Site E described in Chapter IV.

The profile layout for site EE consists of two transects spaced 30' apart. The left profile contains a

small vegetated beach which is 10 feet upstream from the edge of the marsh. Landward of the beach on the left profile is a heavily-vegetated region of mature trees, shrubs, vines, and much small undergrowth. The right profile contains a beach with considerable growth of beach grasses extending 6 feet seaward of the bank. Landward of the beach on the right profile is a steep vegetated bank. The vegetation at the top of the bank consists of mature trees, shrubs, and vines.

Sediment samples at Site EE were collected from the upper 1-2 inches on the shoreline profile (Table 5.1). The sediments collected on the beach and in the nearshore are principally sand and are presumed to be derived from the erosion of the bank. The sediments in the bank contain 70% sand and some pebbles 1-3 mm. in size. The beach face in front of the bank contains 98% sand. Sediments collected from the nearshore zone approximately 4 feet seaward of the grass on the profile contained higher silt and clay content. The sandy nature of the sediments at Site EE stand in sharp contrast to the mucky consistency and high organic content of the adjacent marsh which is the consultants' Site E (Chapter IV).

Next pages: Figure 5.13 (left) Location map showing Site EE.

Figure 5.14 (upper right) Aerial view of Site EE.

Figure 5.15 (lower right) Typical profile of Site EE in October 1978.

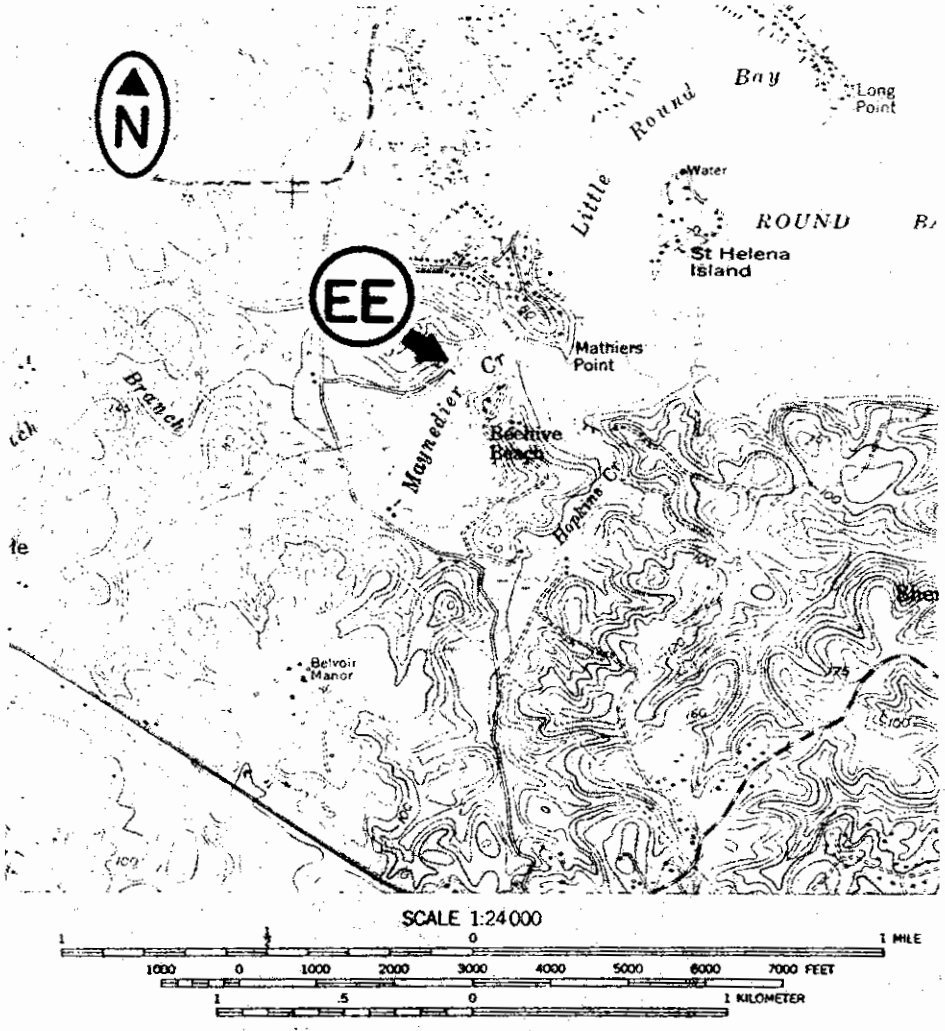
N
EE
Round
Bay
Long Point
Little
Water
ROUND
St Helena Island
Mathiers Point
Branch
Maynedier
Beckive Beach
Hopkins
Belvoir Manor
SCALE 1:24000
1 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER

Figure 5.13

Figure 5.14

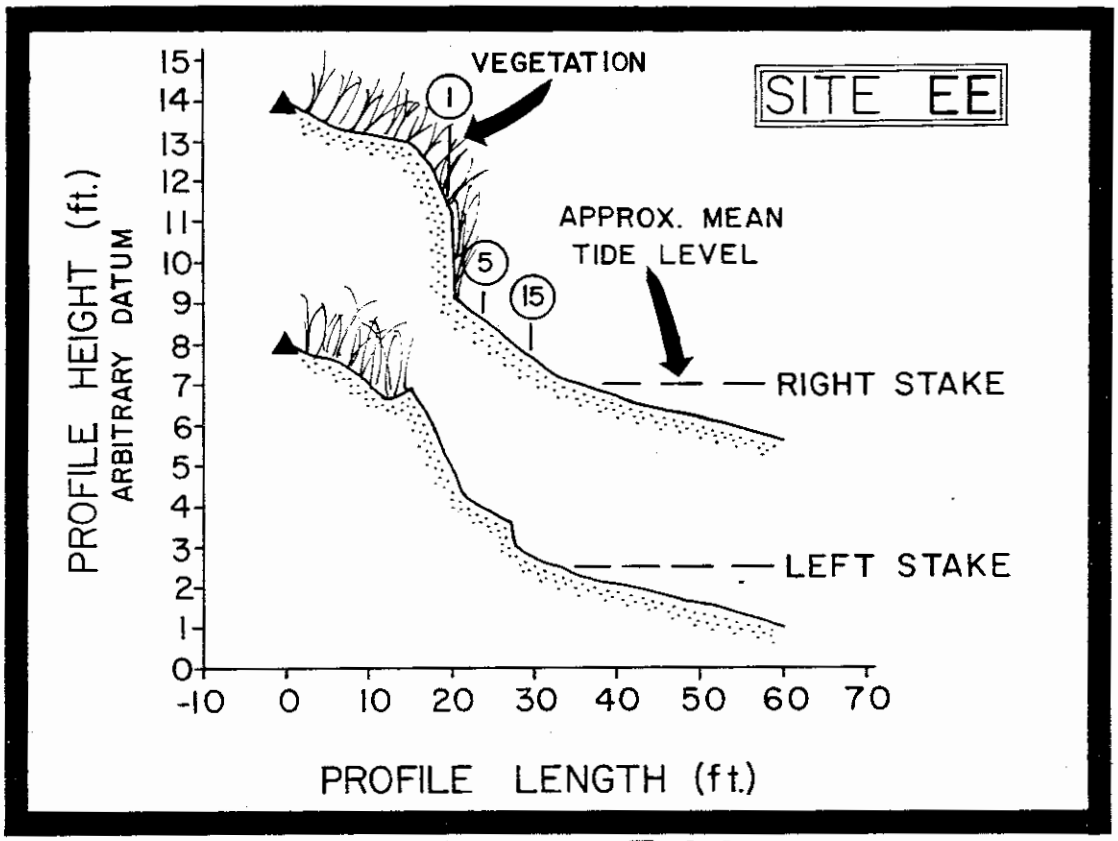

Figure 5.15

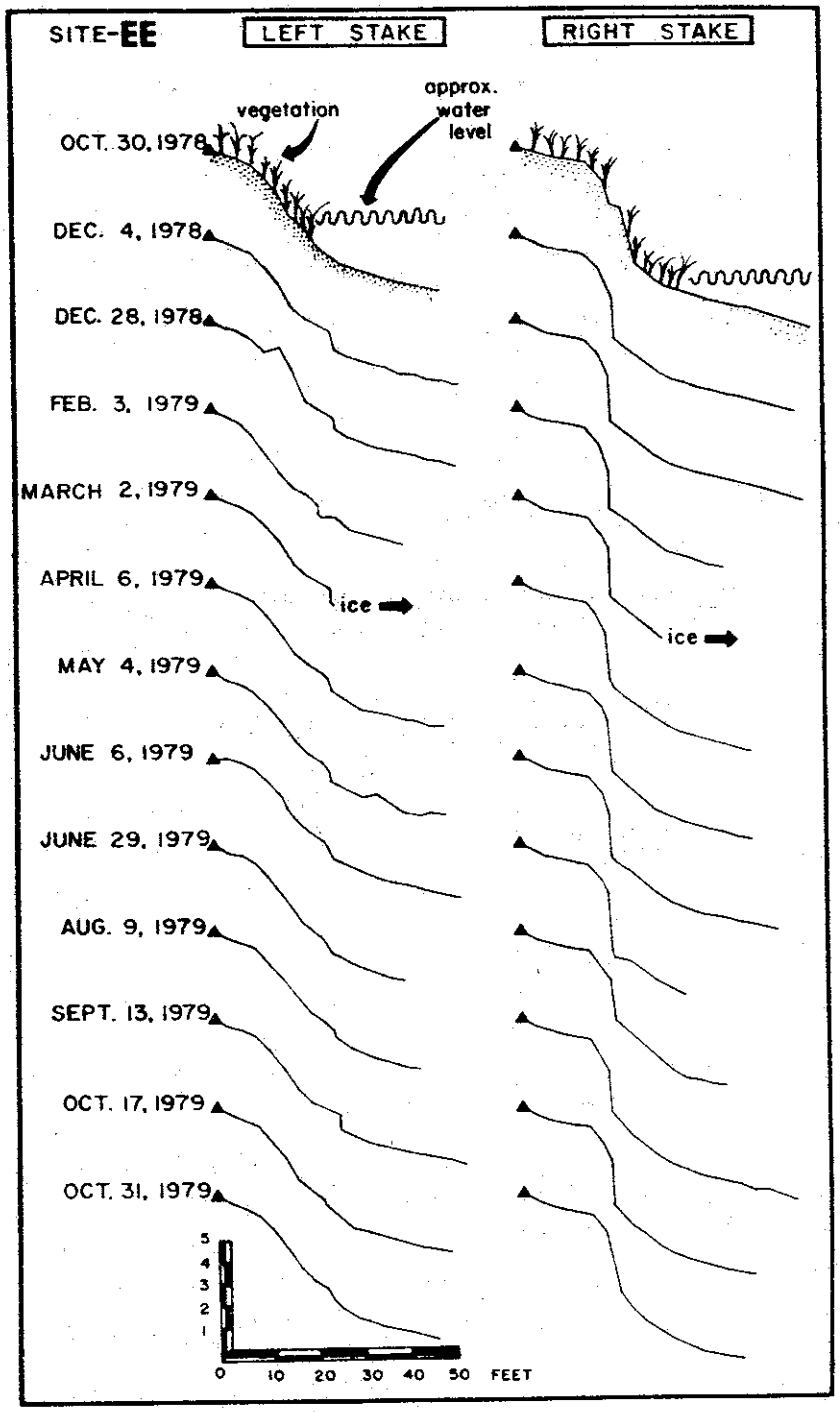
SITE-EE
LEFT STAKE
RIGHT STAKE
vegetation
approx. water level
OCT. 30, 1978
DEC. 4, 1978
DEC. 28, 1978
FEB. 3, 1979
MARCH 2, 1979
APRIL 6, 1979
ice
ice
MAY 4, 1979
JUNE 6, 1979
JUNE 29, 1979
AUG. 9, 1979
SEPT. 13, 1979
OCT. 17, 1979
OCT. 31, 1979
5
4
3
2
1
0
10
20
30
40
50
FEET

Figure 5.16

The mean tidal range at study site EE is approximately 0.8 feet. There were no shoreline protection structures present along this reach during the period of study which are considered to interfere with sediment deposition. There is a pier adjacent to the profiles, but this pier is not considered to have an effect on shore erosion.

The shoreface at Site EE receives boat-wake energy from boats entering or exiting Maynedier Creek. The boating characteristics are discussed for the consultants' Site E in Chapter VI. This study site, because of its extreme northwest location on the upper Severn River, experienced the least amount of boat-wake energy of the study sites. During the weekdays, 53% of the boats were towing waterskiers and made multiple passages of the shoreline. Maynedier Creek has a speed limit on weekends and holidays and 97% of all boats travelled at speeds of 10 mph or less.

The shoreface at Site EE also receives wind-wave energy which is fairly limited by Mathiers Point at the mouth of Maynedier Creek and by the shallow bathymetry of Round Bay beyond. The limited fetch within Maynedier Creek precludes the generation of any appreciable wind waves in the area, except at very high wind speeds. The wind-wave climate in this area is discussed in Chapter VII.

Profiles at Site EE were collected monthly and a comparison between successive months is illustrated in Figure 5.16. The fastland boundary at Site EE for the left

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Opposite: Figure 5.16 Comparison of monthly profiles collected at Site EE.

profile is defined as the landward edge of beach vegetation. The fastland boundary for the right profile site is defined as the base of the bank.

The profile comparisons indicate that only minor changes occurred at both the right and left stakes. Some of these irregularities on successive monthly profiles are due to the driftwood, falling trees, and logs which collected on the shoreline and which were not removed when the surveys were collected. For instance a comparison between the December 4, 1978 and December 28, 1978 profiles at the left stake shows some distortion caused by logs. During the boating season, the left profile experienced a slight episode of bank erosion that is evident on the August 9, 1979 profile. The next monthly profile at the left stake was collected after the passage of Tropical Storm David and more change was observed. By October 31, 1979, the sediments which had accumulated at the base of the bank were mostly removed.

In summary, there were only minor changes in the shoreline profiles at this site. A small amount of bank erosion was measured during the boating seaon, and some additional erosion was observed after the passage of Tropical Storm David.

Site FF: A beach and sandy marsh on Beards Point in the upper South River.

This site is the community beach in a subdivision known

as Glen Isle (Figure 5.17). The shoreline segment chosen for monitoring consists partially of a lawn bank landward of a beach, and an adjacent marsh on Beards Point. The profile layout for Site FF contains three transects spaced 30 feet apart. Figure 5.16 illustrates the exact location of these profiles.

The vegetation for Site FF at the right and center profile locations consists of ordinary lawn grass which is maintained by cutting. This lawn grass extends up to a 2 foot scarp at the waters' edge. Beyond the scarp is a beach composed of brown sand. At the left profile stake, the vegetation consists of a dense cattail marsh which extends up to the shoreline scarp. Sediments exposed in the scarp contain very compact root masses.

Sediment samples were collected from the scarp, beach, and nearshore in the upper 1-2 inches of the shoreline profiles (Table 5.1). The sediments in the nearshore zone at Site FF are considered to be primarily derived from the erosion of the grassy beach. This is shown from samples collected from this scarp which were composed of 97% sand containing pebbles 1-10 mm. in size. The beach samples collected in front of the scarp, and the nearshore samples

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Next pages: Figure 5.17 (left) Location map showing Site FF.

Figure 5.18 (upper right) Aerial view of Site FF.

Figure 5.19 (lower right) Typical profile of Site FF in October 1978.

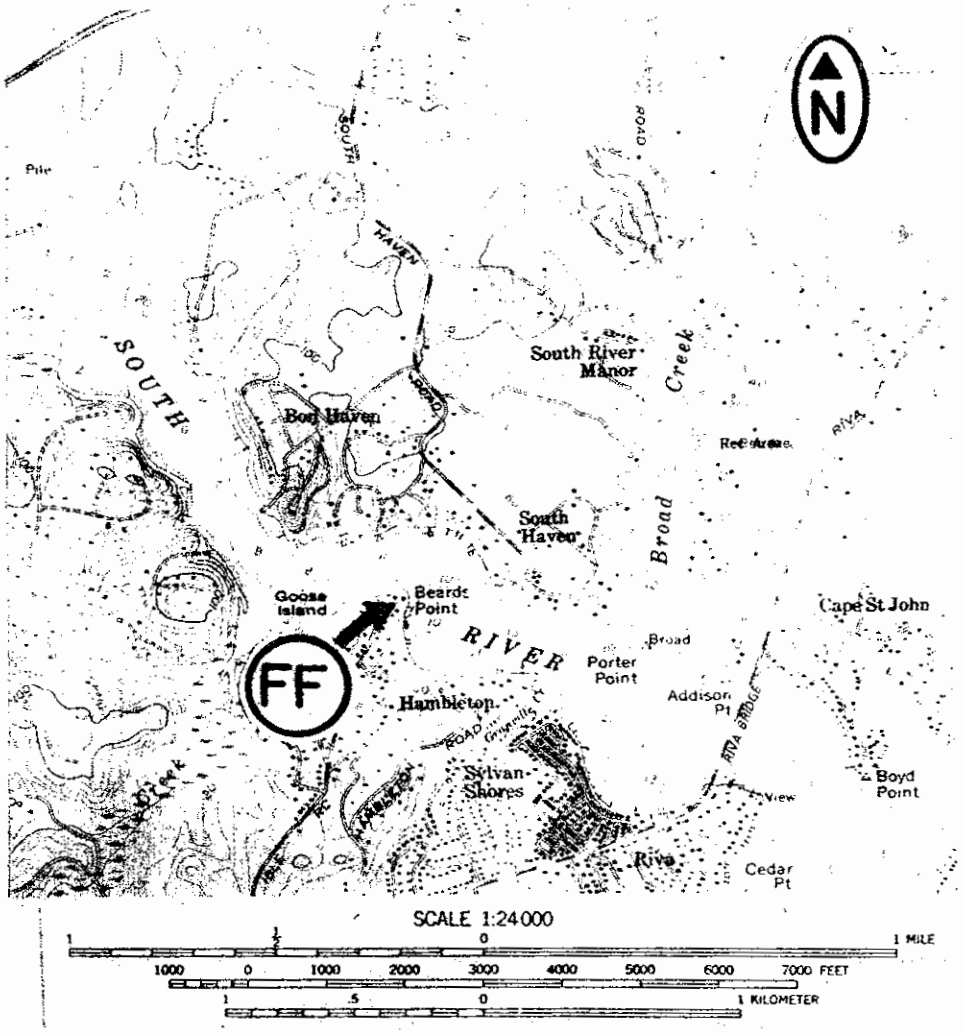
N
SOUTH
HAVEN
ROAD
South River Manor
Creek
Broad
Boat Haven
South Haven
Goose Island
Beards Point
RIVER
Broad
Porter Point
Cape St John
FF
Hambleton
Addison Pt
RIVA BRIDGE
Sylvan Shores
Boyd Point
Riva
Cedar Pt
SCALE 1:24000
1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER

Figure 5.17

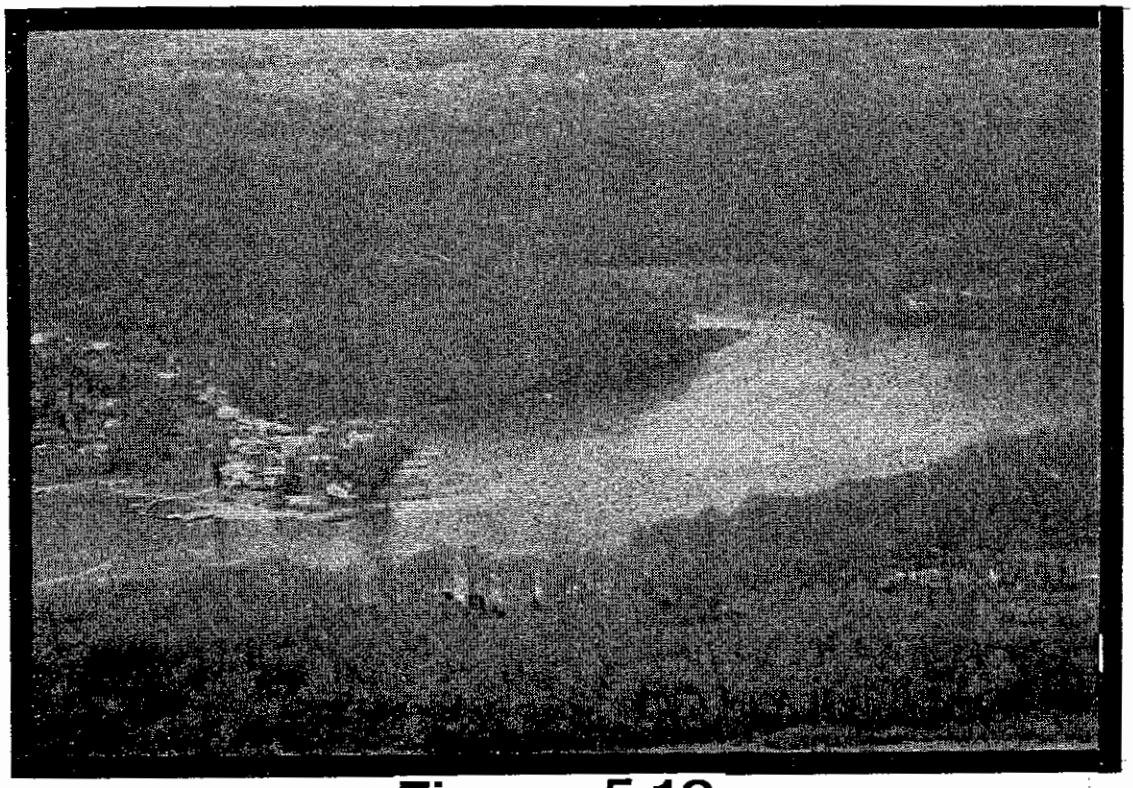

Figure 5.18

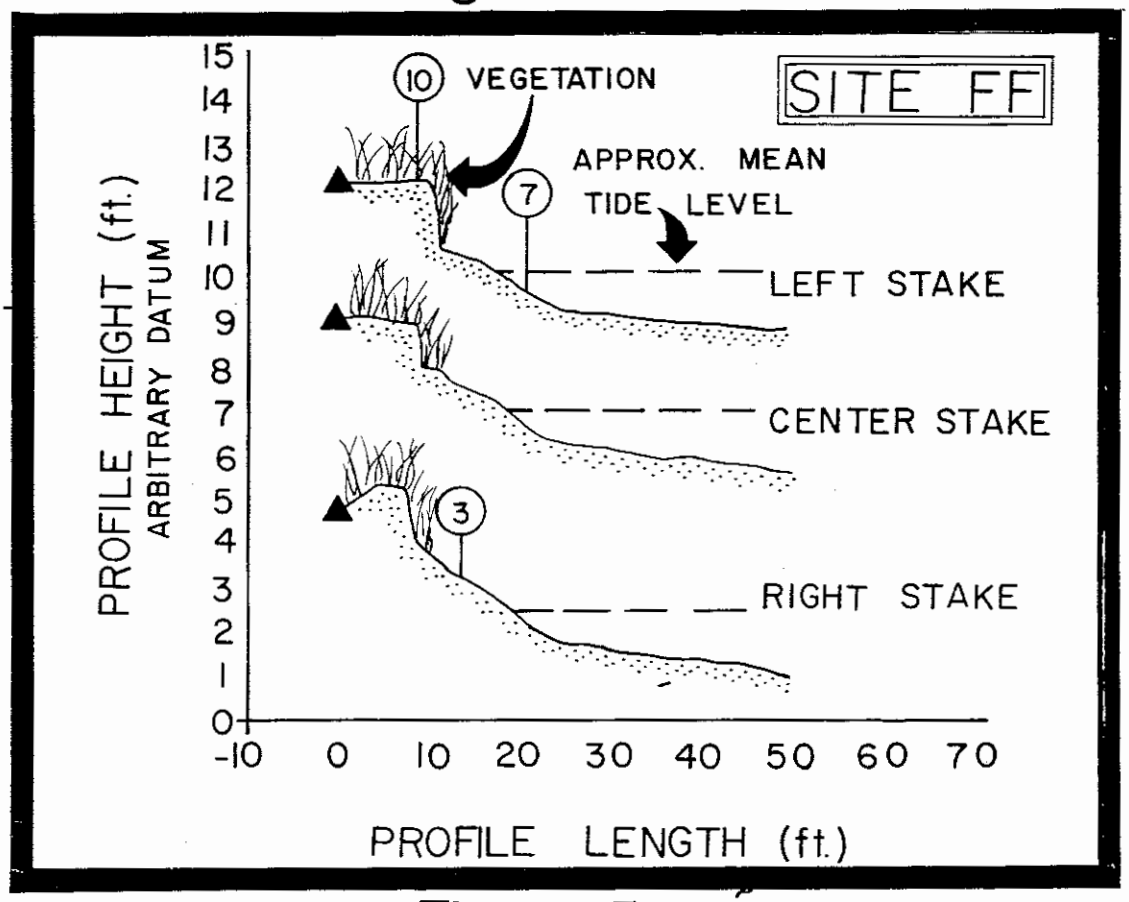

Figure 5.19

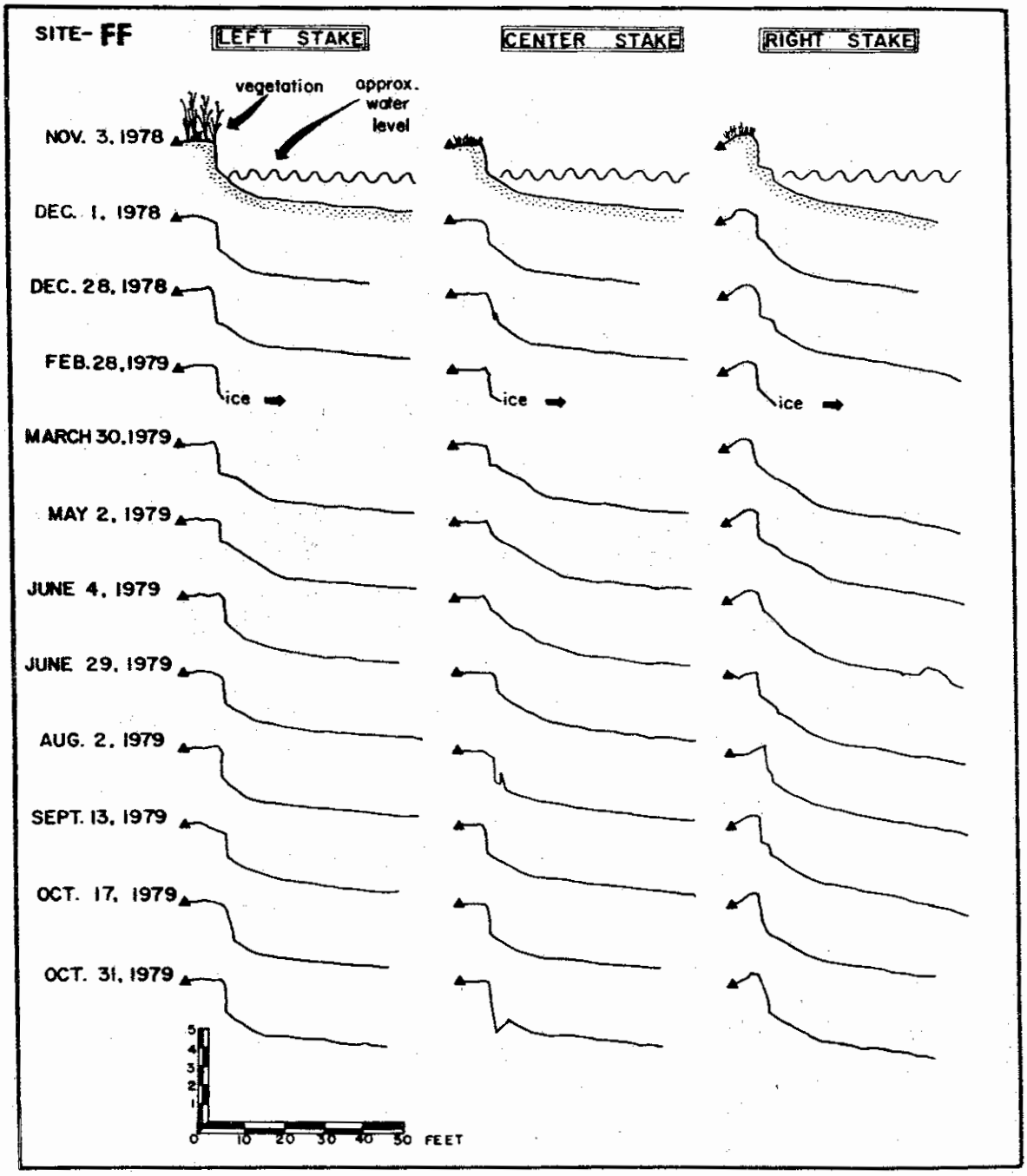
SITE- FF
LEFT STAKE
CENTER STAKE
RIGHT STAKE
vegetation
approx. water level
NOV. 3, 1978
DEC. 1, 1978
DEC. 28, 1978
FEB. 28, 1979
ice
MARCH 30, 1979
MAY 2, 1979
JUNE 4, 1979
JUNE 29, 1979
AUG. 2, 1979
SEPT. 13, 1979
OCT. 17, 1979
OCT. 31, 1979
5
4
3
2
1
0
10
20
30
40
50
FEET

Figure 5.20

contained 97% sand and pebbles ranging from 1-5 mm. in size. Sediment samples taken from the scarp on the left profile contained less sand and slightly more silt and clay, (Table 5.1).

The mean tidal range at Site FF is approximately 1.0 foot. The only shoreline structure present in the area is a community boat pier and mooring area which includes a wooden bulkhead that extends 10 feet out and is approximately 150 feet downstream from the study site. This pier is not considered to have an effect on shore erosion at the study site.

The shoreface of Site FF receives boat-wake energy from boats travelling up and down the South River. There is no speed limit restriction and most of the traffic is travelling at high speeds. The location of Beards Point results in relatively close passages of boats within 75-100 feet of the shoreline. Wakes from boats travelling upstream probably impact the downstream side of Beards Point in the vicinity of site FF more than wakes travelling downstream. Wakes were not measured at this site, but waves were observed to be undergoing refraction around Beards Point during the time profiles were taken.

The shoreface at Site FF also receives wind-wave energy with the longest fetches from the east and southeast. Regional winds from these directions can generate

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Opposite: Figure 5.20 Comparison of monthly profiles collected at Site FF.

appreciable wave energy which would focus directly on Beards Point. Wind waves from the northwest will create the same type of refraction previously mentioned, and could have some effect on this site.

The fastland boundary for all 3 profiles was defined as the edge of vegetation which is also the first pronounced change of slope.

Profiles at Site FF were collected monthly and a comparison between successive months is illustrated in Figure 5.20. The comparison shows that the small scarp at all three profile stakes experienced slight changes during the year of study. The left profile stake in the cattail marsh experienced the greatest change during the passage of Tropical Storm David on September 8-9, 1979. The profile for September 13 at this stake shows a change in the profile near the scarp, and erosion of sediments, when compared to the August 2 profile. There was also noticeable modulation of the sediments on the beach from month to month before the start of the boating season. But the changes in the location of the fastland boundary were minor at all of the stakes at this site.

VI

BOATING FREQUENCIES AND CHARACTERISTICS

Robert J. Byrne, John D. Boon III
Rhonda Waller, and Deborah Blades

A. Introduction

This chapter describes the frequencies of boat passes and other boating characteristics which were observed in front of those sites described in Chapter IV. At the beginning of the study, these sites were known to be located in areas of Anne Arundel County which were popular for boating, but there was no information available on the exact levels or patterns of boating which might be expected at each site. Since this information is useful in interpreting the behavior of the shoreline profiles during the boating season and at other times of the year, each of the five sites was occupied on a daily rotating basis for several weeks during the summer of 1979 (Table 6.1), to inventory the boating characteristics and to measure the boat-wake energies which are discussed in the next chapter.

The results presented in this chapter show there were markedly different frequencies of boat passes at each of the five study sites, together with different patterns of boat speeds, hull configurations, and distances of boat passes from the shoreline. The experiments with controlled boat passes discussed in Chapter VIII show specifically how these different characteristics can affect the wave heights (and

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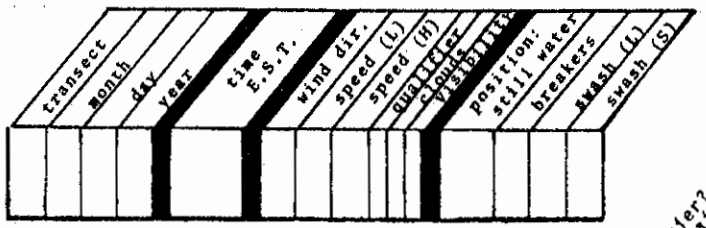
Next pages: Table 6.1 Boating inventories at the study sites.

Table 6.1 Dates and Sites of Boating Inventory

Date	Day	Site	Total Boats	Average Boats/Hr.	Weather
25 May	Fri	A	98	14	
26	Sat	B	72	9	
27	Sun	C	208	26	
28	Mon	D	522 Navy Day	75	
29	Tue	E	1	0	Rain
30	Wed	A	221	28	
31	Thr	C	5	1	Rain/Haze
1 June	Fri	B	18	3	
2	Sat	D	231	29	Rain
3	Sun	E	9	4	Rain
4	Mon	A	64	13	
5	Tue	B	206	26	
6	Wed	C	107	13	
1 July	Sun	A	400	100	
2	Mon	B	67	10	
3	Tue	C	203	25	
4	Wed	D	281	70	
5	Thr	E	35	5	
6	Fri	A	357	45	
7	Sat	B	511	64	
8	Sun	C	647	81	
9	Mon	D	174	22	
10	Tue	E	39	6	
11	Wed	A	188	24	
12	Thr	B	149	19	
13	Fri	C	88	15	Haze/Rain
14	Sat	D	397	50	
15	Sun	E	120	15	
16	Mon	A	234	29	
17	Tue	B	106	13	
18	Wed	C	149	19	
19	Thr	D	148	18	
20	Fri	E	62	12	Haze/Rain
21	Sat	A	302	76	
22	Sun	B	537	67	
23	Mon	C	90	13	Haze/Rain
24	Tue	D	118	15	Rain/Clear
25	Wed	E	38	6	
26	Thr	A	170	21	Haze/Rain
27	Fri	B	104	15	
28	Sat	C	337	42	
29	Sun	D	438	63	
30	Mon	E	30	4	
31	Tue	A	171	21	

Date	Day	Site	Total Boats	Average Boats/Hr.	Weather
1 Aug	Wed	B	159	23	
2	Thr	C	118	20	
3	Fri	D	105	21	
4	Sat	E	106	13	
5	Sun	A	1505	188	
6	Mon	B	107	13	
7	Tue	C	147	18	
8	Wed	D	127	16	
9	Thr	E	74	12	
10	Fri	A	187	23	
11	Sat	B	257	51	Haze/Rain
12	Sun		No Data		
13	Mon		No Data		
14	Tue	E	46	6	
15	Wed		No Data		
16	Thr	B	30	6	
17	Fri	C	75	9	
18	Sat	D	228	28	Clear/Rain
19	Sun	E	84	10	
20	Mon	E	49	6	
21	Tue		No Data		
22	Wed	C	85	11	
23	Thr	D	86	11	
24	Fri		No Data		
25	Sat		No Data		
26	Sun	B	215	43	
27	Mon	C	43	6	
28	Tue	D	44	6	
29	Wed		No Data		
30	Thr	E	28	7	
31	Fri	B	26	4	
1 Sept	Sat	C	113	28	
2	Sun		No Data		
3	Mon	B	60	8	
4	Tue	A	15	2	
5	Wed		No Data		
6	Thr		No Data		
7	Fri	B	11		
8	Sat	E	30	4	
9	Sun	D	38	5	
10	Mon	B	28	4	
11	Tue	C	32	5	
12	Wed	D	40	7	
13	Thr	E	0	0	
14	Fri		No Data		
15	Sat		No Data		



wind qualifier
S - steady
G - gusts
C - calm
V - variable

cloud cover
0 - clear
1 - scattered
2 - broken
3 - overcast

visibility
H - haze
R - rain
F - fog
U - unlimited

time	boat	boat speed (mph)	hull length (feet)	type	skier?	sailing?	direction	distance (feet x 10)
	1	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	2	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	3	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	4	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	5	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	6	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	7	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	8	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	9	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	10	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	11	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	12	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	13	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	14	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	15	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	16	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	17	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	18	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	19	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	20	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	21	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	22	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48
	23	5 10 15 20 25 30	12 14 16 18 22 26 30	P D S	Y	Y	US DS UT	6 8 10 12 14 16 18 20 22 24 28 32 36 40 44 48

Figure 6.1

thus the wave energy) in wakes which break along the shoreline. The experimental data helps to explain why there is not a clear increase in boat-wake energy (discussed in the next chapter) at the sites with the highest boating frequencies.

B. Methods

An inventory of boating activity was conducted at the study sites during an initial 13 day period (25 May - 6 June, 1979) and a following 77 day period (1 July - 15 September, 1979). The initial sampling design called for each site to be inventoried on each day of the week twice (i.e. 2 Sundays, 2 Mondays, etc.). This level of sampling strategy was determined by the fiscal constraints on the study; these constraints precluded anything other than a simple rotation of a single observer from site to site in a sequential series.

An observer categorized all boats passing at each site between 1000 hrs. and 1800 hrs. EDST. Figure 6.1 shows an example of the log sheet which was used on each day that observations were made. Each boat passing the study site was logged, in sequence, noting:

- o Time of day.
- o Boat speed (estimated).
- o Hull length (estimated).
- o Hull type; displacement or planning.
- o Sail boat.

Opposite: Figure 6.1 The log sheet which was used to inventory boating frequencies and other characteristics at the profile sites described in Chapter IV.

- o Presence of a skier in tow.
- o Direction: upstream, downstream or turning.
- o Distance: estimated or determined with range finder.

On each of the days when boats were inventoried at a site, the incoming boat-wake waves were also measured using a surface electronic wave gauge with a strip-chart recorder output (described in Appendix C). The wave heights were used to construct the wake-energy budgets, which are described for each study site in Chapter VII.

When boating activity and boat wakes were measured at a certain study site, observations were also made each hour of:

- o Wind speed and direction at the study site, using a wind-speed gauge and compass.
- o Cloud cover noted as clear, scattered, broken, or overcast.
- o Visibility: haze, rain, fog, unlimited.
- o Position of still water on the shoreline profile.
- o Position of the breaker zone and the upper and lower limits of the swash zone on the shoreline profile.
- o Hourly recording of the wind-wave field using the wave gauge.

C. Results

A comparison of the boating statistics for all the sites is given in Table 6.2. Daily summaries of all the

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Opposite: Table 6.2 Comparison of the boating statistics for all of the study sites.

TABLE 6.2 Summary of Boating Characteristics and Boating Activity: Site Averages Expressed as a Percent

Site	Avg.	Boats/Day	Speed (mph)				Hull Length (ft)				Type		Skier	Sail	Distance (ft)				
			≤10	20	30	>30	≤16	22	30	>30	P	D			≤100	200	360	480	>480
A	WD	170.5	29	47	23	1	32	32	24	12	75	25	14	7	12	34	8	0	46
	WE	735.7	41	31	27	1	33	34	23	10	54	46	0	15	1	8	26	0	65
B	WD	91.9	14	60	26	0	49	35	11	5	82	18	46	0	3	12	5	4	76
	WE	344.2	9	78	12	1	45	45	9	1	91	9	45	0	3	7	4	6	80
C	WD	95.2	9	75	15	1	53	40	7	0	90	10	63	0	28	56	16	0	0
	WE	326.2	11	76	13	0	49	39	12	0	87	12	57	0	36	47	17	0	0
D	WD	155.8	22	37	35	6	27	21	28	24	73	27	2	8	0	1	2	6	91
	WE/H	268.8	30	43	26	1	26	35	25	14	68	32	1	17	0	1	1	2	96
E	WD	44.6	23	51	26	0	59	35	5	1	76	24	53	4	18	68	14	-	-
	WE	69.8	97	2	1	0	63	20	11	6	3	97	1	10	3	55	42	-	-

WD = Weekday Averages; WE/H = Weekend, Holiday Averages

WE = Weekend Averages; P = Planing; D = Displacing

boating characteristics at each site are presented in Tables 6.3 thru 6.7.

SITE DESCRIPTIONS

Site A is located on the vegetated spit along the lower South River near the entrance to Harness Creek. There are two distinct patterns of boating in the vicinity of this site. One group of boats operates in a popular sailing area well away from the shoreline, out near the main channel of the lower South River. Another group of boats enters and leaves a popular anchorage area in Harness Creek, and passes the study site at a much closer distance.

Table 6.3 shows that the total frequency of boat passes, and the portion of boats passing close to shore at Site A can vary from day to day, and from weekday to weekend. The summary of data from all sites in Table 6.2 shows that, on the average, more than two-thirds of the weekend boat passes at Site A take place well away from the shoreline out in the South River and a larger percentage of the weekday boat passes at Site A take place nearer to the mouth of Harness Creek.

Opposite: Table 6.3 Daily inventory of boating activity for Site A.

Table 6.3 Inventory of Boat Activity, Daily Summaries

Site A

Date (1979)	Day	Total Boat Passes	Boat Speed (mph)				Hull Length (ft)				Type		Skier	Sail	*Distance (ft x 10)				
			≤10	20	30	>30	≤16	22	30	>30	P	D			≤10	20	36	48	>48
25 May	Fri	98	30	50	18		18	43	19	18	48	50	2	-	18	18			62
30 May	Wed	221	33	54	117	17	14	53	59	95	178	43	32	-	56	57			108
4 Jun	Mon	64	43	21			6	21	21	16	52	12		-	19	7			38
1 Jul	Sun	400	162	126	112		43	118	78	61	200	194	2	-		21	124	1	247
6 Jul	Fri	357	152	204	1		115	109	83	42	283	14	57	26	50	126	26	1	178
11 Jul	Wed	188	26	126	30	2	87	58	27	10	171	2	38	12	17	86	34		46
16 Jul	Mon	234	61	103	70		120	61	41	13	170	40	43	24	3	46	56		127
21 Jul	Sat	302	130	123	45	4	75	126	96	6	165	97	2	43	18	108	2		152
26 Jul	Thr	170	46	93	29	2	62	69	32	7	107	46	52	17	25	85	11		43
31 Jul	Tue	171	50	58	70	2	72	55	44	6	90	74	8	17	17	68	5		92
3 Aug	Sun	1,505	616	436	431	22	573	479	318	153	653	572	4	285	1	37	454	1	1,021
10 Aug	Fri	187	54	84	49	1	46	70	71	2	73	98	10	19	6	83			98
4 Sep	Tue	15	4	9	2		4	6	3	3		15				15			

7% of the weekday boat passes at Site A consisted of sailboats compared to 15% of the weekend boat passes. This observation partially explains the lower percentage of planing boats which were present in the weekend boating patterns. The average frequency of boat passes on weekends at Site A was 4 times as high as on weekdays. The average hull length and average speed were approximately the same on both weekdays and weekends.

Most important, Table 6.2 shows Site A experienced more boat passes on both weekdays and weekends, on the average, than any of the other 4 study sites whose profiles are described in Chapter IV.

Site B is located at the steep bank on the upper South River near Goose Island. This site is located along a relatively straight reach of shoreline, and in a relatively sheltered portion of the upper South River. The site is not near any popular anchorage or docking facility, and is a popular running ground for high-speed power boats and ski boats.

This popularity is reflected in several of the statistics of boat use on Tables 6.2 and 6.4. Virtually no boats under sail were observed at this site, and almost 50%

Opposite: Table 6.4 Daily inventory of boating activity at Site B.

Table 6.4 Inventory of Boat Activity, Daily Summaries

Site B

Date (1979)	Day	Total Boat Passes	Boat Speed (mph)				Hull Length (ft)				Type		Skier	Sail	Distance (ft x 10)				
			≤10	20	30	>30	≤16	22	30	>30	P	D			≤10	20	36	48	>48
26 May	Sat	72	7	55	10		39	28	5		60	12	23	-	2	29	21	15	15
1 Jun	Fri	18	11	7			2	12	4		12	6		-	1	1	1	1	14
5 Jun	Tue	206	62	144	1		4	90	101	11	195	11	80		9	11	14	4	168
2 Jul	Mon	67	13	53	1		13	39	13	2	58	10	32						67
7 Jul	Sat	511	60	447	8		63	379	92	10	508	5	191	3	22	30	12	31	419
12 Jul	Thr	149	12	127	10		132	83	4	4	147	1	91		5	16	3	4	121
17 Jul	Tue	106	4	101	1		61	39	6		105		71		3	1	1	4	97
22 Jul	Sun	537	40	420	71	6	359	167	25	1	493	60	287	1	3	31	10	21	490
27 Jul	Fri	104	4	88	12		61	39	4		96	7	55		4	9	5	5	82
1 Aug	Wed	159	3	62	94		110	31	2	37	127	19	87		2	20	8	10	107
6 Aug	Mon	107	17	73	26	1	67	48			84	34	53		3	12	2	6	94
11 Aug	Sat	257	14	162	79	2	181	77	2		200	46	121		10	14	8	20	209
16 Aug	Thr	30	3	23	4		16	14			22	8	12			1	3	1	25
26 Aug	Sun	215	8	42	162	3	184	30	6	5	176	50	97		1	26	12	16	184
31 Aug	Fri	26	3	5	16	2	8	15	1	2	10	16	4		1	7	2	4	13
3 Sep	Mon	60	36	24			13	26	6	14		61		4	2	45	7		
7 Sep	Fri	11	2	1	8		1	9	1		8	3	5			10	1		
10 Sep	Mon	28	4	21	2		13	11	4		19	9	8		3	2	3	2	18

of the total number of boats inventoried were pulling skiers both on weekdays and weekends. About 90% of all boats inventoried had speeds which were estimated at 10 mph or more, and lengths of 22 feet or less. Between 75 and 80% of the boats remained more than 480 feet from the shore, probably because of shallow depths and obstructions (tree trunks) near the shore at Site B.

Table 6.4 shows that Site B had, on the average, the second-highest frequency of boat passes (next to Site A) on the weekends. The average number of boats on the weekends was slightly less than 4 times the average number of boats on weekdays.

Site C is located at the small promontory on Broad Creek near the entrance to the South River. Broad Creek is comparatively deep along both shores and relatively straight. Like Sites A and B, considerably more boating activity occurred on weekends as compared to weekdays. Table 6.5 shows Site C experienced the second largest boating frequency on weekdays of the five sites, and some 63% of its average 95 boats per day were pulling skiers. Table 6.2 shows about 93% of the weekday boats were 22 feet or less in length and about 90% had speeds exceeding 10 mph. More than 80% of all boats observed passed within 200 feet

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Opposite: Table 6.5 Daily inventory of boating activity at Site C

Table 6.5 Inventory of Boat Activity, Daily Summaries

Site C

Date (1979)	Day	Total Boat Passes	Boat Speed (mph)				Hull Length (ft)				Type		Skier	Sail	Distance (ft x 10)				
			≤10	20	30	>30	≤16	22	30	>30	P	D			≤10	20	36	48	>48
27 May	Sun	208	27	147	34		63	92	51	2	172	36	73	-	131	77			
30 May	Thr	5																	
6 Jun	Wed	107	29	74	2	2	30	63	14		87	20	58	-	45	56	6		
3 Jul	Tue	203	13	189	3		23	119	52		201	3	145		90	71	17		4
8 Jul	Sun	647	69	542	33	3	366	174	93	3	638	9	400		147	228	191	1	
13 Jul	Fri	88	6	75	8		69	22			91		70		5	71	22		
18 Jul	Wed	149	7	133	7	2	85	63			145	4	97		55	64	31		
23 Jul	Mon	90	7	74	4	5	64	25	1		55	34	51		20	61	6		
28 Jul	Sat	337	34	249	54		143	184	8		241	90	204		121	202	9		
2 Aug	Thr	18	6	88	23		53	65			94	24	89		25	78	5		
7 Aug	Tue	147	13	121	12		106	35	6		97	50	98		48	95	4		
17 Aug	Fri	75	6	35	34		69	4	2		63	12	47		4	35	48		
22 Aug	Wed	85	9	18	58		73	12			74	11	48		5	47	31		
27 Aug	Mon	43	3	20	18	2	15	25	2	1	33	10			10	30	6		
1 Sep	Sat	113	9	57	44	3	54	52	7		89	24	65		37	64	11		
11 Sep	Tue	32	1	23	6	2	8	18	6		22	10	15		7	27			

of the shore and roughly 30% came within 100 feet of shore. Thus Site C is clearly a site in which a high level of activity was concentrated very near the shoreline being monitored.

Site D is located at the bluff near Severnside on the northern shore of the Severn River. This site is the most exposed of the five sites to wind-wave activity. Compared to the sites discussed for the South River, weekend boating activity was not greatly in excess of that observed during weekdays, even though the Fourth of July holiday was included among the former. Table 6.2 and 6.6 shows that very little skiing was observed at this site and boating characteristics were rather mixed with a broader distribution of boat speeds and lengths than at other sites. This was not unexpected in view of the close proximity of Site D to the port of Annapolis, a major center for yachts of all types. It is also apparent in Table 6.6 that most of the boating activity occurs well out in the Severn. Most of the traffic appears to be transiting to and from the Bay.

Site E is located at the pocket marsh inside a cove that opens to the Severn River. The site is well protected,

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Opposite: Table 6.6 Daily inventory of boating activity at Site D.

Table 6.6 Inventory of Boating Activity, Daily Summaries

Site D

Date (1979)	Day	Total Boat Passes	Boat Speed (mph)				Hull Length (ft)				Type		Skier	Sail	Distance (ft x 10)				
			≤10	20	30	>30	≤16	22	30	>30	P	D			≤10	20	36	48	>48
28 May	Mon	522	34	181	243	69	16	74	177	249	374	138	-	-		5			522
2 Jun	Sat	231	99	127	5		24	58	68	91	163	68	1	-		6			225
4 Jul	Wed	281	90	129	62		67	184	58	32	175	46	2	65	1	5	1	1	273
9 Jul	Mon	174	47	86	40		77	45	41	13	144	5	17	-	1				173
14 Jul	Sat	397	92	171	130	4	178	121	46	46	244	72	1	25			7	4	385
19 Jul	Thr	148	69	61	18		73	30	42	1	86	21	1	41			2	59	87
29 Jul	Sun	438	96	161	155	15	102	152	170	14	209	146	3	88	1	1	2	3	444
3 Aug	Fri	105	29	36	39	1	55	15	15	19	48	39	6	17		5	7	1	90
8 Aug	Wed	127	36	47	41		45	37	41	4	72	41	2	19		3	1	3	119
18 Aug	Sat	228	104	85	36	1	53	55	65	49	72	70	10	86			2	2	224
23 Aug	Thr	86	29	26	29	2	35	25	15	11	48	20	-	18				1	85
28 Aug	Tue	44	9	8	19	7	12	24	4	5	19	24	-	1		3	13	5	22
9 Sep	Sun	38	6	9	21	1	4	25	5	3	16	18	4	3		2	10	16	10
12 Sep	Wed	40	15	12	11	2	14	12	14		21	12	-	7				3	37

the nearshore zone is muddy and extremely shallow at low tide in the vicinity of the monitoring site. In contrast to the other sites, Site E experienced minimal boating activity during both weekday and weekend observation periods. Roughly 60% of all boats inventoried had lengths of 16 feet or less. On weekends, 97% of all boats travelled at speeds of 10 mph or less. Skiing activity accompanied about 53% of weekday boating, but dropped to about 1% during weekends. This is an indication that the weekend skiing restriction is being respected by the boaters.

Opposite: Table 6.7 Daily inventory of boating activity at Site E.

Table 6.7 Inventory of Boating Activity, Daily Summaries

Site E

Date (1979)	Day	Total Boat Passes	Boat Speed (mph)				Hull Length (ft)				Type		Skier	Sail	Distance (ft x 10)				
			≤10	20	30	>30	≤16	22	30	>30	P	D			≤10	20	36	48	>48
29 May	Tue	1																	
3 Jun	Sun	9	8			1	3		3	2	2	7			2	6	1		
5 Jul	Thr	35	18	17			28	6	1		26	4	6	6	3	11	22		
10 Jul	Tue	39	6	32	1		15	21	3		38	1	29	-	1	35	3		
15 Jul	Sun	120	116	3	1		82	23	8	7	4	111	4	5	5	23	91		
20 Jul	Fri	62	8	39	15		37	20			59	4	36	2	26	34	1		
25 Jul	Wed	38	7	25	6		34	1	4		29	9	28	-		34	4		
30 Jul	Mon	30	13	3	1		25	6	2		17	13	13	3	1	30	1		
4 Aug	Sat	106	104	1	1		56	28	16	7	2	65	1	21	3	85	18		
9 Aug	Thr	74	9	42	23		15	55	4		49	23	41	2	4	66	4		
14 Aug	Tue	46	11	22	13		31	13	2		33	11	29	2	1	38	7		
19 Aug	Sun	84	80	3	1		61	13	5	6	2	77		5	1	57	27		
20 Aug	Mon	49	13	10	26		42	4	2	1	30	17	26	2		33	16		
30 Aug	Thr	28	4	6	18		8	17	2	2	16	11	6	1	5	20	3		
8 Sep	Sat	30	30				16	6	8			27		3		19	9		
13 Sep	Thr	0																	