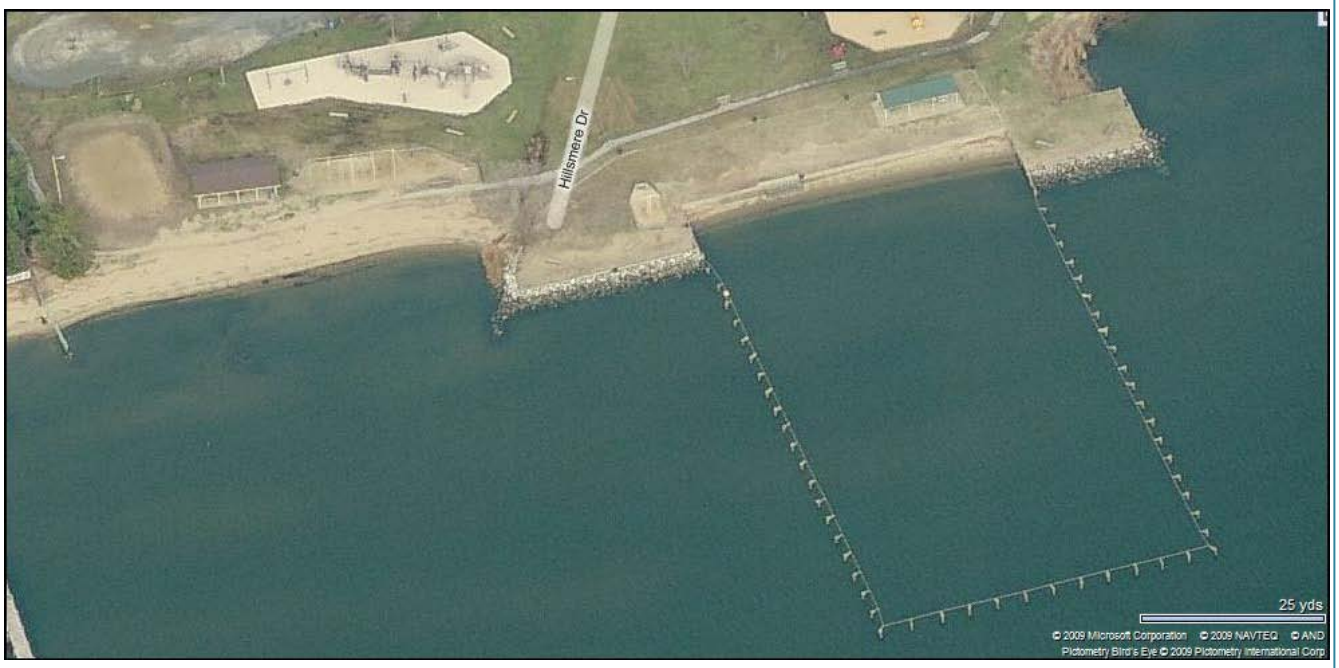
HILLSMERE SHORES COMMUNITY SHORELINE STUDY
BEACH ASSESSMENT AND STABILITY REPORT

Prepared for:
Hillsmere Shores Improvement Association
611 Harbor Drive
Annapolis, Maryland 21403



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March 2010

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1.0 INTRODUCTION

The Hillsmere Community Beach is located at the end of Hillsmere Drive in the Community of Hillsmere Shores in Anne Arundel County Maryland. The community beach is along the northern entrance into Duvall Creek off of the South River. The intent of this shoreline study was to determine the current state and long term stability of this community beach shoreline in the Hillsmere Community. Specifically as it relates to shoreline erosion. It is not the intent of this report to address flooding events as they may relate to large tropical storms and hurricanes. The status of the shoreline was determined by examining existing published data and field collected data focusing on: shoreline aspect, wave energy, fetch (distance over which wind driven waves can travel), weather patterns, littoral drift (material moved by waves and currents), and erosion rates. By reviewing these data, we have a greater understanding of the forces that are applying their energies to this area and the effect these factors ultimately have on shoreline stability. A note to the reader, this report is focused on the Community Beach for the Hillsmere Shores Community located at the end of Hillsmere Drive and the site specific conditions that exist there, the findings contained herein should not be applied to other shorelines within the Hillsmere Community.

2.0 METHODS

Initially, ESA conducted a literature search focused on existing published data for the Hillsmere area of the Chesapeake Bay. This search focused on the existing physical characteristics of the Hillsmere beach such as shoreline aspect, existing structures (breakwaters, bulkheads, groins, etc.), and fetch, and how other factors like weather patterns, wave energy, littoral drift, and erosion impact the existing conditions. In addition, field surveys were conducted by ESA in August of 2009, during which a 458.8 ft detailed profile of the beach was surveyed using stadia rod and laser level. From this profile, ESA established five 350 ft transects perpendicular to the shoreine to determine the slope of the existing beach and river bottom. Elevations were recorded at abrupt grade changes along the beach, and every 20 ft along the river bottom. Two transects were established to the west along the natural shoreline, two along riprap bulkheads, and one through the enclosed swimming area. Monuments were installed at the end points of each transect to allow for additional data collection if necessary. A map that shows the profile and transect locations is provided in **Appendix A**. The beach was also visited during two significant weather events to document extreme wind and wave events.

3.0 RESULTS AND DISCUSSION

3.1 Existing Structures and Shoreline Aspect

The Hillsmere Shoreline is located near the mouth of the South River along the northern entrance into Duvall Creek (2009 ADC Map Anne Arundel County, page 5537, grid A-2). The western portion of the shoreline is characterized by 200 ft of gently sloping natural sand beach. To the east, two exposed rip-rap bulkheads extend from the shoreline and enclose a setback concrete bulkhead as part of a community swimming area. The bulkhead extends 147 ft along the shoreline and the enclosed swimming area extends 216 ft from the bulkhead into the South River. Overall, the community park has gentle sloping topography and a large gradually sloping shoal that extends out toward the river. The natural sand beach has a uniform grade of 7.5-11.5 % over 30 ft. At low tide water level, the grade

quickly flattens where the river bottom forms a low 0.4-0.7 % sloping shoal that extends a minimum of 250 ft from the shoreline. As expected, abrupt slope changes were observed along the steep faces of the riprap and concrete bulkheads. Beyond these areas, however, the river bottom continues at a 0.5 % slope towards open water. The low slope of the natural beach helps to dissipate wave energy and decrease erosion potential. Figures illustrating shoreline slopes are located in **Appendix A**.

3.2 Weather Patterns

According to the Maryland Climate Office, most weather systems approach Maryland from the south and west. Although less frequent, some systems also approach from the north. Larger tropical systems approach Maryland from the south and track up the east coast. Due to their counterclockwise rotation, hurricanes that track up the east coast push water out of the Bay, while hurricanes that move inland west of the Bay push water into the Bay (**Appendix B**). Under easterly hurricane conditions, water levels at Hillsmere would become even shallower, negating erosive wave action from increased wind speed. Under westerly hurricane conditions, the Hillsmere shoreline would be more exposed during high water levels but the low sloping topography and overall shallow conditions of the site offer protection and help to disperse wave energy. The forces associated with these storms are more damaging to unprotected shorelines with abrupt elevation changes. Due to the low sloping aspect of the Hillsmere shoreline and river bottom, the southerly beach aspect, and the surrounding landmasses, the Hillsmere beach is well protected from the erosion effects from such storm events. Coastal flooding from such storms is another matter and is not the focus of this study.

3.3 Fetch

All wind associated with storms produce waves. Waves are produced when energy is transferred from moving air to the water. Fetch is defined as the distance over which wind driven waves can travel. Generally, large stretches of fetch result in larger high energy waves, while small expanses of water are too small for wind energy to create substantial waves. The Hillsmere shoreline faces directly toward the mouth of the South River and Chesapeake Bay (south), exposing it to a large expanse of water from which waves can travel. There is approximately 1.2 miles of open water between Hillsmere and Turkey Point to the South. 8.1 miles of open water lie between Hillsmere and Kent Island (**Appendix C**). Normally, large stretches of fetch such as these have the capacity to create large, destructive, waves. But because of the shallow conditions, which is the result of extensive shoaling out in front of the Hillsmere community beach, most wave energy is dispersed by the time waves reach and break on shore. Storms that blow out of the southwest do not generate a substantial amount of wave energy due to the aspect of the Hillmere shoreline and the amount of fetch from this direction.

3.4 Wave Energy

When a wave enters shallow water, the lower portion of the wave begins to drag on the bottom. This pushes the wave up, increasing its height, while simultaneously decreasing its speed as the base of the wave drags on the bottom. As wave height increases and speed

decreases, a wave will eventually break on itself or the shoreline. All waves behave the same whether they are generated by wind or boat traffic. The largest potential for shore erosion from boat wakes can be anticipated where there is a high frequency of boat passes close to shore. The river bottom at Hillsmere community beach is relatively shallow, 3-4 feet at MHT, and extends out into the river for 200- 500 feet, which prevents boats from traveling close to shore. The enclosed swimming area and long private docks also deter boaters from traveling in close parallel to the beach. Because the Hillsmere shoreline has a very gradually sloping beach and river bottom, wave energy is dissipated over a long distance. By the time waves reach the shore they do not have sufficient energy to cause significant beach erosion. Some of the properties of waves are further explained in **Appendix D**.

3.5 Littoral Drift, Erosion, and Accretion

Littoral Drift or Long Shore Transport is a process that moves sand particles along a shoreline using wave energy and water currents. When two drifts converge, or some other structure prevents further movement of the particles, sand builds up resulting in a constructive process called shoreline accretion. High amounts of littoral drift have been documented in the Annapolis area (Wang, 1982) (Figure 6). Littoral drift maps from the Army Corps of Engineers show two drift patterns converging at or about the Hillsmere shoreline (Figure 7). Existing data and observations from the field suggest the converging drift patterns and shoreline protection structures currently in place at Hillsmere are resulting in shoreline accretion, particularly in the northeast corner of the natural shoreline (Figure 9). The bulkhead acts as a groin and prevents the transport of material along the shore. This area was full of dead floating aquatic vegetation at the time of our field survey, further evidence that the existing bulkhead inhibits transport and results in the buildup of material. The Center for Coastal Resources Management has documented the natural beach area of Hillsmere Shoreline as an area of accretion.

Historic erosion trends may have been the result of longshore transport before bulkheads were installed at Hillsmere Shoreline. Since the shoreline protection structures have been installed, the shoreline has experienced relatively little erosion (Figure 13). Historic longshore transport may have lead to the formation of a point bar in Duvall Creek which has since been converted into a community marina (Figures 11 and 12).

The accretion of sand along the Hillsmere beach has had a positive effect on beach replenishment and long term stability of the shoreline in this area.

4.0 CONCLUSION

It is ESA's professional opinion that the existing Hillsmere shoreline at the community beach is relatively stable and does not require additional protection or armaments. There are three main reasons that the shoreline at the Hillsmere community beach is not experiencing even minor beach or shoreline erosion problems.

- The existing beach structures and naturally occurring forces at the site are not significantly eroding the beach and actually appear to replenish the natural beach through a process known as shoreline accretion. This is due to naturally occurring currents and the existing shoreline protection structures that are in place which help to intercept the littoral drift, causing accretion zones.

- Wind and wave energy associated with most storm systems and boat traffic is dispersed by the low profile river bottom caused by the extensive shoaling out in front of the beach. This results is much lower wave energy impacting the shoreline at the community beach. By the time the wave reaches the beach, much of its energy has already been dissipated on the shallow river bottom.

- The gentle aspect of the natural shoreline allows the wave energy to roll harmlessly up onto the shore and back into the river with no negative effects to the fastland. If the interface of the fastland with the wave energy was more abrupt (vertical) then the result would be drastically different and one would expect to see obvious signs of bank erosion.

For these reasons, ESA recommends the shoreline be passively monitored over time, but at present, protective actions are not necessary.

5.0 REFERENCES

Anthoni, J.F. 2000. Oceanography: Waves theory and principles of waves, how they work and what causes them. < *http://www.seafriends.org.nz/oceano/waves.htm#shallow*>.

Center for Coastal Resources Management. <*http://ccrm.vims.edu/gis_data_maps/interactivemaps/index.html*>.

DNR Coastal Atlas-Shoreline and Littoral Conditions Map. <*http://mdshorelines.towson.edu/conditionsMaps.asp*>.

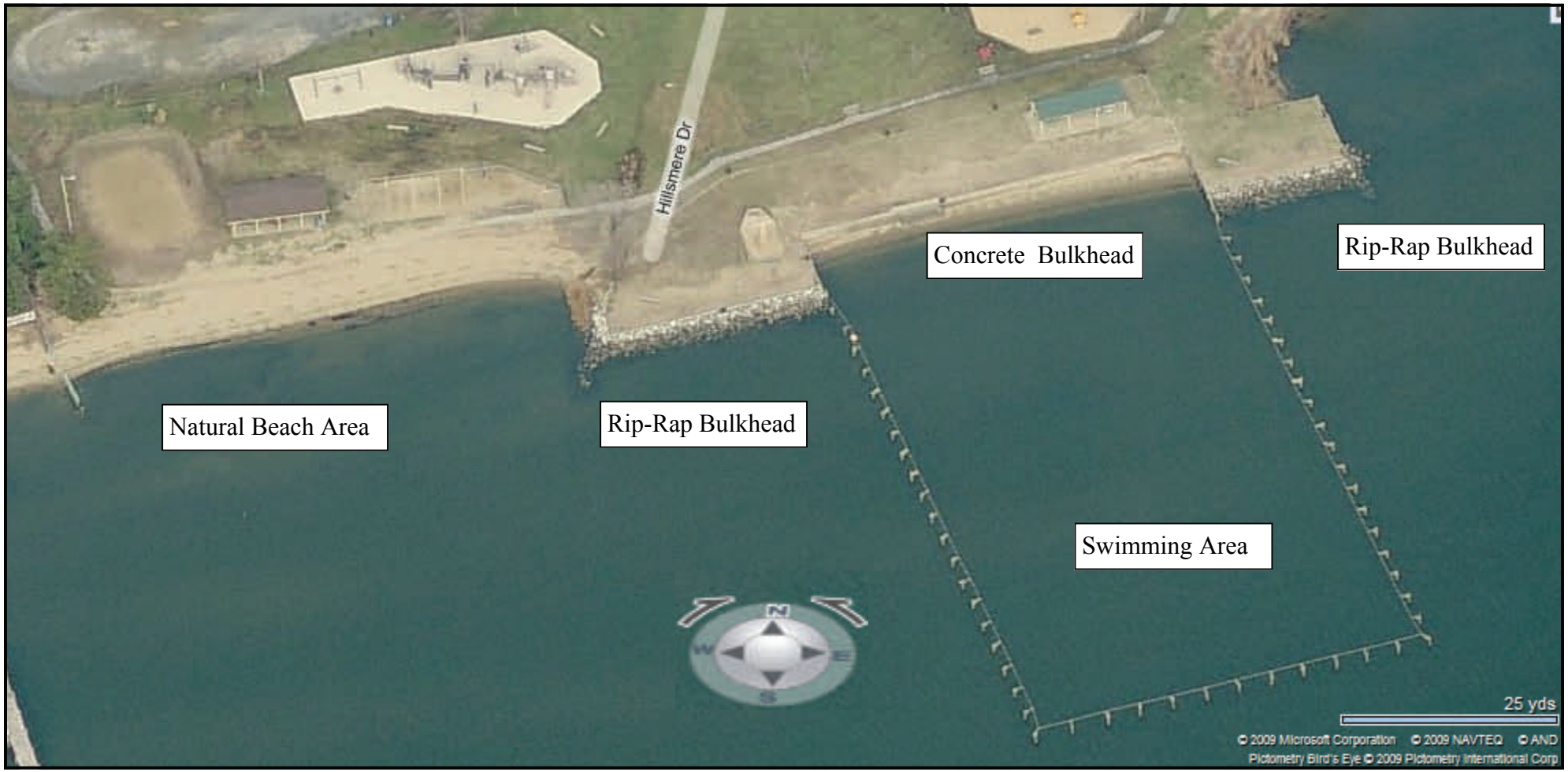
DNR Coastal Atlas-Shoreline Change Rates. <*http://mdshorelines.towson.edu/sc_online.asp*>.

State of Maryland Climate Office. <*http://metosrv2.umd.edu/~climate/*>.

Zabawa, C. and C. Ostrom. 1980. Final Report On The Role of Boat Wakes In Shore Erosion In Anne Arundel County, Maryland. Maryland Department of Natural Resources, Annapolis, MD.

APPENDIX A

SHORELINE AERIAL PHOTO TRANSECT LOCATOR MAP



Aerial Photograph
Hillsmere Community Shoreline

Annapolis, MD

Bing Maps

esa

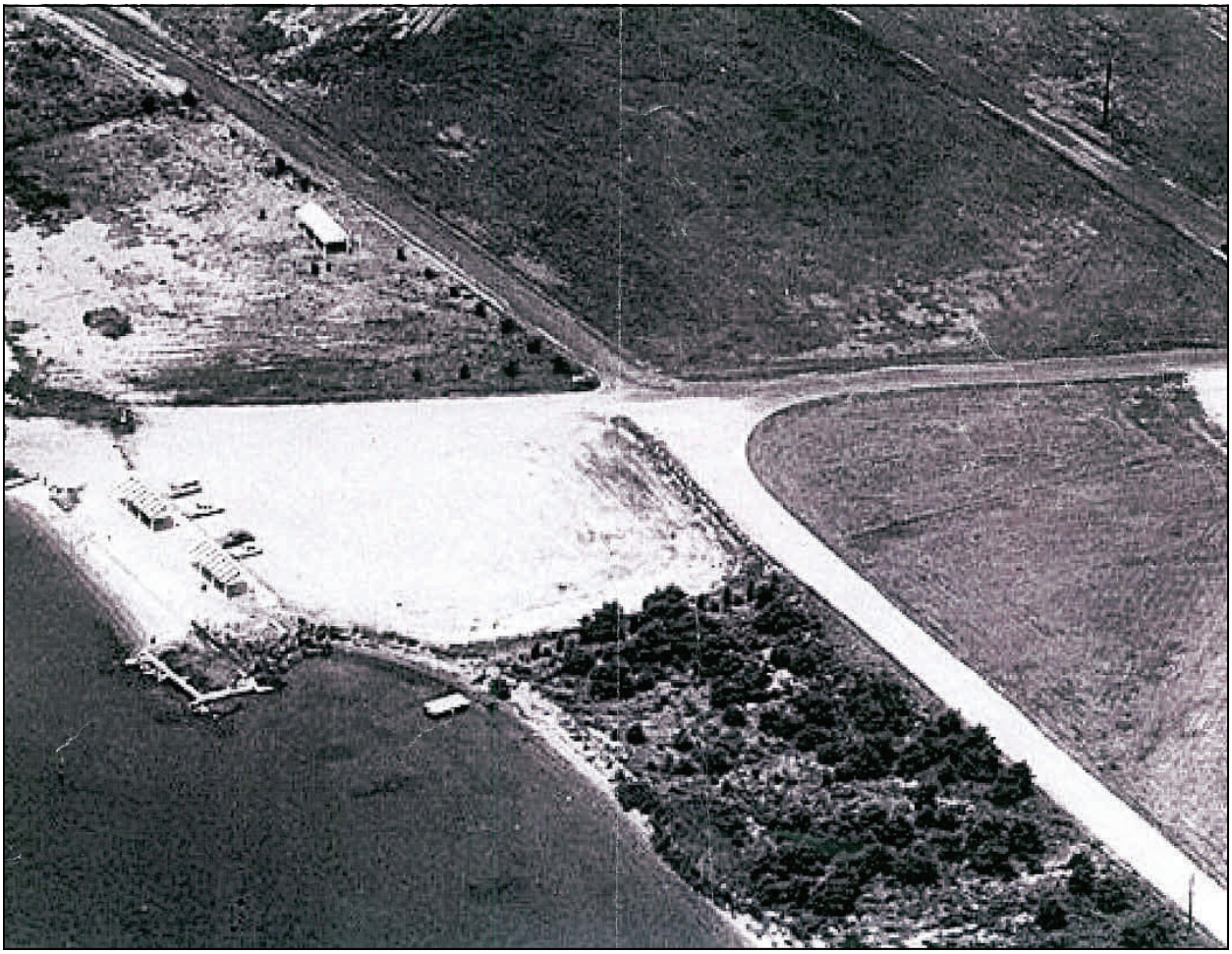


Figure 14. Historic aerial photograph of Hillsmere Shoreline. Date unknown.

Historic Shoreline
Hillsmere Community Shoreline
Annapolis, MD

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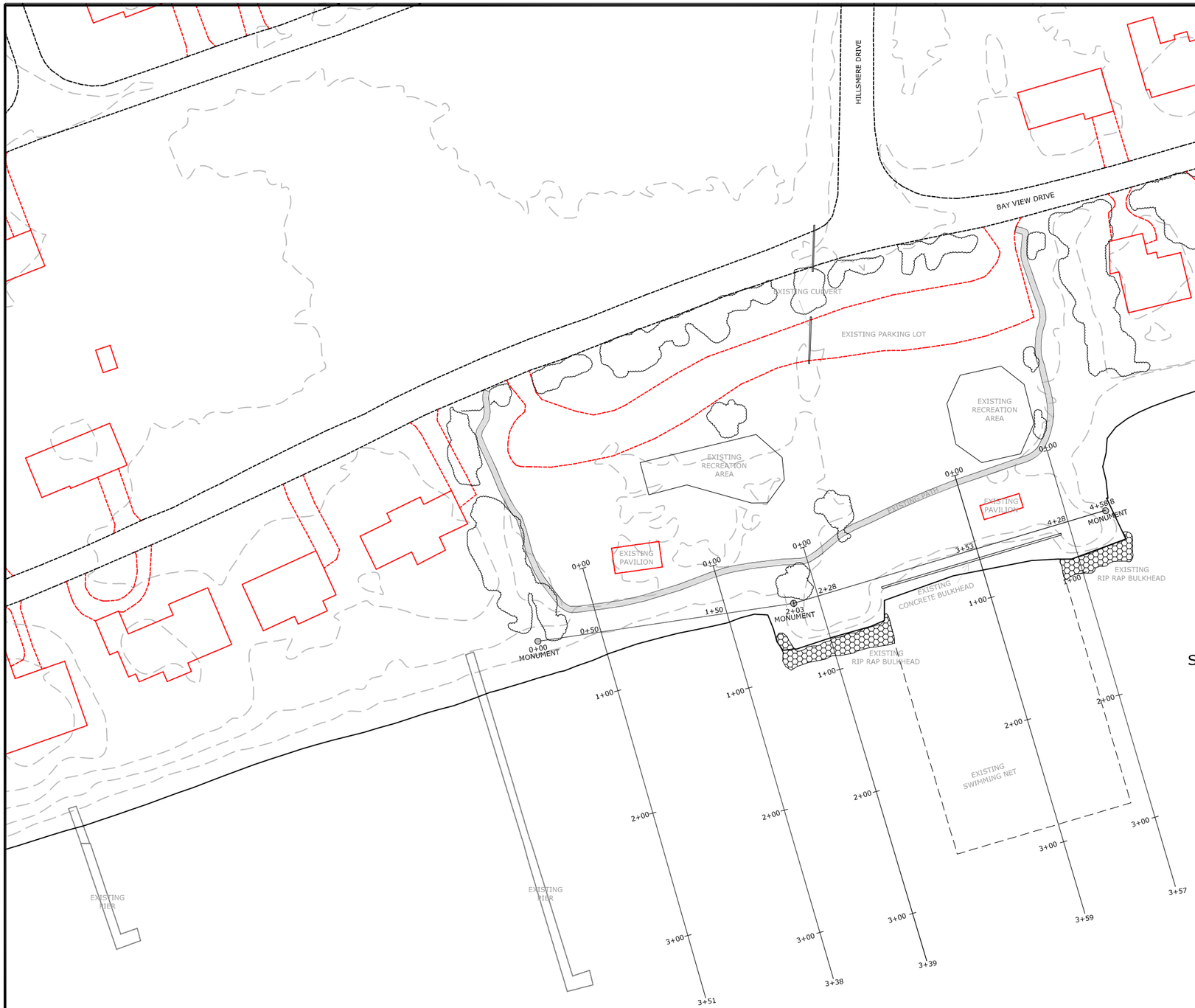
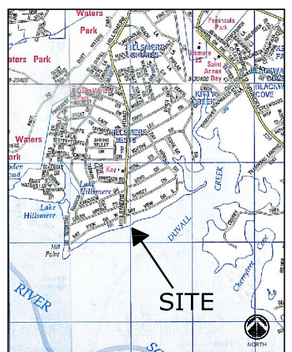


SOUTH RIVER

LEGEND

- Existing Topography
- Exisiting Treeline
- Shoreline Profile
- Transect
- Permanent Monument



VICINITY MAP
SCALE: 1"=2000'

NOTE: Survey work conducted on 8.26.09

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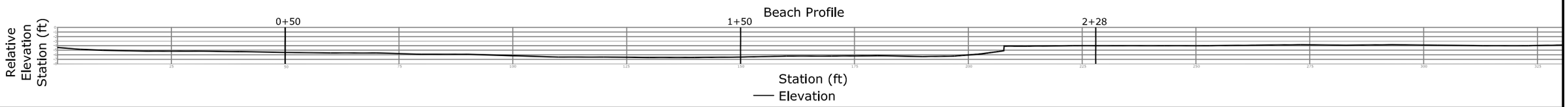
SHORELINE STABILIZATION PLAN

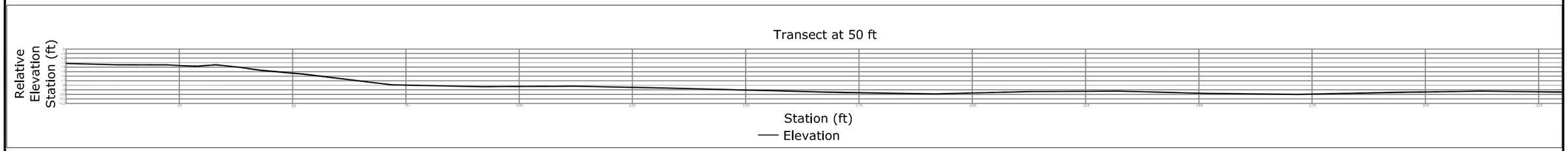
HILLSMERE COMMUNITY SHORELINE

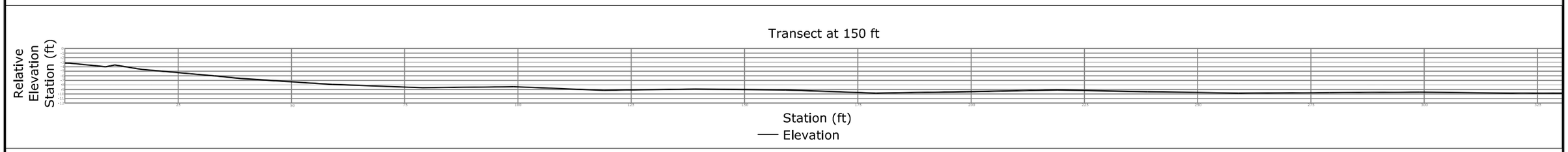
Election District
Anne Arundel County, Maryland

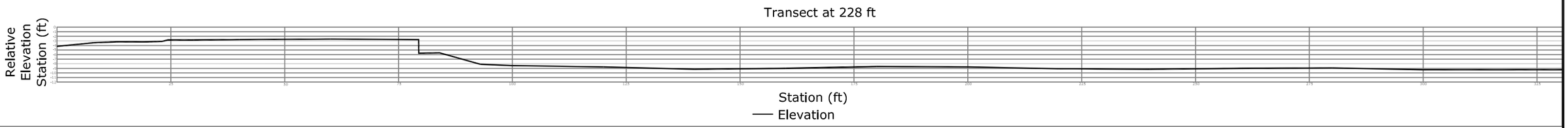
SCALE: Not To Scale
DATE: 9.4.09
ESA PROJECT NAME: 09-08Hillsmere CommunityShorelineStudy\CAD\Indiv. Drawings\HillsmereShoreline9.4.09
SHEET: 1 of 1

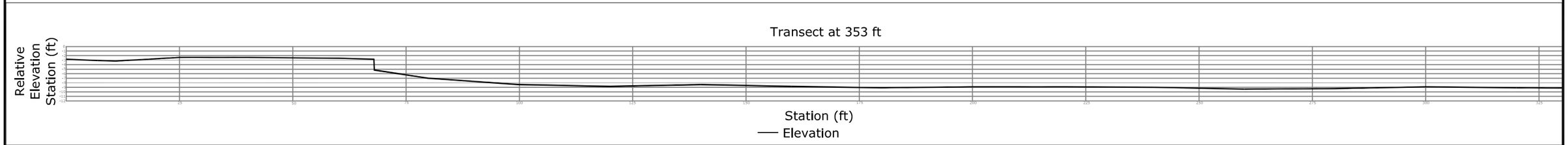
NORTH

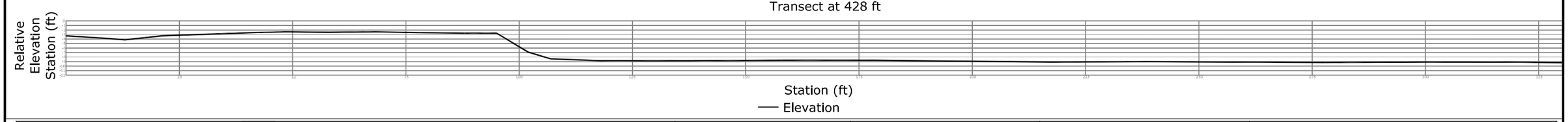












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SHORELINE STABILIZATION PLAN

HILLSMERE COMMUNITY SHORELINE

Election District
Anne Arundel County, Maryland

NORTH

SCALE: Not To Scale
DATE: 9.4.09
ESA PROJECT NAME 09-08Hillsmere CommunityShorelineStudy\CAD\Indiv. Drawings\HillsmereShoreline9.4.09
SHEET: 1 of 1

APPENDIX B

WEATHER PATTERNS

Figure 2. Storms typically enter the state of Maryland from the south/southwest and northeast. Despite the sites long stretches of apparent fetch the area is well protected by features like Turkey Point, shallow shoals, and the southern tip of Hillsmere peninsula. Storms entering from the northeast blow away from the Hillsmere shoreline. The shoreline's northeasterly aspect helps to deflect/dissipate wave energy associated with storms and plays a role in longshore transport.

Weather Direction →

Weather and Storms
Hillsmere Community Shoreline

Annapolis, MD

Google Earth, State of Maryland Climate Office

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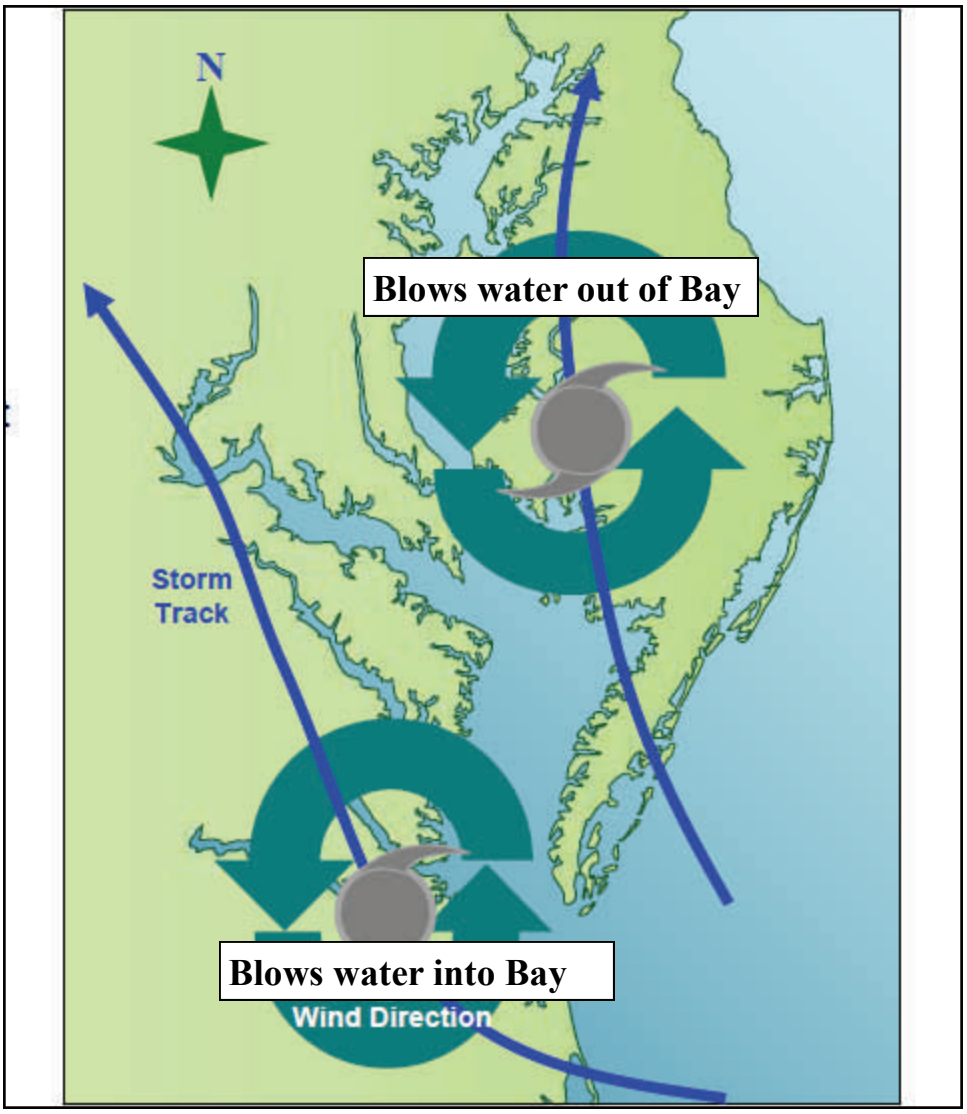

Figure 3. Hurricanes tracking to the west tend to blow water into the Bay creating a storm surge, while systems that track up the coast blow water out of the bay.

Weather and Storms
Hillsmere Community Shoreline
Annapolis, MD

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APPENDIX C

FETCH

Figure 4. The Hillsmere shoreline initially appears vulnerable during storms due to long stretches of fetch. Storms typically enter the state of Maryland from the south southwest and northeast. The Hillsmere shoreline is actually well protected from storm systems by shallow shoals and protruding land features like Turkey Point.

Weather and Storms
Hillsmere Community Shoreline

Annapolis, MD
Google Earth

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APPENDIX D

WAVE ENERGY

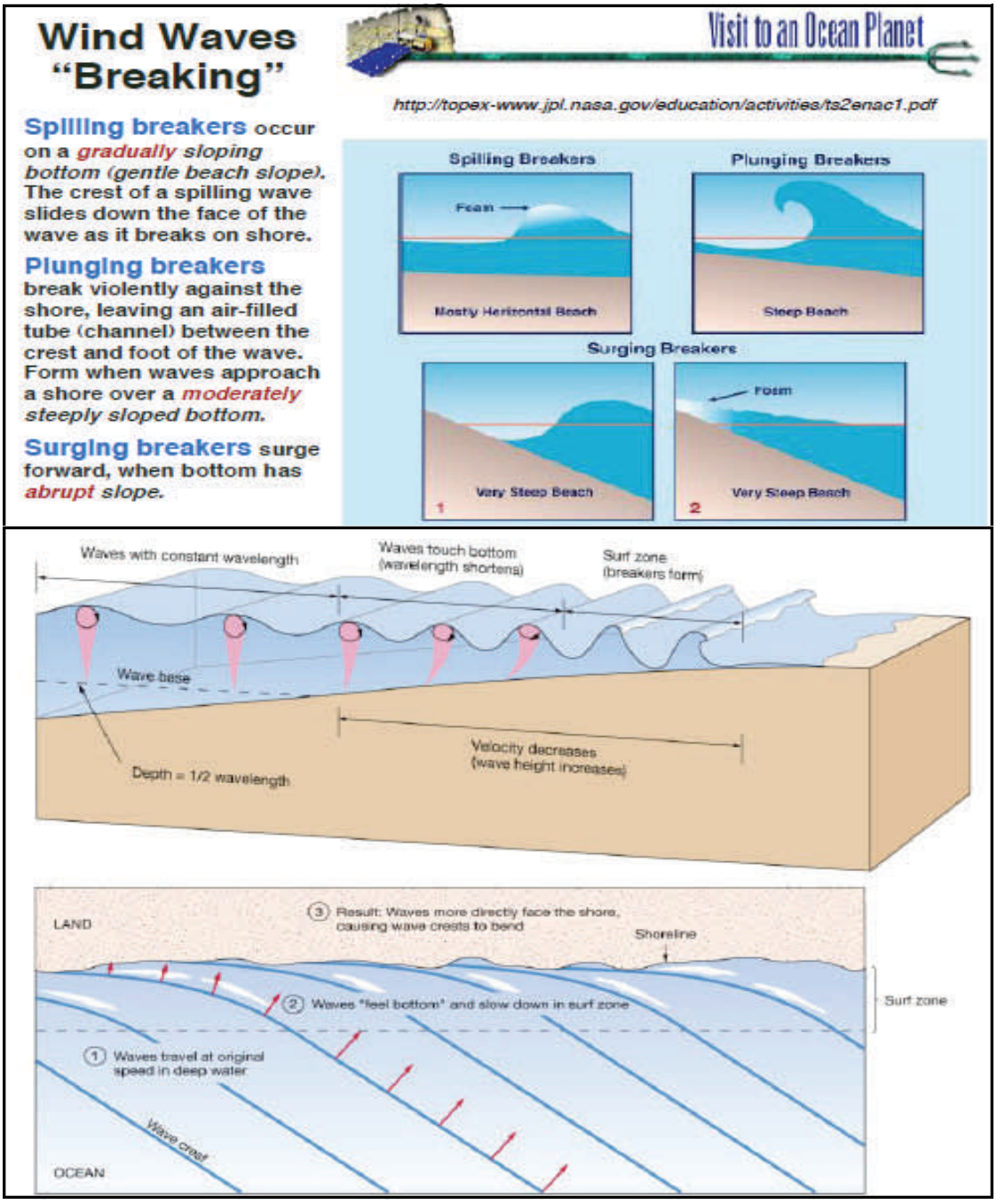

Figure 5. Hillsmere Shoreline is susceptible to low energy spilling breakers. As waves approach shallow water velocity decreases and wave height increases until the wave breaks on itself or spills onto the shore. The waves at Hillsmere behave similarly to waves bending in the lower diagram which contribute to longshore transport and shoreline accretion.

Wave Energy
Hillsmere Community Shoreline
Annapolis, MD

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APPENDIX E

LITTORAL DRIFT, EROSION, AND ACCRETION

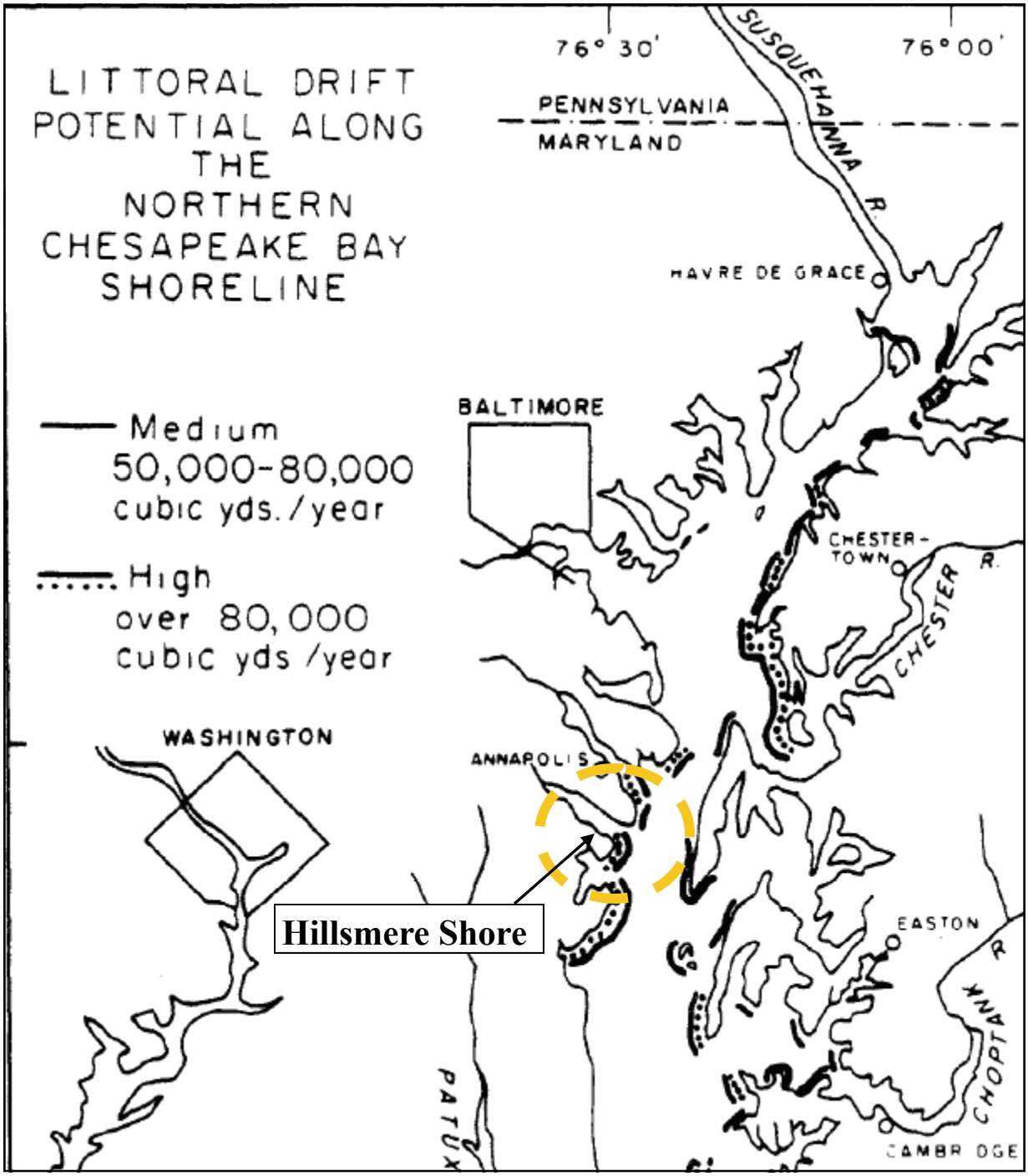

Figure 6. There is a high volume of littoral drift documented in the Annapolis area and near the mouth of the South River.

Littoral Drift
Hillsmere Community Shoreline

Annapolis, MD
Wang, 1982

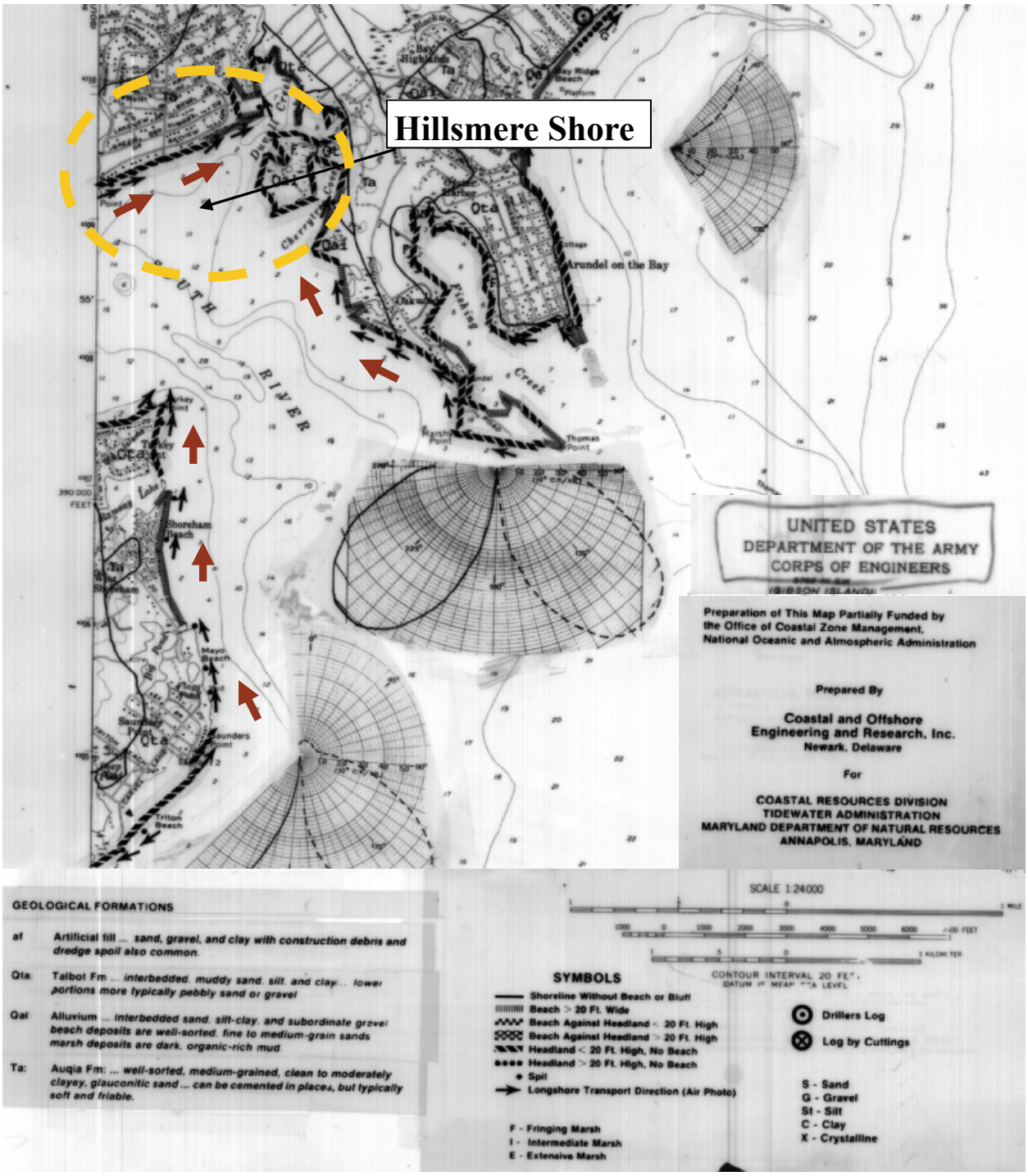

Figure 7. Material is transported along Hillsmere Shoreline into Duvall Creek. Current bulkheads inhibit this transport leading to deposition along the southwest bulkhead. This map was developed in 1982 based on potential longshore sediment movement from computer simulation, not verified by field data.

Direction of Longshore Transport →

Littoral Drift
Hillsmere Community Shoreline

Annapolis, MD

United States Department of the Army Corps of Engineers

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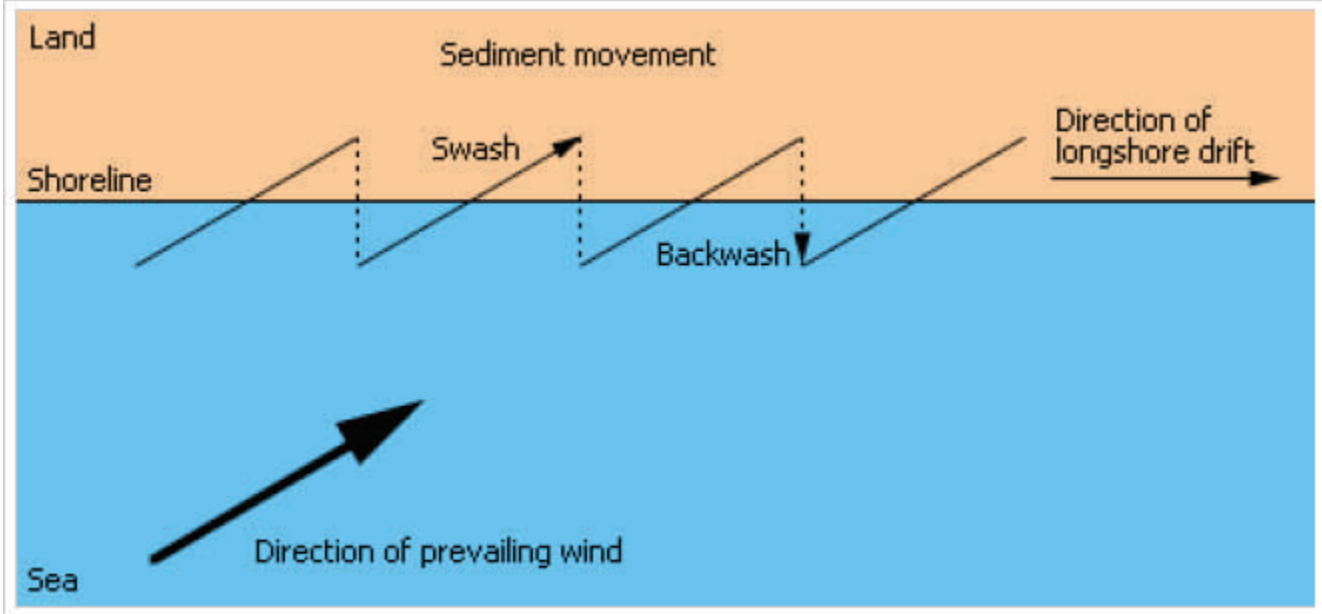

A diagram of Longshore drift

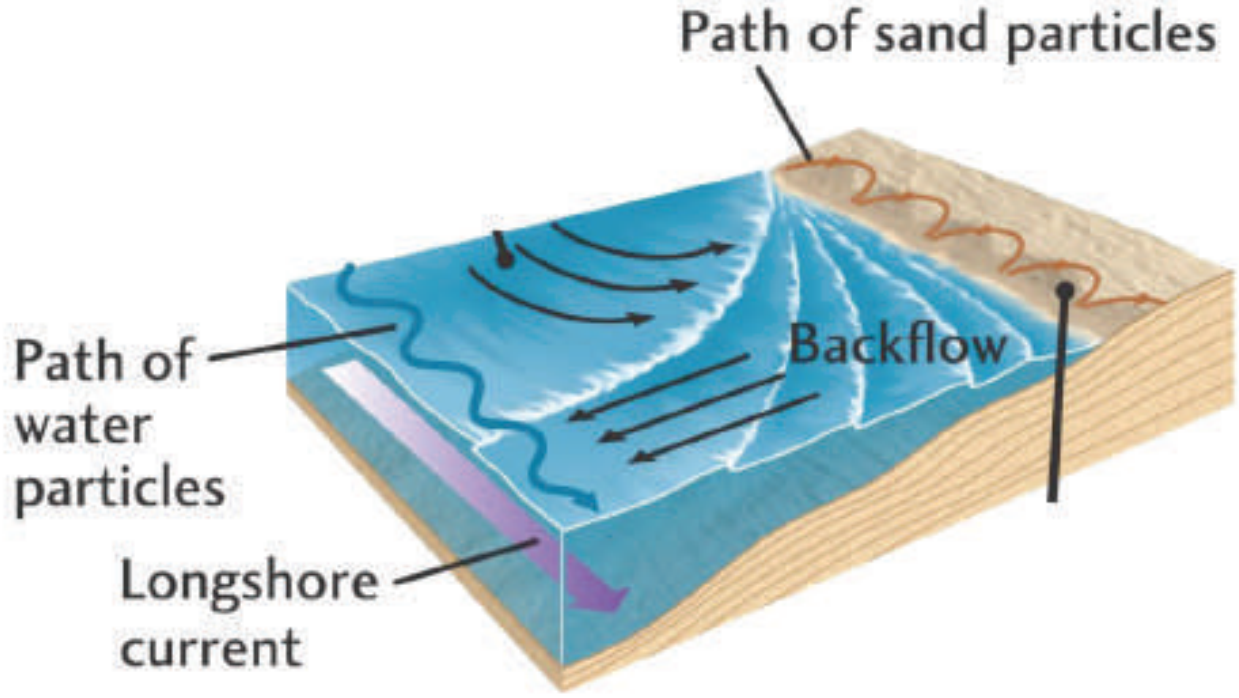

Figure 8. Typical wave patterns and material transport at Hillsmere Shoreline.

Erosion/Transport
Hillsmere Community Shoreline
Annapolis, MD

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Figure 9. Current erosion and deposition features at Hillsmere Shoreline. Deposition is occurring along the southwest bulkhead. Aerial photo from 2007.

MD DNR Merlin Mapping

Accretion
Hillsmere Community Shoreline
Annapolis, MD
State of Maryland, Merlin Online Mapping

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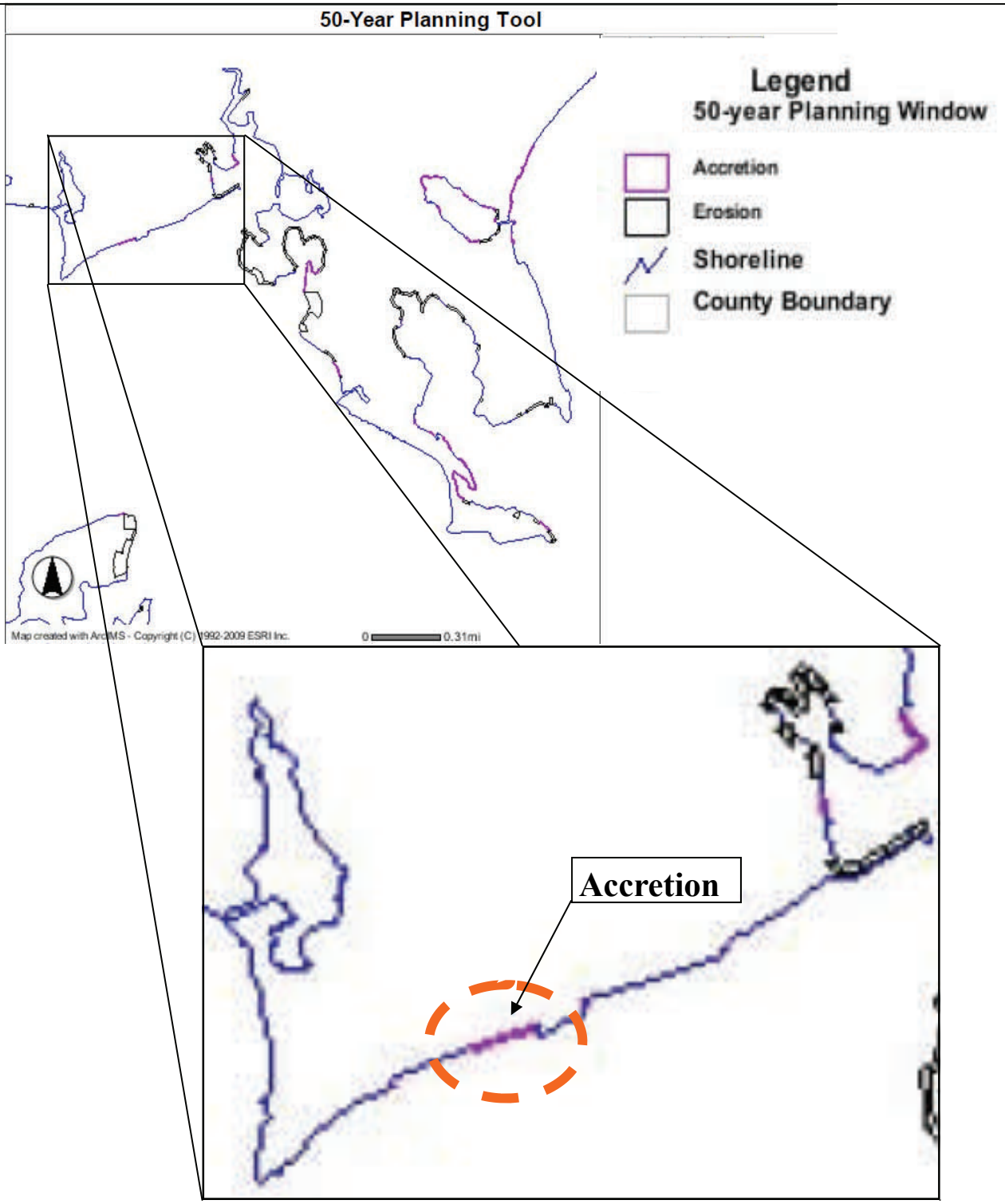

Figure 10. Shoreline accretion documented at Hillsmere by the Center for Coastal Resources Management at the Virgina Institute for Marine Science.

Accretion
Hillsmere Community Shoreline
Annapolis, MD
VIMS Center for Coastal Resources Management

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Figure 11. Point bars can result when littoral drift occurs uninhibited by shoreline structures. This point bar is a result of littoral drift accretion in Cherrytree Cove. Historically transport lead to a point bar extending from the shoreline into Duvall Creek. This point bar has since been converted into a marina. The rip-rap bulkheads at Hillsmere inhibit some transport into Duvall Creek.

Littoral Drift
Hillsmere Community Shoreline

Annapolis, MD

Google Earth

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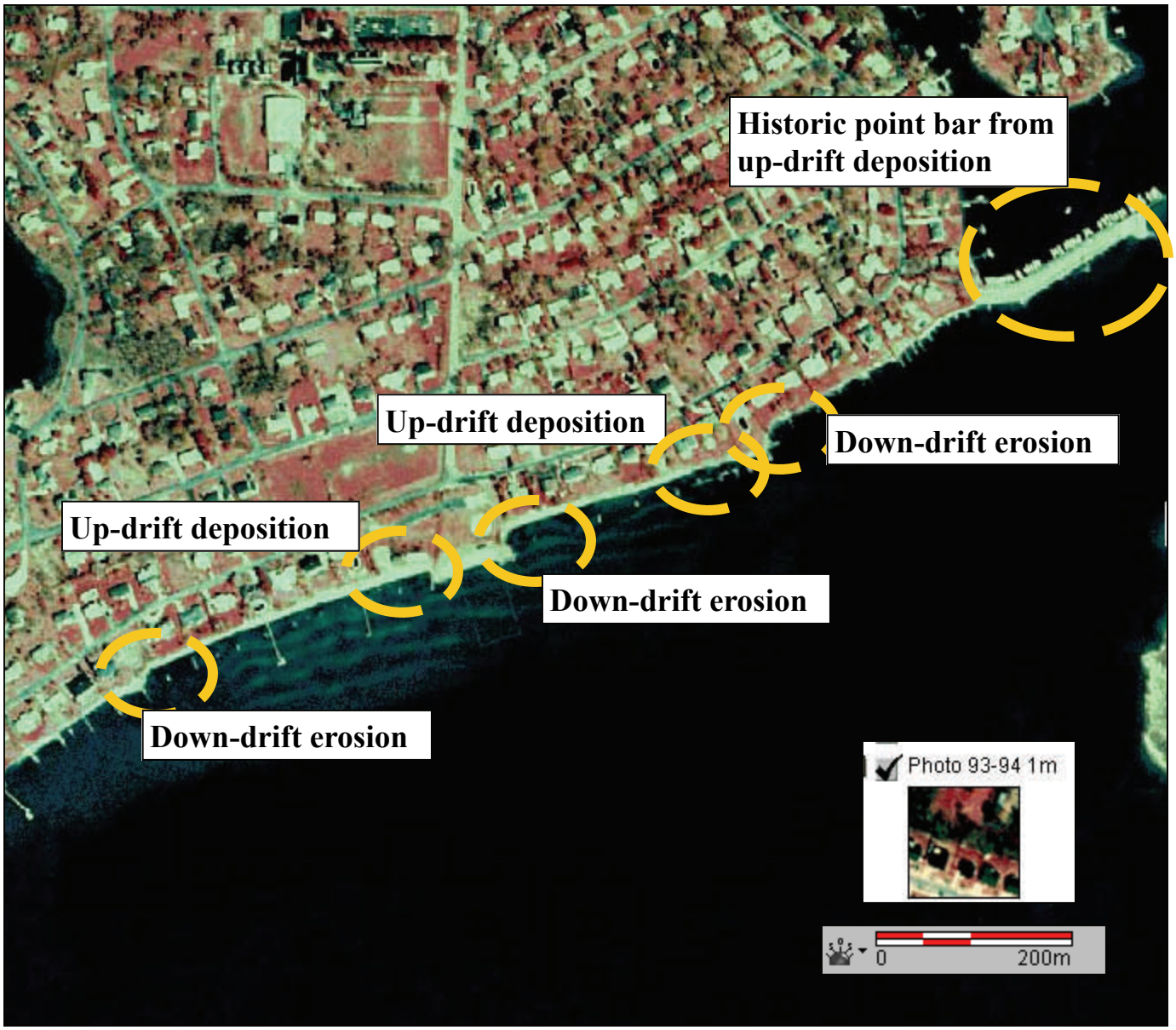

Figure 12. Material is transported along Hillsmere Shoreline into Duvall Creek. Current bulkheads inhibit this transport leading to deposition along the southwest bulkhead. Classic up-drift deposition and down-drift erosion normally associated with structures that interfere with littoral transport seems to be occurring at Hillsmere.

MD DNR Merlin Mapping

Littoral Drift
Hillsmere Community Shoreline

Annapolis, MD

State of Maryland, Merlin Online Mapping

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Figure 13. Historic Shoreline. Historic erosion trends may have been the result of longshore transport before bulkheads were installed at Hillsmere Shoreline.

MD DNR Merlin Mapping

Historic Shoreline
Hillsmere Community Shoreline
Annapolis, MD
State of Maryland, Merlin Online Mapping

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APPENDIX F

SITE PHOTOGRAPHS

Figure 15. Gradually sloping natural beach area looking southwest.

Figure 16. Enclosed swimming area looking northeast.

Field Visit Photographs
Hillsmere Community Shoreline
Annapolis, MD

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Figure 17. Gradually sloping natural beach area looking northeast toward bulkhead. This bulkhead inhibits longshore transport and results in shoreline accretion/up-drift deposition.

Field Visit Photographs
Hillsmere Community Shoreline
Annapolis, MD

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