Venice Beach Community Shoreline Study
Beach Assessment and Shoreline Intervention Report

Prepared for:
Venice Beach Citizens Association, Inc.
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1.0 INTRODUCTION

Venice Beach on the Chesapeake Bay is located at the end of Chesapeake Avenue off of Bay Highlands Drive (by road), and north of Oyster Creek on the Western Shore of MD (by water) in Anne Arundel County. The intent of this study was to understand the erosive properties contributing to the disappearance of the community's swimming beach and develop strategies for protecting or replenishing the beach for future generations to enjoy. It is not the intent of this report to address anomalous storm events such as hurricanes or tropical depressions. The status of the shoreline was determined from published reports and field observations that focused on a range of variables. These variables included: shoreline aspect, wave energy, fetch (the distance over which wind is driven without any above surface obstructions or shallow water shoals to dissipate wave energy), weather patterns, littoral drift (material transported by current and wave action), and historical erosion rates. By reviewing these data, we have a greater understanding of the forces that are applying energy 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 at Venice Beach located at the end of Chesapeake Avenue and the site specific conditions that exist there, the findings contained herein should not be applied to other shorelines within the proximity of this location.*

2.0 METHODS

Initially, ESA conducted a literature search focused on existing published data for the Venice Beach area of the Chesapeake Bay. This search focused on the existing physical characteristics of Venice Beach such as shoreline aspect, existing structures (breakwaters, bulkheads, groins, etc.), and fetch. In addition to the physical characteristics we investigated phenomenological variables of the site including weather patterns, wave energy, littoral drift, and historical erosion rates. The literary investigation was paired with field observations that were conducted by ESA in September of 2014, where multiple weather conditions were recorded. The first weather condition that was recorded was a calm day—light wind and minimal wave action at high tide; and the second set of conditions recorded took place during a North-Easterly storm, where winds speeds exceeded 15 mph out of the East by Northeast and wave height ranged from 2-3 feet. During the described storm event, the site was returned to during both low-tide and high-tide to gain a better understanding of how sediment moves during a short-term storm event.

3.0 RESULTS AND DISCUSSION

3.1 Existing Structures and Shoreline Aspect

Venice Beach is located on the Western Shore of Maryland in between Oyster Creek and Black Walnut Creek, which is south of Annapolis, MD on the Chesapeake Bay. The community beach is comprised of approximately 200 feet of shoreline partially enclosed by man-made structures intended to protect against erosion. From aerial photography and site visits a site inventory was established, which includes: a 120 foot vertical seawall along the Chesapeake/Wayman Ave. with stone grade control on both ends and a stone toe at the base of the wall on the northern edge, an approximately 40 year-old wooden groin to the north (150 ft), a stone groin to the south (175 ft), and a stone breakwater offshore to the east (165 ft offshore and approximately 140 ft long). The composition of the beach makes for a protected shallow haven due to the amount of wave energy reduced by the offshore breakwater and the northern and southern groins. While the groins and breakwater do protect against severe offshore wave attenuation the natural dynamics of sediment distribution/redistribution is interrupted, which is perpetuated by the wall and the residual wave action that affects the sand at the foot of the wall. While it may seem like the shoreline in question is highly protected against wave energy and longshore erosion, it is not completely unsusceptible to the dynamic characteristics of tidal change and deflected wave energy. The protective structures that partially enclose the beach do break down the amount of destructive wave energy from most directions, but there is a rolling effect that occurs when wind-driven waves impact the offshore sill, whereas that energy dissipates along the rocky edge and regains strength when the wave rolls around the end of the breakwater. As the wave rolls past the breakwater and regains strength that energy spills across the near-shore flats developing into a *spilling wave* during low-tide and a *surging wave* during high-tide. Although these small waves may not look like they have the potential to cause much damage, they are quite erosive in repetitious patterns and will continue to degrade the slope of the beach without any natural sand replenishment overtime. Furthermore, as the slope of the beach is reduced, the tide lines will become closer to the seawall along Wayman Avenue and the waters between the wall and the breakwater will become shallower.

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 (Northeast) 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 Venice Beach would become even shallower, negating erosive wave action from increased wind speed. Under westerly hurricane conditions, the Venice Beach shoreline would be more exposed during high water levels where the protective enclosure becomes less effective in protecting against wave attenuation. As the outer barriers become less affective the wall is left as the last line of defense against *surging* waves, which scours sediment away from the bulkhead and degrades the present slope ever further. 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 Venice Beach shoreline faces directly east with very little land mass or shallow shoals to reduce any fetch from the Northeast to the Southeast, which exposes the shoreline to large expanses of water from which waves can travel. There is approximately 5.3 miles of open water between Venice Beach and Mid-Kent Island to the East. 10.8 miles of open water lie between Venice Beach and Northern Kent Island. From the Southwest, there is

12.9 miles of fetch from the Eastern Bay. Normally, large stretches of fetch such as these have the capacity to create large, destructive, waves; although due to the built conditions of the shoreline much of the wave energy is dissipated before the waves can reach the limits of the wall. While the offshore barriers provide a certain degree of protection there are still waves that are able to swell past and surge into the shoreline resulting into accumulated scour found behind the offshore sill. Storms that blow out of the southwest to northwest do not generate a substantial amount of wave energy due to the aspect of the Venice Beach shoreline and the amount of landward-mass from those directions.

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 and energy. 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 bathymetry (Bay floor profile) is relatively shallow ranging from 1.5-4 feet deep at MHWL (Mean High Water Level), and extends out into the Bay approximately 165 feet, which prevents boats from traveling close to shore. The enclosed swimming area also deters boaters from traveling close to the beach. Being that the bathymetric slope is approximately 1.1% the Venice Beach shoreline has a very gradual slope out toward the Bay, which helps dissipate residual wave energy that spills past either groin or sill. By the time a wave reaches the shoreline it does not have sufficient energy to cause significant beach erosion, but due to the condition of the wall there is no way for the beach to replenish itself—instead the low-energy waves that lap the base of the bulkhead transport the sediment outward making the enclosure more shallow over time.

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 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, which includes the Venice Beach shoreline (Wang, 1982). Littoral drift maps from the Army Corps of Engineers show a northerly transport of sediment along the Western Shore of the Chesapeake Bay. Existing data and field notes suggest the drift patterns are no longer nourishing the Venice Beach shoreline at a desirable rate due to multiple variables. One obstacle in particular that retards shoreline accretion at Venice Beach is the southern jetty of Oyster Creek, which has been accreting sediment since it was first established with its J-Hook construction. Another variable at play in this process is the stone groin found at the southern limit of the community shoreline, where the neighboring property to the south has established a healthy natural looking beach, which is defined by a gradual slope in the form of a scalloped shape between the northern jetty of Oyster Creek and the stone groin to the north. Lastly, the reason for the lack of occupiable dry sand along the shoreline above mean high water is due to the wall. The 90 degree angle of the wall does not allow for sediment to establish itself at a desirable slope, which, in turn, does not allow the dynamic nature of a beach to properly form and develop all of its “anatomical” features (http://geology.uprm.edu/Morelock/beachsys.htm).

4.0 CONCLUSION

After a careful investigation of the Venice Beach community shoreline from both a zoomed-in and zoomed-out perspective it is ESA’s professional opinion that the reason for noticeable degradation of the community beach is due to the scouring effect of spilling and surging wave energy against the vertical bulkhead, which separates Chesapeake/Wayman Avenue from the water’s edge and the jetty and groin to the south, which stop the natural northerly transport of sand to replenish Venice Beach.

4.1 DESIGN CONCEPTS

Concept 1 (Recommended): Living Shoreline with Groin Removal
This conceptual idea intends to keep the seawall *in situ*, replenish the beach to acquire a slope that moves the high-tide line and wave impact zone away from the edge of the seawall, construct a stone toe at the base of the newly acquired high-tide line to contain the added sand, and to incorporate plantings to encourage a greater shoreline cohesion. Within this conceptual proposal, the southern stone groin, which was constructed in 1998, is to be reduced in length as it blocks the littoral drift of sediment from naturally replenishing the shoreline. Although the stone will be removed from what makes up the southern groin, it will be strategically repurposed to construct the stone toe with the intention to contain both natural sediment accretion as well as intentional sand replenishment. Additionally a second stone sill will be built on the northern edge of the property to contain placed sand and replace the non-functional wooden groin. The space between these stone structures would be 30-40’ to allow water access and beach maintenance. The wooden northern groin should be completely removed as it no longer functions as a sand capturing device. Plantings will help hold the sand in place and may be a condition of a MDE wetland permit. Proposed plantings within the marsh (between mean high water and mean low water) include marsh grasses (*Spartina patens* and *Spartina alterniflora*) and the Crimsoneyed Rosemallow, which will help soften the look of the stone toe and hold the sand in place. The Groundsel Tree and the Bayberry will also be used as they are tall shrubs (+15 feet) that are salt tolerant and withstand occasional flood tides and will provide privacy on the waterfront. It is ESA’s opinion that this concept best benefits the intentions of the Venice Beach Community and the operations of manmade shorelines today.

There are potential downfalls with this concept as it decreases the thickness and range of diversity between lower and upper beach zones and essentially strives to contain each zone into a neatly confined area; whereas, naturally they would be dynamic. Overtime, vegetation, such as *Phragmites,* may grow on the replenished sand because daily wave action will be limited. The beach will flood during storm events and sand may wash away after a hurricanes or nor’easters. However, if the southern groin is removed, littoral drift should allow sand to move back overtime to naturally replenish the Venice Beach Shoreline.

Concept 2: Living Shoreline without Groin Removal
This concept is similar to concept one (1) with the exception of the groin removal/reduction. The interventions made in the case of this concept is that a 120 foot stone toe will be inserted 35 feet offshore, the beach will be replenished with imported washed sand, and marsh grasses and shrubs will be planted to hold the sand in place and soften the look of the stone toe.

The cost of this concept will be relatively lower than the recommended concept above, but falls short in light of other environmental operations. Specifically, without reducing the size of the southern stone groin there will be little littoral drift to naturally replenish the Venice Beach Shoreline, nor will there be much wave action to counter the expanding growth of shoreline vegetation. Also as the northern wooden groin is failing due to various gaps below the water, it is not necessary to keep the structure as a sediment capturing device. It is in ESA's opinion that the best living shorelines are made with as little structure as possible.

Concept 3: Living Shoreline with Groin, Seawall, and Road Removal
As the seawall has been seen as the catalyst for the erosion of the Venice Beach community shoreline one concept is to remove the wall from the scenario completely, re-grade the slope of the beach from the road's edge out 35 feet (+3.67' elevation) to reach mean high water (+0.45' elevation), plant shoreline vegetation, and build a stone toe to protect the beach replenishment with 30' - 40' gaps to allow wave action to roll back and forth (*swash)* the newly established grade with minimal scouring. In addition to removing the seawall, Venice Beach could remove the existing road that parallels the shoreline to allow for a thicker upper-beach zone to encourage more diverse beach ecology of flora and fauna and increase the zone of human occupation at the water's edge. The removal of the seawall and road allows for natural movement in the shoreline prior to the installation of the seawall. While there may be some traffic confusion within this scenario, this concept will ensure a greater longevity of the Venice Beach Shoreline for the long-run as it allows for all the zones of the beach to develop more adequately.

Concept 4: Living Shoreline without Stone, Seawall and Road Removal
This concept does essentially the same as concept three with one main difference. The main difference in this concept is that there is no proposed stone toe. The reason for not building a stone toe is because by removing the road the shoreline has the desired width and slope for the beach to accommodate surging and spilling wave action to swash the tidal zone of the beach with minimal scouring. Furthermore, the swashing action will eliminate the buildup of marshy vegetation, which is possible behind the construction of a stone toe. We expect the sand to wash away and this concept to fail.

Concept 5: Beach Replenishment without additional stone structures
Venice Beach Citizens Association shared with ESA, Inc. a wetland permit concept plan to replenish the beach. We were also informed that the Association had tried to replenish the beach previously and that the sand had eroded away. Additional sand should be expected to wash away again without protection. Adding sand moves the water away from the vertical seawall, which will stop reverberating waves and scour at the base of the wall. However,

this concept does not address the steady erosion due to spilling and surging wave energy behind the breakwater or the blockage of littoral drift by the southern groin. For this and other sand replenishment scenarios, some sediment could be pumped from the cove between the breakwater and the desired beach.

4.2 Moving Forward

The next steps within this process requires, first, committing to a concept that best reflects the needs of the Venice Beach Citizens. The next phase is design development, where the initial design concept is worked into a final format that is in compliance with county, state, and federal regulations for permit review processes. The required permits for shoreline work include: a United States Army Corps of Engineers wetland permit, a Maryland Tidal Wetland License, a Grading Permit, a Sediment and Erosion Control approval, and a Vegetation Management Plan approval. (Venice Beach Citizens Association will need to file a joint permit application for a Maryland State Programmatic General Permit-4 Tidal Marsh Creation/Beach Nourishment authorized activity, which provides both the State of Maryland and US Army Corps of Engineers approval). Once all final designs are approved and the permit attained then construction may begin.

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*>.

National Oceanic and Atmospheric Administration: Ocean and Coastal Management: http://coastalmanagement.noaa.gov/initiatives/definitions.html

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

Subramanian, Bhaskaren; Slear; Smith; and Duhrin. Current Understanding of the Effectiveness of Nonstructural and Marsh Sill Approaches. Living Shorelines Summit 2006. http://www.vims.edu/cbnerr/coastal_training/recent_workshops/ls_summit.php

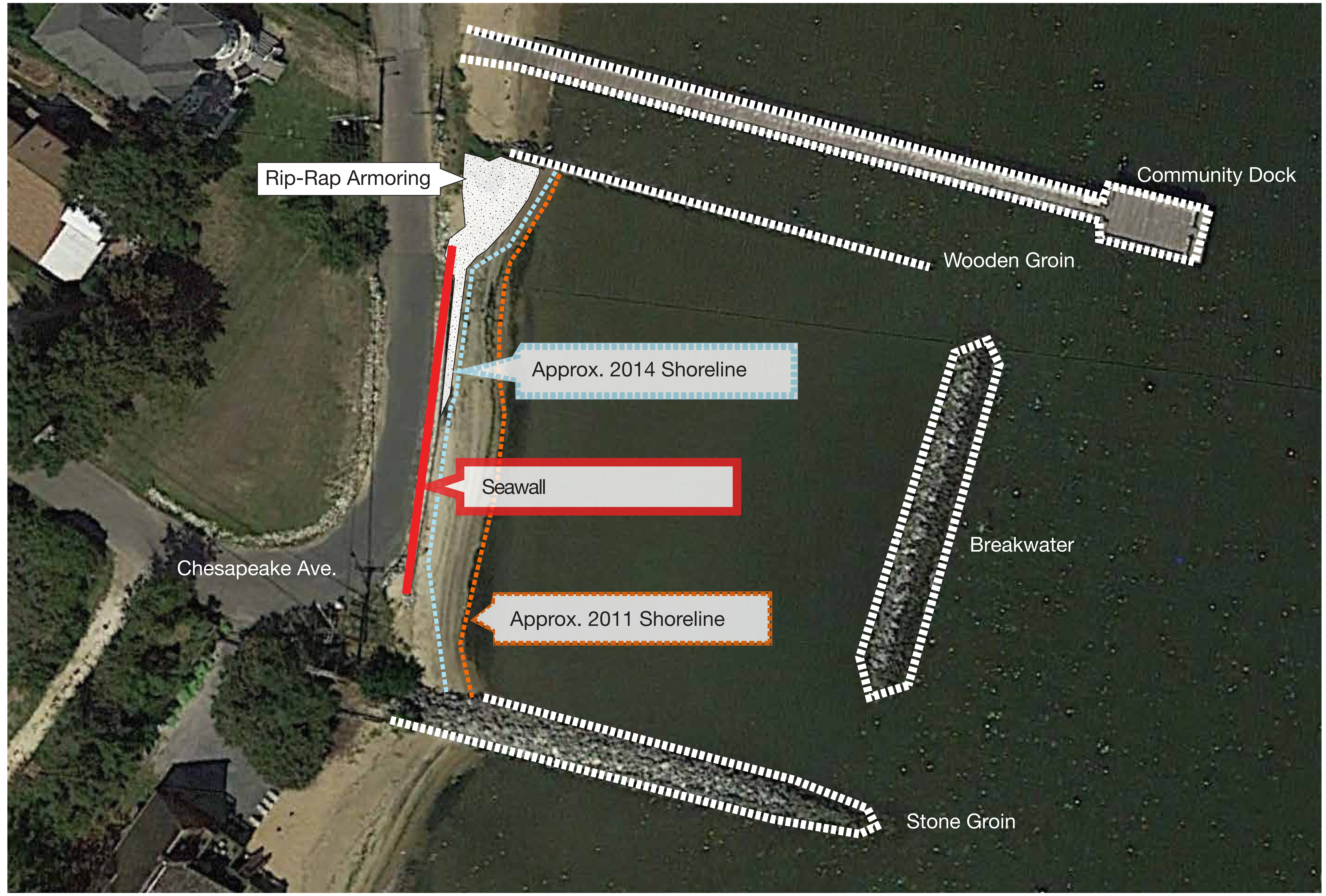
Reis, A. Heitor and Christina Gama. Sand Size versus Beach-face Slope – An Explaination based on the Constructal Law. Geomorphology 114, pgs 276-283. 2010. http://home.uevora.pt/~ahr/9.pdf

University of Puerto Rico Dept. Of Geology: Beach Systems http://geology.uprm.edu/Morelock/beachsys.htm

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

SITE + CONTEXT: AERIAL PHOTOS AND SITE INVENTORY



Site + Context: Venice Beach on the Chesapeake Bay
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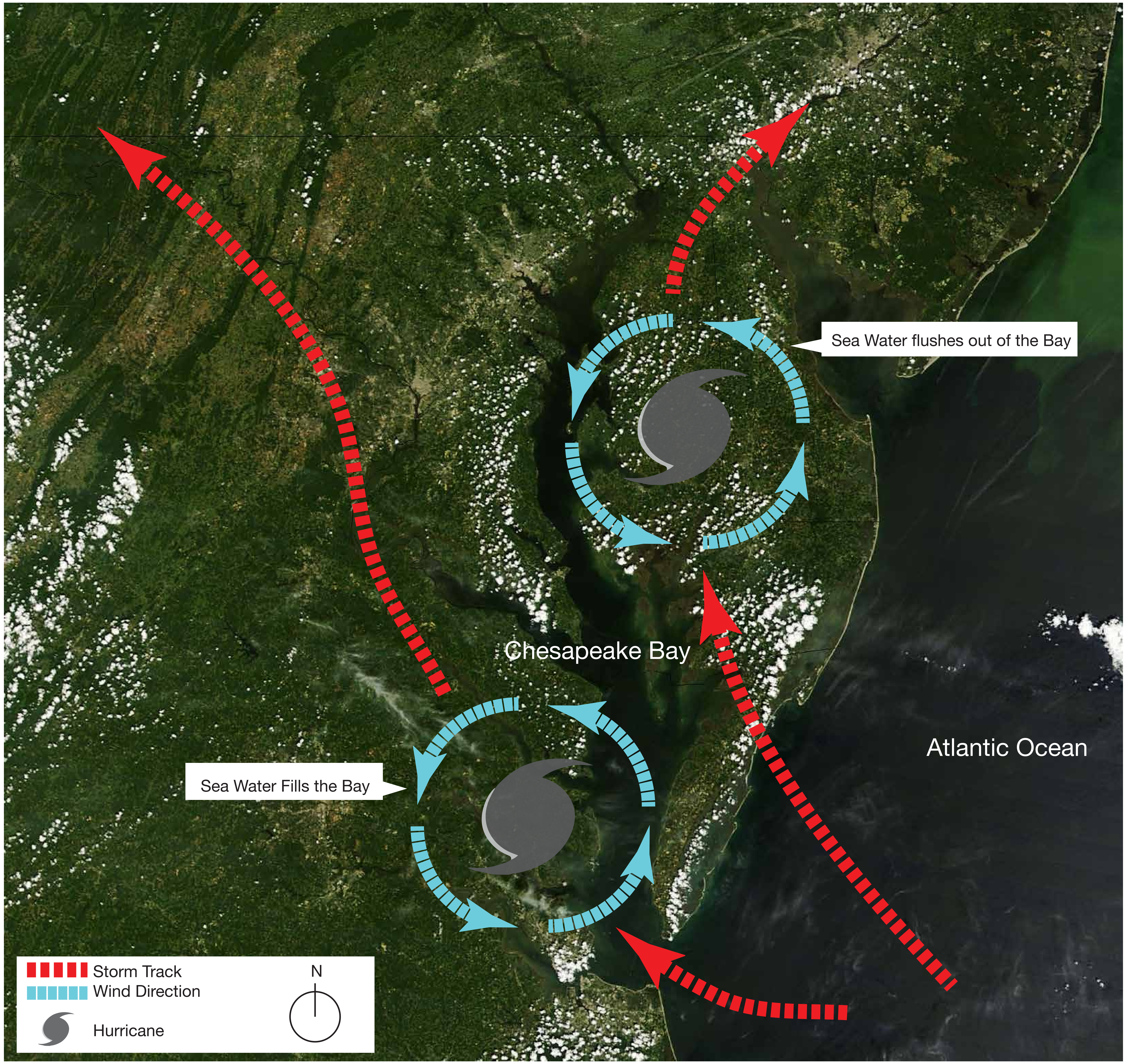
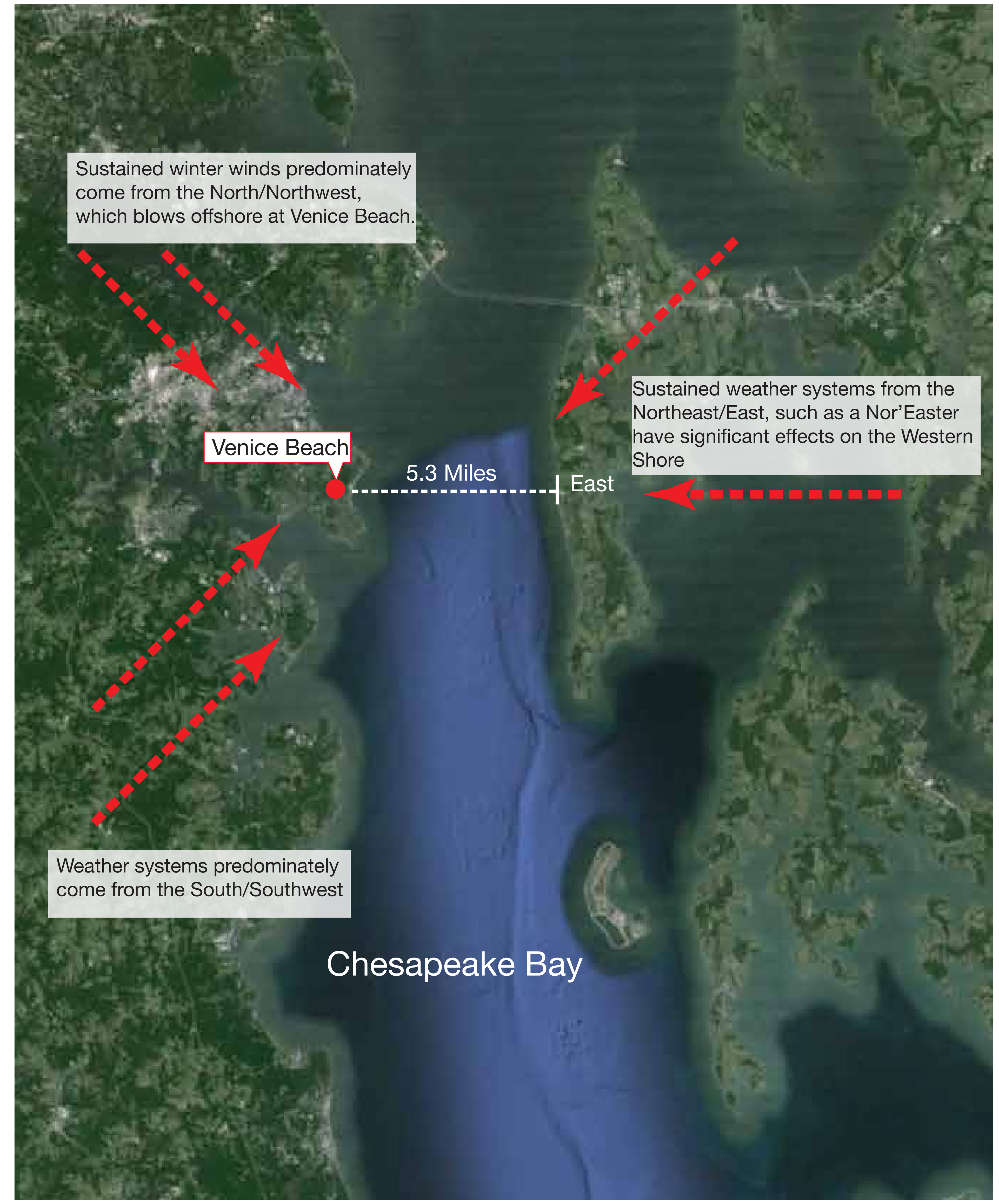
APPENDIX B

WEATHER + STORMS





There are many weather systems that enter the Chesapeake Bay and each event has a different degree of influence on the geological and hydrological composition of the estuary in both long-run and short-run durations. The waters of the Bay are not solely driven by the gravitational pull of the moon and the sun but by wind direction. In a hurricane scenario, when the weather system enters the Bay sea water floods the estuary, and when the system proceeds northeast the water is flushed out of the bay. The forces of wind, whether hurricane force or any other sustained wind induces wave action along the shoreline. The energy of the sustained wind increases over open expanses of water, where are no obstructions to divert or breakdown the wind--this is known as fetch.

Venice Beach is predominantly protected by South/Southwest storms and from powerful northwest winds, but the beach front is highly impacted by eastern and northeast weather systems, as seen above.

Weather + Storms: Venice Beach on the Chesapeake Bay
Annapolis, MD

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APPENDIX C

DEGREES OF FETCH

The forces of wind, whether hurricane force or any other sustained wind induces wave action along the shoreline. The energy of the sustained wind increases over open expanses of water, where are no obstructions to divert or breakdown the wind--this is known as fetch. Venice Beach is predominantly protected by South/Southwest storms and from powerful northwest winds, but the beach front is highly impacted by eastern and northeast weather systems, as seen above.

Degrees of Fetch: Venice Beach on the Chesapeake Bay
Annapolis, MD

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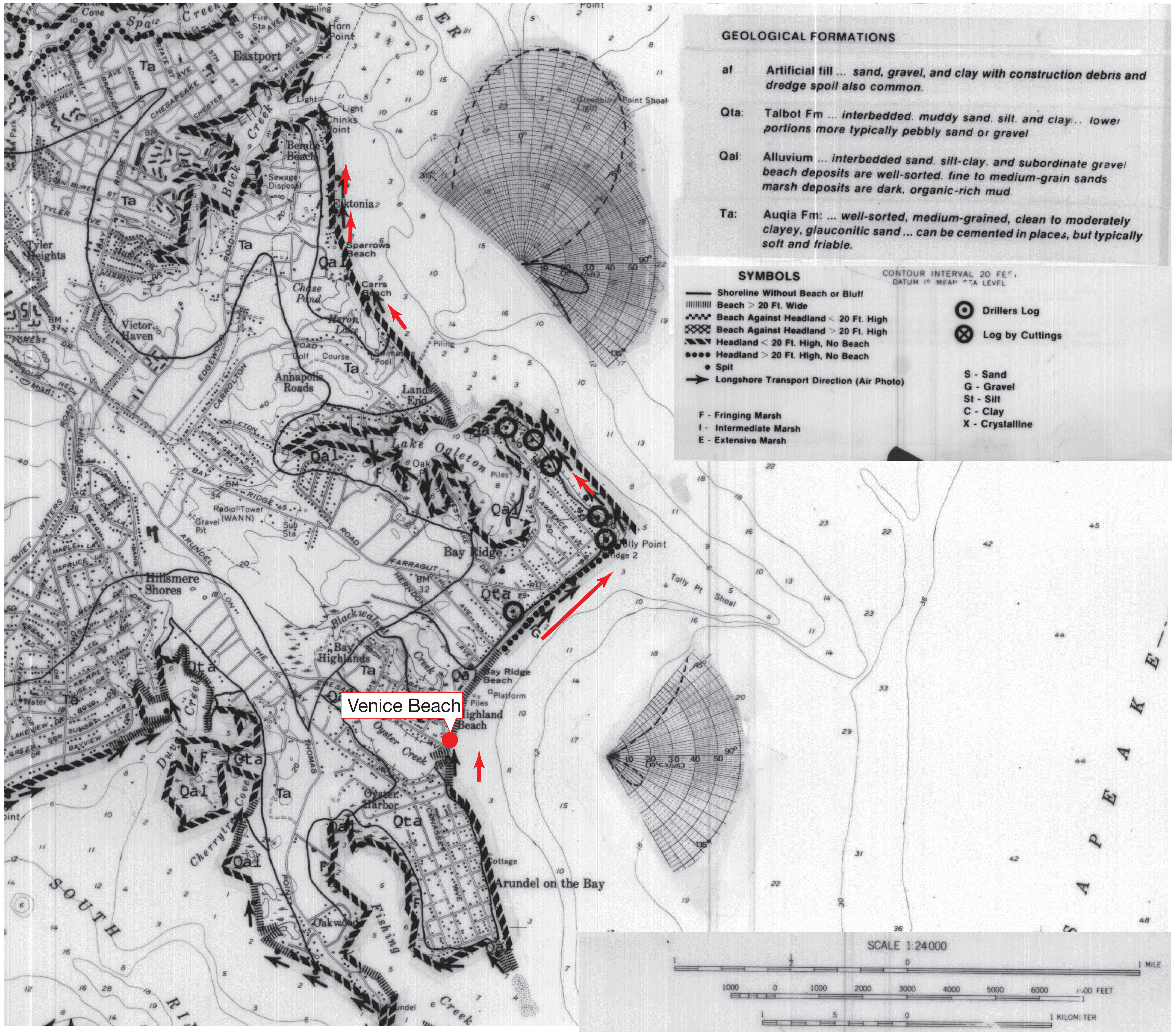
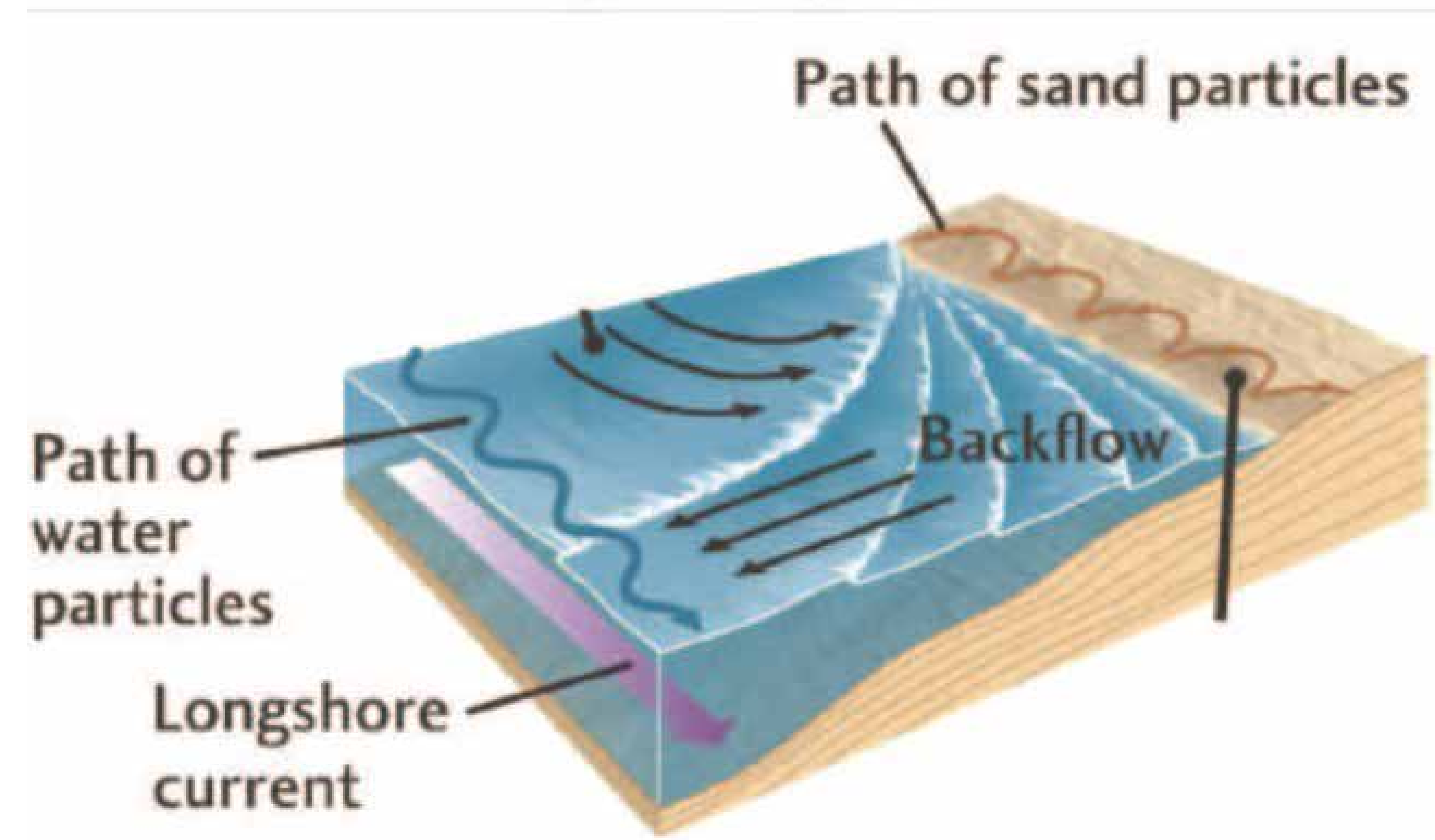
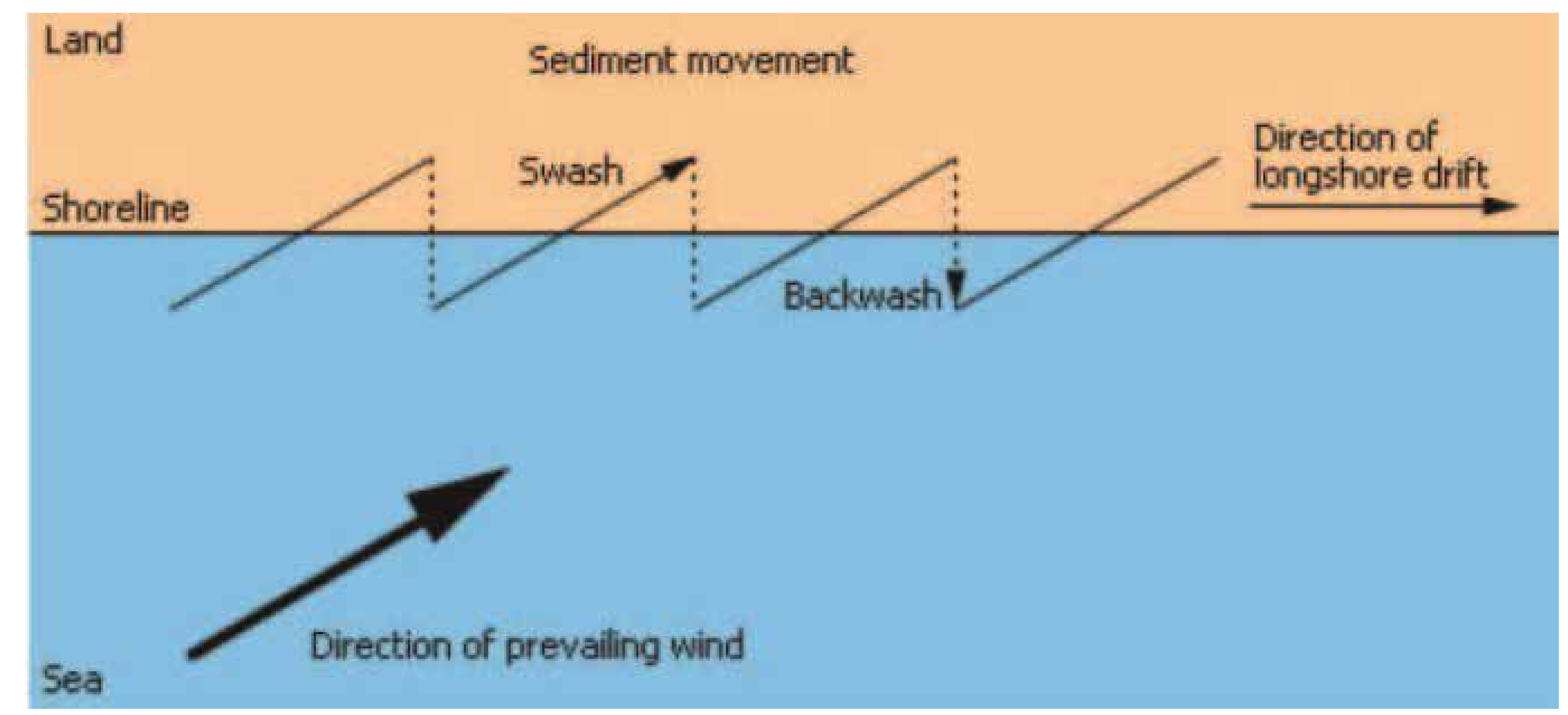
APPENDIX D

LITTORAL DRIFT + EROSION







Material is naturally transported along the Western Shore of the Chesapeake Bay from the Southern tip of Arundel on the Bay, although the much of this shoreline is lined with bulkheads and rip-rap leading to accumulated deposition on the southern side of constructed groins. The chart, left, was developed in 1982 based on potential sediment movement from a computer simulation--not verified by field data. The diagrams above represent the movement of sediment in conjunction with the longshore current.

Littoral Drift + Erosion: Venice Beach on the Chesapeake Bay
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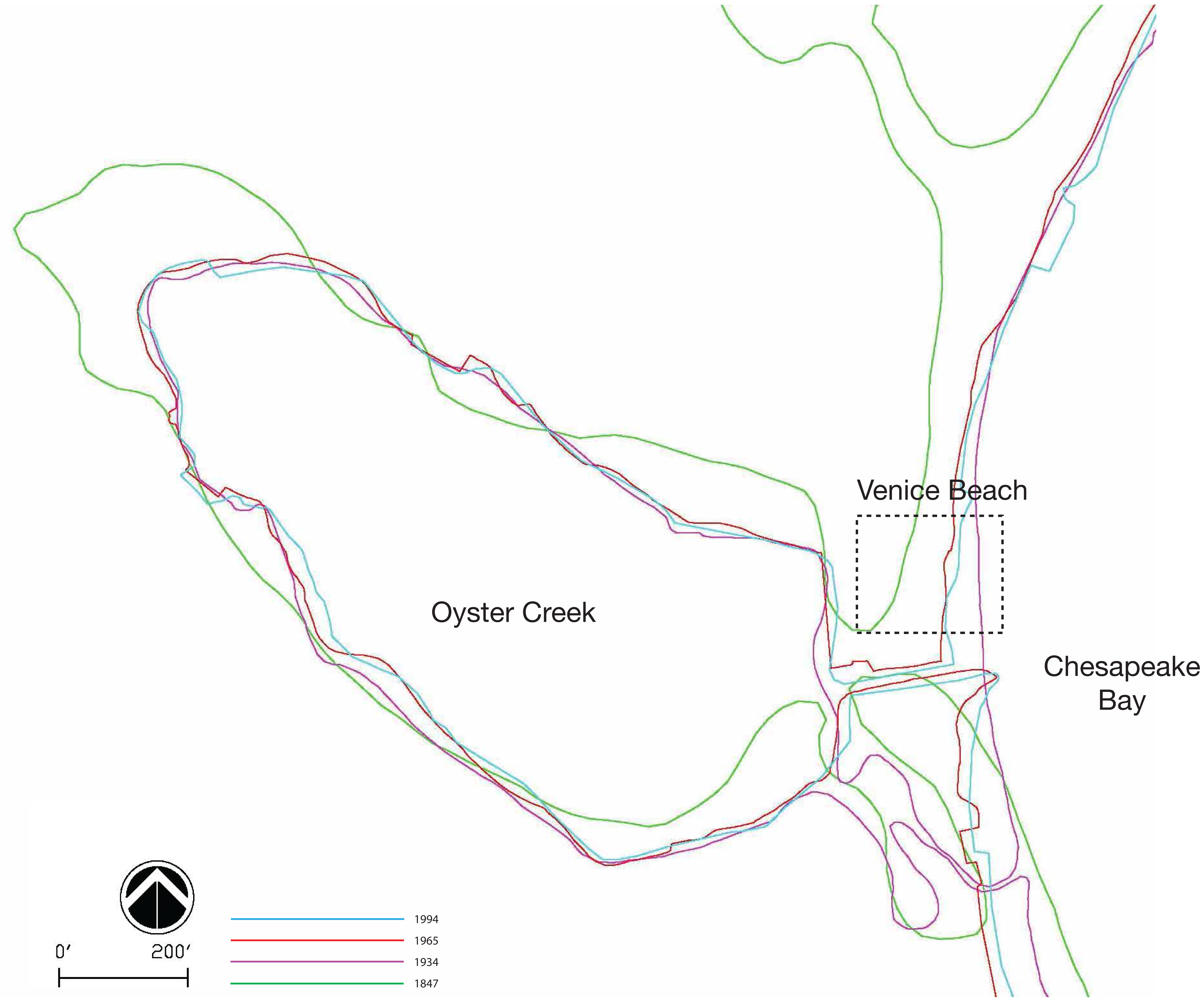
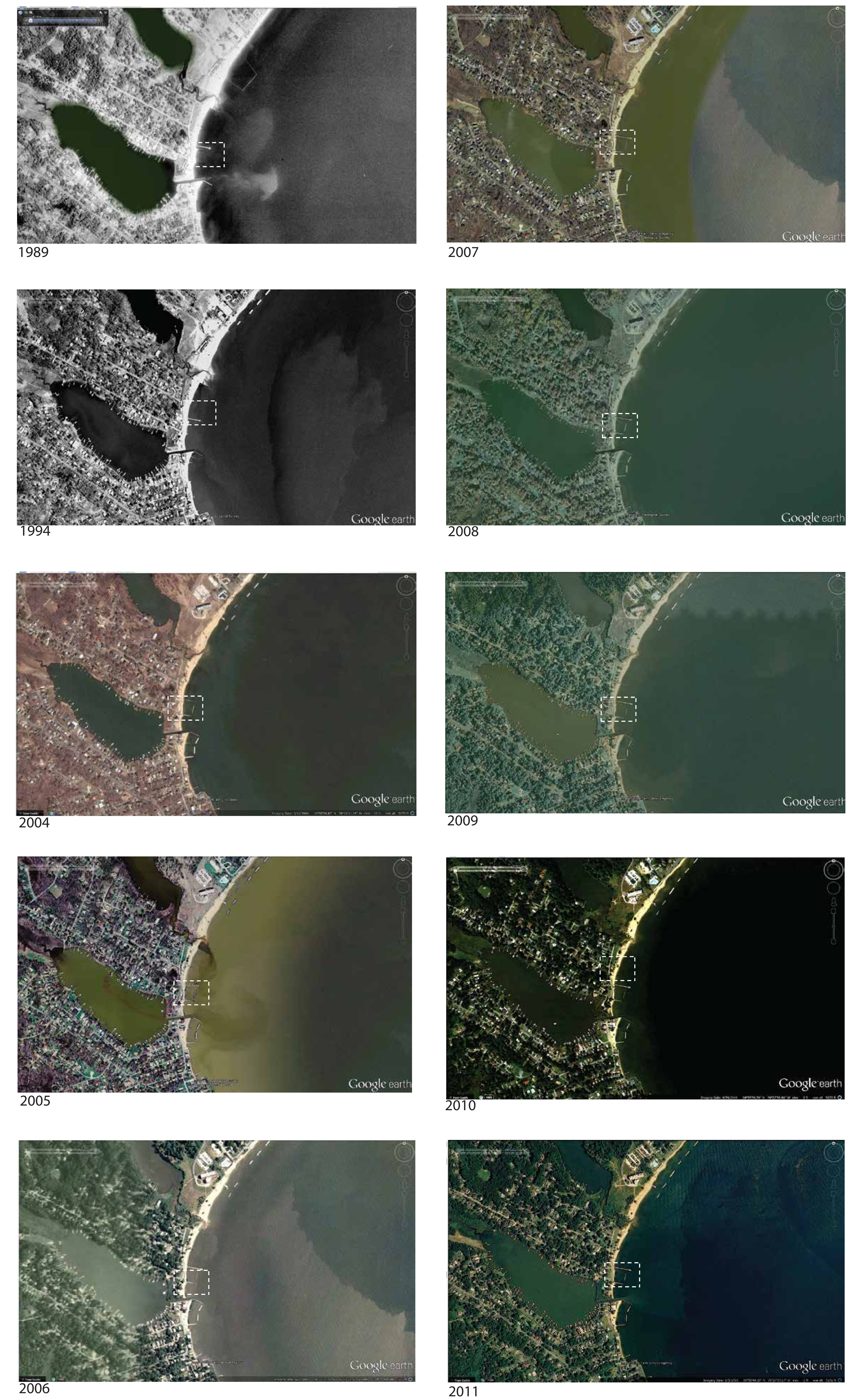
APPENDIX E

HISTORIC BEACH MORPHOLOGY



Based off of research from the Maryland Geological Survey GIS Database and from a camparitve analysis of GoogleEarth satelite photographs it is obvious that the dynamism if the Chesapeake Bay's shoreline has the ability to change dramatically over the course of 100+ years (the above images represent shoreline change from 1847 - 2011).



Beach Morphology: Venice Beach on the Chesapeake Bay

Annapolis, MD

Source: GoogleEarth and Maryland Geological Survey GIS Database

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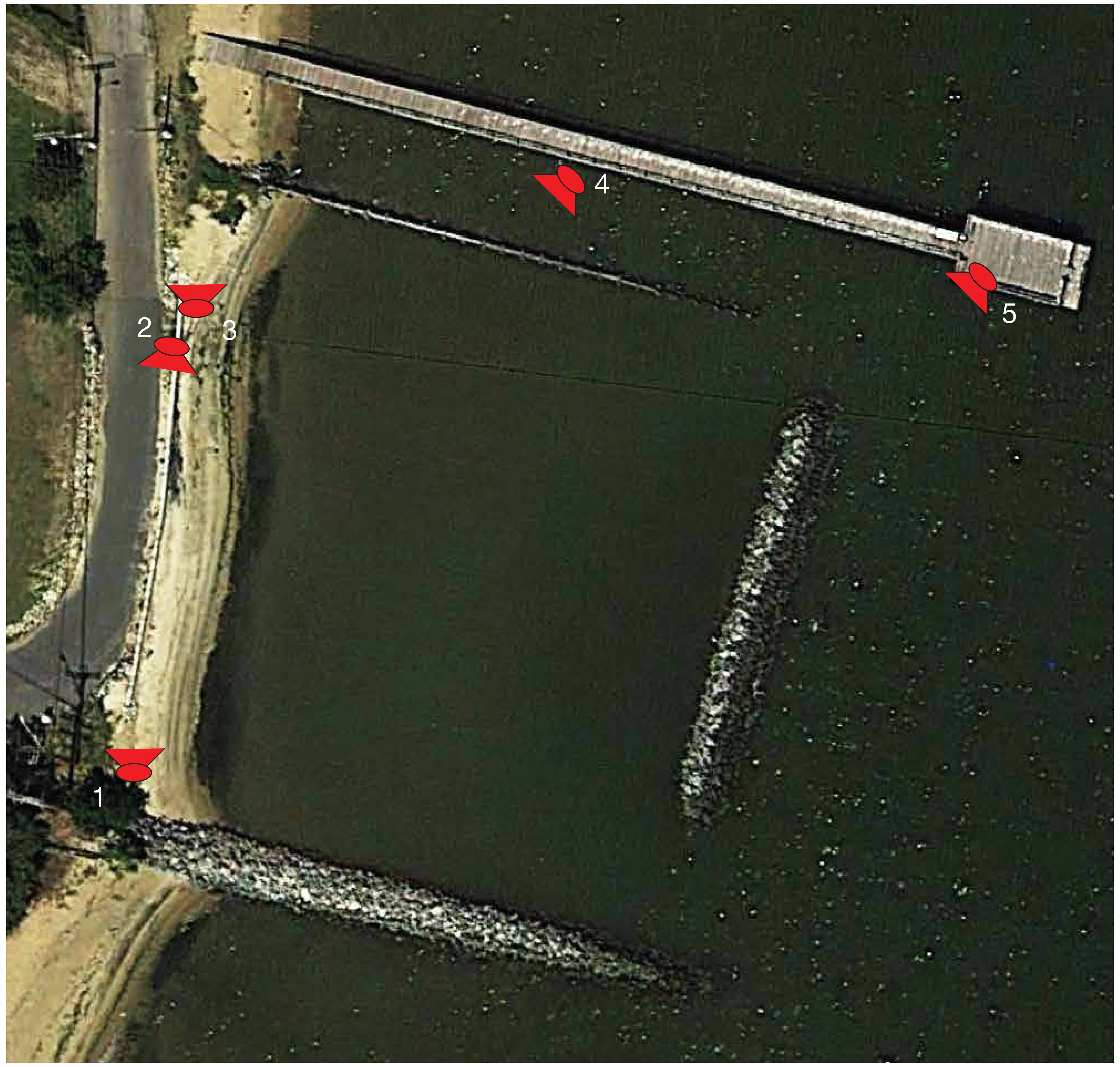
APPENDIX F

SITE PHOTOGRAPHS (2008 + 2014)



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5

1. View of vertical bulkhead looking up the Bay.
2. View of vertical bulkhead with protective toe looking down the Bay.
3. View of wooden groin looking up the Bay.
4. View of wooden groin (foreground) and vertical bulkhead (background).
5. View of bed sill (left), wooden groin (right), stone jetty (left background), and vertical bulkhead (right background).

Site Photographs *(2014)*: Venice Beach on the Chesapeake Bay
Annapolis, MD

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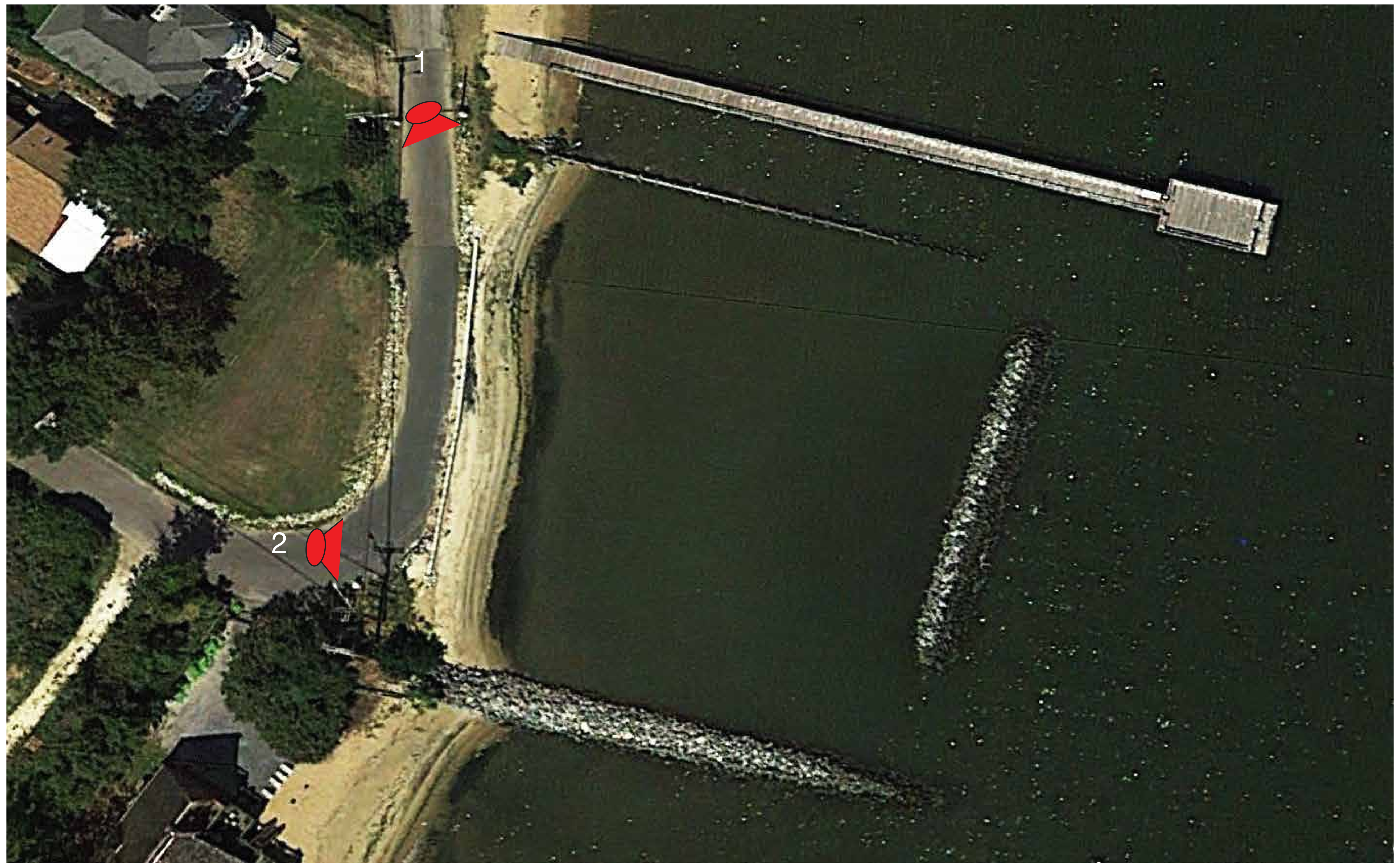

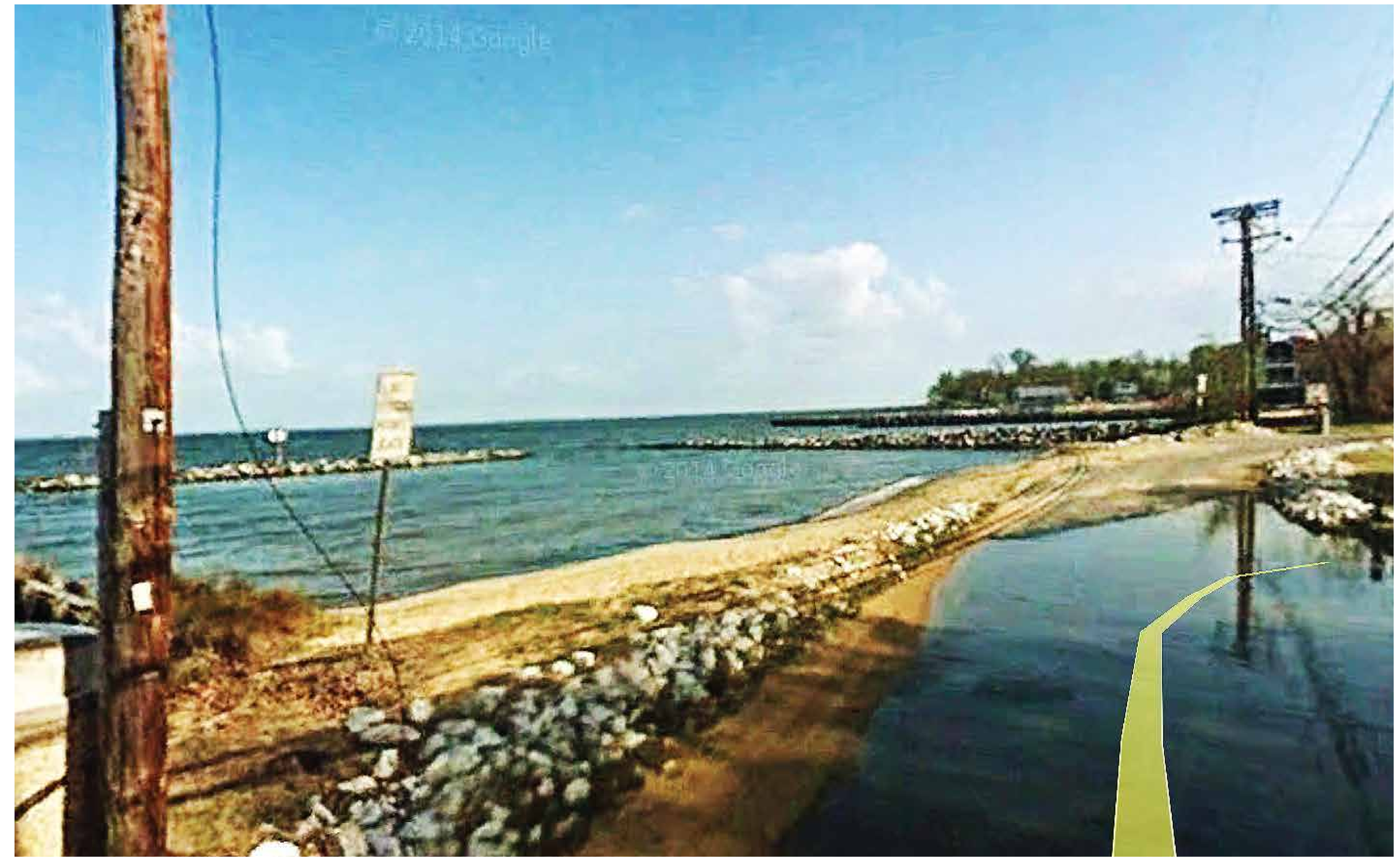

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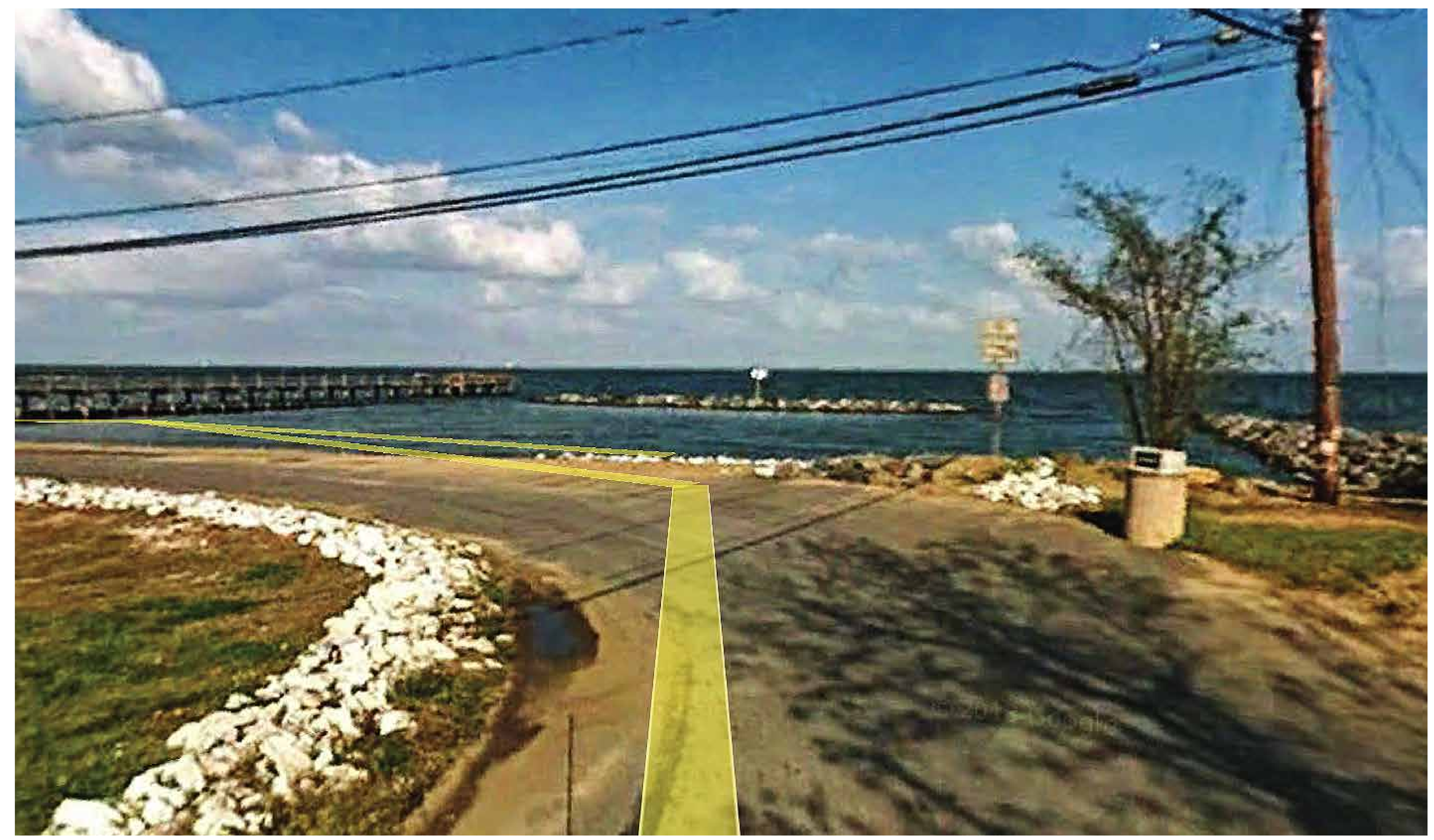

2

1. View from the waterfront (from North) before vertical bulkhead was constructed, notice the gradual sloping beach before the bulkhead was in place.

2. View from the waterfront (from South) before vertical bulkhead was constructed, notice the gradual sloping beach before the bulkhead was in place.

Site Photographs *(2008)*: Venice Beach on the Chesapeake Bay Annapolis, MD

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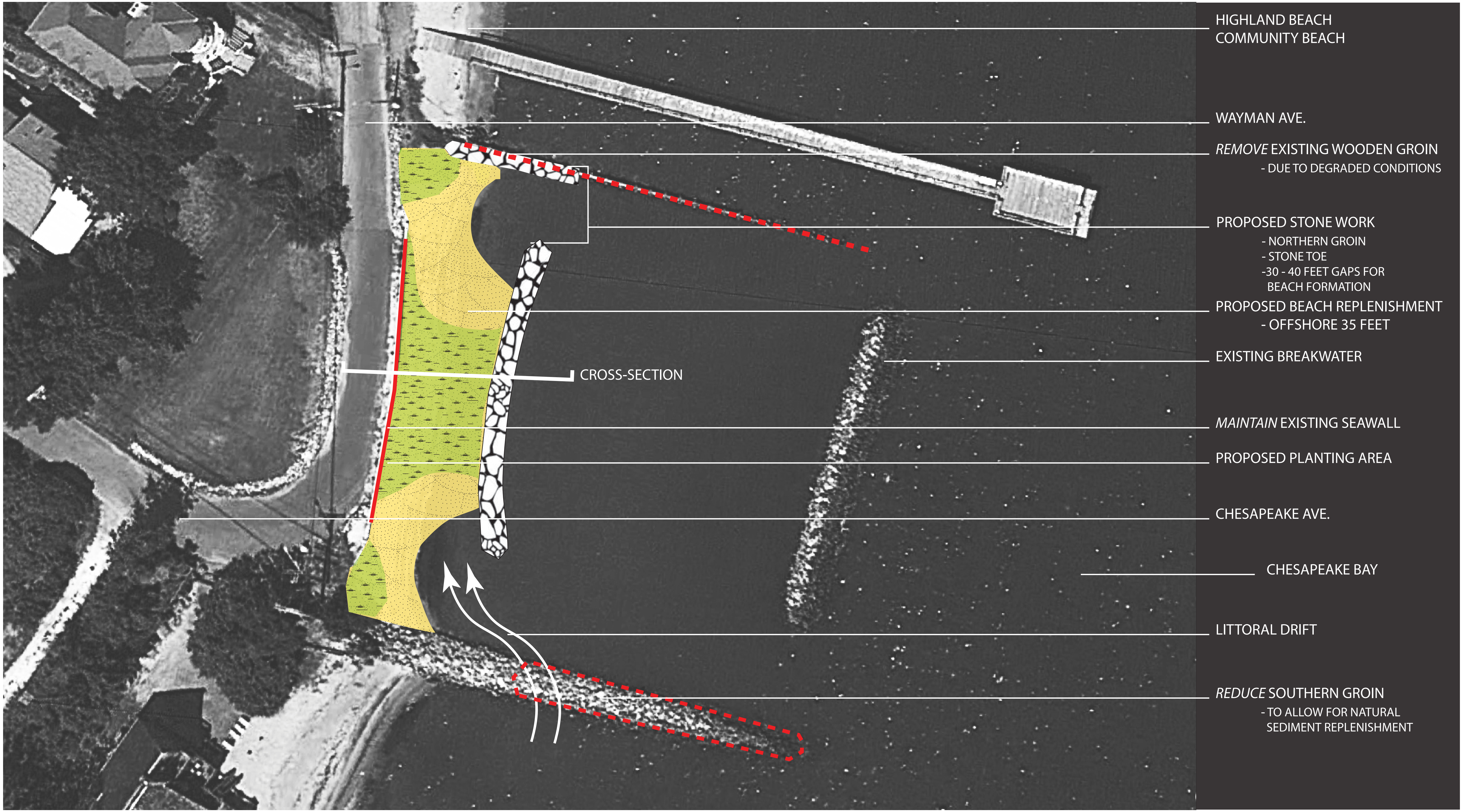
APPENDIX G

DESIGN CONCEPTS/SHORELINE INTERVENTIONS



CONCEPTUAL DESIGN FOR VENICE BEACH ON THE CHESAPEAKE BAY,

1. LIVING SHORELINE WITH STONE TOE + GROIN REMOVAL (RECOMMENDED)

PLAN PROPOSAL
ANNAPOLIS, MD

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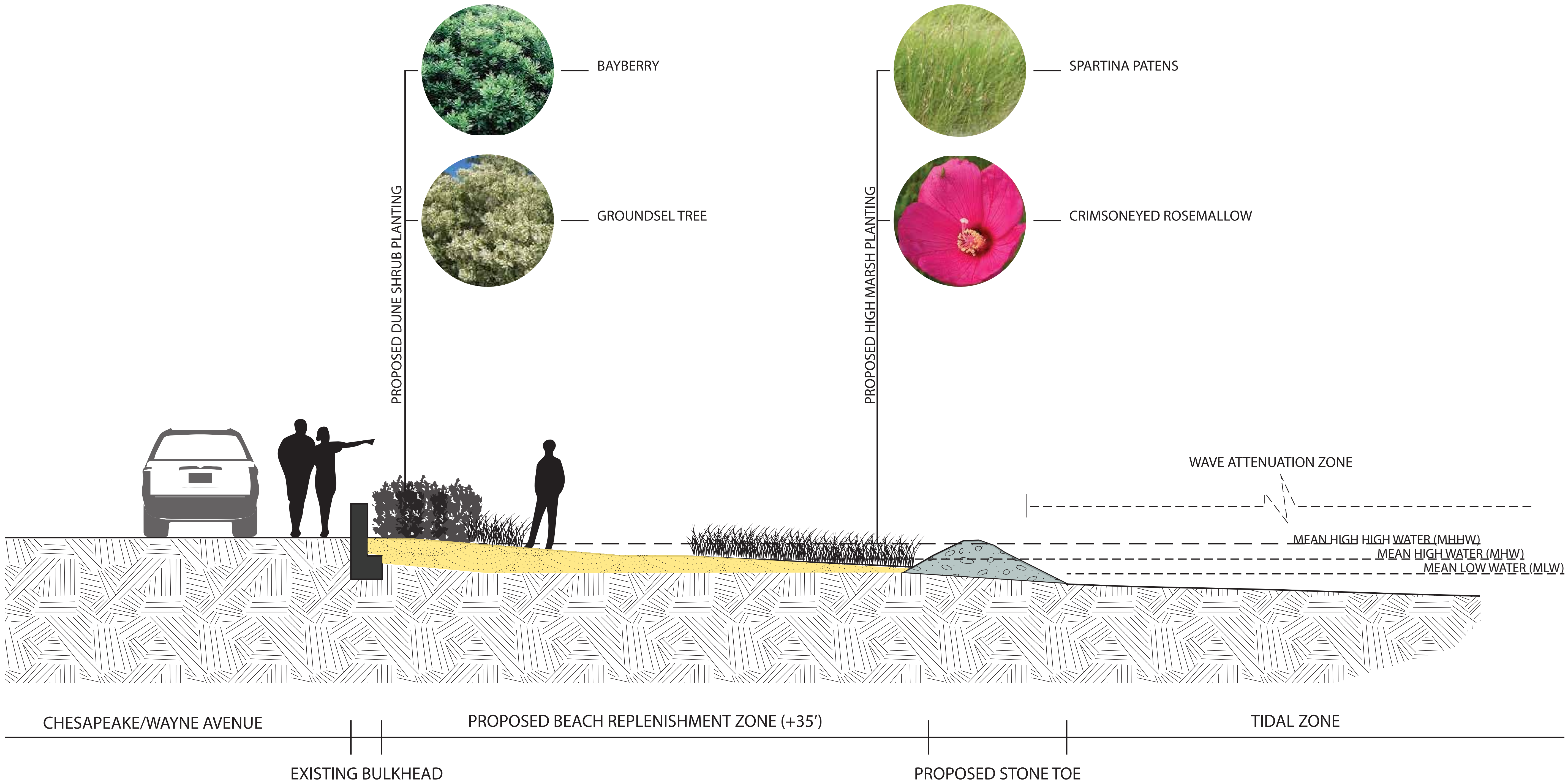

CONCEPTUAL DESIGN FOR VENICE BEACH ON THE CHESAPEAKE BAY,

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ANNAPOLIS, MD

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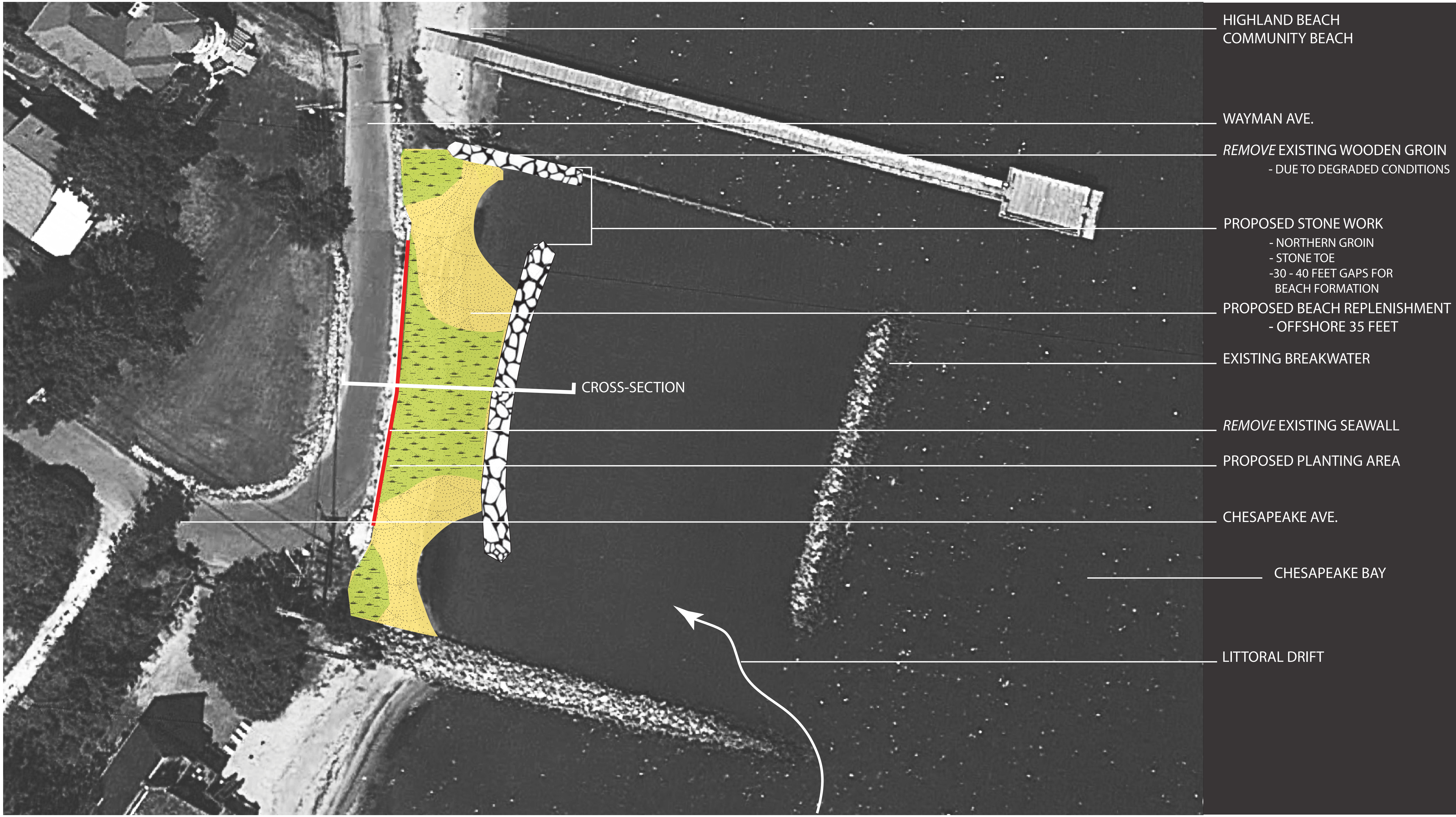

CONCEPTUAL DESIGN FOR VENICE BEACH ON THE CHESAPEAKE BAY,
2. LIVING SHORELINE WITH WITHOUT GROIN REMOVAL

PLAN PROPOSAL
ANNAPOLIS, MD

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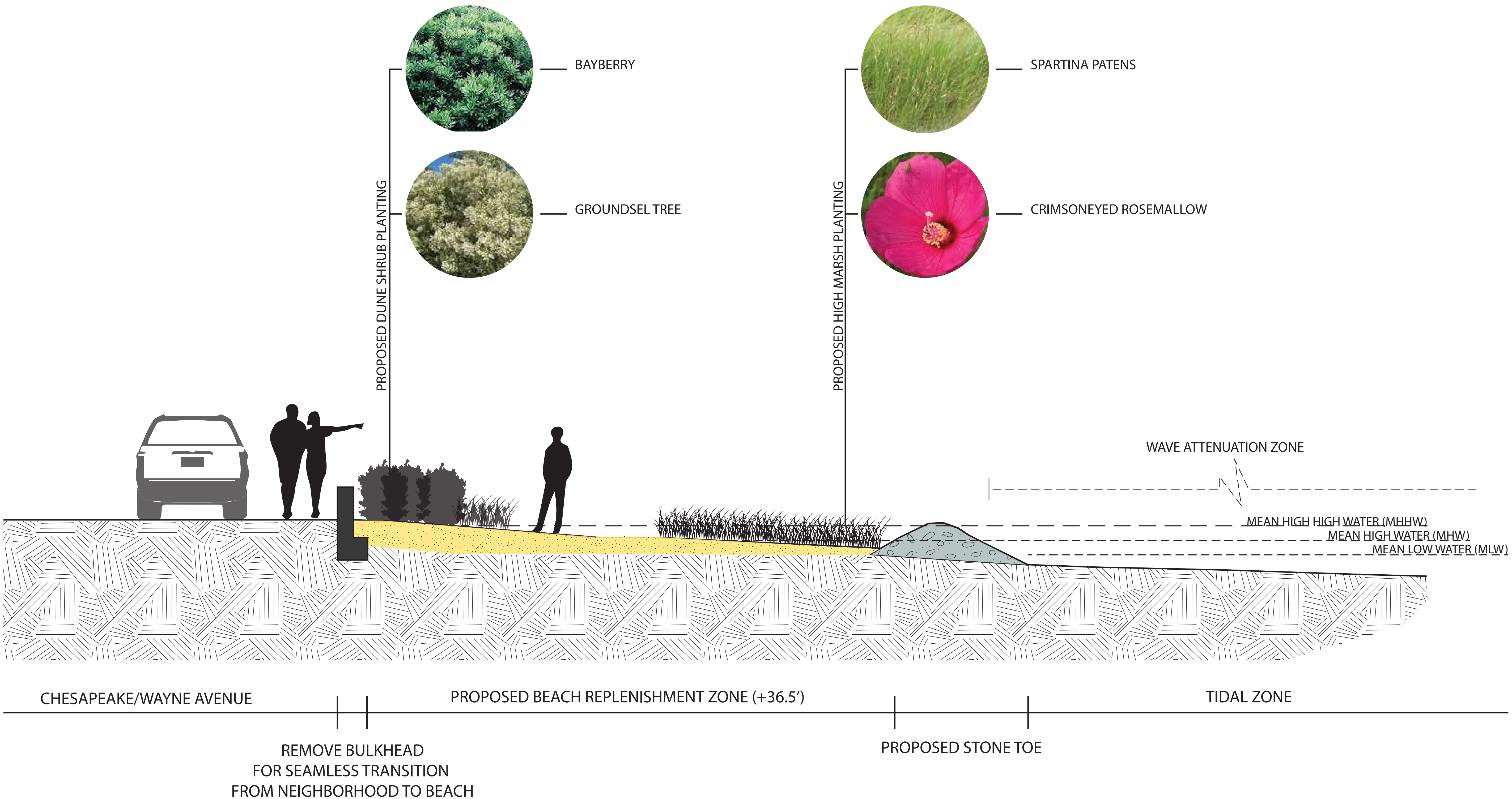

CONCEPTUAL DESIGN FOR VENICE BEACH ON THE CHESAPEAKE BAY,
2. LIVING SHORELINE WITH WITHOUT GROIN REMOVAL

PLAN PROPOSAL
ANNAPOLIS, MD

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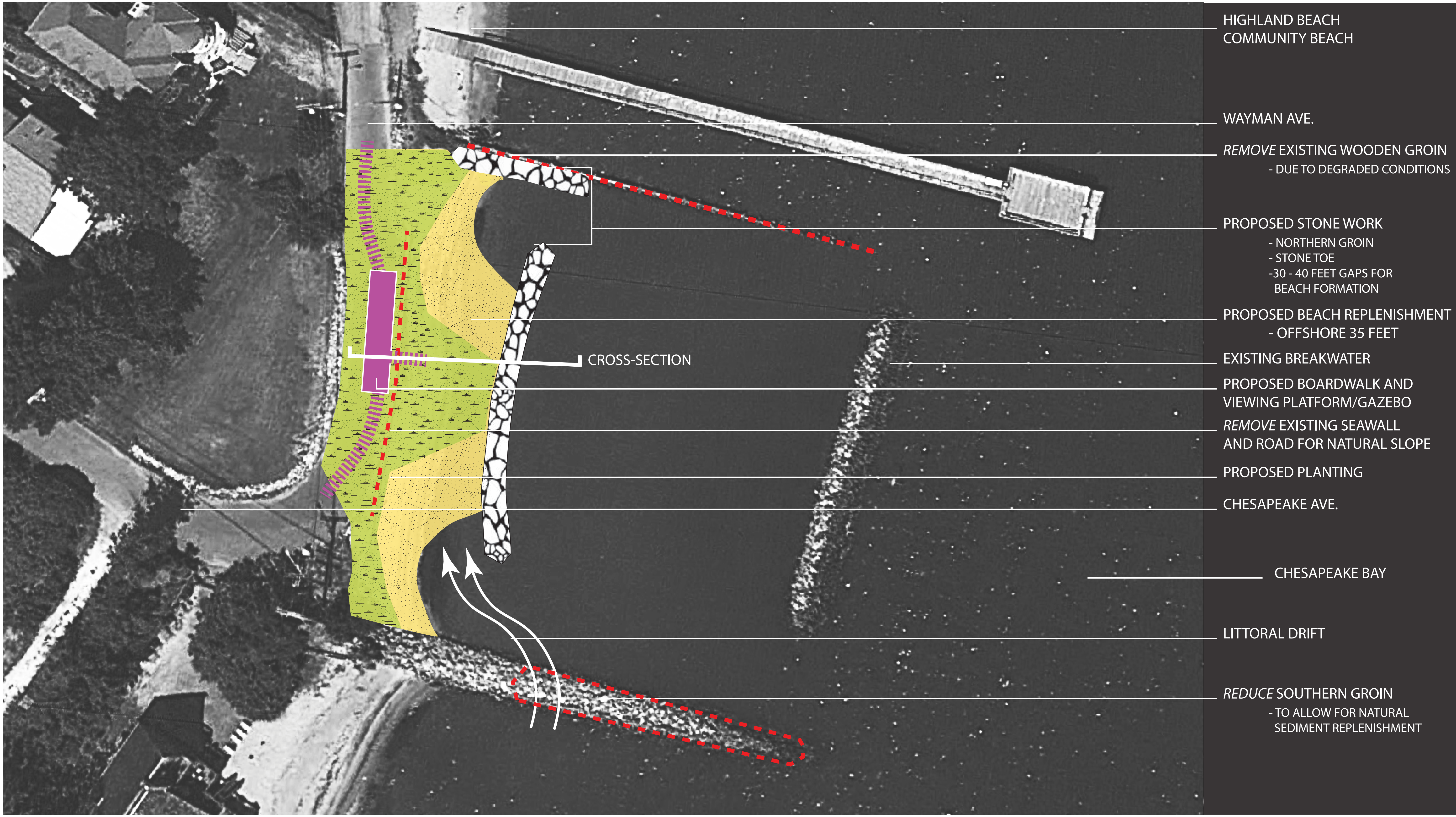
1445 CHESAPEAKE AVE.
ANNAPOLIS, MD
21403

Environmental
Systems
Analysis, Inc.
Natural Resources Management
Ecological Restoration
162 West Street
Annapolis, MD 21401



CONCEPTUAL DESIGN FOR VENICE BEACH ON THE CHESAPEAKE BAY,
3. LIVING SHORELINE WITH STONE TOE + GROIN, SEAWALL, AND ROAD REMOVALS

PLAN PROPOSAL
ANNAPOLIS, MD

Prepared for/Applicant:

VENICE BEACH
CITIZENS ASSOCIATION, INC.
1445 CHESAPEAKE AVE.
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esa
Environmental
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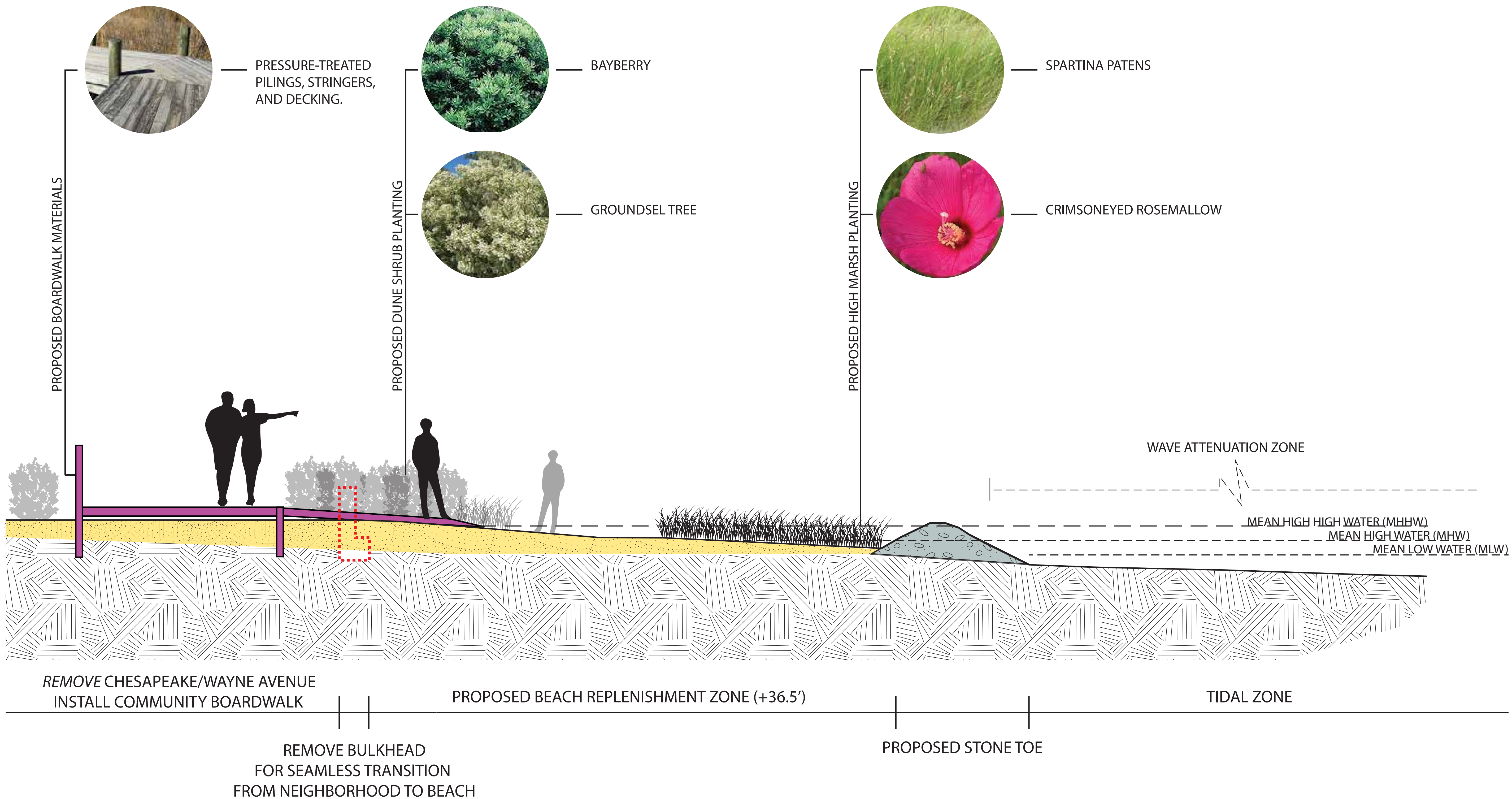

CONCEPTUAL DESIGN FOR VENICE BEACH ON THE CHESAPEAKE BAY,

3. LIVING SHORELINE WITH STONE TOE + GROIN, SEAWALL, AND ROAD REMOVALS

CROSS SECTION PROPOSAL
ANNAPOLIS, MD

Prepared for/Applicant:

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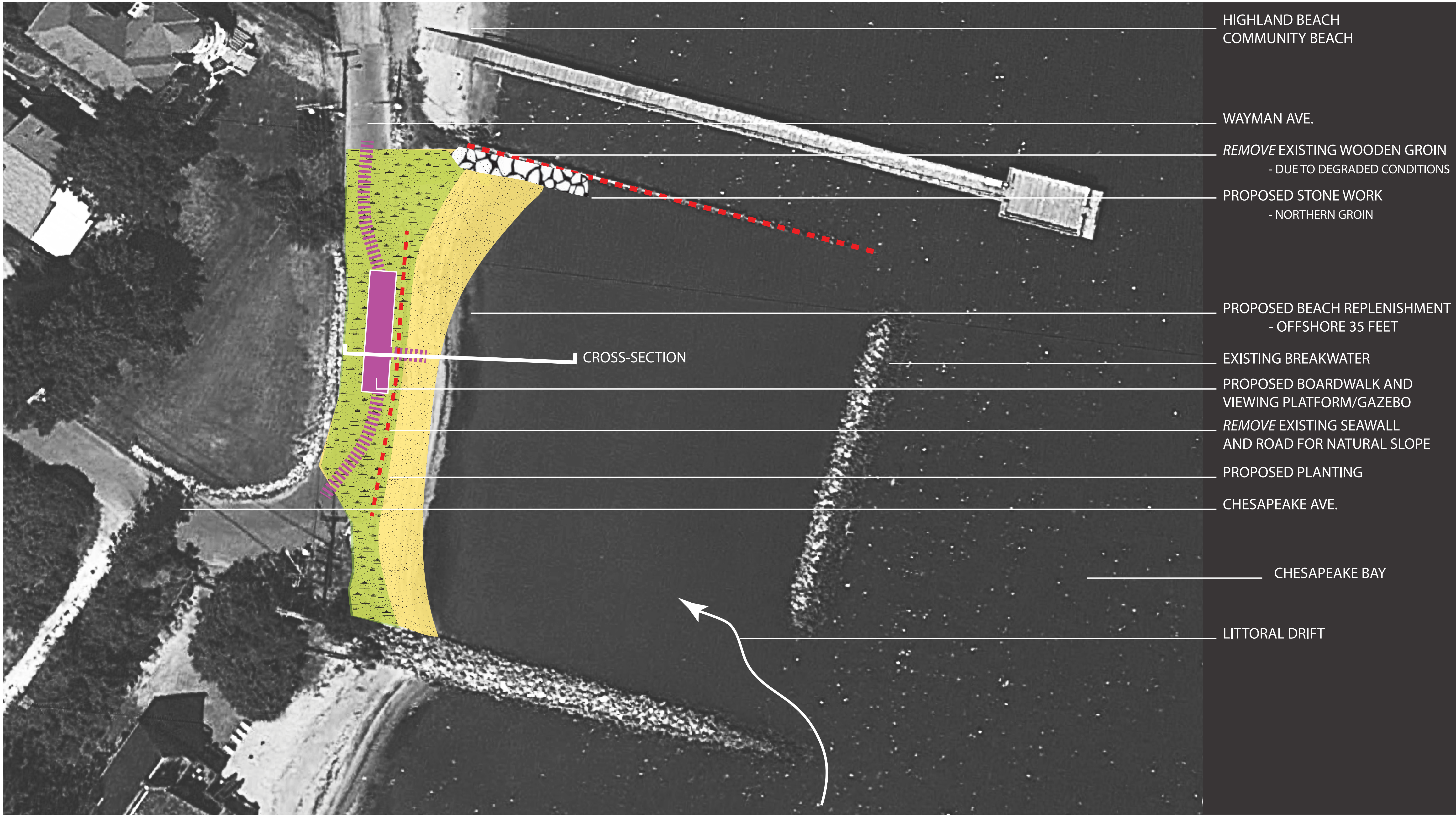

CONCEPTUAL DESIGN FOR VENICE BEACH ON THE CHESAPEAKE BAY,
4. LIVING SHORELINE GROIN, SEAWALL, AND ROAD REMOVALS

PLAN PROPOSAL
ANNAPOLIS, MD

Prepared for/Applicant:

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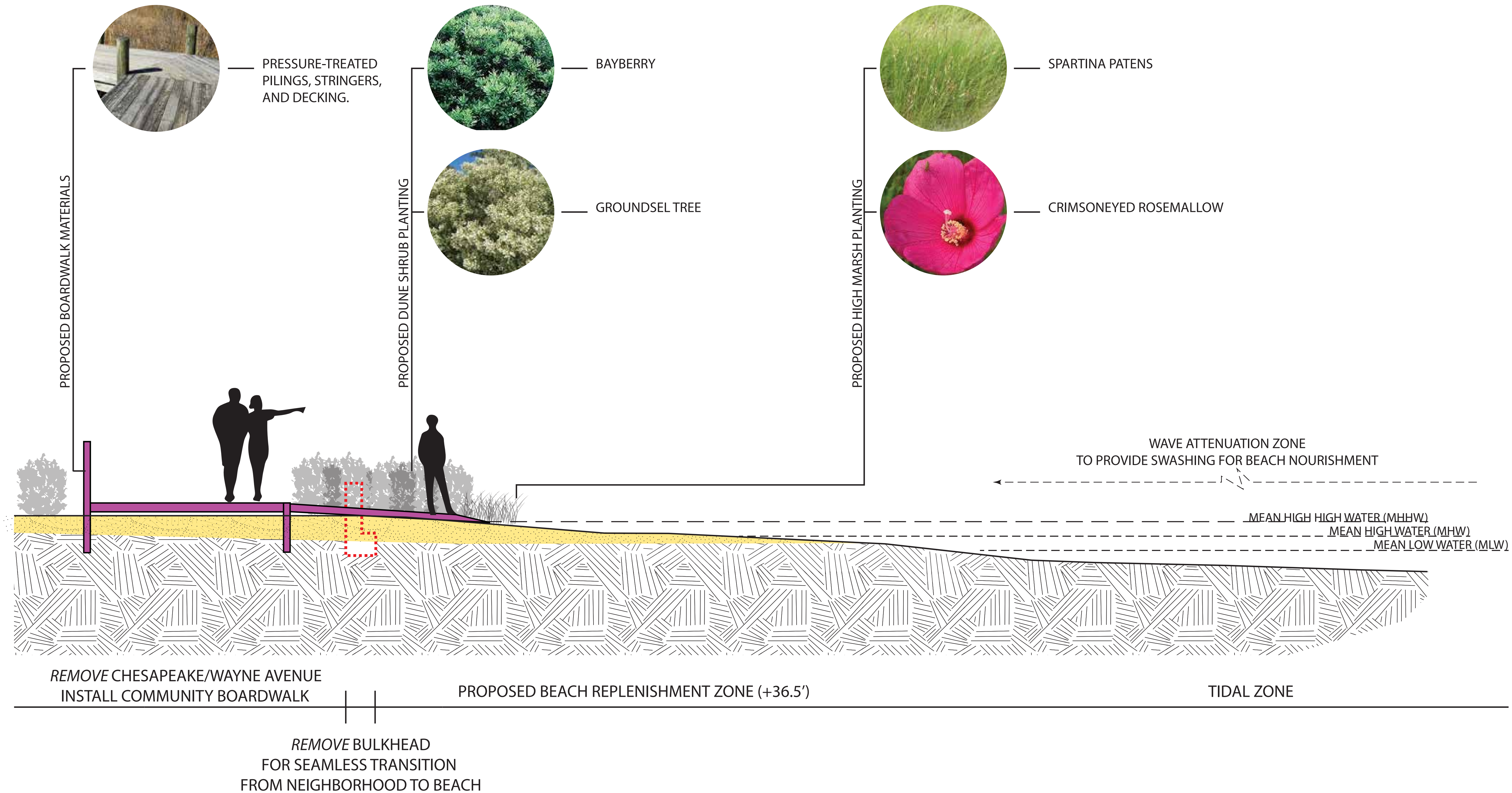

CONCEPTUAL DESIGN FOR VENICE BEACH ON THE CHESAPEAKE BAY,
4. LIVING SHORELINE GROIN, SEAWALL, AND ROAD REMOVALS

CROSS SECTION PROPOSAL
ANNAPOLIS, MD

Prepared for/Applicant:

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APPENDIX H

COST ESTIMATES

CONCEPT 1: LIVING SHORELINE WITH STONE TOE AND GROIN REMOVALS (RECOMMENDED)					
Item #	**Description**	**Est. Quantity**	**Unit**	**Unit Price**	**Total Price**
1	Mobilization/De-Mobilization			10%	$ 6,162.50
2	Washed sand	230	Tons	$ 65.00	$ 14,950.00
3	Sediment and erosion control				$ 9,000.00
4	Move rock from southern groin to stone toe (work done from barge)	Per Day	$4,000.00	6 days	$24,000.00
5	Remove northern wooden groin (work done from barge)	150	LF	$ 60.00	$ 9,000.00
6	Plantings:				
6A	Shrubs	34	containers	$ 50.00	$ 1,700.00
6B	Grasses	1190	plugs	$ 2.50	$ 2,975.00
7	Design Fees				$ 40,000.00
8	Permitting:				$ 45,000.00
	TOTAL				$ 152,787.50
	Contingency			**25%**	$ 38,196.88
	Total w/ Contingency				$ 190,984.38

CONCEPT 2: LIVING SHORELINE WITHOUT GROIN REMOVAL					
Item #	**Description**	**Est. Quantity**	**Unit**	**Unit Price**	**Total Price**
1	Mobilization/De-Mobilization			10%	$ 4,501.70
2	Washed sand	230	Tons	$ 65.00	$ 14,950.00
3	Sediment and erosion control				$ 9,000.00
3	Sand Stone	23	Tons	$75.00	$ 1,725.00
4	Bedding Stone	16	Tons	$85.00	$ 1,360.00
5	Shoreline Labor	3 Days	Per Day	$4,000.00	$ 12,000.00
6	Plantings				
6A	Shrubs	34	containers	$ 50.00	$ 1,700.00
6B	Grasses	1190	plugs	$ 2.50	$ 2,975.00
8	Design Fees				$ 40,000.00
9	Permitting:				$ 45,000.00
	TOTAL				$134,491.70
	Contingency			**25%**	$ 33,622.93
	Total w/ Contingency				$ 175,927.95

CONCEPT 3: LIVING SHORELINE WITH STONE TOE AND SEAWALL AND ROAD REMOVAL					
Item #	**Description**	**Est. Quantity**	**Unit**	**Unit Price**	**Total Price**
1	Mobilization/De-Mobilization			10%	$ 9,777.50
2	Washed sand	230	Tons	$ 60.00	$ 13,800.00
3	Sediment and erosion control				$ 9,000.00
4	Move rock from southern groin to stone toe (work done from barge)	Per Day	$4,000.00	6 days	$ 24,000.00
5	Remove northern wooden groin (work done from barge)	150	LF	$ 60.00	$ 9,000.00
6	Remove seawall	175	LF	$ 60.00	$ 10,500.00
5	Plantings:				
5A	Shrubs	34	containers	$ 50.00	$ 1,700.00
5B	Grasses	1190	plugs	$ 2.50	$ 2,975.00
6	Remove road (Excavation + Removal)	122	CY	$ 100.00	$ 12,200.00
7	Boardwalk	130	LF	$ 200.00	$ 26,000.00
8	Design Fees				$ 40,000.00
9	Permitting:				$ 45,000.00
	TOTAL				$ 203,952.50
	Contingency			**25%**	$ 50,988.13
	Total w/ Contingency				$ 254,940.63

CONCEPT 4: LIVING SHORELINE WITH STONE TOE AND SEAWALL AND ROAD REMOVAL					
Item #	**Description**	**Est. Quantity**	**Unit**	**Unit Price**	**Total Price**
1	Mobilization/De-Mobilization			10%	$ 8,517.50
2	Washed sand	230	Tons	$ 60.00	$ 13,800.00
3	Sediment and erosion control				$ 9,000.00
5	Remove northern wooden groin (work done from barge)	150	LF	$ 60.00	$ 9,000.00
6	Remove seawall	175	LF	$ 60.00	$ 10,500.00
5	Plantings:				
5A	Shrubs	34	containers	$ 50.00	$ 1,700.00
5B	Grasses	1190	plugs	$ 2.50	$ 2,975.00
6	Remove road (Excavation + Removal)	122	CY	$ 100.00	$ 12,200.00
7	Boardwalk	130	LF	$ 200.00	$ 26,000.00
8	Design Fees				$ 40,000.00
9	Permitting:				$ 45,000.00
	TOTAL				$ 178,692.50
	Contingency			**25%**	$ 49,638.13
	Total w/ Contingency				$ 228,330.63

CONCEPT 5: BEACH REPLENISHMENT ONLY					
Item #	**Description**	**Est. Quantity**	**Unit**	**Unit Price**	**Total Price**
1	Washed sand	230	Tons	$ 65.00	$ 14,950.00
2	Mobilization/De-Mobilization			10%	$ 1,380.00
3	Design Fees				$ 10,000.00
4	Permitting:				$ 38,000.00
	TOTAL				$ 64,330.00
	Contingency			**25%**	$ 16,082.50
	Total w/ Contingency				$ 80,412.50