Map Unit Properties Table: Assateague Island National Seashore

"Map Unit" and "Geologic Description" are from Morton et al. (2007). Vegetation information in the "Habitat" column and groundwater information in the "Geologic Features and Processes" column are from Krantz et al. (2009).

Age	Map Unit (Symbol)		Geologic Description	Geologic Issues	Geologic Features and Processes	Geologic History and Park Connections	Habitat
QUATERNARY (Holocene)	Man-made Units	Artificial berm (artfcl_brm)	A low linear ridge of sand, gravel, and shell constructed in the backbeach parallel to the shore to reduce overwash of barrier island. Located along the island's north end, it is 2.4 km (1.5 mi) long and has an elevation up to 3.05 m (10 ft) (NAVD88).	**Disturbed Lands—**This structure impedes overwash processes and shelters backbarrier habitats, thereby fostering accelerated succession of vegetation communities and reducing foraging habitat available for piping plover (*Charadrius melodus)*, a federally-listed threatened species.	**Barrier Island System Units**—The berm was constructed with 285,000 m^3 (373,000 yd^3) of sand, gravel, and shell that were dredged from an offshore shoal.	Constructed with dredged shoal material in 1998 following two northeasters that overwashed large sections of the island's north end. Modified in 2008 and 2009 to allow overwash to flow through 14 "notches" cut into the artificial berm.	Gravel surface provides attractive nesting site for piping plover (*Charadrius melodus)*, a federally-listed threatened species.
		Impoundments (impndmnts)	Former water bodies or flats that have been altered by dikes to retain water, or interior water bodies created by dredging below the water table.	**Disturbed Lands—**These structures alter groundwater hydrology and, when drained to the marsh and bay, have unknown impacts on water quality. **Storm Impacts—**Storm events sometimes overtop dikes, increasing salinity as well as water levels. Many impoundments are located in an area that is highly vulnerable to overwash. **Coastal Vulnerability and Sea Level Rise—**As sea level continues to rise, damage to dikes and other impoundment infrastructure can be expected. Maintaining water depths at desirable levels may also become more difficult.	**Barrier Island System Units**—All impoundments depend entirely on precipitation for freshwater, and gravity or evaporation for drawdown.	In Chincoteague National Wildlife Refuge, fresh- and brackish-water impoundments totaling approximately 1,072 ha (2,650 ac) were created for the primary purpose of providing waterfowl migration and wintering habitat. All impoundments were constructed in the 1950s and 1960s except for the final one, constructed in 1992. The management objectives of the impoundments have broadened over time and they are now intensively managed through flooding, drawdown, disking, hydro-axing, mowing, seeding, planting, burning, and control of non-native *Phragmites.*	Provides important nesting, foraging, and stopover habitat for migratory birds, wintering waterfowl, species of conservation concern, and other wildlife throughout the year.
		Jetty (jetty)	An engineering structure that projects perpendicular to the shoreline. A jetty is typically composed of large blocks of rock and is designed to reduce the flow of sand into a coastal navigation channel, such as a tidal inlet.	**Inlet Impacts on Sediment Transport Processes—**This structure disrupts southward sediment transport, causing increased erosion of the shoreline and active nearshore profile, and lowered island elevation, along the northern 13.2 km (8.2 mi) of Assateague Island.	**Barrier Island System Units**—Originally designed to reduce flow of sand into coastal navigation channels.	The jetty was built in 1934 to stabilize the Ocean City Inlet as a navigation channel. It is 700 m (0.4 mi) long, 400 m (0.25 mi) of which extends seaward from the island. It is regularly maintained and tightened, including work in 1938, 1956, 1963, and 1986. Two breakwaters were also built along the Assateague Island National Seashore inlet shoreline to shelter the shoreline from waves; associated sand buildup sometimes extends from the shoreline to the breakwaters.	None documented.
		Modified land (mdfd_lnd)	Significant alterations of the land surface for residential/commercial development.	**Disturbed Lands—**High percentage of impervious surface relative to other areas of the island. **Storm Impacts—**Roads and infrastructure may be damaged by waves, storm surge, shoreline erosion, overwash, and sand burial. **Coastal Vulnerability and Sea Level Rise—**Infrastructure vulnerability will increase due to climate change impacts including sea level rise, increased flooding and shoreline erosion, and increased wave height and storm surge. The park has replaced some traditional infrastructure with structures that can be moved landward, and parking lots paved with native materials instead of asphalt. The park has also developed long-term plans that consider these future conditions.	**Barrier Island System Units**—Developed areas support park infrastructure.	The national seashore's developed zone and Assateague State Park areas include roads, parking lots, campgrounds, visitor contact stations, and other infrastructure to support visitor use. The Toms Cove visitor parking lot in Virginia is built from shell and clay, rather than impervious surface; when this parking lot is damaged by storms and overwash, much of these native materials can be salvaged to rebuild the parking lot, and uncollected debris blends more easily into the landscape.	Low habitat value due to high percentage of impervious surfaces and human disturbance. Human food and freshwater spigots attract horses and other animals to these areas, modifying animal behavior and increasing nuisance incidents (e.g., horse bites).
		Parking lots (prkg_lots)	Areas cleared for vehicle parking.				

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QUATERNARY (Holocene)	Man-made Units	Reclaimed land (rclmd_lnd)	Formerly low, commonly flooded land that is built up by material dredged from adjacent submerged areas or imported from other sites.	**Disturbed Lands—**Spoil dunes impede overwash processes. The stabilizing vegetation growing on the spoil dunes is grazed by feral horses (*Equus caballus*) **Storm Impacts—**Overwash occurs through gaps in the spoil dunes. These dunes provide a sediment source to the beach when storm waves erode and undermine the toe of the dune.	**Barrier Island System Units**—Developed via dredging.	Spoil dunes on the north end of the island were created in association with channel dredging. Following a North End breach related to the 1962 Ash Wednesday storm, material was dredged from the inlet and Sinepuxent Bay: 16,650 m^3 (21,800 yd^3) in early 1963 to build an emergency dune, and 125,000 m^3 (163,500 yd^3) in mid-1963 to close the breach. A deep channel was dug through the marsh to reach Ferry Landing, which was used heavily in the 1950s when developers brought prospective buyers to the island. Ferry service ended when the Verrazano Bridge was built in 1964 to connect the island to the mainland.	The spoil dune area on the north end of the island is much higher than the island's natural dunes, but supports a state-listed insect (tiger beetle, *Cicindela lepida*). Dominant vegetation is similar to that of natural dunes: panic grass (*Panicum* spp.), seaside goldenrod (*Solidago sempervirens*), and American beachgrass (*Ammophila brevigulata*), which has an extensive root and rhizome system that promotes dune stabilization, but is grazed heavily by horses.
	Barrier Island Units	Accretion mounds (artn_mnd)	Low, oblong vegetated hills formed on the margins of overwash zones by the concentric accumulation of sand.	**Disturbed Lands—**Feral horses (*Equus caballus*), native white-tail deer (*Odocoileus virginianus*), and historically introduced sika deer (*Cervus nippon*) impact vegetation structure in forest and shrub communities on the island.	**Barrier Island System Units**—These are usually slightly higher-elevation features in the otherwise low-lying former inlets or areas of extensive overwash. The larger mounds (wider than about 75 m [246 ft]) have series of arcuate ridges on the seaward side that can be up to 3.5 m (11.5 ft) high. The fresh groundwater lens is deepest (3 to 4 m [10 to 13 ft]) and most stable in the center of the mound, with an abrupt shallowing immediately outside of the outer ridge. Smaller mounds have localized shallow lenses of fresh groundwater that dissipate close to the edges of the features and may be sufficient to allow growth of salt-tolerant shrubs.	These were older sections of the island that have been dissected and sculpted by high-velocity flow of ocean water across the island during major storms.	Vegetation is distinctly zoned. Larger mounds are covered by maritime forest with obligate freshwater plants. The bayward side is typically occupied by low-marsh grasses and high-marsh shrubs and grasses in a low-slope pocket protected by the wrapping storm ridges.
		Accretion mound swales (art_mnd_swl)	Topographic depressions within an accretion mound. May be dry or intermittently pond freshwater after heavy rain.	**Storm Impacts**—Susceptible to saltwater flooding from storm surges and freshwater flooding from intense rainfall events.	**Barrier Island System Units**—Swales and ponds in the center of an accretion mound are mostly fresh, although they are susceptible to flooding during strong to moderate storms.	These are part of the oldest sections of the island. They are the low areas within accretion mounds.	Commonly, the swales are seasonal freshwater wetlands with a distinct plant community that may include *Osmunda* ferns. Some swales that become seasonally dry support trees and shrubs, whereas others that are more persistently wet are covered predominantly by grasses.
		Barrier core (brr_cr)	The central part of the barrier island that commonly lies between dunes on the seaward side and marshes on the landward side. May be sparsely vegetated or covered by grasses or trees.	**Coastal Vulnerability and Sea Level Rise—** Climate change (increased rate of sea level rise and more intense storms) will likely reduce island stability, due to increased likelihood of beach and dune erosion, overwash, inlet breaching, shoreline retreat, and island narrowing. Forest and shrub communities will be among the first affected by sea level rise, overwash, and consequent increased salinity of groundwater. Longer summer droughts and changes in groundwater level will cause species shifts.	**Barrier Island System Units**—The central part of the barrier core has the most stable, deepest fresh groundwater lens, which is up to 7 to 8 m (23 to 26 ft) thick-- shallower than predicted by theoretical considerations but limited in depth by the low-permeability lagoonal silt layer that underlies much of the island. This area has the most consistently fresh groundwater, with ponds that are well protected from saltwater intrusion, permanently fresh, and particularly valuable wildlife habitat.	Many of the prominent storm ridges that isolate the barrier core from the overwash areas were created or enhanced during the 1962 storm.	The vegetation within swales differs from the surrounding maritime forest by adaptation to hydric soils (soils that are water saturated throughout most or all of the year). Ridges more than 2 m (6.5 ft) high are covered by the oldest-growth and most diverse maritime forests on the island, largely due to the depth and stability of the fresh groundwater lens. Ridges of 2.5 to 5 m (8 to 16 ft) height have a thick unsaturated (dry) soil zone and a paucity of vegetation, in particular trees and shrubs.

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Age	Map Unit (Symbol)	Geologic Description	Geologic Issues	Geologic Features and Processes	Geologic History and Park Connections	Habitat
QUATERNARY (Holocene)	Barrier Island Units Beach (beach)	A mostly unvegetated strip of sand parallel to the shore that extends from the water to the seaward edge of the dunes or crest of a washover terrace. The seaward part of the beach is regularly inundated by wave runup during high-water phases of the tidal cycle. Foreshore slope is 4°.	**Storm Impacts—**Storms cause significant beach erosion and overwash. **Coastal Vulnerability and Sea Level Rise**—30% of the shoreline is classified as highly vulnerable to sea level rise; 51% is moderately to highly vulnerable. Sea level rise predictions suggest an additional 0.19 m (0.62 ft) by 2030, up to 0.4 m (1.3 ft) by 2050, and 0.82 to 1 m (2.7 to 3.4 ft), but less than 1.2 m (4 ft), by 2100. Some estimates include the possibility that sea level may rise as much as 2 m (6.5 ft) by 2100. Significant impacts are anticipated. **Inlet Impacts on Sediment Transport Processes**—Ocean City Inlet and jetties disrupt sediment transport, starving beaches and increasing shoreline erosion. North End Restoration Project attempts to restore sediment transport. **Landscape and Shoreline Evolution**—Geologic processes continue to shape the beach. **Recreation and Watershed Land Use**—Oversand vehicle use along park beaches may have physical and biological impacts, including reducing dune elevation and storm resiliency, disturbing organic drift lines that support seed germination and new dune development, preventing vegetative colonization, and impacting habitat quality for rare species. **Paleontological Resources**—Fossils are occasionally found along the shoreline. Interpretation and outreach may lessen public misunderstanding about what can be collected (unoccupied modern shells) and what cannot be collected (fossils). **Archeological Resources**—Shipwrecks and other resources are occasionally uncovered along the beach.	**Wave and Current Activity**—Ocean coastline is wave dominated. Mean significant wave height is 1.2 m (3.9 ft) but can exceed 8 m (26 ft) during storms. Beaches generally gain volume in summer and early fall when offshore sand is transported onto them; winter storms move sand offshore into bars, alongshore, and across the island. **Wind Activity**—Wind transports significant quantities of sediment from beach and dunes to the island's interior and the Coastal Bays. **Tidal Activity**—Coastline is microtidal (0 to 2 m [0 to 6.5 ft] relative to mean low water). In the Maryland Coastal Bays, tidal cycles exert significant control on circulation patterns and tidal ranges. **Sediment Transport Processes**—Supply of new sediment comes from the Delmarva Headland (located between Fenwick Island and Cape Henlopen, Delaware) and from erosion of the shoreface and shelf, which are significant sediment sources via onshore transport. Net longshore transport is southward, between 115,000 m^3 (150,400 yd^3) and 214,000 m^3 (279,900 yd^3) of sand per year. Toms Cove, in Virginia, is the terminus of the regional longshore sediment transport and has grown by 6 km (3.7 mi) since the mid-1800s. **Barrier Island System Units**—The beach is shaped by shoreline erosion and island rollover caused by the movement of sediment alongshore and landward, resulting in the island's overall landward and southward migration.	Beaches represent some of the most recent sediment deposition on the island. The original source of the sediments of Assateague Island is erosion of the Appalachian Mountains and from glaciers scraping off the land surfaces of Ontario, Quebec, Pennsylvania, and New York; these sediments were carried by major river systems to the mid-Atlantic coast. In recent years (1997–2008), the shoreline has eroded at a rate of 0.84 m/year (2.8 ft/year) along the northern 13 km (8 mi) of the island, and at 0.79 m/year (2.6 ft/year) in the middle portion of the island (between km 13 and km 26). This erosion is slower than the rates calculated for the period 1849–1908 and likely reflects the influence of the North End Restoration Project in restoring sediment to the nearshore system.	Vegetation is sparse and limited to taxa specially adapted to the harsh conditions that alternate between inundation by seawater and desiccation because of the thick unsaturated zone. This habitat supports American beachgrass (*Ammophila breviligulata*), sea rocket (*Cakile edentula*), and the endangered seabeach amaranth (*Amaranthus pumilus*), which colonize organic wrack and incipient dunes, and a state-listed insect (tiger beetle, *Cicindela dorsalis media*).
	Beach ridge complex (bch_rdg_cmp)	Sets of long, continuous ridges parallel to the ocean shore, composed of sand that is deposited by a combination of wave runup and the wind. May be covered by grasses or trees.	**Storm Impacts**—Storm-driven waves and wind add sand.	**Sediment Transport Processes**—This accretionary spit complex is the terminus of the regional longshore sediment transport system that moves sand southward from the Bethany Headland nearly 75 km (47 mi) to the north. It has grown by 6 km (3.7 mi) since the mid-1800s and continues to build southwestward at the rate of approximately 50 m (164 ft) per year, according to national seashore shoreline survey data and historic maps. **Barrier Island System Units**—Ridges constructed via wave runup and aeolian processes.	Estimates of volume accumulation range from 165,000 m^3 (215,800 yd^3) per year to 1,100,000 m^3 (1,439,000 yd^3) per year and may have been accelerated by the closure of the historic Green Run and Pope Island inlets and subsequent reworking of their respective ebb-tidal deltas in the late 1800s.	Grasses and trees may cover ridges. Swales may flood or intermittently pond freshwater.
	Beach ridge swales (bch_rdg_swl)	Topographic depressions within a beach ridge complex. May be dry or intermittently pond freshwater after heavy rain.	**Storm Impacts**—Swales are susceptible to saltwater flooding from storm surges and freshwater flooding from intense rainfall events.			

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QUATERNARY (Holocene)	Barrier Island Units Dunes (dunes)	Hills or ridges of windblown sand that form hummocky topography landward of and parallel to the beach. May be sparsely or densely vegetated with grasses.	**Coastal Vulnerability and Sea Level Rise**—Climate change is expected to increase overwash, which will in turn increase disturbance to dunes, potentially converting them to beach and intertidal habitat. Major storm events more than once every 3 years combined with sea level rise will affect the ability of the dunes to rebuild and will likely result in significant dune flattening.	**Barrier Island System Units**—This region has low, wide, and flat islands, with dunes present but extending further landward than in other regions. Dunes can be classified into four main types, representing developmental stages: flats are areas with no foredune and some establishing vegetation; knolls are rounded hummocks resulting from sand accumulation around vegetation; ridges are older dunes with some dense vegetation and extensive root systems; and buttes, most likely the oldest dunes, are scarped with considerable erosion. The man-made dune restricts overwash so effectively that the groundwater in the seaward section of the island that otherwise would experience intermittent or frequent overwash is fresh or only slightly brackish, rather than brackish to saline.	A man-made dune was first built in 1950 from the island's north end southward to the Virginia state line. Currently, it is maintained only along the developed zone (6 km [3.7 mi]) of Assateague Island National Seashore and Assateague State Park. Remnants of the old dune dot the island. Natural dunes have formed by wind and waves when windblown sand is trapped in tidal wrack. Vegetation stabilizes dunes with root and rhizome systems. Low, closely spaced, parallel dune ridges form where the sand supply is abundant and the shore is prograding. Erosion creates a steep seaward edge of the dune. Beaches with fine sand often have larger dunes because the wind can carry the sand higher.	Dominant vegetation includes panic grass (*Panicum* spp.), seaside goldenrod (*Solidago sempervirens*), and American beachgrass (*Ammophila brevigulata*), which has an extensive root and rhizome system that promotes dune stabilization, but is grazed heavily by horses (Carruthers et al. 2012). A state-listed insect (tiger beetle, *Cicindela lepida*) colonizes interior dune habitats and dune blowouts. They are prime habitat for hognose snakes and red fox, support the rare shrub beach heath (*Hudsonia tomentosa*), and provide forage for feral horses at Assateague Island National Seashore.
	Interdune swales (intr_dn_swl)	Topographic depressions between dune ridges. May be dry or intermittently pond freshwater after heavy rain.	**Storm Impacts**—Particularly susceptible to saltwater flooding from storm surges and freshwater flooding from intense rainfall events.	**Barrier Island System Units**—Depressions between dune ridges.	These depressions between shore-parallel dunes exist in areas where the island once experienced abundant sand supply and a prograding shoreline, allowing formation of low, closely spaced, parallel dune ridges.	A state-listed insect (tiger beetle, *Cicindela lepida*) colonizes interior dune habitats and dune blowouts.
	Overwash zones, active (ovrwsh_zn_a)	Overwash zone divided into active and inactive zones. An active overwash zone is frequently flooded by high water and ocean waves generated by storms. It is typically low lying with sparse vegetation and composed of sand with a concentrated layer of shell at the surface.	**Storm Impacts**—Significant overwash events sustain vegetation diversity on barrier islands. **Coastal Vulnerability and Sea Level Rise**—Overwash may become more frequent and intense as a result of climate change impacts and sea level rise. Based on tide gauge records at Lewes, Delaware, the area has experienced a relative sea level rise of 3.1 mm/year (0.12 in/year). In the mid-Atlantic region, land subsidence and a high rate of sea level rise are expected to result in increased coastal flooding.	**Barrier Island System Units**—Overwash moves sand into the island interior, raising island elevation. It sometimes reaches the bay side of the island, creating new marsh platforms. Overwash zones may be wide in low-lying areas, or may be localized as overwash fan complexes. Overwash often flows through low areas among the dunes, can create channels, and may pond in swales, where saltwater infiltrates the surficial aquifer. This recharge of saltwater mixes with and pushes out any fresh groundwater; then, the brackish groundwater flows down gradient in the subsurface. By this process, down-gradient ponds and wetlands receive brackish groundwater, although with a lag time of days to weeks after a storm. Former inlets typically have predominantly saline to brackish groundwater because these are preferential pathways for storm overwash and subsequent groundwater flow due to the coarse, permeable channel fill.	Frequent overwash onto the Toms Cove visitor parking lot, on the Virginia end of the island, encouraged the national seashore to rebuild the parking lot with native materials (clay, clam shells) and to replace damaged and vulnerable infrastructure with facilities (bathhouses, changing rooms) that can be moved to safe storage areas in preparation for large storms.	Swales that receive overwashing seawater several times a year tend to have a distinct salt-tolerant grass community dominated by *Spartina patens*, *Juncus*, and *Panicum*. Unique to barrier islands, these early successional habitats support a variety of rare ground-nesting shorebirds, colonial waterbirds, and federally-listed sea beach amaranth (*Amaranthus pumilus*). Low wet areas support invertebrates foraged by federally-listed piping plover (*Charadrius melodus*).
	Overwash zones, inactive (ovrwsh_zn_i)	Overwash zone divided into active and inactive zones. An inactive overwash zone is an area that was historically overwashed by storm surge, such as during the 1962 Ash Wednesday Storm, or created by overwash, such as the flats that widened the north end of the island during 1998 storms. These areas are not flooded frequently by high water and ocean waves, but are still vulnerable to flooding from extreme storms. In areas that have not experienced overwash in years, the former overwash sand is commonly reworked into low dunes and can be densely vegetated with low wood plants. Inactive overwash zones typically grade landward into marshes.	**Disturbed Lands**—The high, continuous man-made dune that fronts Assateague State Park and the camping area of the national seashore profoundly affects the hydrology of the island immediately behind it by restricting overwash and subsequent infiltration of seawater in the geomorphic setting that otherwise would receive intermittent overwash (during moderate storms).		The 1962 Ash Wednesday northeaster overwashed significant portions of the island, breached the North End, and destroyed many private developments on the island, fueling discussion of appropriate development of the island; this discussion led to the creation of the park in 1965. In 1998, two strong winter northeasters overwashed much of the North End, increasing concern about an island breach and associated impacts on the geologic integrity of the national seashore, the hydrodynamics of Ocean City Inlet, and mainland development. This concern led to the construction of a protective foredune on the North End and the creation of the North End Restoration Project.	Vegetation is sparse and limited to taxa specially adapted to the harsh conditions that alternate between inundation by seawater and desiccation because of the thick unsaturated zone. This habitat supports American beachgrass (*Ammophila breviligulata*), sea rocket (*Cakile edentula*), and the endangered seabeach amaranth (*Amaranthus pumilus*), which colonize organic wrack and incipient dunes.

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QUATERNARY (Holocene)	Barrier Island Units	Marsh (marsh)	Low vegetated wetlands that support plant assemblages tolerant of saltwater, brackish water, and freshwater. Typically found along the landward side of the barrier island adjacent to the lagoon, along the margins of tidal creeks.	**Disturbed Lands**—Mosquito ditches dug in the 1930s continue to impact the hydrology of 960 ha (2375 ac) of marsh and a suite of dependent terrestrial and aquatic species. National seashore staff is currently working to refill some of the 140 km (87 mi) of ditches with sand and to monitor ecosystem effects. Horses trample and compact marsh sediments and their selective grazing changes marsh vegetation structure. **Coastal Vulnerability and Sea Level Rise**—At Assateague Island National Seashore, overwash is an important mechanism for the maintenance of marsh elevation. Increased rates of sea level rise will continue to drown lagoon and mainland marshes, converting them to intertidal mudflats or open water if vertical accretion is less than 1 cm/year (0.4 in/year). Increased storm intensity will increase edge erosion and lagoon marshes will continue to decrease in lateral extent until they are completely eroded and disappear; island fringe marshes will continue to decrease in lateral extent along the open bay margin. Increases in sea level will force transgression of mainland marshes into upland areas.	**Barrier Island Units**—Flooding (from tides and storm surges) is the main mechanism of sediment delivery to the marsh platform. The platform also builds by trapping inorganic sediment in dense vegetation, and by deposition of organic matter as vegetation dies. Groundwater beneath the tidal marsh is typically brackish to fully saline, although fresher groundwater recharged from the island interior may flow shallowly beneath the marsh in discrete sand beds overlain by low-permeability salt marsh peat and mud. The shallow availability of relatively lower-salinity and higher-oxygen groundwater has been shown to be a control on the distribution of *Spartina patens*. Hypersaline brines may be produced in isolated basins due to evaporation of seawater during summer.	Low marsh develops on the distal, bayward margins of the overwash platform where its elevation drops into the intertidal zone, or sometimes on the flood-tidal deltas of now-closed tidal inlets.	Marshes are highly productive, with 27 plant species providing habitat for fish, wildlife, and waterfowl; they have many ecosystem functions, such as sediment stabilization and trapping and nutrient cycling. Subtle variations in elevation are accentuated by the zonation of the salt-adapted, salt-tolerant, and salt-resistant vegetation. Elevation increases of even 0.1 m (0.3 ft) allow colonization by the salt-tolerant plant community, which may result in a high-marsh grassland dominated by *Spartina patens* with stands of *Distichlis* and *Juncus*, or in scrubland populated by *Baccharis* and *Iva*. Low marsh is dominated by *Spartina alterniflora*. Open, unvegetated areas in the grassy plain of the marsh may indicate production of brine that killed the *Spartina*; these are classified as salt pans. Invasive *Phragmites* crowds out native vegetation.
		Tidal flats (tdl_flt)	Unvegetated transitional areas that are alternately inundated and exposed by the astronomical tides or intermittently by wind-driven water.	**Coastal Vulnerability and Sea Level Rise**—If sea level rise outpaces salt marsh accretion rates, tidal flats may increase in area. Greater inundation from sea level rise and increased storm surge may increase shoreline erosion, resulting in a siltier substrate and inhibiting submerged aquatic vegetation.	**Barrier Island Units**—Salt pans may form. The edge of the tidal marsh exposed to the open fetch of the coastal bay commonly has a rim of sand reworked by waves and built upon the marsh surface. **Tidal Activity**—The Assateague Island ocean coastline is classified as microtidal (0 to 2 m [0 to 6.5 ft] relative to mean low water) and has a semi-diurnal tide with a mean range of 1 m (3.3 ft) and an extreme range (spring tide) of 4 m (13 ft), fluctuating from –1 m to 3 m (–3.3 to 10 ft).	Astronomical tides continue to influence the tidal flats.	Where sand rims form along the edge, the increased elevation allows colonization by *Baccharis* and *Iva*. Bayside beaches and mudflats are important foraging habitat, especially for young piping plover chicks (*Charadrius melodus*).

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Age	Map Unit (Symbol)		Geologic Description	Geologic Issues	Geologic Features and Processes	Geologic History and Park Connections	Habitat
	Water	Estuary (water)	The Coastal Bays form a lagoonal estuary where riverine freshwater mixes with seawater. Water was delineated based on lidar data and includes oceanic and estuarine waters in addition to some of the hundreds of ponds on the island.	**Watershed Land Use**—Coastal Bays have low tidal flushing and limited freshwater inflow, and so are highly susceptible to eutrophication. **Recreation and Watershed Land Use**—Small changes in land use have large effects on water quality and sedimentation in the Coastal Bays, and development is increasing. **Coastal Vulnerability and Sea Level Rise**—Climate change may bring more intense storms, which may lead to sustained inlet formation, thereby increasing estuarine salinity.	**Barrier Island Units**—The Coastal Bays are lagoonal estuaries with a mean depth of 1 to 1.2 m (3.3 to 3.9 ft) and sandy soils that facilitate groundwater as the major pathway of freshwater to the bays. Bathymetry and sediment characteristics control the locations of many estuarine resources, including submerged aquatic vegetation, benthic invertebrate communities, and clam distribution, abundance, and ideal commercial mariculture sites. **Tidal Activity**—Tidal range (0.16 to 0.25 m [0.52 to 0.82 ft]) decreases with distance from inlets. Circulation is controlled by wind; tidal currents are weak except near the inlets. **Sediment Transport Processes**—An estimated 75% of the sand comes from storm overwash or Aeolian transport across the national seashore, with the remainder coming from shoreline erosion.	The drop in sea level (125 m [410 ft]) during the last glacial maximum (22,000 to 20,000 years ago) allowed rivers and streams to incise the plain and create the basins that would later become the Coastal Bays estuary when they flooded (5,000 years ago).	The Coastal Bays are spawning and nursery areas for many commercial and recreational fish, hard clams, and blue crabs due to the food and habitat structure provided by seagrass and sandy bottoms. They are also important foraging habitat for migratory birds.
		Ocean (water)	The eastern edge of the park boundary is within the Atlantic Ocean. Water was delineated based on lidar data and includes oceanic and estuarine waters in addition to some of the hundreds of ponds on the island.	**Benthic Habitats**—Assateague Island National Seashore's marine resources are threatened by ongoing commercial shellfish dredging within seashore waters, which creates biological wastelands on the seafloor; and by imminent offshore energy (wind and natural gas) development proposals. Construction of offshore infrastructure would likely cause changes in light penetration, sediment disturbance and resuspension, and the associated potential for prey disturbance and smothering of benthic organisms. Offshore oil platforms and pipelines, or wind turbines and transmission cables, could alter the existing patterns of incident waves and sediment transport reaching the national seashore and, potentially, the island's shoreline configuration, elevation, storm response, erosion rate, and the morphology of nearshore shoals, which serve as waterbird feeding areas, fish habitat, and migratory fish navigation cues.	**Barrier Island Units**—The nearshore shelf surface is medium to fine sand with outcrops of mud and gravel. Shore-oblique ridges are spaced 2 to 4 km (1.2 to 2.5 mi) apart and extend kilometers to tens of kilometers in a southwest–northeast orientation with a maximum relief of 10 m (33 ft).	Shore-oblique ridges are common along the East Coast, but the Assateague Island National Seashore area has the largest number and highest density, and may have developed from ebb-tidal delta sediments reshaped by inlet migration and shoreface retreat.	Marine benthic habitats support a diversity of marine life that is commercially, recreationally, and intrinsically valuable. Six federally-listed threatened or endangered species regularly utilize seashore waters, and waters within or in the immediate vicinity of Assateague Island National Seashore also include essential fish habitat for various life stages of fish species.
		Ponds (water)	Ponds are bodies of water contained within the body of the island. They have variable salinity and water level depending on season, rainfall, drought, and storms. Water was delineated based on lidar data and includes oceanic and estuarine waters in addition to some of the hundreds of ponds on the island.	**Coastal Vulnerability and Sea Level Rise**—Impacts of climate change on ponds may include salt water intrusion into the freshwater lens and longer drought periods in the summer, leading to a reduction of the freshwater lens and earlier drying of vernal ponds. **Storm Impacts**—Ponds on the ocean side can be flooded by overwash, and those on the bay side by wind-driven events. **Disturbed Lands**—Hydrology of shallow ponds within the marsh is impacted by 1930s mosquito ditches.	**Barrier Island Units**—Because the island has no streams other than tidal creeks in the marshes, all ponds on the island are fed by groundwater seepage and may also receive water from precipitation, overwash, and bayside flooding. The most stable ponds are in the barrier core, where the freshwater lens is 7 to 8 m (23 to 26 ft) thick.	Essentially all natural ponds on Assateague Island were formed by channelized overwash during storms that cut below the depth of the water table.	Ponds are the only source of fresh water on the island for animal habitat and drinking. The character of the ponds varies dramatically depending on position on the island, the thickness and dynamics of the fresh groundwater lens, and the relative frequency and extent of input of saltwater by overwash from the ocean or high-water flooding from the bay.