

Adapting Assateague

Design Strategies for Resilient Buildings and Landscapes
at Assateague State Park

Prepared by
Architecture 601: Adapting Assateague Studio

Summer 2021



SCHOOL OF
ARCHITECTURE,
PLANNING & PRESERVATION



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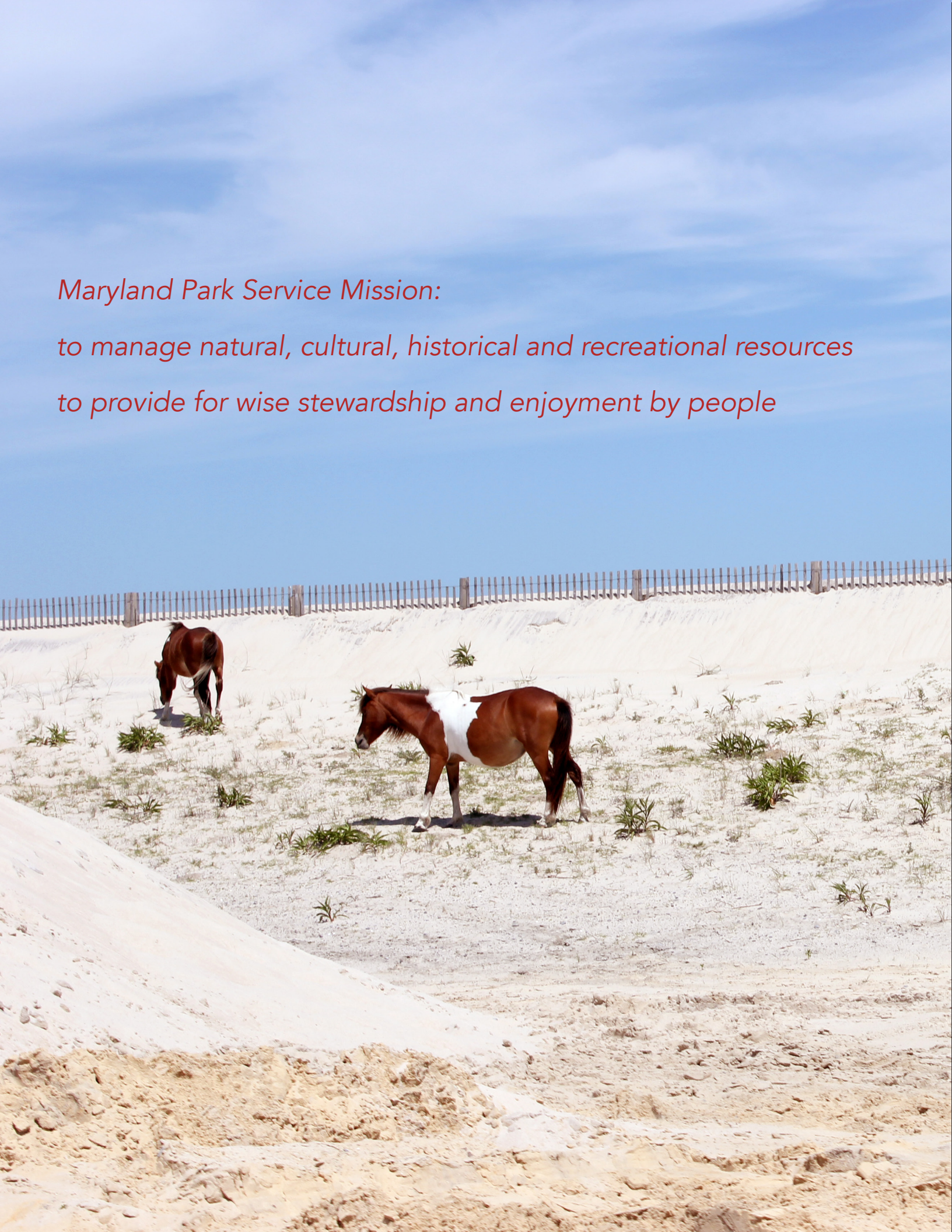
Adapting Assateague was a fruitful collaboration due to the involvement and commitment of a number of people. We are especially grateful to Angela Baldwin at the Assateague State Park, and Sandra Olek and Kate Vogel at the Maryland Department of Natural Resources, for thoughtfully engaging and discussing the work of the studio, providing a great tour of the park, and sharing their work and vision for a more resilient park.

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LEFT View of State Park. (by Y. Konan)



*Maryland Park Service Mission:
to manage natural, cultural, historical and recreational resources
to provide for wise stewardship and enjoyment by people*

Executive Summary

Assateague State Park is the most visited state park in Maryland, and the only state park with ocean access. The 850-acre park is located primarily on Assateague Island, a 37-mile long barrier island along the coasts of Maryland and Virginia. The island is bordered by the Atlantic Ocean on the east and the Sinepuxent Bay on the west. Its landscape is characterized by sandy beaches, salt marshes, maritime forests and coastal bays that are inhabited by waterfowl, deer, clams, and the island’s iconic herd of approximately 230 wild horses.

To serve the average 1.2 million visitors per year, Assateague State Park houses a significant amount infrastructure on the island, including day use areas, a ranger station, visitor center, bathhouses, gift shop, concession stand, marina, and over 340 campsites for RVs and tent camping. All of this park infrastructure sits on the landward side of a 2-mile long dune, constructed in the 1970’s, that was built and is maintained to protect the infrastructure of the park from being damaged by flood and storms.

However, climate change models predict that by 2040 the island will experience increases in temperature and extreme weather, a sea level rise of 3.5–9 inches, and altered precipitation patterns. As a result of these changes, the rate of overwash—the washing of water and deposition of sand toward the island interior—is expected to increase, new breaches and inlets will form, and sand will be carried southward more quickly via longshore currents. Assateague Island is not just a landscape in flux—it is a place of intensifying change as natural coastal processes, storms, and sea-level rise shape and shift the island.

In the face of these changing conditions, a Resiliency Plan is being formed by the Maryland DNR, with a mission to “conserve and foster an appreciation of the natural resources of Assateague State Park and to continue to provide substantial and sustainable recreational opportunities for as long as possible.” To further develop this work, the Maryland Department of Natural Resources is collaborating with the UMD School of Architecture in a UMD PALS Project (Partners in Action Learning). The goal of the collaboration is to provide the DNR with a vision for the future—fresh thinking, provocative representations, and creative design strategies for both the resiliency planning that is already underway, as well as the design of a new, 3,100 sf Ranger Station building for the park.

Part 01 of this report illustrates the contemporary island and park, the pre- and post-colonial history of this landscape, and the future challenges it faces. Part 02 includes resiliency strategies that address dune maintenance, sand fencing, camp loops, parking lots, and educational landscapes. Part 03 provides architectural proposals for a sustainable-designed Ranger Station and resilient landscape. All of this creative work is offered to further the conversation on projected climate impacts and their effects on this dynamic landscape, its vulnerable ecologies, and its vibrant multispecies communities.

LEFT Wild horses. (by Y. Konan)

01

Assateague Island

Historical, Current, and Future Conditions

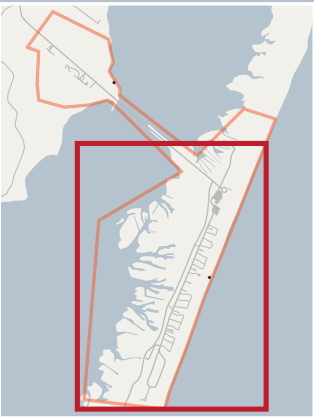
Assateague Island is a 37-mile long barrier island along the coasts of Maryland and Virginia, and is part of a chain of barrier islands stretching from Maine to Texas. The island is bordered by the Atlantic Ocean on the east and the Sinepuxent Bay on the west. The landscape is characterized by sandy beaches, salt marshes, maritime forests and coastal bays that are inhabited by waterfowl, deer, clams, and wild horses.

The island, once used by the Assateague tribe as fishing and hunting grounds, has a rich post-colonial history of changing land use and geomorphological flux. More change is coming, as sea level rises and storm surges intensify, which will have dramatic effects on the ecologies of the island and the infrastructure of Assateague State Park.

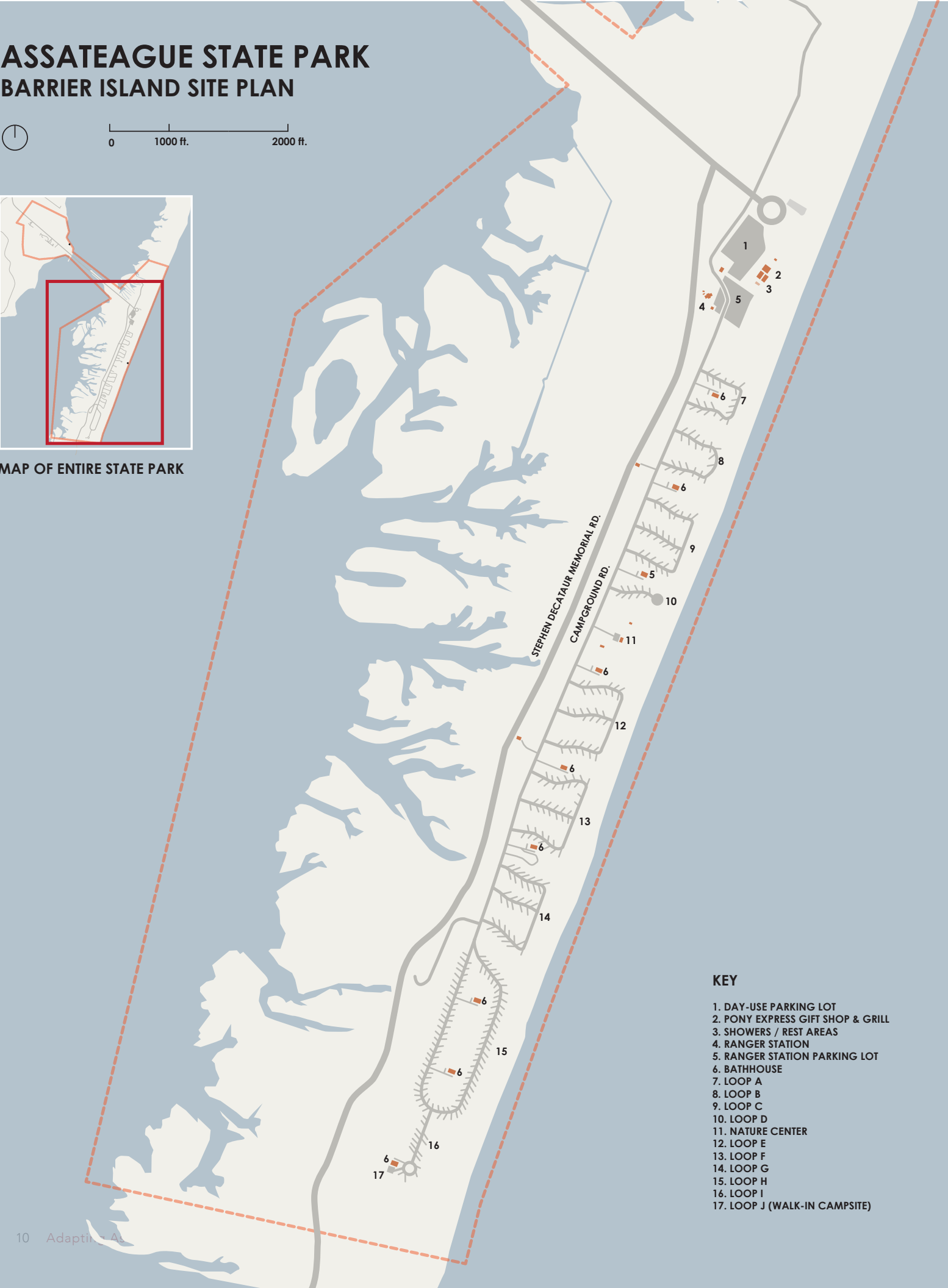
LEFT View of dunes and beach. (by Y. Konan)

ASSATEAGUE STATE PARK

BARRIER ISLAND SITE PLAN



MAP OF ENTIRE STATE PARK



- KEY**
- 1. DAY-USE PARKING LOT
 - 2. PONY EXPRESS GIFT SHOP & GRILL
 - 3. SHOWERS / REST AREAS
 - 4. RANGER STATION
 - 5. RANGER STATION PARKING LOT
 - 6. BATHHOUSE
 - 7. LOOP A
 - 8. LOOP B
 - 9. LOOP C
 - 10. LOOP D
 - 11. NATURE CENTER
 - 12. LOOP E
 - 13. LOOP F
 - 14. LOOP G
 - 15. LOOP H
 - 16. LOOP I
 - 17. LOOP J (WALK-IN CAMPSITE)

Land Use and Ownership, Past and Present

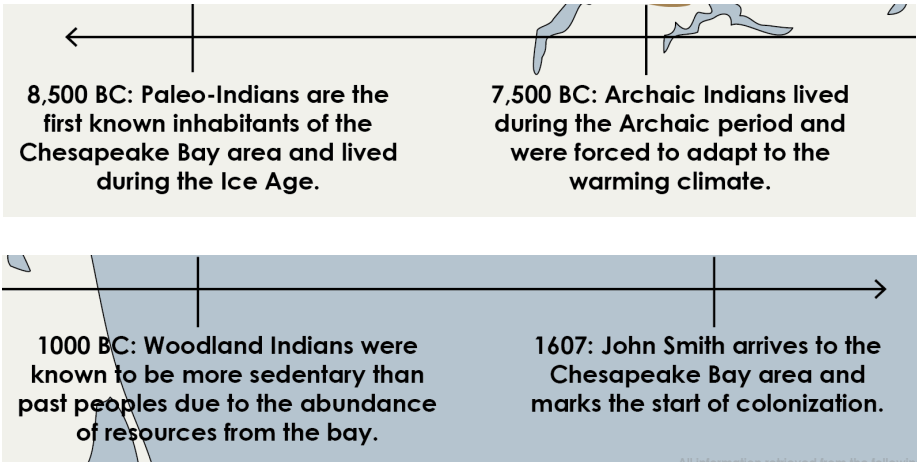
Assateague State Park is an 850-acre coastal park, located primarily along a two-mile stretch of Assateague Island, a 37-mile long barrier island off the eastern coast of the Delmarva Peninsula. Bordered by the Atlantic Ocean on the east and the Sinepuxent Bay on the west, the park's sandy dunes and coastal bays provide diverse habitats that support rich ecological communities. These habitats — bayside mudflats, beach and intertidal zones, dunes and grasslands, wetlands, marshes, and shrub and forest areas — are influenced by the dynamic coastal processes that shape the barrier island.

The many ecosystems and natural resources of Assateague Island have spurred and supported human activity there since the 1300s, when the Assateague tribe used the island for fishing and hunting. Today, people visiting the island have access to its rich wildlife and opportunities for nature-based recreation. The responsibility for the protection and management of the island's natural resources is divided amongst the U.S. National Park Service, the U.S. Fish and Wildlife Service, and the Maryland Department of Natural Resources (DNR). The Maryland DNR manages Assateague State Park, the most visited state park in Maryland.

Assateague State Park occupies area on both the mainland and Assateague Island, and the two areas of the park can be accessed through the Verrazano Bridge. The mainland portion of the park includes the park headquarters and visitor center, as well as the Rackliffe House, an 18th-century plantation house where visitors can learn about the history of the region and the Native, African, and European Americans who occupied the site. On Assateague Island there is a range of park infrastructure, including day use areas, campsites, a ranger station, visitor center, bathhouses, gift shop, concession stand, and marina. Visitors can access day-use areas including the beach, picnic areas, hiking trails, play spaces, and the nature center. Overnight visitors can stay on the campground, where 342 campsites as well as three youth group campsites are located around ten loops along the Atlantic coast (see Appendix for full park map and list of infrastructure).

The infrastructure in Assateague State Park is protected by a 2-mile long artificial dune; however, the dune has impeded naturally-occurring sand transport and overwash processes necessary for the continued health of the island and its habitats. While notches cut through the dune in 2008 and 2009 have permitted overwash and restored habitat, balancing the park's shifting geographies with visitor requirements will be necessary to meet the future needs of the island.

LEFT Contemporary site plan of barrier island portion of Assateague State Park. (by *S. Jamero*)



Indigenous Tribes of the Chesapeake Bay

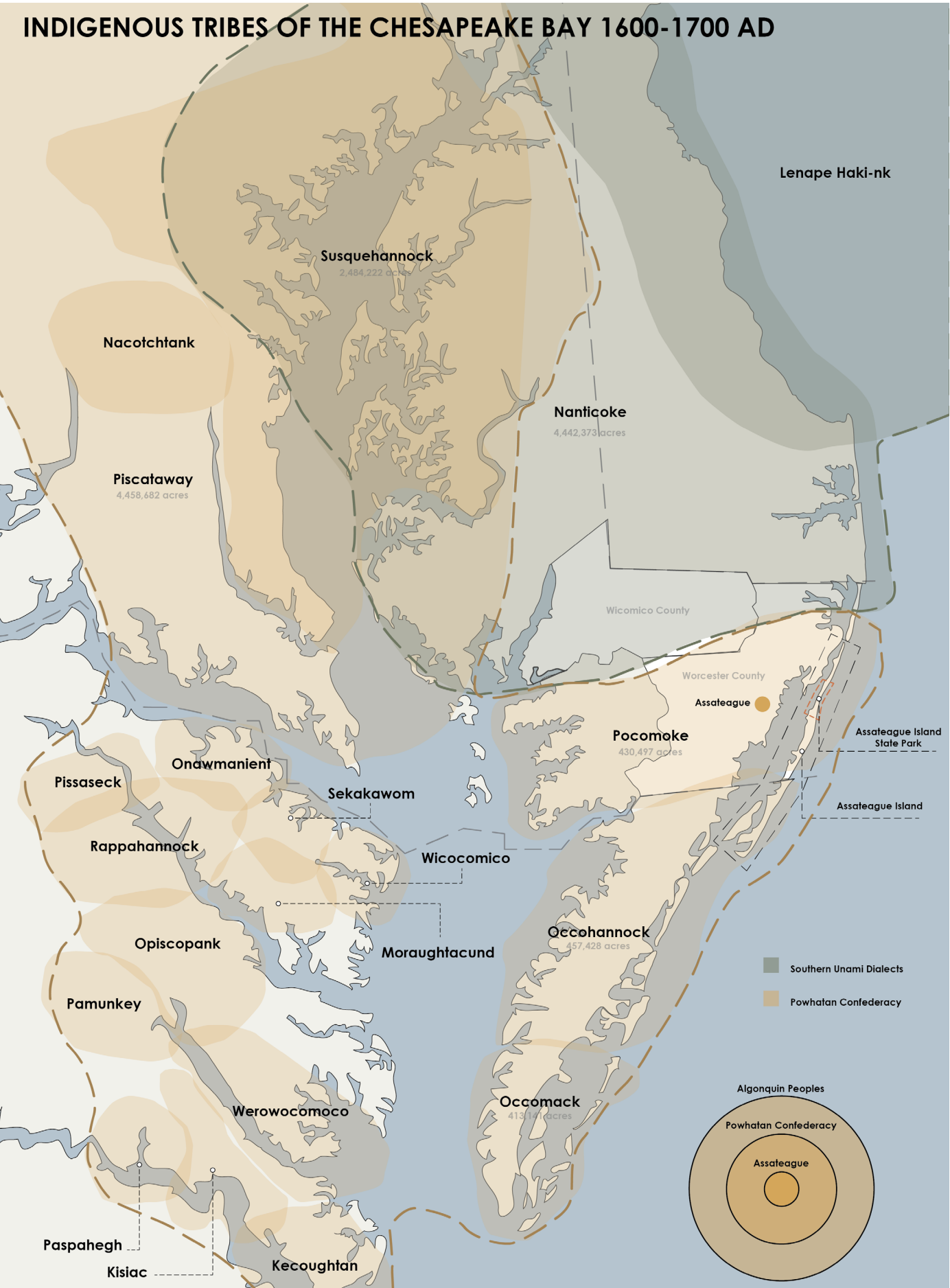
The Chesapeake Bay area was first inhabited by Paleo-Indians, who came to the region for its waterways and abundant wildlife about 10,000 years ago during the most recent Ice Age. Archaic Indians began to dominate the region about 9,000 years ago when the Ice Age was ending and the climate warming. During the Archaic period, tribes adapted to the changing temperatures by using warmer-climate plants and harvesting clams, oysters, and fish brought in from the shallower bay. The melting ice widened channels in the region, further supporting water-based activity and trade. By 1,000 BC, Woodland Indians were the predominant Indigenous group in the Chesapeake Bay region and had access to oysters, herring, shad, bass, wild game, and edible marsh plants abundant in the watershed. Woodland tribes were more sedentary than previous tribes, and they established permanent communities around the bay, traveling periodically to the shores to hunt and gather food.

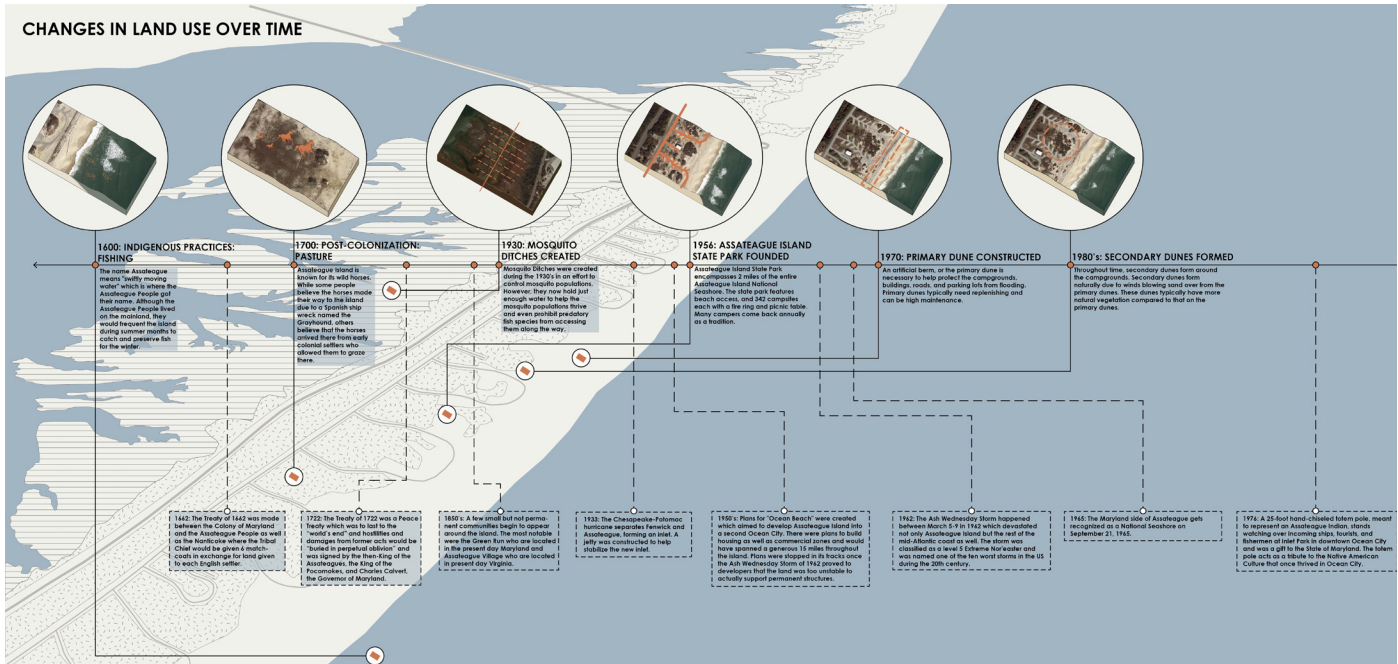
By the early 17th-century, when Captain John Smith and other English settlers first arrived in the Chesapeake region, many distinct subtribes of the Algonquian people, including the Assateague, Piscataway, and Nanticoke, lived around the Chesapeake Bay. Prior to colonization by European settlers, the Assateague people lived on the Eastern Shore of Maryland, fishing and hunting on Assateague Island during the summer months. The Rackliffe House, an 18th century restored plantation house on the grounds of the State Park, offers guided tours and interpretive exhibits on histories of the indigenous tribes of the region.

Throughout the 1600s, as settlers moved to the Mid-Atlantic and farmed the region, colonists used Assateague Island for grazing their cattle and horses, as well as for timber and game. Their use of the island led to the displacement of local tribes, and by the mid-18th century, most of the Assateague people had been driven out of the region and resettled and assimilated with tribes in Delaware.

ABOVE Timeline of Paleo-Indian Inhabitation of the Chesapeake Bay. (by S. Jamero)

RIGHT Indigenous tribes of the Chesapeake Bay, 1600-1700 AD. (by S. Jamero)





Changes in Land Use Over Time

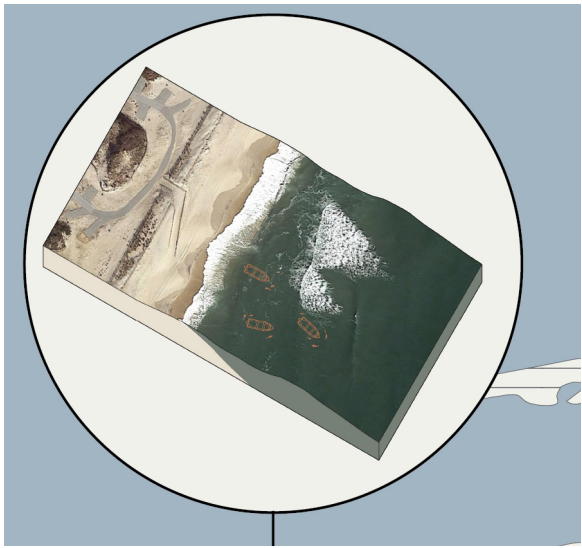
In the 1850s, small, impermanent communities were established on Assateague, which at the time was connected to Fenwick Island, a long barrier island whose southern tip is today located just north of Assateague Island. Residents of the two most prominent villages, Green Run and Assateague Village, typically worked as watermen or for the United States Life-Saving Service, a precursor to the U.S. Coast Guard. In 1933, approximately a decade after a decline in the village populations, tides from the Chesapeake-Potomac hurricane eroded beaches and opened an inlet between Ocean City, Maryland and the newly-formed Assateague Island. After the hurricane, the inlet was fortified with stone jetties so as to allow passage from the ocean to the bay and mainland.

During the 1950s, the development of a resort town called "Ocean Beach" and a second community on the northern tip of the island was proposed, and construction of roads and dwellings began. In March of 1962, a storm destroyed a majority of the permanent structures, suggesting that the island, with its shifting topography, was not suitable for such developments. In 1965, the Federal Government purchased much of the Maryland side of Assateague Island and established it as a National Seashore; Assateague State Park, a two-mile portion of the island established in 1956 and managed by the Maryland Department of Natural Resources, remained a Maryland state park.

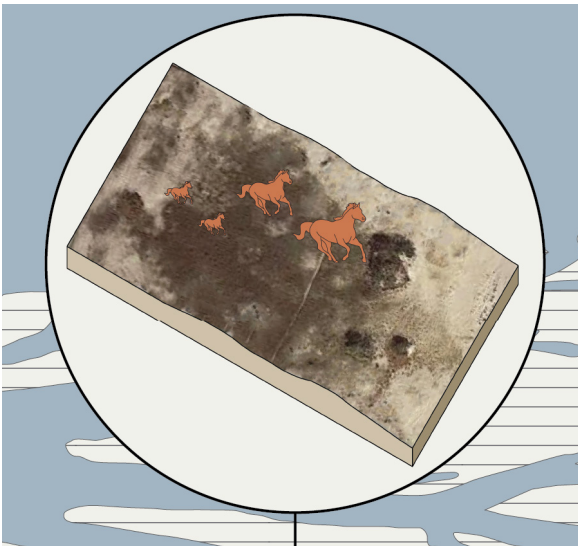
Over time, infrastructure such as roads, buildings, campsites, and parking, designed to support visitor use, has been planned and constructed throughout the park. A 2-mile long artificial dune, first built in 1970 to protect these structures, have resulted in hydrologic and ecological consequences, but have also been necessary to ensure the longevity of the facilities that bring people to the island. The dune features 16 crossovers to provide the public with access to the beach.

ABOVE Changes in land use over time. (by S. Jamero)

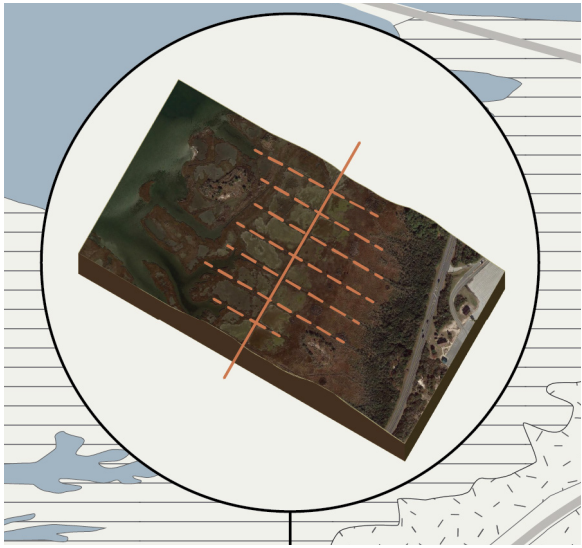
RIGHT Details of spatial changes and land uses over time. (by S. Jamero)



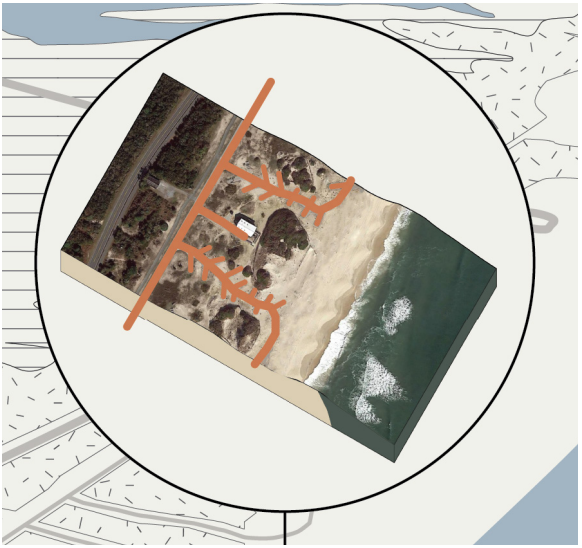
1600 Indigenous practices (fishing)



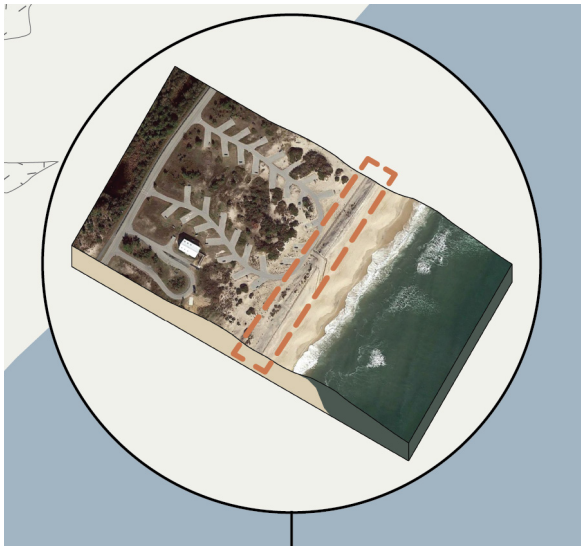
1700 Post-colonization (pasture)



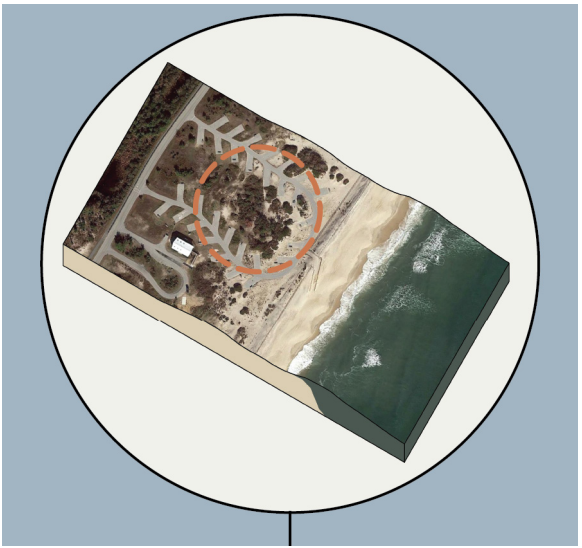
1930's Mosquito ditching



1956 Assateague State Park created



1970's Primary dune constructed



1980's Secondary dunes formed



Day Users and Campers: Two Populations, Two Experiences

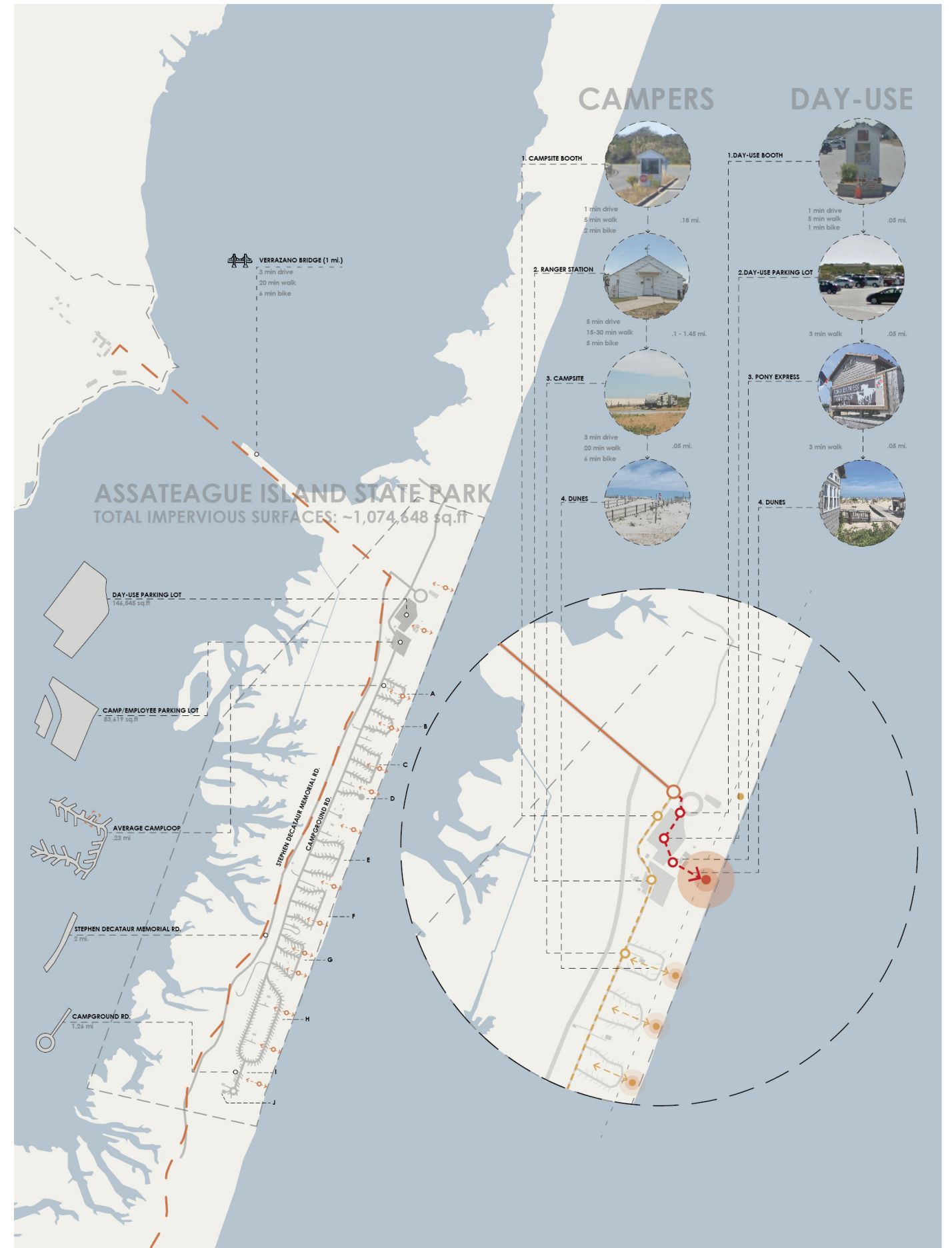
Today, people coming to Assateague State Park can experience it in two ways: as day-use visitors or as campers. As visitors enter the park from Verrazano Bridge, day-use visitors pass through a booth and into a designated parking lot. From there, visitors can pass through the Pony Express gift shop and grill, where concessions, grocery items, and souvenirs are available. The beach is accessible a short walk past the Pony Express and dunes separating the ocean from day-use facilities.

Campers staying on the island enter through the campsite booth and past the Ranger Station, a building constructed in 1981 and housing the campground office and park employees. The 342 campsites are located along quarter-mile loops southwest of the Ranger Station. Each loop contains a bathhouse, with one dump station shared amongst all campsites. In total there are nine newly remodeled bathhouses with warm / cold water, interior and exterior showers, and exterior dishwashing sinks. From the campgrounds, visitors have access to six miles of paved asphalt roads, a paved hiker/biker trail, the nature center, and the Atlantic coast. Trails within the campgrounds connect to other trails within the National Seashore, managed by the U.S. National Park Service.

Through these facilities, visitors of Assateague State Park can observe the island's unique ecosystems and partake in a range of water- and land-based activities such as swimming, fishing, kayaking, crabbing, hiking, bicycling, and wildlife viewing.

ABOVE View to Ranger Station and day-use parking lots. (by Y. Konan)

RIGHT Mapping the separate and different spatial sequences of day-users and campers. (by S. Jamero)





Geomorphological Change and Habitat Distribution

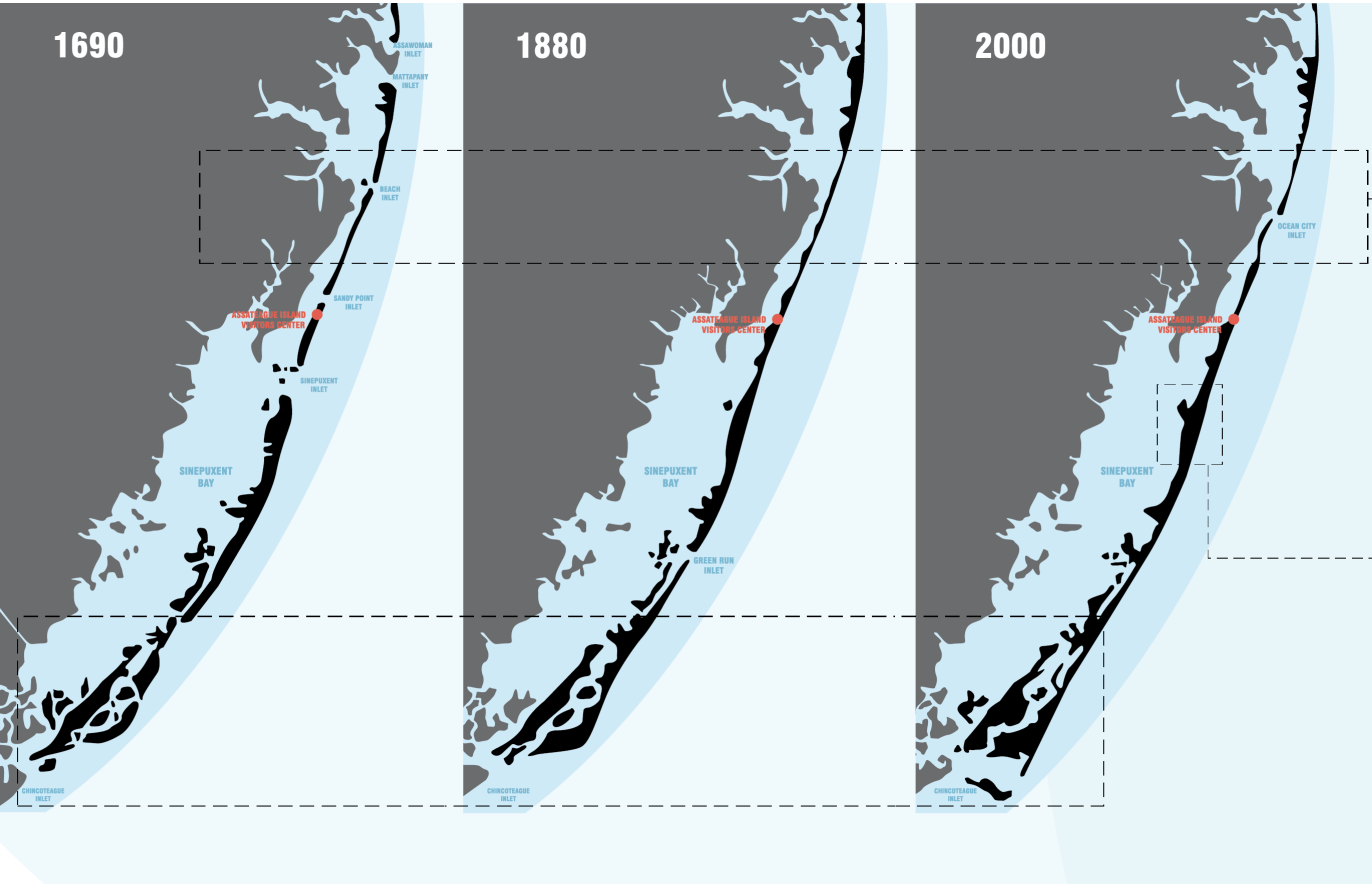
Assateague Island is one of the 450 barrier islands located along Eastern Seaboard and Eastern Gulf of the United States. Barrier islands are the primary interface between the ocean and mainland and are among the most unstable, rapidly changing landscapes occupied by people. These islands are formed over time as waves deposit sediment parallel to the shoreline, and they protect coastal communities on the mainland by absorbing wave energy before waves hit the coast, thereby decreasing flooding and storm surges experienced inland. However, because barrier islands are subject to large tides and storms, they are susceptible to erosion, shoreline retreat, and other processes that constantly move sand and change the islands' shape.

The movement of barrier island sand can be categorized into three classes: movement along the shore; movement across the shore; and movement by wind. The movement of sand along the shore is driven by longshore currents, which transport sand primarily in one direction following the flow of the water. By contrast, during storms when the water level is elevated, waves and tides can push sediment across the island, a process termed overwashing. Finally, strong winds can transport sand across and along barrier islands, often forming dunes and moving sand from dunes to overwash flats and vegetated zones.

The movement of sediment and waves throughout barrier islands shapes the diverse habitats and unique ecosystems typically found on these relatively small, narrow landforms. Closest to the ocean, the beach area is sand-dominated and subject to erosion and accumulation of sediment from waves. Landward of the beach, dunes form, stabilized by salt-tolerant grasses and other vegetation. On the bay side of barrier islands, salt marshes and tidal flats are often dominant.

LEFT United States Eastern Seaboard and Eastern Gulf. (by N. DiBella)

ASSATEAGUE ISLAND Change over time



Changes in Island Footprint Over Time

As with other barrier islands, geomorphologic change in Assateague Island has been driven by storms, sediment supply, and sea level change. Since its formation about 5,000 years ago, these forces have caused a series of inlet formations and closures throughout Assateague Island. Inlets that were present in the 17th and 18th centuries may be read in the landscape still today as accretion mounds, swales, and inactive overwash zones.

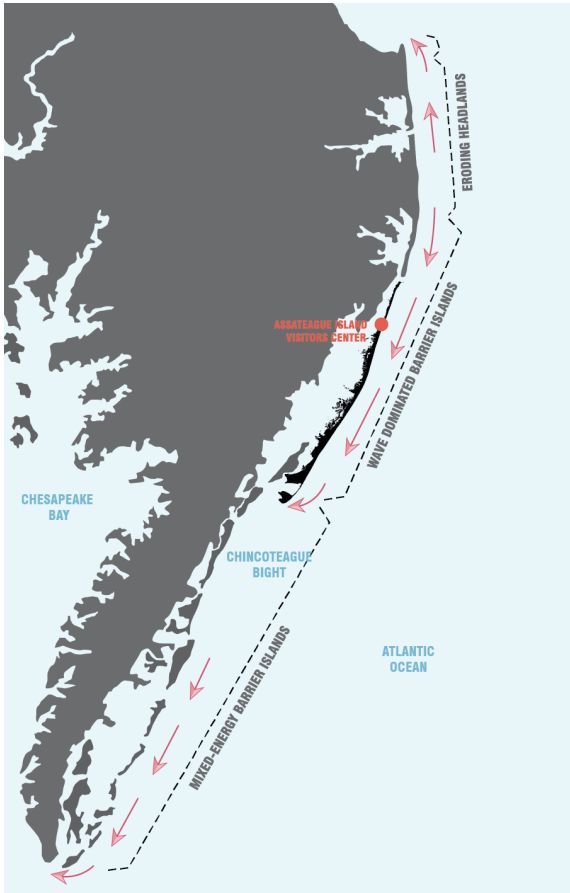
In addition to inlet creation and overwash, erosive processes have shaped and shifted the island. The coastal beach is shaped by longshore erosion, with net sediment movement southward and accretion both at the southern end of Assateague Island and landward towards Sinepuxent Bay.

ABOVE Assateague Island change over time. (by N. DiBella)

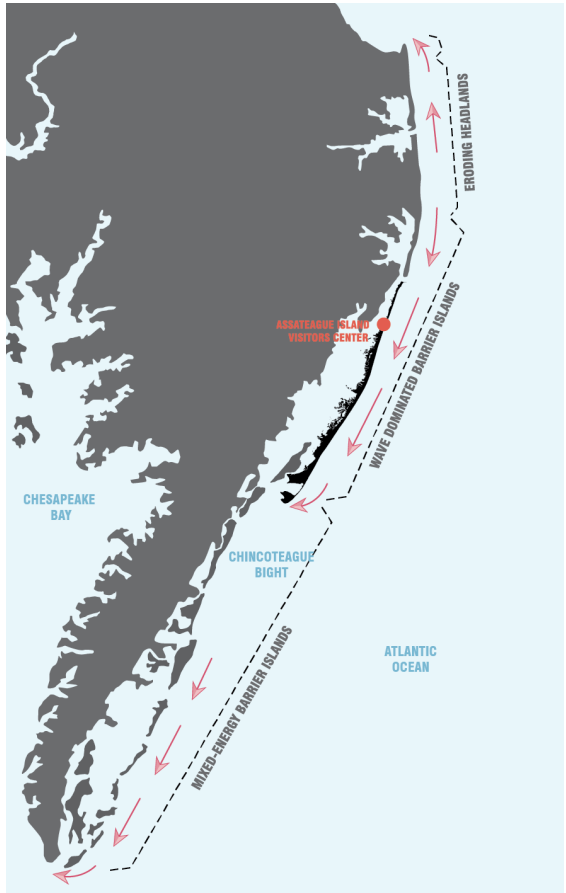
ABOVE RIGHT Delmarva Peninsula: Long shore erosion and sediment wash; and overwash inlet creation. (by N. DiBella)

BOTTOM RIGHT View of a crossover at the primary dune. (by Y. Konan)

DELMARVA PENINSULA Long Shore Erosion and Sediment Wash



DELMARVA PENINSULA Overwash inlet creation





Overwashing and Inlet Formation

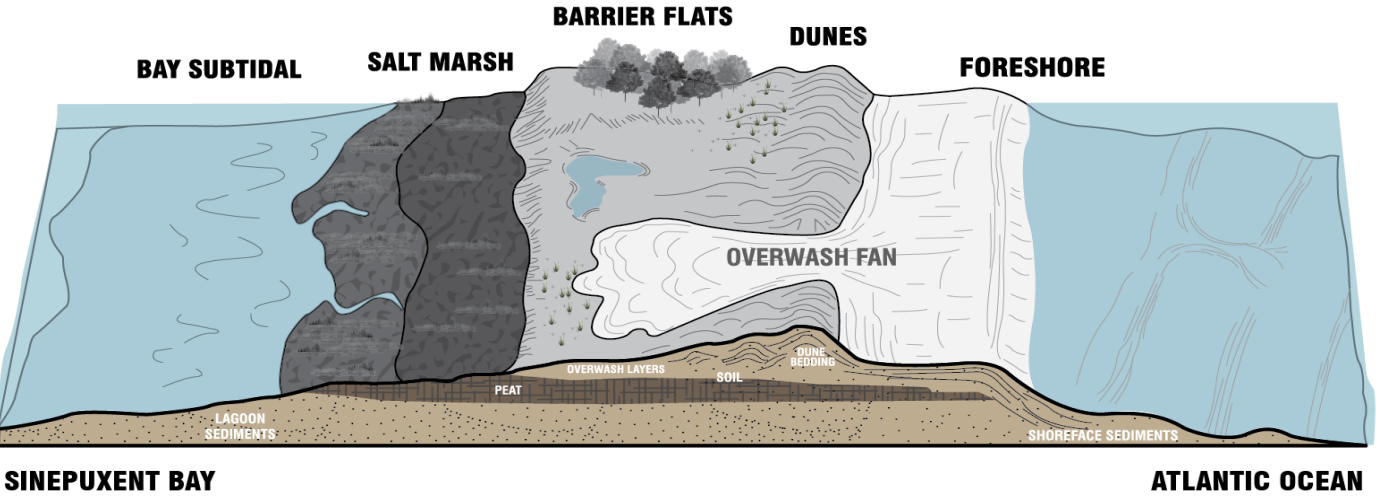
The flow of water across barrier islands, called overwashing, can cause inlets to form in areas of lower topography. While most inlets are temporary, they have significant geological and ecological implications, as their formation results in the movement of nutrient-rich saline waters from the ocean side of an island to the sound side, which in turn provides substrates for marsh grasses.

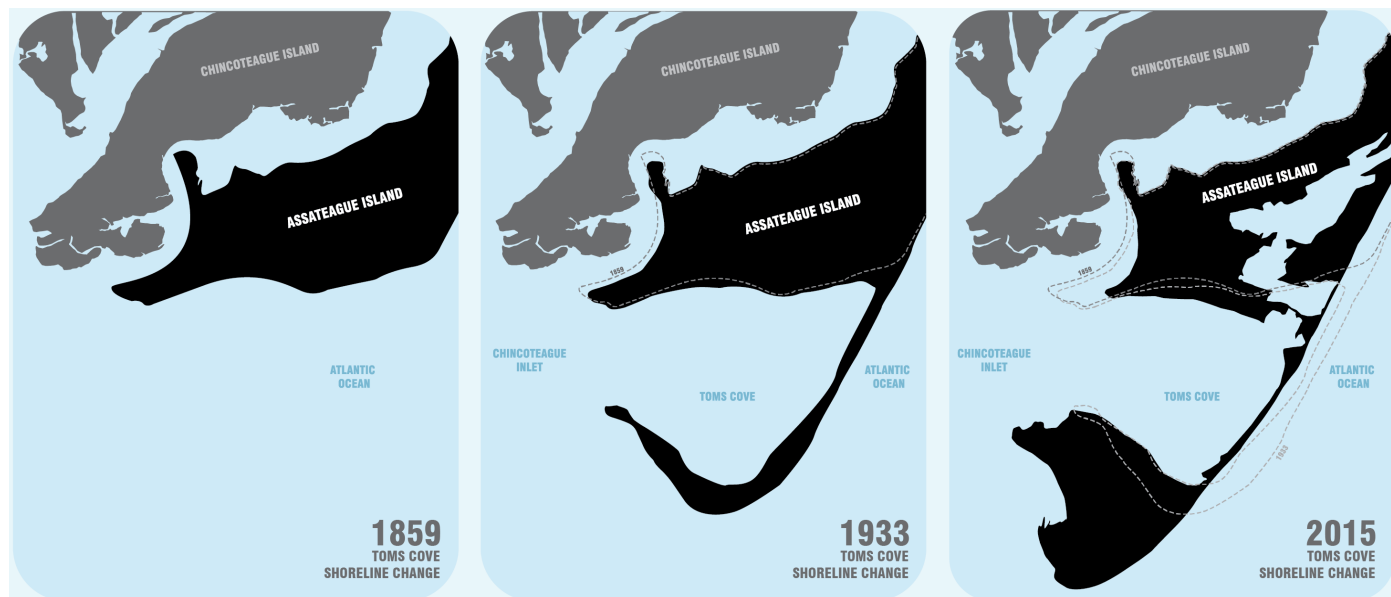
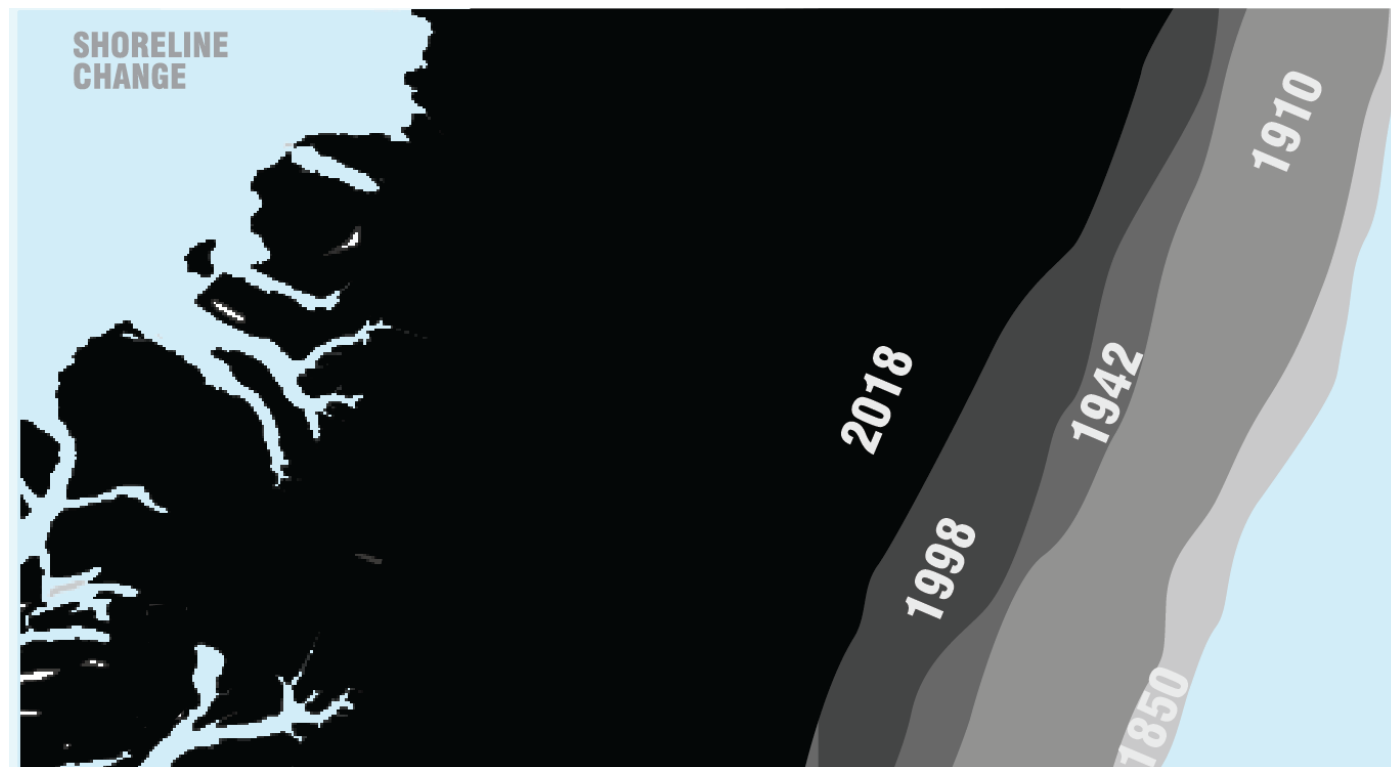
When overwash comes through the dunes, thin layers of sediment, known as washover fans, are deposited. Over time, vegetation can grow on washover fans, forming areas known as barrier flats. If there are long periods between overwash events, thickets, shrubs, and early-successional tree species establish landward of the barrier flats.

ABOVE View of Assateague State Park. (by Y. Konan)

RIGHT Overwash fan and inlet formation diagram. (by N. DiBella)

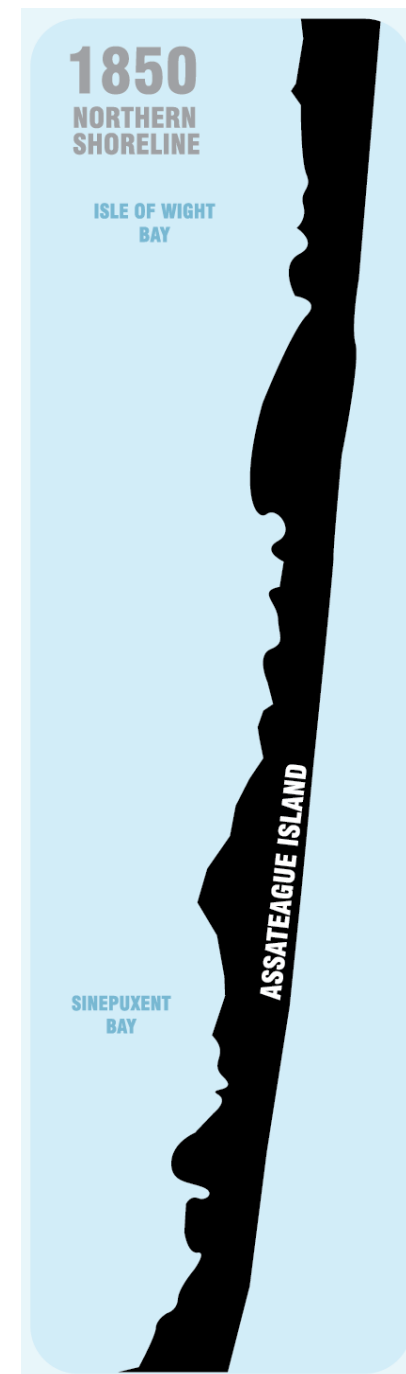
ASSATEAGUE ISLAND Dune Overwash





Shoreline Erosion and Sediment Transfer

The processes of shoreline erosion along the Atlantic coast and sediment deposition on marsh surfaces have pushed the island westward and caused a decline in the width of the bay between Assateague Island and the mainland. Eroded sediment from both Assateague and Fenwick islands has long accumulated at Toms Cove, an accretionary spit and the terminus of the regional longshore sediment transport system. Toms Cove has grown by six kilometers since the mid-1800s and continues to expand at a rate of approximately 50 meters per year.



ABOVE Assateague Island change over time: Typical shoreline erosion, and sediment deposition at Toms Cove. (by N. DiBella)

RIGHT Creation of the Ocean City inlet and subsequent land shifts. (by N. DiBella)



Ecological Zones and Human Impact

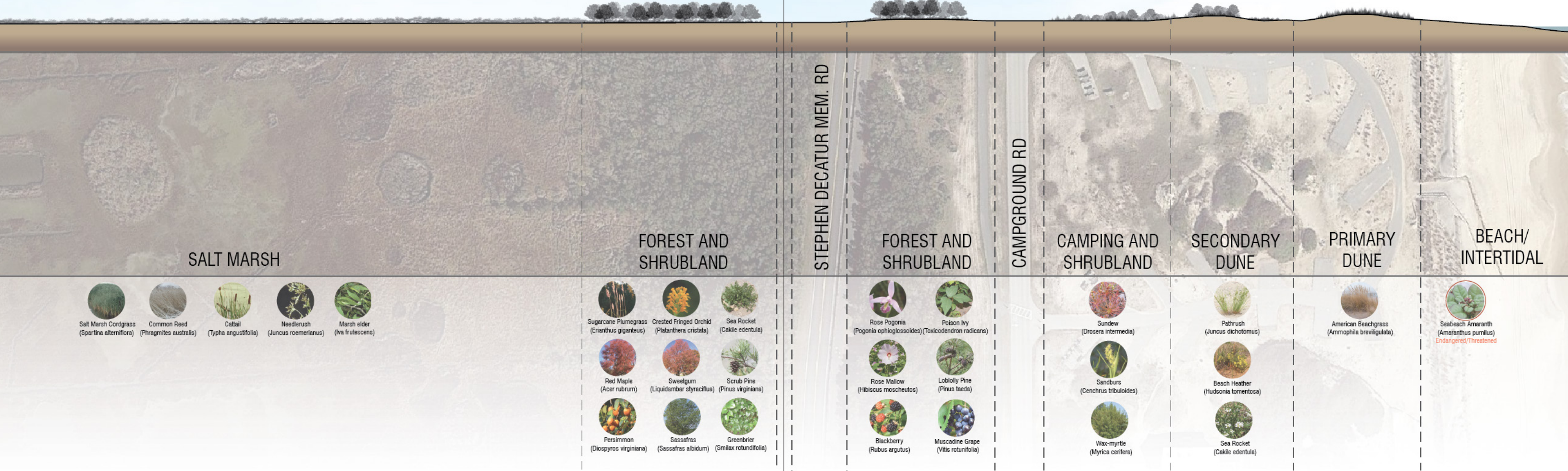
Assateague Island can be divided into three primary ecological zones: salt marshes, covering 42% of the island and consisting of low and high salt marsh, tidal salt scrub, needlebrush marsh, and wetland shrubland; barrier flats, with 27% coverage and containing forest and shrubland; and the shore, with 31% coverage and consisting of the primary dune, bayberry dunes, beach grass dunes, and the beach. In total there are approximately 30 different species of vegetation that inhabit these ecological zones.

The island portion of Assateague State Park contains at least 130 acres of land that has been directly manipulated by humans through the construction of various types of infrastructure, including parking lots, buildings, and camping loops.

ABOVE View of salt marsh and forest and shrubland habitat. (by Y. Konan)

RIGHT Island ecologies and habitats. (by N. DiBella)

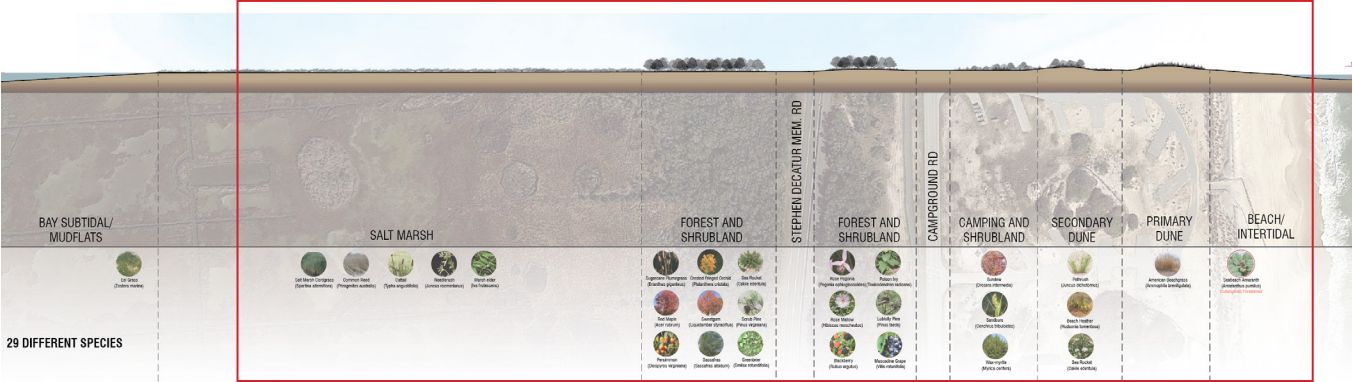


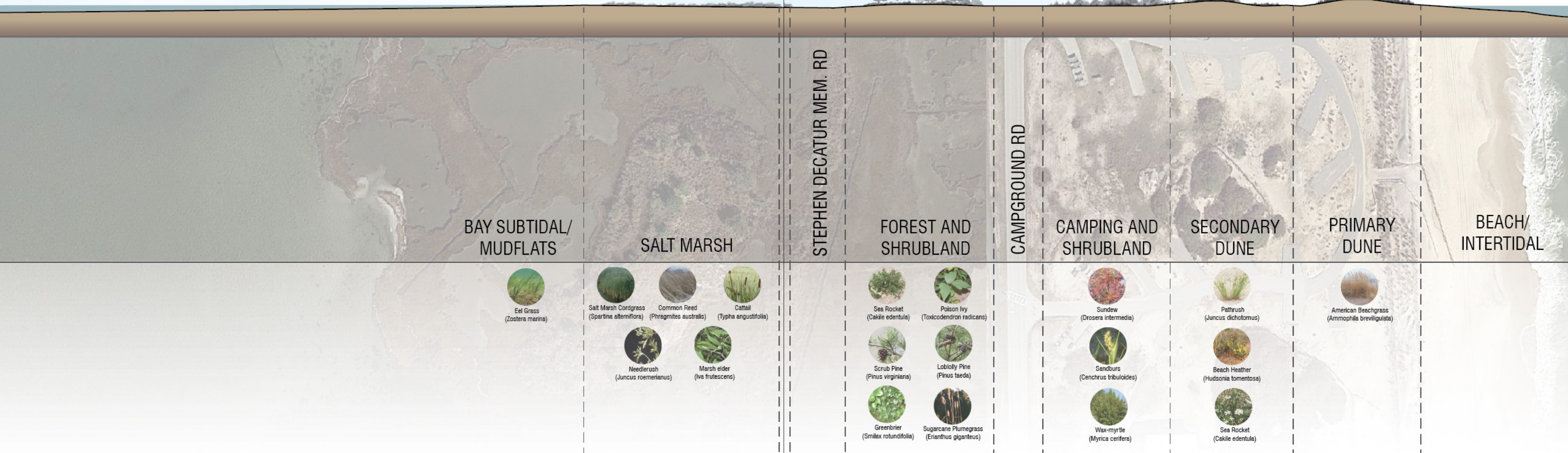


Contemporary Ecological Zones and Plant Species (2021)

While the beach areas contain minimal vegetation, the dunes may be either sparsely or densely vegetated with grasses such as American beachgrass (*Ammophila breviligulata*), forked rush (*Juncus dichotomus*), and American searocket (*Cakile edentula*). Landward of the protective dunes, shrubs and trees — primarily early-successional evergreens — have established. Species present in the island's forest and shrubland communities include wax-myrtle (*Myrica cerifera*), rose mallow (*Hibiscus moscheutos*), loblolly pine (*Pinus taeda*), and sassafras (*Sassafras albidum*). Marsh habitats are highly productive and contain many salt-tolerant plant species including needlerush (*Juncus roemerianus*), saltwater cordgrass (*Spartina alterniflora*), and cattail (*Typha angustifolia*).

ABOVE Contemporary island ecologies. (by N. DiBella)

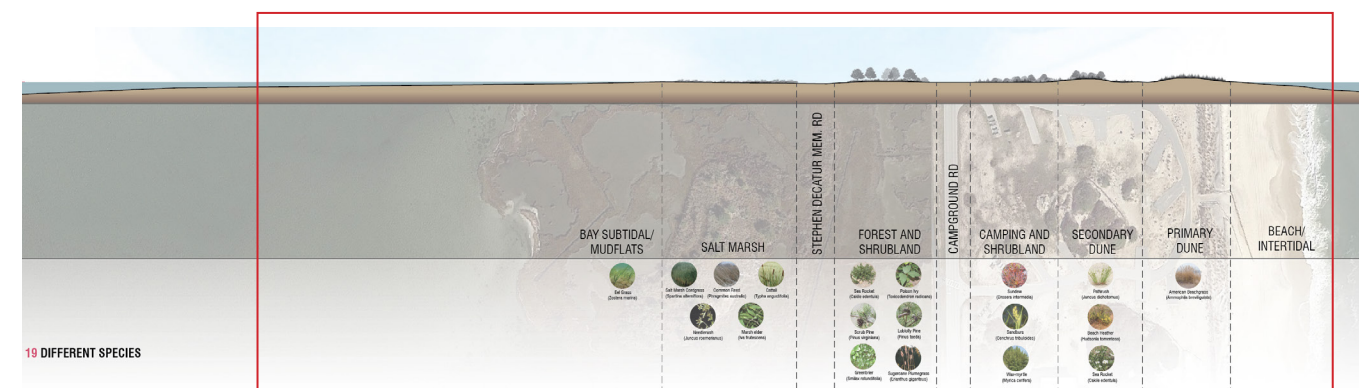


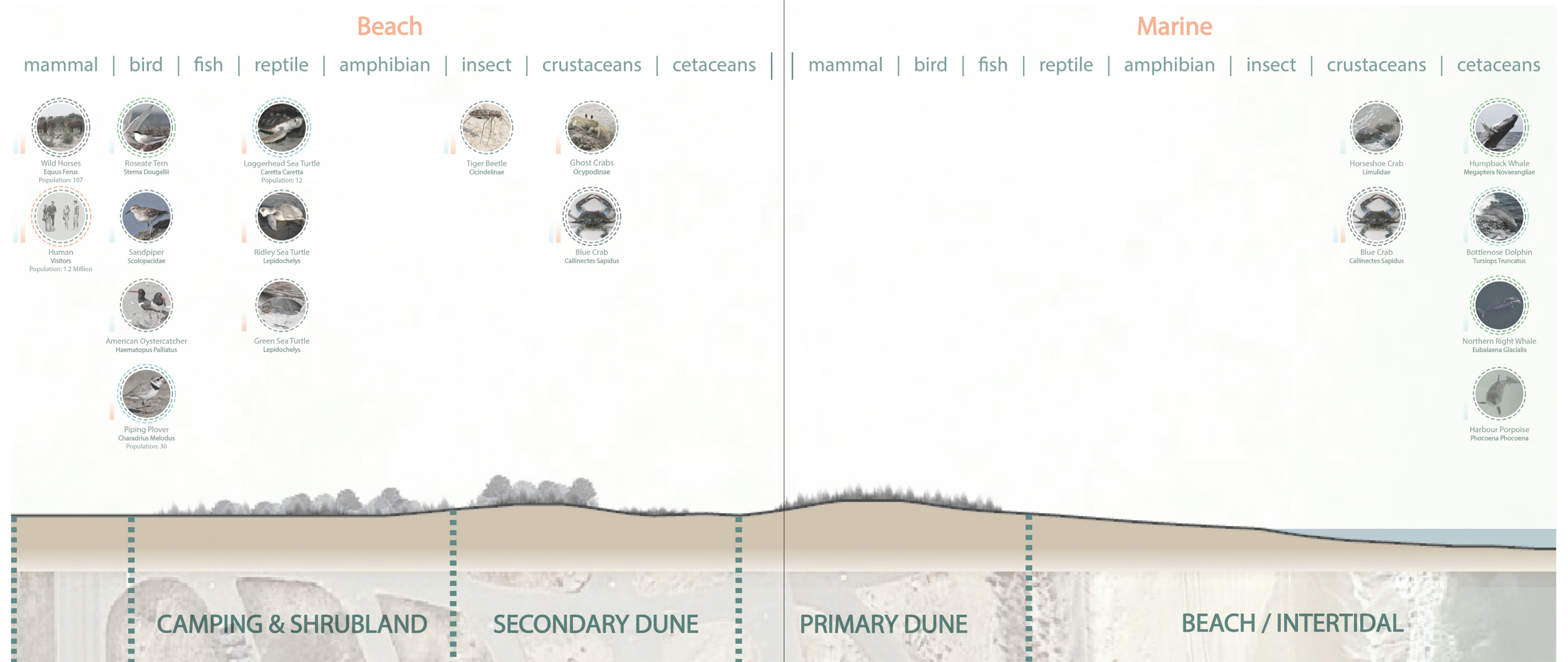


Projected Ecological Zones and Plant Species (2100)

Looking forward, the distribution and composition of these communities are expected to change as sea level rise and other coastal processes reduce beach areas, flatten dunes, and drown out marshes. Such shifts in habitat area and quality will likely result in declines in species diversity and richness, with generalist species tolerant of greater and more frequent disturbances — summer droughts, groundwater salinization, and intense storm and overwash events — surviving while those that require more stable conditions decline.

ABOVE Future island ecologies. (by N. DiBella)



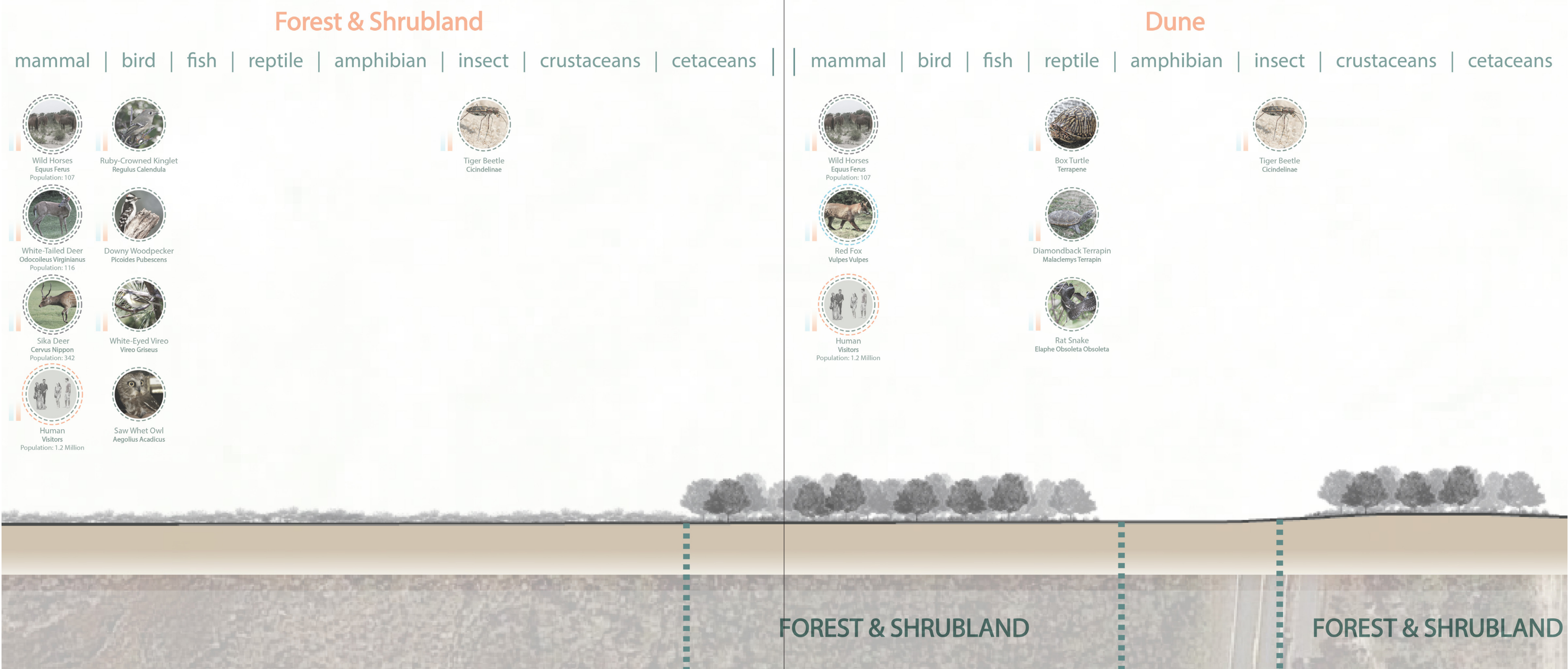


Inhabitation Across the Island

In the ocean surrounding the island, there are whales, seals, and dolphins, as well as flounder, sea trout, and striped bass, with the latter three drawing people to the island for inlet and surf fishing. While the sandy, constantly-changing beach environments support minimal plant life, Loggerhead sea turtles (*Caretta caretta*) and nesting shorebirds such as piping plover (*Charadrius melodus*) and black skimmer (*Rynchops niger*) can be found along the beach. In addition, the coastal waters attract temporary migratory birds such as brent geese (*Branta bernicla*) and brown pelicans (*Pelecanus occidentalis*).

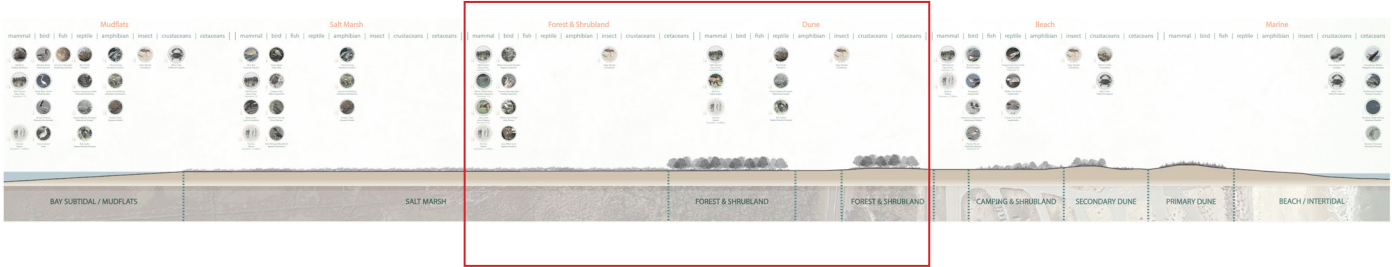
ABOVE Distribution of non-human inhabitants of the park (Beach and Marine). (by Y. Konan)





Moving landward, the harsh and salty dunes provide habitat for red foxes (*Vulpes vulpes*) and several snake species. In the sheltered zones beyond the dunes, forest and shrubland-dwelling species including five-lined skinks (*Eumeces fasciatus*), northern fence lizards (*Sceloporus undulatus hyacinthinus*), native white-tailed deer (*Odocoileus virginianus*), and non-native sika deer (*Cervus nippon*) are present. The island's sika deer, introduced from Asia in the 1920s, competes with some native species for resources; as such their population throughout the island is managed through hunting on Assateague Island National Seashore. Within the shrublands near the center of the island, freshwater ponds provide breeding habitat for several frog and toad species.

ABOVE Distribution of non-human inhabitants of the park (Forest/Shrubland and Dune). (by Y. Konan)



Mudflats

mammal | bird | fish | reptile | amphibian | insect | crustaceans | cetaceans |



BAY SUBTIDAL / MUDFLATS

Salt Marsh

mammal | bird | fish | reptile | amphibian | insect | crustaceans | cetaceans |



SALT MARSH

Closer to the bay, rich and productive salt marshes provide habitat for a wide range of species including blue crab (*Callinectes sapidus*), horseshoe crab (*Limulus polyphemus*), American wigeon (*Mareca americana*), and migratory birds that stop at Assateague Island on their route along the Atlantic migratory flyway. Of the more than 345 bird species that have been sighted on the island, the most prevalent include osprey, herons, egrets, and sandpipers. The marshes and forests on Assateague Island support a diverse range of avian species, including clapper rails (*Rallus longirostris*), red-winged blackbirds (*Agelaius phoeniceus*), downy woodpeckers (*Picoides pubescens*), and great horned owls (*Bubo virginianus*). The sheltered, nutrient-rich waters and mudflats along the bay side of the island provide habitat for many aquatic species, particularly blue crabs (*C. sapidus*), a species culturally and commercially important to the region, and fish, who migrate to the estuary in the spring to breed.

ABOVE Distribution of non-human inhabitants of the park (Mudflats and Salt Marshes). (by Y. Konan)





Dune Formation and Maintenance

The ongoing stability of the dunes along Assateague State Park is of great importance to the protection of infrastructure and habitat. First constructed in the 1970s, the park's 18-foot tall primary dune was designed to protect visitor facilities from overwash and other natural barrier island processes. However, the dune has been continually destroyed by storm events and then later rebuilt, a process that has accelerated erosion and narrowed the beach. To stabilize the dune, two fences have been added, providing places for sand to collect, building up the dune edge and broadening the dune. Other measures to stabilize and reinforce the dune include adding sand to the western side of the dune and planting American beach grass (*Ammophila breviligulata*).

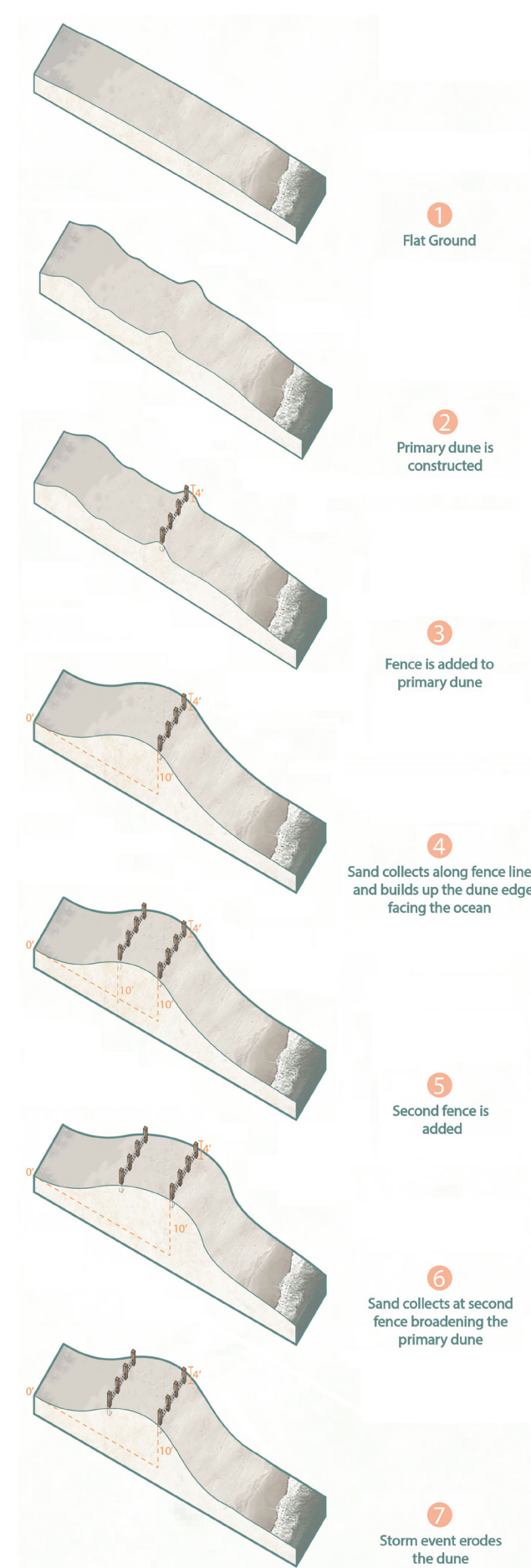
While dune restoration strategies can provide protection from erosion, high tides, intense storms, and storm surges, other measures focused on adaptive infrastructure may also increase the resiliency of the park's facilities to storms and sea level rise. For example, by constructing moveable facilities and replacing asphalt with clay and clamshell construction, it may be possible to protect necessary infrastructure while restoring natural barrier island function and minimizing dune maintenance.

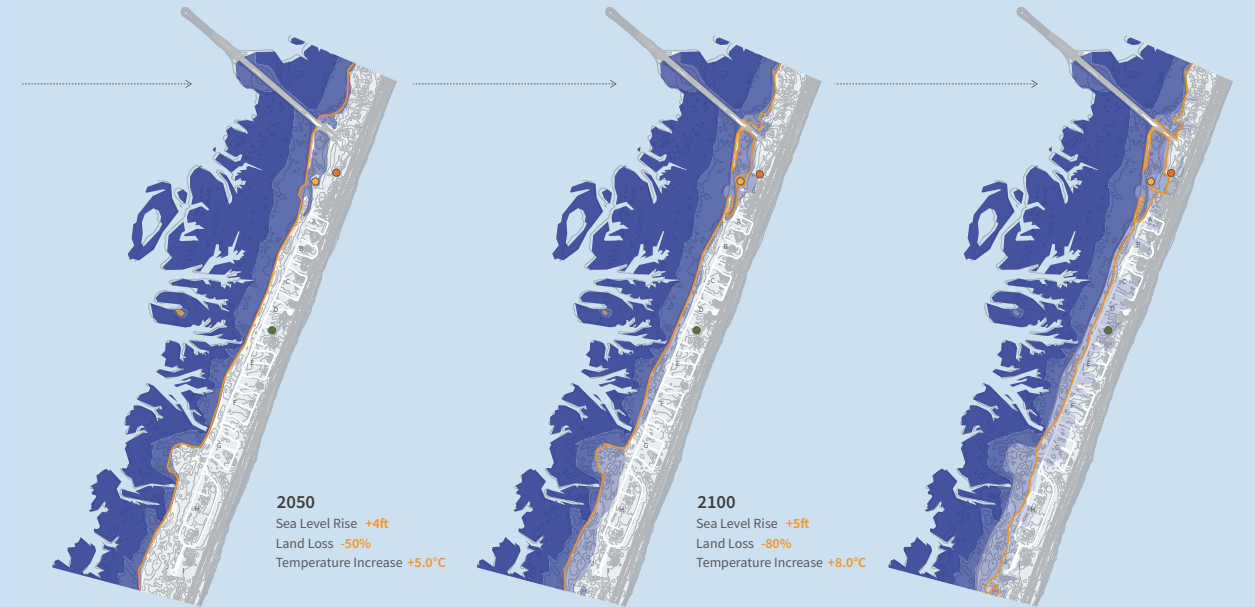
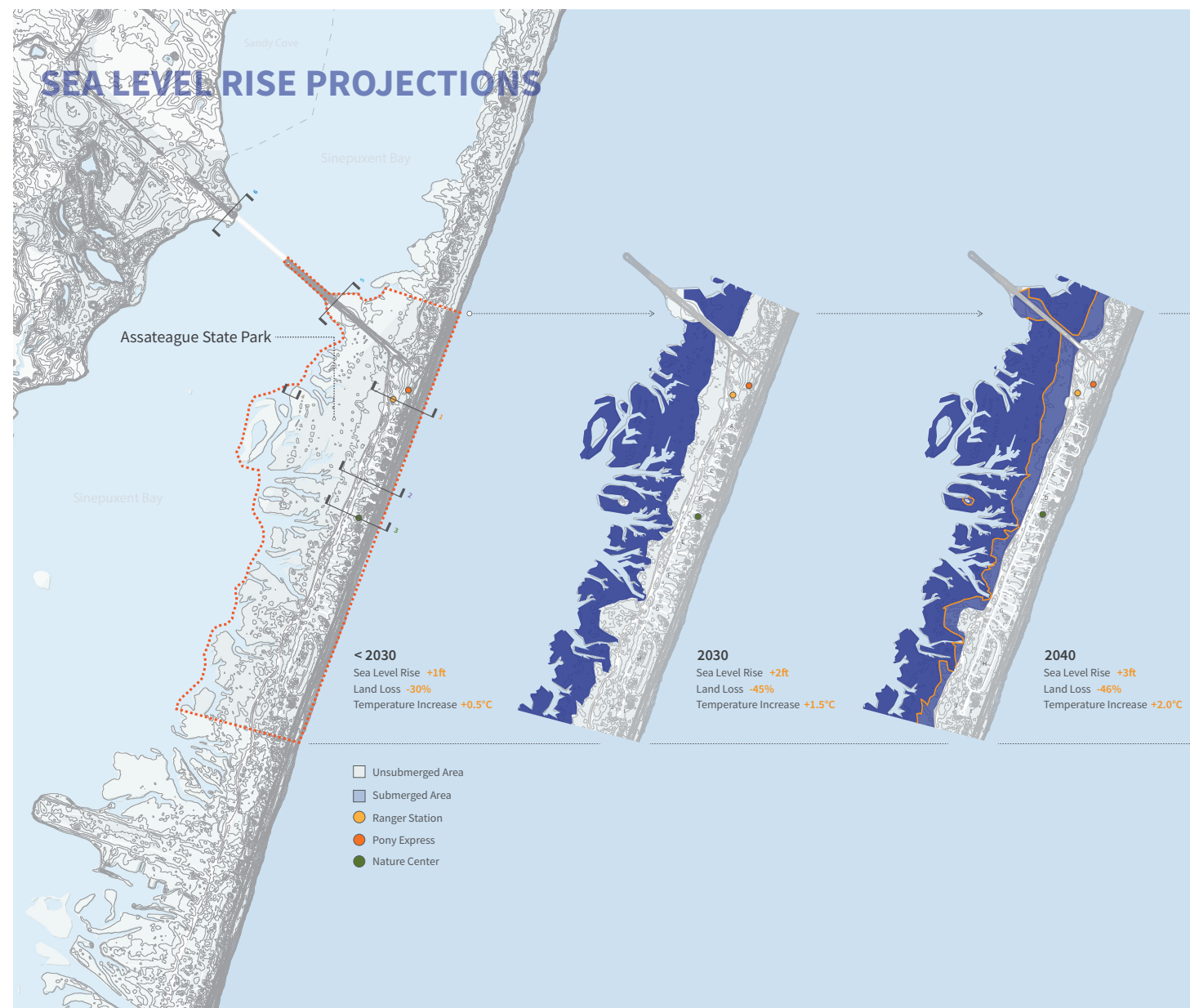
ABOVE Vegetation of secondary dunes. (by Y. Konan)

RIGHT Construction process of primary dune. (by Y. Konan)

ABOVE RIGHT View of fence line at primary dune (detail). (by Y. Konan)

BOTTOM RIGHT View of fence lines at primary dune (aerial). (by Y. Konan)





All data was gathered by Climate Central and accessed through the website, sealevel.climatecentral.org/maps

Impacts of Sea Level Rise on Park Habitats

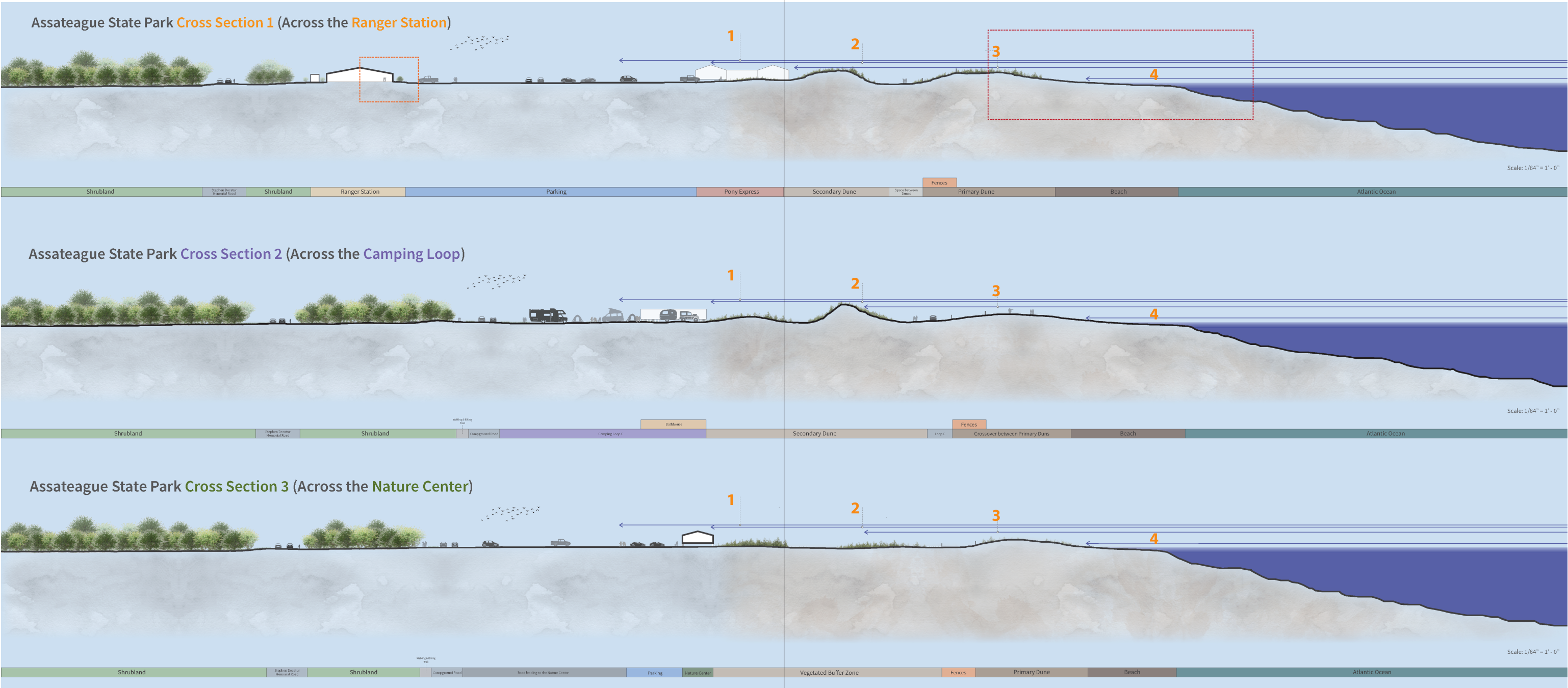
Changes in the rate and extent of erosion, overwash, and inlet formation as a result of sea level rise will cause shifts in habitat throughout the island. Overall, habitat and species diversity is expected to decline, with species tolerant of greater and more frequent disturbances surviving. Inland areas that require more stable conditions, such as forests and shrublands, are likely to decline as sediment movement, saltwater inundation, and other climate-driven changes increase.

Of the island's habitats, salt marshes are particularly vulnerable to sea level rise due to their low elevation. Increases in sea level have the potential to erode and overwhelm the marshes, ultimately converting them from wetlands to intertidal mudflats or open water. Although some marshes may migrate inland to areas of higher elevation, large areas of marshland will likely be lost, resulting in decreased primary productivity, reduced habitat availability for many diverse species, and a decline in the availability of aquatic species necessary to the region's fisheries.

ABOVE Sea level rise projections, 2021-2100.
(by J. Lee)

RIGHT View of primary dune. (by Y.Konan)





Infrastructure Response to Sea Level Rise

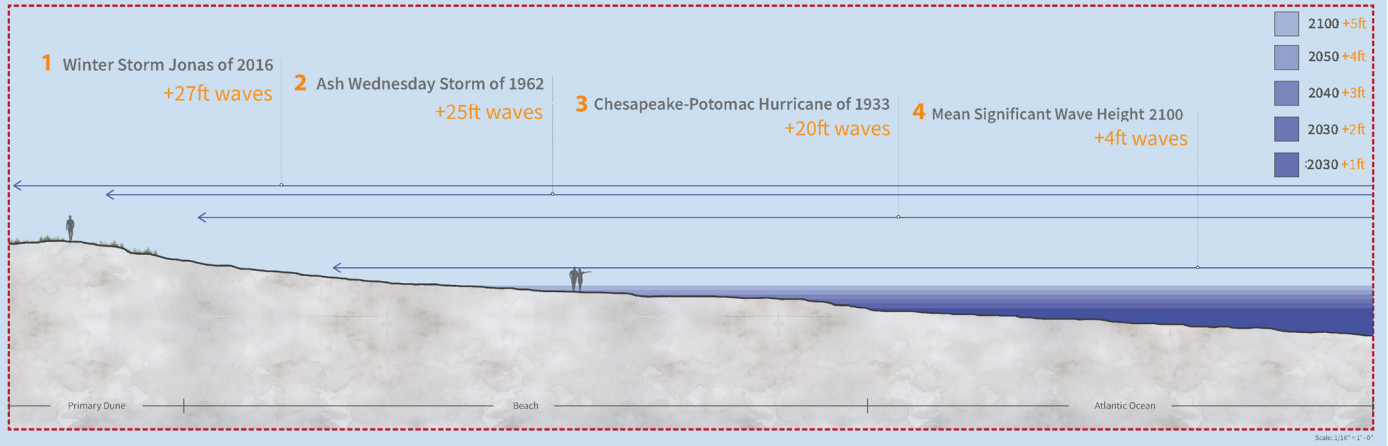
The loss of land expected to occur with sea level rise will impact the ability of the infrastructure in Assateague State Park to continue to provide facilities for visitors. Fixed infrastructure, including roads, parking lots, the visitor center, and ranger station, will be increasingly susceptible to the impacts of climate change — increased flooding, saltwater intrusion, higher tides — and as such will be more difficult and costly to maintain. The campgrounds, also vulnerable to flooding, may become difficult to access due to the movement of sand onto roads and campsites.

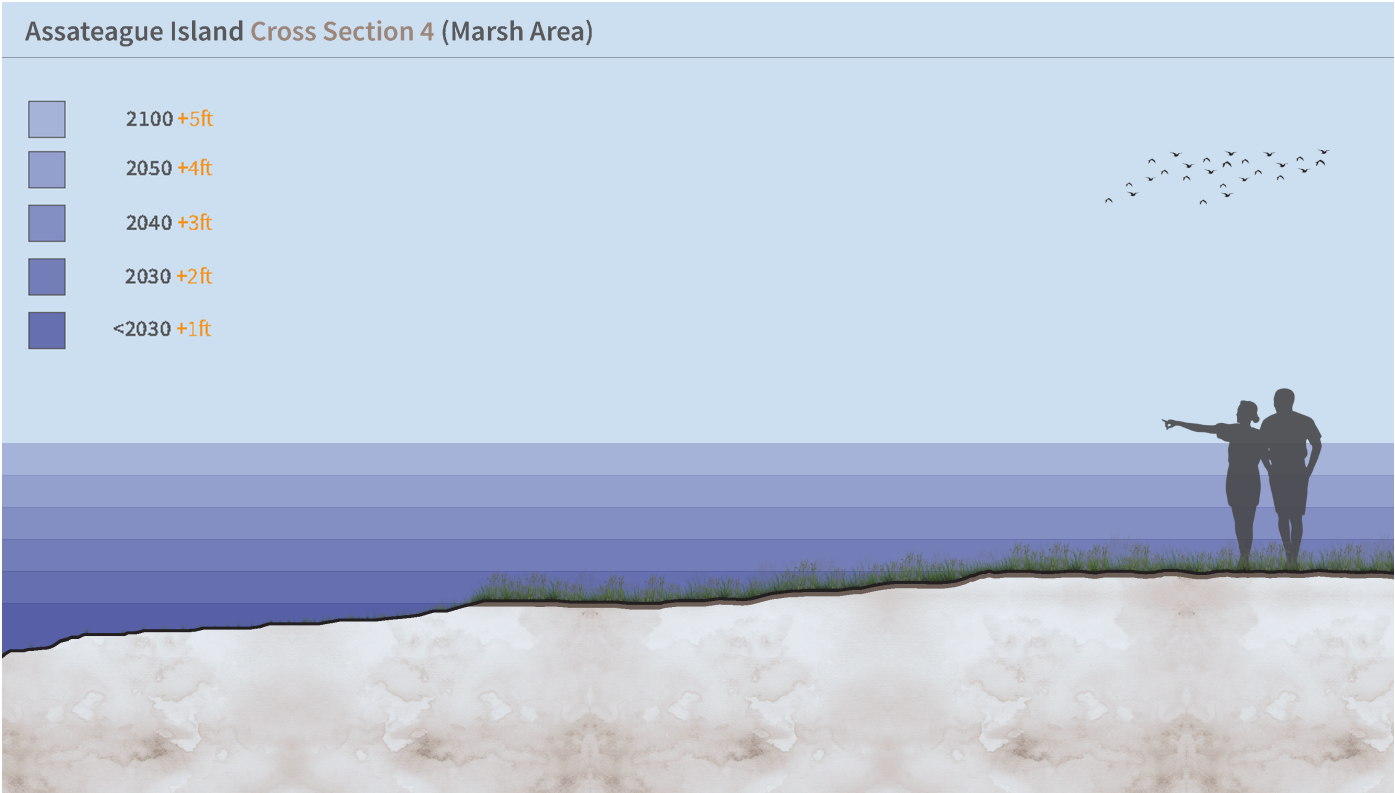
In response to sea level rise and related changes, several adaptive measures for infrastructure are being pursued and undertaken, including low impact road and parking lot construction; the design and construction of mobile facilities that can be moved off-site when necessary; and the construction of flood-proof buildings.

ABOVE Island cross sections with sea level rise elevations and major storm wave heights. (by J. Lee)

RIGHT Detail of major storm wave heights at primary dune. (by J. Lee)

Assateague Island Cross Section (Oceanside)





CRAB (Climate Ready Action Boundary) Elevations

One metric used to inform flood-proof design is the Climate Ready Action Boundary (CRAB) elevation, defined by the Maryland Department of the Environment as the elevation of the 100-year FEMA floodplain plus an additional three feet. The Maryland Department of Natural Resources requires that all new, essential state and local structures located waterward of the CRAB be constructed with a first-floor elevation at least one foot above the CRAB elevation.

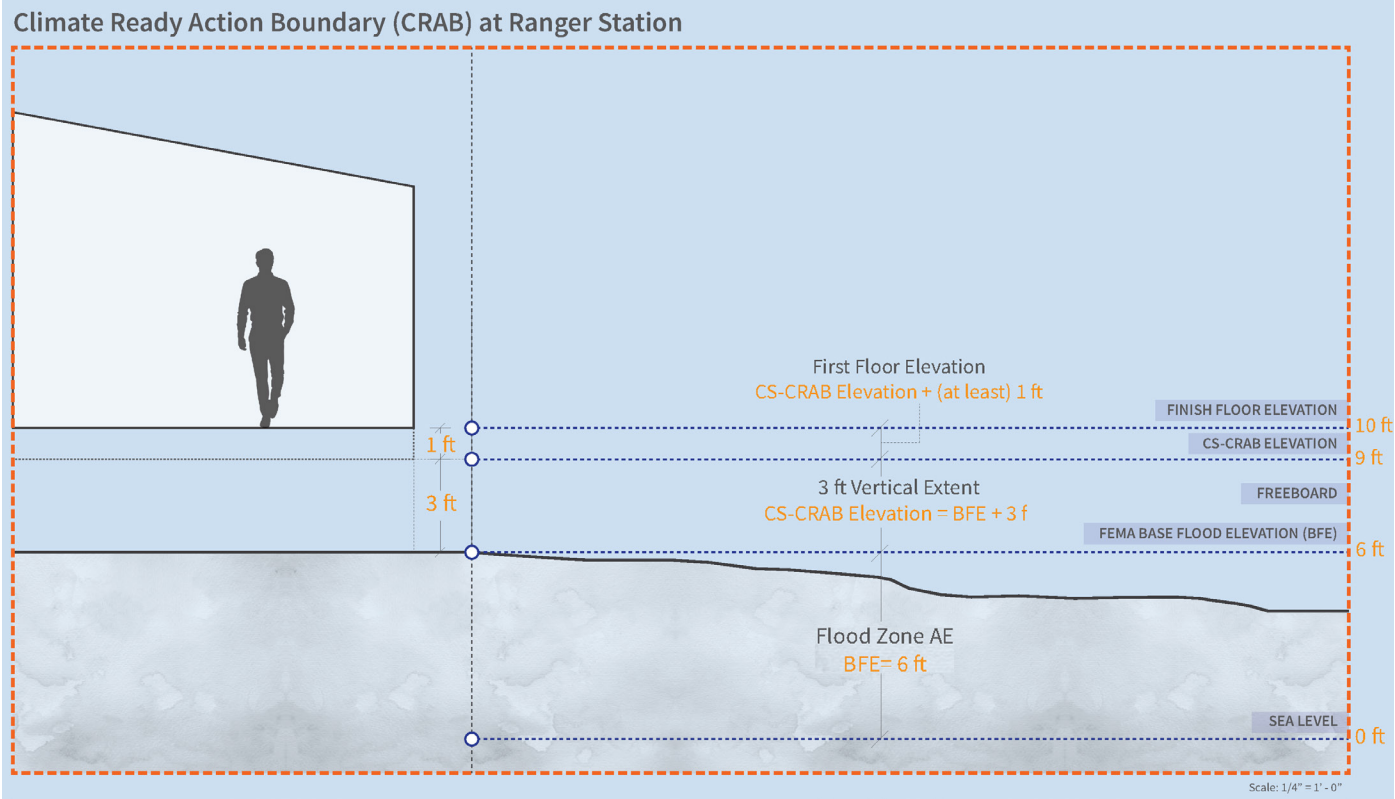
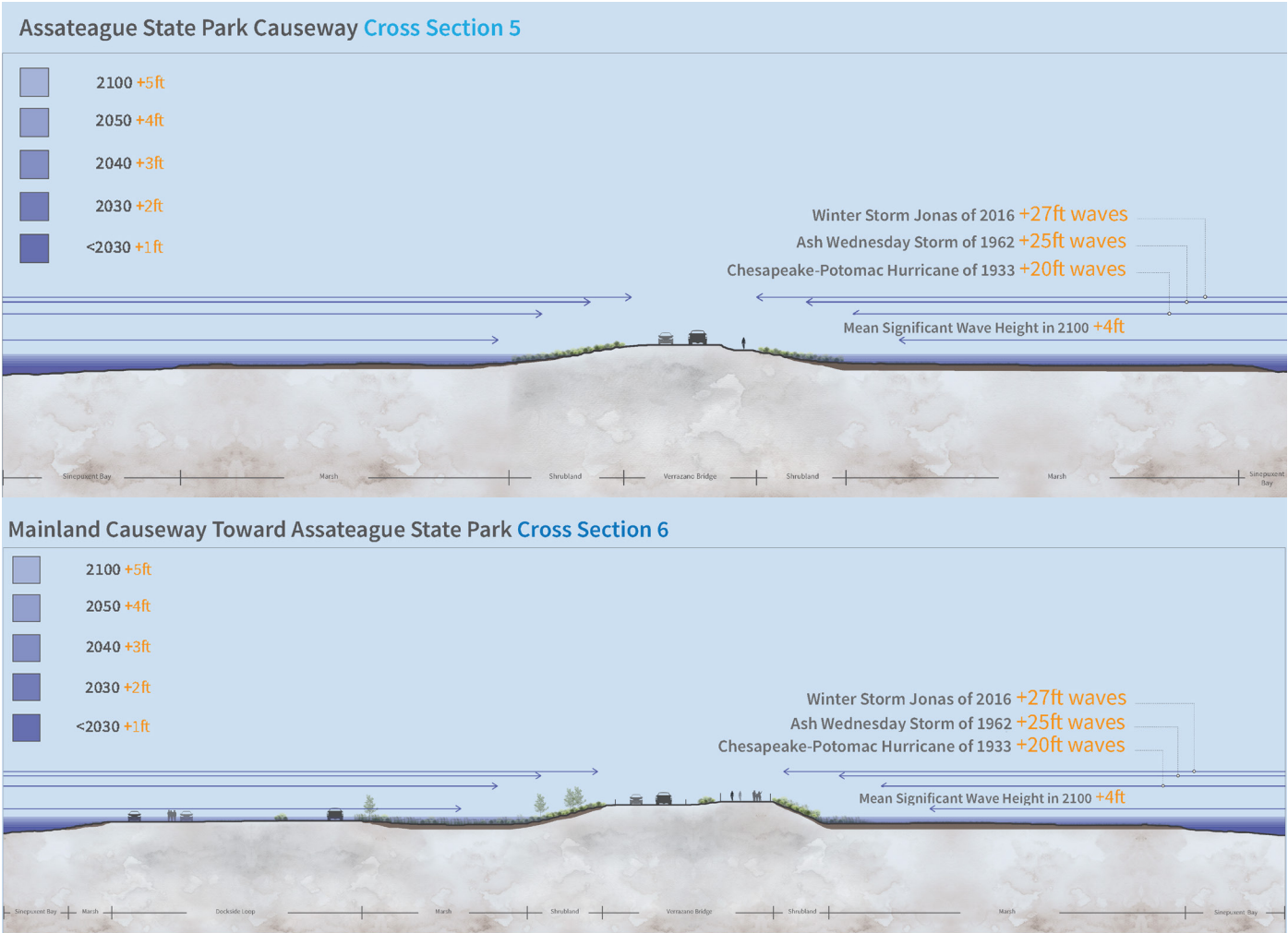
Following these guidelines, the ranger station and other visitor facilities in Assateague State Park must be elevated ten feet above sea level, or four feet above their present ground-level elevation, to ensure that the structures are resilient to sea level rise and flooding events.

ABOVE Assateague State Park marsh cross sections. (by J. Lee)

BOTTOM View of causeway at Assateague island. (by Y. Konan)

ABOVE RIGHT Assateague State Park causeway cross sections with major storm wave heights. (by J. Lee)

BOTTOM RIGHT Climate Ready Action Boundary (CRAB) standards. (by J. Lee)



02

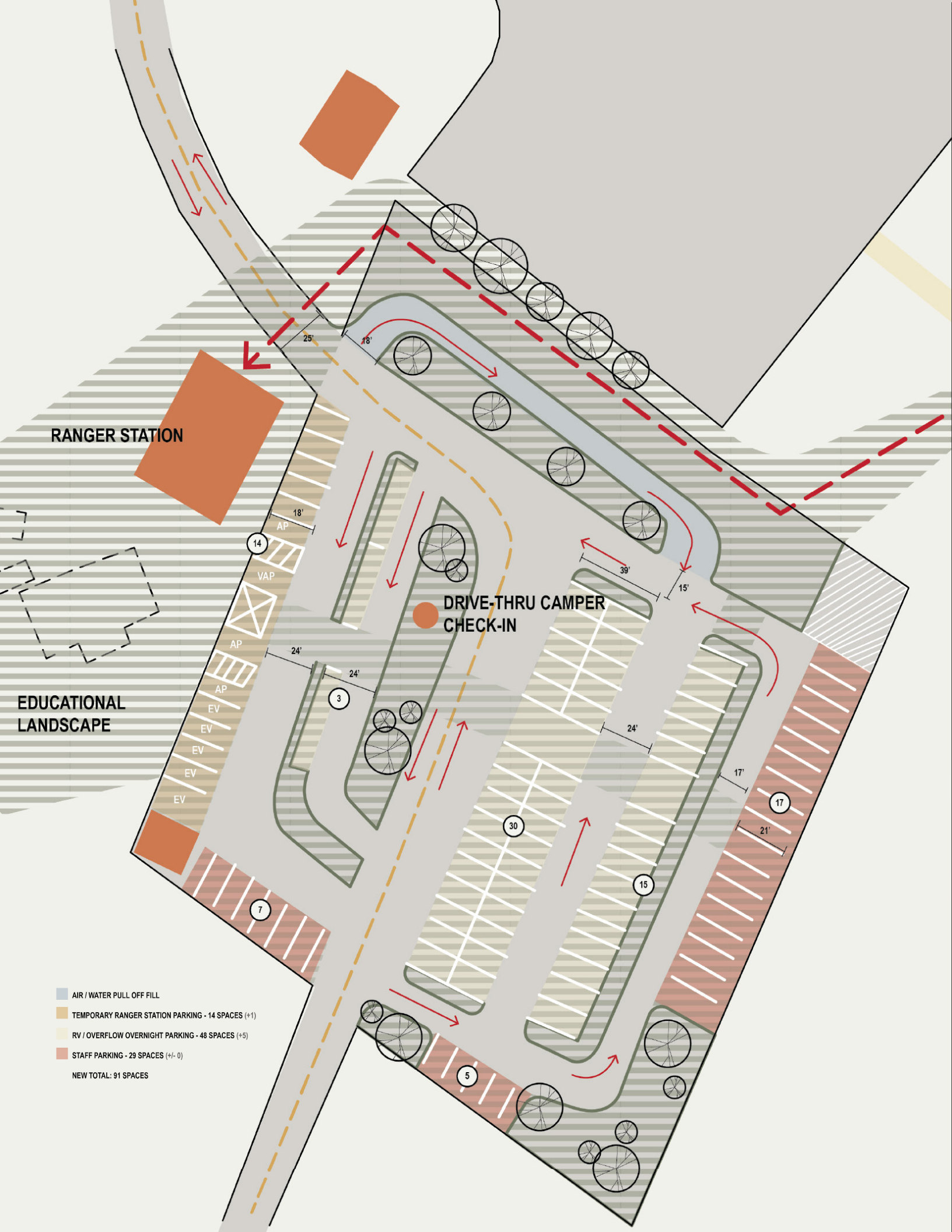
Resiliency Planning

Strategies for a Resilient State Park

Assateague Island is not just a landscape in flux—it is a place of intensifying change as natural coastal processes, storms, and sea-level rise shape and shift the island. Climate change models predict that by 2040 the island will experience increases in temperature and extreme weather, a sea level rise of 3.5–9 inches, and altered precipitation patterns.

In the face of these changing conditions, a Resiliency Plan is being formed by the Maryland DNR, with a mission to “conserve and foster an appreciation of the natural resources of Assateague State Park and to continue to provide substantial recreational opportunities for as long as possible in a sustainable manner.” This ethos guides the range of ongoing and new resiliency strategies on the following pages that address dune maintenance, sand fencing, camp loops, parking lots, and educational spaces.

LEFT View of primary dune. (by Y. Konan)



From Lot to Landscape: Redesigning Park Parking

The Ranger Station parking lot is a sea of asphalt. The lot is vehicularly-oriented, and is divided into four distinct zones: short-term Ranger Station parking directly in front of the building; staff parking around the perimeter of the lot; overflow and overnight parking for campers; and an air/water fill station. When campers arrive at the park, they must check in at the Ranger Station. From there, they may continue on to their campsites, located near the Atlantic coast; however, there is no direct access to beach or day-use facilities from the Ranger Station lot. The lot offers minimal space designated for pedestrians.

The redesign of the Ranger Station parking lot is guided by three main principles: create new, temporary parking spaces and check-in areas for campers; create shaded pedestrian landscapes connecting the Pony Express with the Ranger Station and new educational landscapes around the building; and increase the permeability of parking surfaces and pathways. To achieve these objectives, the design incorporates additional lanes to improve the efficiency of check-in for overnight visitors, landscaped pedestrian walkways between the Ranger Station site and the Pony Express, and multiple strategies to improve shading and increase surface porosity throughout the lot.

The strong separation between the day-use lot and Ranger Station lot inhibits connectivity between the Ranger Station and the Pony Express, making it difficult for day-use visitors to access the Ranger Station, and for those at the Ranger Station to access the Pony Express. To address this issue, this proposal connects the two facilities and accommodates foot traffic by providing a pedestrian corridor between the buildings, along the northeast edge of the site (denoted by the dashed red arrow, left). Through this proposal, the number of parking spaces available is maintained, while added green space and landscaped areas can be more easily occupied by both overnight and day-use visitors.

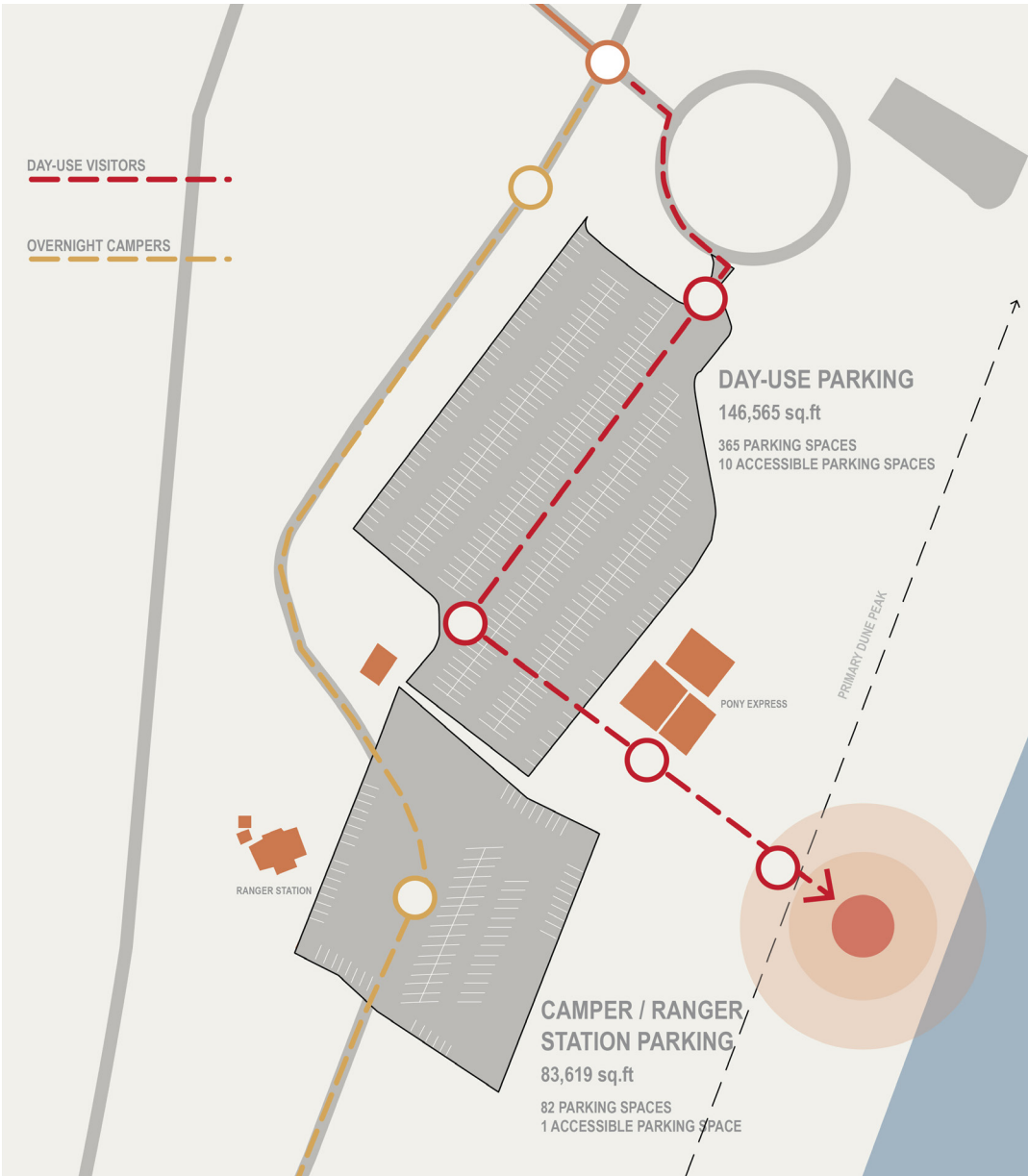
LEFT Proposed Ranger lot landscape. (by S. Jamero)



Proposed Vehicular Circulation

To improve the experience of overnight visitors checking in at the Ranger Station, a drive-thru camper check-in lane is added closer to the Ranger Station, with space adjacent to the lane available for a staffed booth, allowing for increased ease and efficiency of check-in before visitors proceed to their campsites. The lanes are widened, enabling the circulation of both RVs and cars while also providing temporary parking for RVs.

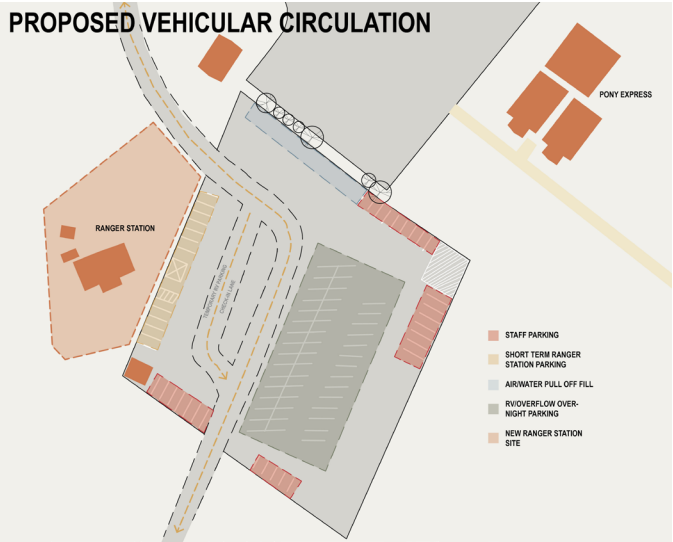
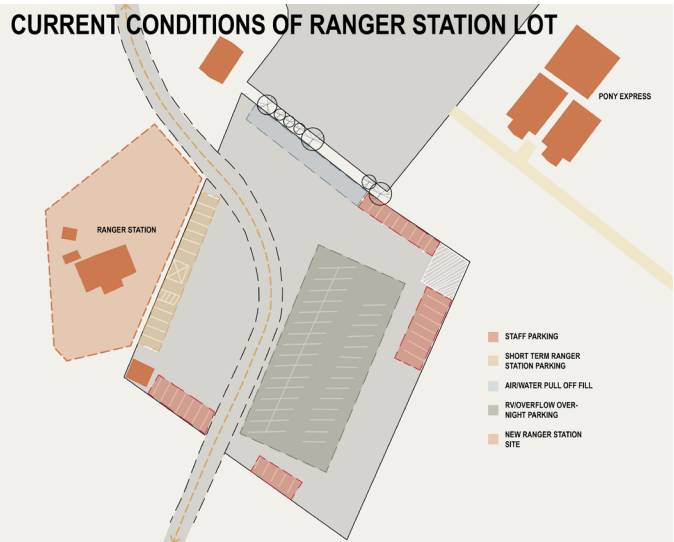
The added median strip where the check-in booth could be located also creates opportunity for additional landscaping and the introduction of green space. Trees, shrubs, and grassy areas would reduce surface heat gain, provide shade, and break up the large asphalt parking lot.



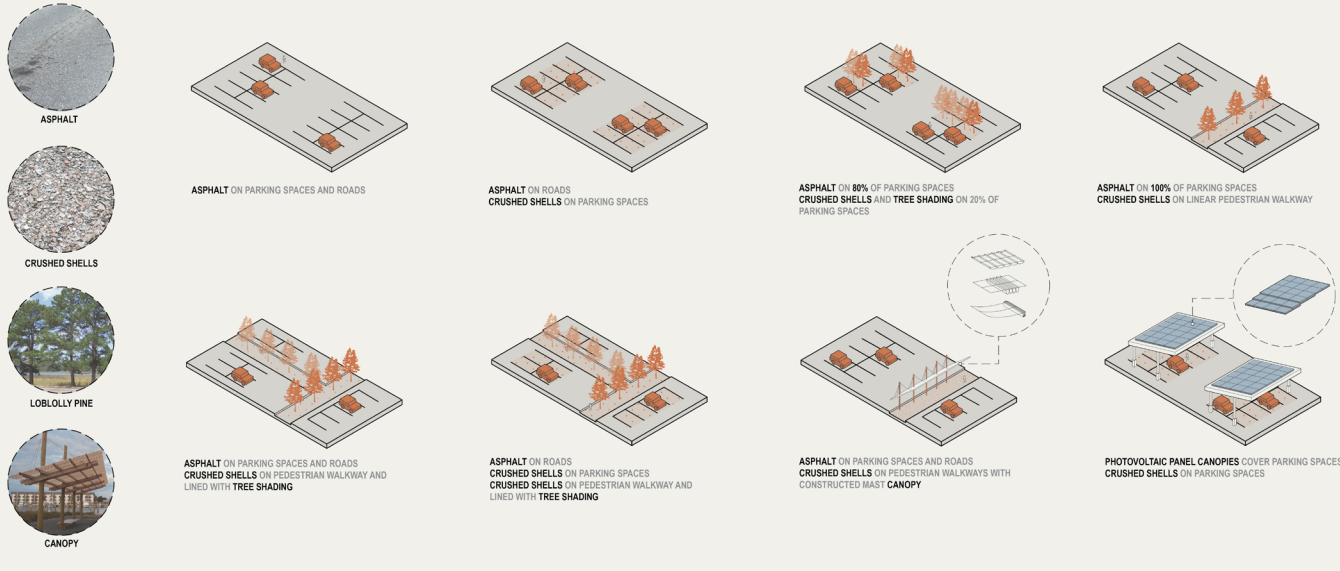
ABOVE View of Ranger Station lot and day-use lot. (by Y. Konan)

RIGHT ABOVE Current parking conditions. (by S. Jamero)

RIGHT BOTTOM Current conditions of ranger station lot; and proposed vehicular circulation with camper check-in lane. (by S. Jamero)



SURFACE POROSITY, PEDESTRIAN ACCESS, AND SHADE



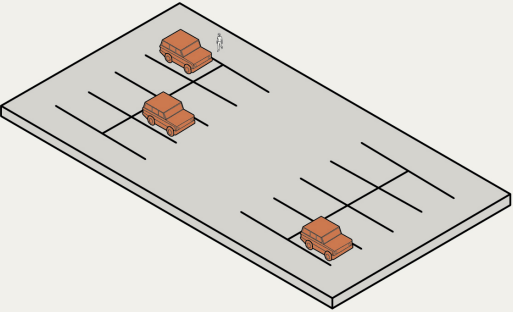
Strategies to Increase Surface Porosity and Shading

Presently, the parking lot is paved entirely with asphalt. This design proposes that some impervious asphalt cover be reduced and replaced by native materials such as clay and crushed shells, particularly on parking spaces and paths. Unlike asphalt, when these materials erode or are damaged, they blend more easily with the environment and cause less harm to the habitats and species across Assateague Island. The crushed shells used on pedestrian walkways also serve as a transitional material between the built-up areas and the permeable dunes and beaches.

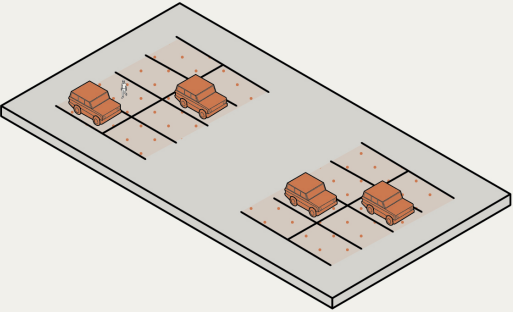
The design proposal also introduces several shading systems throughout the parking lot. Trees, specifically loblolly pines (*P. taeda*), can be planted along walkways to provide shade and comfort for pedestrians as they move across the parking lot and between the Ranger Station and the Pony Express. The trees may be designed as windbreaks as well, serving to block storm winds coming from the northeast and warm, western winds from the Sinepuxent Bay.

ABOVE Surface porosity, pedestrian access, and shade. (by S. Jamero)

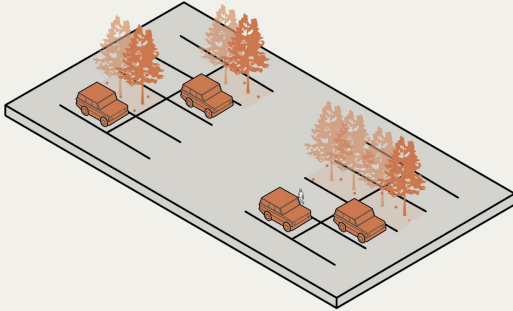
RIGHT Detail of Surface porosity, pedestrian access, and shade. (by S. Jamero)



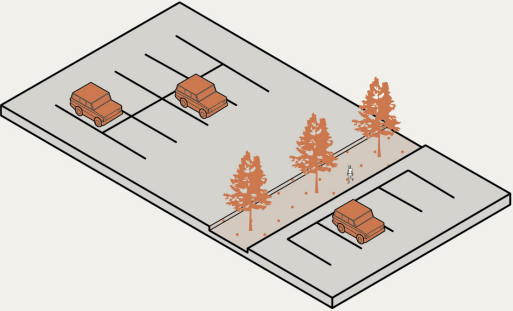
ASPHALT ON PARKING SPACES AND ROADS



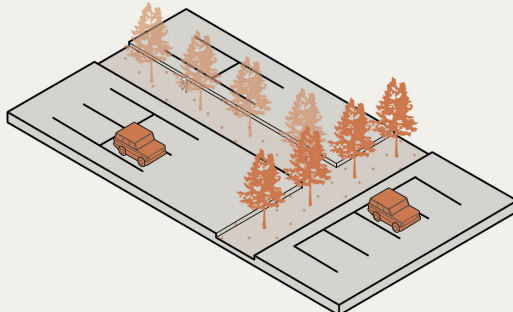
ASPHALT ON ROADS
CRUSHED SHELLS ON PARKING SPACES



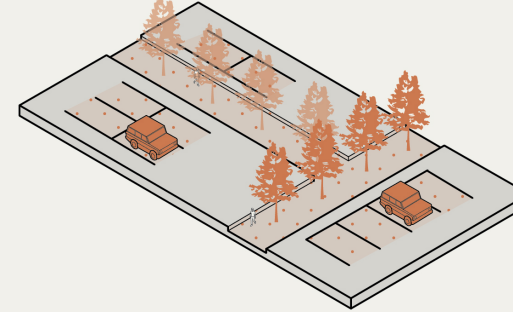
ASPHALT ON 80% OF PARKING SPACES
CRUSHED SHELLS AND TREE SHADING ON 20% OF PARKING SPACES



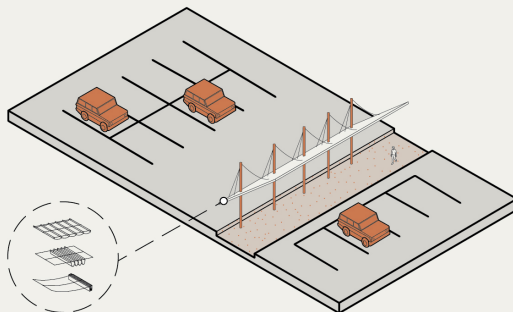
ASPHALT ON 100% OF PARKING SPACES
CRUSHED SHELLS ON LINEAR PEDESTRIAN WALKWAY



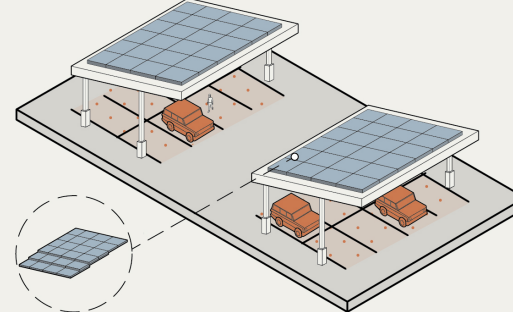
ASPHALT ON PARKING SPACES AND ROADS
CRUSHED SHELLS ON PEDESTRIAN WALKWAY AND
LINED WITH TREE SHADING



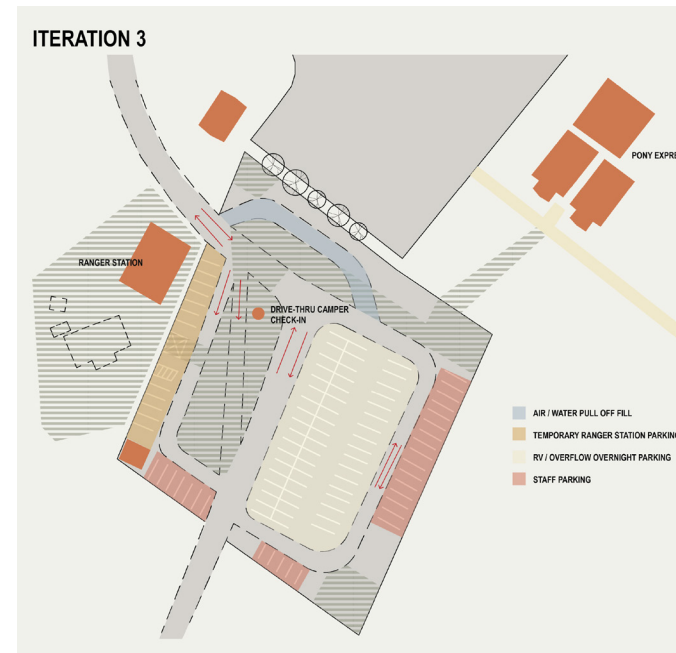
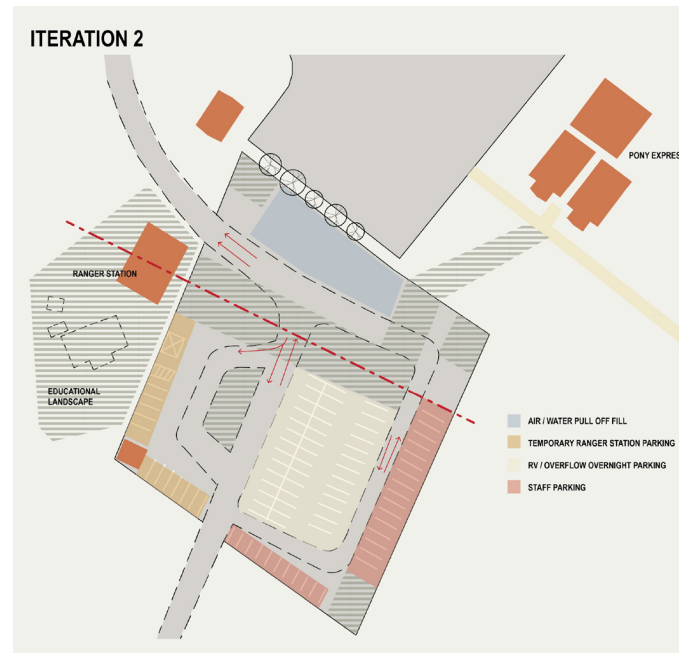
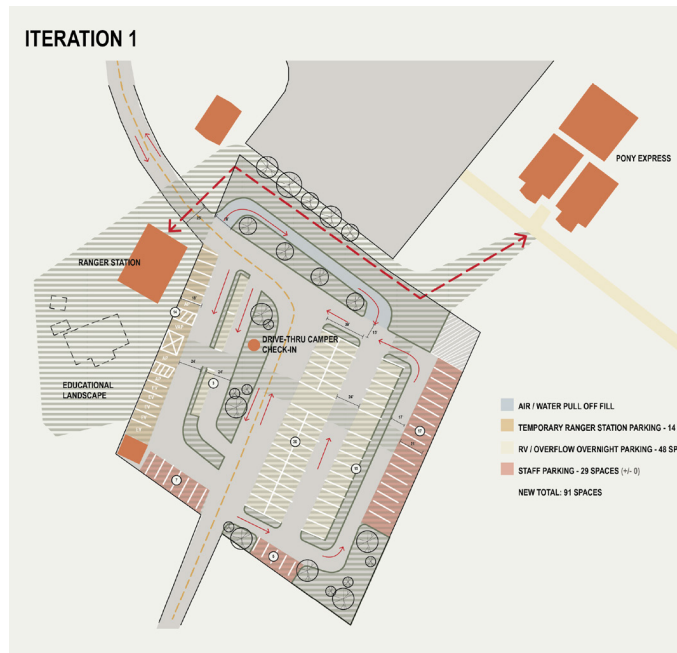
ASPHALT ON ROADS
CRUSHED SHELLS ON PARKING SPACES
CRUSHED SHELLS ON PEDESTRIAN WALKWAY AND
LINED WITH TREE SHADING



ASPHALT ON PARKING SPACES AND ROADS
CRUSHED SHELLS ON PEDESTRIAN WALKWAYS WITH
CONSTRUCTED MAST CANOPY



PHOTOVOLTAIIC PANEL CANOPIES COVER PARKING SPACES
CRUSHED SHELLS ON PARKING SPACES



Ranger Station Landscape

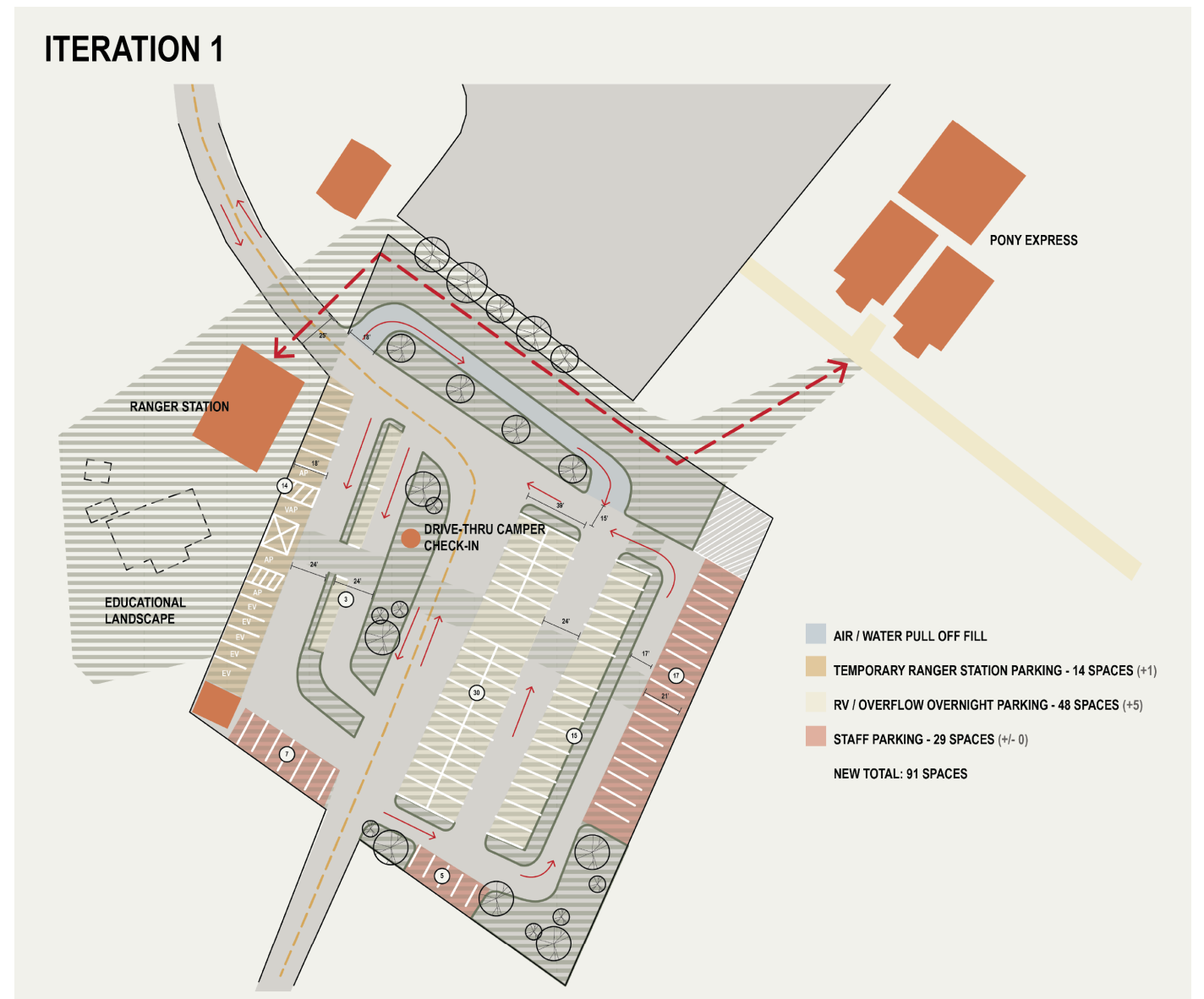
This design proposal suggests expanding the program of the Ranger Station so as to increase public facilities and establish an educational landscape around the building. This landscape creates a welcoming environment and provides an alternative destination for beach-goers. Signage throughout the education landscape will educate visitors about the habitats and animals on Assateague Island and explain rules for visitor interactions with the island's ecosystems.

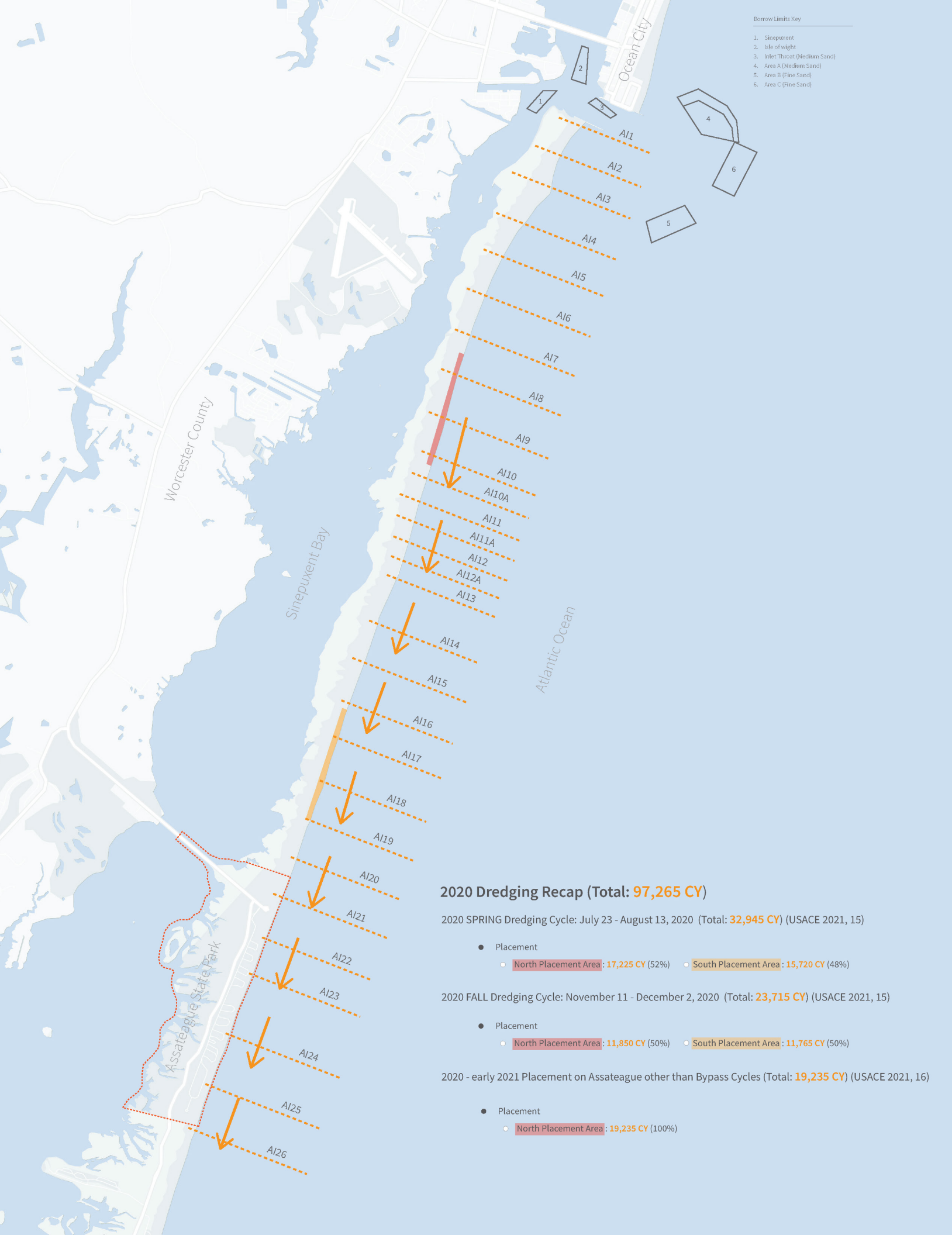
The educational landscape connects to other landscaped areas, including the pedestrian pathway, which links the Ranger Station to the Pony Express and provides a green corridor for park users to enjoy.

ABOVE Proposed Ranger Station lot landscape iterations. (by S. Jamero)

CENTER View of Ranger Station lot. (by Y. Konan)

RIGHT Detail of Proposed Ranger Station lot, Iteration 1. (by S. Jamero)





Shifting Sand: Dune Expansion + Shoreline Nourishment

The sands, dunes, and shoreline of Assateague Island are constantly shifting, moved by winds, waves, and rainfall. Because these forces have caused the sandy areas of the island to shrink and move westward, several restoration projects have been pursued to mitigate the sand starvation and shoreline retreat occurring in Assateague State Park.

Today the shoreline is maintained through a long-term habitat restoration project in a partnership between the National Park Service and the United States Army Corps of Engineers. Twice a year dredged sand is placed on the northern end of the island to mitigate some erosional effects of the inlet on Assateague’s beaches and dunes. The sand is pushed southward towards Assateague State Park by longshore currents and winds, allowing for the park’s shoreline to be passively restored. The sand used for shoreline replenishment is dredged from places in the region where it has accumulated, including at the Ocean City inlet. The dredging and relocation of sand from the inlet both supports beach maintenance and clears the inlet for recreational purposes and utilization by commercial fisheries.

New sand fence strategies can be implemented in Assateague State Park to better maintain the primary dune and prevent sand on the landward side of the dune from covering camp sites following storms, which is a costly and labor-intensive maintenance issue. Currently, the fence line between the dune and the camp loops is a straight line. But new configurations could help to alleviate erosion issues that routinely compromise the camp sites. Placing new fencing near the campsites and in areas between the camping loops and secondary dunes, as well as using fencing to connect the primary dunes with the secondary dunes, could widen the primary dune and thus decrease the occurrence of overwash fans during storm events. Another opportunity could be to place a back fence along the camping loops so as to both widen the existing dune and create a tighter alignment between the dunes and the campsites. As RV camping is phased out in coming years and camp loop configurations shift westward, the fence line can follow and the primary dune can be widened. The broadened primary dune would permit the ongoing use of the park’s campsites, even as the island continues to shift.

LEFT Diagram of passive sand nourishment along Assateague Island. (by J. Lee)



Active Beach Nourishment

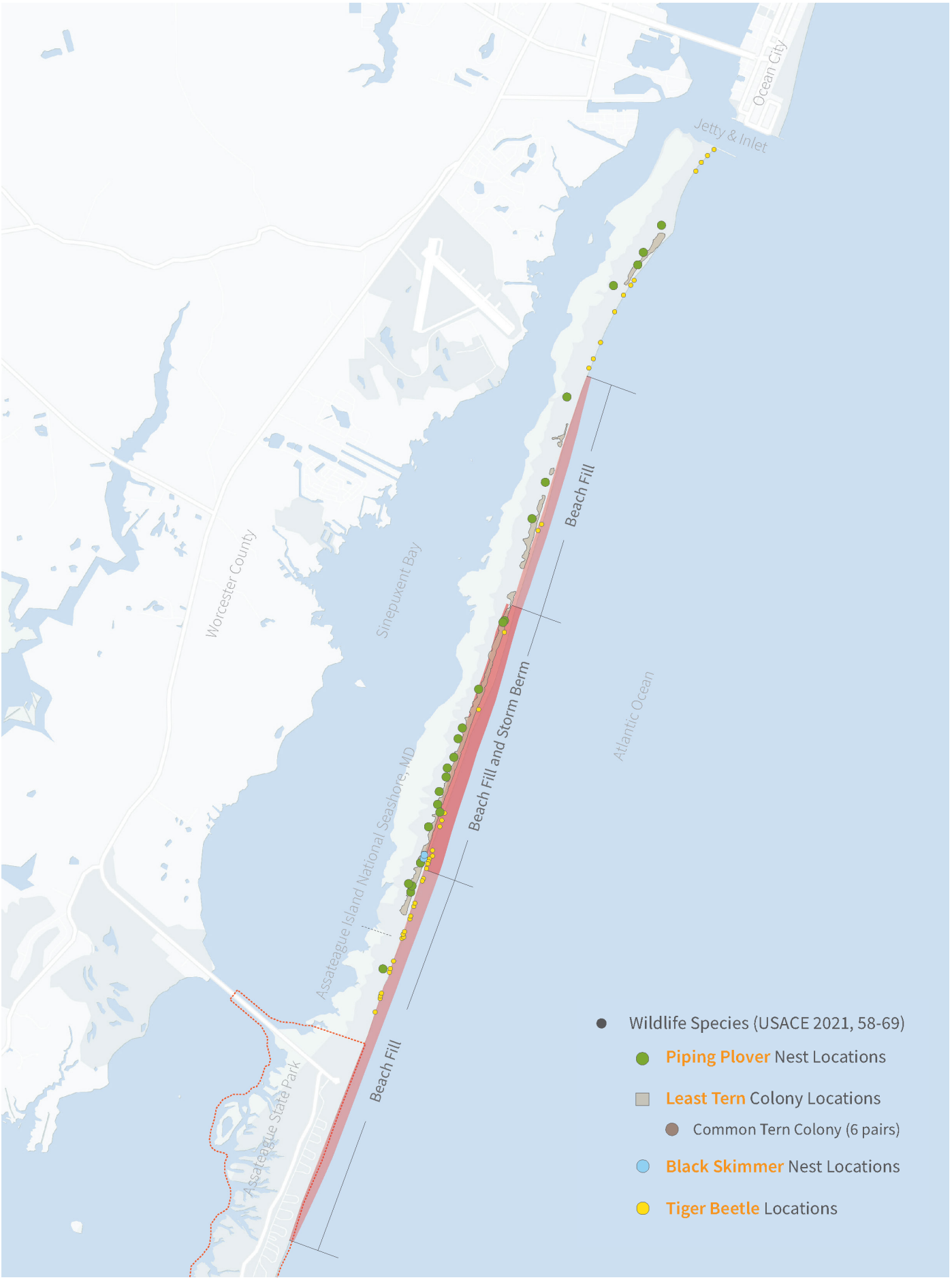
During the early 2000s, an active beach nourishment project was undertaken, replenishing the shoreline by expanding it 50-100 feet seaward through the addition of 1.8 million cubic feet of sand directly onto the beach.

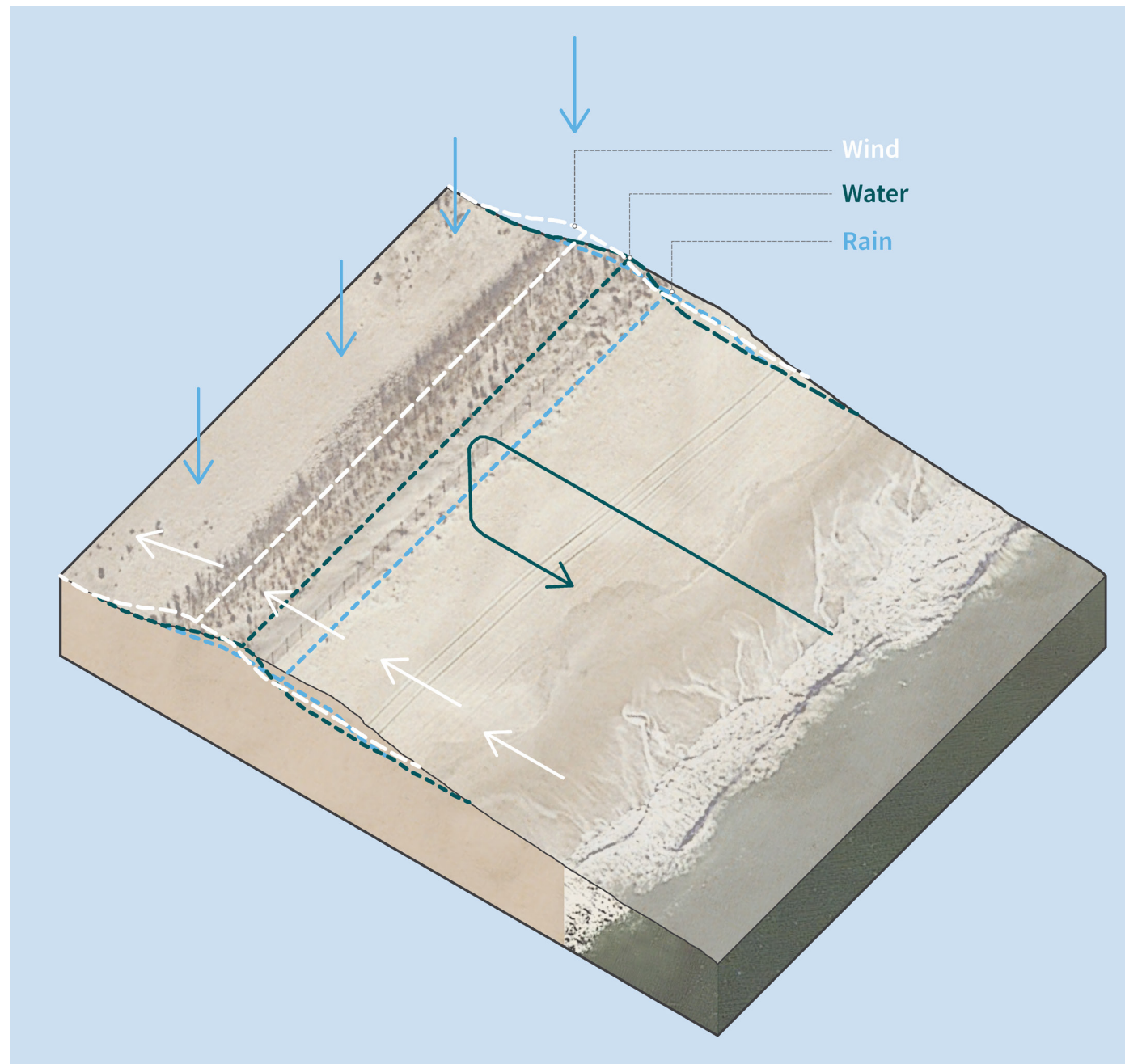
While the addition of sand is necessary for the replenishment of Assateague Island's shoreline, nourishment of this kind can cause damage to existing habitats. For example, several bird and insect species present on the island, including piping plovers (*C. melodus*), least terns (*S. antillarum*), black skimmers (*R. niger*), and tiger beetles, nest along the beach. The large-scale addition of sand to the shoreline can cause nests located near the shore to be covered by sand and can therefore pose a threat to the continued health of beach-dwelling species.

ABOVE Processes of passive sand nourishment (left); and active beach nourishment (right). (by J. Lee)

CENTER View of erosion at dune. (photographer unknown)

RIGHT Diagram of sand placement during one-time active beach nourishment project in early 2000s. (by J. Lee)





Dune Shaping Processes

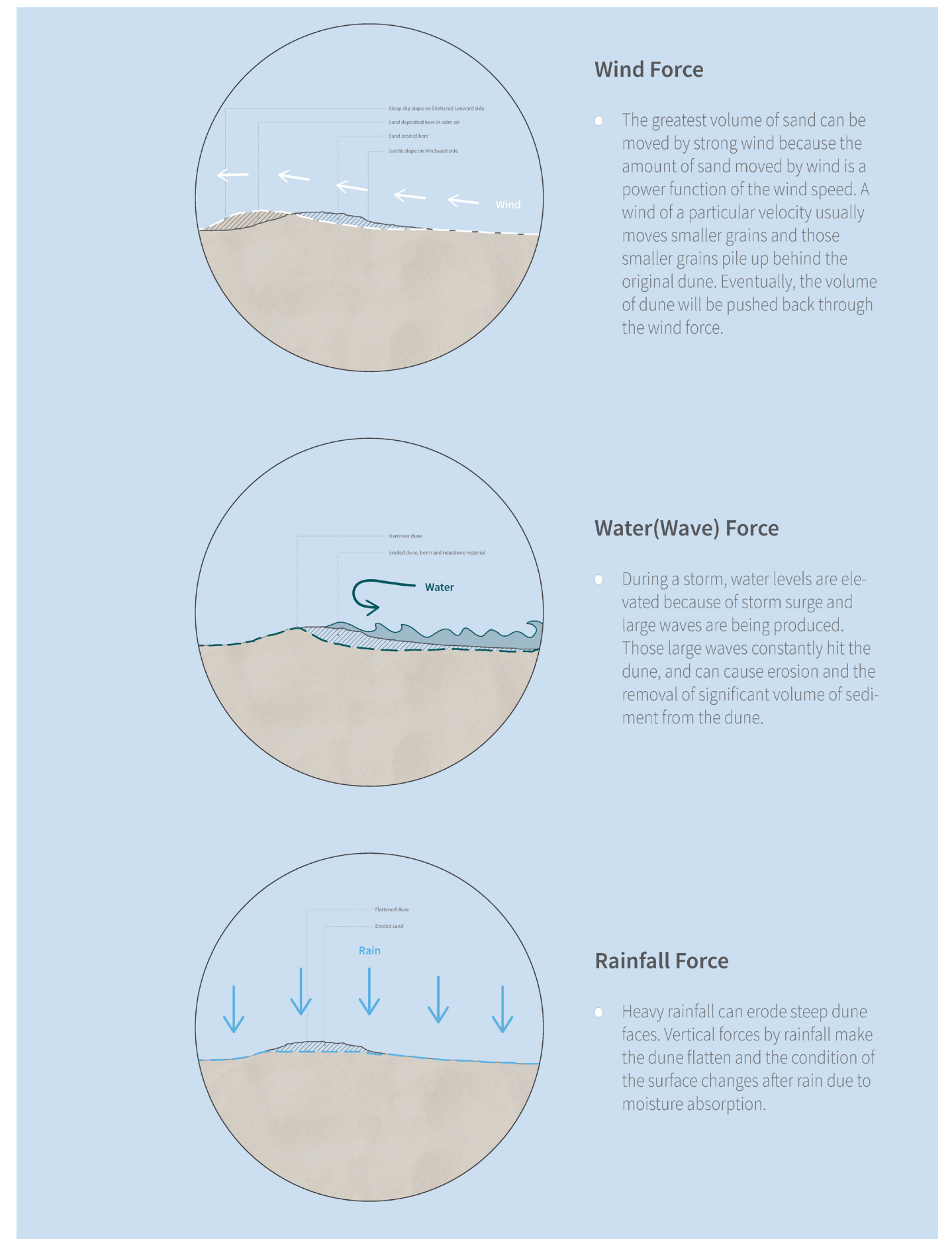
The island's dunes are shaped primarily by three forces: wind, waves, and rainfall. Most of the sand composing the dunes is moved by wind, with the overall volume of the dune being pushed landward as wind causes smaller grains of sand to pile up behind the dune's original location. The dunes are eroded during storm events, when waves hit the dune and remove large volumes of sediment. The vertical force of rainfall can also shape the dunes, flattening them during heavy rain events.

To minimize the impact of these forces, the Maryland Department of Natural Resources has implemented several strategies to maintain the dunes and protect the infrastructure in Assateague State Park. Ongoing dune maintenance practices include: planting shrubs and grasses to stabilize dune sand; adding fencing to trap sand and build up the dunes; and widening the dunes through the addition of sand.

ABOVE Forces acting on dunes (axon). (by J. Lee)

RIGHT Forces acting on dunes (section). (by J. Lee)

NEXT PAGE Proposed practices of dune maintenance through novel fence placement strategies (axons and plan). (by J. Lee)



Wind Force

- The greatest volume of sand can be moved by strong wind because the amount of sand moved by wind is a power function of the wind speed. A wind of a particular velocity usually moves smaller grains and those smaller grains pile up behind the original dune. Eventually, the volume of dune will be pushed back through the wind force.

Water(Wave) Force

- During a storm, water levels are elevated because of storm surge and large waves are being produced. Those large waves constantly hit the dune, and can cause erosion and the removal of significant volume of sediment from the dune.

Rainfall Force

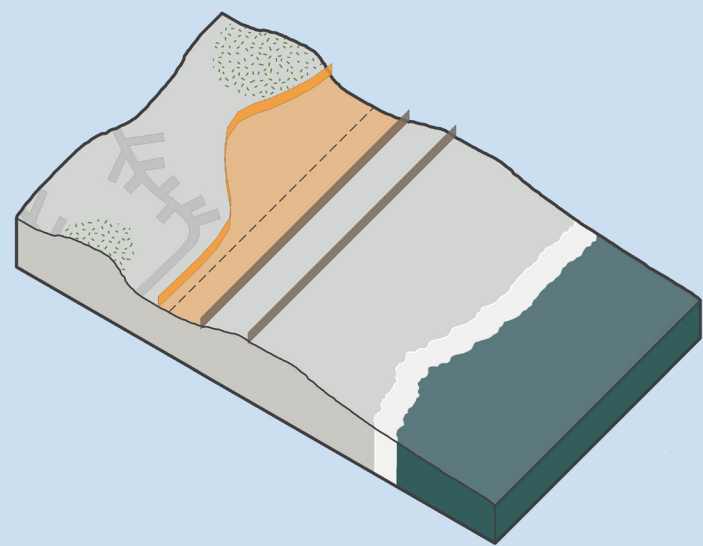
- Heavy rainfall can erode steep dune faces. Vertical forces by rainfall make the dune flatten and the condition of the surface changes after rain due to moisture absorption.

Proposed Practices of Dune Maintenance

Various Shapes of New Fence Placements

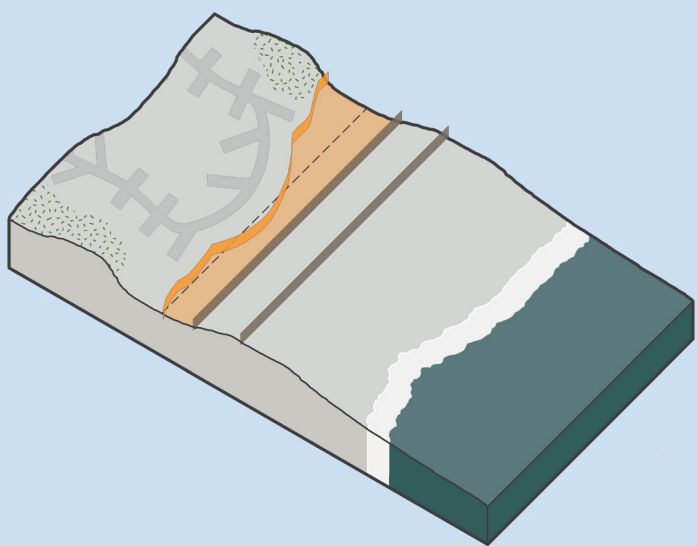


1. Between Loops and Dunes



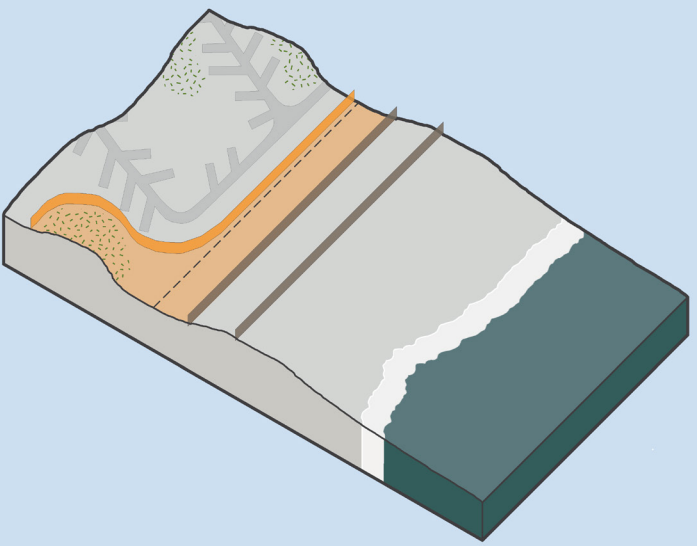
- Back fences near campsite can be shaped so that the primary dune could be extended into areas between camping loop and between secondary dunes. It allows the primary dune to form broaden crest.

2. Parallel to the Camping Loop



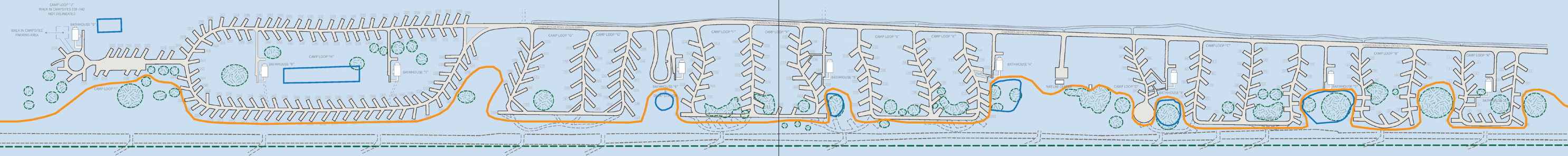
- Another possible shape of back fences is to place them along with the camping loop. It not only creates wider dune but also provides connection with the existing camping loop.

3. Connected to Secondary Dunes



- Through this shape of fence, the primary dune can connect with the secondary dunes. In that way, there could be a chance to reduce overflow fans during the storm events.

Proposed Fence Placement





Resilient Campground: Flexible Loops + Adaptive Sites

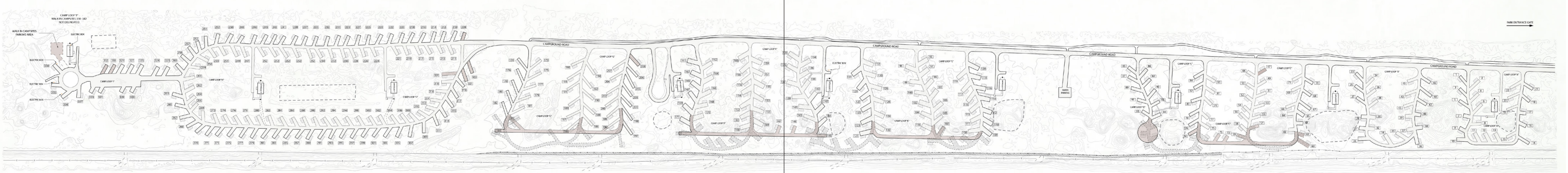
One of the biggest draws to Assateague State Park is the opportunity to camp among the island’s dunes. Presently, there are 342 campsites located along a series of horseshoe-shaped loops, each with a fire ring and picnic table. Most of the campsites are RV-accessible, with just five designated for walk-in use; electric hookups are available at sites in two of the camploops.

As sea level rises and storm intensity increases, erosion on the land side of the primary dune erosion will increasingly cause campsites and loop roads to be covered in sand, making campsites inaccessible and creating costly and time-intensive maintenance. The effects of climate change will likely also cause campsite evacuations when more frequent storms pose a danger to overnight visitors.

Because the campsites are valuable amenities at Assateague State Park, enhancing their resiliency is a priority. Several strategies are being considered, including increasing the number of walk-in campsites; acquiring space on the mainland so as to provide safe camping opportunities; and reducing the impacts of flooding by using shell paving to redirect the flow of water and decrease pooling on roadways.

The proposed campsite redesign aims to incorporate these strategies while creating more flexible, adaptable campsites. To reduce impervious surface area while maintaining accessibility and a large number of campsites, over time, the total number of RV camping sites will be reduced and they will be concentrated near Campground Road, while those closer to the dunes will transition into walk-in campsites. While the sites closest to the dunes will be more vulnerable to dune erosion and migration, the minimal paving the walk-in sites require will enable greater flexibility and movement in response to storm events and gradual displacement.

LEFT Detail of campsite catalog. (by Y. Konan)

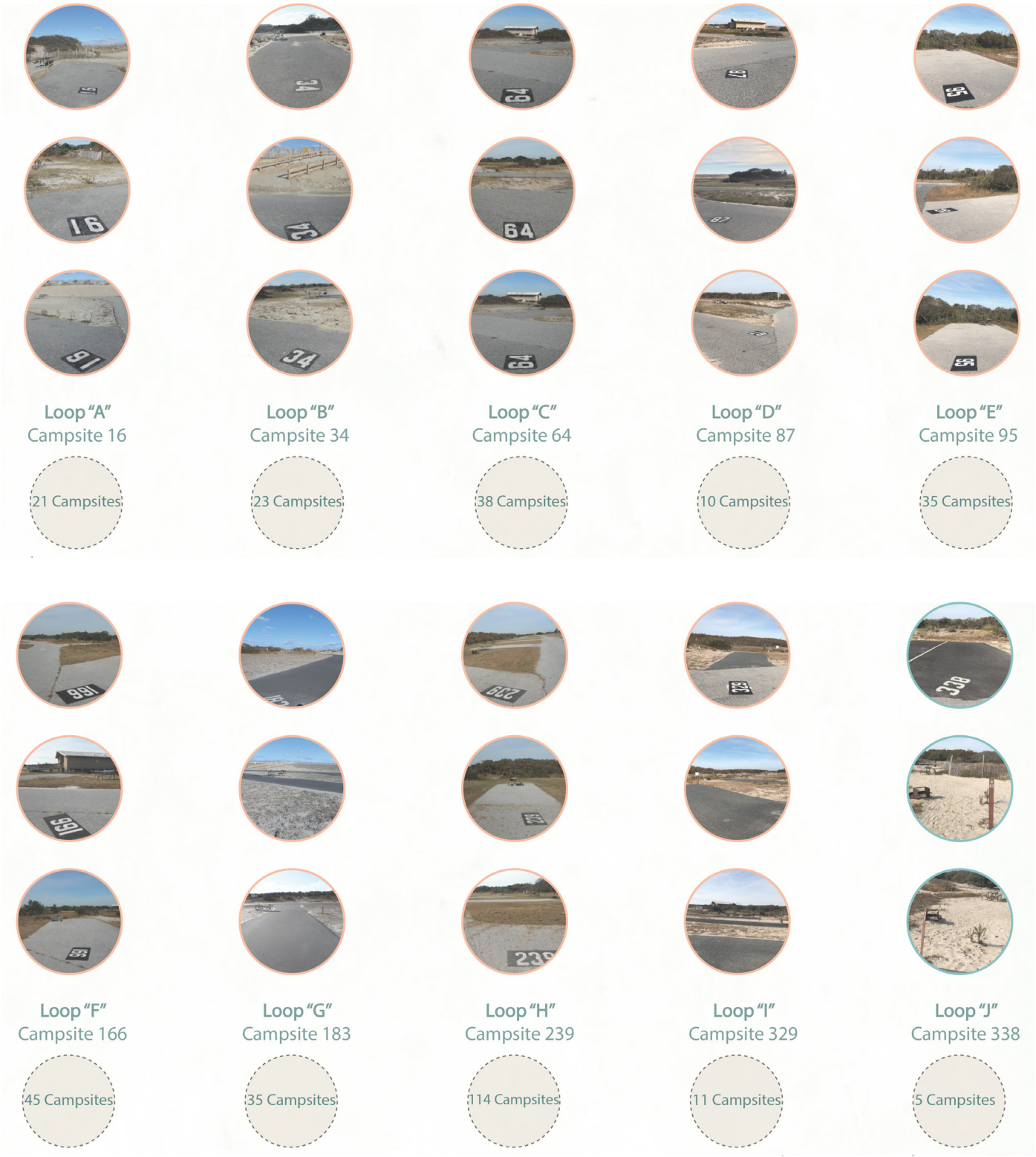


Camp Loop Distribution

To access the campsites, visitors arriving at Assateague State Park will cross the Sinepuxent Bay to Assateague Island, then travel on the north-south oriented Campground Road. The 342 campsites are located directly off of Campground Road, along eleven loops lettered “A” through “J”. While nearly all campsites are intended for park-in use and can be accessed by RVs and cars, Loop “J”, which contains five campsites, is located on the sand at the south end of the campground and can be used only by walk-in visitors. Electric hook-ups are available in Loop “G” and at a limited number of sites in Loop “I”; as such, these campsites are some of the most popular ones in the park. Nine bathhouses, each with a fenced drainage field, are interspersed in the campground.

ABOVE View of campsites at Assateague State Park. (by Y. Konan)

CENTER Assateague State Park camp site plan. (by Y. Konan)

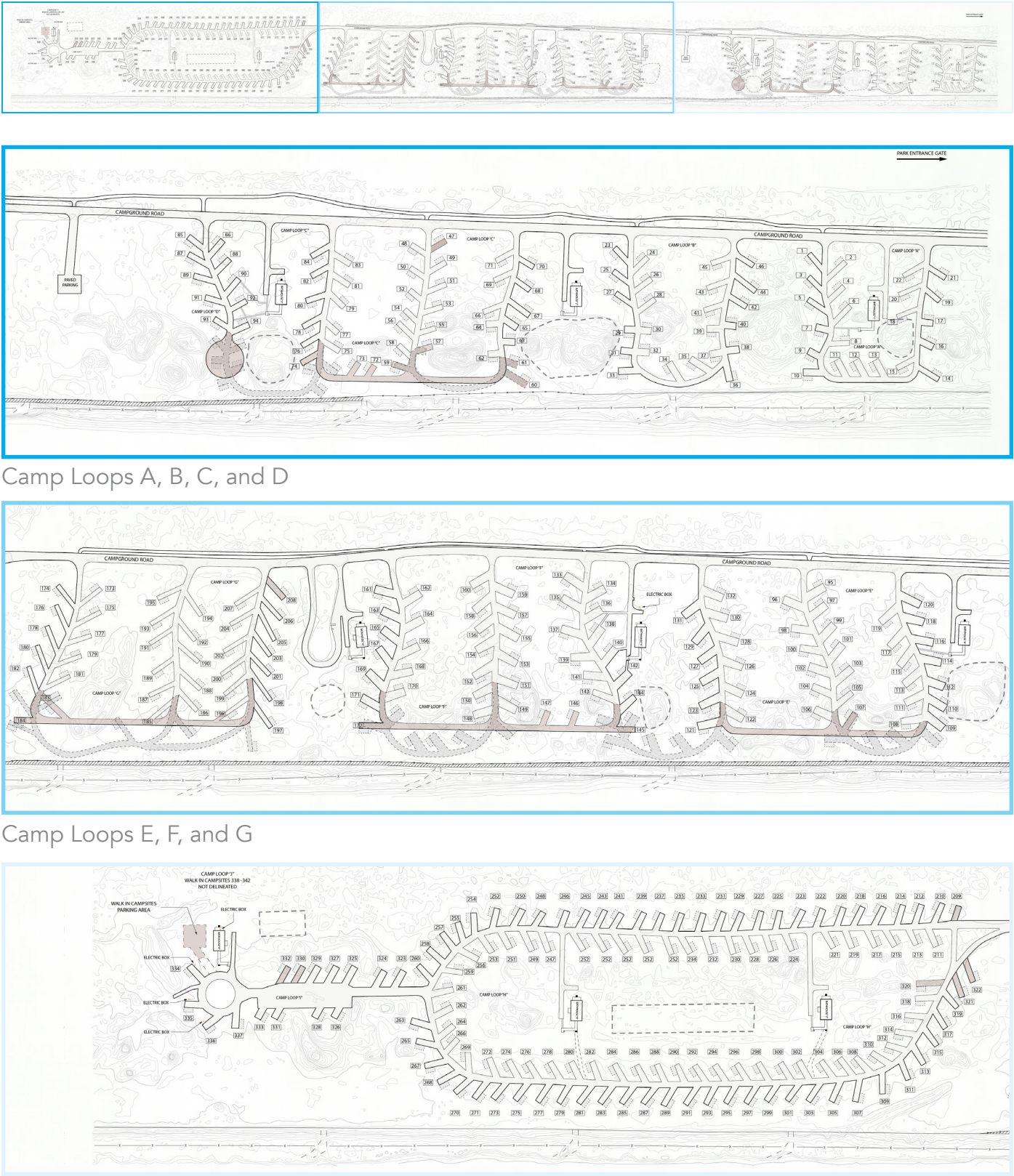


Campsite Distribution

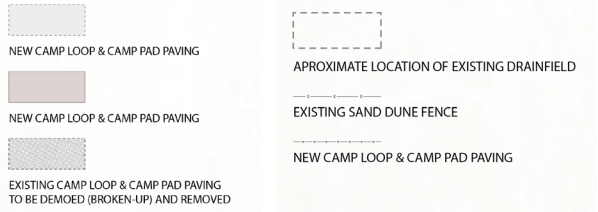
The campsites are divided amongst the various loops, with 21 sites in Loop "A", 23 in Loop "B", 38 in Loop "C", 10 in Loop "D", 35 in Loop "E", 45 in Loop "F", 35 in Loop "G", 114 in Loop "H", 11 in Loop "I", and 5 in Loop "J". In recent years, the paved areas closest to the dunes at several loops have been demolished, removed, and replaced by a loop road that runs inland of the current road and dune fencing. This strategy has removed the most vulnerable campsites from being covered by sand from the primary dune during storm events.

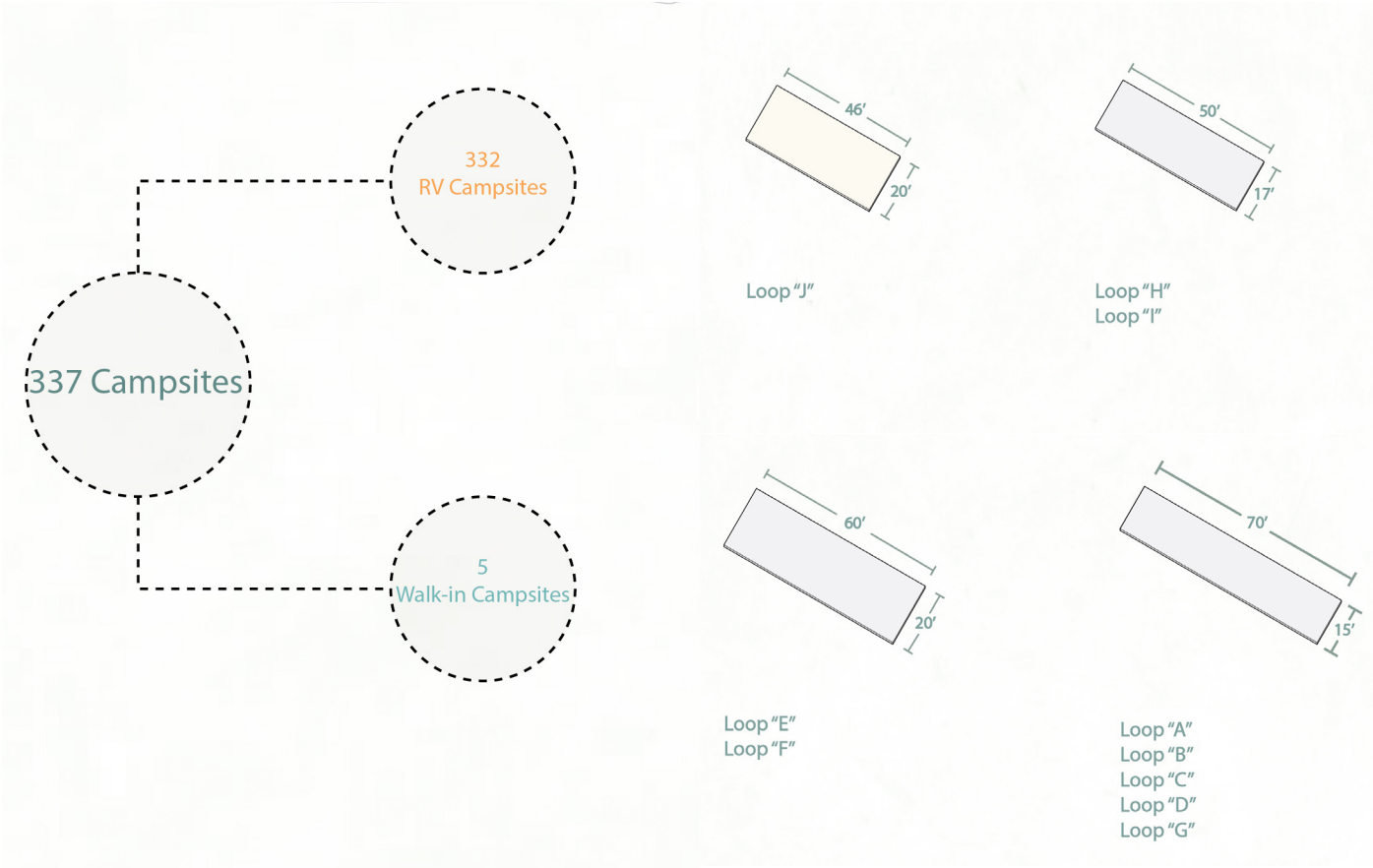
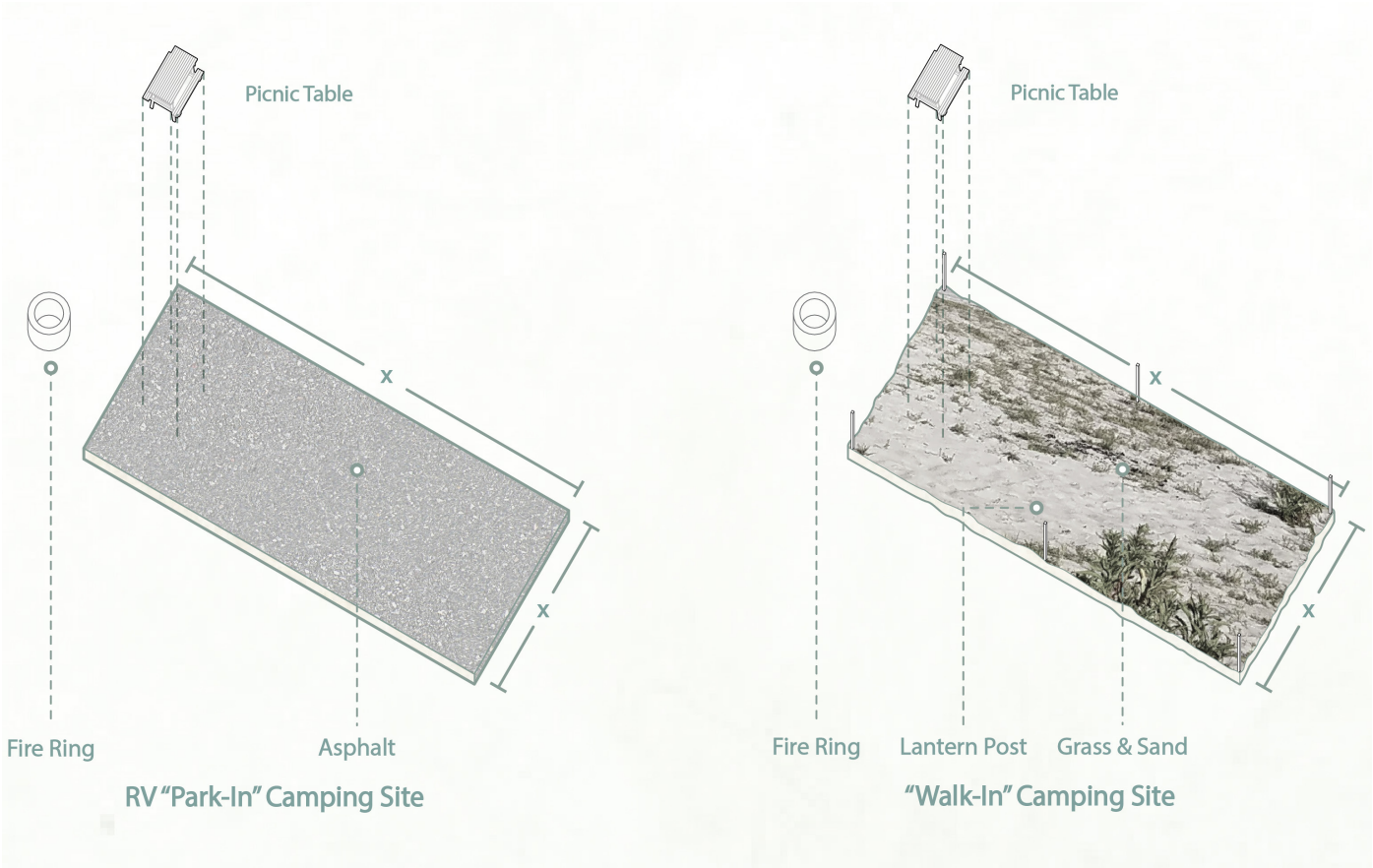
ABOVE Campsite catalog. (by Y. Konan)

RIGHT Campsite loops. (by Y. Konan)



Camp Loops H, I, J, and K





Campsite Characteristics

The park-in campsites, accessible by RV and car, are paved with asphalt and each contains a picnic table and fire ring. The sites range in size from 850 square feet (50' x 17') to 1,200 square feet (60' x 20').

The walk-in campsites are slightly smaller than most of the park-in sites, each with an area of 920 square feet (46' x 20'). The walk-in sites also house a fire ring and exterior seating; however, they are not paved. Rather, the sites follow the natural topography, with the existing grass and sand preserved. The campsites are levelled, with clay added to the paths and the sites delineated by posts along the perimeter.

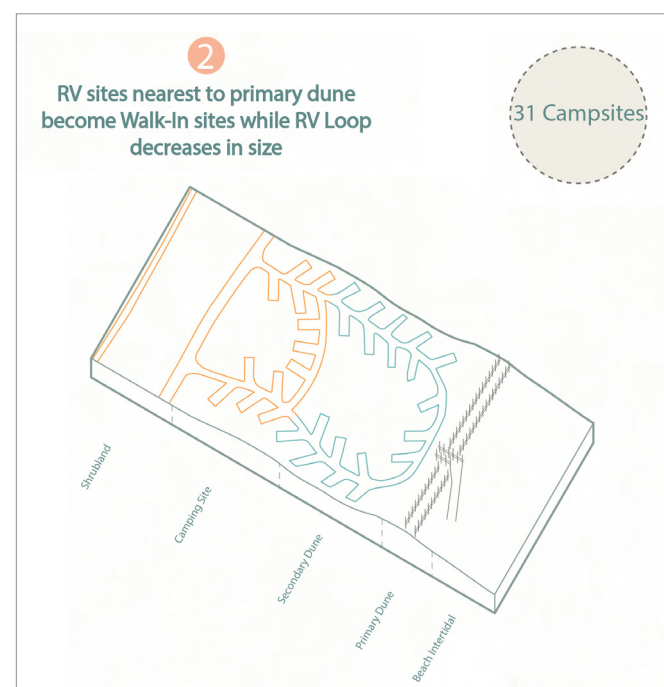
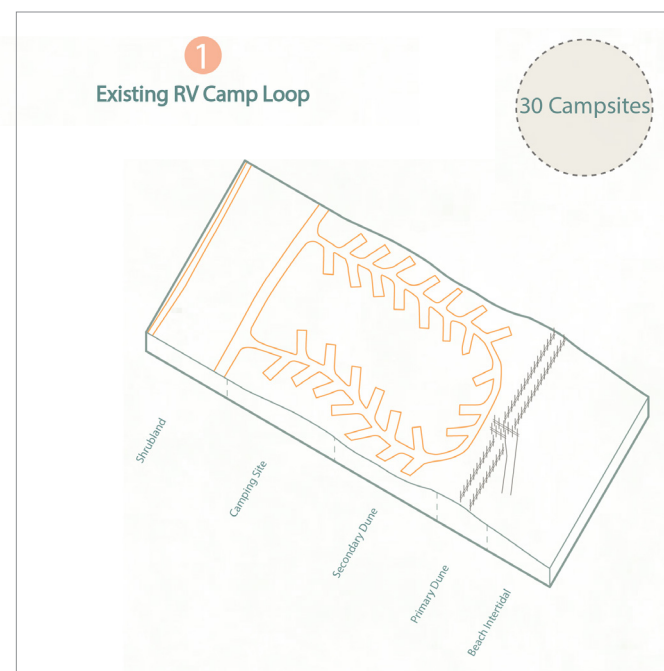
ABOVE Camp site types: RV "Park-in" camping site, and "Walk-in" camping site. (by Y. Konan)

CENTER View of typical campsite bathhouse. (by Y. Konan)

ABOVE RIGHT Campsite count and dimensions. (by Y. Konan)

BOTTOM RIGHT View of typical RV "Park-in" camping site.. (by Y. Konan)





Adaptive Campsites: From RV sites to Walk-in sites

To adapt the campsites to a changing climate, this proposal calls for transforming the existing park-in loops to hybrid loops that accommodate both park-in and walk-in visitors. This change is imagined as happening in phases over time. RV sites closest to the dune can be converted into walk-in campsites, with additional vehicular parking located adjacent to the loop along Campground Road. A smaller RV loop would be established closer to the road so as to continue to provide ample space for park-in campers while protecting the paved sites from dune migration and severe weather events. If a third sand fence were added to widen and reshape the dune, the RV loop could be further reduced in size while the area used for walk-in campsites could increase. Although this configuration would require a more compact arrangement of sites, the campsite layout could more nimbly respond to the topography of the secondary dunes, and will be more resilient to changes along Assateague's coast.

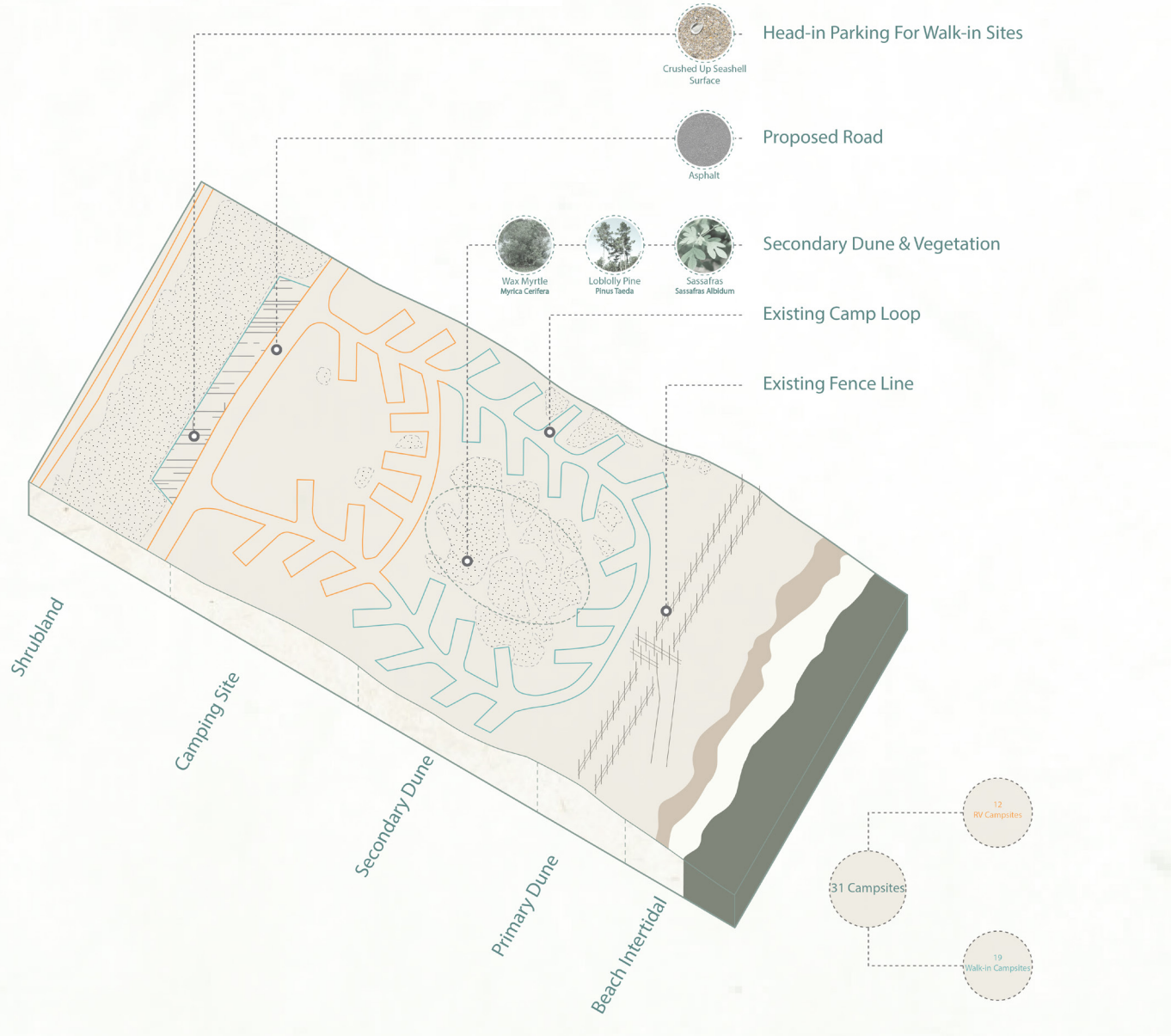
ABOVE RV camp loop F transformation sequence over time. (by Y. Konan)

RIGHT Existing RV camp loop F. (by Y. Konan)



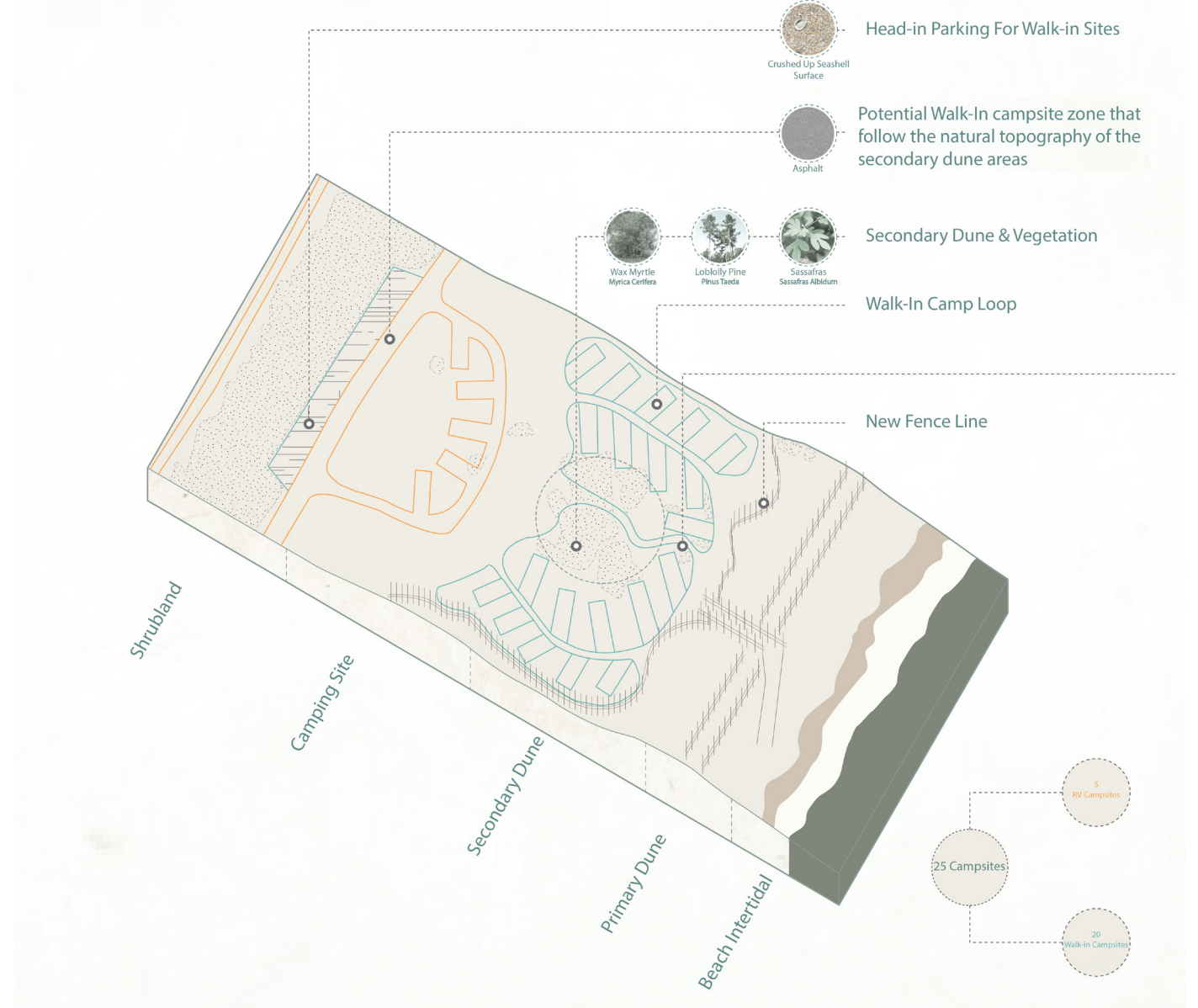
2

RV sites nearest to primary dune become Walk-In sites while RV Loop decreases in size



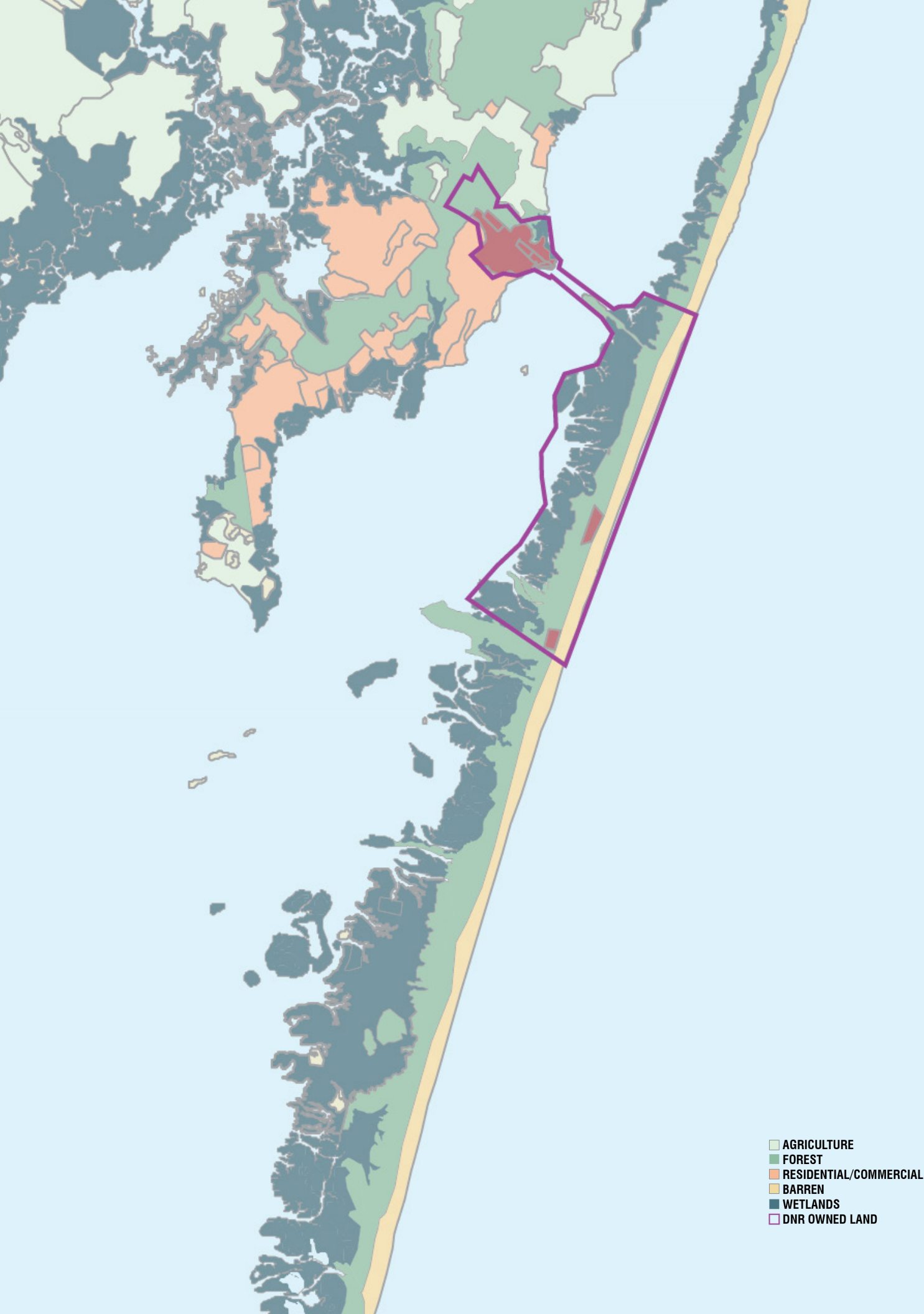
3

RV Loop reduces further in size and area for Walk-In spaces increases. Configuration of 3rd sand fence becomes flexible



ABOVE Proposed hybrid RV / walk-in camp loop F. (by Y. Konan)

RIGHT Proposed hybrid RV / walk-in camp loop F with limited RV camping and increased Walk-In campsites. (by Y. Konan)



Evolving Recreation: Rewilding Rum Pointe Golf Course

Over the next decades, sea level rise and frequent storms will likely cause large portions of Assateague Island to be lost to the bay and ocean. As the island narrows and campsites become increasingly difficult to sustain, land acquisition will become a tool necessary for providing safe camping opportunities and reducing maintenance costs of the campgrounds. By moving campgrounds and other facilities to the mainland, there may be greater opportunity to develop a plan for the state park that better ensures the sustainability and resiliency of the island itself.

Currently, Assateague State Park consists of a two-mile stretch of Assateague Island, as well as a portion of the mainland west of the Verrazano Bridge that houses the Assateague Island Visitor Center and the Rackliffe House. The mainland surrounding the state park’s facilities is composed primarily of wetlands, forests, and land used for agriculture. Some of the areas on the mainland around Assateague State Park may be able to support programming that will soon need to be moved off the island.

Of the potential properties, Rum Pointe Golf Course, a 212 acre property adjacent to the Rackliffe House, has the space, amenities, and bay access that would be needed to replace the existing infrastructure and amenities provided at Assateague State Park. Northwest of the golf course, the Ocean City Country Club also has a large land area and is located close to the state park and Ranger Station. Further south, the EA Vaughn Wildlife Management Area and the George Island Landing are owned by the Maryland Department of Natural Resources and could provide a cost-effective way to expand the footprint and amenities of the state park. However, because these two parcels are located more than 15 miles from the Ranger Station, their acquisition could impede access to the island and the park’s resources.

LEFT Land use surrounding Assateague Island. (by N. DiBella)

PRECEDENTS



ORCHARD HILLS PARK, CHESTERLAND, OHIO

237-ACRE

Formerly managed as a golf course, is in the process of reclaiming a natural landscape. Six trails total 3.6 miles. Children can have fun here on an orchard-themed playground. Restoration has been funded in part through a grant from the Ohio Environmental Protection Agency and U.S. Environmental Protection Agency under provisions of Section 319(h) of the Clean Water Act.

Amenities

- Athletic Fields
- Cross Country Skiing



FORESRT BEACH MIGRATORY PRESERVE, BELGIUM, WISCONSIN

116-ACRE

Located along Lake Michigan in the town of Belgium, Forest Beach Migratory Preserve was established in 2017. This preserve contains a 5-acre hardwood forest with seasonal ponds, open grassland and prairie, a partially wooded ravine and 5 constructed wetland ponds. Today the preserve hosts a "patchwork quilt" of habitats that support all kinds of migratory birds, reptiles and mammals.

Amenities

- Hunting
- Water Features
- Bird Watching



THE HIGHLANDS, GRAND RAPIDS, MICHIGAN

121-ACRE

Blandford Nature Center and the Land Conservancy of West Michigan collaborated on the purchase of the Highlands Golf Club in Grand Rapids in the winter of 2017 with a vision to transform the property into a natural area for community recreation and education. The vision to transform this former golf course into a premier space for learning, recreation and conservation is now a reality. The Highlands is a place where people of all ages can discover nature.

Amenities

- Hiking Trails
- Bird Watching
- Leashed Pets Allowed

Golf Course Rewilding

The acquisition and rewilding of Rum Pointe Golf Course could provide new habitat and amenities comparable to those currently available in the island portion of Assateague State Park. Like most other golf courses, Rum Pointe Golf Course today provides few ecological benefits while requiring extensive maintenance. Through rewilding, defined as the restoration of land to its uncultivated, self-regulated state, the golf course can provide multiple ecosystem services — increased biodiversity, temperature reduction, stormwater management — while some of its existing infrastructure can be adapted for use in the state park. Golf course rewilding practices have been adopted throughout the United States and have resulted in the creation of diverse habitats as well as the provision of recreational opportunities such as bird watching, hunting, and hiking.

ABOVE Precedents of golf courses transformed into biodiverse habitat. (by N. DiBella)

ABOVE RIGHT DNR owned land and acquisition opportunities. (by N. DiBella)

BOTTOM RIGHT View of Rum Pointe Golf Course. (image from www.rumpointe.com)



1 ASSATEAGUE STATE PARK (MAINLAND)

256 ACRES
.4 SQ. MILES
0.00 MILES FROM RANGER STATION

2 ASSATEAGUE STATE PARK (ISLAND)

692 ACRES
1.08 SQ. MILES
1.20 MILES FROM RANGER STATION

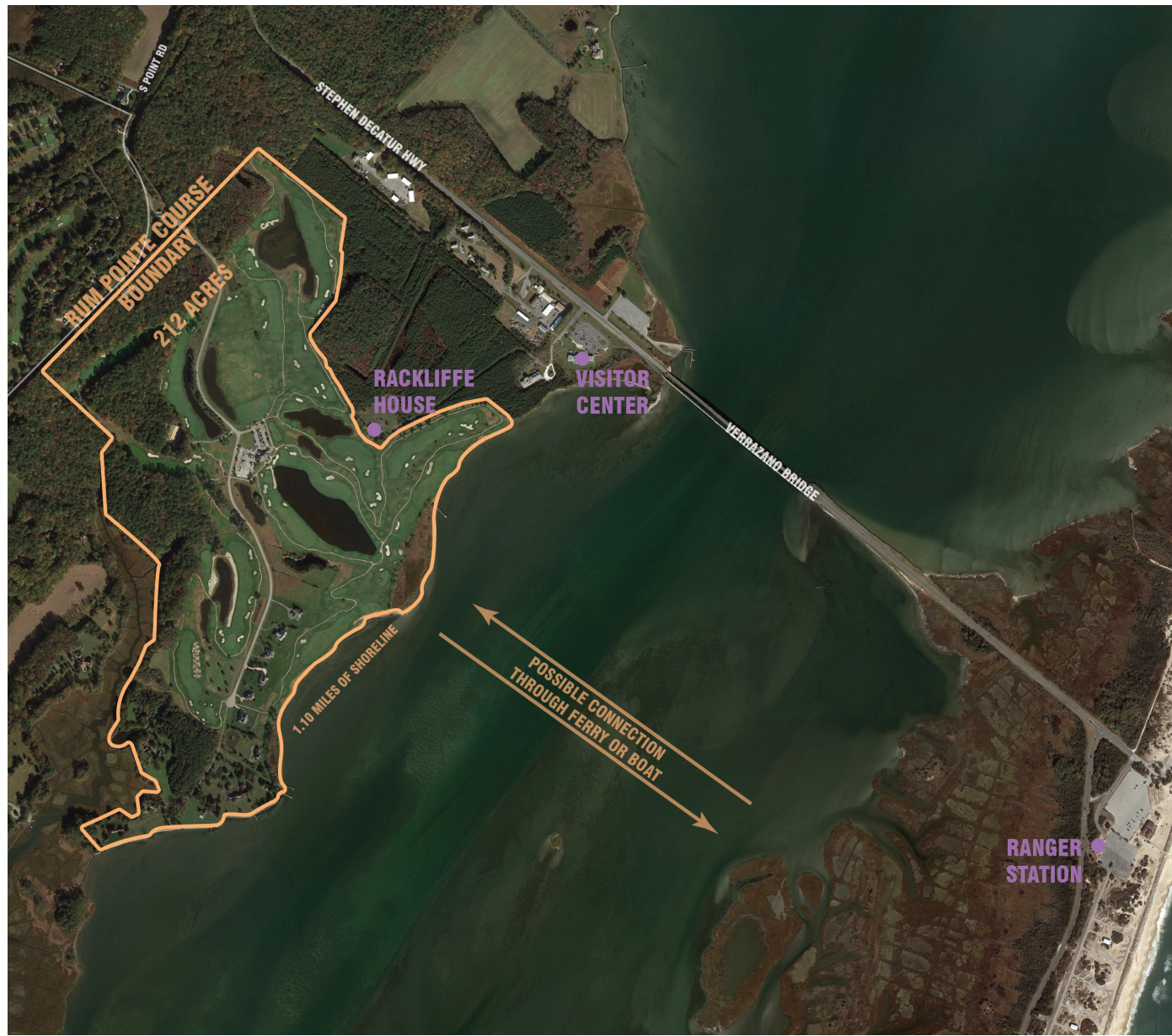
3 RUM POINTE GOLF COURSE

212 ACRE
.33 SQ. MILES
1.57 MILES FROM RANGER STATION

4 OCEAN CITY COUNTRY CLUB

455 ACRE
.71 SQ. MILES
2.42 MILES FROM RANGER STATION





Phases of Rewilding

The rewilding of Rum Pointe Golf Course would be a long-term process, requiring approximately ten years to reach a more natural state. In the proposed process, the first phase would involve removal of some existing buildings on the site and the beginning of reforestation. Trails could also start being constructed so as to connect the acquired land to the visitor center. The next phase would include targeted renaturalization projects including the establishment of meadows, pond fringe enhancement, and increased reforestation. Amenities such as camping sites, recreational fields, and a learning center could then be added throughout the site. Finally, a beachfront could be created through the addition of sand to the property's mile-long shoreline.

Through these strategies, there would be new opportunities and amenities for park visitors. For example, the newly developed RV camping sites could hook up to electricity and water, amenities that are not currently available at most campsites on the island. The island could then be used less intensively while still being easily accessible through boats passing from the mainland to Assateague Island.

ABOVE Rum Pointe land acquisition and rewilding of golf course. (by N. DiBella)

RIGHT Proposed phases of rewilding of golf course. (by N. DiBella)



PHASE 1: DECONSTRUCTION



PHASE 2: RE-NATURALIZING



PHASE 3: ADDING AMENITIES



PHASE 4: BEACH FRONT

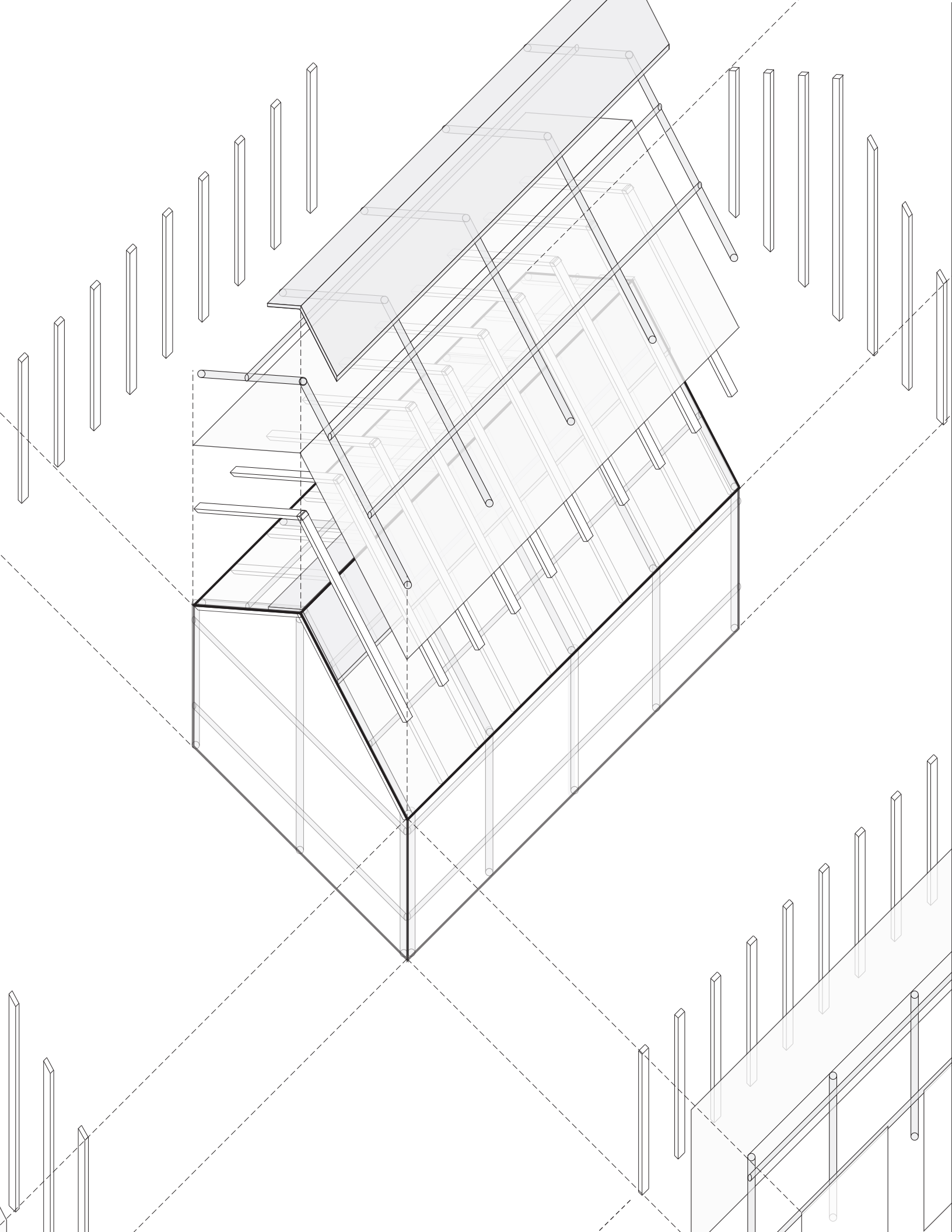
03

Park Architecture

Ranger Station Building and Landscape Design

The redesign of the Ranger Station at Assateague State Park is an opportunity to create a new and welcoming point of arrival to the park. The design proposals on the following pages illustrate how passive solar and ventilation strategies can be creatively employed in the building. Case study projects, along with local indigenous and vernacular building practices were studied to derive design principles. The original program requirements have been expanded to include the design of a public, educational landscape, a space where visitors can gather to learn about the ecologies of the island and dynamic processes that shape it. The proposals also re-imagine the Ranger Station parking lot as a landscape shared by people and cars, which offers a new, shaded pedestrian path between the Ranger Station and the Pony Express.

LEFT View of Ranger Station. (by Y. Konan)

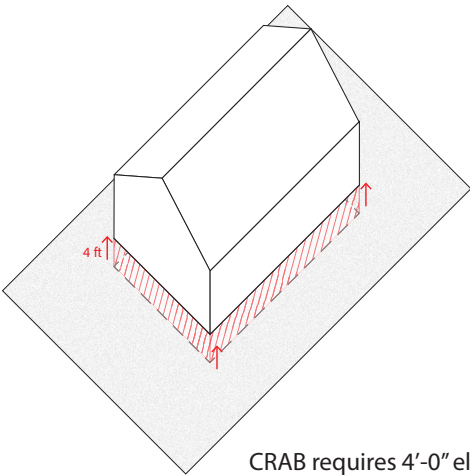


Resilient Architecture: Kit of Parts and Precedents

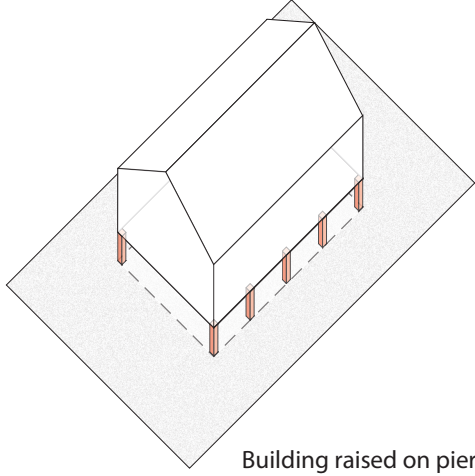
The approach to climate adaptation and resilient architecture illustrated in the following chapter is centered on the idea that some of the most resilient and climate-adapted buildings include materials and techniques derived from local ecosystems, landscapes, and building cultures. Whether that means the construction materials themselves are harvested from nearby landscapes and processed using Traditional Ecological Knowledge (TEK) or that the building form takes its cues from vernacular techniques and regional crafts evolved over time through experimentation, close observation, and trial and error.

The kit of parts drawings included here show a variety of flood-ready elevated buildings that comply with the Maryland Coast Smart Climate Ready Action Boundary (CRAB) guidelines. Also shown are examples of buildings adapted to local wind and solar patterns for passive, low energy heating and cooling. Finally, drawing heavily from precedent examples, building tectonics that improve the durability and structural capacity of natural materials are illustrated in this chapter along with building layouts that maximize efficiency and multi-use spaces.

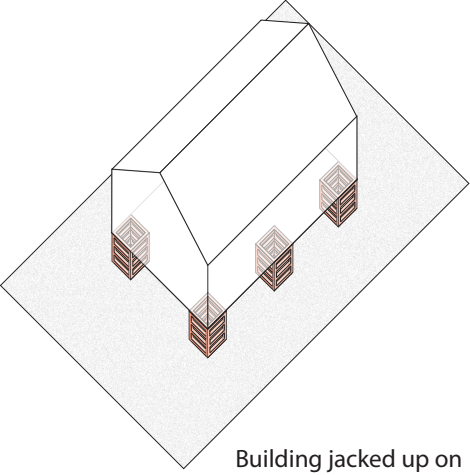
LEFT Multiple layers of cladding (like layers of clothing) help a building withstand winds and weathering. (by R. Shatkey)



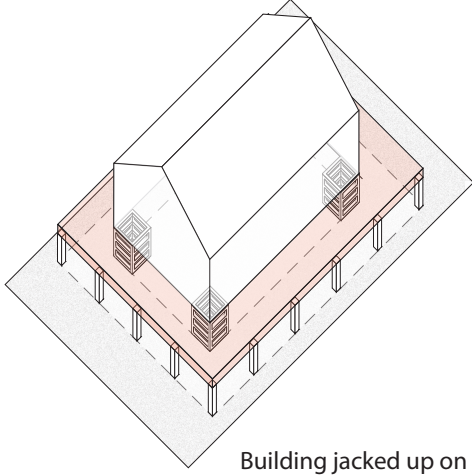
CRAB requires 4'-0" elevation from ground to finished floor



Building raised on piers



Building jacked up on wooden shipping pallets



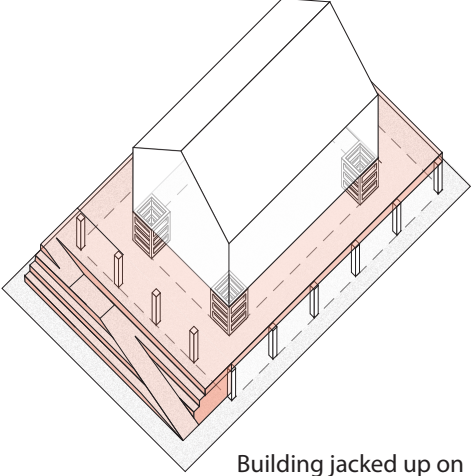
Building jacked up on pallets covered by wrap-around deck with piers

Meeting CRAB Guidelines

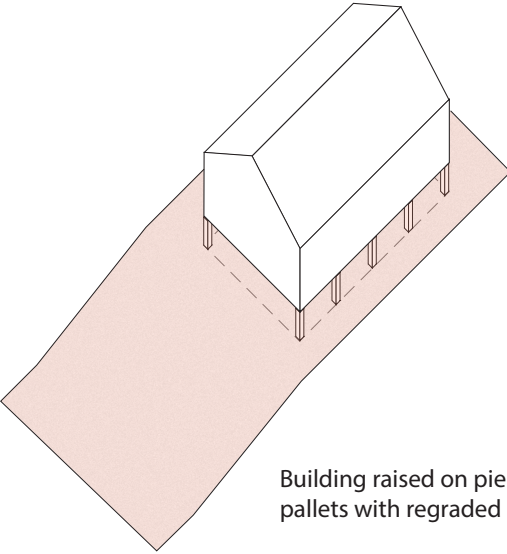
Under the guidance of the Maryland Department of Natural Resource (DNR), Maryland Environmental Service (MES) in partnership with the Maryland Department of Environment (MDE) and the Coast Smart Council have identified a Climate Ready Action Boundary (CRAB) Elevation for new projects in Inundated Zones. The CRAB elevation adds 3 feet to the FEMA Base Flood Elevation plus one additional foot to reach the height of the building's finished floor.

A range of strategies, from using inexpensive wood pallets and stair-ramps to infilling with soil and landscaped berms, can be employed to meet the CRAB Elevation and maintain wheelchair accessibility. Mobile and floating buildings are also options to consider for flexible flood adaptation. The Architectural Precedents section of this booklet offers examples of constructed projects adapted to flood conditions.

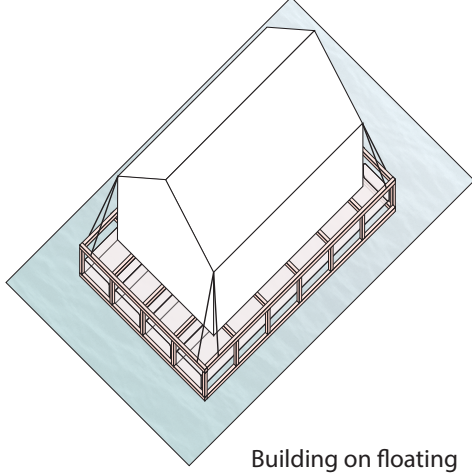
ABOVE AND RIGHT Building adaptations for rising sea level and frequent flooding. (by R. Shatkay)



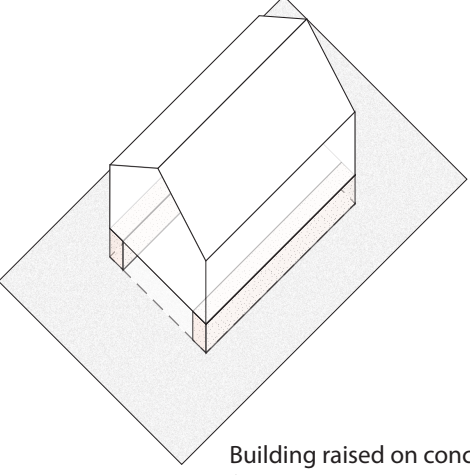
Building jacked up on pallets covered by wrap-around deck and stair-ramp



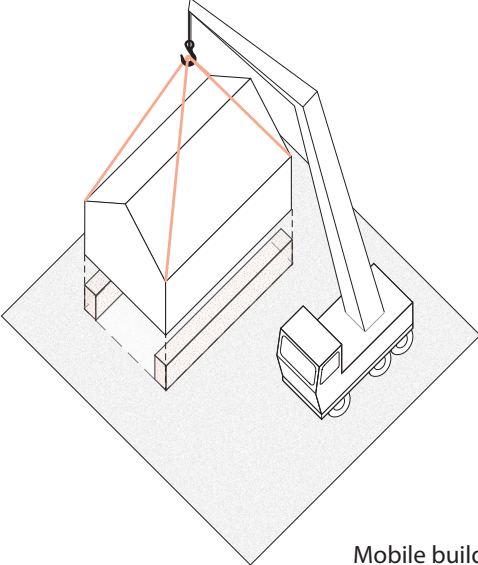
Building raised on piers and pallets with regraded landscape



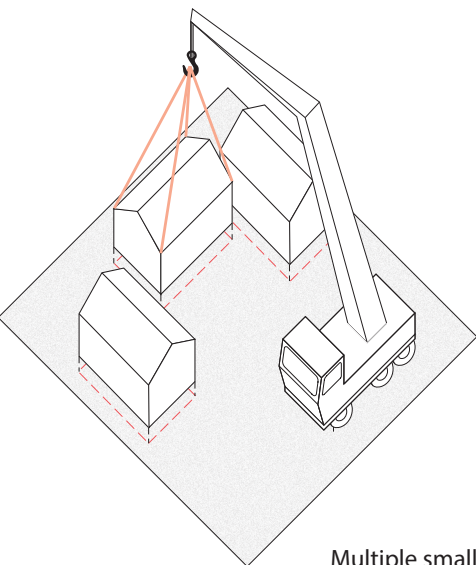
Building on floating raft foundation



Building raised on concrete foundation walls

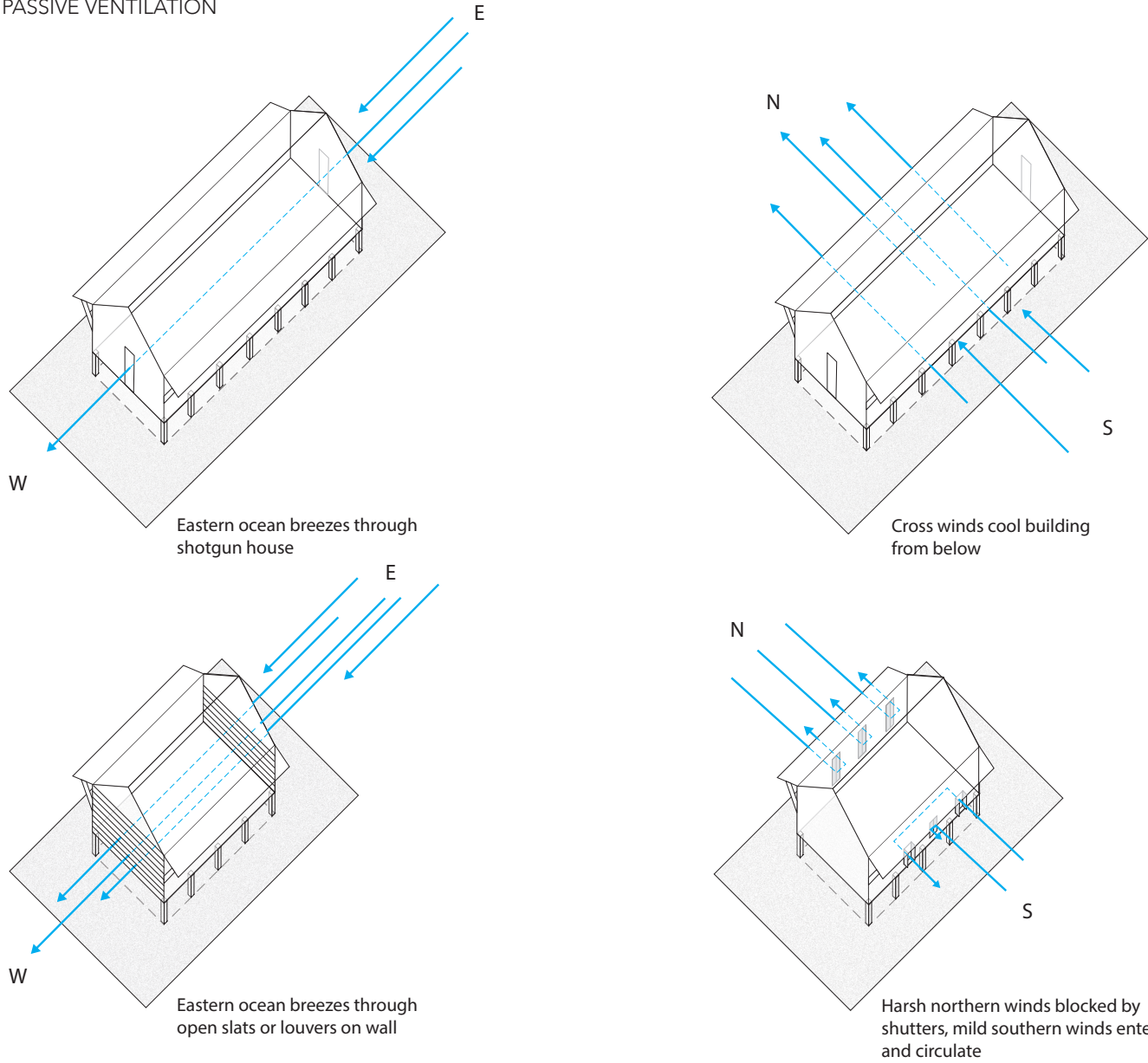


Mobile building on concrete foundation walls



Multiple smaller buildings that are lighter to lift

PASSIVE VENTILATION

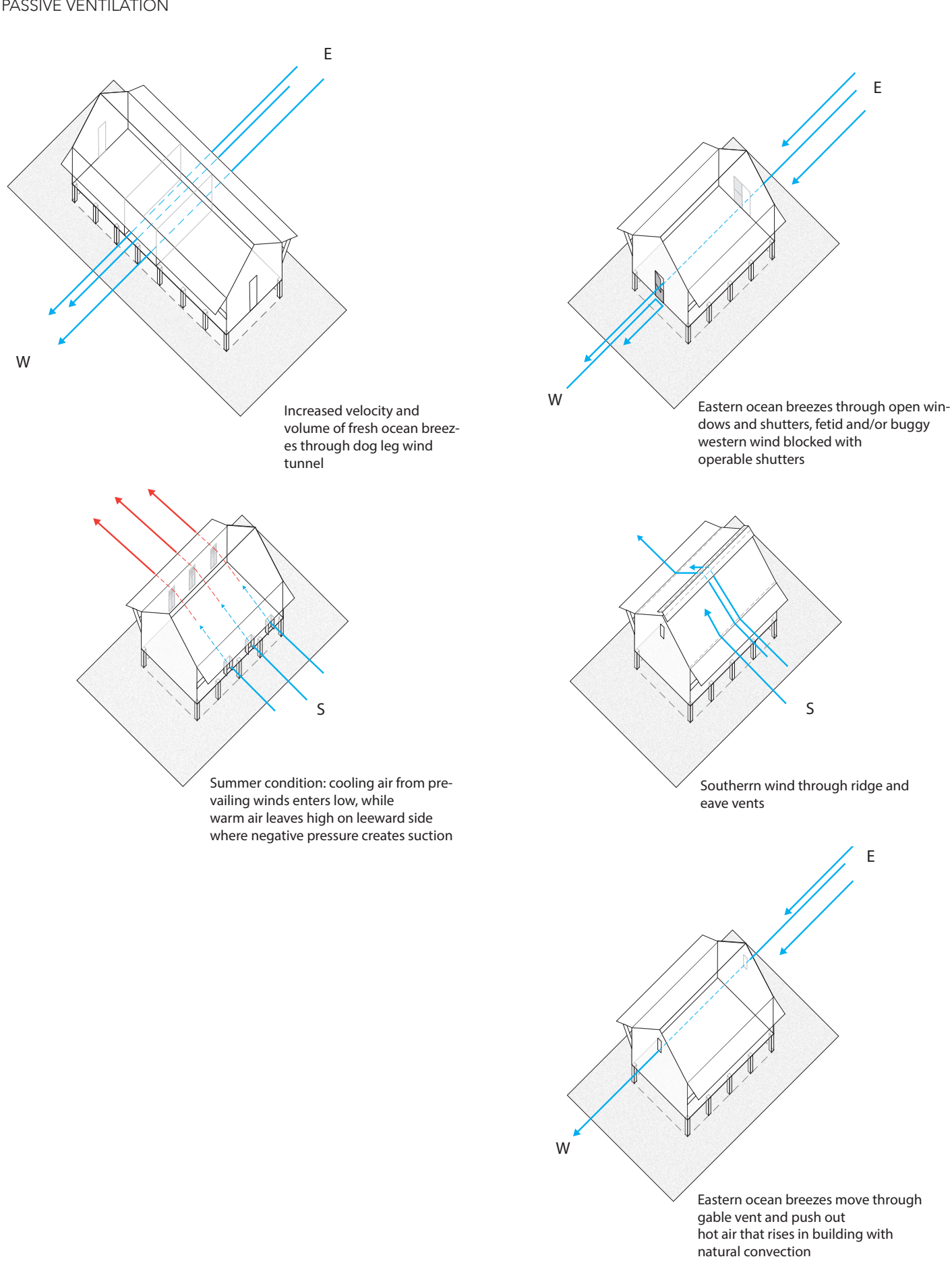


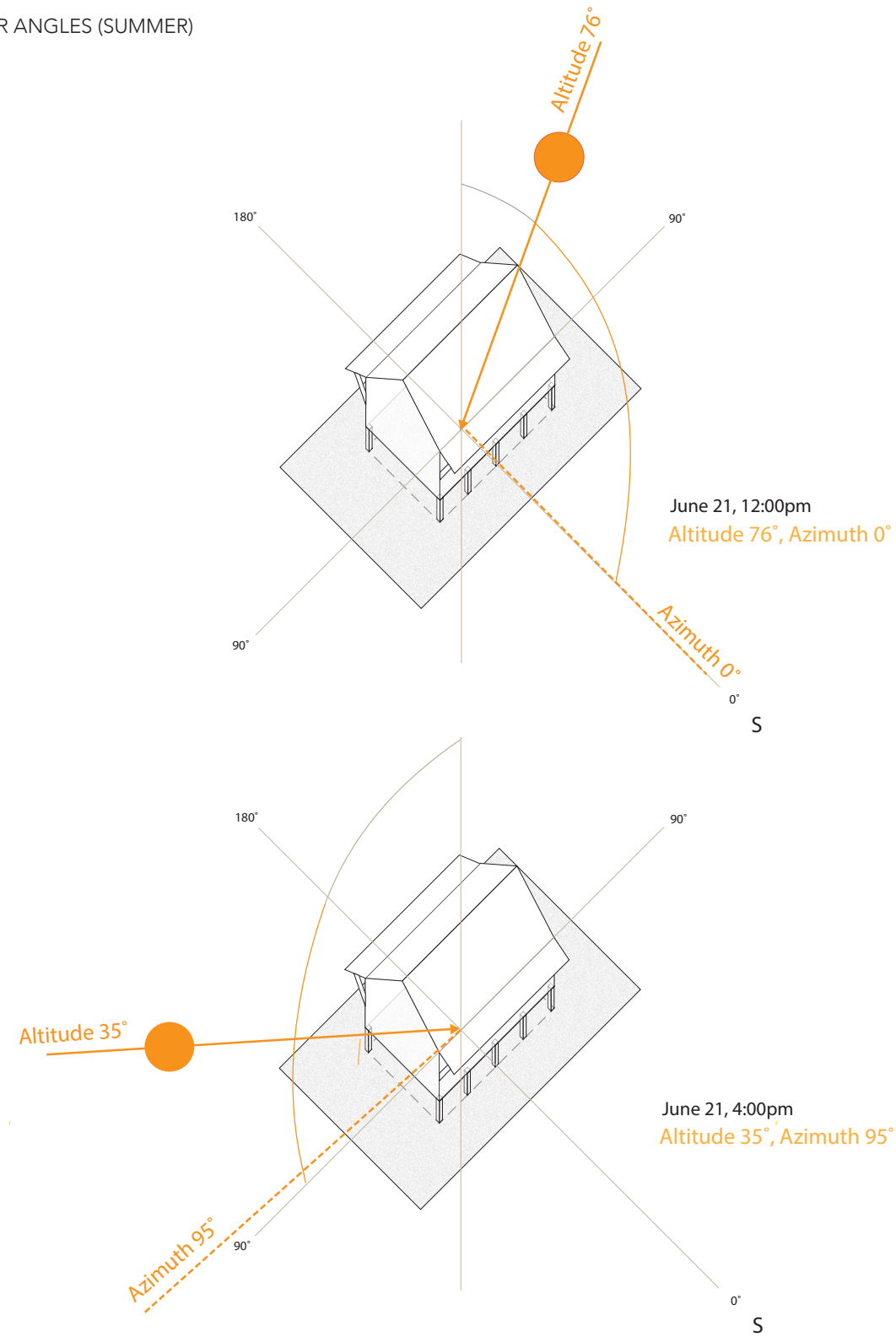
Passive Ventilation

The careful placement of openings in the building envelope and the form of the building itself can greatly improve thermal comfort for inhabitants. Passive ventilation strategies also improve indoor air quality, reduce energy costs, and protect a building from wind damage. Agricultural buildings like corn cribs, tobacco barns, spring houses, and ice houses offer ingenious techniques for modulating the flow of wind and air through the building envelope to control indoor temperature and humidity levels. The work of Glen Murcutt in the Architecture Precedents section of this booklet is a great example of vernacular techniques for passive ventilation in a contemporary context.

ABOVE AND RIGHT Traditional passive ventilation techniques adapted to prevailing winds and site conditions at Assateague Island. (by M. Ezban)

PASSIVE VENTILATION

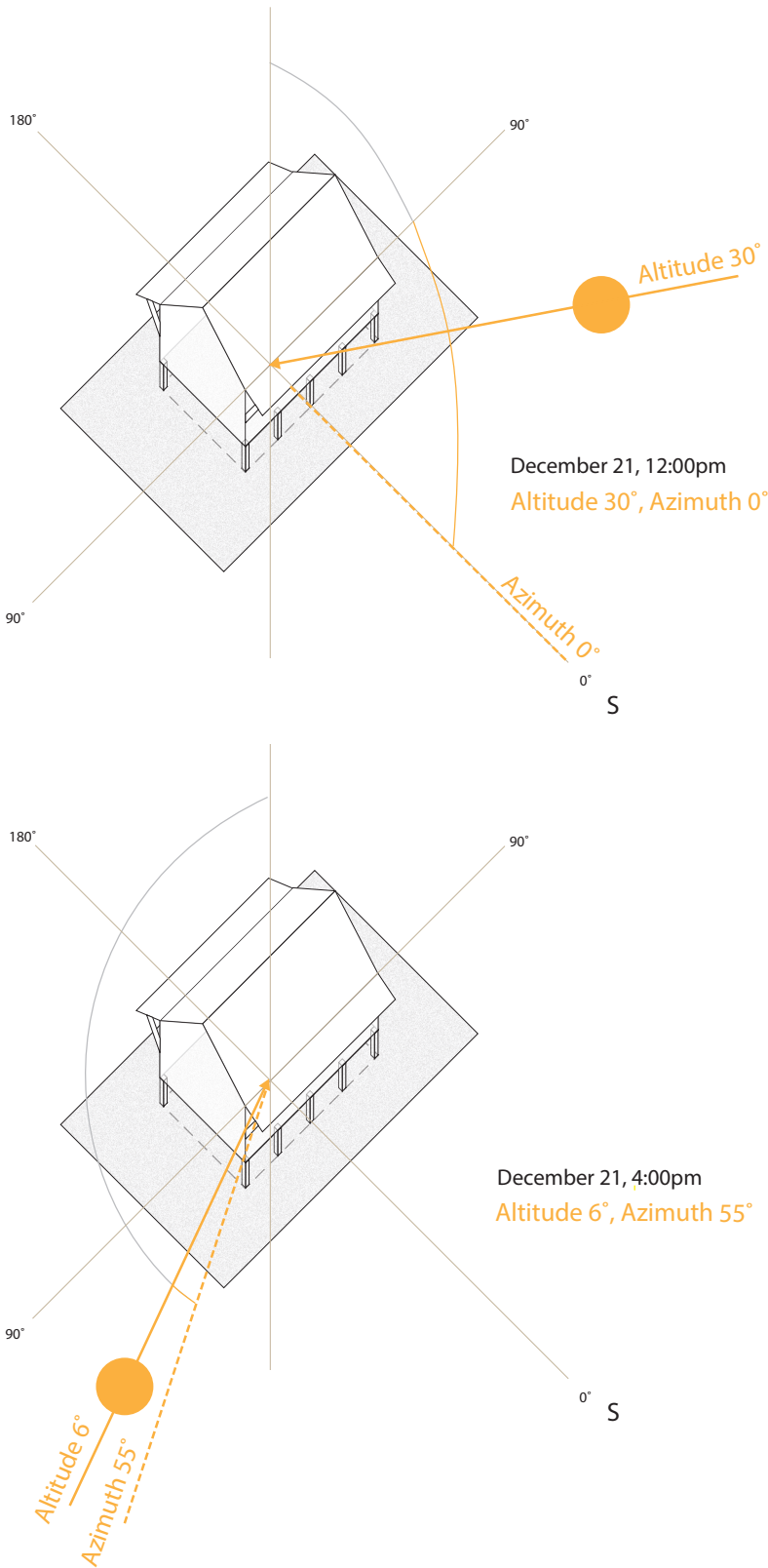


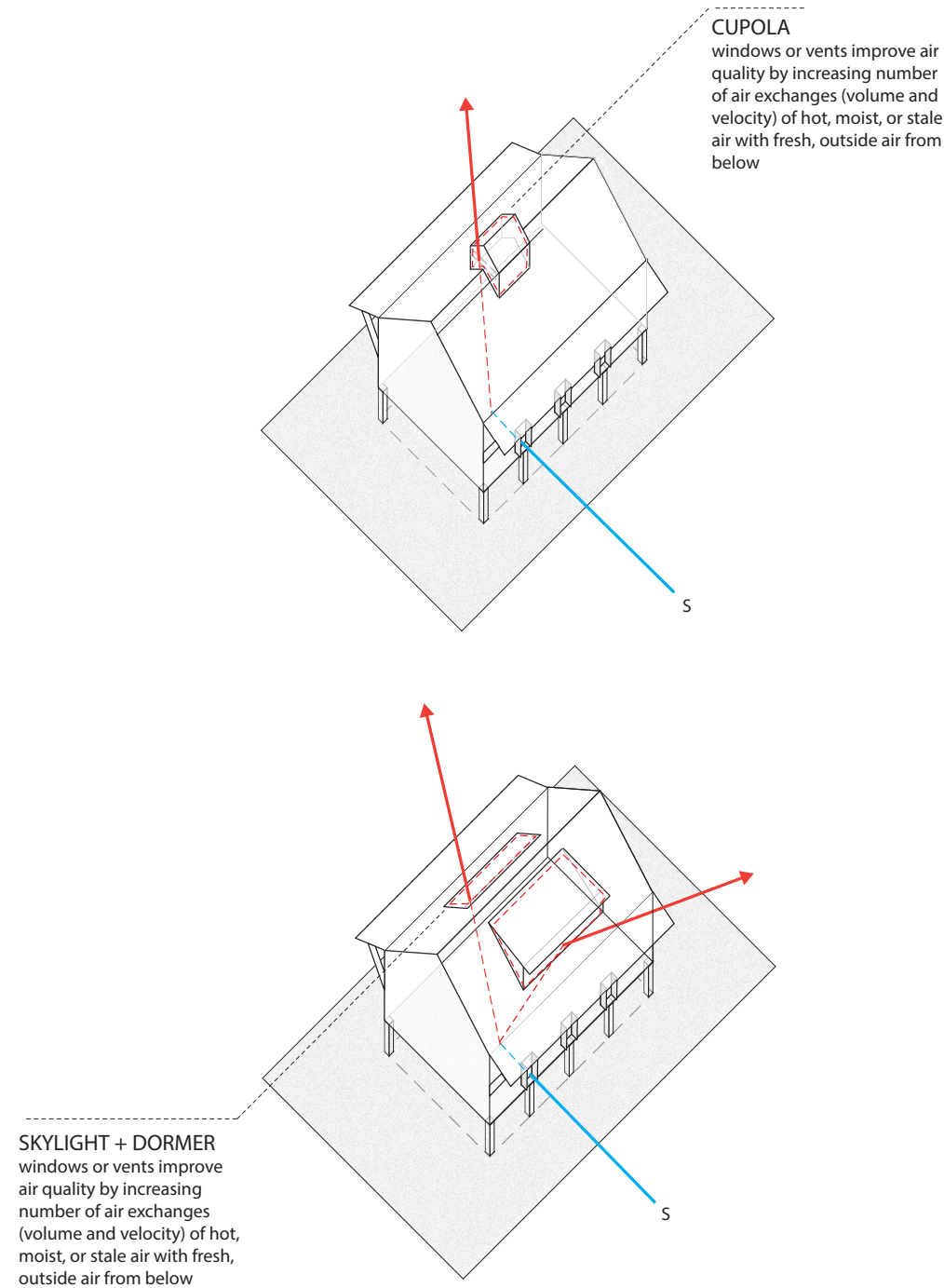


Sun Angles at Assateague Island

The sun path changes throughout the year and depends on lines of latitude. Assateague Island is located in the temperate zone where the sun arcs South and creates four seasons. Strategies for solar design differ based on solar orientation. As a general rule, passive solar design is easier to maximize on south-facing building facades. In temperate climates of the Northern hemisphere, buildings designed for passive solar heating, cooling, and daylighting often have elongated southern faces.

ABOVE AND RIGHT Primary solar angles in summer and winter at Assateague Island, shown on a building with the longer face oriented to the south. (by M. Ezban)

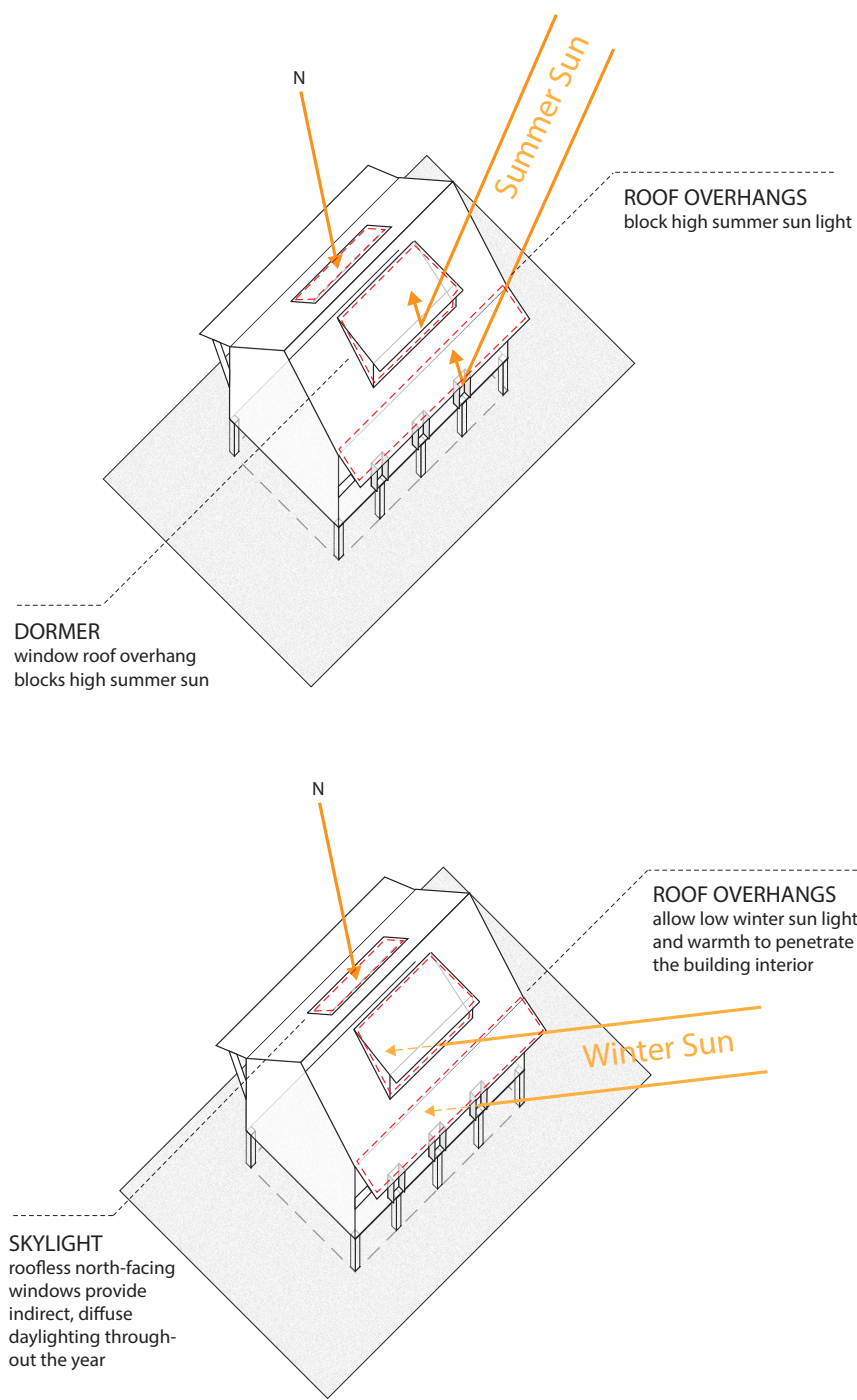


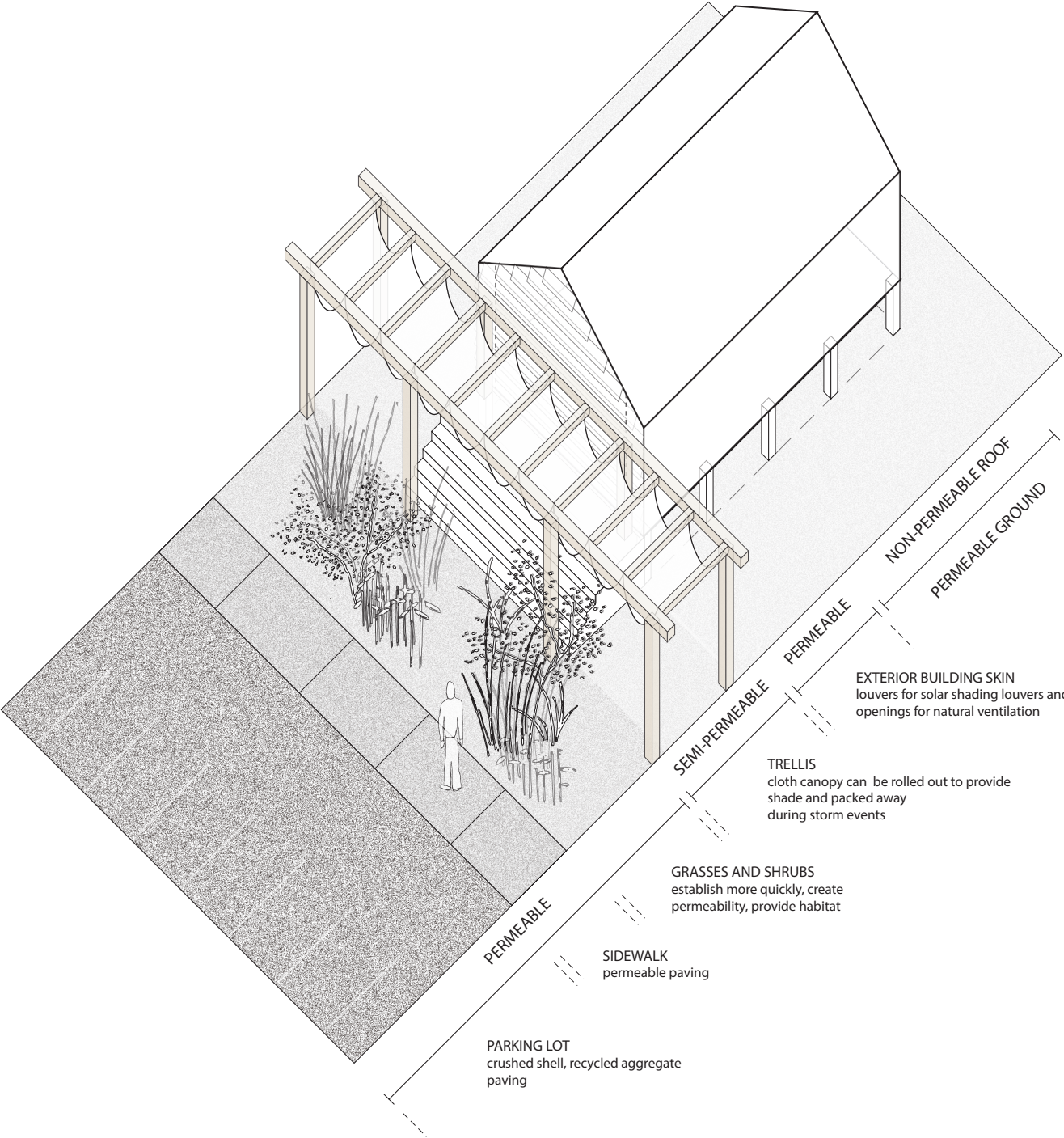


Roof Design

A well-designed roof protects a building from weathering and temperature extremes. Generous overhangs keep rain and snow off of exterior walls and away from foundations and shade windows in the summer. Roof pitch determines how rain, snow, and winds interact with the building. Dormer windows, skylights, and cupolas designed as part of the roof are effective ways to provide consistent amounts of natural daylighting and effective passive ventilation (using the stack effect where warm air rises) through diurnal and seasonal shifts.

ABOVE AND RIGHT Roof elements for natural daylighting and passive ventilation. (by M. Ezban)



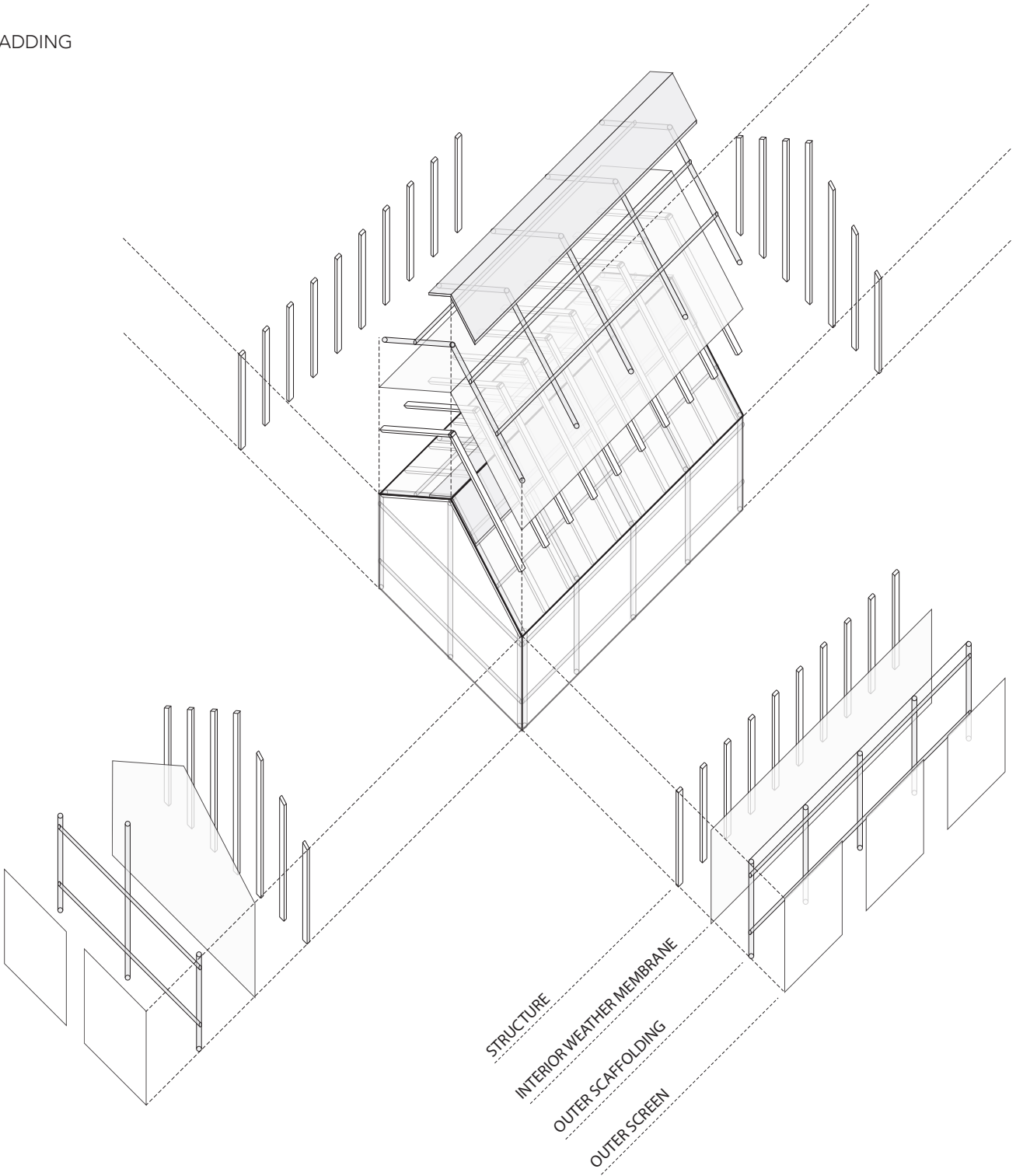


Layering Ecotones

Varying the permeability of spaces that lead from the building interior to the outside perimeter of the building, as well as the adjacent landscape, creates a diversity of microclimates for people, plants, and wildlife. Permeability can apply to sunlight exposure, sense of enclosure, and the ability of construction materials to support ground permeability and infiltration. Variety supports ecological resiliency in the landscape as well as flexible use of space throughout seasons as weather conditions and human activity patterns shift.

ABOVE Variety of permeability supports ecological resiliency and flexible use of spaces. (by R. Shatkay)

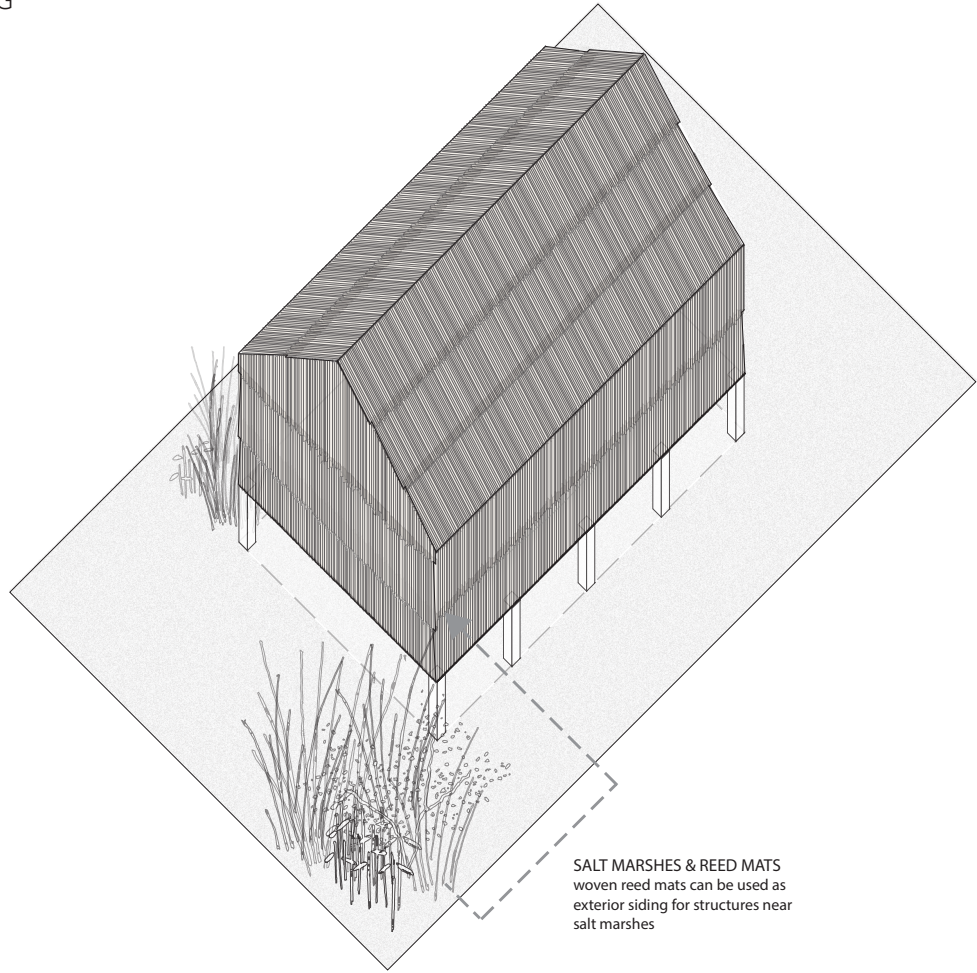
RIGHT Building the cladding from inside to outside. (by R. Shatkay)



Cladding Systems

Wigwam construction techniques used traditionally by tribes of the Chesapeake Bay area use cladding, or layering materials, to create a multi-functional building enclosure. The Architectural Precedents section of this booklet offers examples of cladding systems of indigenous wigwam structures as well as contemporary projects by Bates + Masi Architects with adaptations of traditional wood exterior siding details. Alternating layers of skin and frame allows users to remove or adjust the outer and inner layers to maximize thermal comfort and prepare the building for different weather conditions. Using multiple layers in a cladding system also maximizes the longevity of natural materials used in construction. The outermost layer acts as a rainscreen, guards against wind and salty air, and can be replaced with less expense.

REED MAT SIDING



SALT MARSHES & REED MATS
woven reed mats can be used as
exterior siding for structures near
salt marshes

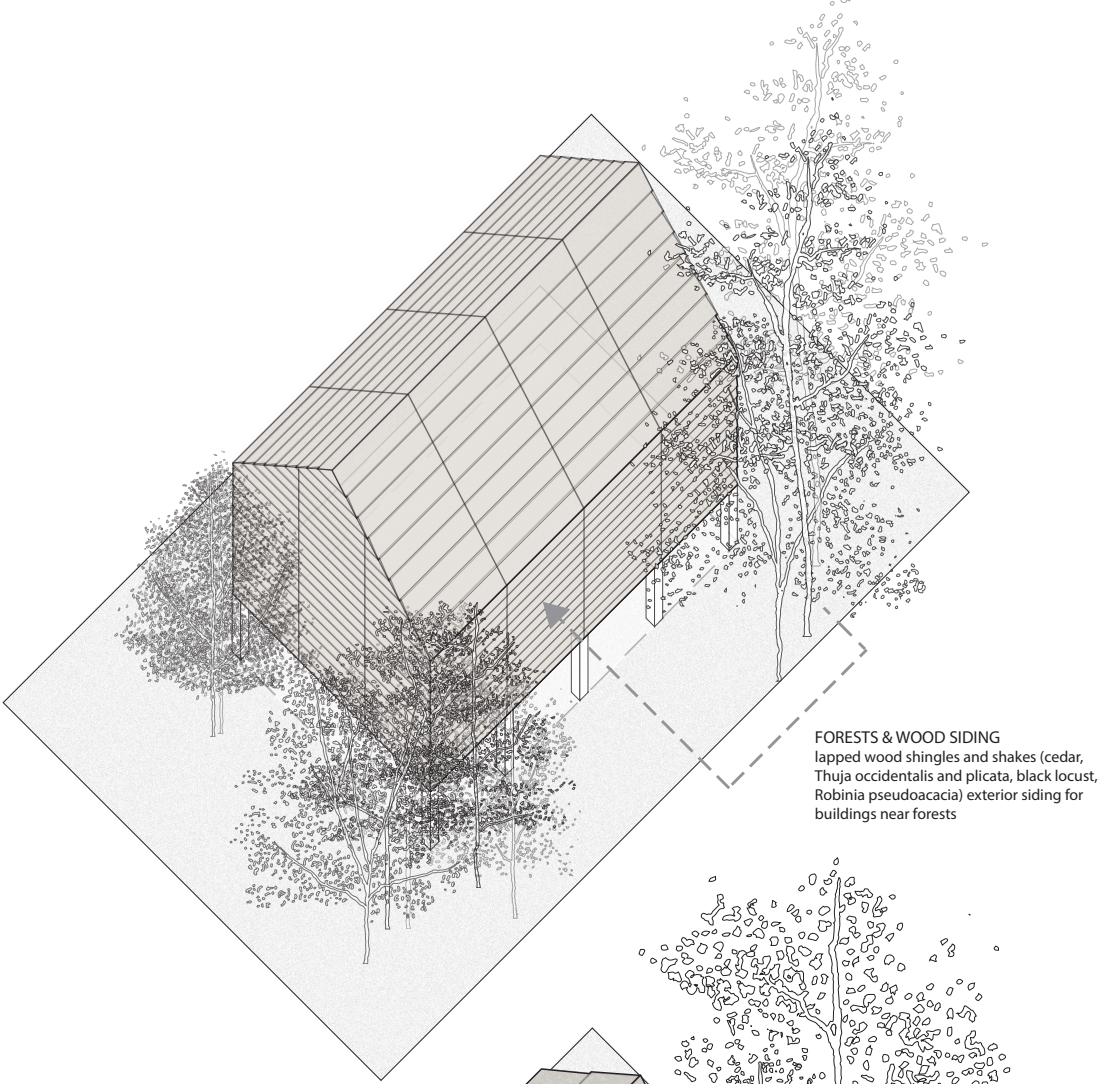
Building Materials and Ecosystems

As a response to climate change, building designers are increasingly asked to use low-carbon and non-toxic building materials. The most progressive projects also center biodegradable, minimally processed, carbon positive raw materials for major portions of the building, such as the structural frames and exterior skin enclosure.

Traditional Ecological Knowledge (TEK) preserved by indigenous tribes and regional building craft communities is a source of technique for harvesting, processing and putting climate responsive materials together to create buildings that are literal extensions of the ecosystems and landscapes in which they are constructed.

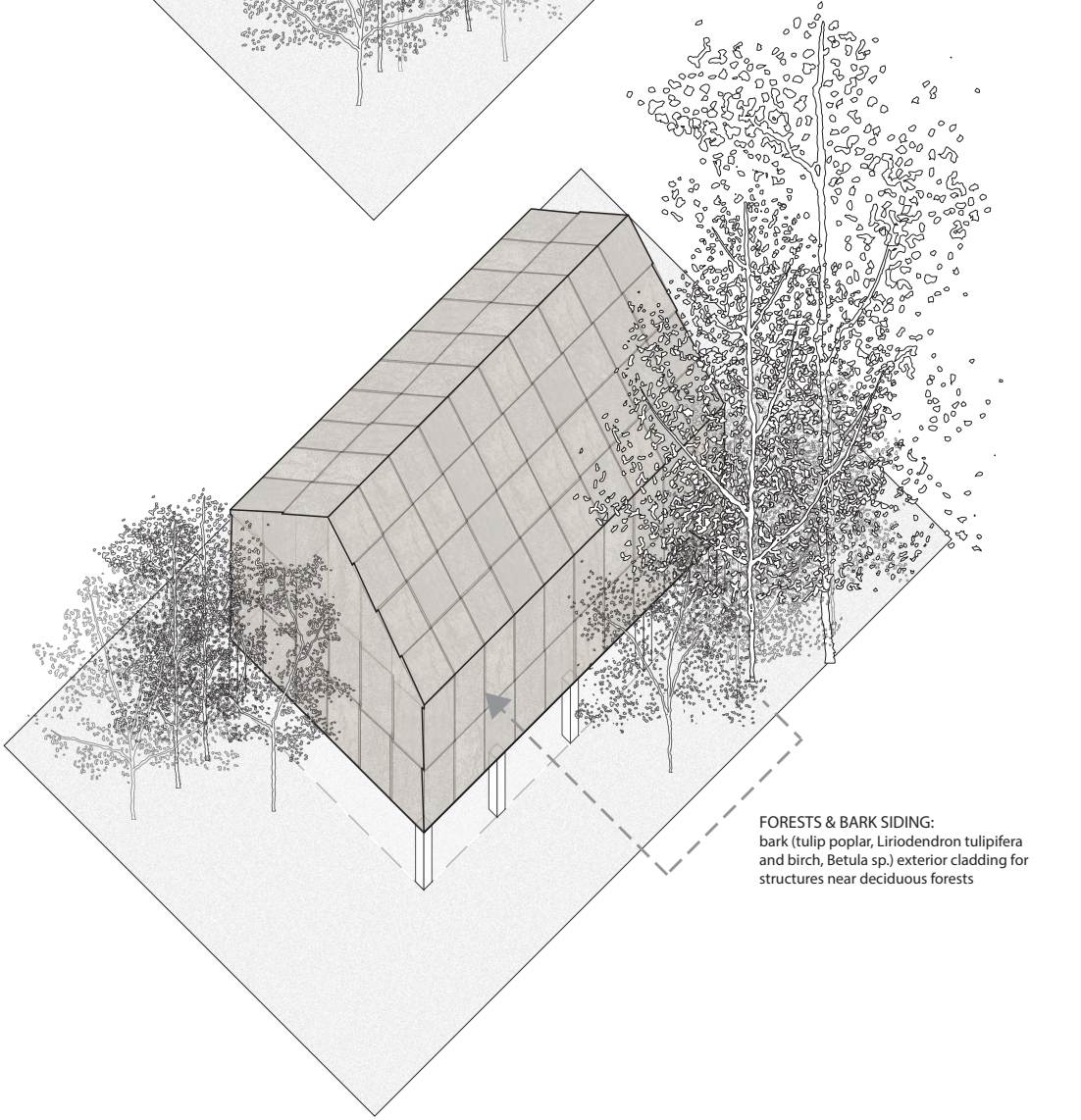
ABOVE AND RIGHT Cladding materials
derived from landscape ecosystems of the
Chesapeake Bay region. (by R. Shatkay)

WOOD SIDING

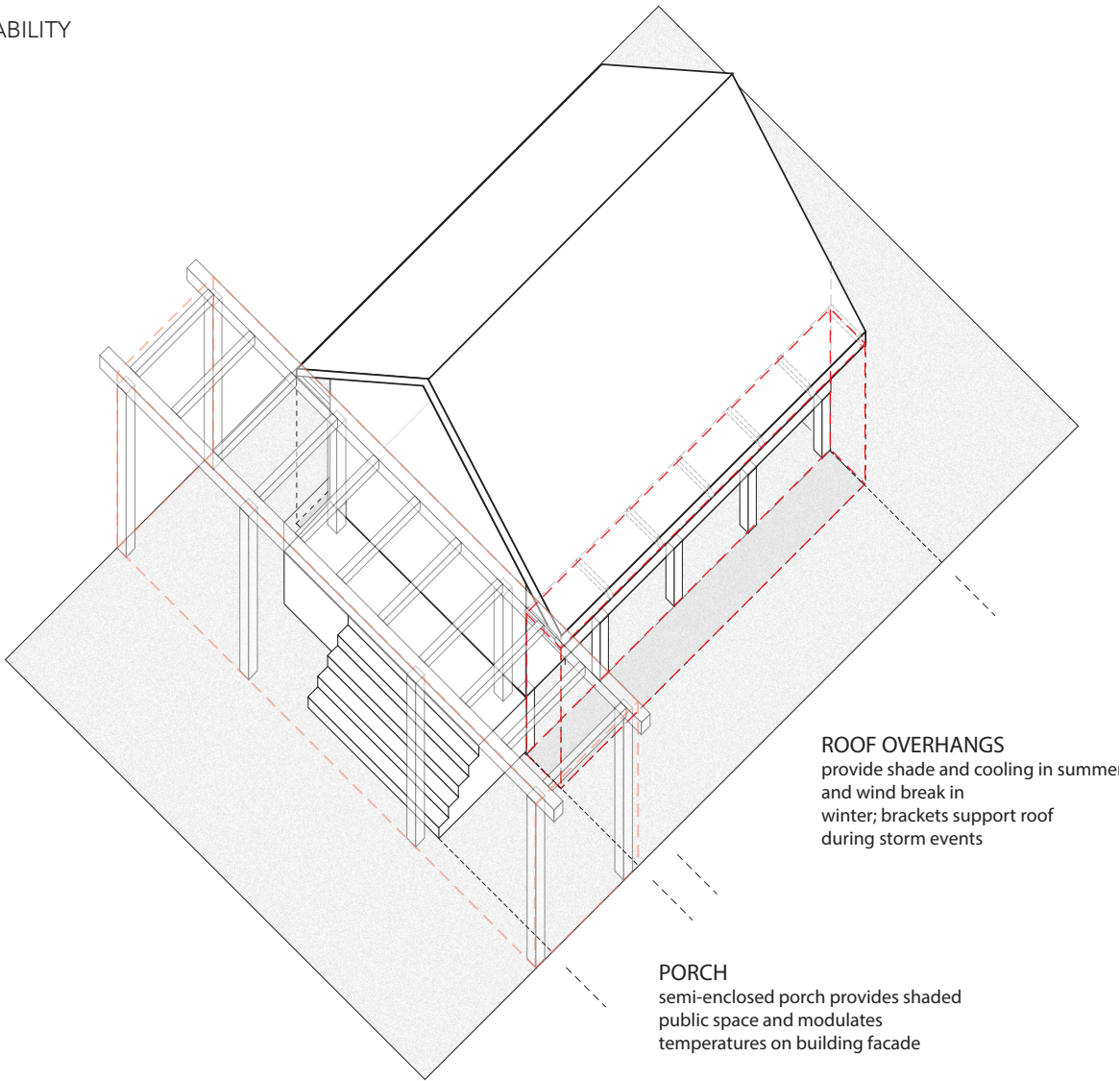


FORESTS & WOOD SIDING
lapped wood shingles and shakes (cedar,
Thuja occidentalis and plicata, black locust,
Robinia pseudoacacia) exterior siding for
buildings near forests

TREE BARK SIDING



FORESTS & BARK SIDING:
bark (tulip poplar, Liriodendron tulipifera
and birch, Betula sp.) exterior cladding for
structures near deciduous forests



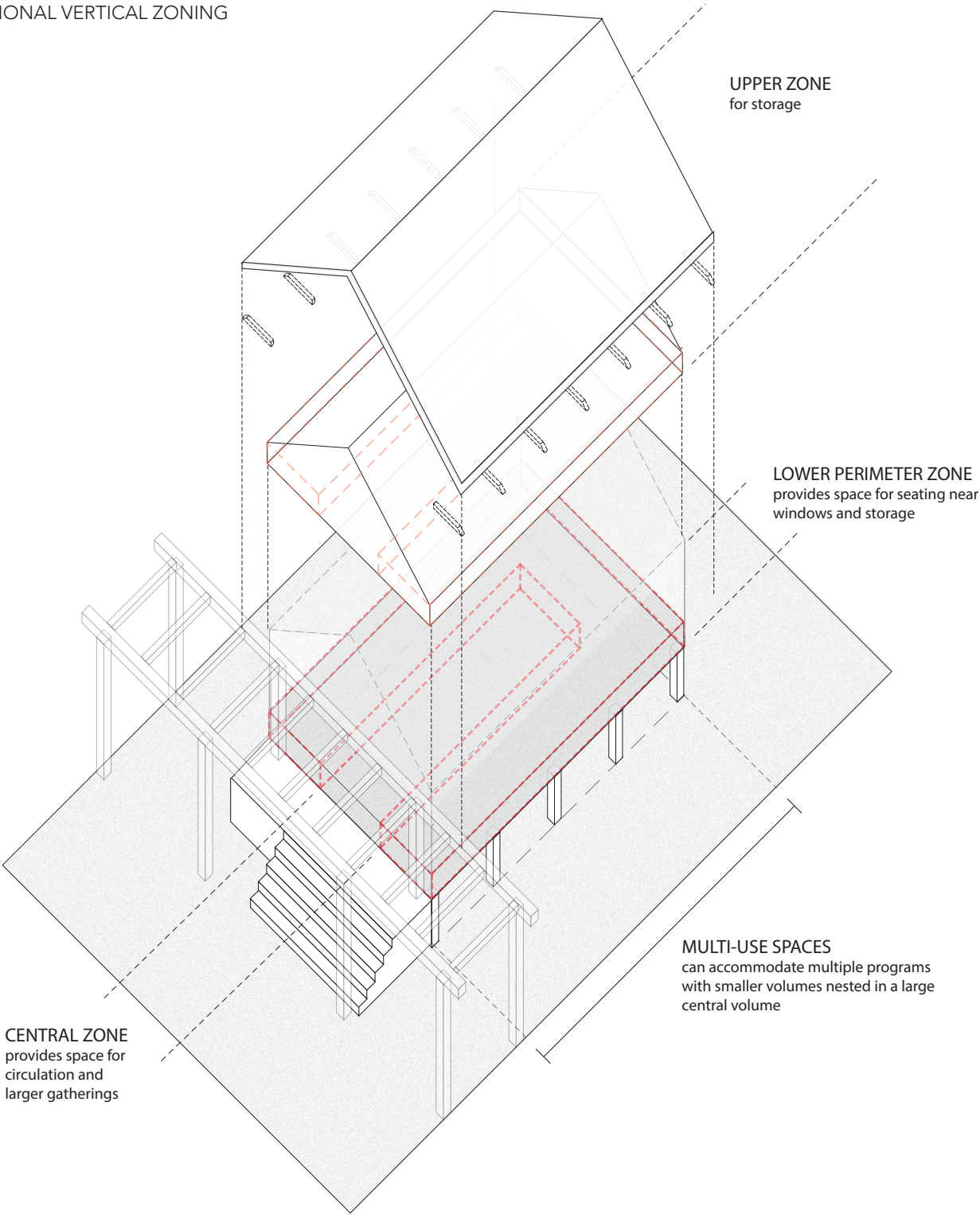
Multi-use Space Planning

The Architecture Precedent section of this booklet offers examples of buildings that zone interior and exterior spaces for multiple uses. The front porch not only acts as a threshold and symbol of entry to a building, but it also is a place for socializing and seeking protection from the weather. It can act as an extension of the main, public interior space. The area under roof overhangs can, on similar programs, perform as semi-private porches protected from the elements and become an extension of semi-private interior spaces.

Interior spaces divided into vertical zones can maximize storage by locating it below seating and above at the mezzanine level. Storage zones can wrap the perimeter of the main public gathering spaces without necessarily requiring separate rooms or closets. The indigenous long house is an example of this clear spatial zoning of one large multi-use space that allows for public and private activities and storage.

ABOVE Multi-functional zones on the building exterior. (by R. Shatkay)

RIGHT Multi-functional zones on the building interior. (by R. Shatkay)



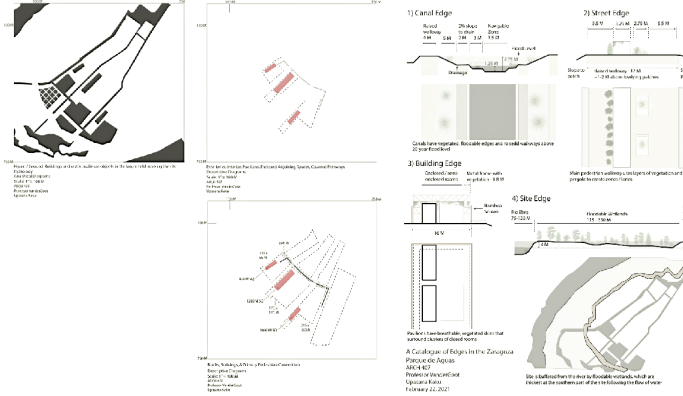
Japan, 4 BCE-present
Ise Shrine



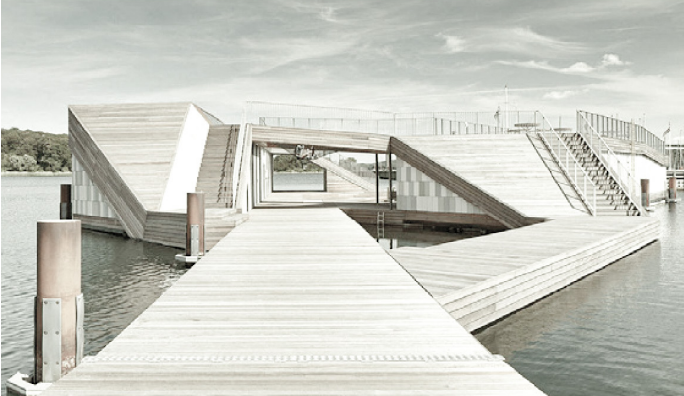
NLE/Kunle Adeyemi
Floating School



Alday Jover
Zaragoza Water Park, Exhibition Pavilions



Force 4 Architects
Floating Kayak Center



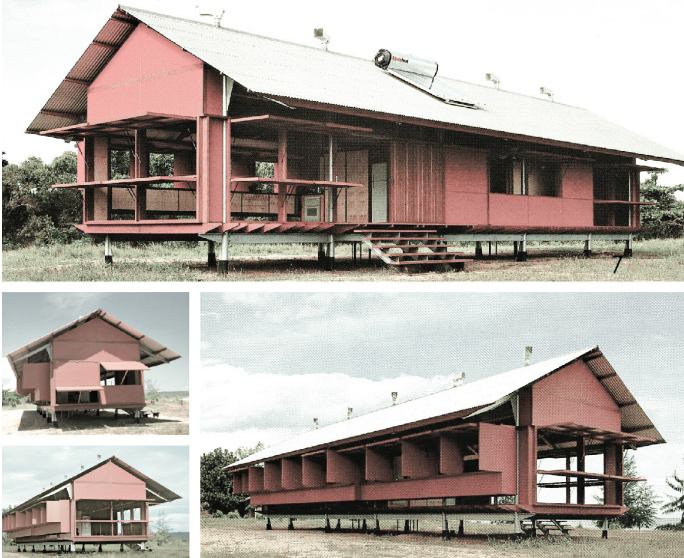
Zaragoza Water Park, Exhibition Pavilions



New Jersey house raising, Ira Wagner



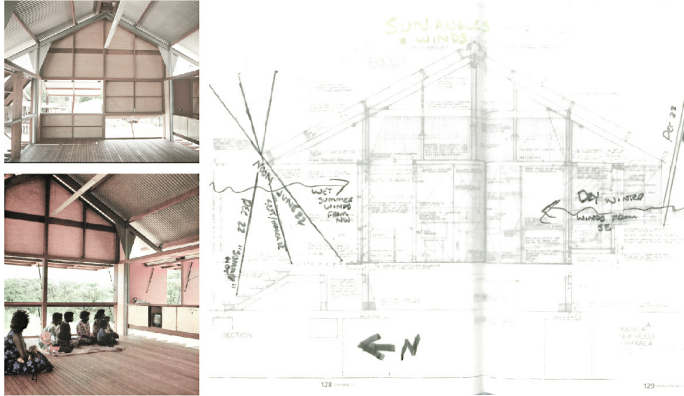
Glen Murcutt
Marika Alderton House



Nanticoke
Wigwam + Long House



Glen Murcutt
Marika Alderton House



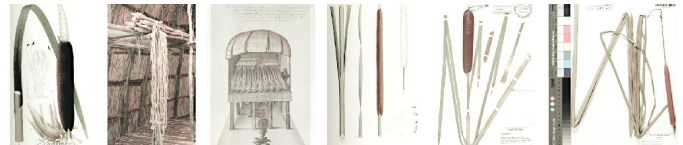
Bates+Masi
Stone Hill / Geogice Cove / Piersons Way



North American Corn Crib



Salt Marsh Materials



Case Study Precedents

Architectural precedents informed design proposals developed during the studio. Projects included both contemporary and historical precedents, and a variety of geographic locations, social contexts, and constituencies. Some projects were developed by architects, while others emerged from vernacular and indigenous practices honed over centuries. Students distilled design principles and tenants from these projects, including strategies for flood management, structure and skin relationships, landscape and building interactions, and building material detailing.

ABOVE AND RIGHT Catalog of architectural precedents that informed student design work. (by Y. Konan)



Design Proposal 01: Assateague Promenade

The Assateague Promenade, a design proposal by Sam Jamero and Jihee Lee, is a pedestrian-oriented design which seeks to unite the experiences of day-users of the park with overnight campers by connecting the Pony Express with the new Ranger Station through a guided promenade. The promenade, structured by trees, cloth canopies, and trellises, provides a shaded route by which visitors can navigate the existing ambiguous parking lot. The main trellis of the promenade leads visitors front door of the Ranger Station. When entering the building from the parking lot, visitors pass through “ecotones,” including tree lines and a trellis.

The Ranger Station building is elevated and appears to sit atop a “constructed dune.” It is a Z-shaped building with public and private wings. The public wing is oriented to the south, allowing for passive solar heat gain during the winter months. This space features a cathedral ceiling with exposed wood trusses and north-facing skylights, and hot air that rises in the space during the summer is passively moved out of the building by harnessing prevailing winds and ocean breezes. The southern slope of the “constructed dune” is designed as an educational space that includes an area shaded by a trellis where visitors can gather and sit for educational talks.

LEFT Site plan. (by S. Jamero and J. Lee)



Site and Building Organization

Assateague Promenade features a parking lot transformed into a landscape with increased permeability, more efficient vehicular traffic, and new pedestrian paths and experiences.

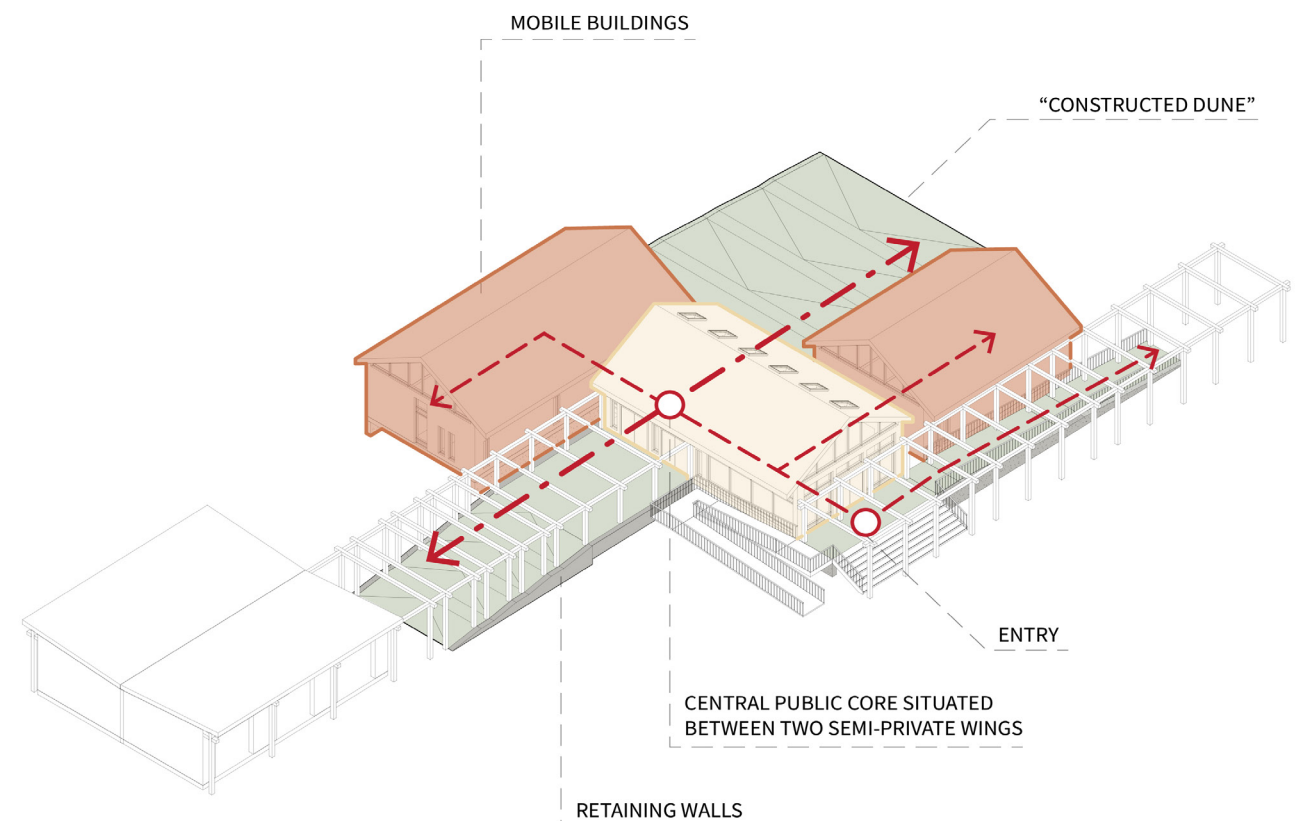
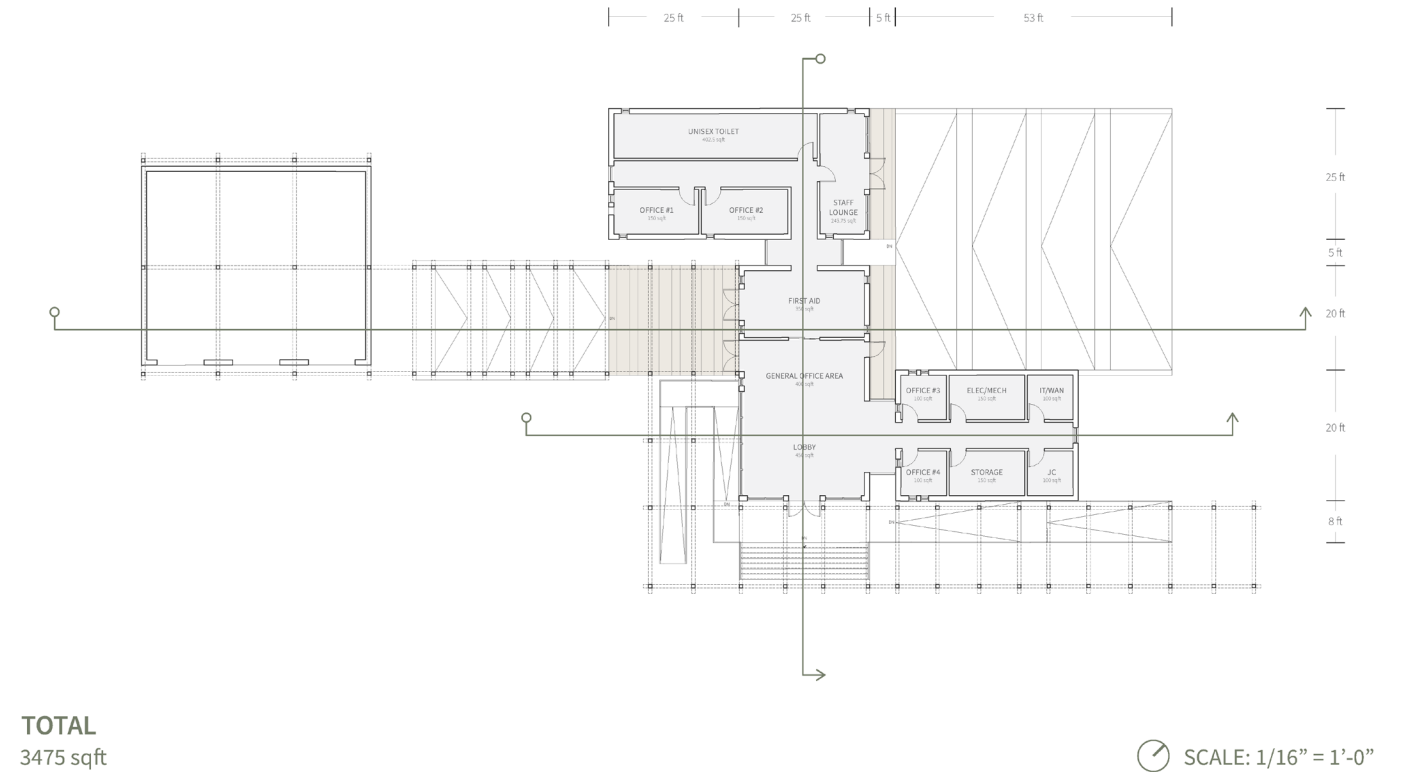
The program of the Ranger Station is distributed among three wings of the Z-shaped building. The public wing features camper check-in spaces and well as administration spaces for staff. The first-aid area is located in this wing, but shielded from the view of the public. The western wing includes staff offices, lounge, and bathroom, while the eastern wing includes office space, service, and storage.

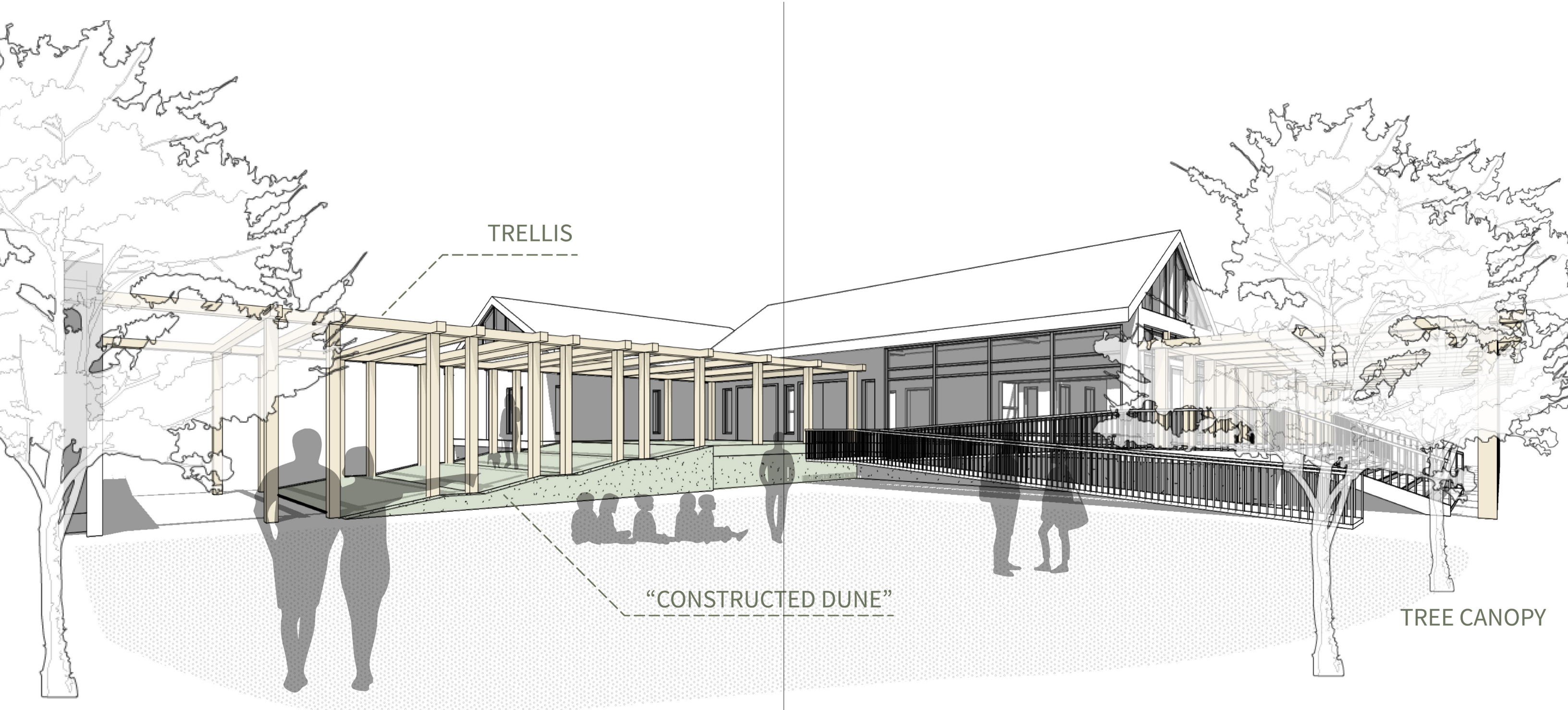
The building is constructed on intermittent foundation walls, and the eastern and western wings of the building are designed to be mobile and can be moved during major storm events to prevent damage.

ABOVE Site plan. (by S. Jamero and J. Lee)

ABOVE RIGHT Ranger Station floor plan. (by S. Jamero and J. Lee)

BOTTOM RIGHT Parti diagram. (by S. Jamero and J. Lee)



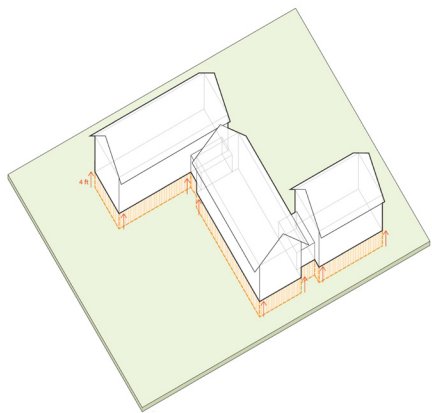


TRELLIS

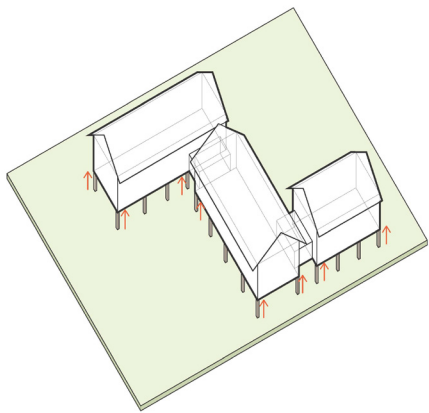
"CONSTRUCTED DUNE"

TREE CANOPY

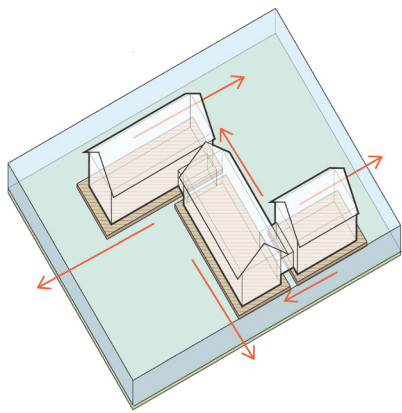
ABOVE Perspective view at "Constructed Dune" learning landscape. (by S. Jamero and J. Lee)



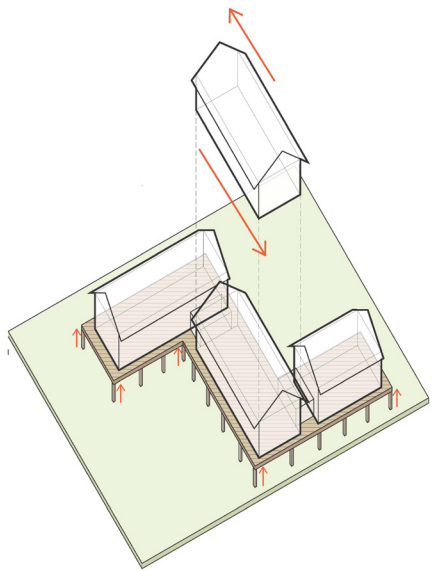
CRAB Elevation Guideline



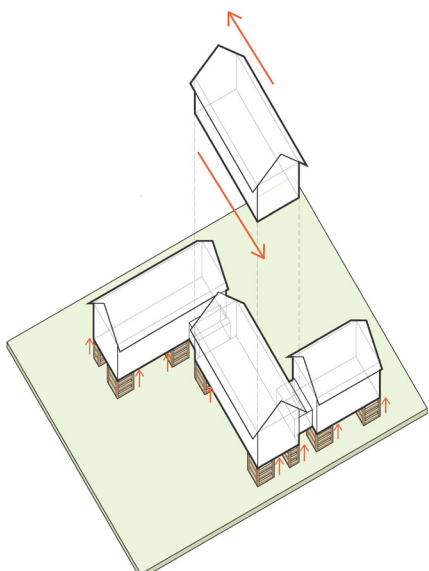
1. Pilotis Structure



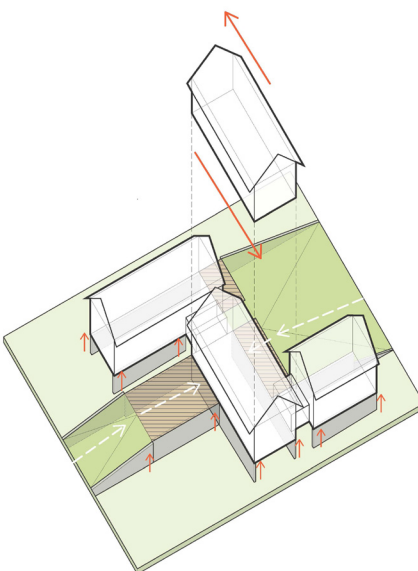
2. Floating Structure:
Mobile deck with massing on top



3. Mobile Structure:
Permanent deck



4. Temporary
Wood Pallets



5. Storm Ready
Foundation Walls

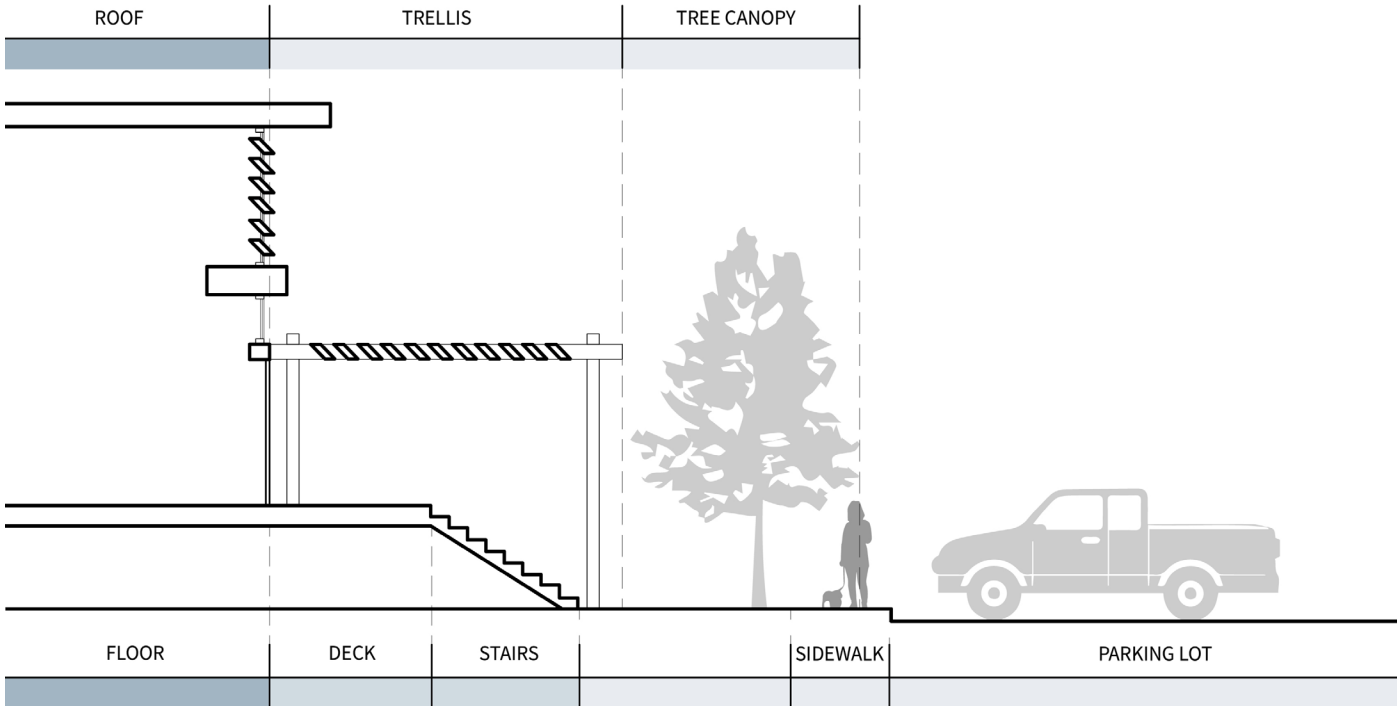
Design Strategies

The need for the building to be elevated such that finished floor is 4'-0" above the ground (based on CRAB standards) opens many design possibilities for linking building and landscape. In the project, the elevated building is supported by a series of foundation walls elevate the building, serve as retaining walls that shape the "constructed dune," and allow air flow below the building. The semi-private wings of the building can be relocated in anticipation of major storm events.

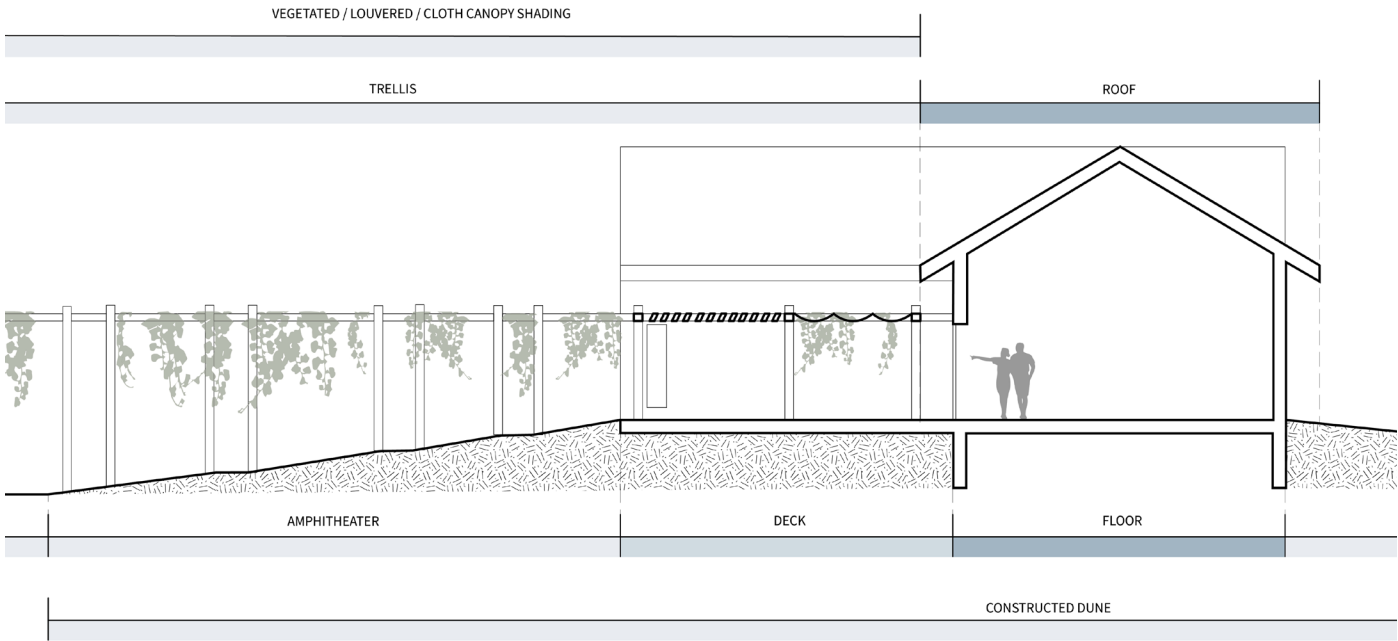
The project also explores the design principle of "ecotones" between building and landscape. At the entry sequence to the building, visitors experience different degrees of permeability both above them and below. Visitors walk under a tree canopy, followed by a trellis, before finally entering under the impermeable canopy of the roof building. On the ground, the parking lot is designed with a high degree of permeability, followed by a semi-permeable deck, and finally the non-permeable floor of the building.

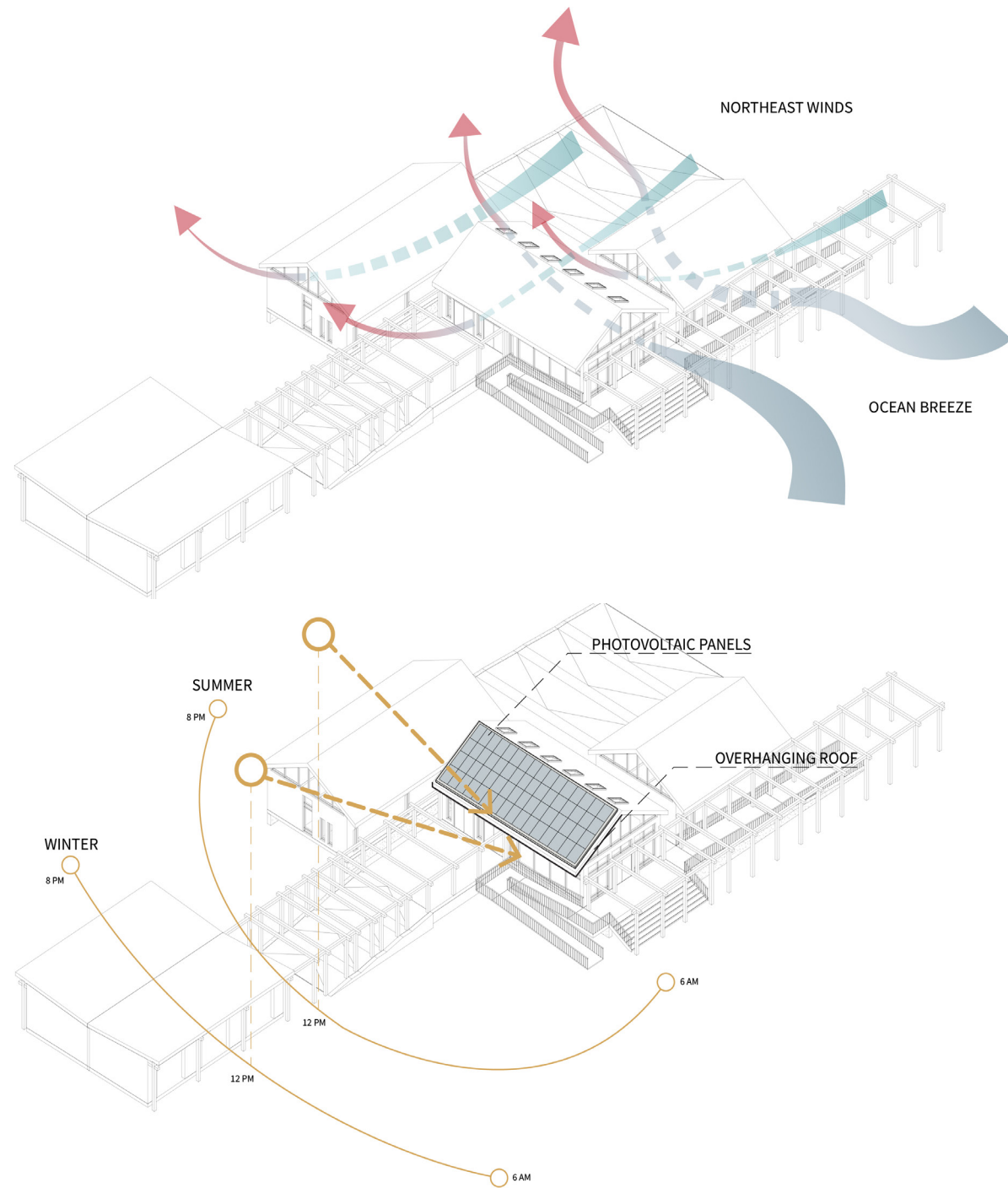
ABOVE Strategies for elevating building for flooding. (by S.Jamero and J. Lee)

RIGHT "Ecotones" between building and landscape. (by S. Jamero and J.Lee)



- PERMEABLE
- SEMI - PERMEABLE
- NON - PERMEABLE





Passive Solar and Ventilation

Passive solar strategies at the building include an overhang that is designed to help mitigate summer sun while allowing winter sun to penetrate the building. Photovoltaic panels are introduced on the southern roof for passive energy production.

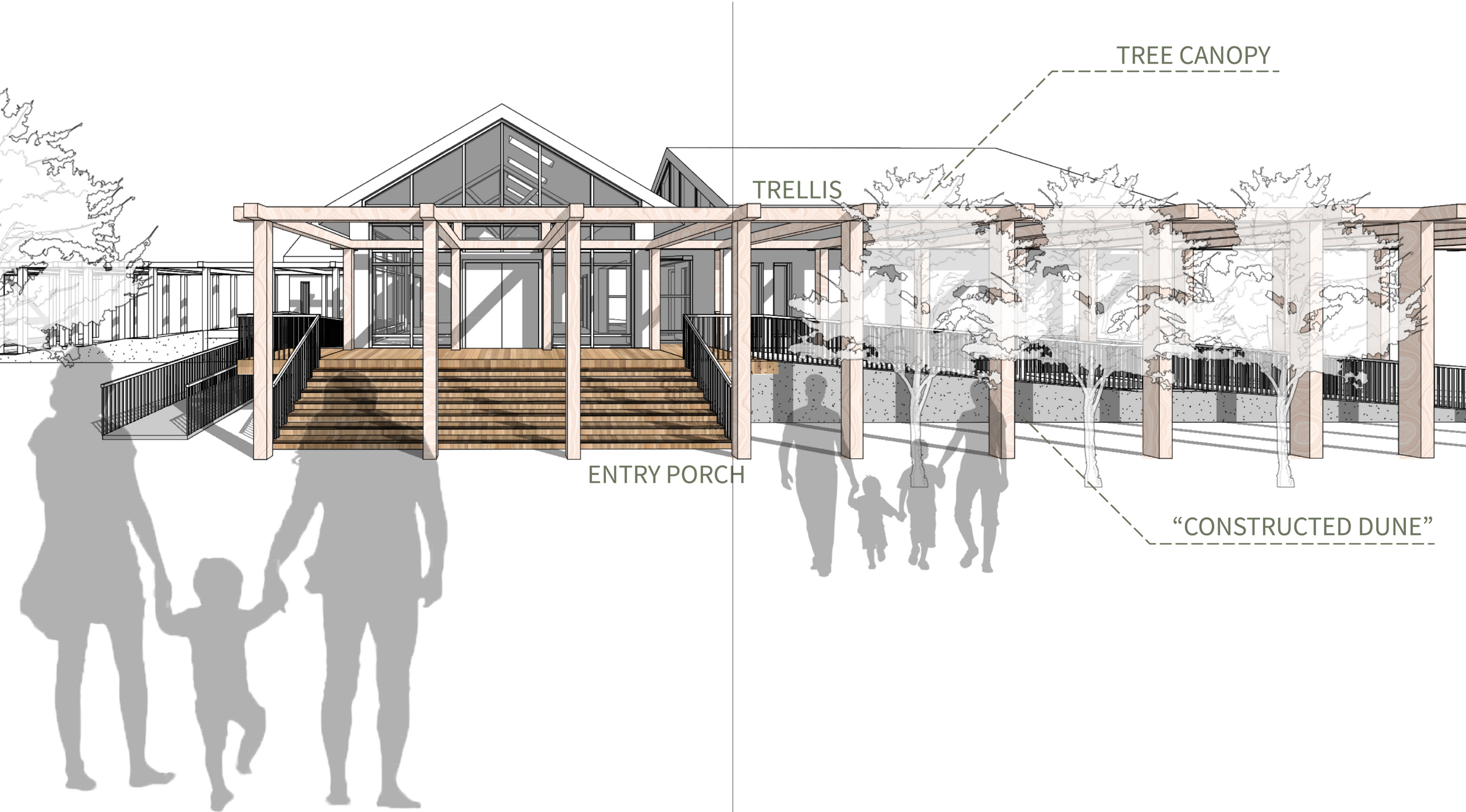
The building is cooled through passive ventilation strategies that allow prevailing winds and ocean breezes to move hot air out of the building via high windows and gable vents.

ABOVE Passive ventilation diagram. (by S. Jamero and J. Lee)

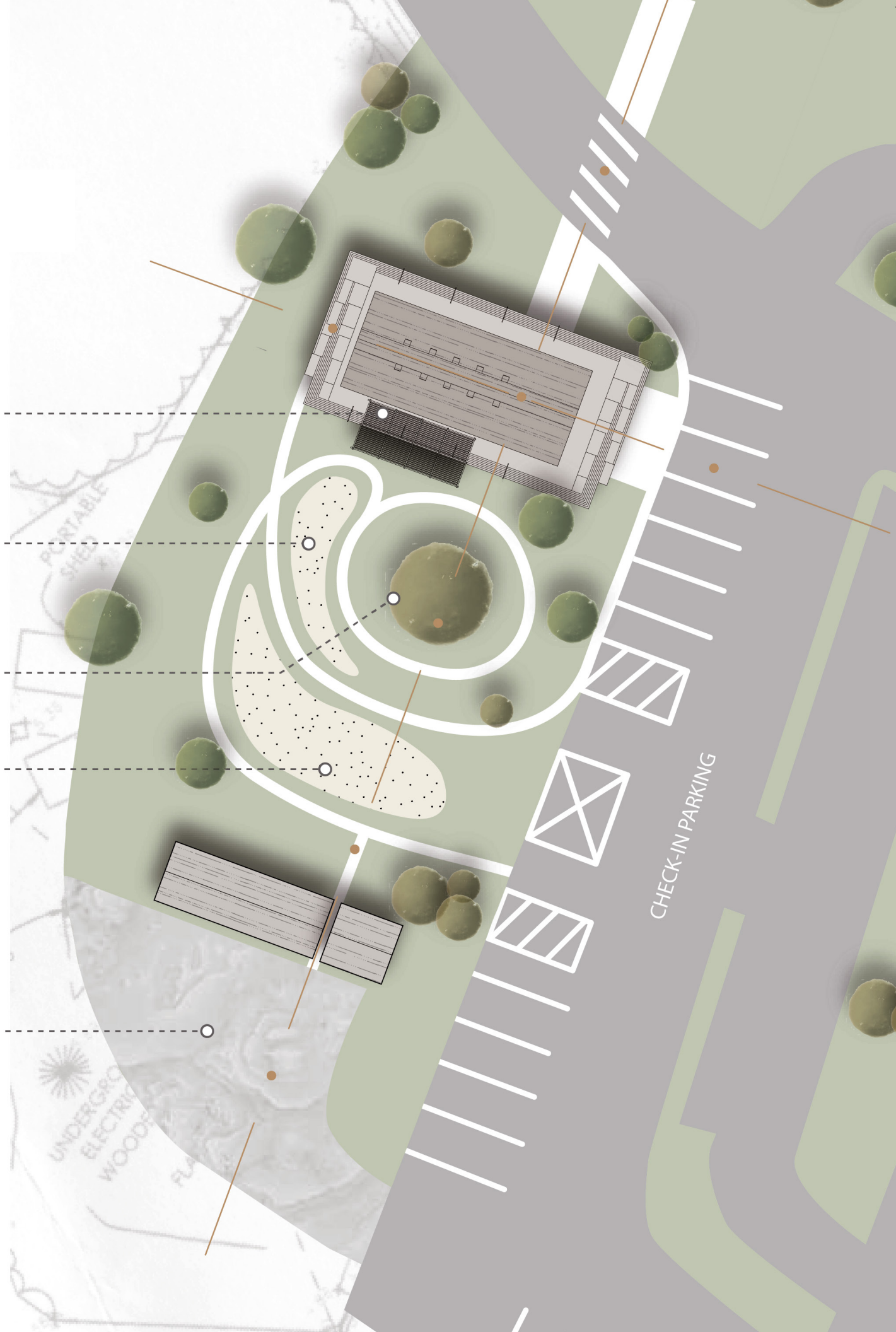
BOTTOM Passive solar diagram. (by S. Jamero and J. Lee)

RIGHT Building sections and elevations. (by S. Jamero and J. Lee)





ABOVE Perspective view at main entry to the Ranger Station. (by S. Jamero and J. Lee)

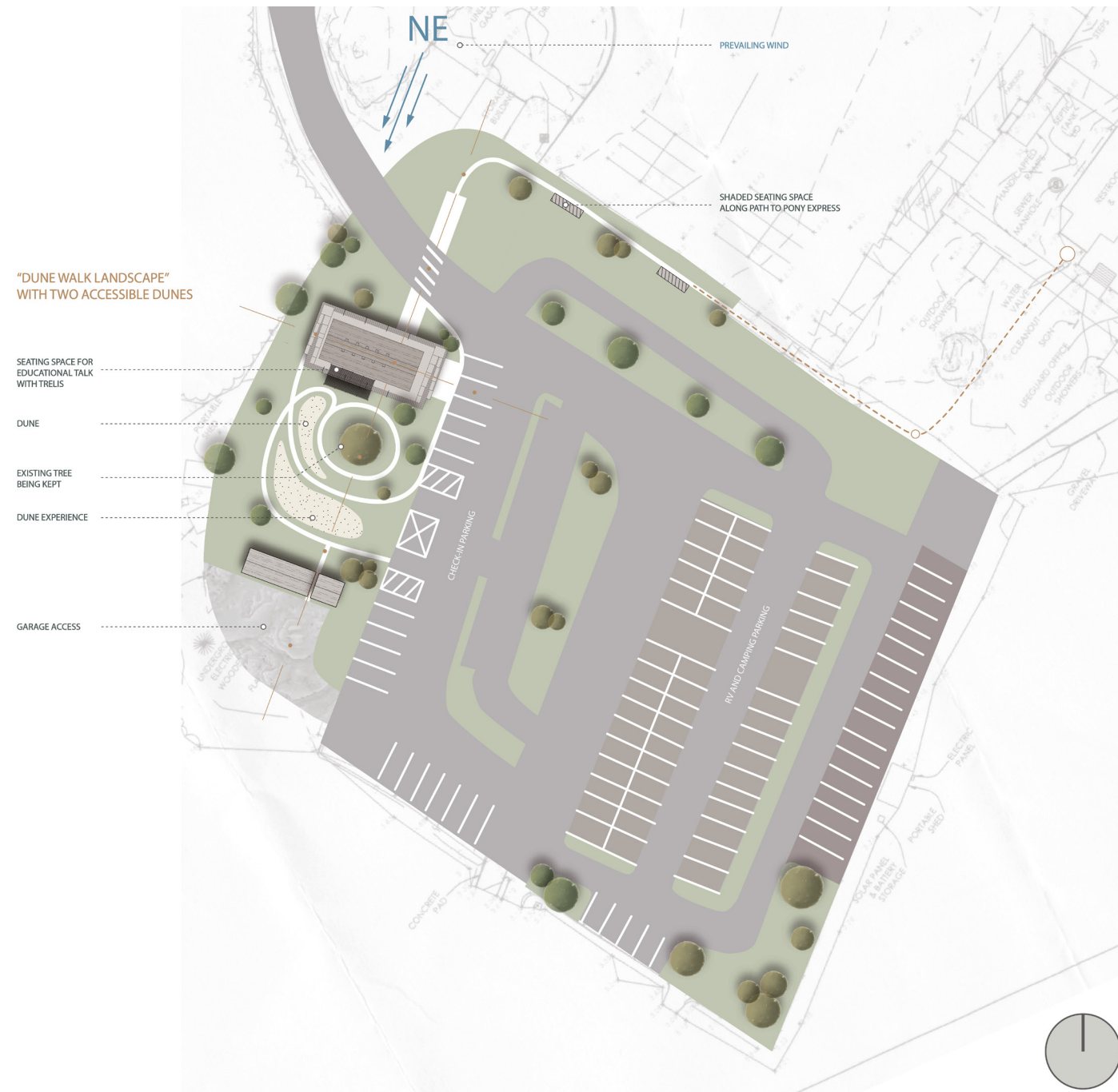


Design Proposal 02: Ranger Station Dunescape

Ranger Station Dunescape, a design proposal by Yan Konan, plays the simple rectangular volume of the Ranger Station against the ovular shapes and curves of an educational "Dunescape." Key to the site strategy of the project is to protect the old growth tree at the center of the site, and to design the sweeping forms of the Dunescape around it. The Dunescape features a shaded walk and two constructed, tear-shaped dunes that circumscribe the tree and give topographic structure to the space.

The Ranger Station is rectangular in form, and positioned to the north of the site. The building is raised on a wooden plinth, which both protects the building from flooding and creates ample public space for sitting and hanging out around the building. These spaces are shaded by deep overhangs and a trellis at the southern side of the building. The public entry to the building is accessible from both the parking lot as well as from the new walk that leads to the building from the Pony Express. Passive solar and ventilation strategies guide the design of the massing, apertures, and program distribution of the Ranger Station.

LEFT Site plan. (by Y. Konan)



Site and Building Organization

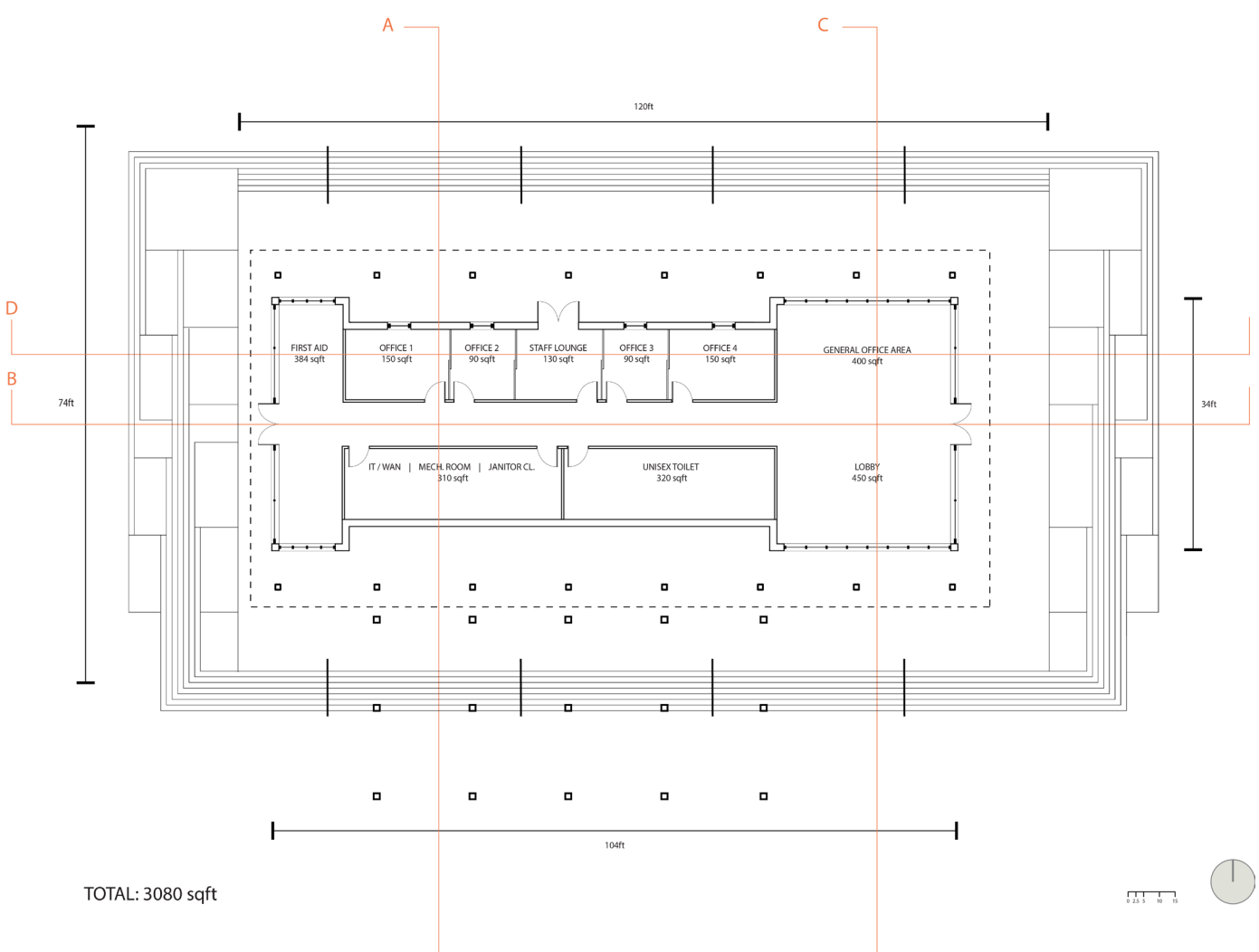
The site strategy for the project includes positioning the Ranger Station to the northern end of the site, in order to preserve an existing tree at the center of the site. The tree becomes a focal point in the Dunescape educational landscape, which features tear-drop shaped dunes and winding paths that encircle the tree. A large trellis projects from the southern facade of the building and provides shade for seating, creating a gathering place in-between architecture and landscape.

The Ranger Station is a rectangular volume, with public program positioned at the ends of the volume, and private program in the space in-between. The main entry to the building is located at the east facade, and is accessible to visitors approaching from the parking lot as well as walking from the Pony Express. The building is elevated on piers for flood protection, and the entire building is encircled with a broad porch and colonnade, which is shaded by generous roof overhangs.

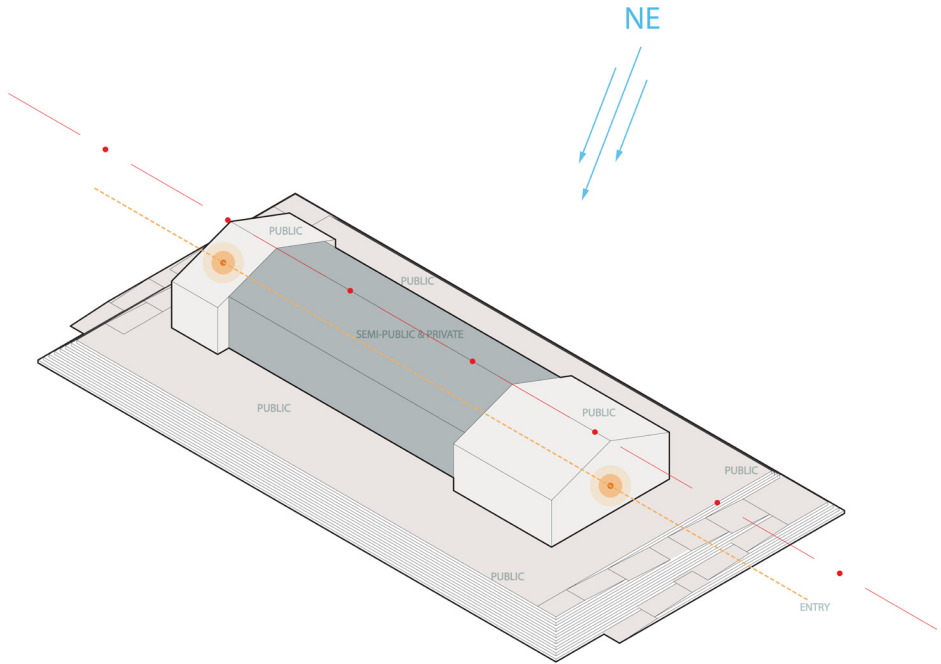
ABOVE Site plan. (by Y. Konan)

RIGHT ABOVE Ranger Station floor plan. (by Y. Konan)

RIGHT BOTTOM Parti diagram. (by Y. Konan)



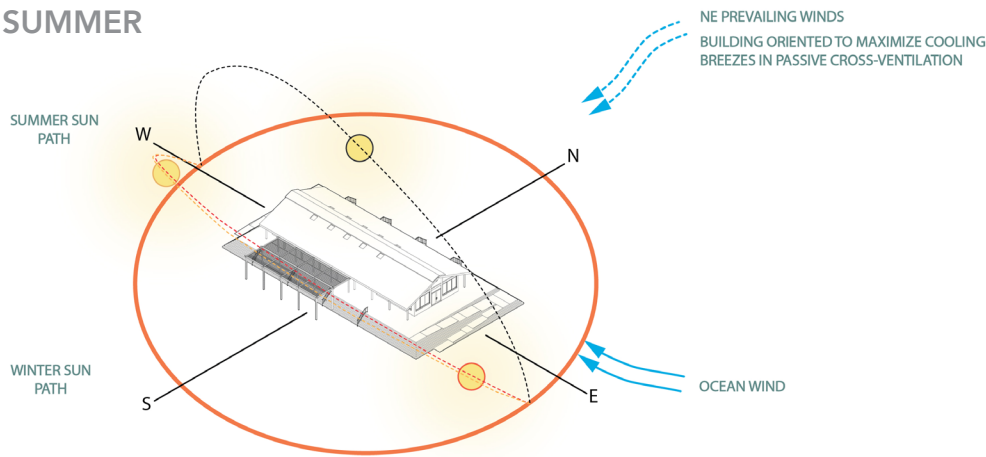
TOTAL: 3080 sqft





ABOVE The Greeting. Perspective view to main entry of Ranger Station. (by Y. Konan)

SUMMER



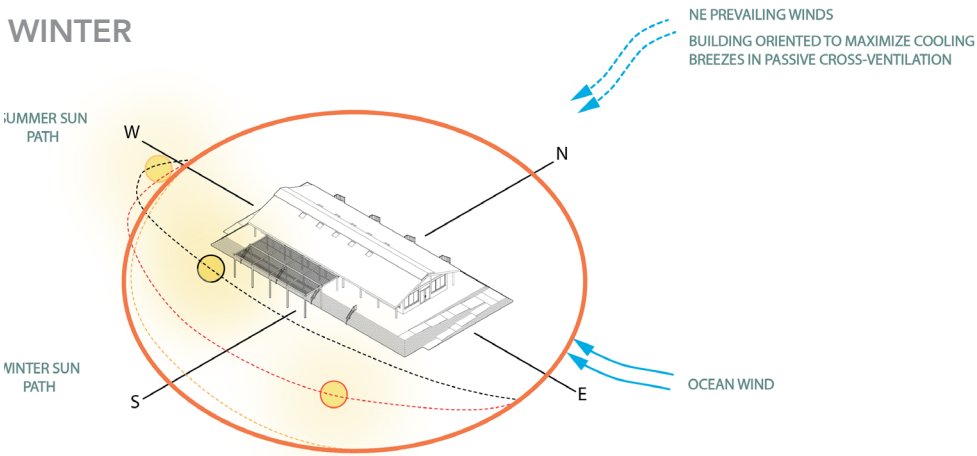
JUNE 21, 2021

9:00AM
ALTITUDE: 37°
AZIMUTH: 87°

12:00 PM
ALTITUDE: 70°
AZIMUTH: 133°

5:00 PM
ALTITUDE: 38°
AZIMUTH: 272°

WINTER



DECEMBER 21, 2021

9:00 AM
ALTITUDE: 15°
AZIMUTH: 137°

12:00 PM
ALTITUDE: 28°
AZIMUTH: 180°

5:00 PM
ALTITUDE: -3°
AZIMUTH: 243°

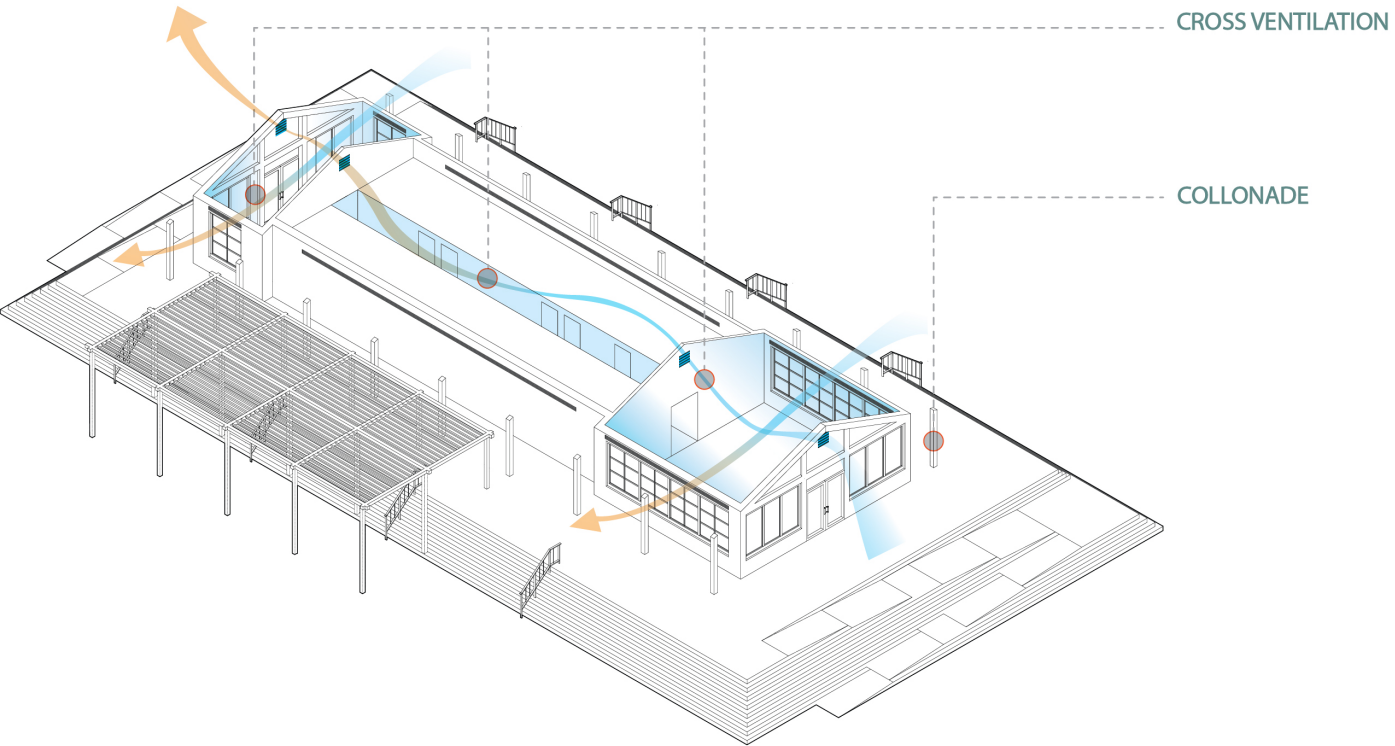
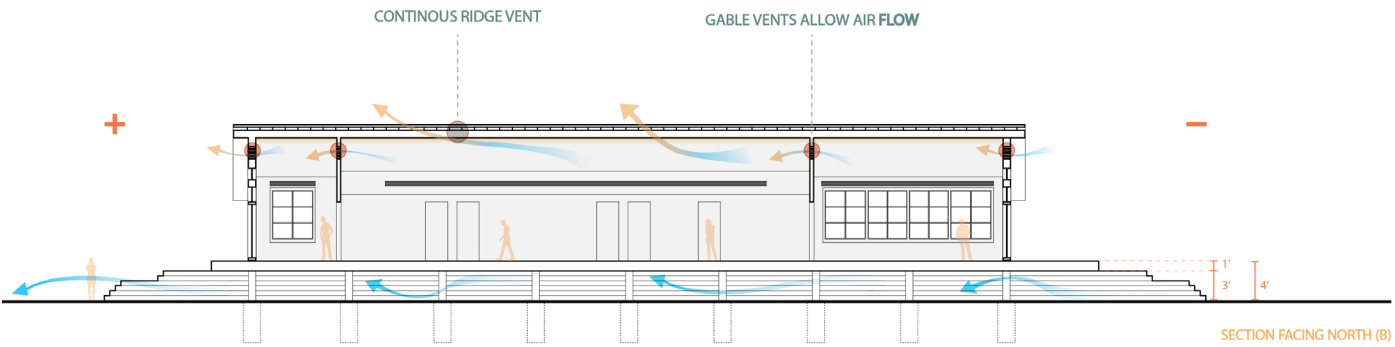
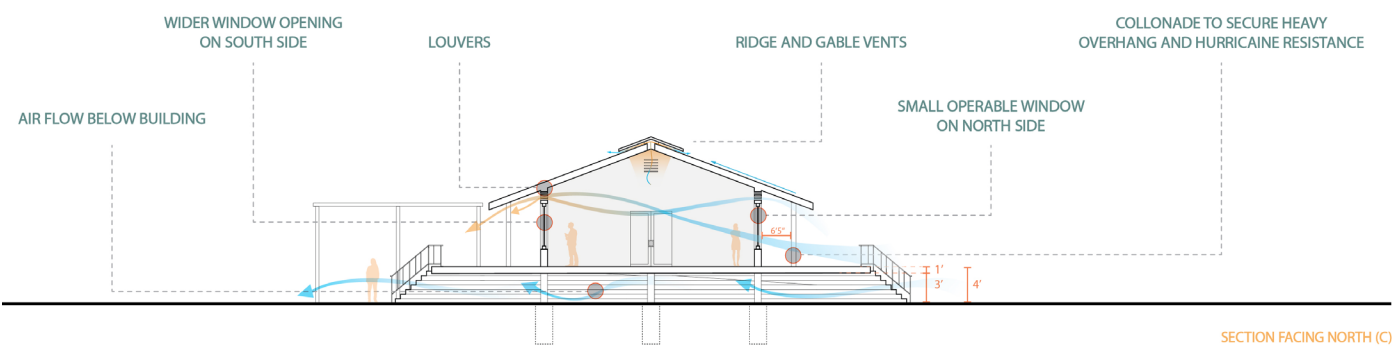
Passive Ventilation Strategies

The Ranger Station employs multiple passive ventilation strategies that take advantage of prevailing winds from the northeast, and ocean breezes from the east, to cool the building. Cross ventilation is designed to move hot air out of the building. The northern facade of the building features small, operable windows, while the southern wall has louvers located high in the wall for hot air to exit. A continuous ridge vent, together with a series of gable vents, work to ventilate along the long axis of the building. Finally, the building is elevated, allowing winds to pass under the building to cool and dry the space.

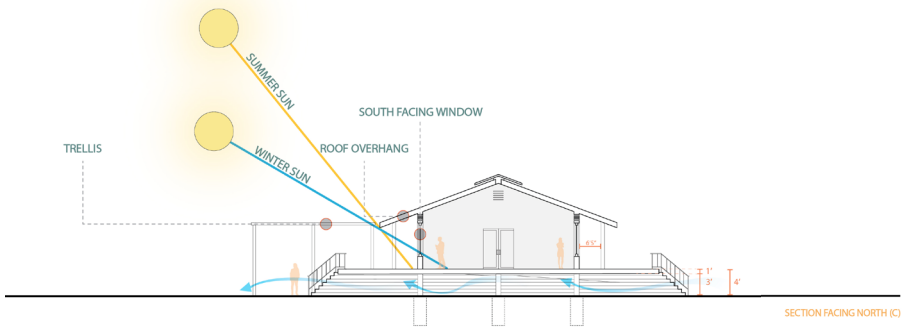
ABOVE Summer and winter solar paths and prevailing wind diagrams. (by Y. Konan)

ABOVE RIGHT Passive ventilation flows and strategies (sections). (by Y. Konan)

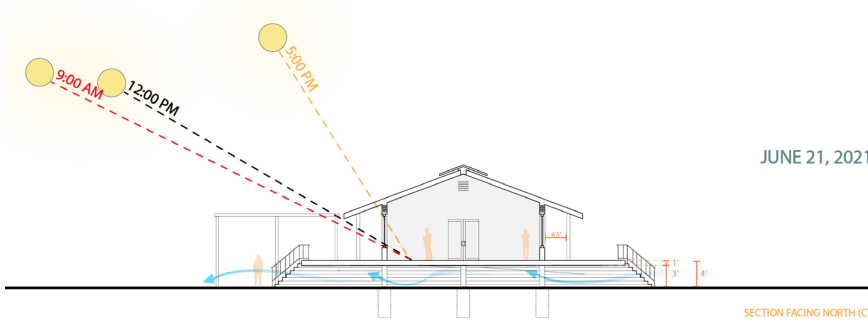
BOTTOM RIGHT Passive ventilation flows and strategies (axon). (by Y. Konan)



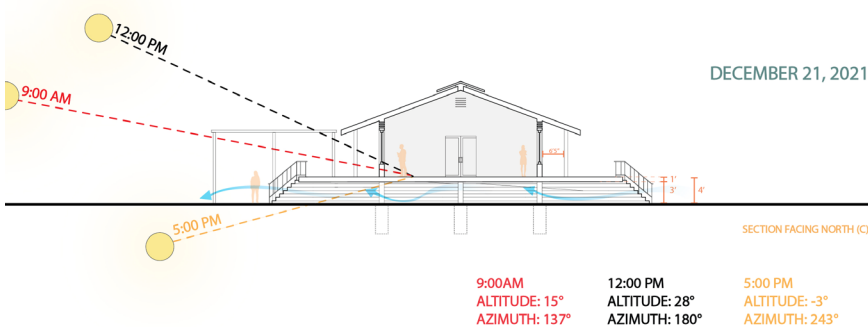
SUMMER + WINTER



SUMMER



WINTER



Passive Solar Strategies

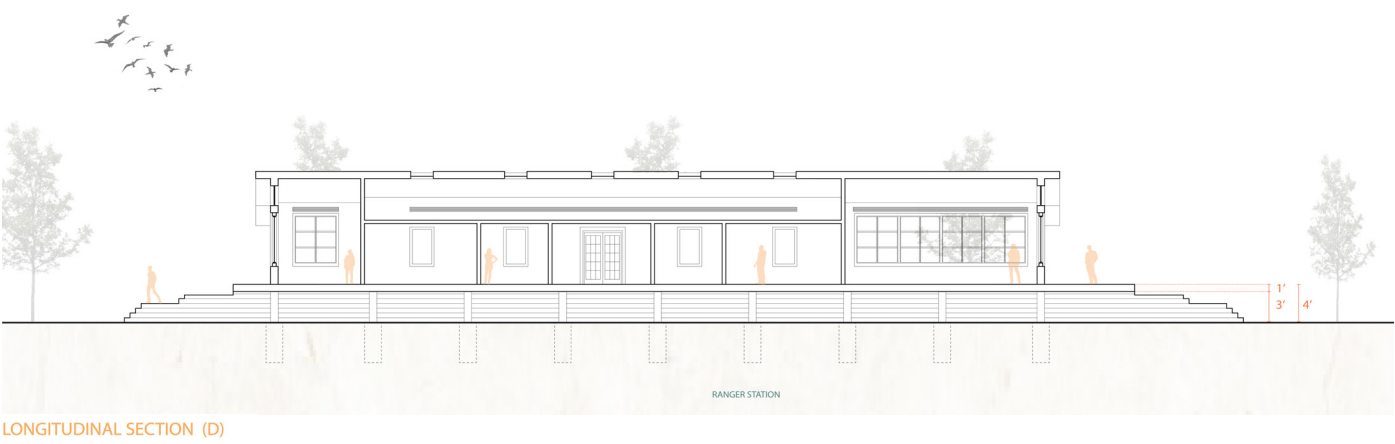
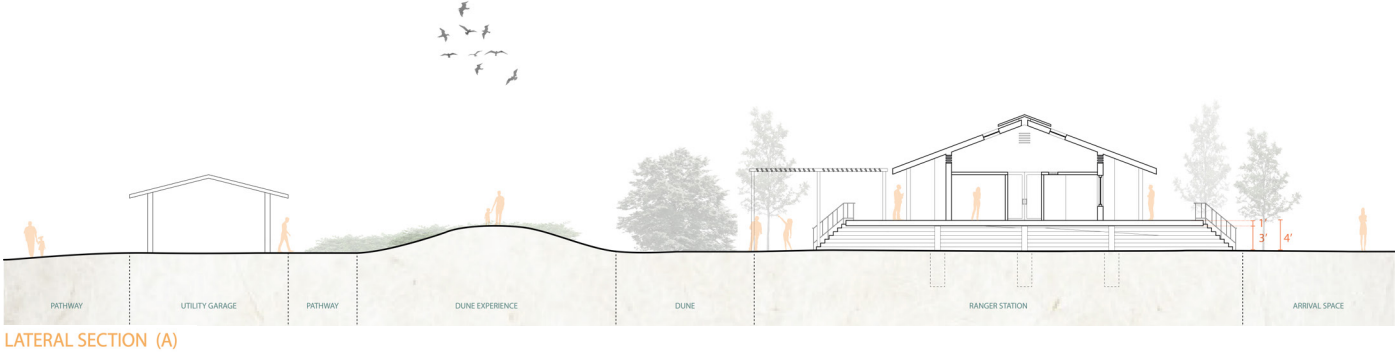
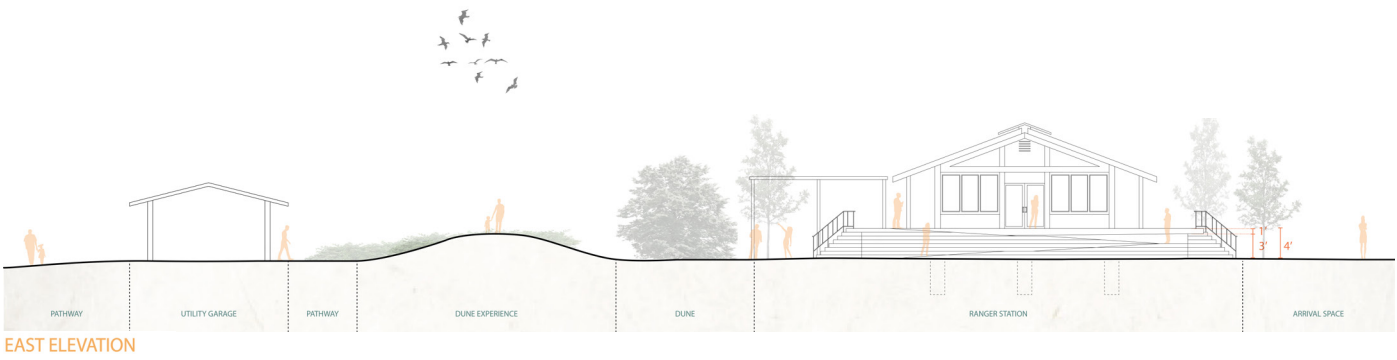
The Ranger Station design follows best practices for passive solar strategies in the Mid-Atlantic region. The rectangular volume is oriented with its long axis in the east-west direction. Deep overhangs are designed to block summer sun from heating the building, which will limit the need for energy intensive cooling in the summer. Allowing the winter sun to penetrate the building means that less energy expended on heating the building during winter months. And a trellis on the southern facade shades the outdoor gathering space at the Dunescape.

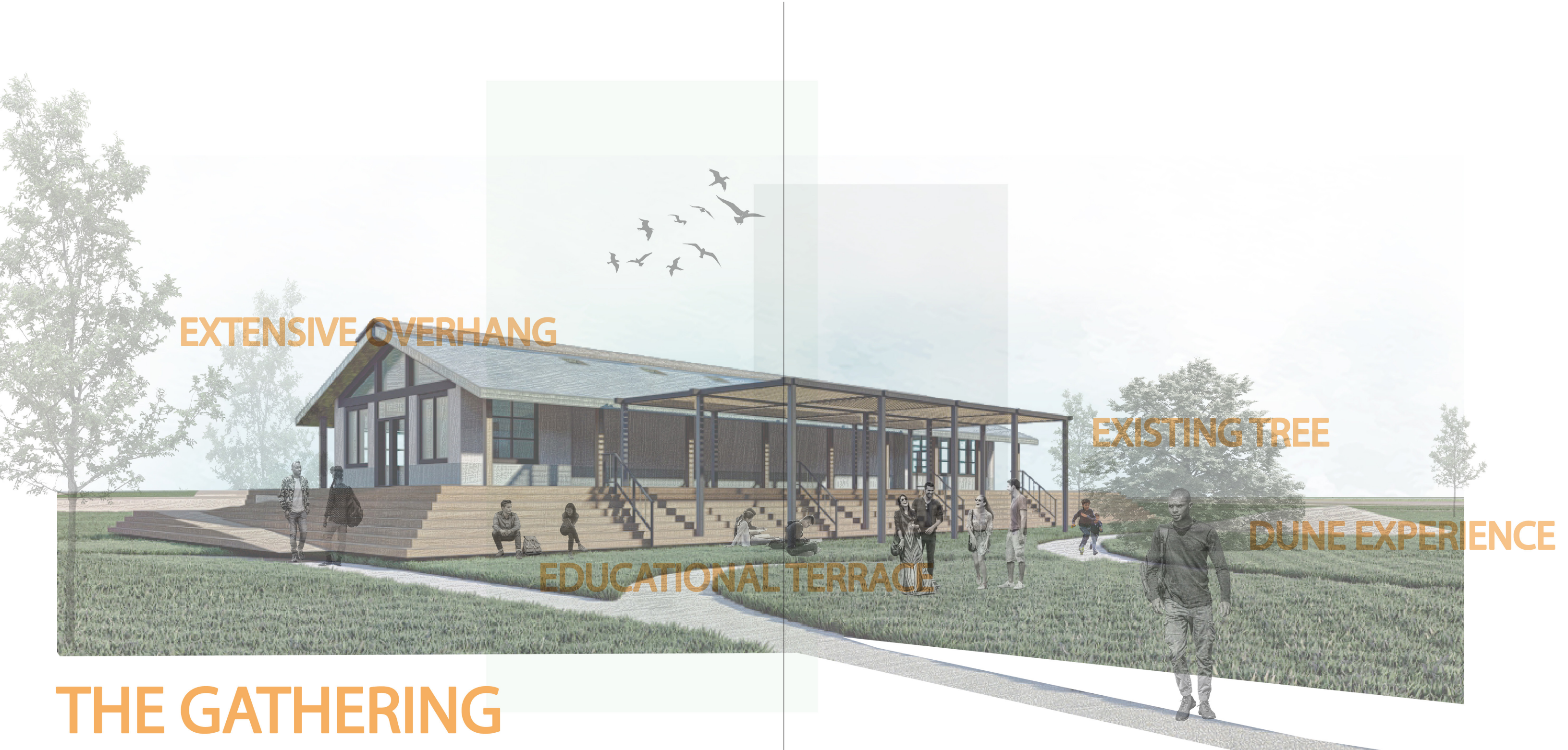
ABOVE Passive solar strategies (section). (by Y. Konan)

CENTER Summer solar angles. (by Y. Konan)

BOTTOM Winter solar angles. (by Y. Konan)

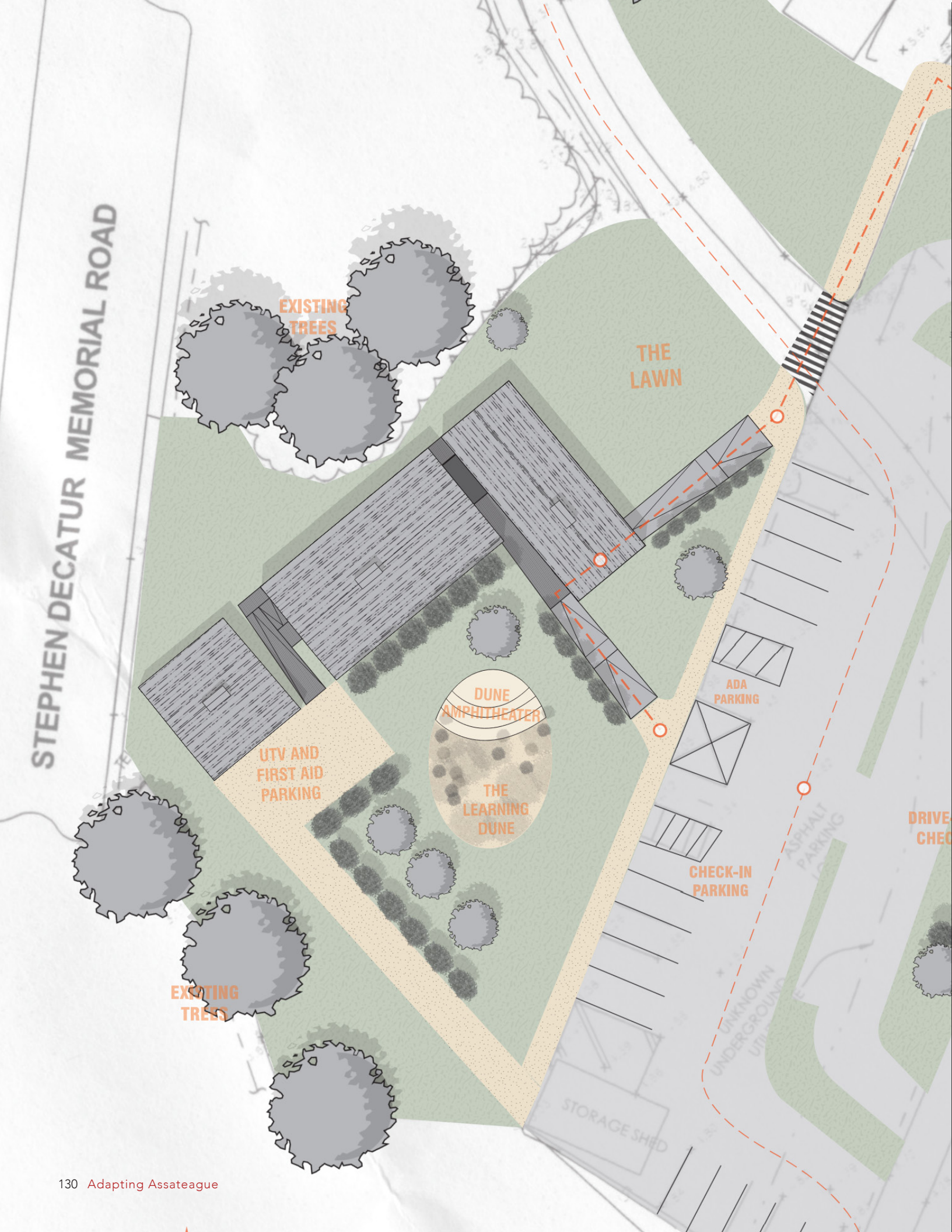
RIGHT Building sections and elevations. (by Y. Konan)





THE GATHERING

ABOVE The Gathering. Perspective view to public gathering and educational area at Ranger Station. (by Y. Konan)



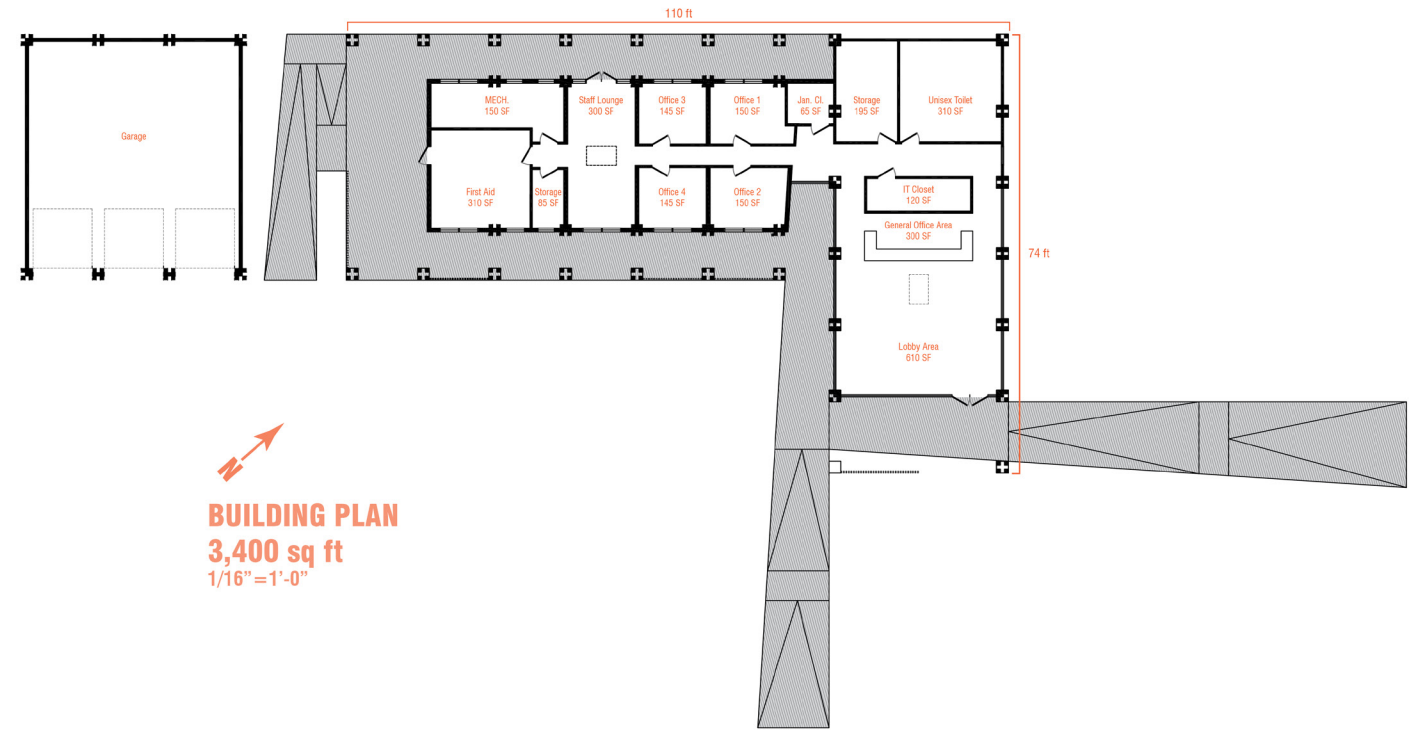
Design Proposal 03: Ranger Station Resiliency

Ranger Station Resiliency, a design proposal by Nick DiBella, is inspired by the vernacular architecture of Assateague State Park, both its existing buildings as well as the indigenous pre-colonial building practices found throughout the region. The architecture of the project references and creatively re-interprets these precedents.

The Ranger Station is an L-shaped building that frames an educational landscape called the “Learning Dune.” The building is elevated on piers, and the main entry of the building can be accessed via a ramp from the main parking lot, as well as a ramp that draws visitors walking from the Pony Express. The roofs are gabled, and have broad overhangs that bring shade to exterior walkways and colonnades. Wood screens, a reference to the ubiquitous sand fencing found through the park, is installed on the south and east facades of the building to further mitigate solar heat gain.

The “Learning Dune” landscape provides an opportunity for visitors to gain an understanding of the various roles that dunes play at the park and across the larger island. The garage adjacent to the courtyard space continues the structure, materiality and form of the Ranger Station, creating an aesthetic continuity across diverse programs.

LEFT Site Map. (by N. DiBella)



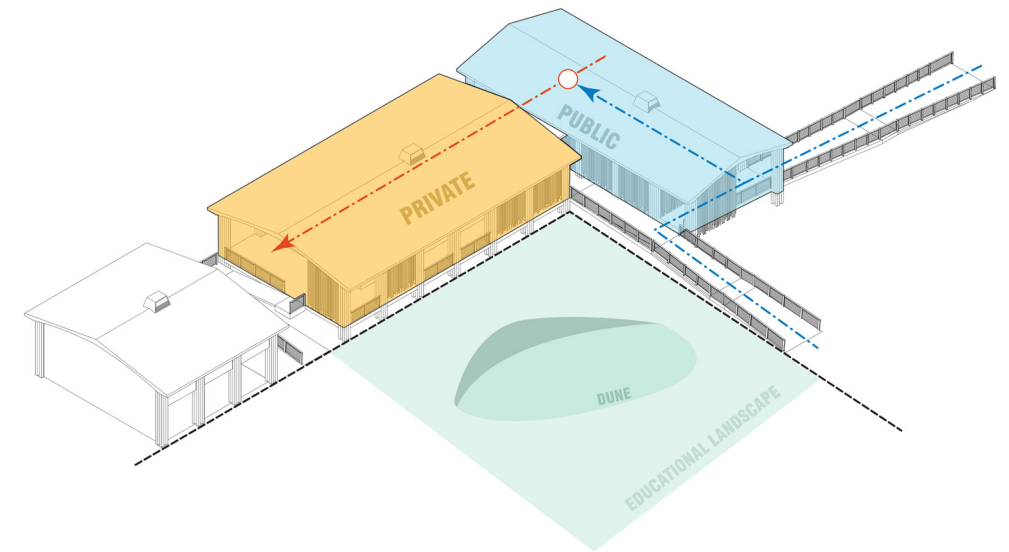
BUILDING PLAN
3,400 sq ft
1/16"=1'-0"

Site and Building Organization

The Ranger Station is organized into two spaces, one public and one private. These two spaces are in a L-shaped configuration, and they frame an educational landscape that features a "Learning Dune." This landscape is a gathering place where visitors can learn about dunes and their functions on Assateague Island.

The structure of the Ranger Station is wood post and beam; columns are designed as four individual wood columns that are ganged together with eight inches of space between them, which creates a single larger column. The post and beam structure supports curved, laminated wood rafters that echo the shape of rafters at the nearby Assateague State Park Nature Center.

The public enters into a lobby area with a cathedral ceiling that is punctuated with a cupola that illuminates the interior. Beyond this public space there is access to the second, more private volume that contains staff and storage spaces. The more private volume is wrapped by an exterior walkway and colonnade, which sets these spaces under a deep overhang.



ABOVE Site plan. (by N. DiBella)

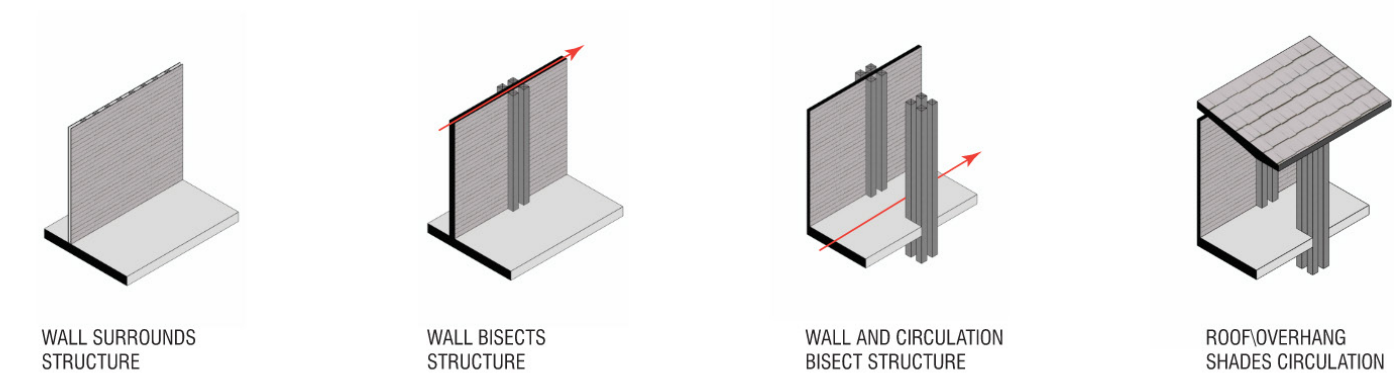
RIGHT ABOVE Ranger Station floor plan. (by N. DiBella)

RIGHT BOTTOM Parti diagram. (by N. DiBella)

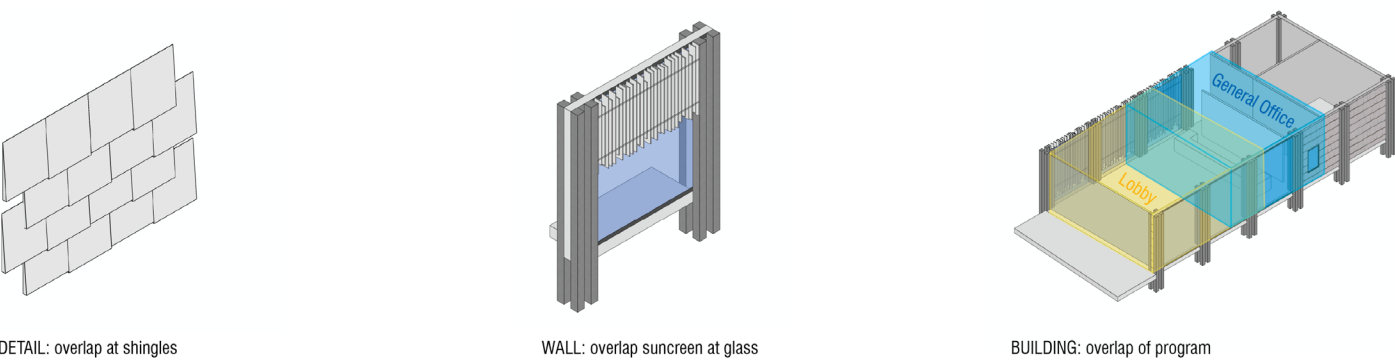


ABOVE Perspective view to courtyard and “Learning Dune” landscape at Ranger Station. (by N. DiBella)

LAYERING OF MATERIAL IN AN EXTERIOR WALL



SCALE OF OVERLAP



Design Strategies

Among the design strategies employed at the building are the design of an exterior wall that is comprised of a layering of various material and elements, as well as a concept of overlap that is evident at multiple scales simultaneously.

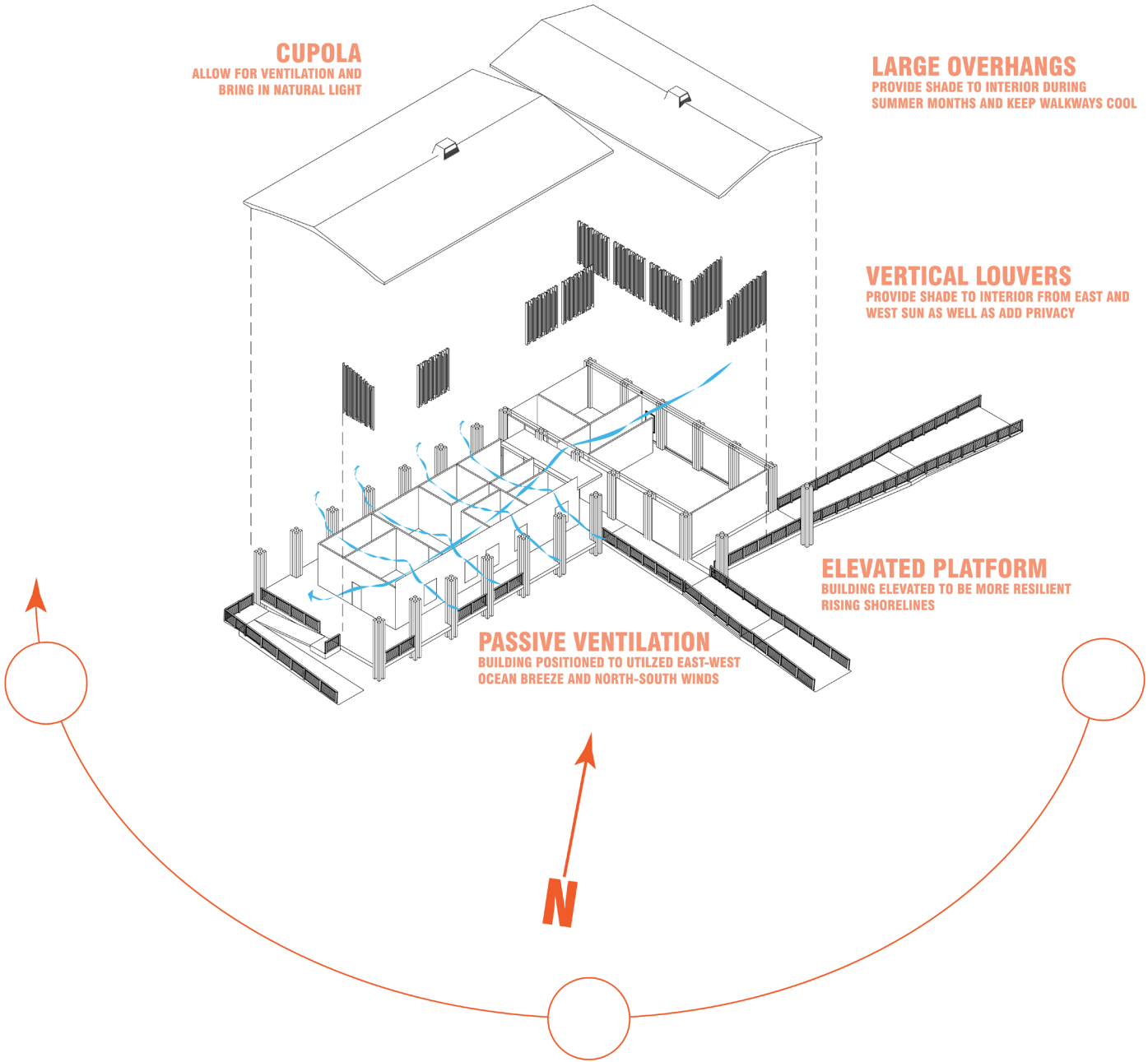
Rather than rely on typical wall construction, the design seeks to separate and make evident the functions of wall, structure, and floor. Walls are slipped through the gaps between gangs of four columns, and a walkway is threaded between gangs of columns. This layered interrelationship between elements recalls traditional wigwam construction strategies, where walls sit between interior and exterior structural frameworks.

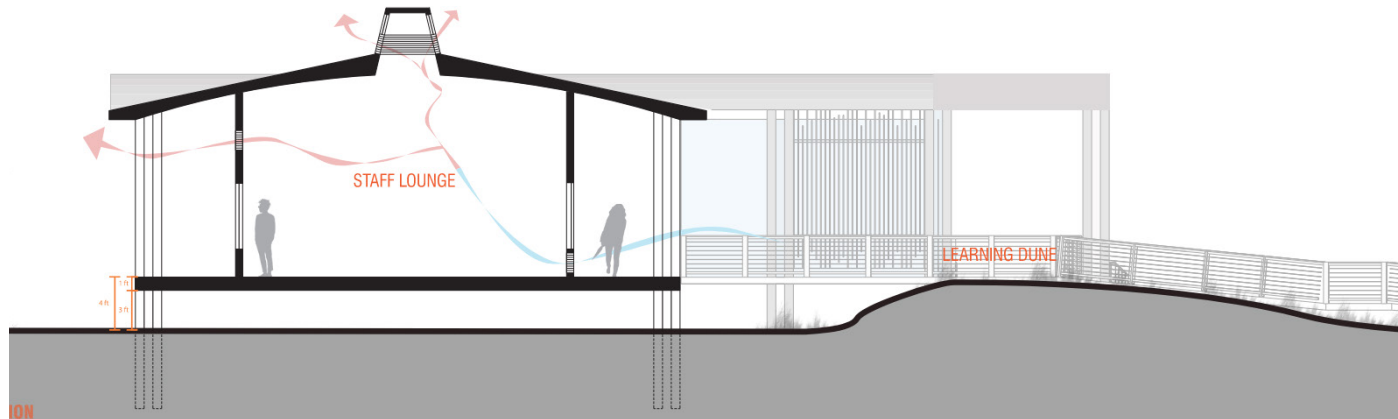
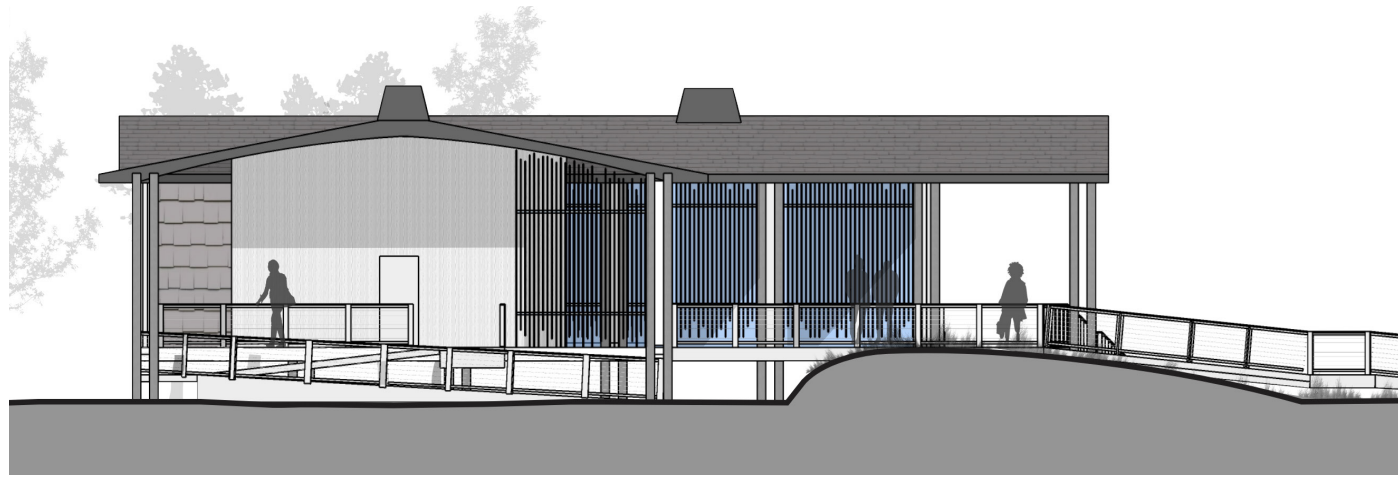
The concept of overlap was also explored in the architecture. At the scale of the detail, overlap is evident in the cedar shingles that form the exterior skin of the building. At the scale of the wall, sunscreens overlap glazing, and the screens recall the ubiquitous sand fences that help to shape the dunes of the park. Finally, at the scale of the building, programmatic overlap is evident in the public volume of the building, where the public lobby overlaps with private functions to create a semi-private general office zone that is accessed and used by both staff and visitors.

ABOVE Diagram of conceptual and actual layering of material in an exterior wall. (by N. DiBella)

CENTER Diagram of “overlap” as a strategy at the scales of detail, wall, and building. (by N. DiBella)

RIGHT Sustainable strategies. (by N. DiBella)

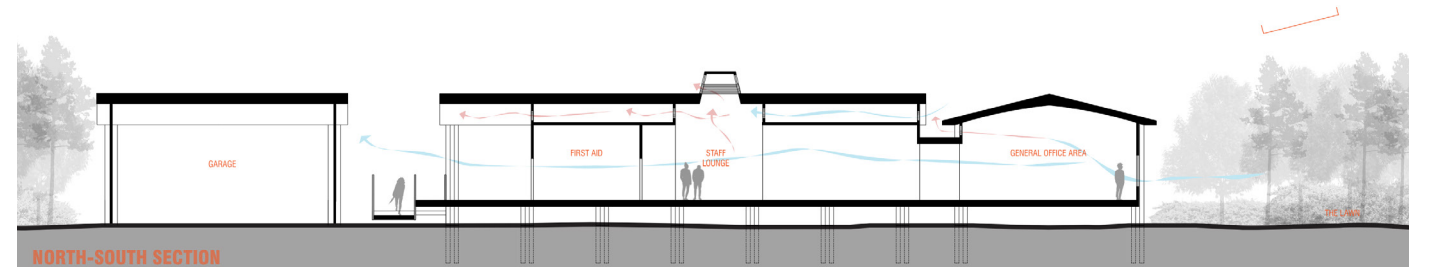
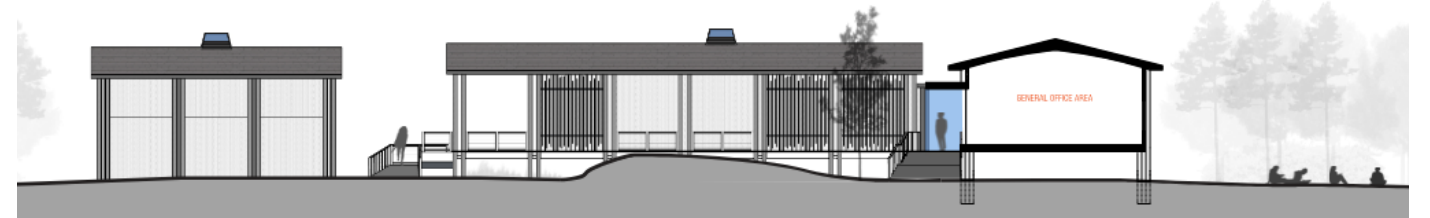
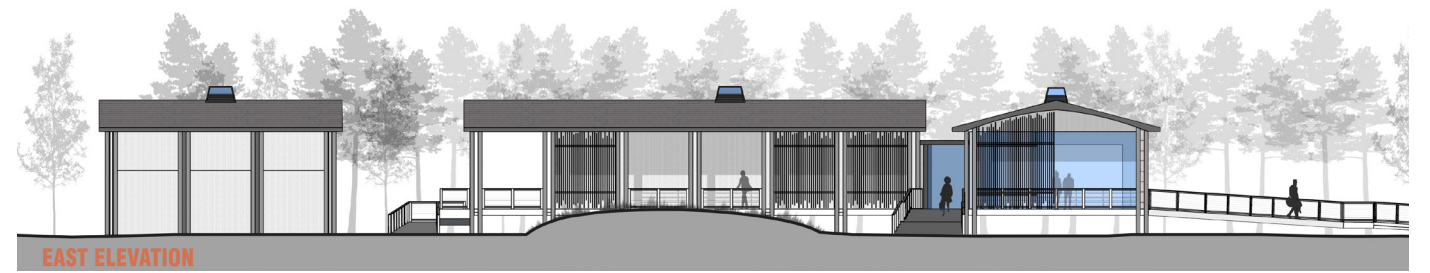




Passive Solar and Ventilation

The roofs of the Ranger Station are designed to block summer sun but allow winter sun to penetrate the building and provide warmth during cold months. Removable wood sunscreens, designed to reference the sand fences of the park, span between the columns that support the overhangs on the east and south facades, providing further protection from summer sun.

On the eastern side of the building windows are operable to allow ocean breezes in, and at the western side louvered vents above windows allow warm air to exit the building. Hot air can also be flushed from the building via vents that allow prevailing winds from the northeast to pass down the spine of the private wing of the building. Cupolas allow rising hot air to escape in the cathedral ceiling spaces of the Lobby, Staff Lounge, and Garage.



ABOVE South elevation. (by N. DiBella)

CENTER East-west section. (by N. DiBella)

ABOVE RIGHT East elevation. (by N. DiBella)

CENTER RIGHT North-south section. (by N. DiBella)

BOTTOM RIGHT North-south section. (by N. DiBella)



ABOVE Perspective view of north elevation of Ranger Station and ramp leading to main entry. (by N. DiBella)

Appendix

Assateague State Park Infrastructure and Data (adapted from the Strategic Management Plan 2021)

General Island

Total Park Acerage: 850

Two miles of constructed dune, with dune fencing at crest and approximately the same fencing on the western side, 16 designated beach crossovers for public access with railings and clay base.

Camping Areas

Ranger Station and campground office with three storage sheds.

Campground with 342 campsites and 3 youth group camping sites.

337 paved campsites, 5 walk-up campsites, paved parking area for youth group campsites, 40 reservable sites offering electric hookups, one dump station located within the campground.

Nine newly remodeled bathhouses with warm / cold water, interior and exterior showers, exterior dishwashing sinks, one day-use bathhouse, four pump houses.

Approximately six miles of paved asphalt roads in campground, hiker / biker trails within the campground and connecting to MD 611 trail and National Seashore trail for walking / hiking / biking.

Nature center, one screened pavilion and one open pavilion, nature play area and traditional playground, small paved basketball court.

Day Use Areas

Concessions building (Pony Express) with a restaurant and gift shop and two storage sheds.

Day-use parking lot offering 370 parking spaces.

Boardwalk from day-use parking lot to beach.

Five shade shelters with picnic tables, charcoal grills, volleyball net, etc. "Nature Outpost" and "Nature Nook" with exhibits and island information.

Mainland

Headquarters building, maintenance shop complex, dormitory, Ranger office, and animal care room, Natural Resources Police house, aviary housing Scales and Tales.

Marina with two boat ramps, fishing pier, soft launch area, parking lot for 67 trailer parking spaces.

Rackliffe House, managed through a Department of Natural Resources' curatorship program lease agreement with the Rackliffe House Trust

Ranger Station Program Requirements

General Office area	400 SF
First Aid	300 SF
Lobby Area	450 SF
Unisex Toilet	320 SF
Electrical/ Mechanical Room	150 SF
Office 1	150 SF
Office 2	120 SF
Office 3	90 SF
Office 4	90 SF
Staff Lounge	120 SF
Storage	150 SF
Janitor's Closet	60 SF
IT/WAN	100 SF
Circulation	300 SF

TOTAL Ranger Station 3,100 SF (approx.)

Garage	1,760 SF
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RIGHT Assateague State Park Site Plan. (by S. Jamero)



Notes

PART 01_ASSATEAGUE ISLAND
Contemporary and Historical Land Use and Ownership
Sources for Text

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