Sea Level Rise Subcommittee Meeting
Subcommittee of Town of Kiawah Island Environmental Committee
Town Meeting Hall
April 11, 2018

Minutes

Persons attending meeting

John Leffler, Subcommittee Chairman Diana Mezzanotte, Town Council Member
Jane Ellis Will Connor (KICA) Jim Chitwood Aaron Given (TOKI) Jim Jordan (TOKI)
Jack Kotz David Pumphrey Lyn Schroeder Bruce Spicher (TOKI) Jim Sullivan
Sara Senst (ARB)
Members Absent: Bob Cheney Matt Hill (KICA)
Others: Mayor Craig Weaver, Wendy Kulick, Diane Lehder, Daphne Wertz (ARB)

Guest Speakers

Mr. Steven Traynum
Coastal Physical Scientist, Coastal Science Engineering

Mr. Traynum specializes in coastal hydrodynamics and estuarine processes for Coastal Science & Engineering (CSE) (2007-present). He is the project manager for several local beach monitoring programs and beach nourishment projects for CSE, and supervises CSE's contract work for the Town of Kiawah Island. CSE produces an annual report on the condition of Kiawah's beaches and recommends actions when appropriate.

Dr. Denise Sanger
Manager, Environmental Research Section, Marine Resources Research Institute, South Carolina Department of Natural Resources

In addition to a variety of other projects, she supervised the biological monitoring of beach nourishment and beach modification projects on Hilton Head, Folly Beach, Myrtle Beach, and Kiawah. She is the Research Coordinator for the ACE Basin National Estuarine Research Reserve which is involved in a nationwide study of SLR impacts on coastal ecosystems.

Dr. William Doar, III
Senior Coastal Geologist, South Carolina Geological Survey, South Carolina Department of Natural Resources

Over the past 25 years Dr. Doar has mapped the geology and geomorphology dynamics for most of the South Carolina coastline. He operates an extensive array of surface elevation tables (SET stations) that measure the rate of marsh elevation changes over time (i.e. can they accrete fast enough to keep up with SLR?)

Traynum's Comments on The Beach

Sea Level Rise

Existing data indicate the sea level rose about 1 foot over the past 100 years. Traynum is not convinced existing data supports the thesis that the rate of SLR has accelerated within the last 30 years. Data collection is subject to uncertainty based on tides and data sampling methods.

One foot of SLR per 100 years is on the low end of SLR assuming there are no changes.

Doar noted inland wet spots will increase as seawater levels increase.

Traynum suggests that plans for large investments and projects should accommodate the worst-case scenario of SLR.

Kiawah's Beach Accretion

Accretion is defined as an increase in the volume of sand on the beach, dunes and the immediate area seaward from the shoreline. Accretion does not refer to the shape of the beach.

Kiawah Island is one of South Carolina's beaches with the highest levels of accretion. The east and west end of the island grow fastest while the central portion of the island is more stable and accretes more slowly. Sullivan's Island is another accreting beach. Traynum expects Kiawah's beach to continue accreting. He expects the beach to maintain its shape and condition if the Town continues to manage storm events as we have been managing them.

Kiawah Island accretes sand that originated from the Stono River inlet. This sand attaches to the east end and moves down the island's beach. Dredging in Charleston Harbor does eventually move sand down to Kiawah, but it takes a very long time. Sand from Charleston Harbor moves from the harbor to Morris Island, to Folly Beach eventually arrives at Kiawah.

Kiawah's Dunes

Hurricanes Matthew, Irma and the 2015 rain storm caused the dune line to recede. The erosion levels over the last three years are high for Kiawah, but low compared to other beaches in the state.

Traynum estimates it will take 1-2 years to restore the dunes to pre-hurricane conditions assuming no new threats emerge in the intervening two years. Kiawah's dunes and beach rebuild and adjust to smaller storm or tide events in weeks or months assuming the sand is in the area.

During a period of accretion, the beach can lose dunes. High tides and storms (both large and small), tend to flatten the beach by taking sand from dunes and spreading it across the beach. As a result, dunes are smaller but the amount of sand on the beach is the same.

Doar noted tall dunes block waves, but unless the dune is broad with plenty of sand, the dune will wash away. Volume of sand is the key to mitigating waves. Tall, broad dunes, like the ones on Kiawah, provide the most protection from waves. The dunes break the wave energy and the sand which erodes from the dune into the water continues to slow the wave. The larger the volume of sand in a dune, the less likely it is for waves to breach the primary dune and flood the dune field.

Traynum noted that if there is vegetation on the dune, the vegetation stabilizes the dune and also helps it grow faster and bigger. If a new dune forms in front of a vegetated dune, the vegetation will migrate to the new dune. Also, adding new vegetation to a dune could serve to stabilize and grow the dune.

Dune height is a function of the amount of dry sand on the beach. Large areas of flat, dry sand allow dunes to build. Near Flyway, the beach builds quickly and new dunes develop fast. In this area the old dunes behind the primary dune are lower because the beach rebuilds so quickly that the new dunes block sand from depositing on the older dunes.

Near Eugenia, the beach accretes more slowly so the dune grows much larger and taller.

SLR and Beach Accretion

Significant sea level rise occurs over decades while natural beach modification processes occur over years. Natural processes like wind and dry sand accumulation raise the whole beach profile and elevation. Higher tides wash in larger amounts of sand which build larger dunes.

Accretion can accommodate 3 feet of SLR over 50 years by building higher dunes and raising the elevation of the beach. Thus, SLR can be offset by accretion. As a result, our beach should be able to maintain its basic morphological characteristics in the face of rising sea levels. The problems might arise from storm surges that start from a higher base MSL.

Water will not rise higher than the primary dune. However, if the primary dune is breached, minor flooding will likely occur behind the primary dune in the dune field because the new primary dune tends to accumulate all the new sand precluding landward dunes from growing larger.

Fencing on the Beach

While adding fences to the beach can increase the height and speed of accumulation of dunes, fencing is visible. When the dune erodes, debris from the sand fence will litter the beach. Traynum believes Kiawah doesn't need fencing since the beach will naturally build large volume dunes.

Bulkheads on the Beach

Installing a bulkhead thwarts the natural processes which wash sand onto the beach and into the dunes; the bulkhead blocks sand migration.

Wildlife on the Beach

Based on the current beach management practices, Traynum believes in the long run we should be able to keep turtle nesting and shorebird habitat, including the piping plover (with temporary and episodic interruptions from storm events.)

Sanger notes that hard pack sand accommodates turtles. Also, shorebirds will likely continue feeding on the beach assuming no changes in the elevation profile. Plovers, which exhibit site fidelity, need habitat and food, and they like to live on the ends of islands where it's muddy. Mud accommodates polychaete worms, which Plovers like. If we lose the mud, we may also lose the Plovers.

Traynum noted that the large shoals which form on the east end of the island act like their own small barrier island. As these large shoals migrate toward Kiawah they create small ponds and mud. Smaller shoals are not as effective in creating ponds and mud.

Bottom line on the beach

If we keep doing what we have been doing to help the beach rebuild after significant storm events, the beach should continue to be in the good shape it is in today for the next 50 years of anticipated sea level rise. The sand scraping that was done after Irma is fine. We are just moving existing sand around and then the water and wind quickly reshape the beach. The dunes will continue to provide good protection from wave action during most storm events: however, any breach of the dunes will produce increasingly deep flooding behind the dunes as sea level rise increases. Our beaches should continue to provide good habitat for sea turtles and shorebirds.

Doar's comments

Doar noted that during nor'easters the dunes on Edisto Island break down and sand washes over the roads and into houses. No sediment reaches the back side of the island. Edisto Island sand is pinned with several groin[1] fields. In a groin field sand accumulates along one side of the groin. When unimpeded by houses or other barriers, surplus sand can move from the front beach to the back of the island.

Raising Kiawah's Elevation

Doar agrees that the beach front can naturally adapt to rising SLR. Other parts of the island which do not receive sand from the beach-front depend upon the marsh to trap or create sediment. As sediment builds, the back side of the island will rise.

Sediment is mud. There are no significant upland or inland drainage areas adding sediment to Kiawah Island. Local bluffs can add sand into the system when they erode, but it is not "new"

[1] Groin: long, narrow structure built out into the water from a beach to prevent beach erosion or to trap and accumulate sand that would otherwise drift along the beach face and nearshore zone under the influence of waves approaching the beach at an angle.

sediment - it is merely redistributing existing sediment. Storms will wash beach sand over the land through inlets.

SET commentary

Doar noted that monitoring SET (Sediment Elevation Tables) shows that each spot develops differently. SETs have been established from Georgia to North Carolina and were deliberately located in diverse environments in order to learn what happens with different tides, elevations and vegetation. The lowest elevation SETs are gaining sediment faster than the 3mm/yr of SLR rise. SETs in areas with low elevations rise faster than SETs in higher elevations.

Louisiana Sinking

South Carolina marshes experience less human intervention than marshes in Louisiana where they have cross cut the marsh with ditches and canals. Cross cutting has changed the marshes' hydrodynamics and the Louisiana marshes are eroding rapidly.

Doar noted his benchmarks show no changes in South Carolina land elevation over 20 years. He concludes it is unlikely that the land is sinking, rather, there are areas that are not accreting fast enough to keep up with SLR. Conversely in Louisiana 200 SETs show the land is actually sinking due to dewatering, as well as gas and oil extraction.

Cape Romaine

Boston University researchers monitor Cape Romaine. In the Cape they see small marsh platform "islands" disintegrating and they also believe they are seeing grass losses. The research is in its early days and scientists expect to learn about how pathogens and changes in salinity affect grasses. He believes the results are 5 – 10 years away.

Givens noted that some birds use small, high areas within the marsh and he worries that these may be lost as water levels rise.

Sanger's Comment on Marshes and Living Shorelines

Living Shorelines and Regulations

Living shorelines, including oyster beds, can help mitigate flooding and protect property because oyster reefs break wave energy and trap sediment. As a result, shorelines retreat more slowly as lower wave energy reduces erosion and sediment trapped by oysters and plants raise the land elevation. Marsh vegetation also raises marsh elevation by trapping sediment and adding organic matter.

The Kiawah River has extensive, healthy, naturally-occurring oyster beds. Thus, installing new living shorelines may provide benefits only in limited locations.

Currently, only the DNR and The Nature Conservancy are easily permitted to build living shorelines. Sanger is working with SCDHEC-OCRM to develop guidelines to allow living shorelines to be adopted more widely. She believes that communities may want to create living shorelines to protect their property.

Current regulations stipulate the marsh (i.e. MHHW) must recede to the property line before a property owner can take action to protect property. Regulations do not allow property owners to be proactive; they must leave the marsh alone until it begins to threaten their property.

In May 2018 Sanger's research team will begin creating a framework of recommended actions to protect property along marsh lands. Changes in regulations are probably 2-3 years away. Currently, if you want to take action beyond what regulations allow, you must submit an application that will be reviewed

SCORE program

SCORE is a SCDNR program for restoring oyster habitat. Often when SCDNR adds an oyster reef along a shore line the marsh behind the oyster reef begins to rise as sediment accumulates. The program focuses on erosion and raising citizen stewardship awareness. Sanger's research monitors 60 sites for erosion and sediment accumulation. On 12 sites they created a reef with bagged oysters. In other areas, they installed crab trap-like wire structures dipped in concrete to provide surface for oyster spat. These structures work best in areas with soft bottoms where the bagged oysters simply sink into the mud, but the cage-like structures sit on the surface.

High, eroding bluffs cannot be stabilized by oyster reefs. Oyster reefs grow up, trapping sediment and raising the land behind them. A bluff will continue to erode, but the sand might be trapped in the reef.

Harvesting the oysters along the shore line can damage the living shoreline. Some harvesting may actually encourage more rapid growth.

In areas where oysters cannot grow efficiently Sanger is studying Curlex and Corelogs. Curlex, a product made of aspen strips, did not work; the tide action and salt water disintegrated the product. Corelogs which are made of coconut fibers, so far, looks more promising. Corelogs are an option rather than oysters. They are testing to see if they get marsh accretion.

Thin layer disposal is spreading or spraying sediment from a dredging operation onto a marsh in order to fill and raise the marsh. Currently, thin layer is not economical; there is no good way to spread the dredging product evenly, 1-3 cm thick. Adding sand to a marsh is difficult unless it's added to the upland where it might then wash down into the marsh and become trapped.

Marsh Accretion

Marshes accrete as the elevation of the marsh floor rise. Plant biomass and sediment increase and raise the land. On the river and marsh shores of the island there is no loose blowing sand to raise the height of the land to accommodate rising water levels. As the water rises, marsh grasses and plants drown.

Generally, shallower parts of marsh build slower than deeper parts. In addition to habitat and scenic value, the main benefit from marsh build-up is breaking wave action and slowing storm

surge (at one of our meetings with the city of Charleston, they said that 15 feet of marsh can absorb 50% of incoming wave energy).

Traynum noted that studies suggest the marsh currently keeps up with SLR but may not if SLR accelerates. Accelerated SLR may cause marshes to drown and produce mud flats. This is why they have tried to add sediment to raise the elevation of marshes.

Spartina grass will naturally move into the area (*Spartina* can tolerate full ocean salt concentrations for periods of time, but also requires freshwater input). There are different types of *Spartina* and each tolerates various levels of salinity.

Marsh Migration

Marsh will naturally migrate upland as sea levels rise. Doar noted that the geology as well as elevation of the uplands will determine where a migrating marsh will go. Water may cut a scarp in a dune or simply erode an area. Marshes need low slope to migrate inland. Low elevation with gentle slopes washed with water offer the best geography for marsh migration.

Doar noted that baseline measurements of shorelines (oceans, creek and rivers) across the state suggest we may be losing salt marsh acreage to water. Marshes move into the uplands as the water inundates the grasses for longer periods of time. He notes that many years of data are required to draw conclusions.

Marsh Die-back

Sanger noted that marshes occasionally die. Often, drought causes the die-back. Less rain means less fresh water, so the marsh becomes saltier. Higher salinity kills the plans. Georgia had massive bouts of marsh die back in 2008. SC also had some, but not as much. Patches of marsh usually grow back and the marsh recovers.

Fresh Water Lens and Maritime Forests

Doar noted the island has a fresh water lens. Fresh water pools and floats upon the surface of the underlying salt water which is denser. If the fresh water lens breaches the land, then it leaks out or evaporates, and decreases the size of the fresh water lens. Fresh water can also drain out through ditches, wells or improperly sealed geothermal tunnels that pierce the lens.

The upland maritime forests may be negatively impacted by rising seas. The head pressure from higher salt water causes saltwater intrusion into the upland which can push the fresh water lens upward. The rising salt water could force the fresh water above ground, causing the freshwater to either evaporate or to create surface water pools. With their roots in saltwater, live oaks and pines may die, leaving uplands largely dominated by junipers which are more salt water tolerant. Other upland plants will also be affected, and the changing habitat will impact the animal species that depend on the oak-pine maritime forest.

Building on Upland

Sullivan Islanders are building wooden walls to protect their property from water intrusion. The ability to build these walls depends upon the property and the conditions on the property. In some areas up to 19 inches of encroachment is allowed. OCRM regulators review the size of the buffer zone to determine where the permit allows walls or fill to be built or added.

Building codes also address where walls or fill will be permitted. If one property owner builds walls or fills land, those actions will impact adjacent properties.

Doar noted that about 10 years ago while beaches had setback regulations, there was little to no regulation or setback for building in estuaries. Connor noted that OCRM sets critical lines. Setbacks are created by the developers, not by OCRM. Sanger believes OCRM used aerial data to determine critical lines but does not believe there are any universal data collected and administered. She also noted that the critical lines may not be accurate.

Sanger also noted that it can be difficult to build walls high enough to preclude intrusion by storm surges. Once walls are built, if water rises over the walls, the water is now trapped behind the wall. It cannot run back into the river or creek; it has to be pumped out.

Imaging and Data and Resources

USC has historical aerial photography images, at least as far back as 1937. These data can be digitized for local areas. Doar's research has information on coastal images since 1937. The data show how shoals, wetlands and water edges have moved over time.

Sanger noted that earthengine.google.com/timelapse can provide a view on how the geography of an area changes over time.

Doar referred to a paper from Hobcaw Barony above Georgetown in collaboration with Clemson and USC's Bell Baruch Marine Laboratory. The study shows aerial photography of upland and salt marshes over 30 years. The photos can be used as indicators of which types of forest best survive increasing levels of salinity.

Land survey information may be available to show changes in portions of our marsh edge.

Ocean Dredged Material Disposal Sites (ODMDS)

There are designated areas in the ocean where dredged material is dumped. There is an ODMDS off Folly Beach. A clay berm has been built around the disposal site to help keep the dredged mud in the disposal site instead of drifting away. This year, dredging in Charleston Harbor was especially deep and the dredging pulled up limestone. The limestone was moved to the ODMDS and used to enhance the berm around the disposal site.

Planning for Marsh and Ocean from Management

Mr. Jordan noted KI has about 10 miles of beach front and about 100 miles of marsh front.

When faced with the question of what to do to manage marsh front, Doar noted the Town must first decide what it wants the island to look like. Raising roads and structures or hardening the shores may protect property but will change how the island looks and how the land develops. For example, building walls or filling along a marsh may preclude marsh migration, cause the plants to drown and turn the marsh into mud flats.

Traynum noted that if you elevate the marsh, properly, the marsh will grow up into the elevated areas. He suggested the causeway probably needs to be raised. Traynum also suggested analyzing the elevations across the island to identify which roads and structures are likely to be first impacted. Elevations will also help forecast what will happen with 1, 2 or 3 feet of SLR.

Engineering landscapes usually change the habitat and wildlife that populates an area. Engineered landscapes can be made to encourage or discourage particular types of plants. Doar noted that often, engineered landscapes promote pines and oak while causing the loss of Wax Myrtles upon which some wildlife depend.

Beaufort Open Land Trust

Doar noted that the Beaufort Open Land Trust, funded by excise taxes, originally set out to purchase property in order to protect views along waterways. The trust inadvertently ended up buying land which allowed marsh migration. Now, the Trust considers the suitability of a property to accommodate marsh migration when they make a purchase.

Some ideas for homeowners on the marsh side

1. The information we have already assembled on flood event adaptation techniques for property owners will be of interest to those on the marsh edge.

2. A property owner can currently put up a seawall on their property extending no more than 18 inches over the critical line (unless an exception is obtained due to property loss). Unless this is done in concert with neighbors, it will be difficult to be effective and to avoid increasing problems for neighbors. Also with heavy rain events (or other flooding), a mechanism for water to flow to the marsh will be needed.

3. Property can be abandoned or donated to allow nature to take its course. Some SC coastal communities are considering buyout plans for this purpose.

4. Perhaps fill could be added to a lot and planted with salt tolerant plants. This action could also provide a source of sediment that might erode and build up the marsh. A berm might delay high tide flooding as sea levels rise.