TOWN OF Kiawah Island

ENVIRONMENTAL COMMITTEE MEETING

Virtual Meeting via Zoom
May 12, 2021; 2:00 PM

AGENDA

I. Call to Order:

II. Approval of Minutes:
- **A.** Minutes of the March 2021 Environmental Committee Meeting

III. Old Business
- ***A.*** Kiawah Landscaping Workgroup (Grow Native)
- ***B.*** Shorebird Stewardship Program
- ***C.*** Flood Mitigation and Sea Level Rise
- ***D.*** Grow Native/Parkway Landscaping
- ***E.*** Rodenticides/Wildlife
- ***F.*** Deer Management
- ***G.*** Kiawah Conservancy Projects

IV. New Business
- ***A.*** Discussion of Conservancy Project Funding for FY 21-22
- ***B.*** Green Initiative Working Group

V. Reports:
- **A.** Town of Kiawah Island
- **B.** Kiawah Island Community Association Land & Lakes Management
- **C.** Kiawah Island Golf Resort
- **D.** Kiawah Island Architectural Review Board
- **E.** Kiawah Conservancy
- **F.** Turtle Patrol

VI. Citizen Comments:

VII. Chairman's Comments:

VIII. Committee Member Comments:

IX. Adjournment:

FOIA: Notice of this meeting has been published and posted in accordance with the Freedom of Information Act and the requirements of the Town of Kiawah Island.

ENVIRONMENTAL COMMITTEE MEETING

Virtual Meeting via Zoom
March 10, 2021; 2:00 PM

AGENDA

I. Call to Order: ***Mr. Jordan called the meeting to order at 2:00 pm.***

Present:	Jim Jordan, Chairman
	Jim Chitwood
	Jim Sullivan
	Jane Ellis
	David Pumphrey
	Scott Nelson
	John Leffler
	Jack Kotz
KINHC:	Lee Bundrick
KICA:	Lucas Hernandez
KICA:	Matt Hill
KIGR:	Liz King
Absent:	Lynne Sager
	Pam Wilson
ARB:	Sara Senst
TOKI:	Aaron Given
Also Attending:	Dr. Scott Parker, *Council Liaison*
	Collie Farah, *Kiawah Conservancy*

II. Approval of Minutes:

A. Minutes of the January 2021 Environmental Committee Meeting

Mr. Nelson made a motion to approve the minutes of the January 13, 2021 Environmental Committee meeting. The motion was seconded by Ms. Ellis and was unanimously approved.

III. Old Business

A. **Kiawah Landscaping Workgroup (Grow Native)**

- No update

B. **Shorebird Stewardship Program**

- Stewardship training conducted on March 9th with 20 to 25 attendees
- Video of the training is available for those interested but unable to attend
- A restart of the program scheduled for March 2021
    - Red Knots on the beach now and will be the focus in March and April
    - Hoping to get birds nesting on both east and west ends this year.

C. **Flood Mitigation and Sea Level Rise**

- Adaptive Management Plan update

Mr. Hernandez stated work was continuing with the off-island engagements, 25 contacts were made to this point. With the information gathered from those conversations, work has begun on breaking down each of the threshold areas into systems, giving a better idea of how to pick out exact threshold values.

***D.* <u>Grow Native/Parkway Landscaping</u>**

Mr. Jordan stated that there continues to be some minor issues with the project, but a firm timeline has been established for completion:

- Work on the irrigation system to be completed this week
- Trees and shrubs going in next week, followed by the installation of grasses and perennials
- Substantial completion by March 31st
- Full completion by mid-April giving time for the perennials to flush out and look good before the PGA Tournament.

***E.* <u>Rodenticides/Wildlife</u>**

- Ten additional animals tested since the January meeting, with 14 animals sent to the lab awaiting results
    - Spreadsheet presented to review details of the test results data gathered since the issue was discovered, along with the samples collected by DNR.
        - Dead or dying bobcats, raccoons, possums, and birds of prey were tested
        - Bobcats tested had high levels of multiple anticoagulants
        - Levels were high until late 2020, with a decrease in exposure noted in 2021
        - Exposure levels to one active ingredient have begun to increase in the last few months
- SCDNR sampling – Potential second visit by DNR staff to collect raccoons, possums, and rodents in January did not happen with no plans to return.
- Clemson Research Project –
    - Funding for at least a minimum proposal has been secured with work continuing to obtain funding for a full-scale project.
        - A full-scale version of the project to cost close to $1 million
        - The medium version of the project to cost around $600,000
        - The minimum version of the project to cost around $450,000
    - A graduate student has been selected and is will start in May
    - Work on the project likely to being mid-year

Mr. Jordan discussed that funding was coming from Clemson PSA and Clemson DPR. Additional funds are being sought from the Pest Control Industry, the South Carolina Pest Control Association, and others. The Town will discuss a request to commit $50,000 a year for the next four years during the budget process.

***F.* <u>Deer Management</u>**

- Harvest of 100 deer was completed in February
- 3400 pounds of ground venison was donated to One80 Place for distribution in their outreach feeding programs.
- No issues, complaints, or calls to security

***G.* <u>Kiawah Conservancy Projects</u>**

Mr. Bundrick stated that phase two of the groundwater proposal for this fiscal year was intended to make the groundwater project a long-term monitoring project that would continue past the funding. He indicated the data pulled from the groundwater wells in February, along with tidal and rainfall information, is being complied to see how it all relates together. The next steps are to look into equipment to measure salinity and what causes salinity changes within the groundwater in some areas.

Mr. Bundrick gave an update of the marsh project by stating he had been working with the College of Charleston to help with mapping where the marsh vegetation ends, and the creek begins and how

sediments move within the marsh to help with the development of appropriate types of restoration projects.

IV. New Business

A. Discussion of Funding for FY 21-22 Environmental Projects

Mr. Jordan explained the funding available for the 2021-2022 Fiscal Year. The Environmental Programs budget supports non-Conservancy projects such as the dolphin and shorebird stewardship programs, the bluebird box program, and other projects. Of the $20,000.00 available, $10,000.00 has not been earmarked for a project. He asked the Committee for feedback on potential projects or areas of interest that should be focused on.

Committee members engaged in an in-depth discussion of a potential study of water quality in the ponds and outfalls from wash-off of road surfaces and fertilizer. Mr. Jordan indicated that the study could be considered a potential Conservancy project for the upcoming funding cycle.

Mr. Jordan indicated that Conservancy projects have a separate line item that has been budgeted in this fiscal year at $50,000.00. He asked if the members of the Conservancy had any projects in mind. Conservancy members indicated that while there were potential projects, they required more discussion within the Conservancy before bringing forth the Environmental Committee. Mr. Bundrick noted the Conservancy was in the beginning stages of its ecological health initiative, trying to gather information on how to create and what type of assessment system would be necessary to measure the ecological health of Kiawah.

V. Reports:

A. Town of Kiawah Island

Mr. Jordan discussed his report along with reviewing the locations of the collared bobcats :

- **Bobcat GPS Study**
  - 3 out of 5 2020 bobcats have died
    - Bobcat 550 – February 16th - Adult Male, Parkside, 17lbs 10oz.
      - Anticoagulant poisoning 5/19/20
    - Bobcat 600 – February 17th – Adult Female, Preserve, 17lbs 6oz.
      - Anticoagulant poisoning 6/10/20
    - Bobcat 500 – March 10th – Adult Female, Willet Island, 13lbs 0oz.
      - New cat.
    - Bobcat 250- March 10th – Adult Female, Preserve, 15lbs 1oz.
      - Hit by car 8/11/20.
    - Bobcat 450 – October 18th – Adult Female, Captain Sams, 13lbs 3 oz.
      - Originally captured in April 2008. Blood sample negative for anticoagulants
  - 4 weeks of trapping in 2021
    - January 25 to February 4
    - February 22 to March 5
  - 5 collars deployed
    - Blood samples were taken from three out of five bobcats. All tested negative for anti-coagulants
    - Three new cats and two Recaptures
      - Bobcat 200 – 2-year-old male, 19lbs 15oz, captured near Ocean Course Clubhouse on January 27, 2021
      - Bobcat 250 – juvenile male, 16lbs 8oz, captured in the Preserve on January 28, 2021 – First-time capture
      - Bobcat 767 – female, 13lbs 5oz, captured near Indigo Park on January 28, 2021

- Bobcat 300 – female, 13lbs 12oz, captured on Flyway Drive on January 29, 2021 – First-time capture
- Bobcat 550 – Adult female, 115lbs 10oz, captured on Little Bear on January 29, 2021. Collard last year on March 10, 2020 – weighted 13lbs last year
- Recapture of Bobcat 200 on January 29, 2021. Originally collared on January 27th and again on January 31st – named this cat "Rainwater."

B. Kiawah Island Community Association Land & Lakes Management

Mr. Hill stated that for the third year, large-scale pruning had been taking place to get rid of overgrown vegetation on the pond edges. He indicated a decrease in the vegetation around the edges, allows more sunlight into the ponds creating a healthier habitat and better water quality. He stated that preparations are being made to stock fish and spray algae blooms since the water temperature is still too cold for the tilapia to start feeding and be effective against the algae blooms. He also stated that landscape maintenance and seasonal planting are taking place in preparation for the PGA Tournament and warmer weather.

Mr. Hill stated that in preparation for "alligator season," this would be the first spring without a graduate student doing any alligator work. He indicated that working with Mr. Jordan and Mr. Given, the decision was made to continue to capture alligators, tag them with visual and pit tags, take measurements, and continue to obtain data.

Committee members engaged in a discussion of the removal of vegetation on the pond edges.

C. Kiawah Island Golf Resort

Ms. King, as part of the previous discussion of project ideas, stated that with car collisions having a huge impact on the bobcat mortality rate, she would suggest considering placing animal crossing or educational signs in the area between Cassique and Freshfields to let people know that there is a tremendous amount of wildlife that is crossing the road.

Ms. King reported that the major push has been updating the Nature Center with new displays to include an educational piece on Sea Turtles and a display on alligators and the alligator research and getting ready for all the guests arriving.

D. Kiawah Island Architectural Review Board

No report.

E. Kiawah Conservancy

Mr. Bundrick stated that have brought on new staf as part of the new strategic planning process and introduced Mr. Collie Farah as the new land preservation specialist with the Conservancy.

F. Turtle Patrol

Mr. Jordan stated that Ms. Sager is preparing for the start of the new season. With the COVID protocol situation still not clarified, she is working on its effect on scheduling and new volunteers.

VI. Citizen Comments:

None

VII. Chairman's Comments:

Mr. Jordan commented on a new bill just introduced in the South Carolina Senate regarding the ability for local governments to regulate the use of second-generation anticoagulants. He read the law that prohibited the regulation of pesticides by the local government and the changes to sections A and B. He noted the legislation introduced by Senator Campsen has been referred to the Agriculture and Natural Resources Committee and is expected to be an incredibly hard-fought uphill battle to get it passed.

VIII. Committee Member Comments:

None

IX. Adjournment:

Mr. Pumphrey motioned to adjourn the meeting at 3:12 pm. The motion was seconded by Mr. Hernandez and carried unanimously.

Submitted by,

_____
Petra S. Reynolds, Town Clerk

Approved by,

_____
Jim Jordan, Chairman

_____
Date

Projects Proposal to the Town of Kiawah Island

FY 2021-2022

Understory Vegetation Monitoring ($10,000)

Vegetation performs many services within the ecosystem which make life possible. They are a significant component of resilient communities, with biodiverse plant communities (e.g., maritime forests, shrub thickets, marshes) providing a wide range of services which support both human and wildlife populations. Publicly available aerial mapping products can be used to collect information related to rural and urban forests. LiDAR (Light Detection and Ranging) can be used to study vegetation density, primarily in the form of aerial-collected data products. This is particularly valuable for measuring the productivity and health of forests. While aerial LiDAR and imagery provides information related to the canopy and overall vegetative cover, the data is collected infrequently and often only covers canopy characteristics.

Terrestrial LiDAR Systems (TLS) are now being used more frequently to gather information on forest vegetation. TLS has the ability to distinguish forest sites from structural diversity metrics similar to aerial LiDAR, but terrestrial LiDAR was able to resolve finer-scale detail within sites (LaRue et al., 2020). Furthermore, they can be rapidly deployed as needed to obtain data to inform land management. They can be attached to a tripod or mounted onto moving vehicles to create GPS correlated 3-D maps of the adjacent environment. The range of points captured by some TLSs is between 50-200 meters with an accuracy of +/- 2 centimeters.

Funds for this project would be used to procure equipment to begin monitoring of understory vegetation on Kiawah Island. By obtaining these ground-based LiDAR systems, there is enhanced ability to conduct high-resolution analyses on the understory vegetation and marsh edges. Funds would be used to procure mountable LiDAR (e.g., LS CX32 3D surround LiDAR device) and ancillary equipment to begin analyzing vegetation in the maritime forest and along residential corridors on Kiawah Island.

Reasoning

- Vegetation on barrier islands provides ecosystem services which benefit humans and wildlife
- LiDAR can be used to monitor vegetative productivity and density
- Terrestrial LiDAR systems can be easily deployed and provide more frequent data necessary for understanding changes to vegetation

Objectives

- Obtain equipment for monitoring vegetation density, forest structure, and productivity
- Analyze landscape vegetation density along parkway viewsheds

Requirements and approximate costs associated or needed to accomplish this project

- Use of Kiawah Conservancy, KICA, and other properties across the island, with pre-selection of suitable sites
- Work with partners to share funding and supply needed expertise and equipment
- Funds necessary for carrying out Phase II of the project ($10,000)
    - Terrestrial LiDAR System and ancillary equipment ($9,000)
    - Equipment and apparatus for mounting on moving vehicle ($1000)

Outcomes

- Better understand and quantify maritime forest structure and landscape vegetation density on Kiawah Island
- Have insight into the perceived impacts on the native plant community and island habitat
- Identify vulnerable areas to prioritize preservation and restoration efforts, low-impact development practices, and green-infrastructure projects.
- Enhance current modeling related to localized flooding in the community
- Refine methods to assess the health of the suburban maritime forest
- Ability to objectively assess environmental impacts to vegetation, especially those related to saltwater intrusion and development
- Assist the Town in pursuing goals listed in the amended comprehensive plan by providing information about protecting natural resources and promoting community resilience:
    - Natural Resources goals 2a - monitoring natural resources on Kiawah Island
    - Natural Resources goal 3d - understand the vegetation density adjacent to open water areas and highlight their importance.
    - Natural Resources goal 6a - Can be deployed to study marsh and marsh edge vegetation to highlight their protection

Mink Monitoring ($15,000)

Tidal marshlands are dynamic habitats rich in biodiversity. The Kiawah community receive natural benefits from these areas in the form of natural protection from hurricane events, remediating stormwater runoff and pollution, and providing aesthetic beauty. They are also some of the most biologically productive habitats in the world, providing resources for a variety of species to thrive. For Kiawah Island, much of the wildlife, such as deer, racoons, bobcats and minks use the marshlands to travel, feed, and reproduce. Understanding the health of these tidal marshlands is critical to protecting the overall integrity of Kiawah Island. Studying indicator species can provide additional details about the health of these habitats and their ability to support wildlife.

American Mink (*Mustela vison*) inhabit Kiawah Island and are often referenced as species which indicate the health of the surrounding habitat by SCDNR (Butfiloski and Baker, 2005). Their historical populations have also been in decline (Baker and Carmichael, 1999). Most of a minks' life is spent within the marshlands foraging for food, shelter and mates; rarely ever touching foot on land other than the local hummock islands. The most recent study of minks on Kiawah Island was completed in 2002 by Lisa Vandiver. While this study was useful in determining populations at the time, the status and home range on Kiawah Island has very likely changed since. A large or small population status will directly correlate with the health of the marsh and their distribution will determine which areas of marsh to prioritize management efforts.

Several methods can be used to monitor the minks. Game cameras can be used to capture footage of individuals who avoid the traps and give a better understanding of population status. These cameras can be attached to the raft, trees, or apparatus to capture footage. The footage can also be sent via cellular network to allow for monitoring accessibility. Cameras can also be mounted on constructed mink rafts so researchers can monitor their movement across the rivers and within the marsh. Furthermore, live cage traps can be used to take samples for lab testing and allow researchers to place collars on minks. Radio collars will be used to monitor movement of minks all across Kiawah and keep track of their survival.

This research project would also assist with future planned efforts to research the environmental effects of rodenticides on local wildlife populations. Seeing as how Minks have a similar diet to those of bobcats, they will provide another source for understanding the spread of SGA's on Kiawah.

Reasoning

- Marshes are biologically productive habitats which support local wildlife
- Minks are an indicator species for the health of marsh and riverine systems
- Monitoring local mink populations will provide additional information about the ecosystem health of Kiawah Island

Objectives

- Monitor the movement and distribution of minks around the marshes
- Monitor population size and reproductive success
- Determine priority areas within the marsh to inform on management efforts for protecting wildlife populations

Requirements and approximate costs associated or needed to accomplish this project

- Use of Kiawah Conservancy, KICA, and other properties across the island, with pre-selection of suitable sites
- Purchase of equipment for monitoring mink and associated wildlife ($15,000)
    - Radio collars to continuously monitor wildlife movement
    - Traps to capture minks
    - Game cameras with cellular network to remotely monitor individuals
    - Materials to mount game cameras and construct raft platforms to attract minks
    - Help through the use of a graduate student

Outcomes

- Better understand mink populations and the health of the marsh
- Identify vulnerable areas to prioritize preservation and restoration efforts, low-impact development practices, and green-infrastructure projects.
- Assist the Town in pursuing goals listed in the amended comprehensive plan by providing information about protecting natural resources and promoting community resilience:
    - Natural Resources goals 2a - monitoring wildlife and natural resources on Kiawah Island
    - Natural Resources goal 6a - can be used to highlight the importance of protecting marsh, marsh edge, and shrub thicket habitats

Hydrological Processes to Informing Land Management

Coastal environments, especially those on barrier islands, contain some of the most dynamic hydrological processes due to changing climatic conditions and tidal influences. Rainfall events introduce freshwater in upland areas and percolate into the shallow subsurface aquifer, referred to as 'groundwater' (Callahan et al., 2012). This recharges the groundwater and increases the elevation of the groundwater table. This freshwater reserve is gradually reduced overtime via plant uptake, evaporation, and drainage into the tidal marsh.

The groundwater elevation lowers overtime as it gets dispersed horizontally throughout the subsurface aquifer and eventually discharges through the marsh. Groundwater will discharge to reach an equilibrium with tidal fluctuations, which are generally around the elevation of the Mean High Water mark on Kiawah Island. Groundwater discharge through the marsh subsurface reduces the groundwater level and dilutes the salinity of seawater around the root structures of marsh vegetation. Forest vegetation also reduces the groundwater level through incremental uptake during the daytime. Finally, water is also evaporated from the soil as surface temperatures increase. Both vegetation and climatic conditions contribute to the overall evapotranspiration of water.

Residential development alters groundwater changes by introducing impervious surfaces that reduce the infiltration rate of accumulated rainfall on soil surfaces. Additionally, infrastructure (i.e., ponds, drainage pipes) is constructed and maintained to mitigate the additional stormwater runoff generated from impervious surfaces. Landscaping activities also contribute to these processes by introducing water from deep subsurface aquifers and civil water districts for purposes of irrigating landscapes.

In addition to freshwater influences, saltwater also impacts the groundwater on mesotidal (2-4m tidal range) barrier islands in several ways. During King Tide events, saltwater mixes with the groundwater. The salinity content and level of groundwater rise due to the increase in the localized hydraulic pressure potential, as evidenced through data gathering during the groundwater table study. Saltwater inundation occurs during extreme weather events that produce a storm surge (e.g., hurricanes), so saltwater can infiltrate the soil and temporarily increase soil salinity content.

Understanding the contributions of these influences on the hydrological processes on Kiawah Island assist land managers in developing best approaches to conserving natural water resources. Water budgets are one approach to determining the holistic impact of these influences. A well-developed water budget provides the means for evaluating availability and sustainability of a water supply and provides a foundation for effectively managing and planning for water resources (Healy et al., 2007; Kassabian et al., 2015). In simple terms, a water budget allows a community to assess and manage the physical conditions of water stored in a hydrological system, which is balanced by the water introduced into and released from the system. The inclusion of groundwater, rainfall, standing water (i.e., tide levels, pond levels) and evapotranspiration data (Pyzoha et al., 2008) can be used to calculate a water budget in a coastal environment.

Previous projects have established monitoring efforts that provide key components to developing a water budget for a coastal environment: groundwater monitoring (Callahan et al., 2012; Kassabian et al., 2015), the Kiawah River Bridge Tidal Station, the weather station on the Timbers, and frequent pond level monitoring. Efforts to gather additional data on estuarine, climatic, and pond conditions will provide critical information for developing a water budget for Kiawah Island.

We also propose that water quality data within stormwater ponds and tidal creeks can provide further information on the biological and chemical conditions within the hydrological system. An effort to couple water quality monitoring with a water budget can provide a comprehensive assessment of local conditions and help understand other environmental cycles of concern within low lying coastal communities (e.g., nitrogen, carbon, sediment). As a result, land managers can develop an ecosystem-based management approach to improve the resilience of the local hydrological system and maximize the benefits to both humans and wildlife.

Climatic Monitoring for Water Budgets ($10,000)

Rainfall replenishes freshwater in a barrier island hydrological cycle. Gaining a better understanding of rainfall accumulation by installing monitoring stations in different sites provides additional information on the various microclimates within an area. For instance, one area of the island may receive a burst of rainfall while another area can receive little to no rainfall in the same day. The distribution of rainfall accumulation on the island can help determine the level to which certain areas where stormwater recharges groundwater and freshwater wetland levels.

Evapotranspiration occurs through the natural evaporation of water and the transpiration of water in through plant activity. There are several methods for determining the potential evapotranspiration [PET] for determining water budgets in shallow aquifers in the lower coastal plain, as mentioned by Kassabian et al. (2015). One method is the Hamon model, which uses daytime length, saturated vapor density, and a calibration coefficient (= 1.2) to calculate PET. Another method is the Modified Hargreaves - Samani model (Dai et al., 2013; Kassabian et al., 2015) which uses daily mean air temperature, extraterrestrial solar radiation, and daily difference in max/min temperature to capture PET.

This can be measured with a weather station that calculates evapotranspiration using humidity, temperature, solar radiation, and wind. Along with the PET values generated, a water budget using PET, precipitation, and change in groundwater levels, normalized using specific yield of soils (Kassabian et al., 2015). The inclusion of an anemometer to measure wind speed is also important for understanding influences on tidal fluctuations. Increasing wind speeds also increases tide levels, which is often a major contributing factor in producing storm surges.

With funding from the Town, equipment will be purchased to establish an additional weather station to collect and monitor climatic data. An Onset brand HOBO RX3000 can be outfitted with wind, solar radiation, temperature, and relative humidity measurements to gather information to calculate PET with both the Hamon PET model and the Hargreaves-Saman model. The calculated costs for obtaining this equipment are around $3,500, not accounting for cellular data and installation costs.

Also included in the budget are efforts to Initiate an island-wide effort to monitor accumulated rainfall through NOAA's Community Collaborative Rain, Hail, and Snow Network (CoCoRaHS). CoCoRaHS is a citizen-science effort to measure rainfall accumulation throughout the contiguous United States. This is facilitated through low-cost monitoring tools for measuring rainfall accumulation. Funds will be used to purchase rain gauges to provide to interested residents, as well as educate them on how to report to CoCoRaHS. Monitoring through an additional weather station and through citizen science efforts will provide enhanced information on rainfall accumulation on the island to help stormwater management.

Reasoning

- Hydrological cycle on barrier islands is dynamic and determine the overall habitat health and community resilience
- Precipitation, evapotranspiration, and groundwater data informs on major components within the natural hydrological cycle.
- Water budgets can be created to inform on land management practices to conserve natural groundwater resources

- Gathering additional climatic data will fill gaps in current knowledge of weather influences on water resources for Kiawah Island

Objectives

- Monitor and analyze climate data
- Create a water budget using climate data
- Observe seasonal weather patterns
- Identify management priorities for the conservation of freshwater resources.

Requirements and approximate costs associated or needed to accomplish this project

- Use of a satellite property on Kiawah Island for long-term deployment, with pre-selection of a suitable site(s)
- ARB approval of monitoring stations and/or additional equipment on existing monitoring sites
- Work with external contractors to inform on best practices and placement of equipment
- Estimated $10,000 in funds needed for the procurement and installation of monitoring equipment, based on previous quotations from potential contractors (quote pending).

Outcomes

- Better understand dynamics of the hydrological cycle on barrier islands
- Develop a water budget to inform on best practices for land management (residential and commercial) on Kiawah Island
- Enhance current modeling related to localized flooding in the community
- Further utilize data gathering from the groundwater table study funded previously by the Town of Kiawah Island
- Respond to the "Groundwater and Salt Intrusion" section in Town's Amended Comprehensive Plan (page V-6)
- Assist the Town in pursuing goals listed in the amended comprehensive plan by providing information about protecting natural resources and promoting community resilience:
    - Land Use goal 5b - Consideration of development strategies based on objective data to better respond to impacts due to flooding and sea level rise.
    - Natural Resources goal 2b - Going forth with recommendations from scientists at the College of Charleston to incorporate a water budget for Kiawah Island (Kassabian et al., 2015).
- Improve the community's FEMA CRS rating by measuring environmental data and highlighting the need for green-infrastructure practices to promote onsite infiltration and treatment of stormwater runoff
    - 330 Outreach - Additional content for messaging related to flooding and flood mitigation
    - 510 Floodplain Management Planning - Additional projects and measures that will reduce the adverse impact of the hazard on the community and help meet other community needs
    - 530 Flood Protection - Utilization of small/minor structural flood control projects for protecting buildings from flooding

Water Quality Monitoring ($30,000)

Tidal marshlands and adjacent estuarine areas are some of the most biologically productive habitats in the world, providing many ecosystem services to both human and wildlife communities. These habitats are also very dynamic in nature and affected by influences from the local mesotidal changes, groundwater discharge through the marsh, and runoff from upland areas. Every day there is a constant flux of saline water, suspended sediments, contaminants, and wildlife, among others. Monitoring these conditions within the marsh and estuarine areas will provide insight into the health of these areas.

Multiparameter water quality sondes have been used by SCDHEC, USGS, USEPA, and NOAA's National Estuarine Research Reserves System [NERRS] to monitor water quality and make management decisions. These are typically equipped with several sensors to capture data on various conditions within the marsh. NOAA-NERRS uses multiparameter sondes with sensors to monitor temperature, depth, conductivity, pH, turbidity, dissolved oxygen, chlorophyll, and nutrients (NOAA). Information related to these measurements can be found in Appendix A. These sondes are deployed directly into aquatic areas to collect data continuously.

Additional *In-situ* sediment analyses would provide supplemental information to include within a sediment budget. Sediment plates provide data on the vertical accretion of the marsh platform across a time period between several months to a decade (Nolte et al., 2013). Flat surface traps can inform on data within a period between a week and up to a year (Nolte et al., 2013). These would be compared with other analyses to understand marsh sediment compaction and transport. Generally, these components inform on the need to use practices which encourage sediment accretion (i.e., coir logs). It is also suggested that *in-situ* samples of the water column be taken to analyze suspended sediments, preferably during times when aerial imagery is flown so geospatial analyses can be performed to provide information across a wide spatial scale.

Monitoring Equipment. The use of Town funds under this proposal item will be used to purchase a multiparameter water quality sonde. The sonde will be similar to the ones used in practice by federal agencies, with a preference towards YSI EXO series multiparameter sondes. Sondes such as these can be easily deployed into any coastal aquatic environment and moved to different locations based on current needs. The purchase of several sondes with similar parameters is recommended so researchers can compare conditions between upstream and downstream areas.

YSI Exo 2 sondes come with 6 sensor ports to measure these parameters. Recommended parameters include conductivity, dissolved oxygen, oxidation reduction potential + pH, turbidity, and depth. This would allow additional monitoring of aquatic conditions to adjust land management practices to better benefit the health of the estuarine ecosystem. Initially, the sondes can be deployed near pond outflows into the marsh, where the greatest complexity of water conditions occur. The sondes can be moved further upstream into various stormwater ponds or further downstream into the marsh based on need. Comparisons can be made between these areas and how aquatic conditions respond to focusing events (e.g., rainfall, saltwater inundation, tides).

Additional equipment to monitor sedimentation within aquatic environments will also be purchased based on the availability of funds following the purchase of the water quality sonde(s). This includes sampling containers and equipment to gather data on suspended sediments, sediment plates and flat surface traps to be installed in the marsh platform, and various other methods based

on availability. This will provide additional information related to purchased probes and determine how water dynamics influence the deposition and removal of sediments.

Reasoning

- Tidal estuaries and marshes are the most biologically productive habitats in the world
- Water quality can affect the productivity of these habitats and influence their provision of ecosystem services
- These habitats are very dynamic and can be impacted by various contributing factors to water quality
- Understanding water quality and its contributions can help prioritize management efforts and restoration practices to benefit the community

Objectives

- Obtain equipment with the capacity to continuously monitor water quality in various aquatic ecosystems on Kiawah Island
- Identify appropriate, site-specific green-infrastructure practices based on site conditions to bolster resilience
- Initiate efforts to begin monitoring sediment transport and deposition through *in-situ* measurements

Requirements and approximate costs associated or needed to accomplish this project

- Use of tidal salt marsh areas, aquatic environments, and adjacent properties for the deployment and anchoring of equipment
- Coordination and collaboration with KICA and other on-island partners
- Conservancy staff time and effort for deploying equipment, data collection, and equipment maintenance
- Funds necessary for carrying out water quality and sedimentation analysis ($30,000)
    - Multiparameter water quality sondes (~$28,000)
    - Sediment plates and flat surface traps (~$2,000)

Outcomes

- Better understand and analyze water quality within aquatic and estuarine habitats on Kiawah Island
- Obtain insight into the perceived impacts to tidal salt marsh habitat
- Identify vulnerable areas to prioritize preservation and restoration efforts, low-impact development practices, and green-infrastructure projects.
- Initiate efforts to understand marsh sediment transport for the creation of a sediment budget, which is recommended for long-term sustainable deployment of restoration projects (Ganju, 2019)
- Assist the Town in pursuing goals listed in the amended comprehensive plan by providing information about protecting natural resources and promoting community resilience:
    - Land Use goal 5b - Consideration of development strategies based on objective data to better respond to impacts due to flooding and sea level rise.
    - Natural Resources goal 2b - Going forth with recommendations from scientists at the College of Charleston to incorporate a better understanding of marsh sediments

    - Natural Resources goal 6a - understanding the health of tidal salt marshes and influencing land use based on efforts through a federally funded resilience project (NFWF ECRF 2019)
- Improve the community's FEMA CRS rating by measuring environmental data and highlighting the need for green-infrastructure practices to promote onsite infiltration and treatment of stormwater runoff
    - 330 Outreach - additional content for messaging related to flooding and flood mitigation
    - 510 Floodplain Management Planning - Additional projects and measures that will reduce the adverse impact of the hazard on the community and help meet other community needs
    - 530 Flood Protection - Utilization of small/minor structural flood control projects for protecting buildings from flooding

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Appendix - Additional Information on Water Quality Parameters

Temperature and dissolved oxygen [DOx] are important factors for monitoring water quality, as they determine the health and abundance of fisheries. As dissolved oxygen is reduced, fish leave these areas and it can sometimes result in massive die offs (Bailey and Secor, 2016). Temperature also impacts DOx, where a rise in temperature leads to lower DOx levels. Stormwater runoff has very low DOx levels and reduces DOx levels when introduced into open water areas. DOx can be increased by two natural processes: diffusion with the atmosphere and aquatic plants (NOAA). Coupling these parameters with climatic data, such as rainfall, provides further insight into how these areas are impacted by changing conditions over seasons.

Depth measurements are essential for determining site specific tidal fluctuations. As tides rise and flood the marsh platform, the tide levels will vary with location and distance from the Atlantic Ocean. Understanding these site-specific conditions helps to understand elevation related characteristics, which can lead to an appropriate approach to restoration efforts. Furthermore, federally funded restoration projects, such as restoration projects funded through the National Fish and Wildlife Foundation [NFWF], often require the use of depth monitoring equipment.

Conductivity provides information on the salinity content within the estuarine environment. Following rainfall events, stormwater runoff lowers salinity levels. Some organisms cannot tolerate low salinity conditions so their survival is affected. Oyster reefs for example are not typically found in low saline marsh environments with a salinity <15ppt and are not recommended for recruitment activities in these areas (SCDNR, 2019). This information is especially valuable for determining the placement of habitat restoration projects involving oysters so they can be appropriately sited to optimize recruitment and establishment.

pH + Oxidation Reduction Potential [ORP] are often included together on a single sensor and provide information on the chemical properties of aquatic environments. pH provides insight into the biological activities occurring within the marsh, including plant production and algal growth. As plants and algae remove CO_2 from the water and introduce DOx, the pH rises and the water becomes more basic. This can lead to a significant increase in algal blooms, which significantly increase the pH of water to 10-11. Since aquatic life typically tolerates a pH between 5.5 and 9.0, this results in massive die-offs of aquatic organisms. Furthermore, the breakdown of dead algae by bacteria and the nighttime respiration processes of algae are both oxygen consumptive and can severely deplete DOx levels, resulting in massive die-offs of aquatic organisms.

ORP/redox is also important for understanding impacts related to contaminants. ORP levels can help determine whether water contains elevated levels of contaminants, including heavy metals, nitrates, and manmade contaminants, among others (USGS). Understanding ORP and the resulting redox reactions will provide information about how the ecosystem breaks down products from animals, vegetation, and chemical contaminants. It is often used in wastewater treatment analyses, where abnormal values of pH + ORP can indicate contaminated, unsafe water supplies (Lin et al., 2017).

Turbidity will provide information on sediment transport through the aquatic system and be included as a component of a sediment budget for Kiawah Island. Sediment budgets are important for understanding erosion and accretion processes which informs on best approaches for marsh protection and restoration practices (Ganju, 2019). In particular, turbidity measurements can

provide information on suspended sediments within the water column. This can be coupled with additional measurements to create a sediment budget.