DEPARTMENT OF GEOLOGY AND GEOGRAPHY
Georgia Southern University
Post Office Box 8149
Statesboro, Georgia 30460-8149
Telephone: (912) 478-5361
Fax: (912) 478-0668

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Jekyll Island Authority
100 James Road,
Jekyll Island, GA 31527

Re. Shoreline Mapping and Acreage Calculations in Proposed Master Plan

To whom it may concern,

I have reviewed the map in the latest draft of the proposed master plan that defines land-use classifications and their respective acreages and I have some concerns with how the shoreline is delineated. It is clear that how the shoreline is defined/mapped greatly determines the sum total acreage of the entire island and what may be deemed developable land. My main concern is with the delineation of the shoreline and lack of accountability for spatial error within the map given the methods used to generate the data.

Shorelines can be delineated as feature-based lines (edge of the marsh, vegetation, dunes, high-water line, etc.) and can be mapped as an elevation-based feature tied to a datum such as a tidal or geodetic datum. In the case of the Jekyll Island map in the master plan, the shoreline's position is delineated to approximate its location at a tidal datum of mean high water (MHW). This presents a problem based on the methodology used to map the shoreline and how it is being applied for planning purposes. I think it is great that JIA is taking steps to incorporate science-based data in planning, however, in this case the JIA is using data that does not adequately delineate the shoreline's position at a scale that is appropriate for planning purposes. As a result, this has led to error in acreage calculations. With this in mind, I see a great opportunity for the JIA to further refine this map to better approximate acreages of each classification. I will briefly describe why the current delineated shoreline is inappropriate for the master plan.

Some of the earliest attemps to delineate a tidal-based (MHW) shoreline along our coast took place during the mid-1800s by surveyors of the U.S. Coast and Geodetic Survey. This proved problematic for a number of reasons. One reason is that to accurately delineate a mean high water shoreline, one must account for all of the principle deviations in tide levels that occur within an 18.6-year lunar cycle or tidal epoch. Surveyors simply did not have the time nor the necessary equipment to accomplish this and attemped to estimate a MHW shoreline on their maps. They had a number of issues with tidal marsh both in the field and later using aerial imagery and resorted to using a feature-based shoreline mapping approach by simply delineating the marsh-water or vegetation edge boundary. This shoreline was ultimately classified by surveyors as the shoreline "as apparent to a mariner" and could be used for navigation purposes. This shoreline is not always coindicent with the MHW shoreline given the topographic variations that can occur within the marsh system. A detailed history of these shoreline mapping efforts along the U.S. coast and mapping techniques/problems are found in 'Shore and Sea Boundaries' by Aaron Shalowitz.

Today, the National Ocean Service (NOS) and NOAA use an array of tide gauges and remote sensing methods such as tide-coordinated aerial photography and LiDAR to estimate both feature-based and tidal-based shorelines. Tidal-based shorelines are mapped using the latest tidal epoch at nearby tide guages where tide heights are assessed from the time period of 1983 to 2001 (National Tidal Datum Epoch or NTDE). The elevation of MHW is only as good as the latest tidal epoch it is calculated from given that

sea level is currently rising along our coast at a rate of about 1 ft/century based on historical tide levels at Ft. Pulaski. Furthermore, the number of tide gauges present in the area can greatly influence how the position of the MHW shoreline is estimated because tide levels/ranges are not consistent along the coast. Currently, the closest long-term (50 + years) running tide gauges operated by NOS that are within or near the Georgia coast are located at Ft. Pulaski and Fenandina Beach, FL. Other NOS tide gauges that once existed for short periods of time are no longer active and tide predictions are simulated for most of our coastal locations since we have extremely limited tide guage data. In the case of the JIA map's shoreline, a regional hydrodynamic model (using limited tide guage data) was used in conjunction with a tool called VDatum to tranform LiDAR-derived elevations from a geodetic elevation (NAVD 1988) to a mean high water tidal datum.

Here are some of the major problems with trying to use this data at the planning level. First, the resolution of the hydrodynamic model and LiDAR data used to approximate tide levels along Jekyll was too coarse and did not model a substantial portion of the backbarrier and marsh regions adequately. Second, the LiDAR elevations that were measured in the marsh have substantial vertical error (in excess of 40 centimeters) in places where there are difficulties with LiDAR sensors resolving "bare earth" in heavily vegetated areas. Third, horizontal error is not accounted for in the JIA mapped features and their resulting acreage calculations. There can be substantial horizontal error (displacement) in the delination of a shoreline and other features using LiDAR, aerial photography, and other remote-sensing methods. Often shorelines mapped using these methods can have displacment errors that can range from 1 to 15 meters. Such horizontal displacement errors of the boundaries of mapped features can inflate or shrink acreage calculations. One can simply go to NOAA's Sea Level Rise Viewer (http://csc.noaa.gov/slr/beta/viewer/) and see a mean-higher high water (MHHW) shoreline estimate for Jekyll Island along with an estimation of the confidence of the location of the shoreline and what is inundated at MHHW. The lowest confidence in the model output occurs in the marsh. The same hydrodynamic model and VDatum transformation technique was used to approximate the MHW shoreline for Jekyll in the master plan. As a result this and other factors mentioned above, the MHW shoreline in the map is being used inappropriately to map and calculate acreage of marsh and other shoreline features in my opinion.

I have been involved with shoreline mapping for well over a decade and feel strongly that shorelines and other coastal features that are mapped, either in the field or using remote-sensing techniques, should be assessed for spatial error. As the JIA moves forward further developing the master plan, I strongly recommend that mapping (spatial) error analysis be performed on data used to calculate acreages. All mapped features contain spatial error. As it stands with the current JIA map and the lack of mapping error accountability/estimates, acreages derived from LiDAR, aerial imagery, or even field survey-based data in the map can be misleading. I think the data that was obtained from NOAA that simulates a MHW shoreline was a great first attempt at delineating a shoreline through using some new shoreline mapping techniques, however, it falls short of the accuracy needed at local scale and detailed planning level. I encourage the JIA to seek an alternative method of shoreline delineation and I am happy to provide input along with my colleagues. It is a great step forward in coastal planning when the scientific community is allowed to provide input given the dynamic conditions of the coast and politics.

Sincerely,

Chester W. Jackson Jr., Ph.D.
Asst. Professor of Geology
Department of Geology and Geography
Applied Coastal Research Lab