



FINAL REPORT

Beaufort County Regional Stormwater Quality BMP Retrofit Project

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Introduction:

The 2006 Beaufort County Stormwater Master Plan recommended regional water quality retrofits for eight basins throughout the County, targeted to reduce bacteria contamination affecting shellfish harvesting. Ward Edwards Inc. was hired to evaluate the feasibility of the proposed retrofit sites and to prepare the conceptual designs. In addition to reducing the amount of bacteria discharged in runoff, the conceptual designs should reduce the volume of freshwater reaching the salt water rivers from existing developments. It is believed that flashy discharges of freshwater in volumes greater than natural conditions are contributing to the bacteria problems, by temporarily reducing the salinity in the receiving waters. It is also believed that increases in volume and the channelization of flow through undeveloped areas may be transporting natural re-growth bacteria to the receiving waters.

Given the added design parameter of volume control and the amount of development that occurred since the 2006 SWMP, all eight of the retrofit sites were reviewed to determine if the original recommended locations were the most feasible locations within each basin. Feasibility criteria included proximity to conveyance channels, topography, parcel accessibility, natural and cultural resources, and soil characteristics. Each basin was reviewed using GIS data such as LiDAR, aerial images, parcel data, and drainage features collected by the County. Lists of candidate sites were developed for each basin and prioritized based on a combination of suitability and availability. Field investigations of leading candidate sites were completed to verify the GIS data and to confirm suitability. The site feasibility review and prioritization resulted in one additional retrofit site within the Okatie River basin. Figure I-1 shows the nine retrofit site locations throughout the county. The site review results, BMP recommendations, construction cost estimates, and prioritization results are summarized in the following report.

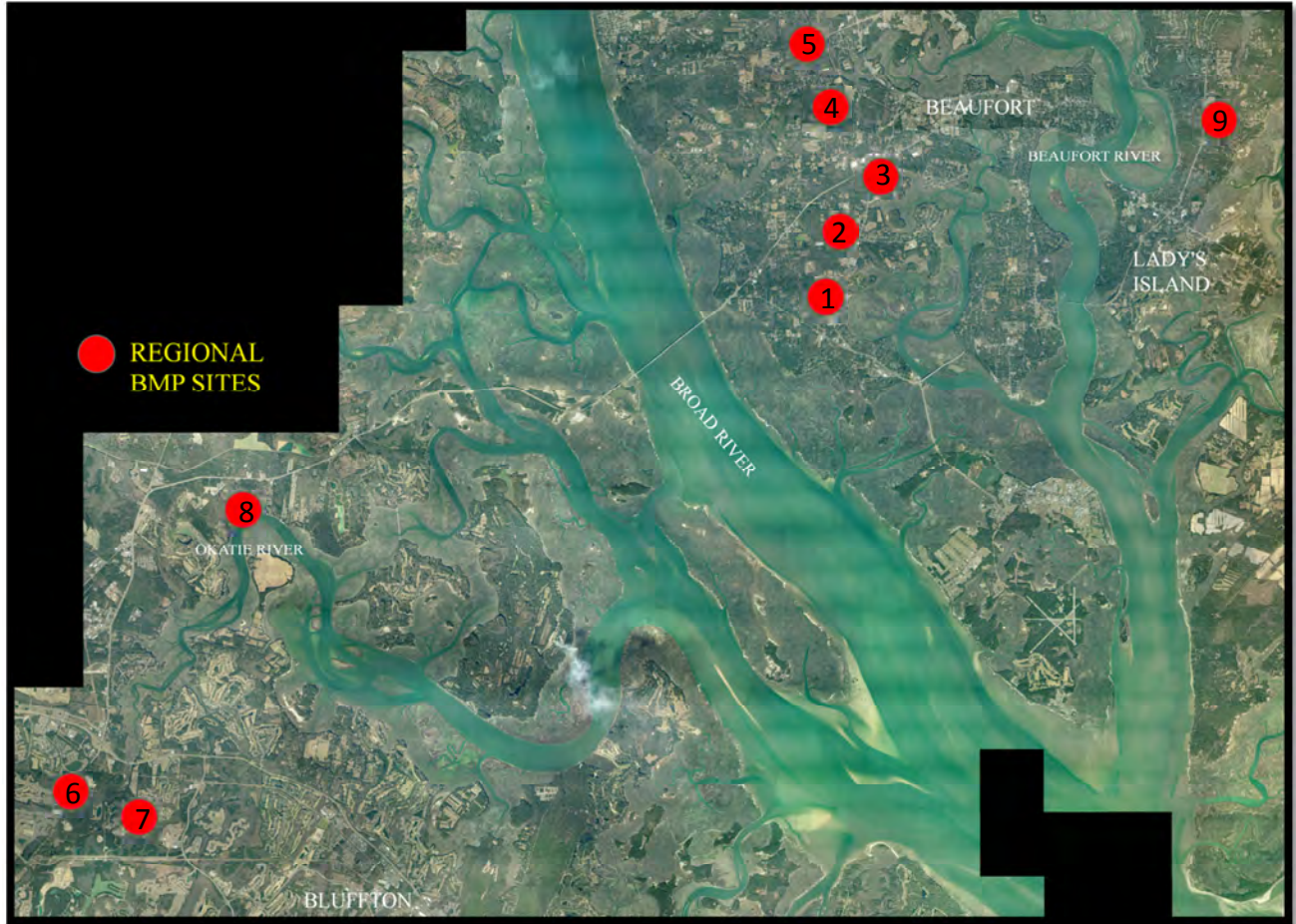


Figure I-1: Regional BMP Site

1. Battery Creek West M1
2. Grober Hil M2
3. Burton Hill M2
4. Salt Creek South M1
5. Shanklin Road M2
6. Okatie East
7. Okatie West
8. Camp St. Mary's M2
9. Factory Creek M2

Section 1 – Battery Creek West M1

1.1 Background

Originally identified in the 2006 SWMP as Site 9, this BMP site is located in the Battery Creek West M1 hydrologic sub-basin, which is a portion of the Battery Creek 1 Water Quality Basin. The sub-basin associated with the original proposed BMP location is approximately 500 acres in size and includes a mixture of property uses, most of which pre-date any stormwater control regulations. Uses in the sub-basin include a par 3 golf course, a lumber storage yard, a convenience store/gas station, single family residential, mobile home parks, a borrow pit, and a BJWSA waste water treatment facility. Figure 1-1 shows the water quality sub-basin and the Battery Creek 1 basin boundaries.



Figure 1-1: Battery Creek West M1 Sub-Basin

The originally proposed BMP site appears to sit on undeveloped land spanning three separate parcels, with the bulk of it being on the wooded portion of the Gifford Golf parcel. The remainder of the BMP is on the Port Republic Lumber Co. parcel and a parcel owned by Doris Taylor, which contains the basin's main conveyance channel. The conveyance ditch inverts appear to be around elevation 6 while the average elevation of the BMP site is around 11 ft, with peak elevations as high as 16 ft. The channel drains through the Port Republic parcel to twin 48" concrete pipe culverts draining under Hwy 280. The culverts discharge to the salt water marshes of Battery Creek and the outfall area immediately downstream has been deemed saltwater critical area by SCDHEC-OCRM, per a reference plat found through Beaufort County ROD. There are two *Stormceptor* brand hydrodynamic separators near the culverts, but they only treat the runoff collected in the highway storm drain system. The majority of the runoff from the 500 acres upstream of the culverts is currently untreated.

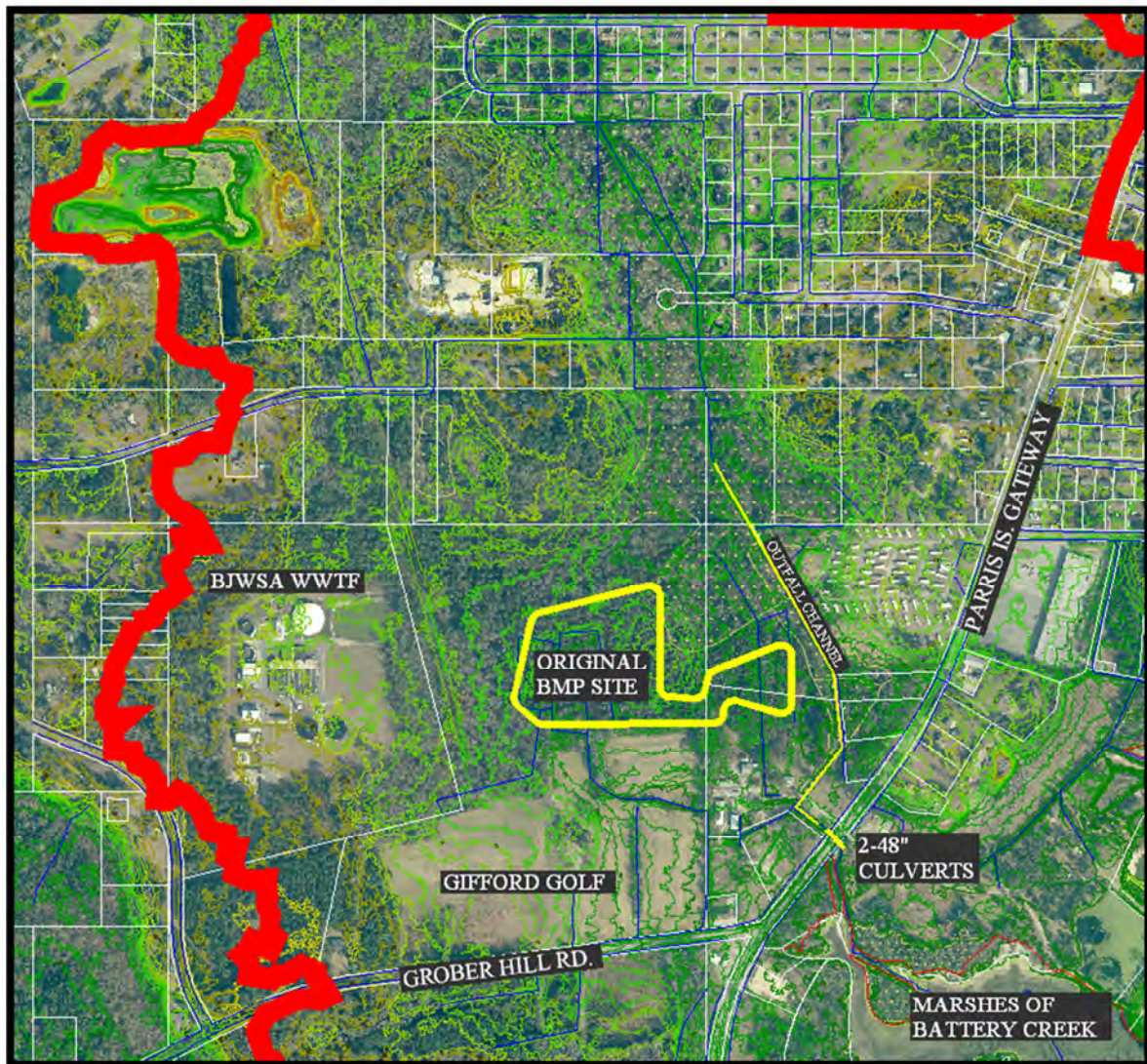


Figure 1-2: Battery Creek West M1 - Original 2006 SWMP BMP Site

Constructing a pond BMP as originally proposed would have a number of significant obstacles:

- With existing grades varying by as much as 8 ft across the site, constructing the pond will require significant excavation in some locations. However it is not completely unfeasible provided enough land can be acquired in order to grade the banks back to existing elevations.
- A review of the NWI data found that there are likely wetlands in the vicinity of the BMP site. Field wetland approximations will be needed if this BMP location is pursued. Impacts to the wetlands are likely needed in order to convey the runoff to and from the main outfall channel.
- Property and/or easement will have to be acquired from multiple property owners.
- Access to the site would likely have to come through the Port Republic Lumber Co. site, as access through the Gifford Golf property would require crossing the golf course.

Considering the above challenges, alternative sites were reviewed upstream and downstream of the original site to determine if there is a more suitable BMP location.

1.2 Alternative BMP Location Considerations

A review of other large parcels on which a BMP retrofit may be feasible was conducted and is summarized below. Figure 1-3 shows the alternate property clusters and the original BMP site.

1. *Port Republic Lumber Company (R112 031 000 038T 0000, R112 031 000 0177 0000, & R112 031 000 0145 0000)*: This cluster consists of three parcels totaling 14.8 acres, with a large amount of frontage on Parris Island Gateway. The site is accessed through two curb cuts to the highway. The majority of the parcel is cleared, with a small portion of wooded area on the northwest end. The site has a series of ditches running through it, including the main outfall ditch for the drainage basin. The main outfall ditch drains to the double 48 inch culverts running under Parris Island Gateway. The site contains a mixture of buildings and exterior storage associated with a small building supply company. The site also contains a communications tower and associated guy wires. The parcels are within the Town of Port Royal's jurisdiction and are zoned for Highway Commercial development. The topography and location of the site makes it highly suitable for the proposed BMP; however the zoning and highway frontage could make acquiring the necessary easements expensive. The presence of the communications tower and any associated underground cables could also complicate the BMP layout. A portion of the property was recently subdivided out and was developed as a standalone retail site (Family Dollar).

2. *Kirkland Land Company (Gifford Golf) (R112 031 000 0039 0000)*: This 73 acre parcel is located to the west of the Port Republic site and borders the BJWSA WWTF. 30 acres of the site contains the par three golf course and driving range, while the remaining area is wooded. Access to the site is from Grober Hill Rd. The property is located in the Town of Port Royal and is zoned for General Commercial development. A series of ditches run through the site and drain toward the Port Republic property. Grades on the site range between 6 ft at the southeast edge up to 17 ft along the northern property line. It appears to contain a small area of wetlands in the wooded portion per the NWI. The large undeveloped area on the site makes it desirable for the BMP site; however, additional easements on either of the two adjacent parcels will be needed to intercept and discharge flow from the main drainage basin channel. Access to the open area will be a challenge, as it would likely have to cross a corner of the driving range or one of the adjacent parcels.

3. *Doris Taylor property (R100 031 000 0140 0000)*: This 10 acre parcel borders both the Gifford property and the Port Republic property, and also has a small frontage on Parris Island Gateway. It is undeveloped and primarily wooded. The basin's main outfall ditch runs through the center of it toward the Port Republic property. Per the NWI, the site is approximately 50% wetlands, including a portion

that would have to be crossed to get access to the highway. The parcel is in unincorporated Beaufort County and is zoned Urban, although given the wetland constraints, it is not a highly developable parcel. This parcel is not of much use to a potential BMP as a standalone piece, but may be needed to supplement one of the adjacent parcels.

4. *Coastal Contractors property (R112 031 000 0632 0000)*: This 78 acre cluster of three parcels is located to the southeast of Parris Island Gateway and contains the point at which the basin outfalls to the Battery Creek marshes. The property is mostly undeveloped, but does contain the LCR Construction materials retail sales area, as well as a single family residential home. The property also contains two upland dug ponds that separate the commercial and residential portions. The property is in the Town of Port Royal and is split zoned, with the front portion being General Commercial, and the back portion being Mixed Use. Grades on the site range between 6 ft to 10 ft, with the majority of it closer to 6 ft. The site contains only a couple of small isolated wetlands per the NWI. The property has great potential for a regional BMP given its location and the existing grades, especially considering it could capture runoff from Parris Island Gateway. However, collecting the runoff at the downstream end of the twin 48" culverts would require impact to OCRM critical area, which would be very difficult if not impossible to permit. Furthermore, the property could be expensive to acquire given its great potential for development. There may already be development plans in place for the property since it is owned by a local developer.

5. *David Fields property (R100 031 000 0033 0000)*: This undeveloped 20 acre parcel borders the Gifford property to the north. The northeast corner contains a small length of the main basin outfall channel, but appears to be within a large wetland consuming approximately a third of the property. Grades range from elevation 9 ft at the channel, up to 20 ft on the northwest corner. The topography and the location of the wetlands make this parcel likely unsuitable for a BMP.

6. *Isaiah Washington property (R100 031 000 0034 0000)*: This undeveloped 5 acre parcel borders the Doris Taylor property to the north and is completely wooded. The main basin outfall channel splits the property, but it also appears to be completely covered with wetlands. The small parcel size and the presence of wetlands makes this parcel likely unsuitable for a BMP.

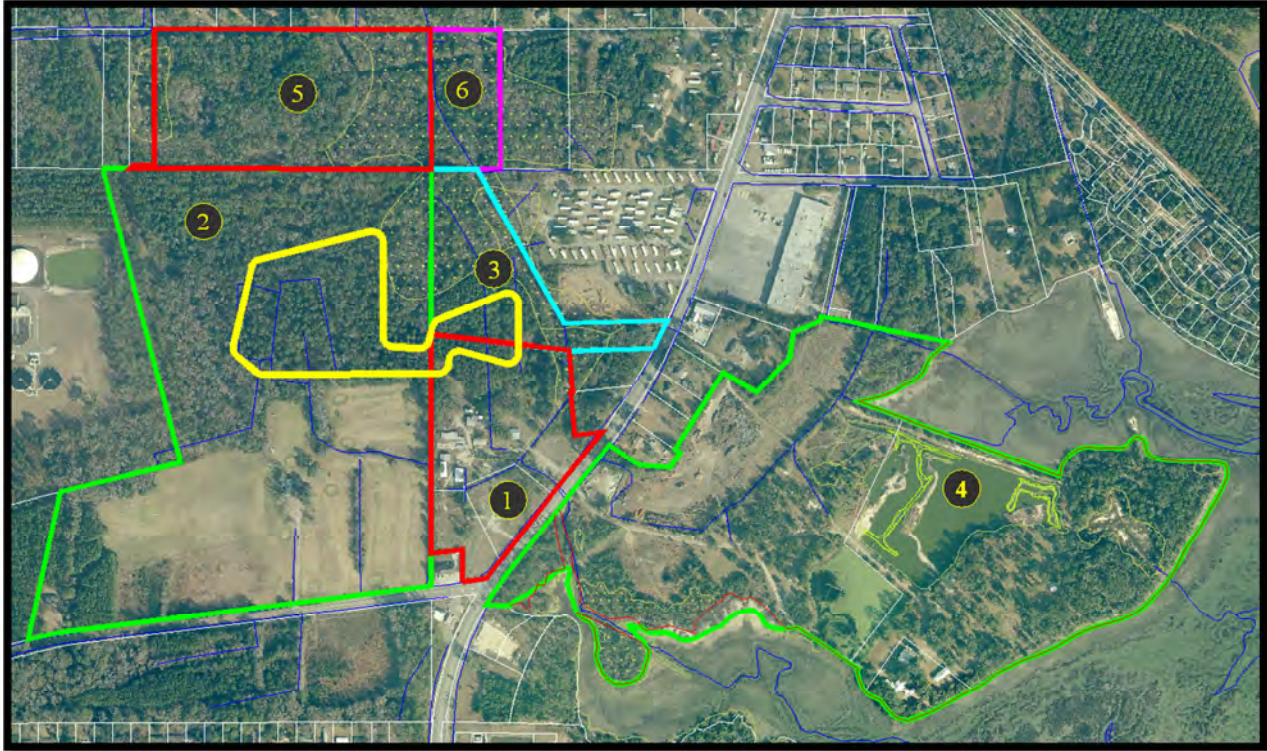


Figure 1-3: Battery Creek West M1 - BMP Sites Evaluated

Although large and in good locations to capture runoff from the main channel, Parcels 1 and 4 are more desirable and suited for development, thus they would be difficult to acquire for the proposed BMP. They both have other sets of challenges, described previously, that would further complicate the installation of a BMP. The wetlands, topography and small sizes will limit the suitability of Parcels 3, 5, and 6 as stand-alone parcels, leaving the Gifford Golf site as the most suitable parcel.

1.3 BMP Recommendations

The large amount of land available in the wooded area of the Gifford Golf site (site #2 in Figure 1-3) makes a regional pond a good choice for a stormwater BMP. Ponds are effective in treating stormwater for bacteria removal and can be designed to reduce the flashy discharge of freshwater to the saltwater river. The location of the pond will allow it to serve approximately 500 acres of area that currently has little to no stormwater treatment. However, there are a number of design challenges associated with this site and the proposed BMP:

- The large variation in site grades, as previously mentioned, will require careful location of the pond and attention to the boundary of the pond. The conceptual layout of the pond shown in Figure 1-4 attempts to locate and shape the pond such that it encompasses the lower portions of the site and minimizes cut from the higher portions of the site.
- The site grades also pose an impediment to conveying the runoff between the pond and the existing outfall channel. Multiple inlet and outlet route options are shown in Figure 1-4. The routes ultimately selected will depend on the results of ground-run survey, the ability to permit, the availability of property/easements, the feasibility of making downstream improvements, and the functionality of the pond. It will be important to locate the inlet and outlet away from

each other such that flow through the pond will not short circuit, as short circuiting will reduce the effectiveness of the pond in treating the stormwater.

- The pond design will have to include an emergency overflow weir sized to limit peak pond stages and to prevent flooding upstream of the pond. Design of the weir and the outfall will have to account for potential impacts to downstream property such as the existing ditches running through the golf course and the Port Republic property.
- Access for temporary construction and long term maintenance will have to be considered. Access may have to go through the Port Republic site in order to prevent impact to the golf course operation.
- All components including the pond location, pond layout, outfall location, and access road will require approval from the property owner(s) and provide the proper buffers from adjacent property lines and wetlands.
- Excavation of the pond will result in a large amount of soil that will need to be used or disposed of offsite. The pond in the current conceptual size and layout will produce an estimated 236,500 cubic yards of material. Review of the NRCS Soils data indicates the existing site soils to be in the Coosaw series and the Yonges series, both of which are considered loamy fine sand. Both soil types would be marginally suitable for structural fill, but soils borings and classification would be needed to verify suitability. If the soil is not suitable and the costs of disposal are too high, options to reduce the size of the pond may need to be evaluated.

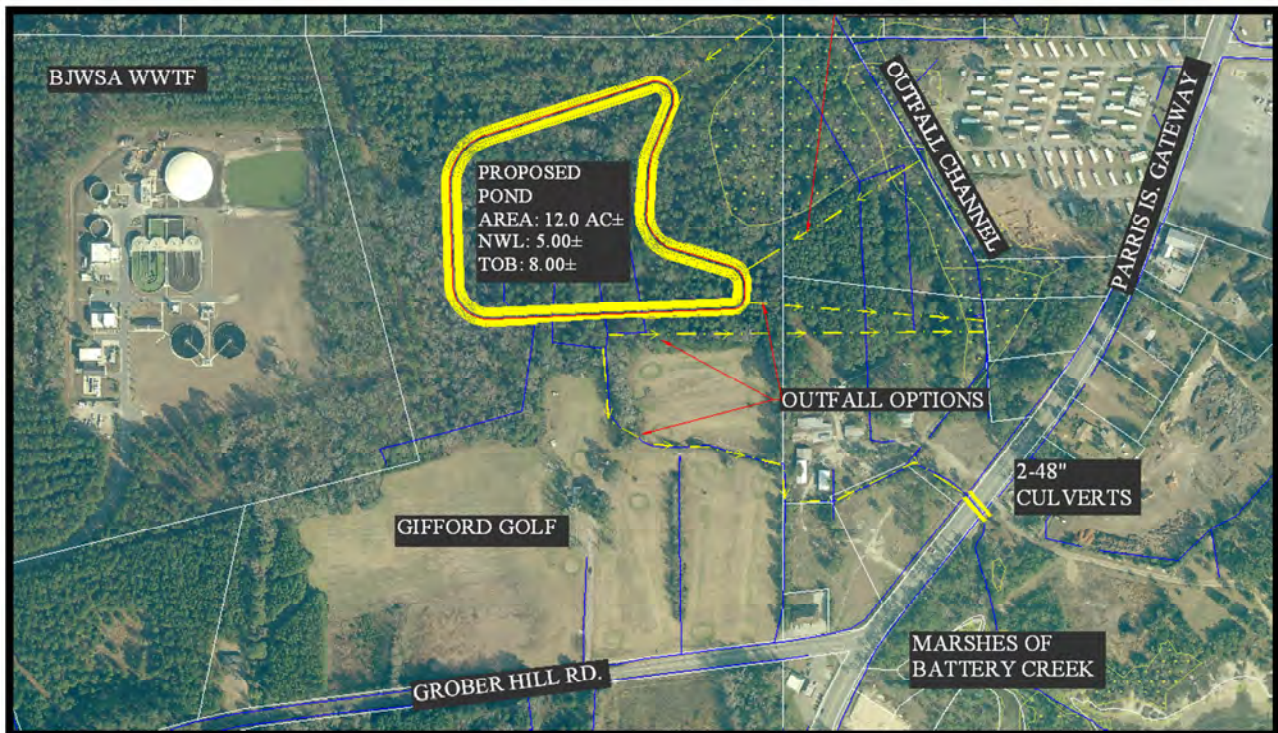


Figure 1-4: Battery Creek West M1 – Conceptual BMP

1.3.1 BMP Sizing and Analysis

The ICPR files from the 2006 SWMP were used to do a basic analysis of the BMP concept. The pre-development ICPR files were run for the 95th percentile storm (1.95") and the 100 yr design storm. As a point of comparison in determining the effectiveness of the pond for volume control and water quality treatment, post-development conditions were modeling assuming flow in the main conveyance channel is re-routed to the proposed pond. The 100 year storm was also modeled in post development conditions to assure upstream flooding problems are not created. Additional field survey work and modeling will be required during the detailed design phase. The original 2006 SWMP model included only high tide conditions (assumed tailwater elevation of 5.6 ft), and only high tide conditions were modeled for the analysis of the proposed pond. If ground-run survey indicates the existing channel may be tidally influenced, then low tide conditions should be modeled as well. Regardless, additional more detailed hydrologic and hydraulic modeling is needed during the detailed design phase, as there are inconsistencies between results from the 2006 SWMP and the 1999 SCDOT Hwy 280 widening plans. The SWMP results estimate the 100 yr discharge through the 48" culverts to be 677 cfs with a peak upstream stage of 7.94, while the SCDOT plans indicate a peak flow of 216 cfs with a peak upstream stage of 7.60 ft. The primary difference is most likely in the estimation of the contributing basin area which is estimated to be 500 acres in the SWMP and only 300 acres in the SCDOT plans.

Table 1-1: Battery West M1 Peak Flow and Peak Stage Results - 95th Percentile Storm

Node	ICPR Node Name	Pre Max Stage (ft)	Post Max Stage (ft)	Pre Max Inflow (cfs)	Post Max Inflow (cfs)
Battery Creek	BYCW_M-3	N/A	N/A	37.57	7.25
Upstream	BYCW_M-23	7.45	7.45	40.91	40.91
Pond	POND_BCW	N/A	6.53	N/A	38.76

Table 1-2: Battery Creek West M1 Pre-Post Volume Comparison for 95th Percentile Storm

Node	ICPR Node Name	Pre Volume High Tide (acre-ft)	Post Volume High Tide (acre-ft)
Battery Creek	BYCW_M-3	19.10	17.40

Results from the conceptual modeling for the 95th percentile storm indicate that constructing the pond and re-routing flow to it will reduce the peak inflow rate at the Battery Creek outfall by an estimated 80%, and reduce the volume by 9% in high tide conditions. It will do so with minimal to no increase in predicted peak stage upstream of the pond. The proposed pond connection was also modeled for the 100 year storm to further check the peak stages and to make sure flooding will not occur. The results show only a small predicted increase in flood stage for the upstream nodes in conceptual post-development conditions. The peak stage for node BYCW_M-23 is estimated to increase from 8.49 ft to 8.62 ft, but will still be well below the warning (max allowable) stage of 11 ft.

Table 1-3: Battery Creek West M1 – Peak Flood Stages for 100 Year Storm

ICPR Node Name	100 yr Pre Peak Stage (ft)	100 yr Post Peak Stage (ft)
BYCW_M-14	8.01	7.97
BYCW_M-23	8.49	8.62

Besides peak flow reduction, volume reduction, and first flush treatment, another expected benefit of retrofitting a detention pond in the basin is reducing the flashy introduction of the freshwater runoff to the saltwater river. Figure 1-5 shows the post-development pond and upstream node stages versus time and demonstrates that the water stored in the pond will be released over a 72 period.

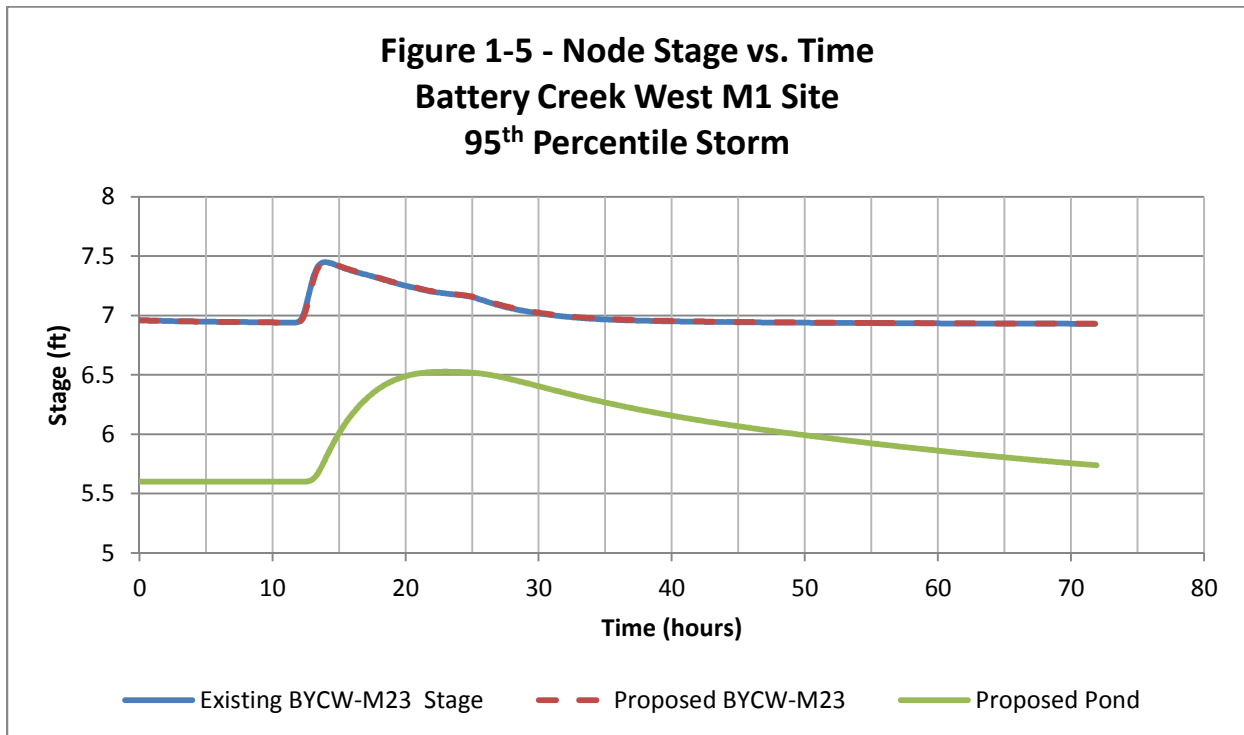


Figure 1-5: Battery Creek West M1 – Node Stage vs. Time for 95th Percentile Storm

1.4 Construction Cost Estimates & Priority

1.4.1 Construction Cost Estimate

The 2006 SWMP estimated a total construction cost for the Battery Creek West M1 regional retrofit to be \$2,111,340. This estimate was based on a proposed pond at the original recommended site assuming a 14 acre area of disturbance. Table 3-4 shows the original cost estimate.

Table 1-4: Battery Creek West M1 – Original 2006 SWMP BMP Construction Cost Estimate

	Units	Unit Cost	Quantity	Cost
Mobilization	EA	\$5,000	1	\$5,000
Site Prep/Restoration Erosion & Sediment Control	EA	\$2,500	1	\$2,500
Land Purchase	AC	\$11,000	31	\$341,000
Clearing	AC	\$5,500	14	\$77,000
Excavation	CY	\$12	97,000	\$1,164,000
Outlet Structure	EA	\$10,000	1	\$10,000
		Subtotal		\$1,599,500
Contingency (20%)				\$319,900
Engineering/Legal/Admin (12%)				\$191,940
		Total		\$2,111,340

The original cost estimate (Table 1-4) appears to significantly under estimate the amount of excavation needed for a 10 to 12 acre pond, thus under estimating the overall project cost. Given the existing grades and the proposed site and the depths needed in the pond to provide the needed water quality depth, the amount of excavation would be approximately 240% higher. However, if the existing soils are suitable for structural fill and there are nearby projects needing material, the excavation costs could be offset by selling the material to contractors. This was recently accomplished in the construction of the 12 acre regional detention pond for the Beaufort Commerce Park. The pond was constructed at little cost to the Economic Network due to the need of fill material on two local road construction projects. More cost savings are possible in the land acquisition. The original cost estimate assumed 31 acres would need to be acquired, however, if only easements or only the portions of the property needed for the drainage features are purchased, the area needed could be as low as 15 acres.

Table 1-5: Battery Creek West M1 – Updated BMP Construction Cost Estimate

	Units	Unit Cost	Quantity	Cost
Mobilization	EA	\$5,000	1	\$5,000
Site Prep/Restoration Erosion & Sediment Control	EA	\$7,500	1	\$7,500
Easement/Property Purchase	AC	\$11,000	15	\$165,000
Clearing	AC	\$5,500	14	\$77,000
Excavation	CY	\$12	236,500	\$2,838,000*
Drainage Structures	EA	\$10,000	1	\$10,000
		Subtotal		\$3,102,500*
Contingency (20%)				\$620,500*
Engineering/Legal/Admin (12%)				\$372,300*
		Total		\$4,095,300*

*Cost could be significantly reduced if material is suitable as fill material

1.4.2 BMP Site Priority and Further Study Needed

Based on Retrofit Sensitivity Maps prepared by Beaufort County using results from the 2006 SWMP, the Battery Creek 1 basin would not see a significant improvement in the water quality Level Of Service if regional retrofit BMPs are installed. However, because of tidal flow action, improvements in this basin could have some effect on the quality of the upstream Battery Creek 2 basin. Given the potential high cost of construction and the low sensitivity to retrofits, **implementing and constructing this BMP site is a medium priority**. However, because of the possible indirect improvements to adjacent basins and the possibility that construction cost could be dramatically reduced if the onsite soils are suitable for structural fill; some preliminary work on this site is recommended.

- The subject property owners should be contacted to determine the likelihood of land and/or easements being available for purchase.
- If land acquisition is possible, soil borings and classification tests should be performed to determine the suitability of the material for structural fill.
- A new construction cost estimate should be prepared based on the land cost and the value of the excavated soil.

If the property may be available and the new construction cost estimate is low, then the project can be reprioritized based on the progress on the other, more retrofit sensitive projects. If work on this site moves forward, then the following work will need to be done:

- Field work for wetland determination and delineation (if wetlands are found), with particular emphasis on determining if the existing ditch is classified as critical area.
- Ground run tree and topographic survey of the proposed site, outfall ditches, and offsite access.
- Detailed hydrologic and hydraulic modeling of the water quality sub-basin, including re-evaluation of existing basin boundaries, flow paths, and land uses.
- Engineering plans for pond excavation, channel re-routing, outfall structure, emergency overflow weir, construction access, and sediment control.
- Permitting through SCDHEC-OCRM, SCDOT, Army Corp of Engineers, and the Town of Port Royal.

Section 2 – Grober Hill M2

2.1 Background

Originally identified in the 2006 SWMP as Site 11, this BMP site is located in the Grober Hill M2 hydrologic sub-basin, which is a portion of the Battery Creek 2 Water Quality Basin. The sub-basin associated with the original proposed BMP location is approximately 130 acres in size and primarily includes single family developments and undeveloped land. It appears the single family developments pre-date all stormwater control regulations, as there are no detention ponds visible in the aerial photos. Figure 2-1 shows the water quality sub-basin and the Battery Creek 1 basin boundaries.

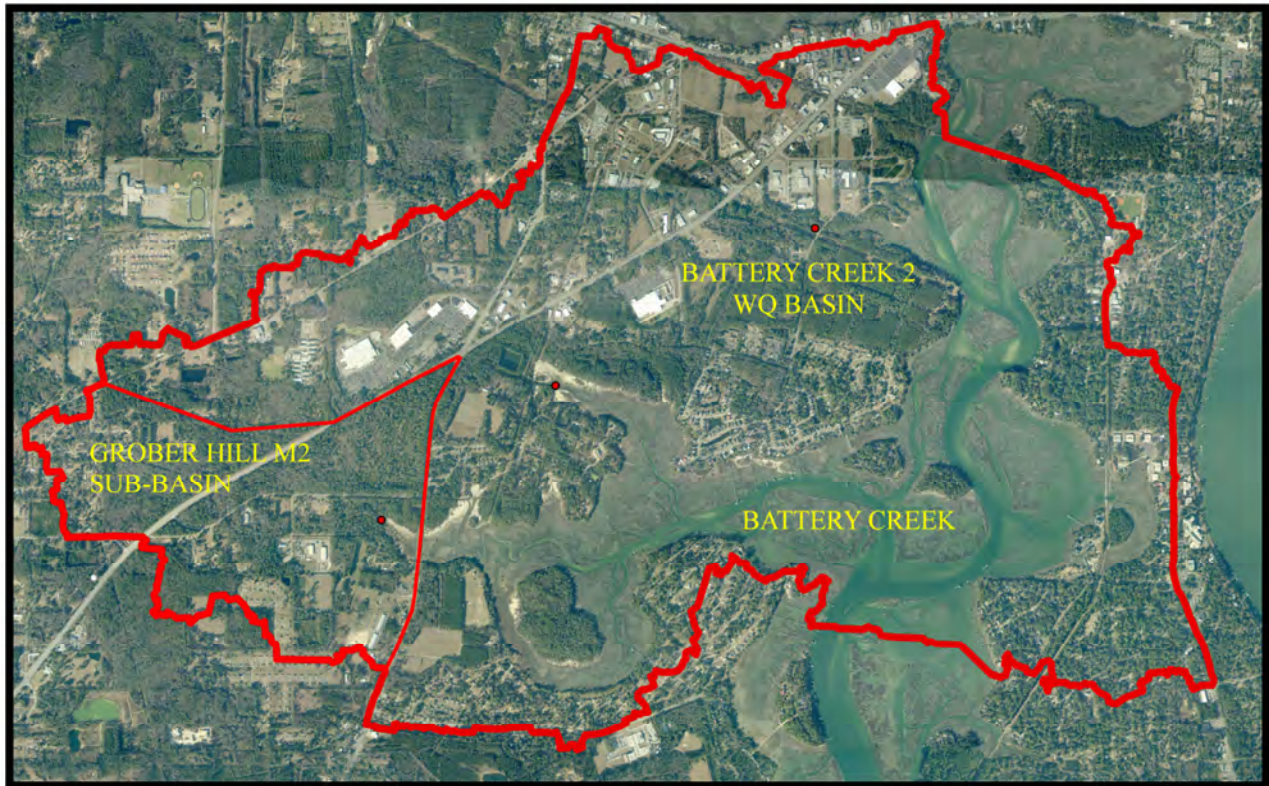


Figure 2-1: Grober Hill M2 Sub-Basin

The originally proposed BMP site sits on a 70 acre undeveloped parcel fronting Hwy 170 that is owned by Myrtle Bush Farms LP. The parcel is heavily wooded and contains a large area of wetlands per the NWI. The parcel has a large ditch collecting runoff from the site and from the upstream residential subdivision. The ditch drains toward Hwy 170 and then under the highway through a single 30 inch diameter culvert. It continues on toward Battery Creek, also crossing under Goethe Hill Road and Hwy 280. Figure 2-2 shows the original BMP site, the sub-basin boundary and the flow path to Battery Creek.

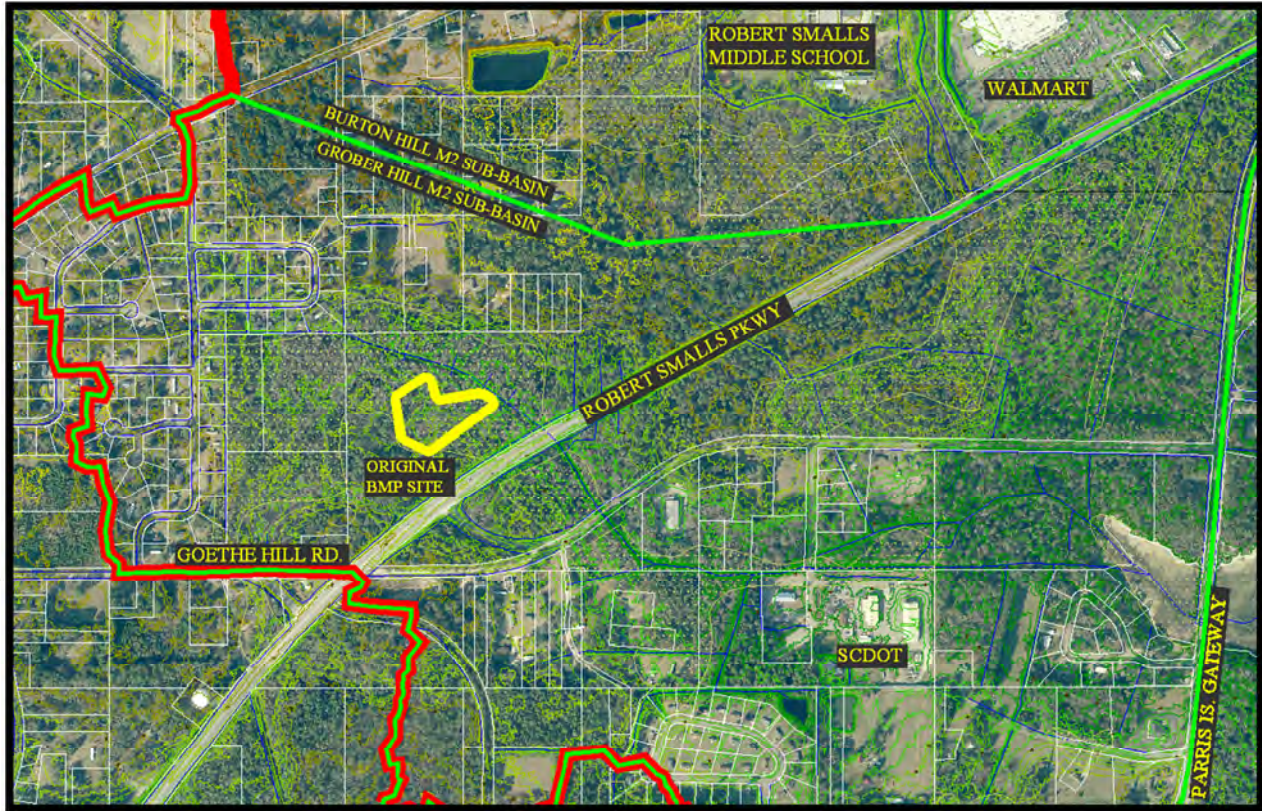


Figure 2-2: Grober Hill M2 – Original 2006 SWMP BMP Site

The site grades for the original location are well suited to installing a retrofit pond without negatively impacting upstream development; however, the main outfall ditch appears to be completely surrounded by wetlands, making it difficult to locate a pond in an area capable of capturing the flow. The original location also sits in the upper portion of the sub-basin meaning it would only treat runoff from a small percentage of the sub-basin. Given the potential wetland impacts and the limited benefits, it was determined that site alternatives should be explored.

2.2 Alternative BMP Location Considerations

A review was conducted of other parcels downstream that may be better suited as a regional BMP site. Suitability criteria included parcel size, proximity to the main conveyance channel, favorable topography, easy parcel accessibility, favorable soils, and limited presence of and potential impact to natural and cultural resources. Figure 2-3 below shows the alternate property clusters and the original BMP site.

1. *Myrtle Bush Farms LP (R120 028 000 0138 0000, R120 028 000 0138 0000, R120 028 000 0138 0000, & R120 028 000 0138 0000)*: In addition to the parcel containing the original BMP site (1A), Myrtle Bush Farms owns three other parcels within the sub-basin flow path. The largest parcel (1B) is located across Hwy 170 from the original site. The 100 acre parcel has over one mile of highway frontage and extends all the way to the Hwy 170 / Hwy 280 intersection. Similar to site 1A, there appears to be wetlands onsite that surround the main sub-basin outfall channel, likely limiting the ability to accommodate a BMP. There may be some room for a BMP to the east of the outfall channel, but further wetland determination would be needed to confirm this. The outfall channel running through 1B drains under Goethe Hill Road through two 30 inch culverts to another small parcel owned by Myrtle Bush Farms.

This 3 acre parcel (1C) appears to be mostly wetlands, limiting its usefulness for a retrofit. The fourth parcel in the sub-basin under the same ownership is a 17 acre parcel (1D) located adjacent to the headwaters of Battery Creek. The main outfall channel bisects the property and discharges to the headwaters within a large sand/mud flat. The NWI indicates only a small area of wetlands at the channel discharge point. The property also collects water from a culvert under Goethe Hill Road that drains the eastern portion of parcel 1B. Existing grades range between elevation 5 at the discharge point, up to elevation 11 on the northwest corner of the site. This site has high potential if the lack of wetlands can be verified. The main challenge for this site will be designing the BMP to prevent flooding on some nearby home sites that sit at about elevation 8. The site has easy access through a curb cut on Goethe Hill Road. Soils on the site are mostly Hydrologic Soil Type B with some Type D mixed in. A BMP located on site 1D has the potential to serve as much as 500 acres of the sub-basin, provided there is adequate space for a properly sized BMP. All four of the parcels are located within the boundaries of the City of Beaufort. Sites 1A and 1B are zoned as Office Commercial and sites 1C and 1D are zoned as General Residential.

2. *Samuel Goethe property (R100 028 000 0152 0000)*: This 7 acre parcel is located to the west of site 1D and contains four single family homes near the Goethe Hill frontage. Behind the homes are what appear to be residential agricultural fields. The remainder of the site is wooded and appears to have some wetlands. It also contains two channels one of which is the sub-basin's main outfall channel. Site grades are favorable to a BMP retrofit, with the homes sitting at least four feet higher than the channel top of bank; however the small size of the parcel limits its value unless it is in addition to one of the adjacent sites. The parcel may also be heirs property, which could make acquiring easements difficult.

3. *Nettie Jenkins property (R100 029 000 112A 0000)*: This parcel is 4 acres in size and is located to the east of site 1B, at the intersection of Goethe Hill Road and Parris Island Gateway. The property is mostly wooded and contains one house with driveway access to Parris Island Gateway. Grades on the site are basically flat, ranging between 8 ft to 9 ft. The small size of the site limits its usefulness as a BMP site unless it can be combined with site 1D.

4. *Providence Jenkins property (R100 028 000 0153 0000, & R100 028 000 0154 0000)*: This site consists of two parcels that total around 17 acres in size and are located to the south of site 1B. The properties contain a channel that collects runoff from an approximate 100 acre tributary and conveys it to the sub-basin's main outfall channel located on site 1B. The properties are under the ownership of multiple people, with Providence Jenkins as the primary owner and they contain two homes. About half of the land is open field or lawns, with the remainder being wooded. Grades range from 8 ft at the north end, up to 18 ft where the homes sit. They appear to contain only two small pieces of wetlands along the southern and eastern property lines. Access to the site is available through Providence Road which connects the parcels to Parris Island Gateway. Based on the location, the grades, and the lack of wetlands, the site has high potential for a BMP retrofit that would capture and treat a portion of the sub-basin, but the multiple property owners could make acquisition difficult.

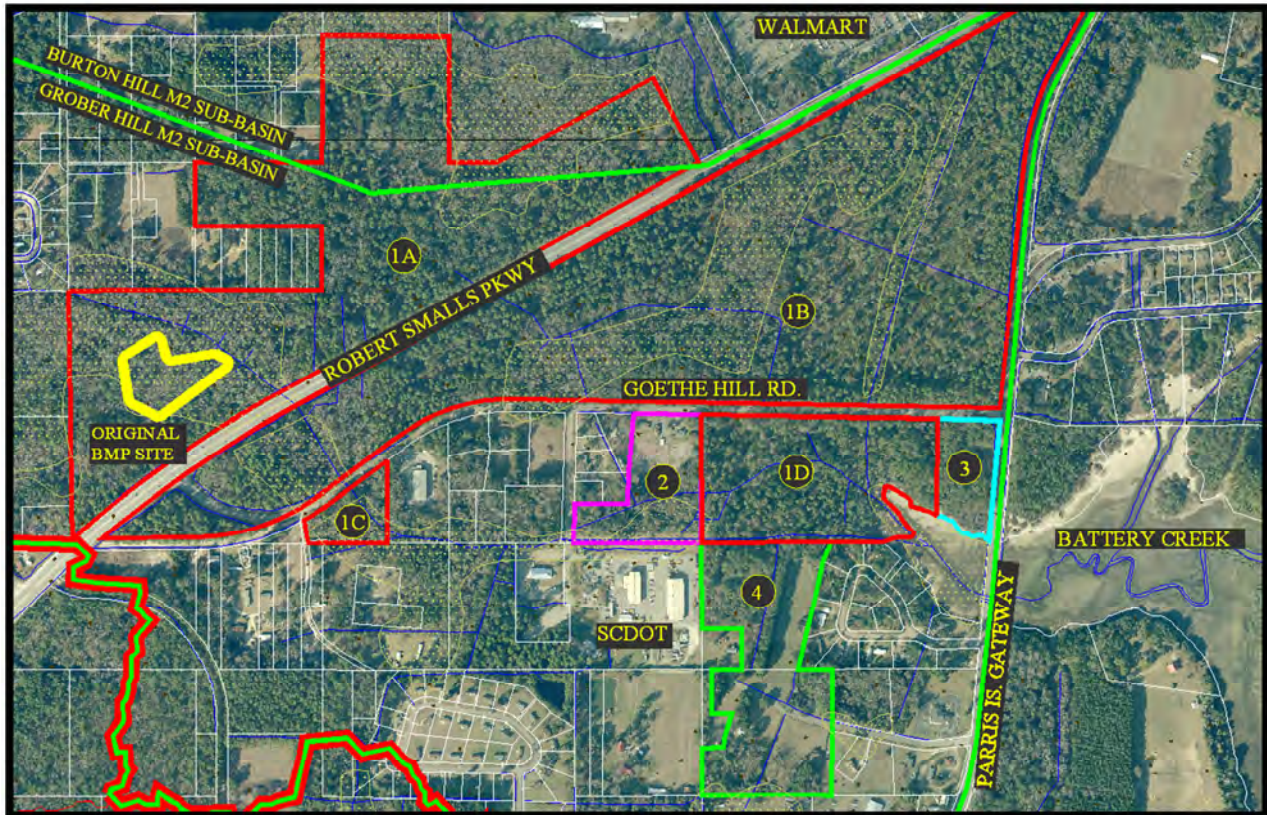


Figure 2-3: Grober Hill M2 – BMP Sites Evaluated

Although large and in good locations to capture runoff from the main channel, use of Parcels 1A and 1B is limited by the presence of existing wetlands. They are also desirable and well suited for development, thus they would be difficult and expensive to acquire. Sites 1C, 2, and 3 are too small to serve as stand-alone BMP sites. Site 4 appears to be large enough and well suited, but would serve only a small portion of the overall sub-basin. Site 1D appears to be the best suited of all sites reviewed, as it contains the main confluence point for the western, southern, and northern branches of the sub-basin. If the NWI is accurate, the site does not contain wetlands that would potentially hinder permitting and constructing a proposed pond. More detailed analysis of the site and recommended BMPs are provided in the next section.

2.3 BMP Recommendations

The size of parcel 1D and the existing topography make a regional pond a good choice for the stormwater BMP. Ponds are effective in treating stormwater for bacteria removal and can be designed to reduce the flashy discharge of freshwater to the saltwater river. The location of the pond will allow it to serve approximately 500 acres, most of which currently has little to no stormwater treatment. Dr. John Gray is associated with Myrtle Bush Farms, the official property owner of the parcel under consideration. Contacting and meeting with property owners were beyond the scope of this project; however Dr. Gray is active in the community and known by Ward Edwards' staff. Given this and that he owns several parcels under consideration, Dr. Gray was contacted and site visits were done in order to field verify suitability and to discuss availability of the property. It is believed that Dr. Gray is marketing the property for development although he seemed to be willing to consider working with Beaufort

County on using the property for a regional BMP. However, there are a number of design challenges associated with this site and the proposed BMP:

- The existing site grades and the grades on the adjacent parcel may require portions of the pond banks to be constructed as berms, in order to prevent stormwater from ponding on offsite property.
- The pond design will have to include an emergency overflow weir sized to limit peak pond stages and to prevent flooding upstream of the pond.
- The pond will collect inflow from four different inflow points. Pretreatment of the inflow in sediment forebays is preferred, but will require special consideration to properly capture all four inlets.
- Access for temporary construction and long term maintenance will have to be provided from Goethe Hill Road. The access location will be dependent on the conceptual pond layout and will require approval from SCDOT.
- Excavation of the pond will result in a large amount of soil that will need to be used or disposed of offsite. The pond in the current conceptual size and layout will produce an estimated 74,000 cubic yards of material. Review of the NRCS Soils data indicates the existing site soils to be in the Seewee series and the Yonges series. The Seewee series is considered to be fine sand and the Yonges is considered loamy fine sand. Both soil types would be marginally suitable for structural fill, but soils borings and classification would be needed to verify suitability. If the soil is not suitable and costs of disposal are too high, options to reduce the size of the pond may need to be evaluated.
- The outfall channel is likely tidally influenced, which must be accounted for in the pond design.

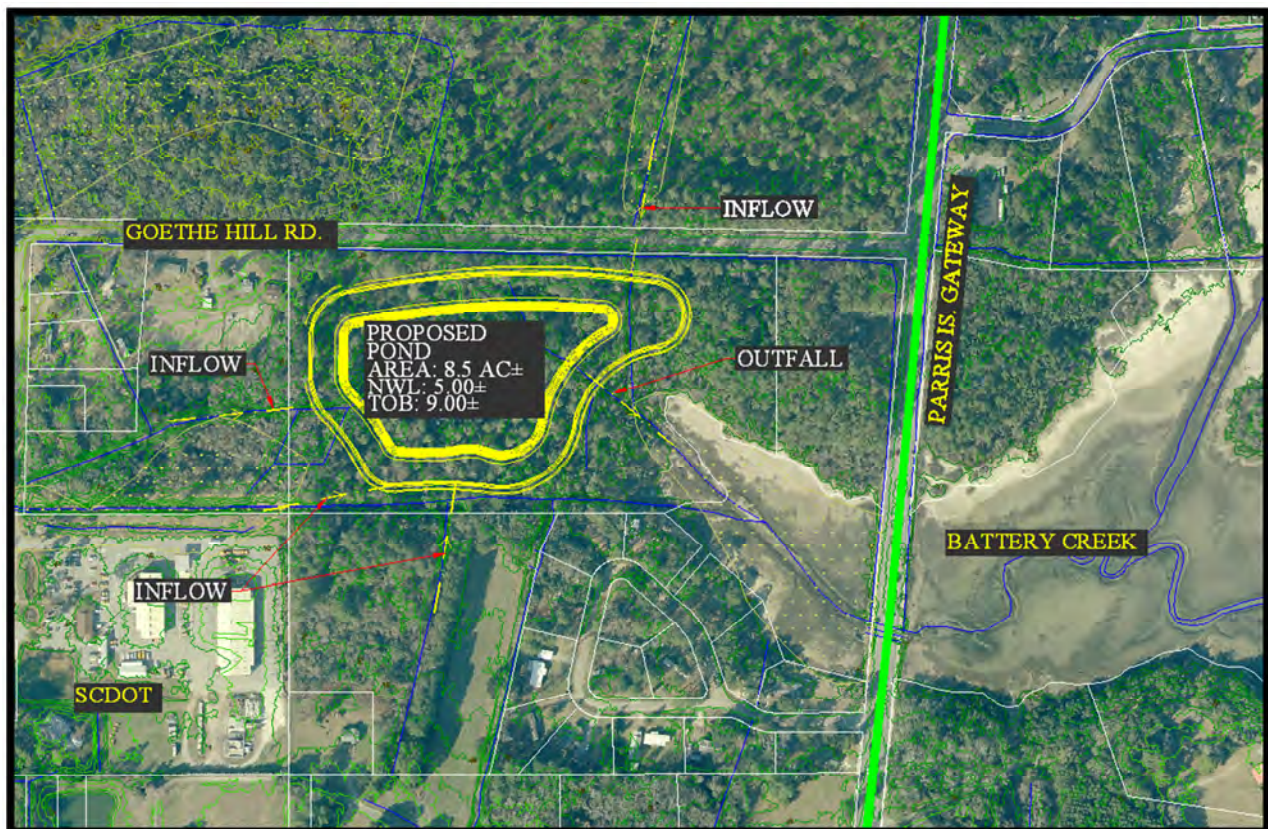


Figure 2-4: Grober Hill M2 – Conceptual BMP

The proposed conceptual pond design recommends an 8.5 acre boundary size (at top of bank) with approximately 4 ft of freeboard over the assumed normal water level of elevation 5 ft. The bottom of the pond should be eight to ten feet deep below the normal water level to provide adequate water quality treatment volume per the Beaufort County BMP Design Manual and to prevent growth of vegetation in the permanent pool. The design also calls for a vegetated flood shelf that will aid in the removal of freshwater volume by providing vegetation that will promote evapotranspiration of the stored stormwater. The top of bank is proposed to be set at elevation 9 ft, which is a couple of feet higher than the existing grades along the eastern side of the pond, meaning the banks will have to be constructed as a berm. The top of the berm should be constructed with enough width to allow access around the pond for routine maintenance.

2.3.1 BMP Sizing and Analysis

The ICPR files from the 2006 SWMP were used to do a basic analysis of the BMP concept. The pre-development ICPR files were run for the 95th percentile storm (1.95") and the 100 yr design storm. As a point of comparison in determining the effectiveness of the pond for volume control and water quality treatment, post-development conditions were modeling assuming flow in the main conveyance channel is re-routed to the proposed pond. The 100 year storm was also modeled in post development conditions to assure upstream flooding problems will not be created. Additional field survey work and modeling will be required during the detailed design phase. The original 2006 SWMP model included only high tide conditions (assumed tailwater elevation of 5.6 ft), and only high tide conditions were modeled for the current analysis of the proposed pond. If ground-run survey indicates the existing channel may be tidally influenced, then low tide conditions should be modeled as well. Regardless, additional more detailed hydrologic and hydraulic modeling will be needed during the detailed design phase, as there are inconsistencies between results from the 2006 SWMP and the 1999 SCDOT Hwy 280 widening plans. The SWMP results estimate the 100 yr discharge reaching the 60" culvert under Hwy 280 to be 644 cfs, while the SCDOT plans indicate a peak flow of 228 cfs. The primary difference is most likely in the estimation of the contributing basin area which is estimated to be 500 acres in the SWMP and only 331 acres in the SCDOT plans.

Table 2-1: Grober Hill M2 – Peak Flow and Peak Stage Results – 95th Percentile Storm

Node	ICPR Node Name	Pre Max Stage (ft)	Post Max Stage (ft)	Pre Max Inflow (cfs)	Post Max Inflow (cfs)
Battery Creek	GH_M-11	N/A	N/A	71.44	9.16
Upstream	GH_M-21	8.43	8.35	78.72	79.13
Pond	POND_GH	N/A	8.06	N/A	76.34

Table 2-2: Grober Hill M2 – Pre-Post Volume Comparison for 95th Percentile Storm

Node	ICPR Node Name	Pre Volume High Tide (acre-ft)	Post Volume High Tide (acre-ft)
Battery Creek	GH_M-11	31.5	21.2

Results from the conceptual modeling for the 95th percentile storm indicate that constructing the pond and re-routing flow to it will reduce the peak inflow rate at the Battery Creek outfall by an estimated 87%, and reduce the volume by 33% in high tide conditions. It will do so with minimal to no increase in predicted peak stage upstream of the pond. The proposed pond connection was also modeled for the 100 year storm to further check the peak stages and to make sure flooding will not occur. The results show no predicted increase in flood stage for the upstream nodes in conceptual post-development conditions.

Table 3-3: Grober Hill M2 – Peak Flood Stages for 100 Year Storm

ICPR Node Name	100 yr Pre Peak Stage (ft)	100 yr Post Peak Stage (ft)
GH_M-19	10.44	9.64
GH-M-21	11.25	11.07
GH_M-37	13.39	13.35

Besides peak flow reduction, volume reduction, and first flush treatment, another expected benefit of retrofitting a detention pond in the basin is reducing the flashy introduction of the freshwater runoff to the saltwater river. Figure 2-5 shows the post-development pond and upstream node stages versus time and demonstrates that the water stored in the pond will be released over a 72 period.

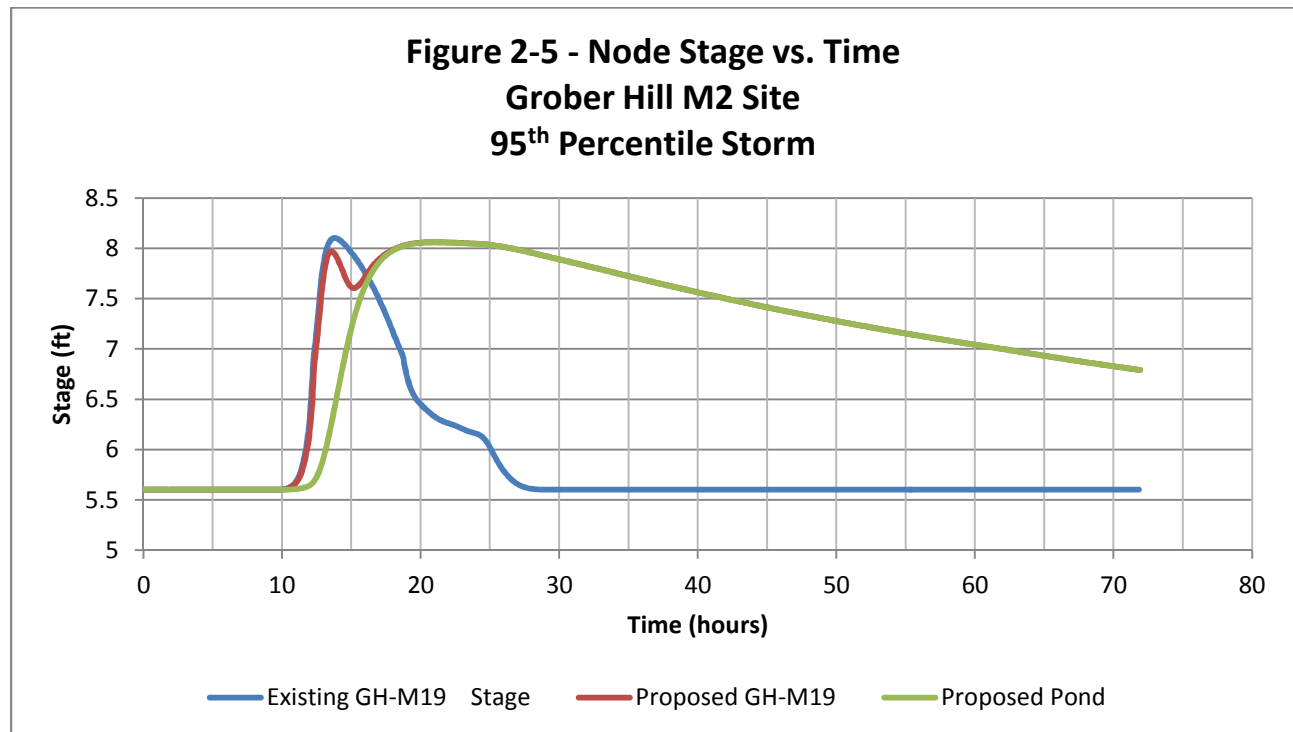


Figure 2-5: Grober Hill M2 – Node Stage vs. Time for 95th Percentile Storm

2.4 Construction Cost Estimates & Priority

2.4.1 Construction Cost Estimate

The 2006 SWMP estimated a total construction cost for the Grober Hill M2 regional retrofit to be \$781,000. This estimate was based on a proposed pond at the original recommended site and assuming a 4 acre area of disturbance. Table 2-4 shows the original cost estimate.

Table 2-4: Grober Hill M2 – Original 2006 SWMP BMP Construction Cost Estimate

	Units	Unit Cost	Quantity	Cost
Mobilization	EA	\$5,000	1	\$5,000
Site Prep/Restoration Erosion & Sediment Control	EA	\$2,500	1	\$2,500
Land Purchase	AC	\$24,000	8	\$192,000
Clearing	AC	\$5,500	4	\$22,000
Excavation	CY	\$12	30,000	\$360,000
Outlet Structure	EA	\$10,000	1	\$10,000
		Subtotal		\$592,000
Contingency (20%)				\$118,400
Engineering/Legal/Admin (12%)				\$71,000
		Total		\$781,000

The original cost estimate assumed a much smaller pond size and disturbed area than the conceptual BMP developed in this study. By locating the pond further downstream and thus serving a larger area, the proposed pond will need to be significantly larger than previously estimated. Given the larger pond size and the larger amount of land needed to be acquired, the expected construction cost will increase dramatically. One major cost increase will come from the amount of soil that will have to be excavated from the pond in order to provide the proper water quality permanent pool. However, if the existing soils are suitable for structural fill and there are nearby projects needing material, the excavation costs could be offset by selling the material to contractors. This was recently accomplished in the construction of the 12 acre regional detention pond for the Beaufort Commerce Park. The pond was constructed at little cost to the Economic Network due to the need of fill material on two local road construction projects. The original cost estimate also considerably under estimated the cost of purchasing the land. Based on the highway frontage, the jurisdiction, and the zoning, the land is much more valuable than the estimated price, which was probably based on rural land costs.

Table 2-5: Grober Hill M2 – Updated BMP Construction Cost Estimate

	Units	Unit Cost	Quantity	Cost
Mobilization	EA	\$5,000	1	\$5,000
Site Prep/Restoration Erosion & Sediment Control	EA	\$7,500	1	\$7,500
Land Purchase	AC	\$50,000	18	\$900,000
Clearing	AC	\$5,500	11	\$60,500
Excavation	CY	\$12	74,000	\$888,000*
Drainage Structures	EA	\$10,000	1	\$10,000
		Subtotal		\$1,871,000*
Contingency (20%)				\$374,200*
Engineering/Legal/Admin (12%)				\$224,520*
		Total		\$2,469,720*

*Cost could be significantly reduced if material is suitable as fill material

2.4.2 BMP Site Priority and Further Study Needed

Based on Retrofit Sensitivity Maps prepared by Beaufort County using results from the 2006 SWMP, the Battery Creek 2 basin could see a significant improvement in the water quality level of service if regional retrofit BMPs are installed. The conceptual modeling indicates very high potential for runoff volume reduction and peak flow reduction from installing a regional detention pond. **The potential benefits would make this project a very high priority; however the potential high cost of construction and land acquisition may lower the priority over some of the more cost effective projects.** There is a possibility that construction cost could be dramatically reduced if the onsite soils are suitable for structural fill. The land acquisition cost is also uncertain at this point. For those reasons some preliminary work on this site is recommended.

- Field work for wetland determination and delineation (if wetlands are found) should be done. If the NWI is correct and the site is relatively clear of wetlands, then further work on this site should continue.
- Discussions should begin with the land owner to determine the land availability and acquisition costs.
- If land acquisition is possible, soil borings and classification tests should be performed to determine the suitability of the material for use as structural fill.
- A new construction cost estimate should be prepared based on the land cost and the value of the soil.

If the property can be acquired at a reasonable price and the new construction cost estimate is low, then the project can be reprioritized based on the high benefit potential of the proposed BMP. If work on this site moves forward, then the following work will need to be done:

- Ground run tree and topographic survey of the proposed site, outfall ditches, and offsite access.
- Detailed hydrologic and hydraulic modeling of the water quality sub-basin, including re-evaluation of existing basin boundaries, flow paths, and land uses.
- Design plans for pond excavation, channel re-routing, outfall structure, emergency overflow weir, construction access, and sediment control.
- Permitting through SCDHEC-OCRM, SCDOT, Army Corp of Engineers, and the City of Beaufort.

Section 3 – Burton Hill M2

3.1 Background

Originally identified in the 2006 SWMP as Site 12, this BMP site is located in the Burton Hill M2 hydrologic sub-basin, which is a portion of the Battery Creek 2 Water Quality Basin. The sub-basin associated with the originally proposed BMP location is approximately 250 acres in size and contains a mixture of uses including single family residential, multi-family residential, Robert Smalls Middle School, and the Walmart shopping center. The single family homes in the basin are mostly rural homes, sitting on large parcels and not part of planned subdivisions. The middle school, the shopping center, and the apartment buildings all have stormwater controls in place, although they were likely not designed or sized to current standards.

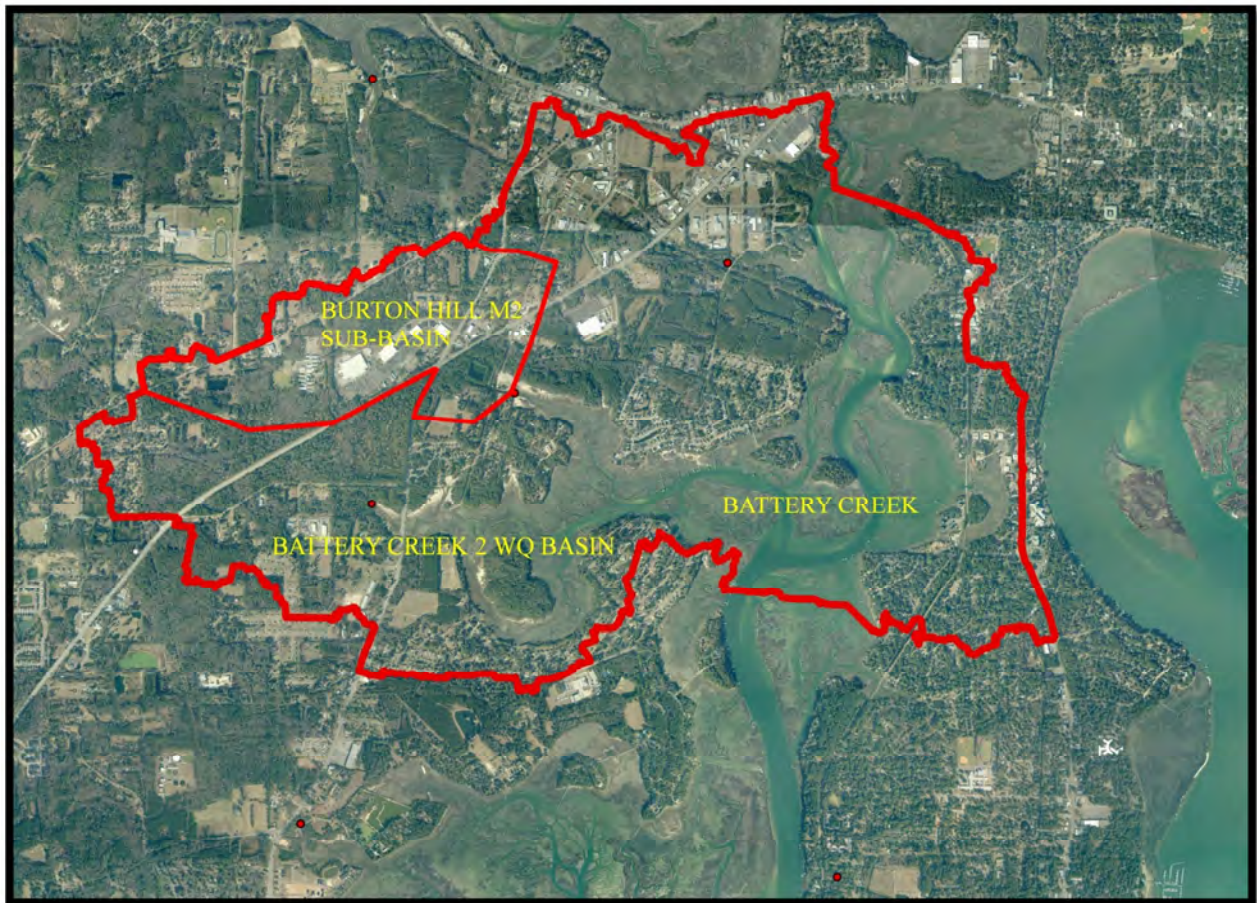


Figure 3-1: Burton Hill M2 Sub-Basin

The originally proposed BMP site sits on a 42 acre parcel located between Broad River Blvd and Walmart. The parcel is heavily wooded, contains a large area of wetlands per the NWI and also contains one of the detention ponds serving the shopping center. Grades on the site range from 30 ft on the north end, down to 6ft at the detention pond normal water level. The pond appears to outfall through pipes to another pond located in the shopping center parking lot. From that pond, pipes discharge stormwater under Robert Smalls Parkway (Hwy 170) to a ditch draining toward Battery Creek.

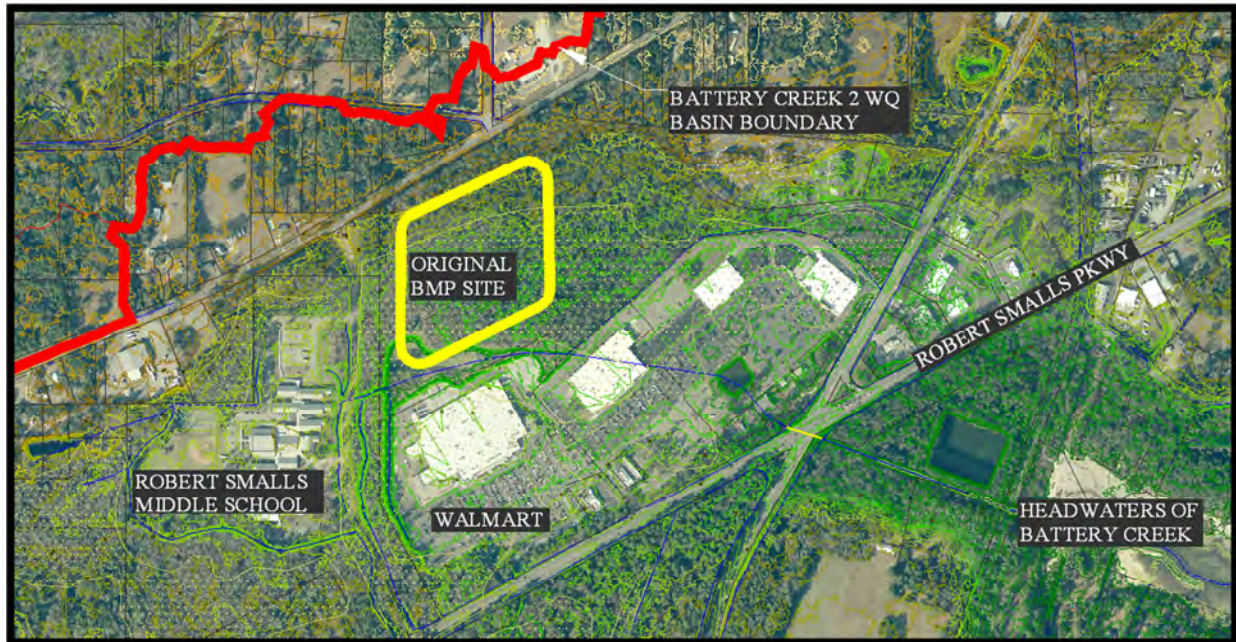


Figure 3-2: Burton Hill M2 – Original 2006 SWMP BMP Site

The biggest obstacle to locating the BMP at this site will be the possible impacts to existing wetlands. The site is also not ideal for capturing and treating runoff from much of the existing untreated land. There are other parcels downstream that may be more suited for a BMP retrofit and that could potentially serve a greater portion of the sub-basin. Figure 3-2 shows the original BMP site, the water quality basin boundary and the flow path to Battery Creek.

3.2 Alternative BMP Location Considerations

A review of other large parcels on which a BMP retrofit may be feasible was conducted and is summarized below. Figure 3-3 below shows the alternate property clusters and the original BMP site.

1. *John Gray property (R120 028 000 0137 0000 & R100 029 000 0110 0000)*: John Gray owns a couple parcels in the area, including the originally recommended BMP site (Site 2A on Exhibit 2) that was determined to have limited suitability for a BMP. The other parcel (2B) under his ownership is located on Old Jericho Rd and is surrounded on three sides by Site 1. The 5 acre parcel is the location of Dr. Gray's home, removing it from consideration as a BMP site. Dr. Gray is also associated with Myrtle Bush Farms LP, which owns other parcels under consideration as a BMP site.

2. *Myrtle Bush Farms LP (R122 029 000 110B 0000 & R120 028 000 0138 0000)*: This 47 acre site is a cluster of parcels under the same ownership as a couple of parcels being considered for the Grober Hill M2 BMP. They are located between the Hwy 170 / Hwy 280 intersection and Old Jericho Road and contain the main outfall channel for the sub-basin. A little over half the site is wooded and the remainder is agricultural fields. The site also contains one building associated with the farmland and a 2 acre pond. The pond was originally constructed as a wastewater treatment lagoon intending to serve a mobile home community on the other side of Hwy 170; however it was never used for that purpose and has only served as a recreational pond for the property owner. It sits adjacent to the sub-basin's outfall channel, but does not intercept the flow. It only collects runoff from the northern portion of the site, all

of which is wooded. Grades on the site range between 22 ft at the fields, down to 2 ft within the outfall channel, and the NWI indicates no wetlands are located on the site. The property is located in the City of Beaufort and is zoned General Commercial. Given the size and the location of the property, and the apparent lack of wetlands, this site has high potential for a regional BMP. It may also be possible to utilize the existing pond in some method to capture and treat stormwater from the adjacent channel. The pond could be modified and expanded as needed to provide additional treatment volume. The main challenge of using this site will be to gain approval from the property owner to make the modification necessary to the pond for capture of the runoff from the adjacent channel.

3. *Beaufort County Open Land Trust property (R100 029 00B 0040 0000)*: This 2.57 acre parcel is located to the east of Old Jericho Road and is directly adjacent to the headwaters of Battery Creek. The sub-basin's main outfall channel connects to the creek on the south edge of this parcel, after passing under a bridged portion of Old Jericho Road. The site contains a sandy area that is likely within the OCRM critical area for the salt water creek, and has a gas line easement crossing it (parallel to Old Jericho Rd). Given this and the small size on the parcel, locating a BMP of the site is not feasible.

4. *William Gray property (R100 029 00B 0039 0000)*: Directly to the south of the Beaufort County parcel is a 6 acre parcel owned by William Gray. This parcel also borders the main outfall channel and is undeveloped, but it also contains a gas line easement that splits the property in half. The small size of the site and the gas line easement limit its usefulness as a BMP site.

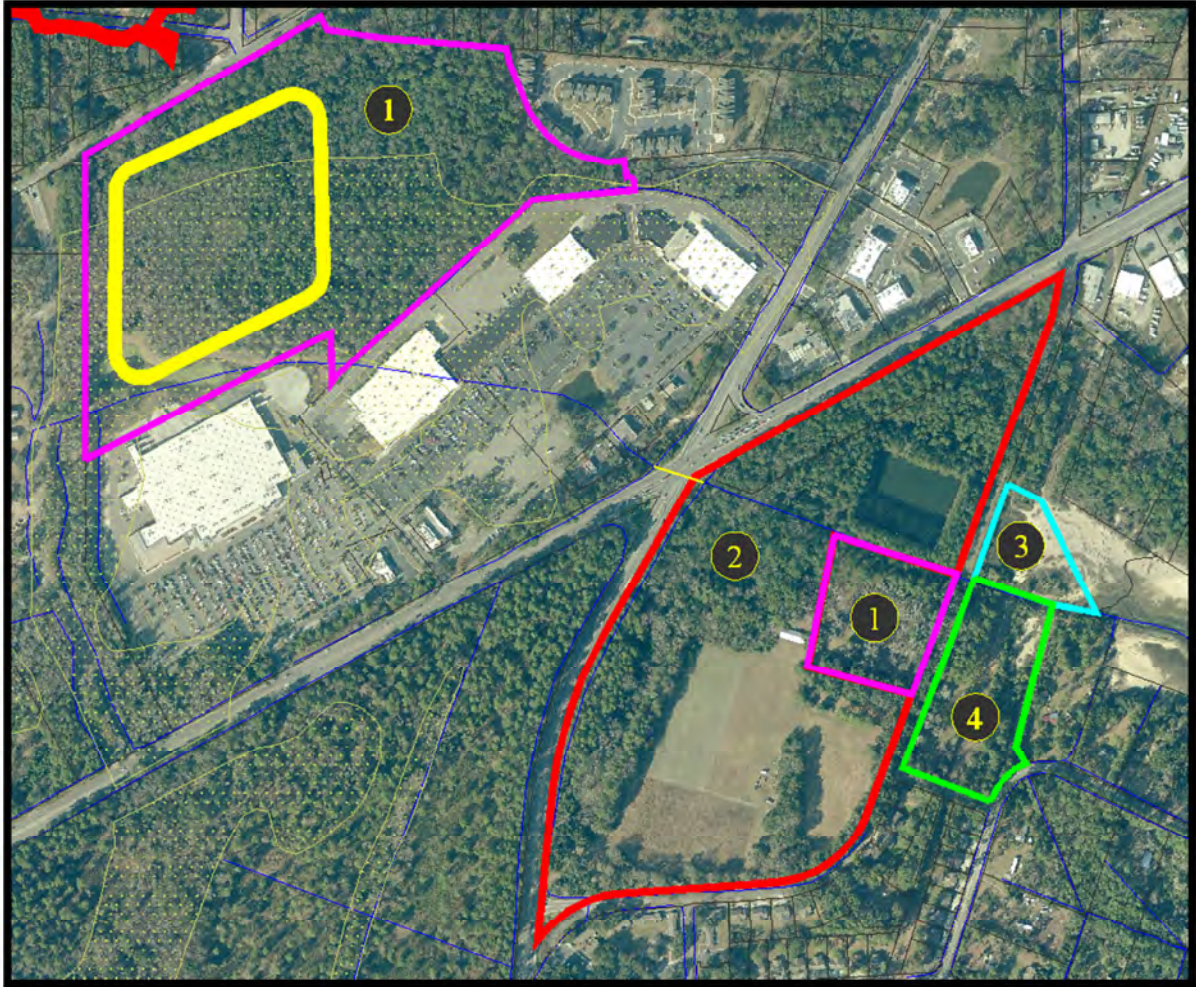


Figure 3-3: Burton Hill M2 – BMP Sites Evaluated

There are a few other large parcels toward the upper boundaries of the sub-basin that may be suitable for BMPs and that have not been examined carefully, since being in the upper portions of the sub-basin would limit the amount of the area they could serve. However, if none of the reviewed parcels are available or prove to be infeasible after further study; these alternate parcels could be considered for multiple, smaller BMPs.

3.3 BMP Recommendations

The property with the existing pond that is owned by Dr. Gray is best suited and most feasible for a regional BMP. Its proximity to the main outfall channel and its location in the downstream end of the sub-basin make it well suited to capture and treat stormwater from much of the sub-basin. The size of the property and apparent lack of wetlands allow adequate room for a BMP and reduces the permitting likely needed. Use of the existing pond as the BMP has good potential to limit impact to the property and reduce the construction cost. Contacting and meeting with property owners were beyond the scope of this project; however Dr. Gray is active in the community and known by Ward Edwards' staff. Given this and that he owns several parcels under consideration, Dr. Gray was contacted and site visits were done in order to field verify suitability and to discuss availability of the property.

The primary concept discussed was the use of the existing pond to capture and treat runoff from the adjacent channel. Dr. Gray expressed some concerns about the concept and mentioned some conditions should it be pursued:

- The property and pond's recreational uses should not be impacted.
- The overall quality of the pond should not be degraded.
- Trash and litter should be captured upstream and not be allowed to enter the pond.
- Access to the pond for maintenance must be provided in an unobtrusive location, preferably from Old Jericho Road on the northeast corner of the pond.



Figure 3-4: Burton Hill M2 – Conceptual BMP

The site visit also yielded some physical concerns about using the pond that need to be addressed:

- The existing channel is tidally influenced, with water surface elevations that could vary several feet. At the time of the site visit it was near low tide and the water level in the ditch was at least 2 ft lower than the level in the pond. This means capturing flow from the ditch will require adjusting the normal pond level down a couple feet and require the installation of a backflow preventer on the outfall pipe.
- Since it is tidally influenced, the channel may be classified as critical area or jurisdictional wetlands, making it more difficult to permit required impacts.
- There are three separate outfall pipes discharging to the channel near the highway intersection. This will make it more difficult to capture the inflow and remove trash via a manufactured hydrodynamic separator.

3.3.1 BMP Sizing and Analysis

The ICPR files from the 2006 SWMP were used to do a basic analysis of the BMP concept. The pre-development ICPR files were run for the 95th percentile storm (1.95") and the 100 yr design storm. As a point of comparison in determining the effectiveness of the pond for volume control and water quality treatment, post-development conditions were modeling assuming the ditch is re-routed to the existing pond. The 100 year storm was also modeled in post development conditions to assure upstream flooding problems are not created. Both high tide and low tide conditions were modeled by altering the boundary conditions at the downstream receiving node. The original 2006 SWMP model included only high tide conditions, so the new conceptual modeling required assumptions about the low tide boundary node conditions. Additional field survey work and modeling will be required during the detailed design phase.

Table 3-1: Burton Hill M2 – Peak Flow and Peak Stage Results – 95th Percentile Storm, High Tide

Node	ICPR Node Name	Pre Max Stage (ft)	Post Max Stage (ft)	Pre Max Inflow (cfs)	Post Max Inflow (cfs)
Battery Creek	BH_M-5	N/A	N/A	42.88	27.86
Upstream	BH_M-21	6.92	8.34	44.66	52.20
Pond	POND	N/A	7.34	N/A	27.96

Table 3-2: Burton Hill M2 – Peak Flow and Peak Stage Results – 95th Percentile Storm, Low Tide

Node	ICPR Node Name	Pre Max Stage (ft)	Post Max Stage (ft)	Pre Max Inflow (cfs)	Post Max Inflow (cfs)
Battery Creek	BH_M-5	N/A	N/A	42.36	27.74
Upstream	BH_M-21	5.23	8.32	42.38	55.81
Pond	POND	N/A	7.34	N/A	27.79

Table 3-3: Burton Hill M2 – Pre-Post Volume Comparison for 95th Percentile Storm

Node	ICPR Node Name	Pre Volume Low Tide (acre-ft)	Post Volume Low Tide (acre-ft)	Pre Volume High Tide (acre-ft)	Post Volume High Tide (acre-ft)
Battery Creek	BH_M-5	28.60	27.50	28.40	27.20

Results from the conceptual modeling for the 95th percentile storm indicate that rerouting the flow to the existing pond will reduce the peak inflow rate at the Battery Creek outfall by an estimated 35%, and reduce the volume by 4% in high tide conditions. It will also result in an increase in predicted peak stage upstream of the pond by 1.43 ft, however the peak stages are still less than allowable peak flood stages. Predicted conceptual low tide conditions indicate a 34% reduction in peak flow and 4% volume

reduction to the river. Peak flowrates and stages upstream are estimated to increase during low tide conditions but aren't expected to cause problems because the peak flood stages are still below the maximum allowable stages based on estimated flood elevations. The proposed pond connection was also modeled for the 100 year storm to further check the peak stages and to make sure flooding will not occur. The results show that the only predicted increase in flood stage for the upstream nodes in conceptual post-development conditions would occur just upstream of the pond. The peak stage for node BH_M-17 is estimated to increase from 8.98 ft to 9.13 ft, but still be well below the warning (max allowable) stage of 13.82 ft.

Table 3-4: Burton Hill M2 – Peak Flood Stages for 100 Year Storm

ICPR Node Name	100 yr Pre Peak Stage (ft)	100 yr Post Peak Stage (ft)
BH_M-17	8.98	9.13
BH_M-21	13.68	13.69
BH_M-31	13.68	13.69

Besides peak flow reduction, volume reduction, and first flush treatment, another expected benefit of rerouting the runoff through the existing pond is reducing the flashy introduction of the freshwater runoff to the saltwater river. Figure 3-4 shows the post-development pond and upstream node stages versus time and demonstrates that the water stored in the pond will be released over a 72 hour period.

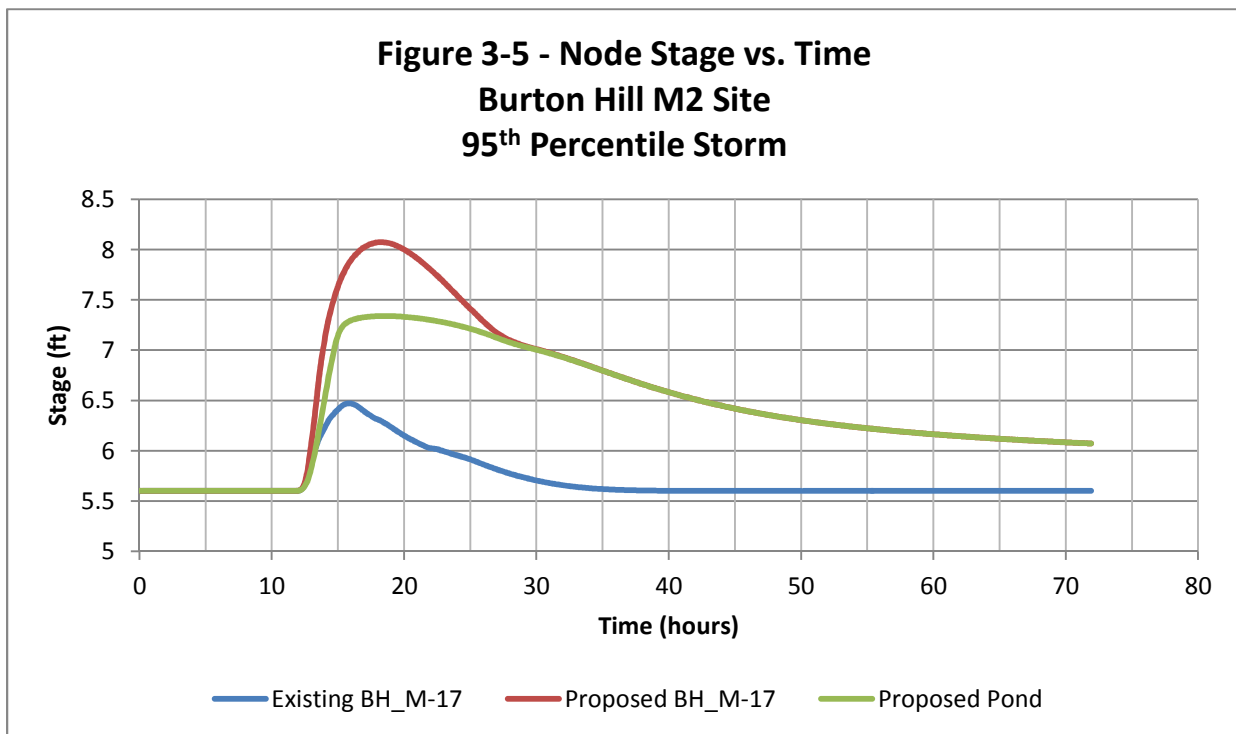


Figure 3-5: Burton Hill M2 – Node Stage vs. Time for 95th Percentile Storm

3.4 Construction Cost Estimates & Priority

3.4.1 Construction Cost Estimate

The 2006 SWMP estimated a total construction cost for the Burton Hill M2 regional retrofit to be \$1,480,000. This estimate was based on a proposed pond at the original recommended site assuming a 12 acre area of disturbance. Table 3-4 shows the original cost estimate.

Table 3-5: Burton Hill M2 – Original 2006 SWMP BMP Construction Cost Estimate

	Units	Unit Cost	Quantity	Cost
Mobilization	EA	\$5,000	1	\$5,000
Site Prep/Restoration Erosion & Sediment Control	EA	\$2,500	1	\$2,500
Land Purchase	AC	\$12,000	18	\$216,000
Clearing	AC	\$5,500	13	\$71,500
Excavation	CY	\$12	68,000	\$816,000
Outlet Structure	EA	\$10,000	1	\$10,000
		Subtotal		\$1,121,000
Contingency (20%)				\$224,200
Engineering/Legal/Admin (12%)				\$134,500
		Total		\$1,480,000

The proposed BMP construction cost is expected to be less than the original estimate given that the work will disturb less area; however, since it also involves modifications to an existing pond, erosion control and excavation unit costs will likely be higher than originally estimated. The need for a sediment forebay or hydrodynamic separators will increase the drainage structure costs. The largest cost savings should come from a reduction in the land acquisition cost, as only easements should be needed. It was assumed that the landowner may request compensation for the easements so it was assumed the unit cost would be half of the cost of purchasing the land outright.

Table 3-6: Burton Hill M2 – Updated BMP Construction Cost Estimate

	Units	Unit Cost	Quantity	Cost
Mobilization	EA	\$5,000	1	\$5,000
Site Prep/Restoration Erosion & Sediment Control	EA	\$7,500	1	\$7,500
Easement Purchase	AC	\$6,000	5	\$30,000
Clearing	AC	\$5,500	0.5	\$2,750
Excavation	CY	\$20	23,000	\$460,000
Drainage Structures	EA	\$10,000	4	\$40,000
		Subtotal		\$545,250
Contingency (20%)				\$109,050
Engineering/Legal/Admin (15%)				\$81,788
		Total		\$736,088

3.4.2 BMP Site Priority and Further Study Needed

Water quality monitoring by Beaufort County has found that the monitoring location immediately downstream of this site typically produces the highest fecal coliform readings of all sites throughout the County. Based on Retrofit Sensitivity Maps prepared by Beaufort County using results from the 2006 SWMP, the Battery Creek 2 basin could see a significant improvement in the water quality level of service if regional retrofit BMPs are installed. Given those two conditions, the cooperative property owner, and the lowered construction cost from utilizing the existing pond, **implementing and constructing this BMP site is a high priority.** In order to construct this site, additional modeling, field work, designing, and permitting is needed, including the following:

- Field work for wetland determination and delineation (if wetlands are found), with particular emphasis on determining if the existing ditch is classified as critical area.
- Ground run tree and topographic survey of the existing pond, outfall ditch, inflow pipes, and offsite access.
- Detailed hydrologic and hydraulic modeling of the water quality sub-basin, including re-evaluation of existing basin boundaries, flow paths, and land uses.
- Design plans for pond excavation, channel re-routing, the outfall structure, pre-treatment device(s), the emergency overflow weir, construction access, and sediment control.
- Permitting through SCDHEC-OCRM, SCDOT, Army Corp of Engineers, and the City of Beaufort.

Section 4 – Salt Creek South M1

4.1 Background

Originally identified in the 2006 SWMP as Site 14, this BMP site is located in the Salt Creek South M1 hydrologic sub-basin, which is a portion of the Albergotti 2 Water Quality Basin. The sub-basin associated with the originally proposed BMP location is approximately 330 acres in size and contains a mixture of uses including single family residential and farming, although most of the basin is undeveloped. Much of the undeveloped land appears to be planted pine on land that was likely previous farm land; however there also appears to be undeveloped wetlands within the basin as well. The single family homes in the basin are mostly rural homes, sitting on large parcels and not part of planned subdivisions. It appears that none of the developed parcels have any sort of stormwater BMPs in place.

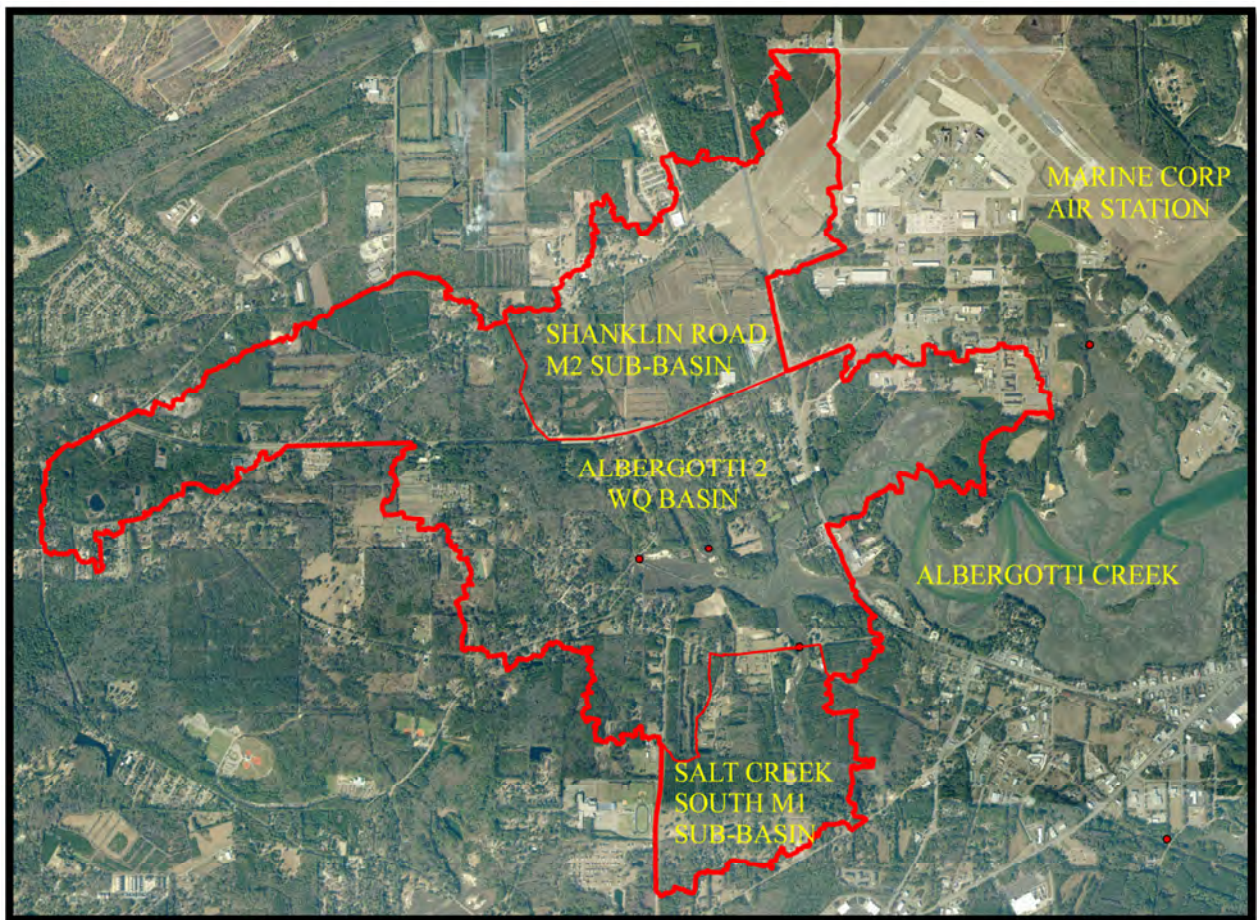


Figure 4-1: Salt Creek South M1 Sub-Basin

The originally proposed BMP site sits on two undeveloped parcels under separate ownership that are primarily covered with planted pines. The eastern parcel is owned by Kinghorn Farm LP and the western parcel is owned by Ramsey Farms LP. The Kinghorn Farm parcel also contains the basin’s main conveyance channel, a wetland system flowing north to the headwaters of Albergotti Creek. The conveyance system appears to have elevations around 4 ft while the elevations of the BMP site are

around 7 ft to 9 ft. Elevations for the remainder of the Kinghorn Farm parcel reach peak elevations as high as 20 ft. The conveyance channel drains an area bordered by Broad River Boulevard to the south, Jennings road to the west, County Shed Road to the north, and wooded farm land to the east. The eastern sub-basin boundary is somewhat uncertain, as the grades in that area are relatively flat and there may be ditches within the wooded areas that are not visible in the LIDAR. The presence of ditches could alter the sub-basin boundary that was determined in the 2006 SWMP. The main conveyance channel flows from the south to the north and drains under County Shed Road through a culvert to the headwaters of Albergotti Creek. Figure 4-2 shows the original BMP site, the sub-basin boundary and the flow path to Battery Creek.

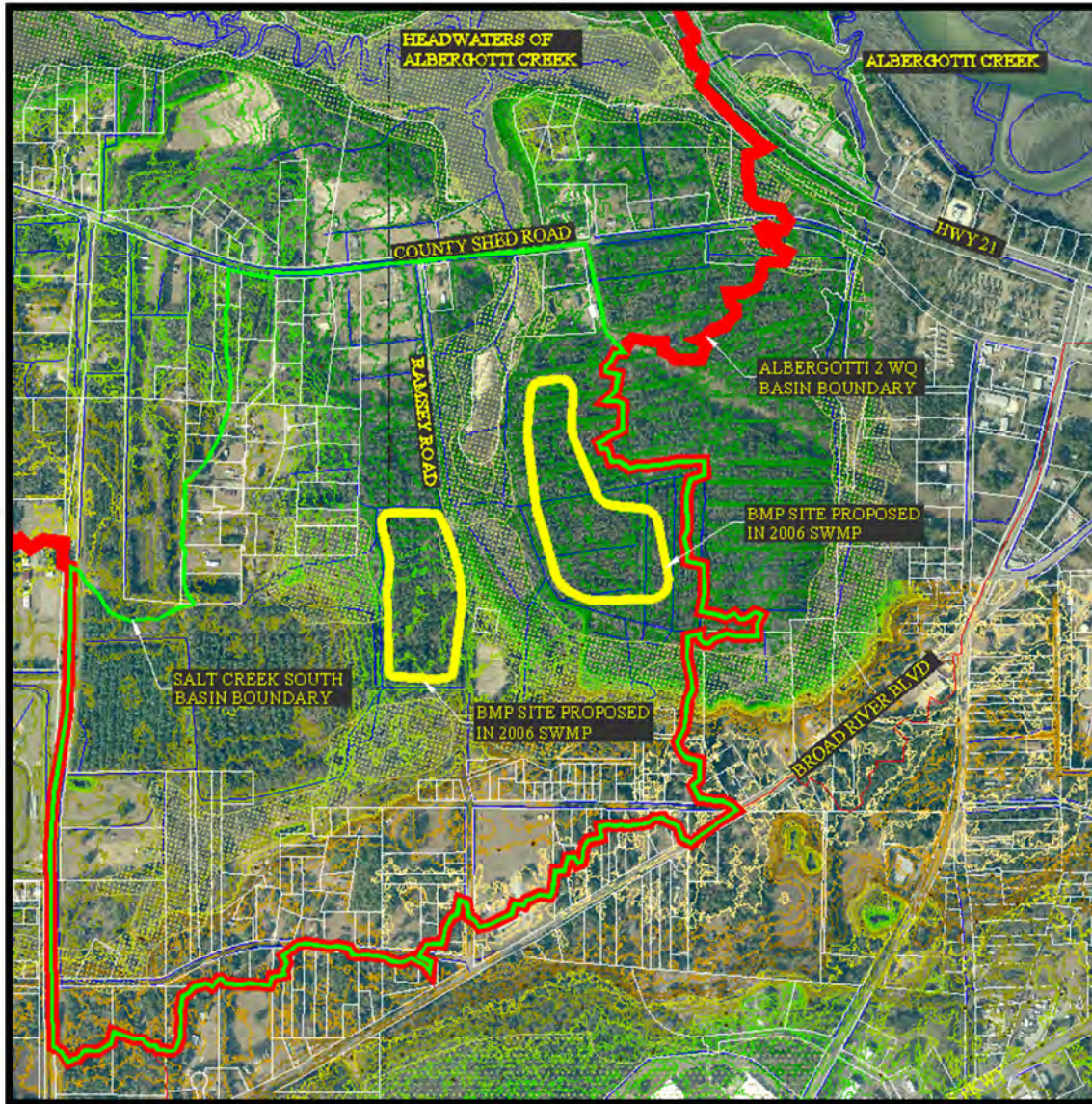


Figure 4-2: Salt Creek South M1 – Original 2006 SWMP BMP Sites

The site grades for the original location are well suited to installing a retrofit pond without negatively impacting upstream development; however, the main outfall ditch appears to be completely surrounded by wetlands, making it difficult to locate a pond in an area capable of capturing the flow. Access to the proposed BMP sites would have to be provided from two different locations, as the wetlands would limit accessibility to Ramsey Road from the eastern BMP. Given the potential wetland impacts, it was determined that site alternatives should be explored.

4.2 Alternative BMP Location Considerations

A review was conducted of other parcels along the main sub-basin flow path that may be better suited as a regional BMP site. Suitability criteria included parcel size, proximity to the main conveyance channel, favorable topography, easy parcel accessibility, favorable soils, and limited presence of and potential impacts to natural and cultural resources. Figure 4-3 shows the alternate property clusters and the original BMP site.

1. *Kinghorn Farm LP (R100 025 000 0027 0000)*: This 129 acre parcel is located at the southeastern quadrant of the intersection of County Shed Road and Ramsey Road, with large frontages on both. This parcel is primarily wooded and undeveloped, but does include a cleared area for a powerline easement and a small agriculture area. Aerial imagery appears to show the wooded areas as mature, planted pines. This parcel contains multiple ditches, with the majority appearing to serve as drainage for previous timber activities; however, along the western boundary of this parcel, near Ramsey Road, is the main conveyance channel for the Salt Creek South M1 hydrologic sub-basin. The channel flows north under County Shed Road until it reaches Albergotti Creek. This parcel would be considered the furthest downstream privately owned parcel that the basin's conveyance channel flows through, prior to crossing the SCDHEC-OCRM Critical Line and entering public waters. This parcel is located in unincorporated Beaufort County, within the Port Royal Island Zoning District, and is zoned Urban. The topography and location of the site makes it highly suitable for the proposed BMP, especially the western portion near the main conveyance channel; however the zoning and multiple highway frontages could make it expensive to acquire the necessary easements.

2. *Ramsey Farm LP (R100 028 000 0264 0000)*: This cluster consists of two parcels divided by Ramsey Road, totaling 94.9 acres. The larger western parcel would be accessed through a proposed curb cut from Ramsey Road, where it has 2,350 linear feet of frontage, or from a proposed curb cut from Ramsey Loop. The eastern parcel would be accessed through a proposed curb cut from Ramsey Road or Ramblin Road, which is a dirt road. Both parcels are wooded and undeveloped, though aerial imagery appears to show the wooded areas as mature, planted pines. The western parcel contains multiple ditches, running in different directions, but ultimately conveying runoff east towards Ramsey Road, while the eastern parcel contains a single ditch flowing south to north, towards the main conveyance channel. Both parcels, including the majority of the eastern parcel, contain wetland areas as determined by National Wetland Inventory mapping. Since the basin's main conveyance channel is located east of Ramsey Road, multiple Ramsey Road crossings may be required to adequately route, treat, and release runoff before reentering the conveyance channel. The parcels are located in unincorporated Beaufort County, within the Port Royal Island Zoning District. The west parcel is zoned Transitional and the east parcel is zoned Urban. The topography and location of the site makes it highly suitable for the proposed BMP, especially the eastern portions of the west parcel; however the zoning, highway frontage, and routing requirements could make it expensive to either acquire the necessary easements or ultimately develop the BMP.

3. *Smith Property (R100 025 000 027B 0000)*: This 8.8 acre parcel located on the southwest quadrant of the intersection of County Shed Road and Ramsey Road, and contains four to five single family homes nearest the intersection, with an approximate 2.25 acre undeveloped and wooded portion along its southern boundary. An additional acre of property currently used as an apparent farmstead may be available, bringing the total available land for potential use as a BMP to approximately 3.25 acres. Since the basin's main conveyance channel is located east of Ramsey Road, multiple Ramsey Road crossings may be required to adequately route, treat, and release runoff before reentering the conveyance channel. As such, the small land available and the routing costs make this not a very highly developable or beneficial parcel for use as a potential BMP.

4. *Deveaux Property (R100 028 000 0248 0000)*: This 8.4 acre parcel is located south of the Ramsey Farm (West) LP property, with access to Ramsey Loop. The southern portion of the property is cleared and contains a single family residence as well as a small pond, while the remainder of the property is wooded and undeveloped. The parcel is primarily covered by a large wetland that continues on both the east and west parcels. Just north of the wetland is a single ditch running west to east along the undeveloped portion, which ultimately leads to the basin's main conveyance channel. The parcel is located in unincorporated Beaufort County, within the Port Royal Island Zoning District, and is zoned Transitional. While the parcel is located upstream of the main conveyance channel and would provide excellent pre-treatment, the wetland and geometrical constraints are such that it would not be considered a highly developable parcel. This parcel is not of much use to a potential BMP as a standalone piece, but may be useful as a supplement to the Ramsey Farms (West) LP parcel.

5. *Williams Property (R100 029 000 032C 0000)*: This 5.0 acre parcel borders both the Ramsey Farms (East) and Kinghorn properties, and is located on the eastern boundary of the Salt Creek South M1 hydrologic sub-basin. It is undeveloped and primarily wooded. Per the NWI, the site is approximately 75% wetlands, with additional geometrical and access issues. The parcel is located in unincorporated Beaufort County, within the Port Royal Island Zoning District, and is zoned Urban, although given the aforementioned wetland, access, and geometric constraints, it is not a highly developable parcel. This parcel is not of much use to a potential BMP as a standalone piece, but may be needed to supplement one of the adjacent parcels.

6. *O'Hanlon Property (R100 028 000 0011 0000)*: This 4.9 acre parcel borders Ramsey Farms (West) property on two sides and is partially cleared to serve two single family residences and a small pond. The remainder of the site is wooded and undeveloped. Per the NWI, the site is approximately 75% wetlands, with the only public access going through a residential neighborhood. The parcel is located in unincorporated Beaufort County, within the Port Royal Island Zoning District, and is zoned Transitional, although given the aforementioned wetland and access constraints, it is not a highly developable parcel. This parcel is not of much use to a potential BMP as a standalone piece, but may be needed to supplement the Ramsey Farms (West) LP parcel.

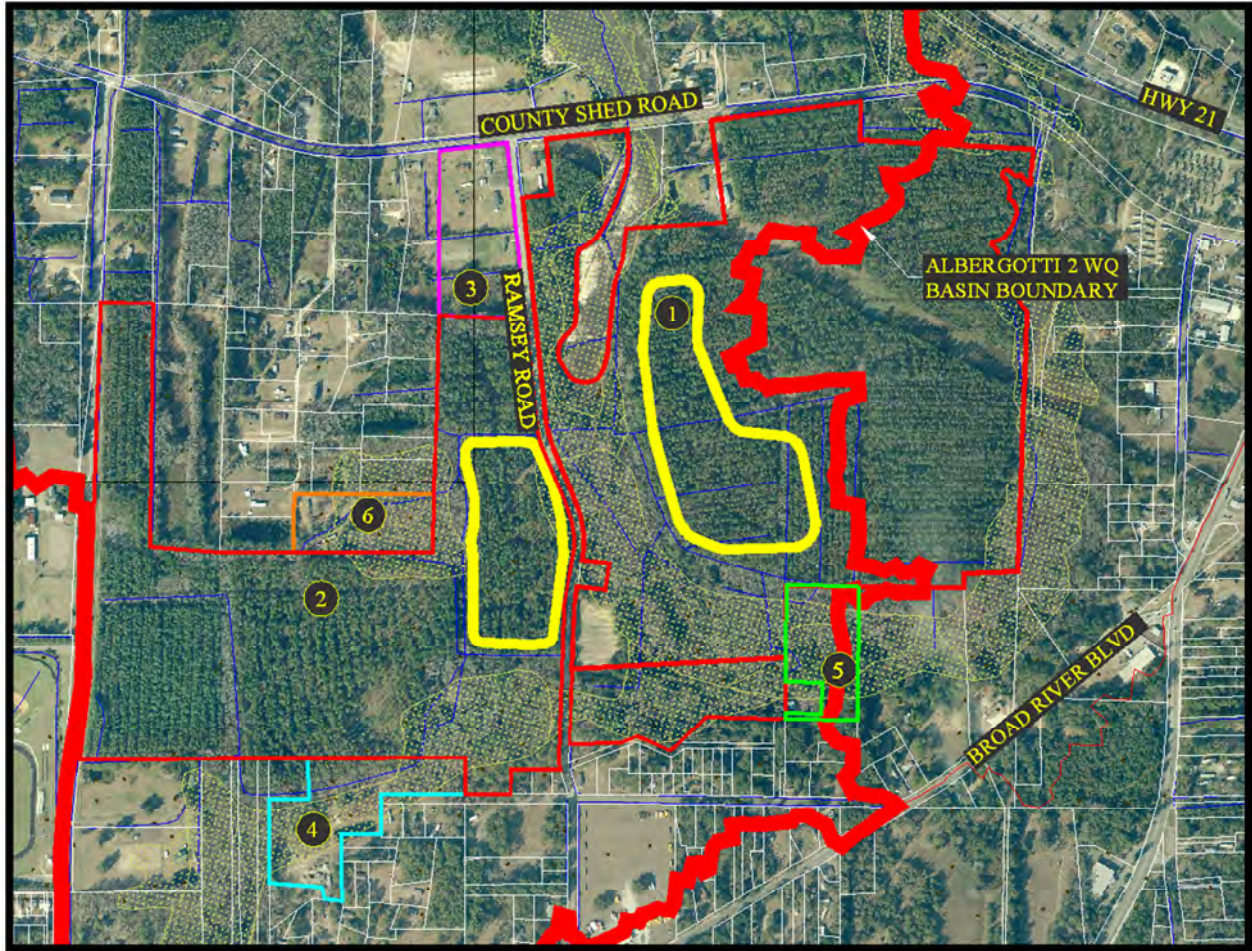


Figure 4-3: Salt Creek South M1 – BMP Site Evaluation

4.3 BMP Recommendations & Priorities

The size of the two originally recommended parcels and the existing topography make regional ponds a good choice for the stormwater BMP. Ponds are effective in treating stormwater for bacteria removal and can be designed to reduce the flashy discharge of freshwater to the saltwater river. The eastern parcel (Kinghorn) is better suited to containing a pond given the topography and the proximity of the uplands to the sub-basin conveyance channel located in the wetlands. Capturing runoff from the channel and discharging water back to the wetland will require some impacts to the wetland, but it should be possible to acquire the needed permits. The western parcel (Ramsey) is a little less suitable to containing a pond mainly due to the need to cross Ramsey Road to hydraulically connect to the main conveyance channel. Multiple road crossings would be needed for the inflow and outflow to the proposed pond, which will increase the construction cost. Both options should remain open however, because the cost and ability of acquiring the needed land may differ significantly

Conceptual BMP design work on this site was suspended to allow additional budget on other higher priority sites. This sub-basin was considered low priority because Albergotti Creek is listed as Restricted in the SCDHEC Shellfish Harvesting Classifications, meaning shellfish cannot be harvested from the waters regardless of the measured fecal coliform concentration. Albergotti Creek is classified as Restricted due to the waste water treatment facility discharge from the Marine Corp Air Station, but Beaufort Jasper Water and Sewer Authority has taken over ownership and operation of the facilities and

plans to remove the treatment facility discharge. After this occurs, Albergotti Creek may be classified to a use permitting shellfish harvesting, and adding retrofits to the Salt Creek South sub-basin may become higher priority. Based on the retrofit sensitivity analysis in the 2006 SWMP, the Albergotti Creek 2 basin would not see a significant improvement in the water quality level of service (LOS) if regional retrofit BMPs are installed. Table 8-19 in the SWMP shows an existing LOS “D” for the basin and a future predicted LOS “D” assuming retrofit BMPs are installed. However, because of tidal flow action, improvements in this basin could have some effect on the quality of the downstream Albergotti Creek 1 basin. The 2006 SWMP implies that modeled improvements in stormwater quality level of service (LOS) in the Albergotti Creek 1 basin are dependent on BMP improvements in the Albergotti Creek 2 basin. The LOS of Albergotti Creek 1 is predicted to improve from LOS “D” to LOS “A” in best case scenario conditions (100% BMP coverage in Albergotti Creek 1 & 2).

Should portions of Albergotti Creek be upgraded by SCDHEC to allow shellfish harvesting and the Salt Creek South M1 sub-basin become a higher priority, the following work will need to be done in a phased approach.

Conceptual BMP Design, Modeling, and Evaluation Phase:

- Prepare conceptual wet detention pond layouts and sizing, including concepts for inflow/outflow routes through the existing wetland to minimize impacts.
- Conceptual hydraulic modeling of the ponds to determine peak discharges and peak stages (pre-post comparison).
- Water quality evaluation of total volume storage and discharge.
- 100 year storm – flood prevention analysis to determine possible effects on upstream properties.
- Conceptual construction cost estimate and comparison to original 2006 SWMP cost estimate.

Property Acquisition and Site Soil Evaluation Phase:

- The subject property owners should be contacted to determine the likelihood of land and/or easements being available for purchase.
- If land acquisition is possible, soil borings and classification tests should be performed to determine the suitability of the material for structural fill.
- A new construction cost estimate should be prepared based on the land cost and value of the soil.

Detailed Design and Permitting Phase:

- Field work for wetland determination and delineation.
- Ground run tree and topographic survey of the existing pond, outfall ditch, inflow pipes, and offsite access.
- Detailed hydrologic and hydraulic modeling of the water quality sub-basin, including re-evaluation of existing basin boundaries, flow paths, and land uses.
- Design plans for pond excavation, channel re-routing, outfall structure, emergency overflow weir, construction access, and sediment control.
- Permitting through SCDHEC-OCRM, SCDOT, Army Corp of Engineers, and Beaufort County.

Section 5 – Shanklin Road M2

5.1 Background

Originally identified in the 2006 SWMP as Site 15, this BMP site is located in the Shanklin Road M2 hydrologic sub-basin, which is a portion of the Albergotti 2 Water Quality Basin. The sub-basin associated with the originally proposed BMP location is approximately 600 acres in size and contains a mixture of uses including single family residential, commercial, industrial, farming and a portion of the Marine Corp Air Station. A small portion of the sub-basin is undeveloped with landcover primarily being wooded. The single family homes in the basin are mostly rural homes, sitting on large parcels and not part of planned subdivisions. The commercial and industrial uses are mostly older buildings and developments, meaning the associated stormwater BMPs are not likely constructed to current standards.

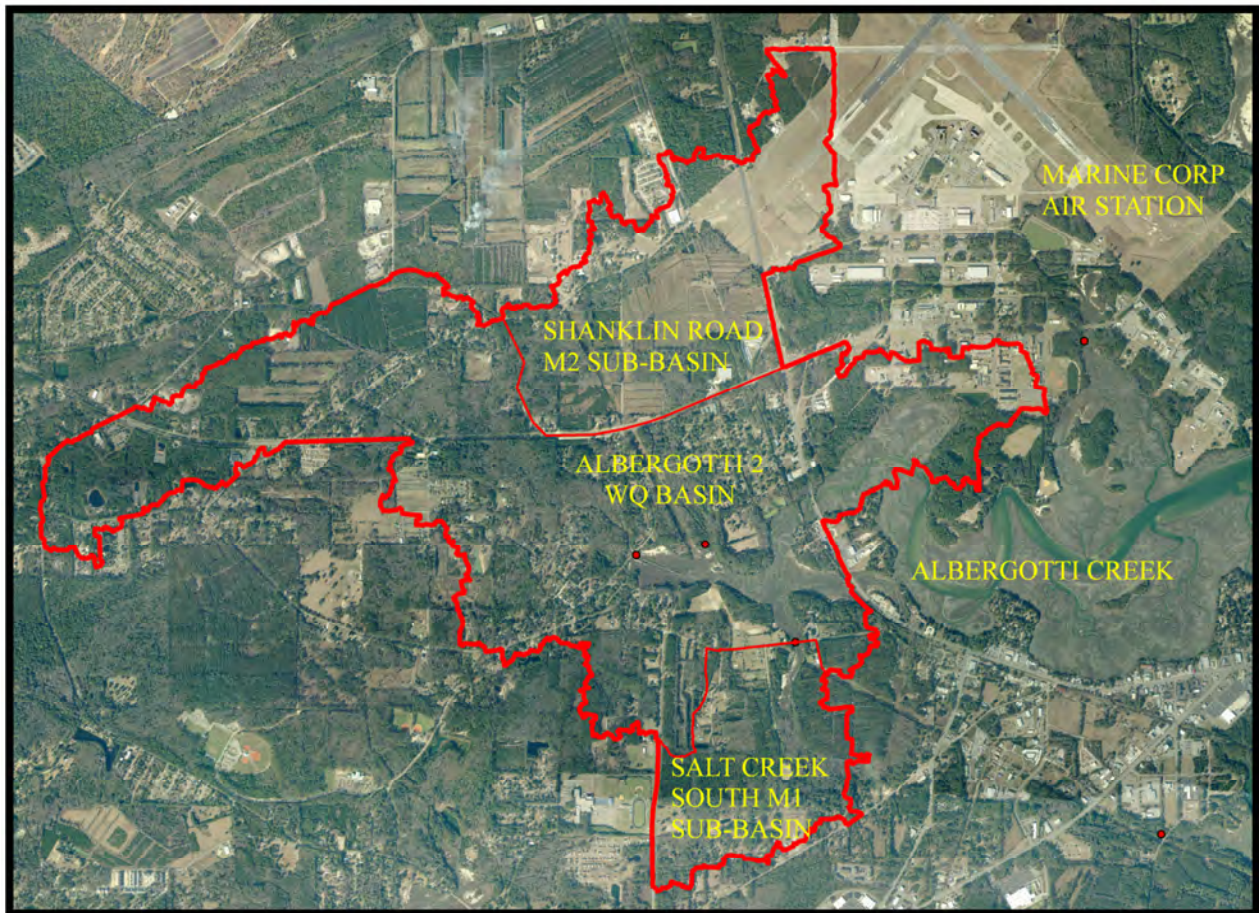


Figure 5-1: Shanklin Road M2 Sub-Basin

The Shanklin Road sub-basin drains from north to south through a jurisdictional wetland system and through culverts under Shanklin Road, Laurel Bay Road, and Roseida Road. It eventually outfalls to the headwaters of Albergotti Creek near the confluence point of the Salt Creek sub-basin, the Shanklin Road sub-basin, and the Salt Creek South sub-basin. The originally proposed BMP site is located between Shanklin Road and Laurel Bay Road and is property owned by the Federal Government as buffer for the Marine Corp Air Station. The site is former farm land that is now the location for a planned wetland

mitigation bank related to future expansion work at the MCAS. Ward Edwards obtained a conceptual Hydrologic Restoration Plan for the wetland mitigation bank from the project's wetland consultants, Tidewater Environmental and briefly reviewed it in an effort to estimate the possible effects the Plan would have on the water quality of the sub-basin. If the wetland restoration work planned for the property will have some water quality benefits to the sub-basin, it could reduce or eliminate the need for Beaufort County to install BMP retrofits in the sub-basin and allow the County to focus its efforts in other sub-basins. A brief summary of the Hydrologic Restoration Plan review is given in Section 5.3. Ward Edwards also reviewed the remainder of the sub-basin looking for other potential BMP sites (Section 5.2), in case the planned wetland mitigation has insufficient benefit to the sub-basin water quality.

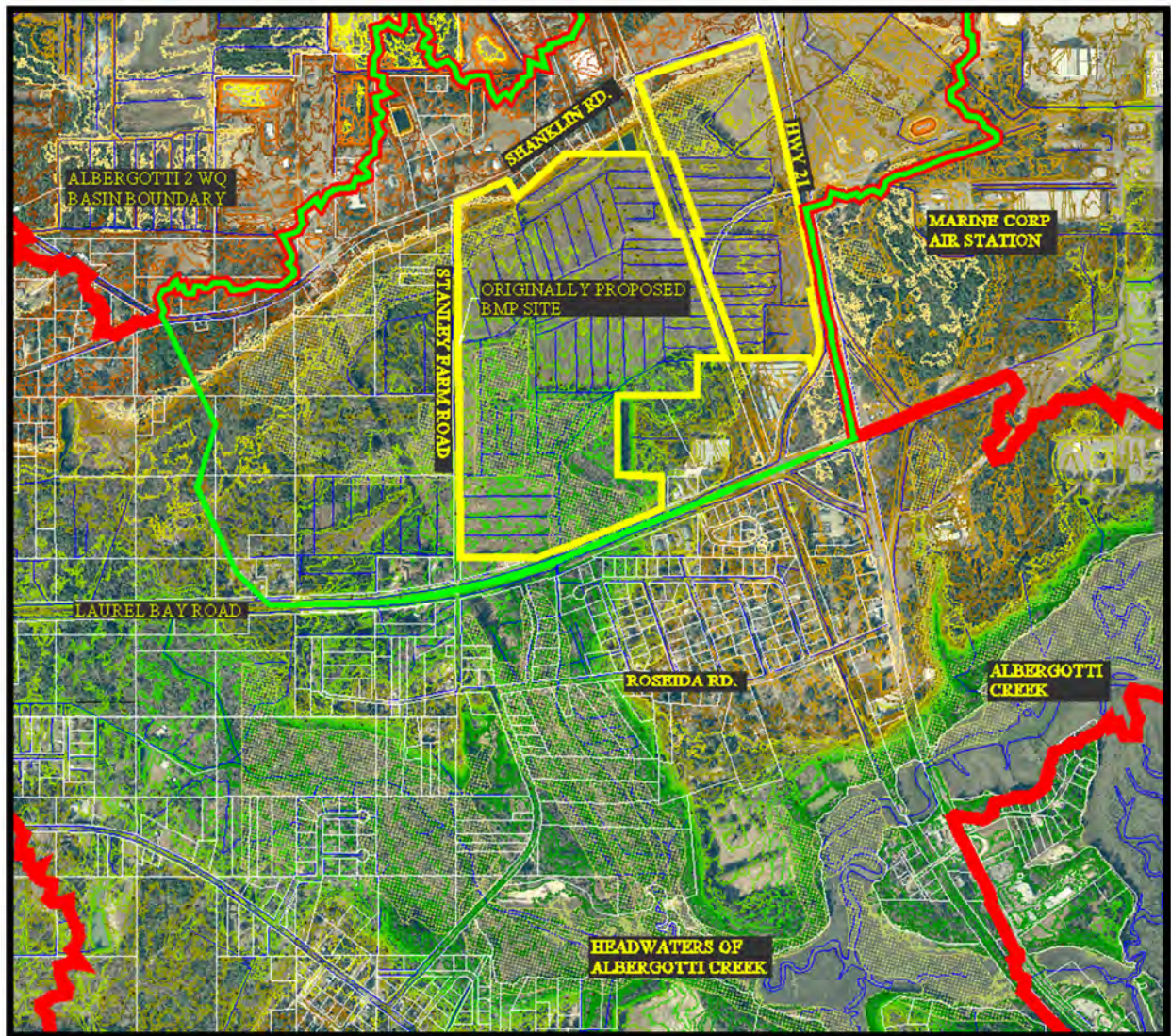


Figure 5-2: Shanklin Road M2 – Original 2006 SWMP BMP Site

5.2 Alternative BMP Location Considerations

A review of large parcels downstream of the MCAS site was conducted to determine if it would be feasible to provide any supplemental treatment within the sub-basin should the planned wetland restoration not provide sufficient water quality treatment. The review found four landowners, each with a cluster of properties near the sub-basin's main outfall channel. Figure 5-3 shows the alternate property clusters and the original BMP site.

1. *Edwin Pike – Roseida Subdivision Open Space (R100 025 00A 0273 0000, R100 025 00A 0022 0000, R100 025 00A 0025 0000, R100 025 00A 0035 0000, R100 025 00A 0034 0000, R100 025 00A 0033 0000, R100 025 00A 0032 0000 & R100 025 00A 0026 0000)*: This cluster consists of a 3.8 acre parcel labeled as open space / pond area for the Roseida Subdivision, and 7 undeveloped single family lots, all together totaling around 7.5 acres. The Roseida Subdivision is the densest development in the sub-basin and predates all County stormwater treatment standards. The open space parcel collects stormwater from the subdivision and conveys it to the south toward the headwaters of Albergotti Creek. The drainage ditch carrying runoff from the MCAS site and upstream areas also runs directly through the cluster. About one third of the cluster appears to be wetlands based on the National Wetland Inventory (NWI) data. This parcel has some potential for a regional BMP. Although it is small compared to the upstream basin area, it could treat the densest development within the basin.

2. *MCAS/Federal Government Land (R120 025 00A 0019 0000, R120 025 00A 0019 0000, & R120 025 00A 0019 0000)*: Across Laurel Bay Road from the MCAS wetland mitigation site are four additional parcels under Federal ownership that don't appear to be part of the mitigation project. The parcels totaling around 10 acres, are adjacent to the main outfall ditch and the Edwin Pike property. They appear to contain some wetlands per the NWI and are also encumbered by a power line utility easement. Alone, they don't have much potential for a BMP site, but could be useful in conjunction with the Edwin Pike property.

3. *Killearn Estates Common Area (R100 025 000 0285 0000)*: To the south and across Roseida Rd from the Edwin Pike property is a 7 acre parcel listed as common area for the Killearn Estates development. The main outfall ditch runs directly through the parcel, however it also appears to entirely consist of wetlands per the NWI.

4. *James Smith – Killearn Estates (R100 025 000 0022 0000, R100 025 000 0268 0000, & R100 025 000 0267 0000)*: This 25 acre cluster consists of undeveloped lots from the Killearn Estates development and is adjacent to the 7 acre common area. It is also directly adjacent to the Albergotti Creek headwaters and contains the main outfall channel for the sub-basin. Similar to the Common Area parcel, this site is primarily wetlands per the NWI. These two clusters offer little potential for BMP unless some sort of shallow channel impoundment is used to further inundate the wetlands and promote evapotranspiration.

5.3 MCAS Hydrologic Plan Analysis

The 152 acre MCAS wetland mitigation bank site consists primarily of old agricultural fields and includes many row ditches used to keep the fields properly drained. The site also includes a main trunk ditch that collects water from the row ditches as well as runoff from two upstream, offsite areas. See Figure 5-3 for the site boundary, the overall site drainage basin, and the two offsite basin boundaries. The restoration plan calls for removing the majority of the old row ditches, but leaving the main trunk ditches in current condition. Stone check dams will be constructed in the main ditches to also help slow the runoff rate. Removing the row ditches will likely slow down the runoff rate from the agricultural fields, promoting wetter soils, more standing water, and wetland vegetation. All this combined is expected to increase the evapotranspiration from the fields and reduce the overall runoff volume from the site.

However, the restoration plan is not expected to provide much additional stormwater detention over current conditions, particularly for the offsite areas draining through the site. It is uncertain how much new detention will be provided by the stone check dams proposed for the main trunk ditches, but assuming a typical maximum storage depth of 12 inches, it is unlikely the ditches will provide much benefit to the 350 acres of upstream offsite area draining through the site.

The likely onsite runoff volume reduction and the impact on the upstream, offsite runoff can be quantified by Ward Edwards using a basic hydrologic and hydraulic model if so desired. Otherwise, it is understood that the County has relocated one of its current water quality monitoring locations to a spot downstream of the MCAS site that will hopefully reflect trends indicating water quality improvements that may result from the wetland mitigation work.

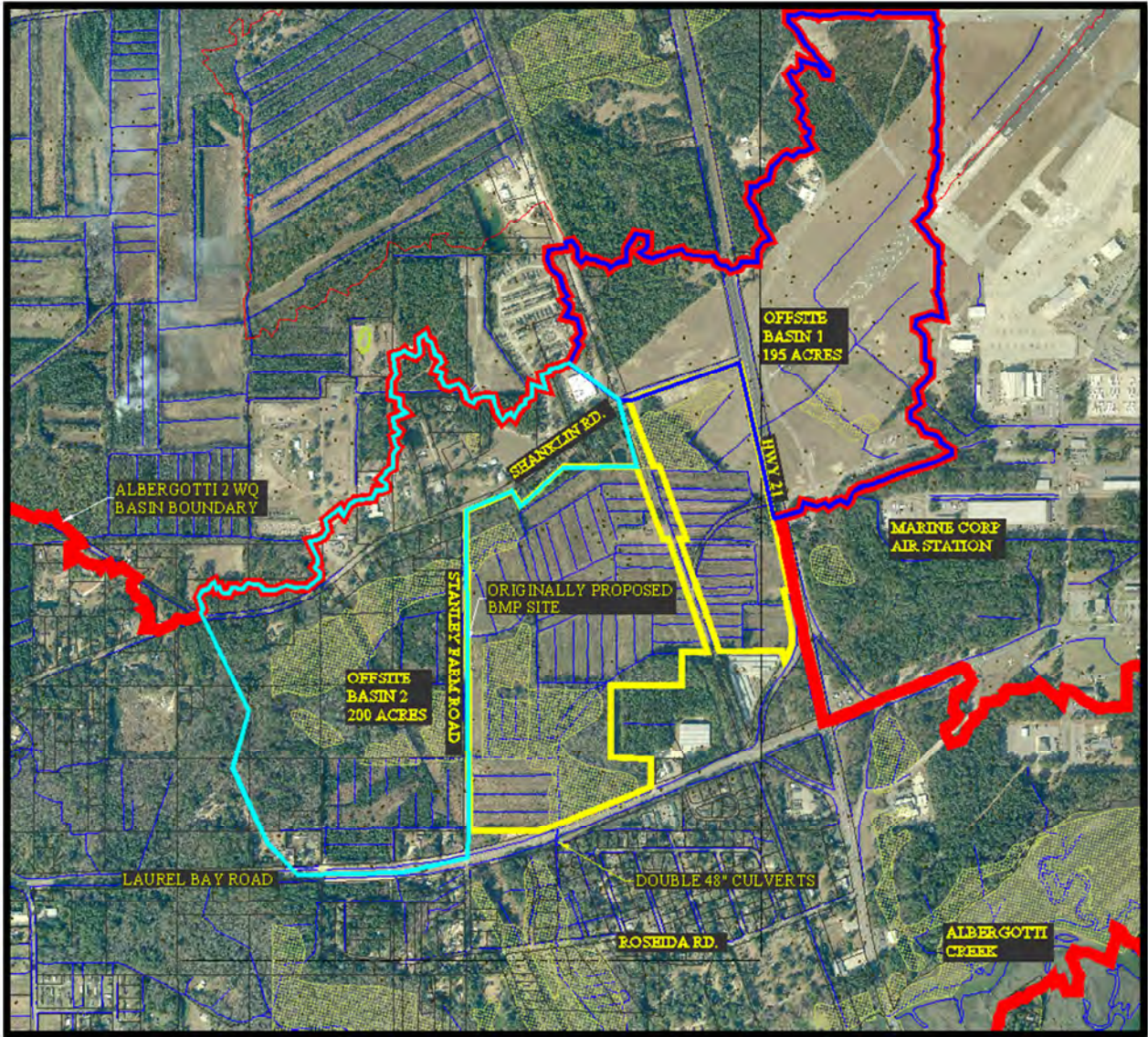


Figure 5-3: Shanklin Road M2 – Offsite Basins Draining Through Wetland Mitigation Site

5.4 BMP Recommendations & Priorities

The size of the originally recommended parcel makes it ideal to contain a regional stormwater BMP, but the planned wetland restoration and mitigation eliminates the availability of the parcel. The small sizes of the downstream parcels limit their usefulness in containing a large regional BMP to serve the entire sub-basin; however use of the parcels for smaller BMPs to supplement any water quality benefits from the upstream wetland mitigation may be feasible. Beaufort County is currently monitoring water quality downstream of the sub-basin discharge to establish a baseline water quality for comparison purposes in the future. The County will continue to monitor the water quality in this location and will evaluate the effectiveness of the planned wetland restoration on the MCAS property. If the results show some marked improvement in the sub-basin water quality then regional retrofits by the County will not be needed.

To allow time for evaluation of the wetland restoration, the conceptual BMP design work on this site was suspended. Budget from the conceptual BMP design phase was applied to the other higher priority sites and to the added Okatie West site. The Shanklin Road sub-basin was considered low priority because Albergotti Creek is listed as Restricted in the SCDHEC Shellfish Harvesting Classifications, meaning shellfish cannot be harvested from the waters regardless of the measured fecal coliform concentration. Albergotti Creek is classified as Restricted due to the waste water treatment facility discharge from the Marine Corp Air Station, but Beaufort Jasper Water and Sewer Authority has taken over ownership and operation of the facilities and plans to remove the treatment facility discharge. After this occurs, Albergotti Creek may be classified to a use permitting shellfish harvesting, and adding retrofits to the Salt Creek South sub-basin may become higher priority. Based on the retrofit sensitivity analysis in the 2006 SWMP, the Albergotti Creek 2 basin would not see a significant improvement in the water quality level of service (LOS) if regional retrofit BMPs are installed. Table 8-19 in the SWMP shows an existing LOS “D” for the basin and a future predicted LOS “D” assuming retrofit BMPs are installed. However, because of tidal flow action, improvements in this basin could have some effect on the quality of the downstream Albergotti Creek 1 basin. The 2006 SWMP implies that modeled improvements in stormwater quality level of service (LOS) in the Albergotti Creek 1 basin are dependent on BMP improvements in the Albergotti Creek 2 basin. The LOS of Albergotti Creek 1 is predicted to improve from LOS “D” to LOS “A” in best case scenario conditions (100% BMP coverage in Albergotti Creek 1 & 2).

Should portions of Albergotti Creek be upgraded by SCDHEC to allow shellfish harvesting meaning the Shanklin Road M2 sub-basin becomes a higher priority, and should the wetland restoration work not have sufficient water quality benefits, the following work will need to be done to proceed with supplemental BMPs in the sub-basin.

Conceptual BMP Design, Modeling, and Evaluation Phase:

- Evaluate conceptual BMP options such as regional detention ponds and wetland inundation at road crossings.
- Select suitable sites based on chosen BMP.
- Prepare conceptual BMP layouts and sizing, including concepts for inflow/outflow routes through the existing wetland to minimize impacts.
- Conceptual hydraulic modeling of the BMP to determine peak discharges and peak stages (pre-post comparison).
- Water quality evaluation of total volume storage and discharge.
- 100 year storm – flood prevention analysis to determine possible effects on upstream properties.
- Conceptual construction cost estimate and comparison to original 2006 SWMP cost estimate.

Property Acquisition and Site Soil Evaluation Phase:

- The subject property owners should be contacted to determine the likelihood of land and/or easements being available for purchase.
- If land acquisition is possible, soil borings and classification tests should be performed to determine the suitability of the material for structural fill.
- A new construction cost estimate should be prepared based on the land cost and value of the soil

Detailed Design and Permitting Phase:

- Field work for wetland determination and delineation.
- Ground run tree and topographic survey of the existing pond, outfall ditch, inflow pipes, and offsite access.
- Detailed hydrologic and hydraulic modeling of the water quality sub-basin, including re-evaluation of existing basin boundaries, flow paths, and land uses.
- Design plans for pond excavation, channel re-routing, outfall structure, emergency overflow weir, construction access, and sediment control.
- Permitting through SCDHEC-OCRM, SCDOT, Army Corp of Engineers, and Beaufort County

Section 6 – Okatie East

6.1 Background

Originally identified in the 2006 SWMP as Site 4, this BMP site is located in the Okatie West T3-A hydrologic sub-basin, which is a portion of the Okatie River 3 Water Quality Basin. The sub-basin associated with the original proposed BMP location is approximately 260 acres in size and includes a mix of developed and undeveloped property. Uses in the sub-basin include single family residential, a golf course, and commercial development. It was discovered early on in the site review that the property for the originally recommended BMP had been developed since the release of the 2006 SWMP and that an alternate site needed to be found. Figure 6-1 shows the water quality sub-basin and the Okatie River 3 basin boundaries. Figure 6-2 shows the originally recommended BMP site and the sub-basin boundary.

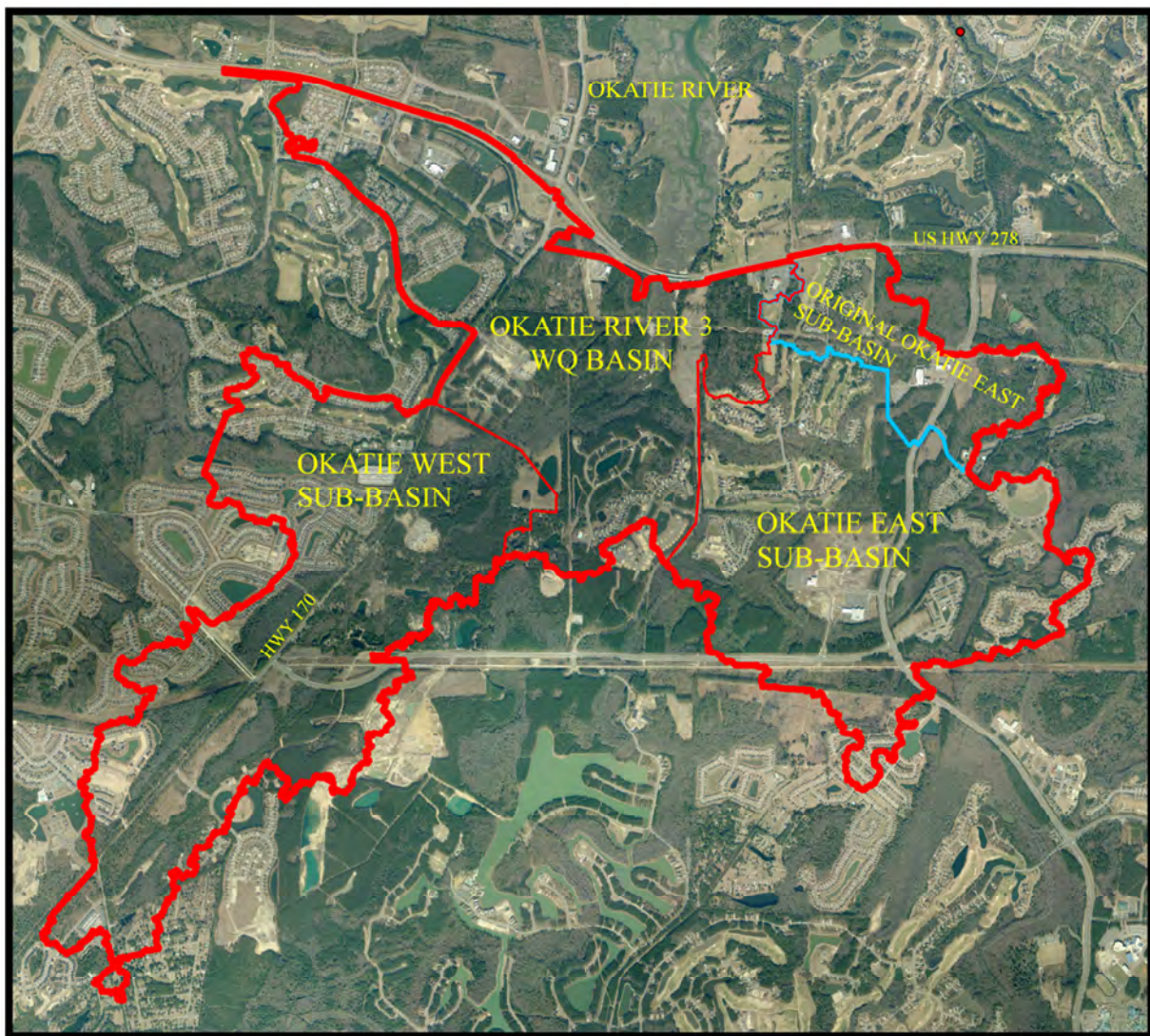


Figure 6-1: Okatie River 3 WQ Basin & Original Okatie East Sub-Basin

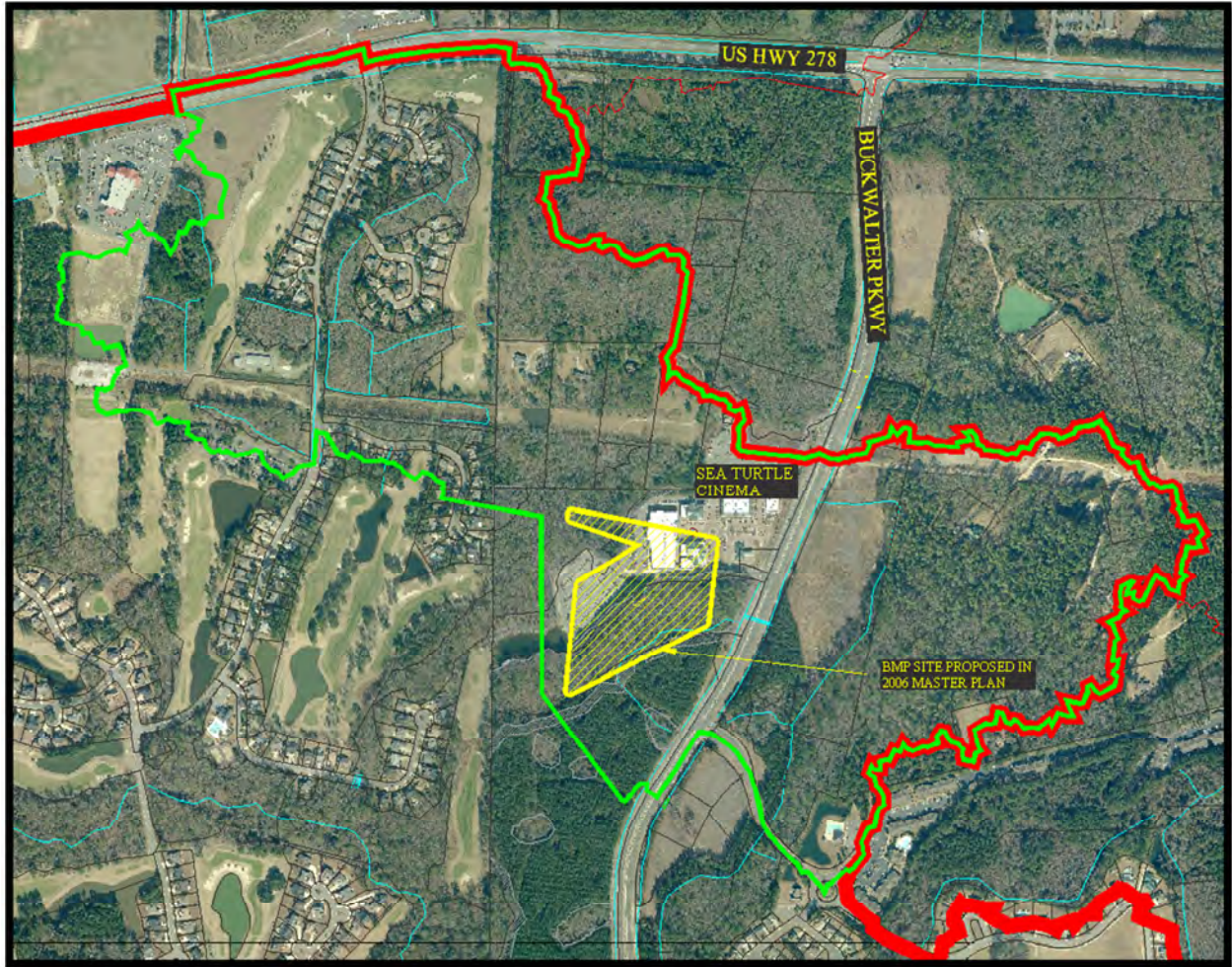


Figure 6-2: Okatie East – Original 2006 SWMP BMP Site

Before examining other properties as potential BMP sites, the overall Okatie River 3 basin stormwater flow patterns were reviewed to determine general areas to focus on. The basin has two main flow branches. The eastern branch starts up near the original BMP site and drains through a jurisdictional wetland system that meanders between mostly developed upland areas. The western branch flows through a mixture of developed and undeveloped land and generally parallels Hwy 170. One portion of the western branch is located on the opposite side of Hwy 170 and receives runoff from Sun City. The eastern and western branches join in a saltwater tidal flat about 2,000 feet south of Hwy 278.

Given two distinct and separate flow paths are contributing to discharge from the Okatie River 3 basin, it was decided to divide the basin into two separate BMP projects, one for the east branch and one for the west branch. This section of the report focuses on the east branch, which is subsequently referred to as Okatie East. The western branch is covered in Section 7 and is designated as Okatie West.

6.2 Alternative BMP Location Considerations

Ward Edwards was made aware of property at the downstream end of the basin that the County purchased through the Rural & Critical Lands program. The property is at the confluence point of the basin's eastern and western branches making it well suited to capture runoff from the majority of the basin. The property contains a mixture of uplands, freshwater jurisdictional wetlands, and saltwater critical area wetlands. It is understood that the County has plans to construct a park on the large upland area located on the western end of the property, and thus that portion of the site is unavailable for use as a stormwater BMP. The uplands available for use are along the southern property line and the eastern property line. These areas were evaluated for BMP suitability by considering the existing topography, the size of the upland area available, site accessibility, and possible connections to the main conveyance channels. The evaluation was conducted using GIS data, LiDAR, aerial images, survey plats and parcel data.

It was determined that the available portions of the site were not suitable due to the narrow width of the uplands and the high amount of grade change over that width. The space limitation and grading requirements would not allow enough room for a detention type BMP in the uplands. Accessibility is a further limitation as there is no easy access to the upland area without crossing the wetlands or getting easements across the adjacent properties. The required hydraulic connections to the existing conveyance channel would also be a limitation as most of the channel onsite is considered OCRM critical area. Permitting the impacts to the critical area would be more difficult than permitting freshwater wetland impacts. Figure 6-3 shows the County owned property, the location of the critical line and the site topography.

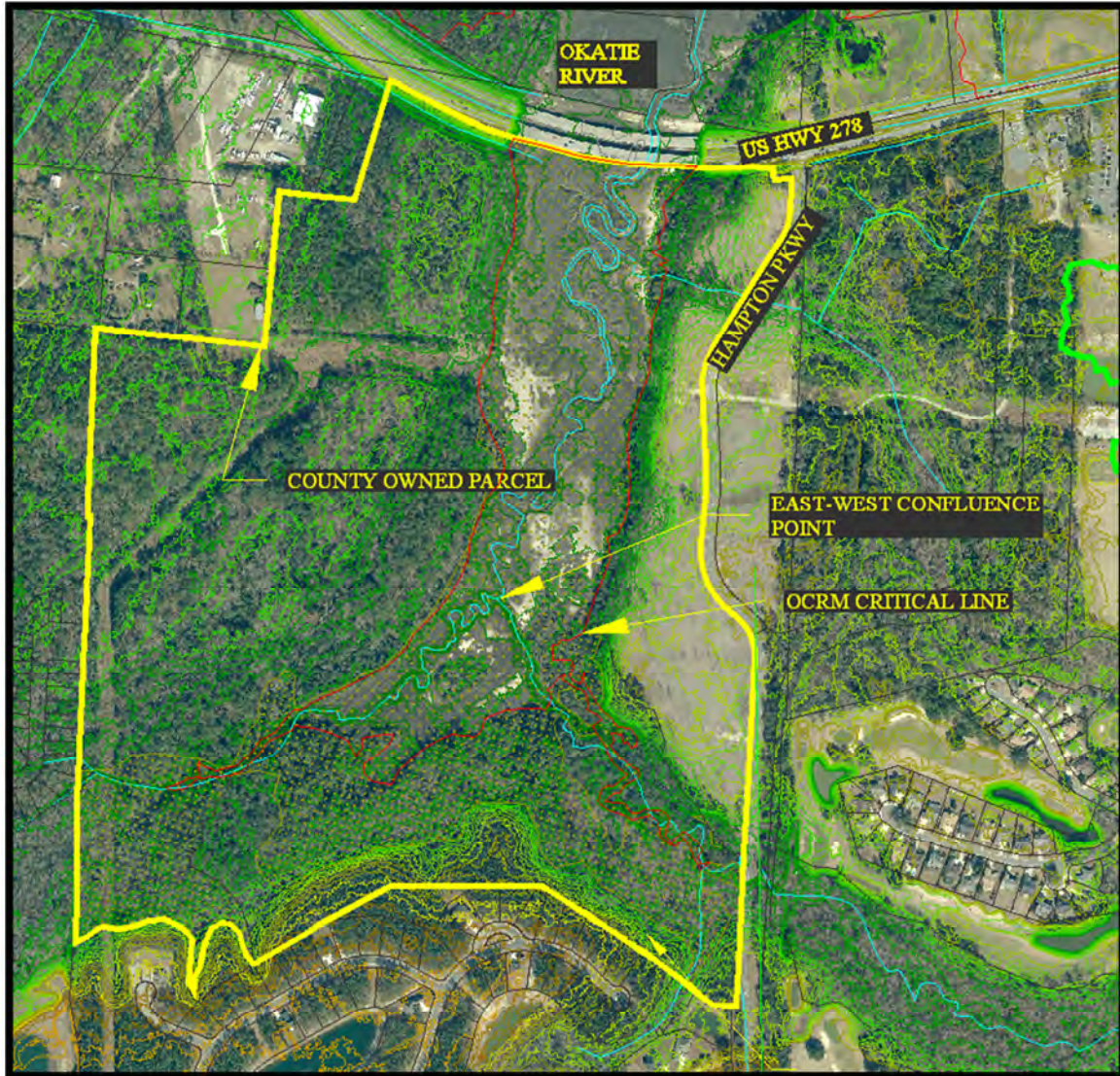


Figure 6-3: Okatie River 3 WQ Basin – Beaufort County Owned Parcel at Basin Confluence

A scan of other properties in the Okatie East basin found no large, undeveloped parcels capable of containing a serviceable stormwater pond BMP and it became apparent that an alternate treatment strategy would need to be found. Just upstream of the County parcel and to the east of Hampton Parkway is an old logging road that contains a large culvert constructed from an old steel boiler. The east basin's main outfall channel runs through the culvert, but doesn't appear to be constricted during the normal baseflow. However this culvert combined with the other upstream road culverts are believed to have over time, channelized the flow through the wetland system. The flow channelization is believed to have increased the total volume reaching the Okatie River by reducing the frequency of wetland inundation and thus the evapotranspiration potential. The concept of detaining the wetland baseflow to increase inundation and ET was discussed as a possible BMP for the east basin, in lieu of a wet detention pond. The detention/inundation concept could be accomplished by replacing the existing boiler culvert with an outlet control structure. Given its location in the sub-basin, the control structure will receive flow from approximately 1,200 acres of land upstream of the logging road.

6.3 BMP Recommendations

Replacing the existing culvert with a designed outlet control structure could serve to impound flow from the 95th percentile or smaller storms and release the runoff slowly over a 72 hour period. This would reduce the flashy introduction of freshwater to the saltwater system, which is believed to be a contributor to the fecal coliform contamination problem. Re-grading the logging road berm to lower the top elevation by a couple of feet could also help prevent potential flooding problems likely to occur in existing conditions with the 100 year design storm.



Figure 6-4: Okatie East – Conceptual BMP

Ward Edwards used LiDAR to determine the areas that could potentially be inundated by the construction of an outlet control structure at the old logging road. The depth of potential inundation was determined by making assumptions on the normal water levels in the Island West ponds, using a combination of the LiDAR and aerial photography. It was estimated that the maximum feasible inundation depth is 5 ft (elevation 10), as this appears to be below the normal water levels in the Island West ponds and would not likely create a tailwater effect in the pond system. A hydraulic model was used to quantify the potential water quality benefits and to estimate the effects the BMP would have on the peak flood stages in the upstream wetland. The results are presented in Section 6.3.1. More detailed hydraulic modeling will be needed to confirm potential impacts to the Island West drainage system and golf course. Details of additional information and study needed are provided in Section 6.4.2.

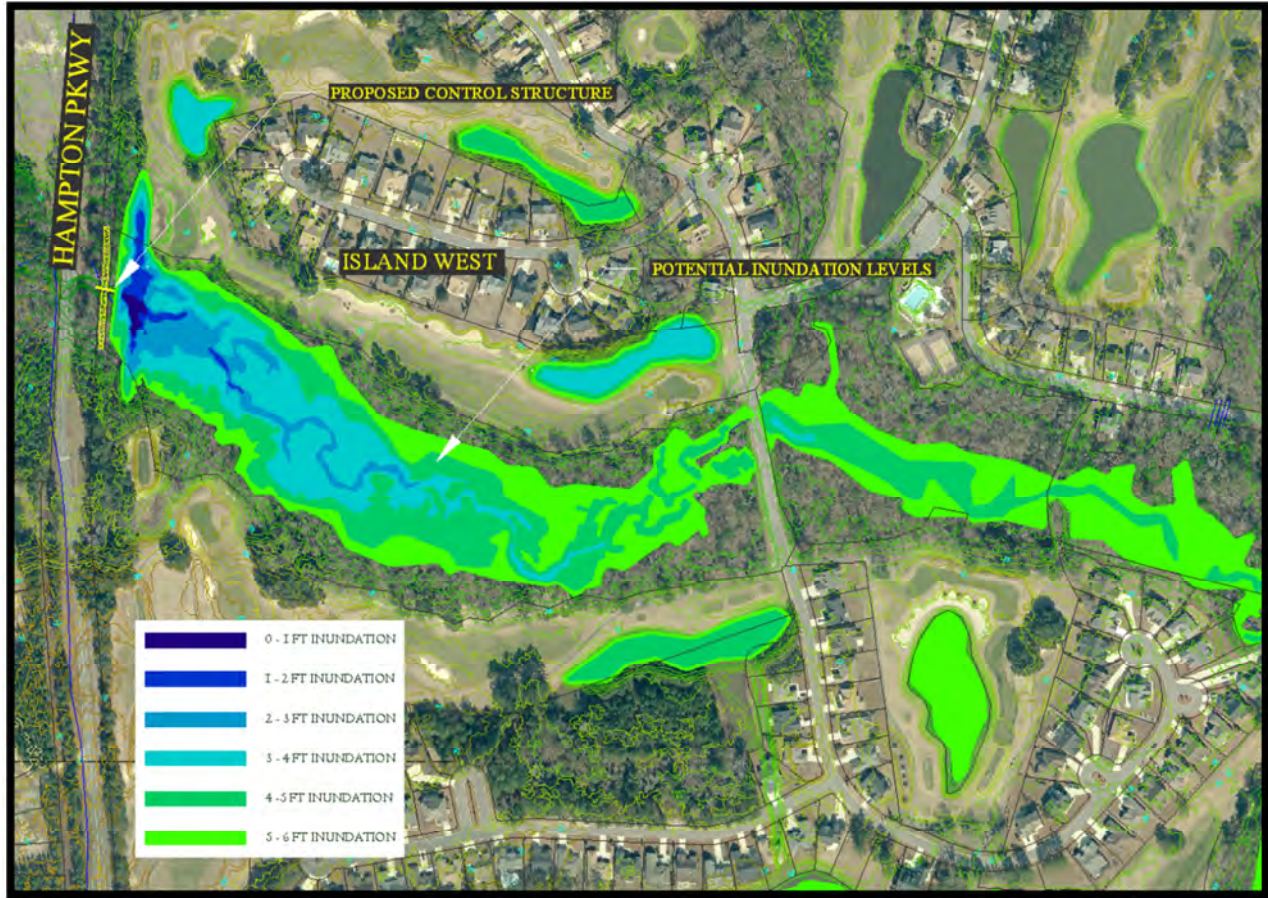


Figure 6-5: Okatie East – Potential Inundation From Proposed Outlet Control Structure

6.3.1 BMP Sizing and Analysis

The ICPR files from the 2006 SWMP were used to do a basic analysis of the BMP concept. The pre-development ICPR files were run for the 95th percentile storm (1.95”) and the 100 yr design storm. As a point of comparison in determining the effectiveness of the proposed outlet control structure for volume control and water quality treatment, post-development conditions were modeling assuming the outlet control structure is in place. The 100 year storm was also modeled in post development conditions to determine if the upstream flood stages could be reduced as intended.

Table 6-1: Okatie East – Peak Flow and Peak Stage Results – 95th Percentile Storm

Node	ICPR Node Name	Pre Max Stage (ft)	Post Max Stage (ft)	Pre Max Inflow (cfs)	Post Max Inflow (cfs)
Upstream of Confluence	OW_T1-0	5.63	5.62	36.62	26.76
Upstream (near)	OW_T-10	6.15	8.28	36.84	30.81
Upstream (far)	OW_T1-37	9.82	9.73	28.49	28.39

Table 6-2: Okatie East – Pre-Post Volume Comparison for 95th Percentile Storm

Node	ICPR Node Name	Pre Volume (acre-ft)	Post Volume (acre-ft)
Upstream of Confluence	OW_T1-0	36.8	31.8

Results from the conceptual modeling for the 95th percentile storm indicate that replacing the existing culvert with a new outlet control structure will reduce the peak inflow rate just upstream of the East-West confluence point (draining to the Okatie River) by an estimated 27%, and reduce the volume by 13%. It will do so with an expected increase in the predicted peak stages just upstream of the BMP, but minimal to no increase further upstream. The outlet structure was also modeled for the 100 year storm to further check the peak stages and to make sure flooding will not occur. The results show a predicted increase in flood stage for the immediate upstream node, but a decrease in the farther upstream nodes in conceptual post-development conditions.

Table 6-3: Okatie East – Peak Flood Stages for 100 Year Storm

ICPR Node Name	100 yr Pre Peak Stage (ft)	100 yr Post Peak Stage (ft)
OW_T1-0	7.62	6.79
OW_T1-10	9.08	10.24
OW_T1-37	11.85	11.11

Besides peak flow reduction and volume reduction another expected benefit of installing the outlet control structure is reducing the flashy introduction of the freshwater runoff to the saltwater river. The impoundment of the water will slow down discharge to the Okatie River and release it over a longer period of time. Reduction in total volume due to evapotranspiration is expected, although it was not modeled at this time. Figure 6-4 shows the post-development pond and upstream node stages versus time and demonstrates that the water stored in the pond will be released just short of a 72 hour period.

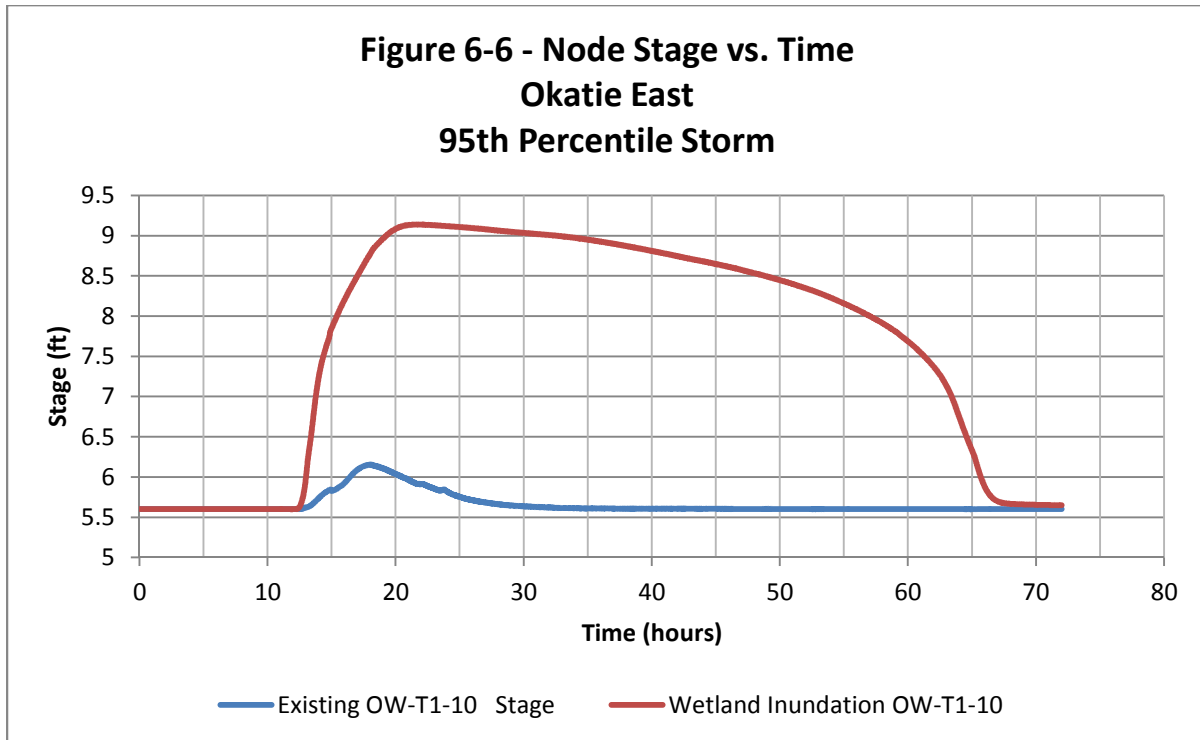


Figure 6-6: Okatie East – Node Stage vs. Time for 95th Percentile Storm

6.4 Construction Cost Estimates & Priority

6.4.1 Construction Cost Estimate

The 2006 SWMP estimated a total construction cost for the Okatie East regional retrofit to be \$1,467,000. This estimate was based on a proposed pond at the original recommended site assuming a 9 acre area of disturbance. Table 6-4 shows the original cost estimate.

Table 6-4: Okatie East – Original 2006 SWMP BMP Construction Cost Estimate

	Units	Unit Cost	Quantity	Cost
Mobilization	EA	\$5,000	1	\$5,000
Site Prep/Restoration Erosion & Sediment Control	EA	\$2,500	1	\$2,500
Land Purchase	AC	\$8,000	25.5	\$204,000
Clearing	AC	\$5,500	9	\$49,500
Excavation	CY	\$12	70,000	\$840,000
Outlet Structure	EA	\$10,000	1	\$10,000
		Subtotal		\$1,111,000
Contingency (20%)				\$222,200
Engineering/Legal/Admin (12%)				\$133,300
		Total		\$1,467,400

The original cost estimate assumed the proposed BMP would be a pond of roughly 9 acres in size. Since the new proposed BMP is much smaller in scope, the construction cost is expected to be much smaller; however, there are many uncertainties about the project that may affect the construction cost. The location and delineation of the existing wetlands will affect access to the existing boiler culvert and the proposed outlet control structure location. The detailed design of the outlet structure cannot be completed until full hydraulic modeling (beyond the scope of this study) is completed, so the cost of the structure is difficult to estimate. Land acquisition costs could vary dramatically, as ownership of the land containing the logging road and culvert is uncertain. It is also possible that the existing wetlands are under protective covenants meaning any needed wetland impacts would require additional fees for mitigation.

Table 0-5: Okatie East – Updated BMP Construction Cost Estimate

	Units	Unit Cost	Quantity	Cost
Mobilization	LS	\$3,000	1	\$3,000
Layout, Staking, & Record Drawings	LS	\$5,000	1	\$5,000
Site Prep/Restoration Erosion & Sediment Control	EA	\$22,000	1	\$22,000
Easement/Property Purchase	AC	\$8,000	2	\$16,000
Clearing	AC	\$8,000	0.25	\$2,000
Grading	SY	\$12	1500	\$18,000
Drainage Structures	EA	\$13,000	1	\$13,000
		Subtotal		\$79,000
Contingency (20%)				\$16,000
Engineering/Legal/Admin (15%)				\$12,000
		Total		\$107,000

6.4.2 BMP Site Priority and Further Study Needed

Based on the retrofit sensitivity analysis in the 2006 SWMP, the Okatie River 2 and 3 basins would not see a significant improvement in the water quality level of service (LOS) if regional retrofit BMPs are installed. Table 6-17 in the SWMP shows an existing LOS “D” for both basins and a future predicted LOS “D” for both assuming retrofit BMPs are installed. However, because of tidal flow action, improvements in these basins could have some effect on the quality of the downstream Okatie River 1 basin. The 2006 SWMP implies that modeled improvements in stormwater quality level of service (LOS) in the Okatie River 1 basin is dependent on BMP improvements in the Okatie River 2 and 3 basins. The LOS of Okatie River 1 is predicted to improve from LOS “B” to LOS “A” in best case scenario conditions (100% BMP coverage in Okatie River 1, 2, & 3 and in Colleton River 1).

SCDHEC has developed a fecal coliform TMDL for the Okatie River, estimating required percent reductions in pollutant loadings required to meet shellfish standards in defined reaches within the Okatie River. The Okatie East and Okatie West sites are located within the Headwaters Reach. Figure 22 and the associated narrative in the *Total Maximum Daily Load, Okatie River, Shellfish Fecal Coliform*, available at https://www.scdhec.gov/environment/water/tmdl/docs/tmdl_okatie.pdf indicates that there is a 50 percent reduction required for the Headwaters Reach, the largest required by the TMDL.

Given the relatively low cost of construction, the indirect sensitivity to retrofits, and the high load reduction required in the Okatie River TMDL, **implementing and constructing this BMP site is a high priority**. Before proceeding with a full detailed design and modeling, some preliminary work on this site is recommended:

- The status of the wetland system should be researched, including the ownership, delineation, and Restrictive Covenants (if any). If Restrictive Covenants are in place, they should be reviewed to determine likely effects on the wetland impact permitting and mitigation costs.
- The subject property owners should be contacted to determine the likelihood of land and/or easements being available for purchase.

If the project remains financially and logistically feasible after the preliminary work is completed, then the following work will need to be done:

- Ground run tree and topographic survey of the proposed site, outfall ditches, and offsite access.
- Detailed hydrologic and hydraulic modeling of the water quality sub-basin, including re-evaluation of existing basin boundaries, flow paths, and land uses.
- Design plans for the proposed outlet structure, logging road re-grading, site access, and erosion control.
- Permitting through SCDHEC-OCRM, SCDOT, Army Corp of Engineers, and Beaufort County.

Section 7 – Okatie West

7.1 Background

This project is an offshoot of the BMP site originally identified in the 2006 SWMP as Site 4. It is located in the Okatie West T3-A hydrologic sub-basin, which is a portion of the Okatie River 3 Water Quality Basin. The Okatie River 3 basin has an eastern and western branch, with the original BMP site located in the eastern branch. The original BMP site and new BMP site, as well as the background on the overall water quality basin are described in greater detail in Section 6. The sub-basin associated with the western branch is approximately 1,170 acres in size and includes a mix of developed and undeveloped property. Developed uses in the sub-basin include single family residential, small commercial subdivisions, and some upland dug borrow pits. Figure 7-1 shows the eastern and western water quality sub-basins and the Okatie River 3 basin boundaries.

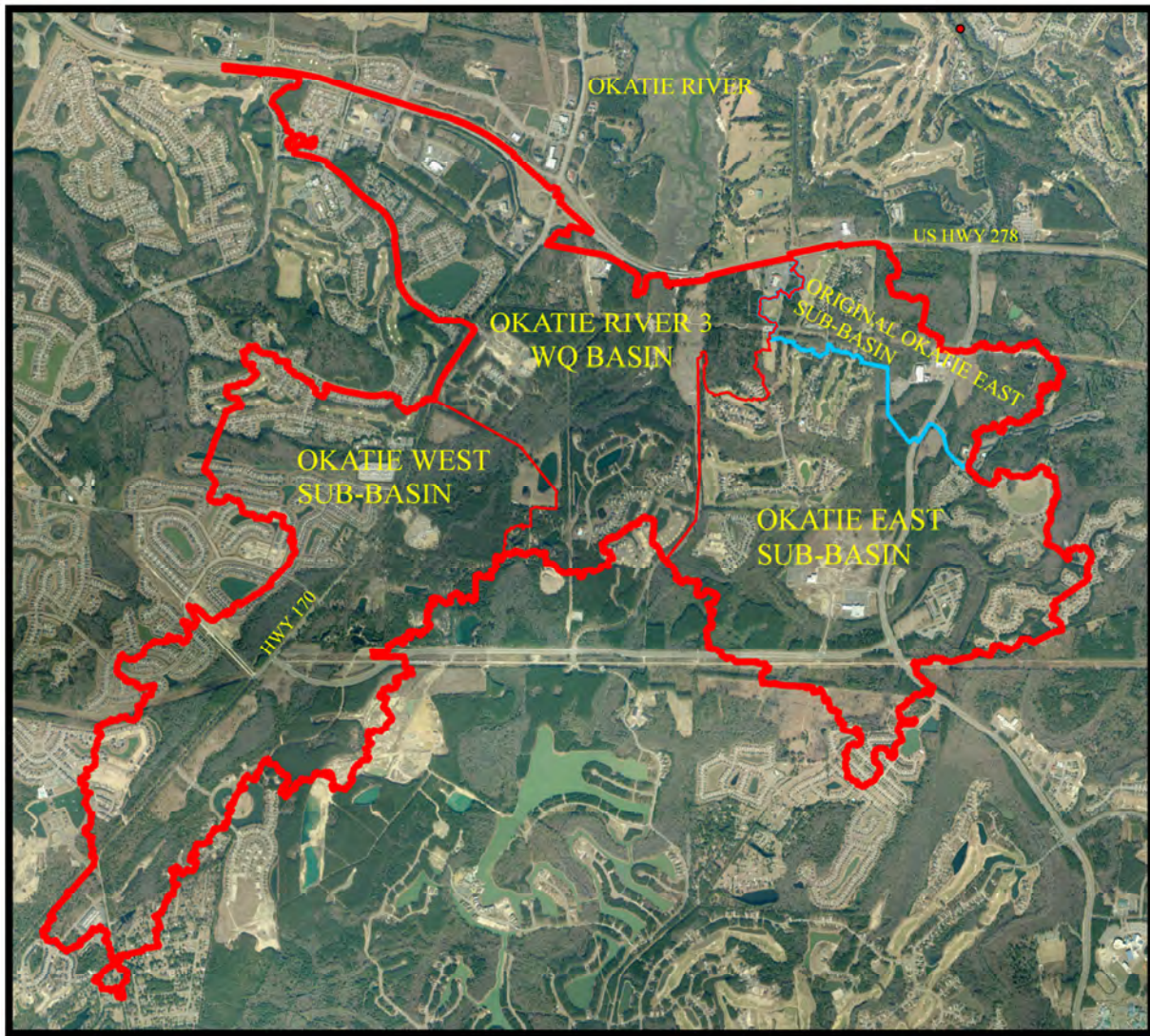


Figure 7-1: Okatie River 3 WQ Basin and Okatie West Sub-Basin

Ward Edwards was familiar with portions of the western sub-basin from development design work done for a site located near the sub-basin's main flow channel (see Figure 7.2). The site consists of two parcels under common ownership, totaling 111 acres. They border Hwy 170 to the west and some partially developed parcels to the north, east, and south. A large jurisdictional wetland that contains the main flow path for the Okatie West sub-basin divides the two parcels. A delineation of that wetland had been done prior to site development master planning work, and the delineation showed a 4.8 acres upland area located near the main conveyance channel. The uplands are bordered on three sides by wetlands and the existing grades in the uplands and wetlands are approximately the same. The low grades of the uplands and its proximity to the conveyance channel make the area well suited to accepting re-routed runoff from the channel and treating it in a stormwater BMP. BMP options were evaluated for the site, which is detailed in Section 7.3; however prior to that, a review of the sub-basin was done to determine if there may be any other feasible BMP sites.

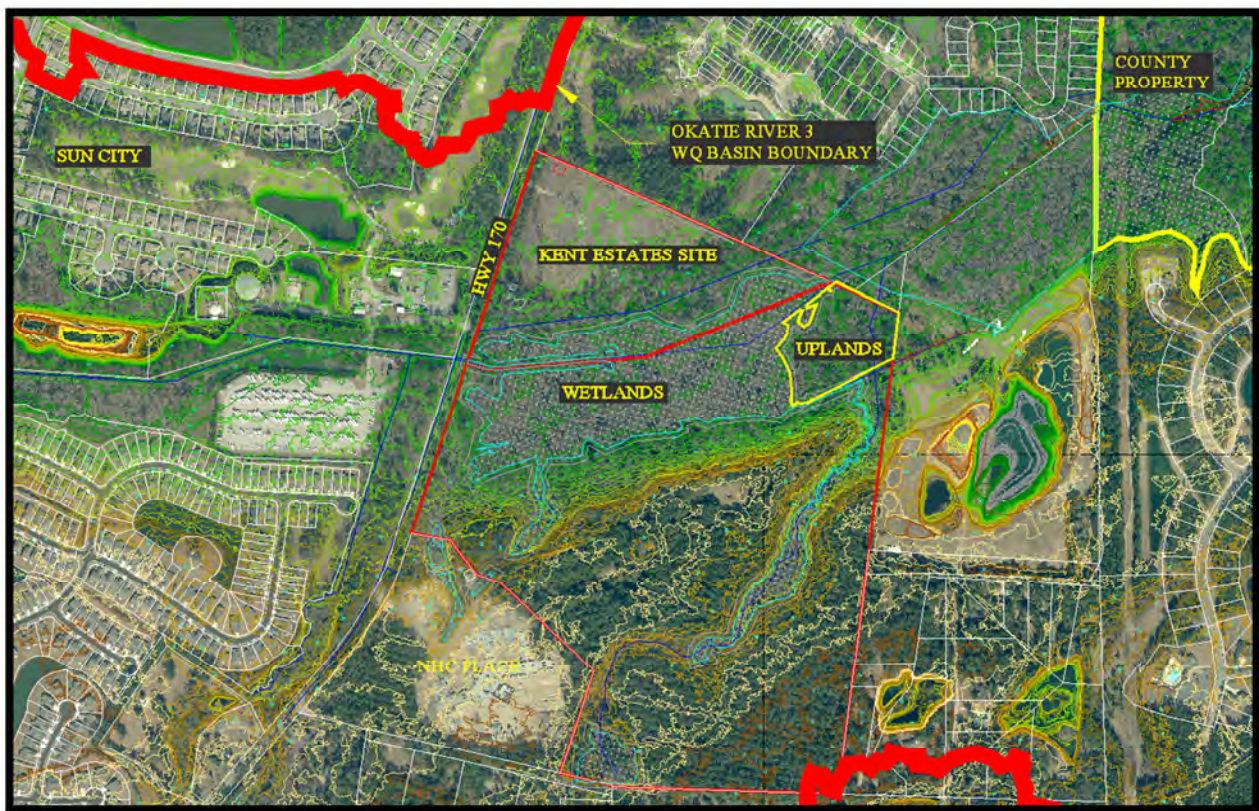


Figure 7-2: Okatie West – Kent Estates Upland Area Considered for BMP Site

7.2 Alternative BMP Location Considerations

With a fairly good BMP option available in the Kent Estates site, a property review to the same degree as the other BMP projects was not warranted. Instead, the western sub-basin was reviewed to determine other possible BMP options that could supplement the proposed Kent Estates BMP.

1. *Cleland borrow pit:* Adjacent and to the east of the Kent Estates property is an upland dug borrow pit owned by Cleland Construction Company. The pit has an outlet control structure that is impounding water and has essentially turned it into a pond. The normal water level in the pond is more than five feet higher than the grades in the jurisdictional wetland that serves as the sub-basin's conveyance channel. This eliminates the pit from serving as a standalone BMP for the sub-basin, but it may have some use as a supplemental BMP. Water captured at the Kent Estates BMP site could be pumped to the pit to take advantage of the available storage volume in it. Water stored in the borrow pit could be stored long term and dissipated by groundwater infiltration and evaporation, or released slowly over a period of greater than 72 hours. A long term goal also considered was using the stored water for residential irrigation reuse for the existing and developing communities nearby. Ward Edwards obtained a copy of a recent survey of the borrow pit and used it to estimate the storage volume available within the pit. It was determined that in its current condition, the pit has approximately 1,000,000 ft³ (276 ac-in) of storage. At an assumed average irrigation use rate of 50 ft³ per home per day, that is enough water to supply 2000 homes with 10 days' worth of irrigation capacity. It may also be possible to increase the available storage volume in the pit by berming up the low side of the pit and get up to as much as 4,000,000 ft³ of storage. There are a few minor and major obstacles that will limit the feasibility of this option, namely the cost of retrofitting the nearby subdivisions with the distribution lines needed to supply the irrigation water. Minor obstacles include added construction, maintenance, and operations cost.

2. *Add control structure to Hwy 46 culverts:* This option is similar to the concept design for the Okatie East BMP, intending for the control structure to cause ponding in the upstream wetland, thus increasing the evapotranspiration (ET) from the wetland. Ward Edwards reviewed the storage capacity available in the existing wetland depending on the level of inundation. It was found that there was a large amount of storage capacity (3,600,000 ft³) with just a few feet of inundation (up to elevation 10); however, it appears the existing Sun City pond system could be affected by this same amount of inundation. Furthermore, a review of the existing conditions model from the 2006 SW Master Plan found that the wetlands adjacent to Sun City already stage up to 10.5 ft during a 2 year rain event. Permitting alterations to the highway culvert could be difficult if not impossible since Hwy 46 is a SCDOT owned road, as opposed to a County owned road considered in the Okatie East BMP. For these reasons, this option does not seem feasible.

3. *Review of properties on western side of Hwy 170:* The majority of the land on the west side of Hwy 170 that is within the Okatie West sub-basin is part of the Sun City development. The land is either developed with single family residential or is preserved wetland open space. There are limited to no opportunities for BMPs in this area.

4. *Review of properties on eastern side of Hwy 170:* The land on the east side of Hwy 170 that is within the Okatie West sub-basin is a mixture of developed and undeveloped land. The parcels north of Bluffton Parkway are mostly smaller parcels, limiting their usefulness as BMP sites. Many of them contain small ponds likely dug as borrow pits. If multiple parcels containing these small ponds could be acquired, they may be of some use as BMPs; however, there does not appear to be a large amount of

sub-basin area draining to them, as the land south of Bluffton Parkway appears to drain to the west under Hwy 170 instead of north under Bluffton Parkway. South of Bluffton Parkway are larger parcels, but they appear to be open space and buffers for the residential developments in the area. The open space appears to be mostly wetland and as mentioned, drains under Hwy 170 and flows through the Sun City wetland system. Based on the land uses and flow patterns, there appears to be little opportunity for BMP retrofits in this area.

7.3 BMP Recommendations

A regional detention pond located in the 4.8 acre upland on the Kent Estates site is the preferred choice for the stormwater BMP. The location and the low grades in the upland make it ideal for capturing and treating runoff flowing through the adjacent wetlands. The location of the pond will allow it to serve over 1,000 acres of area and there are design options that could provide additional detention volume and that could promote ET using the existing wetlands. A number of design options for the pond and supplemental BMPs were considered and are summarized below:

Option 1 - Large pond maximized for detention storage: This concept involves maximizing the potential storage volume within the proposed pond. The conventionally designed pond would give no consideration to the existing trees within the buildable area, and all trees would be removed. Mitigation for the specimen trees removed may be required by the Town of Bluffton. In order to minimize the wetland impacts and thus the permitting effort with the Army Corp, diverting runoff from the existing wetland ditch to the proposed pond will be accomplished by excavating a new channel between the pond and the existing ditch at a lower invert than the existing ditch. This will not allow complete capture of the runoff, as flow through the existing ditch could continue during higher flow stages in the wetlands. Conceptual modeling results indicate the pond will provide 151,000 ft³ of storage in the pond and 11,000 ft³ storage in the upstream wetlands due to increased inundation, during the 95th percentile storm of 1.95" of rainfall. The total increase in storage of 162,000 ft³ is **30%** of the 1,337 acre basin's pre vs. post volume difference for the 1.95" rainfall.

Sub-option 1B – Diversion berm in existing wetland channel: To increase the amount of runoff diverted through the proposed pond, a berm or structure could be constructed in the existing wetland channel. This option will be more difficult and take longer to permit with the Army Corp, but will significantly improve the volume of water treated. Conceptual modeling results for this sub-option indicate the pond will provide 261,000 ft³ of storage and the upstream wetlands will provide 228,000 ft³ of additional storage. The total increase in storage of 489,000 ft³ is **89%** of the pre-post volume difference for the 1.95" rainfall.

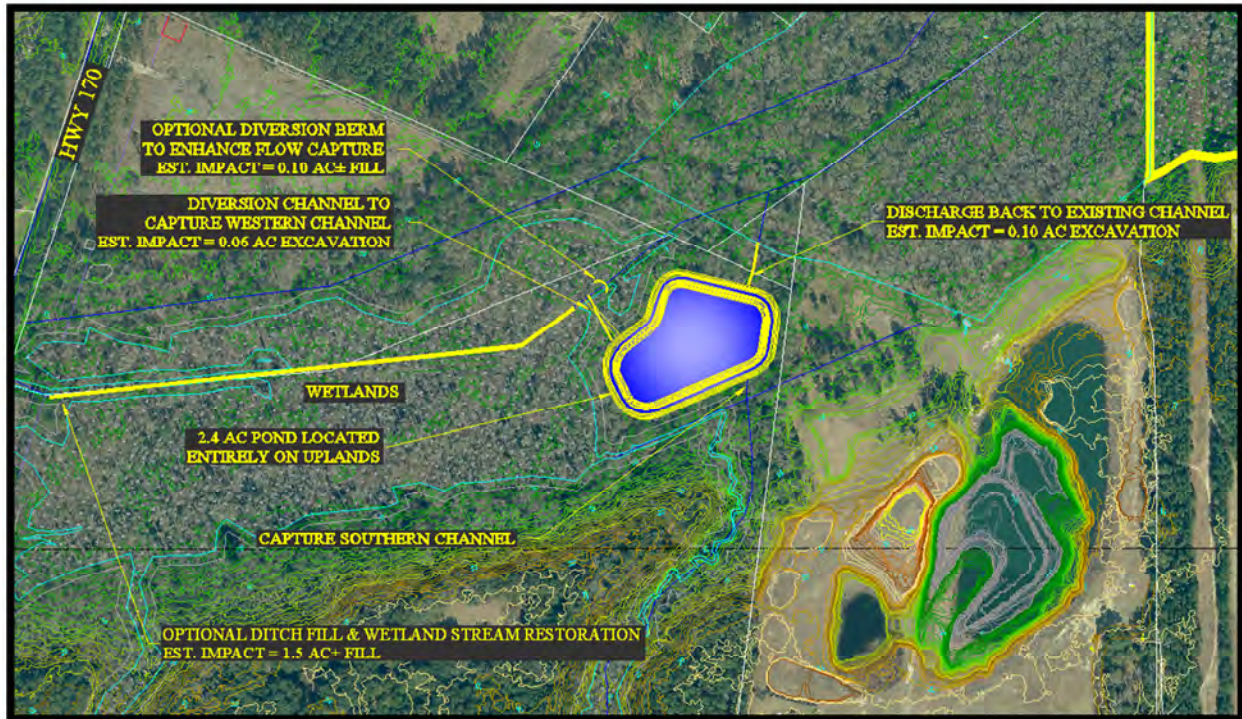


Figure 7-3: Okatie West – Conceptual BMP Option 1, Maximized Pond Size

Option 2 – Smaller pond with ET shelf: This concept involves a pond design with a cross section utilizing a wide, flat vegetated “volume control” shelf designed to increase contact time between ponded stormwater and planted vegetation. This will promote evapotranspiration during the smaller, more frequent storms and help to reduce the stormwater runoff volume. The layout of the pond also considers some of the larger specimen trees and attempts to preserve those located toward the edges of the pond. As with the larger pond, the base method of diverting the water to the pond is the excavation of a new channel at a lower elevation than the existing channel; without a diversion berm or structure. Conceptual modeling results indicate the pond will provide 99,000 ft³ of storage in the pond and 5,000 ft³ storage in the upstream wetlands due to increased inundation, during the 95th percentile storm of 1.95” of rainfall. The total increase in storage of 104,000 ft³ is **19%** of the 1,337 acre basin’s pre vs. post volume difference for the 1.95” rainfall.

Sub-option 2B – Diversion berm in existing wetland channel: Similar to Sub-option 1B, this sub-option seeks to increase the amount of runoff diverted through the pond by constructing a berm or structure in the existing wetland channel. This option will take longer to permit, but will significantly improve the volume of water treated. Conceptual modeling results for this sub-option indicate the pond will provide 183,000 ft³ of storage and the upstream wetlands will provide 316,000 ft³ of additional storage. The total increase in storage of 499,000 ft³ is **91%** of the pre-post volume difference for the 1.95” rainfall.

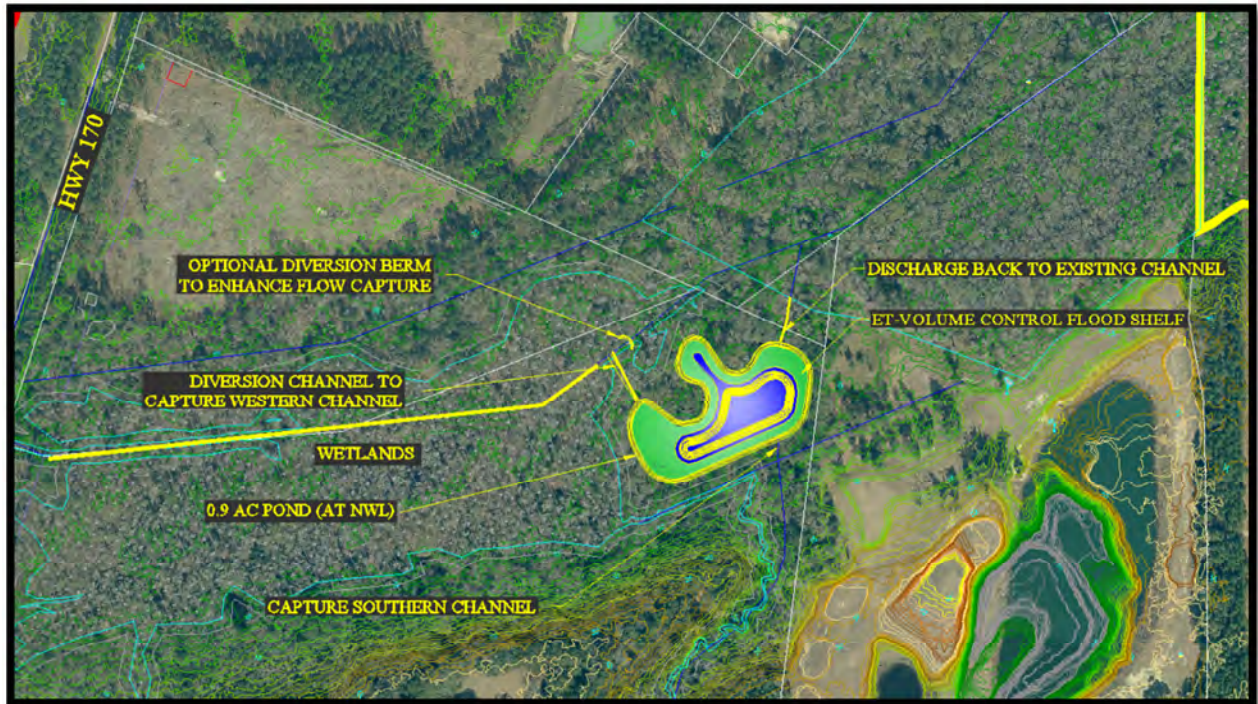


Figure 7-4: Okatie West – Conceptual BMP Option 2, Smaller Pond Preserving Trees

Stream Flow/Wetland Hydraulics Restoration: This option could provide additional volume reduction as a supplement to the proposed pond BMP. The concept is centered on restoring the overland flow through the wetland from the current channelized condition to more of a natural sheet flow condition. This would be accomplished by altering the existing man-made channel to a wide, shallow cross section with a meandering centerline. The meandering path will slow down the flow and the shallow cross section will increase the contact surface area between the water and wetland vegetation, resulting in an overall increase in evapotranspiration. It is expected that the wetland would flood more frequently, thus providing more detention and less discharge from rainfall when compared to the current condition.

7.3.1 BMP Sizing and Analysis

The ICPR files from the 2006 SWMP were used to do a basic analysis of the BMP concept. The pre-development ICPR files were run for the 95th percentile storm (1.95") and the 100 yr design storm. As a point of comparison in determining the effectiveness of the pond for volume control and water quality treatment, post-development conditions were modeling assuming flow in the main conveyance channel is re-routed to the proposed pond. The 100 year storm was also modeled in post development conditions to assure upstream flooding problems are not created. Additional field survey work and modeling will be required during the detailed design phase.

Table 7-1: Okatie West – Peak Flow and Peak Stage Results – 95th Percentile Storm

Node	ICPR Node Name	Pre Max Stage (ft)	Post Max Stage (ft)	Pre Max Inflow (cfs)	Post Max Inflow (cfs)
Upstream of Confluence	OW_M-56	6.34	6.25	46.75	36.97
Upstream (near)	OW_M-77	7.56	7.54	55.01	55.01
Upstream (far)	OW_M-99	9.04	9.04	67.30	67.30
Pond	POND_OW	N/A	7.41	N/A	24.93

Table 7-2: Okatie West – Pre-Post Volume Comparison for 95th Percentile Storm

Node	ICPR Node Name	Pre Volume High Tide (acre-ft)	Post Volume High Tide (acre-ft)
Upstream of Confluence	OW_M-56	49.5	46.2

Results from the conceptual modeling for the 95th percentile storm indicate that constructing the pond and re-routing flow to it will reduce the peak outflow rate at the western sub-basin discharge point by an estimated 20%, and reduce the volume by 6%. It will do so with an increase in the predicted peak stages just upstream of the BMP, but minimal to no increase further upstream. The 1 ft to 1.5 ft increase in peak stage immediately upstream should not be detrimental, as it is still well below the grades in the adjacent, developable uplands. The negligible change in peak stage further upstream at of the Hwy 170 culvert indicates the increase will not impact the hydraulics of the highway box culvert.

Table 7-3: Okatie West – Peak Flood Stages for 100 Year Storm

ICPR Node Name	100 yr Pre Peak Stage (ft)	100 yr Post Peak Stage (ft)
OW_M-56	8.45	10.07
OW_M-77	9.23	10.17
OW_M-99	12.65	12.65

Besides peak flow reduction, volume reduction, and first flush treatment, another expected benefit of the detention pond retrofit is reducing the flashy introduction of the freshwater runoff to the saltwater river. Figure 7-5 shows the post-development pond and upstream node stages versus time and demonstrates that the water stored in the pond will be released over a 72 period. The chart also compares two different conditions for the diversion from the wetlands to the proposed pond. The first assumes that a channel is cut from the wetland to the pond, without blocking off the downstream wetland channel. This is a partial diversion condition, meaning flow will be divided between the pond and the existing wetland flow path. The second condition assumes some sort of check dam or weir is installed in the wetland channel to fully divert flow from the 95th percentile rain event. The chart shows that the full diversion is much more effective at slowing the discharge of the storm and releasing it over a longer period of time.

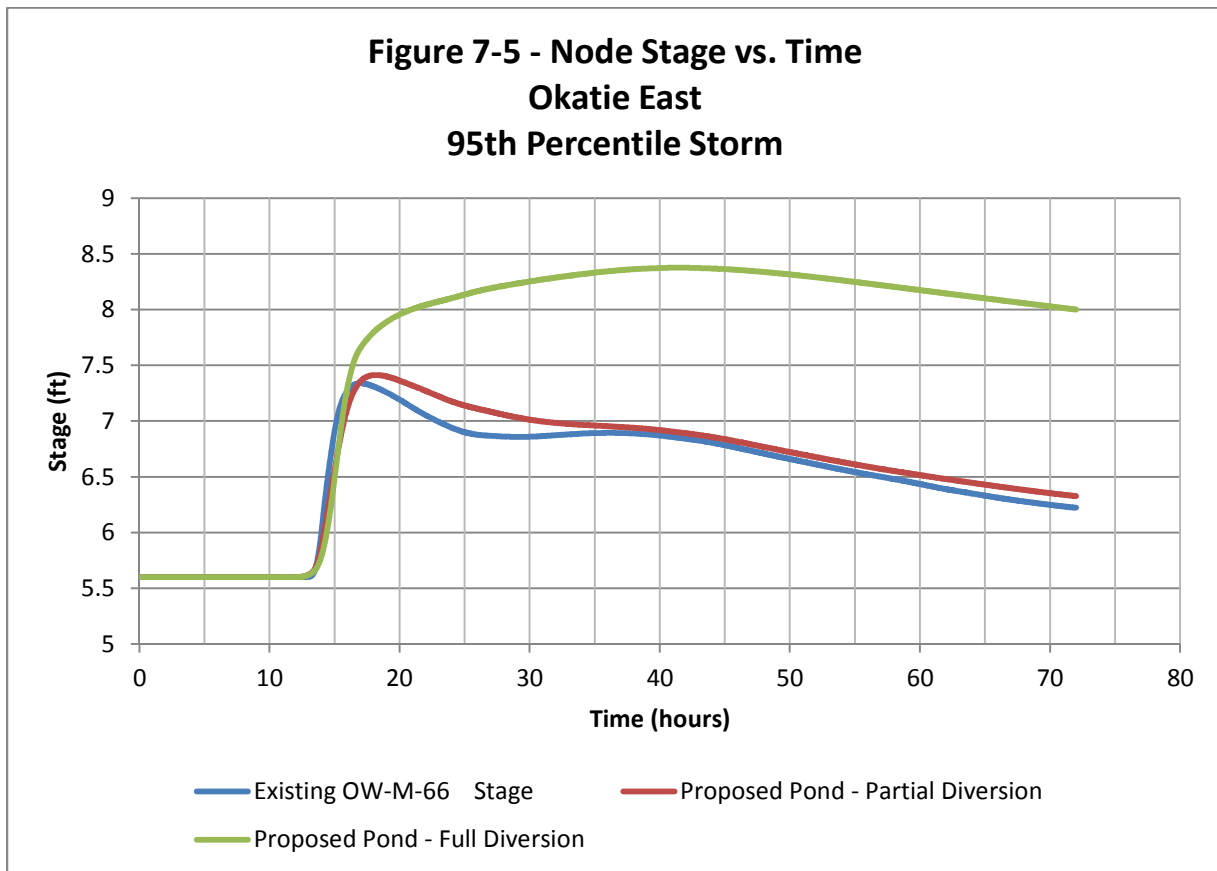


Figure 7-5: Okatie West – Node Stage vs. Time for 95th Percentile Storm

7.4 Construction Cost Estimates & Priority

7.4.1 Construction Cost Estimate

Since the Okatie West project was added as an additional BMP site, a cost estimate from the 2006 SWMP is not available for comparison. However, based on the chosen BMP, there is a significant estimated cost savings for the Okatie East site of \$1,300,000 that could be applied to the Okatie West project. Table 7-4 summarizes the Okatie East estimated savings.

Table 7-4: Available Budget for Okatie West BMP from Estimated Cost Savings in Okatie East

	Cost
Okatie East Original Cost Estimate	\$1,467,400
Okatie East Proposed BMP Cost Estimate	\$107,000
Available Budget for Okatie West	\$1,360,400

Given the existing grades and the depth needed in the proposed pond to provide the required permanent pool volume, there is a large amount of excavation needed to construct the pond. There is no use for excavated material onsite, meaning it will have to be hauled offsite and disposed of. However, if the existing soils are suitable as structural fill and there are nearby projects needing material, the excavation costs could be offset by selling the material to contractors. This was recently accomplished in the construction of the 12 acre regional detention pond for the Beaufort Commerce Park. The pond was constructed at little cost to the Economic Network due to the need of fill material on two local road construction projects.

Another item of significant cost in the construction of this BMP will be providing access to the site. A 2,600 ft. long road from Hwy 170 will be needed for construction access and future maintenance access. The road may have to be constructed through mostly undeveloped, wooded area, although there is an old dirt road to the site that could possibly be improved. This will be dependent on limiting impacts to cultural resources, as there are two known protected historical sites on the Kent Estates property. An important step in the detailed design and permitting phases will be to determine if the access road can be constructed without excavation and thus without impacts to the historical sites.

Table 7-5: Okatie West – BMP Construction Cost Estimate

	Units	Unit Cost	Quantity	Cost
Mobilization	EA	\$5,000	1	\$5,000
Site Prep/Restoration Erosion & Sediment Control	EA	\$7,500	1	\$7,500
Easement/Property Purchase	AC	\$15,000	10	\$150,000
Clearing	AC	\$5,500	8	\$44,000
Gravel Access Road	SY	\$25	7,200	\$180,000
Excavation	CY	\$12	43,000	\$516,000*
Drainage Structures	EA	\$15,000	1	\$15,000
		Subtotal		\$917,500*
Contingency (20%)				\$183,500*
Engineering/Legal/Admin (12%)				\$110,100*
		Total		\$1,211,100*

*Cost could be significantly reduced if material is suitable as fill material

7.4.2 BMP Site Priority and Further Study Needed

Based on the retrofit sensitivity analysis in the 2006 SWMP, the Okatie River 2 and 3 basins would not see a significant improvement in the water quality level of service (LOS) if regional retrofit BMPs are installed. Table 6-17 in the SWMP shows an existing LOS “D” for both basins and a future predicted LOS “D” for both, assuming retrofit BMPs are installed. However, because of tidal flow action, improvements in these basins could have some effect on the quality of the downstream Okatie River 1 basin. The 2006 SWMP implies that modeled improvements in stormwater quality level of service (LOS) in the Okatie River 1 basin is dependent on BMP improvements in the Okatie River 2 and 3 basins. The LOS of Okatie River 1 is predicted to improve from LOS “B” to LOS “A” in best case scenario conditions (100% BMP coverage in Okatie River 1, 2, & 3 and in Colleton River 1).

SCDHEC has developed a fecal coliform TMDL for the Okatie River, estimating required percent reductions in pollutant loadings required to meet shellfish standards in defined reaches within the Okatie River. The Okatie East and Okatie West sites are located within the Headwaters Reach. Figure 22 and the associated narrative in the *Total Maximum Daily Load, Okatie River, Shellfish Fecal Coliform*, available at https://www.scdhec.gov/environment/water/tmdl/docs/tmdl_okatie.pdf indicates that there is a 50 percent reduction required for the Headwaters Reach, the largest required by the TMDL.

Given the relatively low cost of construction, the indirect sensitivity to retrofits, and the high load reduction required in the Okatie River TMDL, **implementing and constructing this BMP site is a high priority**. Before proceeding with a full detailed design and modeling, some preliminary work on this site is recommended:

- The subject property owners should be contacted to determine the likelihood of land and/or easements being available for purchase.
- Since the property is in the Town of Bluffton and a development master plan was in place for the property, it is recommended the Town be contacted and invited to participate in the discussions with the property owner.

If the project remains financially and logistically feasible after the preliminary work is completed, then the following work will need to be done:

- Ground run tree and topographic survey of the proposed site, outfall ditches, and offsite access.
- Detailed hydrologic and hydraulic modeling of the water quality sub-basin, including re-evaluation of existing basin boundaries, flow paths, and land uses.
- Design plans for the proposed BMP, outlet structure, access road, and erosion control.
- Cultural resources coordination to provide site access through known historical sites.
- Permitting through SCDHEC-OCRM, SCDOT, Army Corp of Engineers, SHPO, and the Town of Bluffton.

Section 8 – Camp St. Mary’s M2

8.1 Background

Originally identified in the 2006 SWMP as Site 8, this BMP site is located in the Camp St Mary’s M2 hydrologic sub-basin, which is a portion of the Colleton River 3 Water Quality Basin. The sub-basin associated with the original proposed BMP location is approximately 500 acres in size and includes primarily undeveloped rural property. Uses in the sub-basin include rural-zoned residential units and a segment of SC Highway 170. The adjacent Oldfield Mews (apartment complex) lies within the originally delineated sub-basin, but it was discovered during review of the sub-basin that lakes within the development are interconnected to the Old Field single family development, effectively removing them from the sub-basin. Figure 8-1 shows the water quality sub-basin and the Colleton River 3 basin boundaries.



Figure 8-1: Camp St. Mary’s M2 Sub-Basin

The originally proposed 15.6-acre BMP site appears to lie on a single, undeveloped parcel owned by Coastal Enterprises LP of Savannah, GA according to County tax records. The conceptual size of the regional facility constitutes roughly eleven percent of the contributing sub-basin. The property elevations range from 18-ft to 21-ft which are not significantly higher than the wetland located to the west. There is an existing drainage ditch to the east with an approximate bottom elevation of 17-ft. Stormwater in this sub-basin appears to flow easterly through a system of ditches, through culverts under Camp St. Mary's Road, and into a cove of the Okatie River.

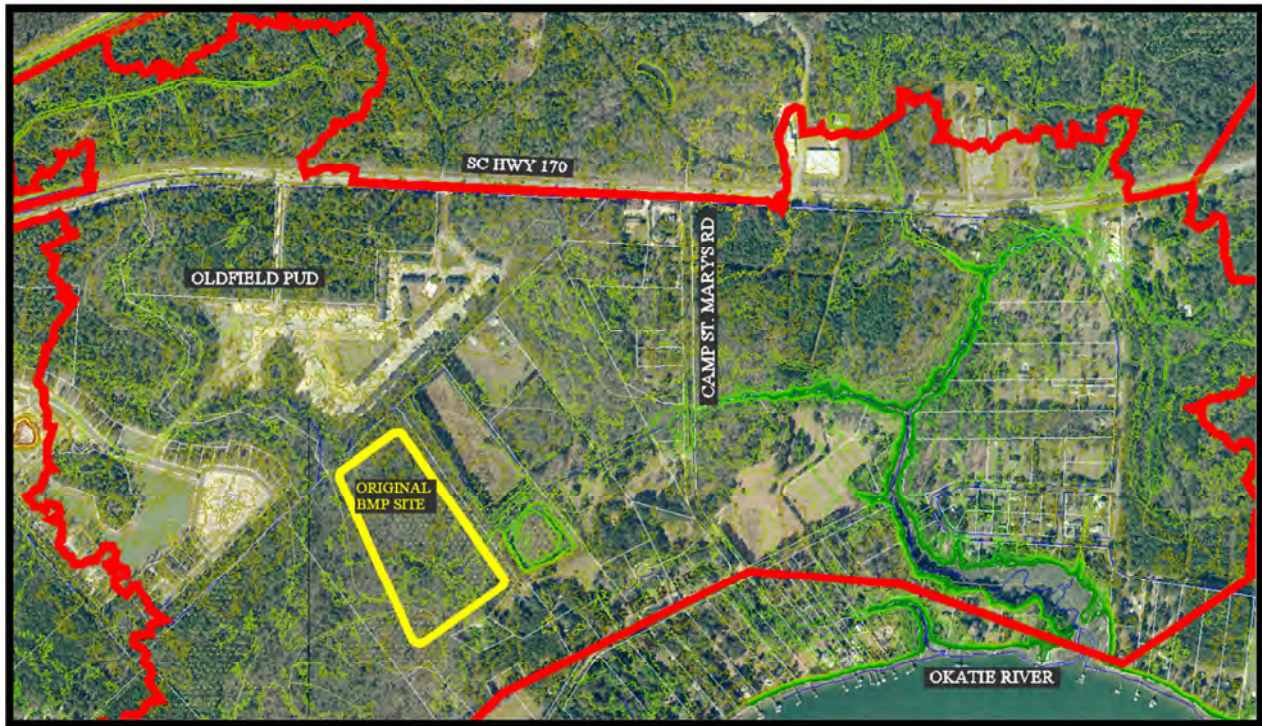


Figure 8-2: Camp St. Mary's M2 - Original 2006 SWMP BMP Site

Figure 8-2 shows the originally recommended BMP site, the water quality sub-basin boundary, the topography, and the flow path to the Okatie River. The property is zoned Rural and does not have highway or water frontage, so its value as a development property would not likely be high. The parcel is immediately adjacent to Okatie Bluff Road which could be used for access; however, an approximate 500-foot long construction and maintenance road would be needed to reach the pond location. A review of National Wetlands Inventory (NWI) data indicates there are possibly wetlands on and in the immediate vicinity of the BMP site. Formal wetland delineation and U.S. Army Corps verification would be needed if this BMP location is pursued. In order to divert the existing flow path through the regional facility, wetland impacts would likely be needed. The presence of wetlands would be the biggest obstacle to the use of this parcel as the BMP site, because permitting the required wetland impacts would be difficult. There would be limited benefits constructing the BMP in the original location as it is positioned in the upper half of the sub-basin and thus would serve only a portion of the sub-basin.

Considering the above challenges, alternative sites were reviewed upstream and downstream of the original site to determine if there is a more suitable BMP location.

8.2 Alternative BMP Location Considerations

A review of other large parcels on which a BMP retrofit may be feasible was conducted and is summarized below. Figure 8-3 shows the alternate property clusters and the original BMP site.

1. *Coastal Enterprises LP property (R600 008 000 010A 0000)*: This site is the location of the regional facility as shown in the 2006 SWMP and was described in Section 8.1. It would appear to be a good location for a facility given its size, access, zoning, lack of existing features, and proximity to existing drainage ways. However, its location would limit the treatment area to only a small portion of the overall water quality sub-basin. Groundwater depth, quality of excavated material, and topography are other possible limitations.
2. *Thomas Moore & Patricia Moore-Berenger property (R600 009 000 007B 0000)*: Easements may be required from this adjacent property to divert existing ditches into and out of the regional facility if located on Coastal Enterprises parcel. This property would not be suitable as a standalone site due to its size. An existing pond is located on the parcel but its purpose and control mechanism are not known.
3. *Dulany Susan Strobhar Trustee property (R600 009 000 0001 0000)*: This 71-acre undeveloped parcel appears to be more than 50% wetlands and is not immediately adjacent to the flow path; therefore, it would not capture and treat much flow.
4. *Joan Coburn property (R603 009 0000 015H 0000)*: This large property may be a candidate for a regional facility due to its undeveloped upland characteristics. It is zoned "Rural" and is downstream of the conceptual SWMP location, so a larger watershed could be treated from this site, including portions of Jasper County north of Highway 170. The property is approximately twelve (12) feet higher than the invert of the drainage way, so significant excavation would be required to divert and treat runoff. According to National Wetland Inventory data, there do not appear to be wetlands on the property. Access is readily available from Camp St. Mary's road and the soil type is Coosaw loamy fine sand which may have potential for use as structural fill.
- 5., 6., & 7. *Sims, Biggs, Wilson property (R600 009 000 0085 0000, R600 009 000 015D 0000, & R600 009 000 0082 0000 respectively)*: These parcels are immediately adjacent to the cove and accessible via residential properties on Old Bailey's Loop Road. The western ends of the parcels are wooded and approximately five feet lower than Property #4, reducing the magnitude of a proposed excavation relative to the cove depth. Complications include the necessity of dealing with multiple property owners to obtain easements/property for the site.

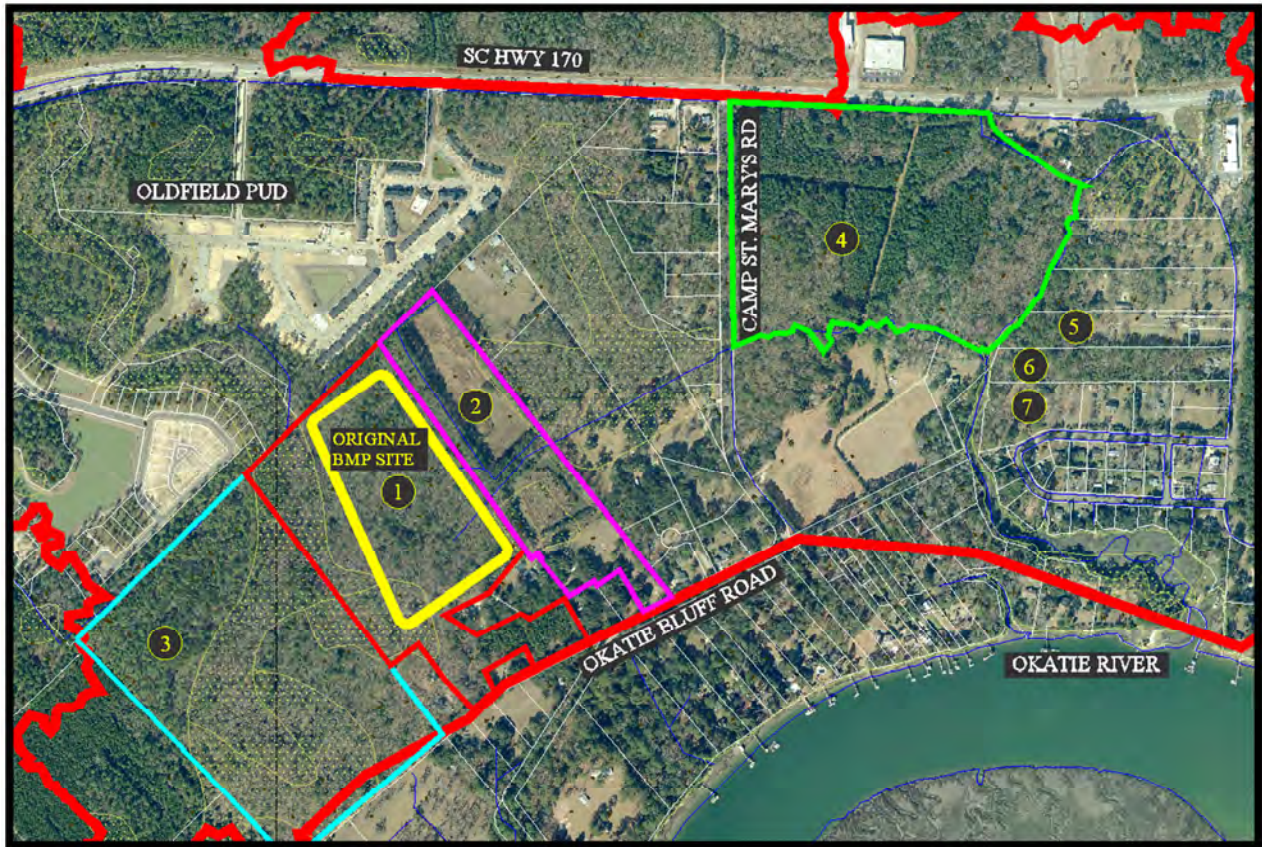


Figure 8-3: Camp St. Mary's M2 – BMP Site Evaluation

Although large and undeveloped, Parcels 1, 2 and 3 are not well positioned to capture runoff from a large portion of the basin. Properties further downstream such as Parcels 4 – 7 would serve a greater percentage of the basin. The small size of Parcels 5, 6, and 7 would limit each as standalone sites, and acquiring land from multiple property owners would be difficult. Therefore, Parcel 4 appears to be the best suited as the proposed BMP site.

8.3 BMP Recommendations

A regional detention pond is the preferred choice for the stormwater BMP given the size of the parcel, the existing topography, and the effectiveness of ponds in treating stormwater for bacteria removal. The potential for a large amount of freeboard in the proposed pond would provide for a lot of detention storage volume and thus greatly reduce the flashy discharge of freshwater to the saltwater river. The location of the pond will allow it to serve approximately 560 acres, most of which currently has little to no stormwater treatment. However, there are a number of design challenges associated with this site and the proposed BMP:

- The main conveyance channel is most likely a jurisdictional wetland and quite possibly tidally influenced. It is unknown at this time how far the OCRM critical area extends up into the channel, but it is possible that it borders the proposed site. The degree of difficulty in permitting the needed channel impacts will depend upon the delineation and classification of the wetland channel, but if classified as critical area, impacts to the channel would be extremely difficult or impossible to permit.

- The pond design will have to include an emergency overflow weir sized to limit peak pond stages and to prevent flooding upstream of the pond.
- The pond will need to collect runoff from two different inflow points in order to serve the whole 560 acres targeted for treatment.
- The existing grades of the site and the conveyance channel will require a large amount of excavation. While this will be a benefit in that it will provide for a great amount of detention storage, it will also result in a large amount of soil that will need to be used or disposed of offsite. The pond in the current conceptual size and layout will produce an estimated 215,000 cubic yards of material. Review of the NRCS Soils data indicates the existing site soils to be in the Coosaw series, which is considered to be loamy fine sand and may have potential for use as structural fill. Soil borings and classification would be needed to verify suitability. If the soil is not suitable and costs of disposal are too high, options to reduce the size of the pond may need to be evaluated.



Figure 8-4: Camp St. Mary's M2 – Conceptual BMP

The proposed conceptual pond design recommends a 9.8 acre boundary size (at top of bank) with approximately 10 ft of freeboard over the assumed normal water level elevation of 6 ft. The large amount of freeboard is needed only because of the high existing site grades above the conveyance channel inverts. Digging the pond to the depths proposed is the only way to capture water from the existing channels and divert it to the pond. The bottom of the pond should be eight to ten feet deep below the normal water level to provide adequate water quality treatment volume per the Beaufort County BMP Design Manual and to prevent growth of vegetation in the permanent pool. The design also calls for a vegetated flood shelf that will aid in the removal of freshwater volume by providing vegetation that will promote evapotranspiration of the stored stormwater.

8.3.1 BMP Sizing and Analysis

The ICPR files from the 2006 SWMP were used to do a basic analysis of the BMP concept. The pre-development ICPR files were run for the 95th percentile storm (1.95”) and the 100 yr design storm. As a point of comparison in determining the effectiveness of the pond for volume control and water quality treatment, post-development conditions were modeling assuming flow in the main conveyance channel is re-routed to the proposed pond. The 100 year storm was also modeled in post development conditions to assure upstream flooding problems are not created. Additional field survey work and modeling will be required during the detailed design phase. The original 2006 SWMP model included only high tide conditions (assumed tailwater elevation of 5.6 ft), and only high tide conditions were modeled for the analysis of the proposed pond. If ground-run survey indicates the existing channel may be tidally influenced, then low tide conditions should be modeled as well. Regardless, additional more detailed hydrologic and hydraulic modeling is needed during the detailed design phase given the changes and discrepancies found in the overall basin boundary related to the drainage patterns for the Old Field development and the offsite Jasper County land. For the purposes of this concept analysis, the basin data from the SWMP was unmodified. The peak stages and discharges will likely change once the basin input is updated, however using the older, unmodified basin data should still provide a relative view of the expected water quality benefits of the proposed BMP.

Table 8-1: Camp St. Mary’s M2 – Peak Flow and Peak Stage Results – 95th Percentile Storm

Node	ICPR Node Name	Pre Max Stage (ft)	Post Max Stage (ft)	Pre Max Inflow (cfs)	Post Max Inflow (cfs)
Okatie River	CS_M-0	N/A	N/A	36.71	6.96
Upstream (near)	CS_M-18	7.88	8.28	30.81	30.81
Upstream (far)	CS_M-25	15.57	15.57	30.81	30.81
Upstream (near)	CS_T-15	7.66	8.27	1.45	1.45
Upstream (far)	CS_T-19	13.37	13.67	1.45	1.45
Pond	POND_CSM	N/A	8.27	N/A	31.49

Table 8-2: Camp St. Mary's M2 – Pre-Post Volume Comparison for 95th Percentile Storm

Node	ICPR Node Name	Pre Volume High Tide (acre-ft)	Post Volume High Tide (acre-ft)
Okatie River	CS_M-0	28.5	12.3

Results from the conceptual modeling for the 95th percentile storm indicate that constructing the pond and re-routing flow to it will reduce the peak outflow rate at the Okatie River outfall by an estimated 81%, and reduce the volume by 63% in high tide conditions. It will do so with a small increase in the predicted peak stages just upstream of the BMP, but minimal to no increase further upstream. The proposed pond connection was also modeled for the 100 year storm to further check the peak stages and to make sure flooding will not occur. The results show no predicted increase in flood stage for the upstream nodes in conceptual post-development conditions.

Table 8-3: Camp St. Mary's M2 – Peak Flood Stages for 100 Year Storm

ICPR Node Name	100 yr Pre Peak Stage (ft)	100 yr Post Peak Stage (ft)
CS_M-18	9.65	13.05
CS_M-25	17.51	17.10
CS_T-17	14.58	15.88
CS_T-19	16.15	16.39

Besides peak flow reduction, volume reduction, and first flush treatment, another expected benefit of retrofitting a detention pond in the basin is reducing the flashy introduction of the freshwater runoff to the saltwater river. Figure 8-5 shows the post-development pond and upstream node stages versus time and demonstrates that the water stored in the pond will be released over a 72 period.

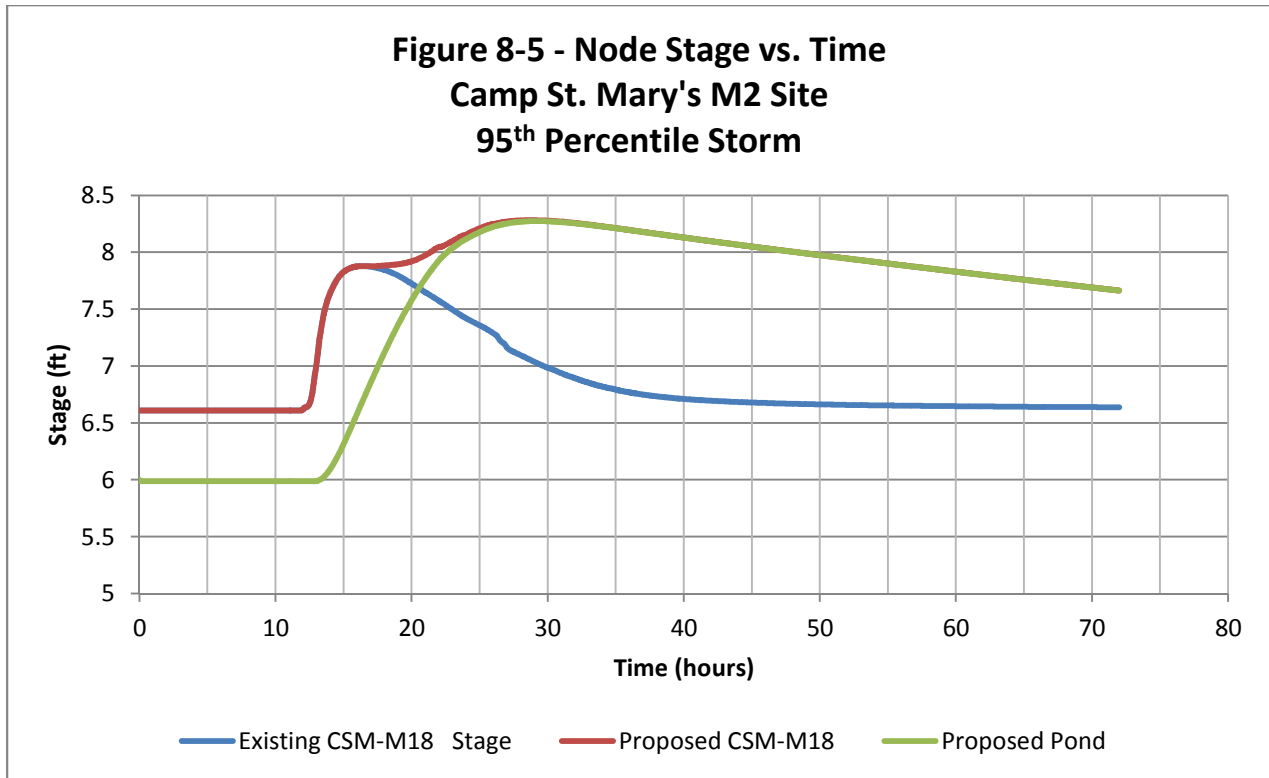


Figure 8-5: Camp St. Mary's M2 – Node Stage vs. Time for 95th Percentile Storm

8.4 Construction Cost Estimates & Priority

8.4.1 Construction Cost Estimate

The 2006 SWMP estimated a total construction cost for the Camp St. Mary's M2 regional retrofit to be \$1,544,000. This estimate was based on a proposed pond at the original recommended site assuming a 14 acre area of disturbance. Table 8-4 shows the original cost estimate.

Table 8-4: Camp St. Mary's M2 – Original 2006 SWMP BMP Construction Cost Estimate

	Units	Unit Cost	Quantity	Cost
Mobilization	EA	\$5,000	1	\$5,000
Site Prep/Restoration Erosion & Sediment Control	EA	\$2,500	1	\$2,500
Land Purchase	AC	\$6,500	29	\$188,500
Clearing	AC	\$5,500	16	\$88,000
Excavation	CY	\$12	73,000	\$876,000
Outlet Structure	EA	\$10,000	1	\$10,000
		Subtotal		\$1,170,000
Contingency (20%)				\$234,000
Engineering/Legal/Admin (12%)				\$140,400
		Total		\$1,544,400

The original cost estimate appears to significantly under estimate the amount of excavation needed for a 10 acre pond, thus under estimating the overall project cost. Given the existing grades and the proposed depths needed in the pond to provide the required water quality depth, the amount of excavation would be approximately 190% higher. However, if the existing soils are suitable as structural fill and there are nearby projects needing material, the excavation costs could be offset by selling the material to contractors. This was recently accomplished in the construction of the 12 acre regional detention pond for the Beaufort Commerce Park. The pond was constructed at little cost to the Economic Network due to the need of fill material on two local road construction projects. More cost savings are possible in the land acquisition. The original cost estimate assumed 29 acres would need to be acquired, however, if only easements or only the portions of the property needed for the drainage features are purchased, the area needed could be as low as 15 acres.

Table 8-5: Camp St. Mary’s M2 – Updated BMP Construction Cost Estimate

	Units	Unit Cost	Quantity	Cost
Mobilization	EA	\$5,000	1	\$5,000
Site Prep/Restoration Erosion & Sediment Control	EA	\$7,500	1	\$7,500
Easement/Property Purchase	AC	\$11,000	15	\$165,000
Clearing	AC	\$5,500	14	\$77,000
Excavation	CY	\$12	215,000	\$2,580,000*
Drainage Structures	EA	\$10,000	1	\$10,000
		Subtotal		\$2,844,500*
Contingency (20%)				\$568,900*
Engineering/Legal/Admin (12%)				\$341,340*
		Total		\$3,754,740*

*Cost could be significantly reduced if material is suitable as fill material

8.4.2 BMP Site Priority and Further Study Needed

Based on the retrofit sensitivity analysis in the 2006 SWMP, the Colleton River 3 basin would not see a significant improvement in the water quality level of service if regional retrofit BMPs are installed. However, because of tidal flow action, improvements in this basin could have some effect on the quality of the upstream Okatie River 1 basin. The 2006 SWMP also states that stormwater controls for any new development in the Colleton River 3 basin are needed to prevent degradation in the level of service of the river. If development occurs in the upstream Jasper County land without the volume control regulations that Beaufort County currently has in place, then the Camp St. Mary’s retrofit may be needed to prevent further degradation.

SCDHEC has developed a fecal coliform TMDL for the Okatie River, estimating the percent reductions in pollutant loadings required to meet shellfish standards in defined reaches within the Okatie River. The Camp St. Mary’s site lies within Reach 5. Figure 22 and the associated narrative in the *Total Maximum Daily Load, Okatie River, Shellfish Fecal Coliform*, available at https://www.scdhec.gov/environment/water/tmdl/docs/tmdl_okatie.pdf indicates that there is no percent reduction required for Reach 5, because that section of the Okatie River currently meets the shellfish standards.

Given the potential high cost of construction, the low sensitivity to retrofits, and the lack of load reduction required in the Okatie River TMDL, **implementing and constructing this BMP site is a low priority.** However, because of the possible indirect improvements to adjacent basins and the possibility that construction cost could be dramatically reduced if the onsite soils are suitable for structural fill; some preliminary work on this site is recommended.

- The subject property owners should be contacted to determine the likelihood of land and/or easements being available for purchase.
- If land acquisition is possible, soil borings and classification tests should be performed to determine the suitability of the material as structural fill.
- A new construction cost estimate should be prepared based on the land cost and the value of the soil.

If the property may be available and the new construction cost estimate is low, then the project can be reprioritized based on the progress on the other, more retrofit sensitive projects. If work on this site moves forward, then the following work will need to be done:

- Field work for wetland determination and delineation (if wetlands are found), with particular emphasis on determining if the existing ditch is classified as critical area.
- Ground run tree and topographic survey of the proposed site, outfall ditches, and offsite access.
- Detailed hydrologic and hydraulic modeling of the water quality sub-basin, including re-evaluation of existing basin boundaries, flow paths, and land uses.
- Design plans for pond excavation, channel re-routing, outfall structure, emergency overflow weir, construction access, and sediment control.
- Permitting through SCDHEC-OCRM, SCDOT, Army Corp of Engineers, and Beaufort County.

Section 9 – Factory Creek M2

9.1 Background

Originally identified in the 2006 SWMP as Site 17, this BMP site is located in the Factory Creek M2 hydrologic sub-basin, which is a portion of the Rock Springs Creek 2 Water Quality Basin. The sub-basin associated with the original proposed BMP location is approximately 300 acres in size and includes a mixture of property uses including low density residential, moderate density residential, commercial, and institutional. The majority are low density residential that pre-dates any stormwater control regulations. The institutional (Beaufort Academy) also pre-dates current stormwater regulations and does not appear to have a detention pond; however the moderate density residential (New Point) does appear to have stormwater detention ponds serving the development. Figure 9-1 shows the basin boundary and the original BMP site.



Figure 9-1: Factory Creek M2 Sub-Basin

The originally proposed BMP site appears to sit on three separate, undeveloped parcels that are under common ownership (Mary Capers). All three parcels, along with most other parcels in the area are part of the Lady's Island Community Preservation Zoning District. Figure 9-2 shows the properties and the original BMP site. The original plan called for two ponds flanking the existing basin's flow path on two sides. The flow path is located in the center of a jurisdictional wetland whose width ranges between 200-ft wide to as much as 350-ft wide (per NWI). The main channel is around elevation 10 ft, while grades on the pond sites range between 13-ft to 17-ft. Constructing the ponds would require significant excavation in some locations, but is not completely unfeasible. There should be sufficient room to grade the top banks back to existing elevations, although it will reduce the pond sizes somewhat. Access to the western pond could easily be provided from Milton Way, as the road fronts about 500 lf of the road. However, access to the eastern pond would be difficult if not impossible, as it is bordered by wetlands on the west and north sides, and by residential lots on the east and south sides. Access would either require wetland impacts or easements crossing the home sites. Field wetland approximations would be needed if this BMP location is pursued, and wetland impact permits would be needed to intercept and redirect flow from the main conveyance channel.

Another important item to consider in evaluating the original BMP location is the potential service area. The ponds' locations are in the upper end of the Factory Creek M2 sub-basin, allowing them to serve only 300 acres of the 1,188 acre sub-basin. Since the 2006 release of the SWMP, the County has done some flood control ditch maintenance in the area that may have altered the sub-basin's flow pattern. The newly deepened and improved ditch may have reduced the area draining to the proposed pond sites, down to a little over 100 acres, by directing 200 acres of the basin to the Morgan River. Given the likely challenges to implementing the original proposed BMP and the reduced benefit, a review of other large parcels upstream and downstream of the original site was conducted to aid in determining the most suitable location.

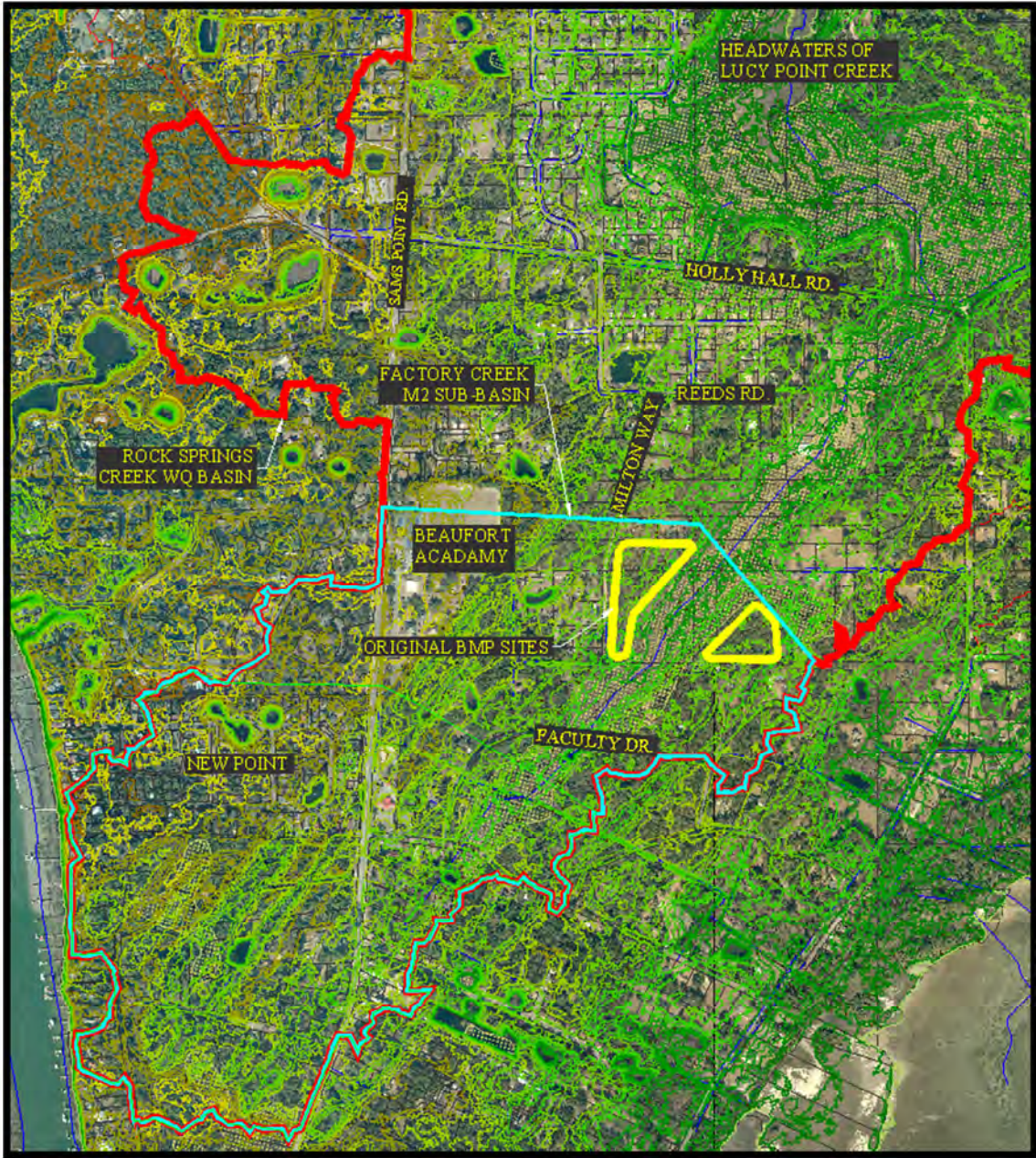


Figure 9-2: Factory Creek M2 – Original 2006 SWMP BMP Sites

9.2 Alternative BMP Location Considerations

A review of other parcels in the Factory Creek M2 sub-basin was conducted to determine if there are other sites better suited to contain regional BMPs. Figure 9-3 shows the alternate property clusters and the original BMP site.

1. *Mary Capers (R200 015 000 0005 0000, R200 015 000 001A 0000, & R200 015 000 0005 0000)*: This cluster of properties described in Section 9.1 total to around 30 acres and was the recommended BMP site from the 2006 SWMP. Limited access and the presence of wetlands prevent this property cluster from being a good candidate for a regional BMP.
2. *Juanita Rooks (R200 015 000 005A 0000 & R200 015 000 0767 0000)*: These are two remotely located parcels which are directly adjacent to the original BMP site. The smaller one is located to the northeast of Site 1, contains a single family house and is of little use for the BMP project. The second parcel however, is surrounded on three sides by Site 1 and may be of some use if the eastern pond option is pursued. It contains some uplands which could be used to provide additional pond area.
3. *David Coleman (R200 010 000 0460 0000)*: This 8 acre parcel is located along the main sub-basin flow path to the north of the original BMP site. A single building is visible on the site in aerial photographs, but its use is unknown. Although NWI indicates the site is mostly wetlands, the site is also mostly cleared and contains a half acre pond. The pond appears to collect the sub-basin flow and discharge it on the north end of the property. Grades on the site range from elevation 14 at the southwest corner down to elevation 9 at the pond top of bank. Access to the site is provided by way of a dirt road connecting to Reeds Road. Although limited in size and although it contains a building, this parcel may be of some value for a BMP given the existing pond. It may be possible to expand or modify the pond to better serve as a water quality treatment pond; however a wetlands investigation will be needed to verify the presence of and potential impacts to any nearby wetlands. Acquiring the property or necessary easements could be difficult given it is being used for some residential or storage purposes.
4. *Edward Ray (R200 010 000 053B 0000)*: This 3 acre parcel is adjacent and to the north of Site 4 and is similar in BMP potential. It contains a small single family residence and a 0.3 acre pond that collects the discharge from the Coleman pond to the south, and discharges to wetlands located to the northeast. NWI indicates that the majority of the site is covered in wetlands; however the site is mostly cleared. Access to the site appears to come from Holly Hall Road via easements across three other properties. Grades on the site range from elevation 15 on the west end of the property where the house is located, down to elevation 8 at the pond top of bank. Similar to the Coleman property, the site may be of some value if the pond can be expanded and improved to act as water quality treatment, but wetland verifications will be needed. Acquiring the property or necessary easements could be difficult given its residential use.
5. *The Pratt Family Trust (R200 011 000 0001 0000)*: A 54 acre parcel that is part of Holly Hall Plantation is located within the sub-basin flow path and is adjacent to the discharge point to the headwaters of Lucy Point Creek. This is by far the largest parcel within the sub-basin capable of capturing the sub-basin flow; however the area around the main channel appears to be mostly wetland. Conveying the runoff to upland portions of the site would require crossing an approximate 300 ft width of wetland. Soils in the upland portion are Wando series (HSG Type A) which are very favorable for drainage uses and as borrow material. Grades for the site range from elevation 5 at the main flow path, up to elevation 17 in the upland portions, although the slopes are gradual. Constructing a pond in the upland area would require a lot of excavation, but is not completely unfeasible. Access to the parcel exists through Hill Road or directly from Holly Hall Road. Availability of the property for purchase or by easement is uncertain at this point. The property is currently zoned Rural.

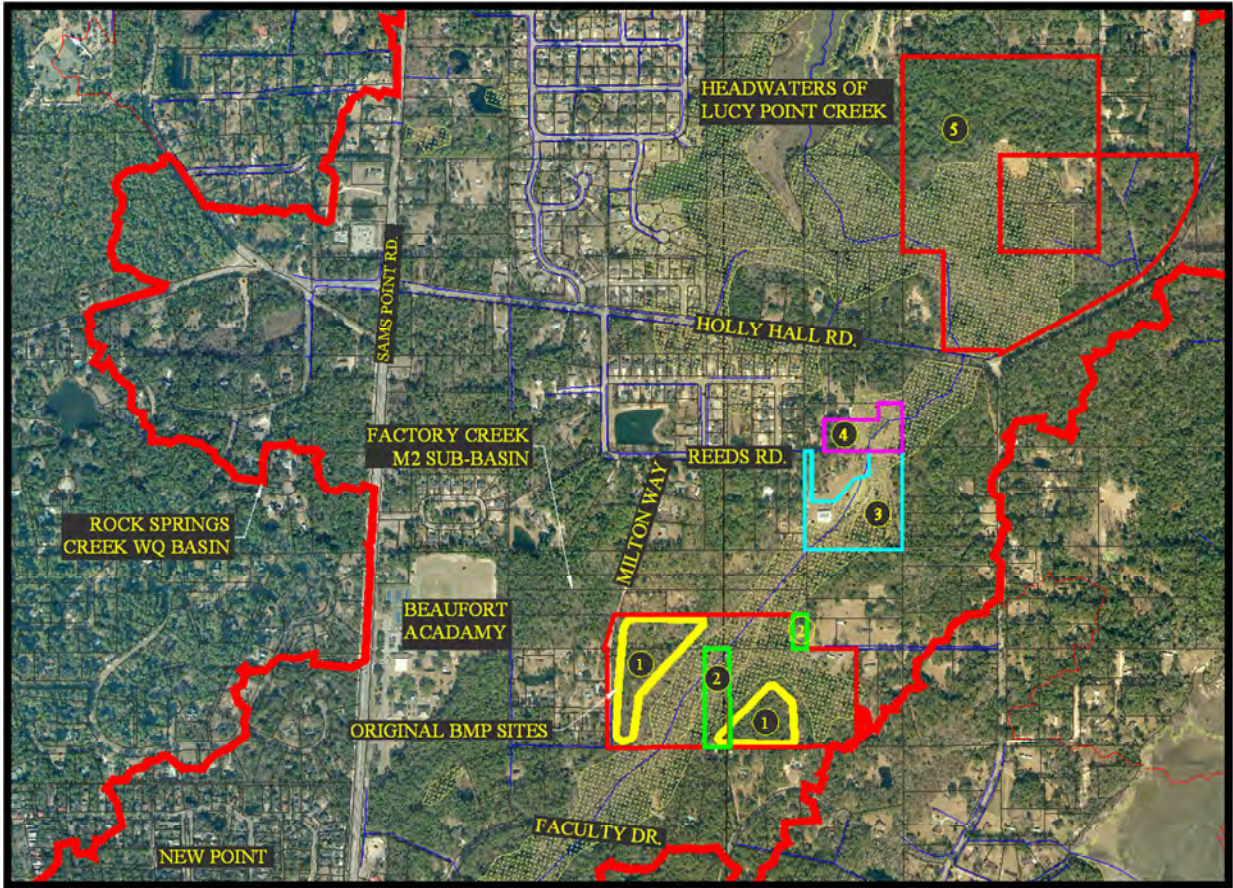


Figure 9-3: Factory Creek M2 – BMP Site Evaluation

9.3 BMP Recommendations & Priorities

There were no clearly feasible BMP options resulting from the property review. The originally recommended sites have the largest available upland area capable of containing BMPs, but these uplands would be difficult to access. Providing hydraulic connectivity between the BMPs and the sub-basin flow channel would also prove problematic due to the likely wetland impacts. The other parcels near the sub-basin flow path are either too small or are entirely encumbered with wetlands. The best option may be to expand the two residential ponds located on Site 3 and Site 4 and reconfigure them to better serve as water quality BMPs. The feasibility of this option will be limited by the ability to acquire the property and to avoid wetland impacts. The water quality benefit to the basin is also uncertain due to some recent re-ditching in the sub-basin. In an effort to mitigate flooding problems, Beaufort County cleaned and improved existing ditches in the upper portion of the sub-basin near Fairfield Road. The improved ditching is believed to have redirected the upper 180 acres of the sub-basin to outfall directly to Morgan River located to the east, instead of draining to the north through the wetland system. Figure 9-4 shows the improved ditch system and the area believed to be re-routed.



Figure 9-4: Factory Creek M2 – Area of Sub-Basin Redirected by Ditch Improvements

With no definite optimum BMP site option and the apparent altered sub-basin boundary, conceptual BMP design work on this site was suspended to allow additional budget on other higher priority sites. Furthermore, this sub-basin was considered low priority because previous modeling indicated the sub-basin is less sensitive to retrofits when compared to some of the other retrofit projects being considered. Based on the retrofit sensitivity analysis in the 2006 SWMP, the Rock Springs Creek 2 sub-basin would not see a significant improvement in the water quality level of service (LOS) if regional retrofit BMPs are installed. Table 11-17 in the SWMP shows an existing LOS “D” for the basin and a future predicted LOS “D” assuming retrofit BMPs are installed. However, because of tidal flow action, improvements in this basin could have some effect on the quality of the downstream Lucy Point Creek South 1 and 2 basins. The 2006 SWMP implies that modeled improvements in stormwater quality level of service (LOS) in the Lucy Point Creek South 1 and 2 basins are dependent on BMP improvements in the Rock Springs Creek 2. The LOS of Lucy Point Creek South 1 is predicted to improve from LOS “C” to LOS “A” and Lucy Point Creek South 2 is predicted to improve from LOS “C” to LOS “A” in best case scenario conditions (100% BMP coverage in all interrelated sub-basins).

Should the Rock Springs Creek 2 sub-basin become a higher priority, the following work will need to be done in a phased approach.

Conceptual BMP Design, Modeling, and Evaluation Phase:

- Re-determination of the sub-basin boundaries based on the completed ditch improvements and re-routing.
- Evaluate conceptual BMP options such as modifying and expanding the existing residential ponds and wetland hydraulic restoration.
- Select suitable sites based on chosen BMP.
- Prepare conceptual BMP layouts and sizing, including concepts for inflow/outflow routes through the existing wetland to minimize impacts.
- Conceptual hydraulic modeling of the BMP to determine peak discharges and peak stages (pre-post comparison).
- Water quality evaluation of total volume storage and discharge.
- 100 year storm – flood prevention analysis to determine possible effects on upstream properties.
- Conceptual construction cost estimate and comparison to original 2006 SWMP cost estimate.

Property Acquisition and Site Soil Evaluation Phase:

- The subject property owners should be contacted to determine the likelihood of land and/or easements being available for purchase.
- If land acquisition is possible, soil borings and classification tests should be performed to determine the suitability of the material as structural fill.
- A new construction cost estimate should be prepared based on the land cost and value of the soil

Detailed Design and Permitting Phase:

- Field work for wetland determination and delineation.
- Ground run tree and topographic survey of the existing pond, outfall ditch, inflow pipes, and offsite access.
- Detailed hydrologic and hydraulic modeling of the water quality sub-basin, including re-evaluation of existing basin boundaries, flow paths, and land uses.
- Design plans for pond excavation, channel re-routing, outfall structure, emergency overflow weir, construction access, and sediment control.
- Permitting through SCDHEC-OCRM, SCDOT, Army Corp of Engineers, and Beaufort County

Summary:

The eight originally recommended BMP sites were reviewed and evaluated based on feasibility criteria including proximity to conveyance channels, topography, parcel accessibility, natural and cultural resources, and soil characteristics. It was discovered that the Shanklin Road M2 site is being used as a wetland restoration and mitigation project for the Marine Corp Air Station, and thus unavailable for use as a BMP site. The Salt Creek South M1 and the Factory Creek M2 sites were determined to be limited in feasibility, so BMP design work on these three sites was suspended to allow additional budget on the more feasible projects. The Okatie West site was added as a ninth retrofit project to better serve the Okatie River 3 water quality basin and budget to analyze and prepare the conceptual BMP design was transferred from the three suspended projects.

Conceptual BMP designs were prepared for the selected project sites and the BMPs were analyzed for effectiveness using hydrologic/hydraulic modeling. Construction cost estimates for each BMP were prepared and compared to the original cost estimates from the SWMP. The sites were then prioritized using the feasibility results, the BMP effectiveness results, retrofit sensitivity results from the 2006 SWMP, recent monitoring results from Beaufort County, and the estimated construction costs.

Table S-1: BMP Site Feasibility & Priority

Site	Feasibility	Recommended Priority	Estimated % Runoff Rate Reduction (95 th Percentile Storm)	Estimated % Runoff Volume Reduction (95 th Percentile Storm)
Battery Creek West M1	Medium (property)	Medium (high cost)	80%	9%
Grober Hill M2	High (wetlands)	Medium (high cost & benefit)	87%	33%
Burton Hill M2	Medium (tidal issues)	High (property owner & low cost)	35%	4%
Salt Creek South M1	Low (property)	Low	N/A	N/A
Shanklin Road M2	Low (property)	Low	N/A	N/A
Okatie East	Medium (wetlands & property owner)	High (high benefit & low cost)	27%	13%
Okatie West	High	High (property owner)	20%	6%
Camp St. Mary's M2	Medium (site grades)	Low (TMDL)	81%	63%
Factory Creek M2	Low (property)	Low	N/A	N/A

Feasibility and Priority Summary:

- Battery Creek West M1 is listed as medium feasibility because property and/or easements would have to be acquired from multiple property owners. Although the BMP would have excellent treatment for runoff rate reduction and a modest amount of volume reduction, the high cost lowers the priority
- Grober Hill M2 is listed as a high feasibility because of the apparent lack of wetlands onsite. If field wetland verifications determine otherwise, the feasibility would be lower. Although the site has a property owner apparently willing to cooperate and a high benefit, the priority is listed as only medium due to the high projected construction cost. If field soil tests indicate the material is suitable as structural fill, the construction cost could be reduced and the priority increased.
- Salt Creek South is listed as low feasibility and priority because of limited suitable site options and the current SCDHEC restriction on shellfish harvesting in the receiving waters due to waste water treatment facility discharges.
- Shanklin Road M2 is listed as low feasibility and priority because of limited suitable site options and the current SCDHEC restriction on shellfish harvesting in the receiving waters due to waste water treatment facility discharges.
- Okatie East is listed as a medium feasibility because of the uncertainty on the ownership and covenant restrictions on the wetlands. It is listed as high priority because of the high benefit and low construction cost.
- Okatie West is listed as high feasibility because of the availability of the uplands in close proximity to and at the same grades as the sub-basin conveyance channel. It is listed a high priority because of the apparent availability of the property and the potential the property will develop if not secured as a BMP site.
- Camp St. Mary's M2 is listed as medium feasibility because of the significant difference in grades between the conveyance channel and the BMP site. It is listed as low priority because it is not within a required load reduction area for the Okatie River TMDL.
- Factory Creek M2 is listed as low feasibility and priority because of limited suitable site options.

Table 0-2: Original and Updated BMP Construction Cost Comparison

Site	2006 SWMP Construction Cost Estimate	Updated Construction Cost Estimate	Cost Difference
Battery Creek West M1	\$2,111,340 ^{&}	\$4,095,300 [*]	+ \$1,983,960
Grober Hill M2	\$781,000 ^{&}	\$2,469,720 [*]	+ \$1,688,720
Burton Hill M2	\$1,480,000	\$736,088	- \$743,912
Salt Creek South M1	\$2,033,000	N/A	N/A
Shanklin Road M2	\$3,301,000	N/A	N/A
Okatie East	\$1,467,400	\$107,000	- \$1,360,400
Okatie West	N/A	\$1,211,100 [*]	+ \$1,211,100
Camp St. Mary's M2	\$1,544,400 ^{&}	\$3,754,740 [*]	+ \$3,754,740
Factory Creek M2	\$1,678,000	N/A	N/A

& - Original cost estimate under estimated volume of soil to be excavated

* - Cost could be reduced if soil material is suitable as structural fill