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Land and Marine Survey and Mapping
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A CECI GROUP COMPANY

MEMORANDUM

TO: Chadd Chustz
FROM: Michael Poff
DATE: February 10, 2020
SUBJECT: Estero Island Beach Renourishment Project Due Diligence
CEC FILE NO. 19.504

1 INTRODUCTION

The Town of Fort Myers Beach (Town) is pursuing the next renourishment project for Estero Island (Figure 1). Coastal Engineering Consultants (CEC) was hired to assist the Town establish beach fill design criteria, review results of past renourishment projects, outline a path forward for design and permitting, and assist the Town with funding and grant pursuits.

This Technical Memorandum presents the history of Estero Island Beach nourishment and results of CEC's project performance analysis, and presents the design criteria for the next renourishment project. Included herein are Project details to support the Town's Fiscal Year (FY) 2020-21 Beach and Shoreline Funding Request to the Lee County Visitor and Convention Bureau for design and permitting costs.

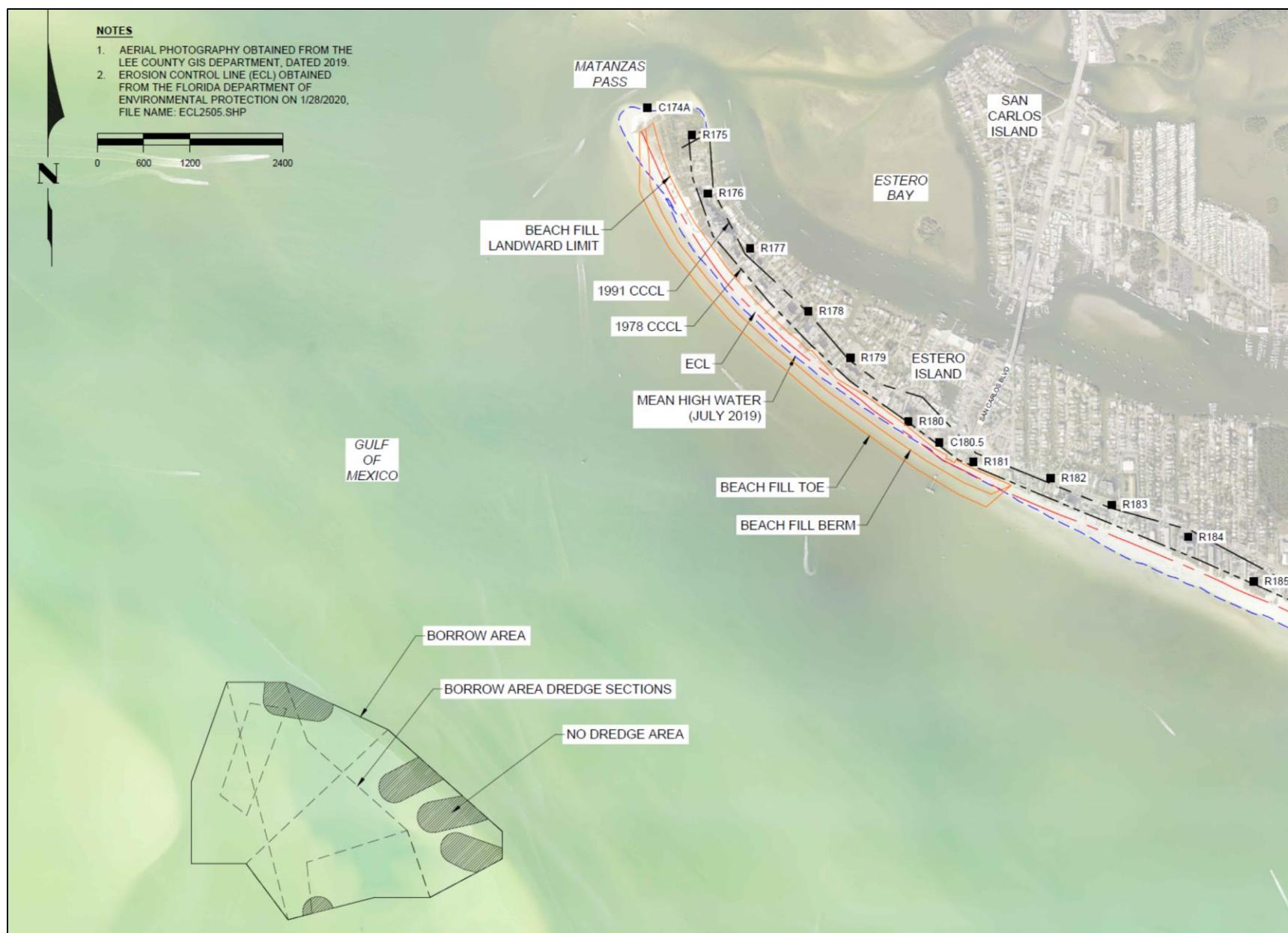


Figure 1. Estero Island Location Map.

2 SCOPE OF WORK

CEC's contracted scope of work with the Town included the following:

- Develop Beach Project Design Criteria by utilizing the 2019 annual monitoring survey of Estero Island and the 2011 nourishment project's permitted fill template between the Florida Department of Environmental Protection (FDEP) reference monuments C-174A.5 and R-181.5 and computing the design volume for the renourishment project to summer 2019 conditions;
- Compute the background erosion rate within the 2011 project limits by utilizing the volume change analyses published in the annual monitoring reports;
- Apply the design volume and two years of background erosion to estimate the fill volume required for renourishment;
- Compute the volume available within the 2011 permitted borrow area limits by utilizing the 2019 annual monitoring survey of the nearshore borrow area;
- Compute the background infill rate of the borrow area by utilizing the borrow area volume change analyses published in the annual monitoring reports. Apply the available volume and two years of background infill to estimate the borrow area volume available for construction;
- Review the 2011 project permits for application to the next renourishment project. Review the special permit conditions and proffer an opinion if the project is in compliance or identify if there are outstanding issues. Prepare a summary of the permits required for the renourishment project;
- Review the shoreline change and volume change analyses published in the 2011 to 2019 annual monitoring reports and compare them to the 2011 beach project design documents. Proffer an opinion on the performance of the project compared to the design criteria. Identify areas along the prior project limits that underperformed;
- Conduct a constructability review specific to the renourishment project fill volume, potential borrow area volume, permit status, and performance assessment. Develop preliminary recommendations for advancing the project to the design and permit stage and address shoreline segments that underperformed;
- Prepare an order of magnitude construction budget for the renourishment project. Prepare a project schedule and timeline;
- Conduct one meeting with Town staff to review the design criteria, permit status, constructability review, and preliminary recommendations and obtain input. Update the recommendations and order of magnitude budget;
- Prepare and submit to the Town a draft letter report summarizing the beach project design criteria, permit status, and constructability review; and present the recommendations, schedule, and budget for the next renourishment project. Address comments and finalize and submit the report to the Town;
- Prepare a presentation and attend one Town Council meeting to present the findings.

3 ESTERO ISLAND BEACH RESTORATION HISTORY

3.1 2011 Initial Nourishment Project

In December 2011, Lee County completed construction of the Estero Island Beach Restoration Project including sand placement along the north-central segment of the island and the addition of a terminal groin on the northern end of the beach fill.

The 2011 Project was constructed between April 2011 and December 2011. Approximately 403,000 cubic yards (CY) of sand were excavated and placed in the beach fill area between FDEP reference monuments (R-monuments) C-174A.5 and R-181.5 (Figure 1). The beach was constructed to a berm height of 2.9 feet NAVD88 over a shoreline distance of approximately 6,700 feet (1.3 miles). The design berm extended seaward at the 2.9 feet NAVD88 elevation an average of 236 feet and then sloped to the -1.2 feet NAVD88 elevation at a 15H:1V slope. The design then adjusted to a 20H:1V slope seaward until it connected with existing grade. All dredging was conducted in the Primary Borrow Area. The terminal groin was constructed with approximately 3,630 tons of limestone rock for a length of 240 feet with a maximum crest width of approximately 12.7 feet. A single vinyl sheetpile row was installed along the centerline of the structure to make it sand tight. FDEP raised concerns that the groin would slow down sediment transport below a rate that will maintain the area north of project in a stable position. As a result Lee County is required to monitor this area and report on the trends observed (Lee County, 2003).

3.2 2016 Maintenance Dredging and Beneficial Use Project

In 2016, the U.S. Army Corps of Engineers (USACE) dredged Matanzas Pass (Figure 2) and placed dredge material (estimated quantity was 130,000 CY based on USACE Project Plans) in the nearshore area between R-182 and R-187. This USACE project is reflected in the analysis presented in this Report.

3.3 2017 Truck Haul Project

In 2017, Lee County imported approximately 2,100 CY via truck haul to address erosion due to Hurricane Irma along the Crescent Beach shoreline in the vicinity of R-181.

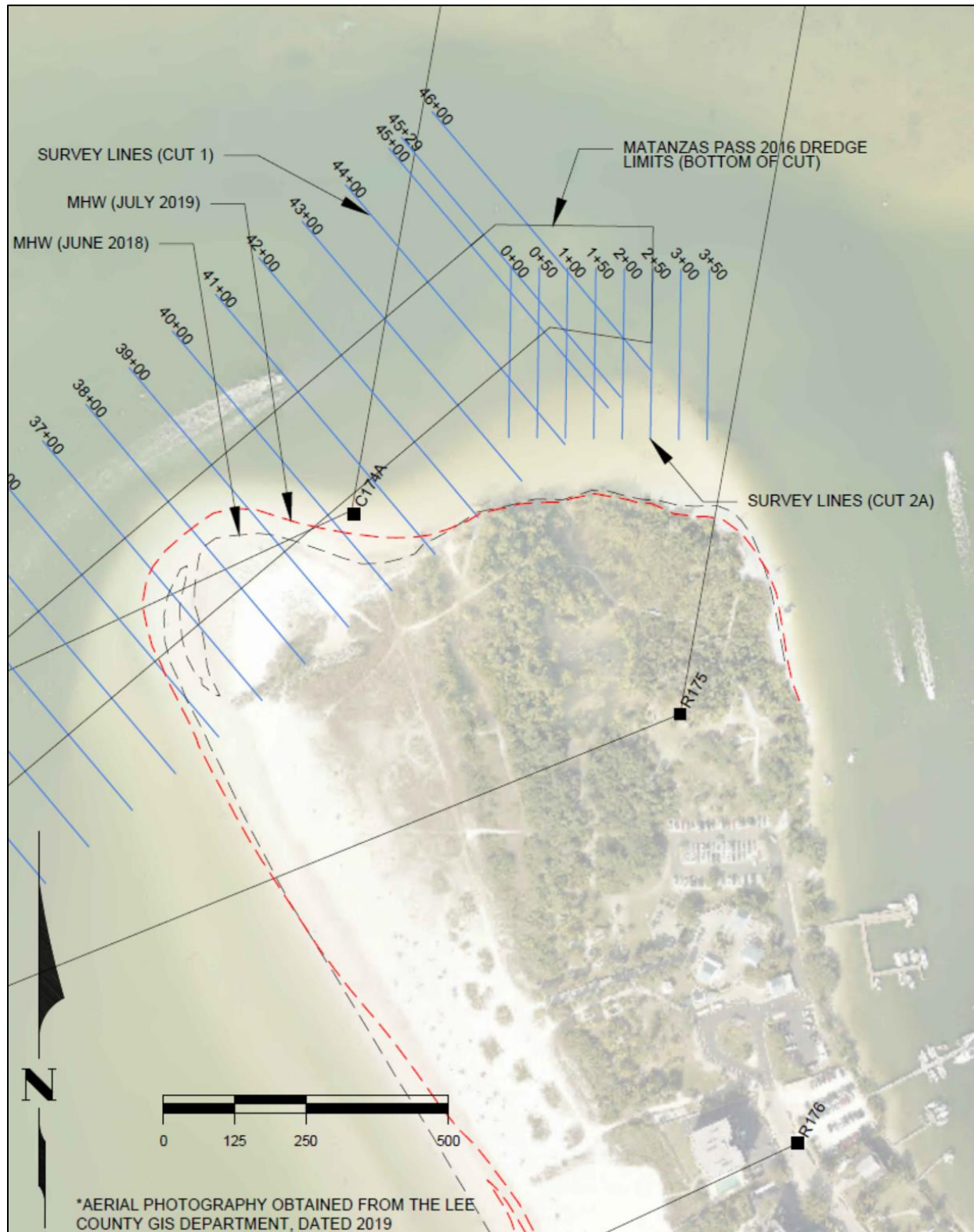


Figure 2. Plan View of North Adjacent Shoreline and 2016 USACE Dredging Project.

4 BEACH PROJECT DESIGN CRITERIA

4.1 Fill Area Background Erosion

Table 1 presents the 2012 post-construction and 2019 monitoring survey shoreline positions at MHW between R-174A and R-186. In addition to the positions, the table includes shoreline change rates calculated for the 2012-2019 time period representing the seven-year post-construction monitoring period. Between 2012 and 2019, the Project Area shoreline experienced an average recession of 14.5 feet. The areas adjacent to the Project Area experienced 0.3 feet of recession north of the Project and 12.3 feet of advancement south of the Project.

Table 2 presents the volumetric changes that occurred from the 2012 post-construction survey to the 2019 monitoring survey within the fill footprint and north and south adjacent areas. The net volume change between 2012 and 2019 within the fill footprint was approximately 148,150 CY of erosion which equated to approximately 19,750 CY of erosion per year. The areas adjacent to the Project Area experienced approximately 290 CY of accretion per year north of the Project and approximately 14,440 CY of accretion per year south of the Project.

Table 1. Summary of 2012-2019 Shoreline Changes.

MONUMENT (AZIMUTH)	POSITION (FT)		2012-2019 SHORELINE CHANGE RATE (FT/YR)	2012-2019 AVERAGE SHORELINE CHANGE RATE (FT/YR)	
	POST-CON JAN. 2012	MONITORING JUL. 2019			
R-175 (az=10)	352.8	350.6	-0.3	-0.3	North Adjacent Shoreline
C-174A (az=10)	N/A	-40.3	N/A		
C-174A (az=245)	N/A	405.0	N/A		
R-175 (az=248)*	759.7	774.1	1.9	-14.5	Project Area
R-176 (az=245)	673.0	526.0	-19.6		
R-177 (az=220)*	739.8	580.2	-21.3		
R-178 (az=227)*	656.2	560.0	-12.8		
R-179 (az=230)*	564.7	439.8	-16.6		
R-180 (az=210)*	332.1	163.8	-22.4		
C-180.5 (az=205)	323.9	153.1	-22.8		
R-181 (az=205)	331.9	162.0	-22.6		
R-182 (az=204)*	394.8	440.8	6.1		
R-183 (az=205)	449.6	510.1	8.1	12.3	South Adjacent Shoreline
R-184 (az=205)	469.5	563.7	12.5		
R-185 (az=200)*	229.1	383.4	20.6		
R-186 (az=205)	296.9	358.3	8.2		

* 2012 Line was shifted from adjacent azimuth

N/A = profile below MHW

Table 2. 2012-2019 Volumetric Changes within Project Area Fill Footprint.

MON (AZIMUTH)	2012 to 2019			VOLUME (CY)	2012 to 2019 TOTAL VOLUME CHANGE (CY)	2012 to 2019 ANNUALIZED VOLUME CHANGE RATE (CY/YR)	2012 to 2019 TOTAL ANNUALIZED VOLUME CHANGE RATE (CY/YR)	
	CELL AREA (CY)	AVE CELL AREA (CY/FT)	LENGTH (FT)					
R-174 (az=245)	0.0				2,142		286	North Adjacent Shoreline
		4.0	531	2,142		286		
R-175 (az=248)*	8.1				-148,153		-19,750	Project Area
		-7.9	817	-6,441		-859		
R-176 (az=245)	-23.8							
		-27.5	1,160	-31,856		-4,247		
R-177 (az=220)*	-31.1							
		-19.8	1,033	-20,456		-2,727		
R-178 (az=227)*	-8.5							
		-14.3	790	-11,320		-1,509		
R-179 (az=230)*	-20.1							
		-30.0	1,244	-37,295		-4,972		
R-180 (az=210)*	-39.8							
		-39.6	500	-19,789		-2,638		
C-180.5 (az=205)	-39.4							
		-36.5	508	-18,545		-2,472		
R-181 (az=205)	-33.6							
		-2.4	1,005	-2,449		-327		
R-182 (az=204)*	28.7				108,329		14,441	South Adjacent Shoreline
		31.4	856	26,921		3,589		
R-183 (az=205)	34.2							
		26.9	1,070	28,770		3,835		
R-184 (az=205)	19.6							
		30.1	980	29,491		3,931		
R-185 (az=200)	40.6							
		24.4	948	23,147		3,086		
R-186 (az=205)	8.3							

* 2012 Line was shifted from adjacent azimuth

4.2 Beach Fill Design Criteria

CEC utilized the 2011 permitted fill template (Permit # 0173059-001-JC, Modification 0173059-004-EM dated April 20, 2005) and the 2019 survey profiles to compute the volume required to fill the template. The permitted fill template has a berm crest elevation at +2.9 feet NAVD88 with a seaward slope of 1V:15H to elevation -1.2 feet NAVD88 where there is a change in the slope of 1V:20H. To restore the beach between R-175 and R-182 to the 2011 beach nourishment project condition, approximately 189,000 CY would be required (Table 3).

Table 3. Fill Volume Quantities.

MON (AZIMUTH)	CELL AREA (CY)	AVE CELL AREA (CY/FT)	LENGTH (FT)	VOLUME (CY)
R-175 (az=248)*	0.0			
		16.0	817	13,030
R-176 (az=245)	31.9			
		29.5	1,160	34,254
R-177 (az=220)*	27.2			
		24.3	1,033	25,099
R-178 (az=227)*	21.4			
		23.2	790	18,360
R-179 (az=230)*	25.1			
		30.8	1,244	38,375
R-180 (az=210)*	36.6			
		39.0	1,003	39,076
R-181 (az=205)	41.3			
		20.6	1,005	20,737
R-182 (az=204)*	0.0			
Total				188,931

* 2012 Line was shifted from adjacent azimuth

To account for background erosion losses that may occur between 2019 and the projected construction period of FY2021-22, 2.5 years of background erosion were applied. The total design volume for the Project equates to 189,000 CY plus 19,750 CY/YR * 2.5 years equal to 238,375 CY. Rounding up, the recommended design criteria for the beach fill volume for the next renourishment event is 250,000 CY.

4.3 Borrow Area: Available Volume

Figure 3 presents a plan view of the Borrow Area including the survey lines with corresponding station numbers. Table 4 presents the volume available within the permitted Borrow Area limits based on the 2019 survey totaling approximately 1 million cubic yards (MCY).

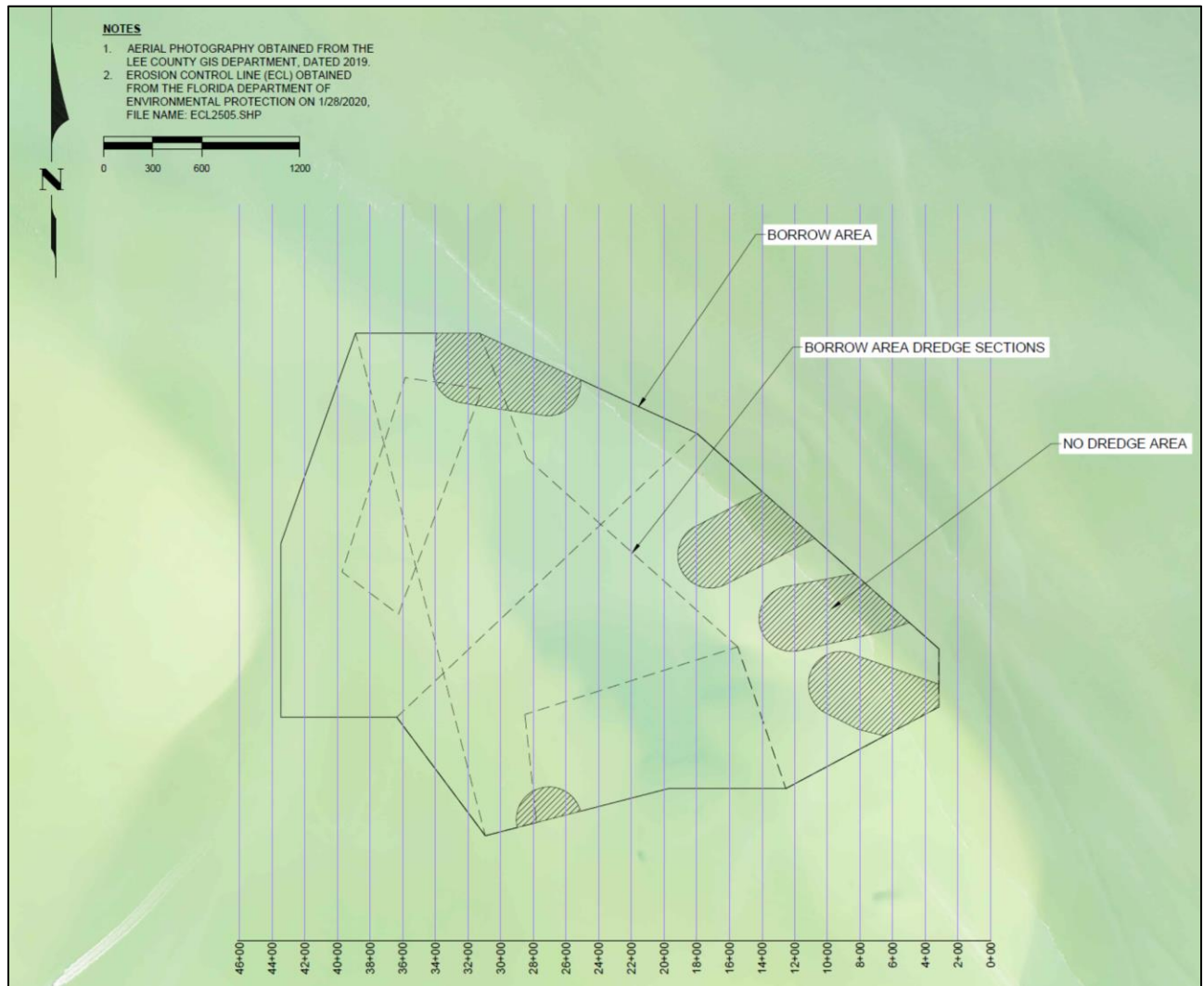


Figure 3. Borrow Area Plan.

Table 4. Borrow Area Available Volume Based on July 2019 Survey.

STATION	CELL AREA (CY/FT)	AVE CELL AREA (CY/FT)	LENGTH (FT)	AVAILABLE VOLUME (CY)
3+17*	3.3			
		4.9	83	408
4+00	6.5			
		18.9	200	3,778
6+00	31.3			
		42.9	200	8,572
8+00	54.4			
		72.0	200	14,404
10+00	89.6			
		142.4	200	28,480
12+00	195.2			
		213.1	200	42,629
14+00	231.1			
		223.6	200	44,712
16+00	216.0			
		169.5	200	33,892
18+00	122.9			
		118.5	200	23,698
20+00	114.1			
		142.2	200	28,431
22+00	170.2			
		203.0	200	40,605
24+00	235.8			
		257.9	200	51,582
26+00	280.0			
		299.9	200	59,971
28+00	319.7			
		369.3	200	73,857
30+00	418.9			
		448.2	200	89,641
32+00	477.6			
		478.9	200	95,777
34+00	480.2			
		480.5	200	96,105
36+00	480.8			
		464.0	200	92,810
38+00	447.3			
		411.0	200	82,196
40+00	374.7			
		324.7	200	64,947
42+00	274.8			
		206.1	146	30,087
43+46*	137.4			
Total				1,006,581

*Borrow Area end stations were not surveyed, the assumed volume was half the volume of the nearest surveyed station

4.4 Borrow Area Volume Changes

Table 5 presents the infilling rate of the Borrow Area which occurred between the 2012 post-construction and 2019 monitoring surveys. It indicates that the Borrow Area experienced scouring of approximately 15,230 CY which equated to approximately 2,030 CY per year. Based on these negligible changes, the recommended design criteria for the available borrow area volume for future renourishment is 1.0 MCY.

Table 5. 2012-2019 Borrow Area Volume Changes.

STATION	CELL AREA (CY/FT)	AVE CELL AREA (CY/FT)	LENGTH (FT)	2012-2019 VOLUME CHANGE (CY)	2012-2019 INFILLING RATE(CY/YR)
3+17*	2.4				
		3.6	83	296	40
4+00	4.7				
		9.1	200	1,824	243
6+00	13.5				
		5.7	200	1,145	153
8+00	-2.1				
		-10.5	200	-2,105	-281
10+00	-19.0				
		-38.0	200	-7,594	-1,012
12+00	-56.9				
		-78.8	200	-15,754	-2,100
14+00	-100.6				
		-82.5	200	-16,493	-2,199
16+00	-64.3				
		-42.6	200	-8,520	-1,136
18+00	-20.9				
		-12.5	200	-2,504	-334
20+00	-4.2				
		27.7	200	5,531	737
22+00	59.5				
		29.8	200	5,960	795
24+00	0.1				
		3.0	200	603	80
26+00	5.9				
		25.3	200	5,067	675
28+00	44.8				
		49.6	200	9,913	1,322
30+00	54.4				
		54.2	200	10,849	1,446
32+00	54.1				
		14.0	200	2,796	373
34+00	-26.2				
		-16.6	200	-3,316	-442
36+00	-7.0				
		-6.3	200	-1,267	-169

STATION	CELL AREA (CY/FT)	AVE CELL AREA (CY/FT)	LENGTH (FT)	2012-2019 VOLUME CHANGE (CY)	2012-2019 INFILLING RATE(CY/YR)
38+00	-5.7				
		-5.9	200	-1,183	-158
40+00	-6.2				
		-2.8	200	-551	-73
42+00	0.6				
		0.5	146	71	9
43+46*	0.3				
Total				-15,232	-2,031

*Borrow Area end stations were not surveyed, the assumed volume was half the volume of the nearest surveyed station

5 PERMITTING AND CONSTRUCTABILITY REVIEW

5.1 2011 Project Permits

5.1.1 FDEP Permit

CEC reviewed the permit related files available on the FDEP website. Below is a list of the issued permit and all permit modifications. In summary, a 10-year permit to nourish the northern segment of Estero Island was issued on March 5, 2002 with permit expiration date of March 5, 2012. In December 2012, FDEP extended the permit to March 5, 2014. The permit's physical monitoring plan (PMP) included seven years of post-construction monitoring which ended in 2019.

Date of Issue: March 5, 2002

Permit/Authorization No.: 0173059-001-JC

Expiration Date/Construction Phase: March 5, 2012

County: Lee

Project: Estero Island and Lovers Key Beach Restoration Project

Description: The Estero Island and Lovers' Key Beach Restoration project is to be divided into three reaches. Reach 1 is located in north Estero Island and extends approximately 4.6 miles and begins 300 feet north of R-175 and continues south to R-198. This project includes the construction of a terminal groin on Estero Island 300 feet north of R-175 to prevent losses of beach sand into Matanzas Pass, which is a Federal navigation project. Reach 2 is located at the southern tip of Estero Island and extends approximately 0.51 miles beginning at R-208 adjacent to the sand spit (Little Estero Island) and extending south to a point 500 feet east of R-210. No sand will be placed within the sand spit region. Reach 3 is located on Lovers' Key, and extends approximately 1.1 miles commencing 500 feet north of R-215 and proceeding to a point 500 feet south of R-220. Borrow Site I is located 1.6 miles offshore of Estero Island. Borrow Site II is located 0.5 miles southwest of south Estero Island.

Date of Issue: March 5, 2002

Permit Variance No.: 0173059-002-EV

Description: Establish a temporary mixing zone greater than 150 meters within an area of Class III Waters of the Gulf of Mexico.

Date of Issue: April 5, 2002

Permit Modification No.: 0173059-002-JC

Description: Applies to Lovers Key

Date of Issue: April 26, 2004

Permit Modification No. 0173059-003-JC

Description: Applies to Bonita Beach

Date of Issue: April 20, 2005

Permit Modification No. 0173059-004-EM

Description: Replace the previously accepted permit plans and drawings for Reach 1 (Estero Island) of the Estero Island and Lovers Key Beach Restoration Project with the updated and revised project plans and drawings that were submitted to the Department in March of 2005 in preparation for Notice to Proceed approval. In addition, the language of the permit will be corrected to reflect the updated plans and drawings. In the previously accepted permit drawings and specifications for the Reach 1 portion of the project, the profile slopes on the design berm had a 1V:10H slope that broke at -0.9' NGVD to a 1V:15H slope, whereas the final construction plans show a 1V:15H slope that breaks at 0.0' NGVD to a 1V:20H slope. These were adjusted based on a suggestion from a contractor, who indicated that sand with a mean grain size in the range of the borrow area creates a flatter slope. This slope was used previously and is the most likely outcome. About half of Lovers Key (Reach 3) slopes corresponded to this slope. In addition, the revised plans show the southern limit of fill of the project extending just south of R-196.5, whereas the previously accepted plans have the project extending south to R-198. There are also other small discrepancies between the previously permitted drawings and the final submitted construction plans, such as the angle at which the profile toe of fill tapers to an end on either side of the fill area, and the dimensions of the terminal groin.

Date of Issue: December 19, 2012

Permit Modification No.: 0173059-005-JN

Original Expiration Date: March 5, 2012

New Expiration Date: March 5, 2014

5.1.2 Permit Summary

Both the FDEP and the USACE permits have expired. New permits will be required for the next renourishment project. The agencies have authority to issue 15-year permits to include the initial project and two subsequent renourishment projects. CEC recommends the Town pursue new 15-year permits for the long-term beach management of Estero Island including one initial event and two subsequent renourishment events on a ten year cycle noting the permits can be extended to allow for the second renourishment event.

5.2 2011 Project Performance

The 2011 Project was monitored for 7 years according to the PMP which included:

- 1) Beach profiles surveys: pre-, post-, 1st-year, 2nd-year, 3rd-year, 5th-year, and 7th-year
- 2) Borrow Area surveys: pre-, post-, 2nd-year, 5th-year, and 7th-year
- 3) Aerial Photography: post-, 1st-year, 2nd-year, 3rd-year, 5th-year, and 7th-year
- 4) Analysis and Reporting: post-, 1st-year, 2nd-year, 3rd-year, 5th-year, and 7th-year

- 5) Special Monitoring of Groin and Borrow Area effects: post-, 1st-year, 2nd-year, 3rd-year, 5th-year, and 7th-year

Analysis of the 1st-year monitoring results was performed by Lee County (Lee County, 2013) and indicated the shoreline within the Project Area between R-175 and R-182 responded as anticipated, adjacent shoreline south of R-182 was accreting and there were no downdrift impacts due to the groin near C-174A.

The 2nd-year, 3rd-year, 5th-year, and 7th-year analyses were performed by CEC (CEC, 2014; CEC, 2015; CEC, 2018; and CEC, 2019). All reports indicated shoreline erosion within the Project Area, shoreline advancement in the adjacent area to the south and no adverse impacts due to the terminal groin.

Based on the analysis of the beach fill and adjacent shorelines, the dredging of the Borrow Area in 2011 did not have measurable effects on the shoreline.

6 COST ANALYSIS

6.1 Methodology

The Tri-Services Automated Cost Engineering System, Micro-Computer Aided Cost Estimating System, Second Generation (MCACES MII Version 3.01) software was used to develop the unit cost for the beach fill. MII is the second generation of the TRACES software used as a costing tool by the USACE. The dredge production rate, equipment daily cost, and sediment dredging and transport duration were developed utilizing a variation of the Cutter Suction Dredge Cost Estimating Program (CSDCEP) developed by the Center for Dredging Studies, Zachary Department of Civil Engineering, Texas A&M University (TAMU). The CSDCEP incorporates costing and production rate tools for dredges. The CSDCEP was customized for current inflation values, specific dredge parameters relating to fuel consumption and various equipment parameters. Shore-based construction and survey crews were eliminated from the derived daily cost equations because these were found to be best computed in the MII. The customized CSDCEP shall hereafter be referred to as the CEC-TAMU costing spreadsheets for dredging.

6.2 Basis

The basis of the Preliminary Opinion of Probable Project Cost is comprised of the following items.

6.2.1 Design and Permitting

Costs for Design and Permitting were based on professional experience and judgment on similar beach fill projects completed in the Project area. The cost includes detailed geophysical survey of a pipeline corridor from the Borrow Area to the Island which was not included in the prior project but it a key item that is being required of current projects and permit processes.

6.2.2 Mobilization/Demobilization

The mobilization/demobilization costs included the anticipated plant and equipment to be used in the excavation, transportation, and placement of beach fill. The derived cost was then compared to historic contract bids from projects of a similar nature.

6.2.3 Beach Fill

The equipment cost was computed by considering the daily rate for dredges, booster pump(s), fuel, per foot sediment pipeline cost, and supporting equipment cost derived from the CEC-TAMU costing spreadsheets for dredging. The fill unit cost was computed by considering the daily rates for the plant, equipment and personnel. The unit cost per CY was based on the required fill volume, anticipated cut-to-fill ratio losses, pumping distance, dredge pumping/transport capacity, total dredging equipment daily cost, construction crews, and shore equipment. This total was then divided by the required fill volume to derive a unit cost inclusive of excavation, transport, and placement. The unit cost was entered into the MII cost analysis as in-place cost for fill and

multiplied by the required volume to derive the total cost for the fill escalated to the anticipated year of construction.

6.2.4 Environmental Protection, Turbidity Monitoring and Shorebird Abatement

Costs for environmental protection, turbidity monitoring and shorebird abatement were based on professional experience and judgment on recent beach fill projects completed in the Project area.

6.2.5 Construction Management

Costs for Construction Management were based on professional experience and judgment on recent beach fill projects completed in the Project area and the computed construction duration.

6.2.6 Monitoring and Maintenance Costs

Costs for Long-Term Monitoring were based on professional experience and judgment on similar beach fill projects completed in the Project area. The Project permits will require biological (sea turtle and shorebird) and physical (surveys, performance analyses) monitoring as well as beach tilling for three years after completion of construction.

6.3 Preliminary Opinion of Probable Project Cost

The Preliminary Opinion of Probable Project Cost is presented in Table 6. It was developed as described above and escalated from the base price year used in the MII and CEC-TAMU costing spreadsheets to the projected construction year. A 10% contingency was applied to account for uncertainties to formulate the project costs for the funding application.

Table 6. Preliminary Opinion of Probable Project Cost

ESTERO ISLAND BEACH RENOURISHMENT PRELIMINARY OPINION OF PROBABLE PROJECT COSTS ANTICIPATED YEAR OF CONSTRUCTION: 2021-22					
Item	Description	Unit	Quantity	Unit Price	Extended Price ¹
1	Design and Permitting	LS	1	\$190,000	\$190,000
2	Mobilization/Demobilization	LS	1	\$2,150,000	\$2,150,000
3	Beach Fill	CY	250,000	\$10.92	\$2,730,000
4	Environmental Protection	LS	1	\$30,000	\$30,000
5	Turbidity Monitoring	Days	100	\$500	\$50,000
6	Shorebird Abatement	Days	110	\$500	\$55,000
7	Construction Management	LS	1	\$300,000	\$300,000
8	Biological Monitoring	Years	3	\$30,000	\$90,000
9	Physical Monitoring	Years	3	\$50,000	\$150,000
10	Beach Tilling	Years	3	\$6,000	\$18,000
¹ Values rounded to the nearest \$1,000 				Subtotal	\$5,763,000
				10% Contingency	\$576,000
				Grand Total	\$6,339,000

7 RECOMMENDATIONS

Based on the seven years of monitoring results, the 2011 beach nourishment project has performed well. The background erosion rate was measured equal to approximately 20,000 CY/YR. The updrift and downdrift beach segments adjacent to the beach fill limits were generally accretional due to the spreading of the beach fill alongshore as well as the beneficial use of the maintenance dredging of Matanzas Pass. There were no documented adverse impacts from the terminal groin or from dredging the Borrow Area.

It is anticipated that re-building the 2011 project to its original design template will address the continuing beach erosion between R-175 and R-182 and will not result in impacts to the adjacent shorelines. Based on the 2019 survey, the volume to fill the 2011 fill template was computed equal to 189,000 CY. Applying 2.5 years of background erosion, the recommended design criteria for the next renourishment event is 250,000 CY.

The Borrow Area has over 1 MCY of available volume which is sufficient for the next renourishment event and future projects within a 15-year time frame assuming a renourishment cycle of ten years.

CEC recommends the Town pursue new 15-year permits for the long-term beach management of Estero Island. The Preliminary Opinion of Probable Project Cost for the next renourishment and three years of post-construction monitoring and beach tilling was developed equal to \$6,339,000.

8 REFERENCES

Coastal Engineering Consultants. (2014). Estero Island Restoration 2nd Year Annual Monitoring Report.

Coastal Engineering Consultants. (2015). Estero Island Restoration 2015 Annual Monitoring Report.

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