

**ESTERO ISLAND RESTORATION  
2018 ANNUAL MONITORING REPORT  
(DEP Permit 0173059-001-JC)**



**Prepared for:**

**Lee County Board of County Commissioners  
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**1.0 INTRODUCTION**

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. This report summarizes the results of the beach fill performance during the sixth-year annual monitoring which was conducted by Coastal Engineering Consultants, Inc. (CEC). The physical monitoring survey was completed in accordance with the Physical Monitoring Plan (PMP) dated May 2002 as outlined in the Florida Department of Environmental Protection (FDEP) Permit No. 0173059-001-JC and Table 1. Funding for the monitoring was provided by Lee County.

**Table 1. Timing of Monitoring Activities.**

<b>Monitoring Activity</b>	<b>Pre-Con</b>	<b>Post-Con</b>	<b>1<sup>st</sup> Year</b>	<b>2<sup>nd</sup> Year</b>	<b>3<sup>rd</sup> Year</b>	<b>5<sup>th</sup> Year</b>	<b>7<sup>th</sup> Year</b>
<b>Beach Profiles</b>	✓	✓	✓	✓	✓	✓	✓
<b>Borrow Area Survey</b>	✓	✓	-	✓	-	✓	✓
<b>Report</b>	-	✓	✓	✓	✓	✓	✓
<b>Special Monitoring Groin and Borrow Area Effects</b>	-	✓	✓	✓	✓	✓	✓

(-) Indicates data collection is not proposed for this time period.

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. 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).

The monitoring plan covers the sand placement area and the adjacent control beaches to the north and south of the sand placement area. The monitored shoreline to the north of the fill area

includes the segment between C-174A and R-175. Monuments C-174A and R-175 are monitored on two (2) separate azimuths with the azimuths of 245° (C-174A) or 248° (R-175) going out into the Gulf, and the azimuth of 10° going across the pass. The monitored shoreline to the south of the fill area includes the segment between R-182 and R-186. A graphical representation of the entire monitoring area with corresponding monument locations is shown in Figure 1. It is noted that the profile comparisons over time are confounded by differences in profile azimuths used by FDEP for historical monitoring and those used by the engineer during construction (Lee County, 2013). CEC employed an assumption and verified same as described herein to enable accurate reporting. However, some of the large-scale volume changes measured since construction may be attributed in part to these differences.

In 2016, the U.S. Army Corps of Engineers (USACE) dredged Matanzas Pass 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. In 2017, the 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 1. Location Map.

## **2.0 SCOPE OF WORK**

The contracted Scope of Work for the monitoring includes the following components.

### **2.1 Physical Monitoring Plan**

The physical monitoring plan (PMP) includes beach profile surveys of the active beach zone to be collected along the shoreline at each R-monument from C-174A to R-186 including one half monument profile at C-180.5. It also includes three (3) additional profile lines (G-lines) to be surveyed at the terminal groin. Profile surveys shall extend landward to the FDEP monument location or approximately 150 feet landward of the vegetation line, whichever is more seaward. Upland profiles shall extend seaward to a wading depth deep enough to provide an approximate 50-foot overlap with the offshore portion of the profile survey where environmental conditions allow. Offshore profile surveys will extend seaward to the -13.2' NAVD contour, 3,000 feet from the shoreline or to the channel center, whichever is least.

### **2.2 Reporting**

An engineering report and the monitoring data are to be prepared and submitted to the County within 90 days following completion of the monitoring survey. The report includes:

- signed and sealed surveyor's report
- beach profile plots depicting the 2017 and 2018 surveys
- 2018 mean high water (MHW) shoreline position and 2017-2018 MHW change tables
- 2017-2018 beach profile volume changes to seaward point of active transport (consistent with prior year reporting)

## **3.0 EQUIPMENT AND QA/QC PROCEDURES**

### **3.1 Survey Report**

The Survey Report is presented in Appendix 1.

### **3.2 Equipment**

The following equipment was utilized for the survey work performed by CEC.

Upland: CEC employed two Trimble R10 Real Time Kinematic (RTK) Global Positioning Systems (GPS) with GLONASS capability for the upland surveys along with a Trimble R8 base receiver installed on an established control point. These systems are capable of delivering RTK positions with coordinate accuracy of  $\pm 10\text{mm} + 2\text{ppm}$ . The standard 2-meter antenna rod allows for data collection seaward of the MHW line up to 5 feet deep while protecting the equipment from the elements.

Offshore: The CEC survey vessel used for this work was a 20-foot fiberglass hull powered by an outboard. An Innerspace 456 single beam echo sounder was used with a side mounted transducer. The GPS antenna was mounted directly above the transducer. A Trimble R8 GLONASS RTK GPS receiver was integrated with the on-board computer system. The HYPACK 2016 software package was the hydrographic guidance program utilized.

### 3.3 QA/QC Procedures

CEC employs an advanced QA/QC program to ensure work performed by us meets the FDEP accuracy standards. CEC upland field crews utilize RTK systems for data collection. CEC also incorporates the necessary equipment on the survey vessel to collect bathymetric survey data "Real-Time". To meet the specification calling for an approximate 50-foot overlap in data between the boat and the upland crew, CEC implements the following procedure. Utilizing "Real-Time" data collection, the boat crew immediately accounts for the tide correction, as well as the draft, and reports measured water depth in NAVD88 at each profile with the upland crew. This gives the upland crew, who simultaneously collects the upland and nearshore profile data, the necessary information to achieve the "overlap" specification.

*Upland Data Collection:* CEC mobilized one operator and GPS rover unit to collect survey data from the approximate MHW line landward to the existing dune while an additional operator and unit collected data just landward of MHW seaward to wading depth or approximately -5 feet NAVD88. The recorded data was maintained within tolerances of  $\pm 3.00$  feet horizontal and  $\pm 0.16$  feet vertical. QA/QC procedures were maintained by both comparison of values with higher accuracy and by repeat measurement.

The Trimble base station was setup on a suitable control point for GPS observations, either a point with provided GPS coordinates or a point with coordinates derived from observations performed during monumentation. The point designation, record coordinates, ellipsoidal height, GEIOD model and antenna height are logged in the field book. At least one check shot was recorded for each RTK rover on a point with known coordinates and GPS observations were collected on known previously established survey control points throughout the day to ensure the integrity of the data.

An electronic list of R-monument coordinates and profile azimuths was loaded into the rover units and measurements were recorded along the azimuth line at intervals no greater than 25 feet or wherever geographical features dictated. The measurements were taken landward along the azimuth line to the location of the R-monument and a measurement was taken on the R-monument when possible. The extent of the vegetation line and prominent features such as seawalls were also noted in the data collection. The measurements were taken seaward along the azimuth line to a minimum depth of -5 feet NAVD88 or as far as conditions dictated, to maintain



a minimum of 50 feet of overlap with the data being collected by the offshore survey crew. This data was then compiled and merged with the offshore data to produce the profile drawings.

*Offshore Data Collection:* All survey equipment was properly calibrated and operated in accordance with FDEP standards. Bar checks to calibrate the fathometer were performed for verification of accuracy at the beginning and end of each survey day. If sea conditions precluded performing the bar check at the end of the day, sea conditions and indication of inability to perform the depth check was recorded and reported. If the day's final bar check was not possible as a result of adverse sea conditions, then the last survey line was repeated during the next day of survey to verify the measurements.

Bathymetric survey data collection was conducted in calm seas. Maximum wave heights during the data collection period were less than 3 feet. The data was collected at intervals not exceeding 25 feet and at all grade breaks along the profile sufficient to accurately describe the bathymetry at the profile locations. The beach profile survey extended seaward to a minimum of 3,000 feet from MHW.

The vertical accuracy of the profile data meets or exceeds the GPS-derived heights (0.2 to 0.5 feet) standard. The horizontal positioning system accuracy of the data was within 2 feet and the off-line horizontal deviation was within 30 feet. Measure downs from a known point to the water's surface were taken periodically throughout the survey as a check for the tides measured by the RTK GPS as necessary.

Bathymetric survey data collection was performed as close in time as possible with the upland topographic survey data collection. This significantly increased efficiency by conducting the work with the same base station set-up. Safety was also increased by having both crews visible to each other at all times.

### **3.4 Data Reduction and Deliverables**

For the beach profiles, the upland and offshore survey data sets were merged together using the HYPACK 2017 subroutines. The reduced data was converted to "xyz" and FDEP formats. The Survey Report is provided in Appendix 1. The "xyz" data file was imported into AutoCAD to generate individual profiles to the specified scale. The profiles are presented in Appendix 2.

## **4.0 PHYSICAL MONITORING**

### **4.1 Survey Dates**

CEC conducted the monitoring survey of North Estero Island on June 20, 2018.

## 4.2 Depth of Closure

The offshore depth beyond which the net sediment transport does not result in significant changes in mean water depth is known as the depth of closure (DOC). For consistency with the prior analyses and monitoring reports (Lee County, 2013 and Coastal Engineering, 2014), the same DOC values were utilized for these analyses and monitoring report.

## 4.3 Shoreline and Volume Change Analyses

### 4.3.1 General

Appendix 2 presents the beach profiles measured at each R-monument for the April 2011 pre-construction, January 2012 post-construction, April 2013 first-year monitoring, July 2014 second-year monitoring, June 2015 third-year monitoring, October 2017 fifth-year monitoring (post-Hurricane Irma), and June 2018 sixth-year monitoring surveys. Summaries of the shoreline and volumetric changes based on the comparisons between the 2017 and 2018 monitoring surveys at the R-monuments are presented below. These comparisons serve as a baseline for determining shoreline and volume change trends.

Table 2 presents the 2017 and 2018 monitoring survey shoreline positions at MHW (= +0.21 feet NAVD88), and the 2017 to 2018 shoreline changes. The table also shows the weighted average which is calculated by using the effective distance. The effective distance is the sum of half the length measured at MHW between the adjacent R-lines. Figure 2 presents the shoreline changes between 2017 and 2018.

Table 3 and Figure 3 present the overall volumetric changes calculated to DOC from comparing the 2017 and 2018 monitoring surveys. Table 4 and Figure 4 present volumetric changes calculated above MHW for this period.

**Table 2. 2017-2018 Shoreline Positions at MHW.**

MONUMENT (AZIMUTH)	POSITION 2017 (FT)	POSITION 2018 (FT)	2017-2018 SHORELINE CHANGE (FT)	2017-2018 AVERAGE SHORELINE CHANGE (FT)		EFFECTIVE DISTANCE (FT)
R-175 (az=10)	382.1	373.4	-8.7	25.9	North Adjacent Shoreline	491.0
C-174A (az=10)	-113.6	-83.4	30.3			332.5
C-174A (az=245)	300.3	356.4	56.1			424.5
R-175 (az=248)	768.2	770.1	1.9	-13.4	Project Area	676.0
R-176 (az=245)	565.1	549.6	-15.5			976.5
R-177 (az=220)	608.0	555.0	-53.0			1089.0
R-178 (az=227)	574.5	576.5	1.9			918.5
R-179 (az=230)	462.9	460.9	-2.1			1006.0
R-180 (az=210)	205.0	166.8	-38.2			860.5
C-180.5 (az=205)	158.7	175.3	16.6			505.5
R-181 (az=205)	140.1	165.5	25.4			757.5
R-182 (az=204)	515.6	457.4	-58.2			930.0
R-183 (az=205)	529.5	493.6	-35.9			-4.5
R-184 (az=205)	512.3	513.6	1.3	1058.0		
R-185 (az=200)	304.5	335.1	30.6	993.8		
R-186 (az=205)	361.0	347.1	-13.9	471.3		
Weighted Avg (FT)				-8.4		
Average Annual Rate (FT/YR)				-12.5		

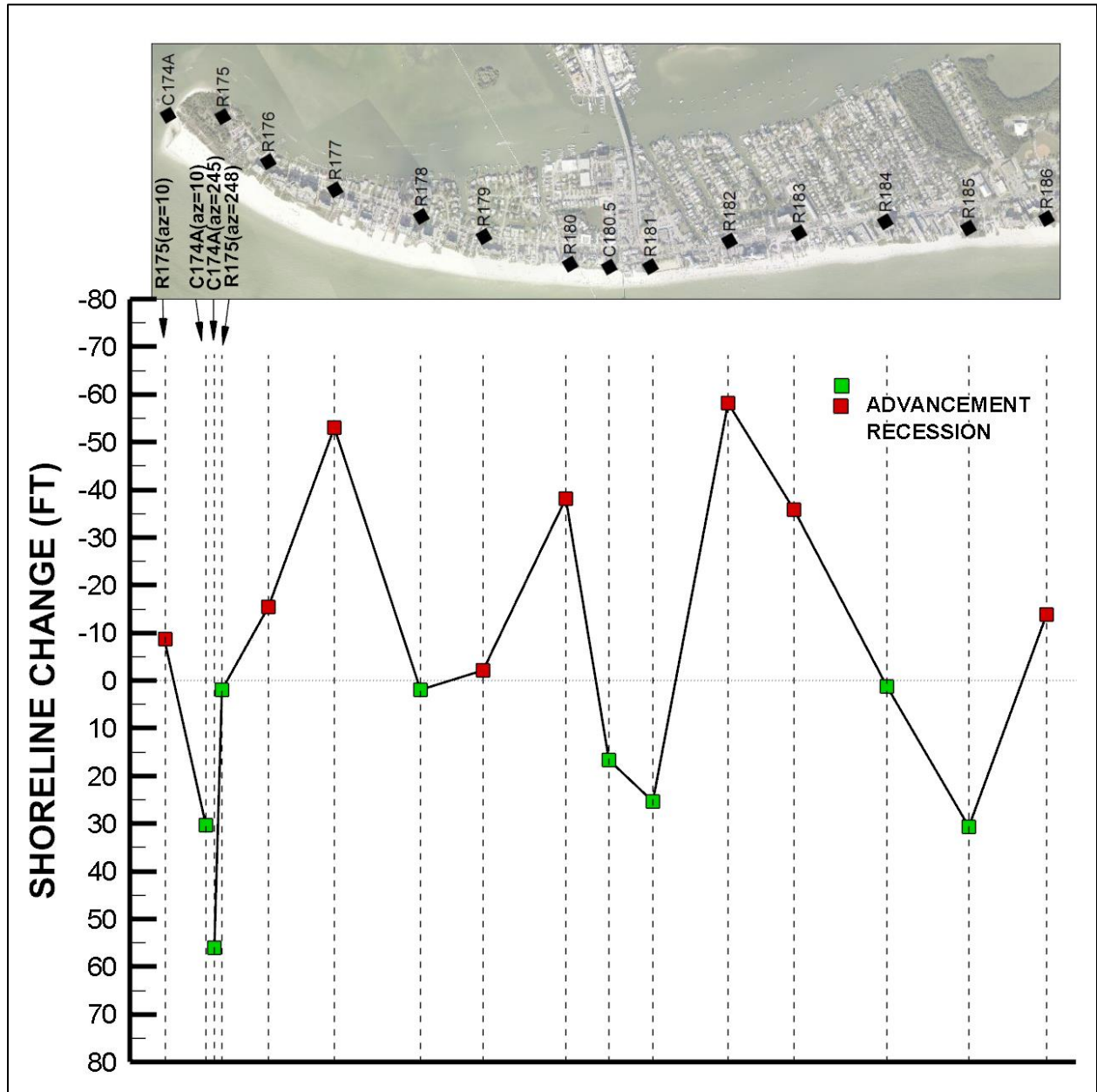


Figure 2. 2017-2018 Shoreline Migration at MHW.

**Table 3. 2017-2018 Volumetric Changes Above Depth of Closure.**

MONUMENT (AZIMUTH)	CELL AREA (YD <sup>3</sup> /FT)	AVE CELL AREA (YD <sup>3</sup> /FT)	LENGTH (FT)	VOLUME (YD <sup>3</sup> )	DOC (FT)	TOTAL VOLUME CHANGE (CY)	
R-175 (az=10)	-2.6				-14.5	32,061	North Adjacent Shoreline
		8.7	675	5,895			
C-174A (az=10)	20.1				-14.5		
		36.6	715	26,166		-40,206	Project Area
C-174A (az=245)	53.1				-14.5		
		27.4	531	14,528			
R-175 (az=248)	1.6				-14.5		
		0.4	817	321			
R-176 (az=245)	-0.9				-14.5		
		-2.4	1,160	-2,782			
R-177 (az=220)	-3.9				-14.5		
		-5.6	1,033	-5,749			
R-178 (az=227)	-7.2				-14.5		
		-9.3	790	-7,328			
R-179 (az=230)	-11.4				-14.5		
		-12.5	1,244	-15,540			
R-180 (az=210)	-13.6				-12.0		
		-11.9	500	-5,928			
C-180.5 (az=205)	-10.1				-12.0		
		-10.6	508	-5,392		-44,659	South Adjacent Shoreline
R-181 (az=205)	-11.1				-12.0		
		-12.3	1,005	-12,335			
R-182 (az=204)	-13.4				-11.0		
		-16.4	856	-14,049			
R-183 (az=204)*	-19.4				-10.5		
		-14.5	1,071	-15,476			
R-184 (az=205)*	-9.5				-10.0		
		-6.5	1,043	-6,738			
R-185 (az=200)	-3.4				-11.0		
		-8.9	945	-8,396			
R-186 (az=205)	-14.4				-11.0		

\* Length of 3,000 feet from MHW was surveyed before DOC was reached

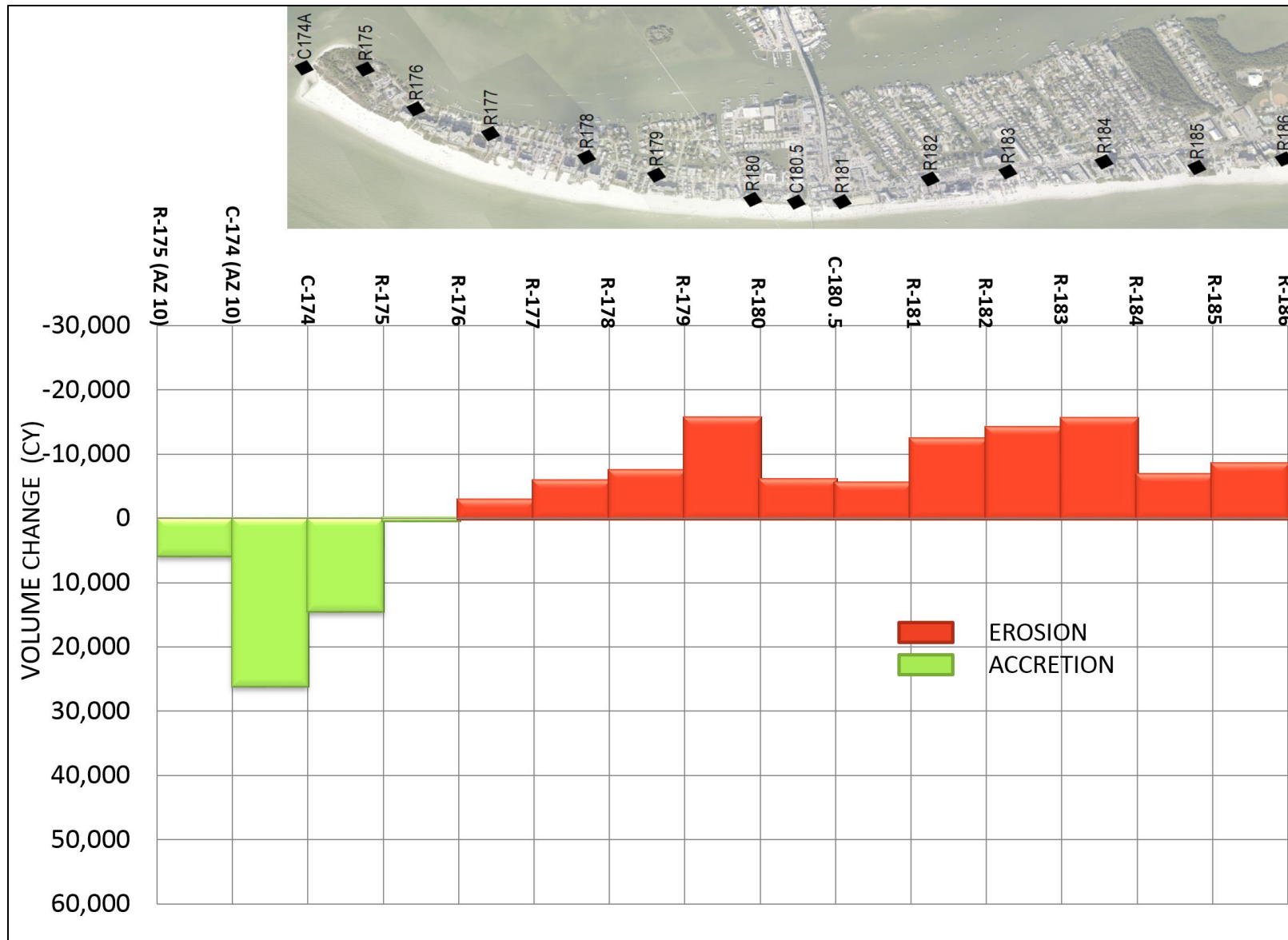


Figure 3. 2017-2018 Volumetric Changes Above Depth of Closure.

**Table 4. 2017-2018 Volumetric Changes Above Mean High Water.**

MONUMENT (AZIMUTH)	CELL AREA (YD <sup>3</sup> /FT)	AVE CELL AREA (YD <sup>3</sup> /FT)	LENGTH (FT)	VOLUME (YD <sup>3</sup> )	TOTAL VOLUME CHANGE (CY)	
R-175 (az=10)	3.3				2,779	North Adjacent Shoreline
		2.1	675	1,448		
C-174A (az=10)	1.0					
		4.2	317	1,331	7,587	Project Area
C-174A (az=245)	7.4					
		4.8	531	2,551		
R-175 (az=248)	2.2					
		1.3	817	1,093		
R-176 (az=245)	0.4					
		-0.6	1,160	-739		
R-177 (az=220)	-1.7					
		-1.4	1,033	-1,460		
R-178 (az=227)	-1.1					
		-0.4	790	-280		
R-179 (az=230)	0.4					
		1.0	1,244	1,189		
R-180 (az=210)	1.5					
		1.5	500	735		
C-180.5 (az=205)	1.4					
		2.7	508	1,353		
R-181 (az=205)	3.9					
		3.1	1,005	3,145	2,632	South Adjacent Shoreline
R-182 (az=204)	2.4					
		1.7	856	1,439		
R-183 (az=204)	1.0					
		0.1	1,071	123		
R-184 (az=205)	-0.8					
		0.8	1,043	793		
R-185 (az=200)	2.3					
		0.3	945	277		
R-186 (az=205)	-1.7					

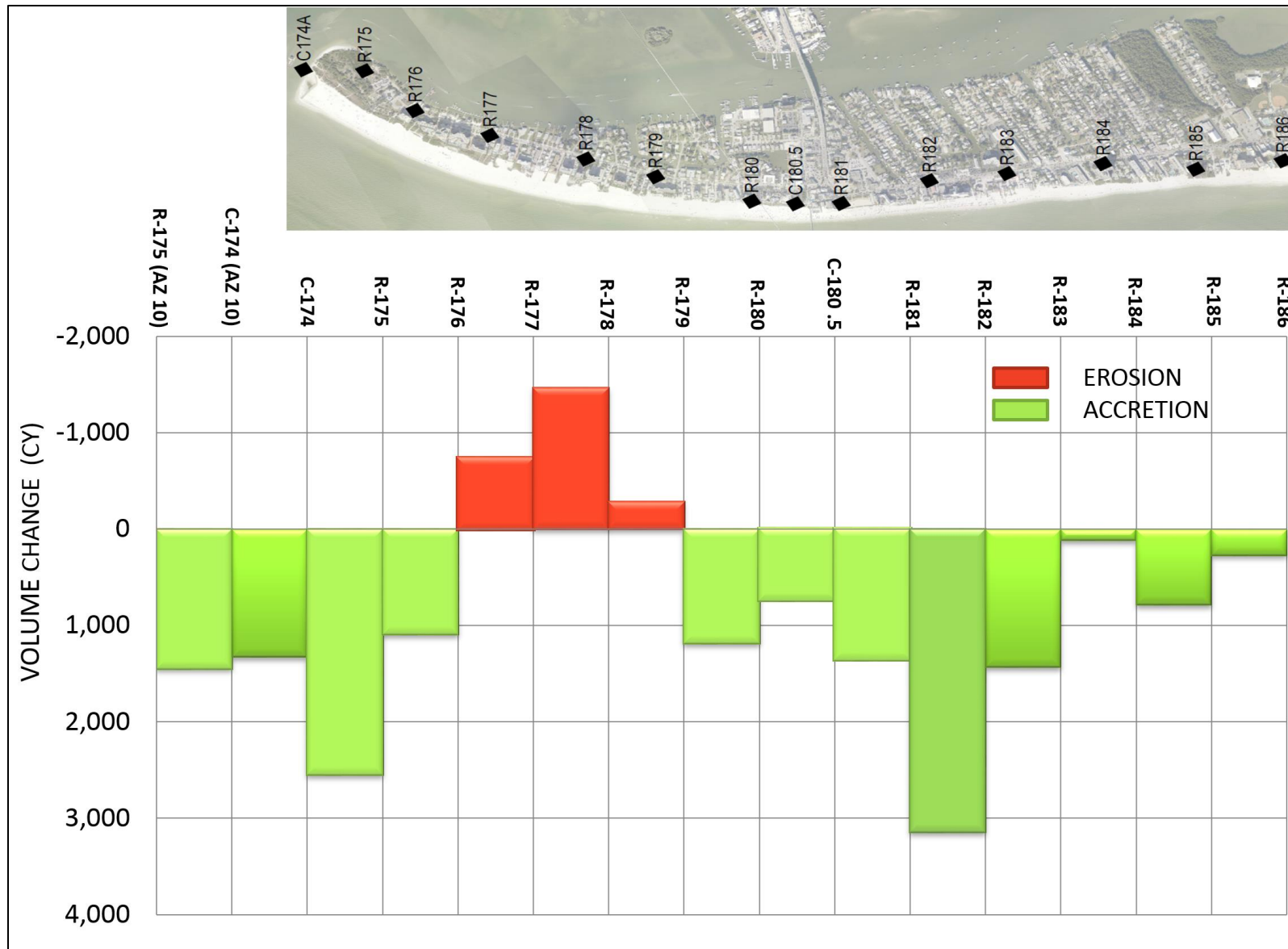


Figure 4. 2017-2018 Volumetric Change Above MHW.



### 4.3.2 Project Area

The Project Area from R-175 to R-182 experienced an average recession of 13.4 feet between the 2017 and 2018 monitoring surveys. The range of shoreline change varied from 58.2 feet of recession at R-182 to 25.4 feet of advancement at R-181. Within the Project Area, the beach experienced erosion of approximately 40,210 cy above DOC. Volumetric changes above DOC ranged from 15,540 cy of erosion between R-179 and R-180 to 14,530 cy of accretion between R-174A (az=245°) and R-175 (az=248°). The Project Area experienced net accretion above MHW of approximately 7,590 cy. The changes above MHW ranged from 1,460 cy of erosion between R-177 and R-178 to 3,150 cy of accretion between R-181 and R-182. The accretion in the vicinity of R-181 may be attributed in part to the truck haul project.

### 4.3.3 North Adjacent Shoreline

The north adjacent shoreline begins at the terminal groin and wraps around the north side of Estero Island into Matanzas Pass to R-175 (az=10°). On average, the shoreline advanced 25.9 feet. The shoreline change ranged from 8.7 feet of recession at R-175 (az=10 °) to 56.1 feet of advancement at C-174A (az=245°).

The net volume change above DOC between 2017 and 2018 was approximately 32,060 cy of accretion. Above MHW, the net change was approximately 2,780 cy of accretion. During the 2016 USACE's maintenance dredge project approximately 25,000 cy were removed from the North Adjacent Shoreline Monitoring Area (CEC, 2018). Figure 5 presents a plan view of the North Adjacent Shoreline Monitoring Area between C-174A (az=10°) and R-175 (az=10°) along with the 2016 dredge project (bottom of cut) and survey lines. The 2015-2017 volumetric analysis yielded approximately 33,710 cy of erosion above DOC (CEC, 2018). The 2017-2018 volume changes indicate the area recovered since completion of the dredging project.

### 4.3.4 South Adjacent Shoreline

The south adjacent shoreline begins at R-182 and extends south to R-186. This stretch of beach experienced average recession of approximately 4.5 feet between 2017 and 2018. The shoreline change ranged from 35.9 feet of recession at R-183 to 30.6 feet of advancement at R-185.

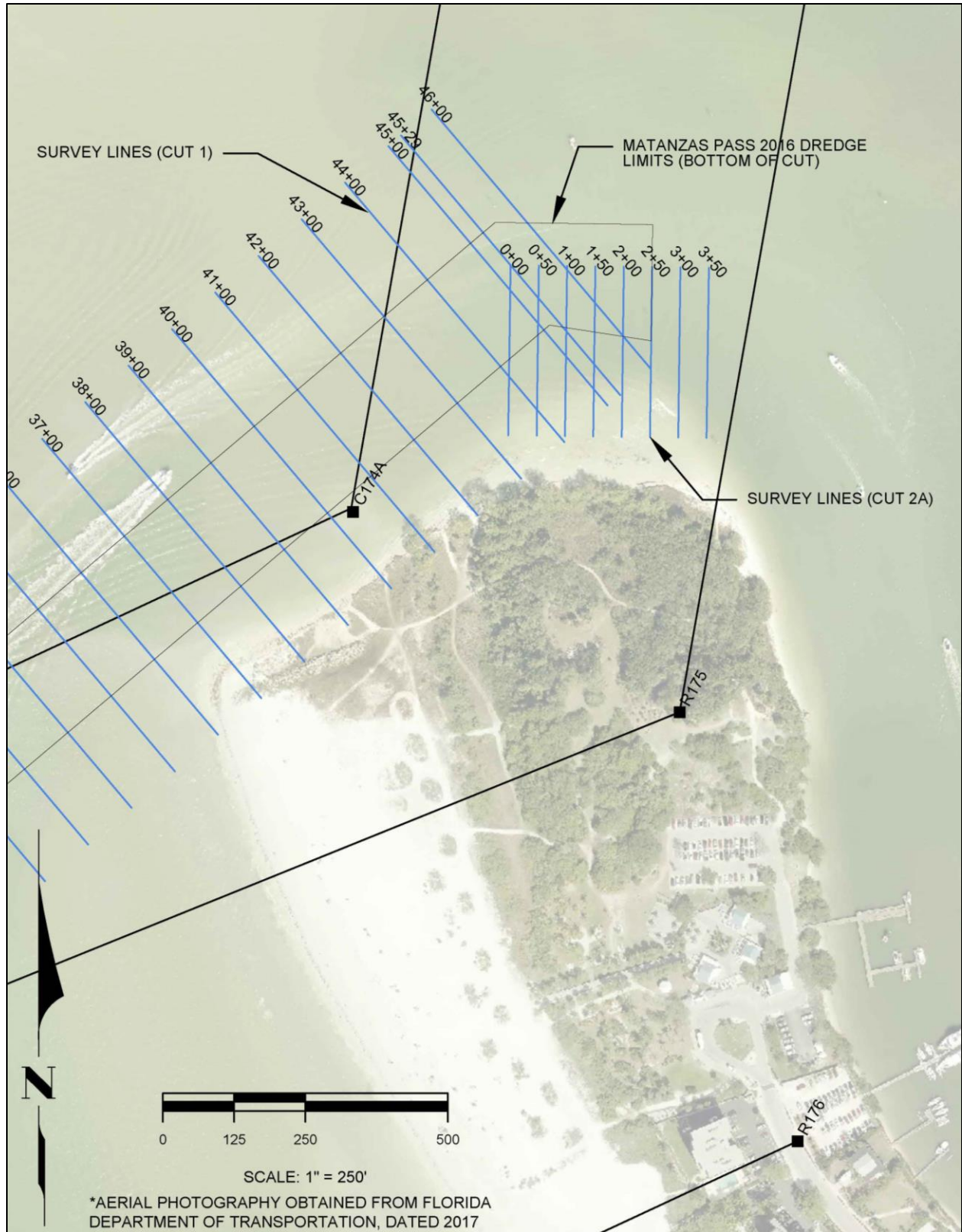


Figure 5. Plan View of North Adjacent Shoreline and 2016 USACE Dredging Project.

The net volume change above DOC between 2017 and 2018 was approximately 44,660 cy of erosion. Above MHW, the net change was approximately 2,630 cy of accretion.

During the 2016 USACE's maintenance dredge project, approximately 130,000 cy were placed in the nearshore between R-182 and R-186 (CEC, 2018). The 2017-2018 volume change analysis indicates that some of the placed material was lost due to fill equilibration noting that these losses were, in general, below MHW.

#### 4.3.5 Summary

The individual beaches within the monitoring area extending from C-174A to R-186 experienced a high degree of variability in the shoreline changes as well as volumetric gains/losses. Overall, between October 2017 and June 2018, the shoreline within the monitoring area receded on average at an annual rate of approximately 12.5 feet per year. The total volume change within the monitoring area was approximately 52,800 cy of erosion above DOC and approximately 13,000 cy of accretion above MHW.

#### 4.4 Project Area Performance

Table 5 presents the 2011 through 2018 monitoring survey shoreline positions at MHW for the monitoring area. In addition to the positions, the table includes shoreline change rates calculated for the 2012-2018 time period representing the six-year post-construction monitoring period. For consistency, the same effective distances as in Table 3 were utilized to determine the weighted average. Between 2012 and 2018, the Project Area shoreline experienced an average recession of 15.5 feet. The areas adjacent to the Project Area have both experienced advancement, 3.2 feet on the north and 9.5 feet on the south. The weighted average shoreline change rate for the entire monitoring area between 2012 and 2018 equated to 6.9 feet per year of recession.

Figure 6 presents the 2012, 2013, 2014, 2015, 2017, and 2018 MHW positions relative to the 2011 pre-construction MHW positions which were utilized as the baseline for the Project Area.

Table 6 and Figure 7 present the volumetric changes from the pre-construction survey in 2011 to the post-construction survey in 2012 within the fill footprint. In addition, the table presents the volumetric changes between 2012 post-construction and each of the 2013, 2014, 2015, 2017 and 2018 monitoring surveys. In summary, the net volume change between 2012 and 2018 within the fill footprint was approximately 144,110 cy of erosion.

**Table 5. 2012-2018 Shoreline Changes.**

MONUMENT (AZIMUTH)	POSITION (FT)							2012-2018 SHORELINE CHANGE RATE (FT/YR)	2012-2018 AVERAGE SHORELINE CHANGE RATE (FT/YR)	
	2018	2017	2015	2014	2013	POST- CON 2012	PRE- CON 2011			
R-175 (az=10)	373.4	382.08	403.85	392.0	355.6	352.8	N/A	3.2	3.2	North Adjacent Shoreline
C-174A (az=10)	-83.4	-113.63	-78.4	-94.8	N/A	N/A	N/A	N/A		
C-174A (az=245)	356.4	300.32	N/A	N/A	N/A	N/A	N/A	N/A		
R-175 (az=248)*	770.1	768.17	786.7	761.7	767.2	759.7	439.6	1.6	-15.5	Project Area
R-176 (az=245)	549.6	565.12	584.46	560.5	591.0	673.0	347.8	-19.1		
R-177 (az=220)*	555.0	607.96	636.37	648.7	647.2	739.8	455.8	-28.6		
R-178 (az=227)*	576.5	574.54	620.1	638.0	611.7	656.2	472.2	-12.3		
R-179 (az=230)*	460.9	462.91	500.5	524.2	516.9	564.7	353.7	-16.1		
R-180 (az=210)*	166.8	204.99	208.33	215.2	257.9	332.1	117.3	-25.6		
C-180.5 (az=205)	175.3	158.71	180.21	202.6	241.2	323.9	132.8	-23.0		
R-181 (az=205)	165.5	140.09	175.88	194.3	220.9	331.9	113.1	-25.8		
R-182 (az=204)*	457.4	515.56	416.46	423.2	424.3	394.8	398.4	9.7		
R-183 (az=205)	493.6	529.45	477.71	428.7	434.2	449.6	N/A	6.8		
R-184 (az=205)	513.6	512.31	502.55	498.2	447.8	469.5	N/A	6.8		
R-185 (az=200)*	335.1	304.47	296.84	305.1	256.2	229.1	N/A	16.4		
R-186 (az=205)	347.1	360.99	329.43	319.7	318.7	296.9	N/A	7.8		
								Avg Annual Rate (FT/YR)	-6.9	

N/A = profile below MHW

\*2012 Line was shifted from adjacent azimuth

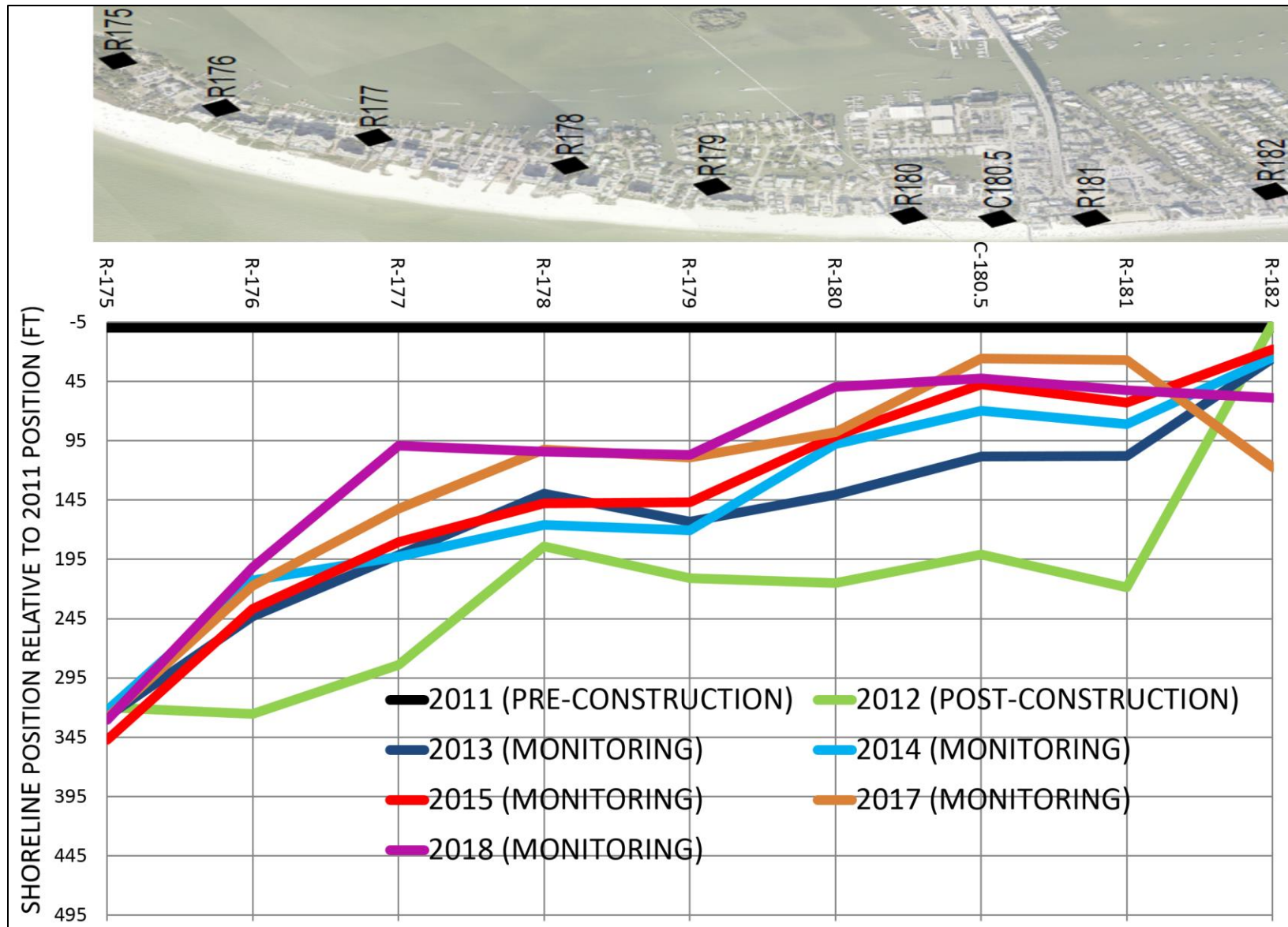


Figure 6. 2012-2018 Shoreline Positions within Project Area Relative to 2011 Pre-Construction Shoreline Position.

**Table 6. 2012-2018 Volumetric Changes within Project Area Fill Footprint.**

MON (AZIMUTH)	2011 to 2012			2012 to 2013			2012 to 2014		
	CELL AREA (YD <sup>3</sup> )	AVE CELL AREA (YD <sup>3</sup> /FT)	VOL (YD <sup>3</sup> )	CELL AREA (YD <sup>3</sup> )	AVE CELL AREA (YD <sup>3</sup> /FT)	VOL (YD <sup>3</sup> )	CELL AREA (YD <sup>3</sup> )	AVE CELL AREA (YD <sup>3</sup> /FT)	VOL (YD <sup>3</sup> )
R-174 (az=245)	0			0			0		
		37.9	20,143		0.7	348		1.7	921
R-175 (az=248)*	40,975			708			1,874		
		79.8	65,199		-4.3	-3,527		-3.7	-3,063
R-176 (az=245)	45,226			-5,371			-5,923		
		79.4	92,107		-11.1	-12,890		-12.7	-14,707
R-177 (az=220)*	40,560			-6,634			-7,775		
		55.9	57,707		-3.4	-3,471		-2.6	-2,657
R-178 (az=227)*	19,801			3,003			4,996		
		41.8	32,973		3.9	3,083		4.7	3,719
R-179 (az=230)*	25,289			1,213			89		
		49.9	62,113		-4.7	-5,842		-11.9	-14,800
R-180 (az=210)*	28,629			-6,284			-12,936		
		50.3	25,132		-11.4	-5,693		-23.0	-11,481
C-180.5 (az=205)	25,703			-6,024			-11,884		
		48.3	24,541		-11.7	-5,944		-21.7	-11,031
R-181 (az=205)	26,479			-6,616			-11,571		
		24.5	24,631		-6.1	-6,154		-10.7	-10,763
R-182 (az=204)*	0			0			0		
<b>Totals</b>			<b>404,545</b>			<b>-40,090</b>			<b>-63,861</b>

\*2012 Line was shifted from adjacent azimuth

**Table 6 (cont'd). 2012-2018 Volumetric Changes within Project Area Fill Footprint.**

MON (AZIMUTH)	2012 to 2015			2012 to 2017			2012 to 2018		
	CELL AREA (YD <sup>3</sup> )	AVE CELL AREA (YD <sup>3</sup> /FT)	VOL (YD <sup>3</sup> )	CELL AREA (YD <sup>3</sup> )	AVE CELL AREA (YD <sup>3</sup> /FT)	VOL (YD <sup>3</sup> )	CELL AREA (YD <sup>3</sup> )	AVE CELL AREA (YD <sup>3</sup> /FT)	VOL (YD <sup>3</sup> )
R-174 (az=245)	0			0			0.0		
		3.5	1,837		1.8	954		2.4	1,257
R-175 (az=248)*	3,736			1,940			4.7		
		-1.7	-1,413		-7.5	-6,117		-7.0	-5,707
R-176 (az=245)	-5,604			-10,028			-18.7		
		-13.6	-15,810		-23.5	-27,234		-25.2	-29,236
R-177 (az=220)*	-9,121			-15,337			-31.7		
		-5.3	-5,435		-16.5	-17,038		-19.2	-19,844
R-178 (az=227)*	3,435			-2,484			-6.7		
		2.4	1,857		-7.7	-6,116		-10.6	-8,378
R-179 (az=230)*	-897			-5,879			-14.5		
		-12.6	-15,668		-21.4	-26,670		-25.5	-31,698
R-180 (az=210)*	-12,704			-17,273			-36.5		
		-24.4	-12,187		-33.6	-16,761		-35.7	-17,857
C-180.5 (az=205)	-13,643			-18,963			-35.0		
		-25.5	-12,970		-33.0	-16,752		-33.2	-16,870
R-181 (az=205)	-13,936			-16,657			-31.4		
		-12.9	-12,964		-15.4	-15,494		-15.7	-15,774
R-182 (az=204)*	0			0			0.0		
<b>Totals</b>			<b>-72,753</b>			<b>-131,228</b>			<b>-144,106</b>

\*2012 Line was shifted from adjacent azimuth

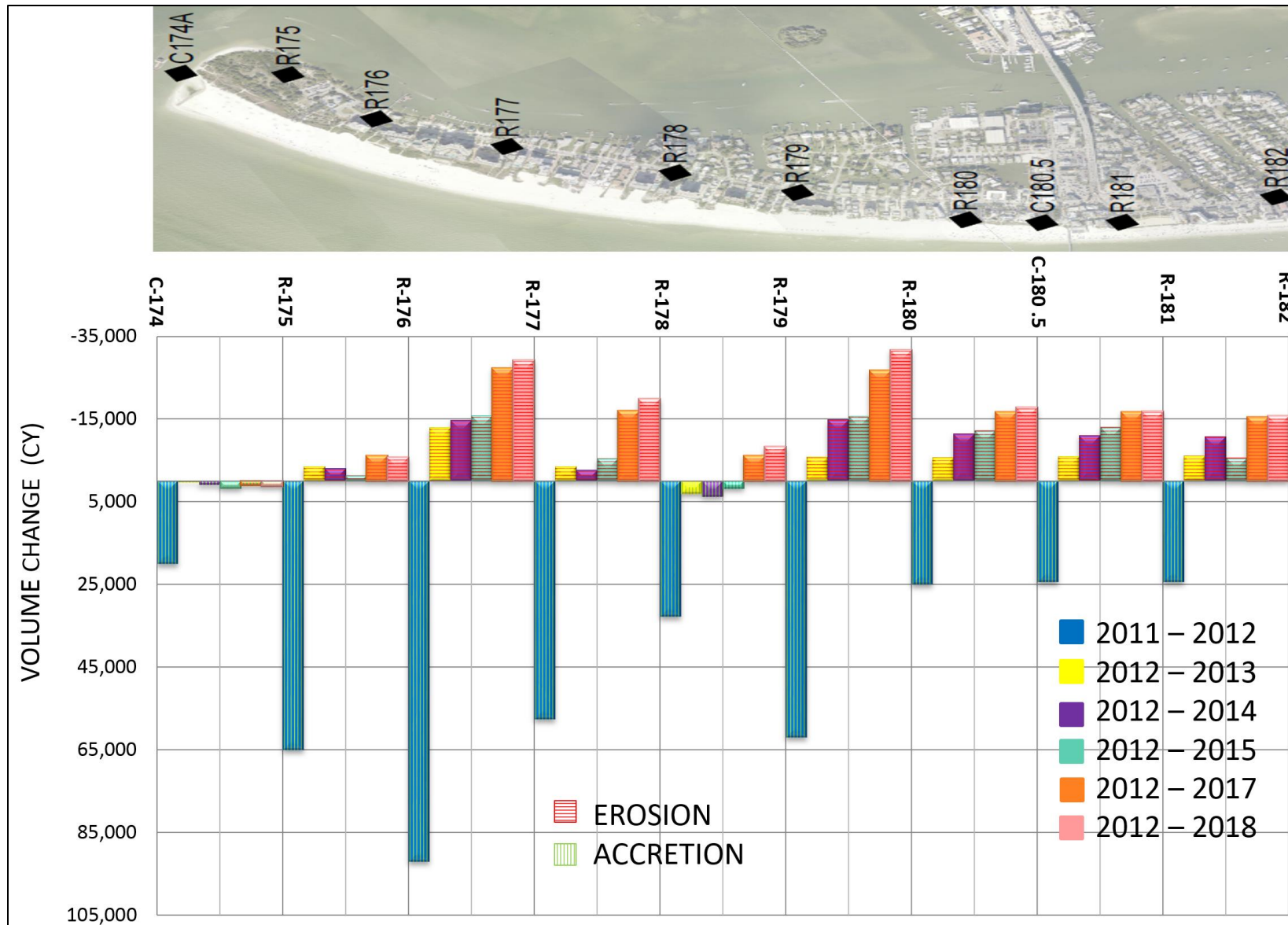


Figure 7. 2012-2018 Volumetric Changes within Project Area.



In order to calculate the percent loss and remaining fill within the Project Area, CEC calculated the volume placed by comparing the 2011 pre-construction survey to the 2012 post-construction survey. The limits of the volume calculations were from the landward extent of the 2011 pre-construction survey to the toe of fill of the 2012 post-construction survey. In addition, some 2012 post-construction lines were shifted from an adjacent azimuth by holding a control point at the elevation of +4 feet NAVD88 to enable volume computations due to varying profile azimuths measured over time. These lines are denoted with an asterisk (\*) in Tables 5 and 6. The volume placed between the 2011 pre-construction and 2012 post-construction survey was calculated to be approximately 404,550 cy. This volume was then compared to the volume recorded in the pays surveys during construction (Lee County, 2013), approximately 403,000 cy, which is within one percent, which confirms the profile adjustments employed and analysis performed herein.

The volumetric changes for 2013, 2014, 2015, 2017 and 2018 were then calculated by comparing the monitoring surveys to the 2012 post-construction survey maintaining the 2012 toe of fill as the seaward limit. Between 2012 and 2013 (15 months), the Project Area experienced erosion of approximately 40,090 cy. Between 2012 to 2014 (30 months), the Project Area experienced approximately 63,860 cy of erosion. Between 2012 and 2015 (41 months), the Project Area experienced approximately 72,750 cy of erosion. Between 2012 and 2017 (69 months), the Project Area experienced approximately 131,230 cy of erosion. Between 2012 and 2018 (78 months), the Project Area experienced approximately 144,110 cy of erosion. The percent remaining in the Project Area in 2018 equates to approximately 64.0%.

Accounting for the time period between the surveys, the annualized erosion rates for the Project Area for the 2012-2013, 2013-2014, 2014-2015, 2015-2017, and 2017-2018 monitoring periods equate to approximately 32,070 cy/year, 19,020 cy/year, 9,700 cy/year, 25,060 cy/year, and 19,110 cy/year, respectively.

#### **4.5 Contingent Area Performance**

The area of contingency includes the northern tip of Estero Island north and west of the terminal groin (Lee County, 2003). This area is monitored to evaluate the potential of downdrift effect as a result of the terminal groin. Between 2017 and 2018 the area experienced an average advancement of 25.9 feet. The segment gained approximately 2,780 cy above MHW and approximately 32,060 cy to DOC. A review of the groin G-line profiles also indicates shoreline accretion between 2017 and 2018 (Appendix 2). Further, the 2018 MHW shoreline at the groin location is still seaward of its 2012 post-construction and 2013 positions. Based on that, it is concluded that during the 2017-2018 monitoring period no terminal groin related adverse impacts to the contingent shoreline were documented.

## 5.0 CONCLUSION

This report describes the sixth-year annual monitoring results of the Estero Island Restoration Project. The information presented herein provides the necessary data for Lee County to observe and assess, with quantitative measurements, the performance of the project, any adverse effects which have occurred, and the need for any adjustments, modifications, or mitigative response to the Project. The scientific monitoring processes also provides the County information necessary to plan, design, and optimize subsequent follow-up projects, potentially reducing the need for and costs of unnecessary work, as well as potentially reducing any environmental impacts that may have occurred or be expected. While the assumption on profile adjustments employed herein was verified, some of the large-scale volume changes measured since construction may be attributed in part to differences in profile azimuths measured over time.

Between October 2017 and June 2018, the shoreline within the monitoring area receded on average at an annual rate of approximately 12.5 feet per year. The total volume change was approximately 52,800 cy of erosion above DOC and approximately 13,000 cy of accretion above MHW.

During the same period, the Project Area from R-175 to R-182 experienced an average recession of 13.4 feet. Within the Project Area, the beach experienced net erosion of approximately 40,210 cy above DOC and net accretion of approximately 7,590 cy above MHW.

The Project Area which received fill in 2011 experienced erosion of approximately 40,090 cy between 2012 and 2013, 23,770 cy between 2013 and 2014, 8,890 cy between 2014 and 2015, 58,480 cy between 2015 and 2017, and 12,880 cy between 2017 and 2018 as measured within the fill template. There is approximately 260,440 cy or 64% remaining within the design template from the original volume placed. These values are with respect to each survey event and computed within the 2011 fill footprint.

Monitoring of the contingency area, adjacent to and downdrift of the terminal groin, indicated there were no documented impacts to the contingency shoreline from the terminal structure. The shoreline segment between C-174A (az=10°) and R-174A (az=245°) experienced an average advancement of 25.9 feet. It gained approximately 2,780 cy above MHW and approximately 32,060 cy to DOC.

Based on the monitoring, there were no unanticipated or documented adverse impacts to the natural resources or coastal system within the Project Area or adjacent control beaches.

## 6.0 REFERENCES

Lee County. (2003). Estero Island, Lovers Key & Bonita Beach restoration; contingency plan. DEP permit 0173059-JC & 0200803-JC. Fort Myers.

Lee County. (2013). "Estero Island Restoration 1<sup>st</sup> Year Annual Monitoring Report." Lee County Division of Natural Resources, Fort Myers.

Coastal Engineering. (2014) "Estero Island Restoration 2<sup>nd</sup> Year Annual Monitoring Report." Coastal Engineering Consultants Inc., Naples.

Coastal Engineering. (2018) "Estero Island Restoration 2017 Annual Monitoring Report." Coastal Engineering Consultants Inc., Naples.

APPENDIX 1

SURVEY REPORT



A CECI GROUP COMPANY

CECI Group Services  
Coastal and Marine Engineering  
Environmental and Geological Services  
Land and Marine Survey and Mapping  
Website: [www.coastalengineering.com](http://www.coastalengineering.com)

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## 2018 ESTERO ISLAND ANNUAL MONITORING SURVEY

### SURVEY REPORT

All Surveys were conducted utilizing multiple Trimble Real Time Kinematic (RTK) Global Positioning Systems (GPS). The Monitoring Survey was performed on June 20, 2018. All GPS control during this survey was referenced from previously established Florida Department of Environmental Protection (FDEP) Bureau of Beaches and Coastal Systems (BBCS) and meets or exceeds Geospatial Positioning Accuracy Standards, Range VIII.

All "R monument" and intermediate beach profiles were collected on the State Plane Coordinate System Grid, Florida West Zone and survey data was collected along FDEP established grid bearings as outlined in the project Scope of Work. The horizontal and vertical datums were North American Datum (NAD) of 1983/2012 Adjustment and North American Vertical Datum (NAVD) of 1988, Geoid 2012A, respectively.

All survey control was established as part of the upland topographic survey control work and conducted in accordance with the FDEP Monitoring Standards for Beach Erosion Control Projects. These surveys meet the requirements set forth in Chapter 5J-17 (F.A.C.) Florida Administrative Code. The following published vertical control was used and checked during the surveys:

ACOE ESTERO 101 2015 JAX DIST, PID BBDV83, Elevation = 4.73 Feet, NAVD of 1988  
FDEP 1283-A25-2, Elevation = 3.37 feet, NAVD of 1988

### **Equipment**

*Upland:* CEC employed two Trimble Real Time Kinetic (RTK) GPS rover receivers with GLONASS capability systems for the upland surveys. These systems are capable of delivering RTK positions with coordinate accuracy of  $\pm 10\text{mm} + 2\text{ppm}$ . Wireless Bluetooth technology allows our surveyors to collect data seaward of the Mean High Water line in the "surf zone" up to 5 feet deep.

*Offshore:* The survey vessel used for this work was a 20-foot fiberglass hull powered by an outboard. An Innerspace 456 single beam echo sounder was used with a side mounted transducer. A Trimble R8 GPS antenna with GLONASS capability was installed on the side mount bracket directly above the transducer. The Trimble R8 receiver was integrated with the on-board computer system. Hypack 2017 software package was the hydrographic guidance program utilized.

### **QA/QC Procedures**

CEC employs an advanced QA/QC program to ensure our work meets the FDEP accuracy standards. CEC upland field crews utilize RTK systems for data collection. CEC also incorporates the necessary equipment on the survey vessel to collect bathymetric survey data "Real-Time". To meet the specification calling for an approximate 50-foot overlap in data between the boat and the upland crew, CEC implements the

following procedure. Utilizing "Real-Time" data collection, the boat crew immediately accounts for the tide correction, as well as the draft, squat, roll and pitch variables, and reports measured water depth in NAVD88 at each profile with the upland crew. This gives the upland crew, who simultaneously collects the upland and near shore profile data, the necessary information to achieve the "overlap" specification.

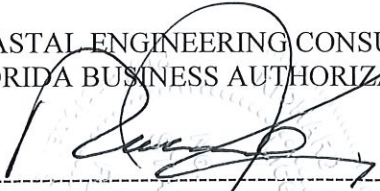
*Upland Data Collection:* CEC mobilized one surveyor equipped with a Trimble RTK GPS rover unit to collect survey data from the approximate Mean High Water line landward to the existing dune while an additional operator collected data just landward of the mean high water seaward to wading depth or approximately -5 feet NAVD88. The recorded data was maintained within tolerances of  $\pm 0.20$  feet horizontal and  $\pm 0.10$  feet vertical. QA/QC procedures were maintained by both comparison of values with higher accuracy and by repeat measurement.

An electronic list of R-monument (R-mon) coordinates and profile azimuths was loaded into the rover units, along with a pre-generated .DXF file representing these profile azimuths, and measurements were recorded along the azimuth line at intervals no greater than 25 feet or wherever geographical features dictated. The measurements were taken landward along the azimuth line to the location of the R-mon and a measurement was taken on the R-mon when possible. The measurements were taken seaward along the azimuth line to a minimum depth of -5 feet NAVD88 or as far as conditions dictated, to maintain a minimum of 50 feet of overlap with the data being collected by the offshore survey crew. This data was then compiled and merged with the offshore data to produce the profile drawings.

*Offshore Data Collection:* All survey equipment was properly calibrated and operated in accordance with FDEP standards. Bar checks to calibrate the fathometer were performed for verification of accuracy at the beginning and end of each survey day. A direct depth measurement check was conducted and recorded at both shallow and maximum depths relative to the work area at the beginning and end of each survey day, and more frequently if necessary. Latency corrections were calculated and adjustments were made to the data using the Hypack subroutines.

Bathymetric survey data collection was performed as close in time as possible with the upland topographic survey data collection.

COASTAL ENGINEERING CONSULTANTS, INC.  
FLORIDA BUSINESS AUTHORIZATION NO. LB 2464

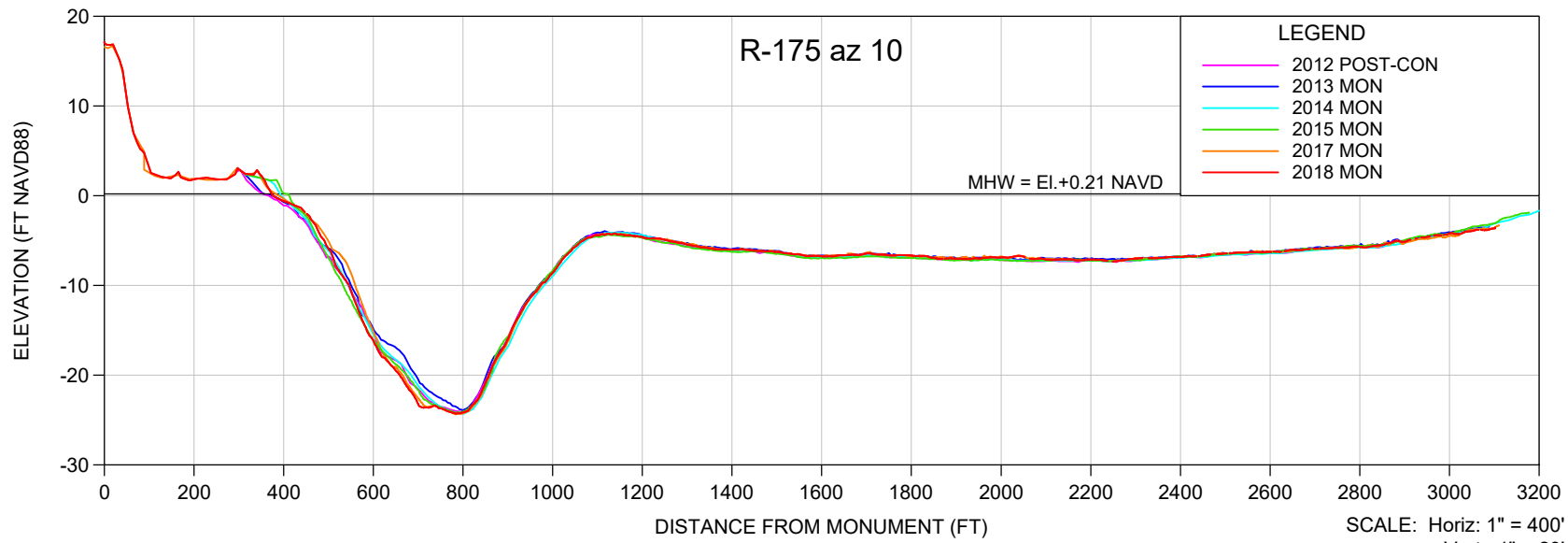
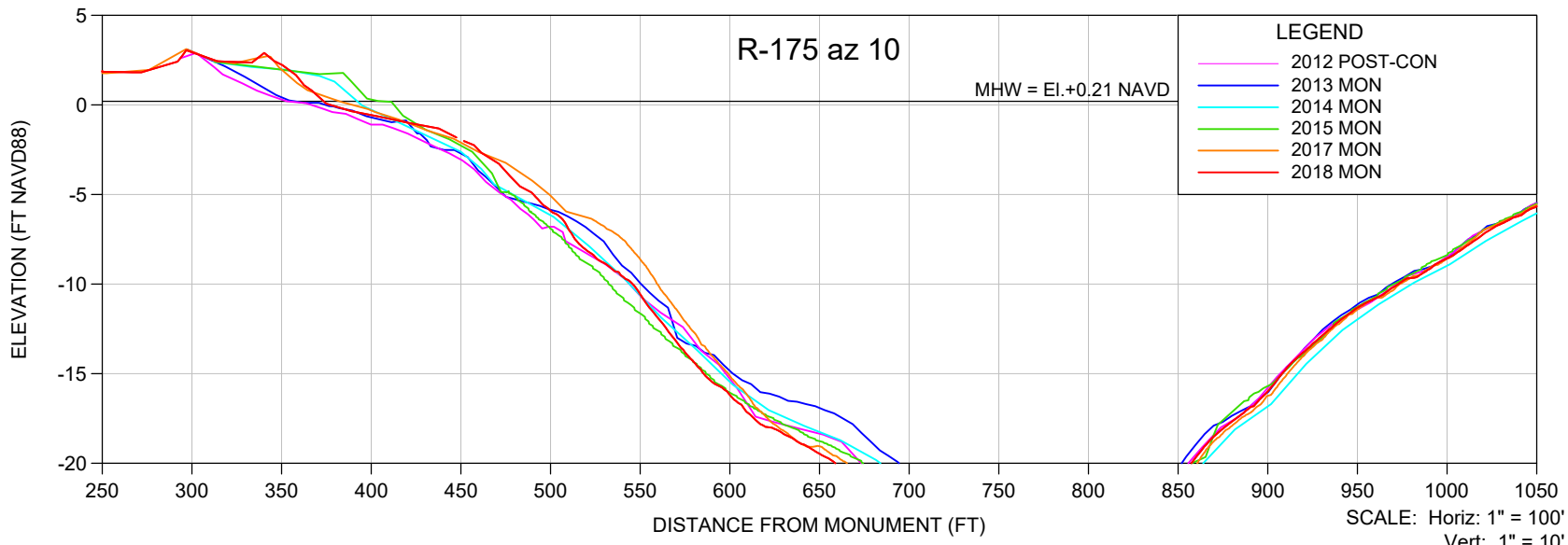


Richard J. Ewing, P.S.M.  
Professional Surveyor and Mapper  
Florida Certificate No. 5295

NOT VALID WITHOUT THE SIGNATURE AND  
THE ORIGINAL RAISED SEAL OF A FLORIDA  
LICENSED SURVEYOR AND MAPPER  
CEC FILE NO. 18.079  
DATE OF SIGNATURE: 8-24-18

## APPENDIX 2

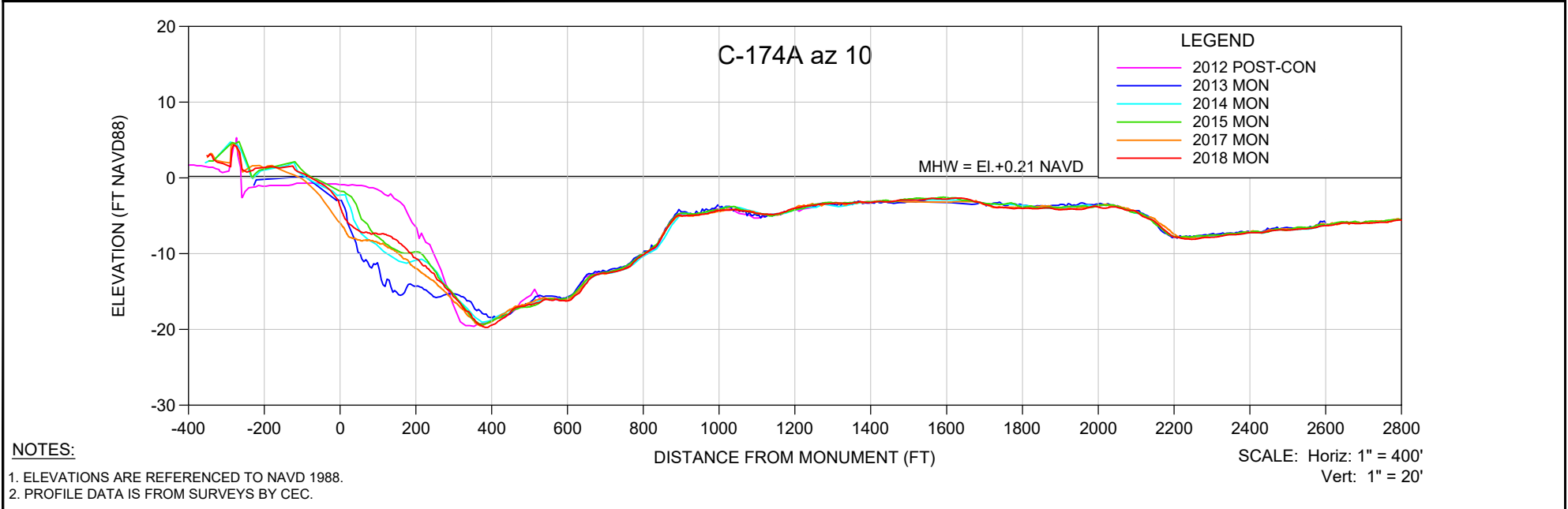
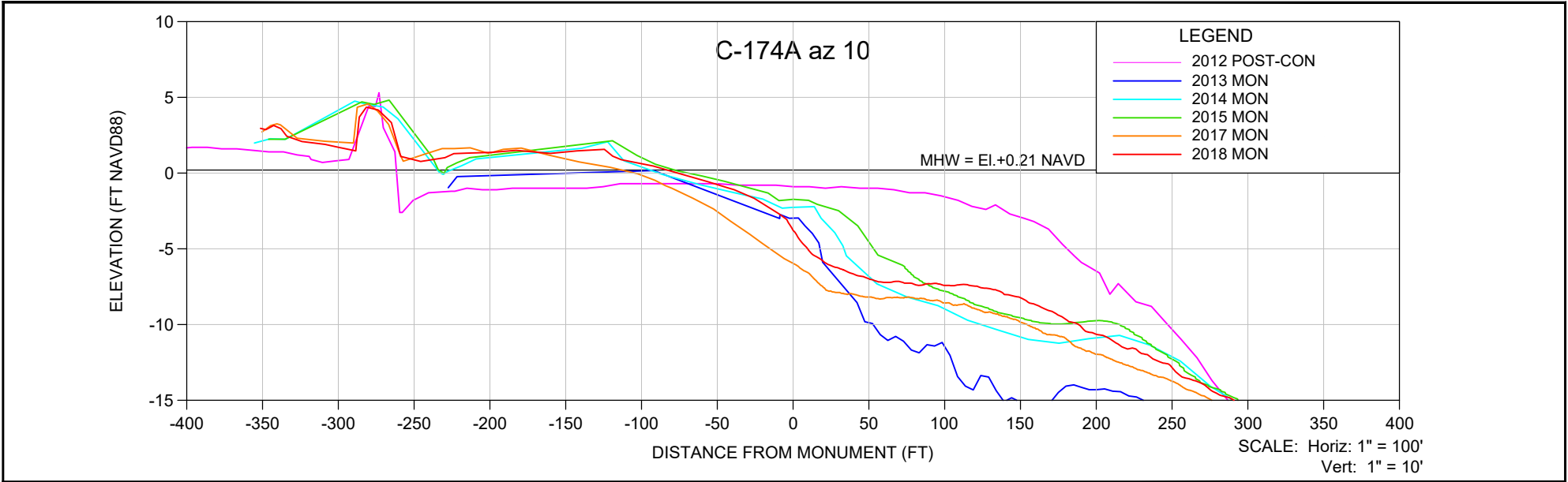
### BEACH PROFILE



- NOTES:**
- ELEVATIONS ARE REFERENCED TO NAVD 1988.
  - PROFILE DATA IS FROM SURVEYS BY CEC.

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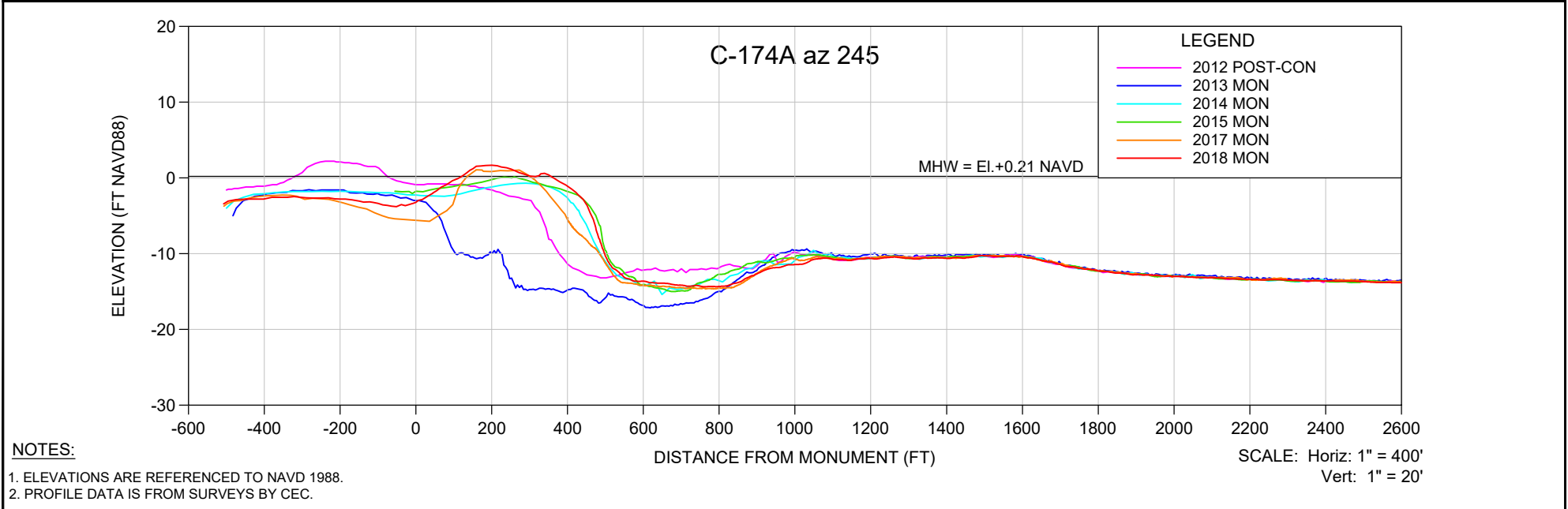
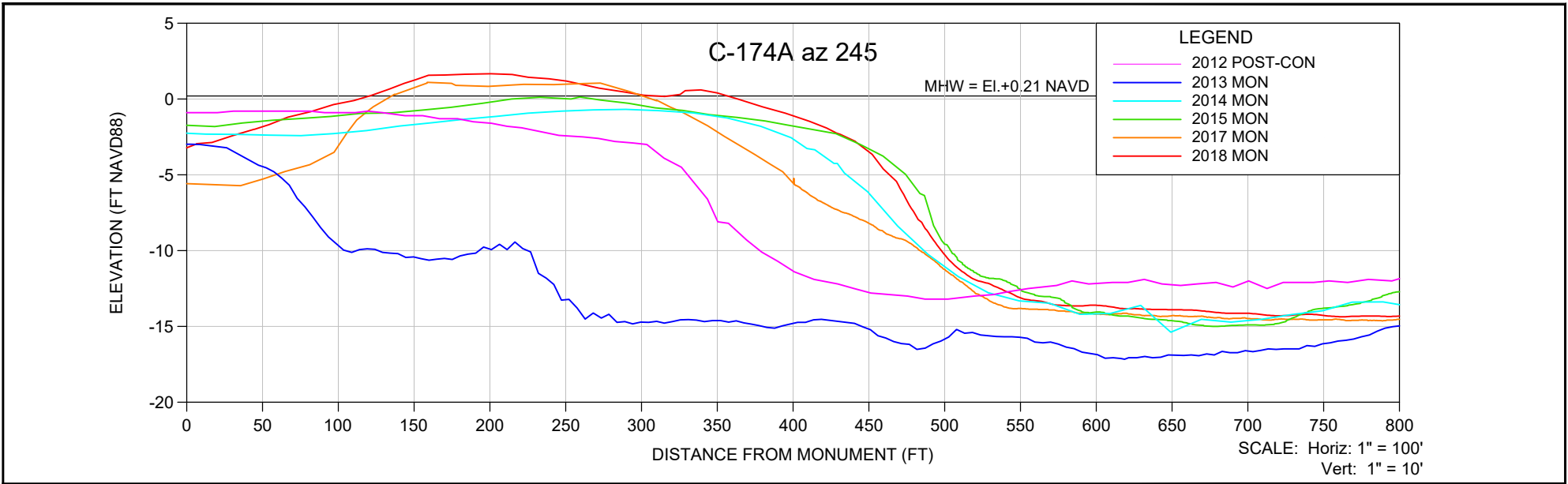




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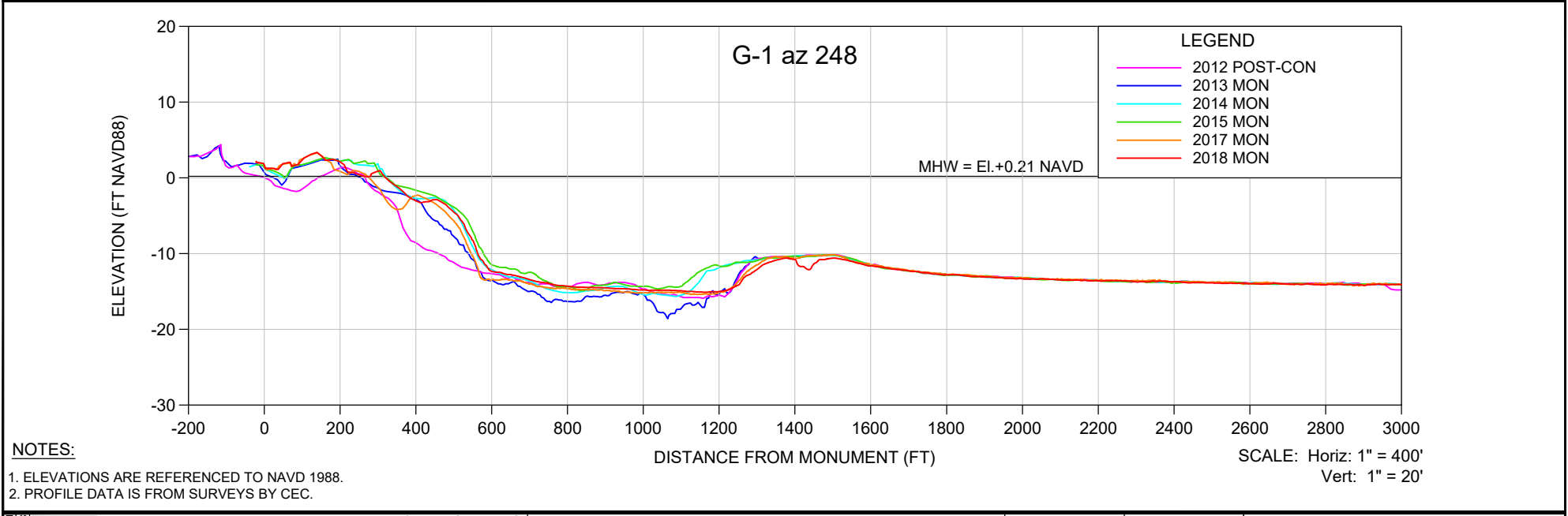
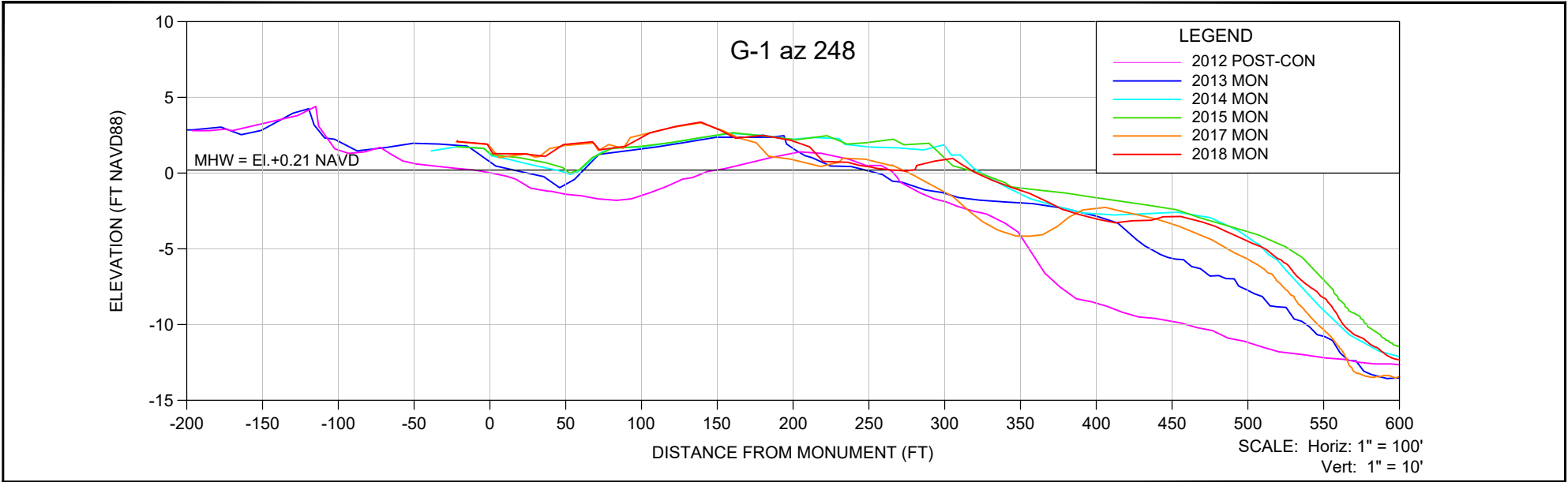
- ELEVATIONS ARE REFERENCED TO NAVD 1988.
- PROFILE DATA IS FROM SURVEYS BY CEC.

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- NOTES:**
1. ELEVATIONS ARE REFERENCED TO NAVD 1988.
  2. PROFILE DATA IS FROM SURVEYS BY CEC.

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**NOTES:**

1. ELEVATIONS ARE REFERENCED TO NAVD 1988.
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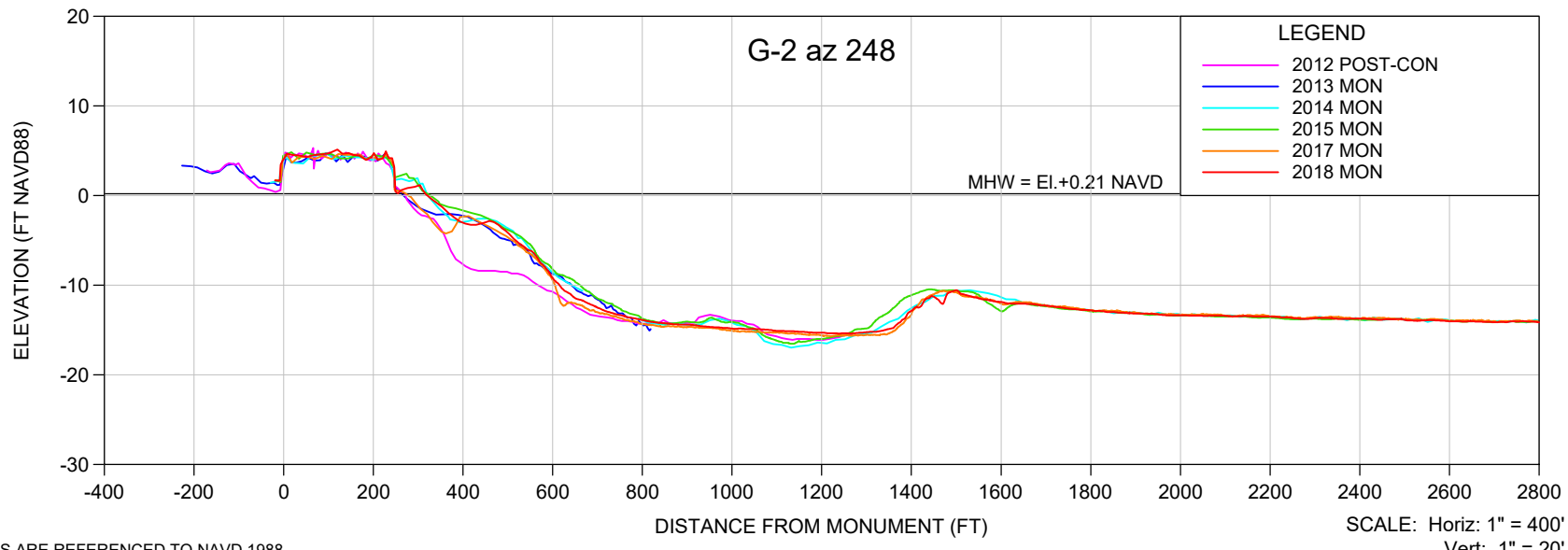
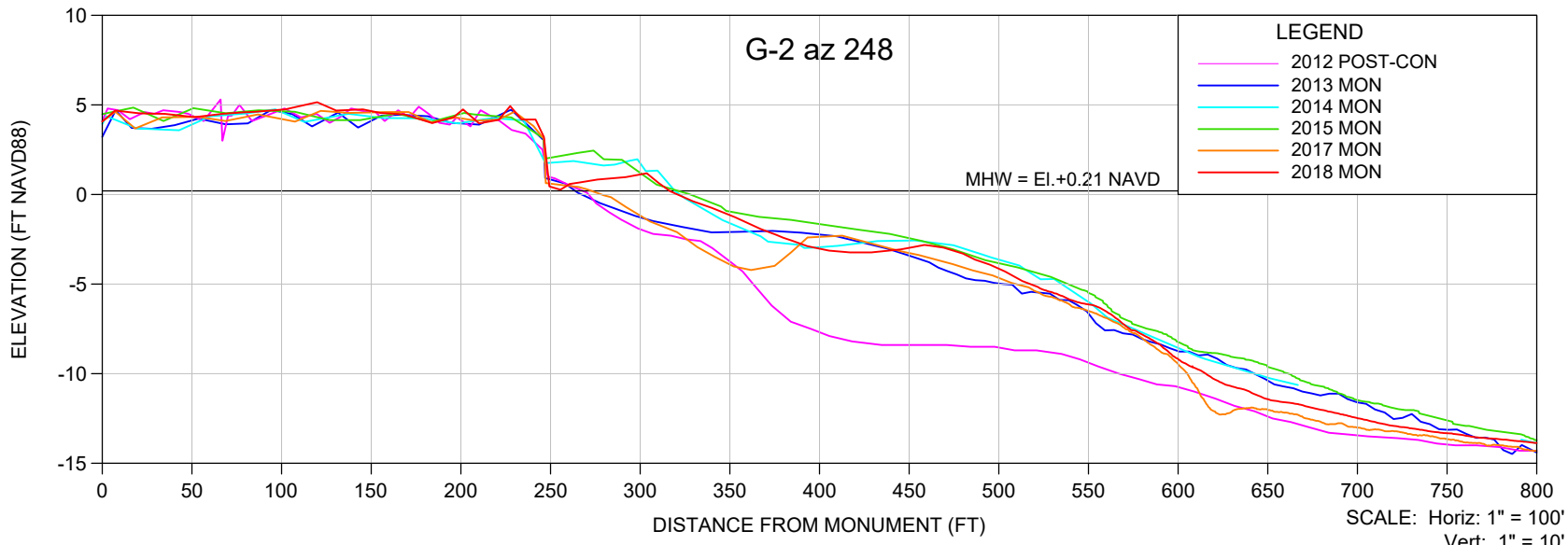
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CLIENT: **LEE COUNTY**  
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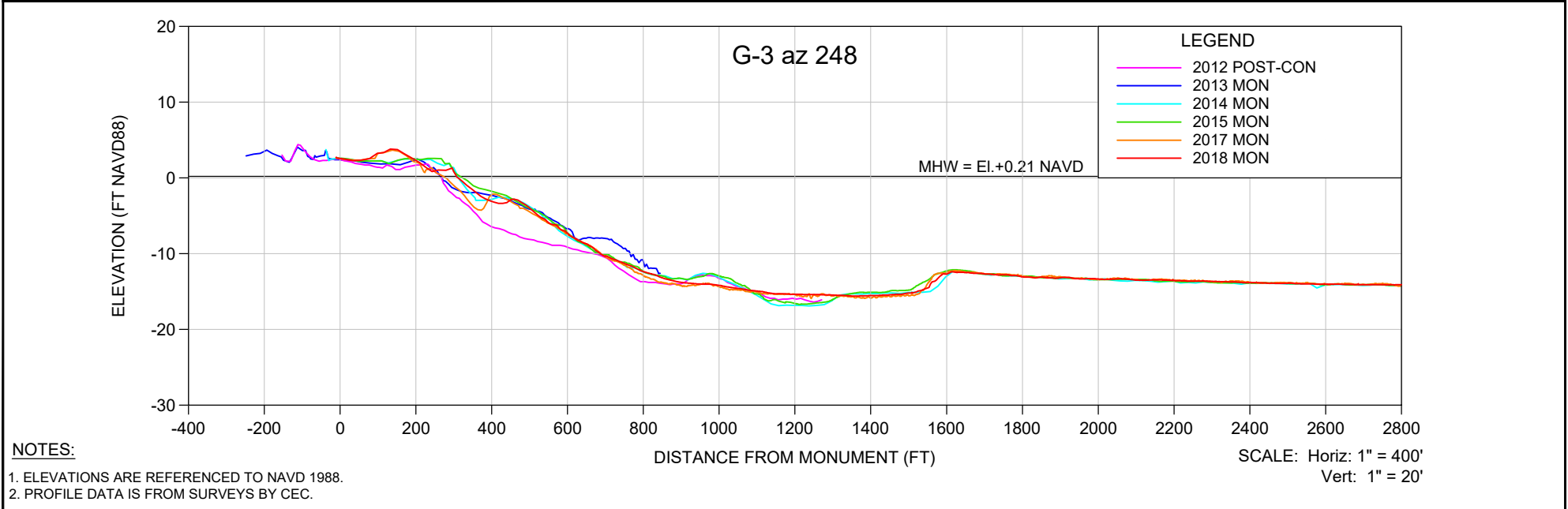
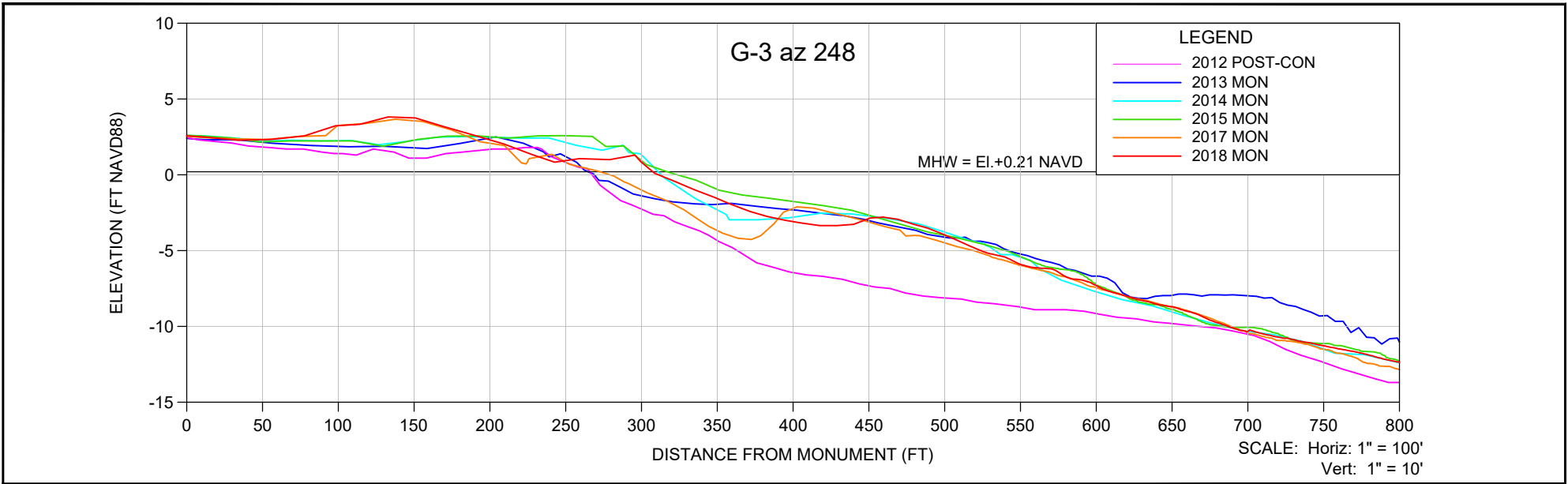
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**NOTES:**  
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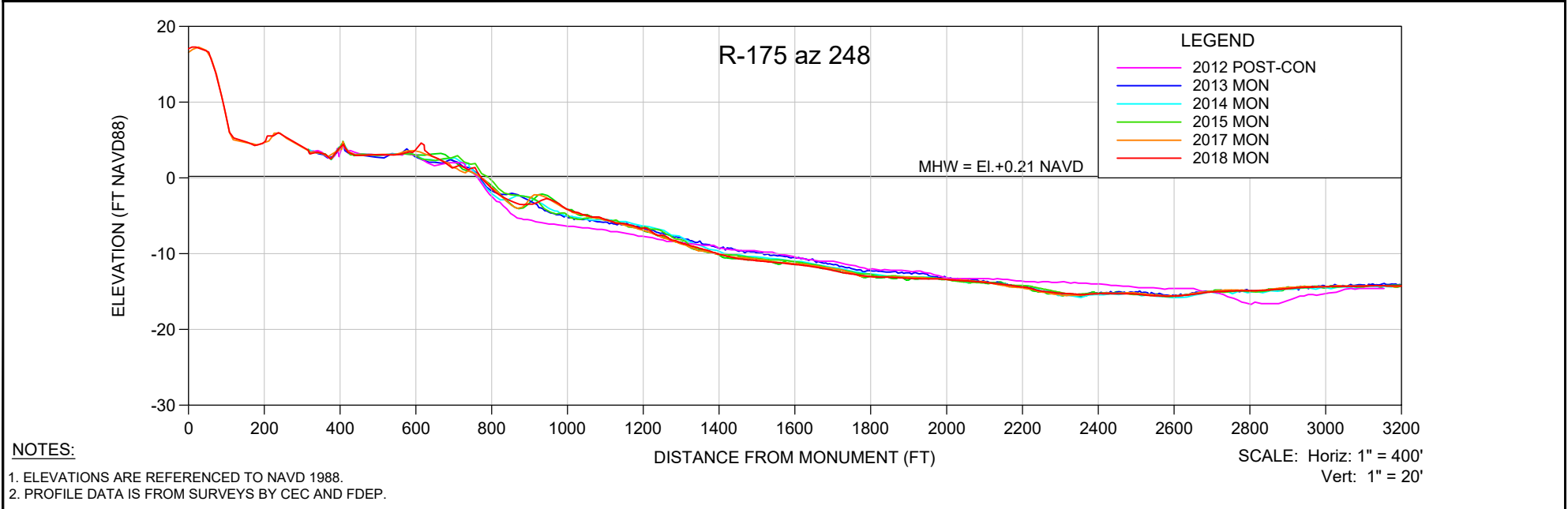
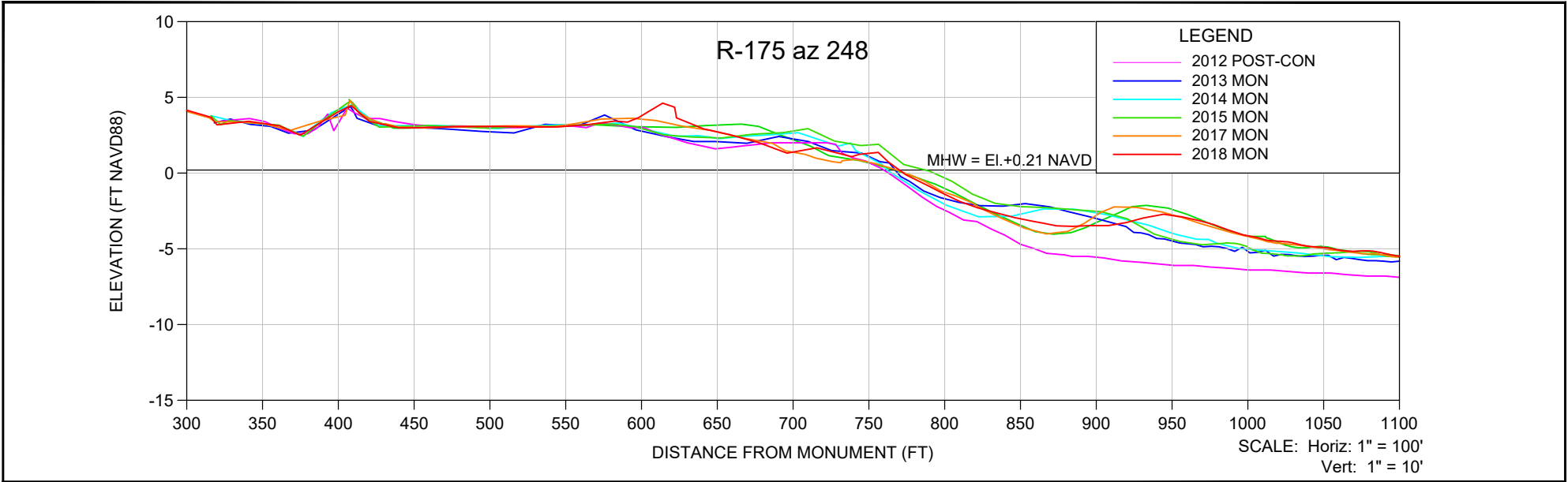
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		PHONE: (239)643-2324 FAX: (239)643-1143 www.coastalengineering.com E-Mail: engcollier@cecifl.com	TITLE: <b>GROIN 2 AZ 248° MONITORING SURVEY</b>		



**NOTES:**

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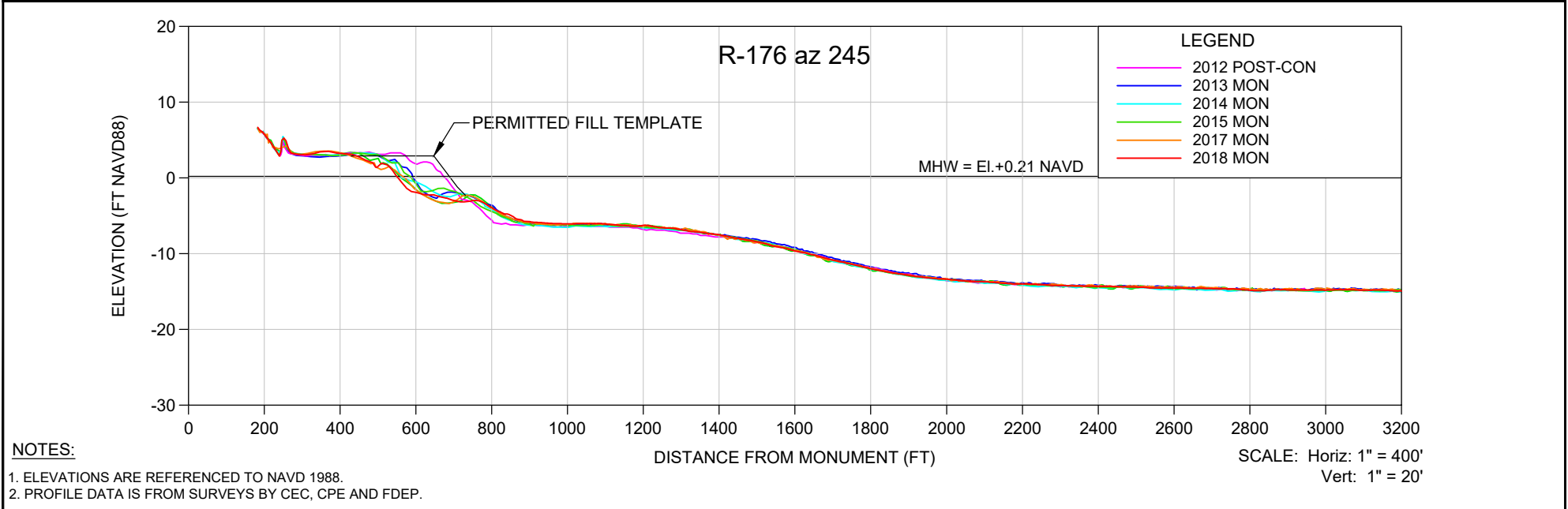
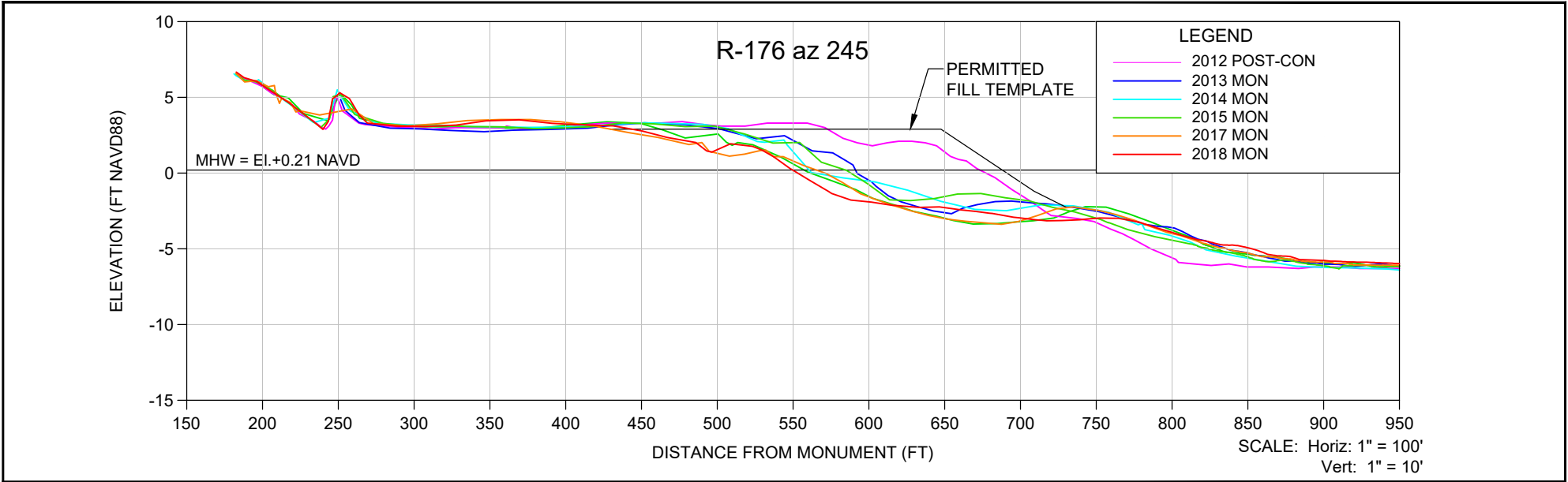
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1. ELEVATIONS ARE REFERENCED TO NAVD 1988.
2. PROFILE DATA IS FROM SURVEYS BY CEC AND FDEP.

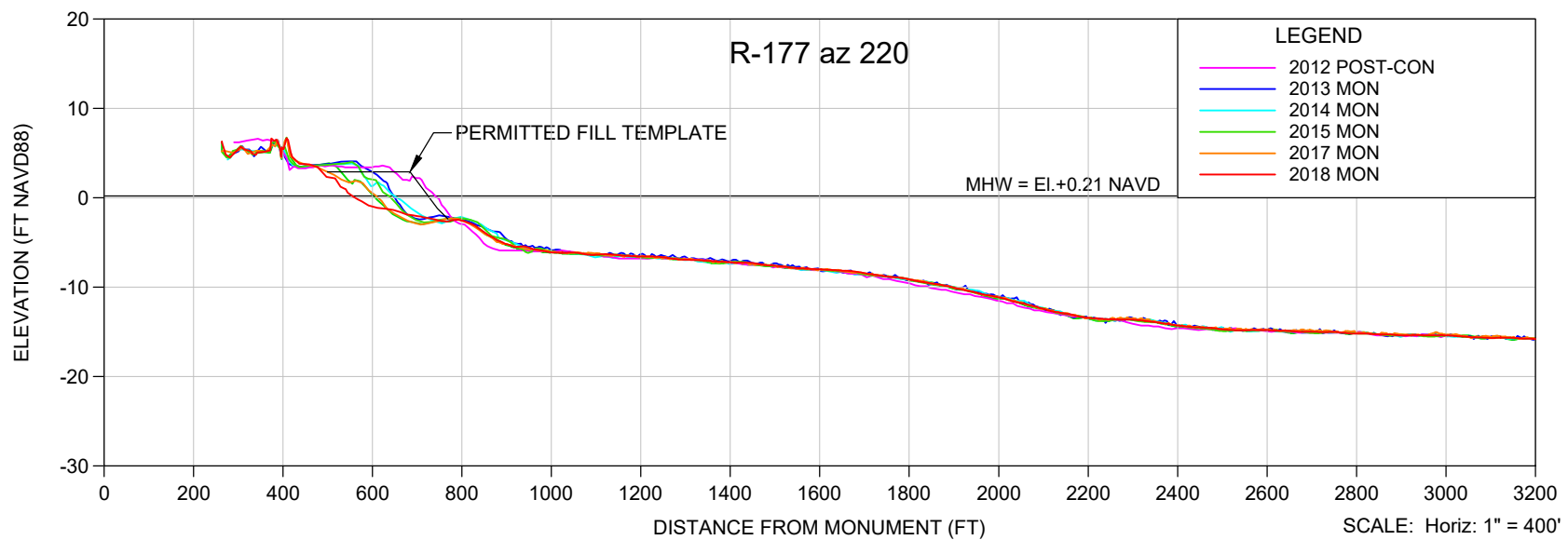
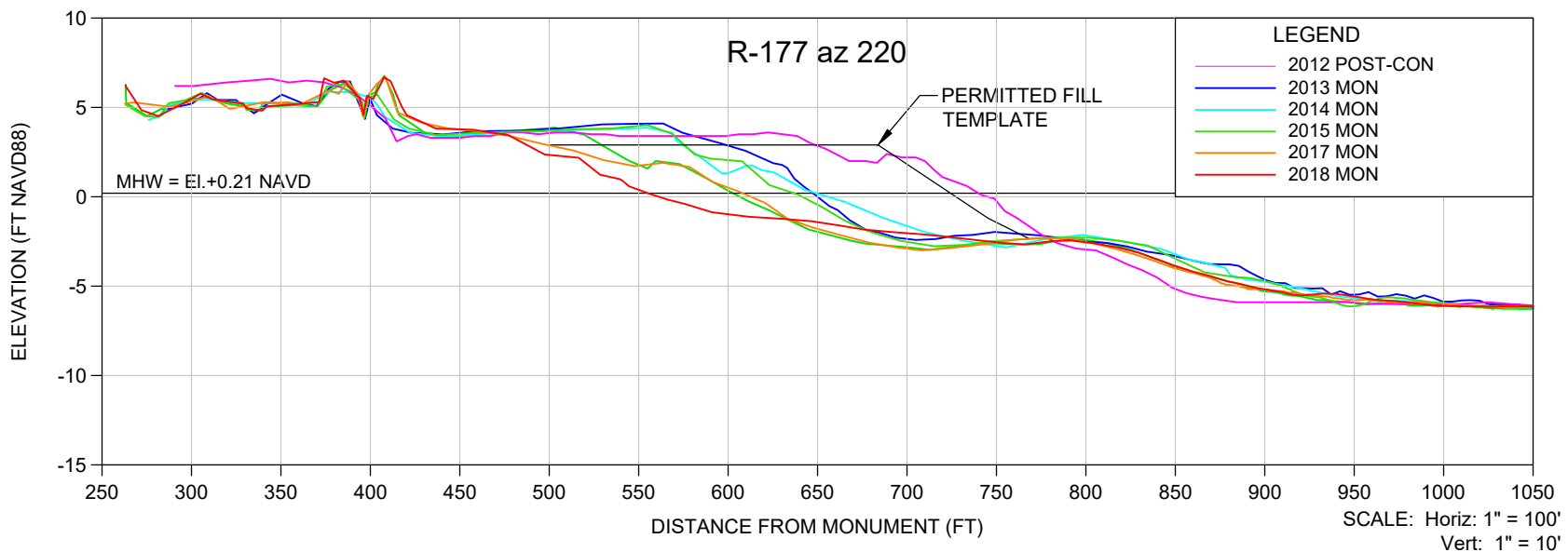
SHEET 4 FILE NO.: 18079-R-175 AZ248	<p><b>COASTAL ENGINEERING CONSULTANTS INC.</b>          A CECI GROUP COMPANY          Serving Florida Since 1977          3106 SOUTH HORSESHOE DRIVE          NAPLES, FLORIDA 34104</p>	<p>CIVIL ENGINEERING          SURVEY &amp; MAPPING          COASTAL ENGINEERING          ENVIRONMENTAL          PLANNING SERVICES</p> <p>PHONE: (239)643-2324          FAX: (239)643-1143          www.coastalengineering.com          E-Mail: engcollier@cecifl.com</p>	CLIENT:	LEE COUNTY			DATE:	6/25/2018	SCALE:	AS SHOWN					
			TITLE:	R-175 AZ 248° MONITORING SURVEY			DRAWN:	SDB	F.B.						
							CHECKED:	MTP	PG.						
							SEC.	TWP.	RNG.						
							ACAD NO.	18079-Estero-Mon Profiles.dwg							
							REF. NO.	18.079							
										NO.	DATE	BY	REVISION DESCRIPTION		



**NOTES:**

1. ELEVATIONS ARE REFERENCED TO NAVD 1988.
2. PROFILE DATA IS FROM SURVEYS BY CEC, CPE AND FDEP.

SHEET 5 FILE NO.: 18079R-176	<p><b>COASTAL ENGINEERING CONSULTANTS INC.</b>          A CECI GROUP COMPANY          Serving Florida Since 1977          3106 SOUTH HORSESHOE DRIVE          NAPLES, FLORIDA 34104</p>	<p>CIVIL ENGINEERING          SURVEY &amp; MAPPING          COASTAL ENGINEERING          ENVIRONMENTAL          PLANNING SERVICES</p> <p>PHONE: (239)643-2324          FAX: (239)643-1143          www.coastalengineering.com          E-Mail: engcollier@cecifl.com</p>	CLIENT:	<b>LEE COUNTY</b>			DATE:	6/25/2018	SCALE:	AS SHOWN					
			TITLE:	<b>R-176 AZ 245° MONITORING SURVEY</b>			DRAWN:	SDB	F.B.						
							CHECKED:	MTP	PG.						
							SEC.	TWP.	RNG.						
							ACAD NO.	18079-Estero-Mon Profiles.dwg							
				REF. NO.	18.079			NO.	DATE	BY	REVISION DESCRIPTION				



**NOTES:**

1. ELEVATIONS ARE REFERENCED TO NAVD 1988.
2. PROFILE DATA IS FROM SURVEYS BY CEC AND FDEP.

SHEET 6  
FILE NO.: 18079-R-177-AZ220

**COASTAL ENGINEERING CONSULTANTS INC.**  
 A CECI GROUP COMPANY  
 Serving Florida Since 1977  
 3106 SOUTH HORSESHOE DRIVE  
 NAPLES, FLORIDA 34104

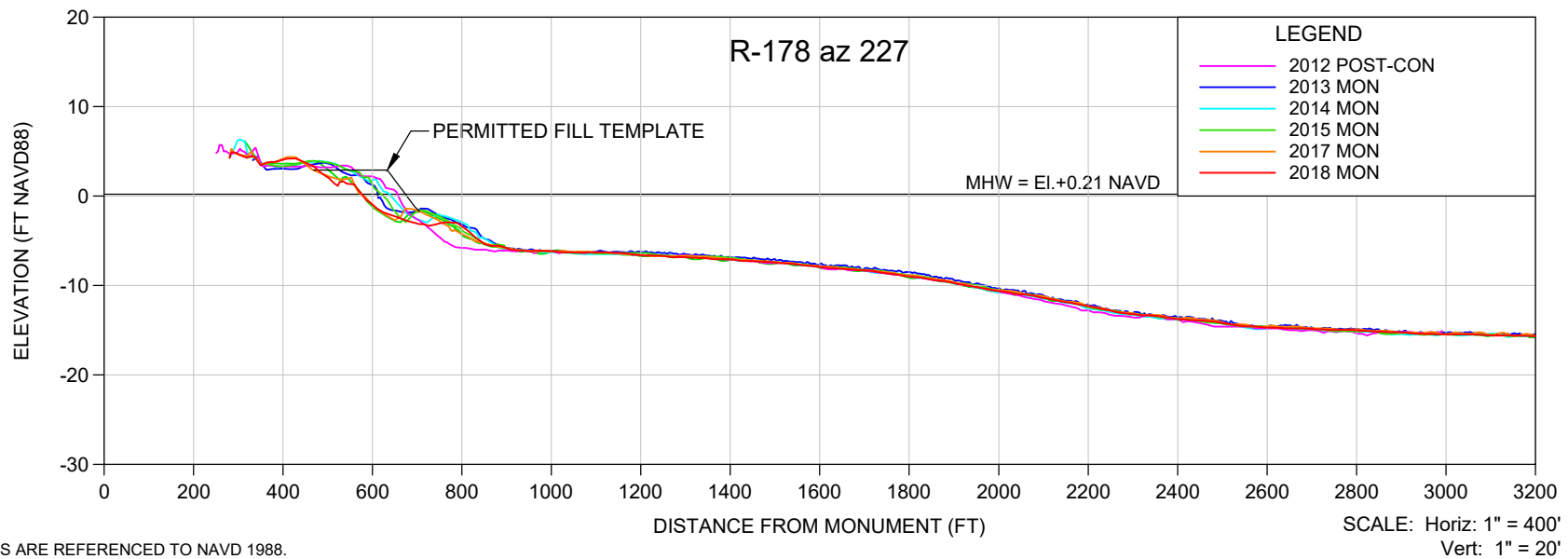
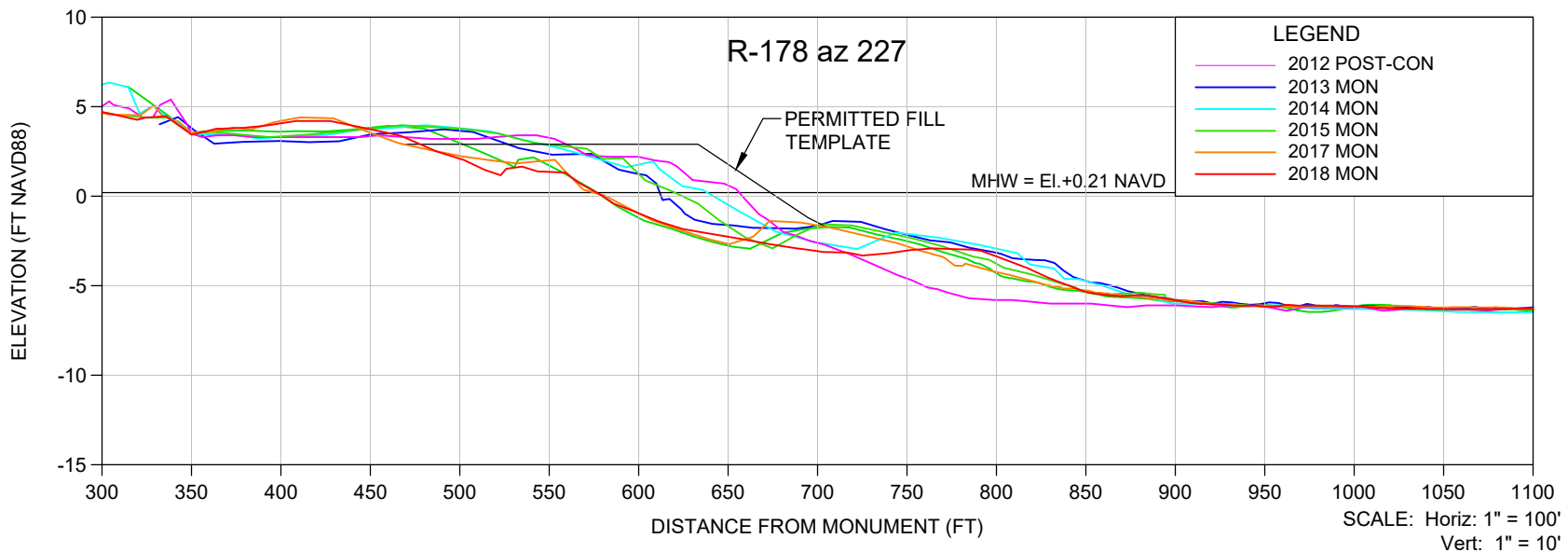
CIVIL ENGINEERING  
 SURVEY & MAPPING  
 COASTAL ENGINEERING  
 ENVIRONMENTAL  
 PLANNING SERVICES  
 PHONE: (239)643-2324  
 FAX: (239)643-1143  
 www.coastalengineering.com  
 E-Mail: engcollier@cecifl.com

CLIENT: **LEE COUNTY**  
 TITLE: **R-177 AZ 220° MONITORING SURVEY**

DATE: 6/25/2018 SCALE: AS SHOWN  
 DRAWN: SDB F.B.  
 CHECKED: MTP PG.  
 SEC. TWP. RNG.  
 ACAD NO. 18079-Estero-Mon Profiles.dwg  
 REF. NO. 18.079

NO.	DATE	BY	REVISION DESCRIPTION





**NOTES:**

1. ELEVATIONS ARE REFERENCED TO NAVD 1988.
2. PROFILE DATA IS FROM SURVEYS BY CEC AND FDEP.

SHEET 7  
FILE NO.: 18079-R-178 AZ227

**COASTAL ENGINEERING CONSULTANTS INC.**  
A CECI GROUP COMPANY  
Serving Florida Since 1977  
3106 SOUTH HORSESHOE DRIVE  
NAPLES, FLORIDA 34104

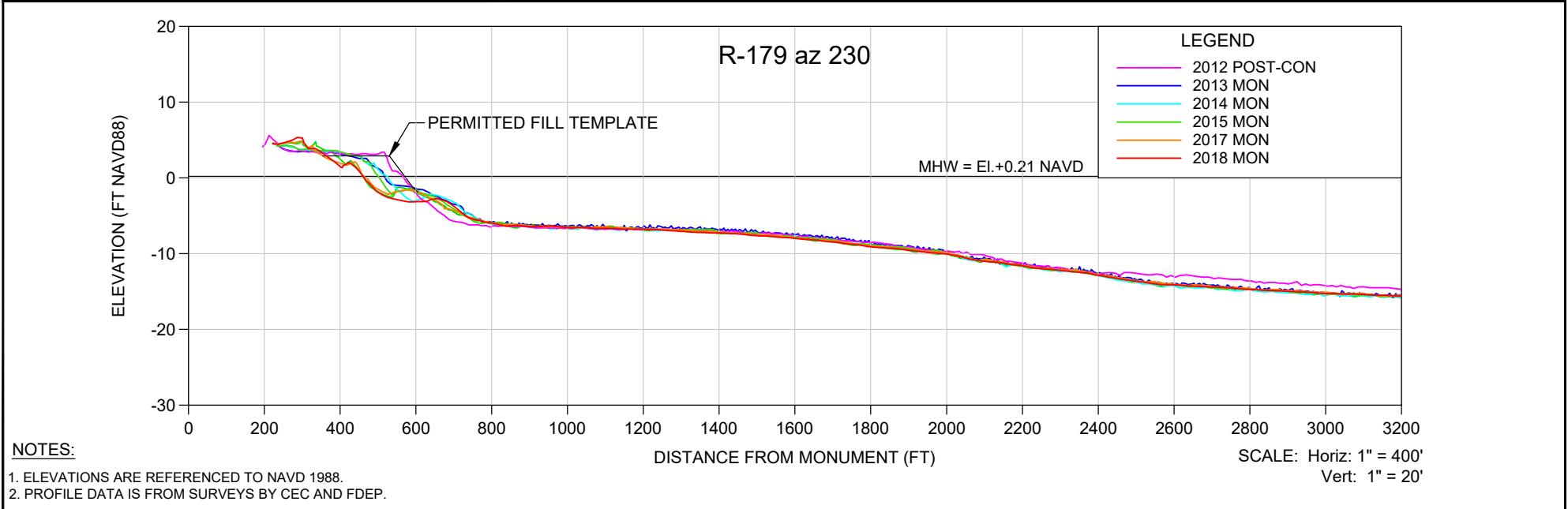
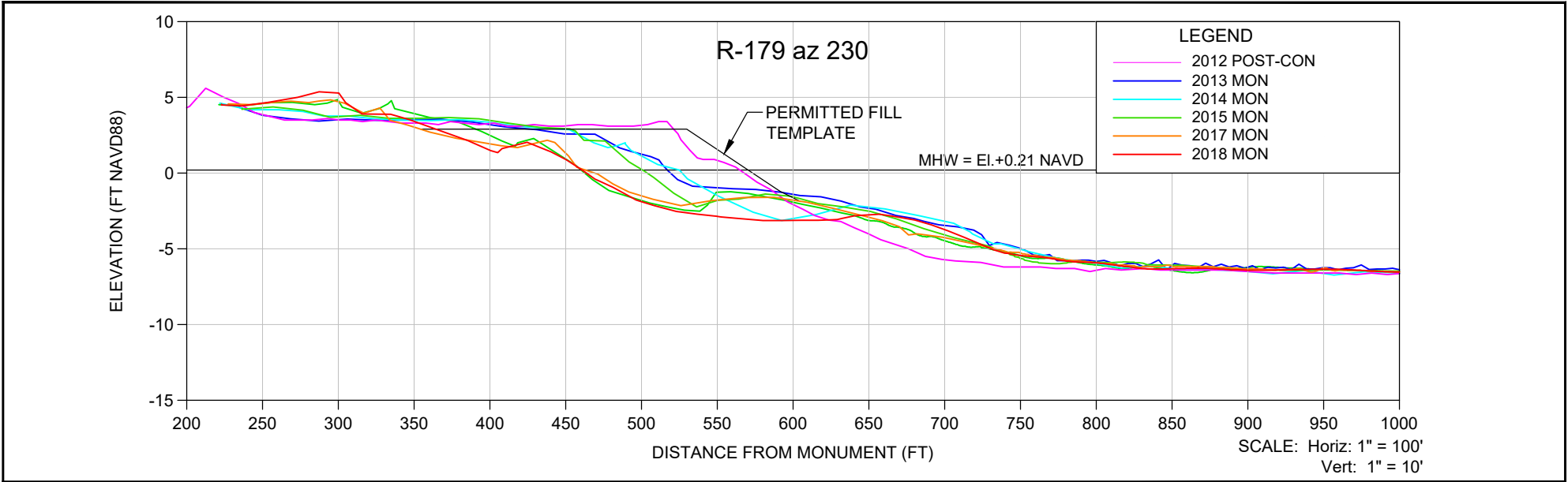
CIVIL ENGINEERING  
SURVEY & MAPPING  
COASTAL ENGINEERING  
ENVIRONMENTAL  
PLANNING SERVICES  
PHONE: (239)643-2324  
FAX: (239)643-1143  
www.coastalengineering.com  
E-Mail: engcollier@cecifl.com

CLIENT: **LEE COUNTY**

TITLE: **R-178 AZ 227° MONITORING SURVEY**

DATE:	6/25/2018	SCALE:	AS SHOWN
DRAWN:	SDB	F.B.	
CHECKED:	MTP	PG.	
SEC.	TWP.	RNG.	
ACAD NO.	18079-Estero-Mon Profiles.dwg		
REF. NO.	18.079	NO.	DATE

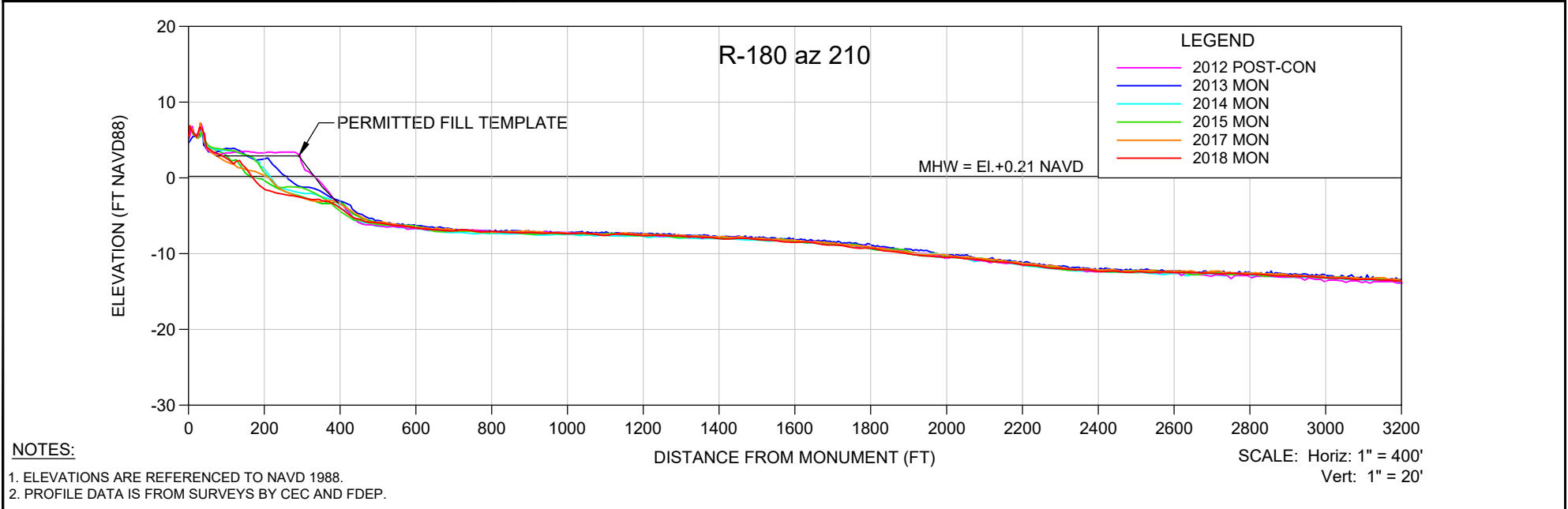
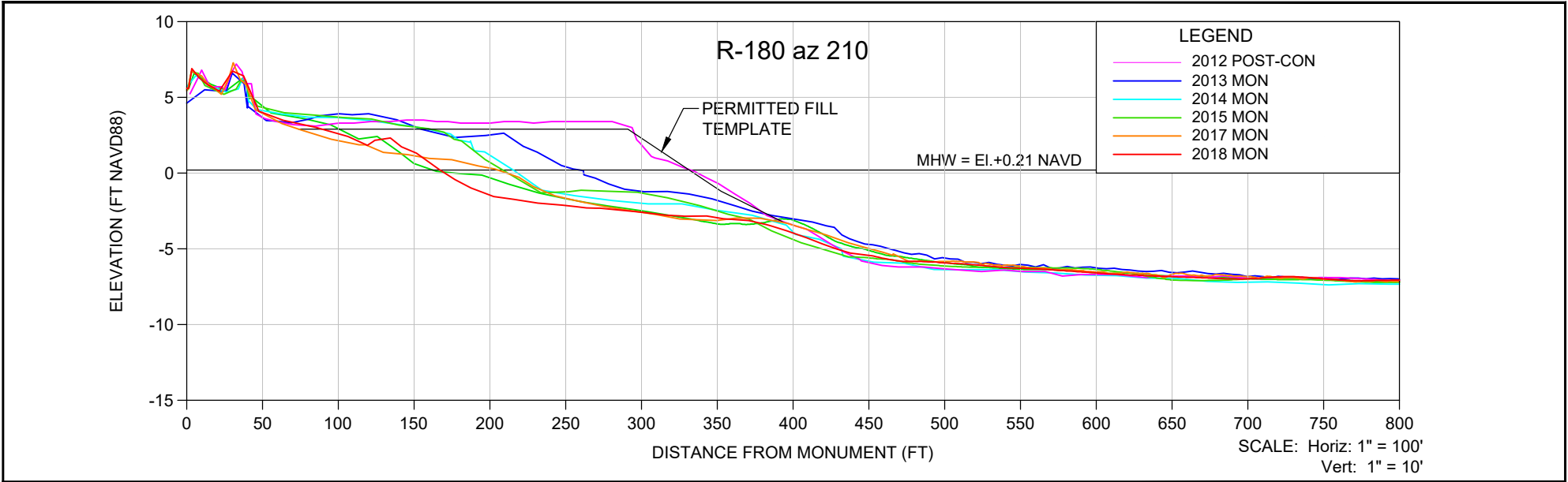
NO.	DATE	BY	REVISION DESCRIPTION



**NOTES:**

1. ELEVATIONS ARE REFERENCED TO NAVD 1988.
2. PROFILE DATA IS FROM SURVEYS BY CEC AND FDEP.

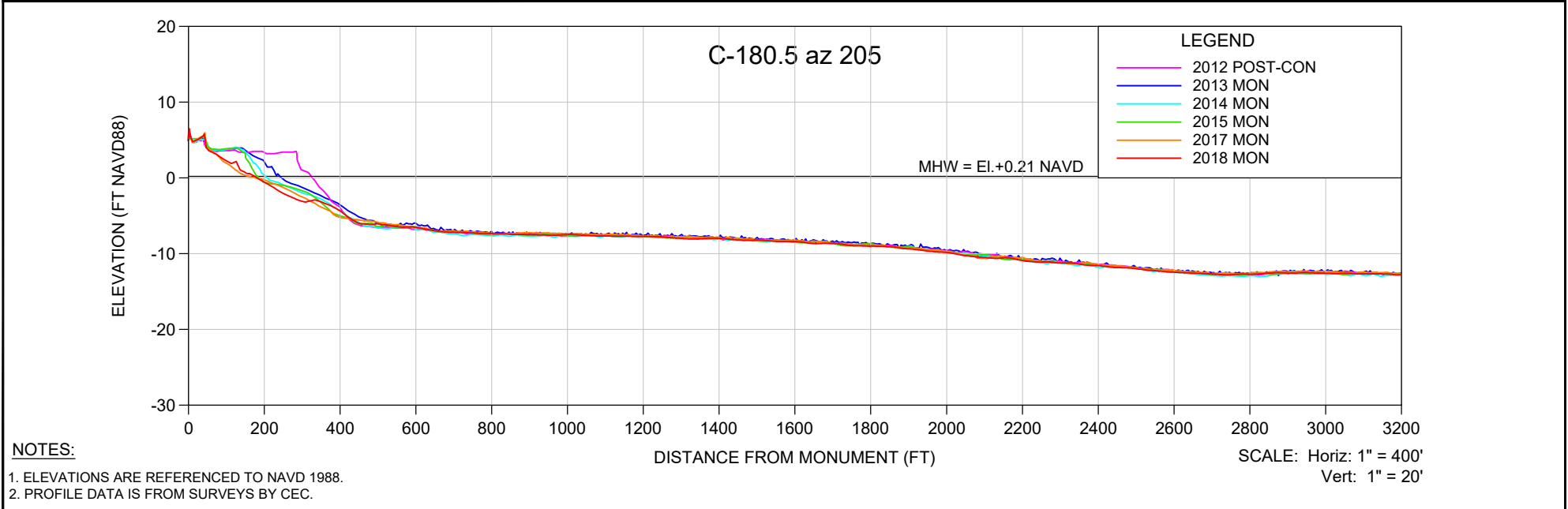
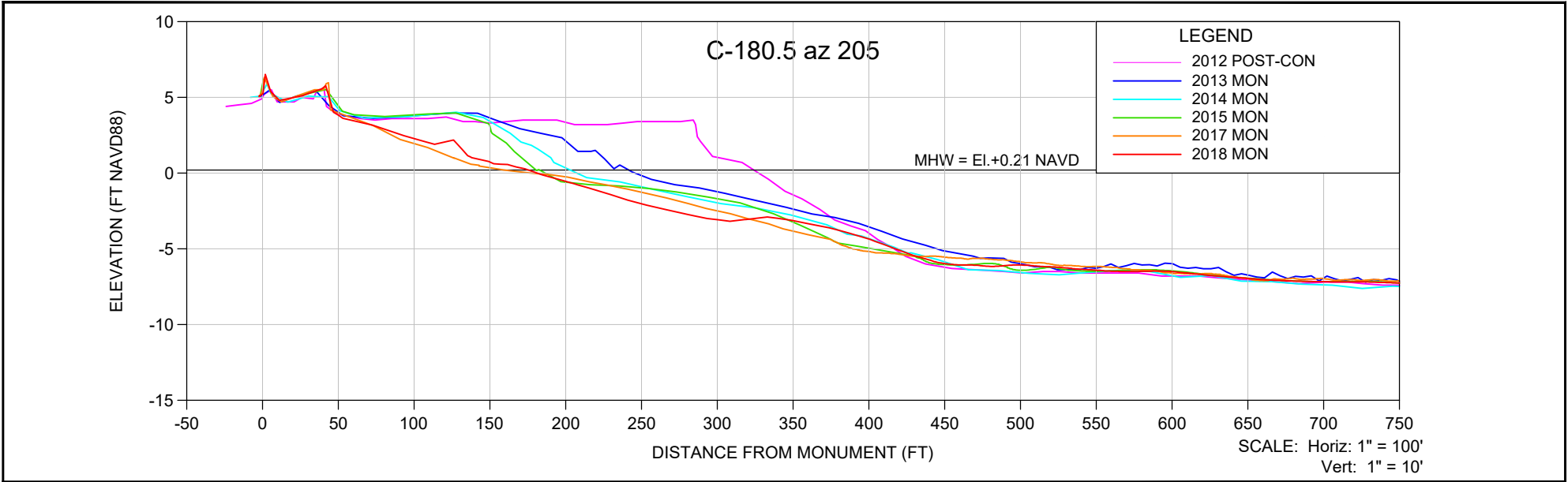
SHEET 8 FILE NO.: 18079-R-179-AZ230	<p><b>COASTAL ENGINEERING CONSULTANTS INC.</b> A CECI GROUP COMPANY Serving Florida Since 1977 3106 SOUTH HORSESHOE DRIVE NAPLES, FLORIDA 34104</p>	<p>CIVIL ENGINEERING SURVEY &amp; MAPPING COASTAL ENGINEERING ENVIRONMENTAL PLANNING SERVICES</p> <p>PHONE: (239)643-2324 FAX: (239)643-1143 www.coastalengineering.com E-Mail: engcollier@cecifl.com</p>	CLIENT:	<b>LEE COUNTY</b>		DATE:	6/25/2018	SCALE:	AS SHOWN							
			TITLE:	<b>R-179 AZ 230° MONITORING SURVEY</b>		DRAWN:	SDB	F.B.								
					CHECKED:	MTP	PG.									
					SEC.	TWP.	RNG.									
		ACAD NO.	18079-Estero-Mon Profiles.dwg													
		REF. NO.	18.079													
										NO.	DATE	BY	REVISION DESCRIPTION			



**NOTES:**

1. ELEVATIONS ARE REFERENCED TO NAVD 1988.
2. PROFILE DATA IS FROM SURVEYS BY CEC AND FDEP.

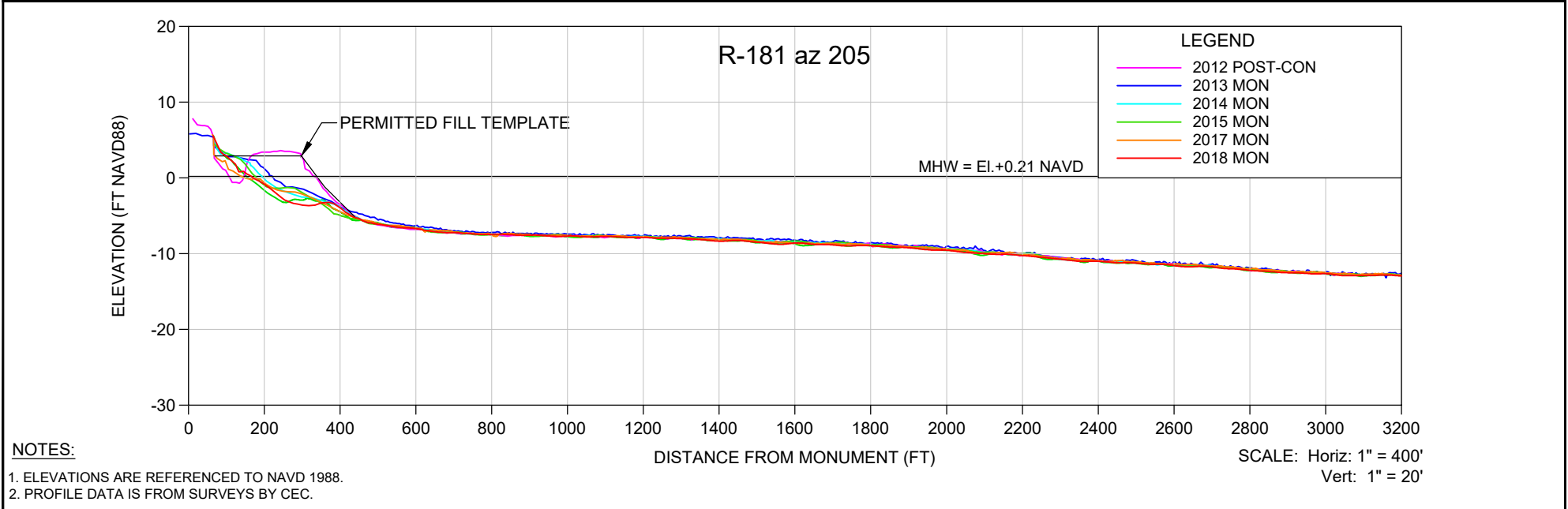
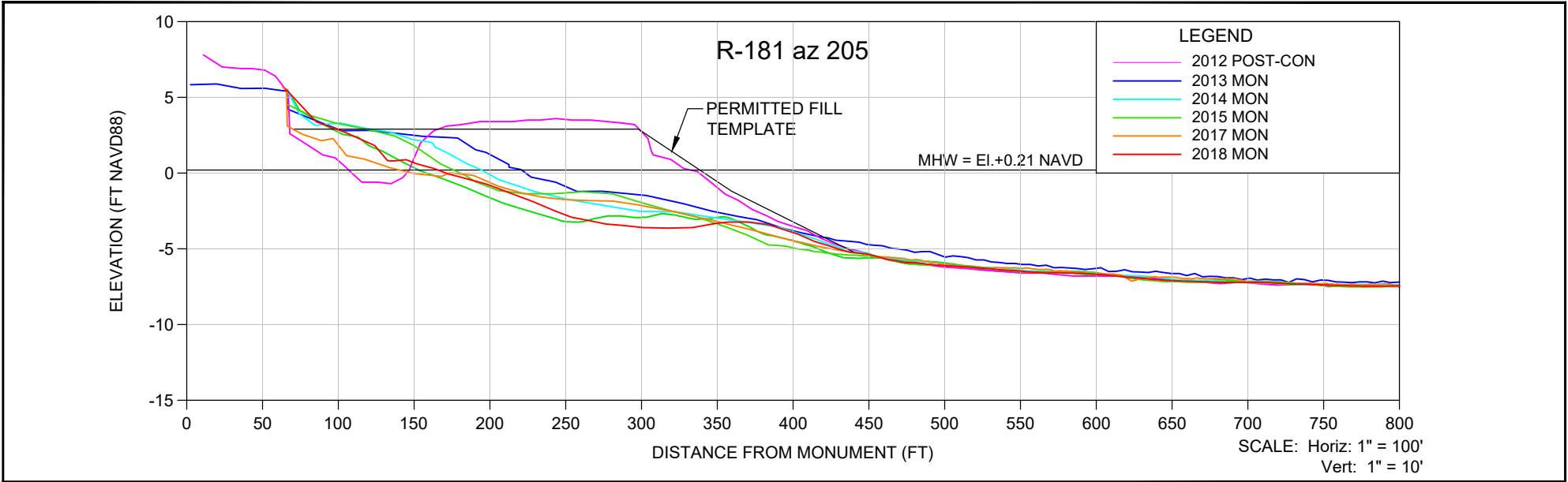
SHEET 9 FILE NO.: 18079-R-180 AZ210	<p><b>COASTAL ENGINEERING CONSULTANTS INC.</b>          A CECI GROUP COMPANY          Serving Florida Since 1977          3106 SOUTH HORSESHOE DRIVE          NAPLES, FLORIDA 34104</p>	<p>CIVIL ENGINEERING          SURVEY &amp; MAPPING          COASTAL ENGINEERING          ENVIRONMENTAL          PLANNING SERVICES</p> <p>PHONE: (239)643-2324          FAX: (239)643-1143          www.coastalengineering.com          E-Mail: engcollier@cecifl.com</p>	CLIENT:	LEE COUNTY			DATE:	6/25/2018	SCALE:	AS SHOWN					
			TITLE:	R-180 AZ 210° MONITORING SURVEY			DRAWN:	SDB	F.B.						
							CHECKED:	MTP	PG.						
							SEC.	TWP.	RNG.						
				ACAD NO.	18079-Estero-Mon Profiles.dwg										
				REF. NO.	18.079										
							NO.	DATE	BY	REVISION DESCRIPTION					



**NOTES:**

1. ELEVATIONS ARE REFERENCED TO NAVD 1988.
2. PROFILE DATA IS FROM SURVEYS BY CEC.

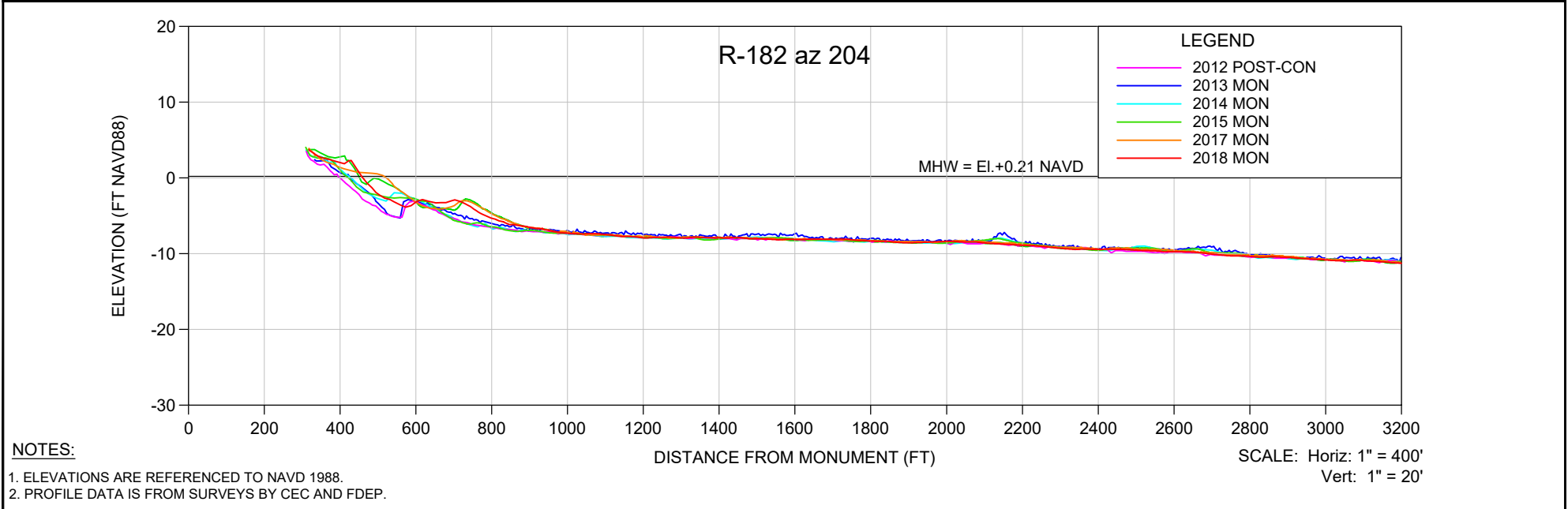
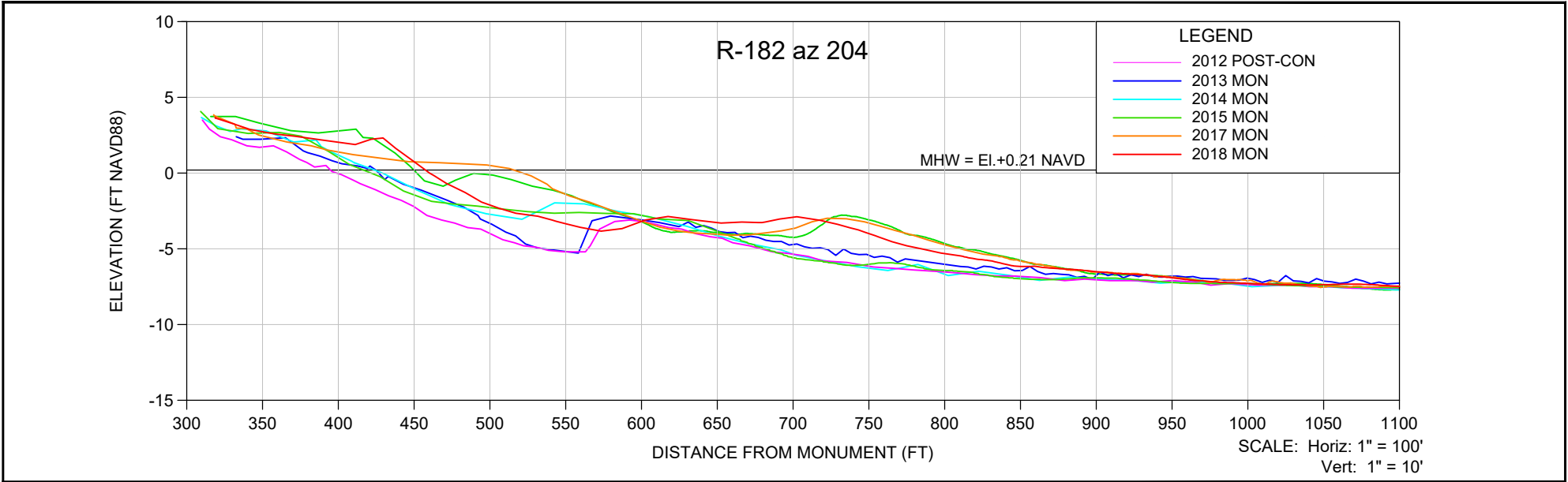
SHEET 10 FILE NO.: 18079-R-180.5	<b>COASTAL ENGINEERING CONSULTANTS INC.</b> <small>A CECI GROUP COMPANY Serving Florida Since 1977</small> 3106 SOUTH HORSESHOE DRIVE NAPLES, FLORIDA 34104	CIVIL ENGINEERING SURVEY & MAPPING COASTAL ENGINEERING ENVIRONMENTAL PLANNING SERVICES  PHONE: (239)643-2324 FAX: (239)643-1143 www.coastalengineering.com E-Mail: engcollier@cecifl.com	CLIENT: <b>LEE COUNTY</b>  TITLE: <b>C-180.5 AZ 205° MONITORING SURVEY</b>	DATE: 6/25/2018 DRAWN: SDB CHECKED: MTP SEC. TWP. RNG. ACAD NO. 18079-Estero-Mon Profiles.dwg REF. NO. 18.079	SCALE: AS SHOWN F.B. PG. NO. DATE BY REVISION DESCRIPTION



**NOTES:**

1. ELEVATIONS ARE REFERENCED TO NAVD 1988.
2. PROFILE DATA IS FROM SURVEYS BY CEC.

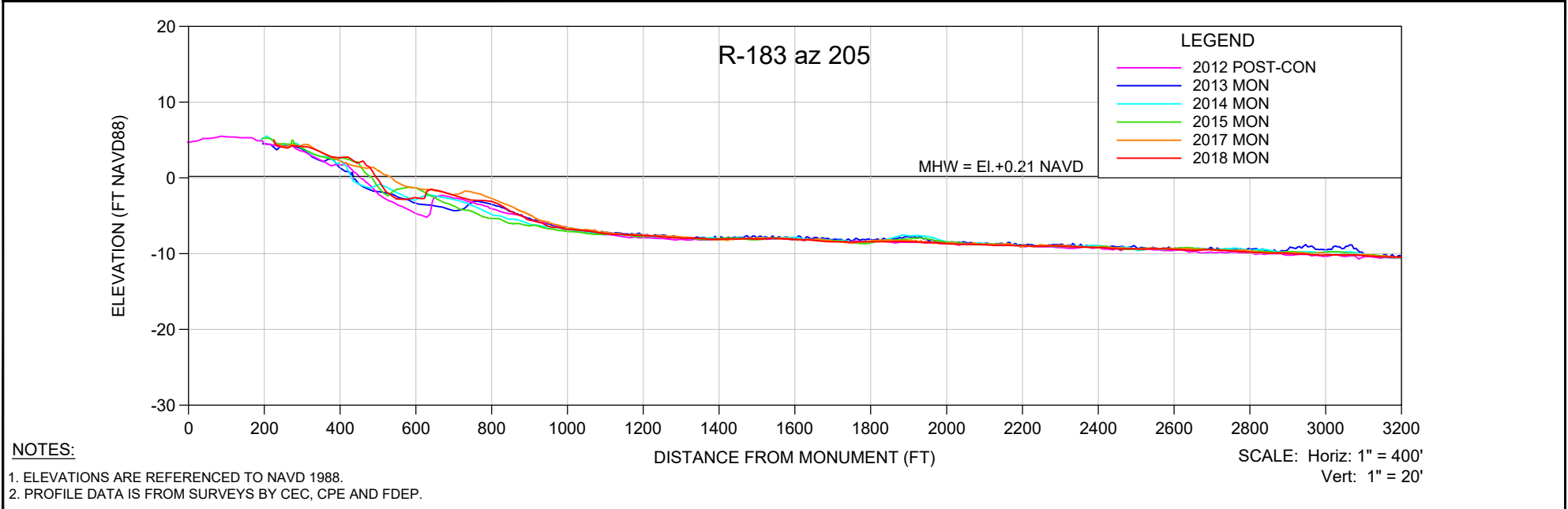
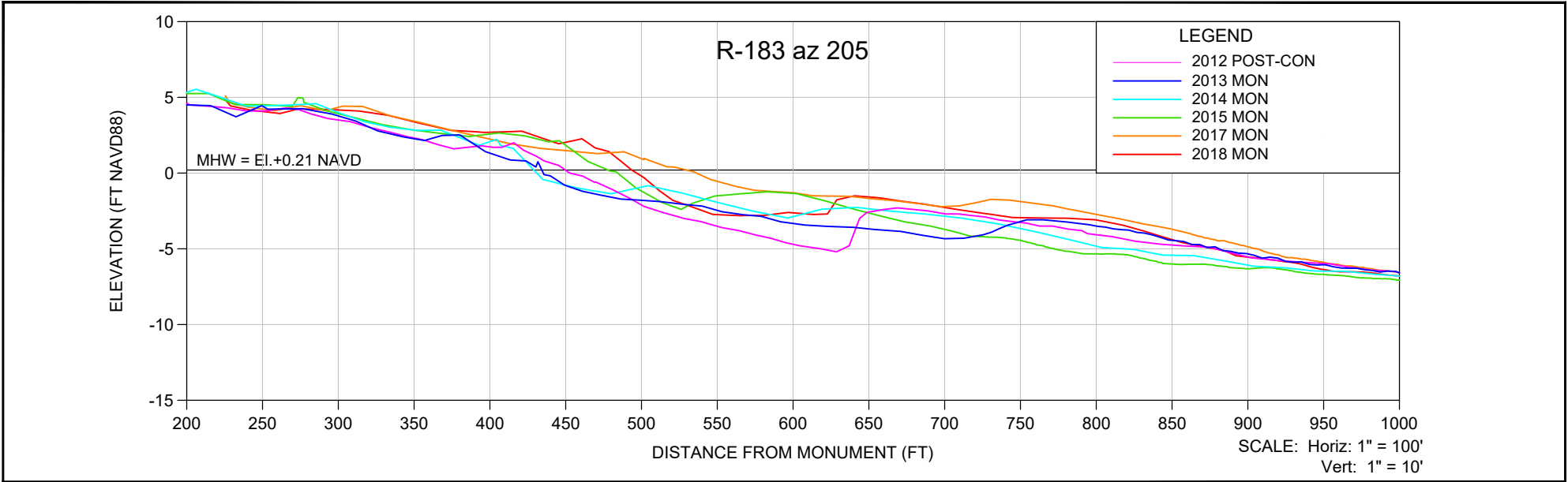
SHEET 11 FILE NO.: 18079-R-181-AZ205	<p><b>COASTAL ENGINEERING CONSULTANTS INC.</b>          A CECI GROUP COMPANY          Serving Florida Since 1977          3106 SOUTH HORSESHOE DRIVE          NAPLES, FLORIDA 34104</p>	<p>CIVIL ENGINEERING          SURVEY &amp; MAPPING          COASTAL ENGINEERING          ENVIRONMENTAL          PLANNING SERVICES</p> <p>PHONE: (239)643-2324          FAX: (239)643-1143          www.coastalengineering.com          E-Mail: engcollier@cecifl.com</p>	CLIENT:	<b>LEE COUNTY</b>			DATE:	6/25/2018	SCALE:	AS SHOWN					
			TITLE:	<b>R-181 AZ 205° MONITORING SURVEY</b>			DRAWN:	SDB	F.B.						
							CHECKED:	MTP	PG.						
							SEC.	TWP.	RNG.						
							ACAD NO.	18079-Estero-Mon Profiles.dwg							
				REF. NO.	18.079			NO.	DATE	BY	REVISION DESCRIPTION				



**NOTES:**

1. ELEVATIONS ARE REFERENCED TO NAVD 1988.
2. PROFILE DATA IS FROM SURVEYS BY CEC AND FDEP.

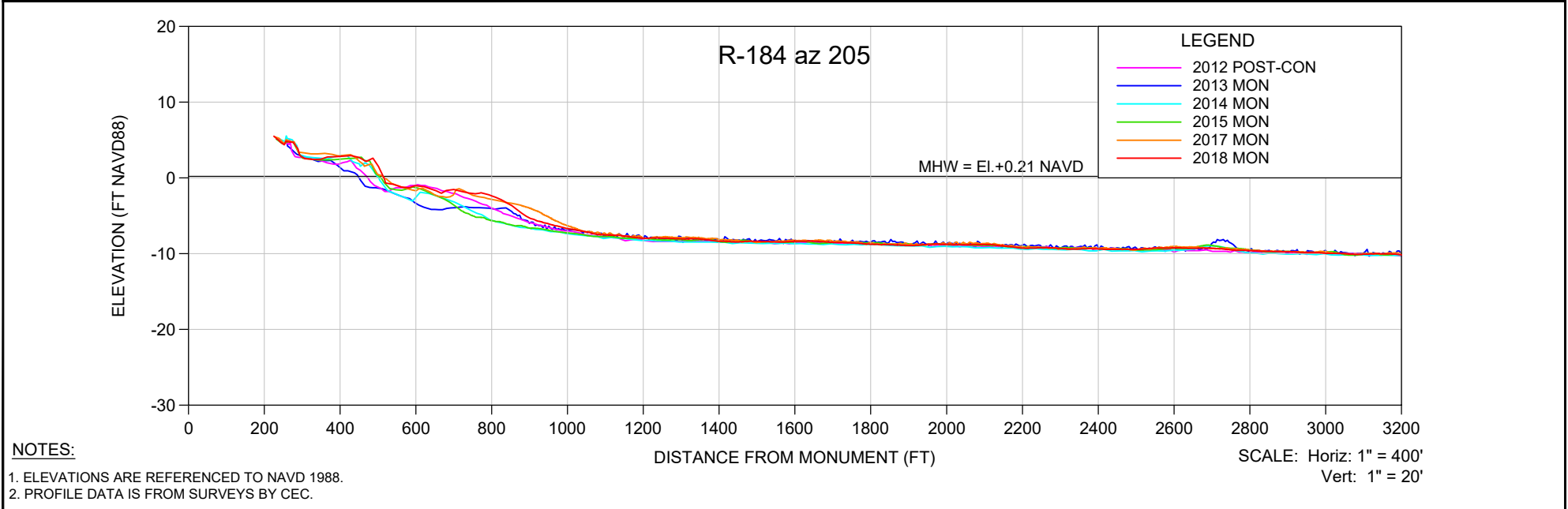
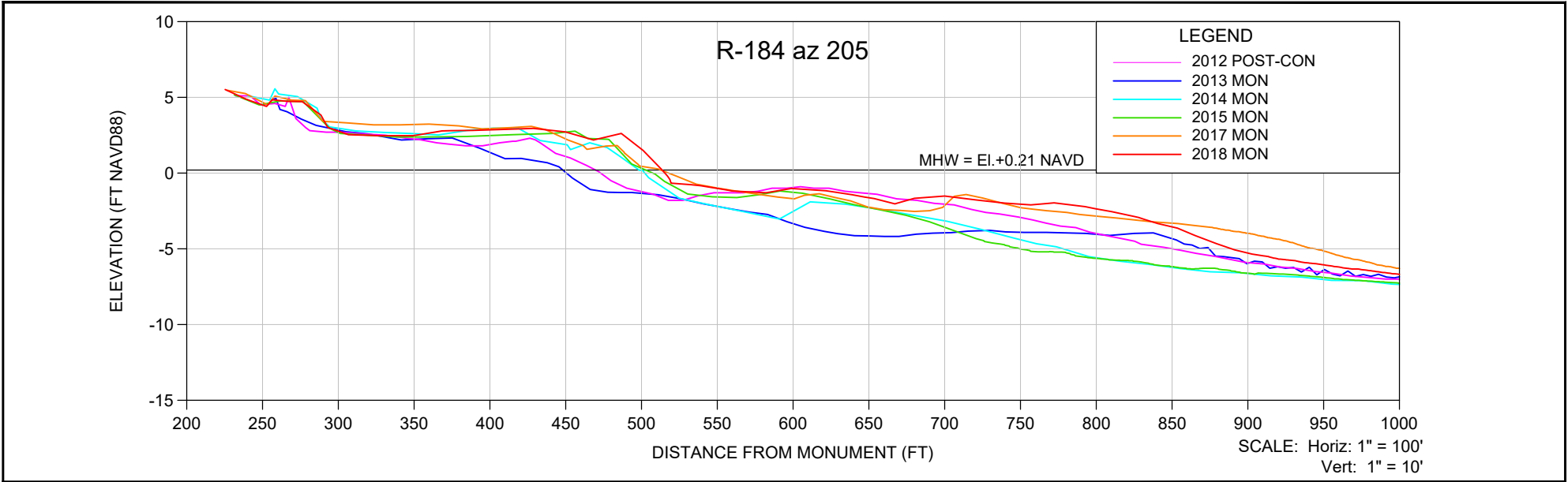
SHEET 12 FILE NO.: 18079-R-182-AZ204	<p><b>COASTAL ENGINEERING CONSULTANTS INC.</b> A CECI GROUP COMPANY Serving Florida Since 1977 3106 SOUTH HORSESHOE DRIVE NAPLES, FLORIDA 34104</p>	<p>CIVIL ENGINEERING SURVEY &amp; MAPPING COASTAL ENGINEERING ENVIRONMENTAL PLANNING SERVICES</p> <p>PHONE: (239)643-2324 FAX: (239)643-1143 www.coastalengineering.com E-Mail: engcollier@cecifl.com</p>	CLIENT:	<b>LEE COUNTY</b>			DATE:	6/25/2018	SCALE:	AS SHOWN					
			TITLE:	<b>R-182 AZ 204° MONITORING SURVEY</b>			DRAWN:	SDB	F.B.						
						CHECKED:	MTP	PG.							
						SEC.	TWP.	RNG.							
						ACAD NO.	18079-Estero-Mon Profiles.dwg								
			REF. NO.	18.079			NO.	DATE	BY	REVISION DESCRIPTION					



**NOTES:**

1. ELEVATIONS ARE REFERENCED TO NAVD 1988.
2. PROFILE DATA IS FROM SURVEYS BY CEC, CPE AND FDEP.

SHEET 13 FILE NO.: 18079-R-183	 <b>COASTAL ENGINEERING CONSULTANTS INC.</b> <small>A CECI GROUP COMPANY Serving Florida Since 1977</small> 3106 SOUTH HORSESHOE DRIVE NAPLES, FLORIDA 34104	CIVIL ENGINEERING SURVEY & MAPPING COASTAL ENGINEERING ENVIRONMENTAL PLANNING SERVICES	CLIENT: <b>LEE COUNTY</b>	DATE: 6/25/2018 DRAWN: SDB CHECKED: MTP SEC. TWP. RNG.	SCALE: AS SHOWN F.B. PG.					
		TITLE: <b>R-183 AZ 205° MONITORING SURVEY</b>			ACAD NO. 18079-Estero-Mon Profiles.dwg					
					REF. NO. 18.079					
							NO.	DATE	BY	REVISION DESCRIPTION

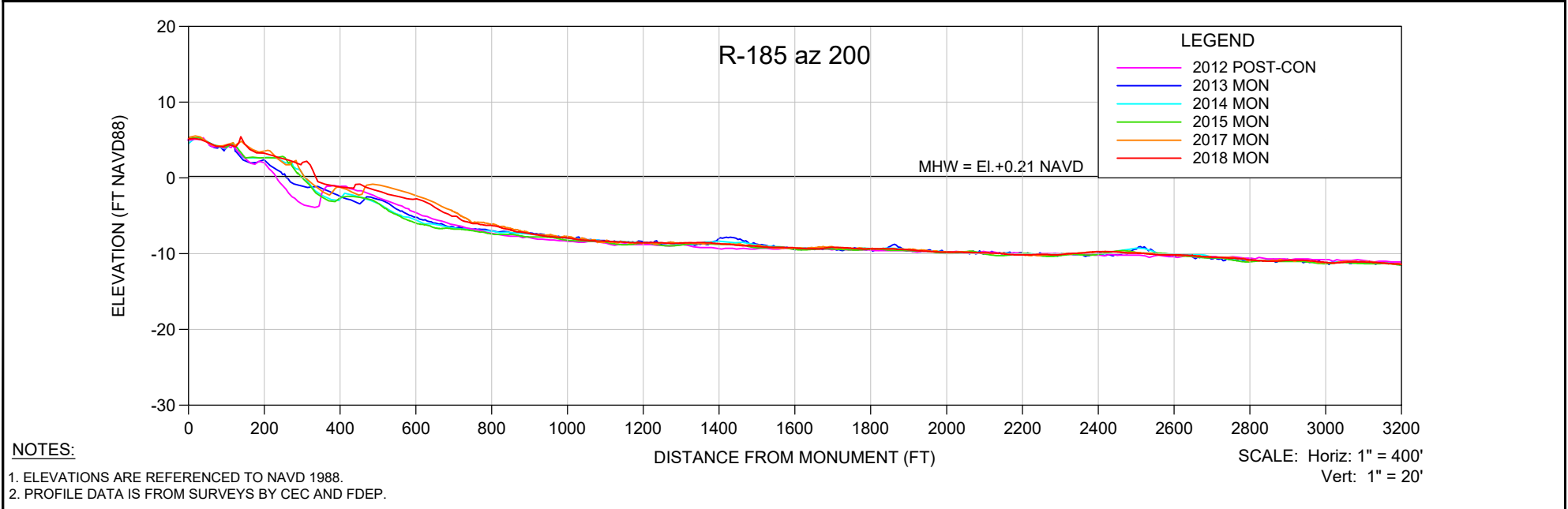
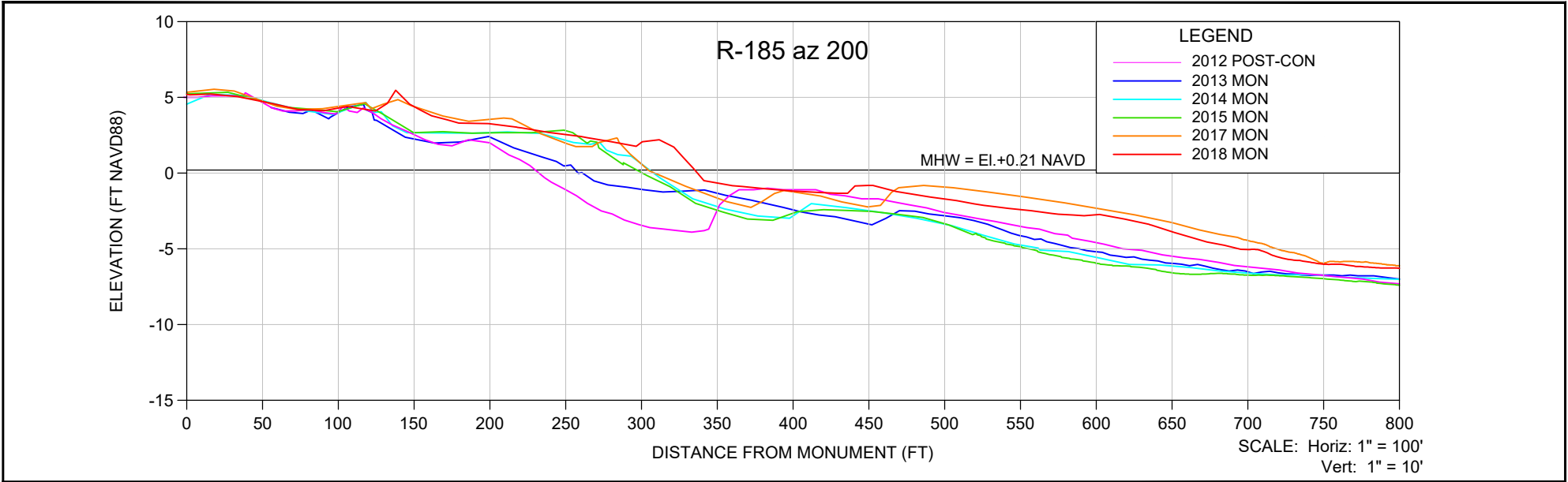


**NOTES:**

1. ELEVATIONS ARE REFERENCED TO NAVD 1988.
2. PROFILE DATA IS FROM SURVEYS BY CEC.

SHEET 14 FILE NO.: 18079-R-184-AZ205	<p><b>COASTAL ENGINEERING CONSULTANTS INC.</b>          A CECI GROUP COMPANY          Serving Florida Since 1977          3106 SOUTH HORSESHOE DRIVE          NAPLES, FLORIDA 34104</p>	<p>CIVIL ENGINEERING          SURVEY &amp; MAPPING          COASTAL ENGINEERING          ENVIRONMENTAL          PLANNING SERVICES</p> <p>PHONE: (239)643-2324          FAX: (239)643-1143          www.coastalengineering.com          E-Mail: engcollier@cecifl.com</p>	CLIENT:	<b>LEE COUNTY</b>			DATE:	6/25/2018	SCALE:	AS SHOWN					
			TITLE:	<b>R-184 AZ 205° MONITORING SURVEY</b>			DRAWN:	SDB	F.B.						
							CHECKED:	MTP	PG.						
							SEC.	TWP.	RNG.						
							ACAD NO.	18079-Estero-Mon Profiles.dwg							
				REF. NO.	18.079			NO.	DATE	BY	REVISION DESCRIPTION				

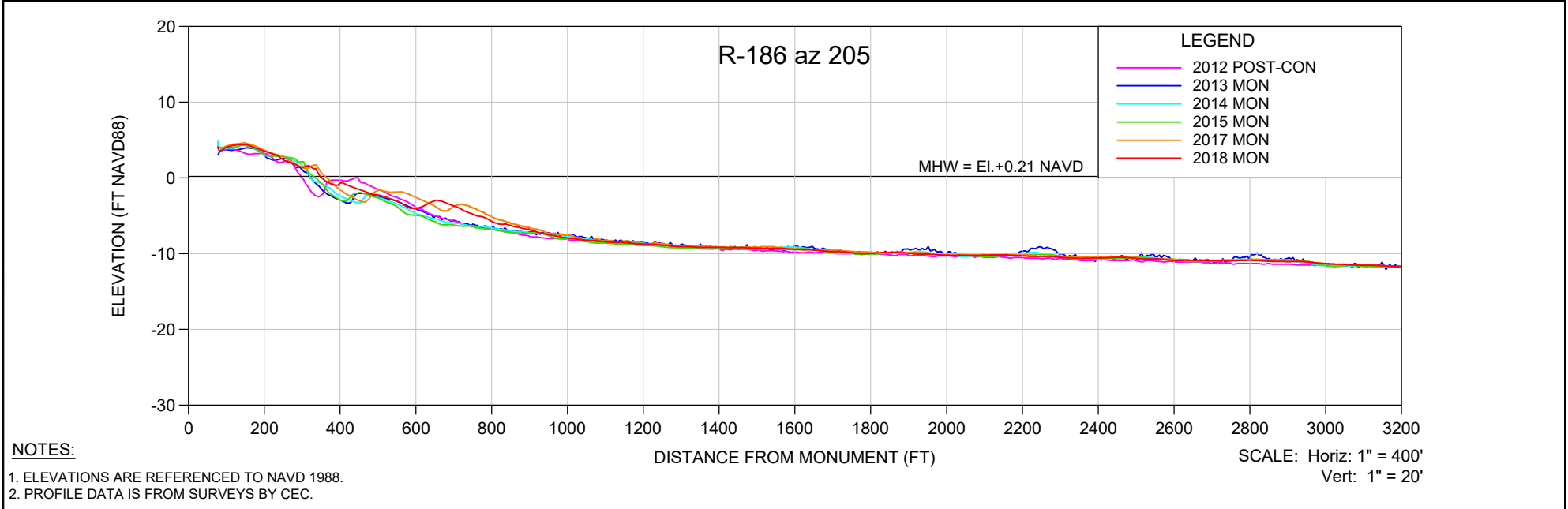
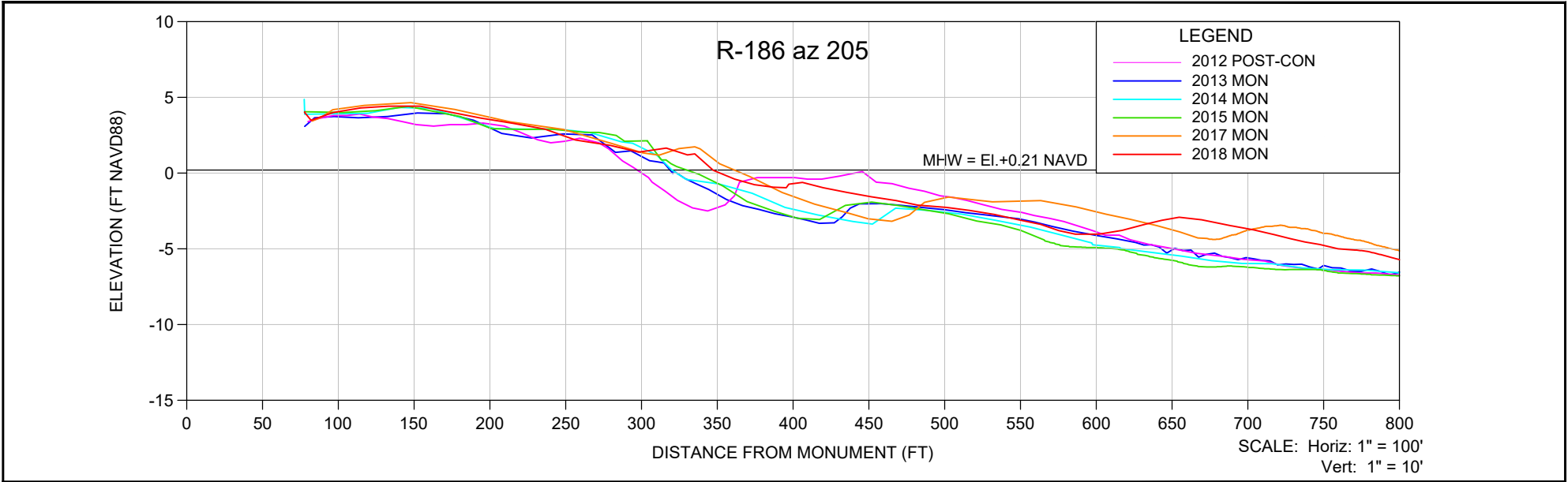




**NOTES:**

1. ELEVATIONS ARE REFERENCED TO NAVD 1988.
2. PROFILE DATA IS FROM SURVEYS BY CEC AND FDEP.

SHEET 15 FILE NO.: 18079-R-185 AZ200	<p><b>COASTAL ENGINEERING CONSULTANTS INC.</b> A CECI GROUP COMPANY Serving Florida Since 1977 3106 SOUTH HORSESHOE DRIVE NAPLES, FLORIDA 34104</p>	<p>CIVIL ENGINEERING SURVEY &amp; MAPPING COASTAL ENGINEERING ENVIRONMENTAL PLANNING SERVICES</p> <p>PHONE: (239)643-2324 FAX: (239)643-1143 www.coastalengineering.com E-Mail: engcollier@cecifl.com</p>	CLIENT:	<b>LEE COUNTY</b>			DATE:	6/25/2018	SCALE:	AS SHOWN					
			TITLE:	<b>R-185 AZ 200° MONITORING SURVEY</b>			DRAWN:	SDB	F.B.						
						CHECKED:	MTP	PG.							
						SEC.	TWP.	RNG.							
						ACAD NO.	18079-Estero-Mon Profiles.dwg								
						REF. NO.	18.079								
										NO.	DATE	BY	REVISION DESCRIPTION		



**NOTES:**

1. ELEVATIONS ARE REFERENCED TO NAVD 1988.
2. PROFILE DATA IS FROM SURVEYS BY CEC.

SHEET 16 FILE NO.: 18079-R-188	<p><b>COASTAL ENGINEERING CONSULTANTS INC.</b> A CECI GROUP COMPANY Serving Florida Since 1977 3106 SOUTH HORSESHOE DRIVE NAPLES, FLORIDA 34104</p>	<p>CIVIL ENGINEERING SURVEY &amp; MAPPING COASTAL ENGINEERING ENVIRONMENTAL PLANNING SERVICES</p> <p>PHONE: (239)643-2324 FAX: (239)643-1143 www.coastalengineering.com E-Mail: engcollier@cecifl.com</p>	CLIENT:	<b>LEE COUNTY</b>			DATE:	6/25/2018	SCALE:	AS SHOWN					
			TITLE:	<b>R-186 AZ 205° MONITORING SURVEY</b>			DRAWN:	SDB	F.B.						
						CHECKED:	MTP	PG.							
						SEC.	TWP.	RNG.							
						ACAD NO.	18079-Estero-Mon Profiles.dwg								
			REF. NO.	18.079											
										NO.	DATE	BY	REVISION DESCRIPTION		