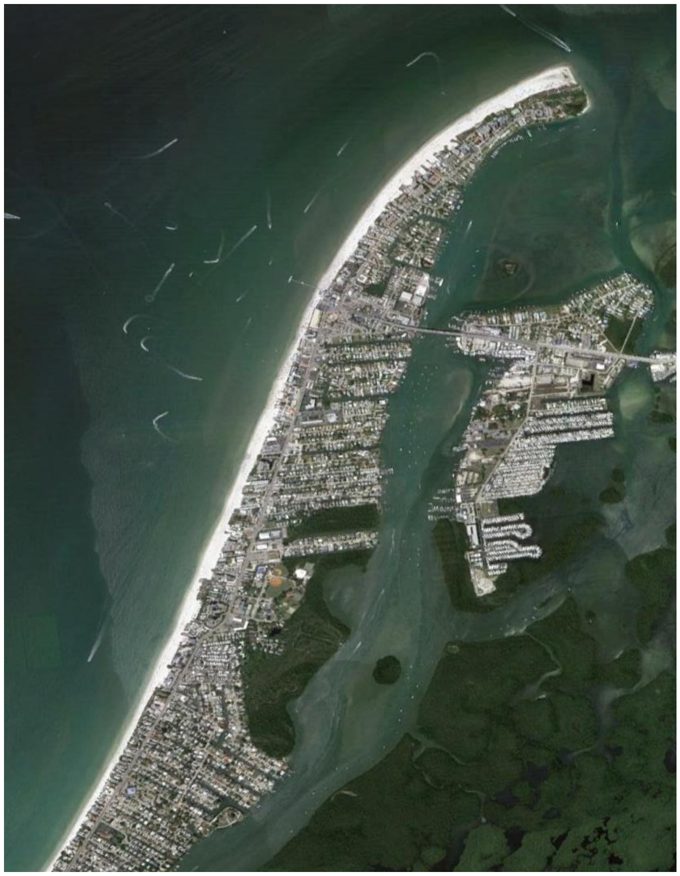
ESTERO ISLAND RESTORATION
2015 ANNUAL MONITORING REPORT
(DEP Permit 0173059-001-JC)



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August 12, 2015
CEC File No. 15.102

COASTAL ENGINEERING CONSULTANTS INC

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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 third year of post-construction monitoring which was conducted by Coastal Engineering Consultants, Inc. (CEC). Funding for the monitoring was provided by Lee County and the Florida Department of Environmental Protection (FDEP).

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.

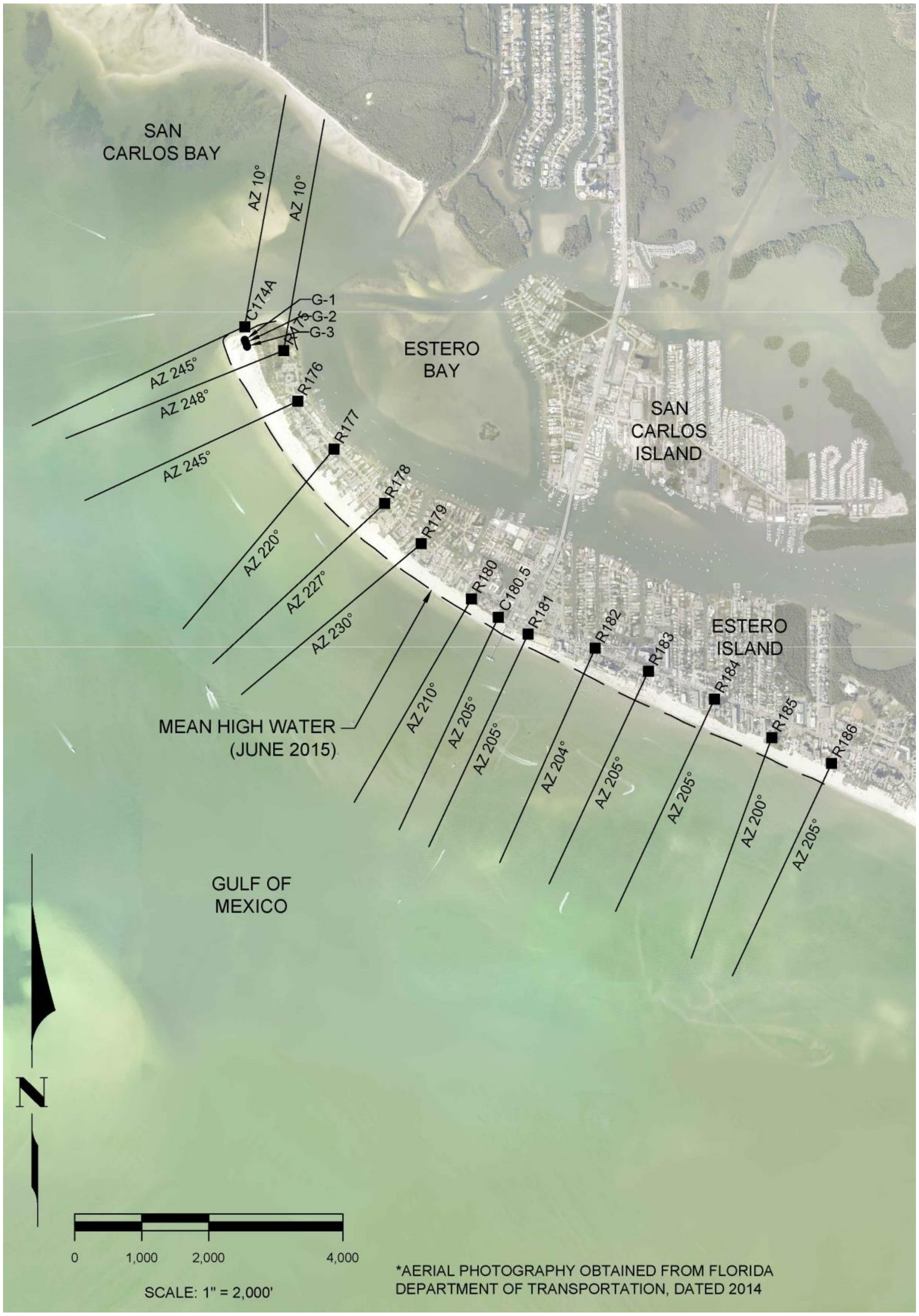

Figure 1. Location Map

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 FDEP within 90 days following completion of the third year monitoring survey. The report includes:

- signed and sealed survey report,
- analysis for patterns, trends, or changes between surveys and for cumulative changes over time,
- evaluation of the erosion and accretion rates occurring between the initial post-construction survey, first annual monitoring survey, and second annual monitoring survey; and an assessment of the volume of fill remaining within the Project Area, and
- comparative review of project performance to performance expectations and identification of adverse impacts attributable to the Project.

3.0 EQUIPMENT AND QA/QC PROCEDURES

3.1 Survey Report

The Survey Report is presented in Appendix 1.

3.2 Equipment

Upland: CEC employed two Trimble 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 that was controlled by the existing R monument. These systems are capable of delivering RTK positions with coordinate accuracy of ±10mm+2ppm. The standard 2 meter antenna rod allows for data collection seaward of the mean high water line up to 5 feet deep while protecting the equipment from the elements.

O*ffshore:* 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. The GPS antenna utilized the same side mount bracket as the transducer to place it directly above the transducer. A Trimble R8 GLONASS RTK GPS receiver was integrated with the on-board computer system. The Hypack 2014 software package was the hydrographic guidance program utilized.

3.3 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 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 mean high water line landward to the existing dune while an additional operator and unit 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 ±3.00 feet horizontal and ±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. 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. 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. Latency checks were conducted periodically throughout each day. The latency corrections were calculated and adjustments were made to the data using the Hypack subroutines.

Bathymetric survey data collection was conducted in calm seas. Maximum wave heights during the data collection period were less than 2 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 mean high water (MHW) or to –13.2 feet NAVD88, whichever was reached first.

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. Manual tide readings were performed periodically throughout the survey as a check for the tides measured by the RTK GPS.

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. The onshore and offshore data were collected concurrently.

3.3.1 Data Reduction and Deliverables

The profile measurement data from the upland and offshore surveys were merged together using the Hypack 2014 subroutines. The processed data was exported into AutoCAD and individual profiles were plotted to the specified scale. Copies of the profiles are included in Appendix 2. The digital data in ASCII format arranged and including all information as required by FDEP specifications and in "x,y,z" format will be electronically submitted to FDEP in addition to this monitoring report.

4.0 PHYSICAL MONITORING

4.1 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.

4.2 Shoreline and Volume Change Analyses

4.2.1 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, and June 2015 third year monitoring surveys. A summary of the shoreline and volumetric changes based on the comparisons between the 2014 and 2015 monitoring surveys at the R-monuments is presented below. These comparisons serve as a baseline for determining shoreline and volume change trends.

Table 1 presents the 2014 and 2015 monitoring survey shoreline positions at MHW (= +0.21 feet NAVD88), and the shoreline changes that occurred between 2014 and 2015. 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 2014 and 2015.

Table 2 and Figure 3 present the overall volumetric changes calculated to DOC from comparing the 2014 and 2015 monitoring surveys. Table 3 and Figure 4 present volumetric changes calculated above MHW for this period.

Table 1. 2014-2015 Shoreline Positions at MHW

MONUMENT (AZIMUTH)	POSITION 2015 (FT)	POSITION 2014 (FT)	SHORELINE CHANGE (FT)	2014-2015 AVERAGE SHORELINE CHANGE (FT)		EFFECTIVE DISTANCE (FT)
R-175 (10)	403.85	392.0	11.8	14.1	North Adjacent Shoreline	739.7
C-174A (10)	-78.4	-94.8	16.4			646.6
C-174A (245)	N/A	N/A	N/A			N/A
R-175 (248)	786.7	761.7	25.0	-6.6	Project Area	890.5
R-176 (245)	584.46	560.5	24.0			988.2
R-177 (220)	636.37	648.7	-12.3			1096.0
R-178 (227)	620.1	638.0	-17.9			911.2
R-179 (230)	500.5	524.2	-23.7			1017.0
R-180 (210)	208.33	215.2	-6.8			871.9
C-180.5 (205)	180.21	202.6	-22.4			503.7
R-181 (205)	175.88	194.3	-18.4			756.3
R-182 (204)	416.46	423.2	-6.7			930.6
R-183 (205)	477.71	428.7	49.0	13.7	South Adjacent Shoreline	963.6
R-184 (205)	502.55	498.2	4.3			1056.7
R-185 (200)	296.84	305.1	-8.3			993.8
R-186 (205)	329.43	319.7	9.7			42.4
N/A = profile below MHW		Weighted Avg (FT)		1.4		
		Avg Annual Rate (FT/YR)		1.6		

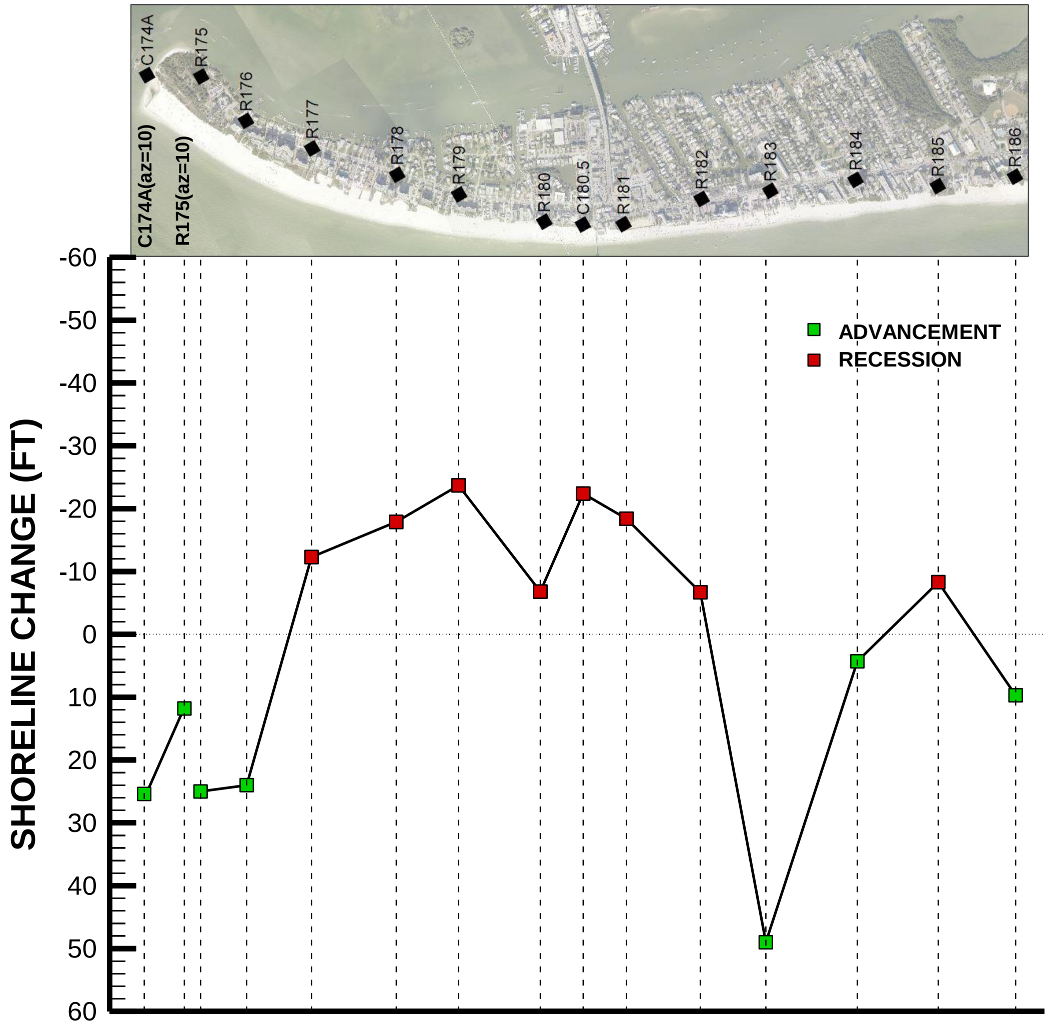

Figure 2. 2014-2015 Shoreline Migration at MHW

Table 2. 2014-2015 Volumetric Changes Above Depth of Closure

MONUMENT (AZIMUTH)	CELL AREA (YD³/FT)	AVE CELL AREA (YD³/FT)	LENGTH (FT)	VOLUME (YD³)	DOC (FT)	TOTAL VOLUME (CY)	
R-175 (10)	-1.4				-14.5	17,828	North Adjacent Shoreline
		6.6	675	4,427			
C-174A (10)	14.5				-14.5		
		18.7	715	13,400			
C-174A (245)	23.0				-14.5	24,605	Project Area
		11.2	531	5,939			
R-175 (248)	-0.6				-14.5		
		3.1	817	2,520			
R-176	6.8				-14.5		
		1.6	1,160	1,841			
R-177 (220)	-3.6				-14.5		
		-0.7	1,033	-769			
R-178 (227)	2.1				-14.5		
		3.9	790	3,085			
R-179 (230)	5.7				-14.5		
		8.4	1,244	10,437			
R-180 (210)	11.1				-12.0		
		6.8	500	3,375			
C-180.5 (205)	2.4				-12.0		
		-1.4	508	-711			
R-181 (205)	-5.2				-12.0		
		-1.1	1,005	-1,113			
R-182 (204)	3.0				-11.0		
		-0.8	856	-667		-1,545	South Adjacent Shoreline
R-183 (204)*	-4.6				-10.5		
		7.3	1,071	7,796			
R-184 (205)*	19.2				-10.0		
		2.2	1,043	2,343			
R-185 (200)	-14.7				-11.0		
		-11.7	945	-11,017			
R-186 (205)	-8.7				-11.0		

* Length of 3,000 feet from MHW was surveyed before a -11.0'FT NAVD DOC was reached

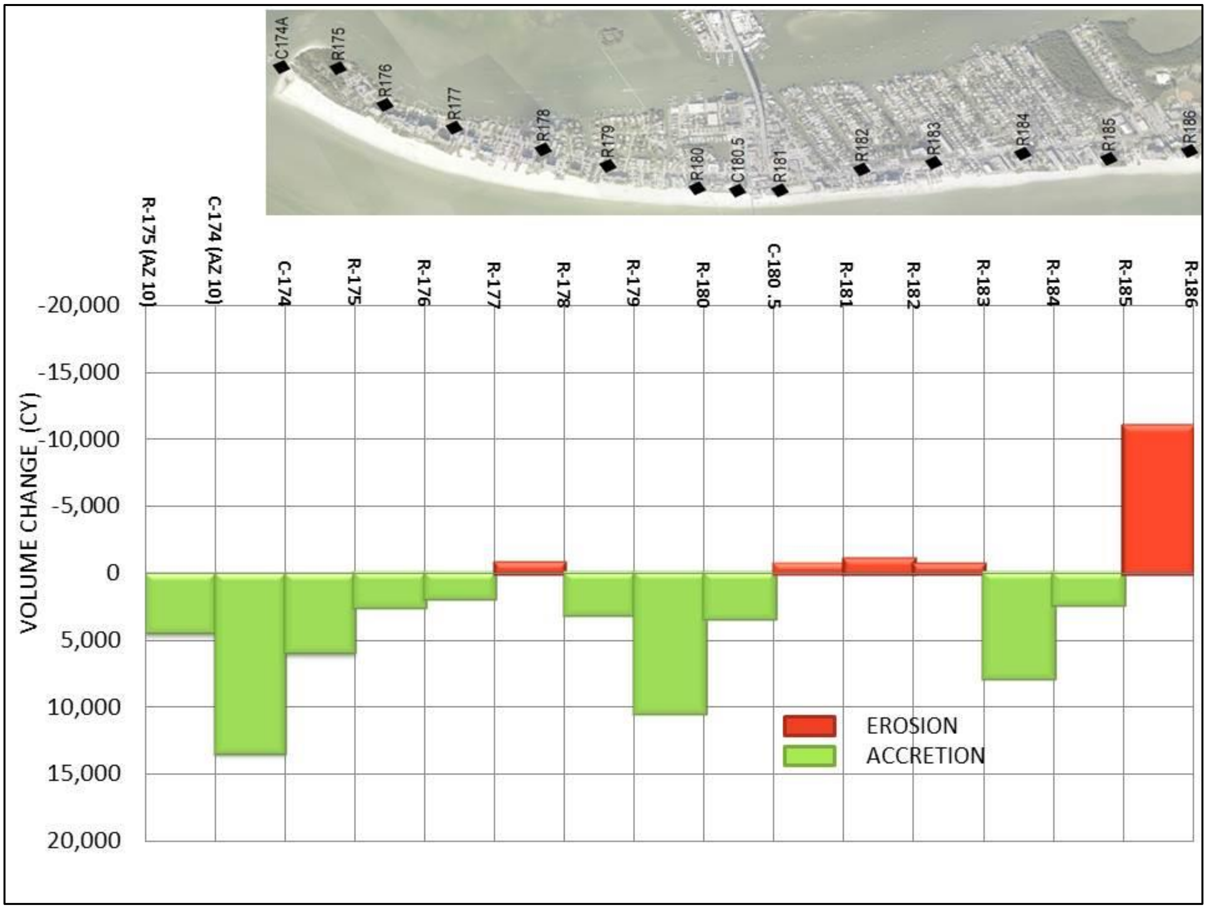

Figure 3. 2014-2015 Volumetric Changes Above DOC

Table 3. 2014-2015 Volumetric Changes Above Mean High Water

MONUMENT (AZIMUTH)	CELL AREA (YD³/FT)	AVE CELL AREA (YD³/FT)	LENGTH (FT)	VOLUME (YD³)	TOTAL VOLUME (CY)	
R-175 (10)	0.8				1,003	North Adjacent Shoreline
		1.5	675	1,003		
C-174A (10)	2.2					
		1.1	0	0		
C-174A (245)	0.0				-126	Project Area
		1.0	531	-		
R-175 (248)	2.0					
		1.4	817	1,155		
R-176	0.8					
		0.7	1,160	828		
R-177 (220)	0.6					
		-0.6	1,033	-644		
R-178 (227)	-1.8					
		-0.8	790	-599		
R-179 (230)	0.3					
		0.2	1,244	249		
R-180 (210)	0.1					
		-0.4	500	-206		
C-180.5 (205)	-0.9					
		-0.9	508	-442		
R-181 (205)	-0.8					
		-0.5	1,005	-466		
R-182 (204)	-0.1				5,525	South Adjacent Shoreline
		2.7	856	2,279		
R-183 (204)	5.4					
		2.3	1,071	2,507		
R-184 (205)	-0.7					
		0.0	1,043	5		
R-185 (200)	0.8					
		0.8	945	735		
R-186 (205)	0.8					

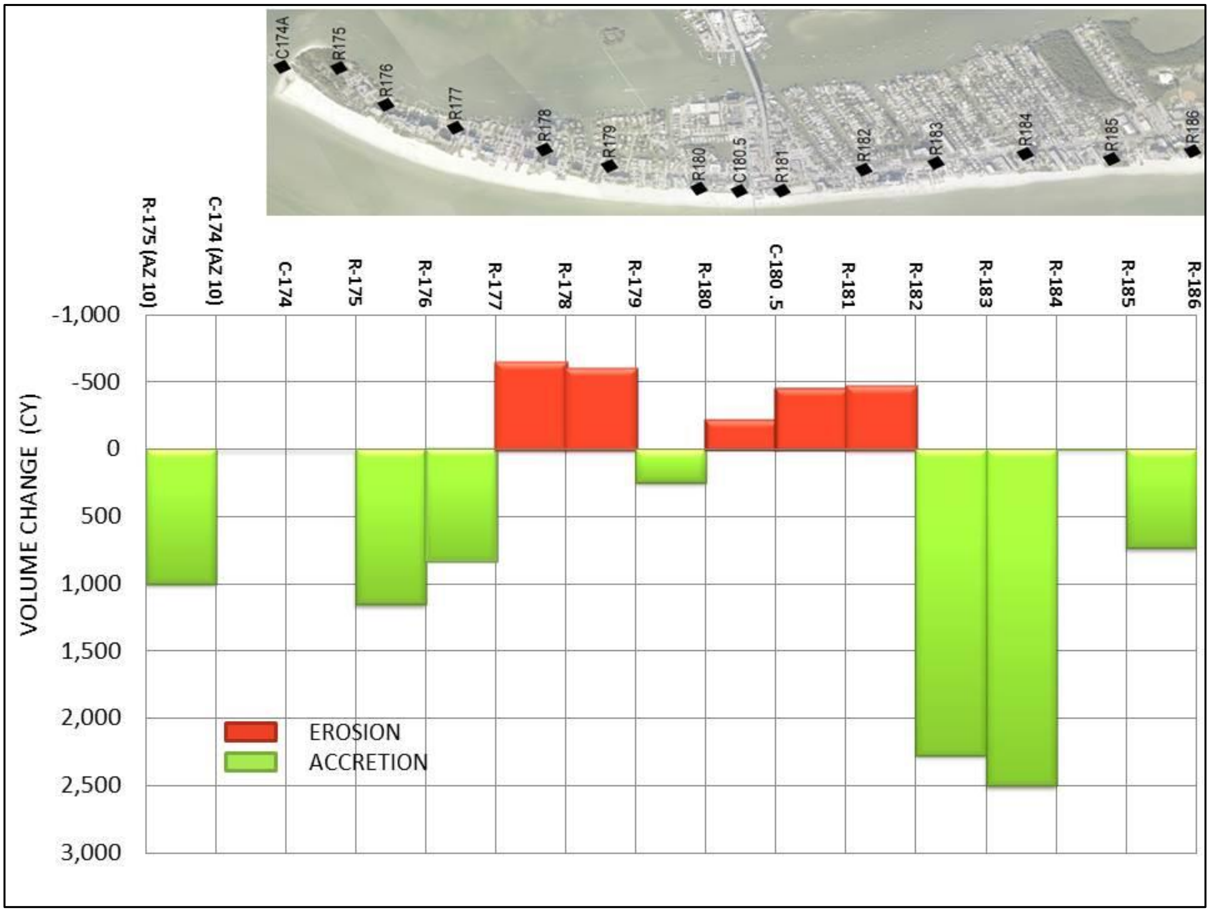

Figure 4. 2014-2015 Volumetric Change Above MHW

4.2.2 Project Area

The Project Area from R-175 to R-182 experienced the highest rate of recession in the entire monitoring area. The range varied from 25.0 feet of advancement at R-175 to 23.7 feet of recession at R-179, with an average shoreline change of 6.6 feet of recession. Within the Project Area, the beach experienced accretion of approximately 24,610 cy above DOC. Volumetric changes above DOC within the Project Area ranged from 1,110 cy of erosion between R-181 and R-182 to 10,440 cy of accretion between R-179 and R-180. The Project Area experienced net erosion above MHW of approximately 130 cy. Volumetric changes above MHW within the Project Area ranged from 640 cy of erosion between R-177 and R-178 to 1,160 cy of accretion between R-175 and R176.

4.2.3 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=10º). It is noted, the measured profile at C-174A (az=245º) in 2014 and 2015 did not extend above MHW. Therefore, shoreline change rates could not be determined for these two monuments for this monitoring period. The only shoreline changes measured were at R-174A (az=10º) and R-175 (az=10º) where there was an average advancement of approximately 14.1 feet.

The north adjacent shoreline between 2014 and 2015 experienced approximately 17,830 cy of accretion above DOC. The north adjacent shoreline experienced approximately 1,000 cy of accretion above MHW between 2014 and 2015.

4.2.4 South Adjacent Shoreline

The south adjacent shoreline begins at R-182 and extends south to R-186. This stretch of beach experienced an average rate of advancement of approximately 13.7 feet between 2014 and 2015. The shoreline changes ranged from approximately 49.0 feet of advancement at R-183 to approximately -8.3 feet of recession at R-185.

The south adjacent shoreline between 2014 and 2015 experienced approximately 1,550 cy of erosion above DOC. The majority of this erosion was between R-185 and R-186. Volumetric changes above DOC ranged from 11,017 cy of erosion between R-185 and R-186 to 7,800 cy of accretion between R-183 and R-184.

The south adjacent shoreline experienced approximately 5,530 cy of accretion above MHW. Nearly 90% of the accretion occurred between R-182 and R-184 which corresponds with the area of highest advancement of the shoreline. Volumetric changes above MHW ranged from 5 cy of accretion between R-184 and R-185 to 2,510 cy of accretion between R-183 and R-184. to

4.2.5 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, shoreline within the monitoring area has receded on average an annual rate of approximately 0.3 feet between the July 2014 and June 2015 monitoring surveys. The total volume change between the 2014 and 2015 monitoring surveys was approximately 40,890 cy of accretion above DOC and approximately 6,400 cy of accretion above MHW.

4.3 Project Area Performance

Table 4 presents the 2011 through 2015 monitoring survey shoreline positions at MHW for the monitoring area. In addition to the positions, the table includes shoreline change rates calculated for the 2012-2015 time period representing the three year post-construction monitoring period. For consistency, the same effective distances as in Table 1 were utilized to determine the weighted average. Figure 5 presents the 2012, 2013, 2014, and 2015 MHW positions relative to the 2011 pre-construction MHW positions which were utilized as the baseline for the Project Area.

Table 5 and Figure 6 present the volumetric changes from the pre-construction survey in 2011 to the post construction survey in 2012. In addition the table presents the volumetric changes between 2012 post construction and each of the 2013, 2014 and 2015 monitoring surveys.

Table 4. 2012-2015 Shoreline Changes

MONUMENT (AZIMUTH)	POSITION 2015 (FT)	POSITION 2014 (FT)	POSITION 2013 (FT)	POST-CON POSITION 2012 (FT)	PRE-CON POSITION 2011 (FT)	2012-2015 SHORELINE CHANGE RATE (FT/YR)	2012-2015 AVERAGE SHORELINE CHANGE RATE (FT/YR)	
R-175 (10)	403.85	392.0	355.6	352.8	N/A	14.9	14.9	North Adjacent Shoreline
C-174A (10)	-78.4	-94.8	N/A	N/A	N/A	N/A		
C-174A (245)	N/A	N/A	N/A	N/A	N/A	N/A		
R-175 (248)*	786.7	761.7	767.2	759.7	439.6	7.9	-21.6	Project Area
R-176 (245)	584.46	560.5	591.0	673.0	347.8	-25.8		
R-177 (220)*	636.37	648.7	647.2	739.8	455.8	-30.2		
R-178 (227)*	620.1	638.0	611.7	656.2	472.2	-10.5		
R-179 (230)*	500.5	524.2	516.9	564.7	353.7	-18.7		
R-180 (210)*	208.33	215.2	257.9	332.1	117.3	-36.1		
C-180.5 (205)	180.21	202.6	241.2	323.9	132.8	-41.9		
R-181 (205)	175.88	194.3	220.9	331.9	113.1	-45.5		
R-182 (204)*	416.46	423.2	424.3	394.8	398.4	6.3		
R-183 (205)	477.71	428.7	434.2	449.6	N/A	8.2	11.8	South Adjacent Shoreline
R-184 (205)	502.55	498.2	447.8	469.5	N/A	9.6		
R-185 (200)*	296.84	305.1	256.2	229.1	N/A	19.8		
R-186 (205)	329.43	319.7	318.7	296.9	N/A	9.5		
				Avg Annual		-9.0		

N/A = profile below MHW

*2012 Line was shifted from adjacent azimuth

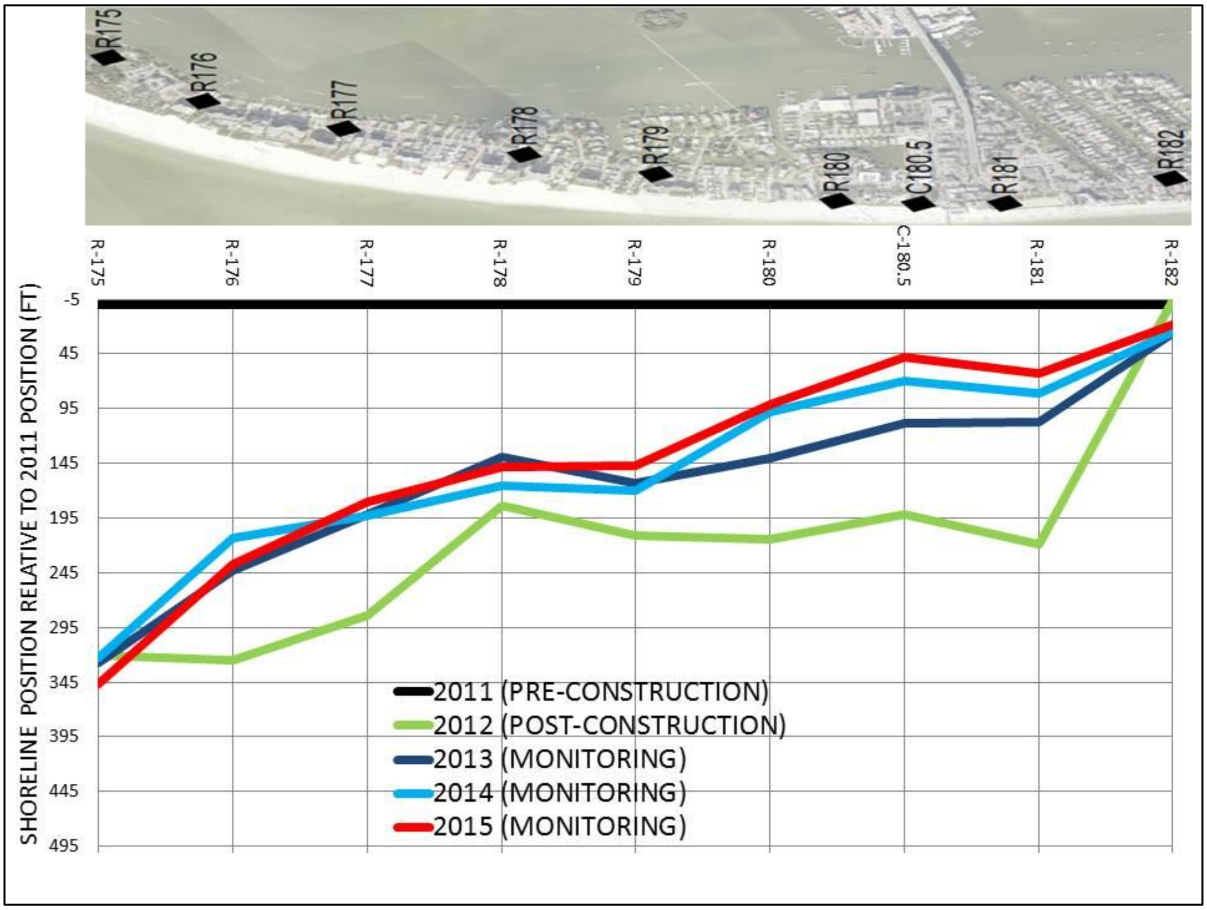

Figure 5. 2012-2015 Shoreline Positions within Project Area

When comparing the 2015 monitoring survey to the 2012 post-construction survey, the Project Area shoreline experienced an average recession of 21.6 feet. The areas adjacent to the Project Area have both experienced advancement, 14.9 feet on the north and 11.8 feet on the south. The weighted average shoreline change rate for the entire monitoring area between 2012 and 2015 equated to 10.8 feet per year of recession.

Table 5. 2012-2015 Volumetric Changes within Project Area

MON (AZIMUTH)	2011 to 2012			2012 to 2013			2012 to 2014			2012 to 2015		
	DIFF IN AREA (YD^3)	AVE CELL AREA (YD^3/FT)	VOLUME (YD^3)	DIFF IN AREA (YD^3)	AVE CELL AREA (YD^3/FT)	VOLUME (YD^3)	DIFF IN AREA (YD^3)	AVE CELL AREA (YD^3/FT)	VOLUME (YD^3)	DIFF IN AREA (YD^3)	AVE CELL AREA (YD^3/FT)	VOLUME (YD^3)
R-174 (245)	0			0			0			0		
		37.9	20,143		0.7	348		1.7	921		3.5	1,837
R-175 (248)*	40,975			708			1,874			3,736		
		79.8	65,199		-4.3	-3,527		-3.7	-3,063		-1.7	-1,413
R-176 (245)	45,226			-5,371			-5,923			-5,604		
		79.4	92,107		-11.1	-12,890		-12.7	-14,707		-13.6	-15,810
R-177 (220)*	40,560			-6,634			-7,775			-9,121		
		55.9	57,707		-3.4	-3,471		-2.6	-2,657		-5.3	-5,435
R-178 (227)*	19,801			3,003			4,996			3,435		
		41.8	32,973		3.9	3,083		4.7	3,719		2.4	1,857
R-179 (230)*	25,289			1,213			89			-897		
		49.9	62,113		-4.7	-5,842		-11.9	-14,800		-12.6	-15,668
R-180 (210)*	28,629			-6,284			-12,936			-12,704		
		50.3	25,132		-11.4	-5,693		-23.0	-11,481		-24.4	-12,187
C-180.5 (205)	25,703			-6,024			-11,884			-13,643		
		48.3	24,541		-11.7	-5,944		-21.7	-11,031		-25.5	-12,970
R-181 (205)	26,479			-6,616			-11,571			-13,936		
		24.5	24,631		-6.1	-6,154		-10.7	-10,763		-12.9	-12,964
R-182 (204)*	0			0			0			0		
	Totals		**404,545**			**-40,090**			**-63,861**			**-72,753**

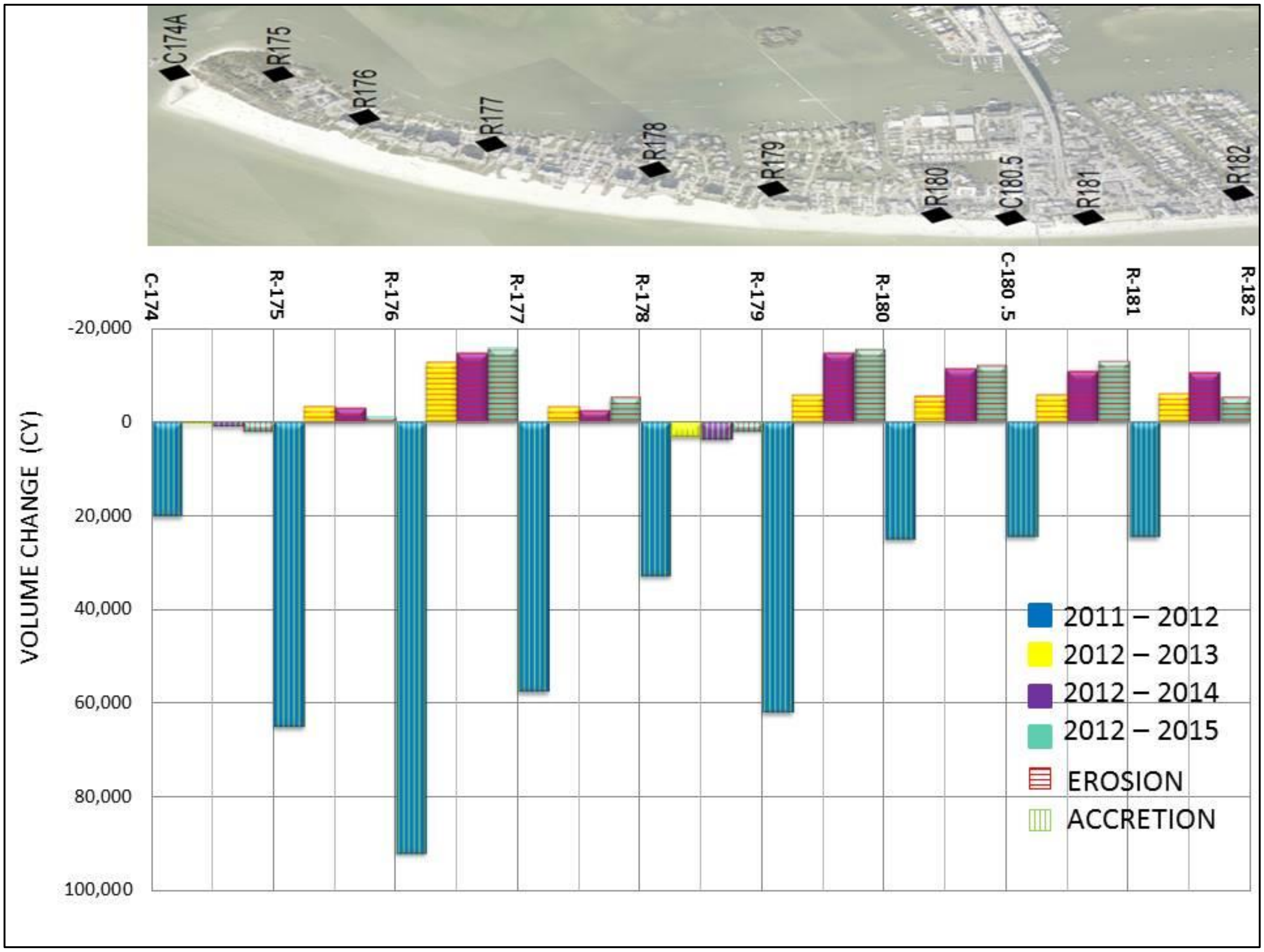

Figure 6. 2012-2015 Volumetric Changes within Project Area

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 where 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 4 and 5. 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) and was found to be within one percent, which confirms the profile adjustments employed and analysis performed herein.

The volumetric changes for 2013, 2014 and 2015 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. The percent remaining in the Project Area in 2015 equates to approximately 82.0%.

Accounting for the time period between the surveys, the annualized erosion rates for the Project Area for the first, second, and third monitoring periods equate to approximately 32,070 cy/year, 19,020 cy/year, and 9,700 cy/year, respectively. As anticipated, the erosion rate was highest in the first year attributed to both profile equilibration and fill diffusion.

4.4 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. Because the measured profile C-174A (az=245º) did not extend above MHW for one or more of the monitoring surveys, the only shoreline change calculation that could be performed was between R-174A (az=10º) and R-175 (az=10º) which experienced significant advancement between 2014 and 2015. A review of the profile comparisons depicts accretion on the upper beach and nearshore with little change across the channel at R-175 (az=10º), accretion on the upper beach and south side of the channel with little change in the channel on the north side at C-174A (az=10º), and accretion in the nearshore at C-174A (az=245º) which lies immediately downdrift of the terminal groin (Appendix 2). A review of the G-line profiles indicates negligible changes between 2014 and 2015 with mild flattening of the slopes below MHW at all three profile lines. Net accretion is observed at all G-line profiles. Based on the 2015 monitoring, no adverse impacts to the contingent shoreline were documented due to the terminal groin.

5.0 CONCLUSION

This report describes the third annual monitoring results of the Estero Island Restoration Project. The information presented herein provides the necessary data for both Lee County and FDEP to regularly 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 and FDEP 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 July 2014 and June 2015, the beach fill segments along the entire monitoring area experienced net shoreline recession of approximately 0.3 feet per year, net accretion of approximately 40,890 cy measured above DOC, and net accretion of approximately 6,400 cy measured above MWH.

Between 2014 and 2015, the Project Area experienced average shoreline recession of approximately 6.6 feet, net accretion of approximately 24,610 cy measured above DOC, and net erosion of approximately 130 cy measured above MWH.

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, and 8,890 cy between 2014 and 2015 as measured within the fill template. There is approximately 331,800 cy or 82% remaining within the design template from the original volume placed.

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.

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; 1st Year Annual Monitoring Report.” Lee County Division of Natural Resources, Fort Myers.

Coastal Engineering. (2014) “Estero Island Restoration; 2nd Year Annual Monitoring Report.” Coastal Engineering Consultants Inc., Naples.

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APPENDIX 1

SURVEY REPORT

APPENDIX 1

2015 ESTERO ISLAND ANNUAL MONITORING PROJECT
SURVEY REPORT

Multiple Real Time Kinematic (RTK) Global Positioning Systems (GPS) were utilized for the Monitoring Survey conducted on June 6, 2015. 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 datum's were North American Datum (NAD) of 1983/1990 Adjustment and North American Vertical Datum (NAVD) of 1988, Geoid 2012A, respectively. The following published benchmarks were used to control this survey:

FDNR Reference Monument 12 80 A27-2, Elevation = 4.94 Feet NAVD of 1988
FDNR Reference Monument 12 83 A25-2, Elevation = 3.37 Feet NAVD of 1988

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.

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 ±10mm+2ppm. 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. A Trimble R8 receiver was integrated with the on-board computer system. The Hypack 2014 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, 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 R8 RTK GPS rover unit to collect survey data from the approximate mean high water line landward to the existing dune while an additional surveyor equipped with a Trimble R10 RTK GPS rover unit 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 ±3.00 feet horizontal and ±0.16 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 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 checks were conducted periodically throughout each day. The 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. Difference in time between the onshore and offshore data was no greater than 1 day.

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

Richard J. Ewing, P.S.M.
Professional Surveyor and Mapper
Florida Certificate No. 5295
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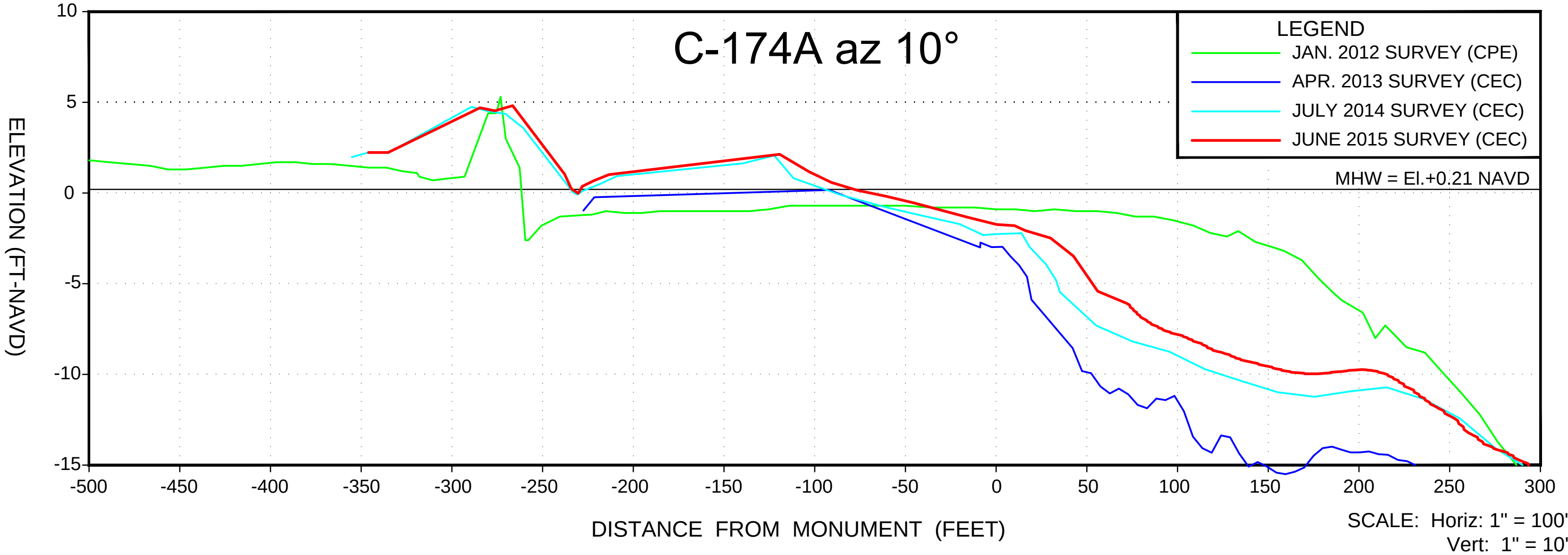
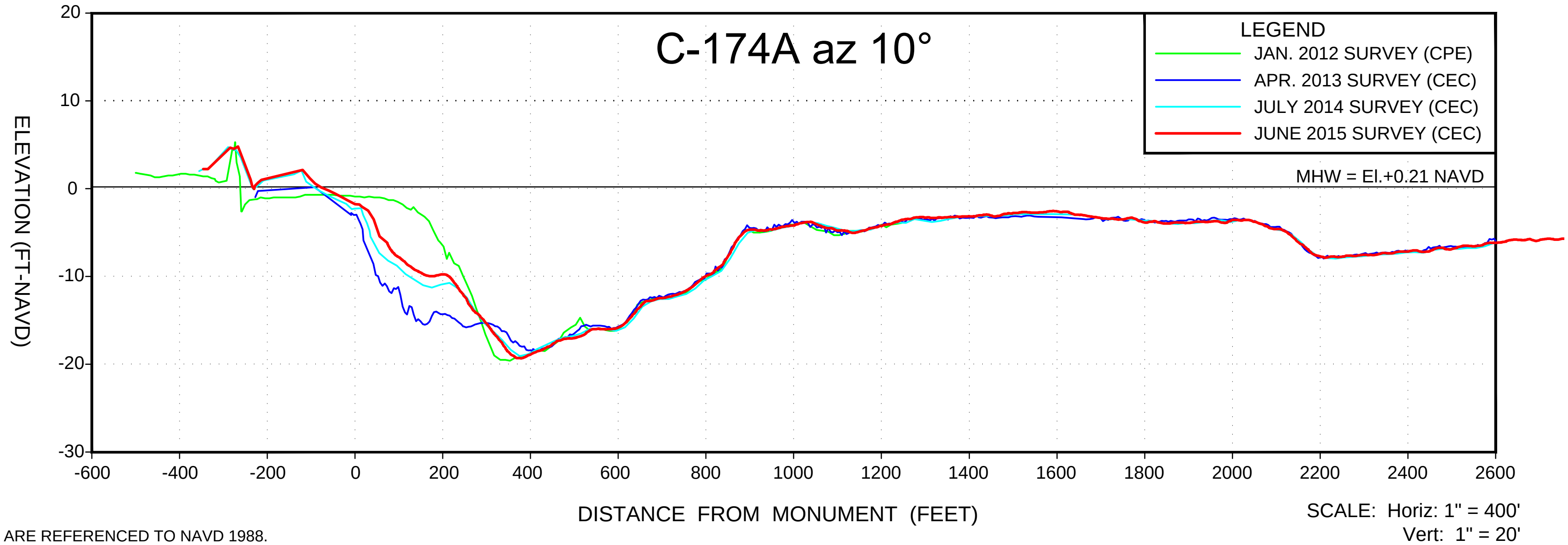
APPENDIX 2

BEACH PROFILES





NOTES:

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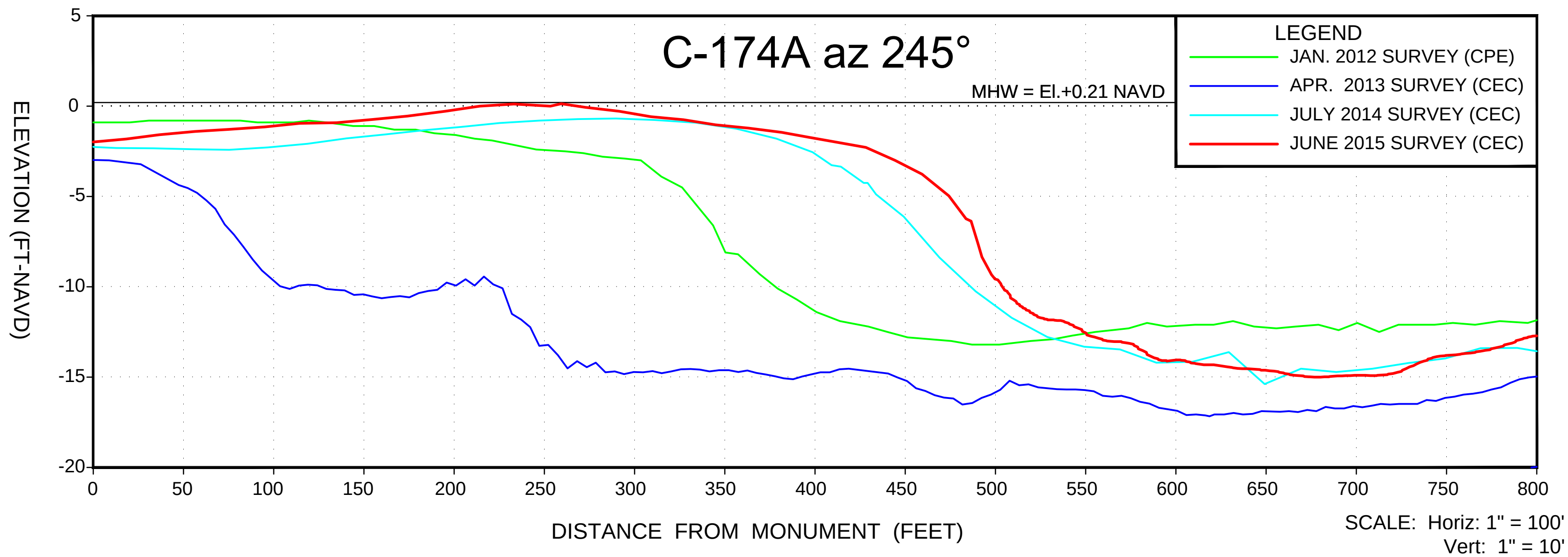

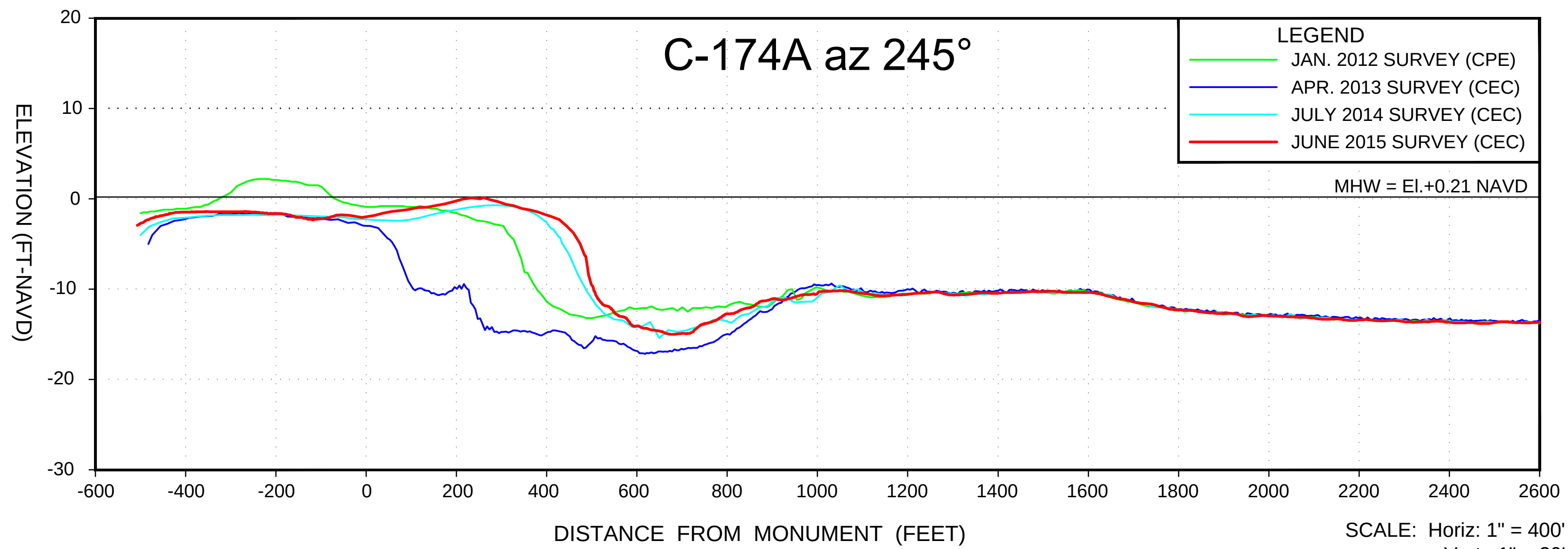

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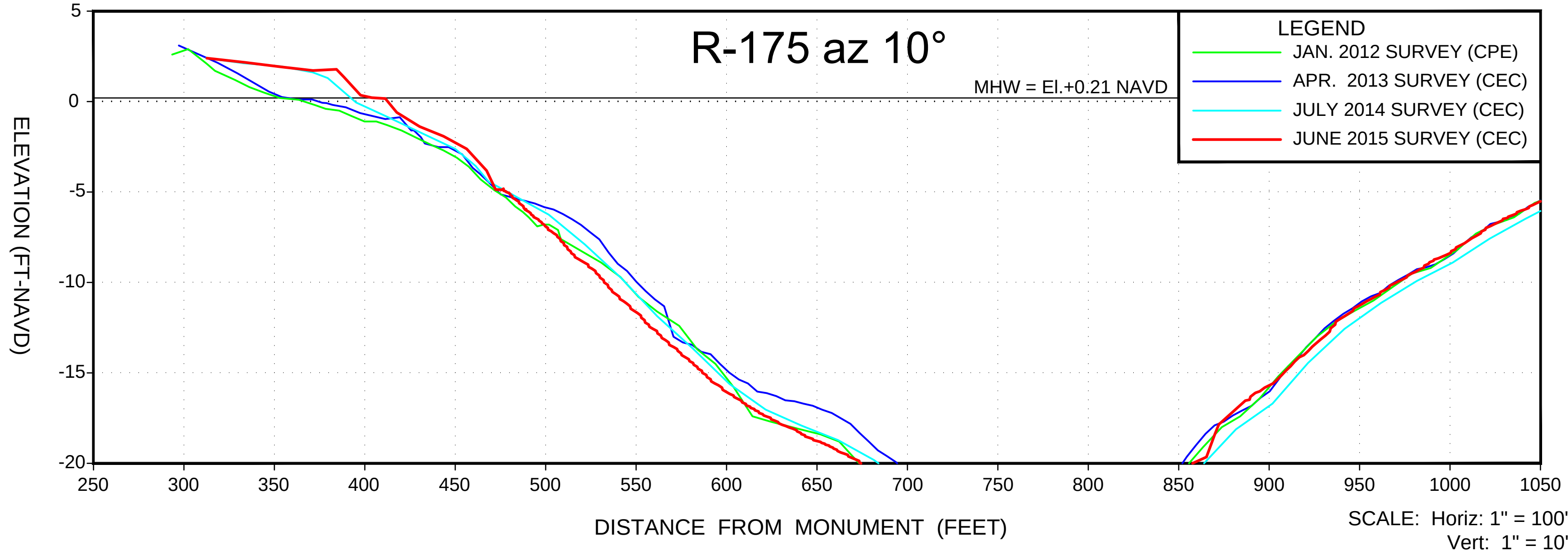

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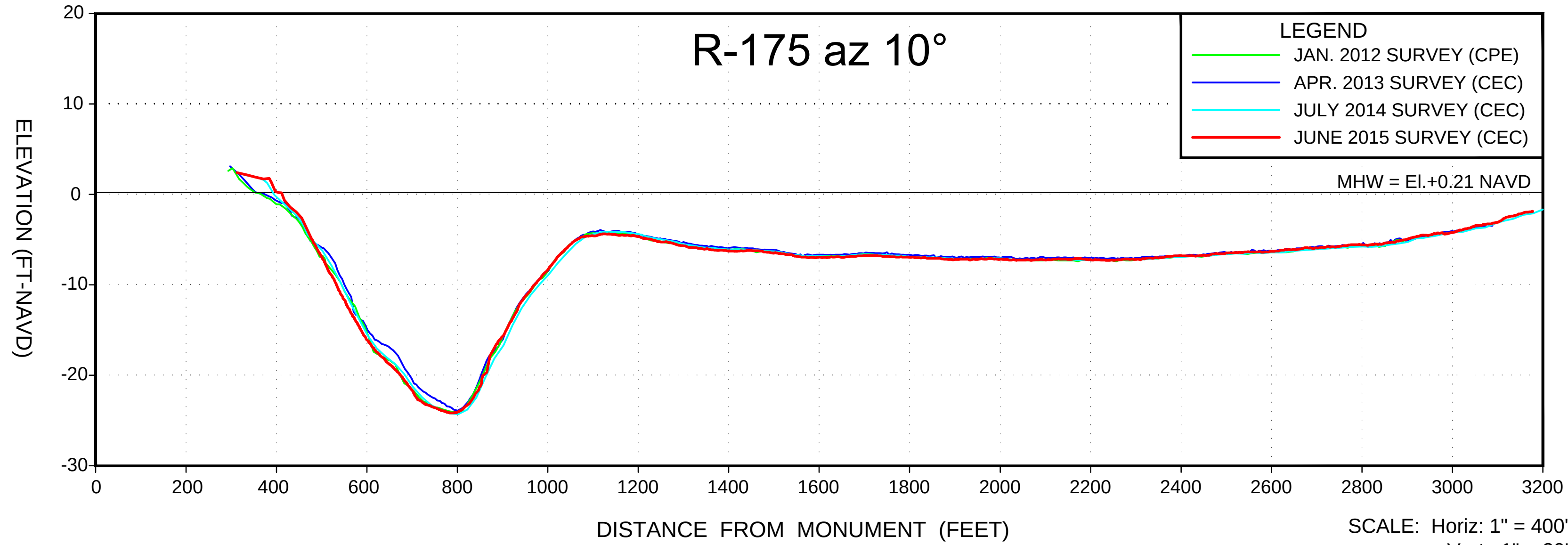

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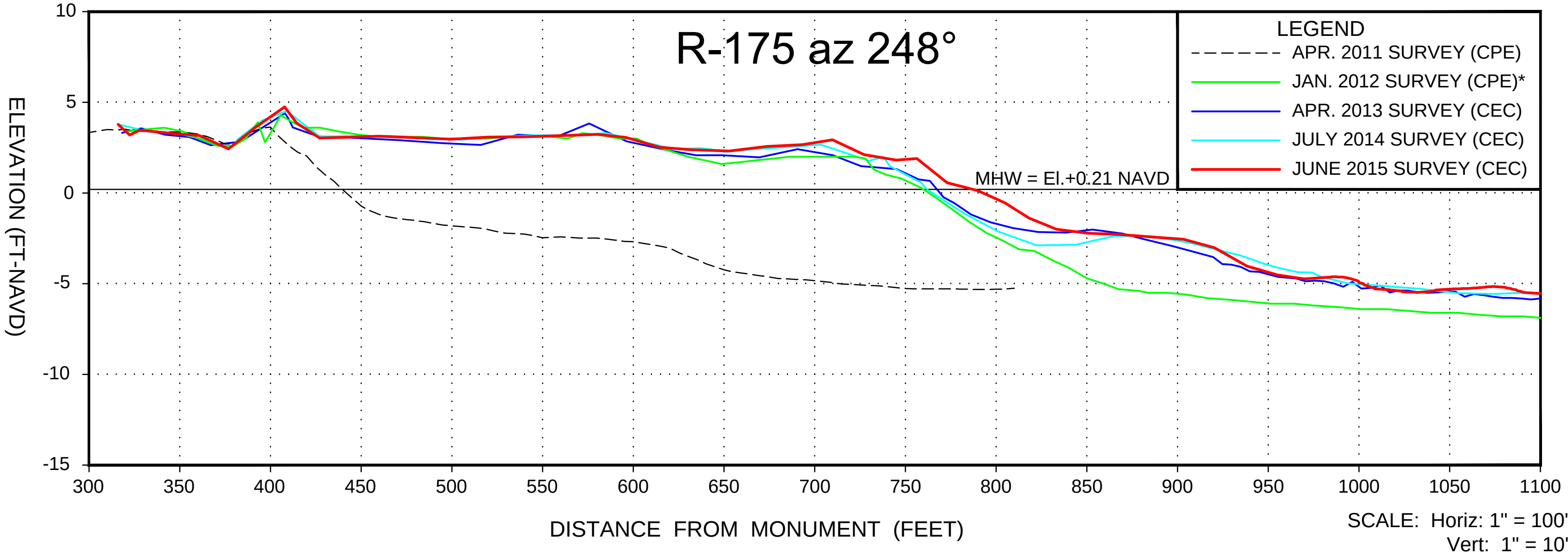

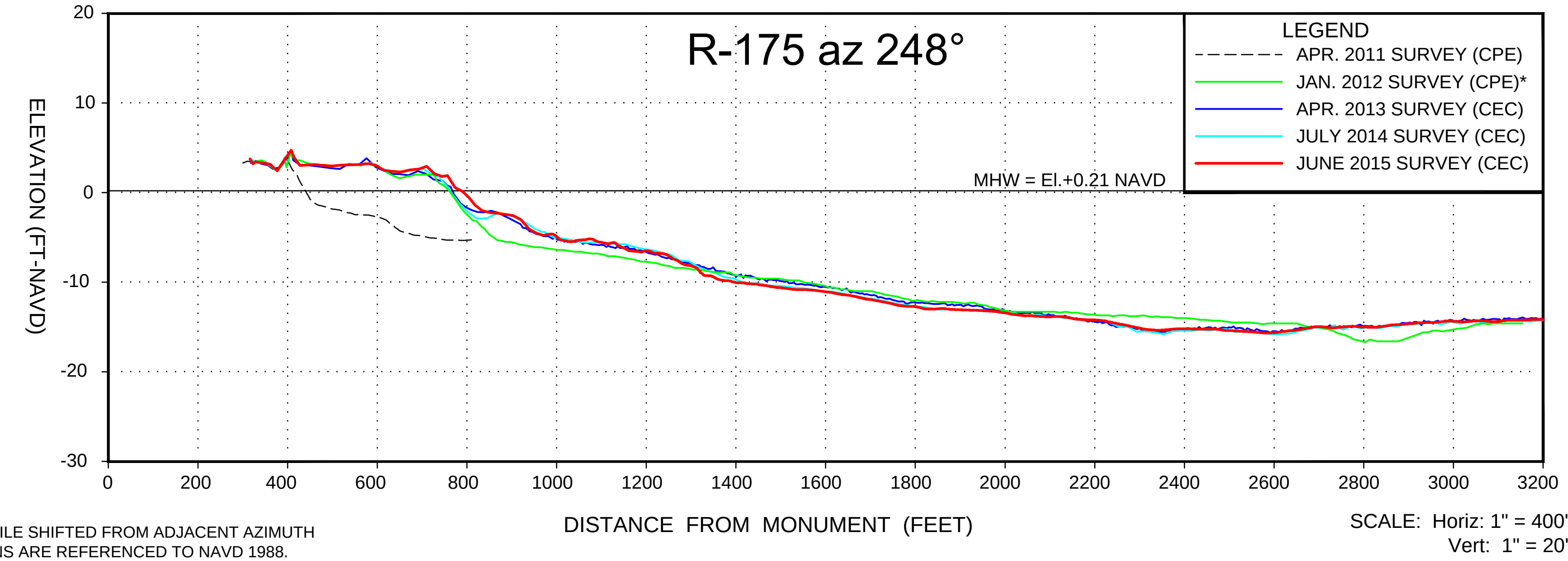

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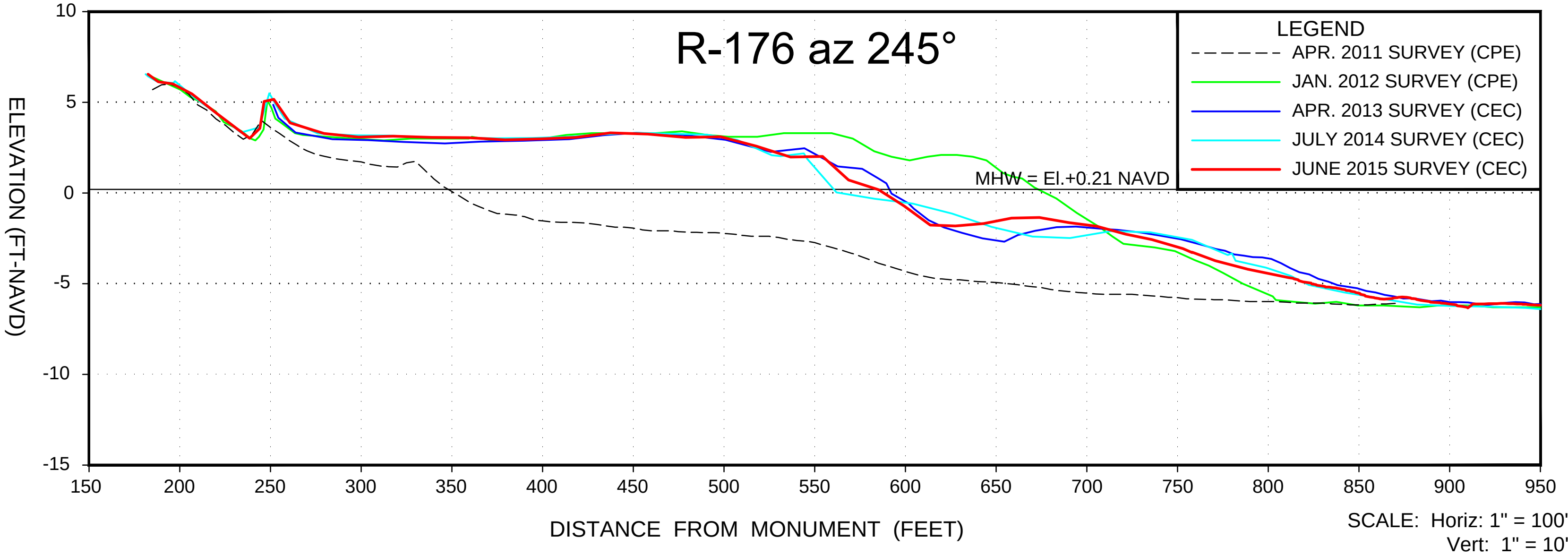

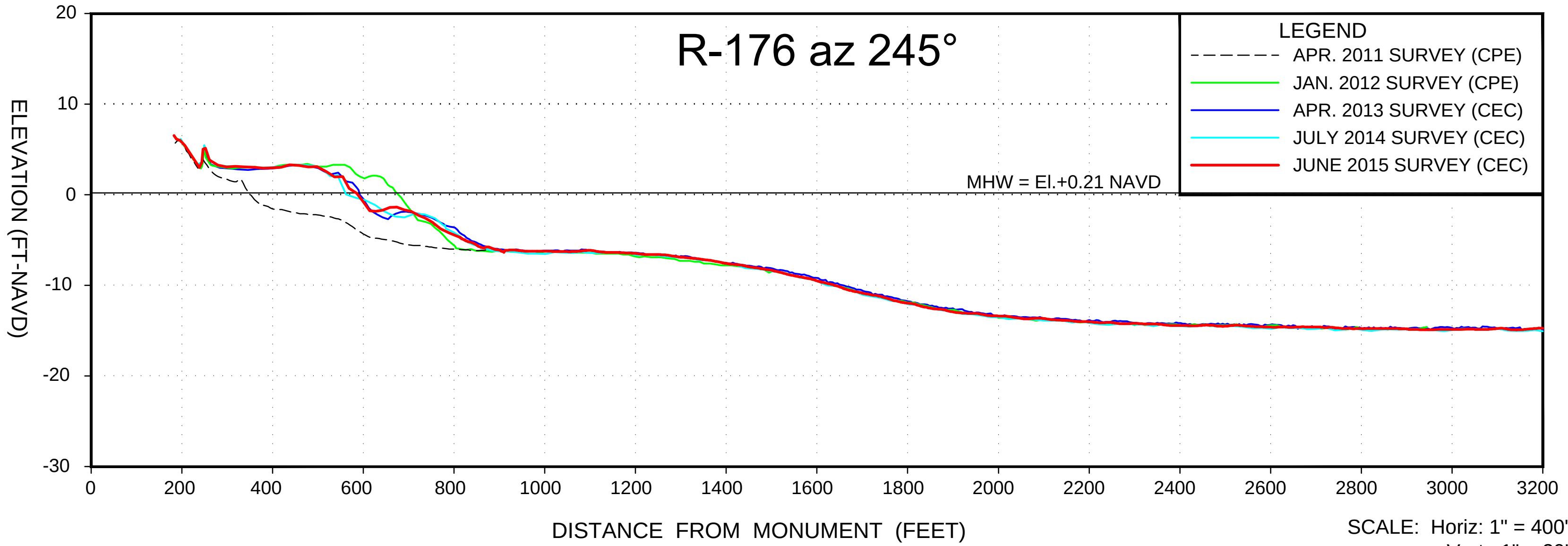

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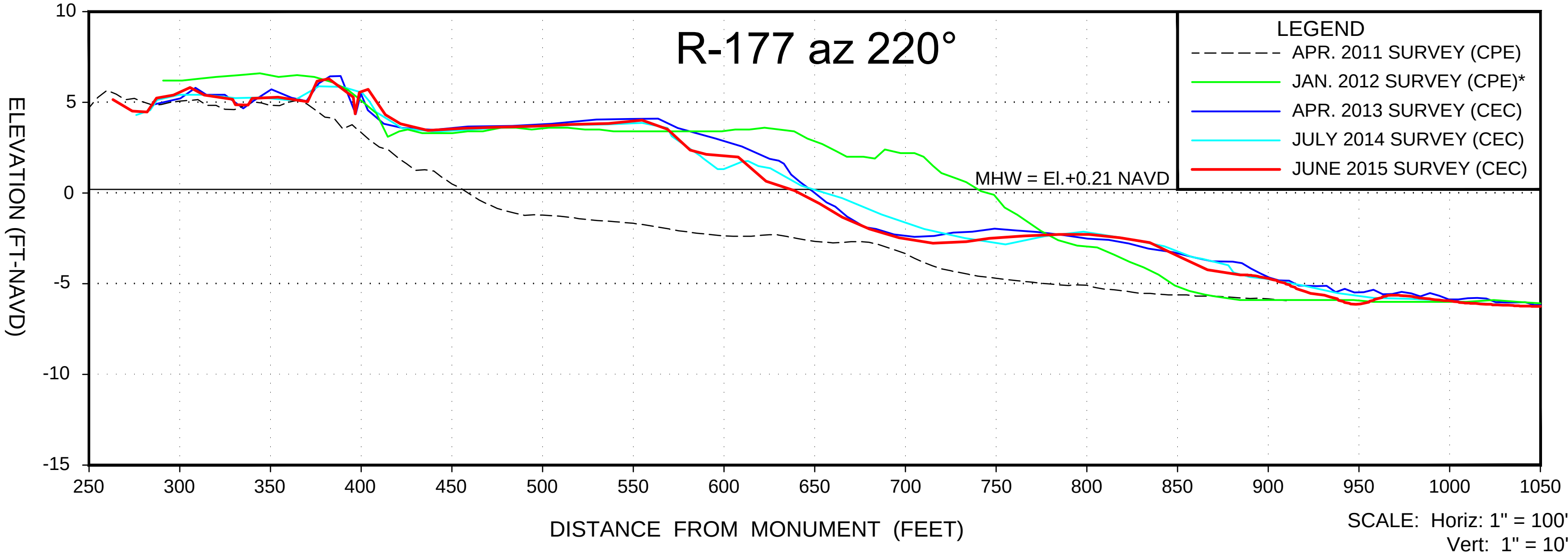

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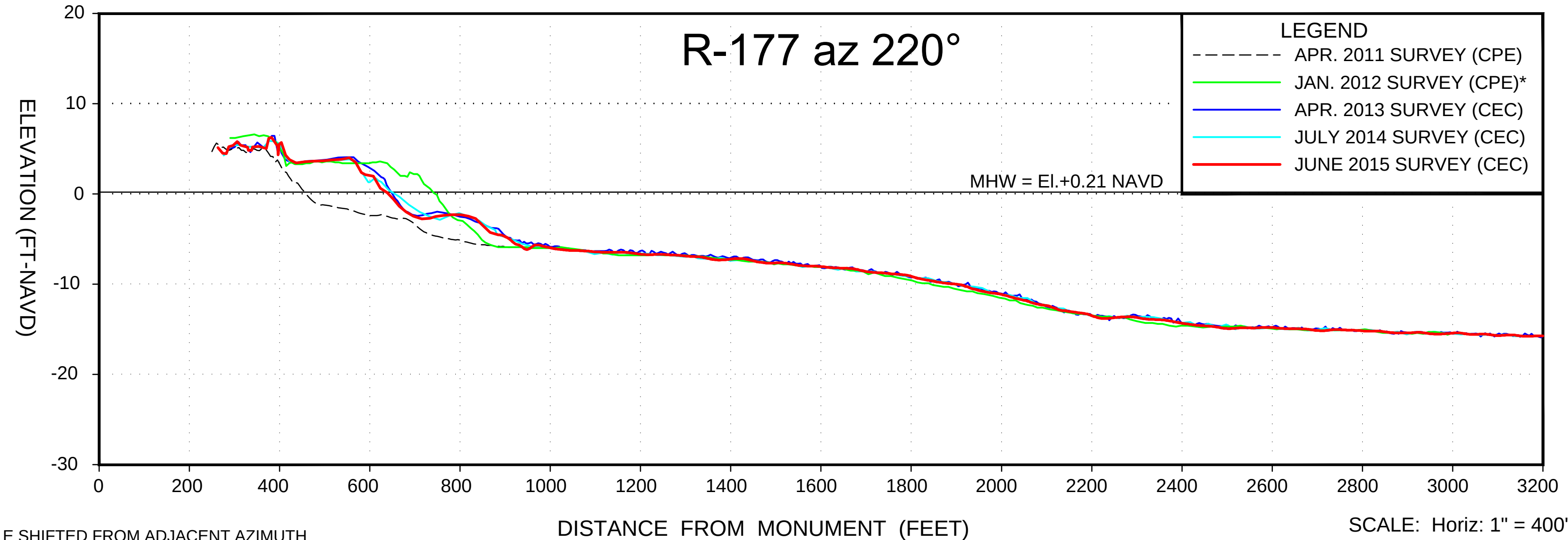

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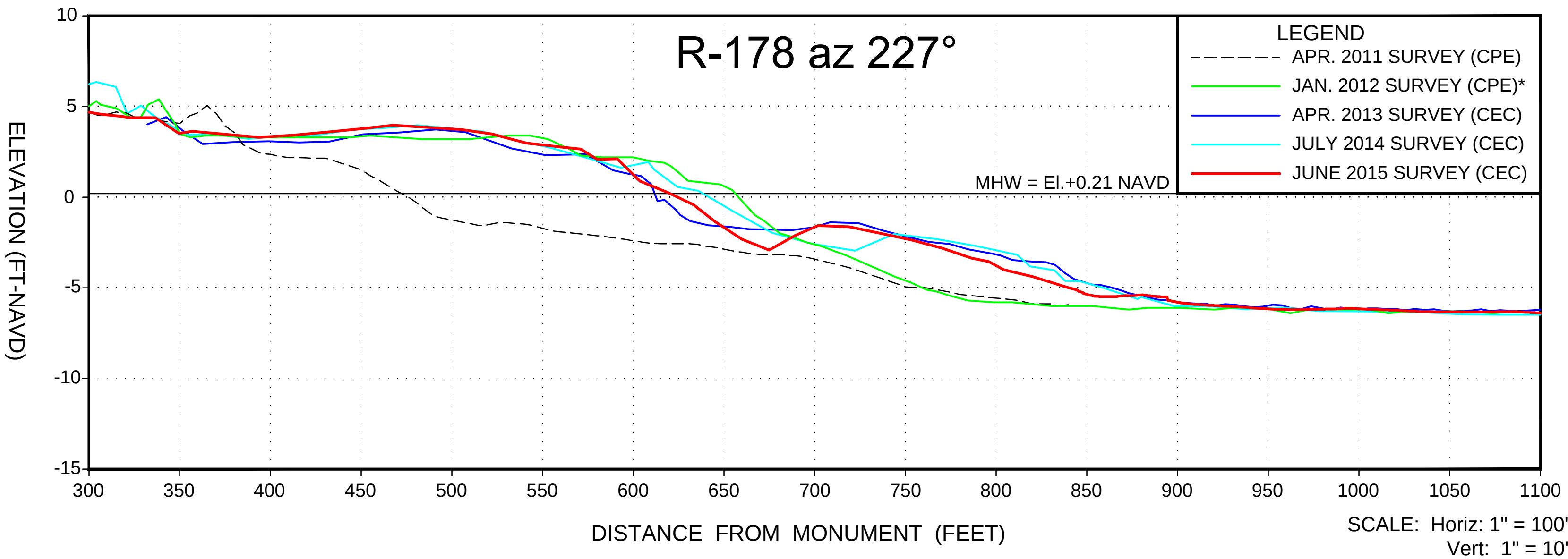

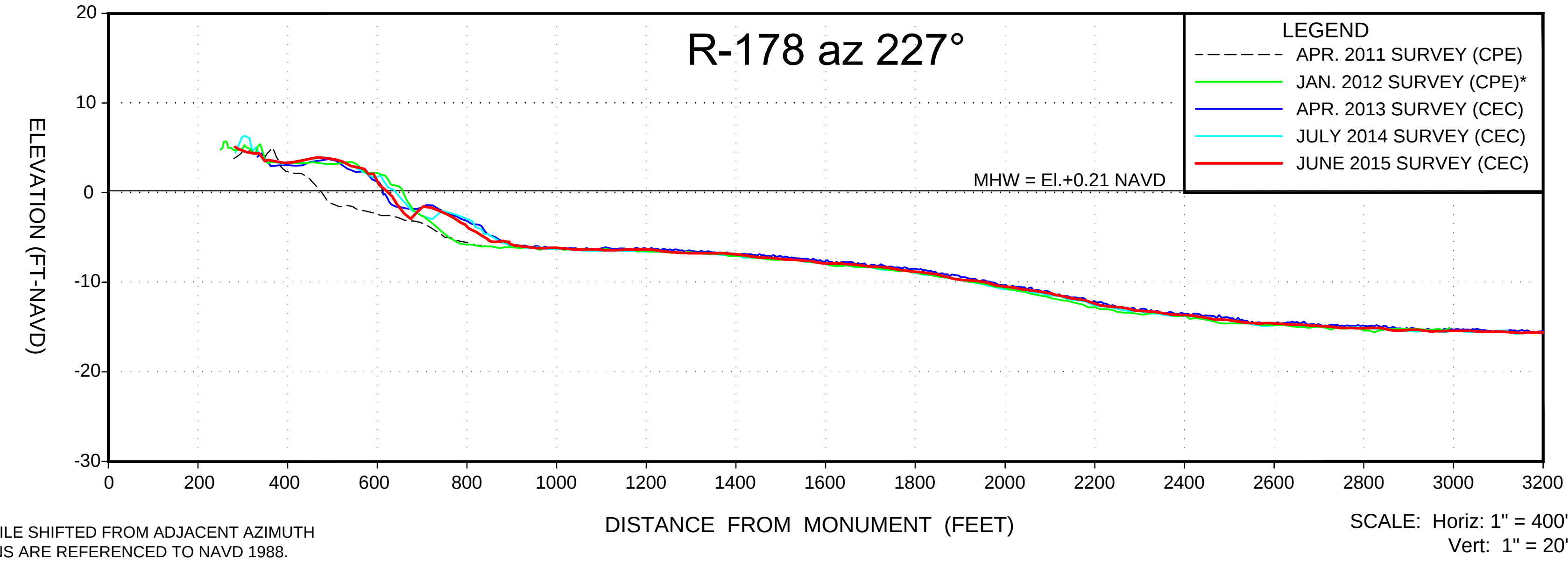

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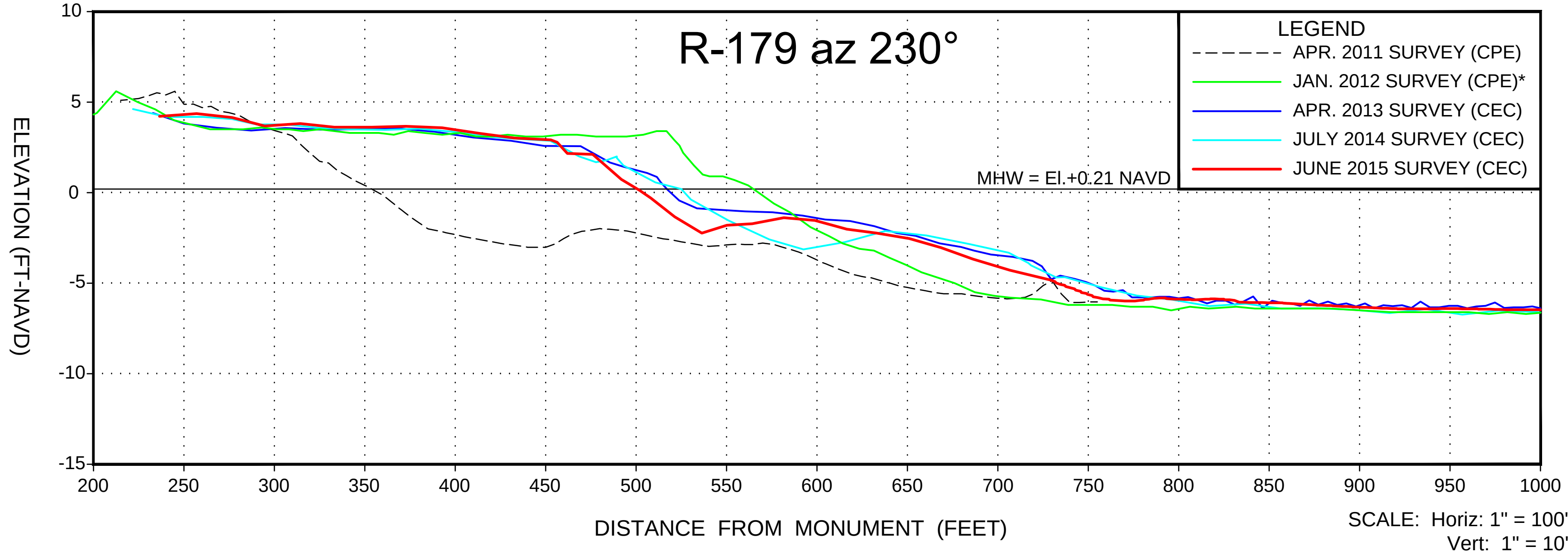

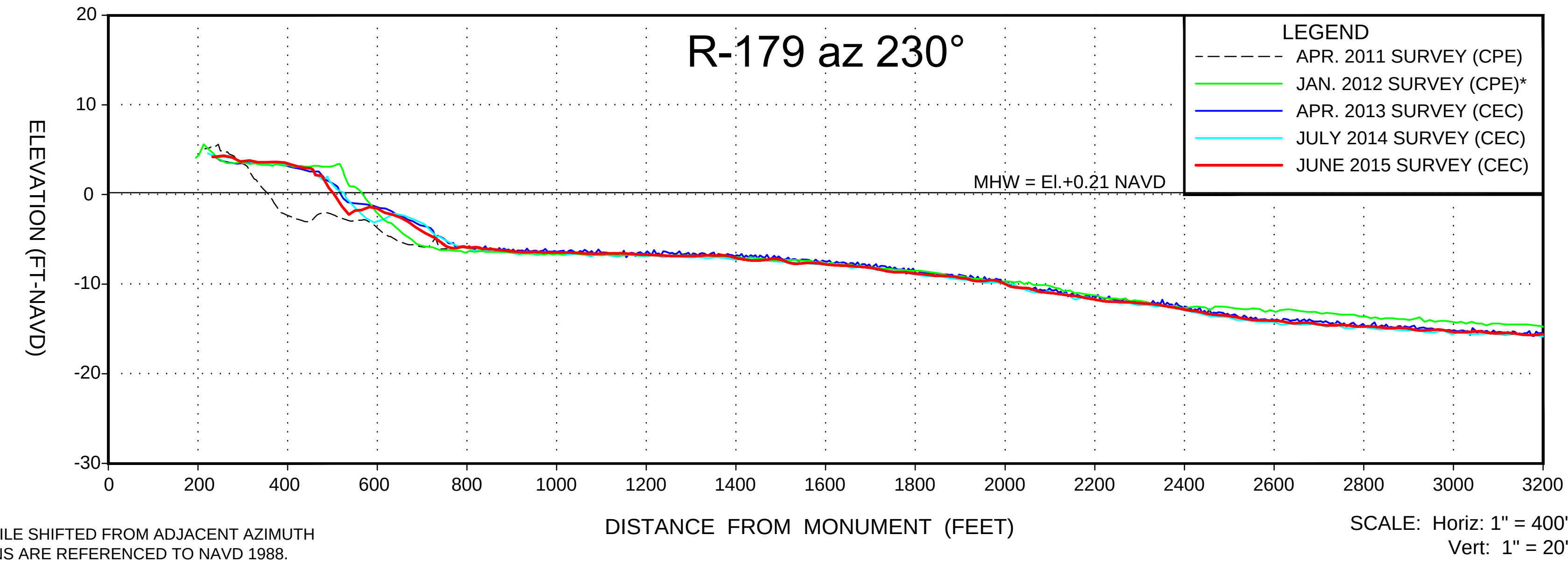

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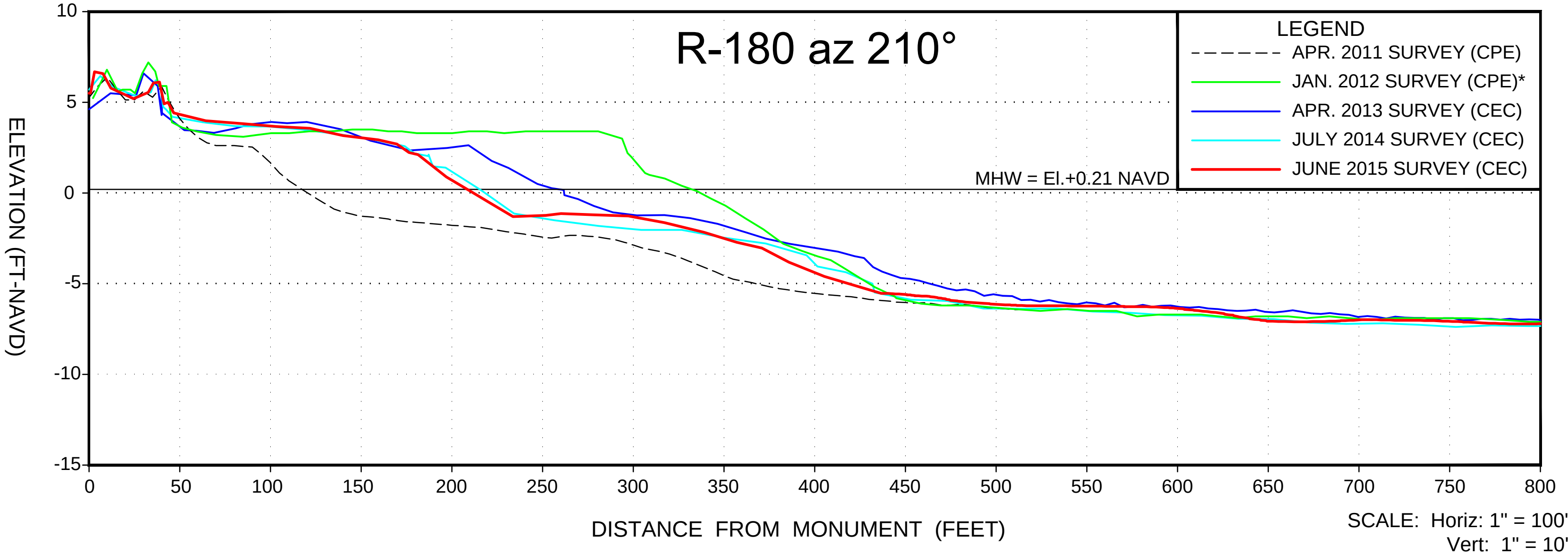

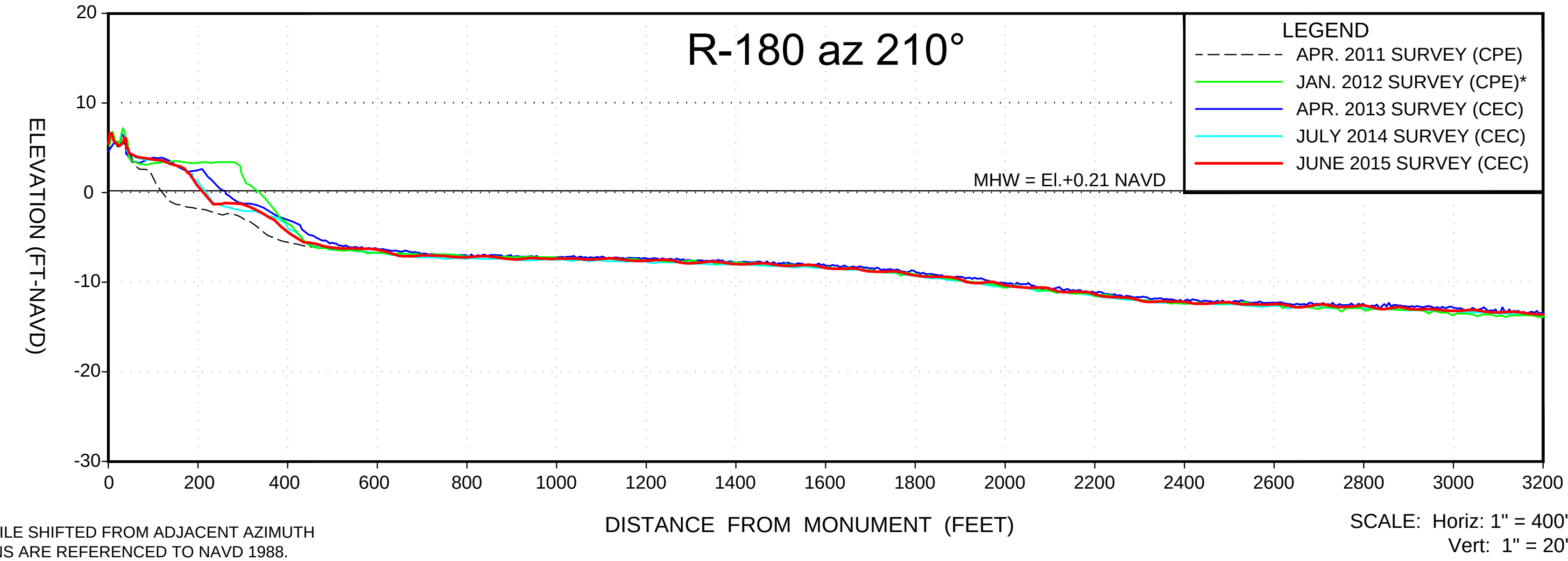

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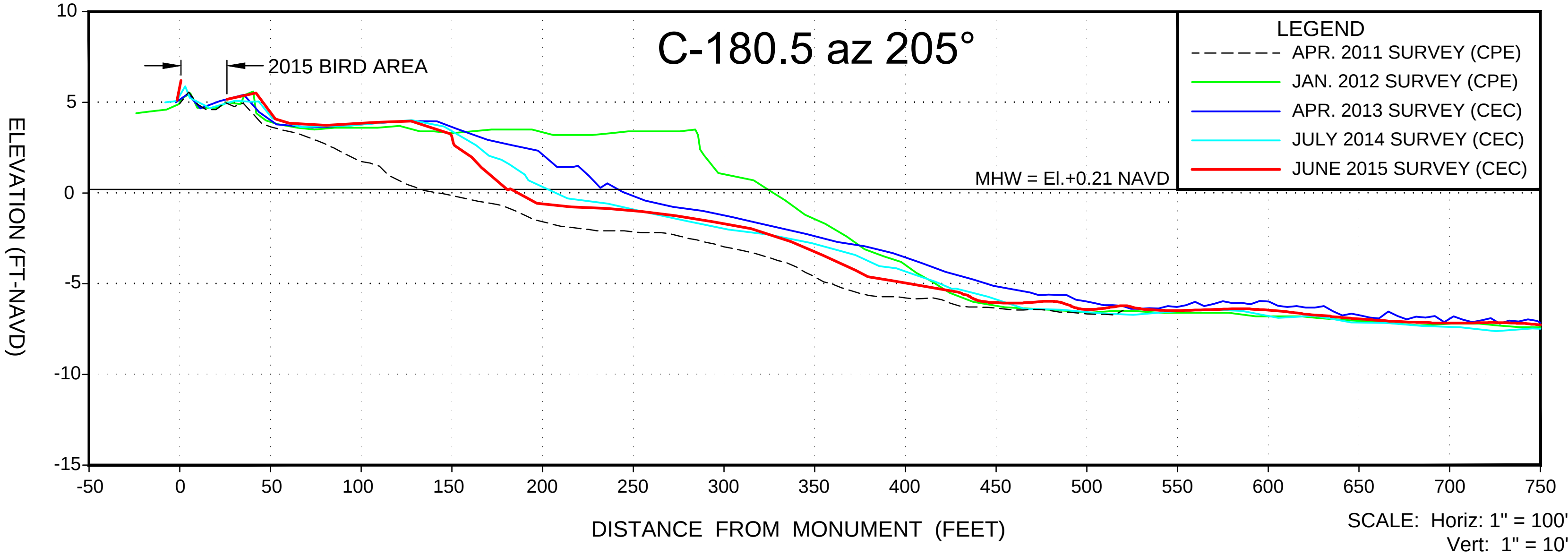

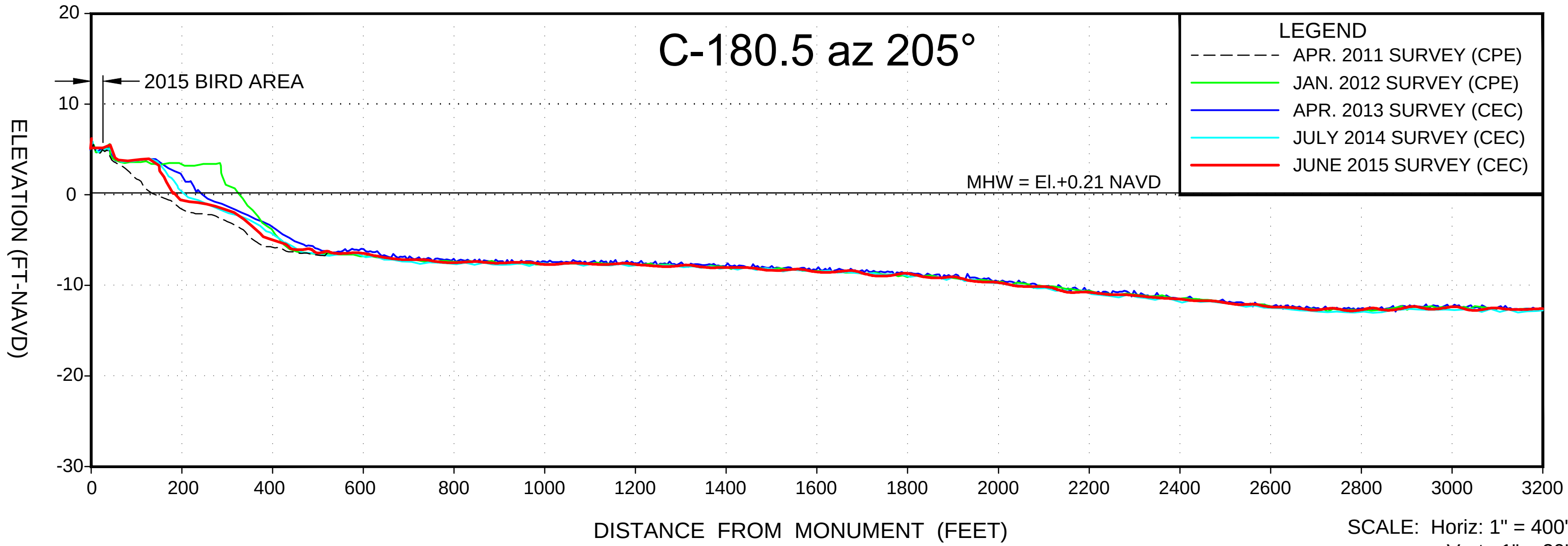

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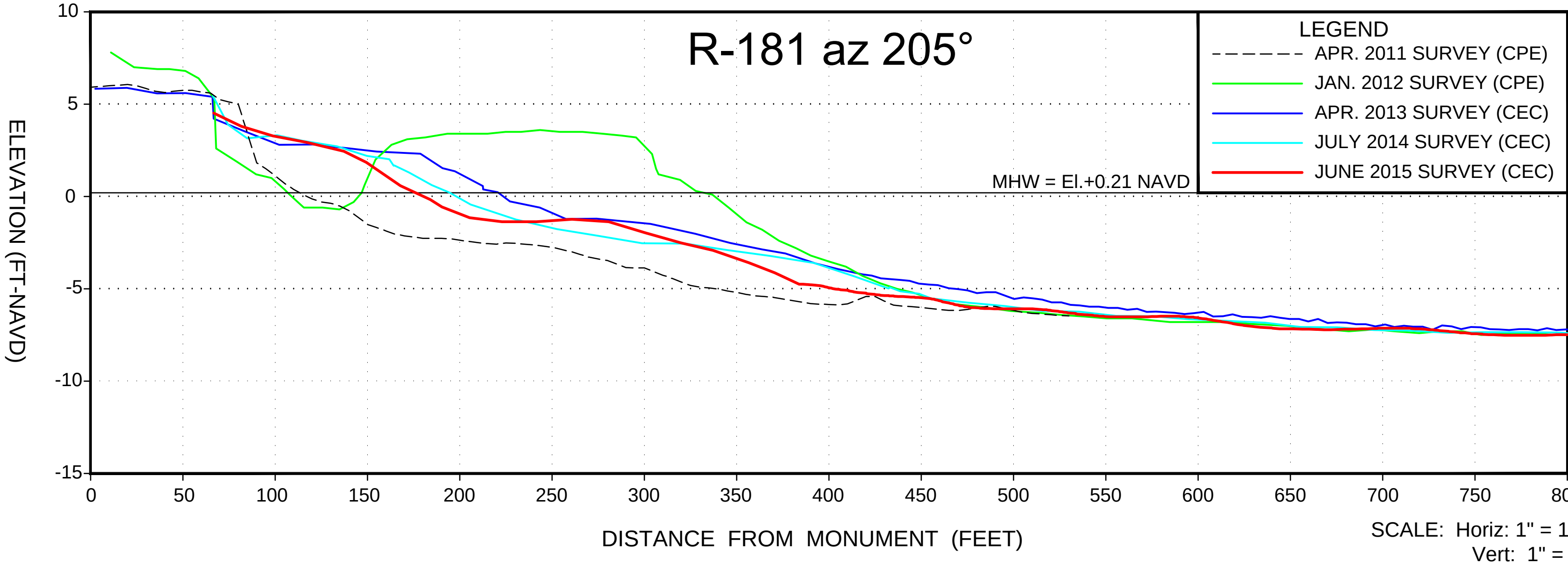

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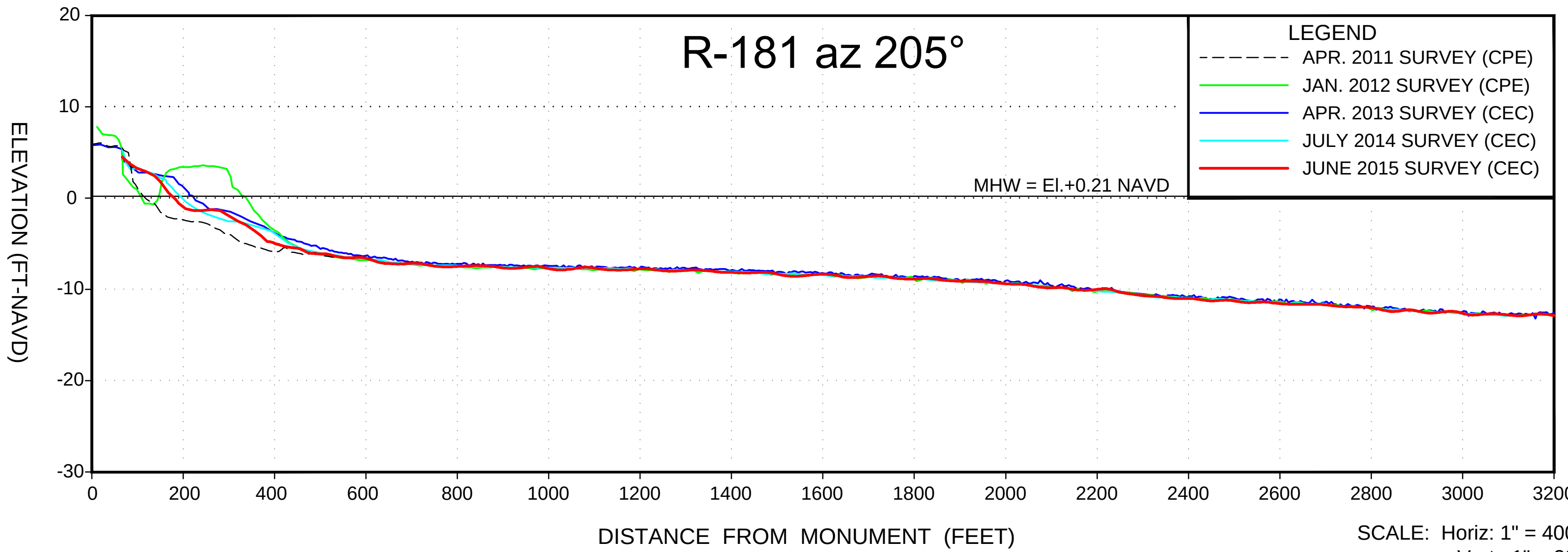

SCALE: Horiz: 1" = 400'
Vert: 1" = 20'

NOTES:

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

FILE NO.: 15102-R-181 AZ205

SHEET OF

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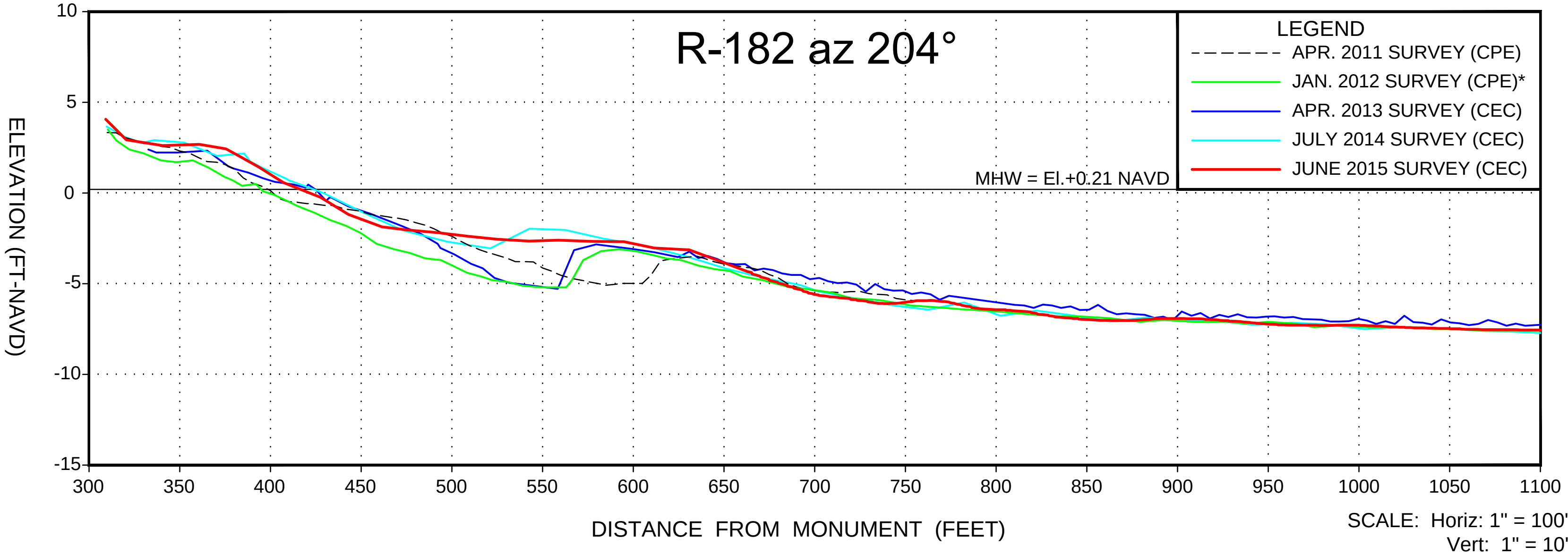
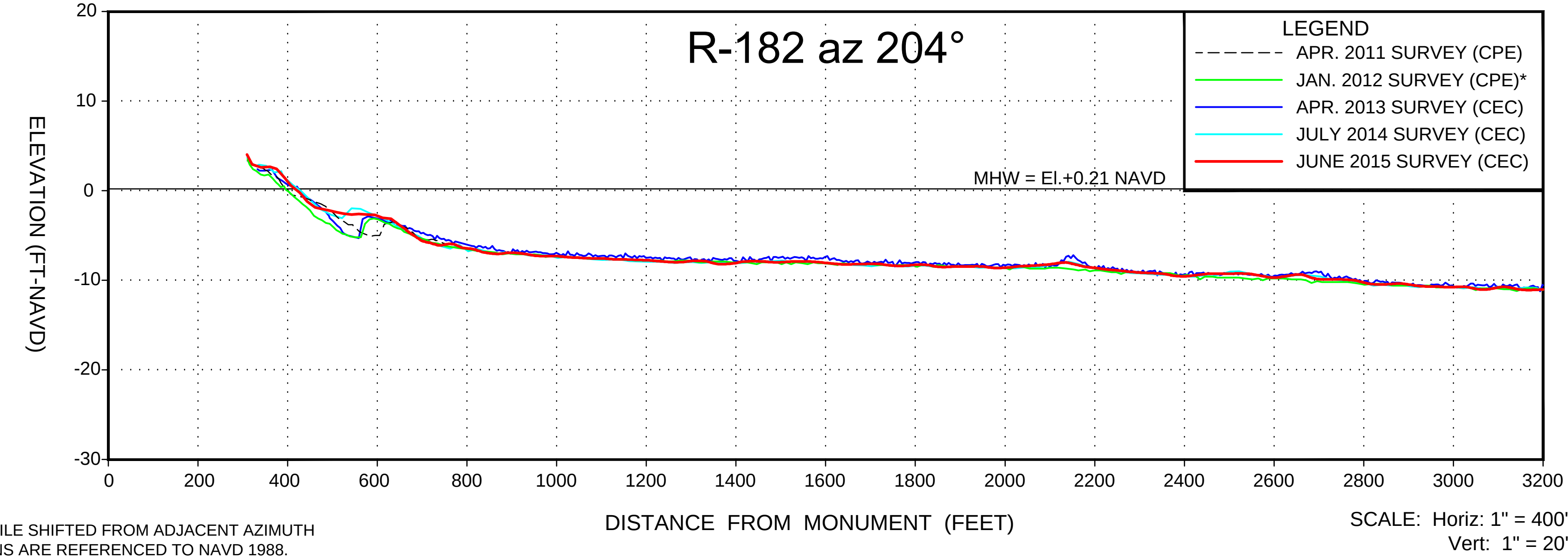
CLIENT: LEE COUNTY

TITLE: R-181 AZ 205° MONITORING SURVEY

DATE: 6/15/2015	SCALE: AS SHOWN		
DRAWN: SDB	F.B.		
CHECKED: MTP	PG.		
SEC.	TWP.	RNG.	
ACAD NO. 15102-XSECT.dwg			
REF. NO. 15.102			

NO.	DATE	BY	REVISION DESCRIPTION





NOTES:

* DATA PROFILE SHIFTED FROM ADJACENT AZIMUTH
1. ELEVATIONS ARE REFERENCED TO NAVD 1988.
2. PROFILE DATA IS FROM SURVEYS BY CEC AND CPE.

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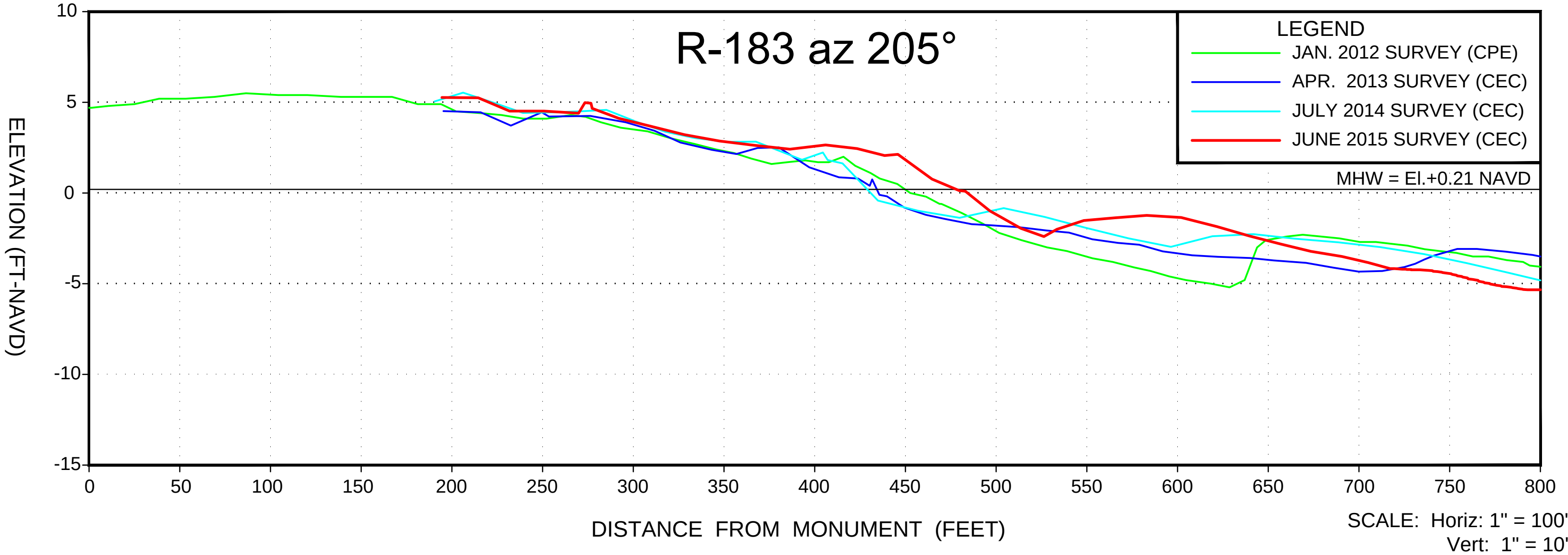
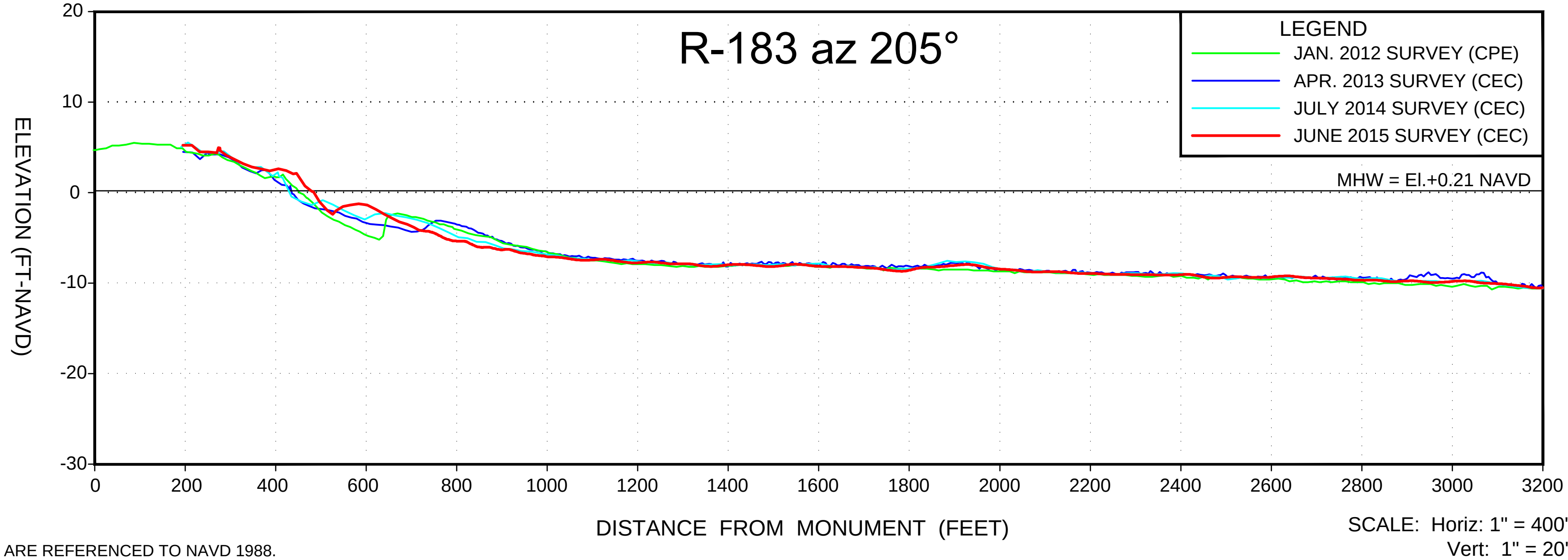
FILE NO.: 15102-R-182 AZ204
SHEET OF

CLIENT: LEE COUNTY		DATE: 6/15/2015	SCALE: AS SHOWN
TITLE: R-182 AZ 204° MONITORING SURVEY		DRAWN: SDB	F.B.
		CHECKED: MTP	PG.
		SEC.	TWP. / RNG.
		ACAD NO. 15102-XSECT.dwg	
		REF. NO. 15.102	

NO.	DATE	BY	REVISION DESCRIPTION





NOTES:

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

FILE NO.: 15102-R-183 | SHEET OF

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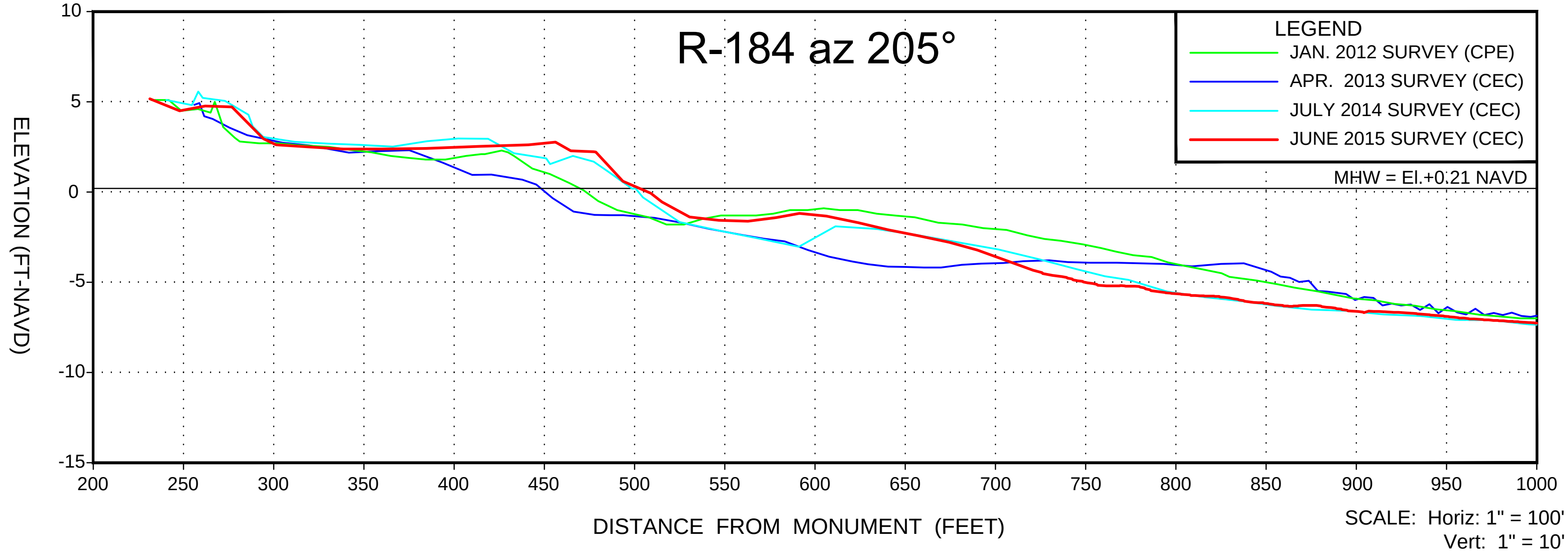
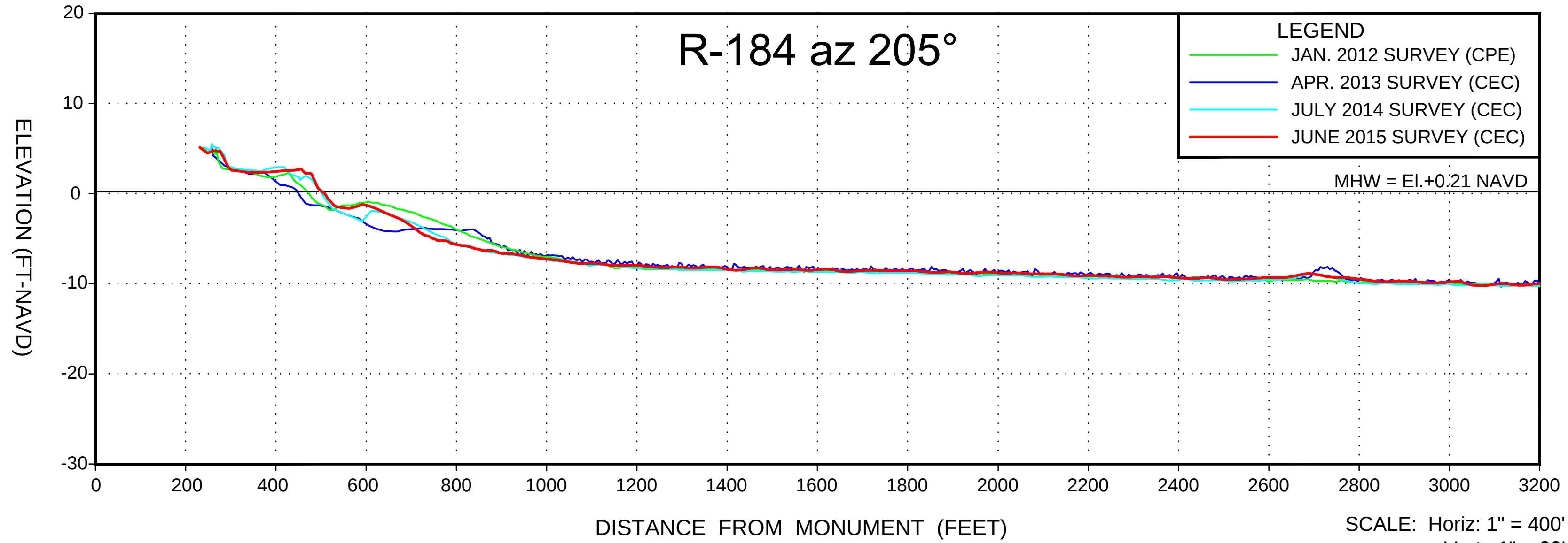
CLIENT: LEE COUNTY

TITLE: R-183 AZ 205° MONITORING SURVEY

DATE: 6/15/2015		SCALE: AS SHOWN	
DRAWN: SDB		F.B.	
CHECKED: MTP		PG.	
SEC.	TWP.	RNG.	
ACAD NO. 15102-XSECT.dwg			
REF. NO. 15.102			

NO.	DATE	BY	REVISION DESCRIPTION





NOTES:

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

FILE NO.: 15102-R-184 AZ205

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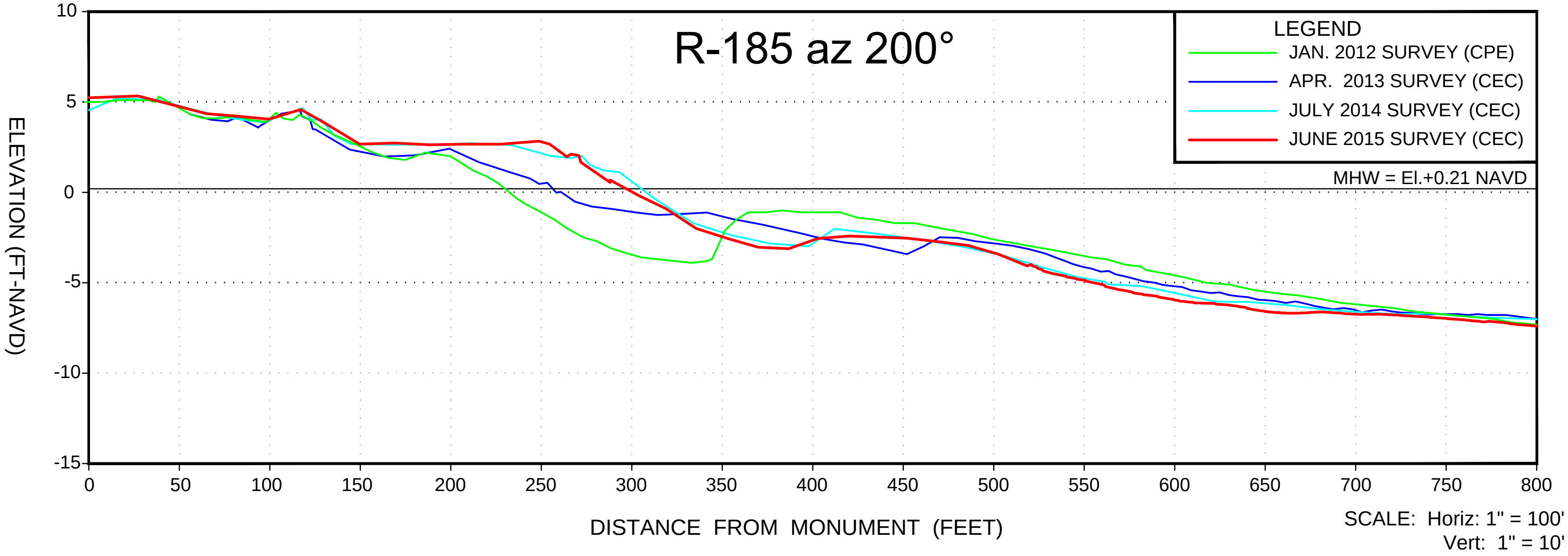
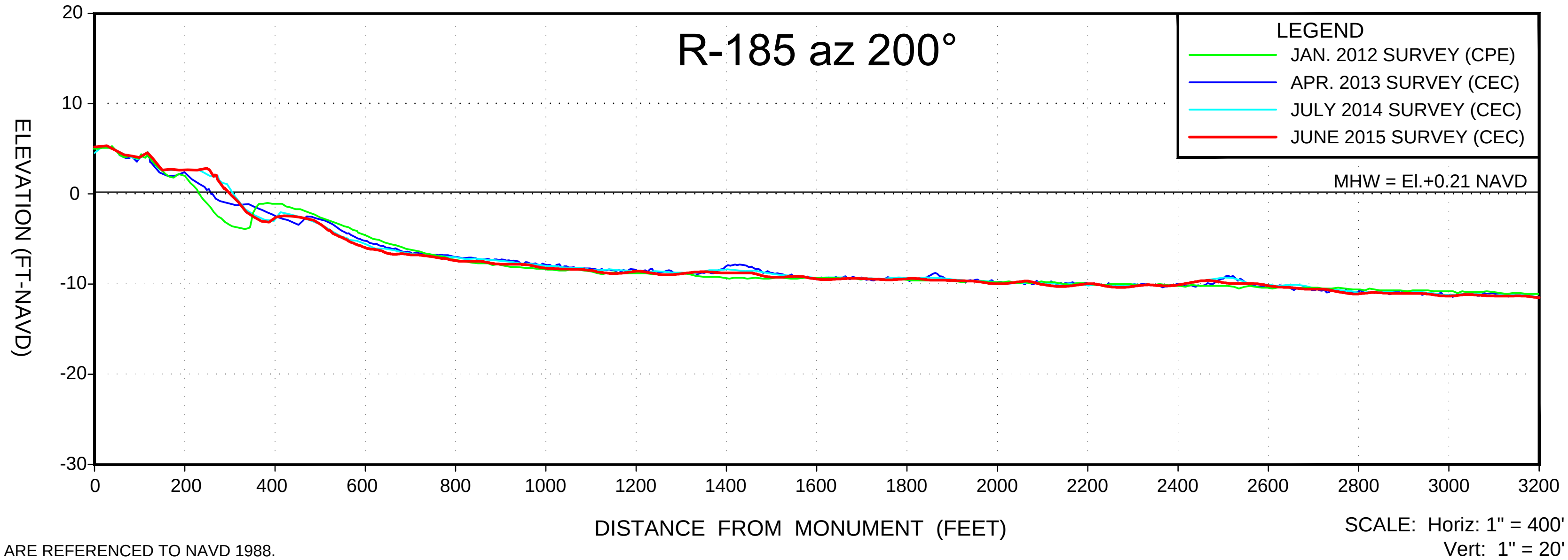
CLIENT: LEE COUNTY

TITLE: R-184 AZ 205° MONITORING SURVEY

DATE: 6/15/2015	SCALE: AS SHOWN		
DRAWN: SDB	F.B.		
CHECKED: MTP	PG.		
SEC.	TWP.	RNG.	
ACAD NO. 15102-XSECT.dwg			
REF. NO. 15.102			

NO.	DATE	BY	REVISION DESCRIPTION





NOTES:

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

FILE NO.: 15102-R-185 AZ200

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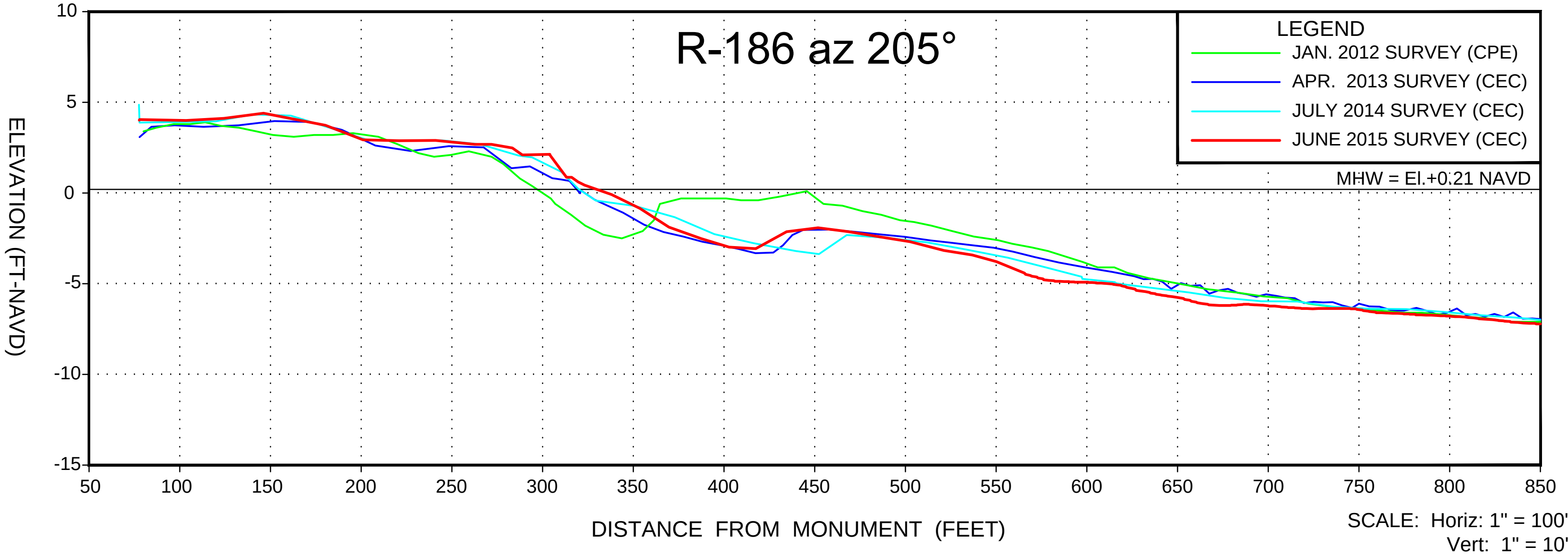
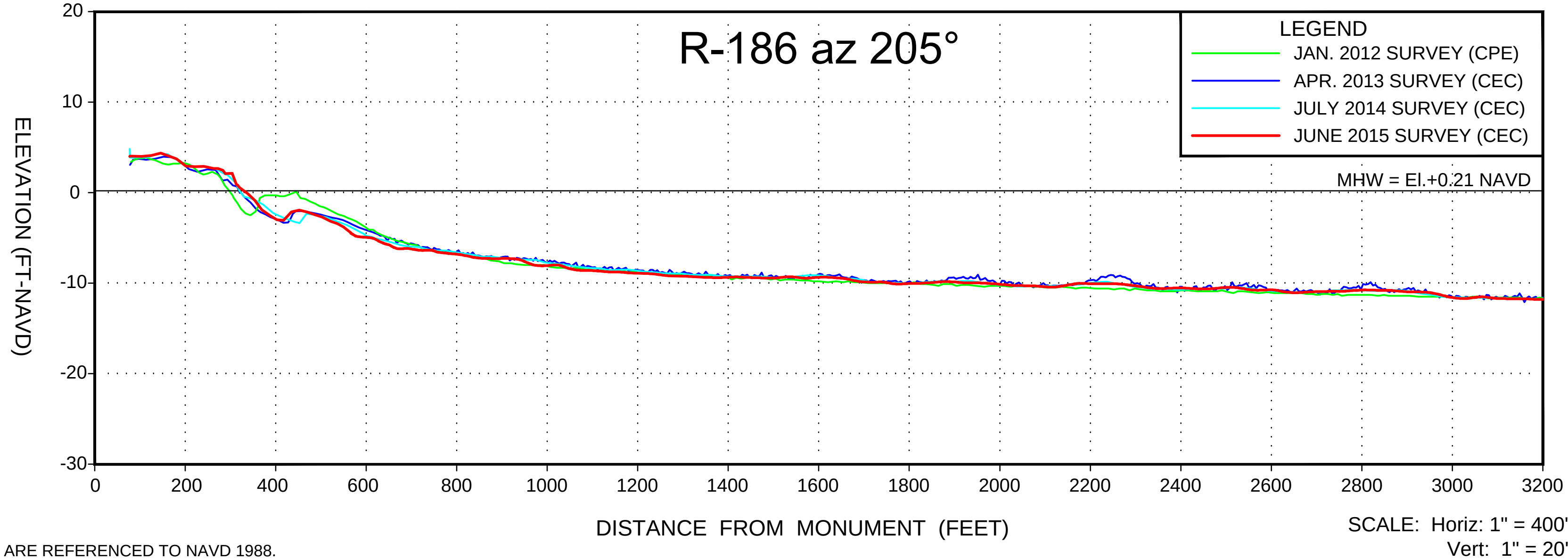
CLIENT: LEE COUNTY

TITLE: R-185 AZ 200° MONITORING SURVEY

DATE: 6/15/2015		SCALE: AS SHOWN	
DRAWN: SDB		F.B.	
CHECKED: MTP		PG.	
SEC.	TWP.	RNG.	
ACAD NO. 15102-XSECT.dwg			
REF. NO. 15.102			

NO.	DATE	BY	REVISION DESCRIPTION





NOTES:

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

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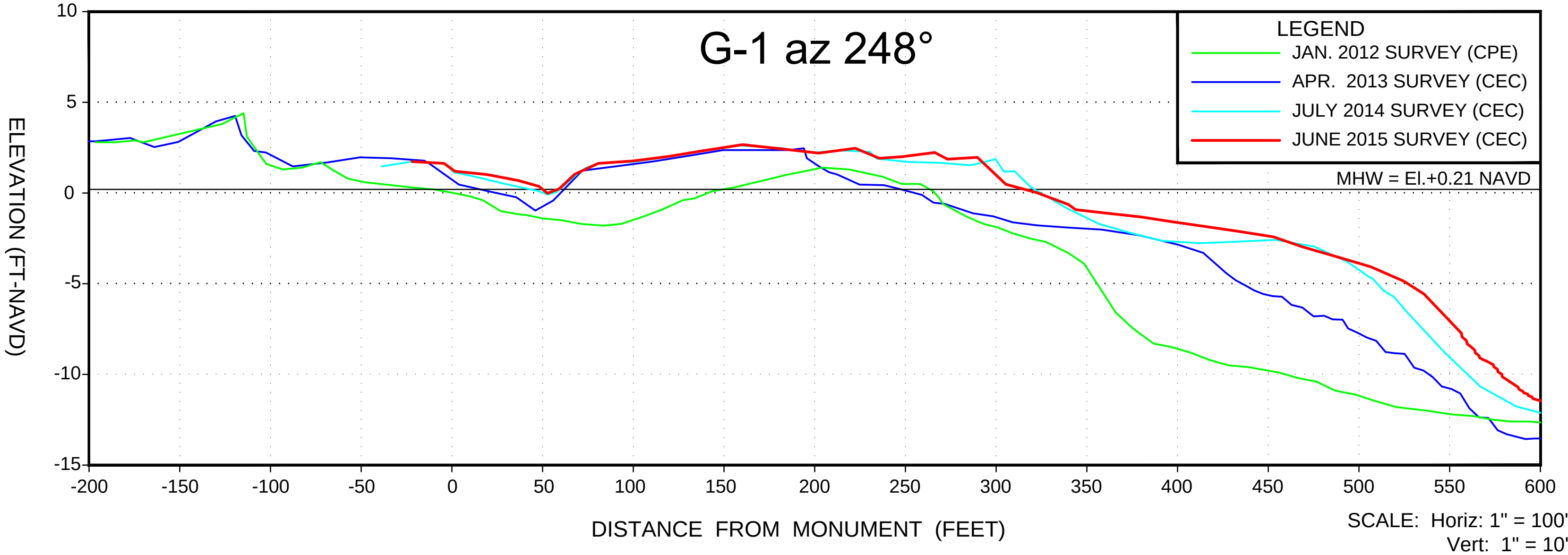
FILE NO.: 15102-R-186
SHEET OF

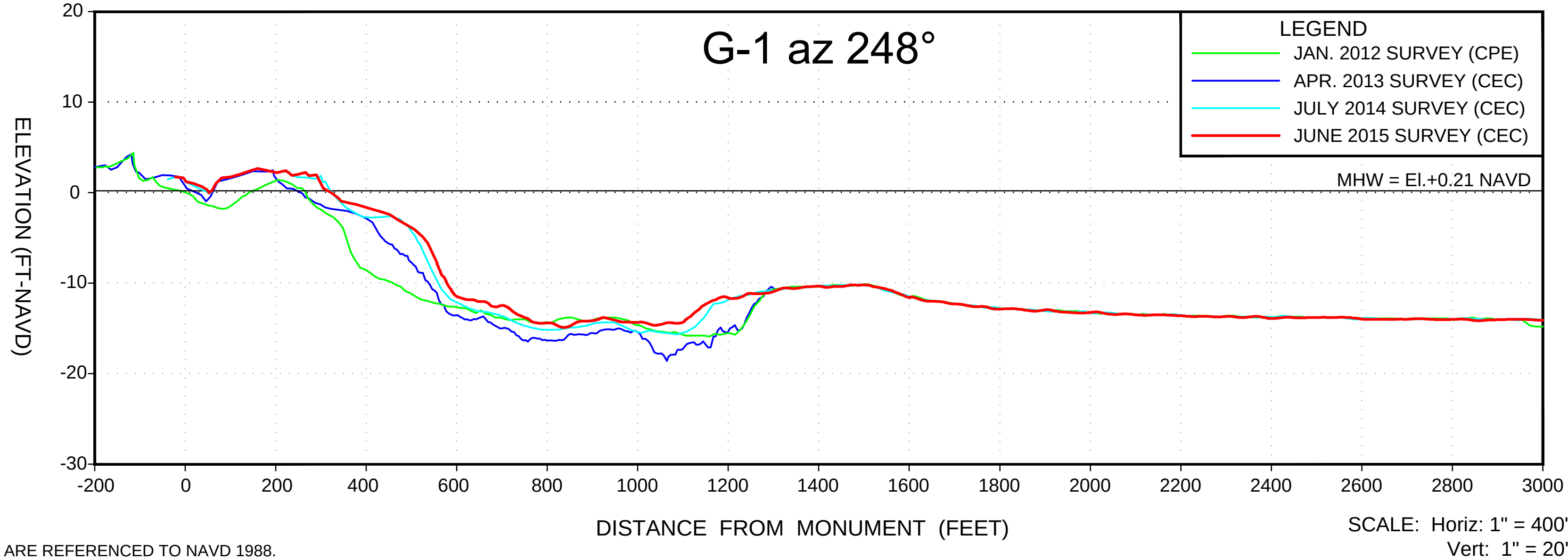
CLIENT: LEE COUNTY

TITLE: R-186 AZ 205° MONITORING SURVEY

DATE: 6/15/2015	SCALE: AS SHOWN		
DRAWN: SDB	F.B.		
CHECKED: MTP	PG.		
SEC.	TWP.	RNG.	
ACAD NO. 15102-XSECT.dwg			
REF. NO. 15.102			

NO.	DATE	BY	REVISION DESCRIPTION





NOTES:

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2. PROFILE DATA IS FROM SURVEYS BY CEC AND CPE.

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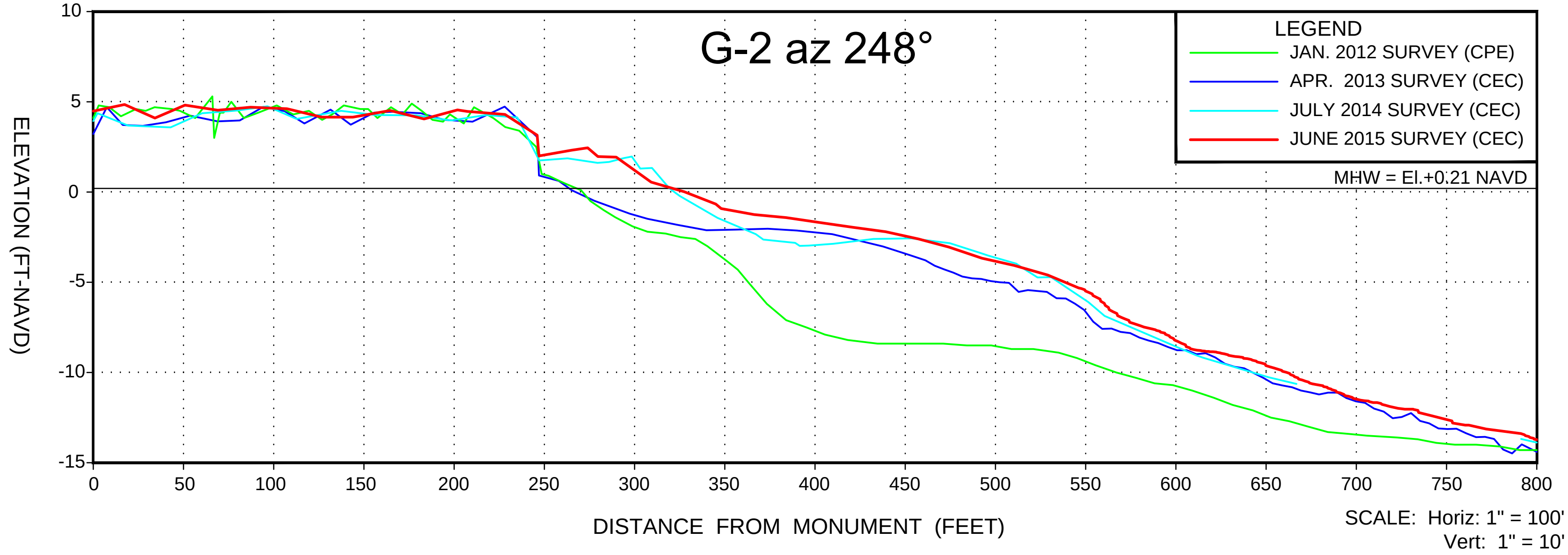
SHEET OF
FILE NO.: 15102-GROIN-1

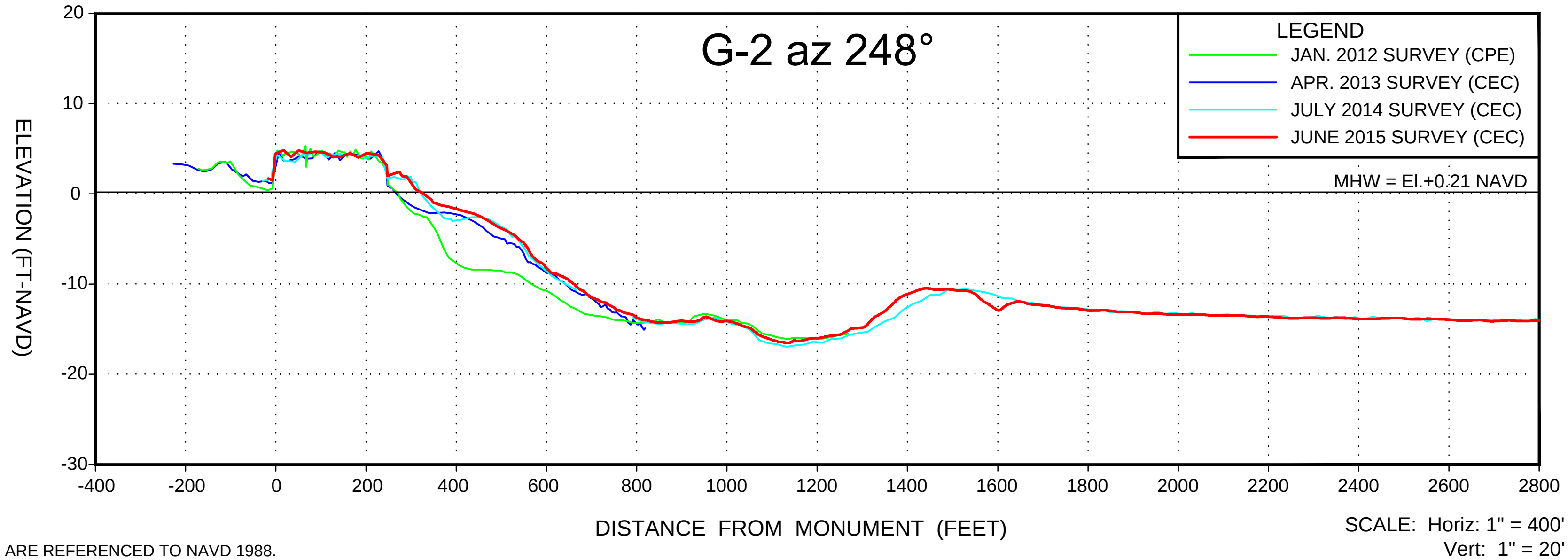
CLIENT: LEE COUNTY

TITLE: GROIN 1 AZ 248° MONITORING SURVEY

DATE: 6/15/2015		SCALE: AS SHOWN	
DRAWN: SDB		F.B.	
CHECKED: MTP		PG.	
SEC.	TWP.	RNG.	
ACAD NO. 15102-XSECT.dwg			
REF. NO. 15.102			

NO.	DATE	BY	REVISION DESCRIPTION





NOTES:

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

FILE NO.: 15102-GROIN-2
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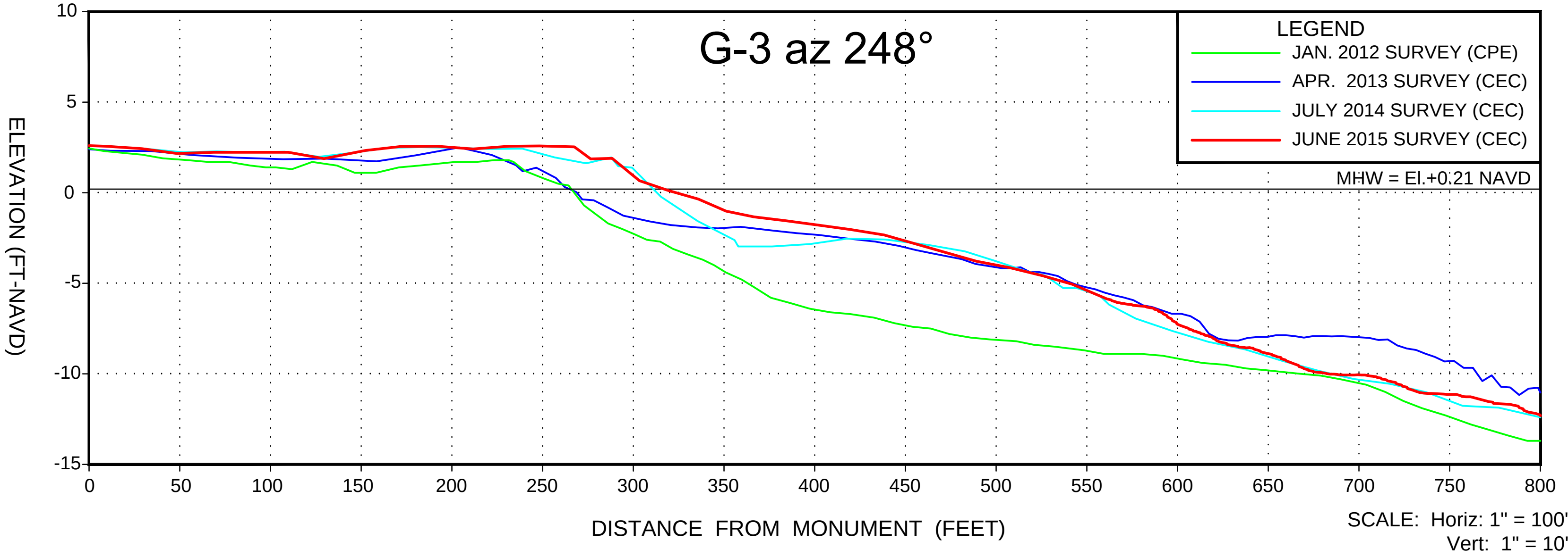
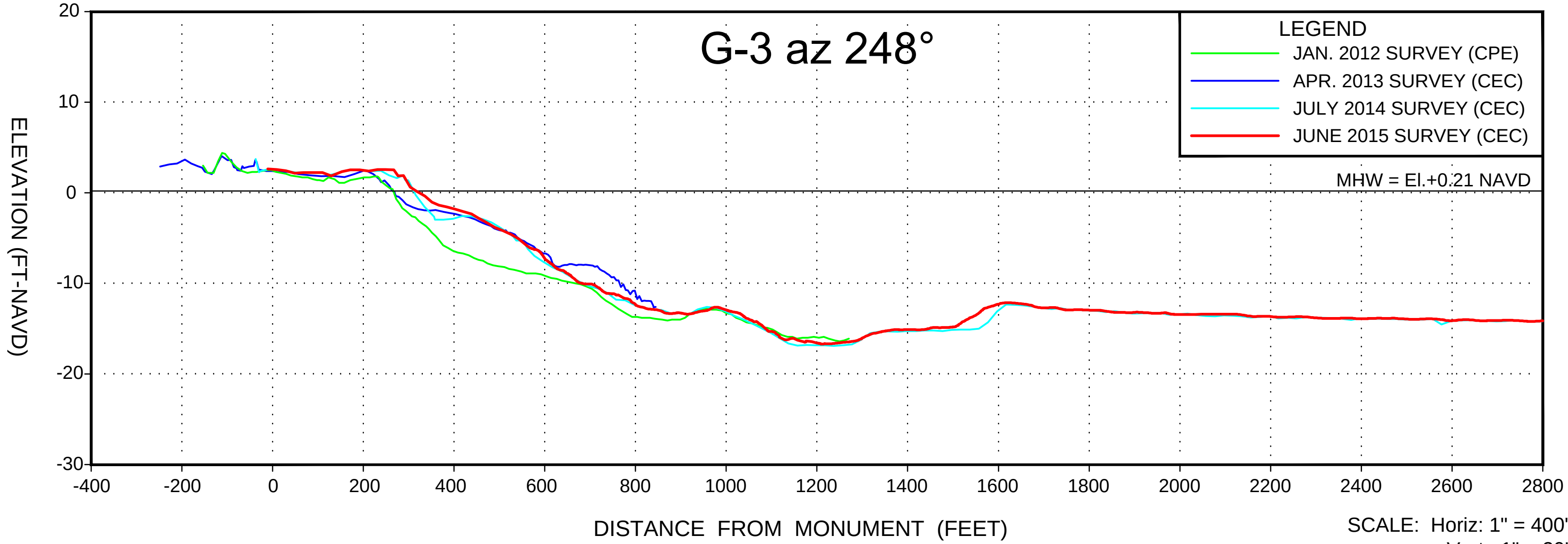
TITLE: GROIN 2 AZ 248° MONITORING SURVEY

DATE: 6/15/2015		SCALE: AS SHOWN	
DRAWN: SDB		F.B.	
CHECKED: MTP		PG.	
SEC.	TWP.	RNG.	
ACAD NO. 15102-XSECT.dwg			
REF. NO. 15.102			

NO.	DATE	BY	REVISION DESCRIPTION





NOTES:

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

FILE NO.: 15102-GROIN-3

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TITLE: GROIN 3 AZ 248° MONITORING SURVEY

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DRAWN: SDB	F.B.
CHECKED: MTP	PG.
SEC. TWP. RNG.	
ACAD NO. 15102-XSECT.dwg	
REF. NO. 15.102	

NO.	DATE	BY	REVISION DESCRIPTION