Lovers Key – Bonita Beach Nourishment Design

FSBPA
FEBRUARY 7, 2024

LEE COUNTY
SOUTHWEST FLORIDA

Steve Boutelle
Mike Campbell

COASTAL ENGINEERING CONSULTANTS INC.

Michael Poff
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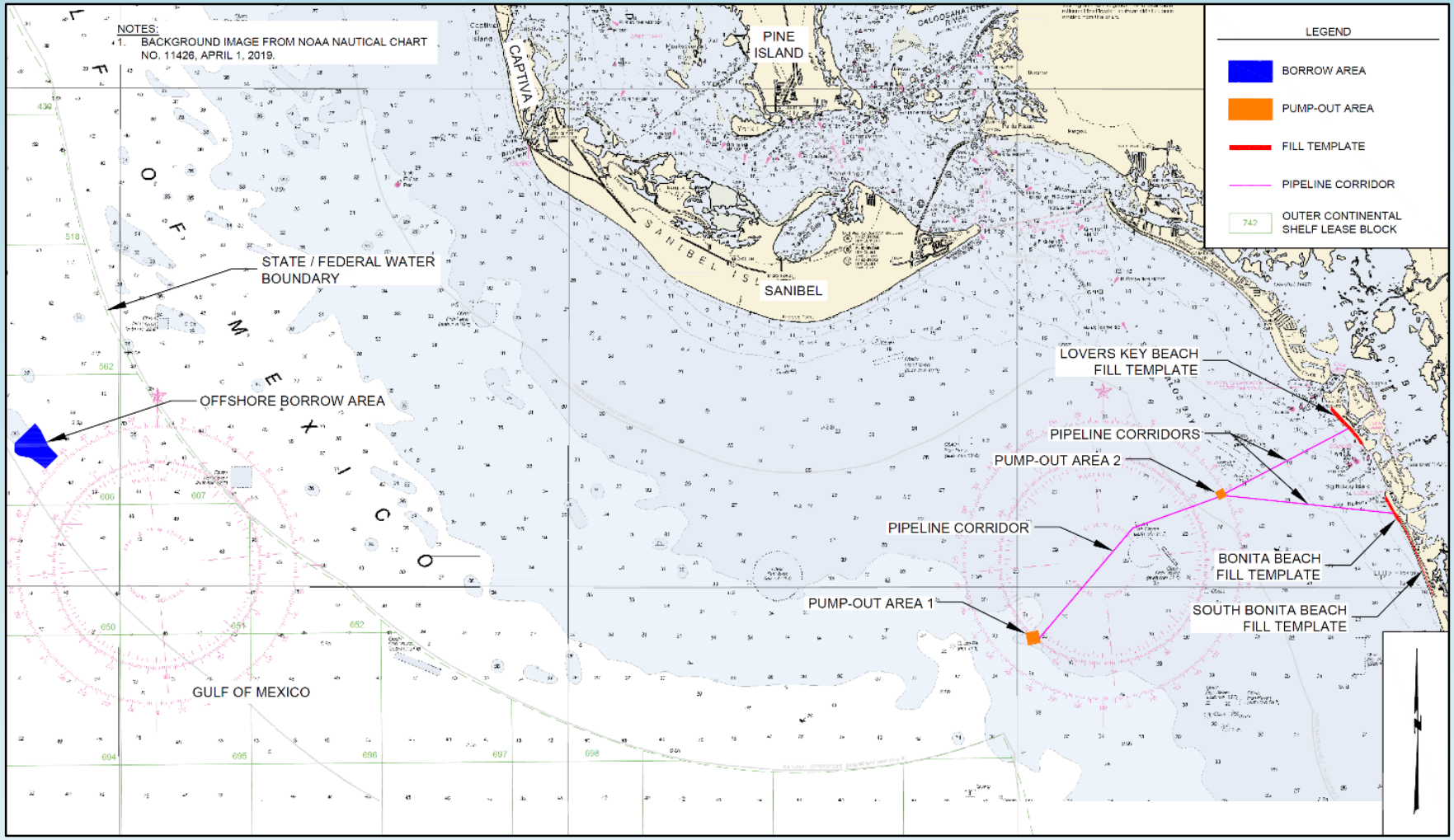
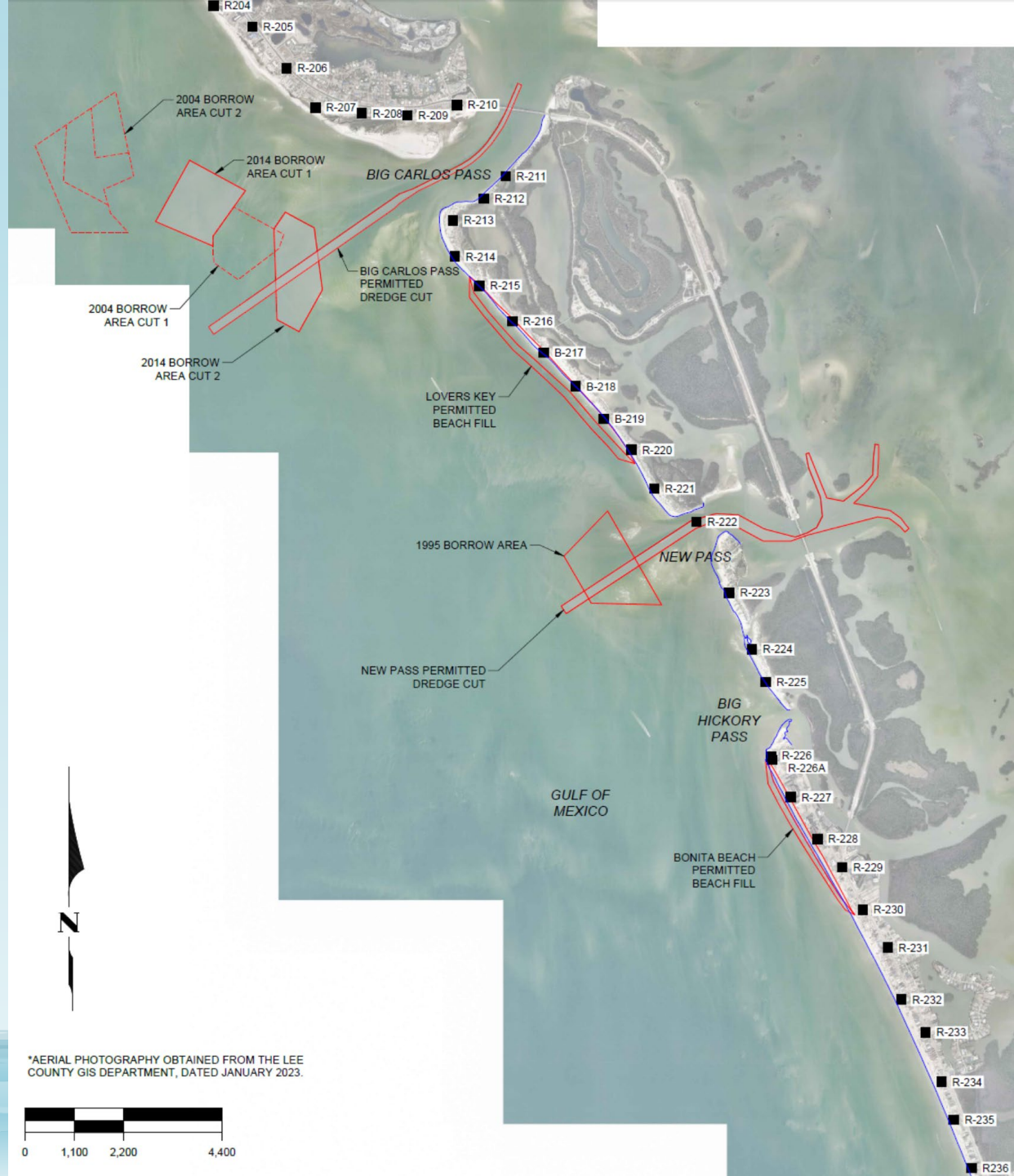
OUTLINE

- Project History
- Performance Assessment
- Bonita Beach Refined Beach Fill Template Design
- Sea Level Change Analysis
- New Offshore Borrow Area & Pipeline Corridors



Project History

- Lee County Sponsored Project
- 1995: Bonita Beach Original Construction (217K CY)
  - Two Groins on North End
- 2004: Bonita Beach 1st Nourishment (150K CY) & Lovers Key Original Construction (570K CY)




Big Hickory Island
1994
(PRE-RESTORATION)
Google Earth
N


Big Hickory Island
TWO GROINS
FILL LIMITS
2004
(POST-CONSTRUCTION)
Google Earth
N

Project History

- 2014: Bonita Beach 2nd Nourishment (135K CY)
  & Lovers Key 1st Nourishment (334K CY)
- 2017: New Pass Beneficial Use: Lovers Key (68K CY)
  - Hurricane Irma
- 2019: Initiated Offshore Sand Search
  - Available Volume in Nearshore Borrow Areas ~ <200K CY (based on monitoring surveys)
  - By 2045 Projected Available Volume in Borrow Areas ~ 562K CY
  - Projected 50-year Needs ~ 2.2M CY
- 2020: New Pass Beneficial Use: Lovers Key (21K CY)
- 2021: JCP Application Submitted Incorporating Major Modifications
  - Tropical Storm Elsa Impacts
- *2022: Plan Reformulation & Permitting*
  - *Hurricanes Ian and Nicole Federal Disaster*
- *2023: Permits Issued*
  - *Hurricane Idalia Impacts*

2014 Project Construction

Before

During

After (almost)

Photos Courtesy of Lee County


Hyatt Regency Coconut Point Resort And Spa
Congo River Golf
LEISURE TIME PARK
Lovers Key State Park
Lovers Key Beach
FILL LIMITS
Bonita Beach Dog Park
Prado
Big Hickory Island
Bay's Island
BONITA BAY
Estero Bay
Little Hickory Island Beach Park
FILL LIMITS
DeRo
2016
Bonita Beach
Google Earth
Image © 2023 Maxar Technologies
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Hyatt Regency Coconut Point Resort And Spa
Congo River Golf
LEISURE TIME PARK
Lovers Key State Park
Lovers Key Beach
Bonita Beach Dog Park
Prado
Big Hickory Island
Bay's Island
BONITA BAY
Estero Bay
Little Hickory Island Beach Park
DeRo
Bonita Beach
2022 (POST-IAN)
Google Earth
Image © 2023 Maxar Technologies
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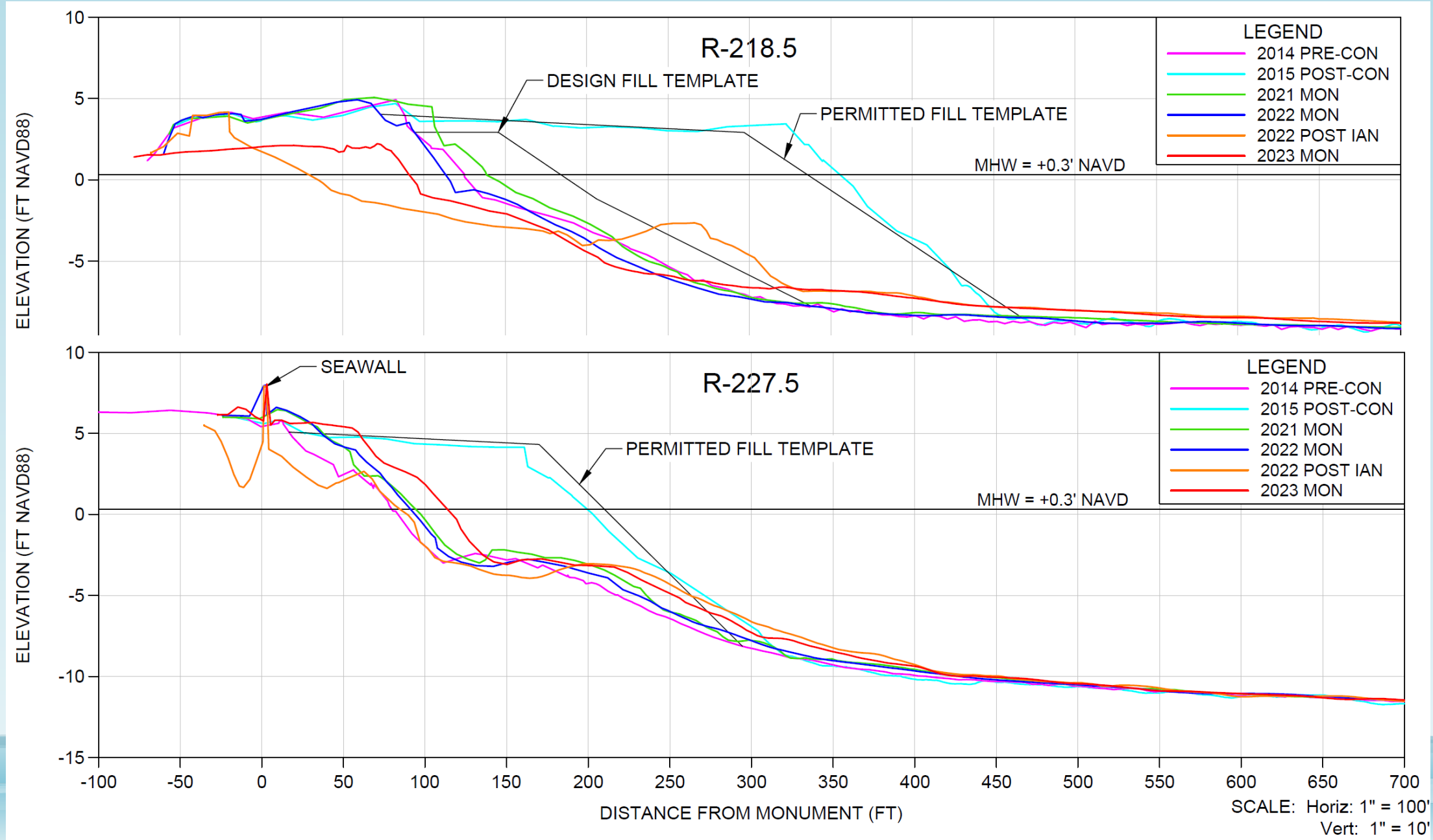
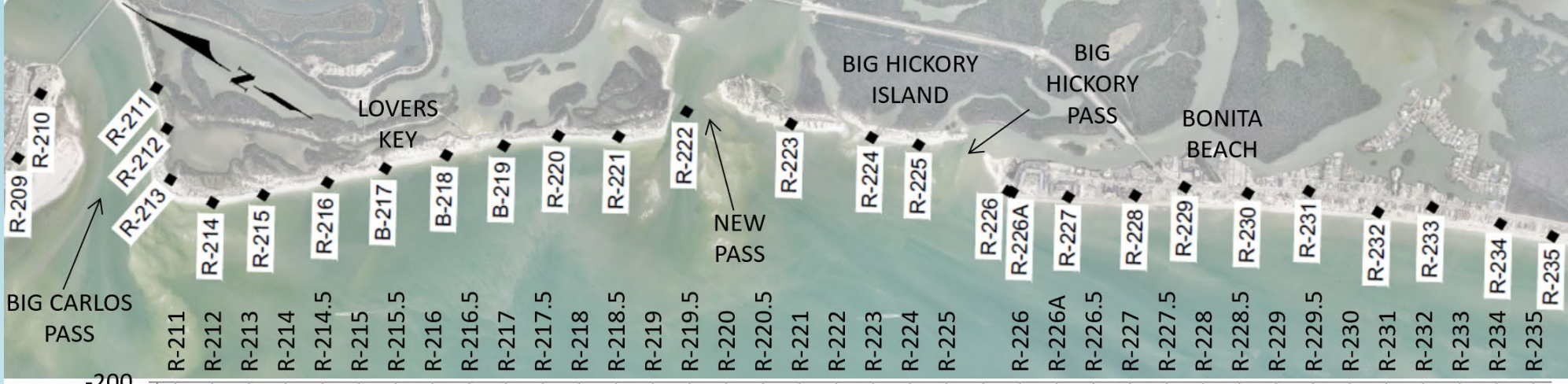
Performance Assessment

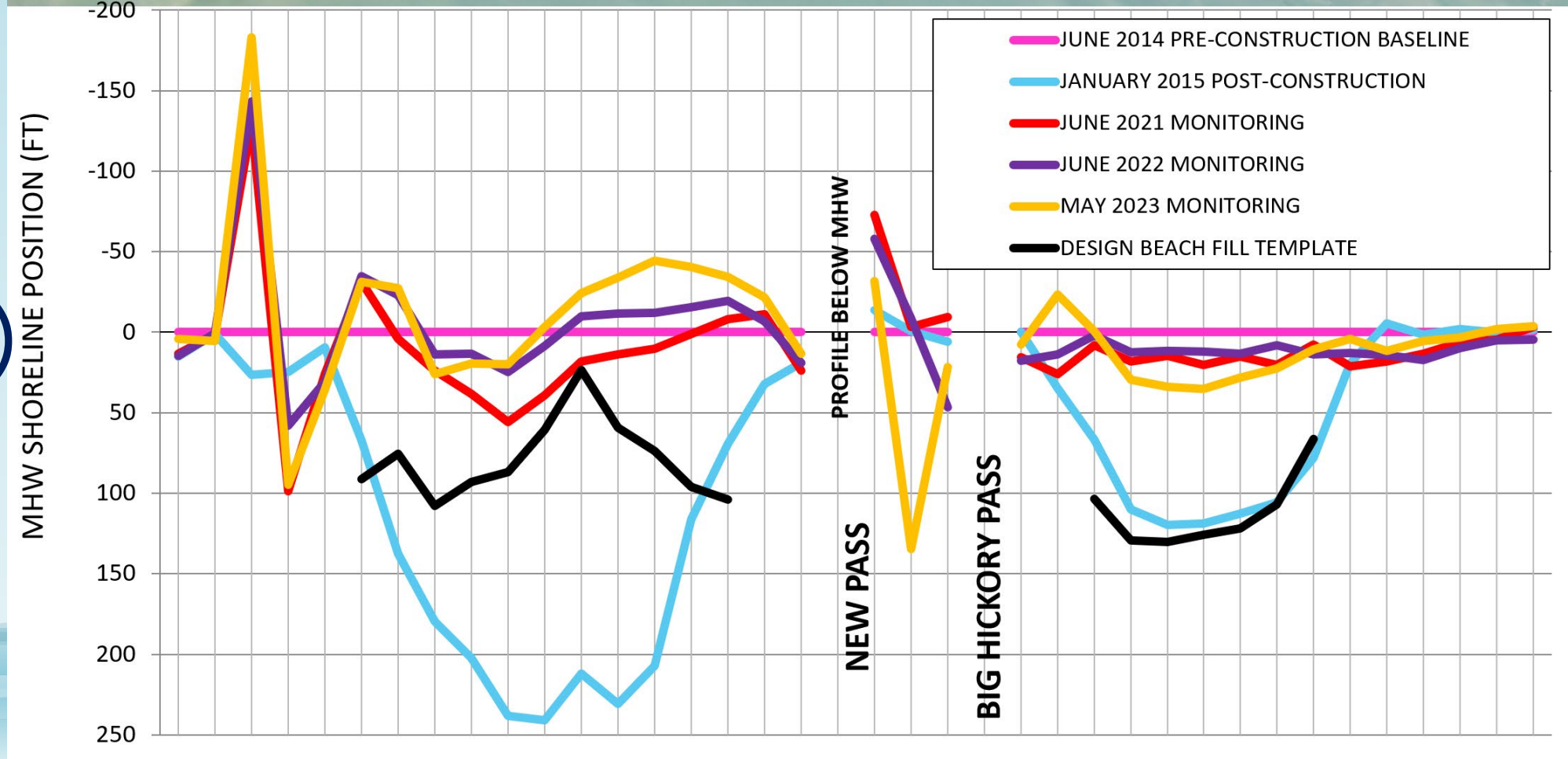
- 2014-2023 Annual Monitoring
  - Beach Profiles
  - Borrow Areas
  - Navigation Channels
  - Ebb and Flood Shoals
  - Regional Survey Transects
- 2020-2023 Regional Inlet Study (Moffatt & Nichol/Olsen)
- Nourishment Permits in place through 2028

BEACH PROFILES (2014-2023)

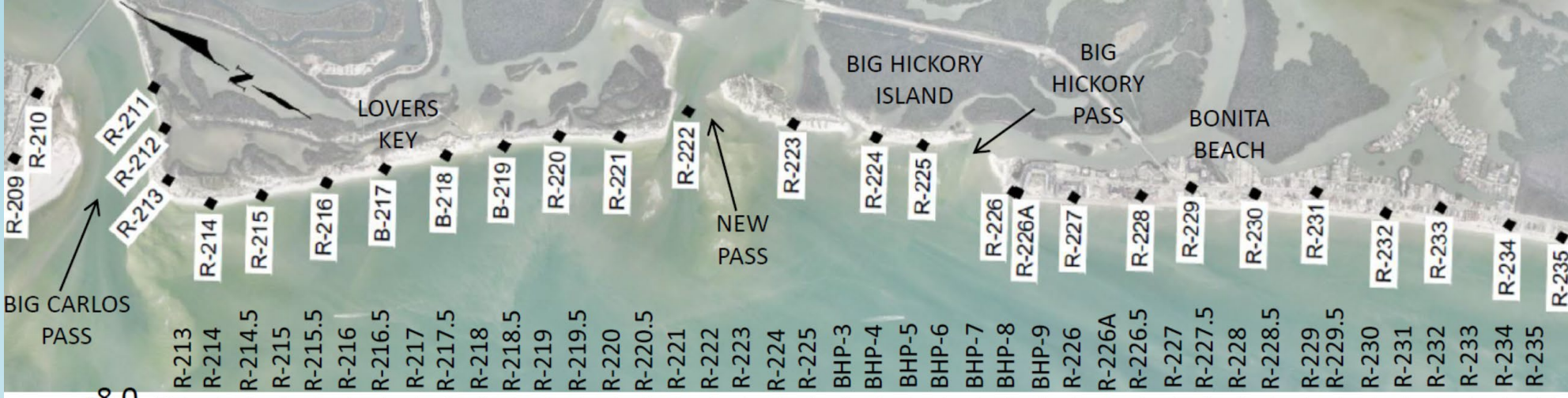


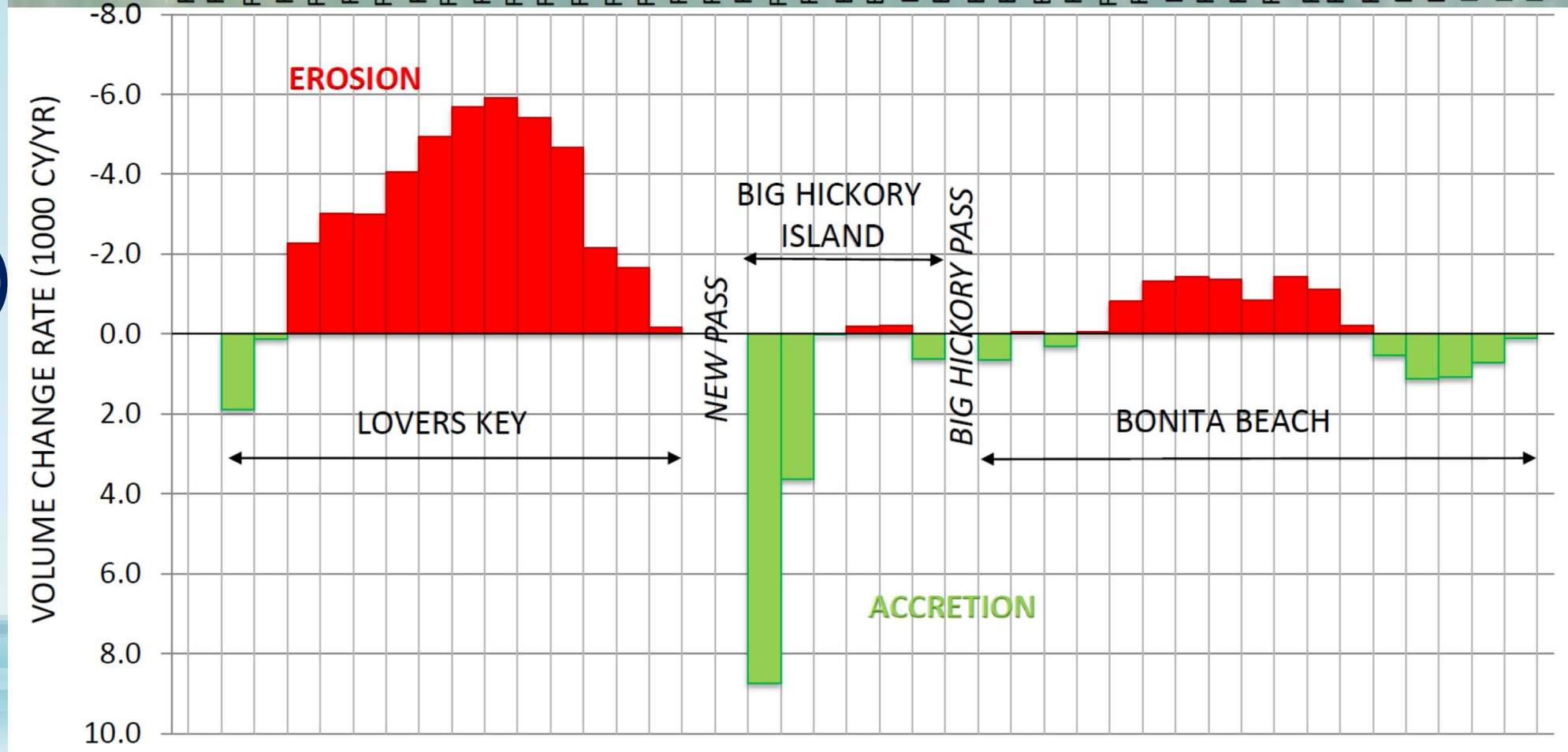
MHW Shoreline Changes (2015-2023)





VOLUME CHANGES (2015-2023)





Bonita Beach Performance Assessment

- Beach Segment
  - R-226A (Groin) to R-230
- 25-Year Design Storm Event
- Shoreline Change Analysis
  - Background Erosion
  - Equilibrium Profile Adjustment
- SBEACH Model Study

SHORELINE CHANGE ANALYSIS (2005-2014)

Monument		Pre Con Jan. 2004	Post Con July 2004	1st Year Mon Nov. 2005	Pre Con June 2014	Fill Placed Jan 2004-July 2004 (feet)	MHW Change Rate (Equilibration) July 2004-Nov 2005 (feet per year)	MHW Change Rate Nov 2005-June 2014 (feet per year)	Average Fill Placed Jan 2004-July 2004 (feet)	Average MHW Change Rate (Equilibration) July 2004-Nov 2005 (feet per year)	Average MHW Change Rate Nov 2005-June 2014 (feet per year)
R-223	BHI	127.6	117.3	60.4	123.2		-42.8	7.3			
R-224	BHI	28.5	28.6	-55.1	-32.3		-62.9	2.7			
R-225	BHI	13.9	8.1	-43.4	-10.2		-38.7	3.9			
R-226	BB between groins	75.8	71.8	109.5	81.0		28.4	-3.3			
R-226A	BB Fill Area	143.2	190.4	162.3	154.6	47.2	-21.1	-0.9	Taper	Taper	Taper
R-226.5		96.7	152.2	107.4	83.7	55.5	-33.7	-2.8	103.7	-49.5	-4.6
R-227		105.0	217.0	131.3	91.8	111.9	-64.4	-4.6			
R-227.5		82.4	206.9	128.4	79.7	124.5	-59.0	-5.7			
R-228		153.7	272.3	200.8	153.4	118.6	-53.8	-5.5			
R-228.5		353.8	470.2	407.5	356.0	116.4	-47.1	-6.0			
R-229		323.0	438.0	367.9	330.0	114.9	-52.7	-4.4			
R-229.5		294.0	378.2	330.6	305.3	84.2	-35.8	-2.9			
R-230		276.6	287.4	291.4	279.1	10.9	3.0	-1.4	Taper	Taper	Taper
R-231	BB south of Fill	350.4	357.2	358.1	373.8		0.6	1.8			
R-232	BB south of Fill	97.7	101.7	94.9	126.5		-5.1	3.7			
R-233	BB south of Fill	280.6	299.2	288.9	317.4		-7.8	3.3			
R-234	BB south of Fill	179.0	185.8	181.9	195.6		-2.9	1.6			
R-235	BB south of Fill	105.5	112.0	105.7	117.3		-4.8	1.3			

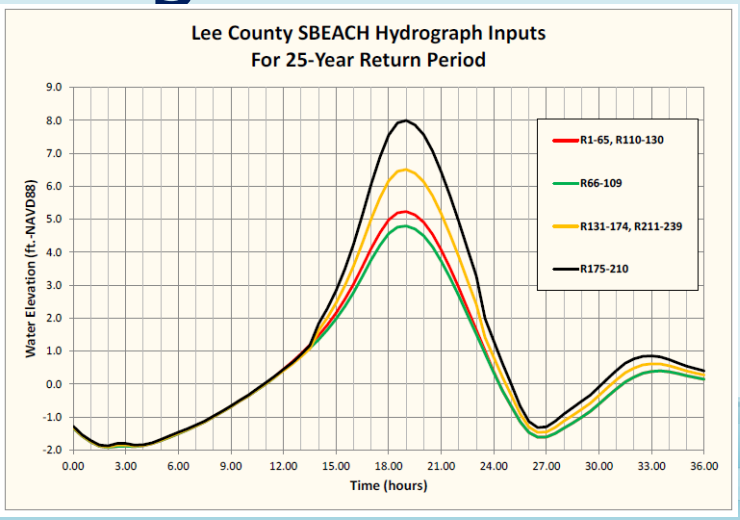
SHORELINE CHANGE ANALYSIS (2016-2020)

Monument		Pre Con June 2014	Post Con Jan. 2015	1st Year Mon June 2016	5th Year Mon June 2020	Fill Placed June 2014 - Jan 2015 (feet)	MHW Change Rate (Equilibration) Jan 2015-June 2016 (feet per year)	MHW Change Rate June 2016-June 2020 (feet per year)	Average Fill Placed June 2014-Jan 2015 (feet)	Average MHW Change Rate (Equilibration) Jan 2015-June 2016 (feet per year)	Average MHW Change Rate June 2016-June 2020 (feet per year)
R-223	BHI	123.2	109.4	79.5	85.5		-21.0	1.5			
R-224	BHI	-32.3	-32.8	-49.9	-6.2		-12.0	10.9			
R-225	BHI	-10.2	-4.1	36.1	-15.7		28.3	-12.9			
R-226	BB between groins	81.0	81.0	111.1	104.2		21.2	-1.7			
R-226A	BB Fill Area	154.6	189.2	149.3	168.1	34.6	-28.1	4.7	Taper	Taper	Taper
R-226.5		83.7	150.3	95.3	85.4	66.6	-38.7	-2.5	101.7	-38.6	-7.1
R-227		91.8	201.8	123.5	106.6	110.0	-55.1	-4.2			
R-227.5		79.7	199.5	128.4	97.5	119.8	-50.1	-7.7			
R-228		153.4	272.3	215.5	177.0	118.9	-40.0	-9.6			
R-228.5		356.0	468.7	420.8	383.3	112.6	-33.7	-9.4			
R-229		330.0	435.6	389.6	350.6	105.6	-32.4	-9.7			
R-229.5		305.3	383.5	354.9	327.7	78.2	-20.1	-6.8			
R-230		279.1	298.6	320.3	299.8	19.6	15.2	-5.1	Taper	Taper	Taper
R-231	BB south of Fill	373.8	368.2	390.3	394.3		15.6	1.0			
R-232	BB south of Fill	126.5	128.1	134.1	145.5		4.2	2.9			
R-233	BB south of Fill	317.4	315.7	317.6	327.9		1.4	2.6			
R-234	BB south of Fill	195.6	195.8	197.8	200.9		1.4	0.8			
R-235	BB south of Fill	117.3	115.7	125.0	123.1		6.5	-0.5			

SBEACH Model Study

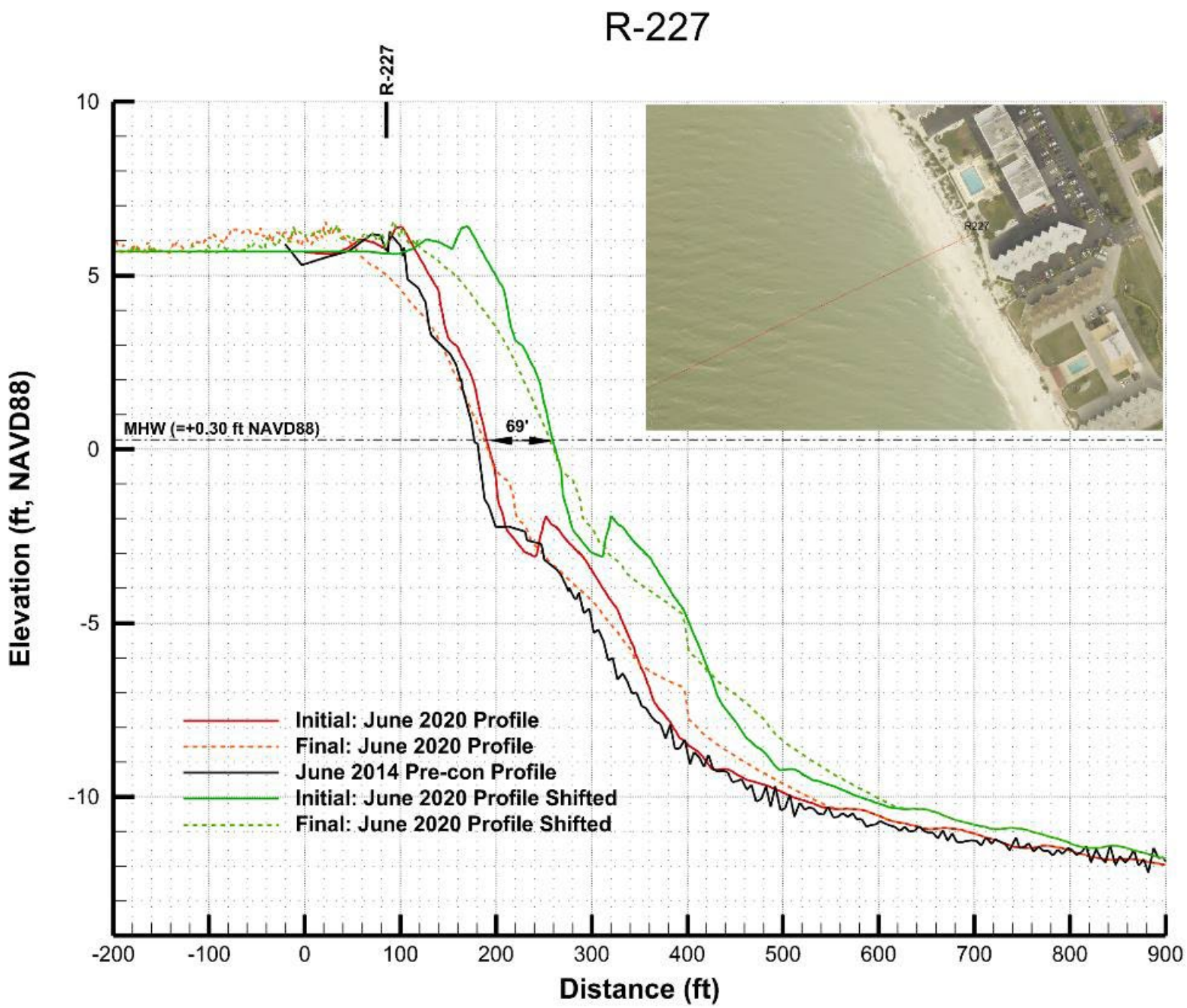
- Lee County Storm Tide Frequency Restudy (Wang, 2012)
- Lee County SBEACH Model Study (Wang&Manausa, 2015)
- Ran 2020 Monitoring Profiles to Identify Shoreline Reaches with Structures Susceptible to 25-Year Storm
- Analyzed Fill Templates to Yield Storm Damage Reduction Benefits

Range Segments	R1 - R130	R131 - R174, R211 - R239	R175 - R210
Transport Rate Coefficient, K	$0.5\ e^{-006}$	$0.5\ e^{-006}$	$0.5\ e^{-006}$
Overwash Transport Parameter	0.002	0.002	0.002
Coefficient for Slope Dependent Term, ε	0.005	0.005	0.005
Transport Rate Decay Coeff. Multiplier, λ	0.5	0.5	0.5
Landward Surf Zone Depth (ft.)	1.0	1.0	1.0
Maximum Slope Prior to Avalanching	15	15	15
Constant Wave Height (ft.)	10	10	10
Constant Wave Period (sec.)	10	10	10
Adjusted 15-year Hydrograph Peak Elevation (ft.)	6.5	7.3	8.2
Adjusted 25-year Hydrograph Peak Elevation (ft.)	7.7	8.7	9.7

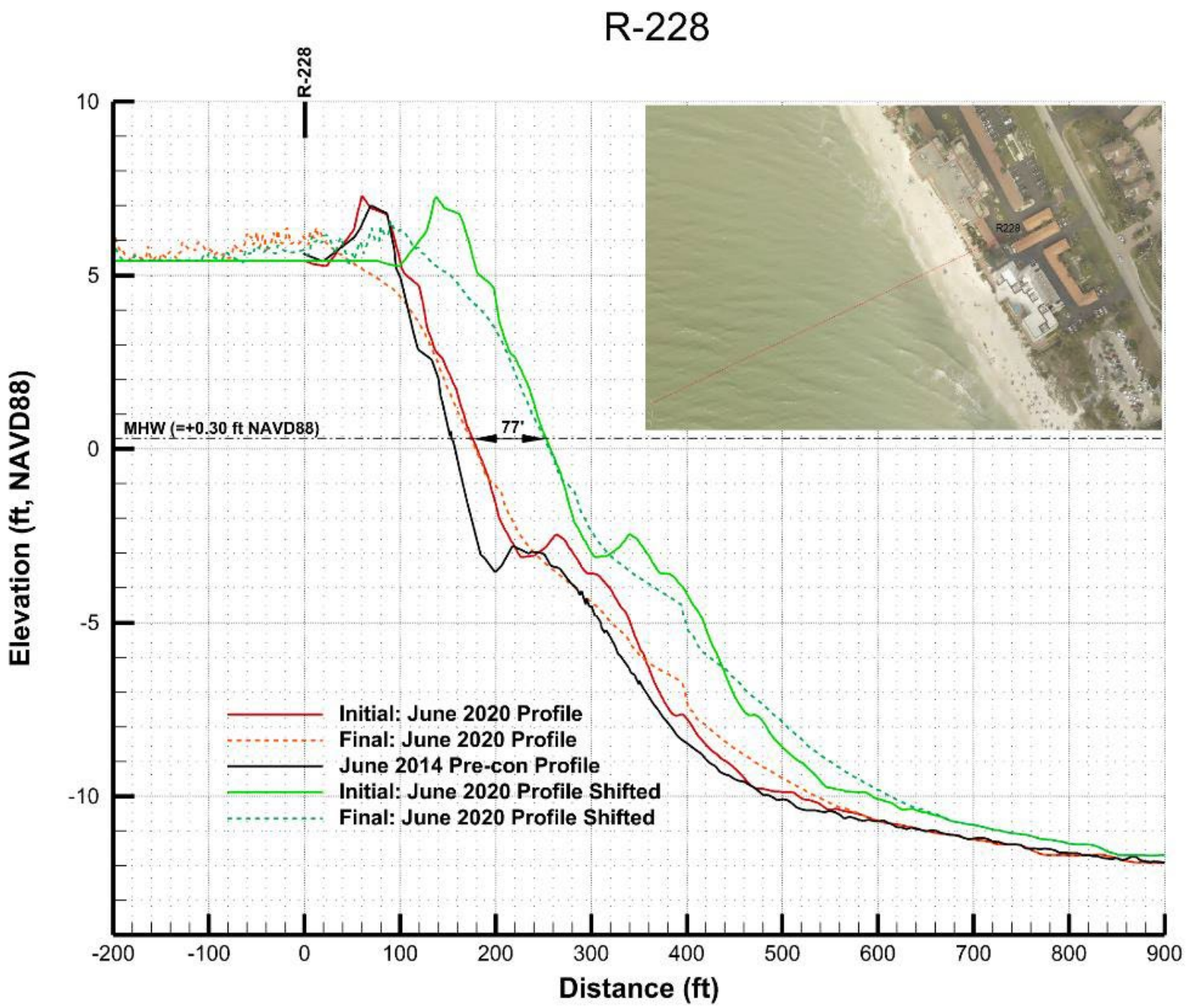


Wang & Manausa (2015)

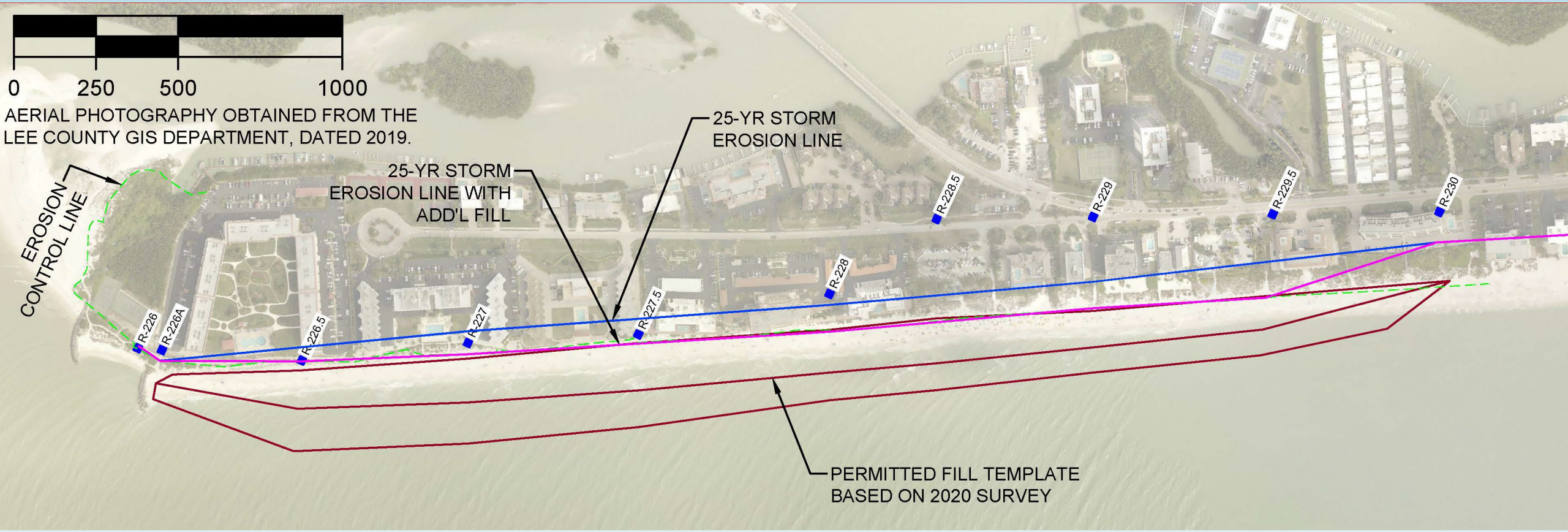
Model Results



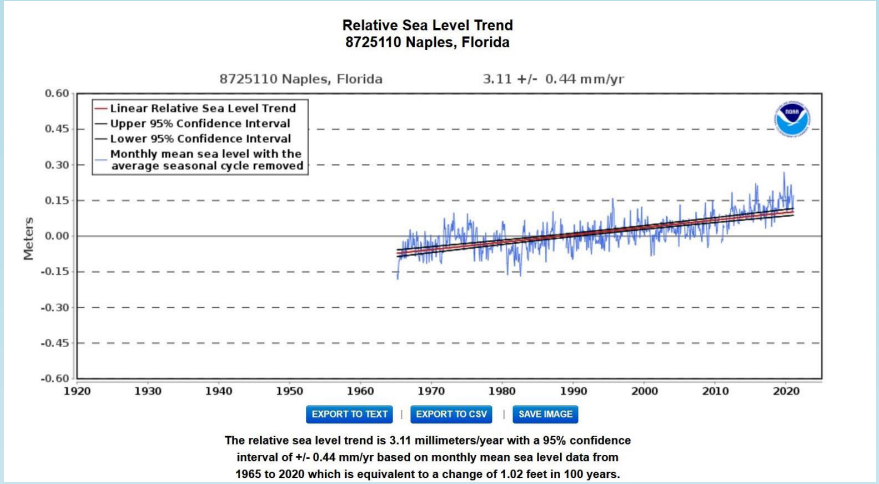
Model Results



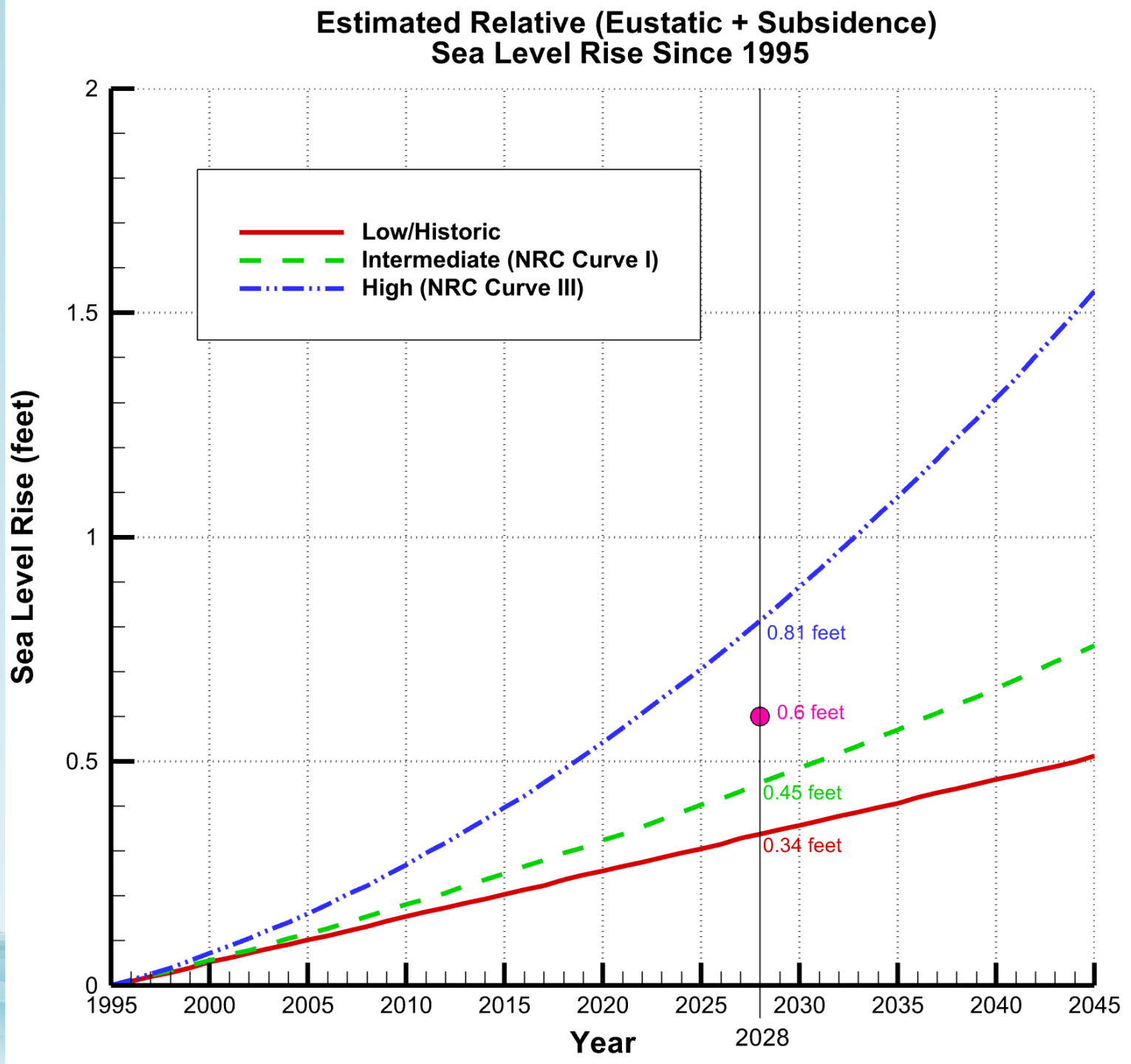
Model Results



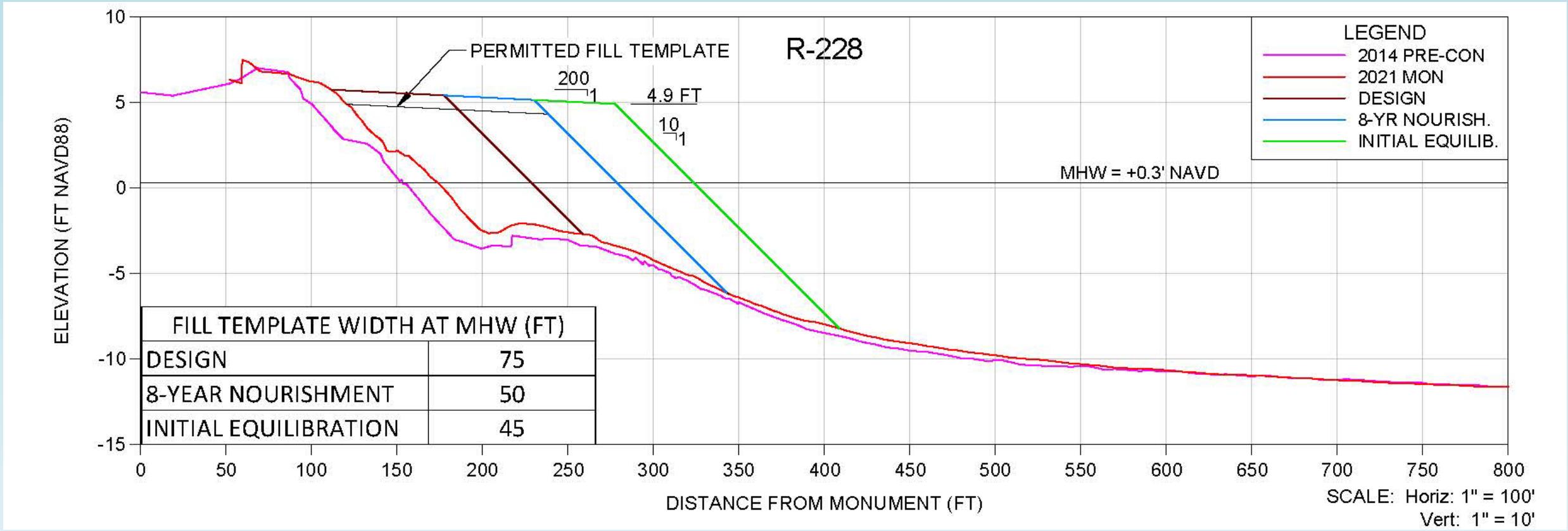
Sea Level Change



- 1995-2028
- 0.3’-0.8’ SLR Range
- 0.6’ Increase in Berm Height Implemented



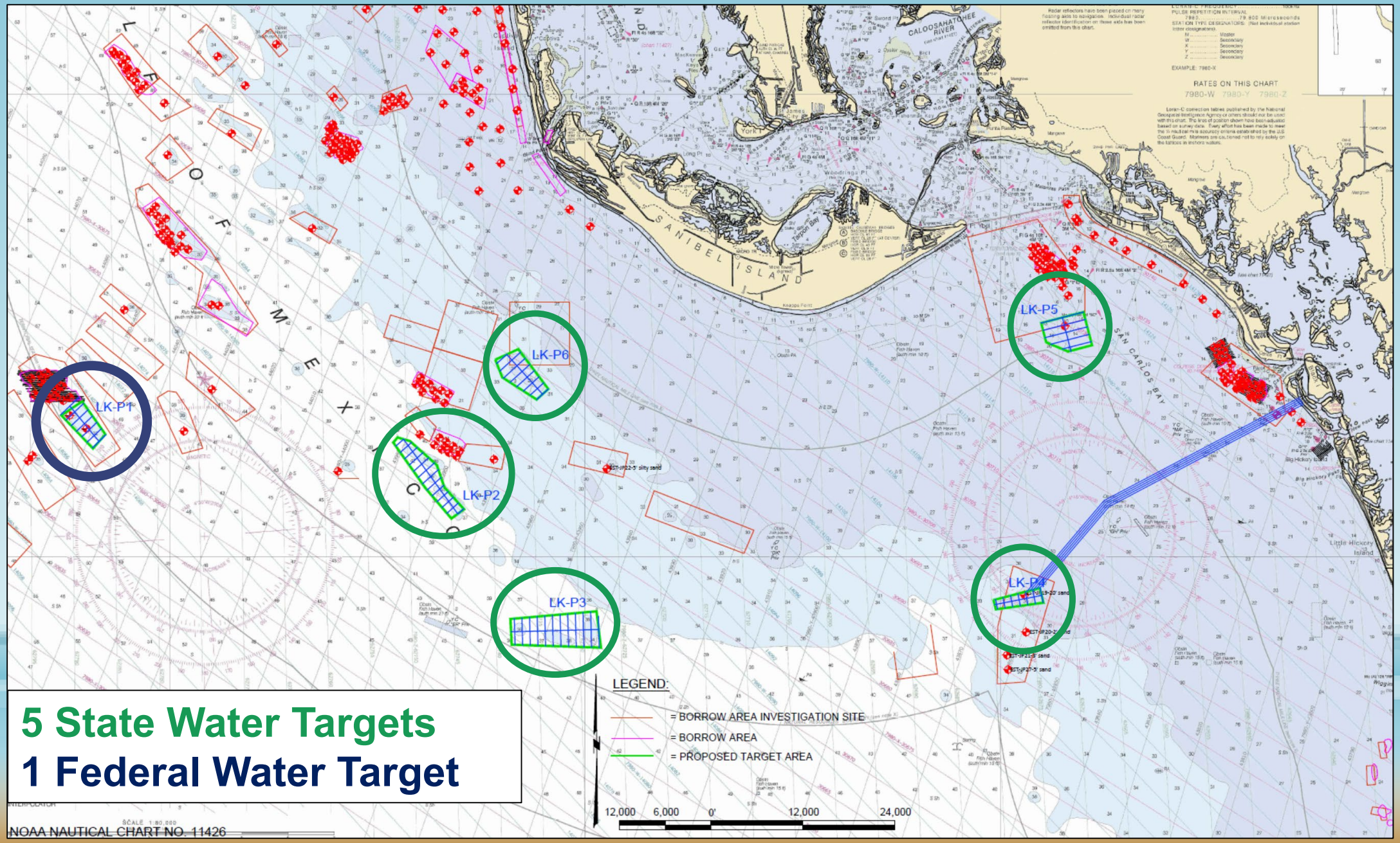
FINAL DESIGN SECTION (TYP)



Offshore Sand Search

- Desktop Analysis
- BOEM & SHPO G&G Survey Permits / Coordination
- Reconnaissance Level G&G
- Detailed Level G&G
- Lessons Learned

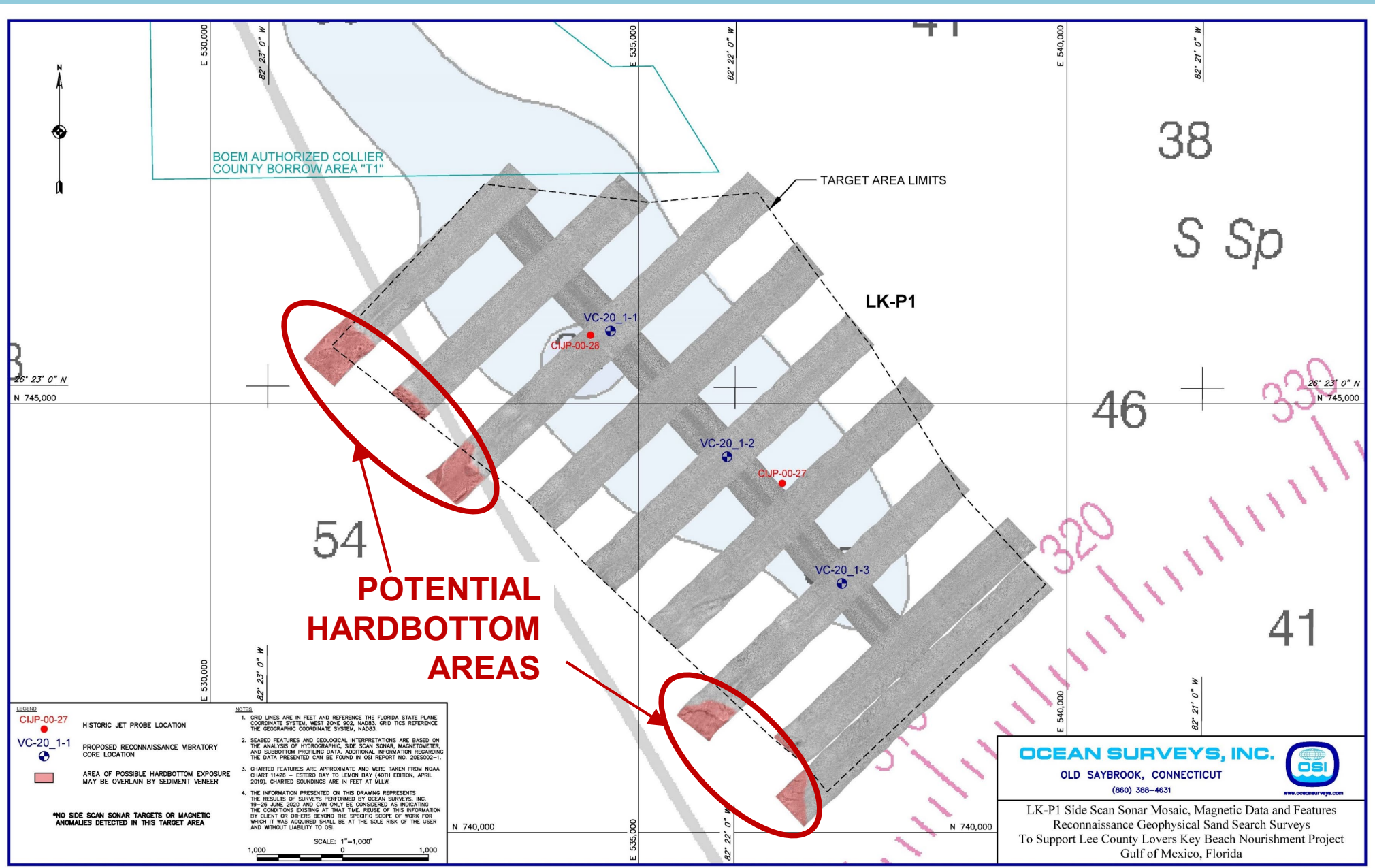
Recon Level Investigation



5 State Water Targets

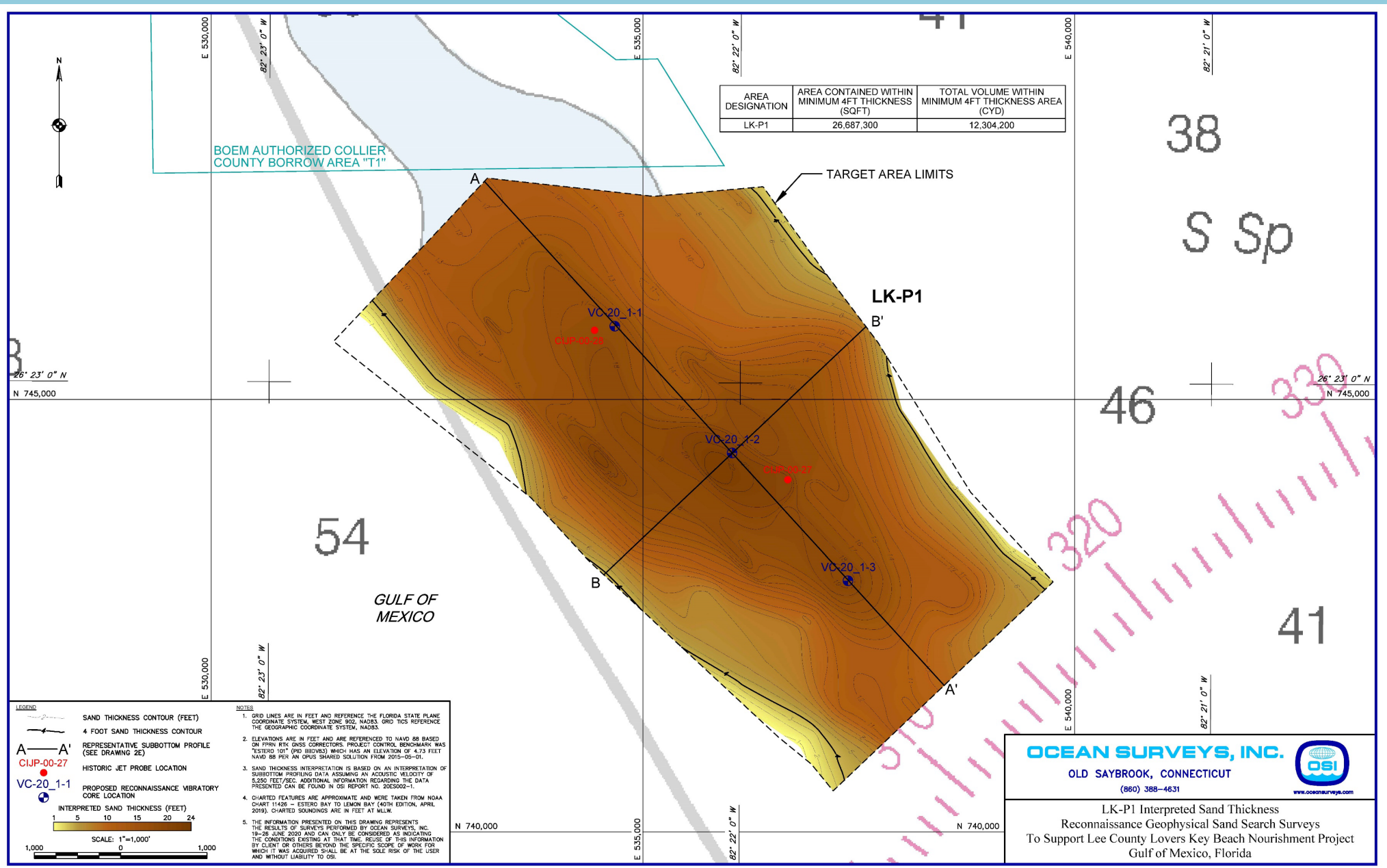
1 Federal Water Target

RECON LEVEL: SIDESCAN SONAR SURVEY



DRAWING 2C

RECON LEVEL: ISOPACH MAP



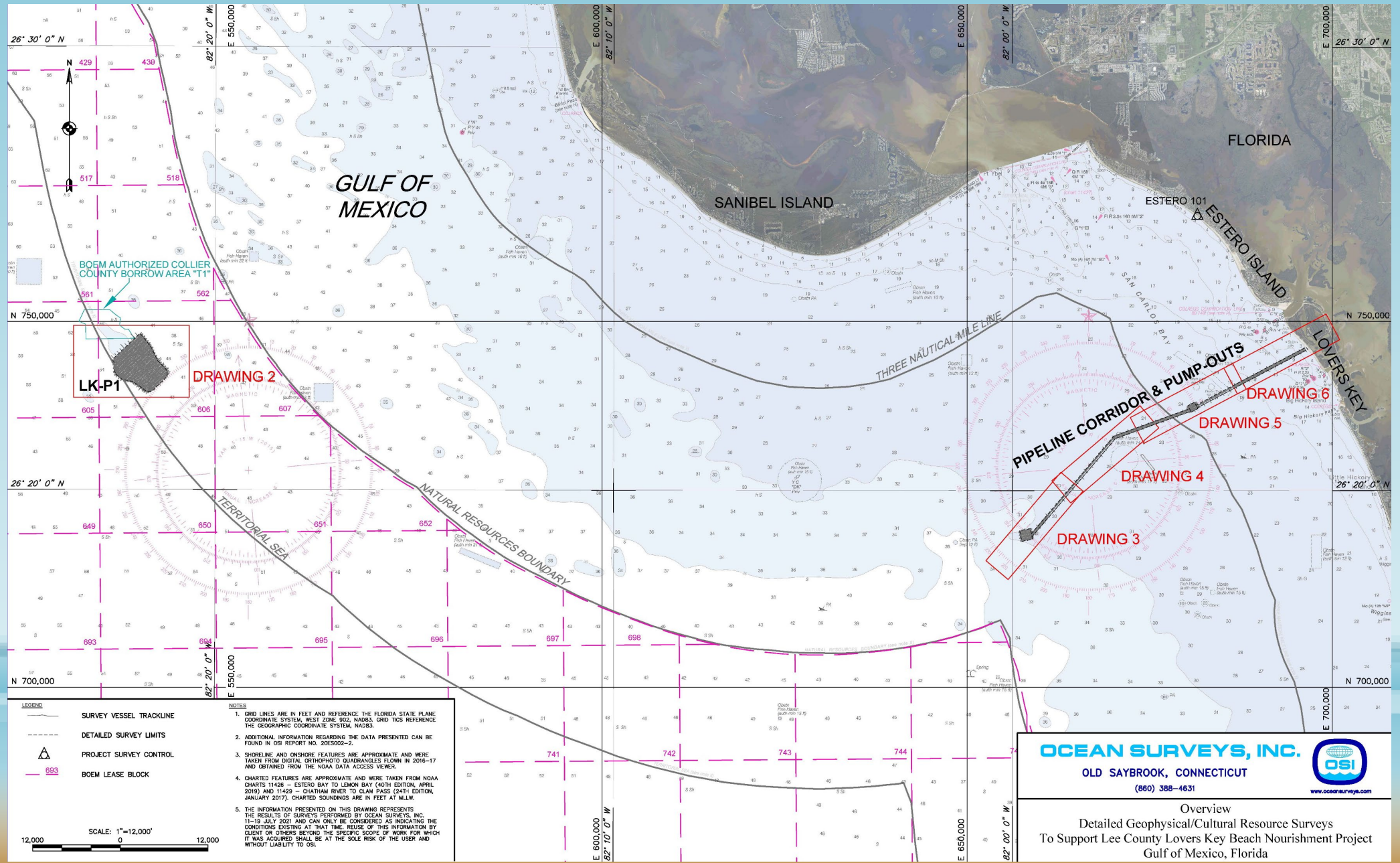
AREA DESIGNATION	AREA CONTAINED WITHIN MINIMUM 4FT THICKNESS (SQFT)	TOTAL VOLUME WITHIN MINIMUM 4FT THICKNESS AREA (CYD)
LK-P1	26,687,300	12,304,200

OCEAN SURVEYS, INC.
OLD SAYBROOK, CONNECTICUT
(860) 388-4631
www.oceansurveys.com

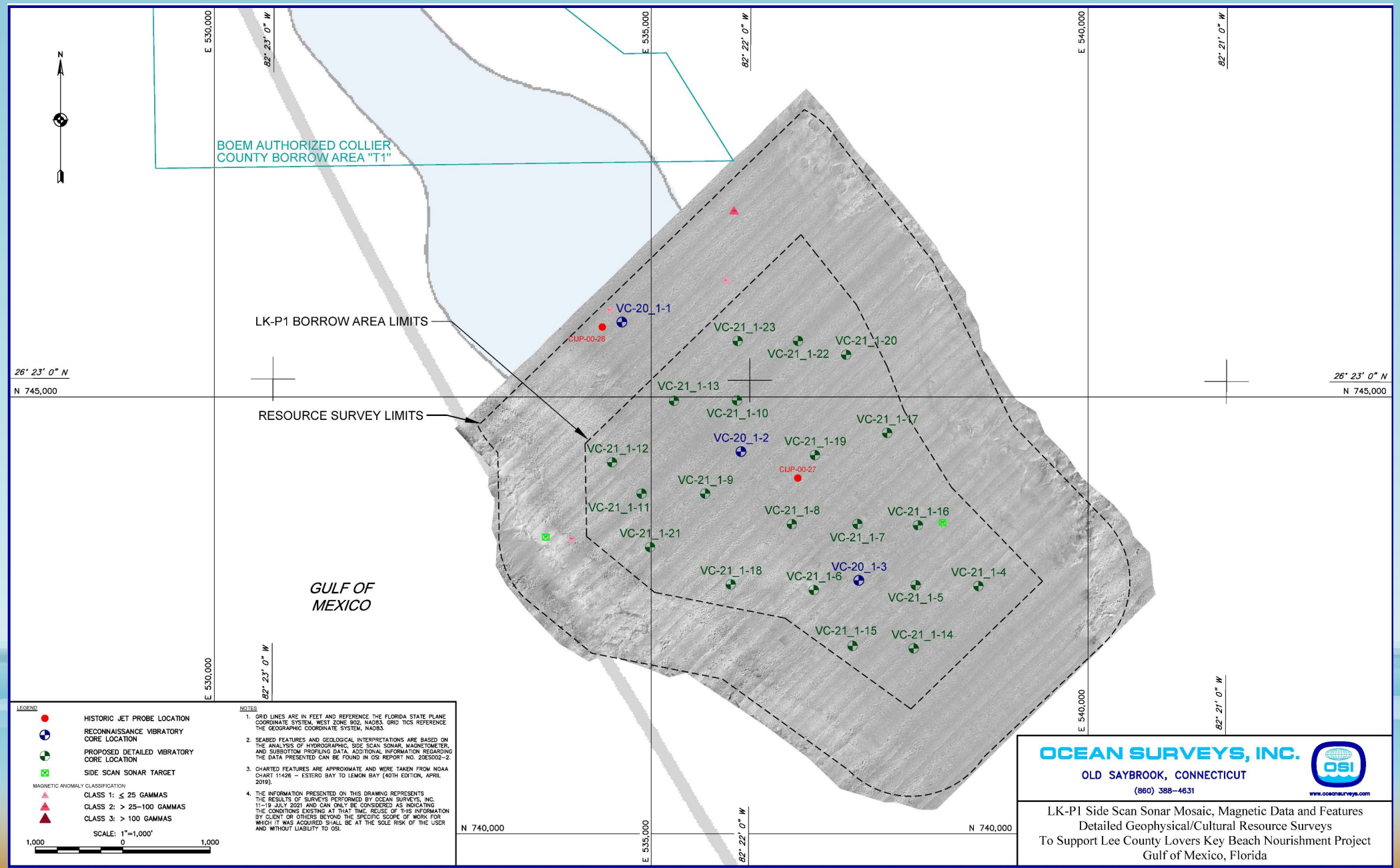
LK-P1 Interpreted Sand Thickness
Reconnaissance Geophysical Sand Search Surveys
To Support Lee County Lovers Key Beach Nourishment Project
Gulf of Mexico, Florida

DRAWING 2D

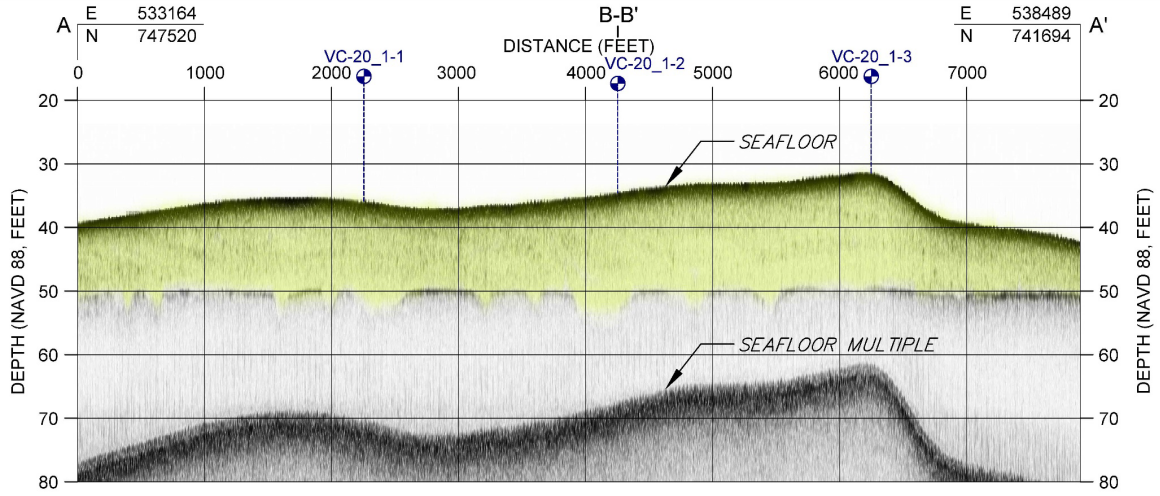
DETAILED LEVEL INVESTIGATION

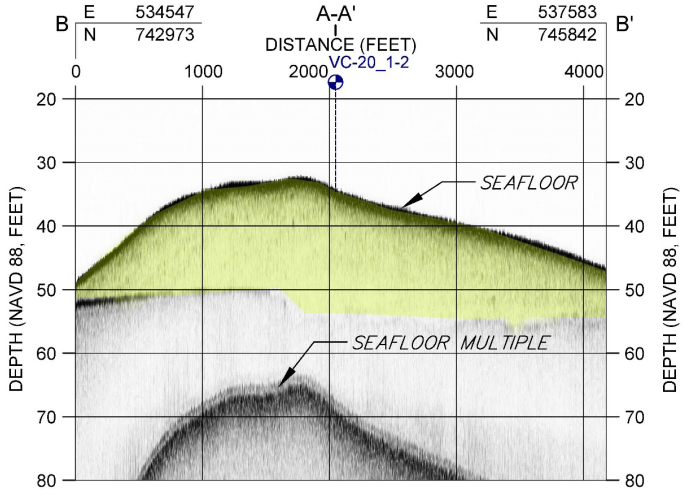


DETAILED LEVEL: G & G INVESTIGATION



SUBBOTTOM PROFILES





LEGEND

VC-20_1-1 — PROPOSED RECONNAISSANCE VIBRATORY CORE LOCATION

INTERPRETED SAND THICKNESS

SCALE: 1"=1,000'

1,000 0 1,000

NOTES

1. GRID LABELS ARE IN FEET AND REFERENCE THE FLORIDA STATE PLANE COORDINATE SYSTEM, WEST ZONE 902, NAD83.
2. DEPTHS ARE IN FEET AND ARE REFERENCED TO NAVD 88 BASED ON FPRN RTK GNSS CORRECTORS. PROJECT CONTROL BENCHMARK WAS "ESTERO 101" (PID: BSDV63) WHICH HAS AN ELEVATION OF 4.73 FEET NAVD 88 PER AN OPUS SHARED SOLUTION FROM 2015-05-01.
3. ADDITIONAL INFORMATION REGARDING THE DATA PRESENTED CAN BE FOUND IN OSI REPORT NO. 20ES002-1.
4. THE INFORMATION PRESENTED ON THIS DRAWING REPRESENTS THE RESULTS OF SURVEYS PERFORMED BY OCEAN SURVEYS, INC. 19-26 JUNE 2020 AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS EXISTING AT THAT TIME. REUSE OF THIS INFORMATION BY CLIENT OR OTHERS BEYOND THE SPECIFIC SCOPE OF WORK FOR WHICH IT WAS ACQUIRED SHALL BE AT THE SOLE RISK OF THE USER AND WITHOUT LIABILITY TO OSI.

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LK-P1 Representative Subbottom Profiles
Reconnaissance Geophysical Sand Search Surveys
To Support Lee County Lovers Key Beach Nourishment Project
Gulf of Mexico, Florida

DRAWING 2E

VIBRACORES

Boring Designation VC20-1-1

DRILLING LOG

DIVISION: Coastal Engineering Consultants Inc.		INSTALLATION: Bonita Springs, Fl	SHEET 1 OF 1 SHEETS
1. PROJECT: Lovers Key Beach Nourishment Sand Search Lee County, Florida		9. SIZE AND TYPE OF BIT: 4.0 In.	
		10. COORDINATE SYSTEM/DATUM: Geographic (Latitude/Longitude)	HORIZONTAL: NAD 1983 / VERTICAL: NAVD 88
2. BORING DESIGNATION: VC20-1-1	LOCATION COORDINATES: X = 26.385157 Y = -82.371143	11. MANUFACTURER'S DESIGNATION OF DRILL: Vibracore	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: American Vibracore Services	CONTRACTOR FILE NO.	12. TOTAL SAMPLES	DISTURBED: 4 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: BM		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER	
		15. DATE BORING	STARTED: 10-06-20 / COMPLETED: 10-06-20
6. THICKNESS OF OVERBURDEN: 0.0 Ft.		16. ELEVATION TOP OF BORING: -36.1 Ft.	
7. DEPTH DRILLED INTO ROCK: 0.0 Ft.		17. TOTAL RECOVERY FOR BORING: 16.6 Ft.	
8. TOTAL DEPTH OF BORING: 20.0 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR	

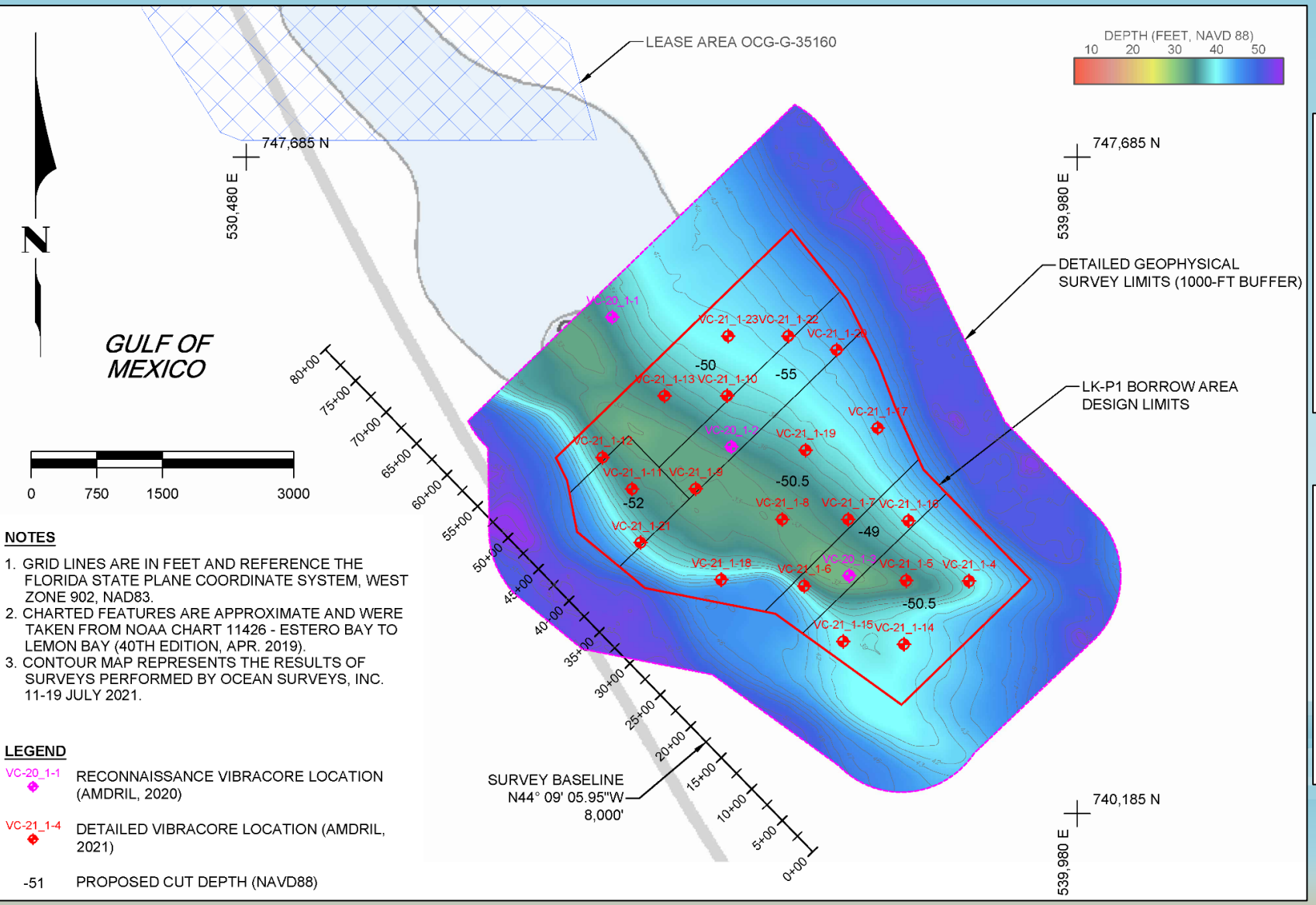
ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-36.1	0.0					
-41.6	5.5		Silica sand (m), with trace shell (up to 0.25" in size), large shell (1.5" dia in size) at 1.7', light gray (10YR-7/1), (SW).		S1	Sample #S1, Interval: 0" - 66.5" Mean Grain Size (mm): 0.40 Silt (%): 1.63 Gravel (%): 0.58 Carbonates (%): 19.70
-47.2	11.1		Silica sand (f), with trace shell (up to 0.25" in size), light gray (10YR-7/1), (SP).		S2	Sample #S2, Interval: 66.5" - 133" Mean Grain Size (mm): 0.18 Silt (%): 3.06 Gravel (%): 0.10 Carbonates (%): 21.8
-50.8	14.7		Silica sand (f), with trace shell (up to 0.5" in size), light gray (10YR-7/1), (SW).		S3	Sample #S3, Interval: 133" - 200" Mean Grain Size (mm): 0.24 Silt (%): 4.12 Gravel (%): 1.35 Carbonates (%): 22.10
-52.7	16.6		Silica sand (f), with trace shell (up to 0.25" in size), light gray (10YR-7/1), (SP).		S4	Sample #S4, Interval: 176" - 200" Mean Grain Size (mm): 0.23 Silt (%): 4.03 Gravel (%): 0.12 Carbonates (%): 23.20
-56.1	20.0		Assumed not recovered, (NR).			
			End of Boring			

0 5 10 15 20 25

FLORIDA DEP ROSS_LOVERS KEY.GPJ FL_DEP_ROSS.GDT 1/7/21

SAJ FORM 1836 JUN 02 MODIFIED FOR THE FLORIDA DEP JUN 04

BORROW AREA DESIGN



NOTES

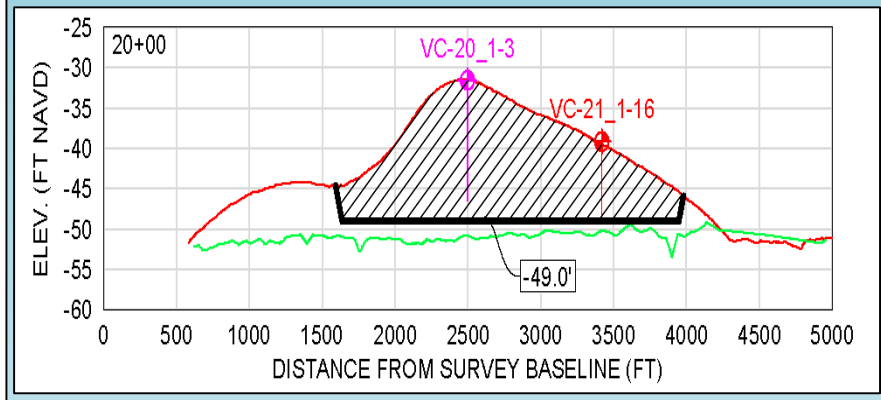
1. GRID LINES ARE IN FEET AND REFERENCE THE FLORIDA STATE PLANE COORDINATE SYSTEM, WEST ZONE 902, NAD83.
2. CHARTED FEATURES ARE APPROXIMATE AND WERE TAKEN FROM NOAA CHART 11426 - ESTERO BAY TO LEMON BAY (40TH EDITION, APR. 2019).
3. CONTOUR MAP REPRESENTS THE RESULTS OF SURVEYS PERFORMED BY OCEAN SURVEYS, INC. 11-19 JULY 2021.

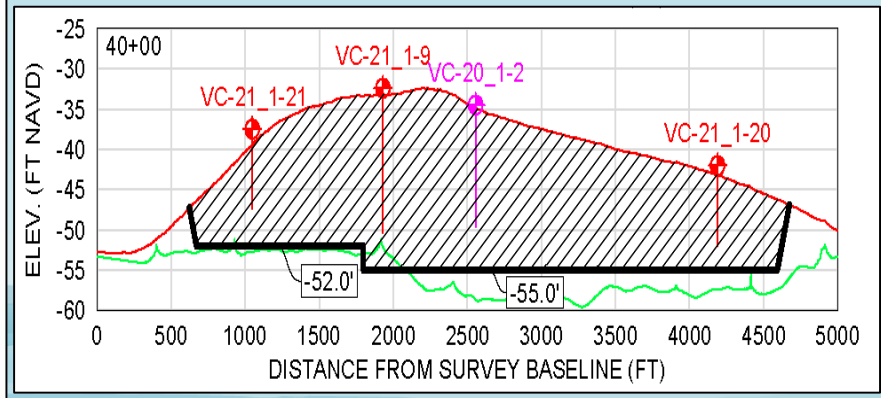
LEGEND

VC-20_1-1 — RECONNAISSANCE VIBRACORE LOCATION (AMDRIL, 2020)

VC-21_1-4 — DETAILED VIBRACORE LOCATION (AMDRIL, 2021)

-51 — PROPOSED CUT DEPTH (NAVD88)





Lessons Learned

- BOEM Integration: Early and Often
- Geophysical Permit Process
  - Target Area Vs. Search Area
  - Vessel Amendment
  - Equipment Specs
- Geotechnical Permit Process
  - Protected Species Observers
- Constant Updates
- Joint Coastal Permitting

SUMMARY

- Updated Bonita Beach Fill Template to Incorporate "Design", "Advanced Nourishment" and "Profile Equilibration" Elements
- Performed SLR analysis and raised Bonita Beach and Lovers Key berm heights by 0.6 feet
- Mapped, Designed, and Permitted Offshore Borrow Area in Federal Waters to provide 50-year Sand Volume in Combination with Nearshore Sources and Inlet Dredging Beneficial Use

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