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March 20, 2018

Gaelan Bishop, P.E.
Senior Engineer III, Transportation
FDOT District Two GEC, Office
Atkins
840 SW Main Blvd., Suite 102
Lake City, FL 32025

RE: SR A1A Coastal Erosion Risk Analysis Study, St. Johns County, FL

Dear Mr. Bishop,

The Florida Department of Transportation (FDOT) District 2 commissioned a study of the SR A1A corridor from near Guana River Road south to the Vilano Bridge (approximately 7.5 miles) to determine segments of roadway vulnerable to erosion failures during various coastal storm events. Atkins subcontracted INTERA Incorporated to help make this vulnerability assessment.

The present study consists of four parts: (1) site observations, (2) coastal analyses including long-term shoreline change and storm-induced erosion, (3) a vulnerability assessment, and (4) opportunities to partner with other agencies to ameliorate any vulnerable areas.

Site Observations

On November 30, 2017, two INTERA coastal engineers visited the study area. The observations intended to help evaluate and identify vulnerable areas where potential loss of pavement/shoulder integrity is possible. Where applicable, observations focused on the height of any escarpments relative to the toe of the dune slope, the distance of the toe of the dune slope from the apparent line of wave runup (e.g., wrack line or line of debris), and the width of the shoulder from the edge of pavement. Concern centers on additional erosion of the dune face and ultimately loss of shoulder/pavement that may occur as a result of future storms. Erosion of the toe can lead to cascading failure of the slope and ultimately to loss of shoulder width.

Table 1 presents field observation notes at select locations. The table also references corresponding photographs that depict the observations noted and reference monuments (survey control). The Florida Department of Environmental Protection (FDEP) maintains an extensive, statewide network of survey control originally established by the Florida Department of Natural Resources in the early 1970's. These locations serve as temporally consistent base points to originate beach profile surveys since that time. They also provide a good reference when observing site conditions. The study area extended from FDEP reference monuments R-83 through R-120 (Figure 1).

Table 1. Field Observations Summary

Locations	Observations
GTMNERR Store Walkover & Parking Lot to SPV Park Walkover & Parking Lot (R-83 to R-95)	North end of study area. Near the Guana Tolomato Matanzas National Estuarine Research Reserve (GTMNERR), a relatively wide beach existed with an enhanced dune (likely sand trucked from an inland sand source) (Figure 2). South of R-86 and until R-94 (approximately 9,000 ft), local residents have built seawalls constructed of wood, vinyl, and steel (Figure 3). For the most part, the wrack line lied at the toe of dunes and seawalls. At the SPV access, the county has placed upland sand to help protect it (Figure 4). Overall, dunes generally wide when vegetated and no structures. Elsewhere, beach is wide during low tide with narrow to no dunes fronting structures.
SPV Park Walkover & Parking Lot to Euclid St. Footpath & Parking Lot (R-95 to R-109)	Similar to north of the access, walls of various types begin again immediately south of access. Vacant lots adjacent to seawalls appeared to experience large erosion offset relative to neighboring unprotected areas (Figure 5). South of R-97, dune widths generally increased. Serenata Beach Club and condominiums (near R-102 and R-103) pushes SR A1A farther west than in other locations along the study area. South of the club, some lots have dunes eroded through the middle of the residences' footprints (Figure 6) such as near R-104. A low, narrow dune exists near R-105 (Figure 7). A mix of seawalls and temporary walls with dune fill generally stops at Fifth St (between R-107 and R-108).
Euclid St. Footpath & Parking Lot to North Beach Park Walkover & Parking Lot (R-109 to R-113)	No dry beach exists at high tide. A mix of walls and unprotected, eroded dunes (Figure 8). Many seawalls of various materials. Some gaps between the walls exist.
North Beach Park Walkover & Parking Lot to Nease Beachfront Park Walkover & Parking Lot (R-113 to R-118)	Little development along this stretch of shoreline. Some protected while others not (Figure 9). Dune recession allowed to occur at unprotected property. A rock revetment exists near R-115. A segment of roadway (R-115 to R-116) had an enhanced dune (likely with sand trucked from an inland sand source). However, dune is very narrow and low (Figure 10). Wrack line at dune toe.
Nease Beachfront Park Walkover & Parking Lot to near Vilano Bridge (R-118 to R-120)	Roadway set very far back from waterline.

Attachment A shows more site observation photographs collected during the entire field visit.

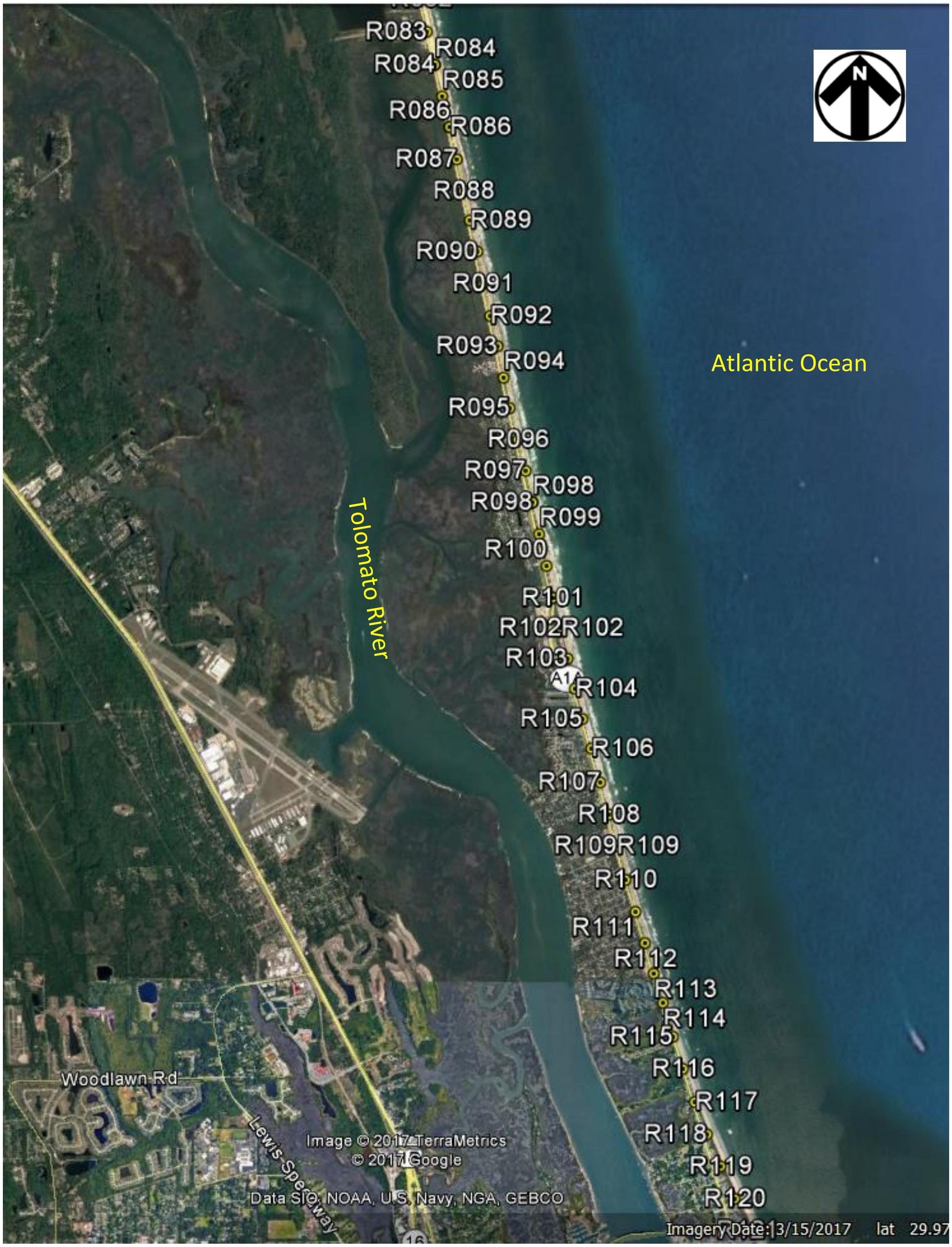

Figure 1. Location Map

Figure 2. Looking South from GTMNERR Access

Figure 3. Looking North at Various Types of Seawalls Intending to Protect Local Residences

Figure 4. Looking North at Sand Placed to Protect County Access

Figure 5. Looking West at Eroded Dune Adjacent to Seawall Termination Point

Figure 6. Lots with Severely Eroded Dunes

Figure 7. Low Spot in Dune System (Breached by Storms) near Eden Bay Dr.

Figure 8. Looking North at Mix of Dune Fill and Seawalls South of Euclid St.

Figure 9. Looking North at Development South of North Beach Park

Figure 10. Looking South along Relatively Unprotected Section of Roadway (R-115 to R-116)

Coastal Analyses

Long-term Shoreline Change Rates

This section examines historical shoreline behavior to identify trends of shoreline accretion and erosion along the study area. Shoreline changes generally indicate subaerial or dry beach behavior. The shoreline change rate, determined for FDEP reference monuments R-83 through R-120 (Figure 1), quantifies shoreline advancement or recession near the project area. The historical mean high water (MHW) shoreline position dataset includes the years 1860 to 2017 (including the effects of hurricanes Matthew [2016] and Irma [2017]).

The historical shoreline change rate is a function of long-term beach processes — accretive and episodic, storm-induced erosive events. The MHW shoreline position data referenced the shoreline locations as a range and azimuth (70° from north) from the fixed reference monuments. Notably, the FDEP recognizes the questionable quality and limited potential usefulness of all data generated before 1972, given source problems. The MHW line for the area lies near +1.7 ft North American Vertical Datum of 1988 (NAVD88). The average shoreline change rate represents the average of three different methods — end point, least squares, and rate averaging — as presented in Foster and Savage (1989). The end-point method takes the difference between the first survey distance and the end survey distance divided by the time between surveys to yield an approximate shoreline change per year. The second method applies the least squares method to fit a straight line to the shoreline positions versus time. The slope of this best-fit line indicates the rate of shoreline change. The rate-averaging method determines the shoreline change rate for each successive survey period.

Figures 11-13 present the shoreline changes calculated via the three methods and three different periods — 1860 to 2017, 1972 to 2017, and 1993/1995/1999 to 2017. The start dates for the latter period vary because of survey availability at each examined reference monument.

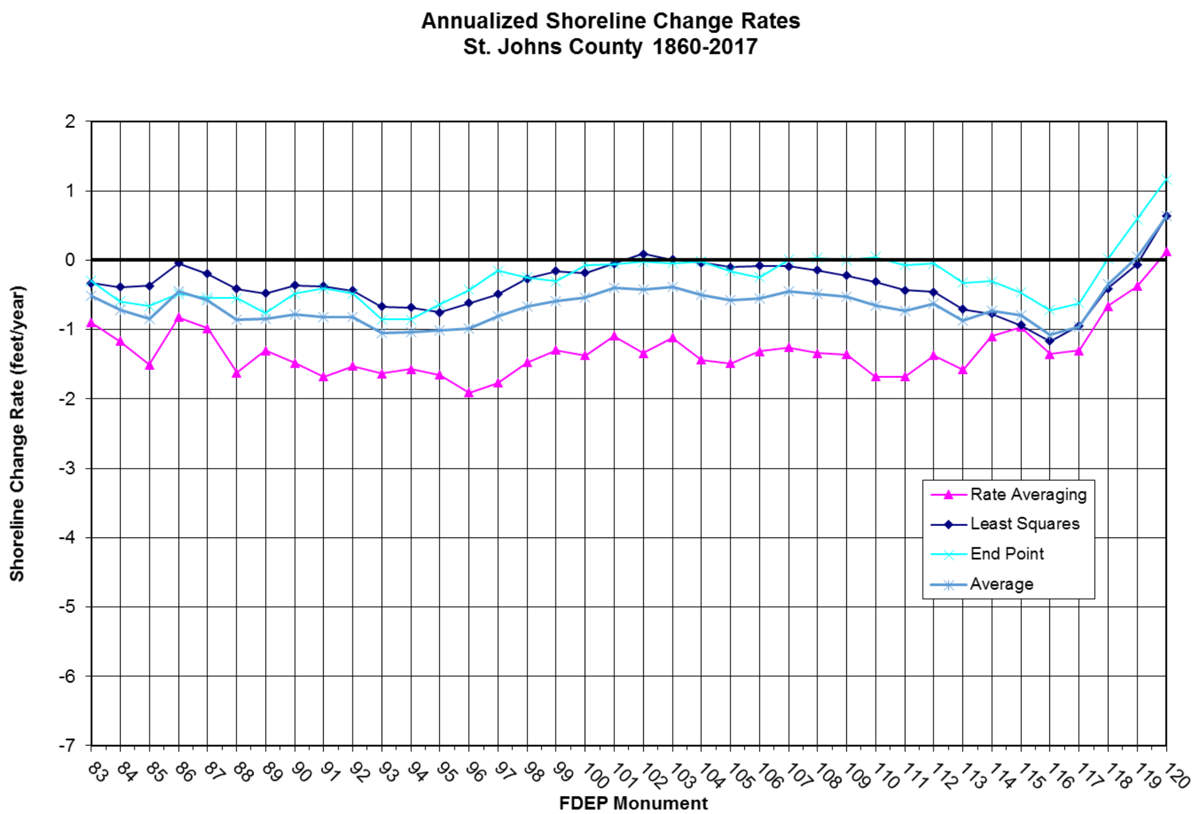

Figure 11. Shoreline Change Rates (1860-2017)

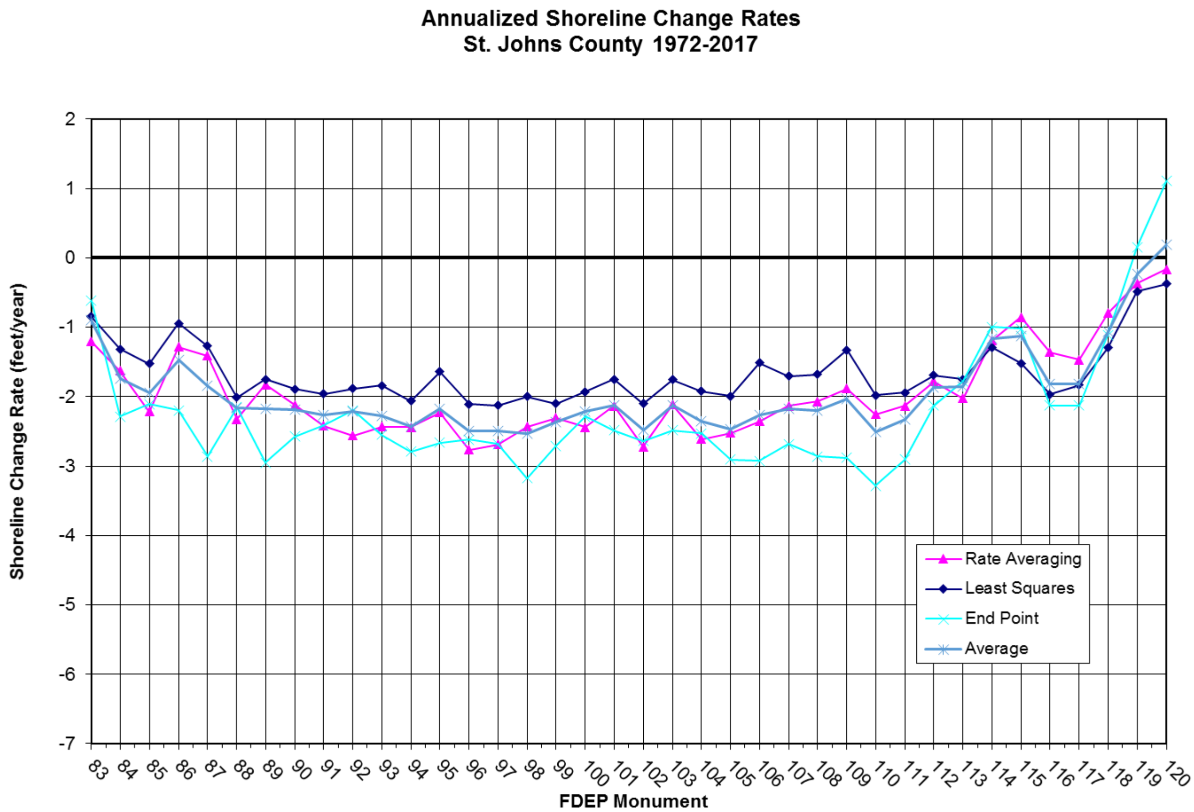

Figure 12. Shoreline Change Rates (1972-2017)

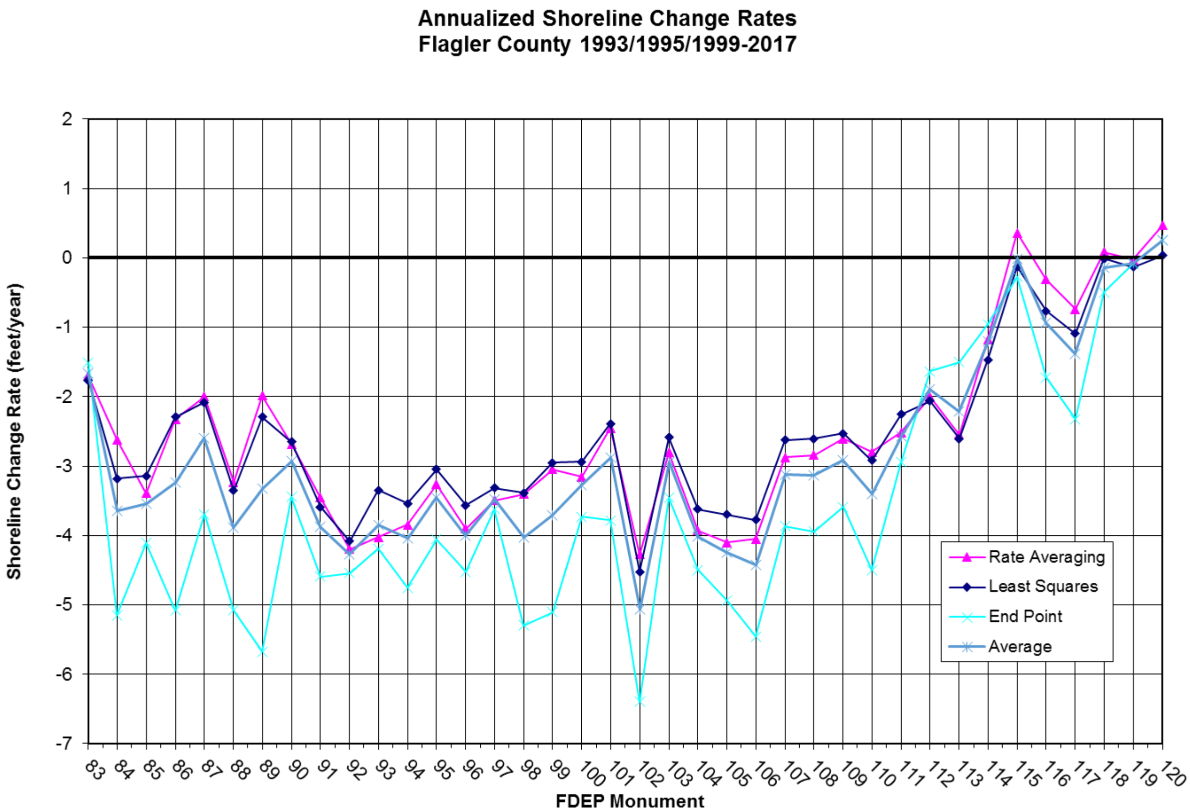

Figure 13. Shoreline Change Rates (1993/1995/1999-2017)

With the exception of very near St. Augustine Inlet (R-120), the beach shows an erosive trend for all methods and examined periods. Across the entire study area, the average shoreline change rate equals about -0.6, -1.9, and -2.9 ft/yr (erosion) during these three periods. Investigating data from 1972 to 2015, the U.S. Army Corps of Engineers (USACE) (2017) report a shoreline change rate of -1.3 ft/yr for R-84 to R-104 (South Ponte Vedra), -1.7 ft/yr for R-104 to R-117 (Vilano Beach), and +0.3 ft/yr for R-117 to R-122 (Vilano Beach). A similar trend appears evident in Figure 12, which covers a similar time but includes hurricanes Matthew and Irma.

The MHW positions reveal an erosive behavior across most of the study area. Until recently, hurricanes have generally not affected the shoreline since 1999. As such, the shoreline position trends generally reflect caused by means other than tropical events (e.g., northeasters and longshore transport). Therefore, any vulnerability analysis should consider these shoreline change rates.

Storm-Induced Erosion

In addition to long-term shoreline changes, INTERA evaluated episodic storms' effects on shorelines within the study area. INTERA applied the Federal Emergency Management Agency's (FEMA) methodology to determine beach/dune erosion at each of the 38 FDEP reference monument locations assessed above. This method is essentially the storm erosion methodology FEMA study contractors apply to map coastal V-zones for a Flood Insurance Study (FIS). This method requires classifying dune erosion as dune retreat or dune removal depending on the dune area lying above the peak storm tide elevation and seaward of the dune peak. If sufficient area exists, a storm causes a dune to retreat. If not, a storm removes the dune. Figure 14 depicts these two cases. The critical dune areas originate from a relationship between dune erosion area and storm return period (recurrence interval) (Figure 15). Table 2 presents dune erosion areas for select storm return periods. Peak storm tide elevations originate from the St. Johns County FIS (FEMA, 2011).

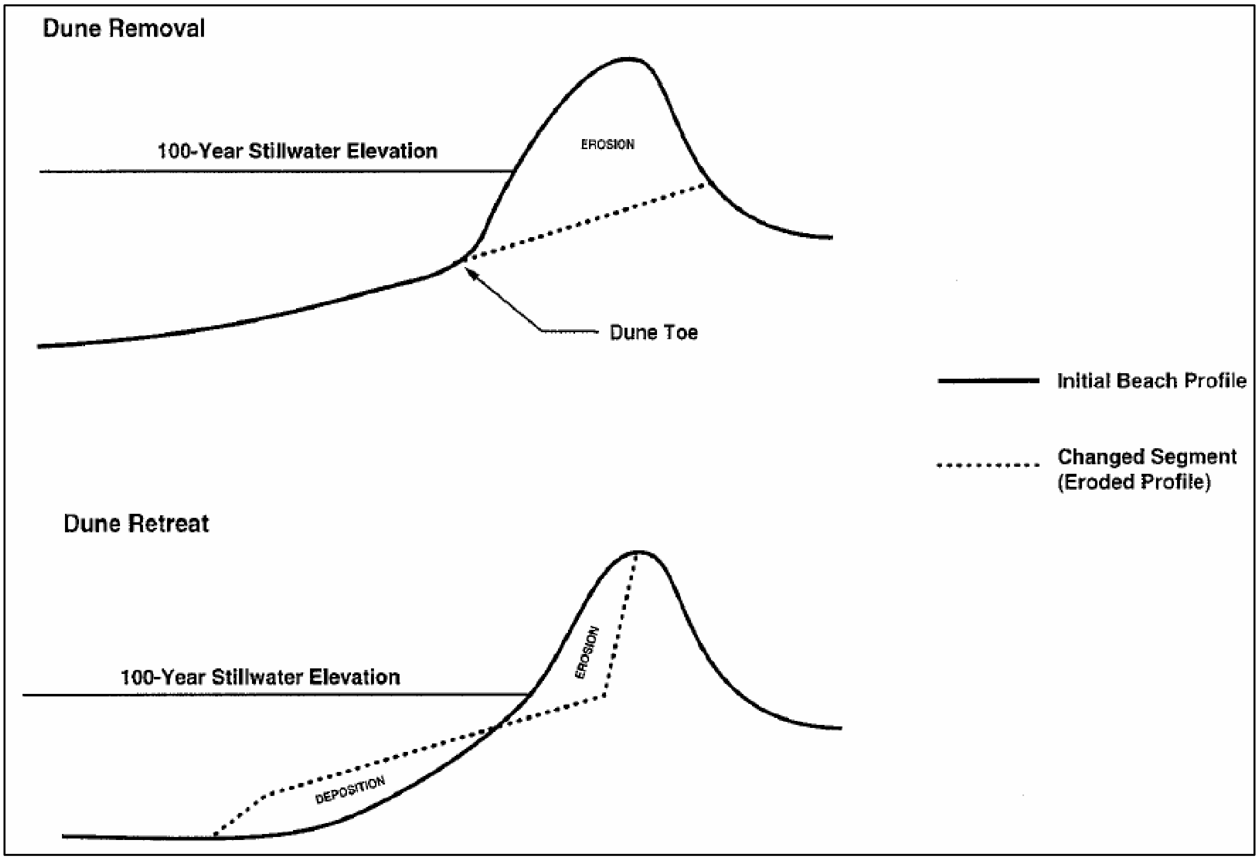

Figure 14. Sketch of Dune Removal and Dune Retreat Cases (FEMA, 2007)

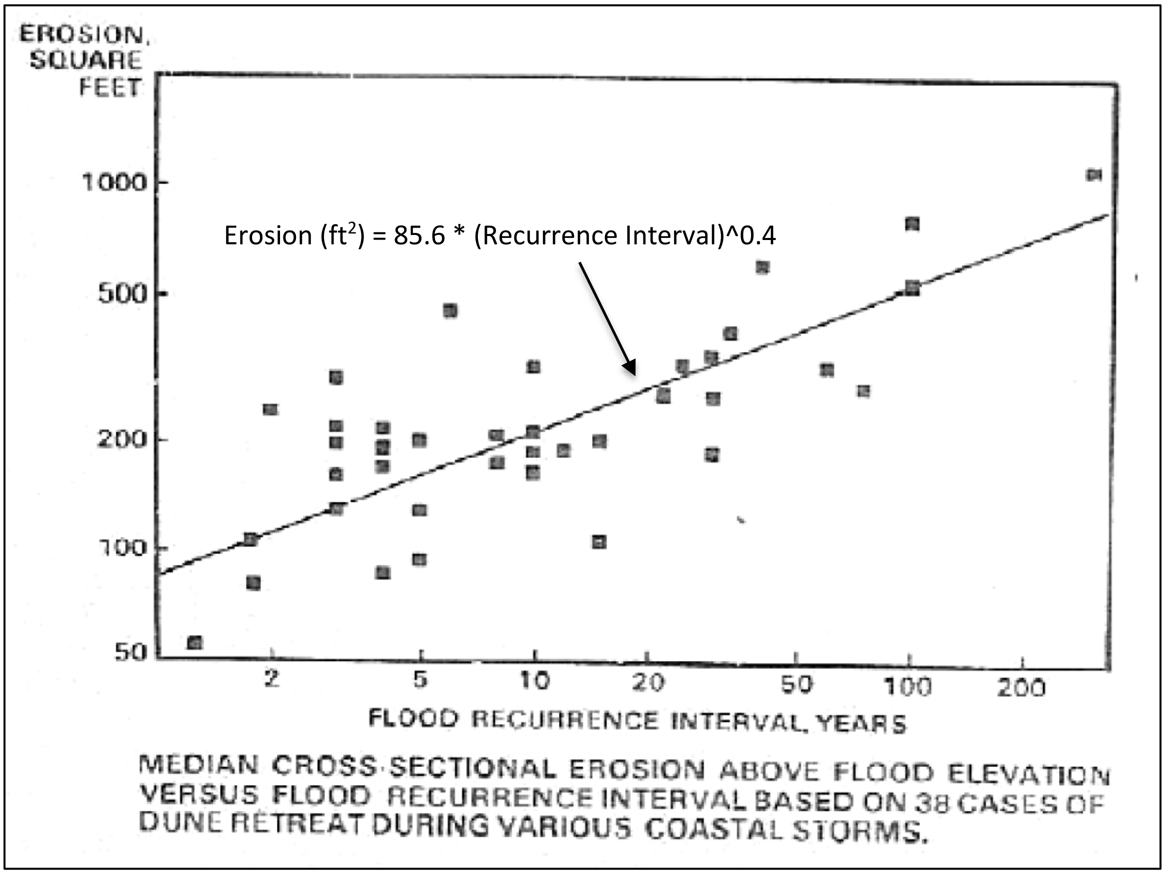

Figure 15. Dune Erosion Areas versus Return Period based on Hallermeier and Rhodes (1988)

Table 2. Dune Erosion Areas for Select Return Periods

Return Period (yrs)	Dune Erosion Area (square feet or cubic feet/foot)
10	215
50	409
100	540
500	1,030

This study applied this erosion method to determine the landward limit of the erosion, critical to assessing the vulnerability to the roadway. The following paragraph describes a typical application for a 100-yr event. First, one calculates the dune area above the 100-yr stillwater level and seaward of the dune peak or rear shoulder peak of a ridge-type dune. If this area exceeds 540 square feet (sf), then one draws an eroded profile with a duneface slope of 1H:1V, a connecting slope of 40H:1V, and a lower slope of 12.5H:1V (lower panel of Figure 14). After fixing the landward tie-in location of the eroded profile by ensuring the eroded area above the stillwater level and seaward of the 1H:1V line equals 540 sf, one adjusts the lower part of the profile until the deposition and erosion areas match. If the dune area above the 100-yr stillwater level and seaward of the dune peak or rear shoulder peak of a ridge-type dune falls below 540 sf, then one constructs a dune removal profile. This profile consists of locating the seaward dune toe and drawing a 50H:1V line landward from this point until intersecting the landward side of the dune (upper panel of Figure 14).

Storm-induced erosion analyses applied post-Hurricane Irma beach profiles obtained from the FDEP (https://floridadep.gov/water/beaches) and based on USACE LiDAR data. Determining the appropriate beach profile to use requires a comparison of post-Hurricane Irma beach profile data with historic beach profile data at each FDEP reference monument (R-83 to R-120) for analysis. Some users of the USACE LiDAR data have noted occasional issues with it. This check revealed the reliability of the post-Irma survey data at each reference monument location. Once completed for each monument, determination of the landward extent of the erosion for each beach profile commenced.

Figures 16 and 17 show the 10-, 50-, 100-, and 500-yr eroded profiles at R-91, approximately 1.5 miles south of Guana River Rd, and R-115, near the Ocean Sands Inn. Note that, just like these two examples, eroded profiles consisted of both dune retreat and removal types based on the post-Hurricane Irma beach profiles (2017_09). Attachment B contains the full set of results at each monument.

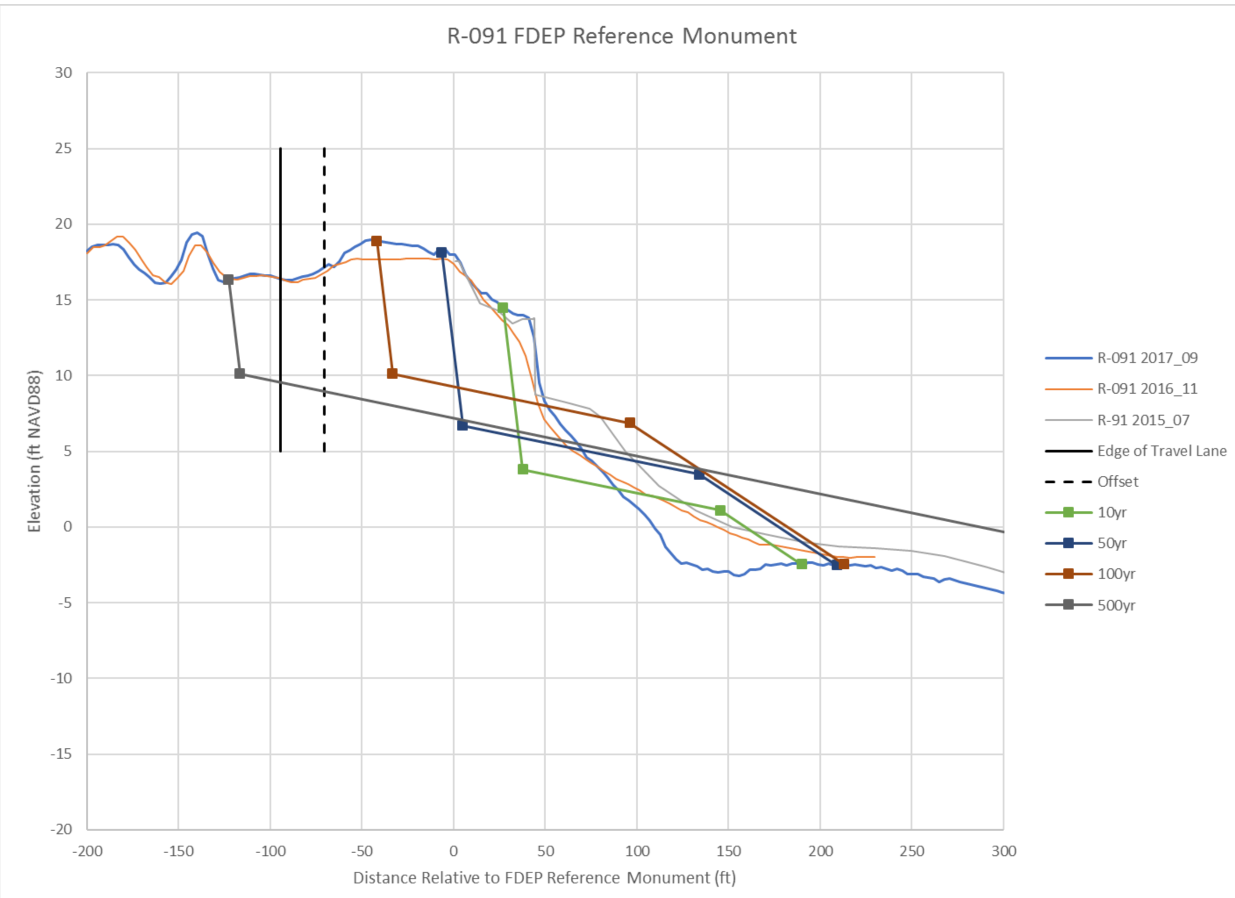

Figure 16. Predicted Eroded Profiles at R-91 for Various Return Period Storms

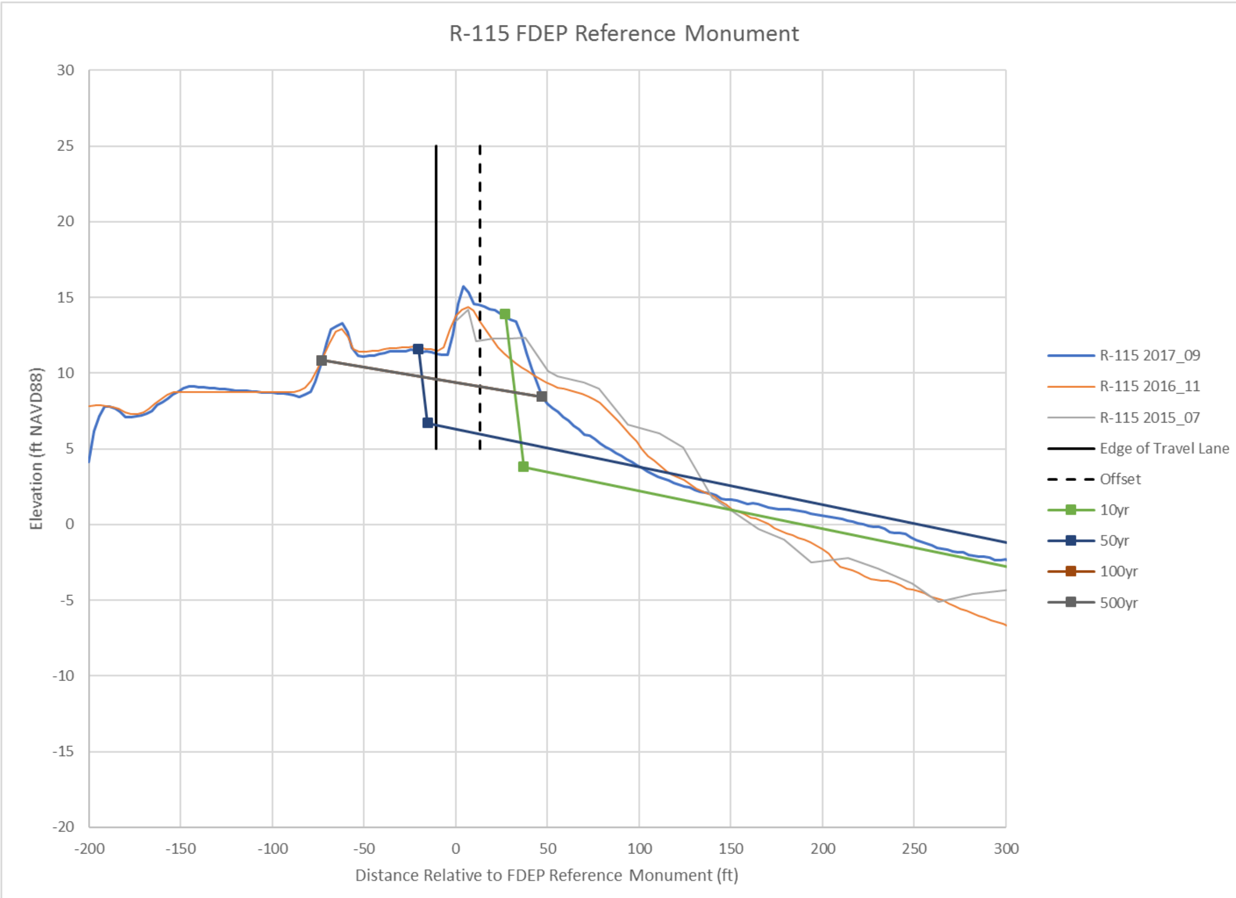

Figure 17. Predicted Eroded Profiles at R-115 for Various Return Period Storms

After calculating the landward limit of storm erosion for 4 events – 10-, 50-, 100-, and 500-yr return period storms – at each monument, determining the proximity of the erosion escarpment to the road helped establish the degree of failure risk. If the erosion escarpment fell landward of the roadway's clear zone, then this study would consider the roadway vulnerable to erosion. From FDOT (2017), the desired clear zone for this type of roadway likely ranges from 18 (R-117 to R-120) to 24 ft (R-83 to R-117) depending on location. Derivation of the edge of the travel lane originated from 2005 FDOT SR A1A roadway rehabilitation plans provided by Atkins (Gaelan Bishop, November 1, 2017, personal communication). By way of example, figures 16 and 17 show the locations of the edge of the travel lane and corresponding offset (or seaward edge of the clear zone) at R-91 and R-115. As shown, the landward extent of erosion from the 500-yr storm lies landward of this offset at R-91, while the landward extent of erosion from all but the 10-yr storm lies landward of this offset at R-115. Note that the 100- and 500-yr erosion profiles lie on top of each other at R-115. Visual observations at these locations support these results.

Table 3 summarizes the effects of various return period storms along the study area in its present (post-Hurricane Irma, September 2017) state (noted in red). Based on post-Hurricane Irma conditions, 10-yr storms do not affect the roadway's clear zone. Note that at R-83, the 50-yr storm produces an erosion scarp landward of the clear zone while the 100- and 500-yr storms do not because very little dune exists to erode above the corresponding surge elevations. Notably, this study only addresses erosion. Wave runup and overtopping of the roadway could also damage the roadway.

Table 3. Predicted Storm-Induced Erosion Results for Beach in Present State and 10 yrs into Future

FDEP Reference Monument	Erosion Scarp Landward of Clear Zone			
	10-yr Storm	50-yr Storm	100-yr Storm	500-yr Storm
83		Present	Future	Future
84		Future	Present	Present
85		Future	Present	Present
86		Future	Present	Present
87		Present	Present	Present
88			Future	Present
89			Future	Present
90			Present	Present
91				Present
92			Present	Present
93			Present	Present
94		Present	Present	Present
95			Future	Present
96			Future	Present
97				Present
98			Future	Present
99			Future	Present
100			Future	Present
101			Future	Present
102				
103				
104		Future	Present	Present
105		Future	Present	Present
106		Future	Present	Present
107		Future	Present	Present
108				Present
109			Present	Present
110	Future	Future	Present	Present
111				Present
112	Future	Future	Present	Present
113		Future	Present	Present
114		Present	Present	Present
115	Future	Present	Present	Present
116	Future	Present	Present	Present
117			Present	Present
118				
119				
120				

To provide a more complete understanding of the threat of coastal erosion to the roadway, this study assessed storm-induced erosion after a period of long-term shoreline recession. As described above, INTERA calculated long-term shoreline change rates at each monument. Combining the post-erosion profiles and the long-term erosion rates served to develop adjusted, post-erosion profiles should the beach continue to erode at historical rates and then become subject to a storm. When the long-term shoreline change rate indicates erosion, translating the post-erosion profiles landward by a distance equal to the product of the long-term shoreline change rate (given in ft/year) and the period of interest (say, 10 yrs) accounts for erosion expected to occur at the site, on average, over the period. These adjusted profiles serve as input for assessing distances from the edge of pavement to the landward edge of erosion. Locations where accretive or stable shorelines occur will see no profile adjustments.

For most of the project area, Figure 3 suggests a recession rate of -2 ft/yr. Exceptions include R-83 to R-86 and R-118 to R-120 where rates of -1.5 and -0.5 ft/yr appear appropriate. Multiplying by a time period of 10 yrs (an estimate of time before management actions might occur), these rates correspond to translating the post-erosion profiles landward by 15 (R-83 to R-86), 20 (R-87 to R-117), and 5 ft (R-118 to R-120). For example, under present conditions, only 100- and 500-yr storms produce escarpments that fall landward of the clear zone offset line at R-113. Ten years from now, the 50-yr storm could also produce an escarpment that falls landward of the clear zone offset line at R-113.

Table 3 also summarizes the effects of various return period storms along the study area 10 yrs into the future (noted in orange). After 10 yrs of long-term erosion, 10-yr storms encroach the clear zones at R-110, R-112, R-115, and R-116. Similarly, the number of locations where 50-yr storms encroach clear zones increases from 6 to 16.

Vulnerability Assessment

Based on site observations, long-term shoreline change rates, and the storm-induced erosion assessment, Table 4 rates the vulnerability of the roadway as low (un-highlighted), medium (orange highlight), and high (red highlight) by FDEP reference monument. The table shows vulnerabilities based on present conditions (with coastal analyses based on post-Hurricane Irma surveys) and conditions 10 yrs into the future. Note that this assessment excluded consideration of existing seawalls identified during the site visit because the durability of these hard structures to various return period storms is unknown. Furthermore, homeowners may have permitted some of these seawalls as temporary. Additionally, this assessment only considers the clear zone and roadway exposed to erosion as vulnerable.

While erosion may not affect the clear zone or roadway, water overtopping the roadway during a storm may occur. Unaccounted in the storm-induced erosion method utilized in this study (or other more sophisticated cross-shore erosion modeling), this effect may cause local scour at the landward edges of the roadway. INTERA staff observed these effects firsthand after Hurricane Ivan (2005) in the Florida Panhandle.

At present, the clear zone/roadway is highly vulnerable to erosion at R-83, R-87, R-94, and R-114 to R-116. In the future, the areas from R-83 to R-87, R-94, R-104 to R-107, R-110, and R-112 to R-116 may become highly vulnerable. Overall, the assessment identified 16% (6/38) of the clear zone/roadway as highly vulnerable, 39% (15/38) as having a medium vulnerability, and 45% (17/38) as having a low vulnerability to erosion in the beach's present state. Ten years into the future, the assessment identified 42% (16/38), 34% (13/38), and 24% (9/38) as having a high, medium, and low vulnerability to erosion.

Table 4. Vulnerability of Clear Zone/Roadway to Erosion

FDEP Reference Monument	Landmark	Present (post-Irma)	Future (10 yrs)
83	Guana River Rd.	High	High
84	2719 S. Ponte Vedra Blvd.	Medium	High
85	2741 S. Ponte Vedra Blvd.	Medium	High
86		Medium	High
87	2795 S. Ponte Vedra Blvd.	High	High
88	2823 S. Ponte Vedra Blvd.	Low	Medium
89	---	Low	Medium
90	2875 S. Ponte Vedra Blvd.	Medium	Medium
91	2903 S. Ponte Vedra Blvd.	Low	Low
92	2931 S. Ponte Vedra Blvd.	Medium	Medium
93	2957 S. Ponte Vedra Blvd.	Medium	Medium
94	Yellow Bill Ln.	High	High
95	SPV Park Walkover & Parking Lot	Low	Medium
96	Beachside Dr.	Low	Medium
97	3047 S. Ponte Vedra Blvd.	Low	Low
98	3056 S. Ponte Vedra Blvd.	Low	Medium
99	Turtle Bay Ln.	Low	Medium
100	3114 S. Ponte Vedra Blvd.	Low	Medium
101	Tides Edge Pl.	Low	Medium
102	Serenata Beach	Low	Low
103	Serenata Beach	Low	Low
104	---	Medium	High
105	Eden Bay Dr.	Medium	High
106	Sandcastle Ln.	Medium	High
107	Third St. Walkover	Medium	High
108	---	Low	Low
109	Euclid St. Foot Path & Parking Lot	Medium	Medium
110	4020 Coastal Hwy.	Medium	High
111	Boating Club Rd. Walkover	Low	Low
112	3810 Coastal Hwy.	Medium	High
113	North Beach Park Walkover & Parking Lot	Medium	High
114	Carcaba Rd. Walkover	High	High
115	Ocean Sands Beach Inn	High	High
116	---	High	High
117	3245 SR A1A	Medium	Medium
118	3148 SR A1A	Low	Low
119	3056 SR A1A	Low	Low
120	Oak Ave.	Low	Low

While the USACE utilizes criteria other than susceptibility to erosion to determine federal interest in a shore protection project, it identified the shoreline segment from approximately R-104 to R-116 as a project worthy of federal participation for shore protection over a 50-yr period (USACE, 2017). Notably, the present vulnerability assessment also identifies this area as potentially highly vulnerable in the future. The USACE project would consist of a dune and 60-ft equilibrium dry beach extension from the +8 ft NAVD88 contour and requiring renourishing approximately once every 12 yrs. The 60-ft extension represents the minimum beach width needed to provide optimal storm damage reduction benefits to the project area. The USACE would initially build a beach wider than 60 ft and waves/currents would naturally erode the beach. Once the beach erodes back to within the 60-ft design template, then the USACE would renourish the beach (i.e., place more sand).

Notably, Taylor Engineering (2009), as a subcontractor, prepared a coastal engineering study for a part of this study area on behalf of the FDOT. That study examined the erosion a new seawall might experience along the section of SR A1A near R-115 to R-116.

Partnering with Other Agencies

As observed during the site visits, shore protection — to protect homes, beach accesses, and in some instances SR A1A — generally consist of a hodgepodge of seawalls and dune fill. Opportunities may exist for the FDOT to partner with other agencies with an interest in protecting upland infrastructure to construct shore protection in a more planned manner.

As alluded above, the USACE has identified a $78 million, 50-yr beach nourishment project from R-104 to R-116. This recommended plan received approval from the USACE Civil Works Review Board in March 2017 and signoff on the Chief of Engineers report in August 2017. Next steps include review by the Office of the Assistant Secretary of the Army for Civil Works and Office of Management and Budget (OMB) and Congressional authorization for design, permitting, and construction (www.saj.usace.army.mil). In this era of no legislative earmarks, the OMB decides on funding. At the time of this writing, a benefit-to-cost (B/C) ratio of 2.5 with a 7% discount rate is the typical cutoff for funding. As currently presented, the St. Johns County project has a B/C ratio of 1.3. Should funding come through, the local sponsor (St. Johns County) must bear 77% of the project cost for initial construction and 82.3% for subsequent nourishments (USACE, 2017). This project would help address the medium to highly vulnerable roadway from R-104 to R-116. However, this project is likely a few years away from initiating construction.

Another, perhaps more imminent, endeavor includes a potential dune restoration project funded by the FDEP and local residents (through taxes collected by St. Johns County). The project, replacing sand lost during Hurricane Matthew, would run from R-76 to R-117 (9 miles) and place approximately 20 cy/ft at a cost of about $24 million. The state would fund 50% of the project with a local match. The county is currently contemplating establishing a Municipal Services Taxing Unit to collect taxes to help meet the local match. Should local residents agree and the state allocates its intended funds, the county anticipates construction commencing as early as November 2018. The FDOT could support part of this project either through supporting larger dune/beach fills at vulnerable locations or supporting a portion of the currently contemplated project.

Notably, INTERA understands that the FDOT District 5 is supporting dune restoration along the Flagler Beach and Beverly Beach shorelines adjacent to SR A1A by contributing approximately $12-16 million toward dune restoration.

Recommendations

Present and potential future beach conditions, absent the effects of local homeowner seawalls, suggests that the FDOT consider protecting SR A1A from erosion along three main areas: (1) R-83 to R-87, (2) R-94, and (3) R-104 to R-116. Conceptually, the FDOT could construct seawalls, similar to one contemplated from R-115 to R-116, to protect these areas, contribute to a dune restoration project, or fund some combination of seawall installation and dune restoration.

Closing the gaps between existing, permanent seawalls may prove a viable option in protecting the roadway from future erosion. Conceptually, a seawall with a 15-20-ft exposed height, concrete cap, and anchor might cost approximately $1,000 per linear foot to furnish and install. Alternatively, the FDOT may want to consider contributing to the ongoing, planned dune restoration projects to help protect the roadway. For example, dune restoration may make sense in areas where homeowners have already placed seawalls (with unquantified level of protection) to provide additional protection to the roadway than afforded by the seawalls alone. Figure 18 shows a conceptual level cross section with a 20 cy/ft dune fill placed adjacent to a seawall. Recent construction costs suggest dune fill from upland sand plants and offshore borrow areas equal about $50/cy and $25/cy. For a 20 cy/ft fill density, these costs correspond to $1,000 and $500 per linear foot of dune fill placed depending on the sand source. Assuming future upper beach erosion rates mimic those experienced over the last decade, this amount of dune fill may last about 15 years. Note that by partnering with other agencies, the FDOT may realize cost savings to protect SR A1A.

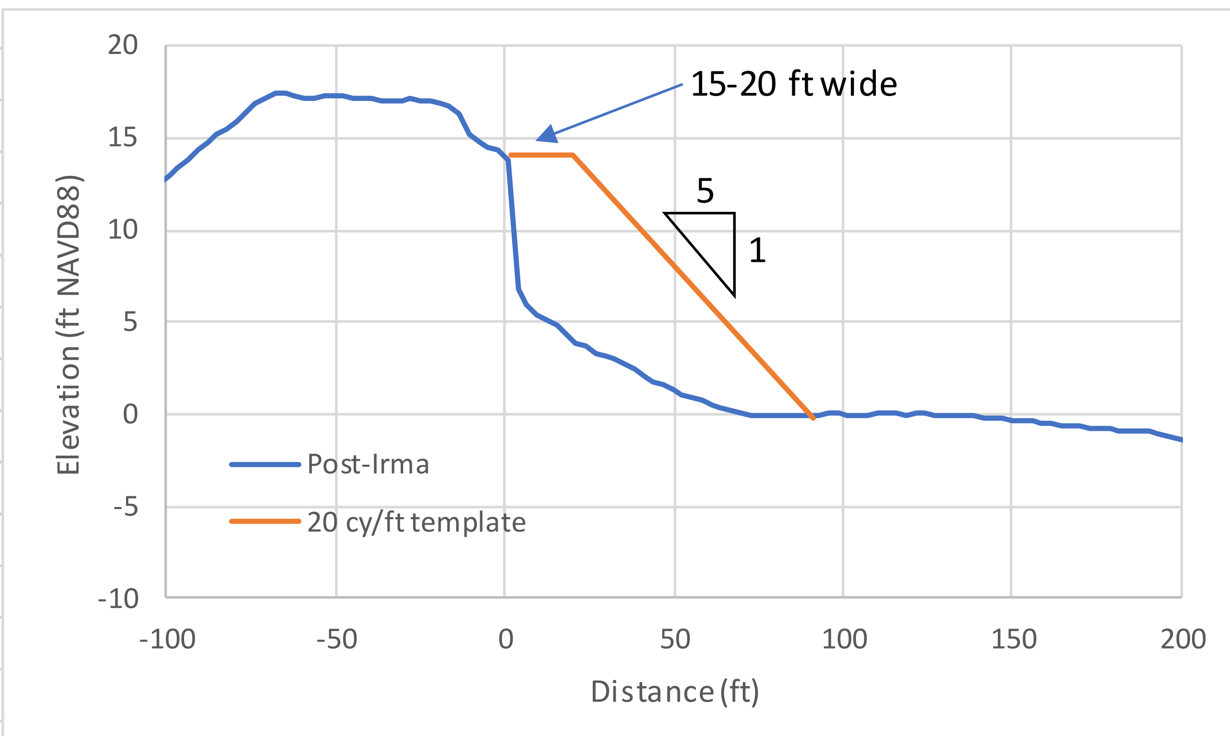

Figure 18. Conceptual Level Dune Fill Template Adjacent to Seawall

Aside from the identified vulnerable areas, prudence dictates monitoring other areas periodically and especially after storms. Good tools include beach survey profiles and aerials collected in the area by the FDEP as part of its Regional Coastal Monitoring Data collection program every four years.

Sincerely,

INTERA Incorporated

Michael R. Krecic, P.E.
Senior Coastal Engineer

Enclosure

References

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MICHAEL R. KRECIC
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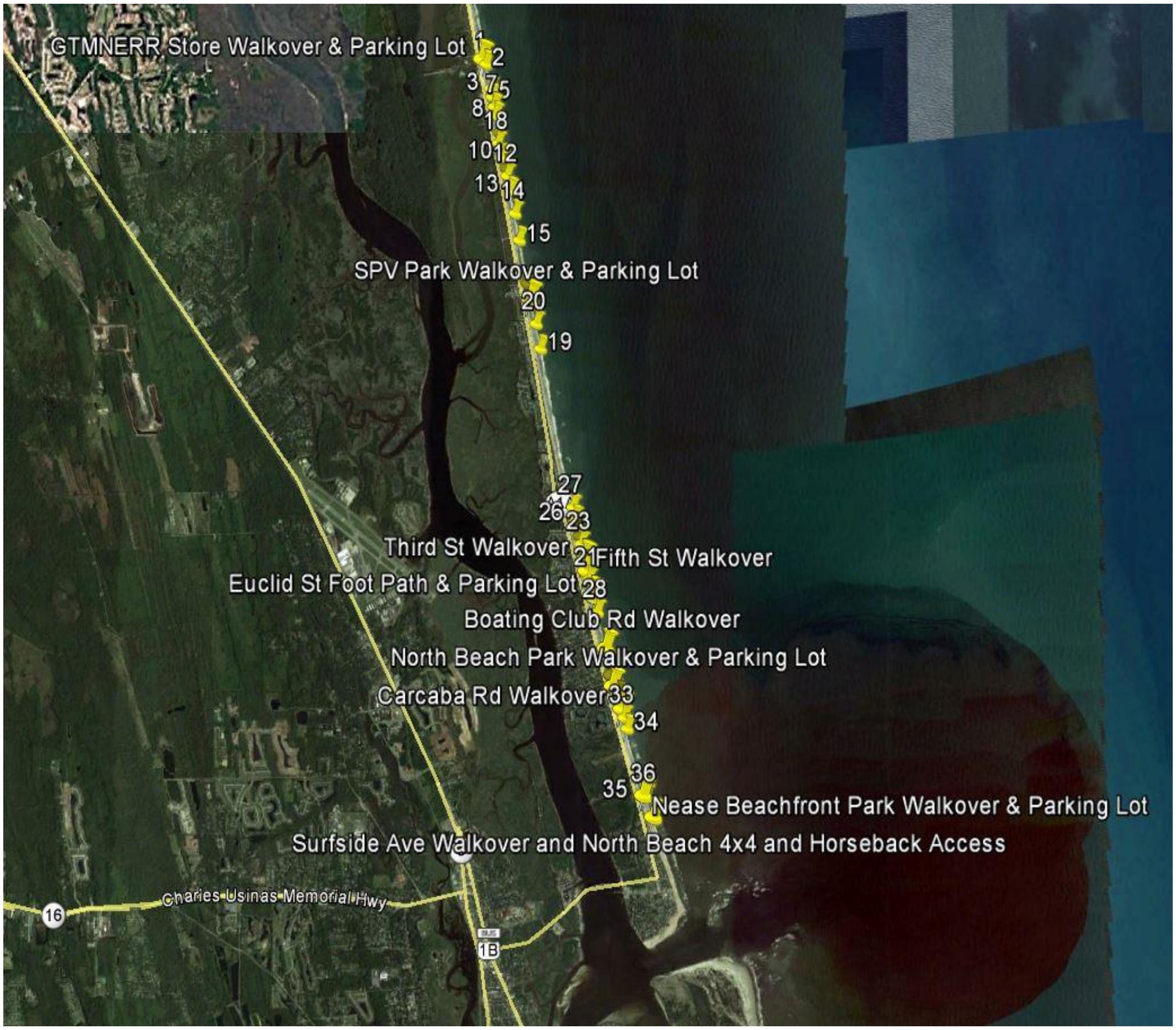
This document has been digitally signed and sealed by Michael R. Krecic P.E. on 03/20/2018 with a Digital Signature.

Michael R Krecic
2018.03.20 09:05:19 -04'00'

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH

INTERA INCORPORATED **DATE: 11/30/2017**

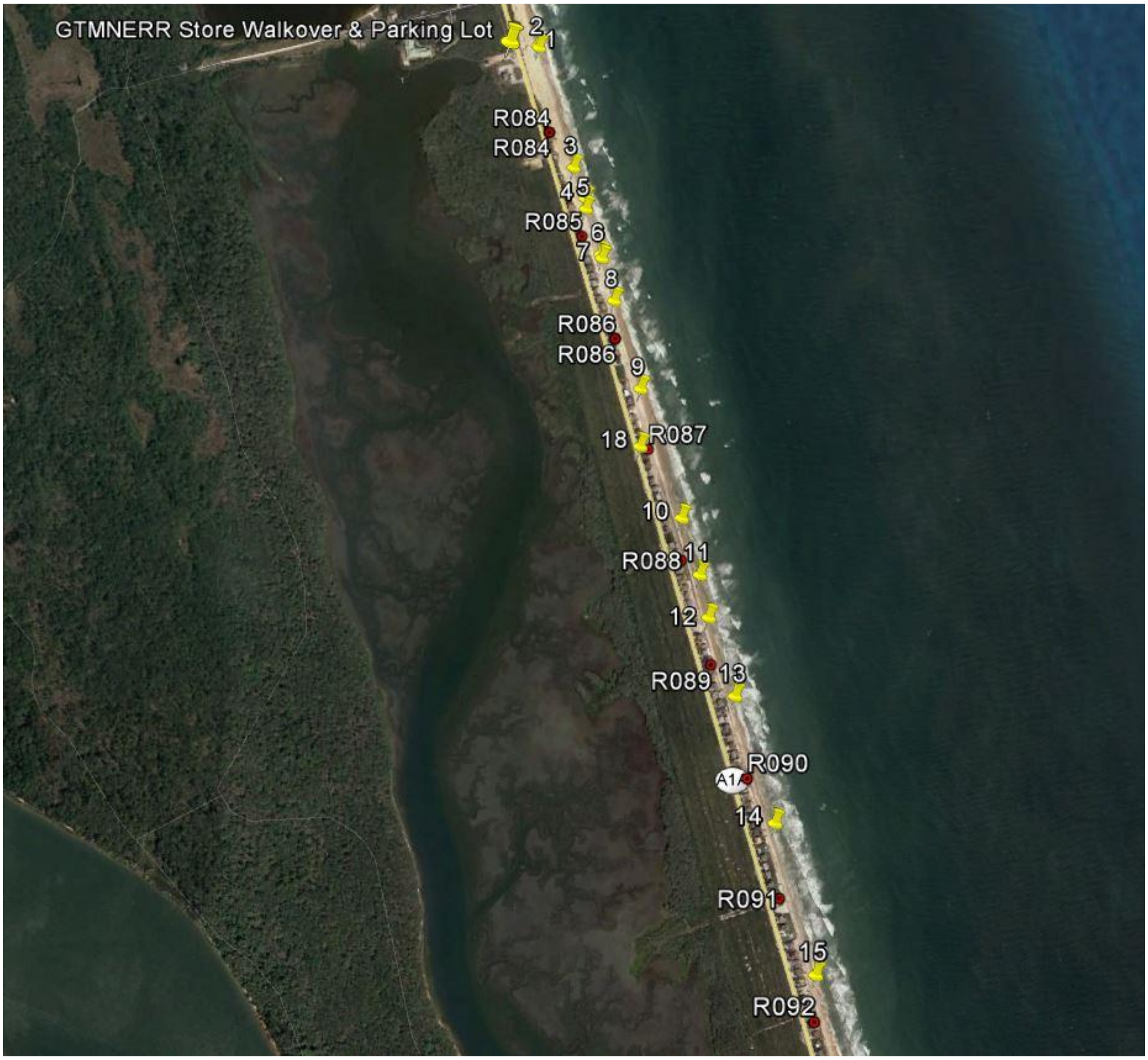


PHOTOGRAPH KEY

Notes: Photographs contained in this report document current state of SR A1A and the adjacent shoreline. Photograph keys on current and following pages indicate the location of each photograph.

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**



PHOTOGRAPH KEY (NORTH)

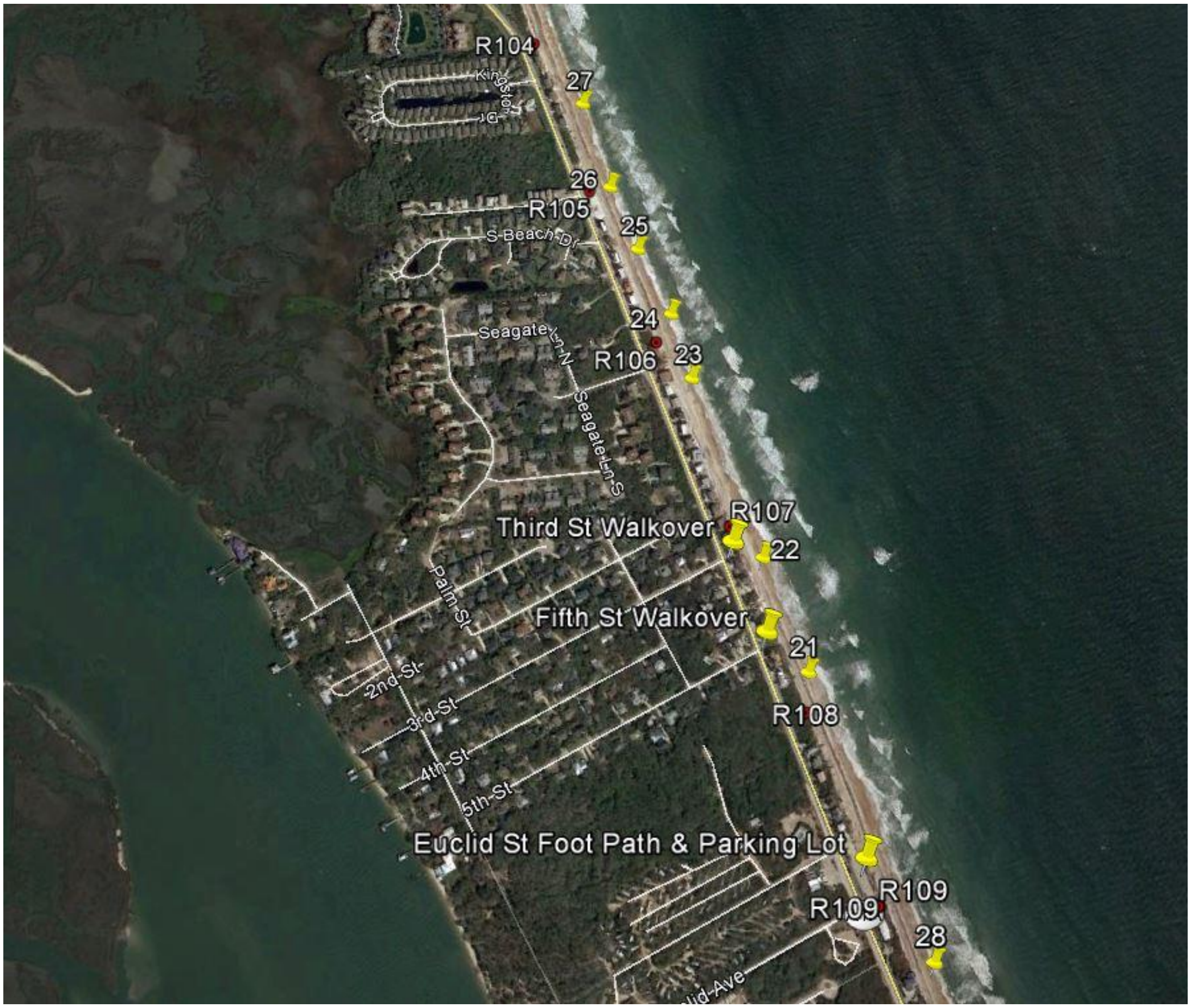
ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH KEY (UPPER MIDDLE)

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

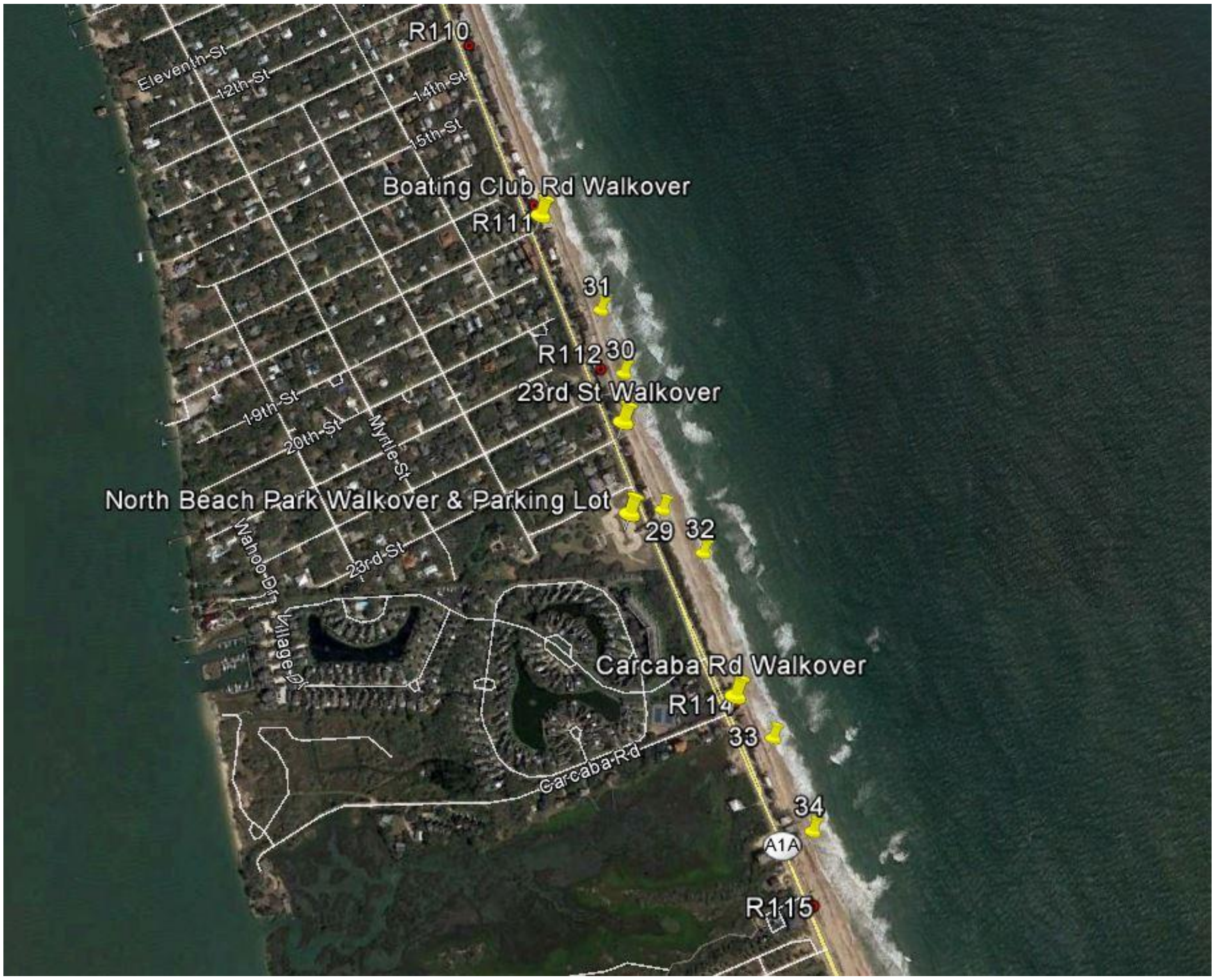
LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**



PHOTOGRAPH KEY (LOWER MIDDLE)

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**



ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED DATE: 11/30/2017

PHOTOGRAPH 1

LATITUDE: 30° 1’20”N

LONGITUDE: 81° 19’22”W

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 2

LATITUDE: 30° 1’19”N

LONGITUDE: 81° 19’21.87”W

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 3

LATITUDE: 30° 1’8”N

LONGITUDE: 81° 19’19”W

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 4

LATITUDE: 30° 1’5”N

LONGITUDE: 81° 19’18”W

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED DATE: 11/30/2017

PHOTOGRAPH 5

LATITUDE: 30° 1’4”N

LONGITUDE: 81° 19’18”W

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 6

LATITUDE: 30° 0’59.63”N

LONGITUDE: 81° 19’16.79”W

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 7

LATITUDE: 30° 0’59.25”N

LONGITUDE: 81° 19’16.67”W

PHOTOGRAPH 8

LATITUDE: 30° 0’55.23”N

LONGITUDE: 81° 19’15.69”W

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 9

LATITUDE: 30° 0’46.96”N

LONGITUDE: 81° 19’13.59”W

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 10

LATITUDE: 30° 0’35.11”N

LONGITUDE: 81° 19’10.34”W

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 11

LATITUDE: 30° 0’29.98”N

LONGITUDE: 81° 19’8.93”W

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 12

LATITUDE: 30° 0’26.20”N

LONGITUDE: 81° 19’8.36”W

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 13

LATITUDE: 30° 0’19.27”N

LONGITUDE: 81° 19’6.32”W

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 14

LATITUDE: 30° 0’8.31”N

LONGITUDE: 81° 19’3.36”W

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 15

LATITUDE: 29° 59’55.59”N

LONGITUDE: 81° 19’0.61”W

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED DATE: 11/30/2017

PHOTOGRAPH 16

LATITUDE: 29° 59’36.02”N

LONGITUDE: 81° 18’55.99”W

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED DATE: 11/30/2017

PHOTOGRAPH 17

LATITUDE: 29° 59’35.01”N

LONGITUDE: 81° 18’55.53”W

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED DATE: 11/30/2017

PHOTOGRAPH 18

LATITUDE: 30° 0’41.72”N

LONGITUDE: 81° 19’14.04”W

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 19

LATITUDE: 29° 59’4.33”N

LONGITUDE: 81° 18’47.31”W

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 20

LATITUDE: 29° 59’16”N

LONGITUDE: 81° 18’50”W

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 21

LATITUDE: 29° 57’16.72”N

LONGITUDE: 81° 18’17.26”W

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 22

LATITUDE: 29° 57’22.96”N

LONGITUDE: 81° 18’19.11”W

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 23

LATITUDE: 29° 57’33.21”N

LONGITUDE: 81° 18’22.17”W

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED DATE: 11/30/2017

PHOTOGRAPH 24

LATITUDE: 29° 57’37.02”N

LONGITUDE: 81° 18’23”W

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 25

LATITUDE: 29° 57’41.01”N

LONGITUDE: 81° 18’24.65”W

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 26

LATITUDE: 29° 57’44.90”N

LONGITUDE: 81° 18’26.01”W

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 27

LATITUDE: 29° 57’50.22”N

LONGITUDE: 81° 18’27.23”W

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED DATE: 11/30/2017

PHOTOGRAPH 28

LATITUDE: 29° 57’1.88”N

LONGITUDE: 81° 18’12.26”W

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 29

LATITUDE: 29° 56’26.07”N

LONGITUDE: 81° 18’1.53”W

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED DATE: 11/30/2017

PHOTOGRAPH 30

LATITUDE: 29° 56’33.85”N

LONGITUDE: 81° 18’3.27”W

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED DATE: 11/30/2017

PHOTOGRAPH 31

LATITUDE: 29° 56’37.59”N

LONGITUDE: 81° 18’4.41”W

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 32

LATITUDE: 29° 56’23.54”N

LONGITUDE: 81° 17’59.26”W

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH

INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 33

LATITUDE: 29° 56’13.46”N

LONGITUDE: 81° 17’56.05”W

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

PHOTOGRAPH 34

LATITUDE: 29° 56’8.53”N

LONGITUDE: 81° 17’54.23”W

LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED DATE: 11/30/2017

PHOTOGRAPH 35

LATITUDE: 29° 55’37.82”N

LONGITUDE: 81° 17’43.09”W

ATTACHMENT A – SITE INSPECTION PHOTOGRAPHS

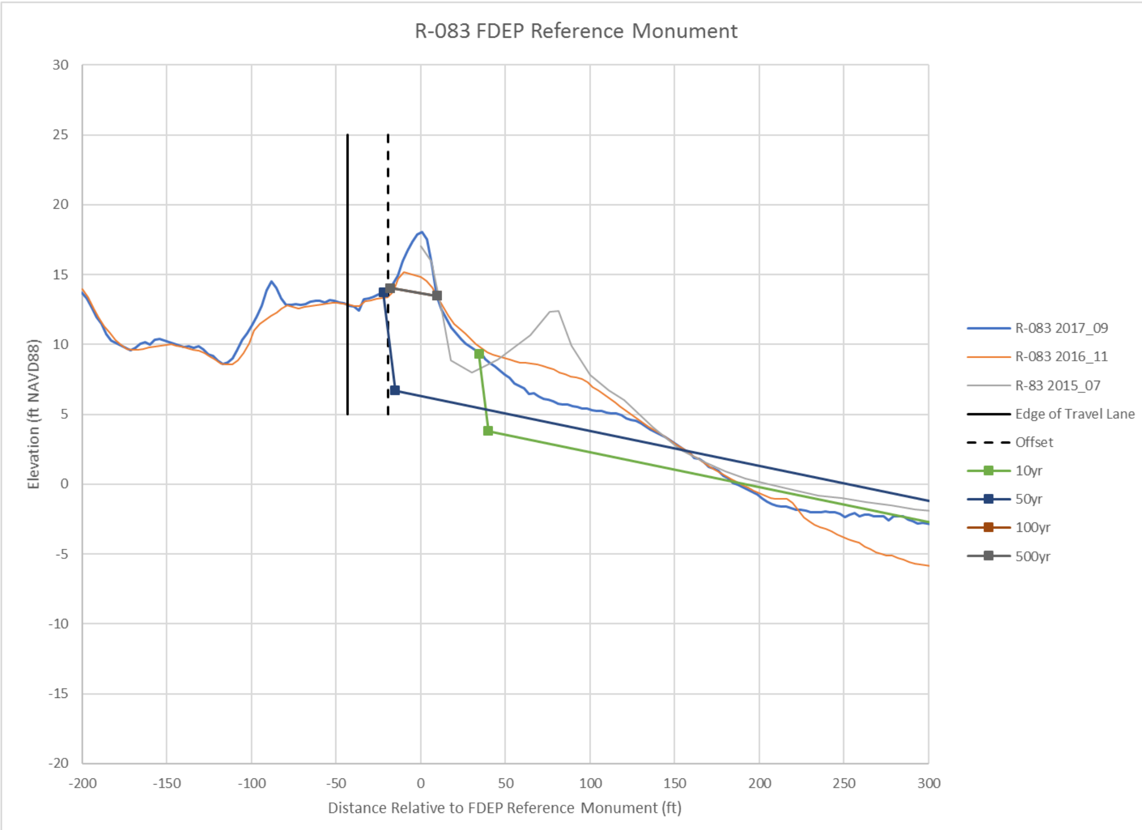
LOCATION: SOUTH PONTE VEDRA BEACH TO VILANO BEACH
INTERA INCORPORATED **DATE: 11/30/2017**

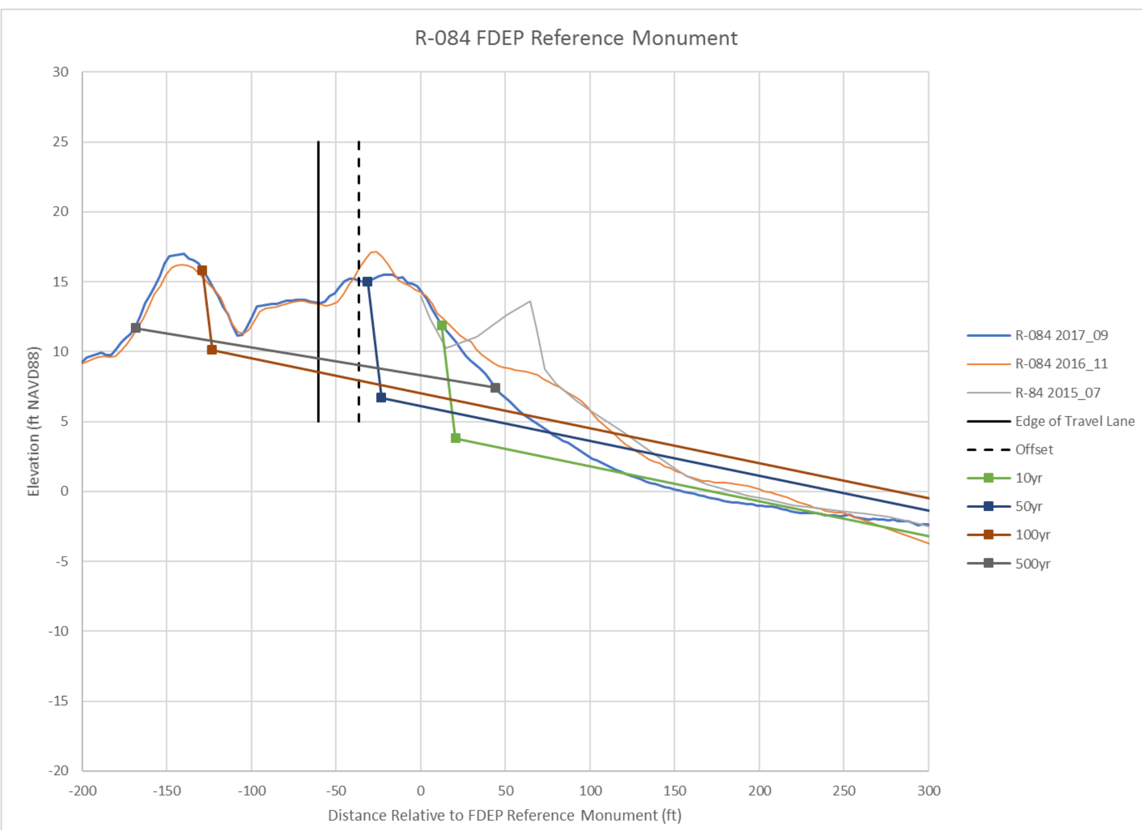
PHOTOGRAPH 36

LATITUDE: 29° 55’37.76”N

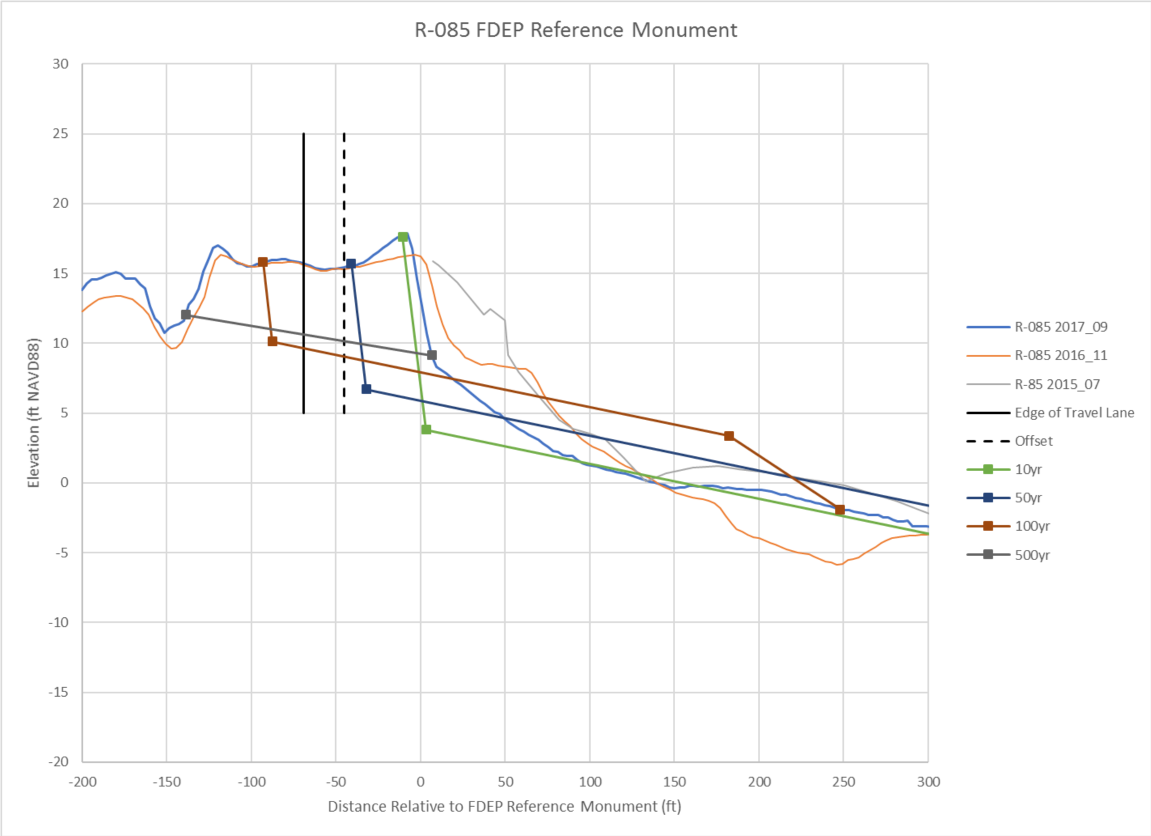
LONGITUDE: 81° 17’43.04”W

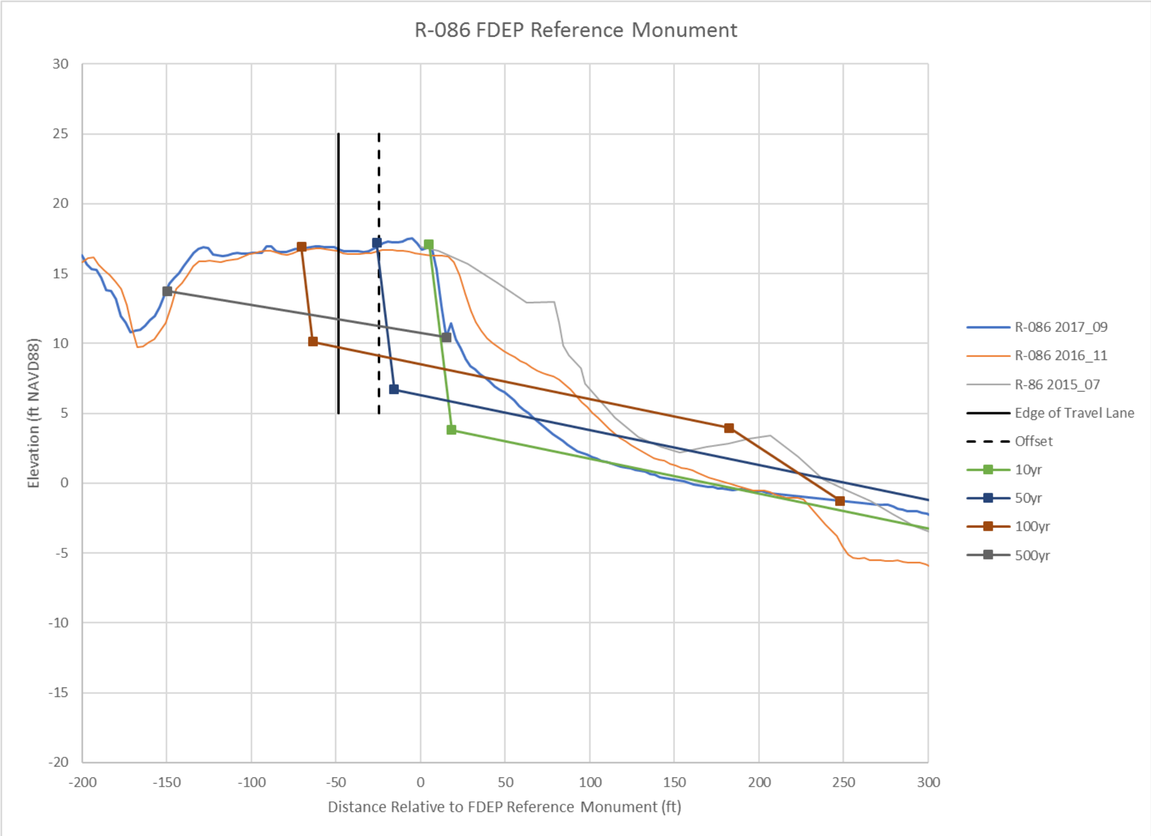
ATTACHMENT B – STORM-INDUCED EROSION PROFILES (NO LONG-TERM RECESSION)



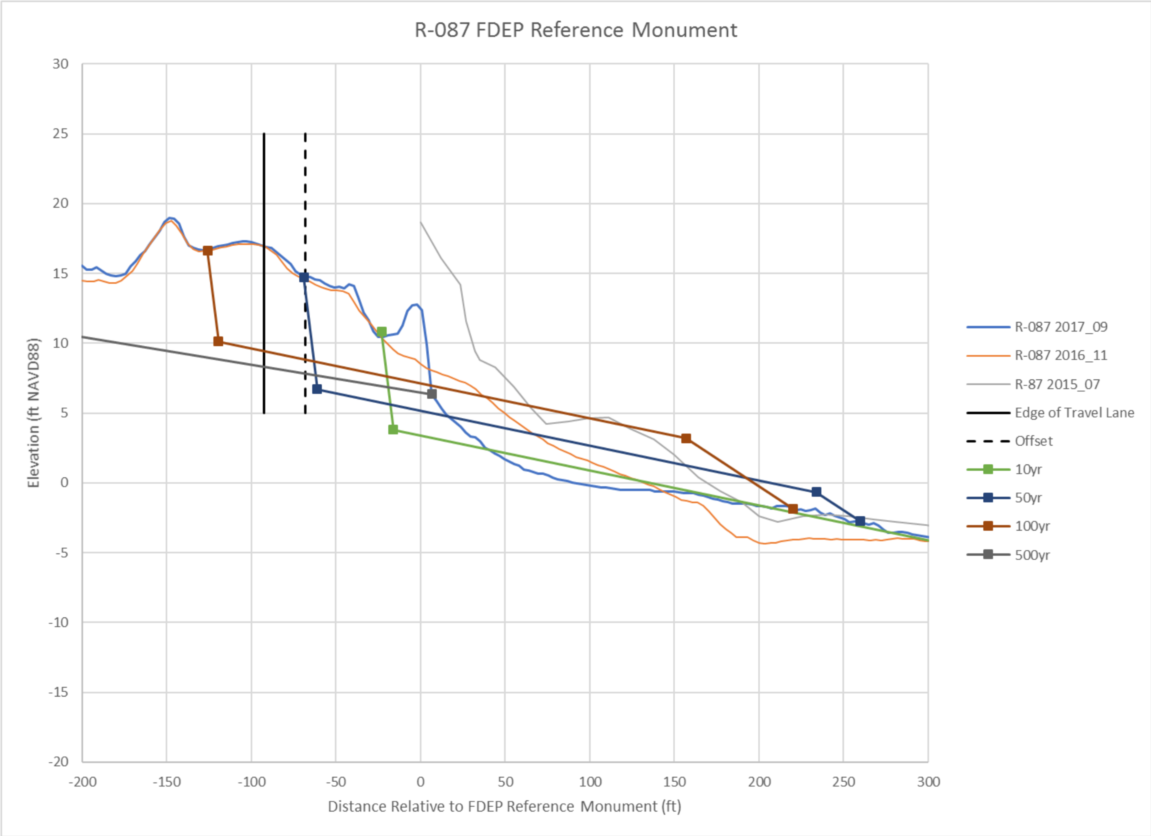


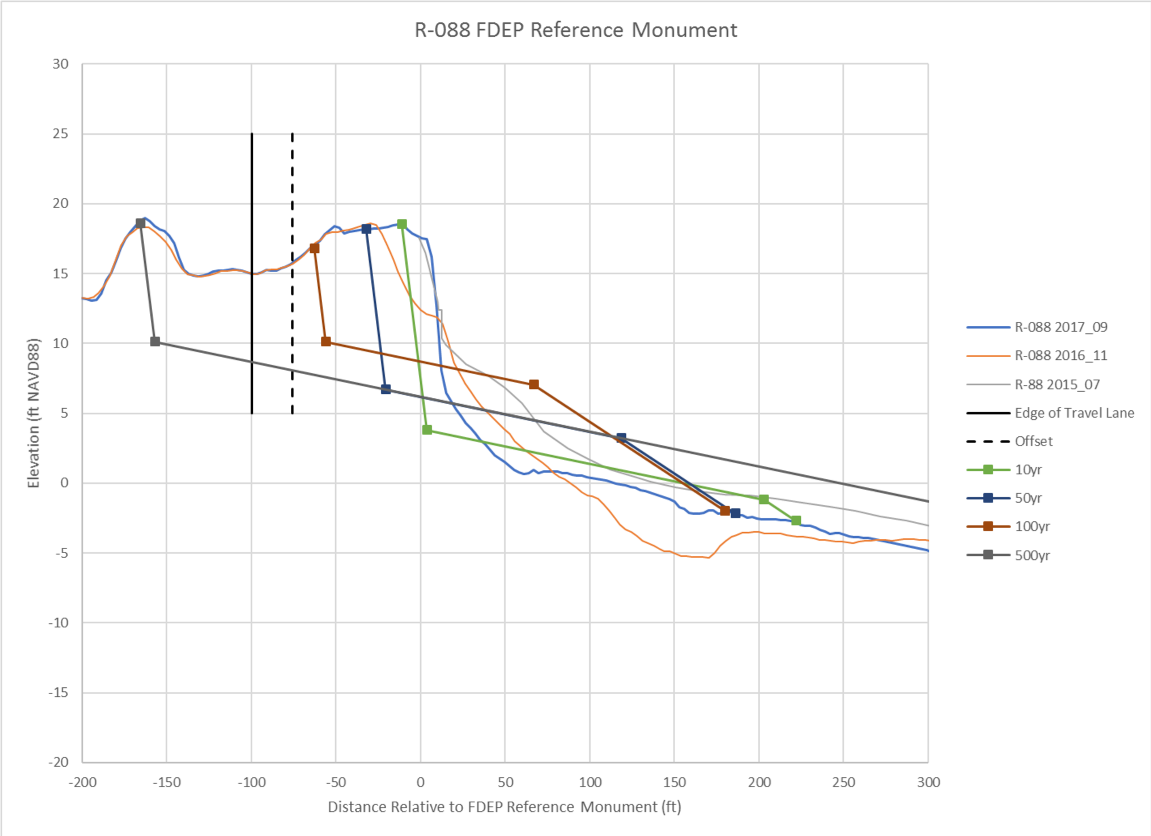
ATTACHMENT B – STORM-INDUCED EROSION PROFILES (NO LONG-TERM RECESSION)



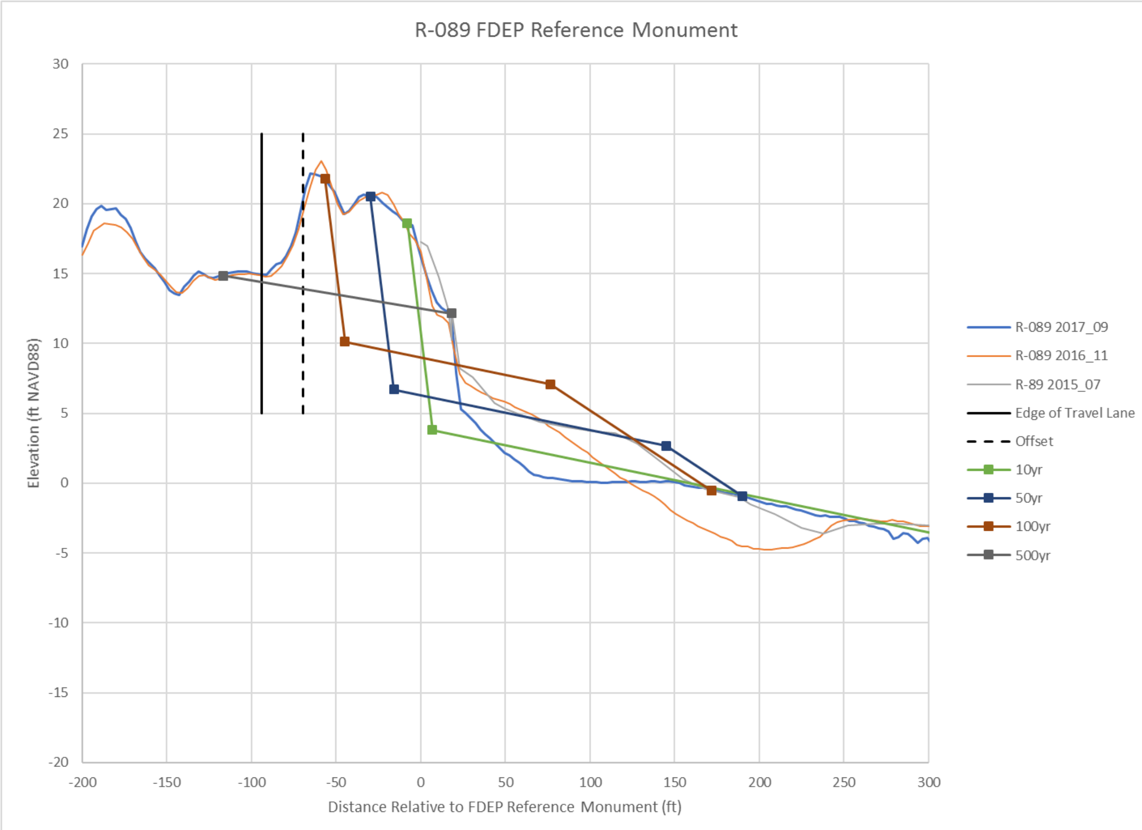


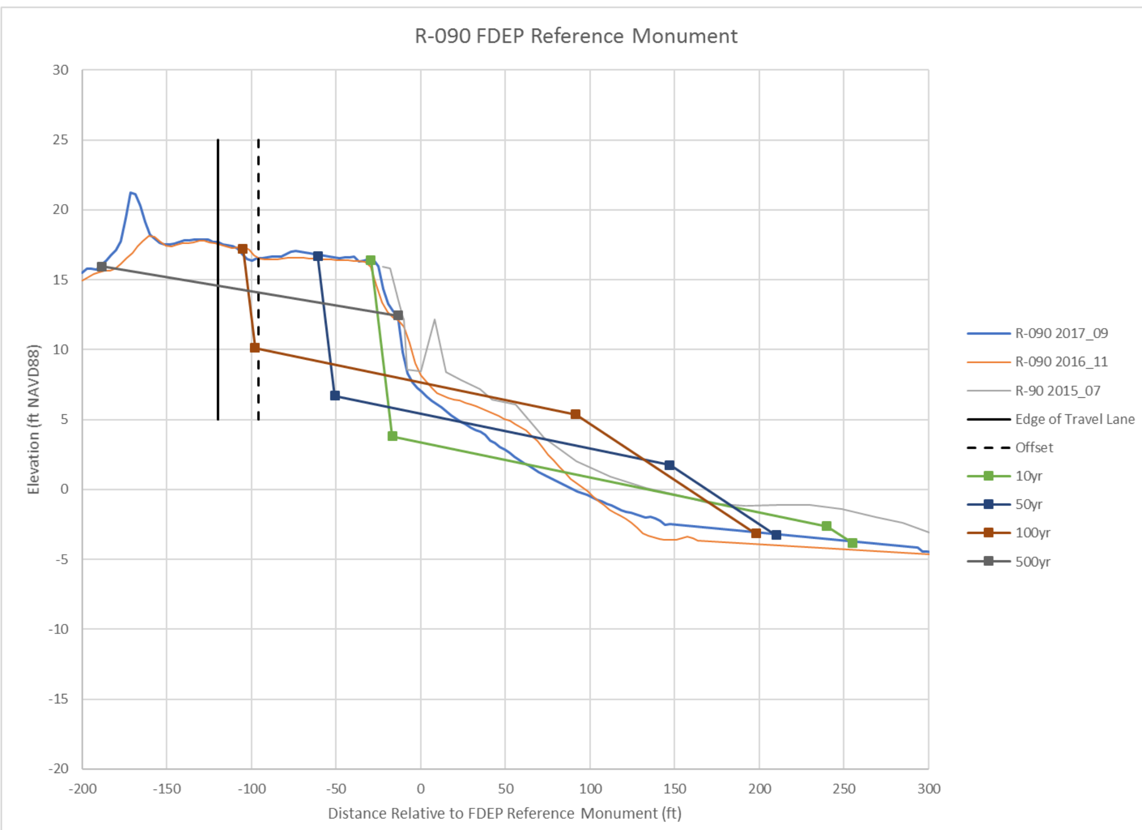
ATTACHMENT B – STORM-INDUCED EROSION PROFILES (NO LONG-TERM RECESSION)



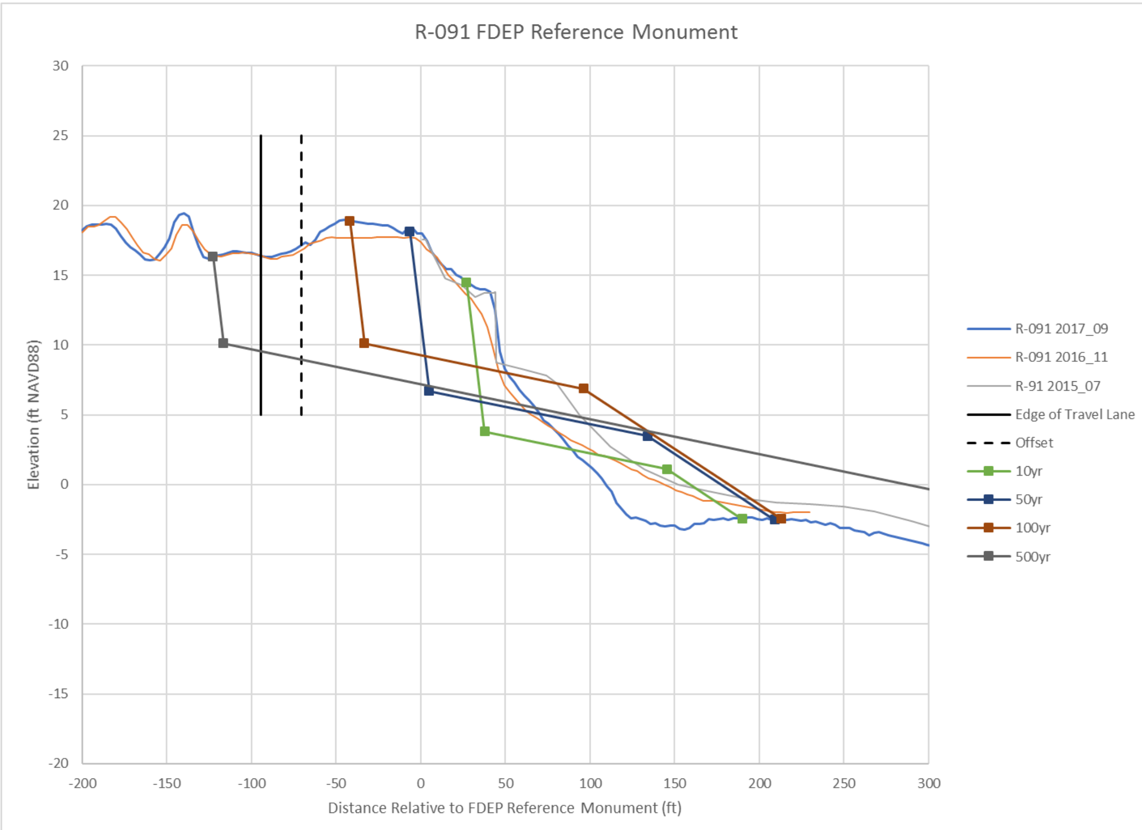


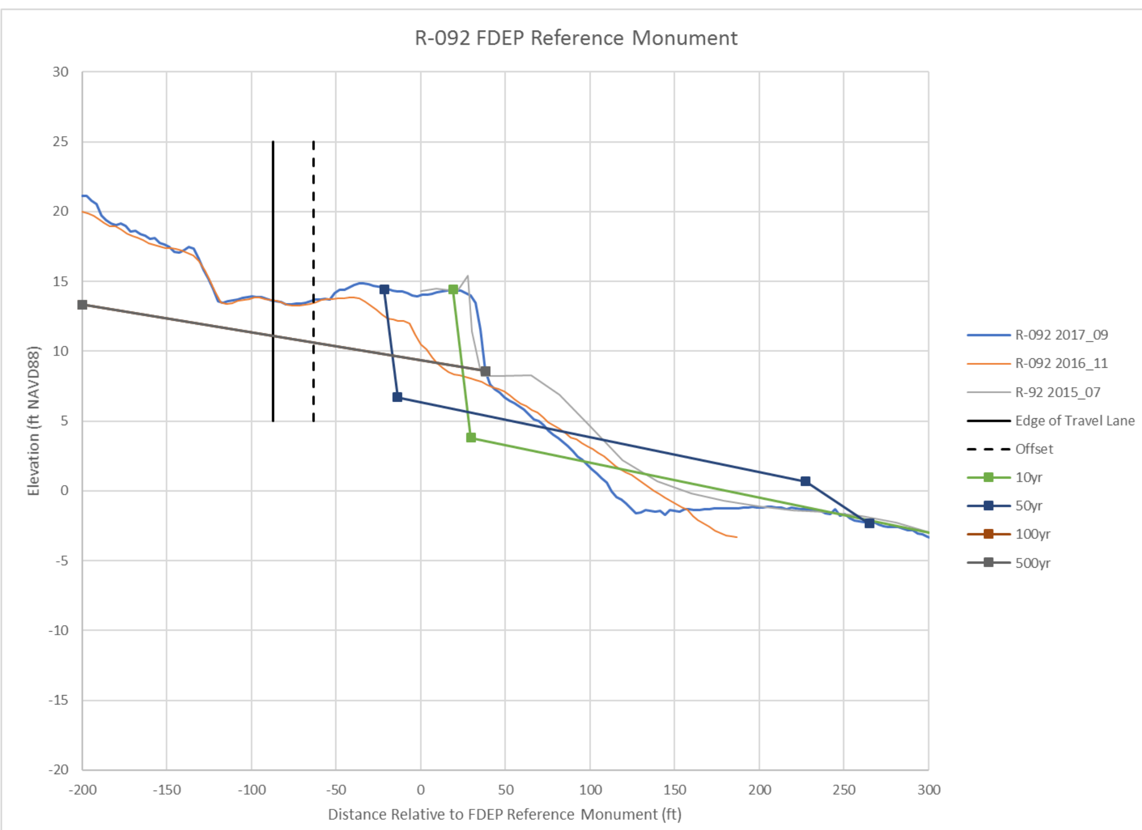
ATTACHMENT B – STORM-INDUCED EROSION PROFILES (NO LONG-TERM RECESSION)



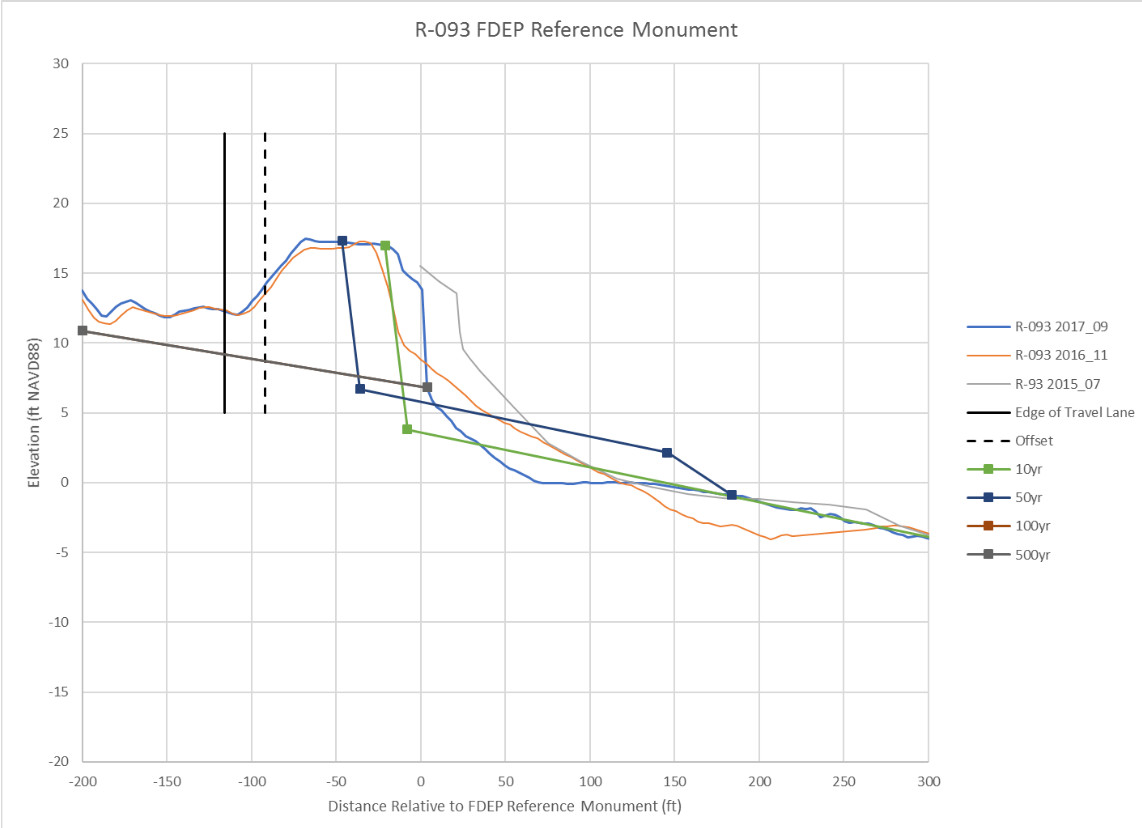


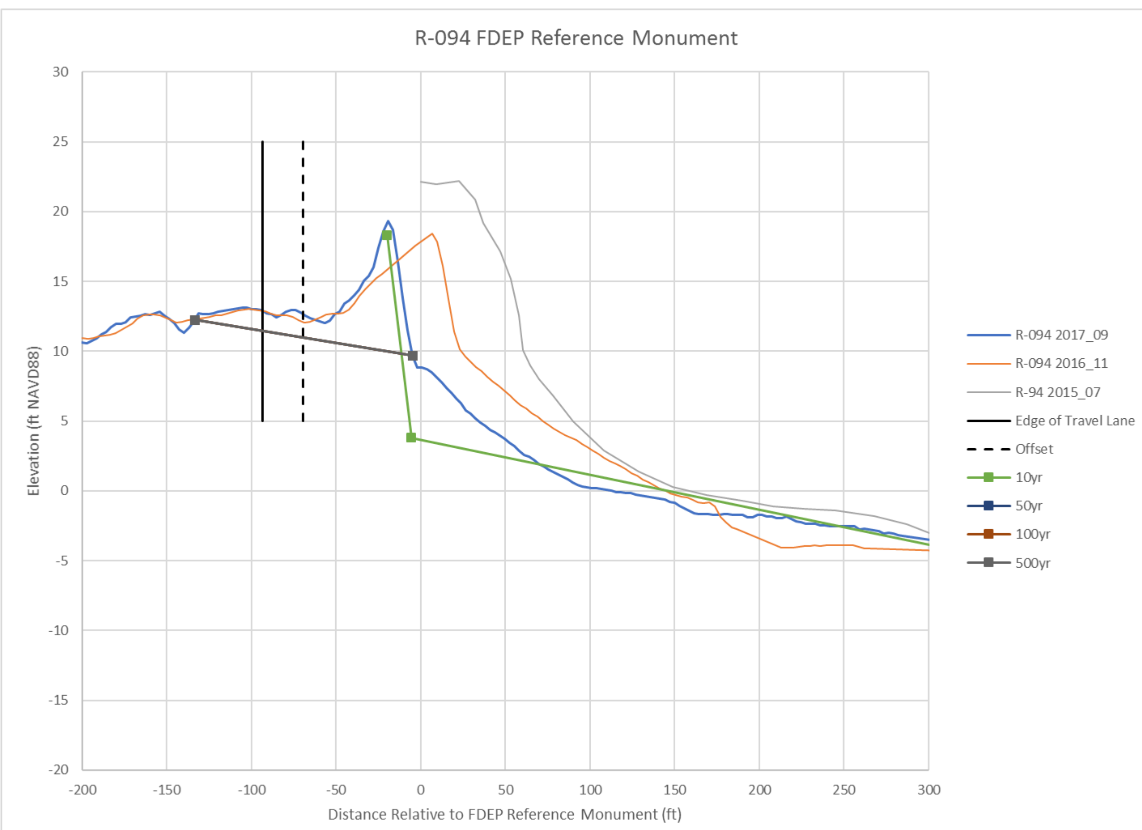
ATTACHMENT B – STORM-INDUCED EROSION PROFILES (NO LONG-TERM RECESSION)



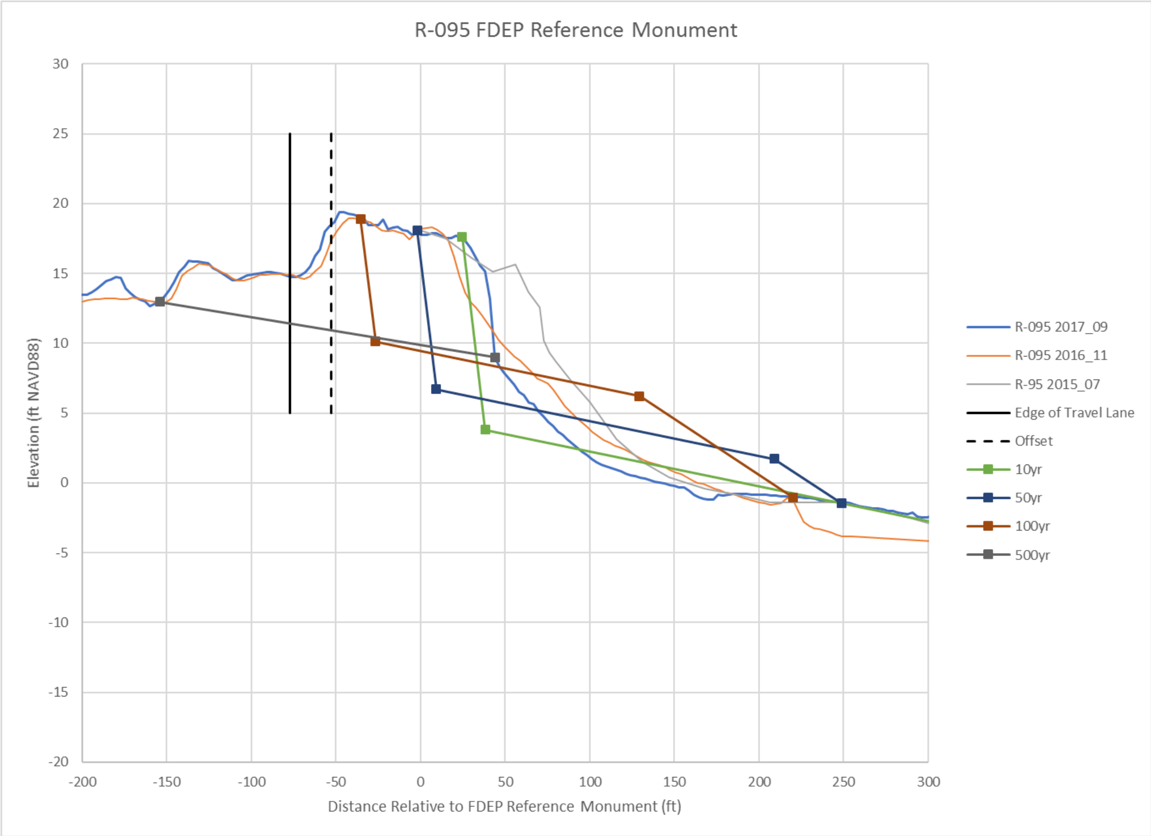


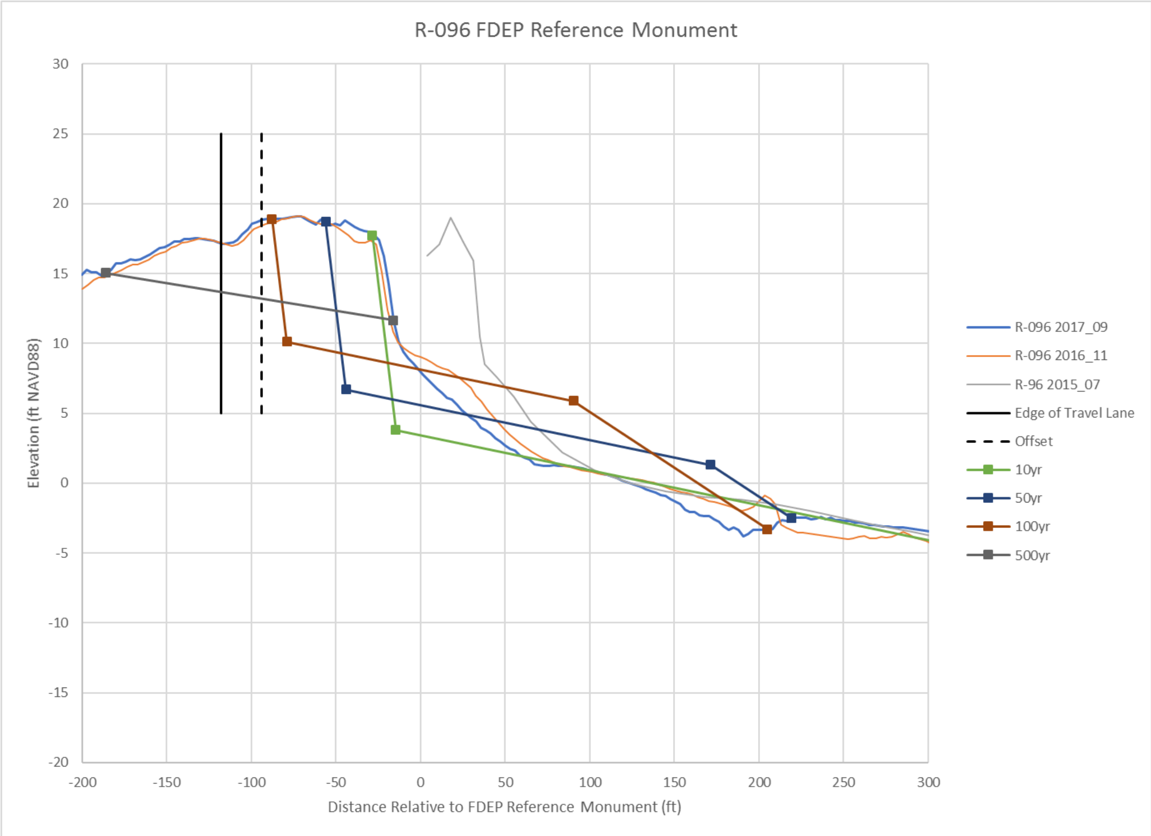
ATTACHMENT B – STORM-INDUCED EROSION PROFILES (NO LONG-TERM RECESSION)



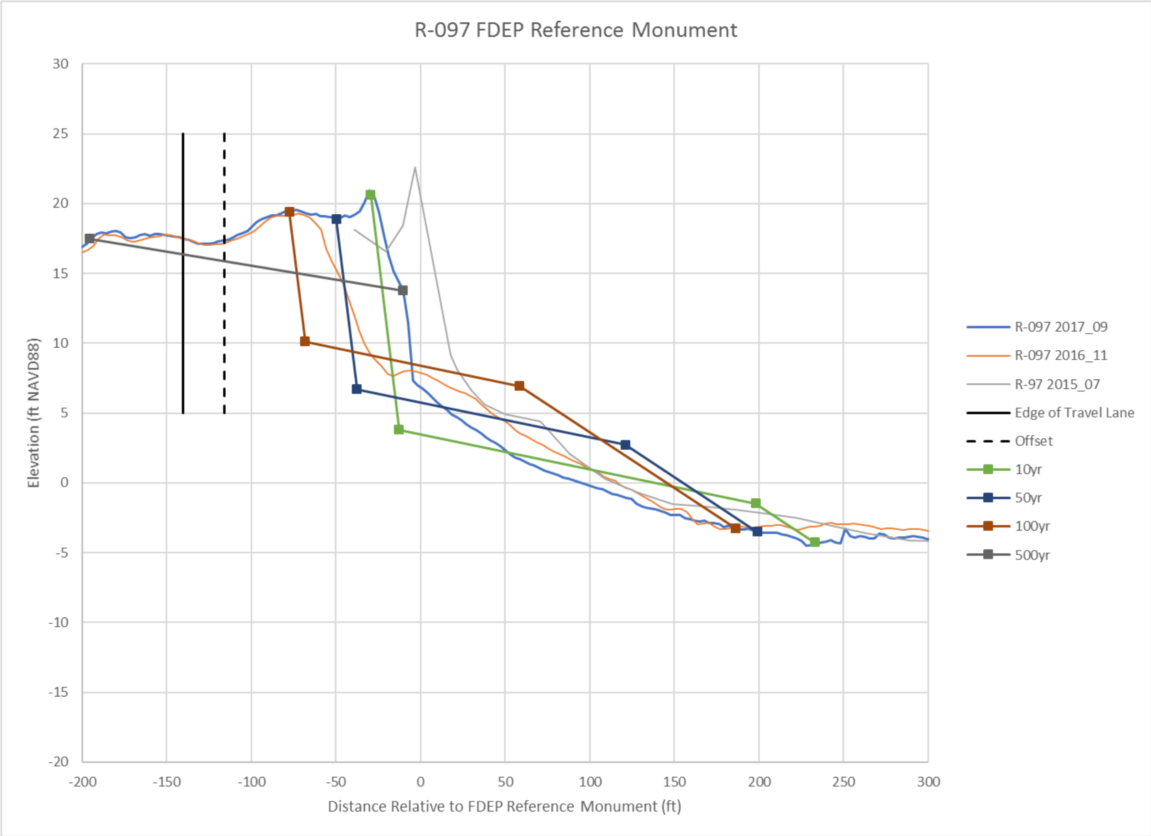


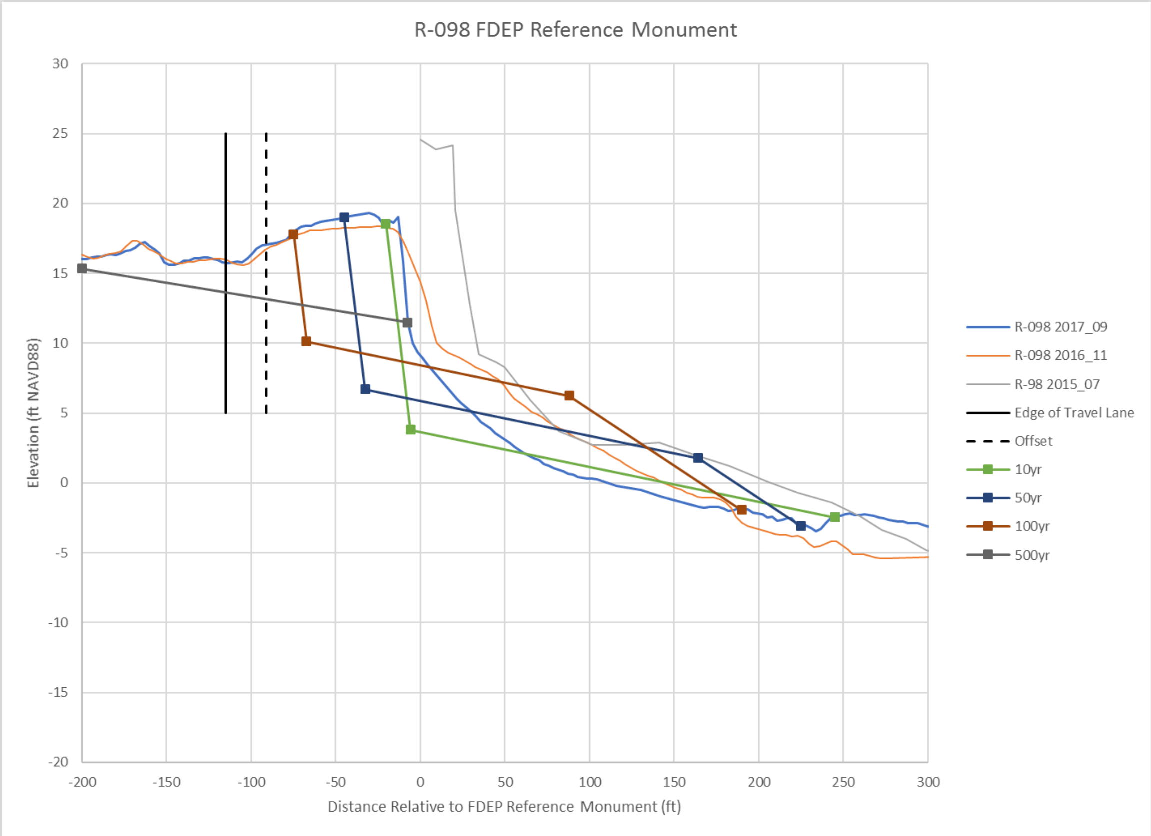
ATTACHMENT B – STORM-INDUCED EROSION PROFILES (NO LONG-TERM RECESSION)



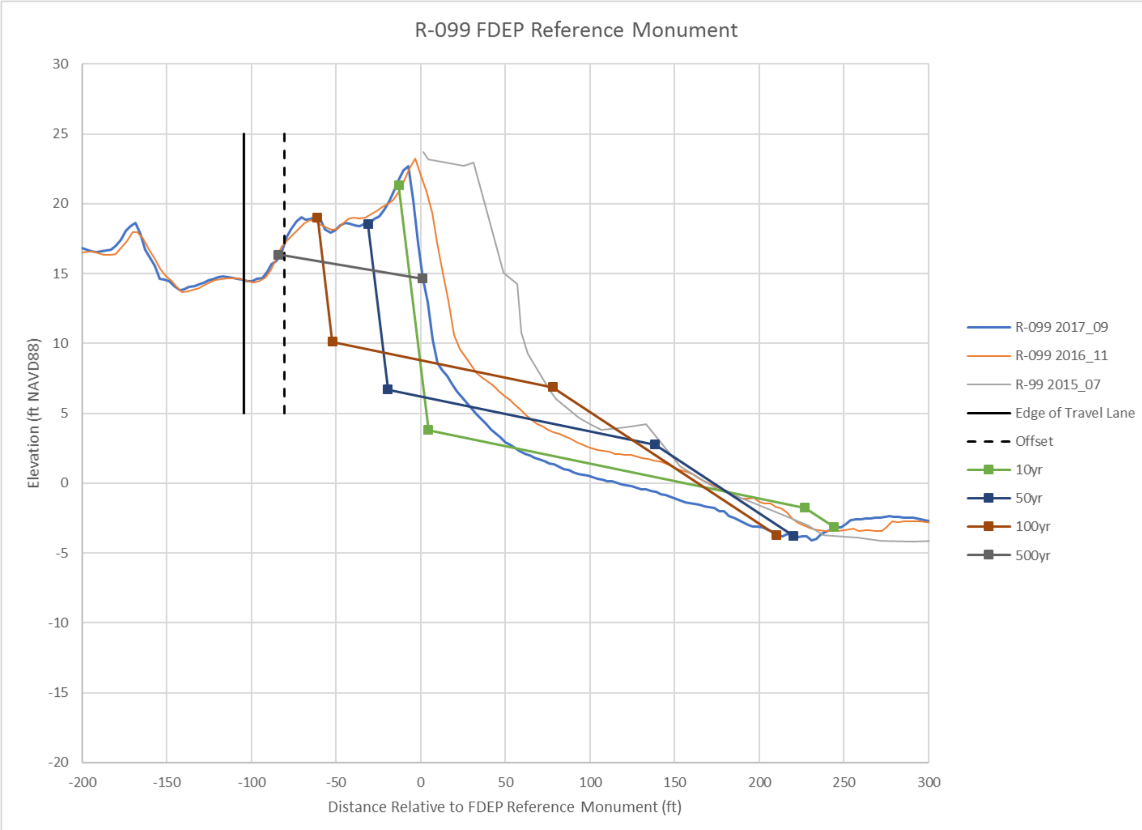


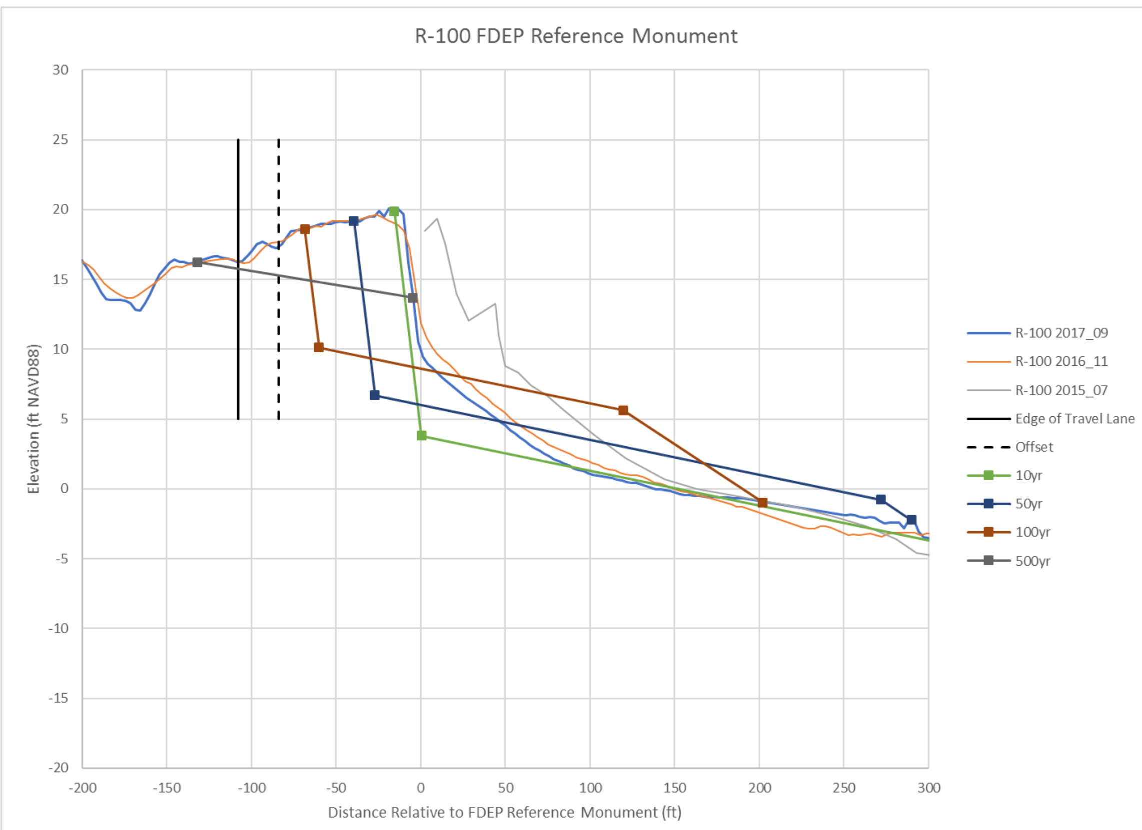
ATTACHMENT B – STORM-INDUCED EROSION PROFILES (NO LONG-TERM RECESSION)



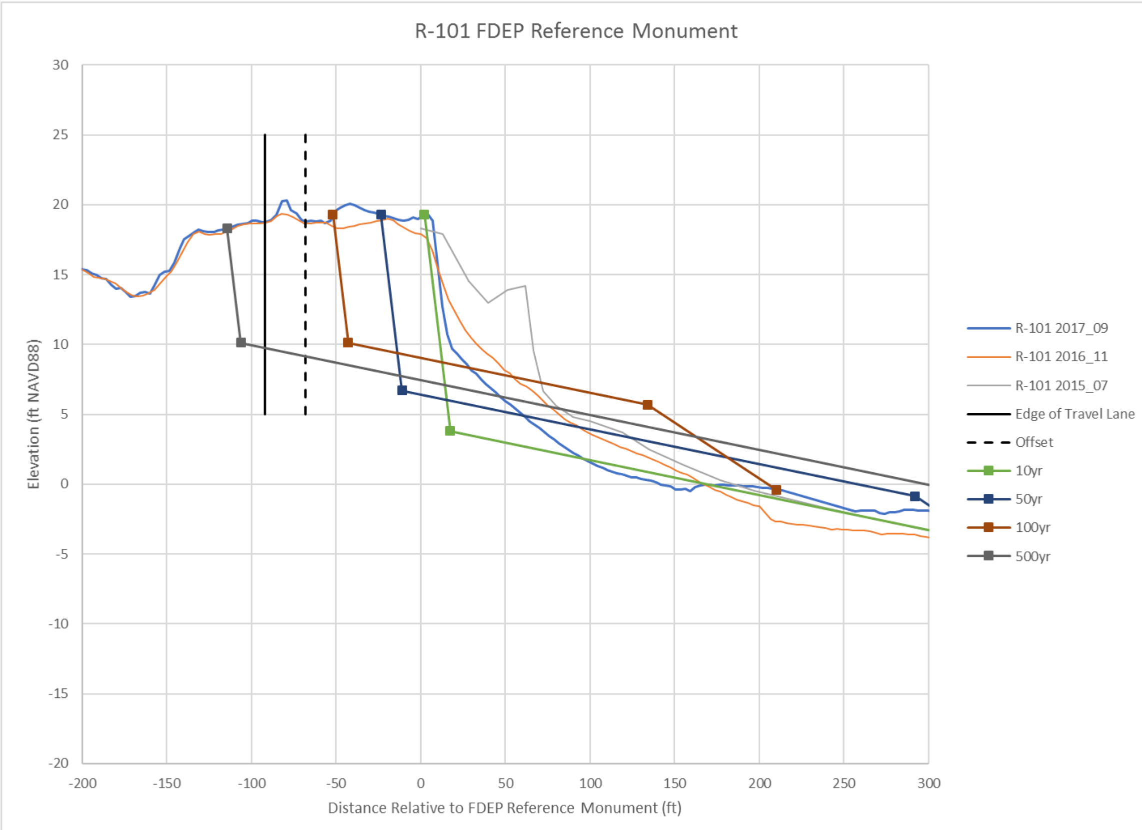


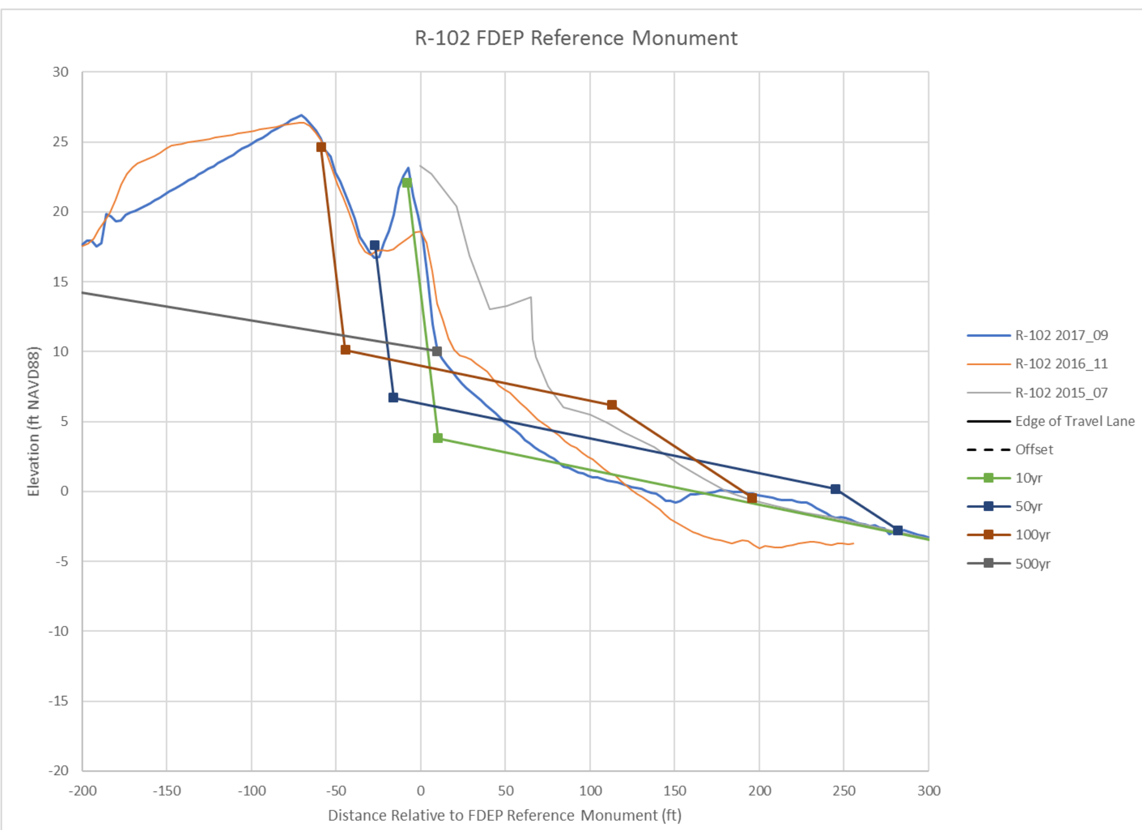
ATTACHMENT B – STORM-INDUCED EROSION PROFILES (NO LONG-TERM RECESSION)



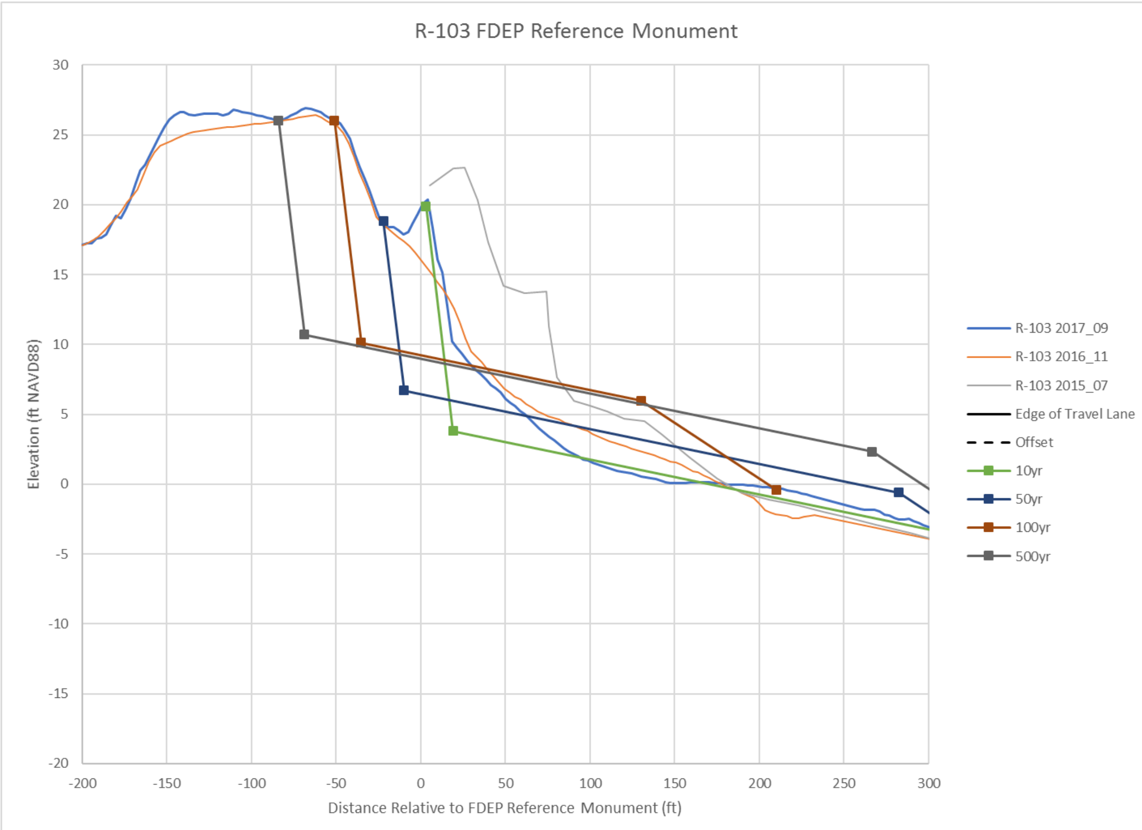


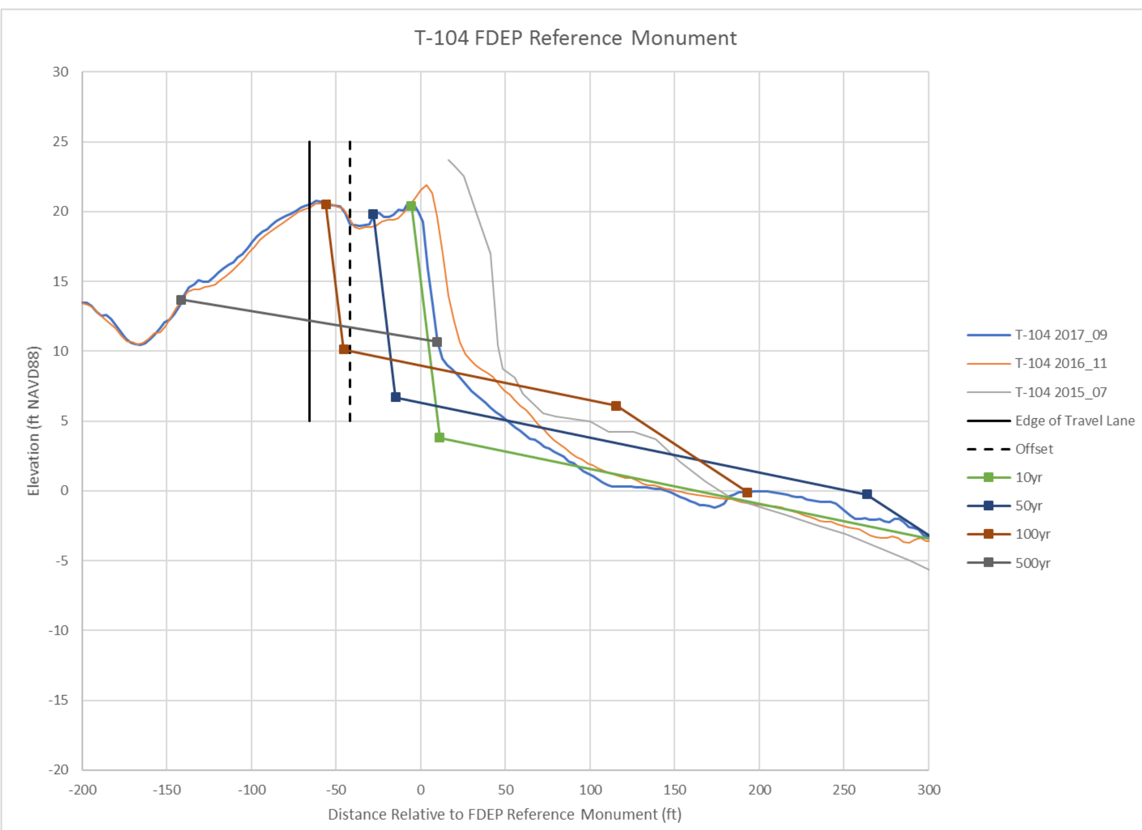
ATTACHMENT B – STORM-INDUCED EROSION PROFILES (NO LONG-TERM RECESSION)



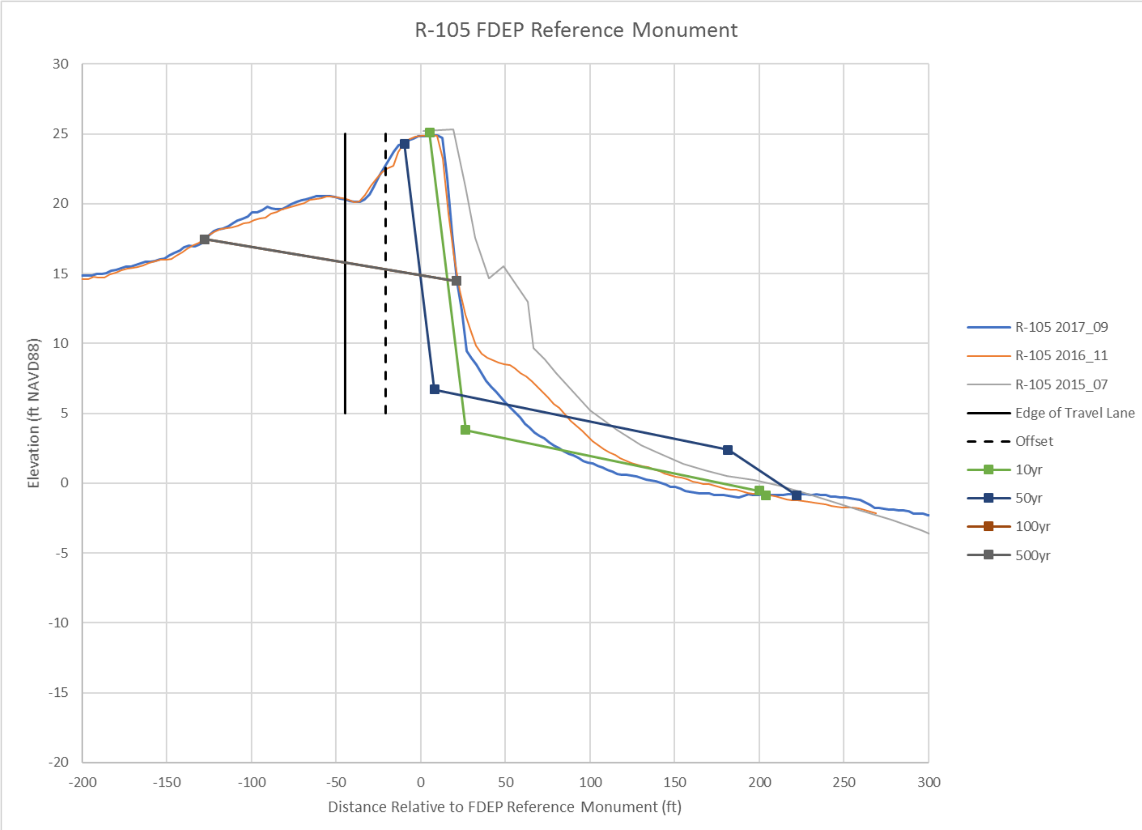


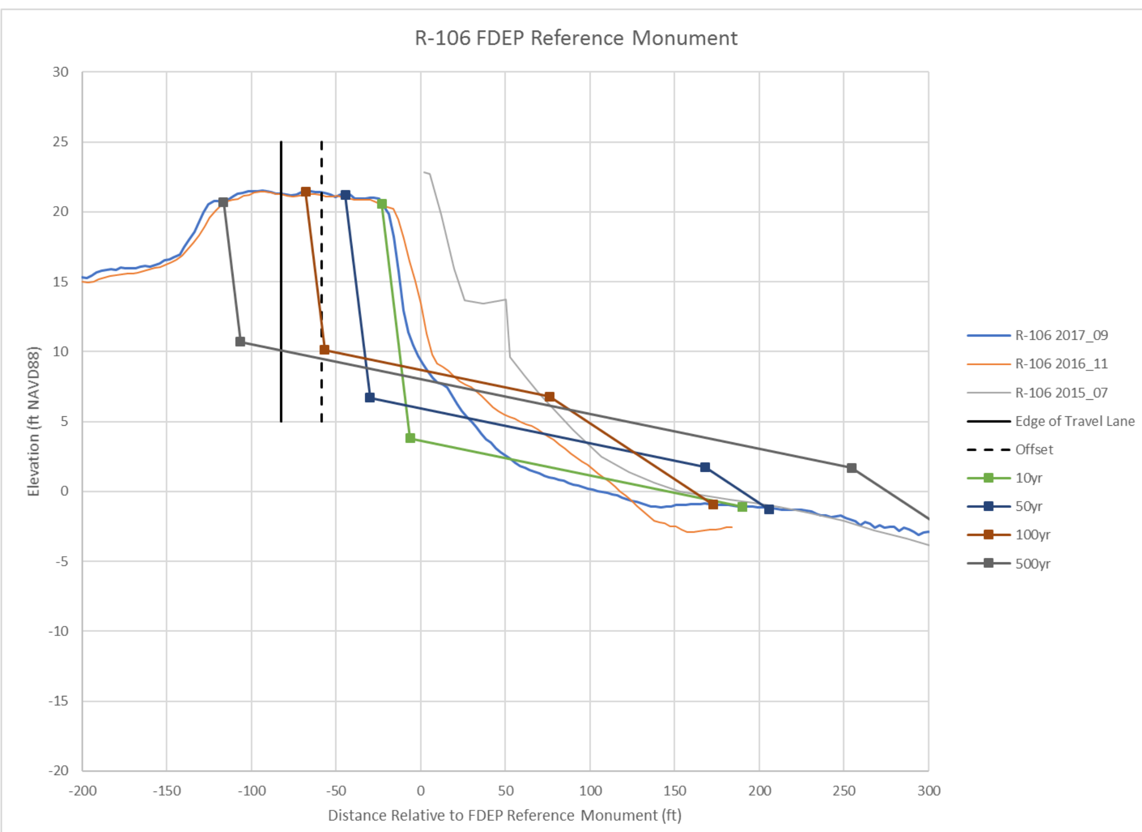
ATTACHMENT B – STORM-INDUCED EROSION PROFILES (NO LONG-TERM RECESSION)



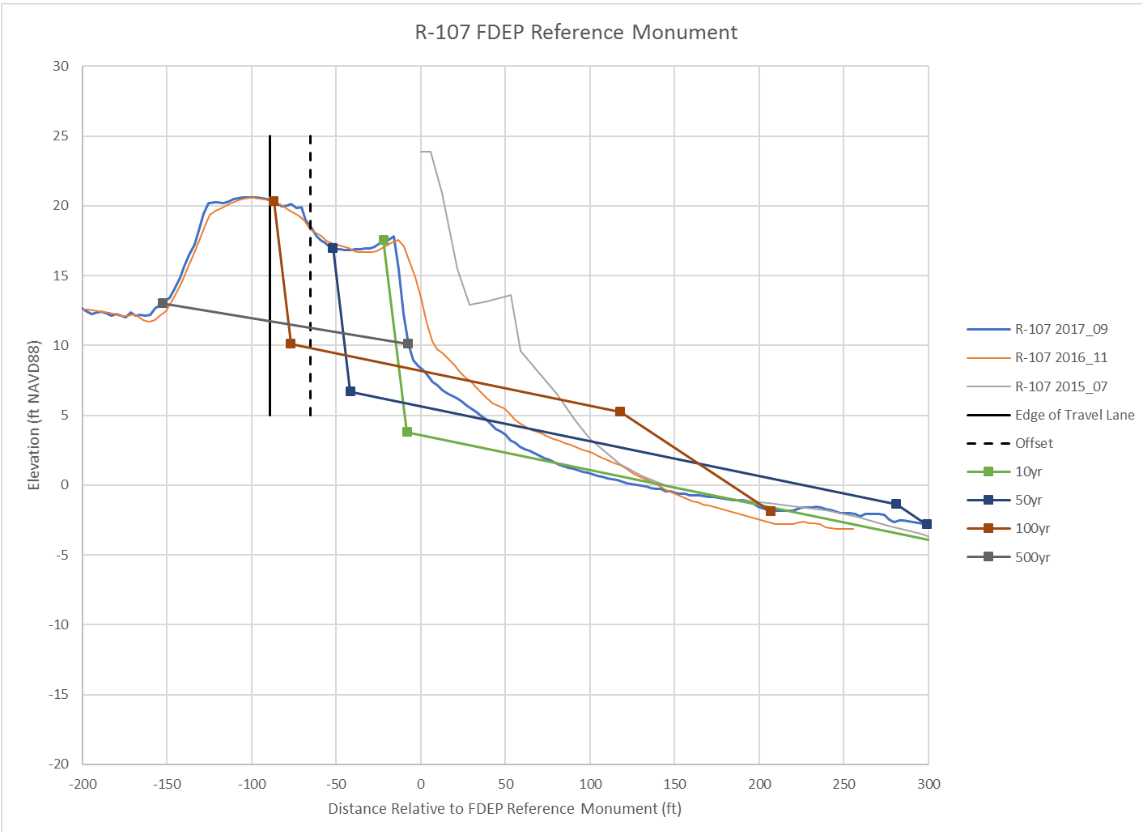


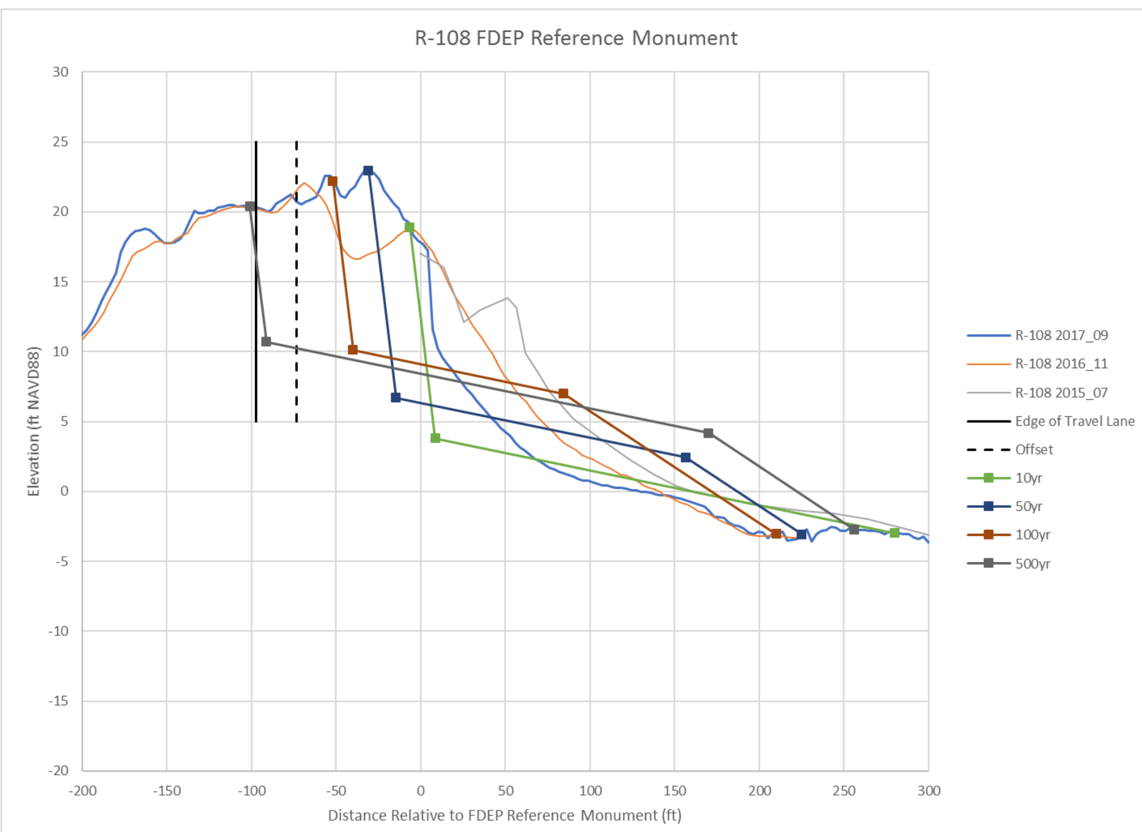
ATTACHMENT B – STORM-INDUCED EROSION PROFILES (NO LONG-TERM RECESSION)



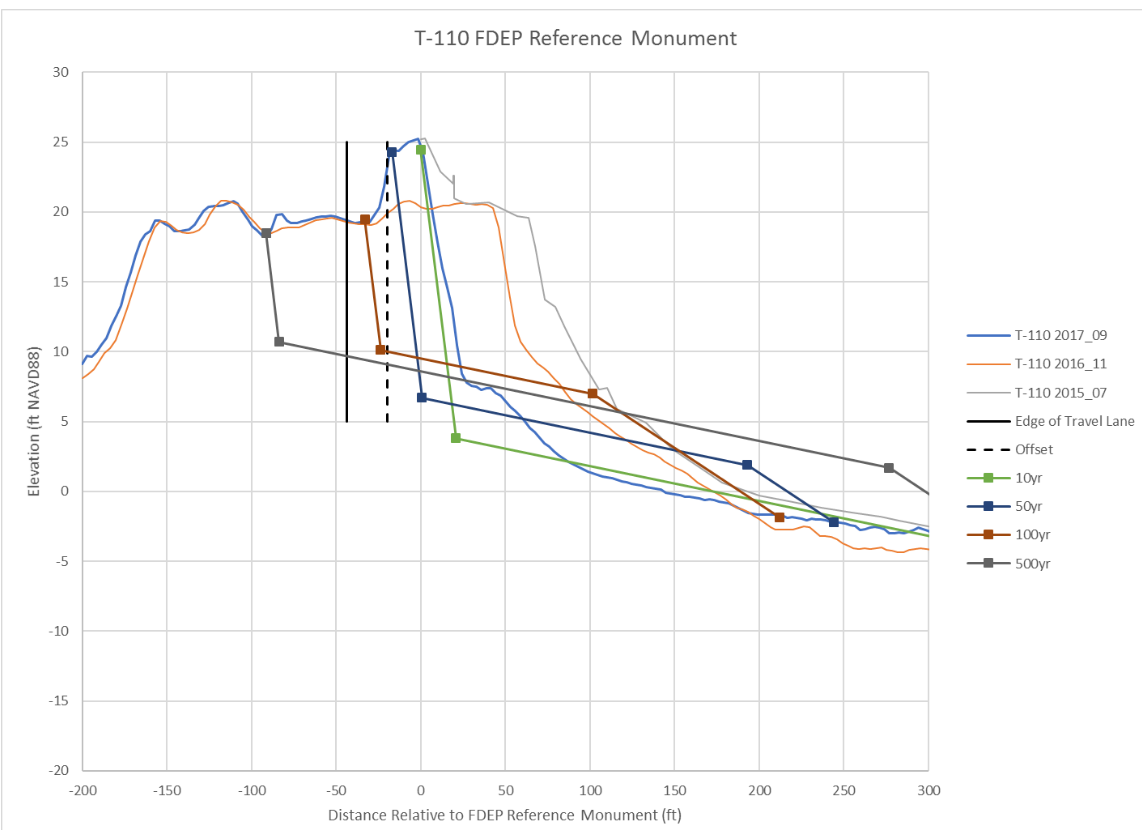


ATTACHMENT B – STORM-INDUCED EROSION PROFILES (NO LONG-TERM RECESSION)

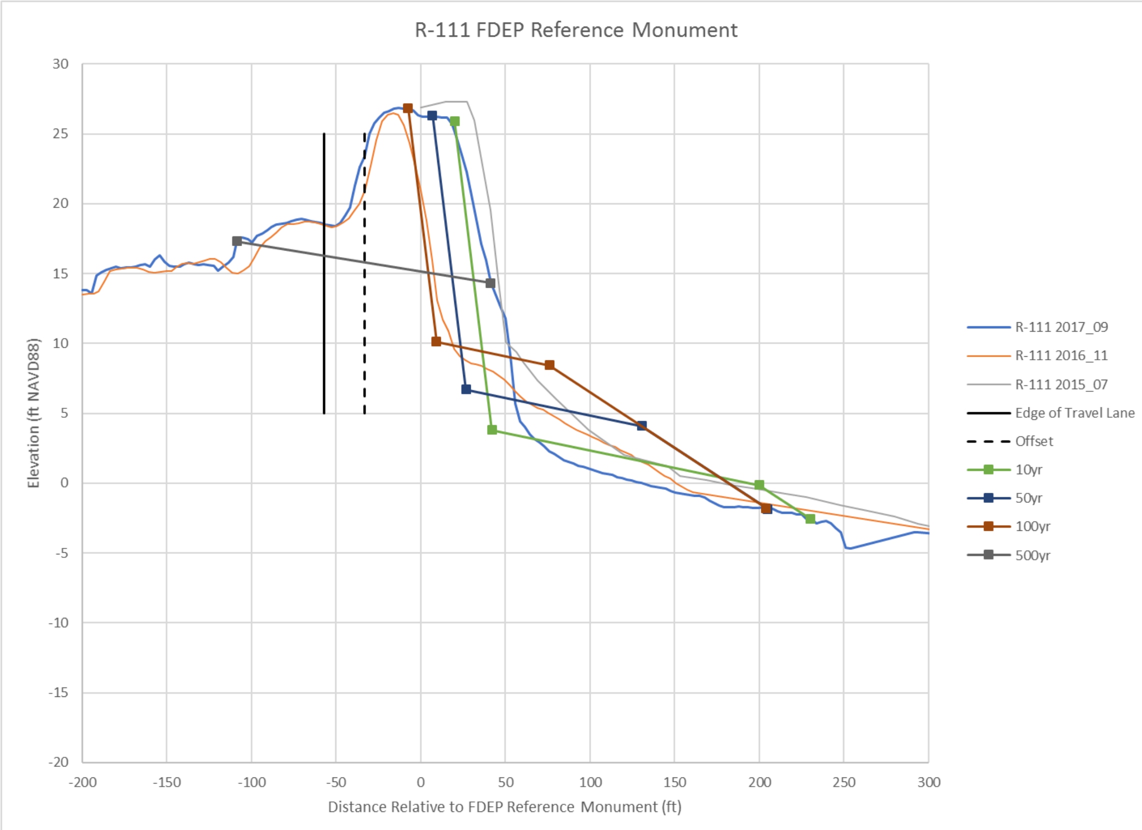


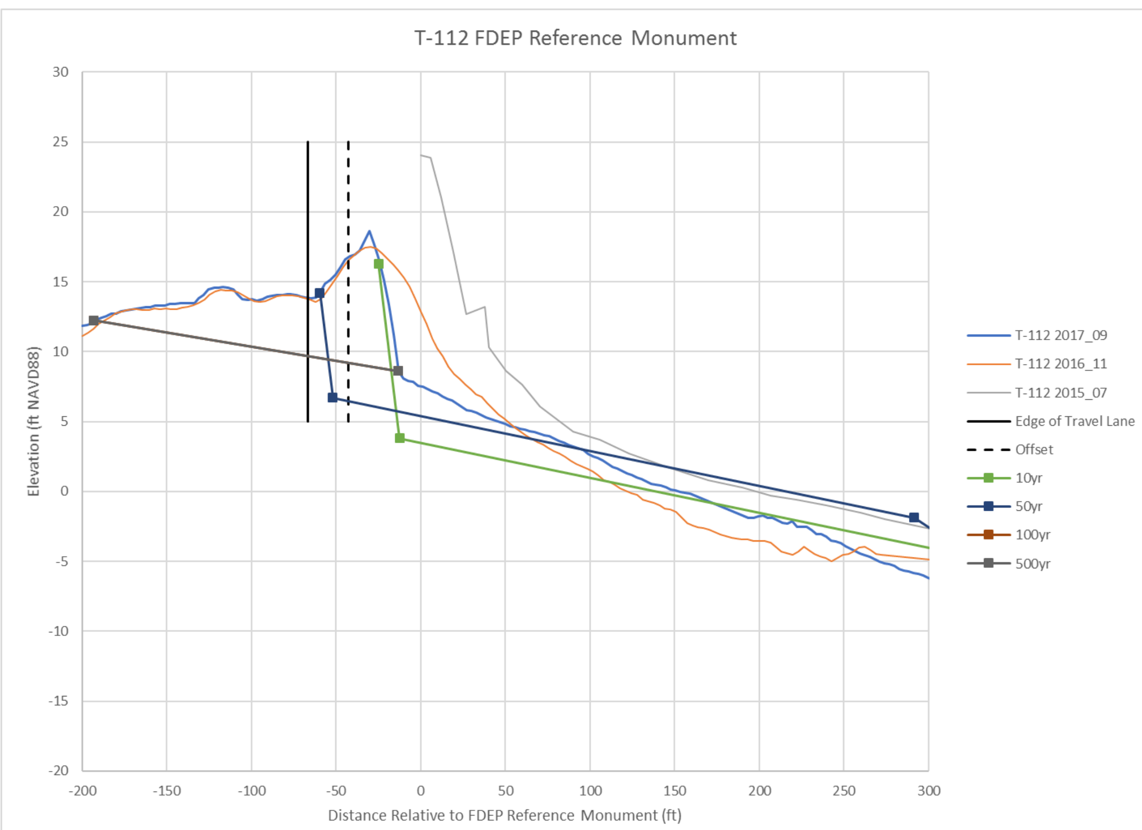


ATTACHMENT B – STORM-INDUCED EROSION PROFILES (NO LONG-TERM RECESSION)

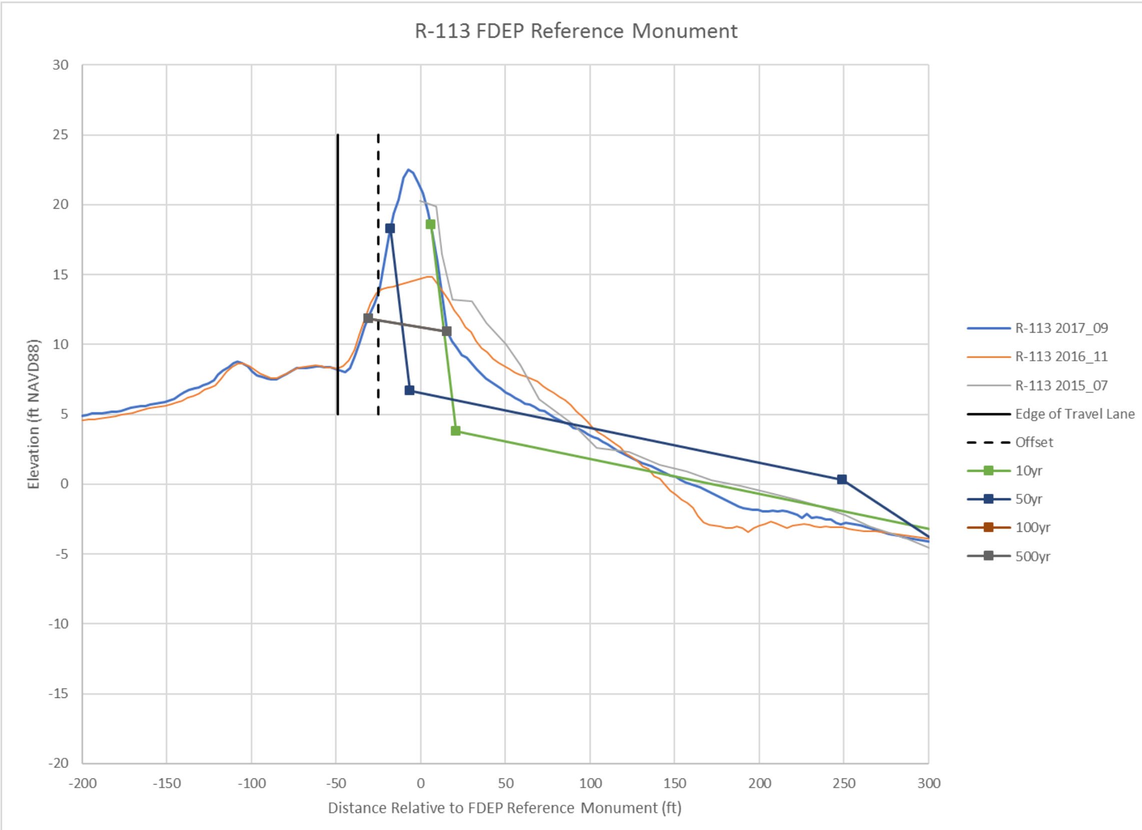


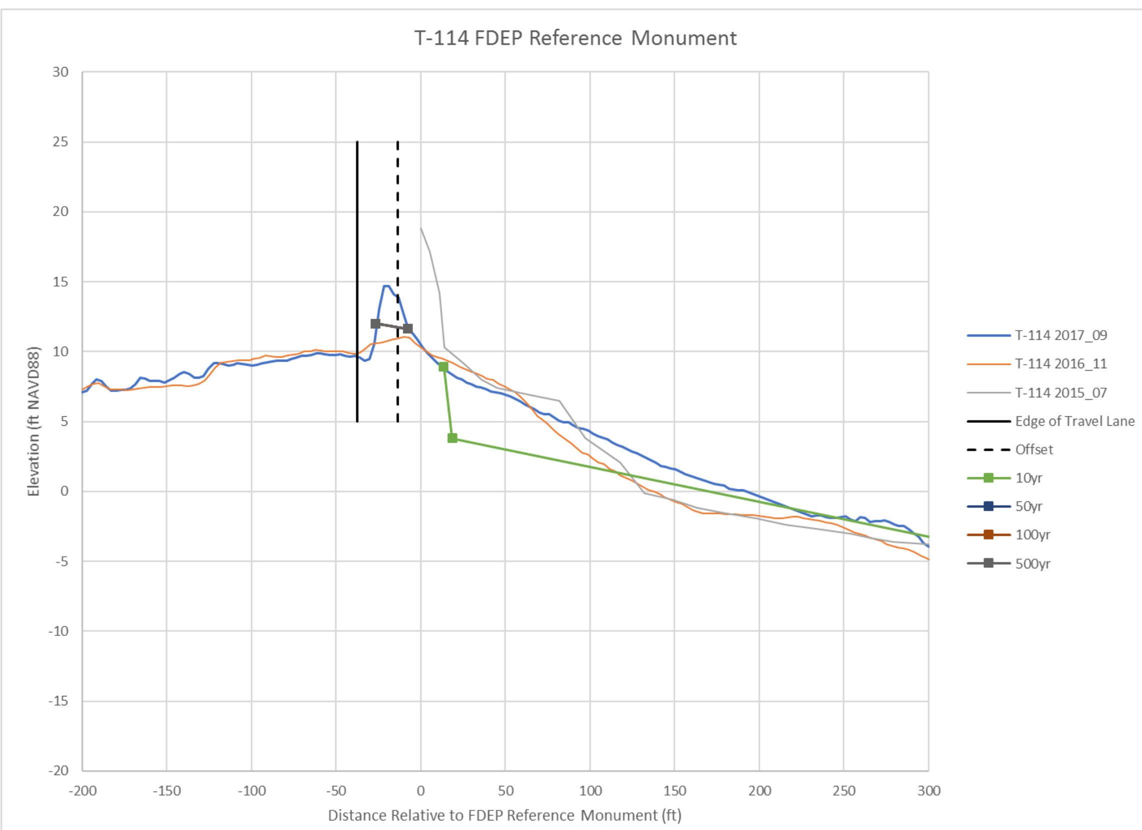
ATTACHMENT B – STORM-INDUCED EROSION PROFILES (NO LONG-TERM RECESSION)



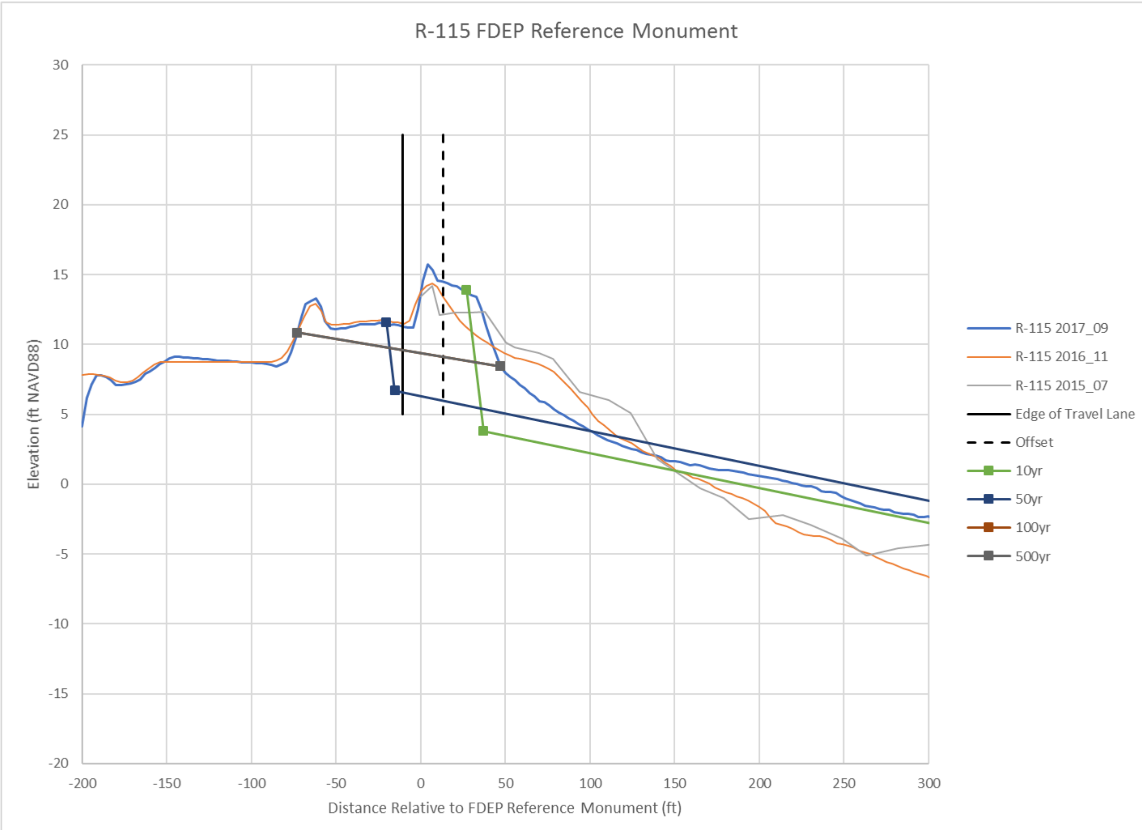


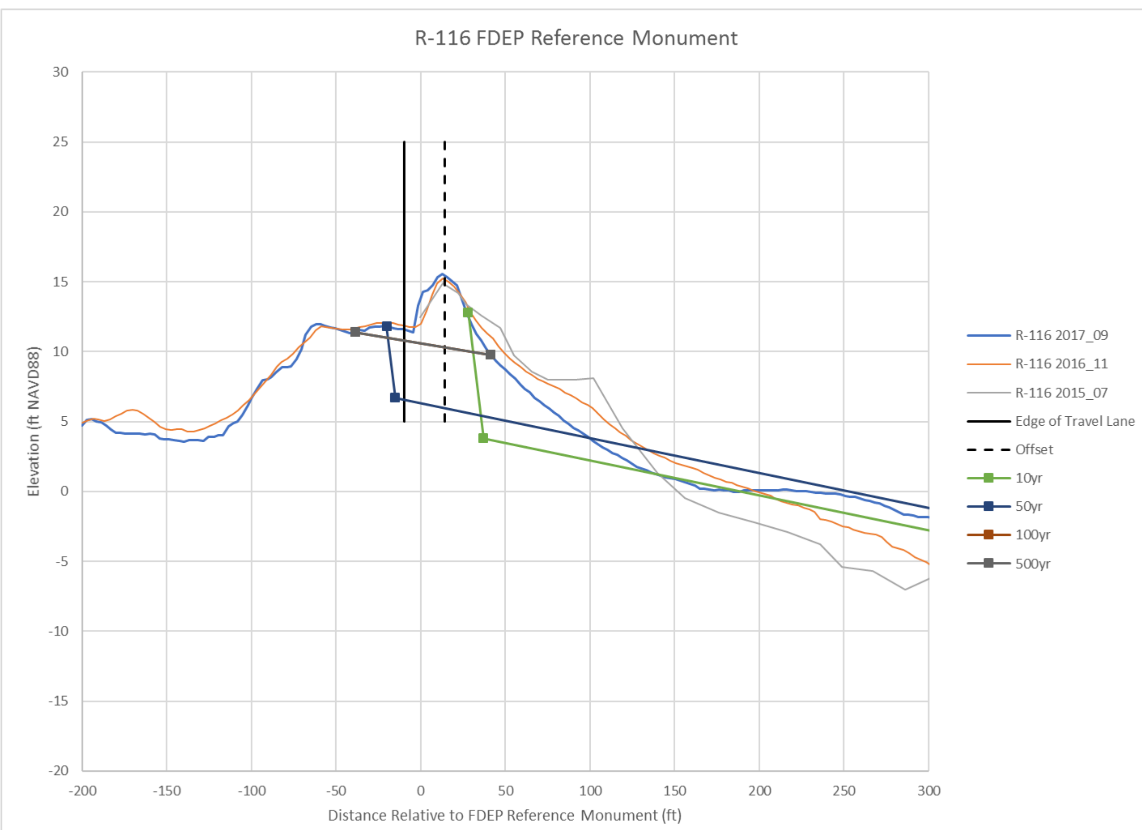
ATTACHMENT B – STORM-INDUCED EROSION PROFILES (NO LONG-TERM RECESSION)



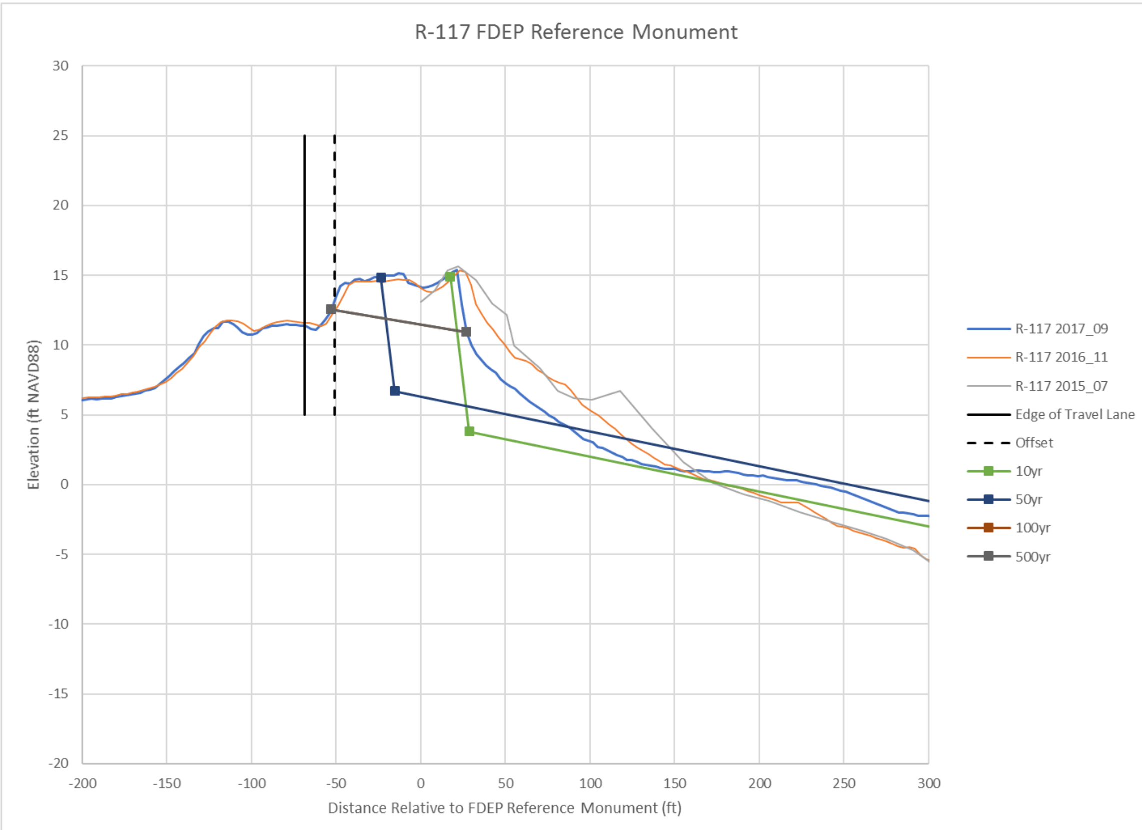


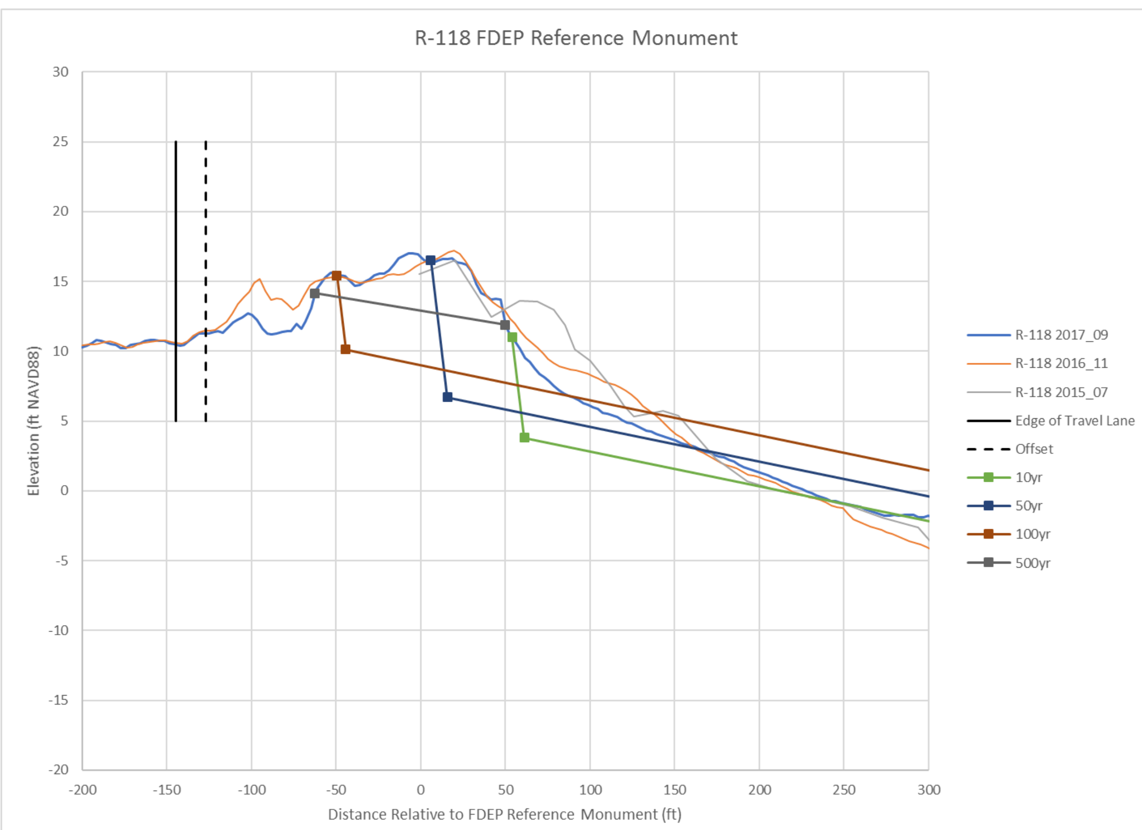
ATTACHMENT B – STORM-INDUCED EROSION PROFILES (NO LONG-TERM RECESSION)





ATTACHMENT B – STORM-INDUCED EROSION PROFILES (NO LONG-TERM RECESSION)





ATTACHMENT B – STORM-INDUCED EROSION PROFILES (NO LONG-TERM RECESSION)