

# **Appendix E – Economics**

## **Galveston Coastal Erosion Galveston, Texas**

Continuing Authorities Program, Section 204  
Beneficial Use of Dredged Material

May 2022

# APPENDIX E ECONOMIC ANALYSIS

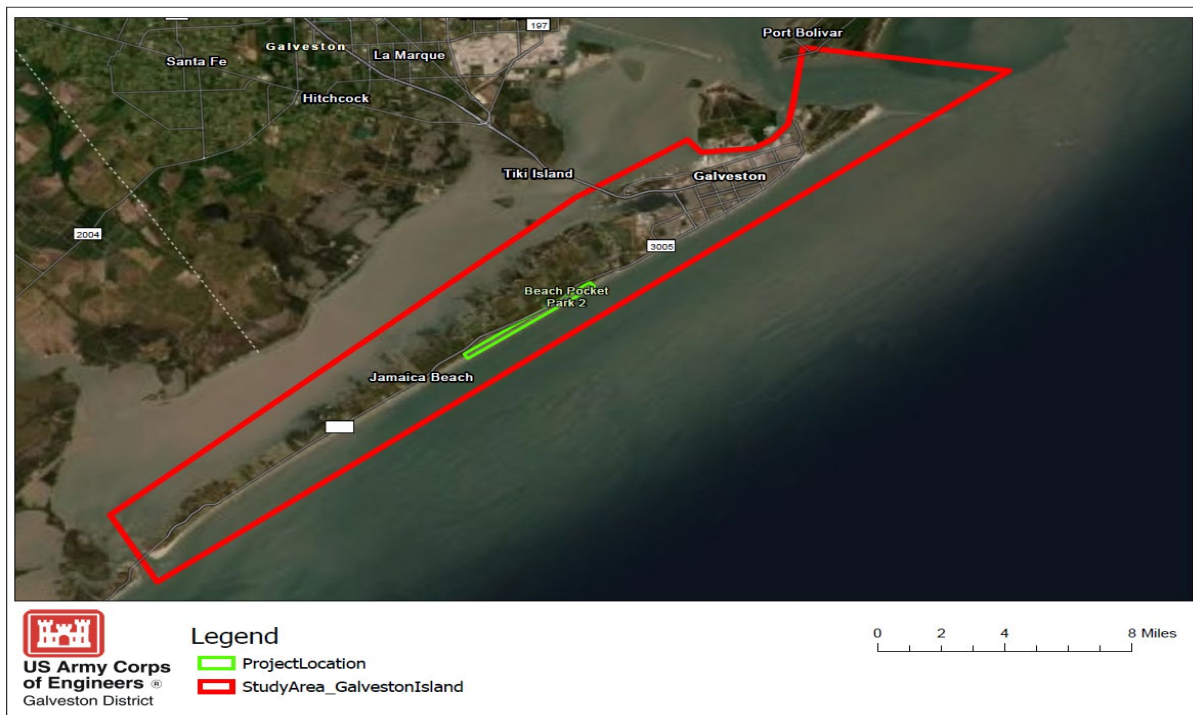
## 1 Introduction

This report presents the economic analysis of using dredged material from the Federal Navigation Project for Galveston TX Harbor to provide coastal storm risk reduction measures on the West End Beach of Galveston Island TX. The analyses follow the U. S. Army Corps of Engineers (USACE) guidance for conducting economic evaluations as contained in EP 1105-2-58 dated 01 March 2019.

The economic benefits of providing coastal storm damage protection through beneficial use of dredged material are calculated in two steps. First, the projected without-project conditions are compared to the with-project condition. Then, the least-cost disposal plan associated with the Navigation maintenance dredging (base plan) is compared to the cost of providing the coastal storm damage protection. This analysis was conducted using the Fiscal Year 2022 Federal interest rate for water resources projects of 2.25%. A twenty-four (24) year period of analysis is used, based upon the period of protection determined by engineering division.

## 2 Description of Study Area

The project location is situated in the center of Galveston Island, running parallel to FM 3005 stretching from 8 Mile Road southwest to Thirteen Mile Road.





Galveston Island is a barrier island on the Texas shoreline of the Gulf of Mexico. The island sits approximately 50 miles southeast of Houston. The study area/potential project site lies on the west side of the island, beyond the western terminus of the Galveston Seawall. The area is generally identified as west of 61<sup>st</sup> and is primarily a residential area with a smattering of commercial businesses. The end of the study area is where the Galveston Island State Park property begins, traveling southwest along the Gulf Coast.

The proposed project will use the dredged material from the Federal Navigation Project for Galveston Harbor as beach-fill on a stretch of beach located on the West End of Galveston. Selected economic characteristics from the 2019 American Community Survey report the following:

- 1) Total Population of 8,556 with a median age of 51.3 years
- 2) The work force numbers approximately 4,200 with a white/blue collar split of 84%/16%
- 3) Total households number 3,744 with an average persons per household at 2.
- 4) Average household income is roughly \$114,000 accompanied with a median income of \$75,300
- 5) There are approximately 559 persons living below the poverty level of income.
- 6) Of the approximately 10,052 housing units, 37% are occupied and roughly 67% are owner-occupied.

<https://www.point2homes.com/US/Neighborhood/TX/Galveston-Bolivar-Peninsula/West-End-Galveston-Demographics.html>

(<https://data.census.gov>).

### 3 Benefit Methodology

The benefits to beach placement are determined by estimating the value of the erosion losses and damages that would occur without beneficial placement and comparing them to the erosion losses and damages that would occur with beneficial placement. The benefits equal the degree to which erosion losses and damages are reduced. For this analysis, the long-term erosion rate of 37.5 feet per year was used for both the with- and without-project conditions based on the hydraulic analysis. If protective measures are not implemented, it is anticipated that long-term erosion will continue at the current rate and eventually threaten shorefront structures along the beach. This location on the beach provides storm damage protection to residential properties, improves recreation benefits, and delays land erosion.

#### 3.1 Future Without-Project Condition

The study evaluated 155 residential structures at risk of being undermined due to coastal erosion from 2023 to 2037. The value of each structure was determined using 2021 tax assessment records available from Galveston County Assessor Office, which stipulates in its methods of assessment that depreciated replacement costs are used for assessment and taxing purposes. Damages were analyzed for the Future Without-Project (FWOP) condition using ArcMap Geographic Information Systems (GIS) to overlay the erosion contours onto aerial photographs containing geo-referenced parcel maps. The hydraulic analysis estimated that the structures closest to the dune line would be impacted as early as 2023. The erosion contours were then advanced landward in annual increments at the 37.5 feet per year

erosion rate. A structure was considered damaged when the erosion line reached the seaward edge of the parcel. The present value of the structure was determined for that same year using the current 2022 Fiscal Year Federal Discount Rate of 2.25%. The structure was considered a total loss and was not rebuilt once this occurred. Structure values totaling \$150,053,000 for the FWOP condition are presented in Table E-2 below.

The local ability to respond to this erosion problem in the future is not known but likely limited. As homes start to erode, political pressure may force regulatory change as has happened historically in other locations along the Texas Gulf Coast.

### **3.2 With-Project Condition**

The with-project condition assumes the placement of dredged material on the beaches within the study area. Coastal engineering analysis determined that the amount of material to be dredged will provide a beach fill with a berm length of approximately 1.7 miles linear feet that will last approximately 8-10 years, although several properties are expected to have some protection for up to 24 years. In the with-project condition, it was assumed that the erosion rate would remain at 37.5 feet per year, but the structures would be damaged up to 24 years later than in the without-project condition. This is a onetime placement with no plans for renourishment. Therefore, while the project life is 8-10 years, the impact of the placement will last beyond those years. The present value was determined for structures in with-project condition based on the additional length of time before erosion undermined the structure. Structure values for the with-project condition are also presented in Table E-2.

<b>Table E-2: Structure Valuation for Without- and With-Project Conditions</b>									
		<b>WITHOUT PROJECT CONDITIONS</b>				<b>ALT 2 WITH PROJECT CONDITIONS</b>			
Structure ID	2021 Depreciated Replacement Values	<i>Year Damaged</i>	<i>Study Year</i>	<i>Present Value Factor</i>	<i>Present Value</i>	<i>Year Damaged</i>	<i>Study Year</i>	<i>Present Value Factor</i>	<i>Present Value</i>
0	1,631,930	2029	6	0.862297	1,451,185	2034	11	0.762	1,282,636
1	45,360	2035	12	0.743556	71,649	2039	16	0.674	64,910
2	1,100,140	2023	0	1	1,151,140	2023	0	1.000	1,151,140
3	336,520	2023	0	1	387,520	2023	0	1.000	387,520
5	123,530	2036	13	0.72542	126,608	2039	16	0.674	117,568
6	234,650	2036	13	0.72542	207,216	2039	16	0.674	192,421
8	124,430	2023	0	1	175,430	2023	0	1.000	175,430
11	375,110	2023	0	1	426,110	2023	0	1.000	426,110
17	1,339,830	2023	0	1	1,390,830	2023	0	1.000	1,390,830
18	1,283,980	2023	0	1	1,334,980	2023	0	1.000	1,334,980
19	688,640	2036	13	0.72542	536,550	2039	16	0.674	498,240
22	428,680	2038	15	0.690466	331,203	2039	16	0.674	323,124
23	644,670	2025	2	0.951814	662,149	2034	11	0.762	530,201
24	551,350	2038	15	0.690466	415,902	2039	16	0.674	405,758
25	667,350	2023	0	1	718,350	2023	0	1.000	718,350
26	1,058,670	2025	2	0.951814	1,056,200	2033	10	0.781	866,872
28	650,790	2038	15	0.690466	484,562	2039	16	0.674	472,743
29	455,360	2028	5	0.883854	447,548	2035	12	0.744	376,507
30	439,640	2037	14	0.707727	347,239	2039	16	0.674	330,507
32	310,910	2027	4	0.905951	327,873	2034	11	0.762	275,828
35	649,950	2029	6	0.862297	604,427	2036	13	0.725	508,483
37	568,520	2035	12	0.743556	460,648	2039	16	0.674	417,324
38	628,840	2023	0	1	679,840	2031	8	0.821	557,976

<b>Table E-2 (Continued): Structure Valuation for Without- and With-Project Conditions</b>									
		<b>WITHOUT PROJECT CONDITIONS</b>				<b>ALT 2 WITH PROJECT CONDITIONS</b>			
Structure ID	2021 Depreciated Replacement Values	<i>Year Damaged</i>	<i>Study Year</i>	<i>Present Value Factor</i>	<i>Present Value</i>	<i>Year Damaged</i>	<i>Study Year</i>	<i>Present Value Factor</i>	<i>Present Value</i>
41	633880	2035	12	0.743556	509,247	2039	16	0.673625	461,352
42	1124820	2023	0	1	1,175,820	2023	0	1	1,175,820
43	538240	2028	5	0.883854	520,802	2035	12	0.743556	438,133
44	657550	2023	0	1	708,550	2023	0	1	708,550
46	257170	2030	7	0.841265	259,253	2037	14	0.707727	218,100
49	935860	2026	3	0.928599	916,398	2033	10	0.781198	770,933
51	511110	2033	10	0.781198	439,119	2039	16	0.673625	378,651
55	1000210	2023	0	1	1,051,210	2023	0	1	1,051,210
59	907900	2031	8	0.820747	787,014	2038	15	0.690466	662,087
61	409280	2036	13	0.72542	333,896	2039	16	0.673625	310,056
63	692260	2026	3	0.928599	690,191	2033	10	0.781198	580,634
68	297370	2024	1	0.97561	339,873	2031	8	0.820747	285,923
69	391790	2034	11	0.762145	337,470	2039	16	0.673625	298,274
76	452780	2033	10	0.781198	393,552	2039	16	0.673625	339,359
77	901150	2023	0	1	952,150	2023	0	1	952,150
79	814520	2030	7	0.841265	728,132	2037	14	0.707727	612,552
80	461360	2023	0	1	512,360	2023	0	1	512,360
82	875600	2031	8	0.820747	760,504	2037	14	0.707727	655,780
83	661170	2038	15	0.690466	491,729	2039	16	0.673625	479,735
86	730370	2033	10	0.781198	610,405	2039	16	0.673625	526,350
88	647510	2035	12	0.743556	519,381	2039	16	0.673625	470,534
89	1189200	2023	0	1	1,240,200	2023	0	1	461,352
90	491140	2029	6	0.862297	467,486	2035	12	0.743556	1,175,820
91	1240010	2033	10	0.781198	1,008,535	2039	16	0.673625	438,133

<b>Table E-2 (Continued): Structure Valuation for Without- and With-Project Conditions</b>									
		<b>WITHOUT PROJECT CONDITIONS</b>				<b>ALT 2 WITH PROJECT CONDITIONS</b>			
Structure ID	2021 Depreciated Replacement Values	<i>Year Damaged</i>	<i>Study Year</i>	<i>Present Value Factor</i>	<i>Present Value</i>	<i>Year Damaged</i>	<i>Study Year</i>	<i>Present Value Factor</i>	<i>Present Value</i>
92	1167350	2023	0	1	1,218,350	2023	0	1	1,218,350
95	1003340	2033	10	0.781198	823,649	2038	15	0.690466	727,985
97	498920	2034	11	0.762145	419,119	2039	16	0.673625	370,440
98	1462160	2023	0	1	1,513,160	2023	0	1	1,513,160
99	257120	2035	12	0.743556	229,104	2039	16	0.673625	207,557
103	392100	2038	15	0.690466	305,945	2039	16	0.673625	298,483
106	273080	2035	12	0.743556	240,972	2039	16	0.673625	218,308
107	1013680	2034	11	0.762145	811,440	2039	16	0.673625	717,195
110	110650	2035	12	0.743556	120,196	2039	16	0.673625	108,891
113	395990	2033	10	0.781198	349,188	2038	15	0.690466	308,631
119	204190	2032	9	0.800728	204,338	2038	15	0.690466	176,200
121	908230	2023	0	1	959,230	2023	0	1	959,230
122	1287400	2023	0	1	1,338,400	2023	0	1	1,338,400
125	840650	2025	2	0.951814	848,685	2029	6	0.862297	768,867
126	1026500	2027	4	0.905951	976,162	2032	9	0.800728	862,785
128	989050	2026	3	0.928599	965,790	2030	7	0.841265	874,958
129	1608730	2028	5	0.883854	1,466,959	2033	10	0.781198	1,296,578
130	1821050	2028	5	0.883854	1,654,619	2033	10	0.781198	1,462,442
135	1028330	2023	0	1	1,079,330	2029	6	0.862297	930,703
138	1182200	2023	0	1	1,233,200	2027	4	0.905951	1,117,218
139	1923030	2023	0	1	1,974,030	2027	4	0.905951	1,788,374
140	908700	2023	0	1	959,700	2029	6	0.862297	827,546
143	467070	2036	13	0.72542	375,819	2039	16	0.673625	348,985
146	711210	2038	15	0.690466	526,280	2039	16	0.673625	513,444



<b>Table E-2 (Continued): Structure Valuation for Without- and With-Project Conditions</b>									
		<b>WITHOUT PROJECT CONDITIONS</b>				<b>ALT 2 WITH PROJECT CONDITIONS</b>			
Structure ID	2021 Depreciated Replacement Values	<i>Year Damaged</i>	<i>Study Year</i>	<i>Present Value Factor</i>	<i>Present Value</i>	<i>Year Damaged</i>	<i>Study Year</i>	<i>Present Value Factor</i>	<i>Present Value</i>
148	549220	2038	15	0.690466	414,431	2039	16	0.673625	404,323
155	810920	2023	0	1	861,920	2024	1	0.97561	840,898
156	967280	2032	9	0.800728	815,366	2039	16	0.673625	685,939
160	418130	2037	14	0.707727	332,016	2039	16	0.673625	316,018
161	197470	2030	7	0.841265	209,029	2038	15	0.690466	171,560
165	382330	2025	2	0.951814	412,450	2034	11	0.762145	330,260
167	632000	2031	8	0.820747	560,570	2039	16	0.673625	460,086
168	455830	2036	13	0.72542	367,665	2039	16	0.673625	341,413
182	320030	2038	15	0.690466	256,183	2039	16	0.673625	249,935
184	949870	2033	10	0.781198	781,878	2039	16	0.673625	674,211
186	682560	2027	4	0.905951	664,569	2036	13	0.72542	532,139
187	440840	2037	14	0.707727	348,089	2039	16	0.673625	331,316
193	486610	2030	7	0.841265	452,273	2038	15	0.690466	371,201
197	550400	2023	0	1	601,400	2031	8	0.820747	493,597
199	253160	2030	7	0.841265	255,879	2038	15	0.690466	210,012
201	154170	2030	7	0.841265	172,602	2038	15	0.690466	141,663
203	249930	2031	8	0.820747	246,987	2038	15	0.690466	207,782
207	177760	2030	7	0.841265	192,448	2038	15	0.690466	157,951
212	447040	2029	6	0.862297	429,458	2037	14	0.707727	352,476
223	281210	2033	10	0.781198	259,522	2039	16	0.673625	223,785
231	232200	2032	9	0.800728	226,766	2039	16	0.673625	190,771
233	331780	2033	10	0.781198	299,027	2039	16	0.673625	257,850
234	253500	2032	9	0.800728	243,822	2039	16	0.673625	205,119
236	411040	2032	9	0.800728	369,969	2039	16	0.673625	311,242

<b>Table E-2 (Continued): Structure Valuation for Without- and With-Project Conditions</b>									
		<b>WITHOUT PROJECT CONDITIONS</b>				<b>ALT 2 WITH PROJECT CONDITIONS</b>			
Structure ID	2021 Depreciated Replacement Values	Year Damaged	Study Year	Present Value Factor	Present Value	Year Damaged	Study Year	Present Value Factor	Present Value
237	276120	2033	10	0.781198	255,546	2039	16	0.673625	220,356
239	216980	2033	10	0.781198	209,346	2039	16	0.673625	180,518
242	228680	2033	10	0.781198	218,486	2039	16	0.673625	188,399
244	273080	2033	10	0.781198	253,171	2039	16	0.673625	218,308
246	361900	2033	10	0.781198	322,557	2039	16	0.673625	278,140
248	379030	2034	11	0.762145	327,745	2039	16	0.673625	289,679
252	356800	2035	12	0.743556	303,222	2039	16	0.673625	274,704
254	242910	2033	10	0.781198	229,602	2039	16	0.673625	197,985
256	395610	2033	10	0.781198	348,891	2039	16	0.673625	300,848
258	522500	2035	12	0.743556	426,429	2039	16	0.673625	386,324
259	167460	2035	12	0.743556	162,437	2039	16	0.673625	147,160
261	180110	2035	12	0.743556	171,843	2039	16	0.673625	155,681
267	311300	2035	12	0.743556	269,390	2039	16	0.673625	244,054
268	393410	2036	13	0.72542	322,384	2039	16	0.673625	299,366
271	240540	2036	13	0.72542	211,489	2039	16	0.673625	196,389
273	436920	2036	13	0.72542	353,947	2039	16	0.673625	328,675
275	426640	2037	14	0.707727	338,039	2039	16	0.673625	321,750
278	224730	2037	14	0.707727	195,142	2039	16	0.673625	185,739
280	325150	2036	13	0.72542	272,867	2039	16	0.673625	253,384
283	76960	2023	0	1	127,960	2023	0	1	127,960
287	229250	2038	15	0.690466	193,503	2039	16	0.673625	188,783
289	346140	2038	15	0.690466	274,211	2039	16	0.673625	267,523
291	646730	2038	15	0.690466	481,759	2039	16	0.673625	470,008
293	727330	2038	15	0.690466	537,410	2039	16	0.673625	524,302

<b>Table E-2 (Continued): Structure Valuation for Without- and With-Project Conditions</b>									
		<b>WITHOUT PROJECT CONDITIONS</b>				<b>ALT 2 WITH PROJECT CONDITIONS</b>			
Structure ID	2021 Depreciated Replacement Values	Year Damaged	Study Year	Present Value Factor	Present Value	Year Damaged	Study Year	Present Value Factor	Present Value
295	577,300	2037	14	0.707727	520,800	2023	16	0	1
299	469,800	2023	0	1	1,253,433	2039	16	16	0.673625
315	1,553,500	2033	10	0.781198	1,351,676	2039	16	16	0.673625
316	1,516,530	2029	6	0.862297	1,442,513	2039	16	16	0.673625
320	1,464,540	2025	2	0.951814	1,142,340	2037	16	14	0.707727
321	1,091,340	2023	0	1	1,605,360	2037	16	14	0.707727
322	1,554,360	2023	0	1	1,670,850	2025	16	2	0.951814
323	1,619,850	2023	0	1	1,236,378	2039	16	16	0.673625
324	1,247,970	2025	2	0.951814	1,614,513	2039	16	16	0.673625
325	1,731,120	2027	4	0.905951	1,134,377	2039	16	16	0.673625
326	1,264,530	2029	6	0.862297	823,761	2039	16	16	0.673625
328	881,010	2028	5	0.883854	2,014,046	2039	16	16	0.673625
329	2,172,130	2027	4	0.905951	1,056,810	2039	16	16	0.673625
333	1,115,520	2027	4	0.905951	1,458,917	2039	16	16	0.673625
334	1,444,390	2024	1	0.97561	1,489,951	2039	16	16	0.673625
337	1,514,380	2025	2	0.951814	1,124,010	2038	16	15	0.690466
340	1,101,110	2024	1	0.97561	23,576,360	2023	16	0	1
342	23,525,360	2023	0	1	1,824,270	2037	16	14	0.707727
344	1,773,270	2023	0	1	88,780	2037	16	14	0.707727
345	40,000	2024	1	0.97561	1,149,750	2037	0	14	0.707727
346	1,098,750	2023	0	1	427,940	2023	16	0	1
348	376,940	2023	0	1	1,230,570	2027	16	4	0.905951
350	1,179,570	2023	0	1	926,910	2026	16	3	0.928599
352	875,910	2023	0	1	520,800	2023	16	0	1

<b>Table E-2 (Continued): Structure Valuation for Without- and With-Project Conditions</b>									
		<b>WITHOUT PROJECT CONDITIONS</b>				<b>ALT 2 WITH PROJECT CONDITIONS</b>			
Structure ID	2021 Depreciated Replacement Values	<i>Year Damaged</i>	<i>Study Year</i>	<i>Present Value Factor</i>	<i>Present Value</i>	<i>Year Damaged</i>	<i>Study Year</i>	<i>Present Value Factor</i>	<i>Present Value</i>
354	919,540	2023	0	1	970,540	2023	0	1	919,540
355	1,547,040	2023	0	1	1,598,040	2023	0	1	1,547,040
356	849,510	2023	0	1	900,510	2023	0	1	849,510
358	608,710	2023	0	1	659,710	2023	0	1	608,710
359	685,140	2023	0	1	736,140	2023	0	1	685,140
360	714,200	2023	0	1	765,200	2023	0	1	714,200
361	619,040	2023	0	1	670,040	2023	0	1	619,040
363	915,780	2023	0	1	966,780	2023	0	1	915,780
365	949,490	2023	0	1	1,000,490	2023	0	1	949,490
366	807,470	2023	0	1	858,470	2023	0	1	807,470
367	1,188,180	2023	0	1	1,239,180	2023	0	1	1,188,180

<b>Table E-2: Structure Valuation for Without- and With-Project Conditions</b>									
		<b>WITHOUT PROJECT CONDITIONS</b>				<b>ALT 3 WITH PROJECT CONDITIONS</b>			
Structure ID	2021 Depreciated Replacement Values	<i>Year Damaged</i>	<i>Study Year</i>	<i>Present Value Factor</i>	<i>Present Value</i>	<i>Year Damaged</i>	<i>Study Year</i>	<i>Present Value Factor</i>	<i>Present Value</i>
0	1,631,930	2029	6	0.862297	1,451,185	2035	12	0.743556	1,213,431
1	45,360	2035	12	0.743556	71,649	2039	16	0.673625	30,556
2	1,100,140	2023	0	1	1,151,140	2023	0	1	1,100,140
3	336,520	2023	0	1	387,520	2023	0	1	336,520
5	123,530	2036	13	0.72542	126,608	2039	16	0.673625	83,213
6	234,650	2036	13	0.72542	207,216	2039	16	0.673625	158,066
8	124,430	2023	0	1	175,430	2023	0	1	124,430
11	375,110	2023	0	1	426,110	2023	0	1	375,110
17	1,339,830	2023	0	1	1,390,830	2023	0	1	1,339,830
18	1,283,980	2023	0	1	1,334,980	2023	0	1	1,283,980
19	688,640	2036	13	0.72542	536,550	2039	16	0.673625	463,885
22	428,680	2038	15	0.690466	331,203	2039	16	0.673625	288,770
23	644,670	2025	2	0.951814	662,149	2034	11	0.762145	491,332
24	551,350	2038	15	0.690466	415,902	2039	16	0.673625	371,403
25	667,350	2023	0	1	718,350	2023	0	1	667,350
26	1,058,670	2025	2	0.951814	1,056,200	2034	11	0.762145	806,860
28	650,790	2038	15	0.690466	484,562	2039	16	0.673625	438,388
29	455,360	2028	5	0.883854	447,548	2036	13	0.72542	330,327
30	439,640	2037	14	0.707727	347,239	2039	16	0.673625	296,152
32	310,910	2027	4	0.905951	327,873	2035	12	0.743556	231,179
35	649,950	2029	6	0.862297	604,427	2037	14	0.707727	459,987
37	568,520	2035	12	0.743556	460,648	2039	16	0.673625	382,969
38	628,840	2023	0	1	679,840	2032	9	0.800728	503,530

<b>Table E-2 (Continued): Structure Valuation for Without- and With-Project Conditions</b>									
		<b>WITHOUT PROJECT CONDITIONS</b>				<b>ALT 3 WITH PROJECT CONDITIONS</b>			
Structure ID	2021 Depreciated Replacement Values	Year Damaged	Study Year	Present Value Factor	Present Value	Year Damaged	Study Year	Present Value Factor	Present Value
41	633880	2035	12	0.743556	509,247	2039	16	0.673625	426,997
42	1124820	2023	0	1	1,175,820	2023	0	1	1,124,820
43	538240	2028	5	0.883854	520,802	2036	13	0.72542	390,450
44	657550	2023	0	1	708,550	2028	5	0.883854	581,178
46	257170	2030	7	0.841265	259,253	2038	15	0.690466	177,567
49	935860	2026	3	0.928599	916,398	2034	11	0.762145	713,261
51	511110	2033	10	0.781198	439,119	2039	16	0.673625	344,296
55	1000210	2023	0	1	1,051,210	2031	8	0.820747	820,919
59	907900	2031	8	0.820747	787,014	2039	16	0.673625	611,584
61	409280	2036	13	0.72542	333,896	2039	16	0.673625	275,701
63	692260	2026	3	0.928599	690,191	2034	11	0.762145	527,602
68	297370	2024	1	0.97561	339,873	2033	10	0.781198	232,305
69	391790	2034	11	0.762145	337,470	2039	16	0.673625	263,920
76	452780	2033	10	0.781198	393,552	2039	16	0.673625	305,004
77	901150	2023	0	1	952,150	2031	8	0.820747	739,616
79	814520	2030	7	0.841265	728,132	2037	14	0.707727	576,458
80	461360	2023	0	1	512,360	2023	0	1	461,360
82	875600	2031	8	0.820747	760,504	2038	15	0.690466	604,572
83	661170	2038	15	0.690466	491,729	2039	16	0.673625	445,381
86	730370	2033	10	0.781198	610,405	2039	16	0.673625	491,995
88	647510	2035	12	0.743556	519,381	2039	16	0.673625	436,179
89	1189200	2023	0	1	1,240,200	2023	0	1	1,189,200
90	491140	2029	6	0.862297	467,486	2036	13	0.72542	356,283
91	1240010	2033	10	0.781198	1,008,535	2039	16	0.673625	835,302

<b>Table E-2 (Continued): Structure Valuation for Without- and With-Project Conditions</b>									
		<b>WITHOUT PROJECT CONDITIONS</b>				<b>ALT 3 WITH PROJECT CONDITIONS</b>			
Structure ID	2021 Depreciated Replacement Values	Year Damaged	Study Year	Present Value Factor	Present Value	Year Damaged	Study Year	Present Value Factor	Present Value
92	1167350	2023	0	1	1,218,350	2023	0	1	1,167,350
95	1003340	2033	10	0.781198	823,649	2039	16	0.673625	675,875
97	498920	2034	11	0.762145	419,119	2039	16	0.673625	336,085
98	1462160	2023	0	1	1,513,160	2023	0	1	1,462,160
99	257120	2035	12	0.743556	229,104	2039	16	0.673625	173,202
103	392100	2038	15	0.690466	305,945	2039	16	0.673625	264,128
106	273080	2035	12	0.743556	240,972	2039	16	0.673625	183,953
107	1013680	2034	11	0.762145	811,440	2039	16	0.673625	682,840
110	110650	2035	12	0.743556	120,196	2039	16	0.673625	74,537
113	395990	2033	10	0.781198	349,188	2039	16	0.673625	266,749
119	204190	2032	9	0.800728	204,338	2038	15	0.690466	140,986
121	908230	2023	0	1	959,230	2023	0	1	908,230
122	1287400	2023	0	1	1,338,400	2023	0	1	1,287,400
125	840650	2025	2	0.951814	848,685	2031	8	0.820747	689,961
126	1026500	2027	4	0.905951	976,162	2033	10	0.781198	801,900
128	989050	2026	3	0.928599	965,790	2032	9	0.800728	791,960
129	1608730	2028	5	0.883854	1,466,959	2034	11	0.762145	1,226,085
130	1821050	2028	5	0.883854	1,654,619	2034	11	0.762145	1,387,904
135	1028330	2023	0	1	1,079,330	2028	5	0.883854	908,894
138	1182200	2023	0	1	1,233,200	2026	3	0.928599	1,097,790
139	1923030	2023	0	1	1,974,030	2023	0	1	1,923,030
140	908700	2023	0	1	959,700	2028	5	0.883854	803,158
143	467070	2036	13	0.72542	375,819	2039	16	0.673625	314,630
146	711210	2038	15	0.690466	526,280	2039	16	0.673625	479,089

<b>Table E-2 (Continued): Structure Valuation for Without- and With-Project Conditions</b>									
		<b>WITHOUT PROJECT CONDITIONS</b>				<b>ALT 3 WITH PROJECT CONDITIONS</b>			
Structure ID	2021 Depreciated Replacement Values	Year Damaged	Study Year	Present Value Factor	Present Value	Year Damaged	Study Year	Present Value Factor	Present Value
148	549220	2038	15	0.690466	414,431	2039	16	0.673625	369,968
155	810920	2023	0	1	861,920	2023	0	1	810,920
156	967280	2032	9	0.800728	815,366	2039	16	0.673625	651,584
160	418130	2037	14	0.707727	332,016	2039	16	0.673625	281,663
161	197470	2030	7	0.841265	209,029	2038	15	0.690466	136,346
165	382330	2025	2	0.951814	412,450	2034	11	0.762145	291,391
167	632000	2031	8	0.820747	560,570	2038	15	0.690466	436,374
168	455830	2036	13	0.72542	367,665	2039	16	0.673625	307,058
182	320030	2038	15	0.690466	256,183	2039	16	0.673625	215,580
184	949870	2033	10	0.781198	781,878	2039	16	0.673625	639,856
186	682560	2027	4	0.905951	664,569	2035	12	0.743556	507,522
187	440840	2037	14	0.707727	348,089	2039	16	0.673625	296,961
193	486610	2030	7	0.841265	452,273	2038	15	0.690466	335,987
197	550400	2023	0	1	601,400	2031	8	0.820747	451,739
199	253160	2030	7	0.841265	255,879	2038	15	0.690466	174,798
201	154170	2030	7	0.841265	172,602	2038	15	0.690466	106,449
203	249930	2031	8	0.820747	246,987	2038	15	0.690466	172,568
212	447040	2029	6	0.862297	429,458	2038	15	0.690466	122,737
223	281210	2033	10	0.781198	259,522	2037	14	0.707727	316,382
231	232200	2032	9	0.800728	226,766	2039	16	0.673625	189,430
233	331780	2033	10	0.781198	299,027	2039	16	0.673625	156,416
234	253500	2032	9	0.800728	243,822	2039	16	0.673625	223,495
236	411040	2032	9	0.800728	369,969	2039	16	0.673625	170,764



<b>Table E-2 (Continued): Structure Valuation for Without- and With-Project Conditions</b>									
		<b>WITHOUT PROJECT CONDITIONS</b>				<b>ALT 3 WITH PROJECT CONDITIONS</b>			
Structure ID	2021 Depreciated Replacement Values	Year Damaged	Study Year	Present Value Factor	Present Value	Year Damaged	Study Year	Present Value Factor	Present Value
237	276120	2033	10	0.781198	255,546	2039	16	0.673625	186,001
239	216980	2033	10	0.781198	209,346	2039	16	0.673625	146,163
242	228680	2033	10	0.781198	218,486	2039	16	0.673625	154,045
244	273080	2033	10	0.781198	253,171	2039	16	0.673625	183,953
246	361900	2033	10	0.781198	322,557	2039	16	0.673625	243,785
248	379030	2034	11	0.762145	327,745	2039	16	0.673625	255,324
252	356800	2035	12	0.743556	303,222	2039	16	0.673625	240,349
254	242910	2033	10	0.781198	229,602	2039	16	0.673625	163,630
256	395610	2033	10	0.781198	348,891	2039	16	0.673625	266,493
258	522500	2035	12	0.743556	426,429	2039	16	0.673625	351,969
259	167460	2035	12	0.743556	162,437	2039	16	0.673625	112,805
261	180110	2035	12	0.743556	171,843	2039	16	0.673625	121,327
267	311300	2035	12	0.743556	269,390	2039	16	0.673625	209,699
268	393410	2036	13	0.72542	322,384	2039	16	0.673625	265,011
271	240540	2036	13	0.72542	211,489	2039	16	0.673625	162,034
273	436920	2036	13	0.72542	353,947	2039	16	0.673625	294,320
275	426640	2037	14	0.707727	338,039	2039	16	0.673625	287,395
278	224730	2037	14	0.707727	195,142	2039	16	0.673625	151,384
280	325150	2036	13	0.72542	272,867	2039	16	0.673625	219,029
283	76960	2023	0	1	127,960	2023	0	1	76,960
287	229250	2038	15	0.690466	193,503	2039	16	0.673625	154,429
289	346140	2038	15	0.690466	274,211	2039	16	0.673625	233,169
291	646730	2038	15	0.690466	481,759	2039	16	0.673625	435,653
293	727330	2038	15	0.690466	537,410	2039	16	0.673625	489,948

<b>Table E-2 (Continued): Structure Valuation for Without- and With-Project Conditions</b>									
		<b>WITHOUT PROJECT CONDITIONS</b>				<b>ALT 3 WITH PROJECT CONDITIONS</b>			
Structure ID	2021 Depreciated Replacement Values	Year Damaged	Study Year	Present Value Factor	Present Value	Year Damaged	Study Year	Present Value Factor	Present Value
295	577,300	2037	14	0.707727	520,800	2039	16	0.673625	388,884
299	469,800	2023	0	1	1,253,433	2023	0	1	469,800
315	1,553,500	2033	10	0.781198	1,351,676	2039	16	0.673625	1,046,476
316	1,516,530	2029	6	0.862297	1,442,513	2039	16	0.673625	1,021,572
320	1,464,540	2025	2	0.951814	1,142,340	2037	14	0.707727	1,036,495
321	1,091,340	2023	0	1	1,605,360	2023	0	1	1,091,340
322	1,554,360	2023	0	1	1,670,850	2023	0	1	1,554,360
323	1,619,850	2023	0	1	1,236,378	2023	0	1	1,619,850
324	1,247,970	2025	2	0.951814	1,614,513	2038	15	0.690466	861,680
325	1,731,120	2027	4	0.905951	1,134,377	2039	16	0.673625	1,166,126
326	1,264,530	2029	6	0.862297	823,761	2039	16	0.673625	851,819
328	881,010	2028	5	0.883854	2,014,046	2039	16	0.673625	593,470
329	2,172,130	2027	4	0.905951	1,056,810	2039	16	0.673625	1,463,201
333	1,115,520	2027	4	0.905951	1,458,917	2039	16	0.673625	751,442
334	1,444,390	2024	1	0.97561	1,489,951	2037	14	0.707727	1,022,234
337	1,514,380	2025	2	0.951814	1,124,010	2038	15	0.690466	1,045,627
340	1,101,110	2024	1	0.97561	23,576,360	2036	13	0.72542	798,768
342	23,525,360	2023	0	1	1,824,270	2023	0	1	23,525,360
344	1,773,270	2023	0	1	88,780	2023	0	1	1,773,270
345	40,000	2024	1	0.97561	1,149,750	2023	0	1	40,000
346	1,098,750	2023	0	1	427,940	2023	0	1	1,098,750
348	376,940	2023	0	1	1,230,570	2023	0	1	376,940
350	1,179,570	2023	0	1	926,910	2023	0	1	1,179,570
352	875,910	2023	0	1	520,800	2023	0	1	875,910

<b>Table E-2 (Continued): Structure Valuation for Without- and With-Project Conditions</b>									
		<b>WITHOUT PROJECT CONDITIONS</b>				<b>ALT 3 WITH PROJECT CONDITIONS</b>			
Structure ID	2021 Depreciated Replacement Values	<i>Year Damaged</i>	<i>Study Year</i>	<i>Present Value Factor</i>	<i>Present Value</i>	<i>Year Damaged</i>	<i>Study Year</i>	<i>Present Value Factor</i>	<i>Present Value</i>
354	919,540	2023	0	1	970,540	2023	0	1	919,540
355	1,547,040	2023	0	1	1,598,040	2023	0	1	1,547,040
356	849,510	2023	0	1	900,510	2023	0	1	849,510
358	608,710	2023	0	1	659,710	2023	0	1	608,710
359	685,140	2023	0	1	736,140	2023	0	1	685,140
360	714,200	2023	0	1	765,200	2023	0	1	714,200
361	619,040	2023	0	1	670,040	2023	0	1	619,040
363	915,780	2023	0	1	966,780	2023	0	1	915,780
365	949,490	2023	0	1	1,000,490	2023	0	1	949,490
366	807,470	2023	0	1	858,470	2023	0	1	807,470
367	1,188,180	2023	0	1	1,239,180	2023	0	1	1,188,180

## 4 Project Benefits

### 5.1 Coastal Storm Damage Reduction

The benefit of providing measures to manage the risk of coastal storm damage in the study area is equal to the reduction in annual damages between the without- and with-project conditions.

The value of structures damaged in the without-project condition is approximately \$127.7 million compared to \$115.5 million under Alternative 2 and \$111.3 million under Alternative 3. Annual damages, presented in Table E-3, were calculated using the current 2021 Fiscal Year Federal Discount Rate of 2.25 percent for the 24-year life of the project. A total of 155 residential structures are expected to be damaged due to coastal erosion from 2023 to 2037 if risk reduction measures are not implemented.

Engineering analysis determined that not all of the damaging erosion could be considered littoral; that approximately 15% of the erosion problem was attributable to storm damage. Based upon those parameters, land values obtained from the Galveston County Assessors Office for 2021 were analyzed for potential land loss avoidance benefits. Based upon those values, the average per acre land value was roughly \$942,000 with a resulting square foot value of \$22.00. Using that last figure with approximately 9000 linear feet of shoreline impacted and the aforementioned landward erosion rate of 37.5 feet per year, annual eroded area was roughly 336,000 square feet with an overall value of \$7.4M. Multiplied by 24 years, that resulted in total potential land loss valued at \$177.7M under FWOP conditions and about \$59.2M under FWP conditions, an overall life cycle benefit of \$118.5M. Finally, that overall benefit was amortized over the project life resulting in an annual benefit of \$16.4M and then multiplied by the 15% engineering portion assigned to storm erosion for an overall benefit of \$2.5M per year attributable to either placement site

**Table E-3: Annual Structure and Land Loss Damages Calculations**

	<b>Without-Project</b>	<b>ALT 2</b>	<b>ALT 3</b>
<b>Total Damages over 24 years</b>	\$139,444,000*	\$135,621,000	\$117,665,000
<b>Capital Recovery Factor</b>	0.0544	0.0544	0.0544
<b>Annual Damages to Structures</b>	\$7,583,000	\$7,375,000	\$6,399,000
<b># Structures Damaged in 24 years</b>	155	81	83
<b>Annual Benefit (Structures)</b>		<b>\$784,800</b>	<b>\$607,400</b>
<b>Annual Land Loss Avoided</b>		<b>\$2,452,300</b>	<b>\$2,452,300</b>

Note: Total and Annual Damages for FWOP damages is an average of Alt 2 and 3; the benefit numbers are actual results due to placement sites protecting slightly different structures, including a condominium high rise for Alt 2..

## 5 Recreation

Beach nourishment provides enhanced recreational benefits based on overall enhanced beach experience. There are a number of beach access points along the stretch of beach under consideration for both Alternative 2 and 3 (see Real Estate Appendix for detailed locations). These facilities basically consist of a paved unlined road off of FM 3005 leading to small unpaved parking lots of sand. The beach activities include typical ones: picnicking and

swimming as well as strolling/walking and occasional bicycle riding on the compacted sand near the Gulf water.

Recreation Benefits were estimated using the USACE-approved Unit Day Value Methodology (Economic Guidance Memo 22-03, Oct 2021). Galveston Park Board provided visitation estimates for all areas generally defined as West End Beaches, which contain the overall study areas described earlier. Using cell phone tracking, approximately 53,000 visitors traveled to the West End of Galveston Island (baseline years 2018-2020). Using the study area length of 1.7 miles out of approximately 20 miles of beach overall, approximately 8.5% of visits (4,500) were allocated to the study area. With an average family size of 2.6 persons, that resulted in just over 12,000 person visits per year to the study area beach stretches.

Next, the Unit Day Value criteria were assigned both under Without and With Project scenarios and assigned an appropriate value per the economic guidance memorandum referenced above; the results are presented here:

<b>UDV Criteria</b>	<b>Point Range</b>	<b>Without Project Points</b>	<b>With Project Points</b>
Recreation Experience	0-30	4	10
Availability of Opportunity	0-18	3	3
Carrying Capacity	0-14	2	5
Accessibility	0-18	6	6
Environmental Aesthetic	0-20	2	6
Total Points		17	30
Value/User/Day		\$5.94	\$7.28

Next, discussions with the Park Board indicated that under expected erosion conditions forecast, half the visitation would be expected to be lost. Thus, under Without Project Conditions, annual recreation value was estimated at \$35,900 (\$5.94 x 6,000 visitors, rounded). With project implementation, that same value would be approximately \$87,800 (\$7.28 x 12,000 visitors). Thus, the difference between the two annual values—\$51,900—represents Annual Recreation Benefits for dredge material placement under both alternatives.

## **6 Benefit and Cost Comparison**

The benefit of providing protection through beneficial use of dredged material is equal to the reduction in annual damages between the without- and with-project conditions, plus additional recreation benefits obtained from the nourished beach. Benefits are analyzed further by comparing the least-cost disposal plan associated with the Navigation maintenance dredging (base plan) to the cost of providing the coastal storm damage protection. Open water disposal is the least-cost Federal base plan that is compared to beach fill, using a pipeline dredge to place disposal material on the beach on the west side of Galveston Island. The cost difference between these plans is then used to determine the overall benefit of the project. Table E-8 below presents the cost comparison between the two plans.

**Table E-8: Benefit-Cost Comparison**

<b>Beneficial Use of Dredge Material - §204</b>	<b>Alternative 2</b>	<b>Alternative 3</b>
<b>FY 2022/(Oct '21) Total First Cost</b>	<b>\$10,732,000</b>	<b>\$10,912,000</b>
IDC - @ 2.25% for 2 months out of 4-month construction schedule	\$19,900	\$20,300
<b>FY 2022 Total Investment</b>	<b>\$10,751,900</b>	<b>\$10,932,300</b>
Capital Recovery Factor—24 years	0.0544	0.0544
<b>FY 2022 Ann. Increment. Costs @ 2.25%; 24-Year Period of Analysis</b>	<b>\$585,000</b>	<b>\$595,500</b>
Annual Land Loss Avoided	\$2,452,300	\$2,452,300
Annual Recreation Benefits	\$51,900	\$51,900
Annual Structures Benefits (using Galv Co Assess Values 2021)	\$784,800	\$607,400
<b>Total Annual Benefits</b>	<b>\$3,289,000</b>	<b>\$3,111,600</b>
Net Annual Benefits	<b>\$2,704,000</b>	\$2,516,000
<b>Benefit-Cost Ratio</b>	<b>5.62</b>	<b>5.23</b>