

**Appendix 4**  
**Economics Appendix**





## MONTAUK POINT, N.Y. - ECONOMICS APPENDIX

<b>General</b> .....	1
<b>Existing Conditions</b> .....	2
<b>Without-Project Conditions</b> .....	4
Proxy for Depreciated Replacement Value of Montauk Lighthouse Complex .....	4
Local Costs Forgone .....	8
Recreation Loss.....	10
<b>With-Project Conditions</b> .....	19
Authorized Plan .....	19
Montauk Point Lighthouse Complex .....	19
Local Costs Forgone .....	19
Recreation Loss.....	19
<b>Benefits</b> .....	24
<b>Summary</b> .....	24



## General

1. The feasibility study is being conducted under the following study authority: 15 May 1991:

*“Resolved by the Committee on Environment and Public Works of the United States Senate, that the Secretary of the Army is hereby requested to review the report of the Chief of Engineers on Fire Island to Montauk Point, New York, published as House Document Number 86-425, 86<sup>th</sup> Congress, 2<sup>nd</sup> session, and other pertinent reports, to determine whether modifications of the recommendations contained therein are advisable at the present time, with a view to preserving, restoring, and protecting Montauk Point and vicinity, including the historic Montauk Lighthouse and associated facilities, from erosion, environmental degradation, and coastal storm damage.”*

2. In addition, Section 110 of the National Historic Preservation Act of 1966, as amended, imposes a responsibility to maintain and protect historic properties. At the present time this responsibility is borne directly by the Montauk Point Historical Society, the current owners of the Montauk Point Lighthouse. However, through the operation of a revisionary interest, as provided for in the land transfer (a quitclaim dated 18 September 1998 from the U.S. Coast Guard to the Montauk Point Historical Society), this responsibility would fall back on the federal government..

3. When originally proposed, the transfer of the property from the U.S. Coast Guard to the Montauk Historical Society would have had an adverse impact on the property because the Montauk Historical Society, as a non-federal entity, would not have been required to adhere to the National Historic Preservation Act. To avoid this adverse impact, the U.S. Coast Guard included a condition in the transfer agreement that required the Montauk Historical Society to maintain and preserve the property in accordance with the National Historic Preservation Act. The Montauk Historical Society is therefore required to act as a federal agency with regards to the preservation of the National Historic Landmark.

4 Alternative ways to follow Section 110 of the NHPA at Montauk Point therefore include:

- Provide mitigation for adverse impacts following a storm event that causes damage to the bluff and other features of the historic property, or
- Take steps now to protect the integrity and significance of the historic property, thereby avoiding the costs of Section 110 compliance that would have been triggered by storm damage.
- Through a combination of Section 110 of the NHPA and the nature of the land conveyance, there is indeed a statutory duty to perform the cultural resources mitigation at Montauk Point. If triggered by coastal storm damage such mitigation would incur a cost; therefore, avoiding that cost should, therefore be counted as a benefit.



5. If the Federal government is not mandated to follow Section 110 of the NHPA and the nature of the land conveyance, then the most likely future without-project scenario is that the bluff will erode and the historic Montauk Point Lighthouse complex will collapse. The economic analysis that follows below is based on this assumption.

6. The proxy used to place a depreciated replacement value of the Montauk Point Lighthouse complex is based on the calculations for the costs of historic property mitigation. Moving the Montauk Point Lighthouse complex, a National Historic Landmark, would preserve the structures but allow for the eventual destruction of the bluff and archaeological resources. These archaeological materials, which are contributing elements to the National Historic Landmark, must be documented through data recovery. Prior to moving the structures, each structure, individually, as well as their interrelationship as a complex, would be documented on engineering drawings and through photographs to facilitate their rebuilding on the new site as well as documenting their historic setting. Archaeological excavations would be performed to recover artifacts pertaining to the use of the lighthouse and the bluff as well as identifying any potentially significant sites at the new location. Alternatively, all of these costs could be avoided by protecting the property from storm damage.

### **Existing Conditions**

7. The lighthouse complex and the surrounding Montauk Point State Park are valued Federal and State properties respectively. Montauk Point Lighthouse complex and the State Park annual attendance figures averaged 90,657 and 866,956 persons, respectively in the 1995-2012 period. The lighthouse complex does not have a parking lot, and visitors must use the state parking lot. The average attendance for the state park only is 776,299 (866,956-90,657). These figures were obtained from Montauk Point Lighthouse and Montauk State Park offices. Recent census data indicate that the populations for Long Island and New York's five boroughs have increased by 2.3% in ten years. The population for the surveyed area increased from 10,762,191 (2000 Census) to 11,008,015 (2010 Census). The economic analysis assumes the lighthouse and state park attendance will remain stable. Tables 1-3 show lighthouse admissions, parks admissions, and state population data.



Year	Adults	Seniors	Children	Group	Total
2004	54,192	6,851	15,427	4,810	81,280
2005	49,592	6,245	14,450	4,161	74,448
2006	46,699	5,574	13,773	3,645	69,691
2007	50,634	6,518	14,567	4,616	76,335
2008	49,697	6,822	13,885	3,668	74,072
2009	51,618	7,137	14,996	4,369	78,120
2010	51,365	7,410	14,569	4,452	77,796
2011	47,770	6,911	12,812	4,118	71,611
2012	57,579	8,160	14,870	3,422	84,031
<b>Total</b>	<b>459,146</b>	<b>61,628</b>	<b>129,349</b>	<b>37,261</b>	<b>687,384</b>
<b>Avg.</b>	<b>51,016</b>	<b>6,848</b>	<b>14,372</b>	<b>4,140</b>	<b>76,376</b>

Year	Attendance
2004	905,950
2005	886,700
2006	898,910
2007	867,045
2008	904,428
2009	863,190
2010	687,830
2011	752,240
2012	738,485
<b>Total</b>	<b>7,504,778</b>
<b>Avg.</b>	<b>833,864</b>



County	1980	1990	2000	2010*	2000-2010 %Change
Nassau	1,321,582	1,287,348	1,334,544	1,339,532	0.4%
Suffolk	1,284,231	1,321,864	1,419,369	1,493,350	5.2%
Bronx	1,168,972	1,203,789	1,332,650	1,385,108	3.9%
Kings	2,231,028	2,300,664	2,465,326	2,504,700	1.6%
New York	1,428,285	1,487,536	1,537,195	1,585,873	3.2%
Queens	1,891,325	1,951,598	2,229,379	2,230,722	0.1%
Richmond	352,029	378,977	443,728	468,730	5.6%
<b>Total</b>	<b>9,677,452</b>	<b>9,931,776</b>	<b>10,762,191</b>	<b>11,008,015</b>	<b>8.4%</b>

\*Source: US Census Bureau, 2010

### **Without-Project Conditions**

7. The Montauk Point Lighthouse complex sits on a high bluff underlain with glacial till, approximately 70-feet above Mean Sea Level (MSL). It is estimated that once the upper sections of the revetment that protects the bluff are displaced by a 15-year or greater storm event, the foundation soil underlying the displaced stone will become exposed and subject to subsequent erosion. To determine the extent of this erosion at the toe of the upper bluff above the damaged revetment that would cause significant bluff failure, a slope stability analysis was performed. The results of this analysis determined that for significant bluff failure, the damaged crest elevation of the revetment should degrade to approximately elevation +10 NGVD and the upper bluff toe at this +10 NGVD elevation recede horizontally approximately 10 ft. This is anticipated to cause approximately 26-30 ft. of loss of the bluff crest which will immediately threaten the lighthouse facility at the most critical area to the southeast of the lighthouse.

8. The period of time estimated for this condition to occur, subsequent to revetment failure, is an additional 10 years of long-term erosion at the upper bluff toe (at el. +10 NGVD). A decision tree analysis was applied to calculate the probability of revetment failure for any given year through the 50-year period of economic analysis due to a 15-year or greater storm event. When revetment failure occurs, the bluff crest will erode at an average rate of 3 feet per year. The lighthouse complex will be immediately threatened after 10 years, or 30 feet of erosion at the bluff crest.

### **Proxy for Depreciated Replacement Value of Montauk Lighthouse Complex**

9. The proxy used to place an economic value of the National Historic Landmark, Montauk Point Lighthouse complex, is based on the hypothetical calculations for the costs of historic properties mitigation of the site. The economic analysis assumes that the historic properties mitigation of the site will be initiated after the revetment that protects the bluff is displaced. The estimated cost for moving the Montauk Point Lighthouse



complex and complete historic properties mitigation of the complex is \$22,090,000<sup>1</sup> (October 2014 price level), as shown in Table 4. This figure takes into account the creation of raised grades landward of the present location of the lighthouse for the move. The raised grade would be necessary to maintain the lighthouse elevation because the existing bluff elevation decreases significantly as one move away from the shorefront. The overall mitigation process would take approximately three years to complete. The cost flows for years 1 through 3 were converted to the first year that mitigation would occur. This was done to convert 3 years of expenditures into an equivalent expenditure that will occur in one year. Table 5 shows the calculations for the one-year equivalent value of the lighthouse complex if the upper section of the revetment is displaced in year 2015. Since this expenditure only happens when a 15-year or greater storm occurs, a decision tree analysis was applied to calculate the probability of occurrence throughout the 50-year period of analysis. For example, the probability for the expenditure to occur in year 0 (base year) is  $(1/15) = 0.067$ ; year 1 (base year +1) is  $(14/15)*(1/15) = .062$ ; and so forth up to the fiftieth year. The expected value (sum of the products of the probability of occurrences multiplied by the one-year equivalent cultural mitigation cost) was then amortized using a 3.375 percent discount rate and a 50-year period of analysis to calculate the average annual mitigation cost at an October 2014 price level.<sup>2</sup>

---

<sup>1</sup> The Cape Hatteras Lighthouse was relocated at a cost of \$12 million in 1999. This is equivalent to approximately \$20 million at 2015 price levels (Civil Works Construction Cost Index). Unlike the Cape Hatteras Lighthouse, which rested on a relatively flat, level surface, the Montauk Point Lighthouse rests upon a hill on top of the bluff. Raised grades would have to be built to raise the level of the ground west of the bluff up to the lighthouse grade to ensure a stable move.

<sup>2</sup> Using the long-term erosion rate of one foot per year at the upper section of the displaced revetment, by year 10, the upper bluff will be in danger of collapse. If a 15-year or greater event will occur in 2015, then 2025 is the estimated date of lighthouse failure.



Year	Tasks	Costs
1	Public Hearings	\$ 100,000
	Phase I&II Surveys	\$ 175,000
	Coordination	\$ 100,000
2	Phase 3 Archaeological Survey	\$ 2,000,000
	Coordination	\$ 60,000
	HABS Work (various)	\$ 750,000.00
	Website, Publications, etc	\$ 500,000.00
	Coordination	\$ 60,000.00
	Public Hearings	\$ 100,000.00
	Subtotal Archaeological Work	\$ 3,845,000
3	Moving Lighthouse	\$ 17,870,278
	Archaeological Monitoring	\$ 375,000
Subtotal Moving the Lighthouse		\$ 18,245,278
Total		\$ 22,090,278

Year		Present Value Factor	Mitigation Cost	Expected Value
2014	BY-4	1.1419894		\$ -
2015	BY-3	1.1047056	\$ 375,000	\$ 414,265
2016	BY-2	1.0686391	\$ 3,470,000	\$ 3,708,178
2017	BY-1	1.0337500	\$ 18,245,278	\$ 18,861,056
2018	BY	1.0000000		\$ -
Total				\$ 22,983,000

10. Table 6 shows the expected annual cultural mitigation costs and lighthouse relocation costs that would be incurred in the without-project condition when the revetment fails and bluff erosion begins. This calculation is the proxy for the depreciated replacement value of the Montauk Lighthouse complex. The year 1994 was used to initiate the probability calculations for revetment failure because 1993 was the most recent occurrence of a 15-year or greater storm event.



**Table 6. Proxy for Depreciated Replacement Value of Lighthouse Complex - without-project (October 2014 P.L., 3.375% discount rate)**

	End of year n	Probability that armor stone will be there at end of year n	Probability that armor stone won't be there at end of year n	Present Value of Lighthouse Complex in Year n	Prob. Of Damage in Year n	Expected Damage in Year n
1994	1	0.9333333	0.0666667			
1995	2	0.8711111	0.1288889			
1996	3	0.8130370	0.1869630			
1997	4	0.7588346	0.2411654			
1998	5	0.7082456	0.2917544			
1999	6	0.6610292	0.3389708			
2000	7	0.6169606	0.3830394			
2001	8	0.5758299	0.4241701			
2002	9	0.5374412	0.4625588			
2003	10	0.5016118	0.4983882			
2004	11	0.4681710	0.5318290			
2005	12	0.4369596	0.5630404			
2006	13	0.4078290	0.5921710			
2007	14	0.3806404	0.6193596			
2008	15	0.3552644	0.6447356			
2009	16	0.3315801	0.6684199			
2010	17	0.3094747	0.6905253			
2011	18	0.2888431	0.7111569			
2012	19	0.2695869	0.7304131			
2013	20	0.2516144	0.7483856			
2014	21	0.2348401	0.7651599			
2015	22	0.2191841	0.7808159			
2016	23	0.2045718	0.7954282			
2017	24	0.1909337	0.8090663			
2018	25	0.1782048	0.8217952	\$22,983,498	0.067	\$1,259,182
2019	26	0.1663245	0.8336755	\$22,233,130	0.062	\$1,153,302
2020	27	0.1552362	0.8447638	\$21,507,260	0.058	\$1,055,122
2021	28	0.1448871	0.8551129	\$20,805,088	0.054	\$964,300
2022	29	0.1352280	0.8647720	\$20,125,841	0.051	\$880,464
2023	30	0.1262128	0.8737872	\$19,468,770	0.047	\$803,224
2024	31	0.1177986	0.8822014	\$18,833,151	0.044	\$732,184
2025	32	0.1099453	0.8900547	\$18,218,284	0.041	\$666,945
2026	33	0.1026157	0.8973843	\$17,623,492	0.038	\$607,118
2027	34	0.0957746	0.9042254	\$17,048,118	0.036	\$552,323
2028	35	0.0893896	0.9106104	\$16,491,528	0.033	\$502,192
2029	36	0.0834303	0.9165697	\$15,953,111	0.031	\$456,377
2030	37	0.0778683	0.9221317	\$15,432,272	0.029	\$414,546
2031	38	0.0726771	0.9273229	\$14,928,437	0.027	\$376,385
2032	39	0.0678319	0.9321681	\$14,441,052	0.025	\$341,599
2033	40	0.0633098	0.9366902	\$13,969,578	0.024	\$309,913
2034	41	0.0590892	0.9409108	\$13,513,498	0.022	\$281,069
2035	42	0.0551499	0.9448501	\$13,072,307	0.021	\$254,829
2036	43	0.0514732	0.9485268	\$12,645,521	0.019	\$230,971
2037	44	0.0480417	0.9519583	\$12,232,668	0.018	\$209,289
2038	45	0.0448389	0.9551611	\$11,833,295	0.017	\$189,595
2039	46	0.0418496	0.9581504	\$11,446,960	0.016	\$171,714
2040	47	0.0390597	0.9609403	\$11,073,238	0.015	\$155,485
2041	48	0.0364557	0.9635443	\$10,711,718	0.014	\$140,762
2042	49	0.0340253	0.9659747	\$10,362,000	0.013	\$127,409
2043	50	0.0317570	0.9682430	\$10,023,700	0.012	\$115,303
2044	51	0.0296398	0.9703602	\$9,696,445	0.011	\$104,330
2045	52	0.0276638	0.9723362	\$9,379,874	0.010	\$94,388
2046	53	0.0258196	0.9741804	\$9,073,639	0.010	\$85,381
2047	54	0.0240983	0.9759017	\$8,777,402	0.009	\$77,223
2048	55	0.0224917	0.9775083	\$8,490,836	0.008	\$69,837
2049	56	0.0209923	0.9790077	\$8,213,626	0.008	\$63,149
2050	57	0.0195928	0.9804072	\$7,945,467	0.007	\$57,097
2051	58	0.0182866	0.9817134	\$7,686,062	0.007	\$51,619
2052	59	0.0170675	0.9829325	\$7,435,127	0.006	\$46,663
2053	60	0.0159297	0.9840703	\$7,192,384	0.006	\$42,179
2054	61	0.0148677	0.9851323	\$6,957,566	0.006	\$38,123
2055	62	0.0138765	0.9861235	\$6,730,414	0.005	\$34,454
2056	63	0.0129514	0.9870486	\$6,510,679	0.005	\$31,137
2057	64	0.0120880	0.9879120	\$6,298,117	0.005	\$28,137
2058	65	0.0112821	0.9887179	\$6,092,496	0.004	\$25,424
2059	66	0.0105300	0.9894700	\$5,893,587	0.004	\$22,972
2060	67	0.0098280	0.9901720	\$5,701,173	0.004	\$20,755
2061	68	0.0091728	0.9908272	\$5,515,040	0.003	\$18,752
2062	69	0.0085613	0.9914387	\$5,334,984	0.003	\$16,940
2063	70	0.0079905	0.9920095	\$5,160,807	0.003	\$15,304
2064	71	0.0074578	0.9925422	\$4,992,316	0.003	\$13,825
2065	72	0.0069606	0.9930394	\$4,829,327	0.003	\$12,488
2066	73	0.0064966	0.9935034	\$4,671,658	0.002	\$11,280
2067	74	0.0060635	0.9939365	\$4,519,137	0.002	\$10,189
						\$13,933,059
					Annual Damages	\$580,692



## Local Costs Forgone

11. The lighthouse complex is situated on 3 acres of land, specifically a bluff that has an appraised value of \$17.1 million<sup>3</sup>. It is estimated that the top of the bluff will erode at a rate of 3 feet per year when the revetment fails. Because of the complexity of actually replacing the bluff surface, a prorated amount of the appraised value of land lost was used as a proxy for the local costs forgone for this loss in the without-project condition. The local costs forgone for this land value due to long-term erosion are calculated to be \$123,000 per year. The average annual local costs forgone are \$117,100 as shown in Table 7. The two numbers differ because the average annual costs take into account the probability that revetment failure will not occur immediately.

---

<sup>3</sup> The land was appraised for \$12 million in 2004. The land value has been adjusted to October 2014 price levels using CPI rent for primary residences,  $(351.398/246.9) \times \$12 \text{ million} = \$16.6 \text{ million}$



**Table 7. Local Costs Forgone (October 2014 P.L. 3.375% discount rate)**

End of year n	Probability that armor stone will be there at end of year n	Probability that armor stone won't be there at end of year n	Present Value Factor		
1994	1	0.9333333	0.0666667		
1995	2	0.8711111	0.1288889		
1996	3	0.8130370	0.1869630		
1997	4	0.7588346	0.2411654		
1998	5	0.7082456	0.2917544		
1999	6	0.6610292	0.3389708		
2000	7	0.6169606	0.3830394		
2001	8	0.5758299	0.4241701		
2002	9	0.5374412	0.4625588		
2003	10	0.5016111	0.4983882		
2004	11	0.4681710	0.5318290		
2005	12	0.4369596	0.5630404		
2006	13	0.4078290	0.5921710		
2007	14	0.3806404	0.6193596		
2008	15	0.3552644	0.6447356		
2009	16	0.3315801	0.6684199		
2010	17	0.3094747	0.6905253		
2011	18	0.2888431	0.7111566		
2012	19	0.2695869	0.7304131		
2013	20	0.2516144	0.7483856		
2014	21	0.2348401	0.7651599		
2015	22	0.2191841	0.7808159		
2016	23	0.2045718	0.7954282		
2017	24	0.1909337	0.8090663	1.000000	\$123,000
2018	25	0.1782048	0.8217952	0.9673519	\$123,000
2019	26	0.1663245	0.8336755	0.9357696	\$123,000
2020	27	0.1552362	0.8447638	0.9052185	\$123,000
2021	28	0.1448871	0.8551129	0.8756648	\$123,000
2022	29	0.1352280	0.8647720	0.8470760	\$123,000
2023	30	0.1262128	0.8737872	0.8194206	\$123,000
2024	31	0.1177986	0.8822014	0.7926680	\$123,000
2025	32	0.1099453	0.8900547	0.7667889	\$123,000
2026	33	0.1026157	0.8973843	0.7417547	\$123,000
2027	34	0.0957746	0.9042254	0.7175378	\$123,000
2028	35	0.0893896	0.9106104	0.6941115	\$123,000
2029	36	0.0834303	0.9165697	0.6714501	\$123,000
2030	37	0.0778683	0.9221317	0.6495285	\$123,000
2031	38	0.0726771	0.9273229	0.6283226	\$123,000
2032	39	0.0678319	0.9321681	0.6078090	\$123,000
2033	40	0.0633098	0.9366902	0.5879652	\$123,000
2034	41	0.0590892	0.9409108	0.5687693	\$123,000
2035	42	0.0551499	0.9448501	0.5502000	\$123,000
2036	43	0.0514732	0.9485268	0.5322370	\$123,000
2037	44	0.0480417	0.9519583	0.5148605	\$123,000
2038	45	0.0448389	0.9551611	0.4980512	\$123,000
2039	46	0.0418496	0.9581504	0.4817908	\$123,000
2040	47	0.0390597	0.9609403	0.4660612	\$123,000
2041	48	0.0364557	0.9635443	0.4508452	\$123,000
2042	49	0.0340253	0.9659747	0.4361260	\$123,000
2043	50	0.0317570	0.9682430	0.4218873	\$123,000
2044	51	0.0296398	0.9703602	0.4081134	\$123,000
2045	52	0.0276638	0.9723362	0.3947893	\$123,000
2046	53	0.0258196	0.9741804	0.3819002	\$123,000
2047	54	0.0240983	0.9759017	0.3694318	\$123,000
2048	55	0.0224917	0.9775083	0.3573706	\$123,000
2049	56	0.0209923	0.9790077	0.3457031	\$123,000
2050	57	0.0195928	0.9804072	0.3344165	\$123,000
2051	58	0.0182866	0.9817134	0.3234985	\$123,000
2052	59	0.0170675	0.9829325	0.3129369	\$123,000
2053	60	0.0159297	0.9840703	0.3027201	\$123,000
2054	61	0.0148677	0.9851323	0.2928368	\$123,000
2055	62	0.0138765	0.9861235	0.2832762	\$123,000
2056	63	0.0129514	0.9870486	0.2740278	\$123,000
2057	64	0.0120880	0.9879120	0.2650813	\$123,000
2058	65	0.0112821	0.9887179	0.2564269	\$123,000
2059	66	0.0105300	0.9894700	0.2480550	\$123,000
2060	67	0.0098280	0.9901720	0.2399565	\$123,000
2061	68	0.0091728	0.9908272	0.2321224	\$123,000
2062	69	0.0085613	0.9914387	0.2245440	\$123,000
2063	70	0.0079905	0.9920095	0.2172131	\$123,000
2064	71	0.0074578	0.9925422	0.2101215	\$123,000
2065	72	0.0069606	0.9930394	0.2032614	\$123,000
2066	73	0.0064966	0.9935034	0.1966253	\$123,000
					\$2,810,548
				Annual Damages	\$117,136



## Recreation Loss

12. Another without-project consequence of storm damage to the bluff would be loss visitations to the lighthouse. Visitation losses associated with the lighthouse's closure were assessed using the Travel Cost Estimate of Willingness to Pay. The lighthouse has a log in which visitors indicate the places where they are traveling from to visit. A recent sample from the log was used to estimate the round-trip distance from each origin. The values of losses are the costs in cents per mile to operate an automobile, plus the opportunity costs of time spent in travel and on site. Surveys were conducted to determine the number of visitors that make the trip to Montauk, NY exclusively to visit the lighthouse. Based on the survey, 47% of the people sampled indicated that visiting the Montauk Lighthouse complex was the reason they drove to Montauk, New York. The remaining 53% of the people indicated that visiting the Montauk Lighthouse complex was part of their itinerary on their visit to Long Island, New York. The travel costs attributed to this category were prorated at 25% of their total travel costs.

13. A rate of \$0.575 per mile<sup>4</sup> was used for calculating the operating costs per car. Costs per person were calculated using state park figures of 3.5 persons per car. The opportunity cost of time is 1/3 and 1/12 the average wage rate for adults and children, respectively. The hourly wage rate is \$20.20<sup>5</sup>. The estimated car driving speed is 40 mph. Tables 8 and 9 show the calculations for the Travel Cost Method. As a result, \$2,700,900 in annual visitation losses have been projected for all visitors to the Montauk Point Lighthouse complex including admissions fees.

---

<sup>4</sup> IRS mileage rate for 2015.

<sup>5</sup> The estimated average payroll tax rate for the region is 30%. The current hourly wage rate is \$28.39 (US Dept. of Labor, May 2014) multiplied by the CPI factor to bring the price level to October 2014 (260.5/256.27). The after-tax hourly wage rate is  $0.7 \times \$28.39 (260.5/256.27) = \$20.20$ .



Table 8. Montauk Point Lighthouse Travel Cost Method												
Mean Hourly Wage	Oct-14		Adult time cost/hr		Child time cost/hr					Annual Admission Fees		
NY&NJ metropolitan area	\$20.20		\$6.73		\$1.68					\$515,093		
Cost per mile	0.575		Avq. time spent									
Round Trip Factor	2		at lighthouse		1 hour							
People per car	3.5		No. Adults per year		59589							
Avg. driving speed	40		No. Children per year		16787							
Residence	No. of people sampled	Multiply Factor	No. of Adults	No. of Children	Miles to Montauk	Travel Cost Per Car	Car Travel Cost per Person	Total Travel Cost	Travel time cost per adult	Travel time cost per child	Total travel time cost	Total time cost spent at lighthouse
E. Hampton	40	0.022	1339	377	16	\$18.40	\$5.26	9,023	\$5.39	\$1.35	\$7,721	\$9,651
So. Hampton(1)	6	0.003	201	57	31	\$35.65	\$10.19	2,622	\$10.44	\$2.61	\$2,244	\$1,448
So. Hampton(2)	7	0.004	234	66	45	\$51.75	\$14.79	4,441	\$15.15	\$3.79	\$3,800	\$1,689
Southold	11	0.006	368	104	42	\$48.30	\$13.80	6,513	\$14.14	\$3.54	\$5,574	\$2,654
Riverhead	10	0.006	335	94	48	\$55.20	\$15.77	6,767	\$16.16	\$4.04	\$5,791	\$2,413
Brookhaven(1)	73	0.041	2444	688	61	\$70.15	\$20.04	62,780	\$20.54	\$5.13	\$53,722	\$17,614
Brookhaven(2)	74	0.042	2477	698	67	\$77.05	\$22.01	69,899	\$22.56	\$5.64	\$59,815	\$17,855
Islip	100	0.056	3348	943	74	\$85.10	\$24.31	104,327	\$24.91	\$6.23	\$89,276	\$24,129
Smithtown	16	0.009	536	151	76	\$87.40	\$24.97	17,144	\$25.59	\$6.40	\$14,670	\$3,861
Babylon	83	0.047	2779	783	83	\$95.45	\$27.27	97,123	\$27.94	\$6.99	\$83,111	\$20,027
Huntington	48	0.027	1607	453	88	\$101.20	\$28.91	59,551	\$29.63	\$7.41	\$50,960	\$11,587
Oyster Bay	21	0.012	703	198	95	\$109.25	\$31.21	28,126	\$31.98	\$8.00	\$24,068	\$5,067
So. Oyster Bay	21	0.012	703	198	90	\$103.50	\$29.57	26,646	\$30.30	\$7.58	\$22,802	\$5,067
Hempstead	143	0.080	4787	1349	100	\$115.00	\$32.86	201,606	\$33.67	\$8.42	\$172,520	\$34,504
No. Hempstead	19	0.011	636	179	103	\$118.45	\$33.84	27,590	\$34.68	\$8.67	\$23,610	\$4,584
Queens	99	0.056	3314	934	115	\$132.25	\$37.79	160,509	\$38.72	\$9.68	\$137,352	\$23,887
Brooklyn	40	0.022	1339	377	115	\$132.25	\$37.79	64,852	\$38.72	\$9.68	\$55,496	\$9,651
Manhattan	106	0.060	3549	1000	116	\$133.40	\$38.11	173,353	\$39.05	\$9.76	\$148,343	\$25,576
Bronx	24	0.013	803	226	120	\$138.00	\$39.43	40,603	\$40.40	\$10.10	\$34,745	\$5,791
Staten Island	12	0.007	402	113	120	\$138.00	\$39.43	20,302	\$40.40	\$10.10	\$17,373	\$2,895
Others	827	0.465	27685	7799	20	\$23.00	\$6.57	233,186	\$6.73	\$1.68	\$199,544	\$199,544
<b>Total</b>	<b>1780</b>	<b>1</b>	<b>59589</b>	<b>16787</b>				<b>1,416,964</b>			<b>\$1,212,537</b>	<b>\$429,490</b>
<b>Prorated Travel Cost</b>								<b>\$946,412</b>			<b>\$809,872</b>	<b>\$429,490</b>



Prorated Car Travel Cost	\$	946,412
Prorated Travel Time Cost	\$	809,872
Time Spent at Lighthouse Cost	\$	429,490
Admissions Cost	\$	515,093
Total	\$	2,700,867

14. Lighthouse visitations will be lost when the existing revetment is damaged by a 15-year or greater storm event, followed by 10 years of erosion to the bluff. If the revetment is damaged in year 2015, the lighthouse visitations will be lost starting in year 2025. Since the base year is 2018, the lighthouse visitations will be lost from 2025 through 2066. The \$2,700,900 per year of lighthouse visitations from 2025 through 2067 is discounted to the first year that visitations are lost, year 2025. This was done to convert 43 years of lost visitations into a one-year equivalent loss that will occur in 2025. Similar calculations converted the lost visitations into one-year equivalents losses that will occur in years 2026 through 2067. These results are shown in Table 10. The average annual lighthouse visitations are calculated to be \$1,140,300 as shown in Table 11.



**Table 10. Montauk Point Lighthouse Visitations - Calculation for one-year equivalent value in year n (October 2013 P.L., 3.375% discount rate)**

Year	Present Value Factor	Lighthouse Visitations in year n	Lighthouse Visitations Present Value	Lighthouse Visitations 1-yr equivalent value in year n
2018	1			
2019	0.967351874			
2020	0.935769649			
2021	0.905218523			
2022	0.875664835			
2023	0.84707602			
2024	0.819420575			
2025	0.792668029	\$2,700,867	\$2,140,891	\$49,839,620
2026	0.766788904	\$2,700,867	\$2,070,995	\$47,698,729
2027	0.741754683	\$2,700,867	\$2,003,381	\$45,627,734
2028	0.717537783	\$2,700,867	\$1,937,974	\$43,624,354
2029	0.694111519	\$2,700,867	\$1,874,703	\$41,686,380
2030	0.671450079	\$2,700,867	\$1,813,497	\$39,811,677
2031	0.649528492	\$2,700,867	\$1,754,290	\$37,998,179
2032	0.628322604	\$2,700,867	\$1,697,016	\$36,243,889
2033	0.607809049	\$2,700,867	\$1,641,611	\$34,546,874
2034	0.587965223	\$2,700,867	\$1,588,016	\$32,905,262
2035	0.56876926	\$2,700,867	\$1,536,170	\$31,317,246
2036	0.55020001	\$2,700,867	\$1,486,017	\$29,781,076
2037	0.532237011	\$2,700,867	\$1,437,501	\$28,295,059
2038	0.51486047	\$2,700,867	\$1,390,570	\$26,857,558
2039	0.498051241	\$2,700,867	\$1,345,170	\$25,466,988
2040	0.481790801	\$2,700,867	\$1,301,253	\$24,121,818
2041	0.466061234	\$2,700,867	\$1,258,769	\$22,820,565
2042	0.450845209	\$2,700,867	\$1,217,673	\$21,561,796
2043	0.436125958	\$2,700,867	\$1,177,918	\$20,344,123
2044	0.421887262	\$2,700,867	\$1,139,461	\$19,166,205
2045	0.408113434	\$2,700,867	\$1,102,260	\$18,026,743
2046	0.394789295	\$2,700,867	\$1,066,273	\$16,924,483
2047	0.381900165	\$2,700,867	\$1,031,462	\$15,858,210
2048	0.36943184	\$2,700,867	\$997,786	\$14,826,749
2049	0.357370583	\$2,700,867	\$965,210	\$13,828,962
2050	0.345703103	\$2,700,867	\$933,698	\$12,863,752
2051	0.334416545	\$2,700,867	\$903,215	\$11,930,054
2052	0.323498471	\$2,700,867	\$873,726	\$11,026,839
2053	0.312936853	\$2,700,867	\$845,201	\$10,153,113
2054	0.302720051	\$2,700,867	\$817,607	\$9,307,912
2055	0.292836809	\$2,700,867	\$790,913	\$8,490,305
2056	0.283276236	\$2,700,867	\$765,091	\$7,699,392
2057	0.274027798	\$2,700,867	\$740,113	\$6,934,301
2058	0.265081304	\$2,700,867	\$715,949	\$6,194,188
2059	0.256426896	\$2,700,867	\$692,575	\$5,478,239
2060	0.248055038	\$2,700,867	\$669,964	\$4,785,664
2061	0.239956506	\$2,700,867	\$648,091	\$4,115,700
2062	0.232122376	\$2,700,867	\$626,932	\$3,467,610
2063	0.224544015	\$2,700,867	\$606,464	\$2,840,678
2064	0.217213074	\$2,700,867	\$586,664	\$2,234,215
2065	0.210121474	\$2,700,867	\$567,510	\$1,647,551
2066	0.203261402	\$2,700,867	\$548,982	\$1,080,041
2067	0.196625298	\$2,700,867	\$531,059	\$531,059



**Table 11. Lighthouse Visitations Damages - without-project**  
(October 2014 P.L., 3.375% discount rate)

	End of year n	Probability that armor stone will be there at end of year n	Probability that armor stone won't be there at end of year n	Present Value of Visitations for Year n	Prob. Of Damage in Year n	Expected Damage in Year n
1994	1	0.9333333	0.0666667			
1995	2	0.8711111	0.1288889			
1996	3	0.8130370	0.1869630			
1997	4	0.7588346	0.2411654			
1998	5	0.7082456	0.2917544			
1999	6	0.6610292	0.3389708			
2000	7	0.6169606	0.3830394			
2001	8	0.5758299	0.4241701			
2002	9	0.5374412	0.4625588			
2003	10	0.5016118	0.4983882			
2004	11	0.4681710	0.5318290			
2005	12	0.4369596	0.5630404			
2006	13	0.4078290	0.5921710			
2007	14	0.3806404	0.6193596			
2008	15	0.3552644	0.6447356			
2009	16	0.3315801	0.6684199			
2010	17	0.3094747	0.6905253			
2011	18	0.2888431	0.7111569			
2012	19	0.2695869	0.7304131			
2013	20	0.2516144	0.7483856			
2014	21	0.2348401	0.7651599			
2015	22	0.2191841	0.7808159			
2016	23	0.2045718	0.7954282			
2017	24	0.1909337	0.8090663			
2018	25	0.1782048	0.8217952			
2019	26	0.1663245	0.8336755			
2020	27	0.1552362	0.8447638			
2021	28	0.1448871	0.8551129			
2022	29	0.1352280	0.8647720			
2023	30	0.1262128	0.8737872			
2024	31	0.1177986	0.8822014			
2025	32	0.1099453	0.8900547	\$49,839,620	0.067	\$2,957,332
2026	33	0.1026157	0.8973843	\$47,698,729	0.062	\$2,663,366
2027	34	0.0957746	0.9042254	\$45,627,734	0.058	\$2,396,006
2028	35	0.0893896	0.9106104	\$43,624,354	0.054	\$2,153,182
2029	36	0.0834303	0.9165697	\$41,686,380	0.051	\$1,932,927
2030	37	0.0778683	0.9221317	\$39,811,677	0.047	\$1,733,389
2031	38	0.0726771	0.9273229	\$37,998,179	0.044	\$1,552,827
2032	39	0.0678319	0.9321681	\$36,243,889	0.041	\$1,389,617
2033	40	0.0633098	0.9366902	\$34,546,874	0.038	\$1,242,246
2034	41	0.0590892	0.9409108	\$32,905,262	0.036	\$1,109,312
2035	42	0.0551499	0.9448501	\$31,317,246	0.033	\$989,516
2036	43	0.0514732	0.9485268	\$29,781,076	0.031	\$881,664
2037	44	0.0480417	0.9519583	\$28,295,059	0.029	\$784,655
2038	45	0.0448389	0.9551611	\$26,857,558	0.027	\$697,477
2039	46	0.0418496	0.9581504	\$25,466,988	0.025	\$619,206
2040	47	0.0390597	0.9609403	\$24,121,818	0.024	\$548,993
2041	48	0.0364557	0.9635443	\$22,820,565	0.022	\$486,066
2042	49	0.0340253	0.9659747	\$21,561,796	0.021	\$429,719
2043	50	0.0317570	0.9682430	\$20,344,123	0.019	\$379,310
2044	51	0.0296398	0.9703602	\$19,166,205	0.018	\$334,254
2045	52	0.0276638	0.9723362	\$18,026,743	0.017	\$294,021
2046	53	0.0258196	0.9741804	\$16,924,483	0.016	\$258,128
2047	54	0.0240983	0.9759017	\$15,858,210	0.015	\$226,140
2048	55	0.0224917	0.9775083	\$14,826,749	0.014	\$197,661
2049	56	0.0209923	0.9790077	\$13,828,962	0.013	\$172,332
2050	57	0.0195928	0.9804072	\$12,863,752	0.012	\$149,831
2051	58	0.0182866	0.9817134	\$11,930,054	0.011	\$129,865
2052	59	0.0170675	0.9829325	\$11,026,839	0.010	\$112,170
2053	60	0.0159297	0.9840703	\$10,153,113	0.010	\$96,508
2054	61	0.0148677	0.9851323	\$9,307,912	0.009	\$82,665
2055	62	0.0138765	0.9861235	\$8,490,305	0.008	\$70,448
2056	63	0.0129514	0.9870486	\$7,699,392	0.008	\$59,682
2057	64	0.0120880	0.9879120	\$6,934,301	0.007	\$50,212
2058	65	0.0112821	0.9887179	\$6,194,188	0.007	\$41,897
2059	66	0.0105300	0.9894700	\$5,478,239	0.006	\$34,610
2060	67	0.0098280	0.9901720	\$4,785,664	0.006	\$28,239
2061	68	0.0091728	0.9908272	\$4,115,700	0.006	\$22,682
2062	69	0.0085613	0.9914387	\$3,467,610	0.005	\$17,847
2063	70	0.0079905	0.9920095	\$2,840,678	0.005	\$13,654
2064	71	0.0074578	0.9925422	\$2,234,215	0.005	\$10,028
2065	72	0.0069606	0.9930394	\$1,647,551	0.004	\$6,905
2066	73	0.0064966	0.9935034	\$1,080,041	0.004	\$4,227
2067	74	0.0060635	0.9939365	\$531,059	0.004	\$1,941
						\$27,360,817
					Annual Damages	\$1,140,324



15. The Montauk Point Lighthouse complex resides within the Montauk Point State Park. The Montauk Point Lighthouse complex offers a unique experience that is not found elsewhere in the New York metropolitan area. Part of the state park experience is its connection with the lighthouse complex. There will be a reduction to the overall aesthetics and recreational value of the state park visitations if the lighthouse complex did not exist. Per ER 1105-2-100, Planning Guidance Notebook, the Unit Day Value method was used to assign visitation values to the state park for the with-project and without-project conditions. It is estimated that the current value for the recreational experience is \$8.67. Without the lighthouse complex, the recreational experience is reduced to an estimate of \$7.52. The annual benefits lost from state park visitations experience are \$862,500 based on 750,000 visitations<sup>6</sup>. Table 12 shows the calculations for the state park recreation values based on Unit Day Value calculations. The two criteria that differ from the without-project versus with-project conditions are the recreation experience and the availability of opportunity. The recreation experience with the project in place will preserve the lighthouse and therefore, have one high quality value activity, the ability to visit the lighthouse. The assigned recreation experience value with the project in place is 15 points versus 10 points in the without-project condition. The availability of opportunity value is also increased with preserving the lighthouse. There is no recreation area that has a historic lighthouse within an hour's drive of Montauk Point State Park<sup>7</sup>. The assigned availability of opportunity value with the project in place is 14 points versus 6 points in the without-project condition. The average annual reduced state park usage values will be incurred when the existing revetment is damaged by a 15-year or greater storm event, and after 10 years of long-term erosion have occurred to the bluff. Tables 13 shows the one-year equivalent reduced state park visitation usages for years 2025 through 2067 and Table 14 shows calculations for the average annual reduced state park recreational experience to be \$364,200.

---

<sup>6</sup> Unit Day Value was used due to study cost considerations. The difference in state park usage value is \$1.15 per visit.  $750,000 \text{ visitations} \times \$1.15 = \$862,500$  (Oct. 2014 P.L.). Although the average annual visitations to the State Park are 833,900, the method of using Unit Day Value to evaluate recreation usage imposes an annual visitation cap of 750,000 persons.

<sup>7</sup> Montauk Point Lighthouse is the oldest lighthouse in New York State. The lighthouse was authorized by the Second Congress, under President George Washington, in 1792. This National Historic Landmark is the fourth oldest active lighthouse in the United States.



<b>Table 12: State Park Visitations, Guidelines for Assigning Points for General Recreation - Unit Day Values</b>							
<b>Criteria</b>	<b>Judgment Factors</b>					<b>Points Assigned Without Project</b>	<b>Points Assigned With Project</b>
<b>Recreation experience<sup>1</sup></b>	Two general activities <sup>2</sup>	Several general activities	Several general activities; one high quality value activity <sup>3</sup>	Several general activities; more than one high quality value activity	Numerous high quality value activities; some general activities		
Total Points: 30							
Point Value:	0-4	5-10	11-16	17-23	24-30	<b>10</b>	<b>15</b>
<b>Availability of opportunity<sup>4</sup></b>	Several within 1 hr. travel time; a few within 30 min. travel time	Several within 1 hr. travel time; none within 30 min. travel time	One or two within 1 hr. travel time; none within 45 min. travel time	None within 1 hr. travel time	None within 2 hr. travel time		
Total Points: 18							
Point Value:	0-3	4-6	7-10	11-14	15-18	<b>6</b>	<b>14</b>
<b>Carrying Capacity<sup>5</sup></b>	Minimum facility for development for public health and safety	Basic facility to conduct activity(ies)	Adequate facilities to conduct without deterioration of the resource or activity experience	Optimum facilities to conduct activity at site potential	Ultimate facilities to achieve intent of selected alternative		
Total Points: 14							
Point Value:	0-2	3-5	6-8	9-11	12-14	<b>6</b>	<b>6</b>
<b>Accessibility</b>	Limited access by any means to site or within site	Fair access, poor quality roads to site; limited access within site	Fair access, fair road to site; fair access, good roads within site	Good access, good roads to site; fair access, good roads within site	Good access, high standard road to site; good access within site		
Total Points: 18							
Point Value:	0-3	4-6	7-10	11-14	15-18	<b>10</b>	<b>10</b>
<b>Environmental</b>	Low esthetic factors <sup>6</sup> that significantly lower quality <sup>7</sup>	Average esthetic quality; factors exist that lower quality to minor degree	Above average esthetic quality; any limiting factors can be reasonably rectified	High esthetic quality; no factors exist that lower quality	Outstanding esthetic quality; no factors exist that lower quality		
Total Points: 20							
Point Value:	0-2	3-6	7-10	11-15	16-20	<b>10</b>	<b>10</b>
					<b>Total Points</b>	<b>42</b>	<b>55</b>
					<b>Unit Day Value</b>	<b>\$7.52</b>	<b>\$8.67</b>

<sup>1</sup>Value for water-oriented activities should be adjusted if significant seasonal water level changes occur.

<sup>2</sup>General activities include those that are common to the region and that are usually of normal quality. This includes picnicking, camping, hiking, riding, cycling, and fishing and hunting of normal quality.

<sup>3</sup>High quality value activities include those that are not common to the region and/or Nation, and that are usually of high quality.

<sup>4</sup>Likelihood of success are fishing and hunting.

<sup>5</sup>Value should be adjusted for overuse.

<sup>6</sup>Major aesthetic qualities to be considered include geology and topography, water, and vegetation.

<sup>7</sup>Factors to be considered to lowering quality include air and water pollution, pests, poor climate, and unsightly adjacent areas.



**Table 13. Montauk Point State Park Visitations - Calculation for one-year equivalent value in year n (October 2014 P.L., 3.375% discount rate)**

Year	Present Value Factor	State Park Visitations in year n	State Park Visitations Present Value	State Park Visitations 1-yr equivalent value in year n
2018	1			
2019	0.967351874			
2020	0.935769649			
2021	0.905218523			
2022	0.875664835			
2023	0.84707602			
2024	0.819420575			
2025	0.792668029	\$862,500	\$683,676	\$15,915,879
2026	0.766788904	\$862,500	\$661,355	\$15,232,203
2027	0.741754683	\$862,500	\$639,763	\$14,570,848
2028	0.717537783	\$862,500	\$618,876	\$13,931,084
2029	0.694111519	\$862,500	\$598,671	\$13,312,208
2030	0.671450079	\$862,500	\$579,126	\$12,713,537
2031	0.649528492	\$862,500	\$560,218	\$12,134,411
2032	0.628322604	\$862,500	\$541,928	\$11,574,193
2033	0.607809049	\$862,500	\$524,235	\$11,032,264
2034	0.587965223	\$862,500	\$507,120	\$10,508,029
2035	0.56876926	\$862,500	\$490,563	\$10,000,909
2036	0.55020001	\$862,500	\$474,548	\$9,510,346
2037	0.532237011	\$862,500	\$459,054	\$9,035,798
2038	0.51486047	\$862,500	\$444,067	\$8,576,744
2039	0.498051241	\$862,500	\$429,569	\$8,132,677
2040	0.481790801	\$862,500	\$415,545	\$7,703,107
2041	0.466061234	\$862,500	\$401,978	\$7,287,563
2042	0.450845209	\$862,500	\$388,854	\$6,885,585
2043	0.436125958	\$862,500	\$376,159	\$6,496,731
2044	0.421887262	\$862,500	\$363,878	\$6,120,572
2045	0.408113434	\$862,500	\$351,998	\$5,756,695
2046	0.394789295	\$862,500	\$340,506	\$5,404,697
2047	0.381900165	\$862,500	\$329,389	\$5,064,191
2048	0.36943184	\$862,500	\$318,635	\$4,734,802
2049	0.357370583	\$862,500	\$308,232	\$4,416,167
2050	0.345703103	\$862,500	\$298,169	\$4,107,935
2051	0.334416545	\$862,500	\$288,434	\$3,809,766
2052	0.323498471	\$862,500	\$279,017	\$3,521,332
2053	0.312936853	\$862,500	\$269,908	\$3,242,314
2054	0.302720051	\$862,500	\$261,096	\$2,972,406
2055	0.292836809	\$862,500	\$252,572	\$2,711,310
2056	0.283276236	\$862,500	\$244,326	\$2,458,739
2057	0.274027798	\$862,500	\$236,349	\$2,214,413
2058	0.265081304	\$862,500	\$228,633	\$1,978,064
2059	0.256426896	\$862,500	\$221,168	\$1,749,431
2060	0.248055038	\$862,500	\$213,947	\$1,528,263
2061	0.239956506	\$862,500	\$206,962	\$1,314,316
2062	0.232122376	\$862,500	\$200,206	\$1,107,353
2063	0.224544015	\$862,500	\$193,669	\$907,148
2064	0.217213074	\$862,500	\$187,346	\$713,478
2065	0.210121474	\$862,500	\$181,230	\$526,132
2066	0.203261402	\$862,500	\$175,313	\$344,902
2067	0.196625298	\$862,500	\$169,589	\$169,589



**Table 14. Park Visitation Damages - without-project design**  
(October 2013 P.L., 3.5% discount rate)

	End of year n	Probability that armor stone will be there at end of year n	Probability that armor stone won't be there at end of year n	Present Value of Visitation for Year n	Prob. Of Damage in Year n	Expected Damage in Year n
1994	1	0.9333333	0.0666667			
1995	2	0.8711111	0.1288889			
1996	3	0.8130370	0.1869630			
1997	4	0.7588346	0.2411654			
1998	5	0.7082456	0.2917544			
1999	6	0.6610292	0.3389708			
2000	7	0.6169606	0.3830394			
2001	8	0.5758299	0.4241701			
2002	9	0.5374412	0.4625588			
2003	10	0.5016118	0.4983882			
2004	11	0.4681710	0.5318290			
2005	12	0.4369596	0.5630404			
2006	13	0.4078290	0.5921710			
2007	14	0.3806404	0.6193596			
2008	15	0.3552644	0.6447356			
2009	16	0.3315801	0.6684199			
2010	17	0.3094747	0.6905253			
2011	18	0.2888431	0.7111569			
2012	19	0.2695869	0.7304131			
2013	20	0.2516144	0.7483856			
2014	21	0.2348401	0.7651599			
2015	22	0.2191841	0.7808159			
2016	23	0.2045718	0.7954282			
2017	24	0.1909337	0.8090663			
2018	25	0.1782048	0.8217952			
2019	26	0.1663245	0.8336755			
2020	27	0.1552362	0.8447638			
2021	28	0.1448871	0.8551129			
2022	29	0.1352280	0.8647720			
2023	30	0.1262128	0.8737872			
2024	31	0.1177986	0.8822014			
2025	32	0.1099453	0.8900547	\$15,915,879	0.067	\$944,400
2026	33	0.1026157	0.8973843	\$15,232,203	0.062	\$850,524
2027	34	0.0957746	0.9042254	\$14,570,848	0.058	\$765,145
2028	35	0.0893896	0.9106104	\$13,931,084	0.054	\$687,601
2029	36	0.0834303	0.9165697	\$13,312,208	0.051	\$617,265
2030	37	0.0778683	0.9221317	\$12,713,537	0.047	\$553,544
2031	38	0.0726771	0.9273229	\$12,134,411	0.044	\$495,883
2032	39	0.0678319	0.9321681	\$11,574,193	0.041	\$443,763
2033	40	0.0633098	0.9366902	\$11,032,264	0.038	\$396,701
2034	41	0.0590892	0.9409108	\$10,508,029	0.036	\$354,250
2035	42	0.0551499	0.9448501	\$10,000,909	0.033	\$315,994
2036	43	0.0514732	0.9485268	\$9,510,346	0.031	\$281,552
2037	44	0.0480417	0.9519583	\$9,035,798	0.029	\$250,573
2038	45	0.0448389	0.9551611	\$8,576,744	0.027	\$222,734
2039	46	0.0418496	0.9581504	\$8,132,677	0.025	\$197,738
2040	47	0.0390597	0.9609403	\$7,703,107	0.024	\$175,316
2041	48	0.0364557	0.9635443	\$7,287,563	0.022	\$155,221
2042	49	0.0340253	0.9659747	\$6,885,585	0.021	\$137,227
2043	50	0.0317570	0.9682430	\$6,496,731	0.019	\$121,130
2044	51	0.0296398	0.9703602	\$6,120,572	0.018	\$106,741
2045	52	0.0276638	0.9723362	\$5,756,695	0.017	\$93,893
2046	53	0.0258196	0.9741804	\$5,404,697	0.016	\$82,431
2047	54	0.0240983	0.9759017	\$5,064,191	0.015	\$72,216
2048	55	0.0224917	0.9775083	\$4,734,802	0.014	\$63,121
2049	56	0.0209923	0.9790077	\$4,416,167	0.013	\$55,033
2050	57	0.0195928	0.9804072	\$4,107,935	0.012	\$47,847
2051	58	0.0182866	0.9817134	\$3,809,766	0.011	\$41,471
2052	59	0.0170675	0.9829325	\$3,521,332	0.010	\$35,821
2053	60	0.0159297	0.9840703	\$3,242,314	0.010	\$30,819
2054	61	0.0148677	0.9851323	\$2,972,406	0.009	\$26,398
2055	62	0.0138765	0.9861235	\$2,711,310	0.008	\$22,497
2056	63	0.0129514	0.9870486	\$2,458,739	0.008	\$19,059
2057	64	0.0120880	0.9879120	\$2,214,413	0.007	\$16,035
2058	65	0.0112821	0.9887179	\$1,978,064	0.007	\$13,379
2059	66	0.0105300	0.9894700	\$1,749,431	0.006	\$11,052
2060	67	0.0098280	0.9901720	\$1,528,263	0.006	\$9,018
2061	68	0.0091728	0.9908272	\$1,314,316	0.006	\$7,243
2062	69	0.0085613	0.9914387	\$1,107,353	0.005	\$5,699
2063	70	0.0079905	0.9920095	\$907,148	0.005	\$4,360
2064	71	0.0074578	0.9925422	\$713,478	0.005	\$3,202
2065	72	0.0069606	0.9930394	\$526,132	0.004	\$2,205
2066	73	0.0064966	0.9935034	\$344,902	0.004	\$1,350
2067	74	0.0060635	0.9939365	\$169,589	0.004	\$620
						\$8,737,455
					Annual Damages	\$364,153



## **With-Project Conditions**

### **Authorized Plan**

16. The Stone Revetment Plan (73-year storm design) was identified as the most feasible alternative both economically and environmentally in providing protection to Montauk Point and its vicinity. This alternative will provide protection to the Montauk Point Lighthouse complex until a 125-year storm exceedance would cause the upper part of the stone revetment to be displaced, thereby exposing the bluff to erosion.

17. The existing revetment has been in place since 1994. In the with-project condition, construction will commence in 2016 and will be completed by January 2018. With-project damages were calculated for the following storm damage categories: Storm damage to the lighthouse complex, and local costs forgone for the land loss values due to erosion. With-project damages were also calculated for two recreation loss categories: lost lighthouse visitations, and lost state park visitations benefits.

### **Montauk Point Lighthouse Complex**

18. Table 15 shows the residual damages that occur to the lighthouse complex under the with-project conditions for the 73-year storm design stone revetment alternative.

### **Local Costs Forgone**

19. Local costs forgone for loss of land value were calculated based on the probability that the stone revetment will be displaced, thereby exposing the bluff to erosion. The long-term erosion rate that is used is three feet per year. Table 16 shows the residual damages for local costs forgone for loss of land value.

### **Recreation Loss**

20. Residual loss of Montauk Point Lighthouse visitation benefits was calculated based on the probability that the stone revetment will be displaced, thereby exposing the bluff to erosion. The long-term erosion rate that is used is three feet per year. Therefore, by the tenth year after the upper sections of the revetment that protects the bluff are displaced the stone revetment the lighthouse will be immediately threatened and closed to the public. Table 17 shows the residual lost visitations benefits.

21. Similarly, residual losses of the Montauk Point State Park visitations benefits were calculated and are shown in Table 18.



**Table 15. Lighthouse Complex - 73yr storm design Residual Damages**  
(October 2014 P.L., 3.375% discount rate)

	End of year n	Probability that armor stone will be there at end of year n	Probability that armor stone won't be there at end of year n	Present Value of Lighthouse Complex in Year n	Prob. Of Damage in Year n	Expected Damage in Year n
1994	1	0.9333333	0.0666667			
1995	2	0.8711111	0.1288889			
1996	3	0.8130370	0.1869630			
1997	4	0.7588346	0.2411654			
1998	5	0.7082456	0.2917544			
1999	6	0.6610292	0.3389708			
2000	7	0.6169606	0.3830394			
2001	8	0.5758299	0.4241701			
2002	9	0.5374412	0.4625588			
2003	10	0.5016118	0.4983882			
2004	11	0.4681710	0.5318290			
2005	12	0.4369596	0.5630404			
2006	13	0.4078290	0.5921710			
2007	14	0.3806404	0.6193596			
2008	15	0.3552644	0.6447356			
2009	16	0.3315801	0.6684199			
2010	17	0.3094747	0.6905253			
2011	18	0.2888431	0.7111569			
2012	19	0.2695869	0.7304131			
2013	20	0.2516144	0.7483856			
2014	21	0.2348401	0.7651599			
2015	22	0.2191841	0.7808159			
2016	23	0.2045718	0.7954282			
2017	24	0.8246699	0.1753301	\$22,983,498	0.008	\$32,238
2018	25	0.8180725	0.1819275	\$22,233,130	0.007936	\$32,100
2019	26	0.8115279	0.1884721	\$21,507,260	0.007872512	\$31,911
2020	27	0.8050357	0.1949643	\$20,805,088	0.007809532	\$31,677
2021	28	0.7985954	0.2014046	\$20,125,841	0.007747056	\$31,402
2022	29	0.7922067	0.2077933	\$19,468,770	0.007685079	\$31,090
2023	30	0.7858690	0.2141310	\$18,833,151	0.007623599	\$30,744
2024	31	0.7795821	0.2204179	\$18,218,284	0.00756261	\$30,369
2025	32	0.7733454	0.2266546	\$17,623,492	0.007502109	\$29,967
2026	33	0.7671586	0.2328414	\$17,048,118	0.007442092	\$29,541
2027	34	0.7610214	0.2389786	\$16,491,528	0.007382555	\$29,096
2028	35	0.7549332	0.2450668	\$15,953,111	0.007323495	\$28,632
2029	36	0.7488937	0.2511063	\$15,432,272	0.007264907	\$28,153
2030	37	0.7429026	0.2570974	\$14,928,437	0.007206788	\$27,660
2031	38	0.7369594	0.2630406	\$14,441,052	0.007149133	\$27,157
2032	39	0.7310637	0.2689363	\$13,969,578	0.00709194	\$26,644
2033	40	0.7252152	0.2747848	\$13,513,498	0.007035205	\$26,124
2034	41	0.7194135	0.2805865	\$13,072,307	0.006978923	\$25,598
2035	42	0.7136582	0.2863418	\$12,645,521	0.006923092	\$25,068
2036	43	0.7079489	0.2920511	\$12,232,668	0.006867707	\$24,535
2037	44	0.7022853	0.2977147	\$11,833,295	0.006812765	\$24,001
2038	45	0.6966670	0.3033330	\$11,446,960	0.006758263	\$23,466
2039	46	0.6910937	0.3089063	\$11,073,238	0.006704197	\$22,932
2040	47	0.6855649	0.3144351	\$10,711,718	0.006650564	\$22,400
2041	48	0.6800804	0.3199196	\$10,362,000	0.006597359	\$21,870
2042	49	0.6746398	0.3253602	\$10,023,700	0.00654458	\$21,344
2043	50	0.6692426	0.3307574	\$9,696,445	0.006492224	\$20,822
2044	51	0.6638887	0.3361113	\$9,379,874	0.006440286	\$20,304
2045	52	0.6585776	0.3414224	\$9,073,639	0.006388763	\$19,792
2046	53	0.6533090	0.3466910	\$8,777,402	0.006337653	\$19,286
2047	54	0.6480825	0.3519175	\$8,490,836	0.006286952	\$18,786
2048	55	0.6428978	0.3571022	\$8,213,626	0.006236656	\$18,293
2049	56	0.6377547	0.3622453	\$7,945,467	0.006186763	\$17,807
2050	57	0.6326526	0.3673474	\$7,686,062	0.006137269	\$17,328
2051	58	0.6275914	0.3724086	\$7,435,127	0.006088171	\$16,858
2052	59	0.6225707	0.3774293	\$7,192,384	0.006039466	\$16,395
2053	60	0.6175901	0.3824099	\$6,957,566	0.00599115	\$15,940
2054	61	0.6126494	0.3873506	\$6,730,414	0.005943221	\$15,494
2055	62	0.6077482	0.3922518	\$6,510,679	0.005895675	\$15,057
2056	63	0.6028862	0.3971138	\$6,298,117	0.00584851	\$14,628
2057	64	0.5980631	0.4019369	\$6,092,496	0.005801721	\$14,207
2058	65	0.5932786	0.4067214	\$5,893,587	0.005755308	\$13,796
2059	66	0.5885324	0.4114676	\$5,701,173	0.005709265	\$13,393
2060	67	0.5838241	0.4161759	\$5,515,040	0.005663591	\$12,999
2061	68	0.5791535	0.4208465	\$5,334,984	0.005618282	\$12,614
2062	69	0.5745203	0.4254797	\$5,160,807	0.005573336	\$12,238
2063	70	0.5699241	0.4300759	\$4,992,316	0.005528749	\$11,871
2064	71	0.5653647	0.4346353	\$4,829,327	0.005484519	\$11,512
2065	72	0.5608418	0.4391582	\$4,671,658	0.005440643	\$11,162
2066	73	0.5563551	0.4436449	\$4,519,137	0.005397118	\$10,821
						\$1,003,903
					Annual Damages	\$41,840



**Table 16. Local Costs Forgone - 73yr storm design Residual Damages**  
(October 2014 P.L., 3.375% discount rate)

	End of year n	Probability that armor stone will be there at end of year n	Probability that armor stone won't be there at end of year n	Present Value Factor		
1994	1	0.9333333	0.0666667			
1995	2	0.8711111	0.1288889			
1996	3	0.8130370	0.1869630			
1997	4	0.7588346	0.2411654			
1998	5	0.7082456	0.2917544			
1999	6	0.6610292	0.3389708			
2000	7	0.6169606	0.3830394			
2001	8	0.5758299	0.4241701			
2002	9	0.5374412	0.4625588			
2003	10	0.5016118	0.4983882			
2004	11	0.4681710	0.5318290			
2005	12	0.4369596	0.5630404			
2006	13	0.4078290	0.5921710			
2007	14	0.3806404	0.6193596			
2008	15	0.3552644	0.6447356			
2009	16	0.3315801	0.6684199			
2010	17	0.3094747	0.6905253			
2011	18	0.2888431	0.7111569			
2012	19	0.2695869	0.7304131			
2013	20	0.2516144	0.7483856			
2014	21	0.2348401	0.7651599			
2015	22	0.2191841	0.7808159			
2016	23	0.2045718	0.7954282			
2017	24	0.8246699	0.1753301	1.0000000	\$123,000	\$21,566
2018	25	0.8180725	0.1819275	0.9673519	\$123,000	\$21,647
2019	26	0.8115279	0.1884721	0.9357696	\$123,000	\$21,693
2020	27	0.8050357	0.1949643	0.9052185	\$123,000	\$21,708
2021	28	0.7985954	0.2014046	0.8756648	\$123,000	\$21,693
2022	29	0.7922067	0.2077933	0.8470760	\$123,000	\$21,650
2023	30	0.7858690	0.2141310	0.8194206	\$123,000	\$21,582
2024	31	0.7795821	0.2204179	0.7926680	\$123,000	\$21,490
2025	32	0.7733454	0.2266546	0.7667889	\$123,000	\$21,377
2026	33	0.7671586	0.2328414	0.7417547	\$123,000	\$21,243
2027	34	0.7610214	0.2389786	0.7175378	\$123,000	\$21,092
2028	35	0.7549332	0.2450668	0.6941115	\$123,000	\$20,923
2029	36	0.7488937	0.2511063	0.6714501	\$123,000	\$20,738
2030	37	0.7429026	0.2570974	0.6495285	\$123,000	\$20,540
2031	38	0.7369594	0.2630406	0.6283226	\$123,000	\$20,329
2032	39	0.7310637	0.2689363	0.6078090	\$123,000	\$20,106
2033	40	0.7252152	0.2747848	0.5879652	\$123,000	\$19,872
2034	41	0.7194135	0.2805865	0.5687693	\$123,000	\$19,629
2035	42	0.7136582	0.2863418	0.5502000	\$123,000	\$19,378
2036	43	0.7079489	0.2920511	0.5322370	\$123,000	\$19,119
2037	44	0.7022853	0.2977147	0.5148605	\$123,000	\$18,854
2038	45	0.6966670	0.3033330	0.4980512	\$123,000	\$18,582
2039	46	0.6910937	0.3089063	0.4817908	\$123,000	\$18,306
2040	47	0.6855649	0.3144351	0.4660612	\$123,000	\$18,025
2041	48	0.6800804	0.3199196	0.4508452	\$123,000	\$17,741
2042	49	0.6746398	0.3253602	0.4361260	\$123,000	\$17,453
2043	50	0.6692426	0.3307574	0.4218873	\$123,000	\$17,164
2044	51	0.6638887	0.3361113	0.4081134	\$123,000	\$16,872
2045	52	0.6585776	0.3414224	0.3947893	\$123,000	\$16,579
2046	53	0.6533090	0.3466910	0.3819002	\$123,000	\$16,285
2047	54	0.6480825	0.3519175	0.3694318	\$123,000	\$15,991
2048	55	0.6428978	0.3571022	0.3573706	\$123,000	\$15,697
2049	56	0.6377547	0.3622453	0.3457031	\$123,000	\$15,403
2050	57	0.6326526	0.3673474	0.3344165	\$123,000	\$15,110
2051	58	0.6275914	0.3724086	0.3234985	\$123,000	\$14,818
2052	59	0.6225707	0.3774293	0.3129369	\$123,000	\$14,528
2053	60	0.6175901	0.3824099	0.3027201	\$123,000	\$14,239
2054	61	0.6126494	0.3873506	0.2928368	\$123,000	\$13,952
2055	62	0.6077482	0.3922518	0.2832762	\$123,000	\$13,667
2056	63	0.6028862	0.3971138	0.2740278	\$123,000	\$13,385
2057	64	0.5980631	0.4019369	0.2650813	\$123,000	\$13,105
2058	65	0.5932786	0.4067214	0.2564269	\$123,000	\$12,828
2059	66	0.5885324	0.4114676	0.2480550	\$123,000	\$12,554
2060	67	0.5838241	0.4161759	0.2399565	\$123,000	\$12,283
2061	68	0.5791535	0.4208465	0.2321224	\$123,000	\$12,016
2062	69	0.5745203	0.4254797	0.2245440	\$123,000	\$11,751
2063	70	0.5699241	0.4300759	0.2172131	\$123,000	\$11,490
2064	71	0.5653647	0.4346353	0.2101215	\$123,000	\$11,233
2065	72	0.5608418	0.4391582	0.2032614	\$123,000	\$10,979
2066	73	0.5563551	0.4436449	0.1966253	\$123,000	\$10,730
						\$858,997
					Annual Damages	\$35,801



**Table 17. Lighthouse Visitations Damages - 73yr with-project design Residual Damages (October 2014 P.L., 3.375% discount rate)**

	End of year n	Probability that armor stone will be there at end of year n	Probability that armor stone won't be there at end of year n	Present Value of Visitations for Year n	Prob. Of Damage in Year n	Expected Damage in Year n
1994	1	0.9333333	0.0666667			
1995	2	0.8711111	0.1288889			
1996	3	0.8130370	0.1869630			
1997	4	0.7588346	0.2411654			
1998	5	0.7082456	0.2917544			
1999	6	0.6610292	0.3389708			
2000	7	0.6169606	0.3830394			
2001	8	0.5758299	0.4241701			
2002	9	0.5374412	0.4625588			
2003	10	0.5016118	0.4983882			
2004	11	0.4681710	0.5318290			
2005	12	0.4369596	0.5630404			
2006	13	0.4078290	0.5921710			
2007	14	0.3806404	0.6193596			
2008	15	0.3552644	0.6447356			
2009	16	0.3315801	0.6684199			
2010	17	0.3094747	0.6905253			
2011	18	0.2888431	0.7111569			
2012	19	0.2695869	0.7304131			
2013	20	0.2516144	0.7483856			
2014	21	0.2348401	0.7651599			
2015	22	0.2191841	0.7808159			
2016	23	0.2045718	0.7954282			
2017	24	0.8246699	0.1753301			
2018	25	0.8180725	0.1819275			
2019	26	0.8115279	0.1884721			
2020	27	0.8050357	0.1949643			
2021	28	0.7985954	0.2014046			
2022	29	0.7922067	0.2077933			
2023	30	0.7858690	0.2141310			
2024	31	0.7795821	0.2204179	\$49,839,620	0.008	\$87,884
2025	32	0.7733454	0.2266546	\$47,698,729	0.007936	\$85,797
2026	33	0.7671586	0.2328414	\$45,627,734	0.007872512	\$83,638
2027	34	0.7610214	0.2389786	\$43,624,354	0.007809532	\$81,417
2028	35	0.7549332	0.2450668	\$41,686,380	0.007747056	\$79,144
2029	36	0.7488937	0.2511063	\$39,811,677	0.007685079	\$76,827
2030	37	0.7429026	0.2570974	\$37,998,179	0.007623599	\$74,477
2031	38	0.7369594	0.2630406	\$36,243,889	0.00756261	\$72,099
2032	39	0.7310637	0.2689363	\$34,546,874	0.007502109	\$69,701
2033	40	0.7252152	0.2747848	\$32,905,262	0.007442092	\$67,290
2034	41	0.7194135	0.2805865	\$31,317,246	0.007382555	\$64,872
2035	42	0.7136582	0.2863418	\$29,781,076	0.007323495	\$62,452
2036	43	0.7079489	0.2920511	\$28,295,059	0.007264907	\$60,034
2037	44	0.7022853	0.2977147	\$26,857,558	0.007206788	\$57,625
2038	45	0.6966670	0.3033330	\$25,466,988	0.007149133	\$55,227
2039	46	0.6910937	0.3089063	\$24,121,818	0.00709194	\$52,845
2040	47	0.6855649	0.3144351	\$22,820,565	0.007035205	\$50,482
2041	48	0.6800804	0.3199196	\$21,561,796	0.006978923	\$48,141
2042	49	0.6746398	0.3253602	\$20,344,123	0.006923092	\$45,825
2043	50	0.6692426	0.3307574	\$19,166,205	0.006867707	\$43,537
2044	51	0.6638887	0.3361113	\$18,026,743	0.006812765	\$41,278
2045	52	0.6585776	0.3414224	\$16,924,483	0.006758263	\$39,052
2046	53	0.6533090	0.3466910	\$15,858,210	0.006704197	\$36,859
2047	54	0.6480825	0.3519175	\$14,826,749	0.006650564	\$34,701
2048	55	0.6428978	0.3571022	\$13,828,962	0.006597359	\$32,580
2049	56	0.6377547	0.3622453	\$12,863,752	0.00654458	\$30,497
2050	57	0.6326526	0.3673474	\$11,930,054	0.006492224	\$28,452
2051	58	0.6275914	0.3724086	\$11,026,839	0.006440286	\$26,447
2052	59	0.6225707	0.3774293	\$10,153,113	0.006388763	\$24,482
2053	60	0.6175901	0.3824099	\$9,307,912	0.006337653	\$22,558
2054	61	0.6126494	0.3873506	\$8,490,305	0.006286952	\$20,676
2055	62	0.6077482	0.3922518	\$7,699,392	0.006236656	\$18,835
2056	63	0.6028862	0.3971138	\$6,934,301	0.006186763	\$17,037
2057	64	0.5980631	0.4019369	\$6,194,188	0.006137269	\$15,280
2058	65	0.5932786	0.4067214	\$5,478,239	0.006088171	\$13,565
2059	66	0.5885324	0.4114676	\$4,785,664	0.006039466	\$11,893
2060	67	0.5838241	0.4161759	\$4,115,700	0.005991115	\$10,262
2061	68	0.5791535	0.4208465	\$3,467,610	0.005943221	\$8,673
2062	69	0.5745203	0.4254797	\$2,840,678	0.005895675	\$7,126
2063	70	0.5699241	0.4300759	\$2,234,215	0.00584851	\$5,620
2064	71	0.5653647	0.4346353	\$1,647,551	0.005801721	\$4,155
2065	72	0.5608418	0.4391582	\$1,080,041	0.005755308	\$2,730
2066	73	0.5563551	0.4436449	\$531,059	0.005709265	\$1,345
						\$1,773,416
					Annual Damages	\$73,911



**Table 18. Park Visitation - 73yr level of protection design Residual Damages**  
(October 2014 P.L., 3.375% discount rate)

	End of year n	Probability that armor stone will be there at end of year n	Probability that armor stone won't be there at end of year n	Present Value of Visitation for Year n	Prob. Of Damage in Year n	Expected Damage in Year n
1994	1	0.9333333	0.0666667			
1995	2	0.8711111	0.1288889			
1996	3	0.8130370	0.1869630			
1997	4	0.7588346	0.2411654			
1998	5	0.7082456	0.2917544			
1999	6	0.6610292	0.3389708			
2000	7	0.6169606	0.3830394			
2001	8	0.5758299	0.4241701			
2002	9	0.5374412	0.4625588			
2003	10	0.5016118	0.4983882			
2004	11	0.4681710	0.5318290			
2005	12	0.4369596	0.5630404			
2006	13	0.4078290	0.5921710			
2007	14	0.3806404	0.6193596			
2008	15	0.3552644	0.6447356			
2009	16	0.3315801	0.6684199			
2010	17	0.3094747	0.6905253			
2011	18	0.2888431	0.7111569			
2012	19	0.2695869	0.7304131			
2013	20	0.2516144	0.7483856			
2014	21	0.2348401	0.7651599			
2015	22	0.2191841	0.7808159			
2016	23	0.2045718	0.7954282			
2017	24	0.8246699	0.1753301			
2018	25	0.8180725	0.1819275			
2019	26	0.8115279	0.1884721			
2020	27	0.8050357	0.1949643			
2021	28	0.7985954	0.2014046			
2022	29	0.7922067	0.2077933			
2023	30	0.7858690	0.2141310			
2024	31	0.7795821	0.2204179	\$15,915,879	0.008	\$28,065
2025	32	0.7733454	0.2266546	\$15,232,203	0.007936	\$27,399
2026	33	0.7671586	0.2328414	\$14,570,848	0.007623599	\$25,865
2027	34	0.7610214	0.2389786	\$13,931,084	0.00756261	\$25,178
2028	35	0.7549332	0.2450668	\$13,312,208	0.007502109	\$24,475
2029	36	0.7488937	0.2511063	\$12,713,537	0.007442092	\$23,758
2030	37	0.7429026	0.2570974	\$12,134,411	0.007382555	\$23,032
2031	38	0.7369594	0.2630406	\$11,574,193	0.007323495	\$22,296
2032	39	0.7310637	0.2689363	\$11,032,264	0.007264907	\$21,555
2033	40	0.7252152	0.2747848	\$10,508,029	0.007206788	\$20,809
2034	41	0.7194135	0.2805865	\$10,000,909	0.007149133	\$20,061
2035	42	0.7136582	0.2863418	\$9,510,346	0.00709194	\$19,313
2036	43	0.7079489	0.2920511	\$9,035,798	0.007035205	\$18,565
2037	44	0.7022853	0.2977147	\$8,576,744	0.006978923	\$17,820
2038	45	0.6966670	0.3033330	\$8,132,677	0.006923092	\$17,079
2039	46	0.6910937	0.3089063	\$7,703,107	0.006867707	\$16,342
2040	47	0.6855649	0.3144351	\$7,287,563	0.006812765	\$15,611
2041	48	0.6800804	0.3199196	\$6,885,585	0.006758263	\$14,887
2042	49	0.6746398	0.3253602	\$6,496,731	0.006704197	\$14,171
2043	50	0.6692426	0.3307574	\$6,120,572	0.006650564	\$13,464
2044	51	0.6638887	0.3361113	\$5,756,695	0.006597359	\$12,765
2045	52	0.6585776	0.3414224	\$5,404,697	0.00654458	\$12,077
2046	53	0.6533090	0.3466910	\$5,064,191	0.006492224	\$11,398
2047	54	0.6480825	0.3519175	\$4,734,802	0.006440286	\$10,731
2048	55	0.6428978	0.3571022	\$4,416,167	0.006388763	\$10,075
2049	56	0.6377547	0.3622453	\$4,107,935	0.006337653	\$9,431
2050	57	0.6326526	0.3673474	\$3,809,766	0.006286952	\$8,799
2051	58	0.6275914	0.3724086	\$3,521,332	0.006236656	\$8,179
2052	59	0.6225707	0.3774293	\$3,242,314	0.006186763	\$7,571
2053	60	0.6175901	0.3824099	\$2,972,406	0.006137269	\$6,976
2054	61	0.6126494	0.3873506	\$2,711,310	0.006088171	\$6,394
2055	62	0.6077482	0.3922518	\$2,458,739	0.006039466	\$5,825
2056	63	0.6028862	0.3971138	\$2,214,413	0.00599115	\$5,268
2057	64	0.5980631	0.4019369	\$1,978,064	0.005943221	\$4,725
2058	65	0.5932786	0.4067214	\$1,749,431	0.005895675	\$4,195
2059	66	0.5885324	0.4114676	\$1,528,263	0.00584851	\$3,678
2060	67	0.5838241	0.4161759	\$1,314,316	0.005801721	\$3,173
2061	68	0.5791535	0.4208465	\$1,107,353	0.005755308	\$2,682
2062	69	0.5745203	0.4254797	\$907,148	0.005709265	\$2,204
2063	70	0.5699241	0.4300759	\$713,478	0.005663591	\$1,738
2064	71	0.5653647	0.4346353	\$526,132	0.005618282	\$1,285
2065	72	0.5608418	0.4391582	\$344,902	0.005573336	\$844
2066	73	0.5563551	0.4436449	\$169,589	0.005528749	\$416
						\$550,174
					Annual Damages	\$22,930



## **Benefits**

22. Benefits are estimated to be annual damages in the without-project condition minus any residual damages in the with-project condition. The benefits claimed are avoided storm damage costs when compared to the existing condition, specifically avoided loss of the lighthouse complex and its associated costs for the preservation of artifacts, prevented local costs forgone for loss of land values, avoided lost visitation benefits to the lighthouse and to the State Park. The project benefits for the 73-year storm design stone revetment are summarized in Table 19 below. All benefits are discounted using a 3.375 percent interest rate and amortized over the 50-year period of analysis. Table 20 summarizes the annual cost for the stone revetment.

<b>Description</b>	<b>Without-Project Damages</b>	<b>Residual Damages - 73yr storm design</b>	<b>Benefits - 73yr storm design</b>
<u>Storm Damage Reduction</u>			
Lighthouse Complex	\$580,692	\$41,840	\$538,852
Land Loss	\$117,136	\$35,801	\$81,335
Subtotal	\$697,800	\$77,600	\$620,000
<u>Recreation</u>			
Lighthouse Visitation	\$1,140,324	\$73,911	\$1,066,413
Park Visitation	\$364,153	\$22,930	\$341,223
Subtotal	\$1,504,500	\$96,800	\$1,408,000

<b>Description</b>	<b>73yr storm design</b>
Total First Cost	\$18,164,000
Interest During Construction	\$459,800
Total Investment Cost	\$18,623,800
Annual Investment Cost	\$776,000
Annual Revetment Maintenance Cost	\$78,000
Total Annual Cost	\$854,000

## **Summary**

23. The Planning Guidance Notebook, ER 1105-2-100, 22 April 2000, Chapter 3-4b(4)(a), reads in pertinent part,

*“The Corps participates in single purpose projects formulated exclusively for hurricane and storm damage reduction, with economic benefits equal to or exceeding the costs, based solely on damage reduction benefits, or a combination of damage reduction benefits and recreation benefits. Under current policy, recreation must be incidental in the formulation process and may not be more than fifty percent of the total benefits*



*required for justification. If the criterion for federal participation project cost sharing is met, then all recreation benefits are included in the benefit to cost analysis.”*

24. Federal participation in this recreation benefit generating shore protection project is warranted since the recreation benefits are incidental, and when combined with and limited to an equivalent amount of primary hurricane and storm damage reduction benefits, they produce an economically justified project. The incidental recreation benefits are limited because the storm damage reduction benefits must be at least 50 percent of the total benefits used for project evaluation. Table 21 shows the 73-year design cost-benefit analysis based on storm damage reduction benefits and an equivalent amount of recreation benefits. All recreation benefits are included in the final benefit cost ratio (BCR) because the criterion for federal participation project cost sharing with limited recreation benefits has been met.

<b>Description</b>	<b>73yr Storm Design</b>
Annual Storm Damage Benefits	\$620,000
Annual Recreation Benefits	\$1,408,000
Annual Recreation Benefits Used for Project Justification	\$620,000
Total Benefits Used for Project Justification	\$1,240,000
Annual Costs	\$854,000
Net Benefits	\$386,000
BCR	1.45
Total Benefits	\$2,028,000
Total Net Benefits	\$1,174,000
Final BCR	2.37

