

**BLUE HILL HARBOR
MAINE
NAVIGATION IMPROVEMENT PROJECT**

APPENDIX B

ECONOMIC ASSESSMENT

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APPENDIX B ECONOMIC ASSESSMENT

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Blue Hill Harbor, Maine Economic Assessment

1.0 Introduction

This Economics Appendix evaluates the economic benefits of providing a Federal channel into the inner harbor in Blue Hill, Maine. The proposed channel would provide all-tides access to the town wharf located in the inner harbor in the town center. A turning basin would also be required. This analysis was conducted based on data provided by the Blue Hill Harbormaster and Selectmen, and based on information provided by fishermen at a workshop held in Blue Hill on 4 October 2016. All information was confirmed in October 2019. The analysis follows Corps guidance for estimating National Economic Development (NED) benefits as contained in ER 1105-2-100, April 2000, Appendix E, Section II - Navigation.

Costs and benefits are initially presented in annual terms using the FY19 Federal interest rate of 2.875 % that was used to determine the NED plan. The cost and benefits for the NED plan have been updated to the FY21 price level and annualized using the FY21 Federal discount rate of 2.5%. The updated analysis is presented at the end of the document to show the current Benefit to Cost analysis using FY21 price levels and discount rate of 2.5%.

2.0 Economic Setting

The town of Blue Hill is located in northeastern Maine in Hancock County. In 2010, Blue Hill had a population of 2,686 and contained 1,936 housing units (2010 US Census). The town is located 28 miles southeast of Bangor, Maine and 98 miles northeast of Portland, Maine. In the summer months the population of Blue Hill swells to over 6,000 with the addition of tourists and seasonal residents attracted to the many recreation and tourism opportunities of the area, cultural amenities such as art galleries and a chamber music center, and nearby Acadia National Park. Summary socioeconomic statistics for the town, county and state are shown in the tables below.

Table B-1 – Population

	2000	2010	% change 2000-2010
Blue Hill	2,390	2,686	12.4%
Hancock County	51,791	54,418	5.1%
State of Maine	1,274,923	1,328,361	4.2%

Source: US Census Bureau

Table B-2 – Housing Units

	2000	2010	% change 2000-2010
Blue Hill	1,486	1,936	30.3%
Hancock County	33,945	40,184	18.4%
State of Maine	651,901	721,830	10.7%

Source: US Census Bureau

Table B-3 – Median Household Income

	2000	2010	% change 2000-2010
Blue Hill	31,484	44,158	40.3%
Hancock County	35,811	47,533	32.7%
State of Maine	37,240	46,933	26.0%

Source: US Census Bureau

Table B-4 – Employment – Blue Hill, Maine

	count	% total
Unemployment rate (Apr 2016)		3.1%
Labor force (Q4 2015)	1,240	
Employment by Sector		
Construction	91	7.3%
Manufacturing	53	4.3%
Retail trade	233	18.8%
Information	27	2.2%
Finance and insurance	46	3.7%
Real estate and rental and leasing	13	1.0%
Professional, scientific, and management	43	3.5%
Administrative and waste management services	74	6.0%
Educational services	111	9.0%
Health care and social assistance	341	27.5%
Accommodation and Food Services	113	9.1%
Other services, except public administration	66	5.3%

Source: Maine Department of Labor, Center for Workforce Research and Information

3.0 Description of Study Area and Harbor Usage

Blue Hill Harbor contains 428 vessels, of which 50 are commercial fishing vessels and 378 are recreational vessels. Commercial vessels moor at several areas around the harbor, including South Blue Hill, Steamboat Wharf, and East Blue Hill. Facilities to support the commercial fishing fleet are located at South Blue Hill and in the inner harbor. As shown in Figure B-1 the inner harbor is located in the center of town within the main downtown

retail district, in upper Blue Hill Bay. In 2012, the town completely rebuilt the inner harbor wharf, a \$300,000 to \$400,000 investment, with the long-term goal of relocating commercial fishing loading and offloading operations to a protected location in the center of town. The new wharf has a crane as well as water service and electricity. Currently, the wharf in the inner harbor is used only minimally since it is accessible at only the highest tides, generally 3 hours per day. The natural channel accessing the inner wharf currently has depths of less than -4 feet mean lower low water (MLLW), with some areas exposed at low tide. The harbor has a mean tidal range of 10 feet.

Figure B-1 – Blue Hill Harbor Aerial View

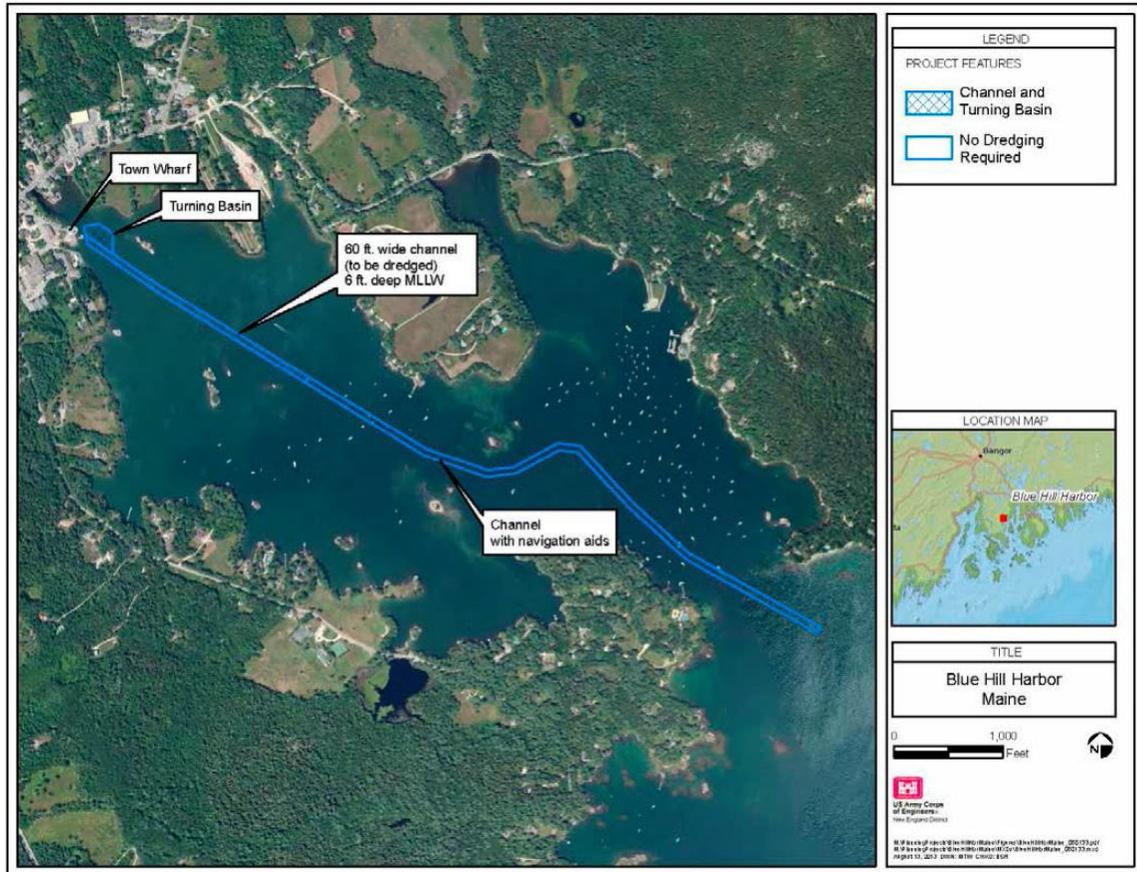


Figure B-2 shows the coastal areas of the town of Blue Hill. Currently, commercial vessels load and offload primarily at town facilities at South Blue Hill Harbor, located outside the protected inner harbor to the south. South Blue Hill Harbor contains a municipal wharf, docks and floats, as well as 23 moorings for commercial fishermen. Bait suppliers, fuel suppliers, and fish buyers operate out of trucks at South Blue Hill. Other fishermen are based in East Blue Hill Harbor, located outside the protected inner harbor to the northeast, and at Steamboat Wharf, located inside the protected inner harbor on the eastern shore. In addition to the 23 fishing vessels which moor at South Blue Hill, 8 commercial vessels moor at East Blue Hill, 12 moor at the Steamboat Wharf area in the inner harbor, and 7 moor elsewhere around the harbor. Currently, there is some use of the wharf in the inner harbor, but its use is limited due to the shallow access. There are no

slips or moorings in the wharf area of inner Blue Hill Harbor. The draft distribution of the commercial fleet is shown in Table B-5 below.

Figure B-2 – Blue Hill Coastal Areas



Table B-5 – Blue Hill Commercial Fishing Fleet

Blue Hill Commercial Fishing Vessels by Draft - Total Count	
Loaded Draft	Number of Boats
10.0'	1
5.6'	1
4.5'	2
4.0'	30
3.6'	1
3.5'	2
3.0'	5
2.0'	1
2.5'	1
n/a	6
Total	50

In 2014, Blue Hill fishermen landed nearly 1.8 million pounds of catch, including 1,547,549 pounds of live lobster valued at nearly \$5,600,000 (Blue Hill Harbormaster, December 2015). Other major species landed include eel and scallops. In 2014, total landings were valued at \$6,113,000 (Blue Hill Harbormaster, December 2015). Blue Hill fishermen generally fish seven to eight months a year, six days a week, and typically fish full-time. Lobster boats predominate, with generally one or two crew per boat plus captain.

4.0 Benefit Methodology

National Economic Development (NED) benefits to dredging a channel into Blue Hill Harbor are calculated based on damages prevented to fishing vessels and town infrastructure, and efficiencies gained by fishermen. NED Benefits are defined as changes in the value of the national output of goods and services. As described in Corps regulation ER-1105-2-100, Appendix E, page E-54, “When no change in aggregate fish catch is expected as a result of a plan..., NED benefits may be measured as cost savings to existing fish harvests.” For Blue Hill Harbor, costs savings are derived from reduced damages and reduced delays. The same regulation, page E-61, states that, “changes in net income to fish harvesters or boat operators is the appropriate measure of NED benefits...Reduction of damage to boats and facilities is frequently a component of commercial fishing benefits. Reduced damages may be a part of the net income analysis or it may proceed as a separate analysis (e.g. damage reduced to public facilities not included in fish harvester’s net income).”

Damages and delays in the without-project condition are compared to those expected in the with-project condition to determine project benefits. Three categories of benefits are calculated: damages prevented to commercial fishing vessels; reduced loading and off-loading delays; reduced tidal delays to the inner harbor wharf, and reduced damages to town infrastructure.

Other benefits which may occur with channel dredging and increased use of the inner harbor wharf include increased business to the suppliers and shops in the Blue Hill area, as well as the potential for new business activity in the area. However, these benefits are typically considered a shift of business activity from one region of the country to another, not increases in national output, and so are considered Regional Economic Development (RED) benefits, not NED benefits. RED benefits are addressed in this analysis but not included in the benefit-cost calculations, since current Corps guidance allows only NED benefits to be counted against project costs.

5.0 Existing Conditions

Under existing conditions, fishing vessels based in the various parts of Blue Hill Harbor load and offload their vessels primarily at South Blue Hill Harbor, where suppliers and fish buyers are located. Some also use the inner harbor wharf when it is accessible, at high tide. While South Blue Hill Harbor is the primary commercial fishing area, the South Blue Hill wharf has no power, water, or other services. Fuel trucks deliver fuel directly to vessels pulled up at the dock. Supplies and catch are loaded and off-loaded while vessels are pulled up at either the dock or at barges moored nearby. The wharf at South Blue Hill

Harbor is very exposed to winds and waves, particularly from the south and southwest. Loading and offloading delays occur frequently due to both congestion and the exposed conditions. As the only loading and offloading facility in the harbor, South Blue Hill facilities can be congested, requiring vessels to wait for a space to load or offload. Offloading delays of one to two hours are common, particularly in the summer months, with fishing vessels often lined up to offload. Offloading delays also occur during bad weather, when high winds or waves make tying up to the exposed wharf too hazardous. Vessels which do tie up in bad weather are sometimes damaged from banging against the dock. The municipal wharf and floats at South Blue Hill Harbor are also regularly damaged, requiring repairs, as vessels knock against the wharf and floats during rough weather.

East Blue Hill suffers from similar disadvantages to South Blue Hill; access is limited, particularly in the summer months, with a small boat ramp, limited parking, and no other public facilities. A large private marina occupies much of the harbor area at East Blue Hill. Fishermen and their floats are moored in the harbor's outer reaches. The harbor would have difficulty accommodating more than the 8 fishing boats that already work out of that location.

Some vessels use the inner harbor wharf periodically, depending on conditions and tides. When using the inner harbor wharf, tidal delays can be significant, with vessels lining up to wait for the tide. Another concern in the inner harbor is that vessels moored in the Steamboat Wharf area use private land to access their vessels and park vehicles. If this access is no longer allowed, an alternative location for access and parking will be required. Access and parking at South Blue Hill Harbor is already at capacity, particularly in the busy summer months.

6.0 Without Project Condition

In the without project condition, South Blue Hill will continue to be the only loading and offloading area with all-tides access for Blue Hill fishermen from South Blue Hill, East Blue Hill, the inner harbor, and elsewhere around the harbor. The exposure of the South Blue Hill wharf to storms and bad weather conditions will continue to result in damages to vessels, damages to town infrastructure, and delays. The lack of a second wharf with all-tides access will result in continued congestion delays at South Blue Hill facilities. For those vessels which use the inner harbor wharf, extensive tidal delays will continue.

7.0 With Project Condition

In the with-project condition, a Federal channel would be dredged from deep water to the town wharf in inner Blue Hill Harbor. Channel depths of five, six, and seven feet are evaluated. With channel dredging, all-tides access would be provided to the inner harbor town wharf, and more commercial fishing loading and offloading could occur in the protected inner harbor. Since suppliers and buyers are truck-based, they could also relocate to the inner harbor area. For commercial fishing vessels which relocate their loading and offloading operations, damages and delays currently experienced at South Blue Hill would be prevented. The significant congestion delays currently experienced at South Blue Hill would be greatly reduced. Damages to town infrastructure and congestion

delays at South Blue Hill would also be reduced. Tidal delays for vessels which currently use the inner harbor wharf would be reduced. Mooring locations would not be changed since no new mooring area would be provided.

In the with-project condition, fishermen would continue to moor at their current mooring location, since no new mooring space would be created with the project. Only the location of loading and offloading operations would be changed. With channel dredging, a second loading and parking area for fishermen would be available in Blue Hill, which will ensure continued access for vessels currently moored at Steamboat Wharf. With channel dredging, the town may place new moorings in naturally deep water in the inner protected area to provide protected mooring space for commercial fishermen. However, the town could do this now, without the channel dredging. There would be no change in fish landings or fish catch with the project, nor would the fishing season be extended, since the fishing season is based on when the lobsters are located in the areas fished and areas close to shore.

Sea Level Change is not expected to impact the FWOP condition in the low and intermediate SLC scenarios for the 50-year period of analysis ending in 2072. The high SLC scenario is projected to exceed wharf elevation only at the tail-end of the period of analysis in 2068. This level of risk is assumed to not impact project feasibility.

8.0 Benefit Calculations

Annual benefits to channel dredging are calculated based on information provided by Blue Hill fishermen and town officials. With dredging of a channel to the wharf at inner Blue Hill Harbor, all-water access to the protected town wharf would be provided. Fishing vessels could load supplies and offload catch well-protected from the weather. Weather-related damages to the town wharf and floats at South Blue Hill would be prevented. Based on information provided by town officials, weather-related damages to the wharf and floats at South Blue Hill that would be prevented with all-tides access to the inner harbor equal \$30,400 per year.

Based on information provided by the town, it is estimated that 17 of the 50 commercial vessels would shift all their loading and offloading operations to the inner harbor with the dredging of a Federal channel, and 15 would shift some of their loading and offloading operations, depending on situational circumstances such as the weather, congestion, or convenience. The remaining 18 vessels would not shift their operations with the project. For the purpose of these benefit calculations, it is assumed that 17 vessels shift to using the inner harbor wharf for all of their loading and offloading, and that of the 15 that would shift partially, they would shift 50% of the time, for the equivalent of 8 additional vessels. This yields an equivalent estimate of 25 vessels shifting their loading and offloading operations in the with-project condition, or half of the 50-vessel fleet.

With all-tides access to the inner harbor wharf in the center of Blue Hill, damages to vessels from loading or offloading at South Blue Hill in poor weather conditions would be prevented, since vessels could choose to load and offload at the more protected inner harbor. Annual damages experienced by the town were provided through surveys by the Harbormaster and Selectmen, based on their town historical records of damages and losses.

Based on information collected by town officials, damages to vessels from banging against the wharf or colliding with other vessels while loading or offloading during adverse weather conditions equal \$133,200 per year, or an average of \$2,664 per vessel. With an equivalent of half the fleet shifting the location of their loading and operations with the project, it is projected that half of the \$133,200 in annual damages to fishing vessels related to loading or offloading in bad weather at South Blue Hill would be prevented with the project, or \$66,600.

The efficiency of fishing operations would also be improved with channel dredging, since having all-tides access to the wharf at the inner Blue Hill Harbor would alleviate the significant congestion delays currently experienced at South Blue Hill and would give fishermen an alternative location to load and off-load during bad weather, thereby reducing weather-related loading and offloading delays. Delays would be prevented for the 25 vessels projected to relocate their loading and offloading operations to the inner harbor wharf. Delays would also be reduced by 75% for the remaining 25 vessels projected to continue operations at South Blue Hill, due to the reduction in number of vessels using the wharf in the with-project condition. Blue Hill fishermen make an average of 180 fishing trips per year, and typically have two men per boat, although larger boats may have 3 onboard in the summer. Based on information obtained in discussions with fishermen, delays at South Blue Hill are estimated to occur on roughly one-third of fishing trips and often last at least an hour. These delays would be prevented with the dredging project. The value of time saved for fishermen is estimated using one-third of the average wage of a production worker in manufacturing, to represent the opportunity cost of time, as required for Corps of Engineers small boat harbor analyses. In May 2018, the average hourly wage of a production worker in manufacturing the state of Maine was \$19.43 (US Bureau of Labor Statistics, State Occupational Employment and Wage Estimates), one-third of which is \$6.48.

Fuel costs during offloading and congestion delays at the South Blue Hill wharf are calculated based on four gallons burned per hour for the typical Blue Hill lobster boat and a cost of \$3.36 per gallon of diesel fuel in the New England area ([Gasoline and Diesel Fuel Update - Energy Information Administration](#)). Annual benefits from the prevention of offloading delays in terms of both time and fuel cost savings are calculated as shown below.

Table B-6 – Calculation of Offloading Delay Costs - South Blue Hill Harbor

FY 2019 Prices - Offloading Delay Costs Prevented - South Blue Hill Harbor							
Federal Discount Rate = 2.875%							
Time Costs	# of Vessels	Crew/ Boat	Average Delay Time (Hours)	Trips/ Year	Probability of Delay	Hourly Wage	Annual Value
	25	2	1	180	33%	\$6.48	\$19,200
Fuel Costs	# of Vessels	Fuel Use (Gallons/Hr)	Average Delay Time (Hours)	Trips/ Year	Probability of Delay	Fuel Cost/ Gallon	Annual Value
	25	4	1	180	33%	\$3.36	\$20,000

Table B-7 – Calculation of Offloading Delay Costs for Remaining Vessels - South Blue Hill Harbor

FY 2019 Prices - Offloading Delay Costs Prevented for Ships Remaining - South Blue Hill Harbor Federal Discount Rate = 2.875%								
Time Costs	# of vessels	Crew/Boat	Average Delay Time (hours)	% of delay time reduced	Trips/Year	Probability of Delay	Hourly Wage	Annual Value
	25	2	1	0.75	180	33%	\$6.48	\$14,400
Fuel Costs	# of vessels	Fuel Use (Gallon s/Hr)	Average Delay Time (hours)	% of delay time reduced	Trips/Year	Probability of Delay	Fuel Cost/ Gallon	Annual Value
	25	4	1	0.75	180	33%	\$3.36	\$15,000

Ten fishing vessels use the inner harbor wharf under current conditions and experience significant tidal delays. The vessels based at Steamboat Wharf are most likely to use the inner harbor wharf. Average tidal delays for these vessels were calculated using a mean tide chart based on a 10-foot tidal range, assuming an average 1-foot existing channel depth, and using the drafts of vessels based at Steamboat Wharf. Tidal delay costs were calculated assuming these vessels use the inner harbor wharf 25 percent of the time, or 45 out of 180 trips per year. Tidal delay costs prevented in terms of time and fuel are shown in the tables below. These costs would be prevented with the channel dredging project.

Table B-8 – Calculation of Tidal Delay Time Costs – Inner Harbor

FY 2019 - Tidal Delay Time Costs Prevented - Federal Discount Rate 2.875%						
Draft (Feet)	# of Vessels	Average Delay (Hours)	Trips/Year	Crew/Boat	\$/Hour	Tidal Delay Time Cost
4	8	1.5	45	2	\$6.48	\$7,000
3	2	1.1	45	2	\$6.48	\$1,300
Total						\$8,300

Table B-9 – Calculation of Tidal Delay Fuel Costs – Inner Harbor

FY 2019 - Tidal Delay Fuel Costs Prevented - Federal Discount Rate 2.875%						
Draft	# of vessels	Average delay (hours)	trips/year	gallons/hour	fuel price/gallon	Tidal delay fuel cost
4	8	1.5	60	6	\$3.36	\$14,500
3	2	1.1	60	6	\$3.36	\$2,700
Total						\$17,200

Dredging of the inner harbor would also increase recreational opportunities in Blue Hill Harbor. Currently there are 378 recreational vessels using the harbor. This number would be expected to increase under with-projection conditions (see Section 9 for more discussion on new recreational opportunities). The number of vessels is assumed to remain constant between the without-project and the with-project conditions to provide a conservative estimate of recreational benefits, as the increased quantity in recreation vessels in the Federal with-project condition is uncertain.

Recreational activities are evaluated based on five criteria that characterize the quality of the recreational experience. Point values for the existing without-project conditions are compared to the with-project condition. Total point values are converted to dollar values based on current Corps guidance as contained in EGM 16-03 Fiscal Year 2017. Additional recreational benefits of approximately \$145,300 would be realized if the project is constructed. The Unit Day Value analysis for Blue Hill Harbor is shown in the table below.

Carrying capacity increases from the Federal without-project condition to the Federal with-project condition, because in the current condition, the channel depth allows for the current recreational vessels to use the area, thus providing a basic facility to conduct activities. The with-project condition will increase channel depth and allow larger recreational, charter, and tour vessels to use the location, and so provide more optimized facilities to conduct activities at site potential. Recreation Experience increases slightly, as there are several general activities in the area such as recreational boating that would expand in the with-project condition to allow educational tours and charter ships to make use of the area. Accessibility increases from the without-project to the with-project conditions, because in the current condition, access to the site remains high both by roads and by ocean access, but the accessibility within the site increases in the with-project condition due to the increased channel depth, thus increasing overall accessibility in the site to a small degree in the with-project condition. Availability of opportunity increases only slightly due to the harbor's proximity to Bass Harbor and South Blue Hill Harbor. Environmental Aesthetic is not changed after the project is constructed.

Table B-10 – Recreational Benefits - Federal Discount Rate 2.875%

UDV CRITERIA	POINT RANGE	POINTS		JUSTIFICATION
		WITHOUT PROJECT	WITH PROJECT	
Recreation Experience	0 - 30	5	7	There are several general activities that increase in number with project.
Availability of Opportunity	0 - 18	4	6	There are other harbors in the area but none that offer the same protection or atmosphere.
Carrying Capacity	0 - 14	5	11	With the project, the adequate facilities would become optimum.
Accessibility	0 - 18	15	16	There is good road access to the harbor and access will not change with the project.
Environmental Aesthetic	0 - 20	20	20	The harbor has outstanding aesthetic qualities which will not change after the project is constructed.
TOTAL POINTS		49	60	
UNIT DAY VALUE		\$7.59	\$9.37	
NUMBER OF DAYS		72	72	
USERS PER BOAT		3	3	
NUMBER OF BOATS		378	378	
DOLLAR VALUE		\$619,708	\$765,042	
RECREATION BENEFIT (Rounded)			\$145,300	

Total annual benefits to dredging a Federal channel into Blue Hill Harbor, providing all-tides access to the town wharf in the inner harbor, are summarized below.

Table B-11 – Benefit Summary

FY2019 - Benefit Summary - Federal Discount Rate 2.875%	
Benefit Category	Annual Benefits
1. Damages prevented to South Blue Hill wharf and floats	\$30,400
2. Damages Prevented to Commercial Fishing vessels	\$66,600
3. Offloading Delays Prevented - Time Savings	\$33,600
4. Offloading Delays Prevented - Fuel Cost Savings	\$35,000
5. Tidal Delays Prevented - Time Savings	\$8,300
6. Tidal Delays Prevented - Fuel Cost Savings	\$17,200
Total Annual Commercial Benefits	\$191,100
7. Recreation Benefits	\$145,300
Total Annual Benefits	\$336,400

In order to determine the optimal channel depth, three channel depths are examined in this analysis, 5-feet, 6-feet, and 7-feet. Benefits are allocated based on the distribution of vessel drafts of the Blue Hill commercial fishing fleet. With sufficient channel depth, vessels which have indicated they would shift their loading and offloading operations to the inner harbor would shift, but with inadequate channel depth, their access would be undependable and they would be less likely to shift. Based on the vessel draft distribution, 96 percent of vessels have drafts of 4.5 feet or below, and 32 percent have drafts of 3.6 feet or below. It is assumed that the vessels which would shift their loading and offloading operations to the inner harbor have a similar draft distribution as the overall fleet. It is also assumed that a 7-foot channel would provide access and therefore full benefits to all vessels, a 6-foot channel would provide full access to the 96 percent of vessels with drafts of 4.5 feet and below, and a 5-foot channel would provide full access to the 32 percent of vessels with drafts of 3.6 feet and below. For the purpose of this analysis, annual benefits are allocated based on these same percentages for all benefits categories to determine project optimization, with the exception of all Tidal Delays Prevented. Because the 6-foot channel sees full benefits for vessels with a 4.5-foot draft or less, and all 10 vessels that see Tidal Delay benefits derived from time and fuel cost savings have 3 or 4-foot drafts, weighing of benefits does not apply to Tidal Delay benefits for the 6-foot channel. Benefit weights for these are 100% in both the 6-foot and 7-foot dredging depth categories. This is reflected in the table below.

Table B-12 – Benefit Allocation

FY 2019 – Federal Discount Rate 2.875%

Channel Depth	Benefit Allocation	Annual Benefits
7-foot Channel	100%	\$336,400
6-foot Channel	96%	\$324,000
5-foot Channel	32%	\$107,700

9.0 Regional Economic Development Benefits

With channel dredging to the inner harbor wharf, there would likely be an increase in business revenues for suppliers, shops, and restaurants located in downtown Blue Hill as more commercial fishing activity would occur in the downtown area. Channel dredging would also allow the wharf to be used by other vessels including recreational, charter and tour vessels. With new uses, downtown businesses would likely experience additional increases in traffic and revenues. The town has been contacted by several vessel operators and marine-related businesses which have expressed interest in using the wharf, including a small cruise line and a marine research vessel providing educational tours. Based on information provided by town officials, use of the wharf for educational tours of the marine research vessel would create new business revenues of \$75,000 per summer season. Increased use of the inner harbor wharf by kayakers, recreational fishermen, and sailors

would generate additional traffic in downtown businesses estimated by the town at \$500 per day, or at least \$45,000 per summer season. The town also received a letter of interest from a small cruise ship line indicating that they would make Blue Hill a regular port of call if the inner harbor wharf were accessible with channel dredging. There has also been interest expressed regarding operating day sail crewed charter trips, which would generate income estimated at \$22,000 per vessel per summer season. This would bring significant additional foot traffic and business revenues to the downtown shops and restaurants. Total increased business revenues with the channel dredging would therefore likely exceed \$142,000. This increase in business revenues would also likely generate indirect and induced multiplier effects, further increasing area business revenues. However, these increases in local economic activity are considered Regional Economic Development (RED) benefits, not National Economic Development (NED) benefits, because they represent economic activity that would likely occur in another area or region if not at Blue Hill. Based on Corps of Engineers regulations, only NED benefits can be counted against project costs for economic justification of improvement projects.

10.0 Other Social Effects

Other social effects of the proposed channel dredging include a significant increase in safety for commercial fishermen and other boaters who will be able to use the protected inner harbor wharf with the proposed dredging project. The risk of personal injury and loss of life will be greatly reduced for Blue Hill fishermen with the channel dredging, since they would have all-tides access to a fully protected wharf for loading and offloading. While these safety benefits are not quantified in monetary terms, they are significant benefits to the project.

11.0 Project Costs

Contaminated materials are known to exist within the harbor and have been identified within the upper 2 feet of harbor material. The contaminant of concern in this case is PAHs, which are petroleum-based products. Environmental testing has revealed that this material is unsuitable for disposal of in open water, so two main alternatives are considered: dispose this material in a CAD cell or dispose of it at an upland site. Each alternative was estimated at 3 different dredged channel depths (5-feet, 6-feet, and 7-feet) and each includes 1-foot of allowable overdepth. Interest During Construction (IDC) was calculated using the end-period monthly basis and assumed a two-month construction period in the with-project condition.

Assumptions for O&M were made by examining nearby harbors such as Bass Harbor and determining that no sediment sources existed and that both connected to small streams. An annual O&M dredging cost of 0.5% was assumed for the with-project condition based on the findings at Bass harbor and other local facilities.

Table B-13 – Project Costs – Federal Discount Rate 2.875%

FY 2019	Alternative A: CAD Cell Disposal			Alternative B: Upland Disposal		
Channel Depth	5 Feet	6 Feet	7 Feet	5 Feet	6 Feet	7 Feet
Project Cost	\$ 4,196,713	\$ 4,545,442	\$ 4,911,001	\$ 9,657,231	\$10,003,196	\$10,364,183
IDC	\$ 5,027	\$ 5,445	\$ 5,883	\$ 11,569	\$ 11,983	\$ 12,415
Total Cost	\$ 4,201,740	\$ 4,550,887	\$ 4,916,884	\$ 9,668,800	\$10,015,179	\$10,376,598
Annual Cost						
I & A	\$159,448	\$172,697	\$186,586	\$366,912	\$380,057	\$393,772
O & M	\$20,984	\$22,727	\$24,555	\$48,286	\$50,016	\$51,821
Total	\$180,432	\$195,425	\$211,141	\$415,199	\$430,073	\$445,593

12.0 Conclusion

This analysis shows that Alternative A at the 6-foot channel depth is the National Economic Development plan as it maximizes net NED benefits at \$128,575 and provides the highest benefit-to-cost ratio of 1.66. The 7-foot channel depth is the second favorable alternative with net benefits of \$125,259 and a BCR of 1.59, while Alternative B at all depths produces no net benefits.

Table B-14 – Benefit-to-Cost Ratios - Federal Discount Rate 2.875%

FY 2019	Alternative A: CAD Cell Disposal			Alternative B: Upland Disposal		
Channel Depth	5 Feet	6 Feet	7 Feet	5 Feet	6 Feet	7 Feet
Annual Benefit	\$107,700	\$324,000	\$336,400	\$107,700	\$324,000	\$336,400
Annual Cost	\$180,432	\$195,425	\$211,141	\$415,199	\$430,073	\$445,593
Net Annual Benefits	(\$72,732)	\$128,575	\$125,259	(\$307,499)	(\$106,073)	(\$109,193)
BCR	0.60	1.66	1.59	0.26	0.75	0.75

13.0 Uncertainty Analysis

Economic results are impacted significantly by offloading delay fuel and time costs, as well as by the damages prevented to the South Blue Hill wharf, floats, and commercial fishing vessels. In order to determine economic viability under a range of conditions, the number of commercial fishing vessels shifting their operations to Blue Hill central harbor were altered and evaluated, as well as the damages prevented to the South Blue Hill wharf, floats, and commercial fishing vessels. When the number of commercial fishing vessels shifting their operations to the Blue Hill central harbor in the with-project condition was reduced by 33% from 25 to 17, time savings benefits for offloading delays decreased from \$32,300 to \$30,900 and fuel savings benefits for offloading delays decreased from \$33,600 to \$32,100. This decreased total benefits from \$324,000 to \$321,100. When the number of commercial fishing vessels shifting their operations to the Blue Hill central harbor was increased by 33% from 25 to 33, time savings benefits for offloading delays increased

from \$32,300 to \$33,800 and fuel savings benefits for offloading delays increased from \$33,600 to \$35,000. This increased total benefits from \$324,000 to \$326,900. When the damages prevented to the South Blue Hill wharf and floats were decreased by 33% in the with-project condition, benefits decreased from \$29,200 to \$19,500. When damages prevented to South Blue Hill Commercial Fishing Vessels were decreased by 33%, benefits decreased from \$63,900 to \$42,600. These decreased total benefits from \$324,000 to \$293,000. When the damages prevented to the South Blue Hill wharf and floats were increased by 33% in the with-project condition, benefits increased from \$29,200 to \$38,900. When damages prevented to South Blue Hill Commercial Fishing Vessels were increased by 33%, benefits increased from \$63,900 to \$85,200. These increased total benefits from \$324,000 to \$355,000.

Recreational benefits also have a significant impact on economic viability, and in order to determine benefits in a similar range of conditions, the number of recreational vessels in the with-project condition was altered and evaluated. When the number of recreational vessels was decreased by 33% to 250, recreational benefits decreased from \$139,500 to \$93,000. This decreased total benefits from \$324,000 to \$277,500. When the number of recreational vessels was increased by 33% to 503, recreational benefits increased from \$139,500 to \$186,000. This increased total benefits from \$324,000 to \$370,500.

Regardless of these uncertainties, the project would still result in a BCR above 1.0 given annual costs of \$195,425.

14.0 Economic Update for 2021

Benefits were updated to FY2021 using the most current data available. Recreation benefits were based on EGM #21-02 Unit Day Value for Recreation for Fiscal Year 2021 (Latest available on 14 Jun 2021).

To calculate the opportunity cost of time for boat operators and crew on commercial vessels during tidal delays, the value of time is estimated using one-third of the average wage for production workers in manufacturing in Maine, as required for Corps small boat harbor analyses. The average production wage in 2020 (latest available) for Maine was \$21.08 (US Bureau of Labor Statistics: Maine Occupational Employment and Wage Estimates, accessed 11 May 2021), one-third of which is \$7.03.

Fuel costs during delays are calculated using the average cost of diesel fuel between the beginning of the boating season in March (\$3.18) and the end of the season in September (\$2.61) for a price of \$2.90 per gallon.

Table B-14 below also presents the minor overall change in annual benefits of \$4,900, or (\$2,500) with only commercial navigation benefits. The 6-foot channel is allocated 96% of these total benefits or \$328,600, or \$182,000 when only commercial navigation benefits are counted.

Table B-15 – Benefit Price Level Comparison

FY 2021 - Benefit Summary - Federal Discount Rate 2.5%				
Benefit Category	Annual Benefits 7-Foot Depth - 100%		Annual Benefits 6-Foot Depth - 96%	
	FY2019	FY2021	FY2019	FY2021
1. Damages prevented to South Blue Hill Wharf and Floats	\$30,400	\$30,700	\$29,200	\$29,500
2. Damages Prevented to Commercial Fishing Vessels	\$66,600	\$67,400	\$63,900	\$64,700
3. Offloading Delays Prevented - Time Savings	\$33,600	\$36,600	\$32,300	\$35,100
4. Offloading Delays Prevented - Fuel Cost Savings	\$35,000	\$30,100	\$33,600	\$28,900
5. Tidal Delays Prevented - Time Savings	\$8,300	\$9,000	\$8,300	\$9,000
6. Tidal Delays Prevented - Fuel Cost Savings	\$17,200	\$14,800	\$17,200	\$14,800
Total Commercial Benefits	\$191,100	\$188,600	\$184,500	\$182,000
7. Recreation Benefits	\$145,300	\$152,700	\$139,500	\$146,600
Total Annual Benefits	\$336,400	\$341,300	\$324,000	\$328,600

The cost for the preferred alternative for dredging Blue Hill Harbor down to -6 feet MLLW was also updated to FY21 price level and is supported by the Total Project Cost Summary presented in Cost Engineering Appendix (Appendix D). The significant decrease in cost estimates between the FY19 and FY21 update is due to the higher level of uncertainties that led to high preliminary FY19 estimates regarding mobilization and demobilization costs as well as dredging costs and construction duration. The current FY21 costs are more in line with the current project’s scope. Table B-15 below presents the net annual benefits for commercial navigation and the BCR calculated at the FY21 Federal Discount Rate (2.5%). Annual costs include interest and amortization of the investment cost plus annualized project maintenance. Interest During Construction is altered to reflect the increase of estimated construction time from two months to four months.

**Table B-16 – Benefit Cost Analysis Update
(FY 2021 Price Levels - Federal Discount Rate 2.5%)**

Project Cost	\$2,960,000
IDC	\$ 9,263
Total Cost	\$2,969,263
CRF at 2.5%	0.03526
Annual Cost	\$104,700
O & M	\$14,800
Total Annual Cost	\$119,500
Annual Benefit	\$328,600
Net Benefit	\$209,100
BCR	2.75

The updated annual cost of the NED plan amounts to \$119,500 with annual navigation benefits of \$328,600. The net annual benefits of dredging Blue Hill Harbor amount to \$209,100 yielding a benefit-to-cost ratio of 2.75.

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