DRAFT DETAILED PROJECT REPORT

TANGIER ISLAND JETTY
ACCOMACK COUNTY, VIRGINIA
SECTION 107
NAVIGATION STUDY

APPENDIX B

ECONOMIC ANALYSIS

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TANGIER ISLAND JETTY, ACCOMACK COUNTY, VIRGINIA SECTION 107,
NAVIGATION STUDY, DRAFT DETAILED PROJECT REPORT
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ECONOMIC ANALYSIS

The purpose of this section of the supporting documentation is to evaluate and quantify the beneficial impacts of the alternative plans considered for the Tangier Island Jetty. Potential beneficial impacts are based primarily on information obtained from site visits, meetings with local business owners and town staff members, and one detailed public participation survey conducted in July of 2013 (See Attachment 1). Specific potential benefit categories include: historical and cultural benefits, reduction in repair and maintenance costs to commercial fishermen and ferry operators, reduction in evacuation costs, and reduction in maintenance dredging for the existing Federal channel with and without the proposed navigation project.

The evaluation procedure used to determine National Economic Development benefits adheres to guidelines provided in "Principles and Guidelines for Water and Related Land Resources Implementation Studies," dated 22 April 2000. The base year used is 2017, with a discount rate of 3.125 percent, and October 2015 price levels.

DESCRIPTION OF THE STUDY AREA

General

Tangier Island is located in the Chesapeake Bay approximately 65 miles north of Norfolk, Virginia and is entirely within the political boundaries of Accomack County on Virginia's Eastern Shore. The island is about five miles long and one and a half miles wide, and, with the exception of three sand ridges, is composed of low marshland and tidal flats. The study area includes the North Channel area and the immediate vicinity.

This island community is entirely dependent upon the waters of the Chesapeake Bay for its economic livelihood. All of the island's supplies, including groceries and fuel, are brought to the island via the water. Thousands of tourists who visit the island annually by boat contribute significantly to the economic base of the community. The shore adjacent to the North Channel is developed with boat repair facilities, crab processing houses, marinas, fuel facilities, docks, retail businesses, and bait and ice houses. Based on previous reports, it is estimated that about 25 businesses are located adjacent to the channel and 65 commercial boats are berthed and moored along the channel. The vast majority of these boats are commercial fishing boats, ranging in size from about twenty feet to forty-five feet.

Natural Resource Conditions

The only natural resource available to this small island community is the fishing grounds in the vicinity. The overall fishing habitat has been rebounding recently, according to annual VMRC numbers and the Virginia Institute of Marine Sciences.[i] However, regulatory restrictions that will be discussed in detail later are limiting access to these resources.

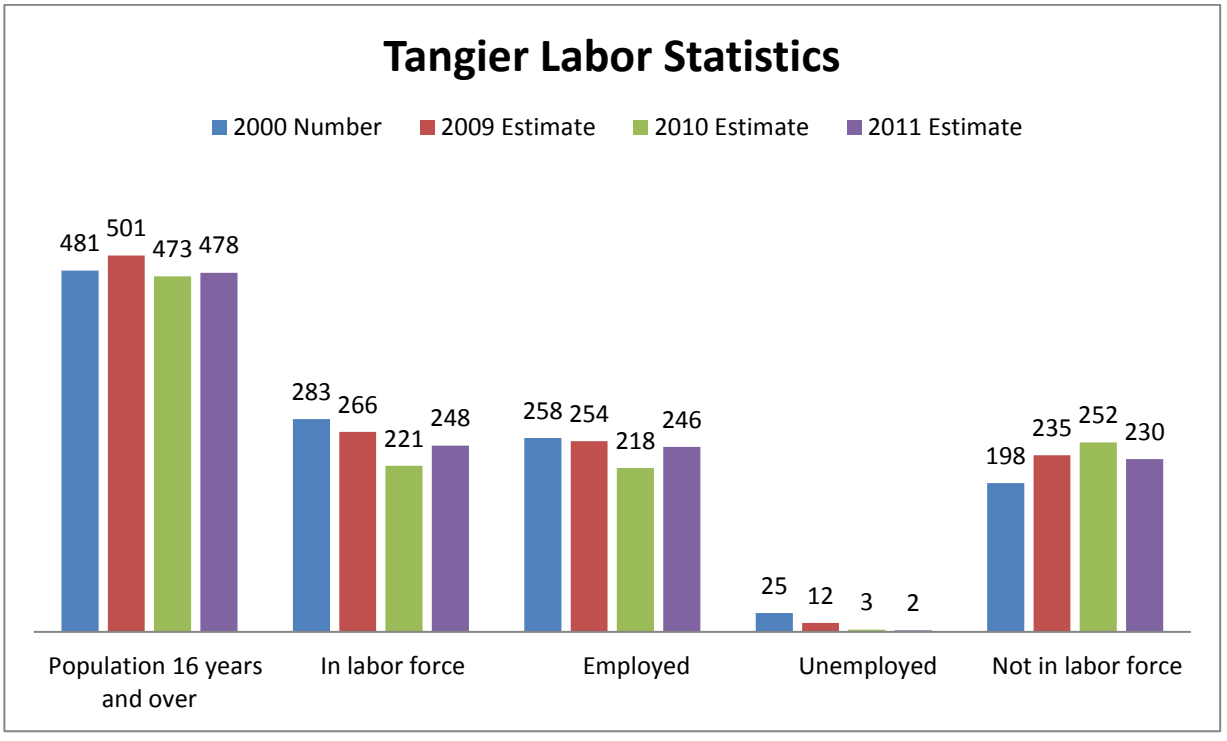
Population Conditions

Tangier Island, which is part of Accomack County, was founded in 1608 by Captain John Smith and first settled by John Crockett in 1686, and currently covers an area of about 1.2 square miles. Today, the island is only about half as wide as it was in 1608 and only half as long as it was in the earliest known map, dated 1859. According to the Census Bureau, the 2010 population was 727 people, a 4 percent increase from the about 700 people indicated in the 1994 Reconnaissance Report. By contrast, Accomack County has decreased since the last census, with a 2010 Census population of 33,164—down from 38,305 in 2000. This trend of population decline along the Eastern Shore began in 1960, and, according to the University of Virginia's Center for Public Service, average annual population growth rates for the Eastern Shore and Accomack County have been nearly stagnant since 1980.[1] So, Tangier's population has continued to grow slightly, despite an overall aging population and a relatively modest county-wide growth.

Employment Conditions

Some current employment figures for Tangier are shown below.

Graph B-1. TANGIER LABOR STATISTICS



Source: Census Bureau 2000 Decennial Census and 2009, 2010, 2011 American Community Survey

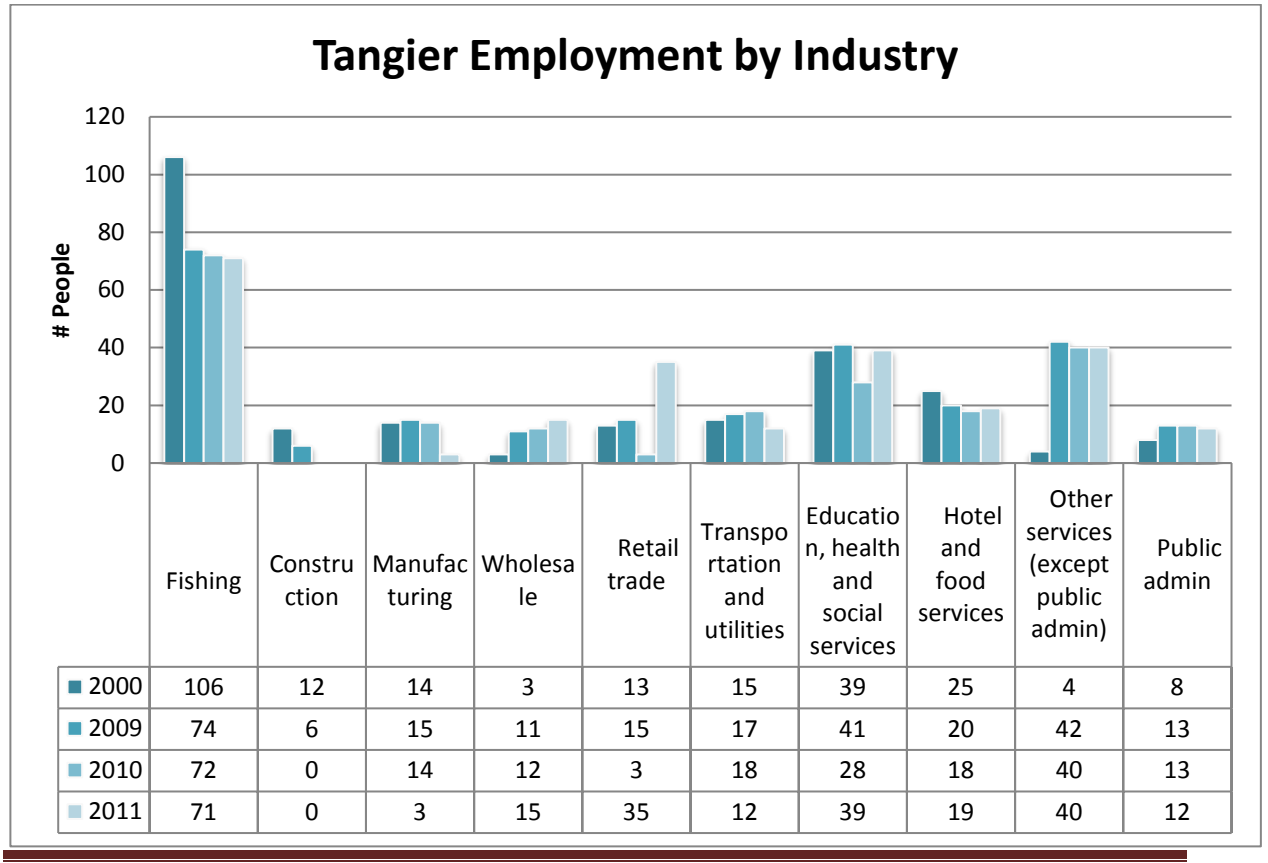
[1] Virginia Statistical Abstract, 1992-93 edition, Center for Public Service, University of Virginia, Charlottesville, VA.

Table B-1. TANGIER LABOR FORCE PARTICIPATION

Year	Labor Force Participation Percentage	National Average	Difference	Male %	Female %
2000	58.84%	66.40%	-7.56%	79.17%	38.59%
2009	53.09%	65.70%	-12.61%	60.61%	46.67%
2010	46.72%	64.80%	-18.08%	53.22%	40.42%
2011	51.88%	64.20%	-12.32%	59.84%	43.23%

People who are not in the labor force are homemakers, students, the elderly, discouraged workers, or the disabled. These numbers reflect that labor force participation is generally stable on Tangier and it's typically lower than the national average. One reason for this is the significantly lower percentage of females in the workforce on Tangier than is typically found in the U.S. (~58% according to the Bureau of Labor Statistics). Another is the declining percentage of males participating, possibly due to the decline of the fishing industry since 2000. Further evidence of this decline is shown in the table below, along with the changes in other industries on Tangier over the last 10 years.

Graph B-2. TANGIER EMPLOYMENT BY INDUSTRY



	Fishing	Construction	Manufacturing	Wholesale	Retail trade	Transportation and utilities	Education, health and social services	Hotel and food services	Other services (except public admin)	Public admin
2000	106	12	14	3	13	15	39	25	4	8
2009	74	6	15	11	15	17	41	20	42	13
2010	72	0	14	12	3	18	28	18	40	13
2011	71	0	3	15	35	12	39	19	40	12

Source: Census Bureau 2000 Decennial Census and 2009, 2010, 2011 American Community Survey

From a productivity standpoint, there are certain conditions on Tangier that may entice more people to move into the labor force over the 50-year period of analysis, thereby increasing overall production. Some of these conditions are changes in social norms, changes in the retirement age, and changes in social programs that encourage workers. One production-increasing social change is that more women will continue to join the workforce. Over the last 11 years, the participation percentage has increase from 38 to 43%. This is expected to continue to increase to meet the national average of 58%. Another production-increasing change will be the increase in the official government retirement age. This will cause more people to remain in the workforce. Social Security participants have risen since 2000 and the population age 60 and older jumped from 25% to 40% over the last 11 years. Both of these social changes bode well for the future productive capacity of Tangier.

Income Conditions

Current income figures for Tangier are shown below.

Table B-2. CURRENT INCOME FOR TANGIER ISLAND, VIRGINIA

Year	2000	2009	2010	2011
Median Household Income ($)	25,607	39,375	40,556	41,875

Source: Census Bureau, 2000 Decennial Census and 2009, 2010, 2011 American Community Survey

Income levels on Tangier in 2010, as measured by median household income, were only 2 percent below those of the county and 18 percent below the national figure (U.S. Census Bureau, 2013). However, that figure is 35 percent below the median figure for the Commonwealth of Virginia, indicating that Tangier is one of the poorer towns in one of the poorest counties of the state.

WITHOUT PROJECT ANALYSIS

The future without project condition is the land use and related conditions likely to occur under existing improvements, laws, and policies. It provides the basis for the evaluation of alternatives that address the problems, needs and opportunities in the study area. In the absence of a Federal project, it is likely that conditions as they currently exist would continue into the foreseeable future.

Identify the affected areas

First, areas where the proposed jetties could have a biological impact must be identified. According to the Virginia Marine Resources Commission (VMRC), there are no public or leased fishing grounds on the west side of Tangier Island. Discussions with fishermen on Tangier confirm this, as most crab fisherman travel 30 minutes to an hour away from the Tangier Harbor to fish. Therefore, the structure will not impact any fishing grounds. Even though it will impact the immediate environment around the structure itself, it won't affect the fishing grounds used by Tangier's watermen.

Second, areas where the jetties will have an economic impact must be identified. This area is limited to Tangier Island. VMRC has an effective quota system in place, so no change in aggregate fish catch is expected. So, the economic impact will be cost savings to existing harvests. This savings will include reduced maintenance and repair costs. These reduced costs will only occur in the project area as a result of jetty protection from wave, winds, and ice sheets.

The commercial fishing process of Tangier links the two areas. The economic activity of fishing relies on the productivity of the land (fishing grounds). Typically, a change to the fishing grounds could cause a change in the economic output surrounding commercial fishing. However, in this case, since the proposed plans won't affect the grounds physically, and a sufficient harvest management system is in place; the plans should not affect the economic output surrounding commercial fishing around Tangier Island. It should only affect the net income of the fishermen via lower costs.

Without Project Condition

According to the 1994 Reconnaissance Study, the three most relevant species are blue crabs, oysters, and clams. Harvest data on landings (in pounds) from 2001-2011 in Tangier Sound was collected from VMRC, and is listed below.

Table B-3. HARVEST DATA ON LANDINGS FROM 2001-2011 IN TANGIER SOUND

YEAR	Species	Total Pounds
2001	Blue Crab	1,578,657.00
2002	Blue Crab	1,337,371.00
2003	Blue Crab	1,362,093.00
2004	Blue Crab	1,258,576.80
2005	Blue Crab	1,514,619.62
2006	Blue Crab	1,038,197.00
2007	Blue Crab	938,124.92
2008	Blue Crab	1,282,652.42
2009	Blue Crab	1,418,584.81
2010	Blue Crab	2,189,689.58
2011	Blue Crab	1,525,520.53

Source: VMRC Plans and Statistics Dept

YEAR	Species	Total Pounds
2001-2009	Clams	3,259.00*
2001-2003	Oysters	110,279.00**
2004	Oysters	87,128.00
2005	Oysters	97,391.00
2006	Oysters	56,112.52
2007	Oysters	37,135.50
2008	Oysters	18,239.62
2009	Oysters	44,280.43
2010	Oysters	44,180.42
2011	Oysters	105,828.34

*2001-2009 clam data has been combined due to confidentiality. There were seven years involved in the amount shown.**2001-2003 oyster data has been combined due to confidentiality. All three years were involved in the amount shown. [2]

Based on these projections of current trends, harvests could continue to increase for both crabs and oysters over the period of analysis. However, to Tangier specifically, the limit on new crab licenses will serve as an effective quota system in the study area. This will keep the overall fish catch in the area relatively constant, despite the overall increase in Virginia fish landings.

The commercial fishing industry in the study area is not presently in the range of absolute decreasing returns. This means that as more units of labor are expended to catch fish , more fish are caught. This indication shows that there is still room for growth in the commercial fishing industry around Tangier and supports the above projections. The increase in labor will not come from residents of Tangier Island due to the license restrictions, however.

INSTITUTIONAL CONDITIONS

The most likely set of institutional conditions that will exist without the project are those that are in place currently. In 2008, the Chesapeake Bay's soft shell blue crab stock hit an all-time low of 249 million crabs, according to a VMRC press release. As a result, the crabbing season was shortened and certain fisheries were marked off-limits. Most

[2] Source: VMRC Plans and Statistics Dept.

importantly for Tangier, in 1999, VMRC placed a moratorium on issuing new crabbing licenses to limit the number of commercial fishermen. Additionally, they put a hold on more than 350 crab licenses that hadn't been used for 7 years. In 2009, VMRC bought back $6.7 Million worth of crab licenses, with no intention of re-issuing them. These combined policies limited the supply of licenses, sending the price for a new license into the thousands of dollars. So, unless a license is endowed to an individual, it is nearly impossible to afford a new license on Tangier.[ii] Thus, as aging fisherman leave the industry, they are not replaced by new, younger fisherman. The current estimate of the crab population is around 764 million crabs and VMRC has indicated that many of the restrictions are likely to stay in place into the near future despite the rebound. This will more than likely continue to limit the overall number of fishermen in Tangier, resulting in no net increase in catch over time.

OPERATING COSTS

A Commercial Fishing Boat Survey, attached, was conducted to address both costs and operation time as it relates to wages and fuel costs. Of the 60 surveys requested, seven were returned for the analysis. The survey results did range in damage severity and the study reflects the average in each response category. The total cost of harvesting fish in Tangier can be broken down into roughly five different categories: repair and maintenance, fuel, wages, storm evacuation, and dockside watches/checks. Based on the responses to the questionnaires, average estimated costs for fishing were calculated for each category and then multiplied by the current estimated fishermen population of Tangier. The results are listed in the table below.

Table B-4. CURRENT OPERATING COSTS OF HARVESTING FISH IN TANGIER

Current Operating Costs (FY 16 Price Levels)	
$ 3,145	Maintenance
$ 655	Repair
$ 10,194	Fuel
$ 30,484	Wages
$ 1,844	Evacuation
$ 589	Watches/Checks
$ 49,910	Sub Total
x 65	# Fisherman
$3,049,178	Total Cost of Fishing

Once the current annual total was calculated, each component of the cost was adjusted into the future using a different index. Repair/Maintenance costs were indexed for 2016 price levels using service other than medical professions indices. Fuel costs were adjusted to 2016 price levels using the Bureau of Labor Statistics' producer price index for #2 diesel fuel. Wages, Watches/Checks, and Evacuation were adjusted to 2016 price levels using the Census Bureau's average weekly wage for natural resources and mining employees.

Once each of these costs was adjusted for the 2016 price levels over the 50 year period of analysis, they were multiplied by the estimated number of fisherman remaining on Tangier. Initially, this number was projected using a simple, linear regression of the count of employees in the agriculture, forestry, fishing, hunting and mining industry from the 2000 Census and the 2009, 2010, and 2011 ACS. However, based on those projections, holding all other assumptions constant, there will be no more fishermen on Tangier by 2035; 24 years into the project life. Despite the significant decrease in fishermen over the last 10 years, this assumption would be catastrophic for the economy of Tangier; it was, in reality, highly unlikely. So, rather than discard it, this scenario would serve as the "worst case" or Scenario 3 for Tangier and 2 alternate fishing population scenarios were developed. The additional scenarios would be:

1) Scenario 1: The fishing population declined to 50% of the current population

2) Scenario 2: The fishing population declined to 25% of the current population

The remaining tables will reflect Scenario 1. This scenario seems the most likely, given the high demand for fishing in the study area, recent data indicating a leveling off in the decrease of fisherman, and data on the amount of fisherman not following the same decreasing pattern as the overall population. The "worst case" scenario and scenario 2 will be revisited in the sensitivity analysis. Once the sum of the costs was multiplied by the projected number of fishermen, an average annual cost was calculated over the 50 year period of analysis using the discount rate of 3.125 percent. The average annual cost for commercial fishing for Scenario 1, with fishermen declining to 30, is $2,443,078.

Another industry that would receive NED benefits from this project would be the passenger ferry industry. Currently, there are three passenger ferry businesses that operate on the North Channel transporting passengers between Tangier Island and the mainland from Reedsville, Maryland. There is one sightseeing cruise that uses the North Channel to navigate around the Chesapeake Bay. Based on the responses to the questionnaires, average estimated operating costs were calculated for ferries and cruises in each of the cost categories and then multiplied by the current number of passenger ferries/cruises on Tangier. For the document, the term "ferry" denotes all passenger vessels including ferries and passenger sightseeing cruises. The results are listed in the table below.

Table B-5. CURRENT OPERATING COSTS OF FERRIES IN TANGIER

Current Operating Costs (FY 16 Price Levels)	
$ 4,717	Maintenance
$ 3,844	Repair
$ 40,787	Fuel
N/A	Wages
$ 1,844	Evacuation
$ 589	Watches/Checks
$ 51,781	Sub Total
x 4	# Ferries
$ 207,125	Total Cost of Ferry Operation

Like the fishing costs, each cost was then adjusted to 2016 price levels throughout the 50 year period of analysis, using the same indices. Once the total for each of the 50 years was calculated, an average annual cost was calculated using the federal discount rate. The number of ferries was assumed to remain at four for the North Channel over the period of analysis. The average annual cost of ferry operation is $215,367.

Another category of costs that will be reduced by the project is that of the maintenance dredging in the Tangier Federal Navigation channel. The impact of reduced maintenance dredging will only occur for those alternatives that include the dogleg, Alternatives 2, 3, and 4. Historic costs and volumes were examined since the project was completed and an average cost of $574,172 was calculated per dredging cycle. The dredging cycle occurs every three years currently and is projected to continue the three-year dredging cycle in the future over the 50 year period of analysis. This was used to calculate an average annual cost of maintenance dredging over the project life under existing conditions. The existing average annual dredging cost is $198,944.

WITHOUT PROJECT AVERAGE ANNUAL OPERATING COSTS

The total average annual operating costs, relevant to the area under consideration without the project in place, are estimated at approximately $2,857,389. A summary of the without project average annual operating costs can be seen in the following table.

Table B-6. WITHOUT PROJECT AVERAGE ANNUAL OPERATING COSTS

Average annual operating costs	
Average annual fishing costs ($)	2,443,078
Average annual ferry costs ($)	215,367
Average annual dredging costs ($)	198,944
Total average annual operating costs ($)	2,857,389

WITH PROJECT ANALYSIS

Alternatives under consideration

Five plans were formulated and evaluated to address the navigational problem at Tangier Island. The alternatives carried forward for considerations include the following (see Appendix A for more detailed information on these alternatives):

Alternative 1: Straight North Jetty alone. Design would reduce wave height, on average, by 11.6%
Alternative 2: Dogleg North Jetty alone. Design would reduce wave height, on average, by 25.8%
Alternative 3: Dogleg North Jetty with South Spur Jetty pointing due north. Design would reduce wave height, on average, by 46.4%
Alternative 4: Dogleg North Jetty with South Spur Jetty pointing NW. Design would reduce wave height, on average, by 49.1%
Alternative 5: Straight North Jetty with South Spur Jetty pointing NW. Design would reduce wave height, on average, by 34.0%

Operating Costs of Fishing

The harvest of stock in each of the 50 years over the period of analysis is expected to remain relatively constant due to the regulatory climate. Therefore, the inflation-adjusted revenues should remain constant over time as well. The alternative plans will primarily affect the harvest costs of crabbers and the operating costs of ferries.

From survey results, the existing condition was quantified along with associated costs to repair damaged vessels during heavy wave action as well as watch checks and evacuation costs associated with these heavy wave events. In order to quantify the benefits to costs, it was assumed that there was a direct relationship between wave height and reduction in costs. Of the 5 categories of costs, only 3 were affected by the project. Repair and maintenance costs, evacuations, and dockside watches and checks were all reduced with the project. Evacuations and dockside watches and checks were effectively eliminated in all 5 alternatives, while repair costs were reduced by the respective wave reduction percentage of each alternative. It is assumed that a reduction in the average wave height in the navigation channel corresponds to an equivalent reduction in repairs for fishing and ferry businesses. So, for example, a 50% reduction in wave height would result in a 50% reduction in repair costs. With Project fishing costs are shown for Alternative 1 below.

Table B-7. CURRENT WITH PROJECT FISHING COSTS (ALT 1)

Current With Project Costs		
$	3,145	Maintenance
$	579	Repair
$	10,194	Fuel
$	30,484	Wages
$	-	Evacuation
$	-	Watches/Checks
$	44,402	Sub Total
x	65	# Fisherman
$	2,886,130	Total cost of fishing

With project, costs for the ferries were calculated in the same way. Evacuation and watches/checks were effectively eliminated and repair costs were reduced by the percentage of average wave height reduction.

Operating costs for Alternative 1 are listed below.

Table B-8. CURRENT WITH PROJECT FERRY COSTS (ALT 1)

Current With Project Costs		
$	4,717	Maintenance
$	3,398	Repair
$	40,787	Fuel
NA		Wages
$	-	Evacuation
$	-	Watches/Checks
$	48,902	Sub Total
x	4	# Ferries
$	195,608	Total Cost of Ferry Operation

As in the without project condition, each cost was then projected into the future for each year of the 50 year period of analysis. Each cost was adjusted using the same indices with the assumption that the number of fishermen on the island would continue to decline until there were 30 fishermen remaining in Tangier. Once the total for each of the 50 years was calculated, an average annual cost was calculated using the federal discount rate. Evacuation and Watches/Checks calculations were eliminated from the each of the alternative calculation because it was assumed that any jetty design would eliminate any associated costs for Evacuation and Watches/Checks.

The fishing and ferries average annual costs are listed in the tables below.

Table B-9. AVERAGE ANNUAL OPERATING COSTS FOR FISHING AND FERRIES

Commercial Fishing Average Annual Operating Costs ($)	
Existing Condition	2,443,078
Alt 1	2,301,031
Alt 2	2,307,565
Alt 3	2,300,536
Alt 4	2,299,615
Alt 5	2,304,767

Ferry Average Annual Operating Costs ($)	
Existing Condition	215,367
Alt 1	199,999
Alt 2	201,123
Alt 3	197,829
Alt 4	197,398
Alt 5	199,812

To determine the with-project dredging costs of the Federal Channel, impacts of the reduction in dredging per cubic yard (CY) was analyzed. Reviewing the design dynamic of each model, significant benefits were realized for the dogleg alternatives, Alternatives 2, 3, and 4 with minimal benefits for the jetty. Benefits for the dogleg were realized at the entire span of the dogleg for dredging, but the jetty benefits were only at the initial point of the jetty construction. Since the dogleg length was the same for each of the 3 alternatives that incorporated the dogleg, the reduction in dredge material, calculated for Stations 24-27 at 2,434 CY, was the same for each of the dogleg alternatives and approximately 122 CY for Alternatives 1 and 5. Benefit calculation was projected over the 50 year period of analysis with operation and maintenance to occur every three years. With the area of benefit reduction capturing only a small segment of the Tangier channel, operation and maintenance frequency was not adjusted due to this improvement. The results of this calculation are listed in the table below.

Table B-10. AVERAGE ANNUAL DREDGING COSTS

Average Annual Dredging Costs ($)	
Existing Condition	198,944
Alt 1	198,357
Alt 2	187,219
Alt 3	187,219
Alt 4	187,219
Alt 5	198,357

The results for total average annual operating costs (AAOC) are shown below. This includes the sum of fishing, ferries, and dredging costs.

Table B-11. TOTAL AVERAGE ANNUAL OPERATING COSTS

Total Average Annual Operating Costs ($)	
Existing Condition	2,857,389
Alt 1	2,699,387
Alt 2	2,695,907
Alt 3	2,685,584
Alt 4	2,684,231
Alt 5	2,702,936

Average Annual Benefits

The average annual benefits are the difference between the "without project condition" and the "with" project condition. Section 577 of the Water Resources Development Act of 1996 stated that "Congress finds that in the view of the historic preservation benefits resulting from the project authorized by this section, the overall benefits of the project exceed the costs of the project." As a result of this language, HQ USACE directed that, "Although a benefit cost ratio is not required, the report will identify the most cost-effective plan for implementation." In other words, the Norfolk District must identify the plan which provides the greatest net benefits. As described in the main report, there are significant, intangible cultural and historic benefits to this project. It has the

strong support of the Congress and the Commonwealth of Virginia, as the relevance and importance of Tangier Island to the Nation are incalculable. However, with that in mind, the monetary benefits of this project will be used to determine the most cost-effective plan.

In this study area, since no change in aggregate fish catch is expected as a result of a plan because of the regulatory system in place, NED benefits will be measured as cost savings to existing fish harvests. The changes in average annual costs for fishing, ferries, and dredging were calculated by subtracting the average annual operating costs of each alternative from the average annual operating costs under the existing condition. The Average Annual Benefit was the change in revenues (zero in this case) minus the decrease in costs. The benefits for commercial fishing, ferries, dredging and total benefits are shown in the tables below.

Table B-12. AVERAGE ANNUAL BENEFITS CALCULATION

Commercial Fishing Benefits			
Benefit	Change in Revenue due to project ($)	Change in Average Annual Costs ($)	Average Annual Benefits ($) *Column E minus Column F*
Alt 1	-	(142,047)	142,047
Alt 2	-	(128,082)	135,512
Alt 3	-	(134,976)	142,542
Alt 4	-	(135,880)	143,463
Alt 5	-	(130,826)	138,310

Ferry Benefits			
Benefit	Change in Revenue due to project ($)	Change in Average Annual Costs ($)	Average Annual Benefits ($) *Column E minus Column F*
Alt 1	-	(15,368)	15,368
Alt 2	-	(14,244)	14,244
Alt 3	-	(17,538)	17,538
Alt 4	-	(17,970)	17,970

Alt 5	-	(15,555)	15,555

Maintenance Dredging Benefits			
Benefit	Change in Revenue due to project ($)	Change in Average Annual Costs ($)	Average Annual Benefits ($) *Column E minus Column F*
Alt 1	-	(587)	587
Alt 2	-	(11,725)	11,725
Alt 3	-	(11,725)	11,725
Alt 4	-	(11,725)	11,725
Alt 5	-	(587)	587

Total Benefits ($)	
Alt 1	158,002
Alt 2	161,481
Alt 3	171,805
Alt 4	173,158
Alt 5	154,452

DESCRIPTION OF COSTS

The costs for constructing the three different alternatives were developed using the Micro-Computer Aided Cost Estimating System. These costs represent total or fixed fee cost estimates, as detailed in Appendix A, and are a conceptual representation of the approximate order-of-magnitude costs associated with the design concepts described. These estimates are based upon representative unit costs for similar construction projects in the area. The costs for each alternative plan include the following: plans and specifications; real estate; construction and plantings; construction management; contingency; and operation, maintenance, repair, rehabilitation, and replacement (OMRR&R). Plans and specifications would include such costs as field surveys and investigations; design; preparation of specifications and construction drawings; coordination of any required environmental permits; and the development, approval, and execution of the Project Cooperation Agreement.

The costs for plans and specifications under consideration are $241,000, $420,000, $532,000, $536,000, $357,000 for plans one through five respectively.

Real estate costs cover lands, easements, rights-of-way, relocations, and disposal areas (LERRD's). The real estate costs associated with this project are $31,000 and consist of only administrative costs. Real estate assumptions and estimates are defined in more detail in the Real Estate Plan, which is Appendix C of the supporting documentation.

Construction management costs cover the contractor's management, supervision, and overhead. These costs were approximately seven percent of the total construction costs. A 19.1 percent contingency cost was added to reflect the effects of unforeseen conditions on estimates of construction costs. These costs do not allow for inflation or for omissions of work items that are known to be required; rather, they take into account any unforeseen construction problems.

After total costs were determined, the cost of interest during construction (IDC) was calculated based upon a three month design period and eight month construction period, and a 3.125 percent discount rate. This calculation measures future value based on straight-line monthly construction costs accruing interest monthly. The below table explains the development of the interest during construction calculation for Alternative 1 at Month 1:

Table B-13. INTEREST DURING CONSTRUCTION CALCULATION

$240,700	Month 1 Construction Increment
x .02597	Future Value of Interest Accrued for 1 month (1+.03125)^(1/12)
$6,251	Month 1 Interest accrual

The above cost were calculated for the entire construction period at a straight lined construction increment. The total costs plus costs of the IDC yield the invetment cost, as seen in the following table.

Table B-14. INVESTMENT COSTS

Cost	Alt1 ($)	Alt2 ($)	Alt3 ($)	Alt4 ($)	Alt 5 ($)
Plans and specifications	241,000	420,000	532,000	536,000	357,000
LERRD	31,000	31,000	31,000	31,000	31,000
Construction	2,135,000	3,731,000	4,695,000	4,755,000	3,161,000
IDC	11,872	17,517	22,127	22,387	14,842
Total Investment Costs	2,418,872	4,199,517	5,280,127	5,344,387	3,563,842

Average Annual Costs

OMRR&R costs of five percent of the construction cost were included annually for the first five years after construction is completed and every three years thereafter. The average annual OMRR&R costs over the life of the project, varies by alternative and covers monitoring and evaluation of the project's performance.

Using the total costs and annual OMRR&R, the average annual equivalent costs were derived for each alternative plan. All costs used in this analysis are in October 2015 (Fiscal Year 2016) price levels, with a 3.125 percent discount rate used in the present value and annualized over a 50-year period of analysis. The average annual costs can be found in the following table.

Table B-15. TOTAL AVERAGE ANNUAL COSTS CALCULATION

Cost ($)	No Action Alternative ($)	Alt1 ($)	Alt2 ($)	Alt3 ($)	Alt4 ($)	Alt 5 ($)
Average Annual Investment	0	95,800	158,185	199,816	202,164	134,026
Interest and amortization	0	472	697	881	891	591
Average annual OMRR&R	0	53,681	88,640	111,968	113,284	75,103
Total Average Annual Costs	0	149,953	247,522	312,665	316,339	209,720

ECONOMICS OF THE ALTERNATIVE PLANS

The economic analysis uses net economic benefits to determine economic feasibility. From survey results, the existing condition was quantified along with associated costs to repair damaged vessels during heavy wave action as well as watch checks and evacuation costs associated with these heavy wave events. In order to quantify the benefits to costs, it was assumed that there was a direct relationship between wave height and reduction in costs. The result of the economic analysis captures benefits using transportation cost savings to compute the benefits of the selected plan. The following table shows the results of the economic evaluation comparing alternative plans, including average annual benefits and costs; net remaining benefits; and benefit-to cost ratios (BCRs) for each alternative.

Table B-16. RESULTS OF ECONOMIC ANALYSIS

Alternative	Average annual benefits ($)	Average annual costs ($)	Net benefits ($)	Benefit-to-cost Ratio (BCR)
No Action Alternative	0	0	0	n/a
Alt 1	158,002	149,953	8,049	1.05
Alt 2	161,484	247,522	(86,041)	0.65
Alt 3	171,805	312,665	(140,860)	0.55
Alt 4	173,158	316,339	(143,181)	0.55
Alt 5	154,452	209,720	(55,268)	0.74

OTHER EVALUATION ACCOUNTS

Regional Economic Development

The Tangier Sound is one of the most sought-after areas for blue crabbing. Commercial and recreational fishermen frequent Tangier Island because of its close approximation to the Tangier Sound. In addition to fishermen, Tangier Island is a tourist attraction as well with many historical attributes and perseveration of the native culture. This historic character, and the excellent fresh seafood available, make Tangier a popular tourist destination in the summer months. The implementation of the jetty would allow easier access to the channel, which will in turn, encourage tourism.

Environmental Quality

Tangier is a unique community, a long settled town with a rich history, recognized by listings in the National Register of Historic Places and Virginia Landmarks Registry in 2014. First mapped and called the "Russell Isles" by Captain John Smith in 1608 the island was periodically inhabited by Native Americans and early colonists. An established community dates to the 1700's. In the War of 1812 the British established a military base called Fort Albion there. Home to a community that retains the culture and dialect of the Chesapeake Bay 'watermen,' the town of Tangier has many buildings dating to the 19th and early 20th centuries, and a small condensed street system adapted to the limited space available.

Other Social Effects

Tangier Island is located approximately 12 miles from mainland Virginia with the closest departure to the island from Onancock, Virginia on the Eastern Shore with no direct rail or highway link to another community. The people on the island depend on the Tangier Channel for majority of the channel's goods and services including food, medical equipment, and carrier services navigate through the Tangier Sound to the island via boat. Because of this, the harbors within the Tangier Channel are considered subsistence harbors, as defined in 33 U.S. Code, Section 2242. Harbor maintenance is not only economically critical for the fishermen of Tangier, but it is also an obligation for the government to maintain as it relates to public health and safety of the local community as well.

SENSITIVITY, RISK, AND UNCERTAINTY

Uncertainty and variability are inherent in water resources planning. The risk and uncertainty aspects associated with the navigation project cannot be characterized by probability distributions based on existing empirical data. Therefore, the potential uncertainty aspects in which different degrees of uncertainty are likely are described in the following paragraphs. Relevant assumptions are varied where appropriate to measure potential impacts on project costs and benefits.

The benefits listed above are for the fishing population decline at the projected rate to 50% of the current population, then cease to decline.

For sensitivity analysis, two different scenarios were developed:

1) Scenario 2: The fishing population declined to 25% of the current population (75% lower bound)

2) Scenario 3: The fishing population declined at the projected rate such that there would be no more fishermen on Tangier by 2035("worst case").

Since fishing is the main industry for the island of Tangier, it is expected that the ferry traffic would decline as well. For Scenario 2, ferry traffic is assumed that ferry traffic will

decline to two ferries entering the North Channel by the end of the study period while the number of fishermen in Tangier is reduced to 15. For Scenario 3, the commercial fishing in Tangier is expected to be eliminated at year 2035, in which ferry traffic is reduced to zero as well.

Below are the benefit calculations for each of these scenarios.

Scenario 2

Table B-17. SENSITIVITY ANALYSIS SCENARIO 2

Commercial Fishing Benefits			
Benefit	Change in Revenue due to project	Change in Average Annual Costs ($)	Average Annual Benefits ($) *Column E minus Column F*
Alt 1	-	(59,829)	59,829
Alt 2	-	33,084	(33,084)
Alt 3	-	(59,830)	59,830
Alt 4	-	(60,271)	60,271
Alt 5	-	(57,802)	57,802

Ferry Benefits			
Benefit	Change in Revenue due to project	Change in Average Annual Costs ($)	Average Annual Benefits ($) *Column E minus Column F*
Alt 1	-	3,818	(3,818)
Alt 2	-	5,268	(5,268)
Alt 3	-	1,974	(1,974)
Alt 4	-	1,542	(1,542)
Alt 5	-	3,956	(3,956)

Maintenance Dredging Benefits			
Benefit	Change in Revenue due to project	Change in Average Annual Costs ($)	Average Annual Benefits ($) *Column E minus Column F*
Alt 1	-	(587)	587
Alt 2	-	(11,725)	11,725
Alt 3	-	(11,725)	11,725
Alt 4	-	(11,725)	11,725
Alt 5	-	(587)	587

Total Benefits ($)	
Alt 1	56,598
Alt 2	(26,627)
Alt 3	69,581
Alt 4	70,454
Alt 5	54,433

Table B-18. AVERAGE ANNUAL BENEEFIT CALCULATION – SCENARIO 2

Alternative	Average annual benefits ($)	Average annual costs ($)	Net benefits ($)
Alt 1	58,598	149,954	(91,356)
Alt 2	(26,627)	247,522	(274,149)
Alt 3	69,581	312,664	(243,083)
Alt 4	70,454	316,339	(245,885)
Alt 5	54,433	209,720	(155,287)

Worst Case Scenario

Table B-19. SENSITIVITY ANALYSIS –SCENARIO 3

Commercial Fishing Benefits			
Benefit	Change in Revenue due to project ($)	Change in Average Annual Costs ($)	Average Annual Benefits ($) *Column E minus Column F*
Alt 1	-	(36,904)	36,904
Alt 2	-	63,336	(63,336)
Alt 3	-	(40,783)	40,783
Alt 4	-	(41,084)	41,084
Alt 5	-	(39,401)	39,401

Ferry Benefits			
Benefit	Change in Revenue due to project ($)	Change in Average Annual Costs ($)	Average Annual Benefits ($) *Column E minus Column F*
Alt 1	-	65,505	(65,505)
Alt 2	-	64,916	(64,916)
Alt 3	-	62,711	(62,711)
Alt 4	-	62,422	(62,422)
Alt 5	-	64,038	(64,038)

Maintenance Dredging Benefits			
Benefit	Change in Revenue due to project	Change in Average Annual Costs ($)	Average Annual Benefits ($) *Column E minus Column F*
Alt 1	-	(587)	587
Alt 2	-	(11,725)	11,725
Alt 3	-	(11,725)	11,725
Alt 4	-	(11,725)	11,725
Alt 5	-	(587)	587

Total Benefits ($)	
Alt 1	(28,014)
Alt 2	(116,527)
Alt 3	(10,203)
Alt 4	(9,613)
Alt 5	(24,050)

Table B-20. SENSITIVITY ANALYSIS –SCENARIO 3

Alternative	Average annual benefits ($)	Average annual costs ($)	Net benefits ($)
Alt 1	(28,014)	149,954	(177,968)
Alt 2	(116,527)	247,522	(364,049)
Alt 3	(10,203)	312,664	(322,867)
Alt 4	(9,613)	316,339	(325,952)
Alt 5	(24,050)	209,720	(233,770)

The above analysis indicates that if the fishing population were to decline at less realistic rates, the project would produce negative net benefits for all alternatives, in some

cases.

CONCLUSIONS

The navigation project is economically justified only for Alternative 1, with a BCR greater than 1.0. Alternative 1 a positive net remaining benefit of 1.05, with an average wave height reduction of 11.6%. This alternative consists of a single straight jetty. This alternative does not provide as high of level of wave reduction as the other alternative plans, comparing between 25% and 35%, however it does provide the greatest net benefit. Cost of construction for the other two plans are justified by the benefits provided.

BENEFIT QUESTIONNAIRE

TANGIER ISLAND JETTY ACCOMACK COUNTY, VIRGINIA SECTION 107 NAVIGATION STUDY

COMMERCIAL FISHING QUESTIONNAIRE

COMMERCIAL FISHING BOAT SURVEY

Tangier Island, Accomack County, Virginia

(Online Survey and Personal Interview)

OMB Control # 0710-0001

Expires: 30 September 2013

The public report burden for this information collection is estimated to average 40 minutes to complete the survey, including time for reviewing instructions, searching existing data sources, gathering and maintaining data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this data collection, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Services, Executive Services Directorate, Information Management Division, 1155 Defense Pentagon, Washington DC, 20301-1155 and the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, D.C. 20503, Attn.: Desk Officer for U.S. Army Corps of Engineers. Respondents should be aware that notwithstanding any other provision of law, an agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

PLEASE DO NOT RETURN YOUR RESPONSE TO THE ABOVE ADDRESS

COMMERCIAL FISHING BOAT SURVEY

INTRODUCTION

The Corps of Engineers is conducting a study of commercial fishing boat activities in the Tangier Island area. If you currently operate or anticipate operating out of Tangier, please answer the questions in this survey and return it to the harbormaster's office by 12 July, 2013.

Your participation in this study is entirely voluntary, and you may refuse to answer any questions. Because only a few people are being selected for the study, the participation of each person selected is very important. The information you provide will be kept strictly confidential and will be used only for overall statistical results. Thanks for your assistance.

SECTION I. Vessel Background Information

Please describe your equipment below.

1. Vessel Type: ( ) Outboard ( ) Inboard ( ) Inboard/Outboard

   ( ) Other (specify) _____

2. What is the name and license or registration number of your vessel?
_____.

3. Vessel Size:

Length (feet) _____

Beam (feet) _____

Draft (light) _____

Draft (loaded) _____

Net Tonnage _____

Engine Size (horsepower) _____

Engine Type (gas, diesel) _____

4. Vessel Speed (knots):

   At Sea _____

   Minimum maneuvering speed in harbor _____

   Maximum maneuvering speed in harbor _____

5. What is your crew size (including skipper): _____

SECTION II. Description of Operations

6. Where is your boat currently based (homeport)?

_____

7. a. Do you rent an exclusive slip? (Circle) Yes No

   b. If yes, name of harbor? _____

8. If you operate from more than one harbor, please give the approximate amount of working time from each:

	Port	Time in Weeks
a.	_____	_____
b.	_____	_____
c.	_____	_____

9. Which waterways do you use?

9. Which waterways do you use?

10. What type of processing facility (shore-based, at-sea, cannery, etc.) do you use and in what proportion?

Facility	Percent
a. _____	_____
b. _____	_____
c. _____	_____

11. What is your fuel use per hour while:

a. Traveling at sea? _____ gallons/hour

b. Within the harbor area? _____ gallons/hour

c. At rest? _____ gallons/hour

d. Fishing? _____ gallons/hour

11a. During a typical day of operation, how many gallons of fuel does your vessel use?

_____ gallons

12. How much do you pay your crew in wages or shares of the catch?

_____

13. If the crew is paid a percentage of returns, are some costs deducted?

a. yes

b. no

13a. If yes, list the type of cost and the amount deducted per employee.

Type of Cost	Amount deducted per employee

_____ $_____

_____ $_____

_____ $_____

_____ $_____

_____ $_____

14. What are your packing and/or processing costs per 100 pounds?

(1 bushel = 50 lbs)

_____

_____

_____

_____

SECTION III. Fishery Data

15. Indicate the number of days you spend fishing by month and species (crab, oyster, clams, menhaden, rockfish, etc.)

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
a.												
b.												
c.												
d.												
e.												
f.												

16. Indicate the number of roundtrips made and the number of days spent fishing vs. in port for each species.

Species	Roundtrips Per Year	Days Fishing Per Trip	Days in Port Per Trip
a.			
b.			
c.			
d.			

17. What is your catch per year of each type of catch?

	Species	Catch per year (lbs/bushels)
a.	_____	_____
b.	_____	_____
c.	_____	_____
d.	_____	_____
e.	_____	_____

17a. If your catch includes shrimp, is this figure for heads off or on?

(circle one)

a. heads off

b. heads on

18. What was the average price per lb.(or bushel) you received for:

	Species	Price
a.	_____	_____
b.	_____	_____
c.	_____	_____

d. _____ _____

e. _____ _____

SECTION IV. Existing Conditions

The purpose of this section is to determine the extent of problems encountered in the Tangier harbor system.

19. a. What are your estimated annual vessel maintenance and repair costs? $_____

b. What portion of your vessel maintenance and repair costs is due to the existing conditions in the Tangier harbor system? $_____

c. Of that portion, how much is due to each of the following causes:

1) Wave damage in Tangier harbor (hull maintenance, mooring line repair, buoy replacement, etc. $_____

2) Harbor overcrowding and congestion (rafting, collisions, etc.) $_____

3) Other (please specify)_____ $_____

20. Please estimate the delays you incur per trip due to the following:

	Hours per Trip	Number of Crew on Board
a. Overcrowding/congestion in basins and channels	_____	_____
b. Overcrowding/congestion at existing working docks	_____	_____
c. Moving vessels from within rafts	_____	_____
d. Channel depths	_____	_____

21. What type or types of equipment does your vessel carry?

_____

_____

_____

22. What types of nets or lines do you use?

_____

23. How many hours per trip do you spend:

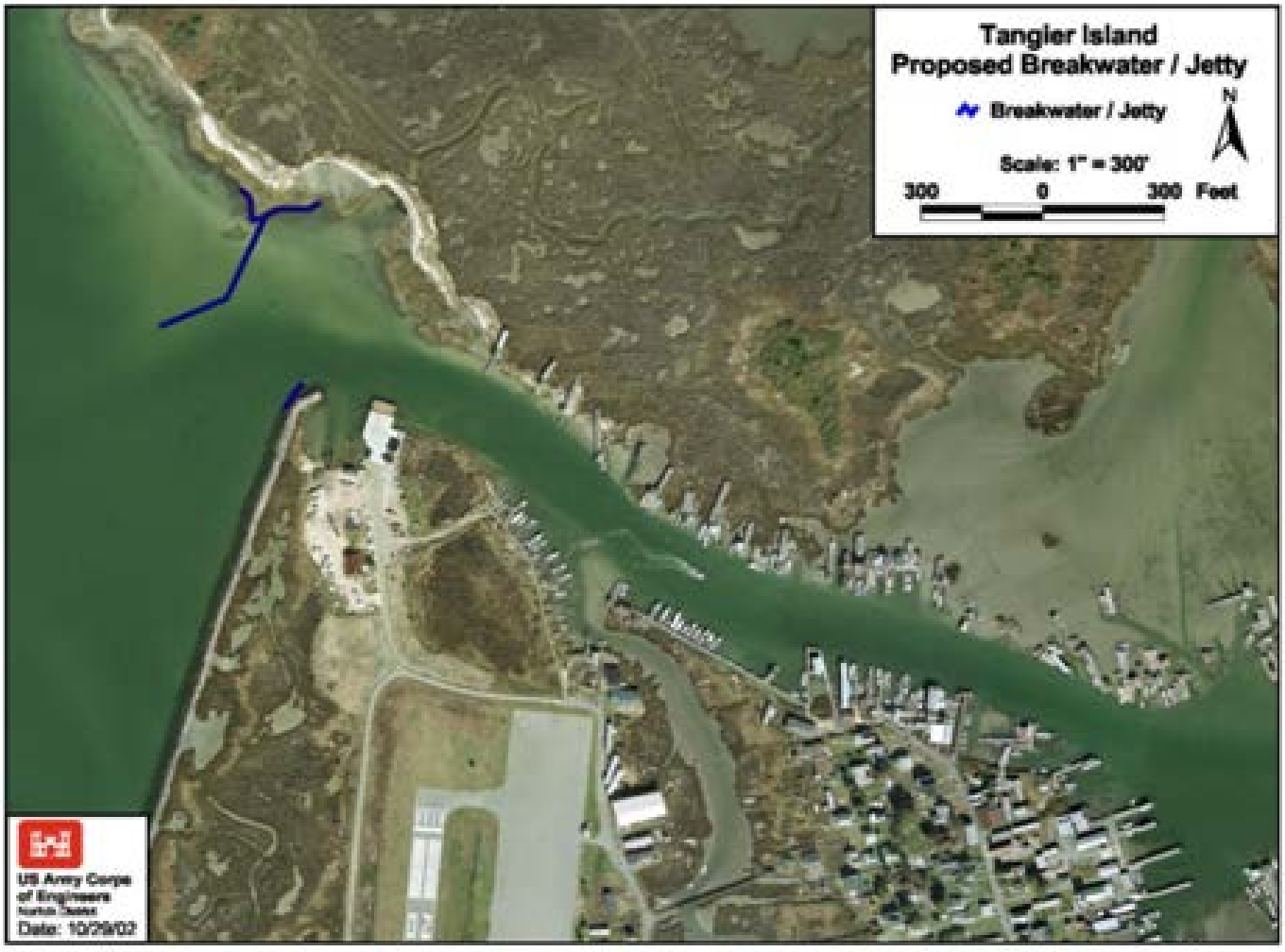
a. Traveling to your fishing grounds? _____

b. Traveling from your fishing grounds?_____

c. At rest? _____

d. With the nets or lines working? _____

Figure 1



SECTION V. Impact of Improvements

The purpose of this section is to determine how Tangier Harbor improvements similar to those shown on Figure 1 would affect your operations. The Tangier Harbor with the planned improvements would have adequate moorage and working space and a wave climate similar to the Onancock Harbor. Because of the breakwater, the wind would be slightly reduced from existing conditions.

24. With Tangier Harbor improvements similar to those shown on Figure 1, how many trips per year traveling to another port such as Crisfield, Onancock, or Reedville could be avoided?

Trips Avoided

Port	Per Year
a. _____	_____
b. _____	_____
c. _____	_____
d. _____	_____

25. With Tangier Harbor improvements similar to those shown on Figure 1, would you check on your boat less?

Number of boat checks per year that would be eliminated _____

Amount of time per check _____

26. With Tangier Harbor improvements similar to those shown on Figure 1, would you stand watch on your boat less during storms?

    Number of watches eliminated per year _____

    Amount of time per watch _____

27. Do you ever leave Tangier Harbor due to the wave climate? If yes,

    a. How many times per year? _____

    b. Where do you go?_____

    c. How long to you stay away? _____

    d. How many crew are on board?____

28. Describe harbor facilities you feel are needed in Tangier, e.g., working docks for gear transfers and repairs, stalls for vessels greater than 120 feet, additional parking, etc.

_____

_____

_____

29. What other information do you have concerning the other waterways that you use that would be helpful in determining your use of this waterway?

_____

_____

_____

_____

[i] 2012 Aquaculture Survey, Virginia Institute of Marine Science

[ii] "Slowed to a crawl: Commercial crabbing regulations alter age-old lifestyle, strain Tangier economy," Mark Robinson, 26 June 2012.