Chesapeake Bay Crossing Study: Tier I NEPA

Modal and Operational Alternative: Chesapeake Bay Ferry Service

August 2020

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1.0 Introduction

As part of the Chesapeake Bay Crossing Study: Tier I NEPA (Bay Crossing Study), the Maryland Transportation Authority (MDTA) is evaluating potential Modal and Operational Alternatives (MOA) along with a range of potential Corridor Alternatives that could meet the Study's Purpose and Need (P&N). The MOAs include Ferry Service, Transit Service (including both Bus and Rail), and Transportation Systems Management/ Travel Demand Management (TSM/TDM). With respect to the Ferry Service MOA, the study team performed research into past analyses of this subject matter, including a 2003 Draft Ferry Evaluation (Appendix 1). This evaluation was considered and then assessed in light of any relevant changes in facts or circumstances in the intervening time (e.g., traffic volumes, additional roadway or other facility improvements) to determine the validity of previous findings and conclusions and if the prior analysis can be used to assess the ability of ferry service to meet the elements of the Bay Crossing Study (BCS) P&N as a standalone alternative.

The *2003 Draft Chesapeake Bay Ferry Evaluation* was undertaken by the Maryland Department of Transportation (MDOT), including MDTA, under the sponsorship of the Maryland Transportation Commission, to determine if a viable ferry route could be implemented within the Maryland portion of the Bay.

As part of this update, MDTA also reviewed the Maryland – Virginia Ferry Feasibility Study Step One Report. The Step One Report was prepared for Somerset County, the City of Crisfield, Northumberland County and the Northern Neck Planning District Commission in 2004 to determine if a viable ferry route could be implemented between the Virginia portion of the Western Shore and the Maryland portion of the Eastern Shore.

For the purposes of the current Bay Crossing Study, the Draft 2003 Chesapeake Bay Ferry Evaluation serves as the basis of the MOA evaluation because it was found to be the most relevant to the BCS P&N and covers the same intrastate study area as the BCS. For this report, the 2003 Chesapeake Bay Ferry Evaluation will be referred to as the "2003 Study".

2.0 Summary of the 2003 Study

2.1 Scope

The 2003 Study considered a broad geographical region defined as "the Maryland Eastern Shore and the Maryland Western Shore of the Bay both North and South of the Bay Bridge" (MDOT, 2003). The 2003 Study was not constrained in terms of routes considered or its findings. The purpose of the 2003 Study was to "develop an inventory of potential terminal locations that meet the basic requirements" (MDOT, 2003) of the following:

- Adequate landside access
- Adequate water access
- Minimized environmental impact

Locations of terminal pairs were also developed to provide a base analysis for examples of capital and operating costs as well as travel times.

2.2 Methodology and Analysis Results from the 2003 Study

The 2003 Study was conducted in two parts: an investigative research effort, and an evaluation and analysis effort. The study team considered locations of Maryland Western and Eastern Shore terminals, impacts to traffic volumes, travel times, costs, and revenue.

2.2.1 Investigative Research

The investigative research effort involved a thorough review of previous studies that considered ferry service across the Bay. Previous studies were conducted in 1984, 1987, 1994, and 2001. Findings and conclusions from those studies found to be beneficial were incorporated and updated for the 2003 Study.

The 2003 Study team looked at existing ferry services in North America and determined which ones were comparable to service on the Chesapeake Bay. Characteristics such as vessel type, passenger and vehicle usage, travel times, and terminal locations were some of the aspects considered. Of the 228 initial routes identified, only six were considered as providing comparable service. Two cross Puget Sound in Washington, two cross Long Island Sound between Connecticut and New York, one crosses Lake Champlain between Vermont and New York, and one crosses the Delaware Bay between New Jersey and Delaware.

Regulatory permit requirements were analyzed to determine which permits were likely to be required if a ferry service were implemented.

2.2.2 Evaluation and Analysis

Fifty-nine sites along the Chesapeake Bay in Maryland were analyzed to determine their suitability to support ferry service. Through a fatal flaw analysis that considered accessibility by land and water as well as environmental or development restrictions, 37 sites were eliminated leaving 22 potential sites that ranged in distance from the Bay Bridge.

Each of the 22 sites was analyzed and scored on a variety of criteria including logical pairing, supporting transportation network, potential ridership, and navigation issues. Of these 22 sites, four terminal pairs, shown below in Table 1 and illustrated in Figure 1, were identified and evaluated further to understand their potential operating costs, environmental impacts, ridership, revenue, and economic benefits:

Terminal Pairs Selected for Further Analysis	
Western Shore	**Eastern Shore**
Canton	Rock Hall
Chesapeake Beach	Cambridge
Solomons Island	Crisfield
Solomons Island	Cambridge

Table 1 - Terminal Pairs Identified through Evaluation

The 2003 Study team assumed only minimal improvements and amenities would be necessary for functional ferry service. Enhancements were not included but noted as a recommendation for future evaluations. Site development costs ranged from $4.2 to $4.9 million (MDOT, 2003).

The 2003 Study team then conducted a probability analysis to determine how likely vehicles were to use a ferry service if one were available. The study used the concept of travel time savings as a basis for estimating how many vehicles would likely divert to a ferry as a means of saving time on their journey. The 2003 Study estimated that the increase in traffic volumes associated with a ferry service on roads conveying traffic to and from terminals would be between 200,000 and 250,000 per year; about a 1,000 vehicle increase in average daily traffic (ADT) on the supporting roadway network.

The 2003 Study team considered two vessel types: a traditional low-speed mono-hull design, and a high-speed catamaran design to understand the difference in capacities and travel times for each of the demonstration routes.

The 2003 Study team then developed operating scenarios for each of the chosen routes by applying the most likely characteristics of the trips (actual operating speeds,) likely ridership, revenues, and costs (both capital and operating.)

Analysis of revenue was based on auto and truck fares, while costs included the capital costs of terminal construction, and operating costs for both vessels and crew. Annual net operating revenues were calculated based on the potential ridership numbers and varied from a loss of $4.4 million to a gain of $305,000.

2.3 Conclusions of the 2003 Study

The analysis of the demonstration terminals and routes indicated that it was "appropriate to consider two potential vessel [types] for each service on each route" (MDOT, 2003). The differences between the vessels were cost and speed-related. The conventional ferry was assumed to operate at a service speed of 20-22 knots with a capital cost of $7 to $10 million per vessel and assumed two in operation per route. The high-speed ferry was assumed to operate at a service speed of 41 knots with a capital cost of between $30 and $40 million with only one vessel in operation per route. Both vessels have an assumed capacity of 54 automobiles or a combination of up to 6 heavy trucks and 36 automobiles with a total passenger capacity of 149. However, no additional trips were provided for the high-speed ferry, and only two headways (that is, the time between departures), were evaluated. The difference in travel time between the conventional and high-speed ferries was 30 minutes which was determined to not warrant the higher cost of the high-speed ferry. In addition, the conventional ferry carried double the capacity per route.

2.3.1 Potential Route Data

Table 2 below summarizes the peak daily vehicle volumes for the four final ferry routes determined by the 2003 Study. They were based upon the traditional vessel and represent the upper end of a range of ridership estimates.

Ferry Route Daily Vehicle Volumes		
Route	Weekday Summer High (veh./day)	Weekend Summer High (veh./day)
Canton to Rock Hall	110	160
Chesapeake Beach to Cambridge	550	2,700
Solomons Island to Cambridge	125	1,000
Solomons Island to Crisfield	60	200

Table 2 - Ferry Route Daily Vehicle Volumes

The 2003 Study concluded that of the four routes identified above, all were physically feasible of supporting service without significant environmental impacts. Only the Chesapeake Beach to Cambridge route was considered economically viable through fare recovery. Other routes were projected to run deficits of between $1.5 and $4 million per year, not including capital costs. However, if capital costs associated with vessels and terminals are considered, none of the routes would be capable of operating without a net deficit.

The 2003 Study concluded that the ridership for the routes analyzed ranged from 25,000 to 335,000 vehicles annually; with the latter representing 1.4% of the [then] 24 million vehicles crossing the Bay Bridge.

3.0 Updates to the 2003 Study

The 2003 Study was comprehensive in its scope and methodology. The study followed a logical and thorough process to identify potential sites and routes and used a suitable range of data and information available at the time to determine potential ridership and viability of a ferry service.

This document is focused primarily on identifying changes to traffic volumes and changes to transportation infrastructure within the study area.

Traffic volumes on the existing Bay Bridge have continued to grow since 2003. Although volumes dropped around 2008, total volumes on a daily and annual basis are greater now than when the 2003 Study was completed.

Summer weekend peak volumes remain higher than weekday peak period volumes, as was documented in the 2003 Study and in the 2015 Bay Bridge Life Cycle Cost Analysis Study conducted by MDTA. Weekday traffic patterns remain similar to those in 2003 when heavy westbound AM volumes and eastbound PM volumes were primarily commuter-based. Summer weekend traffic patterns also remain similar to those in 2003 when heavy eastbound volumes on Fridays and westbound volumes on Sundays were identified as travel or leisure-based.

In 2003, the existing bridge was noted as experiencing delays during summer weekends due to the greater volumes of directional trips (that is, eastbound trips on summer Fridays and Saturdays and westbound trips on summer Sundays). The 2015 Bay Bridge Life Cycle Cost Analysis Study identified 2013 summer weekend delays of one to two hours with up to one-mile long queues. The current Tier I study team has identified Levels of Service of either E or F during weekday westbound PM peaks and on summer weekends. This indicates that delays for travelers continue to exist.

A review of the transportation infrastructure within the study area was focused on identifying major changes or improvements that could potentially affect potential ferry demand or ridership. Small-scale improvements were assumed to not influence traveler decision-making.

One such major improvement, the expansion of MD 404 from two to four lanes between Wye Mills and Denton in Talbot and Caroline Counties, was identified on the Eastern Shore. This improvement would not influence traveler decision-making because:

- It is located 37 miles via road from the closest potential ferry terminal site at Rock Hall
- It is a relatively short section of the travel routes identified in the 2003 Study
- Its location primarily serves existing Bay Bridge traffic and therefore is less likely to be utilized by traffic using one of the ferry routes identified in the 2003 report which would use more direct routes than MD 404 to access points to the east.

No significant roadway capacity was added on the Maryland western shore within the study area. Figure 1 illustrates potential ferry routes identified in the 2003 Study and the location of the MD 404 expansion.

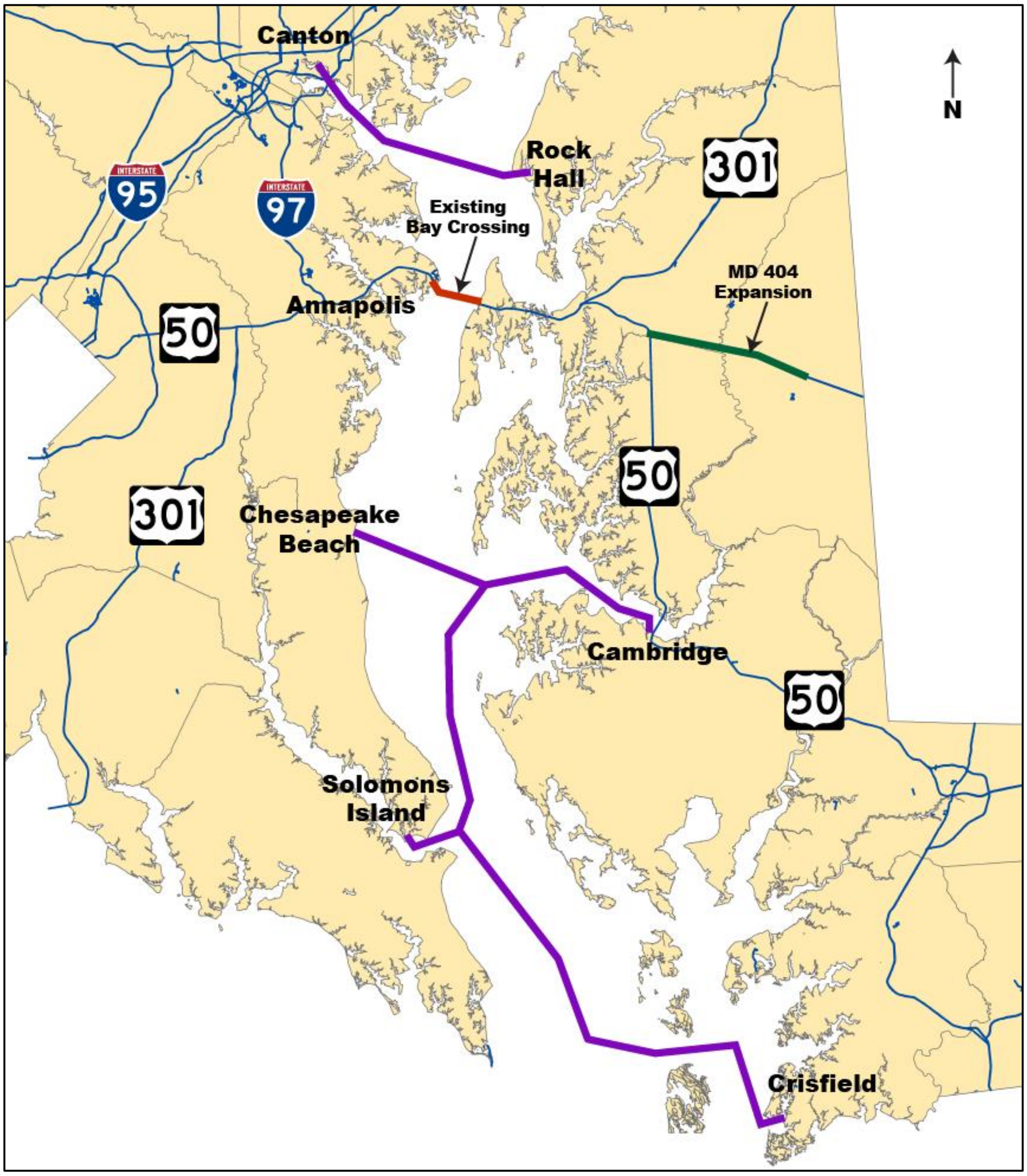


Figure 1 - Ferry routes identified in the 2003 Study and the location of the MD 404 expansion project

The current one to two-hour delays on a summer weekend are comparable to the one-hour delay cited by the 2003 Study. Based upon this delay, the overall attractiveness of a ferry as an alternative travel mode for crossing the Chesapeake Bay has not increased enough to affect the 2003 Study's conclusions.

The capacity of a potential ferry route was analyzed using the capacities, headways, schedules, and vessel counts from the 2003 Study to determine the maximum capacity of a potential ferry route.

Table 3 below shows the parameters used in the analysis:

Ferry Service Parameters	
Scheduled Sailing Hours	16 hours (5:00am to 9:00pm)
Trip Headway	2 hours (per sailing)
Number of vessels	2
Total sailings per day	18
Vessel vehicle capacity	54 cars (maximum.)
Vessel passenger capacity	149 (maximum.)
Assumed vehicle usage rate	100%
Assumed passenger usage rate	100%

Table 3 - Ferry Service Parameters

Using the parameters above, the analysis found that a two-vessel ferry route could convey a maximum of 108 vehicles and 298 passengers per hour which is equivalent to 972 vehicles and 2,682 passengers per day (18 total vessel trips). These numbers do not represent actual demand but give an indication of the maximum number of potential trips a ferry route may provide. Table 4 below gives an indication of how the maximum capacity of a ferry route relates to the existing and projected daily traffic volumes crossing the bay:

Comparison of Daily Existing and Projected Bay Bridge Traffic Volumes and Ferry Capacity				
	Existing 2017	Projected 2040 No-Build	Maximum Ferry Vehicle Capacity	Ferry as a percentage of 2040 volumes
Weekday Average	68,600	84,300	972	1.15%
Summer Weekend Average	118,600	135,300	972	0.72%

Table 4 - Comparison of Daily Existing and Projected Bay Bridge Traffic Volumes and Ferry Capacity

In 2040, daily volumes at the Bay Bridge are expected to be approximately 15,700 higher on non-summer weekdays and 16,700 on summer weekends than they are today. Thus, a ferry service would accommodate less than five percent of the growth in volume and would not reduce existing volumes. As a result of the increases in average daily traffic between 2003 to 2017 and the projected increases in 2040, the percentage of ferry users would be even lower than the 1.4 percent figure in the 2003 Study. Therefore, ferry service, as a standalone alternative, does not provide enough capacity to reduce the transportation demand on the existing Chesapeake Bay Bridge and does not meet the Purpose and Need of the Tier I study.

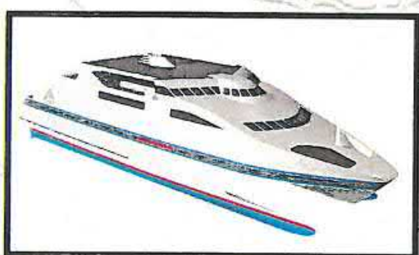
4.0 Summary

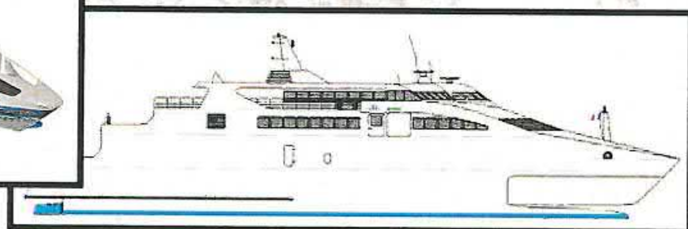
The *2003 Chesapeake Bay Ferry Evaluation* was conducted to understand the viability of ferry service across the Chesapeake Bay. Four routes, Canton to Rock Hall, Chesapeake Beach to Cambridge, Solomons Island to Cambridge, and Solomons Island to Crisfield were identified and evaluated further to understand their potential operating costs, environmental impacts, ridership, revenue, and economic benefits. Two conventional, lower cost ferries would be in operation per route, and could operate at a speed of 20-22 knots. The estimated capital cost (in 2003 dollars) was $7 to $10 million per vessel.

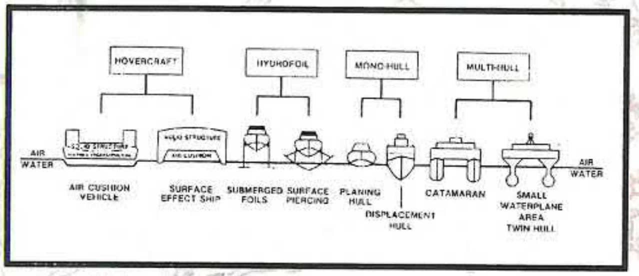
Investigation of the methodology and conclusions of the 2003 Study revealed that if ferry service were in operation today, a two-vessel ferry route could convey a maximum of 108 vehicles and 298 passengers per hour which is equivalent to 972 vehicles and 2,682 passengers per day (18 total vessel trips). This would equate to reductions in 2040 Bay Bridge Traffic Volumes of 1.15 percent on an average weekday and 0.72 percent on an average summer weekend day. Therefore, ferry service, as a standalone alternative, would not provide enough capacity to reduce the transportation demand on the existing Chesapeake Bay Bridge, and does not meet the Purpose and Need of the Tier I study.

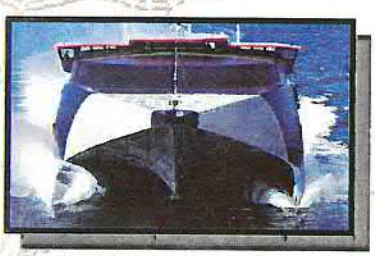
Appendix 1
2003 Draft Chesapeake Bay Ferry Evaluation

CHESAPEAKE BAY FERRY EVALUATION









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Executive Summary

Introduction

The **Chesapeake Bay Ferry Evaluation** sponsored by the Maryland Transportation Commission, was undertaken by the Maryland Department of Transportation (MDOT) and the Maryland Transportation Authority (MdTA) to investigate potential ferry service routes connecting the Western and Eastern Shores of Maryland across the Chesapeake Bay. The purpose of the study was to develop an inventory of potential terminal locations that meet basic requirements of:

- adequate landside access,
- adequate water access,
- and minimized environmental impact.

A series of terminal pairs were also developed to provide base analyses for examples of capital and operating costs as well as travel times.

The study addressed a variety of factors related to providing auto, truck and passenger ferry services on the Bay including:

- findings of previous studies,
- viable sites for ferry terminals,
- representative demonstration routes among various terminals,
- potential vehicle and passenger demand,
- high-speed versus conventional ferry vessels,
- approximate capital and operating costs for vessels, terminals and access improvements,
- marine and landside access facility requirements at each site,
- estimated operating costs and revenues for each demonstration route,
- likely economic benefits/impacts to the Western and Eastern Shore communities.

Several events have occurred during the time frame of this study that warrant mention here:

First, the Phase II Mid-Chesapeake Bay Ferry Feasibility Study Final Report, conducted by Virginia's Northern Neck Planning District, was completed in the Summer of 2002. Due to lack of public support for a terminal location in Accomack County, Virginia, ferry service between Virginia's Northern Neck and Virginia's Eastern Shore was deemed infeasible. The Virginia Study did note the positive interest displayed by Somerset County, Maryland for a ferry connection from Crisfield, Maryland to Reedville, Virginia. It was concluded in the Study that this service would have positive economic benefits for Reedville, but that additional economic studies would be needed for the Maryland market areas.

Secondly, during the Maryland General Assembly session of 2003, Somerset County was successful in having legislation enacted that would permit the County to enter into a franchising agreement with a private ferry operator. The legislation specified that the proposed ferry service would operate between Crisfield and Reedville. Somerset County is now in the process of investigating financing and establishing a potential organization to administer the ferry operation.

This evaluation of ferry service on the Chesapeake Bay was undertaken with the intent of providing a comprehensive look at the entire Bay within Maryland. Rather than focusing on a predetermined site pairing, as several previous studies had done, this effort was designed to gather available information and provide an overview on all aspects of ferry locations, operations, technology and economic impacts. This information is presented here for use by local jurisdictions, public agencies and the private sector as a current source of information for further investigations of the viability of ferry service on the Bay.

Study process:

The study initially identified 59 potential ferry terminal sites on both sides of the Chesapeake Bay and conducted a fatal flaw analysis and site evaluation process to determine a relatively small number of sites for more detailed assessment. The potential sites were identified based on discussions with County Planners, previous ferry studies, locations of former ferry or steamboat routes, locations of public boating facilities, towns on the waterfront and reviews of County planning documents. The initial list included 26 sites on the Western Shore and 33 sites on the Eastern Shore.

The fatal flaw screening examined the sites based on minimum criteria for accessibility by land and water, and for environmental concerns. The 22 sites that passed the fatal flaw screening were subjected to a more comprehensive evaluation using criteria related to relative site accessibility, community and environmental issues, and existing infrastructure and improvement costs. Additional consideration was given to sites that formed a logical pair on each side of the Bay, that were sufficiently far away from the Bay Bridge to provide a viable alternative to driving, and where land costs were reasonable.

Six sites, resulting in four demonstration route pairings, were designated for detailed analysis. MDOT is not endorsing any site pairs as better than the others. The analysis of site pairings is for demonstration purposes only to illustrate what might be required should a ferry service run between these locations. The study results indicate that these site pairs have the most potential to foster a successful ferry service.

Key findings of the study are:

Four demonstration terminal pairs were identified and evaluated to represent a range of potential ferry services across Maryland's portion of the Chesapeake Bay. These were:

- Canton (Baltimore) to Rock Hall
- Chesapeake Beach to Cambridge
- Solomons Island to Cambridge
- Solomons Island to Crisfield

The study examined operating and environmental factors, capital and operating costs, ridership and revenues, and user and community economic benefits for both conventional (22 knots) and high-speed (41 knots) ferries on each route.

Crossing times for the four routes range from 82 to 145 minutes for a conventional ferry, and 55 to 117 minutes for a high-speed ferry. Chesapeake Beach to Cambridge is the shortest route; Solomons Island to Crisfield is the longest.

Ferry tolls were assumed to be \$25 per car and \$75 per truck for a conventional ferry, and \$37.50 and \$112.50, respectively, for a car and truck on a high-speed ferry. The fares would be collected each way so the round trip for a car would be \$50 on a conventional ferry. For comparison, the Bay Bridge toll is \$2.50 for a car and \$10 for a standard 5-axle truck/semi-trailer combination. The toll is collected in the eastbound direction only.

Conventional ferry service would attract a range from 25,000 annual vehicles on the Solomons Island to Crisfield route, to 335,000 vehicles per year for the Chesapeake Beach to Cambridge route. Vehicle demand for high-speed ferry service was substantially less on all routes due to the higher fares, ranging from about 10,000 vehicles per year on the Canton to Rock Hall route up to 136,000 vehicles for the Chesapeake Beach to Cambridge route. The highest ferry route demand (335,000 vehicles) represents only 1.4 percent of the 24 million vehicles using the Bay Bridge annually.

Only one demonstration route (Chesapeake Beach – Cambridge) has a potential for break-even or near-break-even performance in operating costs and revenues; the other demonstration routes would have deficits of $1.5 to $4.0 million per year. None of the routes could pay for capital costs of new vessels, terminals and roadway improvements needed to provide ferry service, which ranged from a low of $18 million to a high of $80 million.

No financing costs, ongoing maintenance costs, or capital preservation costs are included. Potential economic benefits of cross-Bay ferry service would be $1.3 to $3.6 million per year in terms of salaries to employees, business transport cost savings and increased tourist spending. The most cost-effective ferry vessel for the demonstration routes would be about 200 feet in length with a draft of no more than 8 feet and a capacity for 50 to 60 automobiles, or 30 autos and six to ten large trucks. There are a wide variety of both high-speed and conventional vessel designs of this size available for construction by U.S. shipyards. A conventional vessel would cost approximately $7 to $10 million and a high-speed vessel would cost $35 to $40 million.

Some dredging would likely be required on any of the four demonstration routes to provide and maintain a suitable water depth for ferry operation at design speed.

Introduction

STUDY GOALS AND OBJECTIVES

The **Chesapeake Bay Ferry Evaluation** sponsored by the Maryland Transportation Commission, was undertaken by the Maryland Department of Transportation (MDOT) and the Maryland Transportation Authority (MdTA) to investigate potential ferry service routes connecting the Western and Eastern Shores of Maryland across the Chesapeake Bay. The purpose of the study was to develop an inventory of potential terminal locations that meet basic requirements of:

- adequate landside access,
- adequate water access,
- and minimized environmental impact.

STUDY TASKS

- identification of the study area;
- review previous transportation studies of the Chesapeake Bay;
- review transportation and land use policies in relation to study objectives;
- qualitative discussion on the general attributes of comparative ferry services;
- identify likely permits required;
- identify all potential sites in Maryland for ferry service across the Chesapeake Bay;
- identify sites that are most suitable for ferry termini based on a fatal flaw analysis that assesses several basic criteria;
- develop site evaluation criteria and identify a list of demonstration pairs for further analysis;
- investigate four short-listed site pairings in order to demonstrate issues that need to be considered should a ferry service run between these locations;
- assess "off-site" transportation network capabilities to support the proposed ferry service terminal locations and identify improvements needed at each of the short listed sites;
- review available census and travel data;
- review anticipated population, employment and tourism growth in the study area;
- prepare estimates of potential ridership on demonstration ferry routes;
- evaluate navigation issues for the crossing alternatives;
- provide examples of vessels that can be used along the demonstration routes;
- analyze the technical & operating criteria of the demonstration pairs; and
- evaluate the public transportation and economic benefits of the proposed ferry service alternatives.

STUDY AREA

Previous studies of ferry services on the Chesapeake Bay focused on particular origins and destinations. This study takes a broader view and is not limited by any previously identified pair of end points on the Bay. The study area is defined as the Maryland Eastern Shore and Maryland Western Shore of the Bay both north and south of the Bay Bridge. Refer to Figure 1-1 for the location of the potential sites along the Eastern and Western Shores.

Background

THE CHESAPEAKE BAY AND FERRY SERVICES

There is a long history of transportation services across the Chesapeake Bay. From the 1870s to the 1920s, steamboats served nearly all of the cities and towns on the Bay, many connecting to rail passenger and freight services. During the early 20th Century, ferry services on the Chesapeake Bay were popular among residents from the Baltimore and Washington regions traveling to waterfront vacations on the Eastern Shore.

Services operated from many locations, including Baltimore to Salisbury, Baltimore to Claiborne, Annapolis to Claiborne, and Sandy Point to Matapeake. The first regularly scheduled passenger service started in 1919 as a 23 mile, two hour trip between Sandy Point and Claiborne. Later ferries also carried cars as the popularity of private automobiles increased and Ocean City's first vehicle bridge opened.

The William Preston Lane Memorial (Bay) Bridge opened in 1952 as a two-lane roadway connecting the Eastern and Western Shores of Maryland, effectively replacing the Sandy Point to Matapeake Ferry. This was the end of regular ferry vehicle services across the Chesapeake Bay. The opening of the bridge, followed by a doubling of capacity with a parallel structure in 1973, improved access across the Chesapeake Bay and significantly increased the level of tourism and economic activity on the Eastern Shore.

A number of passenger only excursion tourist boat routes still operate on the Chesapeake Bay. However, none of the services provide daily round trips between the Eastern Shore and the Western Shore. The most common tours offer part-day trips to Smith Island, Tangier Island, Cambridge, Oxford, Tilghman Island, St. Michaels, Annapolis and Baltimore Inner Harbor. Boats can also be chartered by groups and itineraries developed to cater to specific needs.

The Chesapeake Bay is 180 miles long. The two bridges that cross it, the Bay Bridge to the north in Maryland and the Chesapeake Bay Bridge-Tunnel to the south near Norfolk in Virginia, are 140 miles apart. Residents between these two points must make sometimes lengthy trips to reach these facilities.

Previous Ferry Studies in Maryland

Cross-Bay ferry services have been studied numerous times over the past two decades. This section describes the most recent efforts for ferry service in Maryland. The summaries provide a context for this current study by outlining a thorough understanding of the previous work completed, locations where there has been significant interest in ferry services and where services have been introduced in the past.

Qualitative Analysis of Ferry Operations and Competing Modes, Prepared for the Office of Management, Research and Transit Services, Urban Mass Transportation Administration, 1984.

A number of existing ferry services and potential new locations for ferry operations around the U.S.A. were reviewed in this study, including a case study of the Chesapeake Bay. A very brief travel time comparison analysis was completed and potential routes identified to serve demand for tourist and recreational travel from the metropolitan Washington and Baltimore areas to resorts along the Atlantic Coast in Delaware, Maryland and Virginia in order to relieve congestion from the road-based route.

Suggested routes were from Chesapeake Beach, in Calvert County to Hudson, Dorchester County, or from Long Beach, Calvert County to Taylors Island, Dorchester County.

The study also recommended that a potential for vehicle ferries connecting Crisfield with the Maryland Western Shore at Point Lookout might be worth considering given the long alternative route. The study found small time saving benefits and low population densities mitigating the feasibility of services. It also noted potential loss of patronage and revenues for the Chesapeake Bay Bridge-Tunnel as a disadvantage of proposed competing ferry services.

Chesapeake Bay Ferry Boat Service: A Preliminary Feasibility Study, Maryland Department of Transportation and Maryland Department of Economic and Community Development, 1987.

The 1987 study was conducted at a time when there was growing private interest in regular ferry service on the Chesapeake Bay. A task force was charged with investigating the feasibility of a ferry service and identifying how, and indeed if, the State should assist private operators.

To assist the task force, the report provided information that included data from public and private ferry services, descriptions of five potential routes and a preliminary economic feasibility and market analysis.

To determine demand for services, the study used 1980 Census journey to work data, factored for population change, for travel between the counties to be served by the proposed ferry. The demand estimated was considered to be the potential market for a ferry commuter service, however the study made no attempt to estimate tourist demand.

The report concluded that the ferry routes between Kent Island, Baltimore and Annapolis and between Chesapeake Beach and Cambridge were those with the most likelihood of success. Services between Baltimore and Annapolis and between Rock Hall, Baltimore and Annapolis were identified as requiring a substantial tourist market and "the outlook for a Baltimore, Annapolis and Cambridge service is bleak". The final recommendation of the report was that the task force be maintained to support private initiatives in ferry services on a case by case basis.

MDOT Grants for Feasibility Studies

In response to the recommendations from the task force, MDOT supported the completion of three feasibility studies for private operators to establish services on the Bay:

- Solomons Island to Taylor Island, Chesapeake Bayway Ferry;
- Baltimore to Rock Hall, Chesapeake Flyer; and
- Solomons Island, Drum Point, Little Cove, Cove Point and Power Plant area to Honga, North of Long Marshes or mouth of Saint John's Creek, Cross Bay Ferry Lines.

The Baltimore to Rock Hall service was proposed in conjunction with a mixed use marina development in Rock Hall. Recreational passenger only services began operation in 1990 and discounted commuter services were planned. The service is no longer operating. Comments from Kent County indicate that reliability of services was an issue in maintaining regular ridership.

In 1987, a passenger only service began operating from Solomons Island in Calvert County to Hooper Island in Dorchester County. The 11-mile route took about 90 minutes in comparison to a four hour drive along the alternative route. Plans to operate a car service did not materialize and the regular cross Bay passenger service no longer operates.

In October/November 1989, MDOT completed a survey of regular Bay Bridge commuters. The survey did not capture casual or recreational users of the bridge, nor did it provide any indication of latent demand of travel from the Solomons Island area to Dorchester County. The main findings from the survey include:

- the most common response groups were from Kent Island and Annapolis;
- the average travel time was 65 minutes one-way by vehicle;
- 213 respondents (38 percent) indicated that they would use an upper Bay Ferry Service;
- the most named ferry route was from Kent Narrows to the Baltimore Inner Harbor;
- the reasons for using a proposed upper bay ferry varied. Generally they were less money-sensitive and more oriented toward issues of convenience and ease of driver effort;
- the reasons for not using an upper Bay ferry were related to cost, time and convenience;
- 29 respondents (5 percent) identified that they would use a lower Bay Service; and
- other general comments included that ferry services were a good idea in general, that a service would be good for tourists/recreation. There were also concerns raised over connections to transit from ferry services, land development and environmental issues.

Feasibility Assessment of Mid-Chesapeake Bay Ferry Service between Crisfield and Point Lookout, Maryland Department of Transportation, 1994.

The study was completed in response to a request by the Maryland General Assembly Budget Committee to assess the economic impact and financial viability of ferry services specifically between Crisfield and Point Lookout. The report concluded that "ferry service between Crisfield and Point Lookout cannot succeed as a viable operation". The main reason for this conclusion was the "lack of sufficient commuter and tourist markets to warrant any further investigations".

The methodology used in the study was to define operating scenarios, including the operating, capital and fixed costs for services, then to calculate the cost per passenger and vehicle trip for break-even operation based on different levels of vessel capacity to see if resulting fares would be economically viable.

To estimate commuter travel, the study took 1990 Census journey to work data to estimate demand between the Eastern Shore and Southern Maryland. Although the study acknowledged that travel was limited due to lack of convenient transportation, it did not estimate any increase in commuter travel between the two regions if more convenient transportation was provided. The estimated travel time of approximately one to two hours and the required fare to break-even were considered unlikely to attract a high demand for work trips.

To estimate tourist demand, the study reviewed the demand for existing excursion boats from Crisfield to Smith Island and from Point Lookout to Smith Island. Based on those numbers, the study estimated a ballpark figure of 10,000 to 15,000 annual tourist trips on the proposed ferry.

Crisfield – Point Lookout Ferry Feasibility Study Phase I: Need and Patronage Assessment, Maryland Department of Transportation, 2000.

The impetus for this more recent study was the belief that a more direct connection between Southern Maryland and the Lower Eastern Shore would provide increased economic benefits to the two regions. The benefits were anticipated based on providing Lower Eastern Shore residents with increased access to employment opportunities in Southern Maryland, allowing improved access for businesses in Southern Maryland to expand into Lower Eastern Shore markets and attracting significant tourist travel.

The Phase 1 study determined estimated commuter, business and tourist demand for the ferry service. This demand was then applied to the operating scenarios developed in the 1994 study.

Commuter ferry ridership was estimated based on a household survey completed by the Schaefer Center for Public Policy at the University of Baltimore. The survey questioned Lower Eastern Shore residents on their willingness to use the proposed ferry service to commute to jobs in Southern Maryland depending on wages, ferry fare and travel time. The total population living within certain travel contours from Crisfield (that meet certain household income and age requirements) multiplied the proportion of respondents who responded that they would definitely or probably take a job in Southern Maryland and would be willing to commute by ferry. This methodology resulted in an estimated potential commuter ridership between 0 and 522 daily trips or up to 130,500 annual trips; the nominal estimate was 27,000 trips.

A second survey, aimed at gathering information on the availability of jobs and business expansion opportunities in the Eastern Shore, targeting Southern Maryland businesses. The survey was not able to provide sufficient information to determine potential West to East business ridership. The responses suggested that business ridership was not likely to be significant in determining the feasibility of services.

Tourist ridership was expected to be a significant component of total travel on a proposed service. Tourist ridership was estimated focusing on existing travel patterns to the Lower Eastern Shore. The first estimate was based on the U.S. National TravelScope survey and the proportion of recreational travelers to the Eastern Shore from each State that would be considered likely to use the Ferry given its location relative to road-based options. This method results in an estimated 100,800 vehicles and 201,700 persons annually, potentially using the ferry for tourist trips.

The second method made use of MdTA traffic count data across the Bay Bridge and the Governor Nice Bridge excluding cars paying tolls using commuter tickets or government passes and heavy trucks. Tourist traffic across the bridges was defined as that in excess of the baseline traffic levels (the average of traffic counts in the shoulder months). An estimate of bridge traffic destined for the Eastern Shore was made. It was estimated that 5 percent of tourist users of the Bay Bridge and 50 percent of users of the Governor Nice Bridge would divert from the bridge to the proposed ferry service. This method resulted in an estimated 58,000 vehicles and 116,000 tourists.

The study concluded that based on the significant number of potential tourist riders during the peak summer tourist months, tourist riders fares could support reduced fares for commuters. Modest commuter ridership was considered possible depending on the ferry crossing travel times and fares.

Crisfield – Point Lookout Ferry Feasibility Study Phase II: Ferry Service Evaluation and Alternatives. A Collection of Technical Memoranda, Maryland Department of Transportation, 2001.

The Phase II study was based on the potential ridership in the commuter and tourist markets identified in Phase I with a key goal to further develop a potential ferry service between Crisfield and Point Lookout. The study produced a number of technical memoranda covering the following issues:

- boat builder questionnaire;
- ferry system questionnaire;

- ferry technology;
- recommended ferry technology for the Chesapeake Bay;
- terminal facility requirements;
- operating scenarios and cost summary; and
- potential environmental issues.

Implementation of a service was not pursued given the estimated costs of establishing and operating a ferry service between Point Lookout and Crisfield.

Other Relevant Studies

Mid-Chesapeake Bay Ferry Feasibility Study, KJS Associates, Inc. for the Northern Neck Planning District Commission and the Virginia Department of Transportation, January 2001.

This study examined the feasibility of a vehicle ferry connecting the Northern Neck and Eastern Shore communities within Virginia. The study identified the most promising route between Reedville and Onancock Creek, roughly parallel to and about 30 miles south of the Crisfield – Point Lookout route in Maryland discussed above. The study concluded that a 2-vessel operation using existing 15-knot boats with a two-hour one-way crossing time would generate sufficient patronage and revenues to "break-even" on operating expenses. However, the route would require outside capital funding for terminals and access roads. It was anticipated that these costs would likely have to be absorbed by public agencies, such as the Virginia DOT.

The study estimated the economic benefits to the Northern Neck and Virginia Eastern Shore communities. Direct ferry-related wages and purchases of supplies and support services in the local areas would be $1 million to $2 million per year. Increased business productivity through lower transport costs and access to new markets by area businesses on both sides of the Bay would generate about $1.5 million in added sales annually. Increased tourist and traveler spending in the Northern Neck and Eastern Shore communities would be $4 million to $6 million annually. In addition, the mid-Bay connection would enhance access to major retail markets for Eastern Shore residents, thereby increasing competition and lowering costs for major household purchases.

Phase II, Mid-Chesapeake Bay Ferry Feasibility Study Final Report, VHB, for the Northern Neck Planning District Commission, June 2002.

This effort built upon the preliminary feasibility study (Phase I) by providing more in-depth analyses of individual study factors. While the feasibility of ferry service between Northumberland County and Accomack County was verified, it was acknowledged that there was no public support for a ferry terminal on Virginia's Eastern Shore. No further study of that route was recommended. The Study did note, however, that with demonstrated support for ferry service in Crisfield, Maryland, the possibility of a Reedville to Crisfield service existed.

Relevant Transportation and Land Use Policies

Chesapeake Bay Critical Areas

In 1986, the State of Maryland approved the final regulation and guideline for the establishment of the Critical Area Commission, and criteria for the Chesapeake Bay Critical Area Law. The purpose of the law is to regulate activities within 1,000 feet of tidal waters of the Chesapeake Bay with the intent of improving the water quality and habitat in the Bay.

The criteria require that local jurisdictions protect the hydrologic regime and water quality of wetlands by minimizing alterations to the drainage area, surface/subsurface flow of water, and overall water quality. Development is permitted within the Critical Area, however, specific regulations restrict the intensity of development. Development within the Chesapeake Bay Critical Areas requires a permit through the Critical Area Commission and Local Governments.

Three designations were defined:

- **Intensely Developed Areas (IDAs):** are defined as areas of twenty of more adjacent acres where residential, commercial, institutional or industrial land uses predominate. IDAs are areas of concentrated development where little natural habitat occurs;
- **Limited Development Areas (LDAs):** are areas in which development is of a low or moderate intensity. LDAs contain areas of natural plant and animal habitats but are not dominated by agriculture, wetland, forest, barren land, surface water or open space; and
- **Resource Conservation Areas (RCAs):** are characterized by natural environments or by resource-utilization activities. Resource-utilization refers to such activities as agriculture, aquaculture, commercial forestry and fisheries activities which the Criteria consider protected land uses.

County Planning Documents

The available comprehensive plans, tourism and economic development plans, recreation plans and master plans for each County in the study were reviewed. Information was gathered including an inventory on major neighborhoods, towns, villages and/or cities within the county along the shore's edge, area demographics (population, employment data, and anticipated growth), tourism statistics, and any relevant plan sections relating to land use, zoning, the environment, and access. A detailed listing of the information gathered can be found in the Appendix. This data was used to identify any potential sites for ferry services along the Bay and will be referred to in more detail during the site feasibility assessment stage of the project.

COMPARATIVE FERRY SERVICES

This section provides a description of the typical circumstances where waterborne transportation has been introduced in other locations to improve access and provide viable travel options for passengers and their vehicles. The discussion will assist in improving the level of understanding of the potential future role that regular ferry services could have on the Chesapeake Bay, given its characteristics.

A brief description of the Chesapeake Bay and the surrounding environment and a review of existing comparable ferry services in the U.S.A. is followed by a general discussion of the common characteristics of ferry services.

Characteristics of the Chesapeake Bay

Regular ferry services have not operated on the Chesapeake Bay on a large scale since 1952 when the Bay Bridge was built. Population growth further away from the Bay, demand for faster, more convenient connections across the Bay, along with the rise of automobile ownership led to the construction of the Bay Bridge.

The Bay Bridge provides the major direct access between Maryland's Western and Eastern Shores. North of the Bay Bridge, the improved highway network also provides greater accessibility between the two regions than the previous ferry services. Since its opening in 1952, traffic on the Bay Bridge has increased from 1.1 million vehicles annually to an estimated 24.0 million vehicles in FY 2001 and 25.0 million in FY 2002.

The Bay Bridge is a toll bridge, and tolls are collected in the eastbound direction only. The toll for two-axle vehicles is $2.50; each additional axle is $2.50 for a round trip.

Increasing congestion on the Bay Bridge, especially during the peak summer tourist months, has rekindled interest in vehicle ferry service across the Bay. The growing demand in cross-Bay traffic, increased tourist attractions in Maryland, coupled with recent improvements in fast ferry technology may make waterborne transportation viable again on the Chesapeake Bay. Waterborne transportation has also been raised as providing alternative transportation in the case of a bridge disaster in which access across the Bay Bridge was no longer viable.

The general characteristics of the Chesapeake Bay region that would influence the success of a regular ferry service include:

- There are only a few large population and activity centers (Baltimore, Annapolis) on the Western Shore of the Bay, and none of comparable size on the Eastern Shore.
- Depending on the location of the route, it may be considered as an *optional* or *complementary* transportation route. A *complementary route* would provide a more direct route than land based alternatives, and an *optional route* would provide an equally direct route as land based alternatives but may provide other advantages. An *essential route* would be one where there are no other alternative land-based routes available such as to an island with no bridge or tunnel access. The Bay Bridge and road access to the north provide viable alternatives to a ferry route on the Chesapeake Bay.
- The Bay Bridge crosses the Chesapeake Bay at the historical ferry terminal points, at the shortest connection route on the Bay, approximately 4.4 miles (3.7 nautical miles).
- Potential route options may range between 8 - 10 nautical miles (Cove Point to Honga or Annapolis to Matapeake) to 23 - 34 nautical miles (Chesapeake Beach – Cambridge, Point Lookout – Crisfield or Annapolis – Cambridge).
- Ferry services would need to carry both passengers and vehicles.
- The major market segment for the service would be for tourists and recreational travelers from the locations on the Western Shore of Maryland to Ocean City and other Eastern Shore destinations during the summer and holiday periods.
- Ocean City is 60 to 80 miles from the Bay's eastern edge, approximately one to one and a half hour drive from any potential ferry landing.
- Previous studies of a proposed ferry service from Point Lookout to Crisfield concluded that the route would require a vessel that could complete the 32 mile (28 nautical miles) journey in one hour in order for the service to carry the projected peak passenger volume with only two vessels.

Comparable Ferry Services in the United States

The U.S. Department of Transportation Federal Highway Administration has produced a comprehensive set of data on United States ferry operators, routes, terminals and vessels. The database, released in March 2001, was developed based on a survey of 224 ferry operators, providing 352 ferry routes, serving 578 ferry terminals. This database has been used to identify services that may be comparative to a ferry service developed for the Chesapeake Bay based on the broad characteristics described above.

The database was searched to identify ferry services that were:

- for both vehicles and passengers;
- high-speed ferries;
- complementary routes;
- less than a one hour travel time; and
- trips covering distances between 8 to 28 nautical miles.

The database indicates that, in the United States:

- there are a total of 228 vehicular ferry routes;
- only one of these routes is serviced by a high-speed ferry, it is a 96 nautical mile route between Bar Harbor, Maine to Yarmouth, Nova Scotia Canada, a 2 hour 45 minute journey that operates seasonally only;
- 127 of the vehicular ferry routes are essential, that is, there is no alternative access;
- 93 of the vehicular ferry routes are complementary, that is, they provide a more direct route than land based alternatives;
- seven of the vehicular ferry routes are optional, that is, they provide an equally direct route as land based alternatives but may provide other advantages;
- of the seven optional routes, six are between 5 and 15 minutes long and the remaining service is 25 minutes long or 4.5 nautical miles; and
- of the 93 complementary routes, approximately 80 percent are 20 minutes or less, and 88 percent are 30 minutes or less. Eight services are between 30 to 80 minutes long and six of these between 7.5 nautical miles and 16 nautical miles.

The six complementary ferry services between 7.5 and 16 nautical miles are briefly described in Table A below:

Table A: Ferry Services in the U.S.A. (with similar distance, travel time and alternative transportation characteristics as the Chesapeake Bay)

Route	Water Crossing	Distance (nm)	Travel Time (min)	Other
Seattle WA – Bainbridge Island WA	Puget Sound	7.5	35	Year round Publicly owned and operated, receives Federal, State and Local funding Ratio of passengers to vehicle (1999): 2.0 Fares ▪ Vehicle one way $19.50 ▪ Passenger round trip $3.70 Estimate of road-based alt.: 1 hour 51 minutes, 95 miles Average speed 13 knots
Burlington VT – Port Kent NY	Lake Champlain	8.9	60	Seasonal Privately owned and operated, does not receive Federal, State or Local funding Ratio of passengers to vehicle (est): 1.2 Fares ▪ Vehicle and driver one way $12.75 ▪ Passenger one way $3.25 Estimate of road-based alt.: 1 hour 37 minutes, 87 miles Average speed 9 knots
Seattle WA – Bremerton WA	Puget Sound	13.5	60	Year round Publicly owned and operated, receives Federal, State and Local funding Ratio of passengers to vehicle (1999): 2.2 Fares ▪ Vehicle one way $19.50 ▪ Passenger round trip $3.70 Estimate of road-based alternative: 1 hour 13 minutes, 66 miles Average speed 13.5 knots
Lewes DE – Cape May NJ	Delaware Bay	14.6	70	Year round Publicly owned and operated, receives Federal and State funding ▪ Ratio of passengers to vehicle (1999): 3.2 Fare ▪ Vehicle one way (incl driver) $20 ▪ Passenger round trip $12.50 Estimate of road-based alternative: 3 hours 41 minutes, 175 miles Average speed 12.5 knots
Bridgeport CT – Port Jefferson NY	Long Island Sound	14.6	75	Year round (more services during summer) Privately owned and operated, receives Federal and Local funding Ratio of passengers to vehicle (1999): 2.3 Fares ▪ Vehicle one way $20 ▪ Passenger (in vehicle) round trip $12.25 ▪ Passenger (walk on) return trip $16.25 Estimate of road-based alternative: 1 hour 49 minutes, 98 miles Average speed 11.5 knots
New London CT – Orient Point NY	Long Island Sound	16	80	Year round (more services during summer) Privately owned and operated, does not receive Federal, State or Local funding Ratio of passengers to vehicle (1999): 2.4 Fares ▪ Vehicle one way (incl driver) $33 ▪ Passenger (walk on) round trip $15 Separate passenger service also operates same route. Estimate of road-based alternative: 3 hours 47 minutes, 210 miles. Average speed 12 knots

These services were initially selected as being the most similar to any service that may be developed for the Chesapeake Bay. However, when these services are reviewed in more detail, the unique character of the Chesapeake Bay stands out from the conditions surrounding these other routes.

Of the services above, two operate between the downtown waterfront terminal of a major metropolitan area (Seattle, WA) and suburban communities (Bremerton and Bainbridge Island, WA). The Seattle terminal is within walking distance of the region's financial-government-office center, and close to very good transit connections through the city. Ferry services to Bainbridge Island and Bremerton provide an attractive option compared to the long and often peak congested road-based alternative for commuters. Even without congestion, the alternative road trip is typically twice as long as by ferry. The ferries have a strong mix of both commuters and tourists, and population growth is the main factor driving ridership growth. The operation of the ferries has led to land use changes and the development of affordable housing options for downtown workers in Bremerton. In addition to the car ferries there are also passenger only services operating to these locations indicating higher mixed use densities close to the terminals.

The three services between New York State (Port Kent, Port Jefferson and Orient Point) and Burlington, VT, Bridgeport CT and New London CT are all privately owned. Only the Port Jefferson to Bridgeport service receives Federal and State funding support; the others are all privately financed. Each of these services result in a 40 percent to 70 percent saving in travel time compared to the road-based alternative. There is also a main population center or downtown area nearby to the ferry landing on at least one end of the trip on each route.

The other service identified is the Cape May (NJ) to Lewes (DE) Ferry. This service is significantly shorter than the road based alternative.

In summary, these services have:

- a significantly shorter travel time than the road-based alternative;
- at least one end of the route is in a town center or major destination point;
- passenger to vehicle ratios (except Lewes to Cape May) suggest that there are many walk on passengers and therefore connecting transit services; and
- the vessels typically average 12 to 13 knots.

The review of other U.S. ferry services did not identify any vehicle/passenger high-speed ferries in settings comparable to the Chesapeake Bay. The majority of all vehicle/passenger ferry services are operated using conventional ferries at speeds of less than 15 knots.

In a presentation on high-speed vehicle/passenger ferries in Canada in May 1999, the Secretary Treasurer of Canadian Ferry Operators Association noted two main challenges for the broader introduction of high-speed ferry vehicle/passenger services. The first is the high cost– the majority of large ferry operators in Canada were financially subsidized by the Federal or Provincial governments to provide services at mandated service levels. The second challenge is how to make services competitive with private automobiles. However, it was identified that high-speed vehicle/passenger ferries were capable of providing an attractive transportation alternative to vehicular travel on congested urban highways between major urban centers.

Characteristics of Comparative Ferry Services

Previous studies of ferry services internationally have identified the following factors relating to quality and level of service and the ferry service catchments as critical to operations. These are general characteristics drawn from reviewing a number of ferry operations.

1. Reliability — On-time service is required to attract and sustain ridership, particularly commuters. Reliability is influenced by the types of vessels, maintenance requirements and weather conditions.
2. Frequency — Frequent sailings during the high demand periods are required to compete with the flexibility offered by the automobile.
3. Pleasant Way to Travel

   Ferries are typically viewed as an enjoyable way to travel. This perception is influenced by vessel characteristics such as on-board dining facilities and smooth performance in moderate weather conditions.
4. Safety — Passengers must feel safe both on land and on the water.
5. Market Development

   Ferry supportive land uses at one or both ends of a ferry route contribute to the success of many ferry services. Residential and commercial developments within walking distance of the terminal(s) are especially important for passenger commuter ferries as they establish a community base for ferry services. For tourist and vehicular ferries, it is also important to provide supporting services at or near the terminals to make waiting times more enjoyable, and to have a nearby tourist destination for ferry users. This factor also highlights the importance of a broad and inclusive marketing campaign integrated with local tourist activities.
6. Integration with Transportation Network

   This factor includes a variety of considerations for seamless connections between the ferry and other modes. It includes supporting road infrastructure for auto access and good connecting transit services for foot passengers, including integrated timetables, ticketing and fares, good pedestrian access; convenient parking and high quality passenger information and waiting facilities.
7. Travel Time on Ferry

   Vessel travel times should be competitive with alternate routes/modes of travel.
8. Absence of an Alternative

   Traditional ferry markets are most successful when there is not any real competitive route or mode of travel, thus providing a virtually captive market for ferry riders.

Chesapeake Bay and Ferry Services

The discussion below identifies possible ways that the above characteristics of comparative ferry services can be applied in the context of the Chesapeake Bay and assist in setting a framework for the study.

Reliability

- Weather conditions on the Chesapeake Bay mean that a service may not be able to operate every day, all year round. The design/selection of the vessels for this service must consider trade-offs between the costs of a vessel with enhanced sea-keeping characteristics and the passenger inconvenience from missed trips due to weather.
- The attractiveness of the ferry service would also be influenced by the reliability of the road-based alternative. Congestion and long delays on the Bay Bridge during the peak summer tourist season could possibly make a ferry alternative more attractive.

Frequency of Services

- Sufficient services would need to be offered to compete with the convenience and flexibility of the alternative land route. Waiting times between ferry arrivals should not discourage users.
- To better capture the tourist market, the frequency and timing of services should coordinate with accommodation check-in and check-out times in Ocean City and the other major Eastern Shore destinations.

Pleasant Way to Travel

- The Chesapeake Bay is an area rich in environmental and cultural heritage. The reintroduction of ferry services on the Bay could raise community awareness on the issues facing the Bay and the need for environmental protection. It provides an opportunity for the travelers to reconnect with the Bay and remove the perception of the Bay being a barrier between the Eastern and Western Shores.
- The route location and the vessel technology would influence the impact that weather conditions would have on services, and the average number of trips lost per year due to weather conditions. It is important that the vessel provides passengers with a sufficient level of comfort so that any fear of rough weather conditions does not discourage travel.
- On-board facilities, such as restrooms, food and beverages, cable television or news services, and internet access would all work towards making the ferry an attractive option for both tourists and commuters.

Safety

- Concerns about safety issues regarding crossing the Bay by ferry over long distances may have an adverse impact on potential ridership.
- Perceptions of safety conditions on the Bay Bridge may also influence an individual's choice of mode.

Integration with Transportation Network

- The study objectives include minimizing the need for new infrastructure and maximizing the use of existing infrastructure. Locations where steamships operated in the past and where there are existing public boat ramps are typically the locations with existing connections to the road network.
- Integration with the transportation network means identifying locations where the road network is already established and provides efficient connections to major origins and destinations.

- Priority should be given to locations where there is the opportunity to provide parking facilities, bus connections to activity centers and good pedestrian and bicycle access.

Market Development

- Ideally, services should focus on locations that are centers of population and mixed use activity on the Chesapeake Bay. This would increase the attractiveness of the service by minimizing the travel time to main destinations and maximizing opportunities for tourism and economic development.
- Landside integration includes the consideration of opportunities for economic development, mixed commercial and recreational land uses at ferry terminals, maximize opportunities for bicycle and walk on passengers to increase ridership levels. There are a number of popular bicycle routes on the Eastern Shore that are currently only accessible by vehicle for residents of the Western Shore. A ferry service could provide a popular connection for recreational bicyclists.
- A ferry terminal site should be consistent with county land use plans, and economic development goals.
- In line with the study objectives, the selection of sites should minimize negative impacts on existing communities and minimize environmental impacts. The focus on existing facilities near to centers of population would work towards meeting this objective. Consideration will be given to the Chesapeake Critical Area Program and the location of wetlands, wildlife refuges, State Parks and other environmentally sensitive locations along the Bay.
- Promotion and advertising will be important in attracting and maintaining ridership. Opportunities for marketing the ferry service should be explored and may include vacation packages to the Eastern Shore inclusive of ferry travel. Advertising could be achieved best through State sponsored publications and establishing an easily recognizable common identity for road signage and promotion.

Travel Time on Ferry

- Ideally, travel time by ferry should be competitive with the road-based alternatives. Consideration should be given to travel by road during the congested peak summer periods.
- Experience from the review of other vehicular ferries over similar distances in the United States indicates a travel time saving of 40 percent to 70 percent in comparison to the road-based alternative from terminal to terminal. The competitiveness would also be influenced by the total door to door travel time.
- The shortest crossing of the Chesapeake Bay is at the location of the Bay Bridge. Other potential crossings range from 8 to 32 nautical miles or 40 to 140 minutes on a conventional ferry or 15 to 60 minutes on a high-speed ferry.
- There are potential sites near the Bay Bridge that would not provide any travel time benefits in comparison with travel across the bridge. Locations within 5 to 10 miles either side of the Bay Bridge are not considered to provide a competitive travel time with the Bay Bridge alternative and are not likely to attract significant ridership for a feasible service.

- The travel time required for the services will also be influenced by the number, type, and speed of vessels required for the volume of passengers and vehicles estimated in the demand assessment.

Absence of an Alternative

- The availability of a reliable road-based alternative is more important for commuter trips than for tourism or recreational travel.

Issues

The review of other vehicular ferry services with geographic characteristics similar to the Chesapeake Bay and the ferry service success factors raises the following issues regarding the potential for regular ferry services on the Bay. These include:

- depending on the location, the need for fast (30+ knots) vehicular ferries to achieve competitive travel times;
- the capital cost of ferry vessels: fast vehicular ferries range from $35 million to $40 million per vessel and conventional haul vehicular ferries range from $7 million to $10 million per vessel;
- most existing ferry services are subsidized by federal, state and local governments;
- the effect of improved transportation across the Bay on long term land use on the Eastern Shore;
- the availability of time and cost-competitive alternatives. In most cases ferry transportation has been superseded by quicker, cheaper, more convenient travel by private vehicles across bridges and through tunnels;
- the market for ferry travel on the Chesapeake Bay is most likely to be based on tourist and recreational travel, not commuter travel. Commuter has a greater need for reliability, competitive price, frequency of service, and integration with the public transportation network. On the other hand, tourist services are more influenced by marketing, safety, quality of travel experience, and presence/absence of an attractive road-based alternative;
- the need for land-side access improvements; and
- the need for waterway access improvements.

PERMIT PROCESS

The construction and operation of ferry facilities and services on the Chesapeake Bay would be subject to certain regulatory and environmental approvals and permits.

At the least, the State permit process would need to be followed. The Maryland Department of Environment (MDE) is responsible for the environmental permitting process of State projects. Any proposed service operating on the Chesapeake Bay would have potential impacts on tidal and non-tidal wetlands and their buffers.

The activity would require:

1. Waterborne vessel operation permit;

2. Floodplain, Waterway, Tidal or Nontidal Wetland approval;
3. Erosion/sediment control and storm water management plan approvals;
4. Chesapeake Bay Critical Area Protection Program compliance;
5. Local building permits conformity; and
6. Other permit requirements from Federal Government Agencies and permits for supporting infrastructure.

Waterborne Vessel Operation Permit

Maryland Public Service Commission regulates public utilities and certain passenger transportation companies in the State, this extends to most intrastate for hire passenger carriers by motor vehicle or waterborne vessels. The Commission has authority for "supervision and regulation of activities of public service companies". The Commission also:

- Sets rates;
- Collects and maintains records and reports of public service companies;
- Reviews plans for service and schedules of operation;
- Inspects equipment including safety of vehicles;
- Audits financial records;
- Handles consumer complaints;
- Promulgates and enforces rules and regulations; and
- Defends its decision on appeal to State courts and intervenes in relevant cases before federal regulatory commissions and federal courts.

Prior to a ferry service being operated on the Chesapeake Bay, the Public Service Commission would require a permit to be issued.

Floodplain, Waterway, Tidal or Nontidal Wetland Approval

The MDE regulates the following activities in tidal wetlands:

- Filling of open water and vegetated wetlands
- Construction of piers, bulkheads, revetments
- Dredging
- Marsh establishment

In non-tidal wetlands, or in a 25 foot buffer, the following activities are regulated:

- Grading or filling
- Excavating or dredging
- Changing existing drainage patterns
- Disturbing the water level or water table
- Destroying or removing vegetation

Under this process, the applicant is required to demonstrate that the proposed impacts to tidal wetlands are necessary and unavoidable. The review process addresses impacts through avoidance and minimization. An alternatives analysis may be required as part of this process. Mitigation may be required for unavoidable impacts. Wetland mitigation monitoring may be required and may extend beyond construction of an approved mitigation project.

A "Joint Federal/State Application for the alteration of any Floodplain, Waterway, Tidal or Nontidal Wetland in Maryland" application would be required to be completed and submitted to MDE, Water Management Administration Regulatory Services Coordination Office (RSC). RSC then forwards the application of the appropriate government agencies and conducts the review in cooperation with local, state and federal agencies.

The project will need to be advertised for comment and an opportunity for public informational hearing provided. The application may be required to notify adjacent property owners.

The Department makes a decision on the application based on the review. On receipt of final construction plans, a permit or license is issued. In some cases, a license may be issued by the Maryland Board of Public Works.

This process can take 30 days for minor projects and up to six months for major projects.

The Water Quality Certification (WQC), which insures the protection of waters of the State and is necessary for activities requiring a U.S. Army Corp of Engineers Section 404 permit, is incorporated into the approval by MDE.

Erosion/Sediment Control and Storm Water Management Plan Approvals

Erosion/sediment control plan and stormwater management plan approval is required before any construction activity that disturbs 5,000 square feet or more of soil or results in the excavation of 100 cubic yards or more of soil. For State projects, the erosion/sediment control plans are reviewed and approved by the MDE. The plans are required to meet the 1994 Maryland Standards and Specifications for Soil Erosion and Sediment Control and adhere to the Erosion and Sediment Control Guidelines issued by MDE in January 1990, and Stormwater Management Guidelines for State and Federal Projects issued by MDE in July 1987.

The approval process requires:

- Erosion/sediment control and storrmwater management plans to be submitted to MDE
- MDE either approves the plans or responds with comments to be addressed before approval is granted
- On approval, MDE informs the applicant in writing
- MDE conducts site inspections, plans must be approved and implemented prior to construction.
- The standard process takes approximately six months. Local agencies may also require grading permits.

Chesapeake Bay Critical Area Protection Program

The Chesapeake Bay Critical Area is a resource protection program that governs land use within 1,000 feet of high tide or tidal wetlands. The program aims to minimize the negative impacts of new development on water quality and to conserve fish, wildlife and plant habitats.

If a site is within the Chesapeake Bay Critical Area, the zoning application must contain a Critical Area Report, Critical Area Plan and a Chesapeake Bay Project Notification Form. A Critical Area Report contains written findings evaluating the impact of the proposed construction on the property and the measures that will be taken to minimize these impacts.

Local Building Permits

An applicant may be required to comply with Local County permitting processes. This would depend on the requirements of the County where the proposed site was located.

A typical County permit process would include, review of:

- Site plans;
- Subdivision regulations;
- Zoning requirements and possible re-zoning (if re-zoning is required additional processes include a public meeting, staff review and Planning Commission review);
- Concept plans;
- Final plans;

The review of the plans and regulations described above would also be considered by a relevant architectural panel, Historic District commission and Planning Commission prior to approval being granted by the County.

Other Permit Requirements

Other permit requirements would be required as follows:

- Upgrade of Road Networks connecting to ferry terminal would be required to go through Maryland State Highway Administration (SHA) and possibly county permitting processes;
- Maryland Environmental Policy Act (MEPA) Compliance;
- If Federal Funds were being used in the project, environmental documentation as required by National Environmental Policy Act (NEPA);
- Reforestation/forestation requirements (State Law administered by Counties);
- Subject to U.S. Coast Guard licensing and vessel inspections;
- Compliance with navigational rules and regulations promulgated by the U.S. Coast Guard; and
- Approval of vessel and operations by U.S. Coast Guard.

Step 1 – Initial Site Identification

Objective: To identify all potential sites in Maryland for ferry service across the Chesapeake Bay.

Outcome: To develop a comprehensive list of potential sites on the Eastern and Western shores of the Chesapeake Bay in Maryland that will be carried forward into the second phase assessment (the Fatal Flaw Analysis.)

Method: Sites were identified based on discussions with County planners, previous studies, locations of previous ferry services or steamboat services, location of public boating facilities, towns on the waterfront and review of County planning documents. The list of initial sites is shown in Table 1-1 and Figure 1-1.

Table 1-1: Initial Site Identification

Western Shore		
Location		**County**
1	Annapolis	Anne Arundel County
2	Beverly Beach	Anne Arundel County
3	Deale	Anne Arundel County
4	Edgewater	Anne Arundel County
5	Highland Beach	Anne Arundel County
6	Sandy Point State Park	Anne Arundel County
7	Brooklyn Park	Baltimore City
	Canton	Baltimore City
	Canton Park	Baltimore City
	Cherry Hill	Baltimore City
	Curtis Bay	Baltimore City
	Fells Point	Baltimore City
	Fort Armistead	Baltimore City
	Inner Harbor	Baltimore City
8	Chase	Baltimore County
9	Dundalk	Baltimore County
	Turner Station	Baltimore County
10	Essex	Baltimore County
11	Gunpowder Park	Baltimore County
12	Middle River	Baltimore County
13	Rocky Point	Baltimore County
14	Sparrows Point	Baltimore County
15	Chesapeake Beach	Calvert County
16	North Beach	Calvert County
17	Port Republic	Calvert County
18	Solomons Island	Calvert County
19	Cove Point	Calvert County
20	Havre de Grace	Harford County
21	Willoughby Beach	Harford County
22	Clark's Landing	St. Mary's County
23	Forest Landing	St. Mary's County
24	Piney Point	St. Mary's County
25	Point Lookout	St. Mary's County
26	Elms WMA	St. Mary's County

Note: Due to each location's close proximity to one another: Western Shore Site #7 includes Brooklyn Park through Inner Harbor, and #9 includes Dundalk and Turner Station.

Eastern Shore		
Location		**County**
1	Charlestown	Cecil County
2	Chesapeake City	Cecil County
3	Elkton	Cecil County
4	Perryville	Cecil County
5	Port Deposit	Cecil County
6	Stemmers Run	Cecil County
7	Cambridge	Dorchester County
8	Crocheron Wharf	Dorchester County
9	Honga	Dorchester County
10	Hoopersville	Dorchester County
11	Kirwins Wharf	Dorchester County
12	Madison	Dorchester County
13	Ragged Point	Dorchester County
14	Taylors Island	Dorchester County
15	Betterton	Kent County
16	Chestertown	Kent County
17	Fairlee	Kent County
18	Green Point	Kent County
19	Rock Hall	Kent County
20	Tolchester Beach	Kent County
21	Chester	Queen Anne's County
22	Piney Narrows-Kent Narrows	Queen Anne's County
23	Love Point	Queen Anne's County
24	Matapeake State Park	Queen Anne's County
25	Queenstown	Queen Anne's County
26	Crisfield	Somerset County
27	Deal Island	Somerset County
28	Rumbley-Fairmont WMA	Somerset County
29	St. Michaels	Talbot County
30	Balls Creek	Talbot County
31	Claiborne	Talbot County
32	Dogwood Harbor	Talbot County
33	Oxford	Talbot County

Initial sites identified resulted in:
26 Sites on the Western Shore, and
33 Sites on the Eastern Shore

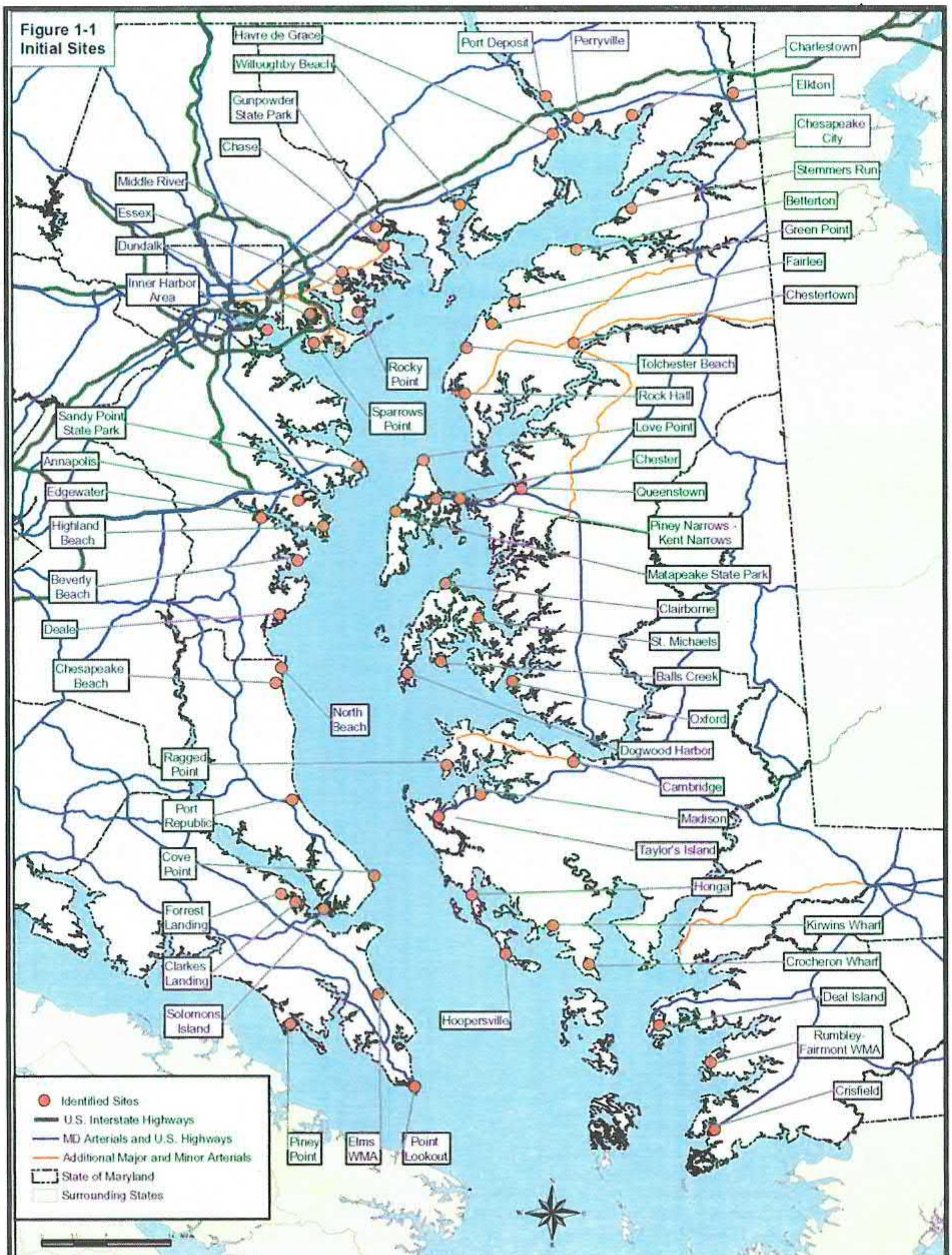


Figure 1-1: Initial Sites

Step 2 – Fatal Flaw Analysis

***Objective*:** To identify sites that are most suitable for ferry termini based on a fatal flaw analysis that assesses several basic criteria.

Outcome: A short list of the most suitable sites on the Eastern and Western shores of the Chesapeake Bay in Maryland that will be carried forward into the third step of the assessment process (the Site Evaluation Criteria.)

Method: Fatal flaw criteria for potential ferry terminal sites were developed based on the review of characteristics of comparable ferry services, project objectives and characteristics of the Chesapeake Bay. Sites that do not meet these criteria are deemed less likely to succeed and may be unsuitable sites for ferry terminals.

The fatal flaw analysis is the second step in site assessment methodology. In order to be carried forward into the third step of the assessment, the sites had to pass three criteria: accessibility by land, accessibility by water, and environmental/development restrictions. A site obtaining a "Fail" on any one of the three criteria failed the total fatal flaw analysis. The criteria are rated as follows:

P – Pass; the site fulfills the criteria requirements.

M – "Maybe"; the site requires a further assessment of that particular criteria.

F – Fail; the site does NOT fulfill the criteria requirements.

Criteria 1, the Accessibility by Land Criteria, will be used to analyze the supporting transportation to major travel origins and destinations. In Criteria 2, the Accessibility by Water Criteria, we will look at existing channels and naturally deep-water locations in the Bay for each site. Whether or not the site is in a Chesapeake Bay Critical Rated Area will be determined in Criteria 3.

The methodology and results involved in rating the sites is described below.

CRITERIA 1

Accessibility by Land: Supporting road infrastructure to major travel origins and destinations

For the "site accessibility by land" criteria, the site must be within five miles of a specific type of road. In this instance, the **urban principal**, **rural principal** and **rural minor arterial** types were designated based on the volume of traffic each typically holds. These types of roads are generally Maryland state roads and designated U.S. highways such as US 50 and US 301. County and local roads were not considered. Sites within 5 miles of an urban principal, rural principal and rural minor arterial passed these criteria. This was the only Pass-Fail criteria out of the three in the fatal flaw analysis. The results of these criteria are shown in Table 2-1.

P – The site is within 5 miles of an urban principal, rural principal and rural minor arterial.

M – The designation is not applicable for this criteria.

F – The site is not within 5 miles of an urban principal, rural principal and rural minor arterial.

Table 2-1: Fatal Flaw Analysis Criteria 1 Results

Western Shore Location		County	Score
1	Annapolis	Anne Arundel County	P
2	Beverly Beach	Anne Arundel County	P
3	Deale	Anne Arundel County	P
4	Edgewater	Anne Arundel County	P
5	Highland Beach	Anne Arundel County	P
6	Sandy Point State Park	Anne Arundel County	P
7	Brooklyn Park	Baltimore City	P
	Canton	Baltimore City	P
	Canton Park	Baltimore City	P
	Cherry Hill	Baltimore City	P
	Curtis Bay	Baltimore City	P
	Fells Point	Baltimore City	P
	Fort Armistead	Baltimore City	P
	Inner Harbor	Baltimore City	P
8	Chase	Baltimore County	P
9	Dundalk	Baltimore County	P
	Turner Station	Baltimore County	P
10	Essex	Baltimore County	P
11	Gunpowder Park	Baltimore County	P
12	Middle River	Baltimore County	P
13	Rocky Point	Baltimore County	F
14	Sparrows Point	Baltimore County	P
15	Chesapeake Beach	Calvert County	P
16	North Beach	Calvert County	P
17	Port Republic	Calvert County	P
18	Solomons Island	Calvert County	P
19	Cove Point	Calvert County	P
20	Havre de Grace	Harford County	P
21	Willoughby Beach	Harford County	P
22	Clark's Landing	St. Mary's County	P
23	Forest Landing	St. Mary's County	P
24	Piney Point	St. Mary's County	F
25	Point Lookout	St. Mary's County	P
26	Elms WMA	St. Mary's County	P

Eastern Shore Location		County	Score
1	Charlestown	Cecil County	P
2	Chesapeake City	Cecil County	P
3	Elkton	Cecil County	P
4	Perryville	Cecil County	P
5	Port Deposit	Cecil County	P
6	Steamers Run	Cecil County	F
7	Cambridge	Dorchester County	P
8	Crocheron Wharf	Dorchester County	F
9	Honga	Dorchester County	P
10	Hoopersville	Dorchester County	P
11	Kirwins Wharf	Dorchester County	F
12	Madison	Dorchester County	F
13	Ragged Point	Dorchester County	F
14	Taylors Island	Dorchester County	F
15	Betterton	Kent County	F
16	Chestertown	Kent County	P
17	Fairlee	Kent County	F
18	Green Point	Kent County	F
19	Rock Hall	Kent County	P
20	Tolchester Beach	Kent County	F
21	Chester	Queen Anne's County	P
22	Piney Narrows-Kent Narrows	Queen Anne's County	P
23	Love Point	Queen Anne's County	F
24	Matapeake State Park	Queen Anne's County	P
25	Queenstown	Queen Anne's County	P
26	Crisfield	Somerset County	P
27	Deal Island	Somerset County	P
28	Rumbley-Fairmont WMA	Somerset County	F
29	St. Michaels	Talbot County	P
30	Balls Creek	Talbot County	F
31	Claiborne	Talbot County	P
32	Dogwood Harbor	Talbot County	F
33	Oxford	Talbot County	P

24 Western Shore sites and 19 Eastern Shore sites passed the Accessibility by Land criteria.

CRITERIA 2

Accessibility by Water: Existing channels and naturally deep-water locations in the Bay

For the "site accessibility by water" criteria, the site must adhere to one of two principals: the water depth near, in and around the site must have a depth of 8 feet or greater, and/or the site must have an existing dredged channel leading up to or present near the site. This criteria is Pass-Maybe-Fail based on the following:

- **P** – The site has a water depth greater than or equal to 8 feet AND/OR there is an existing dredged channel.
- **M** – The site has a water depth less than 8 feet BUT there is an existing dredged channel.
- **F** – The site has a water depth less than 8 feet AND there is no existing dredged channel.

The results of these criteria are shown in Table 2-2.

Table 2-2: Fatal Flaw Analysis Criteria 2 Results

Western Shore			
Location		**County**	**Score**
1	Annapolis	Anne Arundel County	P
2	Beverly Beach	Anne Arundel County	F
3	Deale	Anne Arundel County	M
4	Edgewater	Anne Arundel County	P
5	Highland Beach	Anne Arundel County	F
6	Sandy Point State Park	Anne Arundel County	F
7	Brooklyn Park	Baltimore City	P
	Canton	Baltimore City	P
	Canton Park	Baltimore City	P
	Cherry Hill	Baltimore City	P
	Curtis Bay	Baltimore City	P
	Fells Point	Baltimore City	P
	Fort Armistead	Baltimore City	P
	Inner Harbor	Baltimore City	P
8	Chase	Baltimore County	F
9	Dundalk	Baltimore County	P
	Turner Station	Baltimore County	P
10	Essex	Baltimore County	F
11	Gunpowder Park	Baltimore County	M
12	Middle River	Baltimore County	P
13	Rocky Point	Baltimore County	P
14	Sparrows Point	Baltimore County	P
15	Chesapeake Beach	Calvert County	M
16	North Beach	Calvert County	F
17	Port Republic	Calvert County	F
18	Solomons Island	Calvert County	P
19	Cove Point	Calvert County	P
20	Havre de Grace	Harford County	P
21	Willoughby Beach	Harford County	F
22	Clark's Landing	St. Mary's County	P
23	Forest Landing	St. Mary's County	F
24	Piney Point	St. Mary's County	P
25	Point Lookout	St. Mary's County	F
26	Elms WMA	St. Mary's County	F

Eastern Shore Location			
Location		**County**	**Score**
1	Charlestown	Cecil County	M
2	Chesapeake City	Cecil County	M
3	Elkton	Cecil County	F
4	Perryville	Cecil County	P
5	Port Deposit	Cecil County	P
6	Stemmers Run	Cecil County	P
7	Cambridge	Dorchester County	P
8	Crocheron Wharf	Dorchester County	M
9	Honga	Dorchester County	M
10	Hoopersville	Dorchester County	M
11	Kirwins Wharf	Dorchester County	F
12	Madison	Dorchester County	F
13	Ragged Point	Dorchester County	F
14	Taylors Island	Dorchester County	M
15	Betterton	Kent County	P
16	Chestertown	Kent County	P
17	Fairlee	Kent County	F
18	Green Point	Kent County	P
19	Rock Hall	Kent County	P
20	Tolchester Beach	Kent County	P
21	Chester	Queen Anne's County	F
22	Piney Narrows-Kent Narrows	Queen Anne's County	M
23	Love Point	Queen Anne's County	F
24	Matapeake State Park	Queen Anne's County	M
25	Queenstown	Queen Anne's County	P
26	Crisfield	Somerset County	P
27	Deal Island	Somerset County	M
28	Rumbley-Fairmont WMA	Somerset County	F
29	St. Michaels	Talbot County	P
30	Balls Creek	Talbot County	F
31	Claiborne	Talbot County	F
32	Dogwood Harbor	Talbot County	M
33	Oxford	Talbot County	P

12 Western Shore sites and 13 Eastern Shore sites passed the Accessibility by Water criteria; three Western Shore sites and ten Eastern Shore sites received maybe scores.

CRITERIA 3

Environmental/Developmental Restrictions: Is the site within a Chesapeake Bay Critical Rated Area?

For the "environmental/developmental restrictions" criteria, the site is based on the Critical Area Commission definitions:

- **Intensely Developed Areas (IDAs):** are defined as areas of twenty of more adjacent acres where residential, commercial, institutional or industrial land uses predominate. IDAs are areas of concentrated development where little natural habitat occurs;
- **Limited Development Areas (LDAs):** are areas in which development is of a low or moderate intensity. LDAs contain areas of natural plant and animal habitats but are not dominated by agriculture, wetland, forest, barren land, surface water or open space; and
- **Resource Conservation Areas (RCAs):** are characterized by natural environments or by resource-utilization activities. Resource-utilization refers to such activities as agriculture, aquaculture, commercial forestry and fisheries activities that the Criteria consider protected land uses.

In order for the site to pass these criteria, it must NOT be in a Resource Conservation Area (RCA). These criteria are Pass-Maybe-Fail due to the fact that either some of the designations are not known, or some of the sites have mixed designations. Information for these criteria was obtained from the Critical Area Commission. This criteria is Pass-Maybe-Fail based on the following:

P – The site is not within the boundaries of a RCA.

M – The site has an unspecific designation or mixture of designations.

F – The site IS within the boundaries of a RCA.

The results of these criteria are shown in Table 2-3.

Table 2-3: Fatal Flaw Analysis Criteria 3 Results

Western Shore			
Location		**County**	**Score**
1	Annapolis	Anne Arundel County	M
2	Beverly Beach	Anne Arundel County	F
3	Deale	Anne Arundel County	M
4	Edgewater	Anne Arundel County	M
5	Highland Beach	Anne Arundel County	M
6	Sandy Point State Park	Anne Arundel County	F
7	Brooklyn Park	Baltimore City	P
	Canton	Baltimore City	P
	Canton Park	Baltimore City	P
	Cherry Hill	Baltimore City	P
	Curtis Bay	Baltimore City	P
	Fells Point	Baltimore City	P
	Fort Armistead	Baltimore City	P
	Inner Harbor	Baltimore City	P
8	Chase	Baltimore County	P
9	Dundalk	Baltimore County	P
	Turner Station	Baltimore County	P
10	Essex	Baltimore County	P
11	Gunpowder Park	Baltimore County	F
12	Middle River	Baltimore County	P
13	Rocky Point	Baltimore County	F
14	Sparrows Point	Baltimore County	P
15	Chesapeake Beach	Calvert County	M
16	North Beach	Calvert County	P
17	Port Republic	Calvert County	P
18	Solomons Island	Calvert County	P
19	Cove Point	Calvert County	P
20	Havre de Grace	Harford County	P
21	Willoughby Beach	Harford County	F
22	Clark's Landing	St. Mary's County	P
23	Forest Landing	St. Mary's County	P
24	Piney Point	St. Mary's County	P
25	Point Lookout	St. Mary's County	P
26	Elms WMA	St. Mary's County	F

Eastern Shore Location			
Location		**County**	**Score**
1	Charlestown	Cecil County	P
2	Chesapeake City	Cecil County	P
3	Elkton	Cecil County	F
4	Perryville	Cecil County	M
5	Port Deposit	Cecil County	P
6	Stemmers Run	Cecil County	F
7	Cambridge	Dorchester County	M
8	Crocheron Wharf	Dorchester County	F
9	Honga	Dorchester County	M
10	Hoopersville	Dorchester County	M
11	Kirwins Wharf	Dorchester County	F
12	Madison	Dorchester County	P
13	Ragged Point	Dorchester County	F
14	Taylors Island	Dorchester County	F
15	Betterton	Kent County	M
16	Chestertown	Kent County	F
17	Fairlee	Kent County	P
18	Green Point	Kent County	F
19	Rock Hall	Kent County	P
20	Tolchester Beach	Kent County	F
21	Chester	Queen Anne's County	P
22	Piney Narrows-Kent Narrows	Queen Anne's County	P
23	Love Point	Queen Anne's County	F
24	Matapeake State Park	Queen Anne's County	P
25	Queenstown	Queen Anne's County	P
26	Crisfield	Somerset County	M
27	Deal Island	Somerset County	M
28	Rumbley-Fairmont WMA	Somerset County	F
29	St. Michaels	Talbot County	P
30	Balls Creek	Talbot County	F
31	Claiborne	Talbot County	P
32	Dogwood Harbor	Talbot County	F
33	Oxford	Talbot County	P

15 Western Shore sites and 13 Eastern Shore sites passed the Environmental/Developmental Restrictions criteria; five Western Shore sites and seven Eastern Shore sites received maybe scores.

ADDITIONAL CONSIDERATIONS

Charlestown, Havre De Grace, Perryville, Port Deposit and Chesapeake City passed the three criteria for the fatal flaw analysis, however they will not be included in Step 3 of the analysis (the Site Evaluation Criteria) for several reasons including the following:

- They do not have any logical site pair on the opposite side of the Bay.
- They have a high level of access to major highways and would not provide a more convenient transportation alternative as required in the study objectives.
- A ferry crossing from these locations does not provide an alternative to the Bay Bridge crossing as outlined in the study objectives.

POINT LOOKOUT DISCUSSION

In previous studies, Point Lookout has been considered a possible location for a ferry terminal. The Point Lookout site is not being carried forward in the analysis for the following reasons:

- The existing channel leading to the site is not wide enough to handle ferry service
- The water depth near, in and around the site does not have a consistent depth of 8 feet or greater (varies from 3 – 11 feet)
- The site has water access that is suitable for small boats only and not practical for vessels that are larger than an outboard motor boat.

Other issues identified in the previous Ferry Study that would discourage the use of Point Lookout as a potential vehicular ferry location include:

- Point Lookout is in a State Park, therefore it would be protected by Section 4(f) of the Department of Transportation Act of 1969. Should Federal funding be used to fund the project, MDOT would be required to first demonstrate that there is no feasible and prudent alternative to using the State Parkland and second, show that all possible planning to minimize harm to the surrounding area has been undertaken.
- There are archeological concerns for the entire area (Civil War Prison).
- Point Lookout is located on the tip of a peninsula with excessively long road access for passengers traveling from the Northern Virginia, Washington D.C. or Baltimore Regions. The location does not have a large catchment area or convenient road access. There are very few residences or businesses in the vicinity.
- Nesting locations for Blue Heron and Bald Eagle could be impacted.
- The entire area around the boat launching area is wetlands.
- Wake generated by the ferry could have significant impacts on the surrounding wetlands and habitat. Increased wake could accelerate erosion and eventually destroy the wetlands. To limit these impacts, a "no-wake" zone is currently in place at the existing boat launching facility.

SUMMARY OF THE FATAL FLAW ANALYSIS

Overall, out of 59 sites selected, 22 sites passed while 37 failed. The overall ratings were "Pass-Fail". Sites with no "Fail" ratings were considered to pass the fatal flaw analysis. Sites with any combination of "Pass" and "Maybe" were considered as passing. Table 2-4 (below) shows the numerical tally for Pass-Maybe-Fail scores. A listing of the identified sites from Step 1 is shown in Table 2-5 and Figure 1-1. A summary of the sites that passed the fatal flaw assessment is shown in Table 2-5 and Figure 2-4.

Table 2-4: Summary of Fatal Flaw Analysis: Numerical Tally

Criteria	P	M	F	Total
Land	43	0	16	59
Water	25	13	21	59
Environment	28	12	19	59
Additional Considerations	22	32 *	5 **	59
Overall	22	0	37	59

* Sites that failed one of the three criteria have been rated as "Maybe" for the Additional Considerations, knowing that they have already been eliminated from further analysis.

** Sites that failed the additional considerations include Charlestown, Havre De Grace, Perryville, Port Deposit and Chesapeake City. Reasons for their exclusion from further study area explained in the Additional Considerations section.

Table 2-5: Fatal Flaw Analysis Results

Western Shore

Location			County
1	P	Annapolis	Anne Arundel County
2	F	Beverly Beach	Anne Arundel County
3	P	Deale	Anne Arundel County
4	P	Edgewater	Anne Arundel County
5	F	Highland Beach	Anne Arundel County
6	F	Sandy Point State Park	Anne Arundel County
7	P	Brooklyn Park	Baltimore City
	P	Canton	Baltimore City
	P	Canton Park	Baltimore City
	P	Cherry Hill	Baltimore City
	P	Curtis Bay	Baltimore City
	P	Fells Point	Baltimore City
	P	Fort Armistead	Baltimore City
	P	Inner Harbor	Baltimore City
8	F	Chase	Baltimore County
9	P	Dundalk	Baltimore County
	P	Turner Station	Baltimore County
10	F	Essex	Baltimore County
11	F	Gunpowder Park	Baltimore County
12	P	Middle River	Baltimore County
13	F	Rocky Point	Baltimore County
14	P	Sparrows Point	Baltimore County
15	P	Chesapeake Beach	Calvert County
16	F	North Beach	Calvert County
17	F	Port Republic	Calvert County
18	P	Solomons Island	Calvert County
19	P	Cove Point	Calvert County
20	F	Havre de Grace	Harford County
21	F	Willoughby Beach	Harford County
22	P	Clark's Landing	St Mary's County
23	F	Forest Landing	St Mary's County
24	F	Piney Point	St Mary's County
25	F	Point Lookout	St Mary's County
26	F	Elms WMA	St Mary's County

Eastern Shore

Location			County
1	F	Charlestown	Cecil County
2	F	Chesapeake City	Cecil County
3	F	Elkton	Cecil County
4	F	Perryville	Cecil County
5	F	Port Deposit	Cecil County
6	F	Stemmers Run	Cecil County
7	P	Cambridge	Dorchester County
8	F	Crocheron Wharf	Dorchester County
9	P	Honga	Dorchester County
10	P	Hoopersville	Dorchester County
11	F	Kirwins Wharf	Dorchester County
12	F	Madison	Dorchester County
13	F	Ragged Point	Dorchester County
14	F	Taylors Island	Dorchester County
15	F	Betterton	Kent County
16	F	Chestertown	Kent County
17	F	Fairlee	Kent County
18	F	Green Point	Kent County
19	P	Rock Hall	Kent County
20	F	Tolchester Beach	Kent County
21	F	Chester	Queen Anne's County
22	P	Piney Narrows-Kent Narrows	Queen Anne's County
23	F	Love Point	Queen Anne's County
24	P	Matapeake State Park	Queen Anne's County
25	P	Queenstown	Queen Anne's County
26	P	Crisfield	Somerset County
27	P	Deal Island	Somerset County
28	F	Rumbley-Fairmont WMA	Somerset County
29	P	St. Michaels	Talbot County
30	F	Balls Creek	Talbot County
31	F	Claiborne	Talbot County
32	F	Dogwood Harbor	Talbot County
33	P	Oxford	Talbot County

Results of Step 2 Fatal Flaw Analysis
- Green - Pass
- Red - Fail

Initial sites identified resulted in:
- 26 Sites on the Western Shore
- 33 Sites on the Eastern Shore

Note: A site obtaining a "Fail" on any one of the three criteria caused the site to fail the total fatal flaw analysis.

Sites passing Step 2 Fatal Flaw Analysis:
- 11 Western Shore
- 11 Eastern Shore

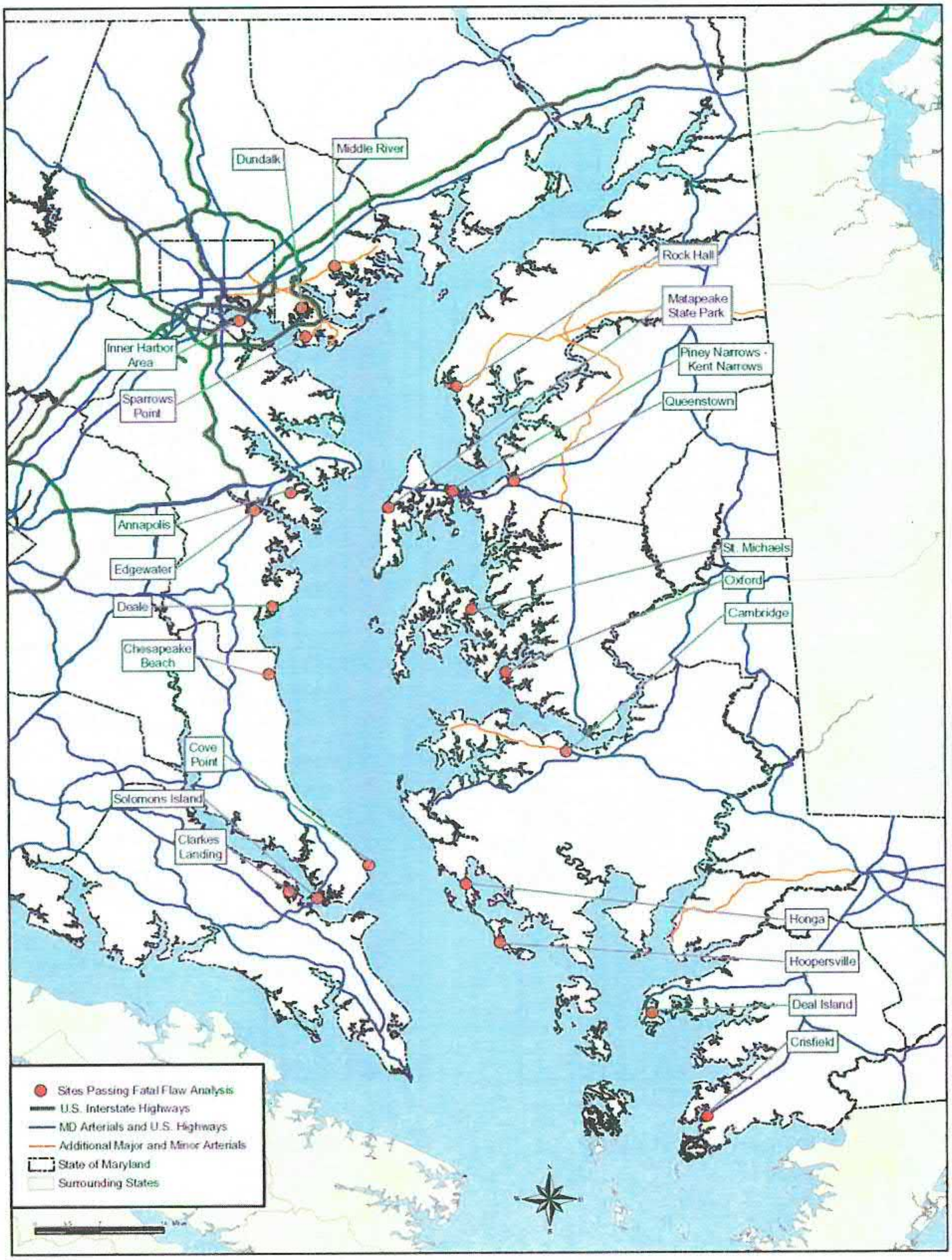


Figure 2-1: Sites Passing Fatal Flaw Analysis

Step 3 – Site Evaluation Criteria

Objective: To identify a list of demonstration pairs for further analysis.

Outcome: To develop a matrix of terminal pairs on the Eastern and Western Shores of the Chesapeake Bay in Maryland that will be carried forward into the demonstration pairs assessment. These pairings are not recommendations. They are thought to be suitable sites and are offered here for illustration purposes only.

Method: The sites were rated on criteria related to Site Accessibility, Community and Environmental Issues, and Infrastructure Improvement Costs. The criteria allows for a more detailed examination of each of the sites. Each criteria consisted of a scale from 0 to 5, with 5 being the highest or best rating for that criteria. Sites were analyzed individually (except where not applicable), and then matched up with possible pairs from the opposite shore. The sites were paired with logical sites on the opposite shore to produce reasonable travel times. Some sites have been paired with several sites on the opposite shore to help evaluate more viable pairing options. The scores for each pair were based on the lowest score between the two sites for each criteria. Cumulative scores for each pair were then calculated, with the intent that the higher scoring pairs will be examined further in the Demonstration Pairs Assessment portion of the study.

DESCTIPTION OF EVALUATION CRITERIA

Site accessibility criteria

1. Does the location have adequate existing road access?

- 0 = No existing roadway to or near the site; extensive new construction on new right-of-way required to provide adequate roadway to site.
- 1 = Substandard or primarily residential road to or near the site; major construction within mostly existing right-of-way required to achieve adequate roadway to site.
- 3 = Standard commercial road or collector road serving site, capable of supporting heavy trucks and with good pavement conditions; arterial roadway serving site in fair or poor condition; some roadway improvements required.
- 5 = Standard arterial roadway serving site, capable of supporting heavy trucks and with good pavement conditions; no improvements needed to off-site roads to support heavy trucks.

This criteria is similar to the Pass-Fail Criteria 1 of the Fatal Flaw Analysis, however, sites have been analyzed in greater detail considering such items as right-of way acquisition, pavement condition, types of roadways, and roadway capability to support heavy truckloads.

Description of Research: Based on the criteria outlined in the SHA Highway Location Reference Guide ratings, ADC Maps, and a GIS database containing roadway information; the roads leading to each site were evaluated.

2. Does the location have adequate existing water depth for ferry vessels?

- 0 = Existing topographic or hydrographic constraints preclude water access for ferry vessels.

1 = Major earthwork, will require a bridge of greater than 300 feet over water to access the site, or extensive dredging of access channel longer than 300 feet required to provide adequate water access to site.

3 = Minor dredging required to provide 8-foot deep clear channel to site.

5 = Site has adequate existing water access with depths greater than or equal to 8 feet.

This criteria is similar to Pass-Fail Criteria 2 of the Fatal Flaw Analysis, however, for this analysis the waterways were rated on the extent of possible earthwork and dredging required to provide depths up to 8 feet. The 8-foot depth was based on the minimum draft needed for the several different types of ferries that are being considered at this time.

Description of Research: The 1992 Edition of the Maryland Boaters Guide as well as the ADC Chesapeake Bay Regional Wall Map were utilized to determine the depth of water within the area of study. The types of ferries considered were as discussed in the Crisfield – Point Lookout Ferry Feasibility Study (by PB for MDOT, in April, 2001.) A detailed look at navigation vessel issues will be presented in Step 7—Navigation issues.

3. Speed restrictions on ferry operation.

0 = Vessels would have to operate at restricted speed (6 knots or less) for more than ten minutes prior to docking approach.

1 = Vessels would have to operate at restricted speed (6 knots or less) for up to ten minutes prior to docking approach.

3 = Vessels would have to operate at restricted speed (6 knots or less) for up to five minutes prior to docking approach.

5 = Vessels could operate at or near cruise speeds until docking approach.

This criteria will cause sites that may have speed restrictions to be rated lower than those that do not. The following Western Shore Sites have restrictions in place: ***Annapolis, Edgewater, Canton, Canton Park, Cherry Hill, Fells Point, Inner Harbor, Turner Station, Middle River, Sparrows Point, Solomons Island***, and ***Clark's Landing***. The following Eastern Shore Sites have restrictions in place: ***Cambridge, Rock Hall, Crisfield, St. Michaels, and Oxford***.

Description of Research: Each location was researched in the Code of Maryland Regulations to determine if speed restrictions were applicable to the immediate area.

4. Does ferry travel for subject route offer time advantages over the road-based alternative? (assuming the site pair was the most direct site across the Bay)

1 = No, there are one or more road-based alternative routes that would provide consistently shorter travel times than a ferry to the area served by this site.

3 = A ferry to this site would provide shorter travel times for some specific market segments during peak travel periods (i.e., summer months).

5 = A ferry to this site would provide consistently shorter travel times for most market segments, including work commuters or walk-on/walk-off tourist/recreation trips.

Approximate travel times were calculated for each site pair. Potential riders were assumed to be traveling from either the Baltimore area or the Washington, D.C. area to Ocean City. These travel times should be considered approximate only. However, they will allow for a consistent comparison between site pairs. The ferry calculated travel times are shown in Table 3-1: Vessel Travel Time Calculations. Automobile travel times are shown in Table 3-2: Bridge Route Travel Time Calculations, the spreadsheet used to compare travel times for the two modes has been shown in Table 3-3: Travel Time Comparisons, and the possible travel routes across the Chesapeake Bay have been shown for each pairing on Figure 3-1: Site Pair Routes.

Travel times are a very important portion of the analysis. The timesavings created by a ferry system would make ferry travel a more desirable alternative to the Chesapeake Bay Bridge.

Description of Research: Each site was paired with logical and practical sites on the opposite shore. For this criteria, one-way travel time was computed as a sum of three legs:

(1) Shortest drive time from either Baltimore or Washington, D.C. areas to the western terminal site; plus (2) Ferry travel time, including loading and unloading (based on 30 knots in unrestricted areas, 5 knots in restricted areas), plus (3) The drive time from each terminal site to Ocean City.

The total land and water travel times were then added together to develop a gross travel time from the Baltimore-Washington Area to Ocean City for each of the pairings. These routes are not recommendations and should be considered for illustration purposes only.

These travel times were then compared to the travel time from the Baltimore-Washington area to Ocean City that included an assumed one-hour delay across the Bay Bridge during peak times during the summer. The one-hour delay was based on three different trips from the Baltimore Area to the Ocean City area during peak summer travel times. Travel times (along roadways) were determined using Mapquest.com.

Table 3-2: Bridge Route Travel Time Calculations

JOURNEY TIMES

Western Shore Terminal Site	Eastern Shore Terminal Site	Estimated Dist (miles)	In-vehicle time (mins) *	Access/ egress/ (mins)	Seasonal Variation (mins)	Average total travel time by Auto. (mins)	Average total travel time by Auto. (hrs)
Baltimore	Ocean City	144.8	198	5	60	263	4.38
Washington	Ocean City	148.11	199	5	60	264	4.40

* At prevailing speed according to Mapquest.com.
Average Travel Time across the Bay Bridge
Source: MapQuest

Table 3-3: Travel Time Comparisons

Western Shore Terminal Site	Eastern Shore Terminal Site	Travel Time in Hours (include access/egress) *		Fastest Mode (fastest by X min.)	
		Ferry **	Car ***		
Middle River	Rock Hall	5.17	4.38	Car	47
Dundalk	Rock Hall	4.78	4.38	Car	24
Inner Harbor	Rock Hall	4.84	4.38	Car	28
Sparrows Point	Rock Hall	4.94	4.38	Car	33
Inner Harbor	Kent-Piney Narrows	4.32	4.38	Ferry	4
Annapolis	Matapeake State Park	4.22	4.38	Ferry	10
Annapolis	Kent-Piney Narrows	4.48	4.38	Car	6
Annapolis	Queenstown	4.51	4.38	Car	7
Edgewater	Matapeake State Park	4.34	4.38	Ferry	3
Edgewater	Kent-Piney Narrows	4.68	4.38	Car	18
Deale	St Michaels	4.94	4.38	Car	34
Chesapeake Beach	Cambridge	4.29	4.38	Ferry	6
Chesapeake Beach	Oxford	4.78	4.38	Car	24
Cove Point	Honga	5.19	4.40	Car	48
Clarkes Landing	Hoopersville	6.82	4.40	Car	145
Clarkes Landing	Honga	5.76	4.40	Car	81
Solomons Island	Hoopersville	6.29	4.40	Car	114
Solomons Island	Honga	5.23	4.40	Car	50
Solomons Island	Deale Island	4.98	4.40	Car	35
Solomons Island	Cambridge	5.24	4.40	Car	51
Solomons Island	Crisfield	5.13	4.40	Car	44

Notes
* Travel Time comparisons are estimates only based on available information, further detailed travel time analysis would be required on specific sites to more accurately test patronage potential of ferry services
** Assumes 30-knot speed in open water and 6-knot speed when approaching the terminal.
*** Prevailing speed according to Mapquest.com

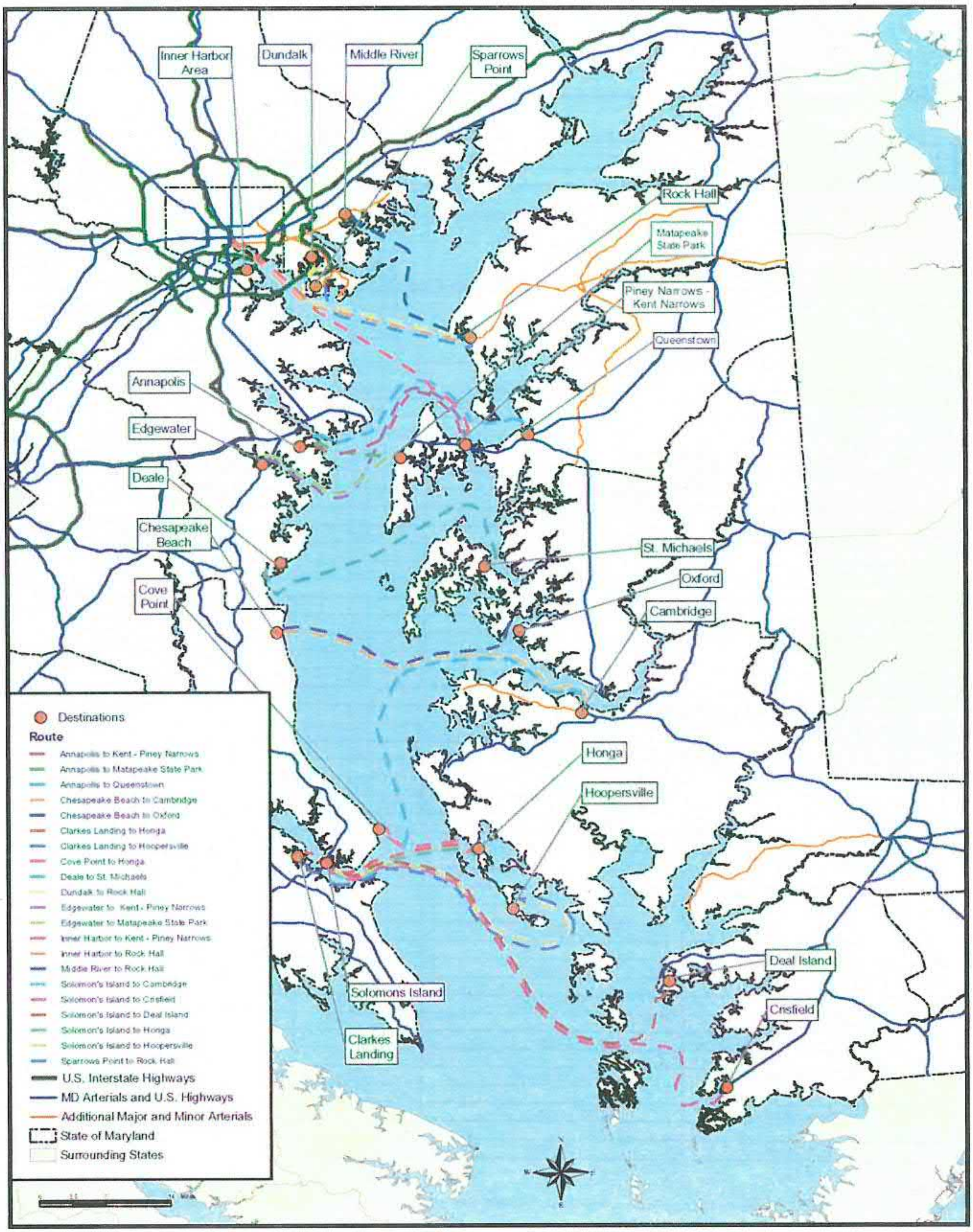


Figure 3-1: Site Pair Routes

Community and environmental issues criteria

1. **Is the site zoned for ferry operations or is it located within a commercial or industrial waterfront district?**

   1 = No.

   3 = The site is not zoned for commercial or industrial uses, but a ferry terminal appears compatible with existing uses.

   5 = Yes.

   Sites with zoning that allow for ferry operations are rated higher than those that do not.

   Description of Research: The County Master Plans and Zoning Requirements from appropriate Counties, applicable to each site were reviewed for this analysis.

2. **Does there appear to be significant potential for wake wash impacts to shoreline properties?**

   1 = Yes, waterside approach width is 2,000 yards (or less) wide for more then 5 nautical miles out from the site.

   3 = Maybe, approach width is 2,000 yards (or less) wide for between 1-5 nautical miles out from the site.

   5 = No, approach width is 2,000 yards (or less) wide for less than 1 nautical mile out from the site.

   Impacts to shoreline are a function of bank slope, geotechnical properties of the bank and the type of existing vegetation or bank protection. Due to the preliminary nature of this study, we did not analyze specific locations at this level of detail. The above "rule of thumb" criteria, which allowed for sites to be analyzed for potential wake wash impacts to the shorelines, was based on our experience.

   Description of Research: The sites were rated based on the length in which their approaching channel width is less than 2,000 yards wide.

3. **Are there any other marine-based or land-based potential environmental issues identified?**

   1 = Yes, and it appears that there would be one or more significant adverse environmental impacts that would require significant mitigation.

   3 = Yes, potential environmental issues have been identified but it does not appear that the ferry operations would have a significant adverse impact on them, and that only minimal environmental mitigation may be required.

   5 = No.

   This criteria is similar to the Pass-Fail Criteria 3 of the Fatal Flaw Analysis. Sites have been rated in more detail as to the extent of possible impacts to the surrounding environment.

   Description of Research: Sites were analyzed based on information provided by the Critical Area Commission.

4. **Is the site located within a priority funding area?**

   1 = No, and it is not near a priority funding area.

   3 = No, however it is located adjacent to a priority funding area.

   5 = Yes.

Sites within a priority funding area could potentially receive higher consideration to obtain funding for the construction of the facilities necessary for ferry operation and maintenance. A priority funding area is a government-designated area that receives funding priority for infrastructure projects like new roads, water and sewer systems, and schools over non-priority areas. The geographic definition of these areas can vary; a priority funding area might include a municipality, a small community, a targeted industrial area, or any region set-aside by counties for planned growth.

Description of Research: Sites were determined to be in or adjacent to a priority funding area utilizing mapping provided by the Maryland Department of Planning.

5. **Are there likely opportunities for economic and tourism development?**

   1 = No, and it is unlikely that the site would provide any significant economic benefits to the area.

   3 = The site may offer indirect economic and tourism benefits and limited opportunities for development to general area.

   5 = Yes, there are existing or under-developed economic and tourist opportunities within walking distance of the site.

Each site has been rated on their proximity to economically developed or potentially developing areas as well as their proximity to existing tourist locations. Sites with greater likelihood of attracting tourists would have a better chance at attracting a larger ridership than those that do not.

Description of Research: Appropriate County Economic Development Plans and/or County Master Plans, web-based searches for tourism and economic development, and ADC Maps at each site were utilized to determine if each site was likely to provide opportunities for economic and tourism development.

Infrastructure and cost issues

1. **Does adequate infrastructure (public utilities, bulkheads, docks, etc.) exist at the site?**

   1 = No, and it would be very costly to construct such infrastructure.

   3 = There are existing public facilities and utilities near the site that could be modified and extended with limited investment.

   5 = Yes, there are existing adequate public facilities and waterfront infrastructure at the site that could be used with minimal cost.

Sites were rated on their accessibility to public utilities (water, sanitary sewer, and power) as well as their potential to have access to bulkheads and docks.

Description of Research: Contacts were made to the appropriate agencies (water agencies, municipalities, power companies...) to determine if an adequate infrastructure was in place.

SITE EVALUATION CRITERIA SUMMARY OF RESULTS

Table 3-4: Single Site Analysis Matrix summarizes the ratings for each criteria at all individual sites. Table 3-5: Site Pair Analysis Matrix summarizes the ratings for each of the site pairs (the lowest rating between the two sites for each criteria). Cumulative ratings for each pair have also been calculated as shown. Site pairs shown in green (5 site pairs) have cumulative ratings equal to or above 38; site pairs shown in yellow (23 site pairs) have cumulative ratings below 38. This will allow for only the top rated sites to be analyzed in the proceeding sections of the Evaluation.

At this time, MDOT is not endorsing one site pair over another, the ratings have been developed for assessment purposes only.

Trends

None of the site pairs analyzed had a travel time that was faster than the car routes during non-peak hours and only three of the site pairs were faster then the car travel times during peak travel times (with an assumed seasonal delay of one hour.) Most ferry travel times were 30-45 minutes longer then the car travel times, with several site pairs close to two hours longer. The site pairs with the greatest cumulative ratings had ferry travel times that were longer then the car travel times.

The site pairs with the greatest cumulative ratings appear to be sites from relatively well-developed areas on the Western shore to moderately developed areas on the Eastern shore. Developed areas tend to have the required infrastructure (roads, utilities, etc.) as well as the potential to attract tourists and new and existing economic opportunities. These sites generally have channels for larger boats, thus making them a more viable option.

Table 3-4: Site Evaluation Criteria: Single Site Analysis Matrix

Western Shore Single Site Evaluation Criteria

Western Shore			Criteria: Site Accessibility				Criteria: Community and Environmental Issues					Criteria: Infrastructure & Cost Issues
	Location	County	1	2	3	4	1	2	3	4	5	1
			Road Access	Water Depth	Speed Restrictions	Travel Time	Zoning	Wake Wash Impacts	Envionmental Issues	PFA	Econmic and Tourism	
1	Annapolis	Anne Arundel County	3	3			5	3	3	5	5	5
2	Deale	Anne Arundel County	3	1			3	5	3	3	1	3
3	Edgewater	Anne Arundel County	3	5			3	1	3	3	3	5
4	Brooklyn Park	Baltimore City	5	3			5	3	5	5	5	5
	Canton	Baltimore City	5	5			5	5	5	5	5	5
	Cherry Hill	Baltimore City	5	3			5	3	5	5	3	3
	Curtis Bay	Baltimore City	3	5			5	3	5	5	3	5
	Fells Point	Baltimore City	5	5			5	3	3	5	5	5
	Fort Armistead	Baltimore City	5	5			5	1	5	5	3	5
	Inner Harbor	Baltimore City	5	5			5	5	5	5	5	5
5	Dundalk	Baltimore County	3	5			5	3	5	5	3	5
	Turner Station	Baltimore County	3	3			5	2	5	5	3	5
6	Middle River	Baltimore County	3	3			5	3	3	5	5	3
7	Sparrows Point	Baltimore County	5	5			5	5	3	5	3	5
8	Chesapeake Beach	Calvert County	5	1			5	5	5	5	5	3
9	Solomons Island	Calvert County	5	5			5	5	5	5	5	5
10	Cove Point	Calvert County	1	5			1	5	3	5	1	5
11	Clark's Landing	St Mary's County	1	5			3	3	3	3	1	1

Eastern Shore Single Site Evaluation Criteria

Eastern Shore			Criteria: Site Accessibility				Criteria: Community and Environmental Issues					Criteria: Infrastructure & Cost Issues
	Location	County	1	2	3	4	1	2	3	4	5	1
			Road Access	Water Depth	Speed Restrictions	Travel Time	Zoning	Wake Wash Impacts	Envionmental Issues	PFA	Econmic and Tourism	
1	Cambridge	Dorchester County	5	3			5	5	3	5	3	5
2	Honga	Dorchester County	1	1			5	5	5	3	1	1
3	Hoopersville	Dorchester County	1	1			5	5	5	5	1	1
4	Rock Hall	Kent County	5	3			5	5	5	5	3	5
5	Piney-Kent Narrows	Queen Anne's County	3	1			5	5	5	5	1	5
6	Matapeake State Park	Queen Anne's County	1	5			1	5	5	5	1	3
7	Queenstown	Queen Anne's County	3	3			1	5	3	5	5	3
8	Crisfield	Somerset County	5	5			3	5	3	5	5	5
9	Deal Island	Somerset County	3	1			5	5	3	1	5	1
10	St Michaels	Talbot County	3	5			5	5	3	5	5	5
11	Oxford	Talbot County	3	5			5	5	5	3	3	3

Sites on both shores were needed for Criteria 3 and 4, therefore, they can only be input on the Site Pair Analysis = (shaded box)

Table 3-5: Site Evaluation Criteria: Site Pair Analysis Matrix

Western Shore	Eastern Shore	Criteria										
		Site Accessibility				Community and Environmental Issues					Infrastructure and Cost Issues	Total
		1	2	3	4	1	2	3	4	5	1	
		Road Access	Water Depth	Speed Restrictions	Travel Time	Zoning	Wake Wash Impacts	Envionmental Issues	PFA	Econmic and Tourism		
Annapolis	Matapeake State Park	1	3	5	3	1	3	3	5	1	3	28
Annapolis	Piney-Kent Narrows	3	1	3	3	5	3	3	5	1	5	32
Annapolis	Queenstown	3	3	3	3	1	3	3	5	5	3	32
Deale	St Michaels	3	1	3	1	3	5	3	3	1	3	26
Edgewater	Matapeake State Park	1	5	5	3	1	1	3	3	1	3	26
Edgewater	Piney-Kent Narrows	3	1	5	1	3	1	3	3	1	5	26
Brooklyn Park	Rock Hall	5	3	1	1	5	3	5	5	3	5	36
Canton	Rock Hall	5	3	1	1	5	5	5	5	3	5	38
Cherry Hill	Rock Hall	5	3	3	1	5	3	5	5	3	3	36
Curtis Bay	Rock Hall	3	3	3	1	5	3	5	5	3	5	36
Fells Point	Rock Hall	5	3	1	1	5	3	3	5	3	5	34
Fort Armistead	Rock Hall	5	3	3	1	5	1	5	5	3	5	36
Inner Harbor	Rock Hall	5	3	1	1	5	5	5	5	3	5	38
Dundalk	Rock Hall	3	3	3	1	5	3	5	5	3	5	36
Turner Station	Rock Hall	3	3	3	1	5	2	5	5	3	5	35
Baltimore **	Piney-Kent Narrows	3	1	3	3	5	5	5	5	1	5	36
Middle River	Rock Hall	3	3	1	1	5	3	3	5	3	3	30
Sparrows Point	Rock Hall	5	3	1	1	5	5	3	5	3	5	36
Chesapeake Beach	Cambridge	5	1	5	3	5	5	3	5	3	3	38
Chesapeake Beach	Oxford	3	1	3	1	5	5	5	3	3	3	32
Solomons Island	Honga	1	1	5	1	5	5	5	3	1	1	28
Solomons Island	Hoopersville	1	1	5	1	5	5	5	5	1	1	30
Solomons Island	Crisfield	5	5	1	1	3	5	3	5	5	5	38
Solomons Island	Deal Island	3	1	5	1	5	5	3	1	5	1	30
Solomons Island	Cambridge	5	3	5	1	5	5	3	5	3	5	40
Cove Point	Honga	1	1	3	1	1	5	3	3	1	1	20
Clark's Landing	Honga	1	1	1	1	3	3	3	3	1	1	18
Clark's Landing	Hoopersville	1	1	1	1	3	3	3	3	1	1	18

Cut-off = 38

Below the Cut-off =

Above the Cut-off=

* The cut-off was set at 38 for the total score.

** Baltimore assumes the minimum score of each of the Baltimore area sites for each category.

SITE EVALUATION CRITERIA CONCLUSIONS

The five highest rated site pairs with scores above the cut-off are shown in green on Table 3-5: Site Evaluation Criteria: Site Pair Analysis Matrix. Four site pairings have been selected for an in-depth examination in Step 4: Demonstration Pairs Assessment. The following four short-listed site pairs will be evaluated in the next phase to demonstrate what is required for ferry service from each of the representative areas:

Western Shore	Eastern Shore
Canton	Rock Hall
Chesapeake Beach	Cambridge
Solomons Island	Crisfield
Solomons Island	Cambridge

Although the Baltimore Inner Harbor to Rock Hall Pair scored high enough to pass the criteria, due to extremely high land values, limited potential site locations, as well as potential traffic impacts through downtown Baltimore; the Inner Harbor has been dropped from further analysis.

MDOT is not endorsing any site pairs as better than the others. The analysis of site pairings is for demonstration purposes only to illustrate what is required should a ferry service run between these locations. The study results indicate that these site pairs have the most potential to foster a successful ferry service, and were selected to be part of a more detailed evaluation in the next step (the Demonstration Pairs Assessment.)

Step 4 – Demonstration Pairs Assessment

***Objective*:** To investigate four short-listed site pairings in order to demonstrate issues that need to be considered should a ferry service run between these locations.

Outcome: To create a matrix of characteristics of each site including land use characteristics, environmental characteristics, and infrastructure requirements; as well as a map indicating the ridership catchment area for each site.

Method: Each of the six sites (Western Shore: Canton, Chesapeake Beach, and Solomons Island; Eastern Shore: Rock Hall, Cambridge, and Crisfield) was visited. Local planning, public works, and public utility departments were contacted to obtain relevant information regarding land availability, zoning, land use and available utilities for each representative area. State Highway Administration (SHA) District Right-of-Way Chiefs were contacted to obtain estimates for land values. Environmental characteristics and infrastructure requirements were developed from information obtained from field visits and local agencies. Ridership catchment areas were determined for areas capturing 75 percent or more of the routes' ridership potential.

DEMONSTRATION CRITERIA

1. **Determine the land use and zoning within the representative area.**

   Determine the land use and zoning of a representative area for a ferry terminal at all of the short-listed site locations. Descriptions of the representative areas were developed and are summarized in the "Description of Representative Areas" section of the analysis, refer to Figures 4-1 throuhg 4-6.

   Description of Research: A Maryland Department of Planning representative for each area was contacted to discuss possible representative areas. Planning departments for each area were also contacted and asked for suggestions of likely representative areas. Land use plans and zoning maps were reviewed to determine the land uses and zoning for each representative area. Water depths (based on NOAA Navigation Charts) were also considered when selecting representative areas.

2. **Compile SHA real estate value information.**

   Develop typical land values in dollars per acre for waterfront property in the representative areas. These have been shown in Table 4-7: Demonstration Pairs Assessment Matrix.

   Description of Research: SHA Right-of-Way Assessors in each appropriate district were contacted and asked to determine typical property values for waterfront property in the representative area. In the Canton area, the Maryland Port Administration was also asked for input.

   The values shown are assessed values and may not necessarily be the market value of the properties in question. More detailed research and appraisals would need to be completed as part of due diligence for a ferry service at any of the sites.

3. **Rate availability of utilities for each site.**

   Determine the availability of water, sanitary sewer, and power in each of the representative areas. The availability of existing bulkheads and piers was also researched at this time.

   Description of Research: Utility and planning departments as well as local power providers were contacted in each representative area to help determine the availability of water, sanitary sewer, and power service. Utility availabilities were confirmed during site visits to each representative area.

4. **Rate site development costs relative to optimal site criteria.**

   Order-of-magnitude development costs have been estimated for each site. Items such as land cost, preliminary estimates for road improvements, new paving for parking lots and boarding queues, restrooms, utility services, marine structures, shore protection, dredging, signage and pavement markings, and landscaping have been included in the estimate. A preliminary cost estimate has been developed for each site and included in Tables 4-1 through 4-6. Concept plans for a generic ferry terminal and slip have been included (Figures 4-7 and 4-8). In this design concept, we have assumed only minimal improvements and amenities will be needed for functional ferry service. Enhancements may be desirable and should be considered in future evaluations. Total Site Development Costs ranged from approximately $4.2 million to $4.9 million.

   The location and the costs associated with a lay berth and maintenance facility for each pairing have not been included in the analysis to this point.

   Description of Research: Possible road upgrades were determined during field visits. The concept plans for the ferry terminal and slip were based upon the concept plans developed in the Crisfield – Point Lookout Ferry Feasibility Study. Building, marine structure, shore protection, as well as signing and pavement markings costs were also based on results from the same study. Land values were based upon the results from Criteria 2, described above. Other costs were developed using various estimating resources.

5. **Develop a Detailed Site Assessment Matrix for the short list of sites. The matrix will consist of a discussion of characteristics for each site, including environmental characteristics and infrastructure requirements needed.**

   Please refer to Table 4-7, Demonstration Pairs Assessment Matrix. The matrix is for information purposes; these sites were not scored or ranked.

   Description of Research: The Site Feasibility Matrix was developed from Criteria 1-4 of this analysis.

6. **Develop catchment areas for the short list of sites.**

   Figure 4-9 shows the relative catchment areas for each of the four routes: Solomons Island to Crisfield, Chesapeake Beach to Cambridge, Solomons Island to Cambridge, and Canton to Rock Hall.

   Part of the site assessment process was to estimate the primary market areas or "traffic sheds" for each of the example ferry routes. Considering the relative travel times between major origins and destinations via either the Nice Bridge, Chesapeake Bay Bridge, or the subject ferry route and its terminals, ridership catchment areas were developed The travel time estimates assumed a high-speed ferry (30 knots or more) on each route and did not, for this specific analysis, consider ferry-waiting times, bridge congestion or bridge tolls or ferry fares. The purpose was to identify the primary catchment area (i.e., the area capturing 75 percent or more of a route's ridership potential) for each route under near ideal conditions as an aid to assessing the relative coverage of each route.

DESCRIPTION OF REPRESENTATIVE AREAS

Western Shore Sites

Canton

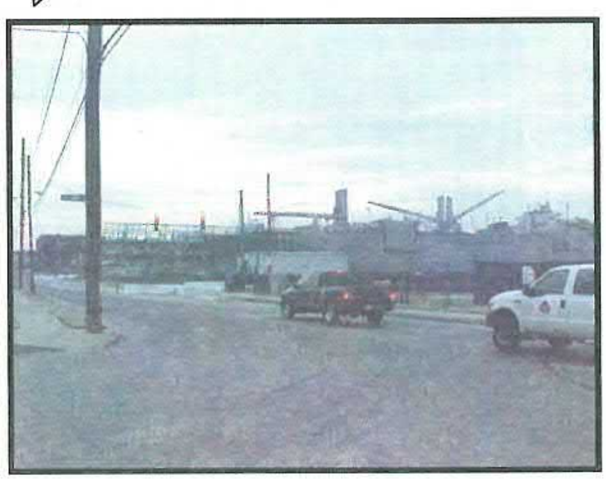
The representative area for Canton is located along Clinton Street, as shown in Figure 4-1: Canton Representative Area. Clinton Street runs perpendicular to Boston Street and is at the edge of industrial zoning in the area, adjacent to the residential and commercial sections. This location is less than 3 miles from the Baltimore Inner Harbor Area with easy access to I-95 and I-895.

Clinton Street consists of industrial parcels with existing bulkheads and piers that would be suitable for use as part of a ferry terminal. The following pictures are from site visits in November 2002 and December 2002.

Figure 4-1: Canton Representative Area
(ADC Map, Permit Use Number 20301163)


(Clinton Street Site)


(Clinton Street Sites)

(Clinton Street Sites)

Chesapeake Beach

The representative area for Chesapeake Beach is located along Bayside Road, approximately 1,500 feet to the south of the intersection of Chesapeake Beach Road (MD 260) and Bayside Road, as shown in Figure 4-2: Chesapeake Beach Representative Area. The only dredged channel leading into Chesapeake Beach is at the mouth of Fishing Creek, along the Chesapeake Bay side of the Bayside Road Bridge. The bridge along Bayside Road, crossing Fishing Creek, is extremely low (6'-8' clearances) and would need major upgrades to allow for a ferry to travel below the bridge. The waterfront property at the mouth of Fishing Creek consists of residential town homes on the north side of the Creek and Rod 'N' Reel Dock along the south side, which contains existing bulkheads and piers that could be used for a ferry terminal.

Without an extensive amount of dredging and/or rezoning of residential areas, the only viable site in Chesapeake Beach appears to be the Rod 'N' Reel Dock. The businesses at the Rod 'N' Reel Dock (fishing and tour charter boats, and restaurants) appear to be financially successful, thus possibly making the property very difficult to obtain. Should ferry service be considered in Chesapeake Beach, a joint venture with the Rod 'N' Reel Dock could be considered. The following photographs of the mouth of Fishing Creek and the Rod 'N' Reel Dock were taken on a December 2002 site visit.

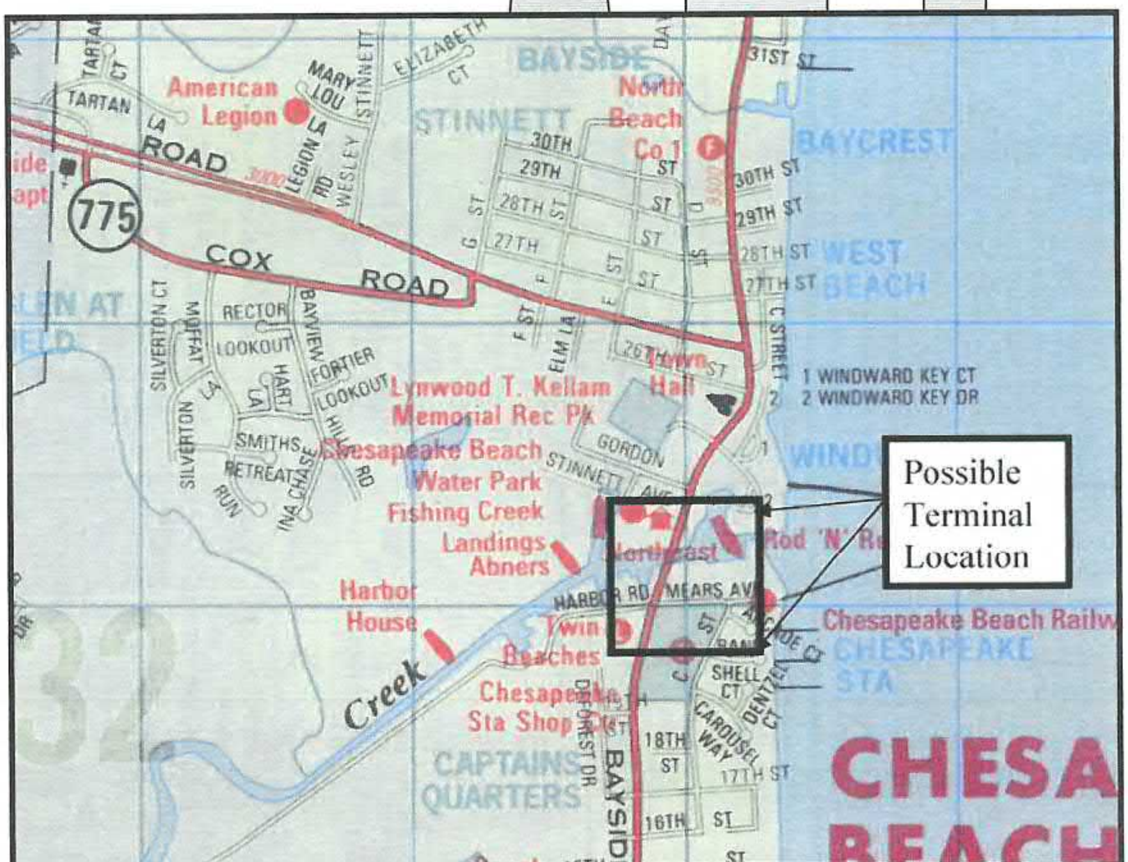


Figure 4-2: Chesapeake Beach Representative Area

(ADC Map, Permit Use Number 20301163)

(Bay Side of Rod 'N' Reel)

(Taken from Rod 'N' Reel, looking across Fishing Creek)

(Piers at Rod 'N' Reel)

(Bay side of Rod 'N' Reel)

(Rod 'N' Reel, from Bayside Road side)

(Parking lot of Rod 'N' Reel)

Solomons Island

The representative area for Solomons Island is known as "The Narrows" and is located along Charles Street (MD 2); as shown in Figure 4-3: Solomons Island Representative Area. At the time of the field visit, no waterfront property appeared to be for sale, however two particular areas did appear to be possible locations for a ferry terminal. Both were located near the end of Charles Street and were adjacent to each other.

The first was the University of Maryland (U of M) Center for Environmental Science and the other was an existing dock along Charles Street. Both sites have bulkheads that could be utilized as part of a ferry terminal location. The U of M Center for Environmental Science site is larger than the dock site and appeared to be a more ideal location. Should either site be utilized, a narrow, curved portion of Charles Street may need to be modified to allow for a greater volume of traffic that might be created due to the ferry service. The following pictures are from a site visit in December 2002.

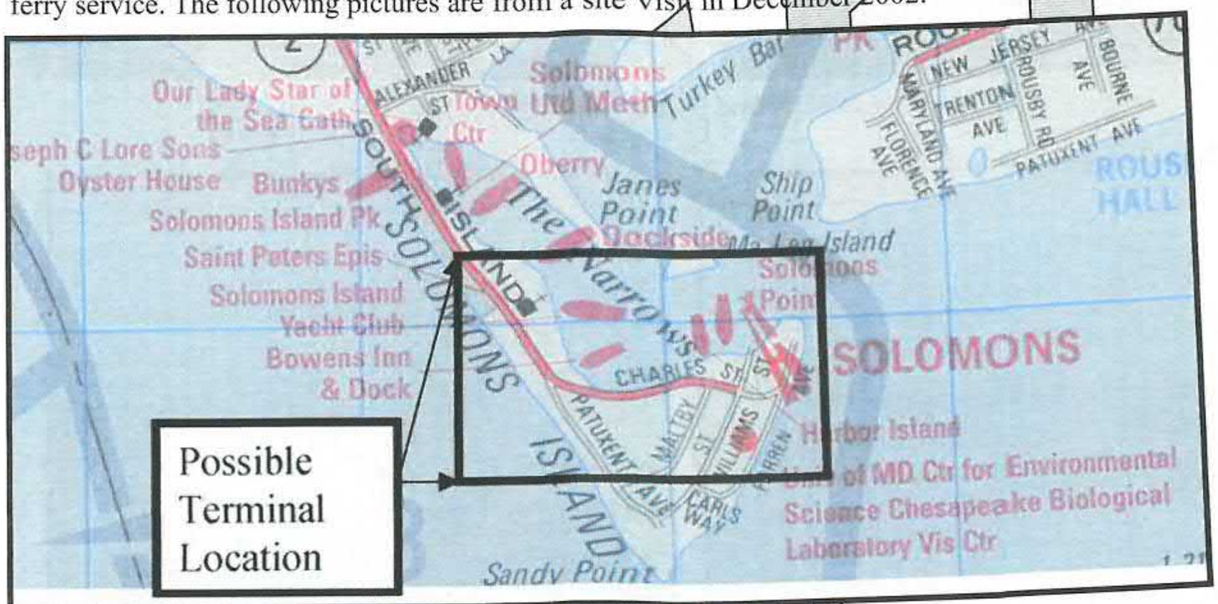


Figure 4-3: Solomons Island Representative Area

(ADC Map, Permit Use Number 20301163)

(University of Maryland Center for Environmental Science)

(University of Maryland Center for Environmental Science)

(Dock Site along Charles Street)

(Dock Site along Charles Street)

(Charles Street looking northwest, from Dock Site, location of possible modifications needed to Charles Street.)

Eastern Shore Sites

Rock Hall

The representative area for Rock Hall includes the waterfront property along Rock Hall Harbor, as shown in Figure 4-4: Rock Hall Representative Area. Rock Hall Harbor consists of mostly commercial and industrial zoned property, adjacent to residential areas. Although not many waterfront parcels were for sale at the time of the site visit, several locations along Bayside Avenue, Hawthorn Avenue, and Chesapeake Avenue could be considered viable locations for a ferry terminal. Many of the parcels in this area range in size from ¼ acre upwards. This being the case, it is very likely that several adjacent parcels would have to be purchased to accommodate a ferry terminal site. At first glance, parcels along Swan Creek and The Haven may appear to be possible locations for ferry terminals, however, these locations consist of mostly residential communities with yacht docking and do not have the required water depth needed for ferry service.

Rock Hall does not provide direct highway access to the Ocean City area; patrons will still need to travel approximately 30-45 minutes before reaching US 50, connecting roughly ten minutes away from the Eastern Shore side of the Bay Bridge. However, this location does lend itself as a viable option for patrons of the Rock Hall and central Delaware areas to travel to the Baltimore/Annapolis area, without having to deal with the traffic along US 50. The following pictures are from a site visit in December 2002.

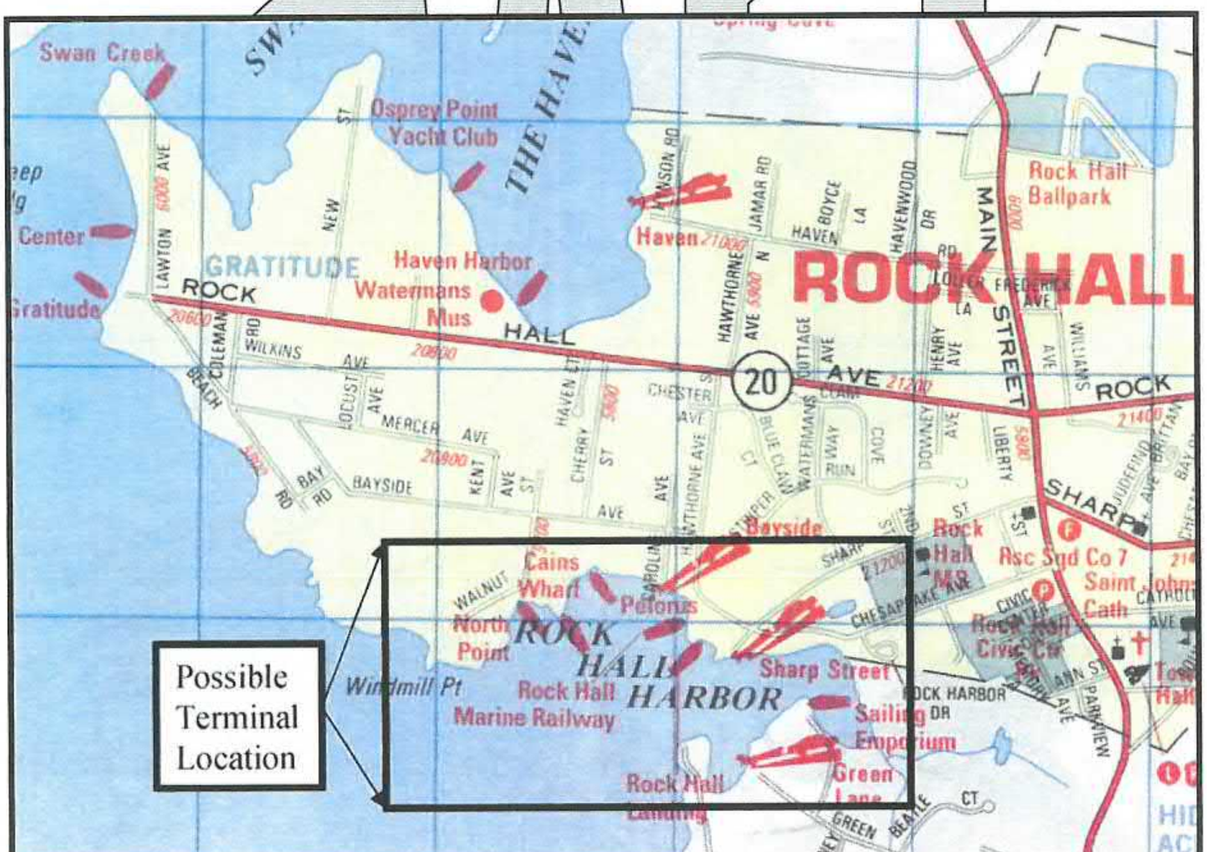


Figure 4-4: Rock Hall Representative Area

(ADC Map, Permit Use Number 20301163)

(Sailing Emporium Area)

(Harbor along Bayside Avenue)

(Harbor along Bayside Avenue)

Cambridge

The representative area for Cambridge includes the waterfront properties along the Choptank River side of the Market Street Bridge, as shown in Figure 4-5: Cambridge Representative Area. Possible locations include Commerce Street, Court Lane, Gay Street, Academy Street, and Hayward Street. Although no waterfront parcels were visibly for sale at the time of the site visit, several locations appeared to be viable potential sites with existing piers and bulkheads that could be used as part of a ferry terminal. One such site was the future home of the James B. Richardson Maritime Museum on Hayward Street.

Additional waterfront sites were available to the south of the Market Street Bridge. However, due to the height of the existing drawbridge, the bridge would need to be closed every time the ferry passed through. This could have a great impact to an already congested Market Street. Sites in the vicinity south of the bridge should not be considered. The following pictures are from a site visit in December 2002.

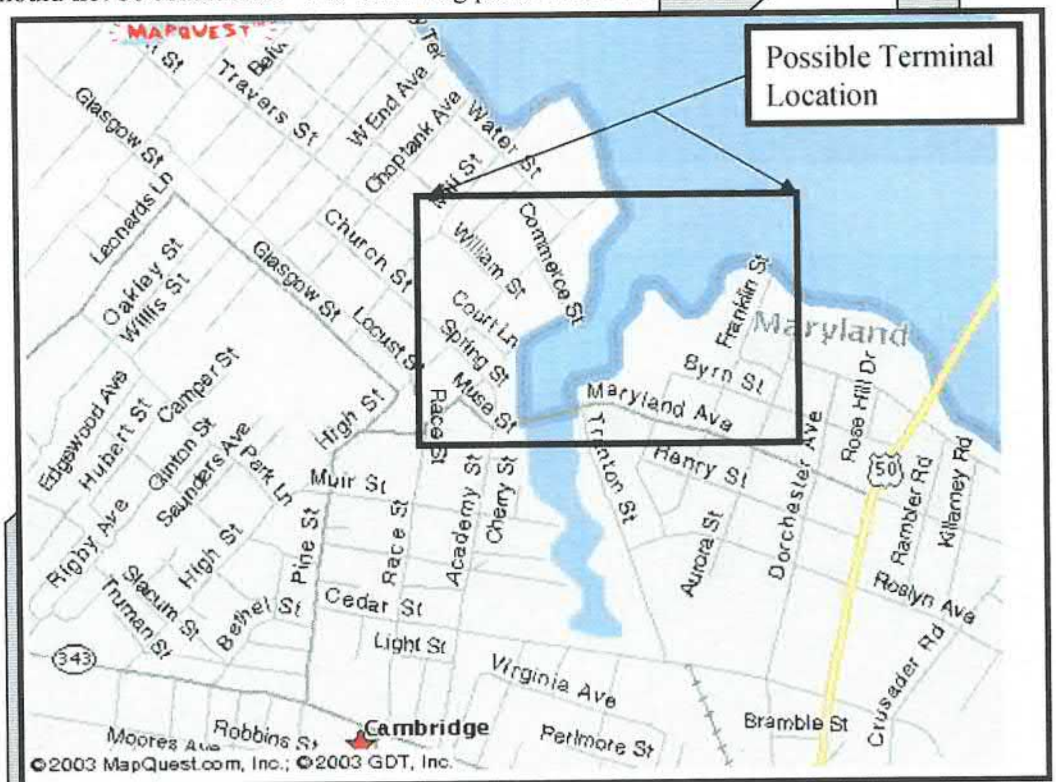
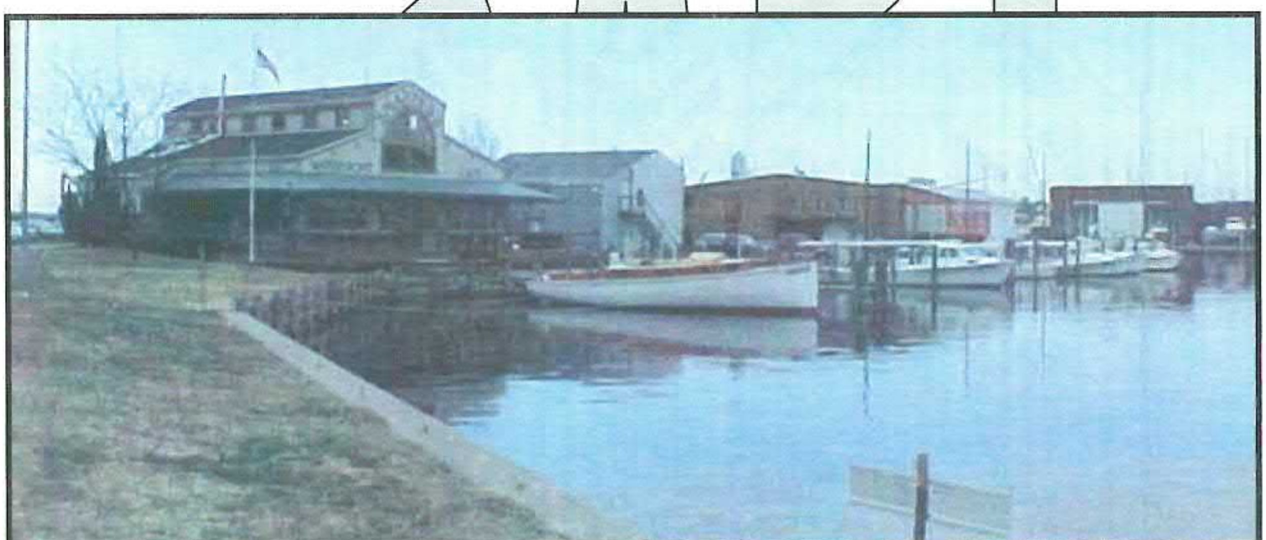


Figure 4-5: Cambridge Representative Area

(From Gay Street, across the Harbor)



(From Government Parking Lot looking toward Gay Street)

(From Government Parking Lot looking across the Harbor)

Crisfield

The representative areas for Crisfield are off of Maryland Avenue (along Seventh and Tenth Streets), refer to Figure 4-6: Crisfield Representative Area. Both locations have plots of land currently for sale. The Seventh Street location has an abandoned fish processing facility that is currently being used as a boat building facility that would need to be demolished or renovated should the site be selected. The Tenth Street location appears to be an old boat-launching site with existing piers and bulkheads. This area could be utilized for a ferry terminal. No buildings exist on this site. Existing piers and bulkheads with required water depth are present at each location. Both areas have easy access to Maryland Avenue. It does not appear that either site would require road widening, however, resurfacing of 7th or 10th Street may be needed. The following pictures are from a site visit in December 2002.

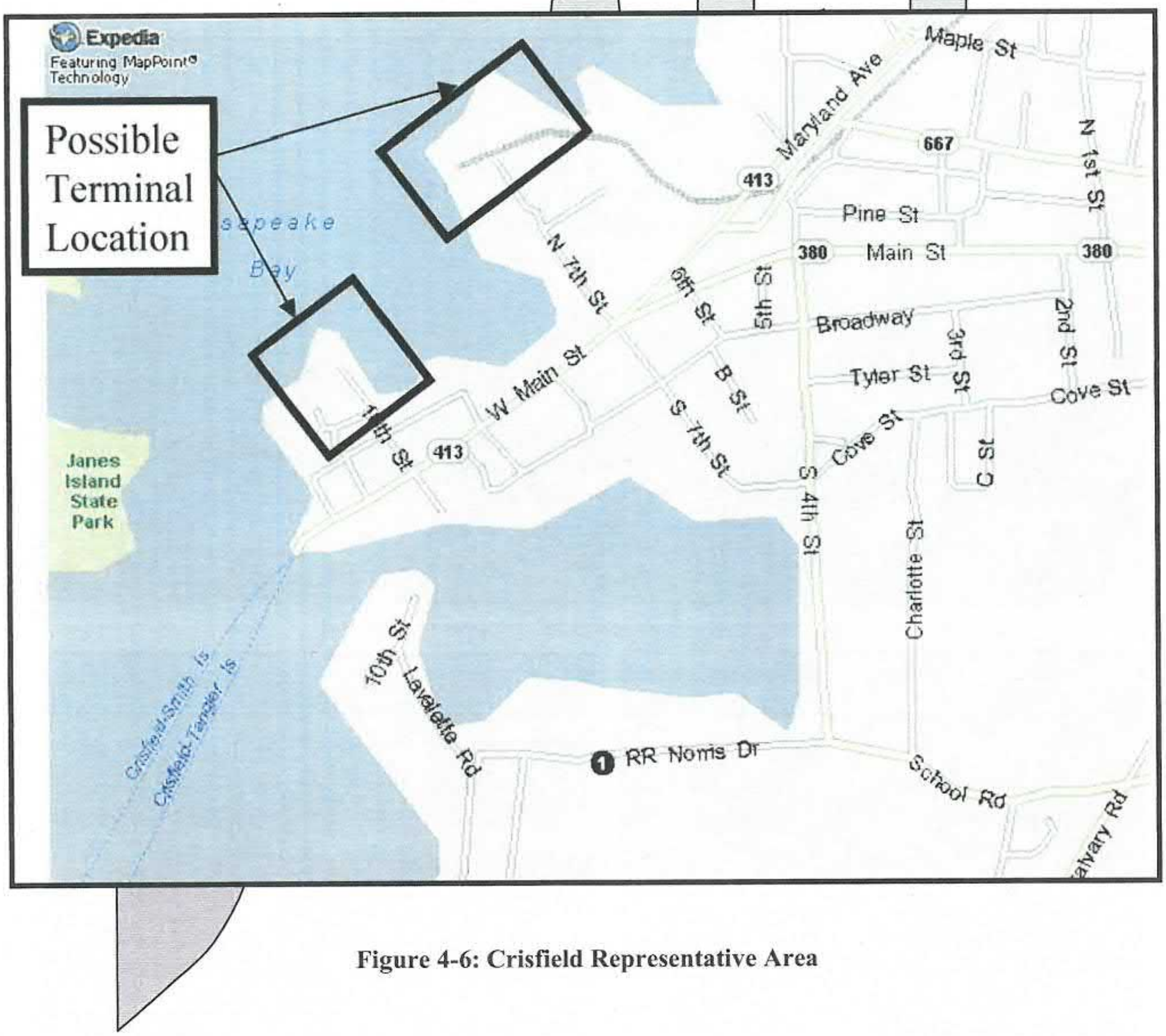


Figure 4-6: Crisfield Representative Area

(7th Street site, abandoned fish processing facility)

(7th Street site, abandoned fish processing facility)

(7th Street, looking from site, toward Maryland Ave)

(10th Street Site)

SITE DEVELOPMENT COSTS

For the purposes of this study, we have assumed that the ferry terminal concepts will be the same for each of the sites (see Figures 4-7 and 4-8), and include the following major elements:

1. **Ferry Slip** – A ferry slip should be approximately 50 feet wide by 200 feet long, based on the dimensions of the concept ferry vessel. The slip is delineated by timber pile dolphins and catwalks with the transfer ramp for passengers and vehicles at the shore side end. This concept assumes minimal dredging of a slip area (but not the channel) in order to achieve a safe draft. Timber catwalks need to be provided for access to each dolphin. Please see Figure 4-8 for a conceptual design of this proposed standard ferry slip.
2. **Vehicle and Passenger Transfer Ramp** – This component is approximately 30 feet wide by 40 feet long and of steel construction. The ramp includes a pedestrian walkway and two traffic lanes, which enable the ferry to load/unload two lines of vehicles simultaneously. The ramp is raised or lowered by overhead electric hoists to adjust to variations in the ferry's deck height.
3. **Bulkhead** – This component should be a concrete cap on steel sheets, extending 50 feet either side of the ferry slip centerline.
4. **Daily Parking Area** – The parking area should include paved parking for 20 automobiles at the terminal.
5. **Paved Boarding Queue** – There should be storage for 80 automobiles (or equivalent in trucks and buses) to queue-up while waiting to board the ferry.
6. **Paved Exit Corridor** – A two-lane exit route for unloaded vehicles should be provided.
7. **Restroom Building** – Men's and Women's restrooms, both handicap accessible, should be included.
8. **Access Driveway** – There should be a two-lane driveway connecting the terminal to a public road.
9. **Miscellaneous** – Site lighting, signage, and minimal landscaping would be provided.

Conceptually, each terminal will require two to three acres of land (2.5 acres has been assumed for cost estimating purposes) with at least 200 feet of water frontage. Demolition costs or potential cost savings for adapting and reusing existing bulkheads, parking lots, or buildings have not been included in this analysis.

The facilities described above have been quantified and estimates prepared in order to establish order-of-magnitude costs for the ferry service requirements. Refer to Tables 4-1 through 4-6 for the individual cost estimates for each of the sites. All costs shown associated with offsite improvements (roadway and utilities) were developed in the next task (Task 5: Supporting Transportation Network). Please refer to Task 5 for a detailed description of the costs.

Figure 4-7: Ferry Terminal Concept

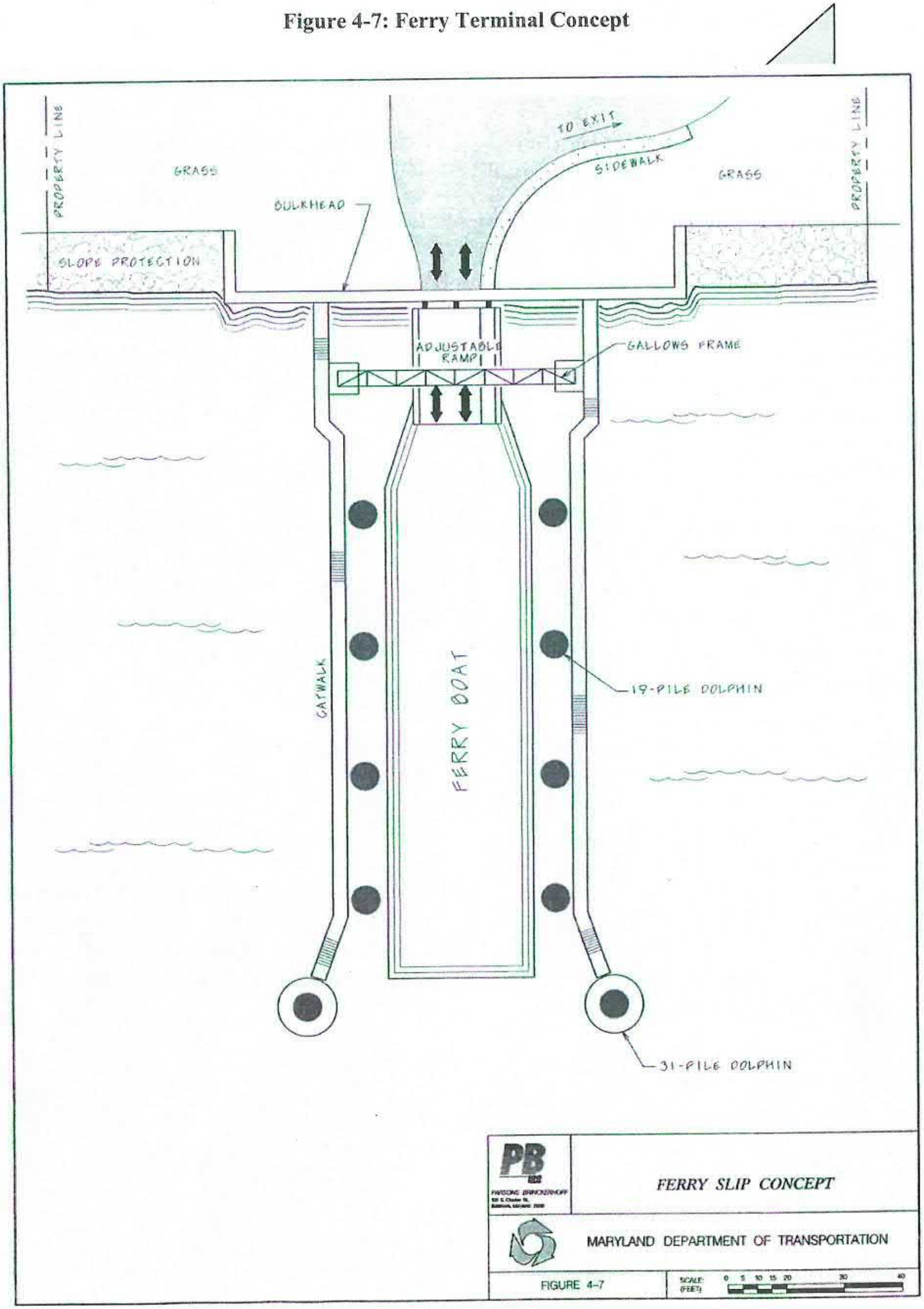


Figure 4-8: Ferry Slip Concept

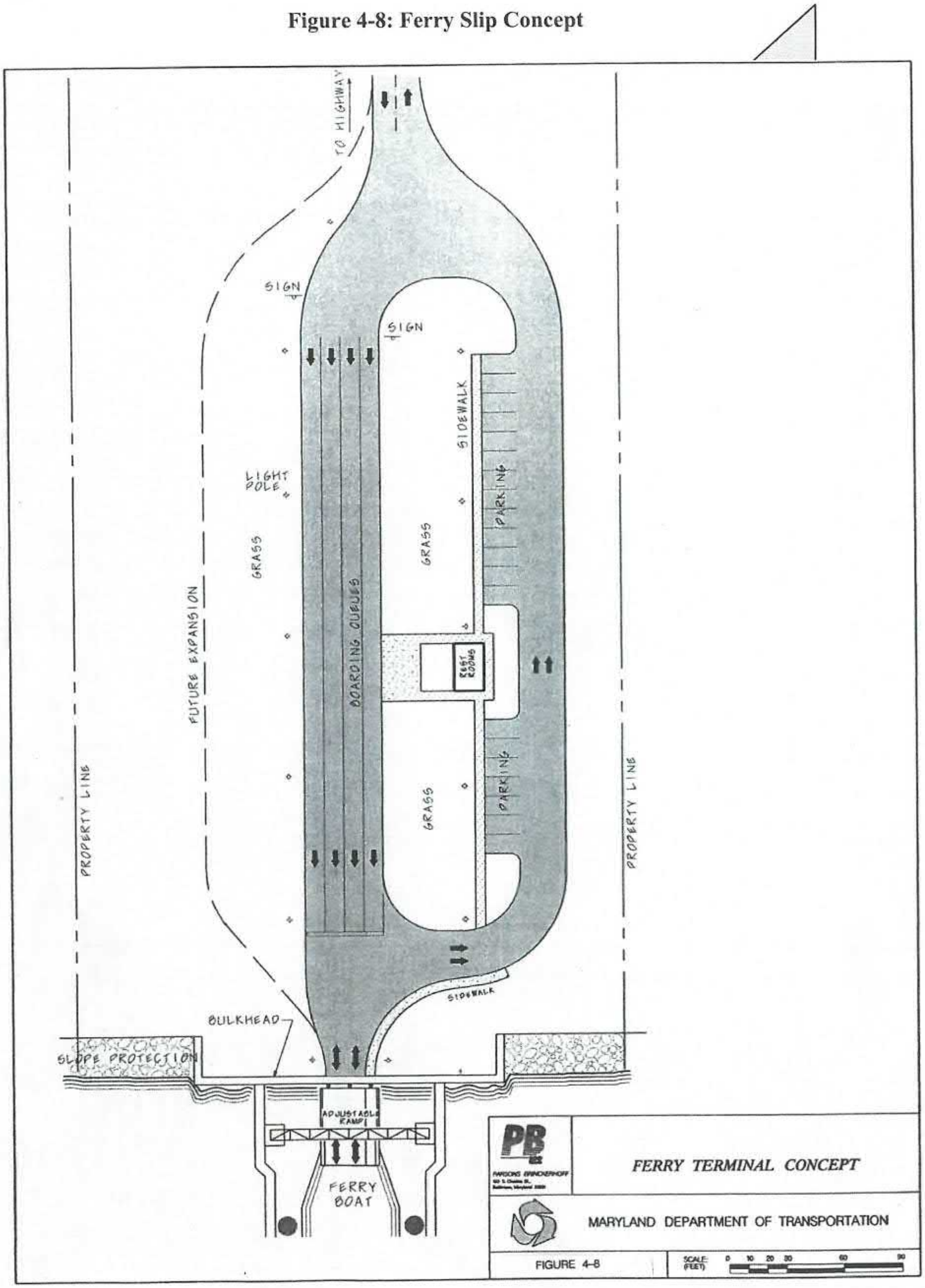


Table 4-1: Preliminary Cost Estimate for Canton Terminal Location

Item	Description	Quantity	Unit	Unit Cost	Total	Remarks
Land Cost	Approximate land value	2.5	AC	$375,000	$937,500	Land values are approximate only, and include overhead costs.
Paving	Asphalt on Gravel Base	6400	SY	$35	$224,000	Includes queuing & parking areas, plus access to terminal.
Road Upgrades *	Resurfacing of Clinton Street	1	LS	$325,000	$325,000	Assume 2,000 LF of resurfacing to Clinton Street, and a traffic signal.
Buildings	2 Restrooms	400	SF	$200	$80,000	Masonry Construction; ADA Compliant
Utilities						
Water	Provide Service	1	LS	$25,000	$25,000	Assumes 400 LF of waterline, watermeter, backflow prevention system.
Sewer	Provide Service	1	LS	$15,000	$15,000	Assumes 400 LF of sanitary sewer and 3 manholes.
Electrical	Provide Service	1	LS	$25,000	$25,000	Includes power connections and site lighting.
Utility Connection Fees		1	LS	$8,000	$8,000	Water and sanitary sewer connection fees.
Marine Structures	**Terminal Only**					
Bulkhead	Concrete cap on steel sheets	150	LF	$1,100	$165,000	Includes deadman anchors
Gallows Frame Foundations	Concrete Cap on Concrete Piles	2	EA	$25,000	$50,000	10' x 10' cap on 4 concrete piles
Gallows Frame Superstructure	Steel Frame welded & painted	1	EA	$200,000	$200,000	Includes two electric hoists
Adjustable Ramp	Steel frame with grating surface, hinged at bulkhead	1	EA	$175,000	$175,000	30' wide x 40' long; includes 2 12-foot lanes with pedestrian walkway on one side
Timber Dolphin	19-pile cluster	8	EA	$50,000	$400,000	Includes fender system
Timber Dolphin	31-pile cluster	2	EA	$100,000	$200,000	Includes fender system
Timber Catwalk	3 foot wide	480	LF	$270	$129,600	Both sides of slip for Dolphin access from shore
Shore Protection	Stone Riprap	550	SY	$75	$41,250	200 linear feet on 25' slope, 18-inches thick, minimum
Dredging	Ferry slip	2800	CY	$15	$42,000	Assumes that dredging will be needed for ferry slip (3' x 100' x 250')
Signage & Pavement Markings	Terminal	1	LS	$20,000	$20,000	
Landscaping	Terminal	1	LS	$30,000	$30,000	
SUBTOTAL					$3,092,350	
Contingency	35%				$1,082,323	
SUBTOTAL					$4,174,673	
Design, Permits & Const. Mgmt.	15%				$626,201	
TOTAL					**$4,800,873**	

SY = square yard, SF = square foot, LS = lump sum, EA = each, LF = linear foot, CY = cubic yard, AC = Acre
* Refer to Task 5: Supporting Transportation Network for a detailed description of the improvements needed.

Table 4-2: Preliminary Cost Estimate for Chesapeake Beach Terminal Location

Item	Description	Quantity	Unit	Unit Cost	Total	Remarks
Land Cost	Approximate land value	2.5	AC	$525,000	$1,312,500	Land values are approximate only, and include overhead costs.
Paving	Asphalt on Gravel Base	6400	SY	$35	$224,000	Includes queuing & parking areas, plus access to terminal.
Road Upgrades *	Road improvements to Mears Ave.	1	LS	$50,000	$50,000	Assume minor improvements to Mears Ave.
Buildings	2 Restrooms	400	SF	$200	$80,000	Masonry Construction; ADA Compliant
Utilities						
Water	Provide Service	1	LS	$25,000	$25,000	Assumes 400 LF of waterline, watermeter, backflow prevention system.
Sewer	Provide Service	1	LS	$15,000	$15,000	Assumes 400 LF of sanitary sewer and 3 manholes.
Electrical	Provide Service	1	LS	$25,000	$25,000	Includes power connections and site lighting.
Utility Connection Fees		1	LS	$6,000	$6,000	Water and sanitary sewer connection fees.
Marine Structures	**Terminal Only**					
Bulkhead	Concrete cap on steel sheets	150	LF	$1,100	$165,000	Includes deadman anchors
Gallows Frame Foundations	Concrete Cap on Concrete Piles	2	EA	$25,000	$50,000	10' x 10' cap on 4 concrete piles
Gallows Frame Superstructure	Steel Frame welded & painted	1	EA	$200,000	$200,000	Includes two electric hoists
Adjustable Ramp	Steel frame with grating surface, hinged at bulkhead	1	EA	$175,000	$175,000	30' wide x 40' long; includes 2 12-foot lanes with pedestrian walkway on one side
Timber Dolphin	19-pile cluster	8	EA	$50,000	$400,000	Includes fender system
Timber Dolphin	31-pile cluster	2	EA	$100,000	$200,000	Includes fender system
Timber Catwalk	3 foot wide	480	LF	$270	$129,600	Both sides of slip for Dolphin access from shore
Shore Protection	Stone Riprap	550	SY	$75	$41,250	200 linear feet on 25' slope, 18-inches thick, minimum
Dredging	Ferry slip	2800	CY	$15	$42,000	Assumes that dredging will be needed for ferry slip (3' x 100' x 250')
Signage & Pavement Markings	Terminal	1	LS	$20,000	$20,000	
Landscaping	Terminal	1	LS	$30,000	$30,000	
SUBTOTAL					$3,190,350	
Contingency	35%				$1,116,623	
SUBTOTAL					$4,306,973	
Design, Permits & Const. Mgmt.	15%				$646,046	
TOTAL					**$4,953,018**	

SY = square yard, SF = square foot, LS = lump sum, EA = each, LF = linear foot, CY = cubic yard, AC = Acre
* Refer to Task 5: Supporting Transportation Network for a detailed description of the improvements needed.

Table 4-3: Preliminary Cost Estimate for Solomons Island Terminal Location

Item	Description	Quantity	Unit	Unit Cost	Total	Remarks
Land Cost	Approximate land value	2.5	AC	$375,000	$937,500	Land values are approximate only, and include overhead costs.
Paving	Asphalt on Gravel Base	6400	SY	$35	$224,000	Includes queuing & parking areas, plus access to terminal.
Road Upgrades *	Improvements to Charles Street	1	LS	$500,000	$500,000	Improve curve geometry.
Buildings	2 Restrooms	400	SF	$200	$80,000	Masonry Construction; ADA Compliant
Utilities						
Water	Provide Service	1	LS	$25,000	$25,000	Assumes 400 LF of waterline, watermeter, backflow prevention system.
Sewer	Provide Service	1	LS	$15,000	$15,000	Assumes 400 LF of sanitary sewer and 3 manholes.
Electrical	Provide Service	1	LS	$25,000	$25,000	Includes power connections and site lighting.
Utility Connection Fees		1	LS	$2,700	$2,700	Water and sanitary sewer connection fees.
Marine Structures	**Terminal Only**					
Bulkhead	Concrete cap on steel sheets	150	LF	$1,100	$165,000	Includes deadman anchors
Gallows Frame Foundations	Concrete Cap on Concrete Piles	2	EA	$25,000	$50,000	10' x 10' cap on 4 concrete piles
Gallows Frame Superstructure	Steel Frame welded & painted	1	EA	$200,000	$200,000	Includes two electric hoists
Adjustable Ramp	Steel frame with grating surface, hinged at bulkhead	1	EA	$175,000	$175,000	30' wide x 40' long; includes 2 12-foot lanes with pedestrian walkway on one side
Timber Dolphin	19-pile cluster	8	EA	$50,000	$400,000	Includes fender system
Timber Dolphin	31-pile cluster	2	EA	$100,000	$200,000	Includes fender system
Timber Catwalk	3 foot wide	480	LF	$270	$129,600	Both sides of slip for Dolphin access from shore
Shore Protection	Stone Riprap	550	SY	$75	$41,250	200 linear feet on 25' slope, 18-inches thick, minimum
Dredging	Ferry slip	2800	CY	$15	$42,000	Assumes that dredging will be needed for ferry slip (3' x 100' x 250')
Signage & Pavement Markings	Terminal	1	LS	$20,000	$20,000	
Landscaping	Terminal	1	LS	$30,000	$30,000	
SUBTOTAL					$3,262,050	
Contingency	35%				$1,141,718	
SUBTOTAL					$4,403,768	
Design, Permits & Const. Mgmt.	15%				$660,565	
TOTAL					$5,064,333	

SY = square yard, SF = square foot, LS = lump sum, EA = each, LF = linear foot, CY = cubic yard, AC = Acre
* Refer to Task 5: Supporting Transportation Network for a detailed description of the improvements needed.

Table 4-4: Preliminary Cost Estimate for Rock Hall Terminal Location

Item	Description	Quantity	Unit	Unit Cost	Total	Remarks
Land Cost	Approximate land value	2.5	AC	$375,000	$937,500	Land values are approximate only, and include overhead costs.
Paving	Asphalt on Gravel Base	6400	SY	$35	$224,000	Includes queuing & parking areas, plus access to terminal.
Road Upgrades *	Improvements to side street.	1	LS	$125,000	$125,000	500 LF of improvements assumed to either Bayside Ave, Walnut St, Hawthorne Ave, or other street.
Buildings	2 Restrooms	400	SF	$200	$80,000	Masonry Construction; ADA Compliant
Utilities						
Water	Provide Service	1	LS	$25,000	$25,000	Assumes 400 LF of waterline, watermeter, backflow prevention system.
Sewer	Provide Service	1	LS	$15,000	$15,000	Assumes 400 LF of sanitary sewer and 3 manholes.
Electrical	Provide Service	1	LS	$25,000	$25,000	Includes power connections and site lighting.
Utility Connection Fees		1	LS	$3,500	$3,500	Water and sanitary sewer connection fees.
Marine Structures	**Terminal Only**					
Bulkhead	Concrete cap on steel sheets	150	LF	$1,100	$165,000	Includes deadman anchors
Gallows Frame Foundations	Concrete Cap on Concrete Piles	2	EA	$25,000	$50,000	10' x 10' cap on 4 concrete piles
Gallows Frame Superstructure	Steel Frame welded & painted	1	EA	$200,000	$200,000	Includes two electric hoists
Adjustable Ramp	Steel frame with grating surface, hinged at bulkhead	1	EA	$175,000	$175,000	30' wide x 40' long; includes 2 12-foot lanes with pedestrian walkway on one side
Timber Dolphin	19-pile cluster	8	EA	$50,000	$400,000	Includes fender system
Timber Dolphin	31-pile cluster	2	EA	$100,000	$200,000	Includes fender system
Timber Catwalk	3 foot wide	480	LF	$270	$129,600	Both sides of slip for Dolphin access from shore
Shore Protection	Stone Riprap	550	SY	$75	$41,250	200 linear feet on 25' slope, 18-inches thick, minimum
Dredging	Ferry slip	2800	CY	$15	$42,000	Assumes that dredging will be needed for ferry slip (3' x 100' x 250')
Signage & Pavement Markings	Terminal	1	LS	$20,000	$20,000	
Landscaping	Terminal	1	LS	$30,000	$30,000	
SUBTOTAL					$2,887,850	
Contingency	35%				$1,010,748	
SUBTOTAL					$3,898,598	
Design, Permits & Const. Mgmt.	15%				$584,790	
TOTAL					**$4,483,387**	

SY = square yard, SF = square foot, LS = lump sum, EA = each, LF = linear foot, CY = cubic yard, AC = Acre
* Refer to Task 5: Supporting Transportation Network for a detailed description of the improvements needed.

Table 4-5: Preliminary Cost Estimate for Cambridge Terminal Location

Item	Description	Quantity	Unit	Unit Cost	Total	Remarks
Land Cost	Approximate land value	2.5	AC	$450,000	$1,125,000	Land values are approximate only, and include overhead costs.
Paving	Asphalt on Gravel Base	6400	SY	$35	$224,000	Includes queuing & parking areas, plus access to terminal.
Road Upgrades *	Resurfacing of a side street.	1	LS	$200,000	$200,000	Assume 500 LF of resurfacing and some patching to a side street as well as a new traffice signal.
Buildings	2 Restrooms	400	SF	$200	$80,000	Masonry Construction; ADA Compliant
Utilities						
Water	Provide Service	1	LS	$25,000	$25,000	Assumes 400 LF of waterline, watermeter, backflow prevention system.
Sewer	Provide Service	1	LS	$15,000	$15,000	Assumes 400 LF of sanitary sewer and 3 manholes.
Electrical	Provide Service	1	LS	$25,000	$25,000	Includes power connections and site lighting.
Utility Connection Fees		1	LS	$2,000	$2,000	Water and sanitary sewer connection fees.
Marine Structures	**Terminal Only**					
Bulkhead	Concrete cap on steel sheets	150	LF	$1,100	$165,000	Includes deadman anchors
Gallows Frame Foundations	Concrete Cap on Concrete Piles	2	EA	$25,000	$50,000	10' x 10' cap on 4 concrete piles
Gallows Frame Superstructure	Steel Frame welded & painted	1	EA	$200,000	$200,000	Includes two electric hoists
Adjustable Ramp	Steel frame with grating surface, hinged at bulkhead	1	EA	$175,000	$175,000	30' wide x 40' long; includes 2 12-foot lanes with pedestrian walkway on one side
Timber Dolphin	19-pile cluster	8	EA	$50,000	$400,000	Includes fender system
Timber Dolphin	31-pile cluster	2	EA	$100,000	$200,000	Includes fender system
Timber Catwalk	3 foot wide	480	LF	$270	$129,600	Both sides of slip for Dolphin access from shore
Shore Protection	Stone Riprap	550	SY	$75	$41,250	200 linear feet on 25' slope, 18-inches thick, minimum
Dredging	Ferry slip	2800	CY	$15	$42,000	Assumes that dredging will be needed for ferry slip (3' x 100' x 250')
Signage & Pavement Markings	Terminal	1	LS	$20,000	$20,000	
Landscaping	Terminal	1	LS	$30,000	$30,000	
SUBTOTAL					$3,148,850	
Contingency	35%				$1,102,098	
SUBTOTAL					$4,250,948	
Design, Permits & Const. Mgmt.	15%				$637,642	
TOTAL					$4,888,590	

SY = square yard, SF = square foot, LS = lump sum, EA = each, LF = linear foot, CY = cubic yard, AC = Acre
* Refer to Task 5: Supporting Transportation Network for a detailed description of the improvements needed.

Table 4-6: Preliminary Cost Estimate for Crisfield Terminal Location

Item	Description	Quantity	Unit	Unit Cost	Total	Remarks
Land Cost	Approximate land value	2.5	AC	$375,000	$937,500	Land values are approximate only, and include overhead costs.
Paving	Asphalt on Gravel Base	6400	SY	$35	$224,000	Includes queuing & parking areas, plus access to terminal.
Road Upgrades *	Resurfacing of a side street	1	LS	$185,000	$185,000	Assume 500 LF of resurfacing to 10th Street and a new traffic signal.
Buildings	2 Restrooms	400	SF	$200	$80,000	Masonry Construction; ADA Compliant
Utilities						
Water	Provide Service	1	LS	$25,000	$25,000	Assumes 400 LF of waterline, watermeter, backflow prevention system.
Sewer	Provide Service	1	LS	$15,000	$15,000	Assumes 400 LF of sanitary sewer and 3 manholes.
Electrical	Provide Service	1	LS	$25,000	$25,000	Includes power connections and site lighting.
Utility Connection Fees		1	LS	$3,000	$3,000	Water and sanitary sewer connection fees.
Marine Structures	**Terminal Only**					
Bulkhead	Concrete cap on steel sheets	150	LF	$1,100	$165,000	Includes deadman anchors
Gallows Frame Foundations	Concrete Cap on Concrete Piles	2	EA	$25,000	$50,000	10' x 10' cap on 4 concrete piles
Gallows Frame Superstructure	Steel Frame welded & painted	1	EA	$200,000	$200,000	Includes two electric hoists
Adjustable Ramp	Steel frame with grating surface, hinged at bulkhead	1	EA	$175,000	$175,000	30' wide x 40' long; includes 2 12-foot lanes with pedestrian walkway on one side
Timber Dolphin	19-pile cluster	8	EA	$50,000	$400,000	Includes fender system
Timber Dolphin	31-pile cluster	2	EA	$100,000	$200,000	Includes fender system
Timber Catwalk	3 foot wide	480	LF	$270	$129,600	Both sides of slip for Dolphin access from shore
Shore Protection	Stone Riprap	550	SY	$75	$41,250	200 linear feet on 25' slope, 18-inches thick, minimum
Dredging	Ferry slip	2800	CY	$15	$42,000	Assumes that dredging will be needed for ferry slip (3' x 100' x 250')
Signage & Pavement Markings	Terminal	1	LS	$20,000	$20,000	
Landscaping	Terminal	1	LS	$30,000	$30,000	
SUBTOTAL					$2,947,350	
Contingency	35%				$1,031,573	
SUBTOTAL					$3,978,923	
Design, Permits & Const. Mgmt.	15%				$596,838	
TOTAL					$4,575,761	

SY = square yard, SF = square foot, LS = lump sum, EA = each, LF = linear foot, CY = cubic yard, AC = Acre

* Refer to Task 5: Supporting Transportation Network for a detailed description of the improvements needed.

DEMONSTRATION PAIRS ASSESSMENT MATRIX

Site characteristics are compiled in Table 4-7: Demonstration Pairs Assessment Matrix to summarize the results of the Site Feasibility Analysis. The matrix is for illustration purposes and was not used to rate, recommend, or select sites or pairs. The criteria within the matrix is described below.

Zoning

The zoning for each of the representative areas is conducive to developing a ferry terminal. Industrial, town center, commercial, and tourism zonings should allow for the development of the area for a terminal facility with little difficulty. Should these areas have been zoned as residential or some type of other zoning that does not lend itself to the development of a terminal, we would have expressed concern.

Land Value

These land values are approximate only and will vary depending on the exact parcel location. Also, as speculation of a ferry terminal begins, land prices in the immediate areas may increase. Most of the land values for the representative areas are just under $400,000/acre, with the exception of Chesapeake Beach and Cambridge. Chesapeake Beach land values are higher ($525,000/acre) due to the proximity to the Washington, D.C. area and the development of the surrounding area. Cambridge is a historic community, which helped to raise land values.

Availability of Land

Most of the representative areas are fairly developed, and finding vacant properties may be very difficult.

Utilities

All of the representative areas have water, sewer, and electricity available. Providing these utilities should not be a problem.

Existing Bulkheads

Each of the representative areas have existing bulkheads, however, depending on the size of the vessels used for the ferry service, new bulkheads will need to be constructed in most cases.

Water Depth/Dredging Issues

Adequate depths are present for all of the areas overall, however, some dredging will be needed to provide continuous adequate channel widths and more depth in most cases. Canton and Crisfield will require the least amount of dredging. Many of these issues will be addressed later in Step 7: Navigation Issues.

Possible Roadway Upgrades Needed

Potential road upgrades have been listed. These improvements have been included in the cost estimates for each site and are described in greater detail in Step 5 – Supporting Transportation Network.

Environmental Issues

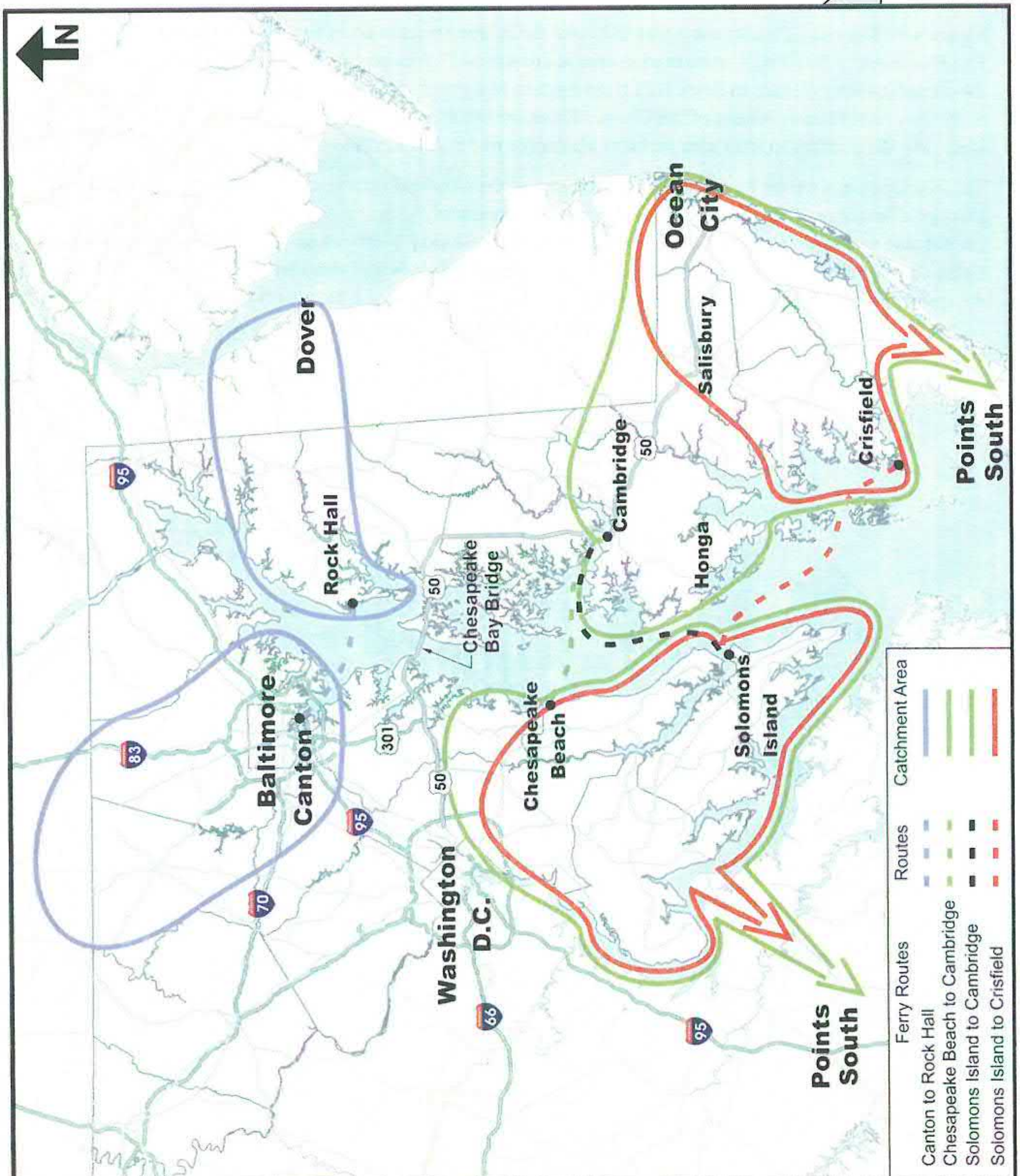
Potential environmental issues pertaining to each of the representative areas have been listed. These issues include traffic impacts, potentials for hazardous materials, dredging, zoning implications, shore impacts, potential for historic impacts, and impacts to the local economies. Many of these issues will be addressed later in Step 7 – Navigation Issues and Step 10 – Assess Public Benefits of Service.

RIDERSHIP CATCHMENT AREAS

Figure 4-9: Ridership Catchment Areas indicates the relative market areas for each of the site pairings. The Baltimore to Rock Hall route market area is constrained by its proximity to the Bay Bridge and by the circuitous access route to Rock Hall from Eastern Maryland and southern Delaware. On the east side of the Bay, locations southeast of the Chester River are better served by the existing Bay Bridge; on the west side, the primary market area includes Baltimore and points north and northeast.

The overlapping areas on Figure 4-9 demonstrate that the Crisfield terminal does not serve Southeastern Maryland locations (with the exception of the area immediately in and around the town of Crisfield) that are not also served by the Cambridge terminal. On the west side, there is a similar overlap between the Solomons Island and Chesapeake Beach terminals, with the Solomons Island terminal capturing most of the traffic that would also use the Chesapeake Beach terminal. The market area for a Chesapeake Beach ferry terminal is constrained to the north by the attractiveness of the Bay Bridge as a faster driving alternative to the ferry.

Figure 4-9: Ridership Catchment Areas



Step 5 – Supporting Transportation Network

Objective: Assess "off-site" transportation network capabilities to support the proposed ferry service terminal locations and identify improvements (roadway, utilities, etc.) needed at each site.

Outcome: The output of this task is a tabulation of "off-site" infrastructure improvements needed to support the proposed ferry service, including order-of-magnitude costs.

Method: Site visits as well as the Highway Location Reference Guide were utilized to determine the existing roadway characteristics. Planned roadway improvements for State roads were determined from the Maryland Department of Transportation's Consolidated Transportation Plan (FY 2002-2007). Planned improvements for local roadways were obtained by contacting local agencies. Order-of-magnitude costs were estimated using SHA 2002 cost data.

CURRENT ROADWAY ACCESS CHARACTERISTICS

1. Characterize and rate current roadway access to the selected sites.

A matrix consisting of the roadway characteristics associated with each of the representative areas was developed, as shown in Tables 5-1 and 5-2. The limits of study area for Eastern Shore sites ended at US50.

Description of Research: The following characteristics of existing state roadways was obtained from the State of Maryland 1997 Highway Location Reference Guide: route number, state system type, functional class, highway type, number of marked lanes, speed limit, and AADT.

2. Identify planned improvements to roadway access routes including the schedule for the same.

Determine the scheduled improvements and identify possible improvements for existing roadways associated with the representative areas for each representative terminal site. These items have been shown in Tables 5-1 and 5-2.

Description of Research: Scheduled improvements for state roads were determined utilizing the Maryland Department of Transportation's Consolidated Transportation Plan (FY 2002-2007). Planned improvements for local roadways were obtained through local agencies. Site visits to each representative area were used to develop descriptions of existing conditions as well as needed improvements.

3. Assess costs for planned and identified improvements using order-of-magnitude basis.

Identify costs for the scheduled improvements and develop order-of-magnitude costs for needed improvements for existing roadways associated with the representative areas for each site. The costs for planned projects have been shown in Tables 5-1 and 5-2. Detailed descriptions of and costs for identified improvements (roadway, utilities, etc.) have been provided in the Identified Improvements section of this Task.

Description of Research: Costs associated with scheduled improvements for State roads were determined utilizing the Maryland Department of Transportation's Plan (FY 2002-2007). The costs associated with needed improvements were determined using SHA cost data.

4. Present findings associated with current capacity and improvements needed for shortlisted sites.

Identify costs for the scheduled improvements and develop order-of-magnitude costs for needed improvements for existing roadways to and within the representative areas for each site. The costs for scheduled improvements have been shown in Tables 5-1 and 5-2. Detailed descriptions of and costs for identified improvements (roadway, utilities, etc.) have been provided in the Identified Improvements section of this Task.

Description of Research: The findings presented were developed as part of items 1-3 described above.

IDENTIFIED ROADWAY IMPROVEMENTS

Traffic increases associated with ferry service would be in the order-of-magnitude of 200,000 to 250,000 vehicles per year. This would mean at most a 1,000 vehicle increase in the ADT volume. The type, condition and load-carrying "capacity" of the roads serving the terminal sites are the focus of this task rather than congestion-related capacity. Safety considerations may dictate the need for construction of left or right turn lanes and signals at the entrance to the terminals.

Utility improvements discussed in this section include infrastructure improvements only. The costs associated with the onsite utilities for the ferry terminal, parking lot, and restrooms have been included in the Cost Estimates for the Ferry Terminal Locations in Step 4 (the Demonstration Pairs Assessment.)

Western Shore Sites

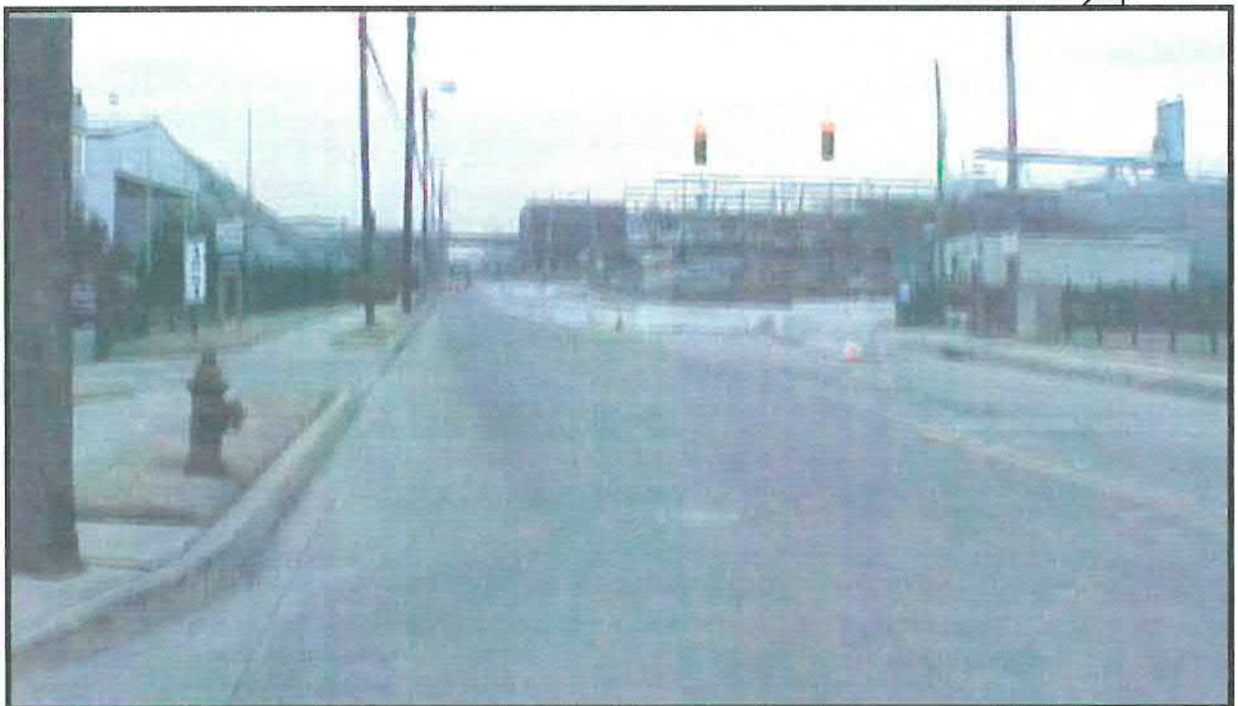
Canton

We have assumed that improvements such as patching and resurfacing of some areas will be needed along Clinton Street. The extent and location of these improvements would depend upon the location of the ferry terminal along Clinton Street. We have estimated that these improvements would include resurfacing of Clinton Street for approximately 2,000 LF. Due to the extent and nature of traffic on Clinton Street, we anticipate that a traffic signal will be needed at the entrance to the ferry terminal along Clinton Street. Cost associated with the signal would be around $100,000. The total anticipated cost for these improvements is approximately $325,000. The location of the identified improvements is shown in Figure 5-1. Refer to Table 5-3 for the cost estimate of the improvements.

One block of Clinton Street (south of Holabird Avenue, adjacent to Pier 7) was closed in Sept. 2001 for approximately 6-9 months to accommodate emergency repairs to the roadway and the adjacent piers. Clinton Street has been reopened, however a traffic light has been installed to allow for only one lane of traffic to be open at a time, for the block of improvements. The scheduled date of completion is unknown at this time.

Clinton Street is a well-traveled section of roadway (with an AADT between 2,500 and 5,500), with truck traffic to the marine terminals as well as traffic to I-95. Once the traffic associated with the ferry service has left the immediate area, its impacts to the existing traffic will not be enough to warrant upgrades. Boston Street is also a heavily traveled section of roadway and would not warrant roadway upgrades as a result of traffic associated with the ferry terminal.

Water, sanitary sewer and electricity are currently available along Clinton Street and we do not anticipate that any upgrades will be needed to the infrastructure of these existing utilities to provide service to the ferry terminal.



(Clinton Street, north of closed section looking south)

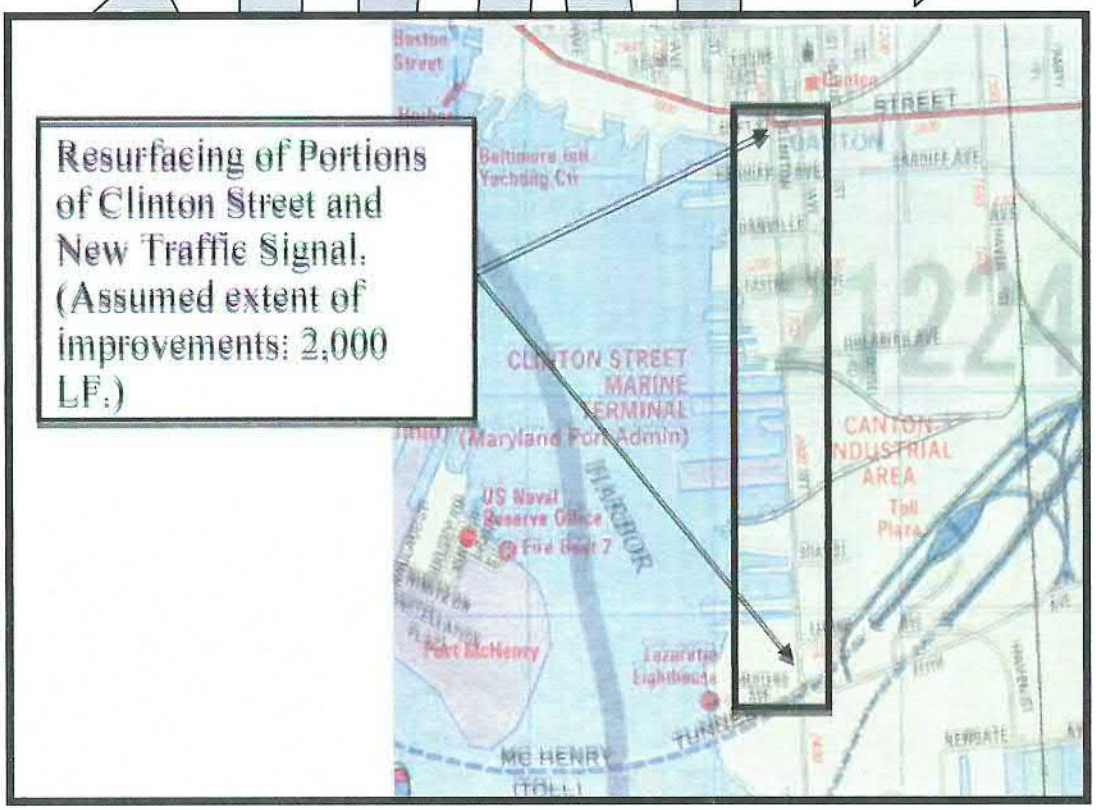


Figure 5-1: Canton Possible Road Upgrades

Table 5-3: Canton Cost Estimate for Off Site Improvements

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
Grinding Hot Mix Asphalt Pavement 0 Inch to 2 Inches	SY	6,700	$ 3.50	$ 23,450
Hot Mix Asphalt Superpave 12.5mm for Surface, PG76-22, Level-3	TONS	745	$ 60.00	$ 44,700
Subtotal				**$ 68,150**
Drainage	%	30%	$ 20,445.00	$ 20,445
Utilities	%	20%	$ 13,630.00	$ 13,630
Subtotal				**$ 102,225**
Maintenance of Traffic	%	15%	$ 15,333.75	$ 15,334
Signing	%	10%	$ 10,222.50	$ 10,223
Pavement Markings	%	5%	$ 5,111.25	$ 5,111
Design	%	15%	$ 15,333.75	$ 15,334
Construction Stakeout	%	2%	$ 2,044.50	$ 2,045
Mobilization	%	10%	$ 10,222.50	$ 10,223
Construction Engineering	%	15%	$ 15,333.75	$ 15,334
Subtotal				**$ 175,827**
Contingency	%	45%	$ 46,001.25	$ 46,001
Traffic Signal	LS	1	$ 100,000.00	$ 100,000.00
TOTAL PROJECT COST				**$ 321,828**
ASSUME TOTAL PROJECT COSTS =				**$ 325,000**

Chesapeake Beach

We expect that minor improvements will be needed along Mears Avenue to allow for the additional traffic associated with the potential ferry service. Improvements could include patching and resurfacing as needed. These pavement related items would most likely be done in conjunction with the onsite upgrades needed for the ferry terminal. There is an existing traffic signal at the corner of Mears Avenue and Bayside Beach Road, thus a new traffic signal will not be needed. The anticipated cost for these improvements is approximately $50,000. The location of the identified improvements is shown in Figure 5-2. Refer to Table 5-4 for the cost estimate of these improvements.

Bayside Road is a Rural Major Collector, with an AADT of 12,075, and is in good condition. The amount of traffic generated as a result of the ferry service would not have a large enough impact to warrant modifications.

Water, sanitary sewer and electricity currently serve Mears Avenue, therefore we do not anticipate that any upgrades will be needed to the infrastructure of these existing utilities to provide service to the ferry terminal.

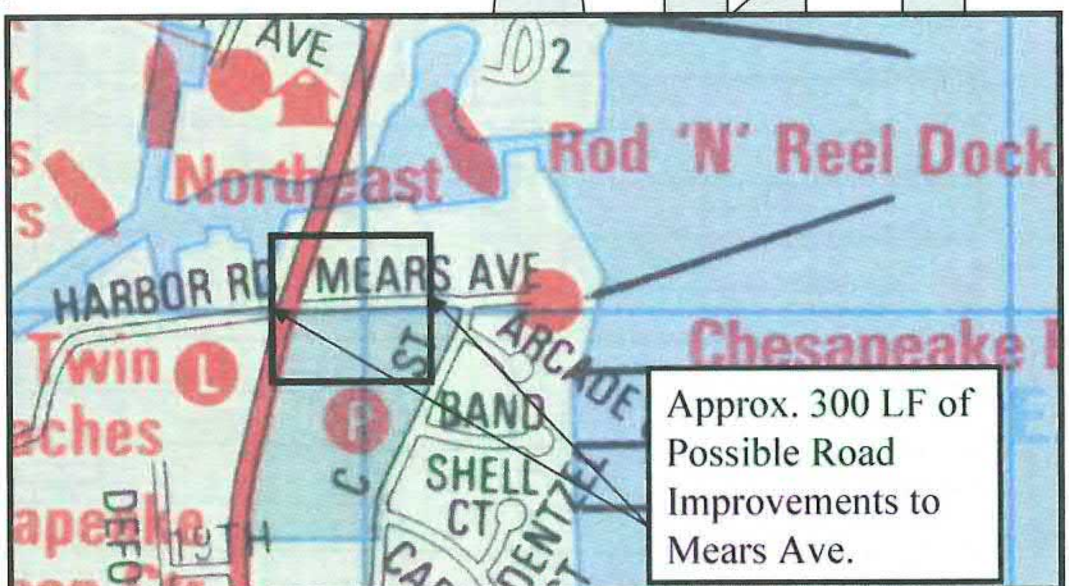


Figure 5-2: Chesapeake Beach Possible Road Upgrades

Table 5-4: Chesapeake Beach Cost Estimate for Off Site Improvements

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
Grinding Hot Mix Asphalt Pavement 0 Inch to 2 Inches	SY	670	$ 5.50	$ 3,685
Hot Mix Asphalt Superpave 12.5mm for Surface, PG76-22, Level-3	TONS	75	$ 75.00	$ 5,625
HMA Mix Asphalt Superpave 19.0mm for Partial Depth Patch, PG64-22, Level-4	TONS	50	$ 55.00	$ 2,750
HMA Asphalt Superpave 19.0mm for Full Depth Patch, PG64-22, Level-4	TONS	50	$ 45.00	$ 2,250
Subtotal				**$ 14,310**
Drainage	%	40%	$ 5,724.00	$ 5,724
Utilities	%	30%	$ 4,293.00	$ 4,293
Subtotal				**$ 24,327**
Maintenance of Traffic	%	15%	$ 3,649.05	$ 3,649
Design	%	15%	$ 3,649.05	$ 3,649
Construction Stakeout	%	2%	$ 486.54	$ 487
Mobilization	%	10%	$ 2,432.70	$ 2,433
Construction Engineering	%	15%	$ 3,649.05	$ 3,649
Subtotal				**$ 38,193**
Contingency	%	45%	$ 10,947.15	$ 10,947
TOTAL PROJECT COST				**$ 49,141**
ASSUME TOTAL PROJECT COSTS =				**$ 50,000**

Solomons Island

We anticipate that the turn on Charles Street (at the intersection with Patuxent Avenue) will need to be widened and straightened. Improvements could include additional pavement, grinding and resurfacing of old pavement, acquisition of additional right-of-way, utility relocations, maintenance of traffic along Charles Street and Patuxent Avenue, and other items associated with the improvements. We have assumed that no buildings would be affected by this construction. Due to the low traffic volumes in this area of Charles Street, we do not expect that a traffic signal will be needed at the entrance to the ferry terminal site. The anticipated cost for these improvements is approximately $500,000. The location of the identified improvements is shown in Figure 5-3. Refer to Table 5-5 for the cost estimate of the improvements.

Traveling from the potential site locations north of the Patuxent Avenue intersection, MD 2 (Solomons Island Road) appears to have the capacity to handle the traffic associated with the ferry service. To the north of this area, Solomons Island Road becomes a Rural Principle Arterial, with an AADT of 16,683, The amount of traffic generated as a result of the ferry service would not have a large enough impact to warrant any modifications to this section of roadway.

Water, sanitary sewer and electricity are currently available along Charles Street. We do not anticipate that upgrades will be needed to the infrastructure of these existing utilities to provide service to the ferry terminal.

(Location of Possible Improvements to Charles Street. View from south of the Patuxent Ave. intersection, looking north.)

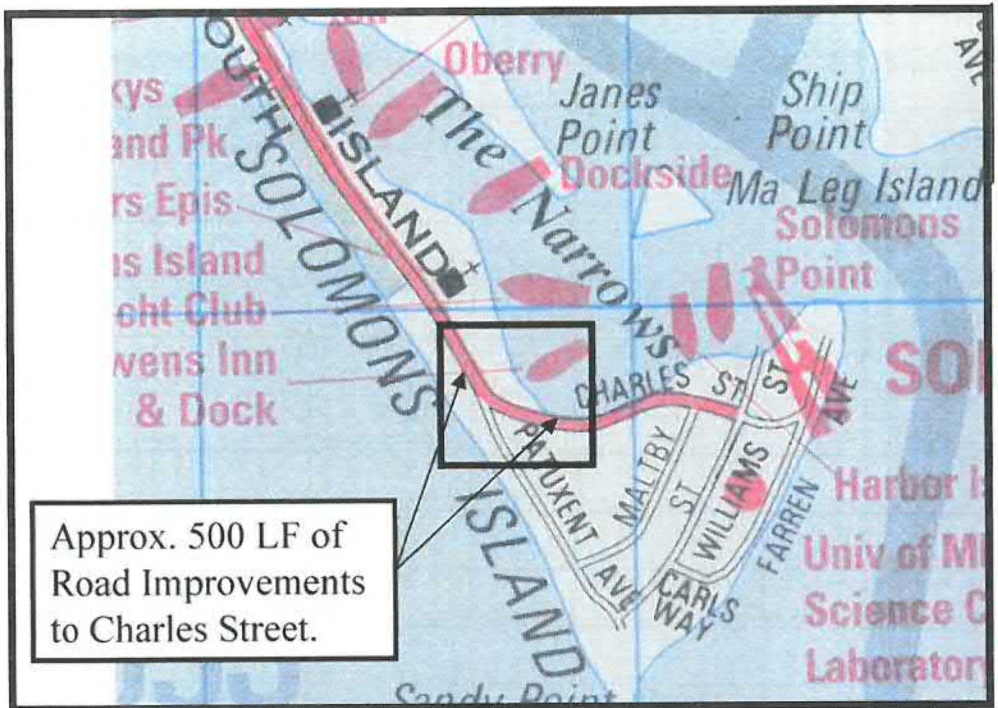


Figure 5-3: Solomons Island Possible Road Upgrades

Table 5-5: Solomons Island Cost Estimate for Off Site Improvements

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT	
Grinding Hot Mix Asphalt Pavement 0 Inch to 2 Inches	SY	670	$	5.50	$	3,685
Hot Mix Asphalt Superpave 12.5mm for Surface, PG76-22, Level-3	TONS	75	$	75.00	$	5,625
HMA Mix Asphalt Superpave 19.0mm for Partial Depth Patch, PG64-22, Level-4	TONS	115	$	55.00	$	6,325
HMA Asphalt Superpave 19.0mm for Full Depth Patch, PG64-22, Level-4	TONS	115	$	45.00	$	5,175
Select Borrow	CY	150	$	40.00	$	6,000
Class 1 Excavation	CY	200	$	35.00	$	7,000
GAB (Assuming 12" Thickness)	SY	335	$	22.00	$	7,370
Hot Mix Asphalt Superpave 19.0mm for Base, PG 64-22, Level-4	TONS	115	$	55.00	$	6,325
Drainage	LS	1	$	25,000.00	$	25,000
Utilities	LS	1	$	25,000.00	$	25,000
Misc. Items	%	40%	$	39,002.00	$	39,002
Subtotal					$	**136,507**
Maintenance of Traffic	%	15%	$	20,476.05	$	20,476
Signing	%	10%	$	13,650.70	$	13,651
Pavement Markings	%	5%	$	6,825.35	$	6,825
Design	%	15%	$	20,476.05	$	20,476
Construction Stakeout	%	2%	$	2,730.14	$	2,730
Mobilization	%	10%	$	13,650.70	$	13,651
Construction Engineering	%	15%	$	20,476.05	$	20,476
R/W	AC	0.50	$	375,000.00	$	187,500.00
Subtotal					$	**422,292**
Contingency	%	45%	$	61,428.15	$	61,428
TOTAL PROJECT COST					$	**483,720**
ASSUME TOTAL PROJECT COSTS =					$	**500,000**

<u>Eastern Shore Sites:</u>

Rock Hall

We estimate that approximately 500 LF of improvements will be needed to the smaller two lane streets that would be affected by traffic associated with the ferry service. These roads could include Bayside Avenue, Hawthorne Avenue, and Chesapeake Avenue depending on the location of the ferry terminal and parking lot. Improvements could include resurfacing, widening, as well as other associated improvements. Due to the low traffic volumes in this area, we do not anticipate that a traffic signal would be needed at the entrance to the ferry terminal. The anticipated cost for these improvements is approximately $125,000. The location of the identified improvements is shown in Figure 5-4. Refer to Table 5-6 for the cost estimate of the improvements.

MD 20 (Rock Hall Avenue) is a Rural Minor Arterial roadway, with an AADT of 3,725. We do not anticipate that the amount of traffic generated as a result of the ferry service would have a large enough impact to warrant modifications to this section of roadway.

Water, sanitary sewer and electricity are currently available in the Rock Hall Harbor representative area, we do not anticipate upgrades to the infrastructure of these existing utilities will be needed to provide service to the ferry terminal.

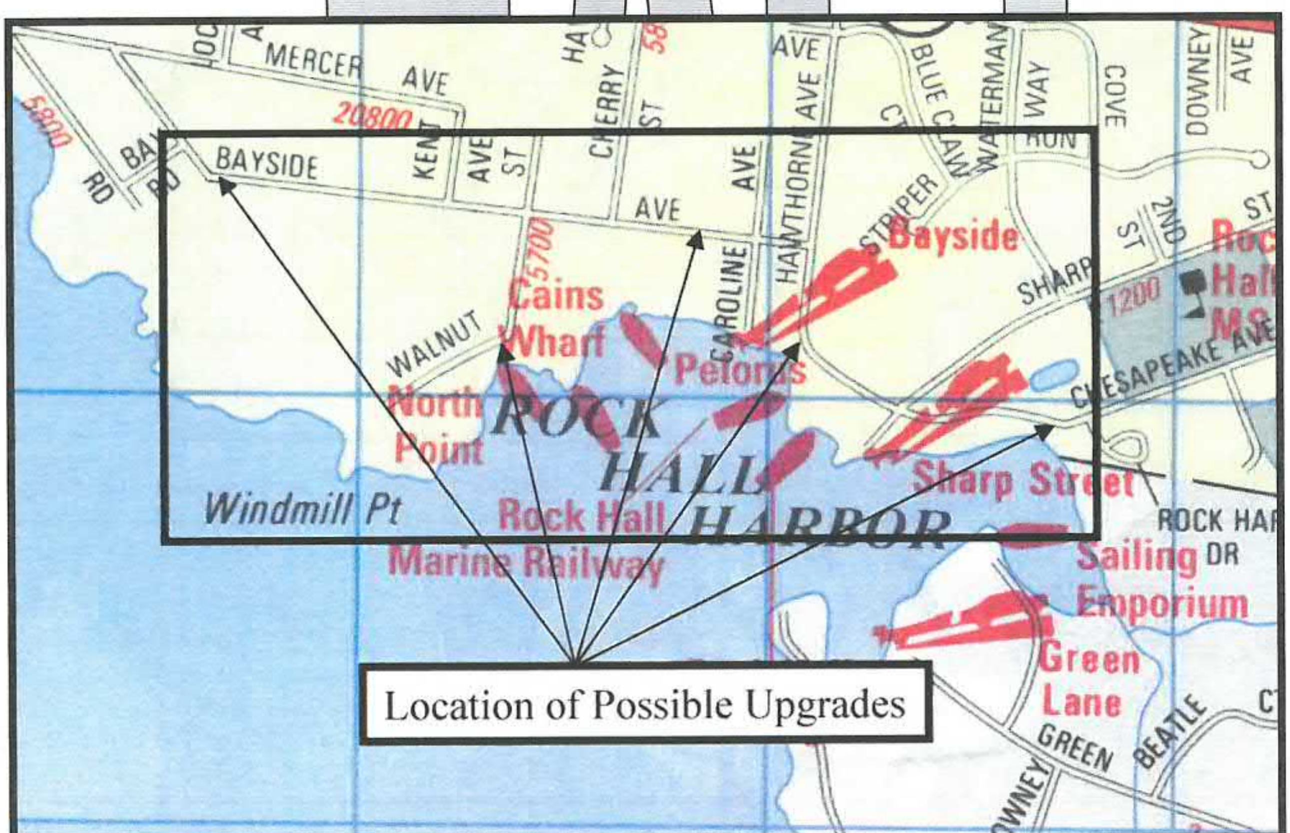


Figure 5-4: Rock Hall Possible Road Upgrades

Table 5-6: Rock Hall Cost Estimate for Off Site Improvements

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
Grinding Hot Mix Asphalt Pavement 0 Inch to 2 Inches	SY	1,700	$ 5.00	$ 8,500
Hot Mix Asphalt Superpave 12.5mm for Surface, PG76-22, Level-3	TONS	190	$ 70.00	$ 13,300
HMA Mix Asphalt Superpave 19.0mm for Partial Depth Patch, PG64-22, Level-4	TONS	115	$ 55.00	$ 6,325
HMA Asphalt Superpave 19.0mm for Full Depth Patch, PG64-22, Level-4	TONS	115	$ 45.00	$ 5,175
Subtotal				**$ 33,300**
Drainage	%	40%	$ 13,320.00	$ 13,320
Utilities	%	30%	$ 9,990.00	$ 9,990
Subtotal				**$ 56,610**
Maintenance of Traffic	%	15%	$ 8,491.50	$ 8,492
Signing	%	10%	$ 5,661.00	$ 5,661
Pavement Markings	%	5%	$ 2,830.50	$ 2,831
Design	%	15%	$ 8,491.50	$ 8,492
Construction Stakeout	%	2%	$ 1,132.20	$ 1,132
Mobilization	%	10%	$ 5,661.00	$ 5,661
Construction Engineering	%	15%	$ 8,491.50	$ 8,492
Subtotal				**$ 97,369**
Contingency	%	45%	$ 25,474.50	$ 25,475
TOTAL PROJECT COST				**$ 122,844**
ASSUME TOTAL PROJECT COSTS =				**$ 125,000**

Cambridge

We estimate that approximately 500 LF of improvements will be needed to the smaller streets that would be affected by traffic associated with the ferry service. These roads could include Hayward Street, Byrne Street, and Commerce Street depending on the location of the ferry terminal and parking lot. Minor upgrades may be needed to Market Street also. We have estimated that these improvements would include resurfacing of one of the side streets (depending on the location of the terminal) for approximately 500 LF as well as patching along Market Street, at a cost of $100,000. Due to the extent and nature of traffic in the area, we have anticipated that a traffic signal will be needed at the entrance to the ferry terminal. Cost associated with the signal would be around $100,000. The total anticipated cost for these improvements is approximately $200,000. The location of the identified improvements is shown in Figure 5-5. Refer to Table 5-7 for the cost estimate of the improvements.

MD 343 (Washington Street) is an Urban Principal Arterial roadway, with an AADT of 8,950. The amount of traffic generated as a result of the ferry service would not have a large enough impact to warrant modifications to this section of roadway.

Water, sanitary sewer and electricity are currently available at the representative area for the Cambridge site, we do not anticipate upgrades to the infrastructure of these existing utilities will be needed to provide service to the ferry terminal.

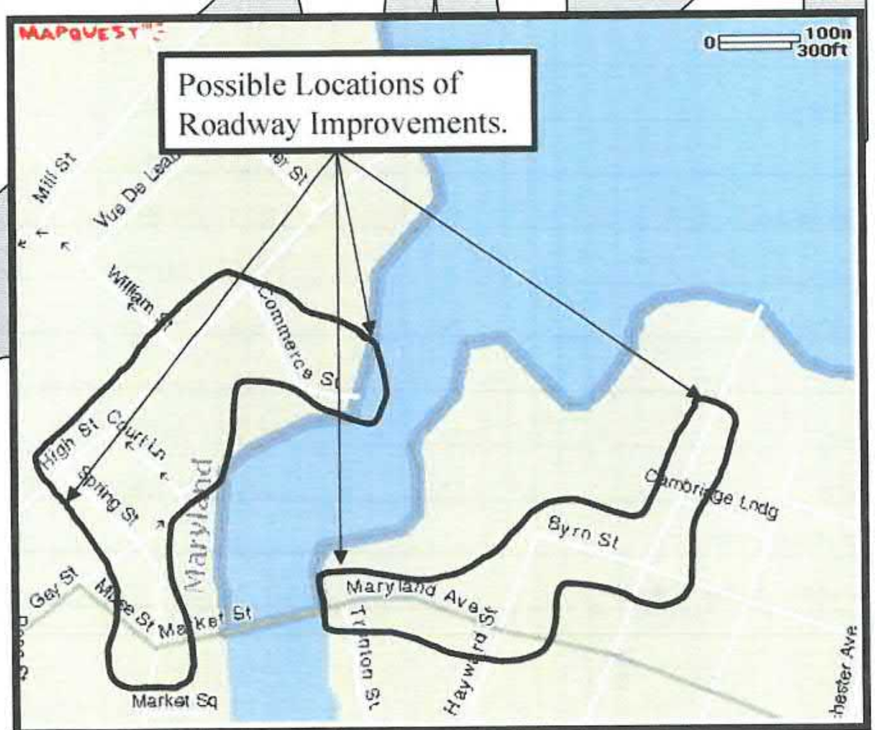


Figure 5-5: Cambridge Possible Road Upgrades

Table 5-7: Cambridge Cost Estimate for Off Site Improvements

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
Grinding Hot Mix Asphalt Pavement 0 Inch to 2 Inches	SY	1,700	$ 5.00	$ 8,500
Hot Mix Asphalt Superpave 12.5mm for Surface, PG76-22, Level-3	TONS	190	$ 70.00	$ 13,300
HMA Mix Asphalt Superpave 19.0mm for Partial Depth Patch, PG64-22, Level-4	TONS	50	$ 55.00	$ 2,750
HMA Asphalt Superpave 19.0mm for Full Depth Patch, PG64-22, Level-4	TONS	50	$ 45.00	$ 2,250
Subtotal				**$ 26,800**
Drainage	%	40%	$ 10,720.00	$ 10,720
Utilities	%	30%	$ 8,040.00	$ 8,040
Subtotal				**$ 45,560**
Maintenance of Traffic	%	15%	$ 6,834.00	$ 6,834
Signing	%	10%	$ 4,556.00	$ 4,556
Pavement Markings	%	5%	$ 2,278.00	$ 2,278
Design	%	15%	$ 6,834.00	$ 6,834
Construction Stakeout	%	2%	$ 911.20	$ 911
Mobilization	%	10%	$ 4,556.00	$ 4,556
Construction Engineering	%	15%	$ 6,834.00	$ 6,834
Subtotal				**$ 78,363**
Contingency	%	45%	$ 20,502.00	$ 20,502
Traffic Signal	LS	1	$ 100,000.00	$ 100,000.00
TOTAL PROJECT COST				**$ 198,865**
ASSUME TOTAL PROJECT COSTS =				**$ 200,000**

Crisfield

Seventh Street was resurfaced and widened in FY 2000; no improvements to the roadway are anticipated should the Seventh Street site be utilized. Tenth Street may require resurfacing. We have assumed that 500 LF of resurfacing would be needed along Tenth Street, at an estimated cost of $80,000. Due to the extent and nature of traffic along West Main Street, we have anticipated that a traffic signal will be needed at the entrance to the ferry terminal, either at 7th Street or at 10th Street. Cost associated with the signal would be around $100,000. The total anticipated cost for these improvements is approximately $180,000. The location of the identified improvements is shown in Figure 5-6. Refer to Table 5-8 for the cost estimate of the improvements.

An old railroad bed leads directly to the 7th Street site (from West Main Street). A road could be placed along the old railroad bed to access the site, however, the costs associated with this have not been determined.

MD 413 (West Main Street) is a Rural Major Collector, with an AADT of 10,325. The amount of traffic generated as a result of the ferry service would not have a large enough impact to warrant modifications to this section of roadway.

Water, sanitary sewer and electricity currently serve the representative areas for the Crisfield site, we do not anticipate upgrades to the infrastructure of these existing utilities will be needed to provide service to the ferry terminal.

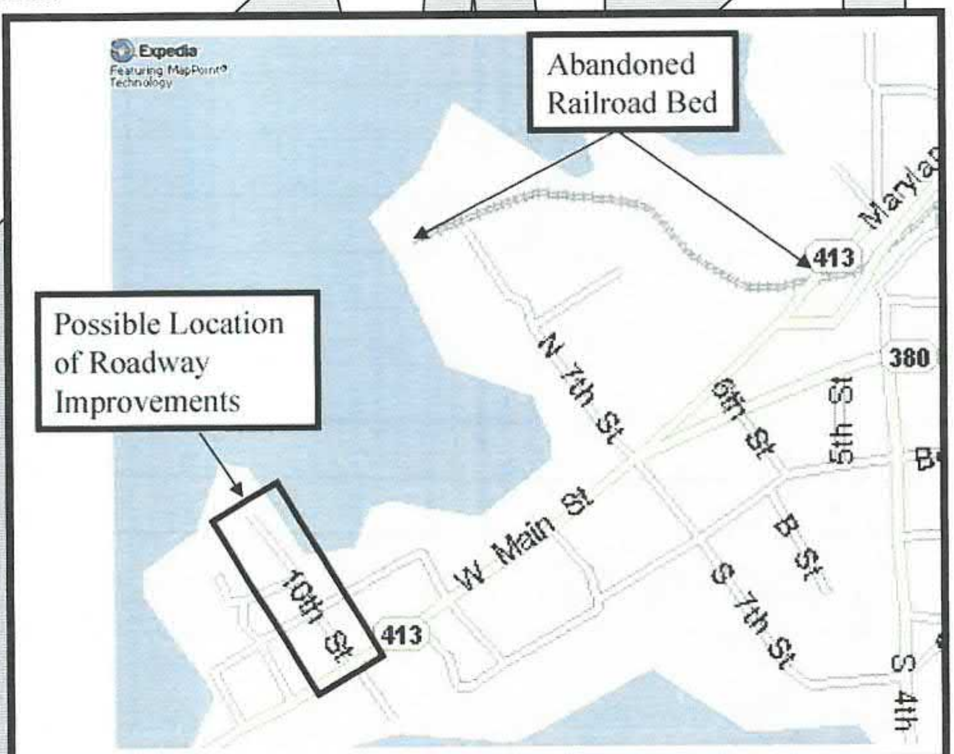


Figure 5-6: Crisfield Possible Road Upgrades

Table 5-8: Crisfield Cost Estimate for Off Site Improvements

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
Grinding Hot Mix Asphalt Pavement 0 Inch to 2 Inches	SY	1,700	$ 5.00	$ 8,500
Hot Mix Asphalt Superpave 12.5mm for Surface, PG76-22, Level-3	TONS	190	$ 70.00	$ 13,300
Subtotal				**$ 21,800**
Drainage	%	40%	$ 8,720.00	$ 8,720
Utilities	%	30%	$ 6,540.00	$ 6,540
Subtotal				**$ 37,060**
Maintenance of Traffic	%	15%	$ 5,559.00	$ 5,559
Signing	%	10%	$ 3,706.00	$ 3,706
Pavement Markings	%	5%	$ 1,853.00	$ 1,853
Design	%	15%	$ 5,559.00	$ 5,559
Construction Stakeout	%	2%	$ 741.20	$ 741
Mobilization	%	10%	$ 3,706.00	$ 3,706
Construction Engineering	%	15%	$ 5,559.00	$ 5,559
Subtotal				**$ 63,743**
Contingency	%	45%	$ 16,677.00	$ 16,677
Traffic Signal	LS	1	$ 100,000.00	$ 100,000.00
TOTAL PROJECT COST				**$ 180,420**
ASSUME TOTAL PROJECT COSTS =				**$ 185,000**

Step 6 – Potential Ridership

Objective: Prepare estimates of potential ridership on demonstration ferry routes.

Outcome: To develop a set of ridership estimates by passengers, autos and trucks for each of the four Demonstration Pairs that correspond to the proposed operations concept for each route.

Method: Using an extensive survey of vehicles prepared by the Maryland Transportation Authority based on the Chesapeake Bay Bridge, a traffic diversion model that estimated the percent of drivers taking the ferry or using the Bay Bridge based on a comparison of travel time and out-of-pocket costs was developed. The model was applied to the 2001 Bay Bridge traffic volumes to develop operating scenarios for each route, and the final results were refined based on specific vessel and operating characteristics.

KEY ELEMENTS OF POTENTIAL RIDERSHIP

Ferry service across Maryland's Chesapeake Bay for vehicles and passengers could attract users from several readily identifiable travel markets which currently use the Bay Bridge or other land routes to make their trip. In addition, there may be new travel markets induced by ferry service that do not currently exist, such as day-trip foot passengers to tourist destinations like Cambridge or Crisfield on the Eastern Shore. The key questions are: How large are these markets? How likely are they to be attracted to a ferry? The answers to these questions feed into the financial question: How much revenue can be generated from each market relative to the total cost of the service and the incremental cost of serving that particular market?

In areas like the Chesapeake Bay, ferries can take advantage of the relatively short travel distances (compared to the drive-around alternative) across uncongested waterways to connect a multitude of *potential* origins and destinations. The key is to identify those travel patterns having sufficient demand to make the service worthwhile. If ferry service does not offer time and user cost advantages to driving around via the Bay Bridge, it will not be economically viable.

PREVIOUS CHESAPEAKE BAY FERRY STUDIES

There have been two preliminary feasibility studies of cross-Bay ferry service in recent years which included forecasts of potential ridership. These were:

Crisfield – Point Lookout Ferry Feasibility Study, Phase I: Need and Patronage Assessment; Parsons Brinckerhoff Quade & Douglass, Baltimore, MD; September 29, 2000.

Mid-Chesapeake Bay Ferry Feasibility Study: Phase I, KJS Associates, Inc., Vanasse Hangen Brustlin, Inc., and FXM Associates, Bellevue, WA; 2000. *Phase II*, Vanasse Hangen Brustlin, Inc., PB Consult, Inc. and FXM Associates, Glen Allen, VA; 2001.

Since these earlier studies address similar market areas and ferry services, their results provide a reasonable indication of expected ridership for the routes included in this study.

Crisfield – Point Lookout Ferry Feasibility Study

This MDOT study looked specifically at commuter, business-related and tourist travel patterns between Southern Maryland and the Lower Eastern Shore. An important aspect of that study was the attempt to connect areas of high unemployment or underemployment in the Lower Eastern Shore with job opportunities in Southern Maryland, as well as providing an incentive for Southern Maryland businesses to expand across the Bay in currently underserved areas. In addition, it was expected that the service would stimulate additional tourist travel through both areas and provide an economic benefit to the tourist markets in each area.

The results of that study indicated that there was a potential for 143,000 to 228,000 annual trips for a ferry service between Crisfield and Point Lookout with the vast majority (80 to 90 percent) of these trips being made by tourists. [1]

Mid-Chesapeake Bay Ferry Feasibility Study

This study was conducted for the Northern Neck Planning District Commission and the Virginia Department of Transportation. It examined the potential for a vehicle ferry service between Reedville, VA, and several potential destinations along the Eastern Shore of Virginia. As with the study above, the principal reasons for the ferry route was to provide an economic stimulus to Virginia counties on both sides of the Bay, and to re-establish historical connections between fishing communities.

The Mid-Bay study looked at potential ridership from four markets: commercial trucks, tourists, residents and work-related (not commuter) travel, and through traffic diverted from I-95 or the Chesapeake Bay Bridge Tunnel. Using a service plan with two 50 to 70 car boats at 16 to 18 knots, the route was estimated to generate 200,000 to 250,000 vehicles per year between Reedville and Virginia's Eastern Shore. [2] That study also forecasted vehicle trips between Reedville and Crisfield, Maryland using their previous study. [3] Using the private operator's proposed fares of $100 for trucks and $35 per car plus $10 per person, the forecast for Crisfield to Reedville was 30,000 to 40,000 vehicles per year.

FORECASTING APPROACH

A two-step process was used to produce the forecasts of potential ferry users for this expanded study of cross-Bay ferry routes. The first step was to estimate the likely diversion of existing travelers from the Bay Bridge to each ferry route based on optimistic assumptions of ferry operations. This initial estimate was used to develop a realistic operations plan for each potential route, and those assumptions were then used to refine the forecasts based on specific traveler markets served by that route.

The principal source for information on the existing cross-Bay travel market was a 2001 survey of eastbound drivers on the Bay Bridge. The results of this survey are discussed below, followed by a description of the diversion model used for the initial forecasts, and an explanation of the markets served by a cross-Bay ferry route.

Bay Bridge Data

The William Preston Lane Jr. Memorial Bridge ("The Bay Bridge") connects the Eastern and Western shores of Maryland's Chesapeake Bay region. It is a toll bridge operated by the Maryland Transportation Authority (MdTA). Tolls are collected only in the eastbound direction. Cash tolls are $2.50 for two-axle

[1] *Crisfield-Point Lookout Ferry Feasibility Study, Phase 1:* Table 3.1, Need and Patronage; Sept. 2000; p. 32.
[2] *Mid-Chesapeake Bay Ferry Feasibility Study: Phase II*; Table 3-12 Patronage Analysis; June 2001, p. 84.
[3] *Mid-Chesapeake Bay Ferry Feasibility Study: Phase II*; Table 3-12 Patronage Analysis; June 2001, p. 84.

vehicles and up to $12.50 for vehicles with six or more axles (including vehicle-trailer combinations with a total of six or more axles).

Monthly eastbound traffic volumes on the Bay Bridge during 2001 are listed in Table 6-1. In total, the Bay Bridge carried about 24 million vehicles across the Chesapeake Bay in 2001. The monthly variations are typically seasonal in nature with July and August volumes being about one-and-a-half times the January and February months. Traffic volume across the Bay Bridge tends to be heaviest on Fridays and Saturdays across all months and highest in June and July. Volumes during peak days in the winter months (Friday & Saturdays) were similar to summer volumes on off-peak days (Mondays & Tuesdays).

Table 6-1. 2001 Bay Bridge Traffic by Month (eastbound-only)

Month	Autos	Trucks	Totals	Percent of Annual
Jan	708,156	75,849	784,005	6.5%
Feb	686,348	71,839	758,187	6.3%
Mar	806,022	86,731	892,753	7.4%
Apr	884,259	91,225	975,484	8.1%
May	968,679	100,898	1,069,577	8.9%
Jun	1,096,346	96,143	1,192,489	9.9%
Jul	1,174,611	98,231	1,272,842	10.5%
Aug	1,180,790	95,743	1,276,533	10.6%
Sep	958,732	85,315	1,044,047	8.7%
Oct	912,406	92,326	1,004,732	8.3%
Nov	862,336	78,995	941,331	7.8%
Dec	788,339	67,250	855,589	7.1%
Total			**12,067,570**	**100.0%**

In 2001, origin-destination surveys were conducted at the Bay Bridge and at the Governor Harry W. Nice Bridge[4] (located along US301 over the Potomac River in Charles County, MD.) Surveys were taken on August 11 and 18, 2001 (both Saturdays) for weekend trip patterns, and on October 17, 2001 (Wednesday) for weekday trip patterns. A total of 9,252 usable survey records were obtained for the Bay Bridge, and coded into an Excel® spreadsheet database. After removing address-specific information for privacy reasons, these records were made available for this study.

The key items used for the ferry forecasting model were: beginning zone, ending zone, trip purpose and weekday or weekend. Table 6-2 summarizes the survey trip records by purpose. The majority of weekday trips were work related (53%), while recreation trips were the majority (53%) of the weekend trips. A significant portion of both weekday (17%) and weekend (28%) trips were home-based other trips which includes medical-dental, visit friends and relatives, and personal business trips.

The survey records were coded by Parsons Transportation Group (PTG) into geographic subareas known as traffic analysis zones. PTG designated 80 zones on the west side of the bridge and about 60 zones on the east side (including Delaware, New Jersey, Virginia's Eastern Shore and other areas outside

[4] *Origin-Destination Study at the Governor Harry W. Nice Bridge*, Parsons Transportation Group, Oct. 2001.

Maryland). These designations were compressed into 70 west side and 50 east side zones for this analysis. The result was a 70 by 50 matrix of trips (origin and destination) using the Bay Bridge.

The result of the Bay Bridge origin-destination survey was a comprehensive picture of daily and weekend travel patterns across the Chesapeake Bay in Maryland. These travel patterns constitute the potential market for cross-Bay ferry service as an alternate to the Bridge route. Refer to Table 6-2 below.

Table 6-2. Bay Bridge Survey Trips by Purpose

Purpose	Weekday	Percent	Weekend	Percent	Total	Percent
Home Based Work-related	1,771	53%	469	8%	2,240	24%
Home Based School	78	2%	65	1%	143	2%
Home Based Other	581	17%	1,651	28%	2,232	24%
Home Based Shop/rest	196	6%	334	6%	530	6%
Home Based Rec. / Tourist	379	11%	3,135	53%	3,514	38%
Home Based Hotel	48	1%	83	1%	131	1%
Total Home Based Trips	**3,053**	**92%**	**5,737**	**97%**	**8,790**	**95%**
Non Home Based	280	8%	182	3%	462	5%
Total All Records	**3,333**	**100%**	**5,919**	**100%**	**9,252**	**100%**

PROCESS

The ferry ridership forecasts were derived from the 2001 Bay Bridge survey using a traffic diversion model based on a comparison of travel time and travel cost between the existing Bay Bridge and the proposed ferry route. The Bay Bridge route travel times were computed using the *Street Atlas 2003®* software discussed above, plus an allowance for excess delays caused by congestion on the Bay Bridge and its approaches. Ferry travel times included over-the-road times to and from the ferry terminals, the computed ferry crossing time and an allowance for waiting time at the outbound terminal. These initial demand levels were used to develop specific service plans for each route, and the results recycled to refine the forecasts.

Diversion Model

A binomial logit model was used to calculate the likelihood of choosing a ferry or the Bay Bridge for the various origins and destinations recorded in the 2001 Bridge survey. The logit model is a standard tool in travel demand forecasting and it is most often used in its more general form, the multinomial logit model, to predict the traveler's choice of mode among several possibilities such as drive alone, carpool, bus, rail, etc. The binomial logit formulation for two choices, C_1 and C_2, is given by:

$$P(C_1) = 1 / [1 + \exp(-(U_1 - U_2))]$$

where

$P(C_1)$ = probability of Choice 1

U_1, U_2 = "Utility" values associated with Choices 1 and 2, respectively

exp = exponential function, e^x

In our model, the two choices are between the ferry and the Bay Bridge. The "utility values" are functions of the total point-to-point travel times by ferry and by the Bridge, the ferry fare and the Bridge toll. The ferry fare and Bridge toll are converted to equivalent time increments using an assumed value of travel time for the traveler.

A series of Excel® spreadsheets were constructed to implement the binomial logit model for each of the four demonstration routes. For each potential ferry route, the spreadsheet model takes input data and assumptions like origin – destination travel times by ferry and by Bay Bridge, ferry fare, Bridge toll, congestion delay, etc.; and calculates logit percentages for origin-destination pairs by trip purpose (work-related, tourist/recreation, all other); applies the percentages to the expanded survey records within each ferry route's market shed for weekday and weekend day, and for autos and trucks, separately; and sums the potential trips for that route. Separate model runs were made for conventional and high-speed ferry scenarios on each route.

Relative values of travel times and costs

One of the most difficult aspects in modeling transportation choices is determining how travelers view the trade-offs between travel time and travel cost, and among the various components of both time and cost. Extensive research studies in these subjects have produced many numerous statistics on specific examples but little consensus on "standard" or "generally acceptable" values for key parameters. These parameters include a monetary value of time which is used to convert out-of-pocket tolls (such as the $2.50 toll charged on the Bay Bridge) to an equivalent travel time value, and the relative perceived value of time spent in stop-and-go driving on a congested roadway versus time driving over uncongested alternate routes or as a passenger in an alternate mode like a bus or even a ferry.

For example, the estimated values of *travel time savings*, i.e., the incremental amount consumers would be willing to pay to shorten their journey by taking a new route or modal alternative, range from 25 to 100 percent of prevailing wage rates in a number of studies. This is a particularly important consideration in evaluating new toll facilities. However, some travel time has a very low cost or even a positive value (i.e., consumers are willing to pay more even though the route or mode takes longer than the baseline alternate) because people enjoy the experience. There is also a significant difference between how consumers value the daily commuter-to-work travel time versus time spent in longer distance recreation travel.

In addition, travelers often consider time and cost factors differently for different types of trips. For example, home-to-work commuters are typically very concerned about the times and costs of various alternate routes and modes because they make this trip frequently (daily, in most cases) and they want to minimize their total time and cost expenditures. On the other hand, tourists may be more attracted to a pleasant travel experience on a ferry with less concern about travel time than would be business travelers and commercial truckers. Vacationers from Northern Virginia going to Ocean City beaches in the summer would be more likely to take a cross-Bay ferry as part of their recreation experience than a Salisbury resident driving to the Washington, DC area on personal business on a weekday morning in October. Therefore, specific time and cost factors were used in the model to reflect these differences.

For purposes of this study, the assumptions shown in Table 6-3 were made about the economic values of travel times and costs related to a traveler's choice between using the Bay Bridge or a ferry.

Table 6-3. Time and Cost Adjustment Factors

Category	Value	Description	Explanation
Dollar value of time	**$17.67 per hour**	Used to convert bridge toll and ferry fare in dollars to travel time in minutes	100% of prevailing hourly wage rate. Source: U.S. Department of Labor, Bureau of Labor Statistics, Occupational Employment Statistics, 2001 Mean Hourly Wage for All Occupations; www.bls.gov/oes/2001/oes_md.htm#b00-0000.
Congestion delay time	**X 1.1**	Used to factor excess bridge delays	Travelers perceive excess delays due to congestion on the Bay Bridge as more onerous than normal travel conditions
Ferry travel time	**X 0.8**	Used to factor time spent on the ferry	Ferry users perceive travel on the boat as a positive experience and the ferry time was discounted by 20% in comparison to driving for an equivalent time on a highway
Ferry fare and bridge toll cost factor	**X 2.0**	Used to factor out-of-pocket costs	Travelers tend to value out-of-pocket expenditures like fares and toll higher than indirect expenses like wear-and-tear on their vehicle.

Data Inputs

This section describes the various input data that were used in the diversion model.

Trip Data

The estimates assumed that all potential ferry trips would be diverted from existing trips using the Bay Bridge, and that the 2001 survey of Bridge users was a representative sample of the travel patterns and trip purposes of those users. To simplify the analysis, we also assumed that each eastbound trip in the survey was one half of a round trip, and that there was a complementary westbound trip for each eastbound trip. The survey trips were expanded to total trips based on 7.87 vehicles per weekday survey and 7.60 weekend vehicles per survey. In addition, the vehicle trips were factored using the monthly variations reported in Table 6-1 to obtain estimates of demand for summer, shoulder and winter seasons. Thus, a combination of the survey records and actual traffic counts was used.

Highway travel times

The attractiveness for a new ferry service depends largely on providing shorter travel times between the user's origin and designation in comparison to existing overland routes. Although some users will want to take the ferry just for the lure of the ride itself, the majority will look first at trade-offs in time and costs between the ferry and the Bay Bridge (or other routes). In order to provide a basis for estimating those tradeoffs, travel times were computed for each of the survey trips via the Bridge and via an alternate route using each proposed ferry.

The first step in computing travel times was to assign specific points of origin and destination for each of the trips based on the coded traffic analysis zone (TAZ). In order to limit the origins and destinations to a manageable number for computing, the most frequently reported city/town in each zone was designated as the start or end of all trips from/to that zone.

For zones outside Maryland and adjoining states, a logical point on the paths of these trips was chosen to represent an "entry/exit" point for such trips. For example, trips on the Bay Bridge to New York and New England states were assumed to pass through Wilmington, DE, on I-95; similarly, trips from southern states were assigned to I-95 in Emporia, VA, as their "entry point" to the Chesapeake Bay

Market. At each of these entry points, travelers would have a choice of north-south routes which included: (1) continuing through on I-95, (2) diverting to US 13/301 to the Bay Bridge, (3) diverting to US 13 to the Chesapeake Bay Bridge Tunnel, and (4) using various routes to reach a cross-Bay ferry terminal.

Specific travel times were computed using a commercial travel planning software program, *Street Atlas 2003 USA®* by DeLorme of Yarmouth, MA. Initial travel time estimates were computed automatically by the program using default speeds by roadway type. Table 6-4 shows the default speeds used in the initial calculations; the "toll road" speed was specifically changed to reflect the average travel speed across the Bay Bridge. These are average speeds under typical though not overly congested conditions, and include brief delays at traffic signals on non-freeway facilities. These initial travel times were then modified to account for congestion delays on the Bay Bridge in forecasting potential ferry ridership.

Table 6-4. *Street Atlas 2003®* Default Travel Speeds

Roadway Type	Average Speed, MPH
Freeway	55
Toll Road*	45*
Major Arterial	50
Minor Arterial	45
Other State Highway	45
Collector Road	35
Local Road	25

*Default value adjusted for Bay Bridge.

Ferry Service Scenarios

Forecasts of potential ridership were developed for four demonstration ferry routes across the Bay:

- Canton (Baltimore) – Rock Hall
- Chesapeake Beach – Cambridge
- Solomons Island – Cambridge
- Solomons Island - Crisfield

The specific characteristics of each route are discussed in Task 7: Navigation Issues. For the purpose of the patronage forecasting, some basic operating parameters were assumed as shown in Table 6-5. The principal factors influencing ridership potential were crossing time (related to route length and vessel speed) and fare. For the estimates, it was assumed that a ferry service operated about 18 hours daily in the summer (less in the winter), had a crossing time that allowed headways of no more than about 2 hours between sailings, and charged a fare of $25 (low speed ferry) or $37.50 (high-speed ferry) each way for car and driver (passengers were assumed to be free). Commercial truck fares were assumed to be $75 for a conventional ferry and $112.50 each way for the high-speed ferry. Fares were based on those used in the previous cross-Bay studies and were similar to those charged on the Cape May – Lewes Ferry.

Table 6-5. Ferry Service Assumptions

Route	Distance, nautical miles	Crossing time at 22 knots	Crossing time at 41 knots
Baltimore (Canton) - Rock Hall	22.3	100 minutes	87 minutes
Chesapeake Beach - Cambridge	26.9	82 minutes	55 minutes
Solomons Island - Cambridge	39.9	120 minutes	117 minutes
Solomons Island - Crisfield	43.7	145 minutes	79 minutes
Auto Fare – Conventional Ferry	$25.00	**Auto Fare – High-speed Ferry**	$37.50
Truck Fare – Conventional Ferry	$75.00	**Truck Fare – High-speed Ferry**	$112.50
Ferry Operating Hours	18 hours in summer, 16 hours in shoulder and 12 hours in off-season	**Ferry Capacity**	54 to 75 autos up to 10 trucks

RESULTS

The demand forecasts for each of the four demonstration routes are presented in Tables 6-6 through 6-9. For each route, the table shows the range of daily ferry traffic demand by auto and truck vehicle types for weekday and weekend day for summer, shoulder and off-season months. Summer season months are June, July and August; shoulder season months consist of May, September and October; the winter off-season would run from November through the following April.

The weekend demand volumes are significantly higher than the weekday volumes for each of the routes. This difference is consistent with both the recreational nature of the trip attractions on the Eastern Shore of Maryland and the substantially longer delays to traffic observed on the Bay Bridge.

Table 6-6: Canton – Rock Hall Demonstration Route Demand

22 knot Conventional Ferry

	Weekday		Weekend		Annual*
Auto	**Low**	**High**	**Low**	**High**	
Summer	80	110	140	160	
Shoulder	70	90	110	130	
Off-Season	60	80	80	110	**31,000**
Truck	**Low**	**High**	**Low**	**High**	
Summer	15	20	5**	5**	
Shoulder	10	15	5**	5**	
Off-Season	10	15	5**	5**	**3,100**
Total Annual Vehicle Demand*					**34,100**

41 knot High Speed Ferry

	Weekday		Weekend		Annual*
Auto	**Low**	**High**	**Low**	**High**	
Summer	30	50	40	60	
Shoulder	25	40	30	50	
Off-Season	20	40	25	40	**10,000**
Truck	**Low**	**High**	**Low**	**High**	
Summer	5**	5**	5**	5**	
Shoulder	5**	5**	5**	5**	
Off-Season	5**	5**	5**	5**	**900**
Total Annual Vehicle Demand*					**10,900**

Note: Weekday = Monday, Tuesday, Wednesday & Thursday;
Weekend = Friday, Saturday & Sunday
*Assumes sufficient capacity provided to handle demand year-round.
** = Estimated dmand not significantly diferent from zero (0.0).

Table 6-7: Chesapeake Beach to Cambridge

22 knot Conventional Ferry

	Weekend		Weekday		Annual*
Auto	**Low**	**High**	**Low**	**High**	
Summer	450	550	2,500	2,700	
Shoulder	400	450	2,000	2,300	
Off-Season	350	400	1,500	2,000	**305,000**
Truck	**Low**	**High**	**Low**	**High**	
Summer	125	150	75	100	
Shoulder	100	125	40	60	
Off-Season	90	120	40	60	**30,000**
Total Annual Vehicle Demand*					**335,000**

41 knot High Speed Ferry

	Weekend		Weekday		Annual*
Auto	**Low**	**High**	**Low**	**High**	
Summer	250	300	900	1,000	
Shoulder	180	220	700	800	
Off-Season	160	200	600	700	**124,000**
Truck	**Low**	**High**	**Low**	**High**	
Summer	50	80	20	40	
Shoulder	40	70	15	30	
Off-Season	40	60	10	25	**12,000**
Total Annual Vehicle Demand*					**136,000**

Note: Weekday = Monday, Tuesday, Wednesday & Thursday;
Weekend = Friday, Saturday & Sunday
*Assumes sufficient capacity provided to handle demand year-round.

Table 6-8: Solomons Island to Cambridge

22 knot Conventional Ferry

	Weekday		Weekend		Annual*
Auto	**Low**	**High**	**Low**	**High**	
Summer	100	125	900	1,000	
Shoulder	80	100	800	900	
Off-Season	70	90	600	700	**95,000**
Truck	**Low**	**High**	**Low**	**High**	
Summer	80	100	40	50	
Shoulder	70	80	30	40	
Off-Season	60	70	30	40	**21,000**
Total Annual Vehicle Demand*					**116,000**

41 knot High Speed Ferry

	Weekday		Weekend		Annual*
Auto	**Low**	**High**	**Low**	**High**	
Summer	40	60	400	500	
Shoulder	30	50	300	400	
Off-Season	30	50	250	300	**39,000**
Truck	**Low**	**High**	**Low**	**High**	
Summer	50	60	20	30	
Shoulder	40	50	15	25	
Off-Season	30	40	10	20	**11,000**
Total Annual Vehicle Demand*					**50,000**

Note: Weekday = Monday, Tuesday, Wednesday & Thursday;
Weekend = Friday, Saturday & Sunday
*Assumes sufficient capacity provided to handle demand year-round.

Table 6-9: Solomons Island to Crisfield

22 knot Conventional Ferry

	Weekday		Weekend		Annual*
Auto	**Low**	**High**	**Low**	**High**	
Summer	40	60	120	200	
Shoulder	30	50	100	150	
Off-Season	20	40	80	120	**21,000**
Truck	**Low**	**High**	**Low**	**High**	
Summer	10	20	10	10	
Shoulder	10	20	10	10	
Off-Season	10	20	10	10	**3,800**
Total Annual Vehicle Demand*					**24,800**

41 knot High Speed Ferry

	Weekday		Weekend		Annual*
Auto	**Low**	**High**	**Low**	**High**	
Summer	5**	10	60	100	
Shoulder	5**	10	50	90	
Off-Season	5**	10	40	70	**7,500**
Truck	**Low**	**High**	**Low**	**High**	
Summer	5**	10	5**	10	
Shoulder	5**	10	5**	10	
Off-Season	5**	10	5**	10	**1,700**
Total Annual Vehicle Demand*					**9,200**

Note: Weekday = Monday, Tuesday, Wednesday & Thursday;
Weekend = Friday, Saturday & Sunday
*Assumes sufficient capacity provided to handle demand year-round.
** = Estimated dmand not significantly diferent from zero (0.0).

Comparison of Route Demands

Table 6-10 summarizes the estimated annual vehicle demand by demonstration ferry route. The Chesapeake Beach – Cambridge demonstration route would have the highest potential demand, followed by the Solomons Island – Cambridge route. The greater attractiveness of these routes is due to their accessibility to both the Washington, D.C. metro area on the west side of the Bay, and to the major recreation attractions on the Eastern Shore. In addition to being a major recreation destination itself, Cambridge is located on a direct route to Ocean City and nearby beaches which are the primary attraction of recreational trips to the Eastern Shore. This high accessibility enables them to tap into a larger recreational travel market than the Canton – Rock Hall or Solomons Island – Crisfield routes.

Table 6-10 also demonstrates that potential users are not willing to pay higher fares for high-speed ferry service, and the high-speed scenarios yielded ridership less than half that of that conventional ferries on each of the four routes. This is largely because the increased speed capability is offset by the significant distances on each route that have low speed restrictions due to no wake zones, shallow waters and other conflicts discussed in Task 7: Navigation Issues.

Figure 6-1 illustrates the relative ridership potentials for each of the four demonstration routes.

Table 6-10: Annual Ridership Estimates by Ferry Demonstration Route

Route	Ferry type	Passenger vehicles	Commercial trucks	Total vehicles
Canton (Baltimore) to Rock Hall	Conventional High-speed	31,000 10,000	3,100 900	34,100 10,900
Chesapeake Beach to Cambridge	Conventional High-speed	305,000 124,000	30,000 12,000	335,000 136,000
Solomons Island to Cambridge	Conventional High-speed	95,000 39,000	21,000 11,000	116,000 50,000
Solomons Island to Crisfield	Conventional High-speed	21,000 7,500	3,800 1,700	24,800 9,200

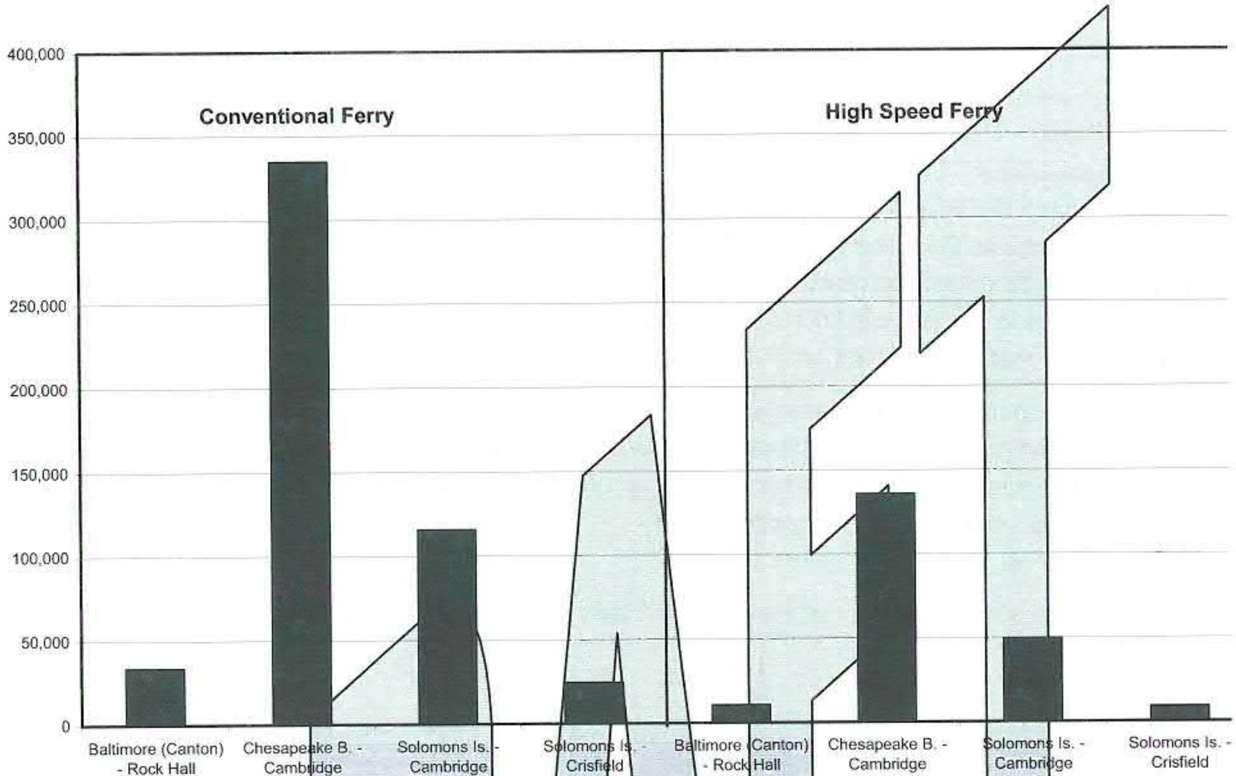


Figure 6-1. Annual Ridership by Ferry Route

Step 7 – Navigation Issues

Objective: Evaluate navigation issues for the crossing alternatives, including effects of tide and local currents, water depth, wave conditions for seasonal norms and storm conditions, fog, other maritime traffic and available aids to navigation.

Outcome: The output of this task is a tabulation of possible "navigation issues" for each of the four demonstration pairings. The results would include detailed descriptions, mapping, evaluations of, and an analysis of the restrictions and requirements along each of the routes.

Method: Nautical charts of the Chesapeake Bay, knowledge of the areas and COMAR speed restrictions were utilized to develop the routes. Interviews and sight visits were conducted, overall conditions of the Chesapeake Bay relative to ferry vessel operations were considered, and each terminus was visited to determine the overall suitability for ferry access. Water depths and navigational hazards were identified along the extension of each route utilizing charts and interviews with regional Coast Guard and local watermen.

ROUTE DEVELOPMENT AND EVALUATION PROCESS

The demonstration ferry routes would incorporate a passenger/vehicle capability that provides market opportunities for tractor-trailer combinations and buses as well as the expected passenger automobiles.

The evaluation described in this task focuses on the waterside navigational elements of the proposed ferry routes. Consideration of land side access and support infrastructure is described in Task 4: Site Feasibility and Task 5: Supporting Transportation Network. In conducting this evaluation, the following assumptions are made:

- For the purposes of analyzing navigation, piloting and maneuvering for each route, the ferry may be a traditional displacement ferry or a high-speed, catamaran ferry.
- The ferry would be of adequate size to accommodate 54 automobiles or a combination of up to 6 standard size, over-the-road trailer trucks on two centerline lanes and 36 automobiles in two outboard lanes.
- The ferry's draft would be no more than 8 feet at low speeds; however the vessel may draw up to 15 feet at higher speeds due to the "squat" effect.
- A catamaran ferry would be capable of a cruising speed of up to 40 to 41 knots.
- A conventional displacement monohull ferry would be capable of a cruising speed of 18 to 22 knots.
- Potentially insufficient water depths in the Chesapeake Bay portions of the routes (i.e. charted shoals, bars, and obstructions) would normally be avoided to minimize dredging needs.

A relatively conservative approach was used to determine the approximate route centerlines to minimize navigational risks based on the available information. The final actual routes used in vessel operations may involve a higher degree of risk or navigational difficulty based on the operator's judgment. The following navigation charts were used in analysis: (12230) Chesapeake Bay – Smith Point to Cove Point, (12231) Chesapeake Bay – Tangier Sound – Northern Part, (12264) Chesapeake Bay – Patuxent River and Vicinity, (12266) Chesapeake Bay – Choptank River and Herring Bay, (12272) Chester River, (12278) Chesapeake Bay – Approaches to Baltimore Harbor, (12281) Baltimore Harbor, and (12284) Patuxent River – Solomons Island and Vicinity.

Each proposed route was laid out by hand on standard NOAA navigation charts giving due consideration to typical navigation issues such as :

- aids to navigation
- water depths
- obstructions
- expected marine traffic
- vessel speed
- vessel maneuvering characteristics
- vessel physical characteristics
- restricted areas
- regulated navigation areas

Criteria

After developing the routes for each of the pairs and utilizing the assumptions described above, the routes were analyzed based upon the following criteria:

1. Tidal Range

The tidal range influences the configuration of ingress and egress accommodations at each end of the route. A large tidal range may require more sophisticated and costly loading procedures and equipment. Each route was evaluated on the predicted value of the tidal ranges at each of the sites.

- Tidal range over 5 feet
- Tidal range between 4 feet and 5 feet
- Tidal range between 2 and 4 feet
- Tidal range between 1 feet and 2 feet
- Tidal range < 1 feet

2. Current Velocity

Current velocity affects vessel speed through the water, fuel consumption, total travel time, and maneuverability (particularly at the terminals where vessel speeds are low). Current velocities were broken down into the following categories:

- Current velocity over 3 knots
- Current velocity between 1.5 and 3 knots
- Current velocity between 0 and 1.5 knots

3. Water Depth

Besides directly impeding vessel transits (as in a charted shoal), low water depths may increase the risk of grounding, decrease the prudent vessel speed, and influence the point where the vessel can accelerate/decelerate to/from cruising speed due to the squat phenomenon. The water depths for each of the routes were evaluated based on the percentage of a route outside of the main Bay channel where low water depths are a hazard given the assumptions.

- Water depth creates navigational hazards over 100% of the route outside of the main Chesapeake Bay channel

- Water depth creates navigational hazards over 75% of the route outside of the main Chesapeake Bay channel
- Water depth creates navigational hazards over 50% of the route outside of the main Chesapeake Bay channel
- Water depth creates navigational hazards over 25% of the route outside of the main Chesapeake Bay channel
- Water depth creates no hazard to navigation on the route

4. *Waves*

Wave height is a measure of the sheltered nature of a route. Significant wave heights affect the vessel ride, the travel time, fuel consumption, and speed. High waves also increase the potential for personnel injuries and equipment failures. Large swells are usually the result of sustained wind direction and fetch. The prevailing winds on the Chesapeake Bay are from the southwest during the period covering May through September and from the north for most of the rest of the year. The United States Coast Pilot predicts wave heights exceeding 9 feet less than 1% of the time. However, even 4-foot waves can impact vessel operations. Therefore, the most significant waves are probably those due to a northerly wind blowing down the Bay. Routes have been assessed based on the percentage of the route than the vessel would be subjected to waves.

- Waves encountered along 100% of the route
- Waves encountered along 60%-80% of the route
- Waves encountered along 40%-60% of the route
- Waves encountered along 20% – 40% of the route
- Waves encountered along 0 – 20% of the route

5. *Travel Time*

Travel time is dependent on total route length and the combination of cruising, piloting, and docking speeds. For example, a short route may require more travel time than a longer route if a significant portion of the route can not be transited at cruising speed due to the proximity of shallow waters or mandated speed/wake restrictions. Travel times for each route were developed for four different types of vessels. We have estimated the travel times for a high-speed catamaran with an average speed of 35 knots, a high-speed catamaran with an average speed of 41 knots, a conventional displacement monohull vessel with an average speed of 16 knots, and a conventional displacement monohull vessel with an average speed of 22 knots. A detailed discussion of the recommended vessels will be provided in Task 8: Develop Conceptual Ferry System Recommendations.

6. *Marine Traffic*

Marine traffic along a route raises the risk of collision and can increase the travel time if the ferry must slow to allow vessels the right of way in a crossing situation or to accommodate regattas, fishing tournaments, and other pleasure craft activities. The U.S. Coast Guard Activities Baltimore Station reports that the Port of Baltimore receives approximately 150 oceangoing vessel arrivals per month and that, on a typical day, 8 to 10 oceangoing vessels are underway inbound or outbound on the Chesapeake Bay. The Coast Guard also reports that most of the larger commercial vessels arrive and depart at night to ensure a full day of cargo operations.

As commercial vessels typically steer north/south routes along the Chesapeake Bay, a ferry route that is mainly east/west, minimizing time in the main channel, is less likely to encounter a large commercial vessel in a dangerous situation, than a ferry traveling primarily north/south. In addition to oceangoing vessels, domestic vessels, such as pleasure boats and tugs/barge combinations, routinely transit the Chesapeake Bay both north/south and east/west. As these vessels are not required to give arrival and departure notices and pleasure boat traffic is seasonal, it is very difficult to determine a count, and thereby, the likelihood of encounters.

The Maryland Watermans' Association reports that tug and barge traffic is heaviest in the summer and that, on any given day, more than a dozen tugs with barges are underway on primarily north/south routes, on the Chesapeake Bay. However, recreational boaters, day-sailors, commercial crabbers, recreational fishermen, and charter fishing vessels tend to concentrate around their homeport, particularly at the beginning and end of the day when they are departing and returning to port.

Some of the demonstration routes terminate in an area of relatively heavy vessel traffic, such as Canton, and others terminate in areas of low vessel traffic, such as Cambridge. Since commercial vessels are crewed by professional mariners, they are required to have communications and radar equipment. They are also generally easier to detect than pleasure or charter boats. The most significant hazards of marine traffic are from smaller boats that are operated by less experienced personnel with less sophisticated communications and radar equipment. The hazards and time delays posed by concentrations of boats in regattas and tournaments is somewhat mitigated by Coast Guard requirements to obtain permits, which would be evaluated with consideration for any established ferry route.

The routes have been analyzed based on the direction of the route, the time traveled, and the possibilities of encountering concentrations of marine traffic at either terminus. The following categories were used:

- N/S 0: North/South route with low likelihood of encountering concentrations of vessels at both ends
- N/S 1: North/South route with high likelihood of encountering concentrations of vessels at one end
- N/S 2: North/South route with high likelihood of encountering concentrations of vessels at both ends
- E/W 1: East/West route with high likelihood of encountering concentrations of vessels at one end
- E/W 2: East/West route with low likelihood of encountering concentrations of vessels at both ends

7. *Aids to Navigation*

Aids to navigation include the buoys, lights, bells, and range markers that are set and maintained by the U.S. Coast Guard and some private owners, as well as shoreline features, buildings, spires, and other structures that can be used for steering reference and to establish a vessel's position. Navigation has become a much simpler task with the introduction of reliable, accurate, and cheap Global Positioning System (GPS) receivers, making aids to navigation most important as a verification of the GPS position. Otherwise, aids to navigation are critical when navigating by eye, experience, and familiarity and when primary navigation equipment is inoperative. The helpfulness of aids to navigation depends partly on the size, range, and type of aid. For example, in restricted visibility, some aids are difficult to distinguish by eye or with radar. Additionally, some aids, such as those marking shoals, are more crucial to safe navigation than others, such as those that indicate the main Chesapeake Bay channel. The routes have been analyzed based on the location and characteristics of the traditional aids and the shoreline features that can be detected by eye or radar along the route.

- Limited: Aids to navigation are limited and do not facilitate piloting in critical areas, and would require the placement of additional aids to navigation.
- Somewhat Limited: Aids to navigation facilitate piloting in critical areas, and would require the placement of some additional aids to navigation.
- Somewhat Frequent: Aids to navigation are frequent, but may not facilitate piloting of the particular route; additional placement of aids to navigation may be needed.
- Frequent: Aids to navigation are frequent and facilitate piloting in critical areas, should not require the placement of additional aids to navigation.

8. *Restricted Visibility*

Restricted visibility due to fog or precipitation causes a decrease in vessel speed and increased fuel consumption (caused by longer operating periods at inefficient speeds) and travel time. Restricted visibility also increases the risk of accidents such as groundings and collisions with other vessels and fixed objects. The United States Coast Pilot reports that the occurrence of visibility less than 2 nautical miles on the Chesapeake Bay, varies over the course of the year. Restricted visibility is about half as likely during June, July, and August as the rest of the year. Radar is the most critical piece of navigation equipment in restricted visibility. However, radar has limited ability for detecting shoal areas and flat coastline, compared to its ability to detect marine traffic. For this reason, challenging navigation is considered a greater hazard than marine traffic. The routes have been assessed based on the length of the route, the difficulties in navigating the route, and the likelihood of encountering other vessel traffic.

- Lengthy route, challenging navigation, high likelihood of encountering marine traffic
- Lengthy route, challenging navigation, low likelihood of encountering marine traffic
- Average route, modestly difficult navigation, high likelihood of encountering marine traffic
- Short route, modestly difficult navigation, low likelihood of encountering marine traffic
- Short route, straightforward navigation, low likelihood of encountering marine traffic

ROUTE DESCRIPTIONS

Canton to Rock Hall

The route would begin in the Baltimore Harbor northeast of Fort McHenry. The Canton end of the route is well marked with buoys and other navigational aids. There is sufficient water depth as far as the probable docking area. However, a ferry would have to contend with diverse marine traffic, including pleasure craft and the oceangoing ships inbound and outbound from the numerous marine terminals inside the mouth of the Patapsco River in the Baltimore Harbor.

Leaving Canton, the route would proceed due south to meet the Fort McHenry Channel which extends towards the mouth of the Patapsco River and passes underneath the Francis Scott Key Bridge. The Fort McHenry Channel intersects with the Brewerton Channel, which passes out of the mouth of the Patapsco River and into the Chesapeake Bay in almost a straight line towards Rock Hall. At this point, the route would turn south to navigate around the shallow waters of Swan Point Bar. At a point about 2.5 miles south of Rock Hall, off Eastern Neck, the route would turn north again towards Rock Hall Harbor. The water is barely sufficient for a vessel with an 8-foot draft approaching Rock Hall Harbor and Gratitude Marina. The southern portion of this route has few buoys or shore side structures with which to navigate around the extent of Swan Point Bar. However, the shoreline, though flat is detectable on radar and could serve as a guide to stay in the deeper water.

This area has a long history of ferry service. In the early 1900s, a cargo ferry sailed on a route between Rock Hall and Baltimore. The Rock Hall area is an avid sailing community. Although regattas are not often held, during the sailing season, a steady traffic procession of sailboats departs and enters Rock Hall Harbor and Gratitude Marina.

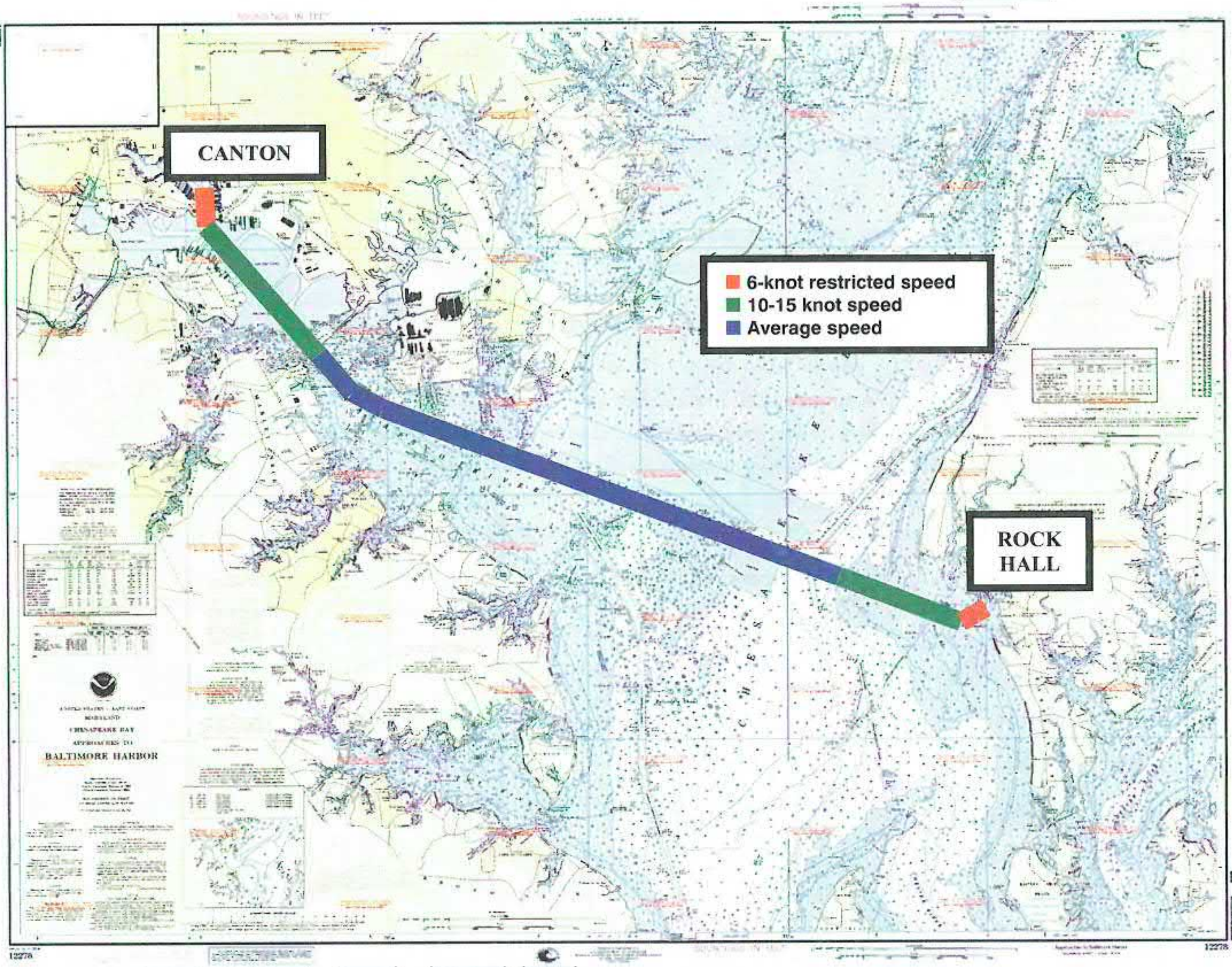


Figure 7-1: Canton to Rock Hall Route

Table 7-1: Canton to Rock Hall Distances

Average Speed	Reduced Speed (16 knots)	Reduced Speed (10 knots)	Restricted Speed (6 knots)	Totals
11.2 nm	0 nm	9.4 nm	1.7 nm	22.3 nm

Table 7-2: Canton to Rock Hall : Water Total Travel Times

Monohull		Catamaran	
Average Speed = 16 knots	Average Speed = 22 knots	Average Speed = 35 knots	Average Speed = 41 knots
111 minutes	100 minutes	90 minutes	87 minutes

- Maximum predicted tidal range – 2.2 ft (Canton)
- Maximum currents – 1.4 Kt ebb/1.5 Kt flood (Rock Hall)

Table 7-3: Canton to Rock Hall Rating Descriptions

Tidal Range	Current Velocity	Water Depth	Wave Height	Travel Time	Marine Traffic	Aids to Navigation	Low Visibility
2-4'	1.5-3 knots	50%	100%	90-111 min.	N/S 0	Frequent	Ave. Route, Mod. Diff., High Marine Traffic

The following is a list of possible restrictions associated with this route:

- Channel depths along the approach to Rock Hall Harbor and within Rock Hall Harbor are restricted to vessels with a draft of less than 8 feet.
- Swan Point Bar is restricted to vessels with a draft of less than 8 feet and fast boats must divert around the Bar.
- Vessels of 200 feet in length would have difficulty maneuvering within the entrance channel and throughout Rock Hall Harbor.

The following is a list of potential issues should ferry service be considered along this route:

- The two-mile section across Swan Point Bar on the Brewerton Range is exposed and the ferry would experience waves with troughs, may require dredging to an acceptable depth and width to maintain a desirable speed throughout this portion of the route. Significant dredging may be required for a high-speed vessel to safely navigate the relatively shallow bar.
- The approach to Rock Hall may require dredging of up to 15 foot depth and 250 foot width for a distance of 3/4 mile; additional dredging may be necessary to create a mooring and turning basin.

Chesapeake Beach to Cambridge

This route would begin just off the seawall at Chesapeake Beach and proceed due east across the Chesapeake Bay towards Tilghman Island. Chesapeake Beach is a small town and is surrounded by very shallow water. There are many sailboats and powerboats moored at Chesapeake Beach, but regattas or other concentrations of boats are rarely held. During the summer, boats typically leave Chesapeake Beach and disperse through the Bay, and return in the evening. The entrance channel to the main marinas is well marked with buoys. However, the bridge at Bayside Road above the entrance to Fishing Creek is 36 feet wide and 10 feet high, and would restrict ferries to the Bay side of the bridge.

The route transits restricted areas "B" and "C" established by the U.S. Coast Guard in Title 33 CFR 334.170 for the Naval Research Laboratory firing range, with its center South of Chesapeake Beach. The regulation states, in part,

> "(2512) (2) No person or vessel shall enter or remain in Area B or Area C between the hours of 1:00 p.m. and 5:00 p.m. daily except Sundays, except that through navigation of commercial craft will be permitted in Area C at all times, but such vessels shall proceed on their normal course and shall not delay their progress."

The Naval Research Laboratory in North Beach, MD reports that the restrictions described in Title 33 CFR remain in effect. However, the Lab also states that, in consideration of frequent vessel traffic, the restrictions are not enforced unless testing is being conducted. During Lab operations, a ferry schedule may need to be adjusted to avoid the restricted area. The portion of the route through the restricted areas has no buoys.

After passing through the restricted area, the route would turn southeast around Tilghman Island to enter the Choptank River. The Choptank River is broad and has good water to Cambridge, about 14 miles upstream. The River narrows between Island Neck and Castle Haven Point, but the channel is well marked with buoys, and the shoreline offers many navigation points, including the U.S. 50 Bridge across the Choptank River to Cambridge. A small ferry currently runs between Cambridge and Oxford, MD, about 11 miles downriver. The Choptank River is heavily used by commercial crabbers, particularly during the summer.

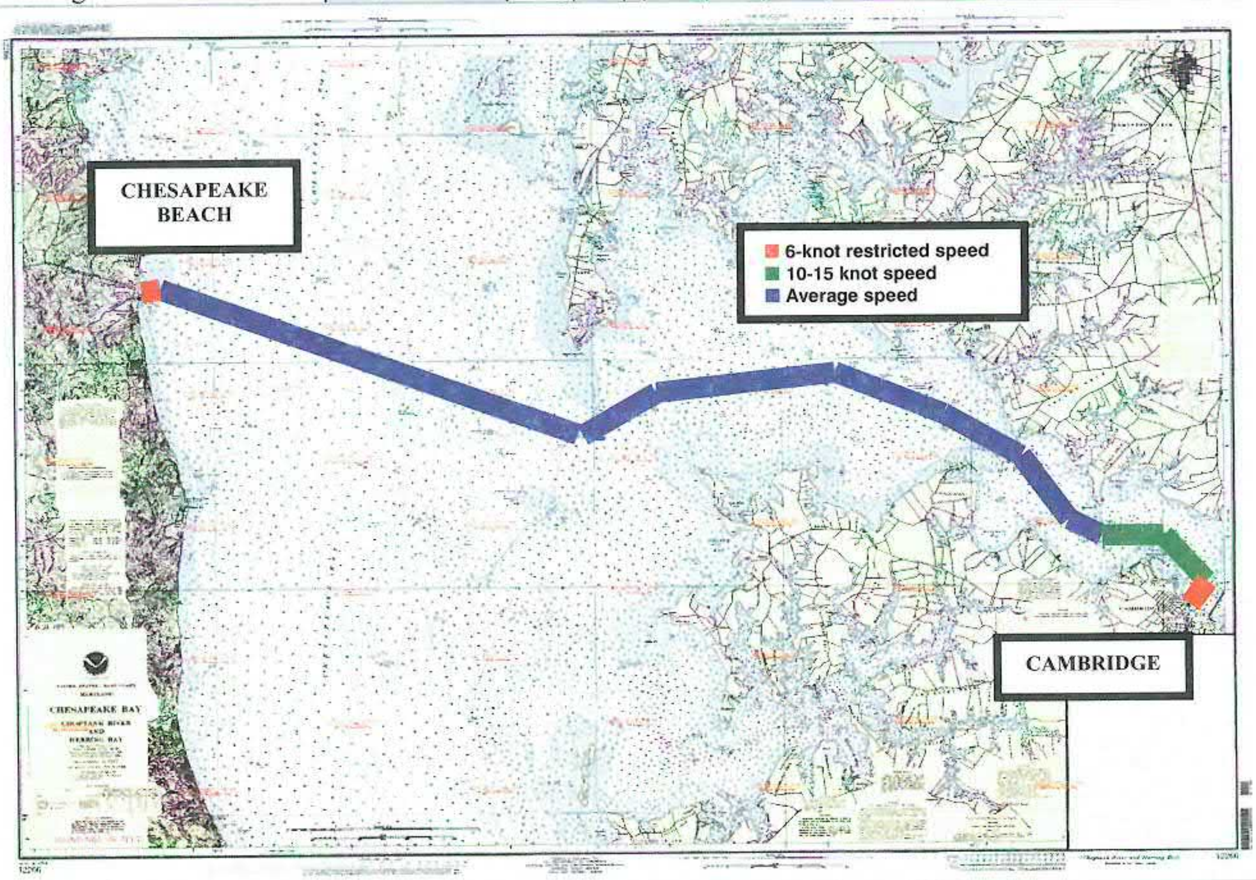


Figure 7-2: Chesapeake Beach to Cambridge Route

Table 7-4: Chesapeake Beach to Cambridge Distances

Average Speed	Reduced Speed (16 knots)	Reduced Speed (10 knots)	Restricted Speed (6 knots)	Total
23.5 nm	2.2 nm	0 nm	1.2 nm	26.9 nm

Table 7-5: Chesapeake Beach to Cambridge Water Total Travel Times

Monohull		Catamaran	
Average Speed = 16 knots	Average Speed = 22 knots	Average Speed = 35 knots	Average Speed = 41 knots
104 minutes	82 minutes	61 minutes	55 minutes

Table 7-6: Chesapeake Beach to Cambridge Rating Descriptions

Tidal Range	Current Velocity	Water Depth	Wave Height	Travel Time	Marine Traffic	Aids to Navigation	Low Visibility
2-4'	<1.5 knots	0%	20-40%	61-104 min.	E/W 1	Somewhat Frequent	Short Route, Straight Forward Navigation, Low Marine Traffic

Maximum predicted tidal range – 3.1 ft (Cambridge)
Maximum predicted currents -0.7 Kt ebb/0.4 Kt flood (Cambridge)

The following is a list of possible restrictions associated with this route:

- Channel depths are restricted at Chesapeake Beach and Cambridge to vessels with a draft of less than 8 feet. Outside the entrance channels, the waters around Chesapeake Beach and Cambridge are 4 feet and 8 feet deep respectively.
- Additional range markers and lighted buoys are required to assist navigation through a narrow channel and shallow bar areas.
- Vessels of 200 feet in length would have difficulty maneuvering into Cambridge Creek and Chesapeake Beach.

The following is a list of potential issues should ferry service be considered along this route:

- It may be necessary to construct a dock outward from the Chesapeake Beach seawall for a considerable distance to reach sufficiently deep water. The 0.6 mile existing channel serving Chesapeake Beach is exposed and may require the dredging of a channel 15 feet deep and 150 feet wide for the entire 0.6 miles.
- Due to very shallow water depths outside of the channel, range lights would be needed on the shore to guide a ferry into the channel.
- The existing marinas at Chesapeake Beach cannot accommodate a vessel of the size envisioned.
- Cambridge Creek is too narrow and congested for a vessel of the size envisioned to maneuver safely.
- It may be necessary to construct a dock out from the Cambridge seawall, and dredge a channel 15 feet deep and 150 feet wide to serve the ferry.
- A lighted buoy would be needed to mark the shoal off Island Neck.

- Range markers would be needed on Horn Point to help avoid Hambrooks Bar and place a lighted buoy on the northernmost point of Hambrooks Bar.
- Buoys "23", "24", "25", and "2" in the Choptank River would need to be replaced with lighted buoys.

Solomons Island to Cambridge

Solomons Island, at the mouth of the Patuxent River, is a very busy harbor with both commercial traffic and extensive pleasure boat traffic. Dredges and tugs with barges are very common. The river is very deep and broad approaching Solomons Island and the U.S. Navy seaplane operating area on the South side of the entrance to Solomons Island poses no difficulties. The entrance to Solomons Island is well marked with lighted buoys and there are numerous shoreline navigation features.

The Solomons Island to Cambridge demonstration ferry route would proceed east through the mouth of the Patuxent River and then turn north in the vicinity of Cove Point. From Cove Point to the approaches to the Choptank River, there are few buoys in the Chesapeake Bay. However, the western shoreline is steep and the eastern shoreline is diverse. Both sites offer many radar navigation points. The transit up the Choptank River is similar to that described for the Chesapeake Beach to Cambridge Route above.

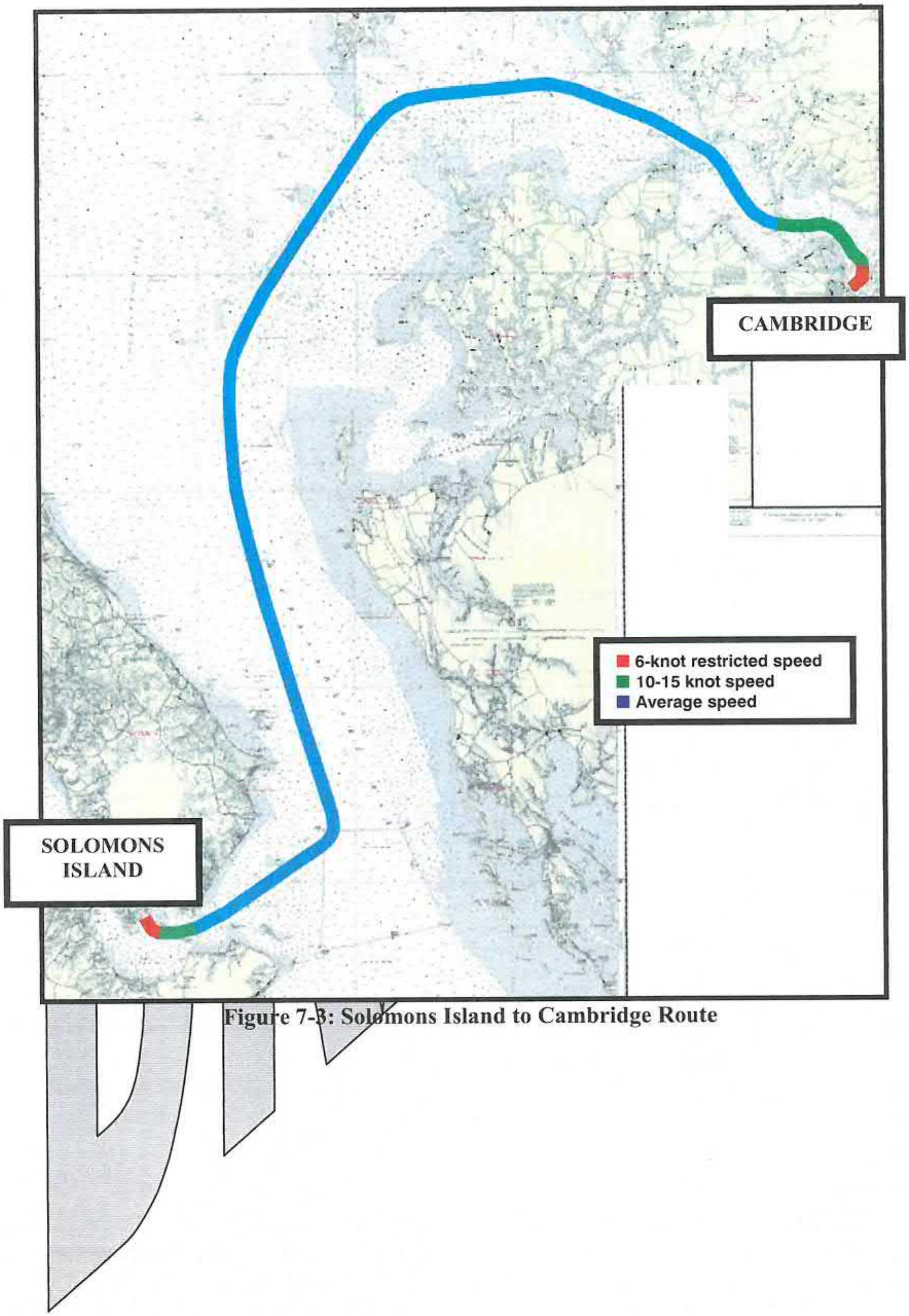


Figure 7-3: Solomons Island to Cambridge Route

Table 7-7: Solomons Island to Cambridge: Distances

Average Speed	Reduced Speed (16 knots)	Reduced Speed (10 knots)	Restricted Speed (6 knots)	Total
35.0 nm	2.2 nm	1.1 nm	1.6 nm	39.9 nm

Table 7-8: Solomons Island to Cambridge: Water Total Travel Times

Monohull		Catamaran	
Average Speed = 16 knots	Average Speed = 22 knots	Average Speed = 35 knots	Average Speed = 41 knots
153 minutes	120 minutes	88 minutes	79 minutes

Table 7-9: Solomons Island to Cambridge Rating Descriptions

Tidal Range	Current Velocity	Water Depth	Wave Height	Travel Time	Marine Traffic	Aids to Navigation	Low Visibility
2-4'	<1.5 knots	0%	60-80%	88-153 min.	N/S 1	Somewhat Frequent	Ave. Route, Mod. Diff., High Marine Traffic

Maximum predicted tidal range – 3.1 ft (Cambridge)
Maximum predicted currents – .6 Kt ebb/.8 Kt flood (Solomons Island)

The following is a list of possible restrictions associated with this route:

- Dredging may be required near the terminals in areas where operations would be difficult for vessels with an 8-foot draft.
- Additional buoys and markers would be required to aid navigation.
- Vessels of 200 feet in length would have difficulty maneuvering into Cambridge Creek.

The following is a list of potential issues should ferry service be considered along this route:

- Cambridge Creek is too narrow and congested for a vessel of the size envisioned to maneuver safely.
- It may be necessary to construct a dock out from the Cambridge seawall, and dredge a channel 15 feet deep and 150 feet wide to serve the ferry.
- A lighted buoy would be needed to mark the shoal off Island Neck.
- Range markers would be needed on Horn Point to help avoid Hambrooks Bar and place a lighted buoy on the northernmost point of Hambrooks Bar.
- Buoys "23", "24", "25", and "2" in the Choptank River would need to be replaced with lighted buoys.

Solomons Island to Crisfield

The route out of Solomons Island to Crisfield would be similar to that described for the Solomons to Cambridge above. After leaving the mouth of the Patuxent River, the route would proceed southeast down the Bay to a point west of Kedges Straits between South Marsh Island and Smith Island in the Tangier Sound. This route would then transit almost the entire length of the restricted area between the

Potomac and Patuxent Rivers that contains two live ordnance areas. The U.S. Coast Guard regulations in Title 33 CFR 334.200 state, in part:

> (2537) (2) *The regulations*. (i) Through navigation of surface craft outside the target areas will be permitted at all times. Vessels shall proceed on their normal course and shall not delay their progress.
>
> (2538) (ii) Prior to firing or ordnance drops, the range will be patrolled by naval surface craft or aircraft to warn watercraft likely to be endangered. Surface craft so employed will display a square red flag. Naval aircraft will use a method of warning consisting of repeated shallow dives in the area, following each dive by a sharp pull-up.
>
> (2539) (iii) Any watercraft under way or at anchor, upon being so warned, shall immediately vacate the area and shall remain outside the area until conclusion of firing practice.

The Air Operations Center at the Patuxent Naval Air Station confirms that the ordnance areas are active and that the U.S. Coast Guard broadcasts a "Notice to Mariners" when operations will take place.
The passage through Kedges Straits is difficult though fairly well marked. Numerous shoal areas must be transited before finding deep water again on the East side of Smith Island. The route would turn south in the main channel of Tangier Sound, then east into the Little Annemessex River to approach Crisfield.
The waters of the Little Annemessex River are 8-10 feet deep outside the main entrance channel. The Crisfield channel is maintained at a depth of 9 feet or greater, and it is well marked throughout.
Crisfield is a major crabbing community. Many boats depart and enter the harbor during the day and Tangier Sound is frequently rife with fishing boats. Tugs and barges are also very common in Tangier Sound, particularly in the north-south channel towards Salisbury, MD. Two excursion passenger boats currently operate from Crisfield on short routes to Smith Island and Tangier Island.

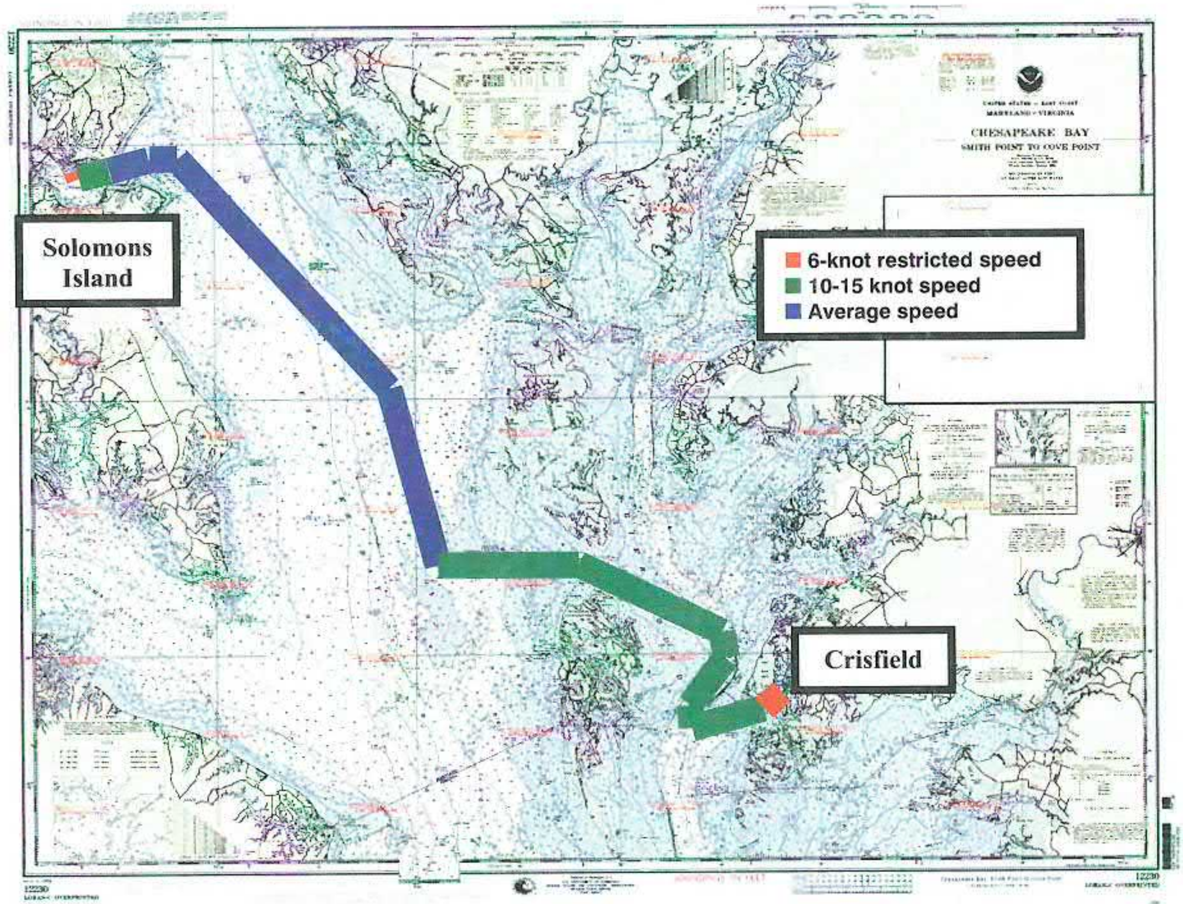


Figure 7-4: Solomons Island to Crisfield Route

Table 7-10: Solomons Island to Crisfield: Distances

Average Speed	Reduced Speed (16 knots)	Reduced Speed (10 knots)	Restricted Speed (6 knots)	Total
23.8 nm	17.0 nm	1.1 nm	1.8 nm	43.7 nm

Table 7-11: Solomons Island to Crisfield: Water Total Travel Times

Monohull		Catamaran	
Average Speed = 16 knots	Average Speed = 22 knots	Average Speed = 35 knots	Average Speed = 41 knots
167 minutes	145 minutes	123 minutes	117 minutes

Table 7-12: Solomons Island to Crisfield Rating Descriptions

Tidal Range	Current Velocity	Water Depth	Wave Height	Travel Time	Marine Traffic	Aids to Navigation	Low Visibility
2-4'	1.5-3 knots	75%	40-60%	123-167 min.	N/S 2	Somewhat Frequent	Long Route, Challenging Nav., High Marine Traffic

Maximum predicted tidal range – 3.3 ft (Crisfield)
Maximum predicted currents – 1.6 Kt ebb/1 Kt flood (Crisfield)

The following is a list of possible restrictions associated with this route:

- Vessels must travel slowly to operate through the Kedges Straits for approximately 9.5 miles.
- Dredging may be needed for portions of the approaches and main channel into Crisfield.
- Channel and operating areas approaching Crisfield are difficult to determine.
- Existing docking areas are not able to accommodate a vessel of 200 in length.

The following is a list of potential issues should ferry service be considered along this route:

- A 20 foot deep and 250 foot wide channel may need to be dredged across the Kedges Straits a distance of 9.5 miles to connect Chesapeake Bay with the Tangier Sound channel, particularly for a high-speed ferry.
- Channel ranges would need to be marked and buoy "4" in the Kedges Straits would need to be replaced with a lighted buoy.
- Some dredging may be required within the main Crisfield channel from the Tangier Sound main channel to Crisfield for a distance of 2.8 miles. Additional dredging would be needed to create a mooring and turning basin.
- The existing marinas in Crisfield cannot accommodate a vessel of the size envisioned, however, there is seawall space available outside the main marinas.
- Buoys "2" and "4" would need to be replaced with lighted buoys. Install a lighted buoy on the western edge of the shoal off Jane's Island.

ADDITIONAL CONSIDERATIONS

Speed Restrictions

The U.S. Coast Guard has not regulated speed along any of the proposed routes. The Maryland Department of Natural Resources (DNR) has imposed a 6 knot speed limit in most harbors and inlets year-round. Speed restrictions would most likely be the result of concentrations of vessels in certain areas, such as in Tangier Sound around Crisfield, MD and in the waters off Rock Hall, MD. Speed restrictions would also be prudent when navigating in shallow waters, specifically through Kedges Straits, the Little Annemessex River, and Swan Point Bar. There area three areas on the Crisfield approach where speeds are restricted.

It is possible that speed restrictions may be placed on a large ferry operating in the Choptank River if large wakes are created that impact riverfront homes. Although the river is broad along almost all of its length to Cambridge, MD, a 2 to 3 foot wake could cause significant concerns for bank erosion and dock damage. A similar scenario unfolded during the 1990s in Seattle, WA and resulted in greatly reduced ferry speeds. Vessel performance histories should be an important factor in matching vessel design to a proposed route.

The following specific restrictions apply to the individual routes referenced:

- A vessel traveling from Canton to Rock Hall could navigate at 6-10 knots from Canton to the Francis Scott Key Bridge, and then accelerate to cruising speed. The vessel would have to slow to approximately 10 knots in the vicinity of buoy "1" approaching Rock Hall.
- A vessel traveling from Chesapeake Beach to Cambridge could accelerate to cruising speed after clearing the 5 fathom line about a mile outside the entrance channel. The vessel could maintain cruising speed until reaching buoy "19" in the Choptank River. Thereafter, a cruising speed of 16 knots until reaching the Cambridge entrance channel would be prudent. Speed into Cambridge channel would be 6 knots.
- A vessel traveling from Solomons Island to Cambridge could accelerate to cruising speed abeam Drum Point at the mouth of the Patuxent River and maintain cruising speed until reaching buoy "19" approaching Cambridge.
- A vessel traveling from Solomons Island to Crisfield could accelerate to cruising speed abeam Drum Point and maintain cruising speed until reaching Kedges Strait. A speed of 6-10 knots would be prudent crossing the Strait until abeam buoy "9." In the absence of traffic, the vessel could accelerate until making the turn into the Little Annemessex River. Speed in the Crisfield channel would be restricted to 6 knots.

Water Depth

Water depth is a critical factor in all navigation. Vessels respond slowly in shallow waters, compared to deep waters, due to increased hull drag near the bottom and the difficulty of moving water around the hull. Squat, an increase in trim aft, in particular, can be dramatic under certain conditions. Squat occurs as a result of waves, vessel speed, vessel shape, and channel topography. Vessels approaching a shoal area can experience an enhanced bow wave as water piles up at the entrance to the shoal. The bow wave lifts the bow, causing the stern to sink. This condition is exacerbated if the stern is also in the trough of a surface swell. A vessel accelerating in shallow water can also suck water from under the hull, causing the stern to sink. In restricted channels, water is unable to flow 3-dimensionally around the hull and water that would normally flow beneath the vessel is forced to the sides, further causing the vessel to sink. As the resulting draft at the stern (13 feet) is still much less than the water depth, the ferry is in no danger of touching the bottom. However, one negative result is that the vessel's resistance is increased, necessitating more power than in deeper water.

Step 8 – Demonstration Vessels

Objective: To provide example vessels that can be used along the demonstration routes.

Outcome: Sample vessels will be identified for use in the conceptual systems developed for the demonstration pairs in Step 9.

Method: Interviews were conducted with vessel design and build firms to discuss vessel styles and specifications. Comparisons were developed between two styles of vessels (conventional displacement hull ferries and high-speed ferries) and similar comparisons were developed within each style. Vessel profiles were developed and analyzed based upon speed, and capacities for passengers, automobiles, trucks and buses. Shipyards were interviewed to discuss the vessel costs and their experience in building the types of vessels selected.

VESSEL REVIEW

This section updates and supplements information on ferry vessel technology that was presented in the earlier report on *Crisfield – Point Lookout Ferry Feasibility Study*[5]. That study looked at the characteristics of conventional (displacement) hull vessels, hydrofoils, hovercrafts and catamarans. The study concluded that a high-speed (> 30 knots) catamaran would be the best type of vessel for the potential Crisfield – Point Lookout ferry route. In this study, the analysis of the four demonstration ferry routes examined both high-speed and conventional vessel options for each route, starting with an update on the most recent vessel designs in both categories.

The recommended vessel specification from the 2001 Crisfield to Lookout Point Study are shown in Table 8-1. These recommendations were based upon specific criteria including a trip time of no more than 1 hour and capacity for automobiles, trucks and buses. The market for the route included year-round home-to-work commuters which drove the time criteria. This in turn, drove the decision on the vessel type and speed. In addition, the need to carry trucks and buses resulted in design requirements beyond those necessary to support passengers and autos only.

Table 8-1: Recommended Vessel Specifications From 2001 Study[6]

CATEGORY	SPECIFICATION
Vessel Designation	High-speed Vehicle/passenger Catamaran
Length Overall	180'
Beam	43'
Draught	12'
Number of Passengers	149
Number of Vehicles	30 to 40
Speed	35 knots top speed; 33 knots service
Engines	Four diesel engines
Propulsion	Four water jets
Cost	Approx $20-30m

[5] *Crisfield – Point Lookout Ferry Feasibility Study, Technical Memorandum 2, Ferry Technology*; Parsons Brinckerhoff, February 13, 2001, pages 1-15.
[6] Ibid, pages 8-9.

There are a number of vessel designs that could provide the range of capacities and speeds needed for the proposed demonstration routes. Some of the vessel design and construction yards that provided data for the Crisfield to Point Lookout study were revisited for a general update on improvements in technology and product. Many of these boat builders continue to produce or maintain the capability to design and construct vessels in the appropriate size and speed range. All of these boat builders were located in the United States. Vessels, even though designed in a foreign land, would be constructed in the U.S. and qualify under the Jones Act for service in U.S. waters.

Conventional Displacement Hull Ferries

The vast majority of vehicle and passenger carrying ferry vessels operating today are conventional monohull steel "displacement hulls". As the term implies, these vessels ride in the water and displace an amount of water equal to their weight. Most U.S. vehicle-passenger ferries operate at speeds of 12 to 20 knots, with typical lengths of 250 to 450 feet. These vessels are considerably more fuel efficient and require much less horsepower than designs operating at or near the maximum practicable speeds.

Conventional ferries may be single-ended or double-ended, meaning that they always travel in the same forward direction (single-ended) and must turn around at each terminal, or that they simply reverse direction (double-ended) while traveling between terminals. Most ferries have drive-through loading/unloading, with single-ended vessels backing into one of the two terminals. Single-ended ferries are typically more efficient on longer routes due to their more streamlined hull design, while double-ended vessels provide an advantage on short routes because they do not have to spend time turning around or backing into the dock.

Conventional displacement hull vessels are typically slower and more maneuverable, and are less expensive to own and operate than the high-speed catamarans. Monohull boats also provide a smoother ride for passengers since they sit in the water rather than on top of it. Displacement hull ferries include boats ranging in speed from 11 to 22 knots, priced from \$5-\$10 million per vessel for the capacity needed for the Chesapeake Bay demonstration routes. Examples of previously built conventional monohull vessels are shown in Table 8-2.

Table 8-2: Examples of Conventional Monohull Vessels

Shipyard	Vessel	Vessel Length (feet)	Service Speed (knots)	Capacity		Cost
				Passengers	Vehicles	
Blount-Barker USA	Single ended*	200	22	150-200	30-40	\$7-\$10 million
Dakota Creek USA	Single ended	175	15	149	30	\$10 million
Conrad Industries USA	Single ended	181	14	149	18	\$5-\$7 million
Eastern Shipbuilding USA	Double ended	216	11	200	55	\$5-\$7 million
	Double ended	306	16.5	1,000	115	N/a

* As shown in Figure 8-1: Blount Baker Monohull Vessel.

Although Blount Barker Shipbuilding has not built a high-speed catamaran ferry vessel, they have developed a 22-knot monohull boat based upon their highly successful vessel, the *Cavo Norte,* which has been in service for many years with the Puerto Rico Ports Authority. A picture of the *Cavo Norte* is shown in Figure 8-1. The shipyard indicated that they could build a 200-foot monohull with an open vehicle deck and raised cabin for passengers forward of the open deck. This vessel would be wider than the *Cavo Norte* with a 45-foot beam and would be capable of 22 knot service speeds. The cost of this vessel was estimated at $6 million to $7 million.

At the time of the previous study, Dakota Creek Industries was preparing to respond to the request for proposals from the Alaska Marine Highway System, but did not receive the award. They have, however, been awarded a contract for a conventional monohull vessel for the Inter-Island Authority Passenger-Vehicle Ferry in Alaska that could be considered for use for the Chesapeake Bay demonstration routes.

Figure 8-1: Blount Baker Monohull Vessel

High-speed Ferries

High-speed ferries (defined by the U.S. Coast Guard as ferries operating at 30+ knots) differ from conventional ferries in that they ride on top of, rather than in, the water. By hydroplaning across the top of the water, they greatly reduce the drag of the water's friction forces and thus achieve the higher speeds. However, they require substantially greater horsepower than displacement hull vessels to achieve and maintain their hydroplaning effect, and thus have significantly higher capital and operating costs. Examples of high-speed catamaran ferries are shown in Table 8-3.

Table 8-3: Examples of Fast Ferry Catamaran Vessels

Shipyard	Vessel	Vessel Length (feet)	Service Speed (Knots)	Capacity		Cost
				Passengers	Vehicles	
Derecktor USA	Alaska [1] Catamaran	241	36	250	30	\$35-\$40 million
Dakota Creek	AMD 700	193	38	250-450	54	\$30-\$40 million
	AMD 770	219	36	250	40	
	AMAD 1130	254	58	446	52	
Austal USA	Austal [2] Express 72	192	33	300	46	\$30-\$35 million
	Austal [3] Express 60	190	33	460	94	
Gladding Hearn USA	Incat 54	178	30-35	250	40	\$30 million
	Incat 57	187	30	300	54	

[1] As shown in Figure 8-2: Alaskan Catamaran Vessel.
[2] As shown in Figure 8-3: Austal Express 72
[3] As shown in Figures 8-4a: Austal Express 60 (Exterior), and 8-4b: Austal Express 60 (Interior.)

Although high-speed vehicle-passenger ferries have been used in revenue service worldwide for the past three decades, none have been built or operated in the U.S. until recently. Derecktor Shipyards of Mamaroneck, NY, is currently constructing a 35-vehicle, 32 knot vessel for the Alaska Marine Highway System (AMHS) that will go into service in the summer of 2004. AMHS will introduce a second Derecktor high-speed ferry in 2005. These two vessels are the only two fast vehicle-passenger-ferries built or under construction in the U.S.

In June 2003, Austal USA, the U.S. subsidiary of long-time Australian ferry builder Austal Limited, announced an order from Milwaukee (WI)-based Lake Express LLC for a 46-car, 34-knot ferry. This 58-meter boat is scheduled to begin service in summer 2004 between Milwaukee and Muskegon, MI across Lake Michigan. This aluminum-hulled ferry will be the first vehicle-passenger ferry designed and built to U.S. Department of Transportation's Subchapter K regulations which were developed specifically for high-speed vessels in the U.S.

Austal also has a design concept for a 216-foot long catamaran that will handle either 275 passengers and 54 automobiles, or 9 tractor trailers and 18 automobiles. This vessel operates in planning mode at 24 knots service speed with just automobiles or in displacement mode at 15 knots with heavy trucks.

Dakota Creek has updated their AMD 700 design, a 193-foot catamaran with capacity for 250 passengers and 35 American size automobiles. The service speed of this vessel is 42 knots maximum speed and 38 knots service speed.

Gladding Hearn has two vessels designed by Incat that will handle both passengers and automobiles. A 57 meter version has a capacity for 300 passengers and 54 cars with a service speed of 30 knots. The cost estimate for this vessel is \$15-20 million. Gladding Hearn's second vessel is an Incat 54 meter catamaran. The vessel will handle 250 passengers, 40 vehicles at speeds up to 35 knots.

Figure 8-2: Derecktor, Alaska Marine Highway System Catamaran Ferry

Figure 8-3: Austal Express 72

Figure 8-4a: Austal Express 60 (Exterior)

Figure 8-4b: Austal Express 60 (Interior)

Design Considerations

This section discusses some of the specific considerations for the design of a vessel for the four demonstration routes.

Water Depth and Vessel Draft

As discussed in the Additional Considerations section of Step 7: Navigation Issues, water depth is a critical factor of consideration when developing ferry vessels. Experiments with various hull designs have demonstrated that a speed to length ratio, Taylor's Quotient $V/\sqrt{L}$, and the depth to draft ratio, h/H, are important factors in vessel performance in shallow water.[7] For example, curves published by SNAME indicate a 200 foot ferry, with an 8 foot draft, traveling at 30 knots, in 20 feet of water would experience a trim of about 5 feet aft. As the resulting draft at the stern (13 feet) is still much less than the water depth, the ferry is in no danger of touching the bottom. However, one negative result is that the vessel's resistance is increased, necessitating more power than in deeper water.

Some specific restrictions that dictate vessel draft on the four demonstration routes include:

- A vessel with a draft of more than 8 feet cannot safely enter Crisfield harbor because the depth at Mean Low Water (MLW) is only about 9 feet from Long Point to Crisfield.
- A vessel with a draft of more than 8 feet cannot safely enter Cambridge Creek because the channel is narrow, congested, and offers limited maneuverability. In addition, the waters outside the turning basin and along the seawall are only 3 feet to 5 feet deep.
- A vessel with a draft of more than 8 feet cannot safely enter Rock Hall Harbor at Mean Low Water (MLW) because the channel depth is only 8 feet to 9 feet at MLW. In addition, the waters for almost a mile bayward from Rock Hall are shallow shoals.
- A vessel with a draft of more than 8 feet cannot safely enter Chesapeake Beach because the water depth is insufficient, an overpass obstructs Fishing Creek, and the marina by the Rod N' Reel is too small.
- The water depths at Solomons Island are sufficient for a vessel with an 8 foot draft to safely navigate well into Back Creek or Mill Creek.
- The water depths at Canton are sufficient for a vessel with an 8 foot draft to safely navigate all the way to the sea wall.

The design and shipbuilding firms contacted for this study indicated that 7 to 8 feet is probably the minimum draft available for a ferry of the length, weight and capacity required on the routes suggested for this study, especially if the vessel will be handling trucks and buses. These vessels would be catamaran designs. Along the approaches to at least one of the terminals for each of the route pairs of Canton to Rock Hall, Chesapeake Beach to Cambridge, Solomons Island to Cambridge and Solomons Island to Crisfield, there is a water depth issue. A vessel with a draft of 8 feet may either not be able to traverse a portion of the route or be placed in a difficult maneuvering condition with less than two feet of water under its keel (unless dredging is used to deepen the shallow areas).

[7] *Principles of Naval Architecture, Hydrodynamics in Ship Design, Volume 1*; Society of Naval Architects and Marine Engineers, Pavonia, NJ, 1988

Icing

Icing poses a potential threat to yearlong operations along most of the proposed routes. The *U.S. Coast Pilot* contains the following excerpt discussing icing on Chesapeake Bay:

> (80) Ice.–The intra-coastal passages of New Jersey, Delaware, and Maryland usually are closed by ice during ordinary winters; the Virginia passages are closed only during severe winters and then only for short periods. Local vessels use all the inlets and adjacent channels from Sandy Hook to Cape Charles all winter, even when through navigation is blocked. (81) In Delaware River, ice is present in sufficient amounts even in ordinary winters to be of some concern. The Chesapeake and Delaware Canal is kept open as long as possible, but may be closed at times. In severe winters, navigation has been interrupted above Chester but tugs and large vessels keep the channels open to Philadelphia. Above Philadelphia, the river may be closed for extended periods in January and February, and navigation is practically suspended during severe winters. (82) Ice seldom interferes with navigation of full-powered vessels in Hampton Roads even in severe winters. Large vessels can always pass up and down Chesapeake Bay, but ice jams are of frequent occurrence off Baltimore Harbor. The harbor itself sometimes freezes over and navigation may be blocked for small, low-powered vessels for limited periods. (83) Conditions in other Chesapeake Bay tributaries are somewhat similar to those in the same latitudes along the coast. Ice is not much of a problem in the southerly tributaries. The upper part of Potomac River is closed during severe winters, and Patuxent River is closed nearly to the mouth. Severn River, strangely enough, is said to remain open except for short periods in severe winters. Susquehanna River, at the head of the bay, usually is completely closed for about 3 months. Ice conditions in the Eastern Shore tributaries correspond roughly to those across the bay. (84) During some winter months or when threatened by icing conditions, lighted buoys may be removed from station or replaced by unlighted buoys; unlighted buoys, day beacons, and lights on marine sites also may be removed. It is doubtful that a ferry of the size and power envisioned for this report would be significantly affected by ice except in the harshest of winters. The worst ice area, in the vicinity of Baltimore Harbor, will probably be cleared by large ship transits. An aluminum-hulled vessel will be more susceptible to damage from ice because aluminum is a less forgiving material than steel under impact loads. However, Classification Society Rules address ice strengthening and can accommodate either material. Therefore, with regard to ice resistance, either steel or aluminum should be acceptable.[8]

Aluminum Ship Repair and Construction Yards

Most high-speed ferries are made of aluminum instead of steel plate to reduce weight and achieve hydroplaning at reasonable power levels. Two aluminum shipbuilding and repair specialty yards are currently operating on the Chesapeake Bay. AlumaCat is located in Solomons Island, MD, and Chesapeake Shipbuilding Corp. is located in Salisbury, MD. Chesapeake Shipbuilding has larger

[8] US Coastal Pilot (source).

construction capacity than AlumaCat. Neither yard has a dry dock or marine railway to haul out a large ferry. For this purpose, one of the large steel shipbuilding yards in Baltimore would be more suited, with an aluminum yard contracted for the repairs.

Measurement and Weight

It would be much easier and less costly to select a vessel design that is off the shelf, but this may not be possible. Selected fast ferry design and build shipyards such as Direcktor, Gladding Hearn, Austal USA, Bollinger, and Dakota Creek indicated that they have vessel designs that will meet the passenger/vehicle vessel requirements.

There is a significant difference between a vessel that will handle passengers and automobiles and one that will also accommodate buses and tractor trailer trucks. Trucks are longer (equivalent to 3 auto spaces), higher (minimum 12-foot overhead clearance) and wider than passenger autos. The average combination tractor and trailer weigh at least 82,000 lb when loaded which is the legal load limit in most states. Therefore, a vessel's design must be lengthened, widened, the overhead clearances increased, the decks strengthened, and the vessel's dead weight must be increased to handle the additional load. The vessel also must be powered properly to produce the required speeds when carrying the number and weight of tractor trailers and buses anticipated on this ferry crossing.

Relative to vessel classification based upon tonnage, a tonnage of < 100 tons may be the most cost effective approach under the U.S. Coast Guard Regulation, 46CFR Subchapter K or T. [Note: "Ton" in respect to vessel classification is a measure of a vessel's size (enclosed volume) not its weight or displacement. Thus, a "100-ton vessel" may *weigh* more or less than 200,000 pounds (2,000 x 100).] Austal USA reports that a catamaran with an overall length of 200 feet can be designed under 100 tons. This is a significant consideration since the purchase, operating, maintenance and crewing costs associated with a large fast ferry catamaran with both passenger and all vehicle capacity can be upwards 33% more than a vessel with similar capability under 200 feet and <100 tons registered weight. The weight factors involved in producing and operating a passenger/vehicle ferry capable of handling a number of trucks or buses are, in the long run costly in vessel costs as well as the potential impact on crew levels and maintenance support.

Step 9 – Develop Conceptual Ferry System Findings

Objective: To analyze the technical & operating criteria of the demonstration pairs. Specifically, this step will assess the most suitable vessel type, speed criteria, capacity issues, landside facilities, schedule, staffing, administration, etc., for the demonstration pairs.

Outcome: The output of this task is revised order-of-magnitude cost estimates from Step 4 – Demonstration Pairs Assessment and Step 5 – Roadway Improvements for the demonstration pairs.

Method: Prototype vessels were developed from various manufacturers discussed in Step 8. Estimated travel times for the roadway portions, were based on the results of Step 3, detailed vessel travel times were based on the routes developed in Step 7 – Navigation Issues. Fair structures, ridership and revenues were based upon supply and demand models. Order-of-magnitude costs for the landside improvements and terminal improvements were based on costs developed in the Demonstration Pairs Assessment and Step 5 portions of the report. Operating costs were based upon historical data.

This chapter summarizes the results of the various analyses presented in the previous sections of the report and presents the recommended operating concepts for each of the four demonstration routes. Capital and operating costs, anticipated ridership and estimated revenues are presented for each of the four routes.

BASIC OPERATING SCENARIOS

Although each of the four demonstration routes discussed in Step 4 – Demonstration Pairs Assessment and Step 7 – Navigation Issues presents unique considerations for ferry operations, the analysis of ridership, costs and revenues made some basic assumptions about general operating characteristics. This section addresses some of the basic questions concerning operating assumptions.

Vessels

Navigational constraints on the Chesapeake Bay, along with constraints in and around the demonstration terminal sites, limit the size of potential ferry vessels for these routes. Most of the Bay and its environs are relatively shallow, and the shoals and near-shore water depths restrict vessel drafts to no more than 8 feet without extensive dredging. Even a vessel with a draft of 8 feet may require localized dredging (say 1 to 3 feet) to safely traverse some harbor channels during Mean Low Water (MLW) tide levels. Constrained maneuvering room at several ferry demonstration sites suggests a practical limit for vessel length of no more than about 200 feet length overall (LOA).

Conventional Displacement Hull Ferries

As stated in Step 8, the vast majority of vehicle and passenger carrying ferry vessels operating today are conventional monohull steel “displacement hulls”. The speed of a displacement hull is related to its length at the water line; for engines of a given horsepower, the longer the vessel the faster it will go. The relationship among speed, length and power is not a linear one, however, and various design parameters dictate maximum practicable speeds. For displacement hulls in the 200 foot range, the maximum practicable operating speed is 20 to 22 knots; beyond this limit, it is simply not economical to provide the power required to achieve, say, 25 knots or greater for an extended period.

Most U.S. vehicle-passenger vessels operate well below their theoretical maximum speeds for reasons of lower fuel consumption and lower capital costs for their propulsion systems. Typical ferry speeds are 12 to 20 knots, with lengths of 250 to 450 feet.

The advantages of using a conventional displacement hull ferry for the Chesapeake Bay demonstration routes include: (1) a proven technology with many potential designs readily available from a variety of shipbuilders; (2) good seakeeping abilities; (3) well-documented minimal adverse wake/wash effects on shorelines; and (4) significantly lower capital and operating costs compared to high-speed ferries.

The primary disadvantage of a displacement hull is its slower cruising speed relative to catamarans and other high-speed ferry hulls.

High-speed Ferries

As described in Step 8, high-speed ferries (defined by the U.S. Coast Guard as ferries operating at 30+ knots) differ from conventional ferries in that they ride largely on top of, rather than in, the water.

There have been many designs developed and tested, and some constructed, for high-speed vehicle-passenger ferries, ranging from air-cushioned Hovercraft to Boeing's aircraft-engine driven Jetfoil. The twin-hulled catamaran design powered by water jets has been the most successful combination in recent years.

The Jones Act of 1920 prevents foreign-built vessels from carrying passengers directly between U.S. ports. However, foreign-built fast vehicle-passenger ferries have been or are planned or are planned to be operated on several North American routes. Bay Ferries of Canada operates a 900 passenger, 240 car high-speed catamaran ("The Cat") between Bar Harbor, Maine, and Yarmouth, Nova Scotia during the summer months. In past years the operator had run the vessel between Miami, Florida and Nassau, Bahamas, in the winter but has since discontinued this service. Austal Ships (Australia) is building a 238 car, 40 knot vehicle-passenger ferry for Canadian American Transportation Systems (CATS) to operate between Rochester, NY and Toronto, Ontario, across Lake Ontario beginning in 2004. British Columbia Ferries recently auctioned three 250-car high-speed ferries for less than 3 cents on the dollar. They were built in 1999 but only two operated for a few months and the third was never put into service due to continuing mechanical problems and concerns about environmental wake/wash damage.

Considerations in Vessel Speed Selection

Vessel cruising speed is but one of several factors that determine total travel times on a ferry route. The shallow waters of the Bay have a potentially adverse effect on practical speeds for certain vessels, and the speed restrictions in the channels limit channel transit times regardless of maximum vessel speed. In addition, there are considerations for the turn-around time at each terminal, including vessel docking, unloading and loading times for vehicles, and undocking/underway maneuvers. For short routes, open water cruising speed may have little effect on the actual point to point travel times observed by ferry users.

In addition to the estimated vessel travel times, scheduling times for vessel sailings had to be considered since it would be more convenient for ferry patrons to sail at regular intervals, say on the hour or on the half hour, rather than at irregular intervals with different sailing times each hour.

Analysis of travel times for the four demonstration ferry routes determined that the high-speed vessels would reduce crossing times by 15 to 33 percent in comparison with conventional ferry times.

Prototypical Vessels

Two prototypical vessels were developed to represent the spectrum of possible vessel choices for the four demonstration routes: a conventional displacement monohull and a high-speed catamaran. These two prototypes provide reasonable estimates of service characteristics, operating costs, capital costs and terminal requirements for the range of ferries available today. Although based on the various vessels discussed in Step 8 – Demonstration Vessels portion of the report, they are not meant to denote any one specific vessel, or the current products of any single shipbuilder or designer.

Each of the four demonstration routes was evaluated separately with each of the vessels. Due to speed restrictions, route distances, potential ridership, costs differences, and owner preference, one vessel type may serve one route more efficiently than another. The analysis presented in this report provides decision makers with the likely costs and benefits associated with each vessel on each route.

Conventional Displacement Hull

Ferries are typically designed to meet the specific requirements of the route(s) that they will service. Principal factors include vehicle and passenger demand, route length, and physical and environmental restrictions (i.e., depth and width of waterways, sensitivity to wake/wash impacts, seakeeping abilities). Based on the previously manufactured vessels described above, a sample vessel for the conventional displacement hull category was developed. Displacement hull ferries include boats ranging in speed from 11 to 22 knots and priced from $5-$10 million per vessel for the capacity needed for the Chesapeake Bay demonstration routes. This vessel would be similar to the vessel shown in Figure 8-1: Blount Baker Monohull Vessel, described in Step 8.

The sample conventional ferry would have a U.S. Coast Guard Subchapter T classification, would not be a licensed vessel, be less than 100 tons, have an approximate 22-knot service speed, require a capacity for no more than 149 passengers, could hold 54 automobiles (or a combination of up to 6 trucks and 36 autos), and other characteristics shown below in Table 9-1. The crew requirements are shown in Table 9-2. The sample vessel is not a specific design recommendation and is for demonstration purposes in analyzing the demonstration pairs.

Table 9-1: Conventional Displacement Hull Vessel Characteristics

Hull Form	Conventional Displacement Monohull
Length	<200 feet
Beam	<60 feet
Draft	7 to 8 feet
Speed	20 to 22 knots service speed
Passenger Capacity	149 persons
Fuel Consumption	300 gallons per hour
Vehicle Capacity	54 autos, or a combination up to 6 trucks and 36 autos
Engines	Diesel engines
Propulsion	Shaft and Propeller
Construction	All welded Aluminum
Classification	USCG, Subchapter T
Loading Configuration	Fore and aft ramps
Estimated Cost	$7-$10 million
Construction Time	15 to 24 months

Table 9-2: Conventional Displacement Hull Ferry Crew Requirements

Position	Number
Captain	1
Engineer	1
Seaman	2-3

Fast Ferry Catamaran

The second prototype vessel is a fast ferry catamaran. The catamaran design includes boats ranging in speed from 24 to 47 knots and priced from $30-$40 million per vessel. The Austal Express 60, shown in Figures 8-4a and 8-4b in Step 8, is a typical example of a high-speed catamaran design.

The recommended example high-speed ferry would have a U.S. Coast Guard Subchapter T classification, would be a licensed vessel, have a 40 to 41-knot service speed, provide a capacity for up to 149 passengers, 54 automobiles (or a combination of up to 6 trucks), as well as the other characteristics shown below in Table 9-3. For comparison purposes, the analysis assumed that the vessel would be designed with the same vehicle and passenger capacities as the displacement vessel prototype, and would have the same crew requirements (crew requirements are based mainly on passenger capacity). The sample vessel is not a recommendation and is proposed only for demonstration purposes in analyzing the demonstration pairs.

Table 9-3: Fast Ferry Catamaran Vessel Characteristics

Hull Form	Catamaran – High-speed Ferry
Length	<200 feet
Beam	<60 feet
Draft	7-8 feet
Speed	41 knots (service speed)
Passenger Capacity	Up to 149
Fuel Consumption	700 gallons per hour
Vehicle Capacity	54 autos, or a combination up to 6 trucks and 36 autos
Engines	Diesel engines
Propulsion	Water jets
Construction	All welded Aluminum
Classification	USCG, Subchapter T
Loading Configuration	Fore and aft ramps
Estimated Cost	$35 million
Construction Time	15 to 24 months

TRAVEL TIMES

Travel times for both sample vessels were calculated for each of the four demonstration pairs. The computed times provide a good comparison of the trade-offs between the two vessel types. For each of the demonstration pairs, the one-way ferry travel times were computed as a sum of three legs:

(1) Shortest drive time from either Baltimore or Washington, D.C. areas to the western terminal site; plus
(2) Ferry travel time, including loading and unloading (based on the times developed in the individual route analyses in Step 7 – Navigation Issues), plus
(3) The drive time from each terminal site to Ocean City (the most frequent east side destination).

The total land and over-water travel times were then added together to develop a gross travel time from the Baltimore-Washington areas to Ocean City for each of the pairings as shown in Table 9-4.

The alternative Bridge-route travel times were also computed for the Baltimore-Washington areas to Ocean City trip using the Bay Bridge instead of the ferry, using Mapquest.com. These Bridge-route travel times included an assumed one-hour average delay across the Bay Bridge during peak times in the summer. The Bridge-route travel times are shown in Table 9-5, and the comparisons are shown in Table 9-6.

Table 9-4: Conceptual Ferry System Vessel Travel Time Calculations

Automobile Travel Times from Baltimore/Washington to Ocean City

Western Shore Terminal Site	Eastern Shore Terminal Site	Estimated Dist (miles)	In-vehicle time (hours) *	Seasonal Variation (hours)	Average total travel time by Auto. (hours)
Baltimore	Ocean City	144.8	3.30	1.00	4.30
Washington	Ocean City	148.11	3.32	1.00	4.32

Automobile Travel Times from Terminal to Terminal

Western Shore Terminal Site	Eastern Shore Terminal Site	Estimated Dist (miles)	In-vehicle time (hours) *	Seasonal Variation (hours)	Average total travel time by Auto. (hours)
Canton	Rock Hall	82.19	1.87	1.00	2.87
Chesapeake Beach	Cambridge	82.93	1.88	1.00	2.88
Solomons Island	Cambridge	110.57	2.48	1.00	3.48
Solomons Island	Crisfield	282.00	3.67	1.00	4.67

* At prevailing speed according to Mapquest.com.
Average Travel Time across the Bay Bridge
Source: MapQuest

Table 9-5: Conceptual Ferry System Bridge Route Travel Time Calculations

Automobile Travel Times from Baltimore/Washington to Ocean City

Western Shore Terminal Site	Eastern Shore Terminal Site	Estimated Dist (miles)	In-vehicle time (hours) *	Seasonal Variation (hours)	Average total travel time by Auto. (hours)
Baltimore	Ocean City	144.8	3.30	1.00	4.30
Washington	Ocean City	148.11	3.32	1.00	4.32

Automobile Travel Times from Terminal to Terminal

Western Shore Terminal Site	Eastern Shore Terminal Site	Estimated Dist (miles)	In-vehicle time (hours) *	Seasonal Variation (hours)	Average total travel time by Auto. (hours)
Canton	Rock Hall	82.19	1.87	1.00	2.87
Chesapeake Beach	Cambridge	82.93	1.88	1.00	2.88
Solomons Island	Cambridge	110.57	2.48	1.00	3.48
Solomons Island	Crisfield	282.00	3.67	1.00	4.67

* At prevailing speed according to Mapquest.com.
Average Travel Time across the Bay Bridge
Source: MapQuest

Table 9-6: Conceptual Ferry System Travel Time Comparisons

Travel Time Comparisions from Baltimore/Washington Area to Ocean City

Western Shore Terminal Site	Eastern Shore Terminal Site	Boat Type	Travel Time in Hours (include access/egress)		Fastest Mode (fastest by X hours.)	
			Ferry	Car *	Mode	Hours
Canton	Rock Hall	Monohull (22 knots)	5.33	4.30	Car	1.03
		Catamaran (41 knots)	5.12	4.30	Car	0.82
Chesapeake Beach	Cambridge	Monohull (22 knot)	4.60	4.30	Car	0.30
		Catamaran (41 knots)	4.15	4.30	Ferry	0.15
Solomons Island	Cambridge	Monohull (22 knot)	5.97	4.32	Car	1.65
		Catamaran (41 knots)	5.50	4.32	Car	1.18
Solomons Island	Crisfield	Monohull (22 knot)	5.67	4.32	Car	1.35
		Catamaran (41 knots)	4.99	4.32	Car	0.67

Travel Time Comparisions from Terminal to Terminal

Western Shore Terminal Site	Eastern Shore Terminal Site	Boat Type	Travel Time in Hours (include access/egress)		Fastest Mode (fastest by X hours.)	
			Ferry	Car *	Mode	Hours
Canton	Rock Hall	Monohull (22 knots)	2.17	2.87	Ferry	0.70
		Catamaran (41 knots)	1.95	2.87	Ferry	0.92
Chesapeake Beach	Cambridge	Monohull (22 knot)	1.87	2.88	Ferry	1.02
		Catamaran (41 knots)	1.41	2.88	Ferry	1.47
Solomons Island	Cambridge	Monohull (22 knot)	2.92	3.48	Ferry	0.57
		Catamaran (41 knots)	2.45	3.48	Ferry	1.03
Solomons Island	Crisfield	Monohull (22 knot)	2.50	4.67	Ferry	2.17
		Catamaran (41 knots)	1.82	4.67	Ferry	2.84

Notes
* Prevailing speed according to Mapquest.com

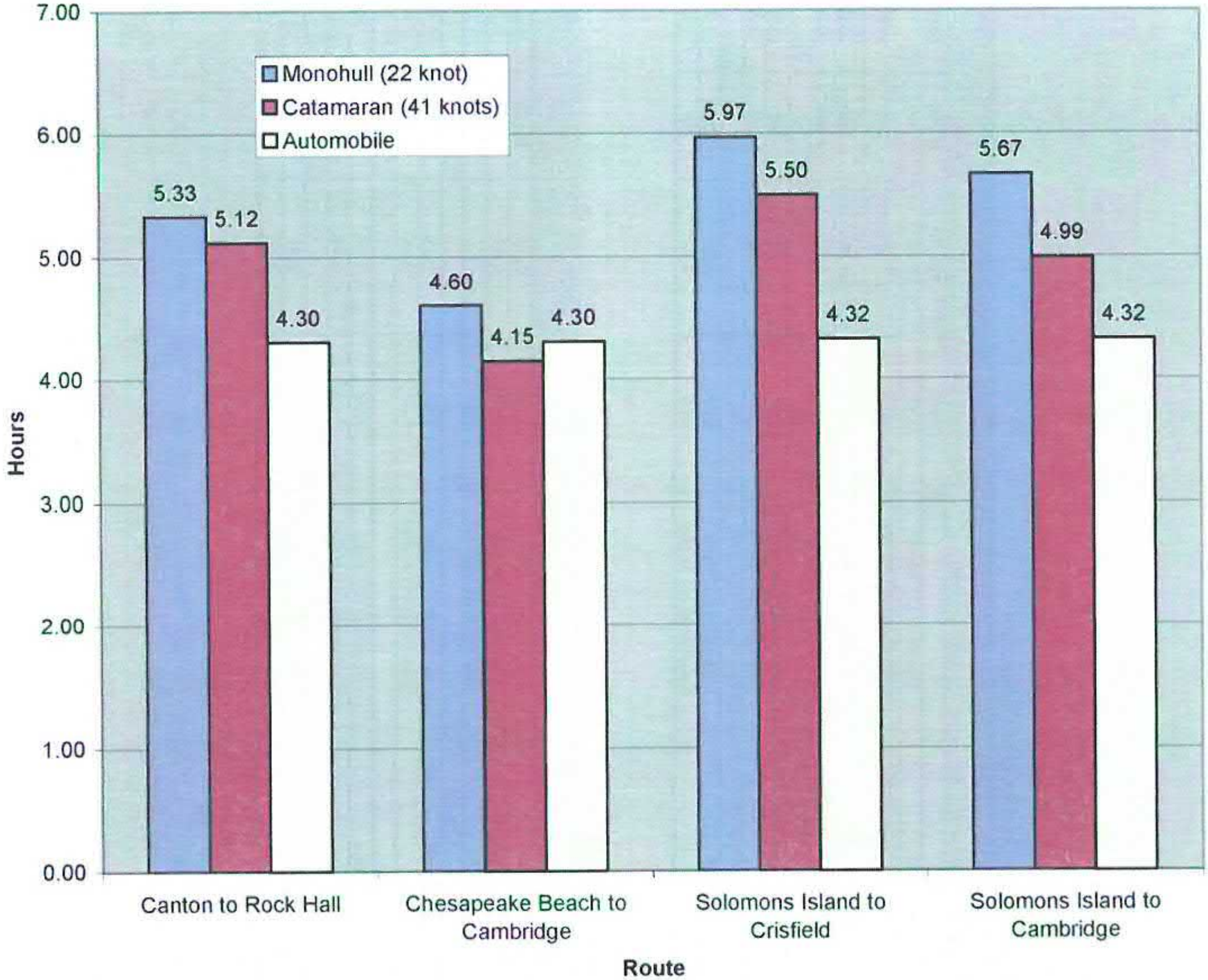


Figure 9-1:Travel Time Comparison (Washington, D.C./Baltimore to Ocean City)

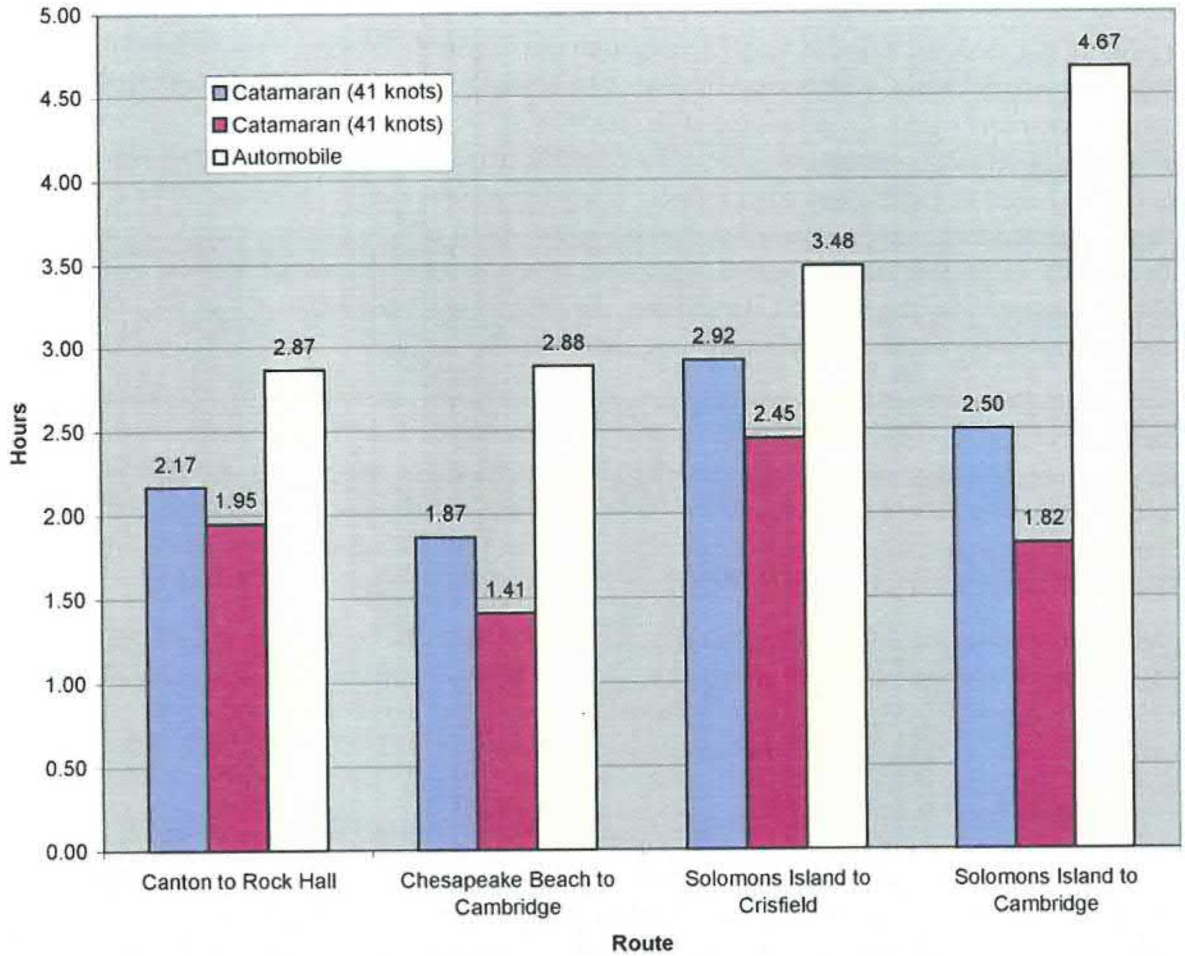


Figure 9-2: Travel Time Comparison (Terminal to Terminal)

As shown in Table 9-6 and Figure 9-1, travel times for vehicles traveling from the Washington, D.C./Baltimore area to Ocean City via the Bay Bridge are shorter than most of the ferry routes. The one exception is the Chesapeake Beach to Cambridge route with the fast ferry catamaran vessel, which is quicker by nine minutes. Also shown in Table 9-6 and Figure 9-2, travel times for the terminal-to-terminal trip (i.e., Canton to Rock Hall, Solomons Island to Crisfield,...) are significantly shorter by ferry when compared to the Bridge-route alternate.

FARE STRUCTURE

For purposes of this analysis, a simple ferry fare structure was assumed. Charges were assessed only on an average "per vehicle" basis, using a single rate for all autos and private vehicles and another single rate for all large commercial trucks. In actual operation, the ferry service would more likely charge a variety of rates for both private and commercial vehicles based on the amount of deck space occupied by the vehicle, vehicle height and width, and other factors. Many ferry routes charge higher fares in the summer due to higher demand than in the winter when demand is low. Most ferry routes also charge for both drive-on and walk-on passengers, but these charges were assumed to be incorporated into the average "per vehicle" fares used for this analysis. In addition, the fares were set conservatively on the low side of a probable market rate to avoid over-optimistic revenue estimates.

Fares were based on those used in the previous cross-Bay studies and were similar to those charged on the Cape May – Lewes Ferry. The *Mid-Chesapeake Bay Ferry Feasibility Study* of a cross-Bay route in Virginia's portion of the Bay assumed an average of $30 per private auto and $75 per commercial truck. The Cape May – Lewes Ferry recently raised the summer (April – October) season fares to $25 for car and driver, $8 per auto passenger (over six years of age), $29 to $36 for over-sized recreational vehicles, and $52 for a 45 to 60-foot truck.

The revenue calculations for the four demonstration ferry routes assumed fares of $25 (low speed ferry) or $37.50 (high-speed ferry) each way for private vehicles. Large commercial truck fares were assumed to be $75 for a conventional displacement ferry and $112.50 each way for the high-speed ferry. Truck fares were set at a rate of three times the auto fare because the longer trucks take about three times as much deck space as an auto.

The existing bridge tolls are substantially less than the proposed ferry fares. The basic cash tolls on the Bay Bridge are $2.50 for an auto (all 2-axle vehicles) and $10 for a typical truck-trailer combination (5-axel vehicles). These tolls are collected in the eastbound direction only in contrast to the ferry fares that would be collected in each direction. Thus, a round-trip ferry fare for an auto ($50) would be twenty (20) times as much as the round-trip Bay Bridge toll ($2.50).

DESCRIPTION OF OPERATING SCENARIOS AND COST SUMMARIES

<u>Operating Scenarios</u>

Based on the demands developed in Step 6 – Potential Ridership, travel times from Step 7 – Navigation Issues, and fare structures developed in this step, operating scenarios were developed for both vessel categories for each of the demonstration pairs. For each route, weekday and weekend operating plans were developed for summer, shoulder and off-season levels of service. This approach matched vessel service hours with the changing demands on different days of the week and at different times of the year.

Several assumptions have been made in developing the operation scenarios:

- Fridays were considered a weekend day for service planning purposes.
- The summer service period includes the months of June, July and August; shoulder season includes May, September, and October; and the off-season service plan for the months of January, February, March, April, November, and December.
- Ferry service may be provided for up to 18 hours during the summer season, up to 16 hours during the shoulder season, and up to 12 hours during the off-season. Due to potentially low

traffic demands and to help reduce operating costs, some of hours of operation suggested are shorter than the maximum allowable time frames described above.

- One truck occupies the space of three cars, and a varying mix of trucks and cars will be allocated to meet the required demands.
- An additional half-hour was added to the vessel travel times to allow time for loading and unloading between trips.

The tables shown for the operating scenarios indicate the potential fares, travel times, number of vessels, hours of operation, projected vehicle breakdown (cars vs. trucks), and the number of trips provided. The low and high demands from Step 6 have also been shown for easy comparison of the supplied number of automobiles and trucks to the projected demands.

Capital Costs

Detailed cost estimates for the terminal construction were developed in Step 4 – Demonstration Pairs Assessment and roadway improvement were developed in Step 5 – Supporting Transportation Network.

The numbers of vessels required for each scenario were determined in the operating scenarios for each of the vessels for all of the demonstration pairs. Summaries of the capital costs (including terminal and roadway improvement costs developed in Steps 4 and 5 as well as vessel costs developed in the Demonstration Vessels section) have been included for each of the demonstration pairs.

Terminal Operating Cost Assumptions

Annual operating costs for ferry terminals were assumed to be the same for all demonstration sites. Each demonstration route would have two terminals, and the terminal operating costs would be the same for all routes. Table 9-7 shows a breakdown of the annual operating costs for each of the terminals.

Table 9-7: Terminal Operating Costs *

Category	Annual Salary	Positions	Annual Cost
Superintendent (1)	$85,000	0.5	$42,500
Supervisor (2)	$60,000	2	$120,000
Traffic Director (2)	$50,000	2	$100,000
Cashier (2)	$25,000	2	$50,000
Admin. Salaries (3)	$50,000	1	$50,000
Taxes & Benefits (4)	$94,500	1	$94,500
Insurance & Misc	$20,000	1	$20,000
Office Costs	$15,000	1	$15,000
Dock Maintenance	$35,000	1	$35,000
Total Operating Costs per Terminal			**$527,000**

* Notes

(1) One position per route; allocate one-half to each terminal
(2) One position per shift at each terminal.
(3) Portion of full-time positions allocated to ferry operations.
(4) 35% of salary costs.

Vessel Operating Cost Assumptions

Potential operating costs for each type of vessel were estimated based on a typical service year of 5,300 operating hours. Since most vessel operating costs are related to the annual hours of service, a typical hourly cost rate was developed for each vessel type. These hourly rates were multiplied by the annual operating hours that were calculated from the demonstration route operating scenarios to yield an estimate of vessel operating costs for each vessel on each route. Although the actual costs may vary among routes, this approach provided a consistent basis for the evaluation process.

The vessel operating costs were based on the following assumptions:

- Hours of operation for each of the scenarios for the demonstration pairs may differ based on the operating scenarios described.
- Crew requirements are shown in the above Demonstration Vessels section. Crew salary costs were based on Chesapeake Bay area salary rates, 35 percent add-on for employer taxes and employee benefits, and an assumed 15 percent add-on for over time expenses.
- Fuel consumption will be 300 gallons per hour for the displacement monohull vessel and 700 gallons per hour for the fast ferry catamaran vessel.
- Fuel is $1.20 per gallon.
- Maintenance will be contracted out for $200,000 per year for the displacement monohull and $300,000 total per year for the fast ferry catamaran.
- Insurance will cost $50,000 per year for the displacement monohull and $125,000 total per year for the fast ferry catamaran.

The estimated operating costs were $545 per vessel hour for a displacement hull ferry (20 to 22 knots operating speed) and $1,060 per vessel hour for a high-speed catamaran (40 to 41 knot operating speed). Detailed breakdowns of these hourly rates are shown in Tables 9-8 and 9.9.

Table 9-8: Conventional Displacement Vessel Operating Costs

Crew	**Position**	**Hourly**	**Per Boat**	**Total hrs/yr**	**Annual Cost**
	Captain	$33.65	1	5,300	$178,365
	Engineer	$19.23	1	5,300	$101,923
	Seaman	$10.02	2	5,300	$127,404
	Base Wages				$407,692
	Overtime			15%	$91,731
	Taxes and benefits			35%	$174,798
	Total Yearly Crewing Costs (rounded value)				**$674,000**
Fuel	**Total hours/year**	**Gallons/hour**	**Fuel Price**		**Annual Cost**
	5,300	300	$1.20		$1,908,000
	Total Fuel Costs				**$1,908,000**
Other	**Type of Cost**				**Annual Cost**
	Maintenance				$200,000
	Insurance				$50,000
	Miscellaneous				$50,000
	Total Other Costs				**$300,000**
Total	**Total Annual Vessel Operation Cost (rounded value)**				**$2,882,000**
Hourly Rate	**Hourly Operating Cost for Conventional Displacement Hull Vessel**				**$545**

Table 9-9: High-speed Catamaran Vessel Operating Costs

Crew	**Position**	**Hourly**	**Per Boat**	**Total hrs/yr**	**Annual Cost**
	Captain	$33.65	1	5,300	$178,365
	Engineer	$19.23	1	5,300	$101,923
	Seaman	$10.02	2	5,300	$127,404
	Base Wages				$407,692
	Overtime			15%	$91,731
	Taxes and benefits			35%	$174,798
	Total Yearly Crewing Costs (rounded value)				**$674,000**
Fuel	**Total hours/year**	**Gallons/hour**	**Fuel Price**		**Annual Cost**
	5,300	700	$1.20		$4,452,0000
	Total Fuel Costs				**$4,452,0000**
Other	**Type of Cost**				**Annual Cost**
	Maintenance				$300,000
	Insurance				$125,000
	Miscellaneous				$50,000
	Total Other Costs				**$475,000**
Total	**Total Annual Vessel Operation Cost (rounded value)**				**$5,601,000**
Hourly Rate	**Hourly Operating Cost for Conventional Displacement Hull Vessel**				**$1,060**

Potential Revenues

Potential revenues were calculated for each of the demonstration routes and service scenarios based on the demands from Step 6 – Potential Ridership, and the fare structure described in the Fare Structures section above. This calculation involved adjusting the potential ridership by the actual capacity provided by the proposed operating scenario. For instance, the summer weekend demand projected for the Chesapeake Beach – Cambridge route would require three or more vessels to be fully accommodated, but no more than two vessels would be needed at other times. It was decided that it would not be cost effective to purchase and maintain one or two extra vessels for use on only 20 or 30 days per year, and then have them tied up the remainder of the time. In this instance, the actual ridership used for the revenue calculation was limited to the maximum capacity of auto and truck spaces provided by two vessels.

Net Operating Revenues

Net operating revenues were also calculated for each of the demonstration routes and scenarios. These revenues were determined by subtracting the operating costs from the potential revenues. Capital costs for the terminal building, roadway improvements, and vessels were excluded from these calculations.

OPERATING SCENARIOS AND COST SUMMARIES

Based on the above descriptions and assumptions, operating scenarios, capital costs, operating costs, potential revenues, and net operating revenues were calculated for both of the vessel categories in each of the demonstration pairs. The projected financial results for each demonstration route are summarized in the sections below.

Canton to Rock Hall

The Canton (Baltimore) to Rock Hall demonstration route would be operated with a single vessel for either the 22 knot displacement hull ferry or the 41 knot catamaran. The operating hours for each season were scaled to the projected traffic to avoid running nearly empty boats in low demand periods. Since crewing costs are a significant portion of the operating expenses, care was taken to schedule the operations so that they could be covered with a single shift per day with limited overtime.

The operating scenarios for both the 22 knot displacement hull ferry and the 41 knot catamaran ferry are shown in Table 9-10. This table shows the details of the operating plans for weekdays and for weekend days by season. The table lists the number of boats assigned, the daily hours of operation, the number of trips (total) per day, the average capacities for cars and trucks per trip, the total daily supply of automobile and truck spaces delivered by the ferry, and the low and high range of estimated demand. As previously noted, both the displacement hull ferry and the catamaran were assumed to have the same vehicle capacity: up to 54 autos and no trucks, or a combination of up to 6 heavy trucks (each counting as 3 autos) and 36 autos.

Capital costs for the Canton to Rock Hall demonstration route are shown in Table 9-11. Capital costs for the terminal and roadway improvements would be $9.3 million with either vessel. Vessel costs would be $8.5 million for the displacement hull ferry and $35 million for the high-speed catamaran. Total capital costs would be $17.8 million for the displacement hull ferry scenario and $44.3 million for the high-speed catamaran scenario.

Tables 9.12 and 9.13 show the estimated annual operating costs and projected net operating revenues for the Canton to Rock Hall demonstration route, respectively. A conventional 22 knot ferry would likely generate about $2.8 million in annual operating costs and $1.0 to $1.3 million in revenues for a net operating loss of - $1.5 to -$1.8 million per year. For a high-speed ferry on this route, operating costs would be higher and revenues would be lower than the conventional ferry, resulting in annual operating losses of $-3.3 to - $3.5 million.

Table 9-10: Canton to Rock Hall Operating Scenarios

Operating Plan for 22 knot Conventional Displacement Hull Ferry

Canton - Rock Hall Vehicles per boat = 54 Additional time added per trip (hrs)= 0.5
Trucks = 6 Trip time (hours)= 1.67

Combination		Weekday							Weekend					
Cars		Boats	Hours/day	Trips	Cars/Trip	Supply	Demand		Boats	Hours/day	Total Trips	Cars/Trip	Supply	Demand
	Summer	1	9	4	39	156	80 - 110		1	9	4	48	192	140 - 160
	Shoulder	1	9	4	42	168	70 - 90		1	9	4	48	192	110 - 130
	Off-Season	1	9	4	42	168	60 - 80		1	9	4	48	192	80 - 110
Trucks		Boats	Hours/day	Total Trips	Trucks/Trip	Supply	Demand		Boats	Hours/day	Total Trips	Trucks/Trip	Supply	Demand
	Summer	1	9	4	5	20	15 - 20		1	9	4	2	8	5 - 5
	Shoulder	1	9	4	4	16	10 - 15		1	9	4	2	8	5 - 5
	Off-Season	1	9	4	4	16	10 - 15		1	9	4	2	8	5 - 5

Operating Plan for 41 knot High Speed Catamaran Hull Ferry

Canton - Rock Hall Vehicles per boat = 54 Additional time added per trip (hrs)= 0.5
Trucks = 6 Trip time (hours)= 1.45

Combination		Weekday							Weekend					
Cars		Boats	Hours/day	Trips	Cars/Trip	Supply	Demand		Boats	Hours/day	Total Trips	Cars/Trip	Supply	Demand
	Summer	1	8	4	48	192	30 - 50		1	8	4	48	192	40 - 60
	Shoulder	1	8	4	48	192	25 - 40		1	8	4	48	192	30 - 50
	Off-Season	1	8	4	48	192	20 - 40		1	8	4	48	192	25 - 40
Trucks		Boats	Hours/day	Total Trips	Trucks/Trip	Supply	Demand		Boats	Hours/day	Total Trips	Trucks/Trip	Supply	Demand
	Summer	1	8	4	2	8	5 - 5		1	8	4	2	8	5 - 5
	Shoulder	1	8	4	2	8	5 - 5		1	8	4	2	8	5 - 5
	Off-Season	1	8	4	2	8	5 - 5		1	8	4	2	8	5 - 5

Table 9-11: Canton to Rock Hall Capital Costs

Vessel Costs				Terminal and Roadway Improvements Costs		Total Capital Costs
Type of Vessel	Number of Vessels	Cost per Vessel	Total Vessel Cost	Western Terminal	Eastern Terminal	
Conventional Displacement Hull	1	$8.5 million	$8.5 million	$4.8 million	$4.5 million	**$17.8 million**
Fast Ferry Catamaran	1	$35 million	$35.0 million	$4.8 million	$4.5 million	**$44.3 million**

Table 9-12: Canton to Rock Hall Total Operating Costs

Vessel Type	Annual Vessel Hours	Vessel Operating Costs	Total Terminal Operating Costs *	Total Annual Operating Costs
Conventional Displacement Hull Ferry	3,300	$1,790,000	$1,054,000	$2,844,000
Fast Ferry Catamaran	2,900	$3,095,000	$1,054,000	$4,149,000

* Terminal operating costs were calculated in the Operation Costs portion of the Description of Operating Scenarios and Cost Summaries section. The same terminal operating cost ($527,000/year) has been used for each of the terminal locations. Assuming two terminals per demonstration pair.

Table 9-13: Canton to Rock Hall Net Operating Revenue Summary

Vessel Type	Total Annual Revenues		Total Annual Operating Costs	Total Annual Operating Revenues *	
	Low	High		Low	High
Conventional Displacement Hull Ferry	$1,013,000	$1,325,000	$2,844,000	($1,831,000)	($1,519,000)
Fast Ferry Catamaran	$567,000	$816,000	$4,149,000	($3,582,000)	($3,333,000)

* Total annual operating revenues do not include capital costs.

Chesapeake Beach to Cambridge

The Chesapeake Beach to Cambridge demonstration route would require two vessels to provide a reasonable level of service under either the conventional or high-speed ferry scenarios. As shown in the operating scenario summary in Table 9-14, even two conventional vessels would not be able to accommodate the projected weekend demand. However, it was decided not to recommend a third vessel for the analysis of this route because it would not be needed for weekday service, resulting in excessive capital and maintenance costs that could not be recovered by the relatively small increment of additional revenues generated by the weekend service.

Capital costs for the Chesapeake Beach to Cambridge demonstration route would be $26.9 million for conventional ferry service and $79.9 million for high-speed ferry operation. Terminal and roadway improvement costs would be $9.9 million under either scenario with the difference being the costs of the vessels. Capital costs are summarized in Table 9-15.

Annual operating costs for this route are presented in Table 9-16. The vessel operating hours in the second column of Table 9-16 are three to four times those shown previously for the Canton to Rock Hall route reflecting the higher traffic demand generated by this route. Net operating revenues are summarized in Table 9-17 and range from near break-even conditions for a conventional ferry (-$79,000 to +$305,000) to net operating losses of -$0.9 to -$1.6 million for a high-speed ferry.

Table 9-14: Chesapeake Beach to Cambridge Operating Scenarios

Operating Plan for 22 knot Conventional Displacement Hull Ferry

Ches - Cam — Vehicles per boat = 54; Trucks = 6

Additional time added per trip (hrs)= 0.5; Trip time (hours)= 1.37

Combination		Weekday						Weekend					
Cars		Boats	Hours/day	Trips	Cars/Trip	Supply	Demand	Boats	Hours/day	Total Trips	Cars/Trip	Supply	Demand
	Summer	2	18	18	36	648	450 - 550	2	18	18	45	810	2,500 - 2,700
	Shoulder	2	16	16	36	576	400 - 450	2	18	18	48	864	2,000 - 2,300
	Off-Season	2	16	16	36	576	350 - 400	2	18	18	48	864	1,500 - 2,000
Trucks		Boats	Hours/day	Total Trips	Trucks/Trip	Supply	Demand	Boats	Hours/day	Total Trips	Trucks/Trip	Supply	Demand
	Summer	2	18	18	6	108	125 - 150	2	18	18	3	54	75 - 100
	Shoulder	2	16	16	6	96	100 - 125	2	18	18	2	36	40 - 60
	Off-Season	2	16	16	6	96	90 - 120	2	18	18	2	36	40 - 60

Operating Plan for 41 knot High Speed Catamaran Hull Ferry

Ches - Cam — Vehicles per boat = 54; Trucks = 6

Additional time added per trip (hrs)= 0.5; Trip time (hours)= 0.91

Combination		Weekday						Weekend					
Cars		Boats	Hours/day	Trips	Cars/Trip	Supply	Demand	Boats	Hours/day	Total Trips	Cars/Trip	Supply	Demand
	Summer	1	18	12	36	432	250 - 300	2	18	24	48	1,152	900 - 1,000
	Shoulder	1	16	11	36	396	100 - 220	2	16	22	48	1,056	700 - 800
	Off-Season	1	12	8	36	288	100 - 200	1.5	16	17	48	792	600 - 700
Trucks		Boats	Hours/day	Total Trips	Trucks/Trip	Supply	Demand	Boats	Hours/day	Total Trips	Trucks/Trip	Supply	Demand
	Summer	1	18	12	6	72	50 - 80	2	18	24	2	48	20 - 40
	Shoulder	1	16	11	6	66	40 - 70	2	16	22	2	44	15 - 30
	Off-Season	1	12	8	6	48	40 - 60	1.5	16	17	2	33	10 - 25

Table 9-15: Chesapeake Beach to Cambridge Capital Costs

Vessel Costs				Terminal and Roadway Improvements Costs		Total Capital Costs
Type of Vessel	Number of Vessels	Cost per Vessel	Total Vessel Cost	Western Terminal	Eastern Terminal	
Conventional Displacement Hull	2	$8.5 million	$17.0 million	$5.0 million	$4.9 million	**$26.9 million**
Fast Ferry Catamaran	2	$35.0 million	$70.0 million	$5.0 million	$4.9 million	**$79.9 million**

Table 9-16: Chesapeake Beach to Cambridge Total Operating Costs

Vessel Type	Annual Vessel Hours	Vessel Operating Costs	Total Terminal Operating Costs *	Total Annual Operating Costs
Conventional Displacement Hull	12,000	$6,566,000	$1,054,000	$7,620,000
Fast Ferry Catamaran	7,100	$7,539,000	$1,054,000	$8,593,000

* Terminal operating costs were calculated in the Operation Costs portion of the Description of Operating Scenarios and Cost Summaries section. The same terminal operating cost ($527,000/year) has been used for each of the terminal locations. Assuming two terminals per demonstration pair.

Table 9-17: Chesapeake Beach to Cambridge Net Operating Revenue Summary

Vessel Type	Total Annual Revenues		Total Annual Operating Costs	Total Annual Operating Revenues *	
	Low	High		Low	High
Conventional Displacement Hull	$7,541,000	$7,925,000	$7,620,000	($79,000)	$305,000
Fast Ferry Catamaran	$6,996,000	$8,837,625	$8,593,000	($1,597,000)	($908,000)

* Total annual operating revenues do not include capital costs.

Solomons Island to Cambridge

The operations for the Solomons Island to Cambridge demonstration route would require two conventional displacement hull ferries or a single high-speed catamaran ferry. As with the Chesapeake Beach to Cambridge demonstration route discussed above, even two conventional ferries would leave some unsatisfied weekend demand. The operating scenarios are shown in Table 9-18.

As indicated in Table 9-19, capital costs for the Solomons Island to Cambridge demonstration route range from $27 million for the conventional ferry to $45 million for a high-speed catamaran scenario. Terminal and highway improvements would account for $11 million in both cases.

Annual operating costs and net operating losses would be higher for conventional ferries than for a single high-speed ferry on this route. As shown in Tables 9.20 and 9.21, the two conventional ferries would generate $6.2 million in annual operating costs compared to $5.7 million for the single high-speed catamaran, compared to revenues of $3.6 to $3.7 million and $3.1 to $3.3 million respectively. Net operating revenues would be -$2.5 to -$2.6 million for conventional ferries compared to -$2.4 to -$2.6 million for high-speed operations.

Table 9-18: Solomons Island to Cambridge Operating Scenarios

Operating Plan for 22 knot Conventional Displacement Hull Ferry

Sol - Cam   Vehicles per boat = 54   Trucks = 10

Additional time added per trip (hrs)= 0.5

Trip time (hours)= 2.01

Combination		Weekday							Weekend					
Cars		Boats	Hours/day	Trips	Cars/Trip	Supply	Demand		Boats	Hours/day	Total Trips	Cars/Trip	Supply	Demand
	Summer	2	16	12	36	432	100 - 125		2	18	14	48	672	900 - 1,000
	Shoulder	2	12	8	36	288	80 - 100		2	16	12	48	576	800 - 900
	Off-Season	2	12	8	36	288	70 - 90		2	12	8	48	384	600 - 700
Trucks		Boats	Hours/day	Total Trips	Trucks/Trip	Supply	Demand		Boats	Hours/day	Total Trips	Trucks/Trip	Supply	Demand
	Summer	2	16	12	6	72	80 - 100		2	18	14	2	28	40 - 50
	Shoulder	2	12	8	6	48	70 - 80		2	16	12	2	24	30 - 40
	Off-Season	2	12	8	6	48	60 - 70		2	12	8	2	16	30 - 40

Operating Plan for 41 knot High Speed Catamaran Hull Ferry

Sol - Cam   Vehicles per boat = 54   Trucks = 6

Additional time added per trip (hrs)= 0.5

Trip time (hours)= 1.32

Combination		Weekday							Weekend					
Cars		Boats	Hours/day	Trips	Cars/Trip	Supply	Demand		Boats	Hours/day	Total Trips	Cars/Trip	Supply	Demand
	Summer	1	8	4	36	144	40 - 60		1	18	9	45	405	400 - 500
	Shoulder	1	8	4	36	144	30 - 50		1	16	8	48	384	300 - 400
	Off-Season	1	8	4	36	144	30 - 50		1	12	6	48	288	250 - 300
Trucks		Boats	Hours/day	Total Trips	Trucks/Trip	Supply	Demand		Boats	Hours/day	Total Trips	Trucks/Trip	Supply	Demand
	Summer	1	8	4	6	24	50 - 60		1	18	9	3	27	20 - 30
	Shoulder	1	8	4	6	24	40 - 50		1	16	8	2	16	15 - 25
	Off-Season	1	8	4	6	24	30 - 40		1	12	6	2	12	10 - 20

Table 9-19: Solomons Island to Cambridge Capital Costs

Vessel Costs				Terminal and Roadway Improvements Costs		Total Capital Costs
Type of Vessel	Number of Vessels	Cost per Vessel	Total Vessel Cost	Western Terminal	Eastern Terminal	
Conventional Displacement Hull	2	$8.5 million	$17.0 million	$5.1 million	$4.9 million	**$27.0 million**
Fast Ferry Catamaran	1	$35 million	$35.0 million	$5.1 million	$4.9 million	**$45.0 million**

Table 9-20: Solomons Island to Cambridge Total Operating Costs

Vessel Type	Annual Vessel Hours	Vessel Operating Costs	Total Terminal Operating Costs *	Total Annual Operating Costs
Conventional Displacement Hull	9,500	$5,175,000	$1,054,000	$6,229,000
Fast Ferry Catamaran	4,400	$4,643,000	$1,054,000	$5, 697,000

* Terminal operating costs were calculated in the Operation Costs portion of the Description of Operating Scenarios and Cost Summaries section. The same terminal operating cost ($527,000/year) has been used for each of the terminal locations. Assuming two terminals per demonstration pair.

Table 9-21: Solomons Island to Cambridge Operating Revenue Calculations

Vessel Type	Total Annual Revenues		Total Annual Operating Costs	Total Annual Operating Revenues *	
	Low	High		Low	High
Conventional Displacement Hull	$3,615,000	$3,726,000	$6,229,000	($2,614,000)	($2,503,000)
Fast Ferry Catamaran	$3,120,000	$3,311,000	$5,697,000	($2,577,000)	($2,386,000)

* Total annual operating revenues do not include capital costs.

Solomons Island to Crisfield

The relatively low traffic demand on the Solomons Island to Crisfield means that this route could be operated with a single conventional or high-speed vessel, and for only 10 to 12 hours per day compared to the 12 to 18 hour operating days on some of the other routes. These adjustments were incorporated into the operating plan shown in Table 9-22 to match service capacities provided with projected traffic demands by season.

Capital costs for this route range from $18.2 million for a conventional ferry to $44.7 million for a high-speed ferry operation as shown in Table 9-23. Annual operating costs are shown in Table 9-24, and net operating revenues are presented in Table 9-25. The projections for this route indicate annual operating losses of -$2.3 to -$2.7 million for a conventional ferry to -$3.9 to -$4.4 million for a high-speed ferry.

Table 9-22: Solomons Island to Crisfield Operating Scenarios

Operating Plan for 22 knot Conventional Displacement Hull Ferry

Sol - Crisfield — Vehicles per boat = 54; Trucks = 10

Additional time added per trip (hrs)= 0.5

Trip time (hours)= 2.41

Combination		Weekday						Weekend					
Cars		Boats	Hours/day	Trips	Cars/Trip	Supply	Demand	Boats	Hours/day	Total Trips	Cars/Trip	Supply	Demand
	Summer	1	12	4	45	180	40 - 60	1	12	4	45	180	120 - 200
	Shoulder	1	12	4	45	180	30 - 50	1	12	4	45	180	100 - 150
	Off-Season	1	12	4	45	180	20 - 40	1	12	4	45	180	80 - 120
Trucks		Boats	Hours/day	Total Trips	Trucks/Trip	Supply	Demand	Boats	Hours/day	Total Trips	Trucks/Trip	Supply	Demand
	Summer	1	12	4	3	12	10 - 20	1	12	4	3	12	10 - 10
	Shoulder	1	12	4	3	12	10 - 20	1	12	4	3	12	10 - 10
	Off-Season	1	12	4	3	12	10 - 20	1	12	4	3	12	10 - 10

Operating Plan for 41 knot High Speed Catamaran Hull Ferry

Sol - Crisfield — Vehicles per boat = 54; Trucks = 6

Additional time added per trip (hrs)= 0.5

Trip time (hours)= 1.95

Combination		Weekday						Weekend					
Cars		Boats	Hours/day	Trips	Cars/Trip	Supply	Demand	Boats	Hours/day	Total Trips	Cars/Trip	Supply	Demand
	Summer	1	10	4	45	180	5 - 10	1	10	4	45	180	60 - 100
	Shoulder	1	10	4	45	180	5 - 10	1	10	4	45	180	50 - 90
	Off-Season	1	10	4	45	180	5 - 10	1	10	4	45	180	40 - 70
Trucks		Boats	Hours/day	Total Trips	Trucks/Trip	Supply	Demand	Boats	Hours/day	Total Trips	Trucks/Trip	Supply	Demand
	Summer	1	10	4	3	12	5 - 10	1	10	4	3	12	5 - 10
	Shoulder	1	10	4	3	12	5 - 10	1	10	4	3	12	5 - 10
	Off-Season	1	10	4	3	12	5 - 10	1	10	4	3	12	5 - 10

Table 9-23: Solomons Island to Crisfield Capital Costs

Vessel Costs				Terminal and Roadway Improvements Costs		Total Capital Costs
Type of Vessel	Number of Vessels	Cost per Vessel	Total Vessel Cost	Western Terminal	Eastern Terminal	
Conventional Displacement Hull	1	$8.5 million	$8.5 million	$5.1 million	$4.6 million	**$18.2 million**
Fast Ferry Catamaran	1	$35 million	$35.0 million	$5.1 million	$4.6 million	**$44.7 million**

Table 9-24: Solomons Island to Crisfield Total Operating Costs

Vessel Type	Annual Vessel Hours	Vessel Operating Costs	Total Terminal Operating Costs *	Total Annual Operating Costs
Conventional Displacement Hull	4,400	$2,387,000	$1,054,000	$3,441,000
Fast Ferry Catamaran	3,700	$3,869,000	$1,054,000	$4,923,000

* Terminal operating costs were calculated in the Operation Costs portion of the Description of Operating Scenarios and Cost Summaries section. The same terminal operating cost ($527,000/year) has been used for each of the terminal locations. Assuming two terminals per demonstration pair.

Table 9-25: Solomons Island to Crisfield Net Operating Revenue Summary

Vessel Type	Total Annual Revenues		Total Annual Operating Costs	Total Annual Operating Revenues *	
	Low	High		Low	High
Conventional Displacement Hull	$790,000	$1,120,000	$3,441,000	($2,651,000)	($2,321,000)
Fast Ferry Catamaran	$524,000	$974,000	$4,923,000	($4,399,000)	($3,949,000)

* Total annual operating revenues do not include capital costs.

COMPARISON OF OPERATING SCENARIOS AND COST SUMMARIES

Table 9-26 and Figure 9-3 summarize the operating revenues and costs for the four demonstration ferry routes.

Table 9-26: Summary of Annual Revenues, Costs and Net Revenues

Annual Revenues

Route	Ferry type	Low	High
Canton - Rock Hall	Conventional	$1,013,000	$1,325,000
	High Speed	$567,000	$816,000
Chesapeake Beach-Cambridge	Conventional	$7,541,000	$7,925,000
	High Speed	$6,996,000	$7,685,000
Solomons Is. - Cambridge	Conventional	$3,615,000	$3,726,000
	High Speed	$3,120,000	$3,311,000
Solomons Is. - Crisfield	Conventional	$790,000	$1,120,000
	High Speed	$524,000	$974,000

Annual Operating Costs

Route	Ferry type	Low	High
Canton - Rock Hall	Conventional	$2,844,000	$2,844,000
	High Speed	$4,149,000	$4,149,000
Chesapeake Beach-Cambridge	Conventional	$7,620,000	$7,620,000
	High Speed	$8,593,000	$8,593,000
Solomons Is. - Cambridge	Conventional	$6,229,000	$6,229,000
	High Speed	$5,697,000	$5,697,000
Solomons Is. - Crisfield	Conventional	$3,441,000	$3,441,000
	High Speed	$4,923,000	$4,923,000

Note: Low and high operating costs are assumed equal.

Net Operating Income (Revenues - Expenses)

Route	Ferry type	Low	High
Canton - Rock Hall	Conventional	-$1,831,000	-$1,519,000
	High Speed	-$3,582,000	-$3,333,000
Chesapeake Beach-Cambridge	Conventional	-$79,000	$305,000
	High Speed	-$1,597,000	-$908,000
Solomons Is. - Cambridge	Conventional	-$2,614,000	-$2,503,000
	High Speed	-$2,577,000	-$2,386,000
Solomons Is. - Crisfield	Conventional	-$2,651,000	-$2,321,000
	High Speed	-$4,399,000	-$3,949,000

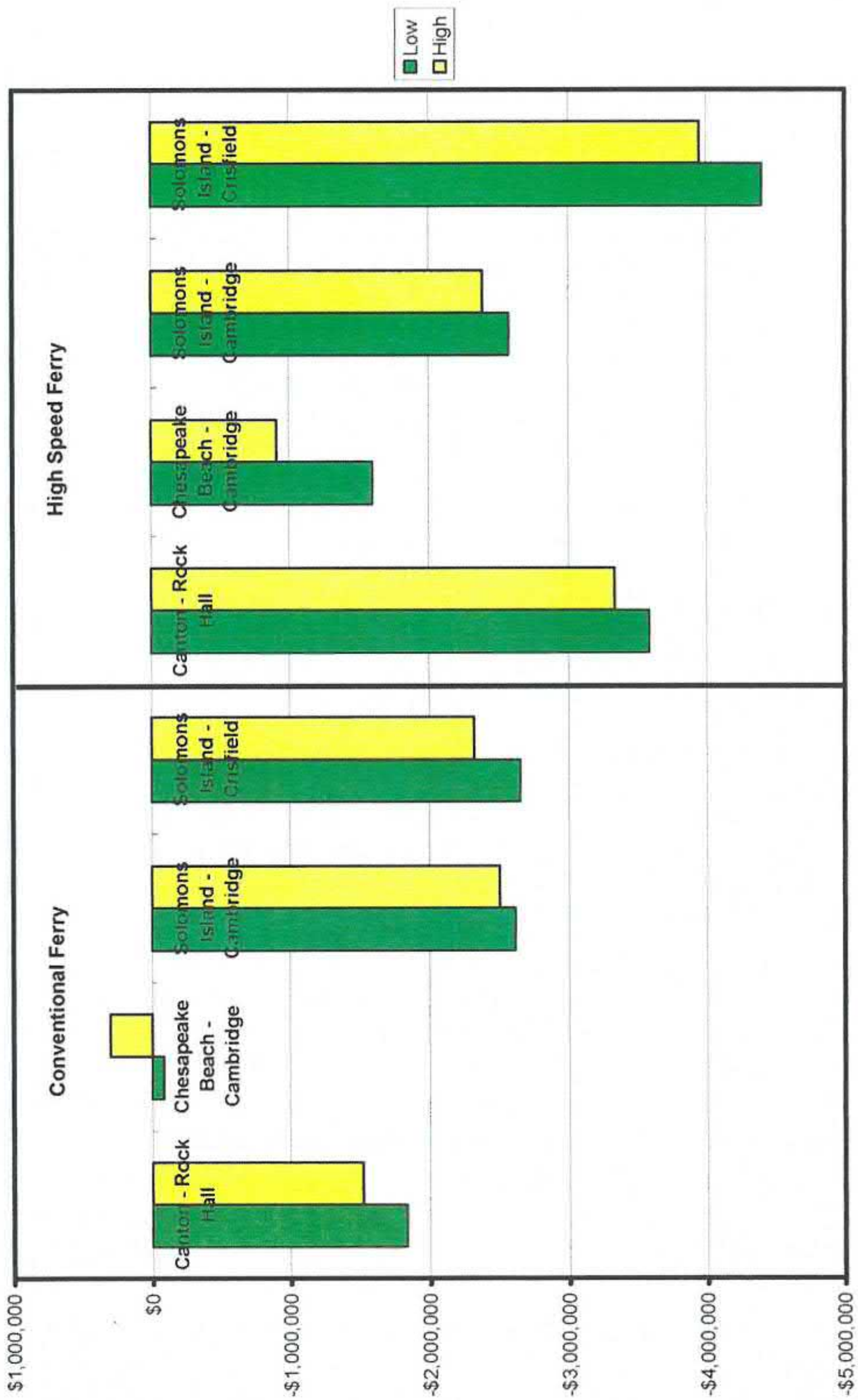


Figure 9-3: Comparison of Annual Net Operating Revenues by Demonstration Route

Step 10 – Assess Public Benefits of Service

Objective: To evaluate the public transportation and economic benefits of the proposed ferry service alternatives.

Outcome: The product of this task is an assessment of the direct and indirect public benefits of a ferry route across the Chesapeake Bay.

Method: Drawing on the analysis and results of Tasks 6.1 through 6.7, we developed system level estimates of potential user and non-user benefits associated with each of the four demonstration routes. For users, the analysis focused on travel time and transportation cost savings, including both direct out-of-pocket costs for fares and tolls and cumulative indirect costs for gas, oil, tires, wear-and-tear on vehicles using standard per mile costs for passenger cars and commercial vehicles. Economic benefits included direct benefits to the local economy of salaries for ferry personnel, fuel purchases, supplies, etc., and indirect economic benefits resulting from increased accessibility and increased revenues from tourist related businesses. The economic benefit analysis drew heavily on a recent similar study of a proposed Mid-Chesapeake Bay Ferry route between Reedville, VA and Virginia's Eastern Shore.

DIRECT FERRY USER BENEFITS

This section summarizes the direct benefits to ferry users of each of the four demonstration routes.

Time and Cost Savings

The most obvious benefits to ferry users are the savings in travel time and travel costs provided via the ferry service compared to drive-around options. The ferry may not produce the shortest travel time path between the origin and destination of a trip if the driver could maintain the posted speed limit the whole way, however, growing congestion on the Bay Bridge can add significant time to a cross-Bay trip, particularly on summer weekends. Although ferry users may face some delay to board the boat, avoiding an hour or more of start-and-stop driving on congested freeways can be a powerful incentive for taking the ferry.

Total travel time savings were calculated for each ferry route by computing the difference in travel times between the ferry and the Bay Bridge for the users' origins and destinations, and then multiplying by the number of trips between those points assigned by the diversion model to the ferry. Similar computations were made for travel distance savings, and the distances multiplied by the IRS allowable rate of $0.375 per mile to calculate cost savings for passenger cars and $1.00 per mile for commercial trucks.

Figure 10-1 illustrates the relative annual hours of travel time saved by ferry users by demonstration route. The time savings are weighted by the number of estimated vehicles carried on each route. As Figure 10-1 shows, the Chesapeake Beach / Cambridge route provides the greatest total time savings benefits to ferry users, largely because it also has the highest ridership potential.

In addition to time savings, there is also the savings in travel costs associated with not driving around the north or south end of the Chesapeake Bay. For many users, the ferry provides a more direct route from point to point than the over-the-road route via the Bay Bridge. Savings in driving distances translates to lower fuel costs, and less wear-and-tear on the vehicle.

Total savings in ferry user travel costs are shown in Figure 10-2.

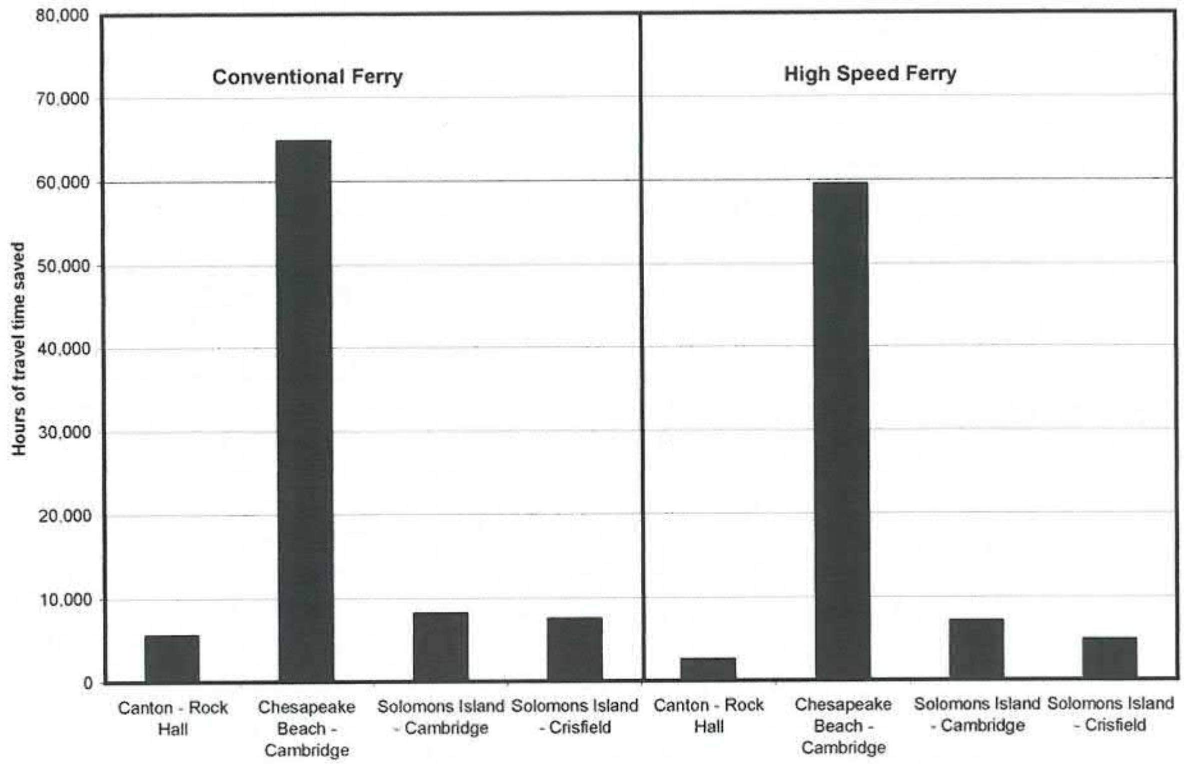


Figure 10-1. Total Annual Times Savings for Ferry Users by Route

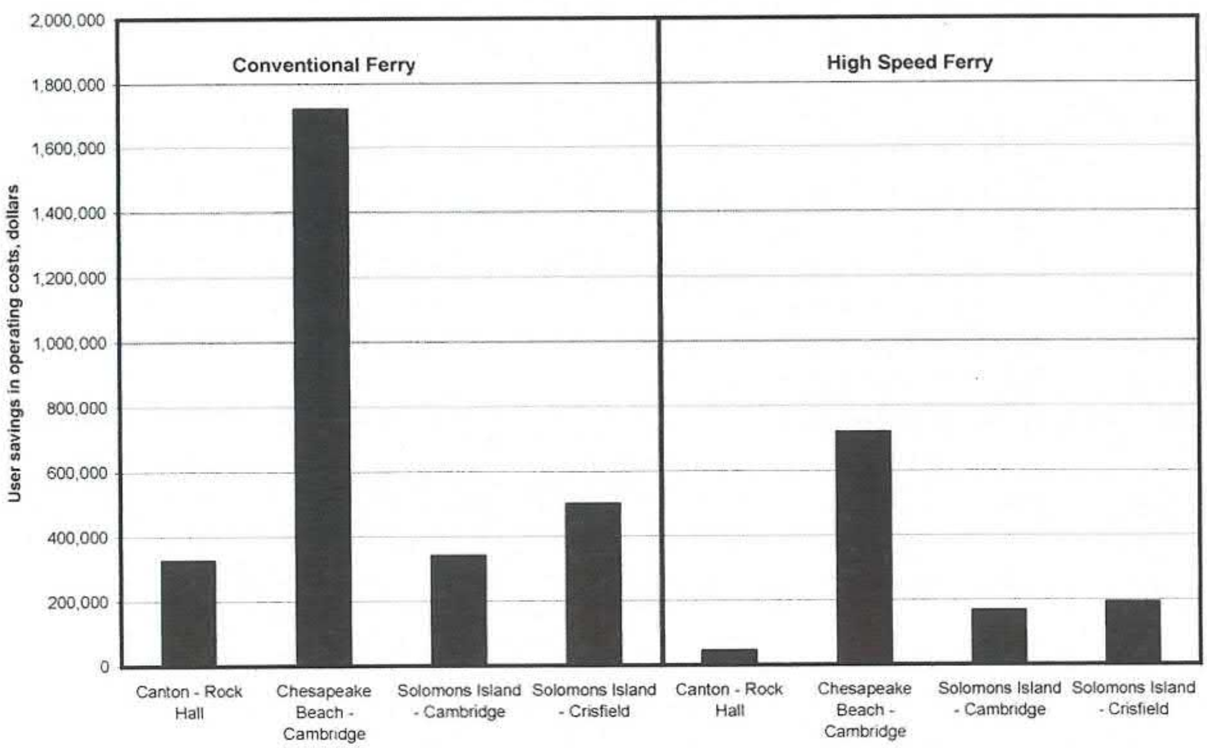


Figure 10-2: Total Annual Vehicle Operating Cost Savings for Ferry Users by Route

ECONOMIC BENEFITS

The prospect of economic benefits to the counties of the Lower Eastern Shore is a major impetus to continued interest in a cross-Bay ferry operation. This section discusses both direct and indirect benefits of the proposed routes, and estimates an "order-of-magnitude" impact on the local economies.

Benefits to Eastern Shore Businesses Due to Improved Access To Markets

Transportation improvements that reduce travel times for businesses result in increased productivity for those businesses. Like the time savings discussed above for travelers , local businesses and industries on the Eastern Shore would benefit from shorter travel times to their mainland markets, particularly during peak congestion periods on the Bay Bridge. Trucks which avoid start-and-stop congestion on the Bay Bridge by taking a ferry save their owners not only the direct costs associated with the driver's time and vehicle operating costs, they also save extra costs from missed delivery times and fender-bender accidents common in congested situations.

Even small changes in average travel times can be significant to many businesses, particularly those involved in wholesale trade supplying major metropolitan areas like Washington, DC and Baltimore, MD. Recent estimates reported by the trucking industry indicate operating costs for commercial tractor-trailer truck combinations are $1.00 to $1.25 per mile and $60 to $100 per hour. A quick, shorter route across the Chesapeake Bay could realize cost savings and thus could be integrated into a company's planned expansion, new equipment and new hires to expand marketing for the company's product.

Business Benefits by Route

Table 10-1 summarizes the potential business benefits of cross-Bay ferry service for each of the four demonstration routes. This table shows the estimated annual dollar savings in transport costs to businesses for commercial truck trips by using the ferry, and the potential number of new jobs created by this savings. The Chesapeake Beach – Cambridge and Solomons Island – Cambridge ferry routes would provide the highest potential for business savings. As shown previously in Step 6, the forecasts indicated a demand of 100 to 125 commercial trucks on the Chesapeake Beach – Cambridge route in the shoulder season, and 70 to 80 trucks on the Solomons Island – Cambridge route with a 22 knot vessel. These estimates are conservatively consistent with the findings of a previous study[9] for a potential cross-Bay ferry route between Reedville, VA and an undesignated location on Virginia's Eastern Shore just south of this study area. Based on interviews conducted for that study with major businesses on the Eastern Shore, including some in Somerset, Worcester and Wicomico counties in Maryland, that study estimated a demand for about 150 truck trips per day across the Chesapeake Bay.

Applying an estimate of one-half hour per truck movement saved by the Chesapeake Beach – Cambridge ferry route yields about 15,000 hours saved annually in the movement of goods. The east side terminal at Cambridge is well placed to intercept truck traffic on US 50 from the prime agricultural areas of the Lower Eastern Shore. The west side terminal at Chesapeake Beach provides good access to the suburban Washington D. C. metro markets for poultry and agricultural producers from the Lower Eastern Shore.

[9] *Mid-Chesapeake Bay Ferry Feasibility Study: Phase I*, KJS Associates, Inc., Vanasse Hangen Brustlin, Inc., and FXM Associates, Bellevue, WA; 2000. *Phase II*, Vanasse Hangen Brustlin, Inc., PB Consult, Inc. and FXM Associates; Glen Allen, VA; 2001.

Table 10-1. Potential Annual Transport Cost Savings and Jobs Created on the Eastern Shore

Route	Ferry type	Annual Transport Savings to Businesses[1]	Potential New Jobs[2]
Canton - Rock Hall	Conventional	$200,000	2 to 4
	High-speed	$100,000	1 to 2
Chesapeake Beach - Cambridge	Conventional	$1,000,000	15 to 20
	High-speed	$600,000	8 to 12
Solomons Island - Cambridge	Conventional	$600,000	8 to 12
	High-speed	$500,000	5 to 10
Solomons Island - Crisfield	Conventional	$300,000	4 to 6
	High-speed	$100,000	1 to 2

[1]Rounded to nearest $100,000 per year.
[2]Assuming businesses expand due to savings in transport costs.

The reduced travel times and costs translates to about $1 million in potential new business sales by Eastern Shore producers and distributors from their ability to reach expanded geographic areas at the same distribution costs. This business expansion in turn could produce 15 to 20 new jobs in the Lower Eastern Shore counties.

The Solomons Island terminal, for the route connecting it with Cambridge, is located farther away from the Washington D. C. metro area and does not compete as well with the Bay Bridge for commercial truck traffic effectively as the Chesapeake Beach location. However, this route benefits from the access to agricultural production areas near Cambridge described above, and the convenient connection to US 301 across the Potomac River via the Governor Nice Memorial Bridge. A ferry on the Solomons Island – Cambridge route would generate annual savings of $500,000 to $600,000 for businesses and potentially create 5 to 12 new jobs.

For the Solomons Island – Crisfield route, the location of the Crisfield terminal at the very southern end of the Eastern Shore market greatly reduces its attractiveness for commercial truck traffic. Most truckers would have to back-track to reach the terminal, largely offsetting any potential travel time savings via the ferry. The Solomons Island – Crisfield route would generate 1 to 6 new jobs.

The Canton (Baltimore) – Rock Hall route serves an entirely different and much smaller market than the other routes. There is very little commercial truck traffic between the area north of the Chester River and Baltimore, and the potential time savings for ferry users is relatively small in comparison with the Bay Bridge unless the driver is going to a location very close to the terminals at either end. As such, the transport cost savings are small and the job creation potential would only be 1 to 4 new jobs in the Rock Hall vicinity.

Benefits to Tourist-related Businesses

A recent study[10] for a ferry service between the Northern Neck (counties) and the Eastern Shore of Virginia examined its potential economic effects from autos and passengers in these areas. Since it

[10] *Mid-Chesapeake Bay Ferry Feasibility Study, ibid.*

covered a similar service in a similar geographic area, the results of that study provide a good starting point for this Maryland ferry study.

The economic analysis for the *Mid-Chesapeake Bay Ferry Feasibility Study* was conducted by FXM Associates of Mattapoisett, MA. For that study, FXM conducted case studies in areas currently served by vehicle ferries[11] and applied the findings on expenditures by ferry passengers to the Virginia communities. FXM included surveys and interviews of selected business owners in two areas where vehicle ferry traffic is a significant portion of drive-by traffic: Woods Hole, Massachusetts, and the North Fork of Long Island, between Orient Point and Greenport, New York. FXM also conducted surveys of business owners in Galilee, Rhode Island, to determine the level of expenditures by persons traveling through that area by ferry.

The results of FXM's research showed that ferry passengers spend from about \$2.50 to \$6.00 per person in the local communities served by the ferry route. The lower figure applies in areas with only primarily transient services (gas stations, fast food restaurants, convenience stores, etc.) along routes leading to the ferry terminal, and the higher value in areas with established destination activities that attract people on their own in addition to drawing on pass-through trips on the ferry.

A major difficulty in estimating the economic benefits of the proposed ferry routes is that areas are already served by land routes via the Bay Bridge, and most of the ferry riders would simply be diverted from the drive-around option. Therefore, these diverted trips would not be new to the Eastern Shore, although they may be new to the specific terminal areas. Thus, the incremental economic effects of proposed routes (i.e., additional economic activity that would not otherwise occur without the ferry service) are highly speculative.

As Figure 10-3 shows, tourists using the Chesapeake Beach – Cambridge route could add as much as \$700,000 to the local economies of these two areas (combined). The values shown in Figure 10-3 are for recreation/tourist trips only, and do not include any contribution from spending by other users. This order-of-magnitude estimate translates to about 15 to 20 additional tourist-related jobs combined between the two communities served by that route.

The Solomons Island – Cambridge route would serve the tourist/recreation areas in and around both Solomons Island and Cambridge, and could generate about \$100,000 to \$230,000 in added tourist spending annually between the two. It could add 2 to 5 new tourist-related jobs. The Solomons Island – Crisfield and Canton (Baltimore) – Rock Hall routes would each produce less than \$100,000 annually in new tourist spending, and could add 1 to 2 new jobs each.

Benefits from Direct Ferry Service Expenditures

The most significant and directly quantifiable economic benefits of the proposed cross-Bay ferry would be to existing residents and businesses in the Chesapeake Bay communities through direct wages paid to ferry employees (most of whom would live in these communities), and direct purchases of goods and supplies such as office supplies , security and building maintenance.

Ferry Employee Salaries

Annual salaries paid to ferry employees would be a significantly higher economic benefit to ferry communities than the indirect benefits from increased tourism and better accessibility for businesses. As shown in Table 10-2, salaries paid to employees would range from \$1.0 million to \$1.8 million annually,

[11] The case studies are described in detail in the referenced report.

and most of this would be spent in the communities on both sides of the Bay for local retail purchases, food, restaurants, medical and other services, rent, etc. These expenditures would be a direct, new input to these regional economies, and considering the economic multiplier effects, could result in a net benefit to $2 to $3 million per year of tangible increases in economic revenues in these communities.

Staffing plans and salary expense calculations for each of the demonstration routes are shown in Step 9. Each of the terminals and each of the vessels were assumed to employ the same number of staff/crew, and the only difference among the routes is the number of vessel operating hours per year.

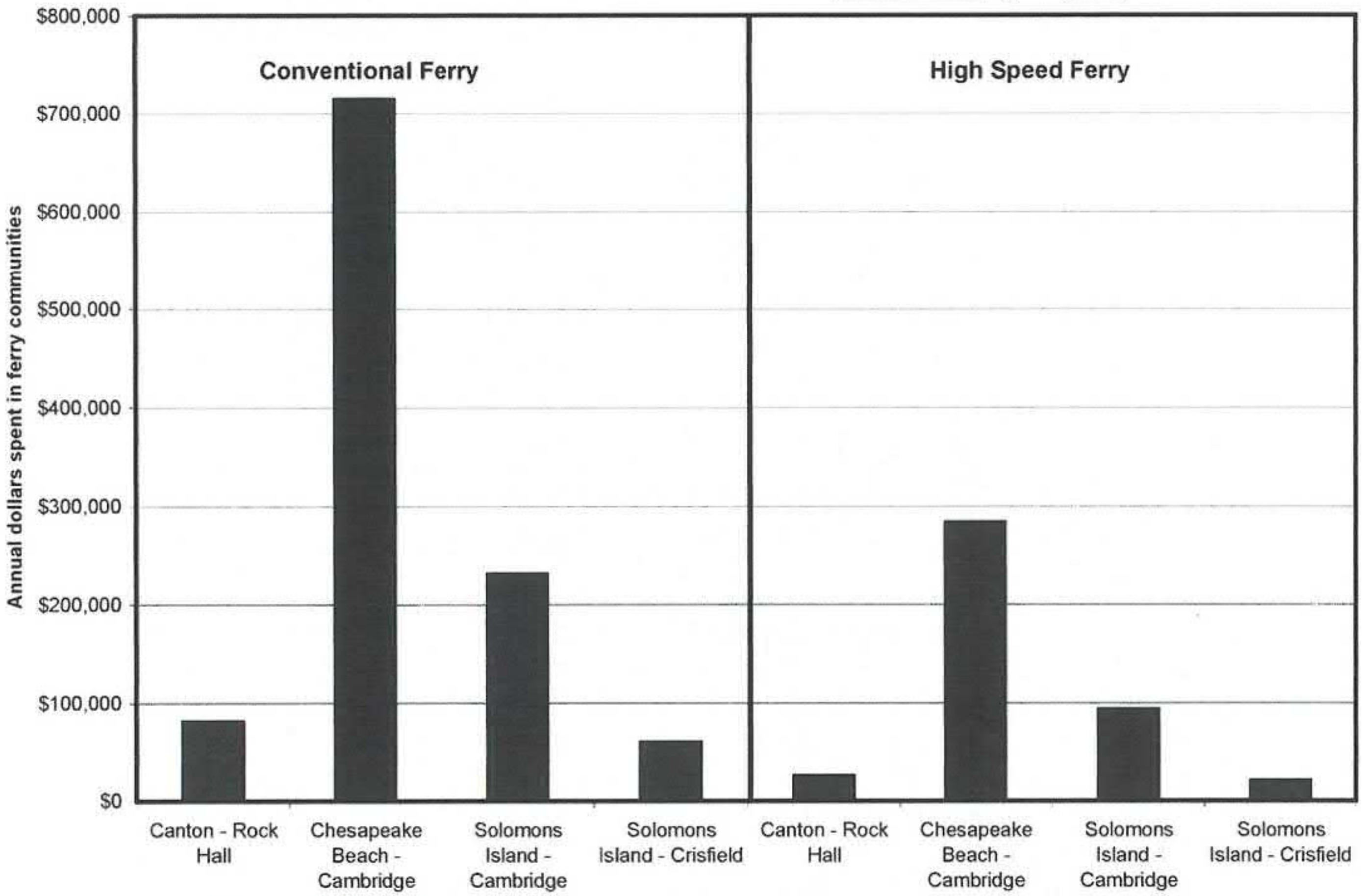


Figure 10-3. Potential Annual Economic Benefits to Local Communities from Ferry Tourists

Supplies and Services

There would be local purchases of fuel, supplies, and services for the boats and terminals on each route. The largest of these expenditures would be for fuel (up to $10 million per year), which would probably be purchased directly from a major fuel supplier and have little direct or indirect impact on the local economy. Besides fuel, other purchases are estimated at $50,000 per terminal ($100,000 per route) per year.

Table 10-2. Estimated Economic Benefits of Expenditures for Ferry Operations

Route	Ferry type	Ferry crew and terminal staff salaries[1]	Purchases other than fuel	Total input to local economies
Baltimore (Canton) - Rock Hall	Conventional	$1,000,000	$100,000	$1,100,000
	High-speed	$1,000,000	$100,000	$1,100,000
Chesapeake B. - Cambridge	Conventional	$1,800,000	$100,000	$1,900,000
	High-speed	$1,400,000	$100,000	$1,500,000
Solomons Is. - Cambridge	Conventional	$1,600,000	$100,000	$1,700,000
	High-speed	$1,100,000	$100,000	$1,200,000
Solomons Is. - Crisfield	Conventional	$1,100,000	$100,000	$1,200,000
	High-speed	$1,000,000	$100,000	$1,100,000

[1]Rounded to nearest $100,000 per year as discussed in Section 8.

Benefits of Increased Accessibility to Employment, Goods and Services for Lower Eastern Shore Residents

Residents of the Lower Eastern Shore would benefit from the reduced travel times offered by a cross-Bay ferry in several ways. Residents would have better access to competitive retail markets in the Baltimore – Washington urban corridor for everything from household and personal goods to medical and dental services. Eastern Shore retailers would benefit from lower transportation costs for their goods, and greater access to more wholesale suppliers, and be able to offer their merchandise at lower prices to their customers.

Although the ferry routes are not primarily oriented to typical daily commuters, they could enable some Lower Eastern Shore residents to take jobs in Southern Maryland that could be accomplished by a combination of tele-commuting and infrequent office visits. This work mode has proven effective and popular in the software and publishing industries in the Puget Sound region, allowing workers to maintain a semi-rural waterfront lifestyle on the west side of the Sound while working for companies in Seattle and Redmond on the east side.

Although these benefits are difficult to quantify, they need to be considered as real potential benefits to Eastern Shore residents should ferry service be provided.

Summary of Economic Impacts

The potential annual economic benefits of the four demonstration ferry routes are summarized in Table 10-3. They range from about $1.5 million per year for the Canton – Rock Hall and Solomons Island – Crisfield routes to $3.6 million per year for the Chesapeake Beach – Cambridge route with a conventional ferry. However, the expenditures for salaries and supplies for ferry operations would provide direct, tangible economic benefits to the local economies of $1.1 to $1.9 million per year if one of the four demonstration ferry routes were implemented.

Table 10-3. Summary of Potential Annual Economic Benefits

Route	Ferry type	Direct ferry operations expenditures[1]	Business transport cost savings	Increased tourist spending[2]	Total input to local economies
Canton - Rock Hall	Conventional	$1,100,000	$200,000	$100,000	$1,400,000
	High-speed	$1,100,000	$100,000	$100,000	$1,300,000
Chesapeake Beach - Cambridge	Conventional	$1,900,000	$1,000,000	$700,000	$3,600,000
	High-speed	$1,500,000	$600,000	$300,000	$2,400,000
Solomons Island - Cambridge	Conventional	$1,700,000	$600,000	$200,000	$2,500,000
	High-speed	$1,200,000	$500,000	$100,000	$1,800,000
Solomons Island - Crisfield	Conventional	$1,200,000	$300,000	$100,000	$1,600,000
	High-speed	$1,100,000	$100,000	$100,000	$1,300,000

[1]Rounded to nearest $100,000 per year.
[2]Minmum $100,000 per year allocated.

The following assumptions were made for the above table:

- Direct ferry operations expenditures: These expenditures for salaries and for goods and services purchased locally. Refer to Table 10-2. Staffing and salary expense calculations for each of the demonstration routes are shown in Section 9.
- Business transport cost savings: Recent estimates reported by the trucking industry indicate operating costs for commercial tractor-trailer truck combinations of $1.00 to $1.25 per mile and $60 to $100 per hour.
- Increased tourist spending: The results of FXM's research showed that ferry passengers spend about $2.50 to $6.00 per person in the local communities served by the ferry route.
- Cost and benefits were estimated on the basis of trips and either annual estimates related to trip making (such as annual salaries for crew members) and per trip costs or expenditures (tourist expenditures per trip or vessel fuel costs per operating hour of commercial truck time savings per truck trip.)

Findings and Conclusions

DEMONSTRATION FERRY VESSELS

The analysis of the demonstration terminals and routes indicated that it was appropriate to consider two potential vessels for service on each route: a conventional displacement monohull and a high-speed (30 knots or greater) catamaran. The major reasons for considering two vessel types was the significant difference in capital and operating costs between conventional and high-speed vessel technology. In order to make the comparisons as similar as possible, prototypical demonstration vessels were assumed to be about the same size and have the same vehicle-carrying capacity, 54 automobiles.

Navigational constraints limited the size of the ferry to 200 feet long and 60 feet wide, with a draft of no more than 8 feet. Both the conventional and high-speed vessels were assumed to have a capacity of 54 automobiles, or a combination of up to 6 heavy trucks and 36 autos. The analysis assumed a single ended design with drive on, drive off loading via fore and aft ramps. Both vessels were assumed to be U.S. Coast Guard Subchapter T classification with a rated passenger capacity of 149 persons.

The differences between the vessels were cost and speed-related. The conventional displacement ferry was assumed to operate at a service speed of 20 to 22 knots, using 300 gallons of fuel per hour. The capital cost for a conventional ferry was estimated at $7 to $10 million. The high-speed ferry was assumed to be a catamaran design with a service speed of 41 knots, using about 700 gallons of fuel per hour; its cost would be $30 to $40 million.

POTENTIAL TERMINAL SITES

The study initially identified 59 potential ferry terminal sites on both sides of the Chesapeake Bay and conducted a fatal flaw analysis and site evaluation process to determine a relatively small number of sites for more detailed assessment. The initial 59 sites were identified based on discussions with County Planners, previous ferry studies, locations of former ferry or steamboat routes, locations of public boating facilities, towns on the waterfront and reviews of County planning documents. The initial list included 26 sites on the Western Shore and 33 sites on the Eastern Shore.

The fatal flaw screening examined the 59 sites based on minimum criteria for accessibility by land (i.e., within 5 miles of an adequate arterial road), and by water (minimum water depth of 8 feet), and for environmental concerns (Resource Conservation Area). The 22 sites which passed the fatal flaw screening were subjected to a more comprehensive evaluation using criteria related to relative site accessibility, community and environmental issues, and existing infrastructure and improvement costs. Additional consideration was given to sites that formed a logical pair on each side of the Bay, that were sufficiently far away from the Bay Bridge to provide a viable alternative to driving, and where waterfront land costs were reasonable.

Six sites, resulting in four demonstration route pairings, were designated for additional analysis. These sites were felt to be reasonable examples in that they paired several of the more highly populated communities that maintained a relatively high level of economic activity. One pairing is north of the Bay Bridge, the other three are to the south. MDOT is not endorsing any site pairs as better than the others. The analysis of site pairings is for demonstration purposes only to illustrate what might be required should a ferry service run between these locations. The study results indicate that these site pairs have the most potential to foster a successful ferry service.

Western Shore Sites

Canton

The representative area for Canton is located along Clinton Street in Baltimore. Clinton Street runs perpendicular to Boston Street and is at the edge of industrial zoning in the area, adjacent to the residential and commercial sections. This location is less than 3 miles from the Baltimore Inner Harbor Area with easy access to I-95 and I-895. Clinton Street consists of industrial parcels with existing bulkheads and piers that would be suitable for use as part of a ferry terminal.

Located to the north of the Bay Bridge, the Canton site draws potential ferry riders from Baltimore and the surrounding area, north central and north west Maryland and south central Pennsylvania via I-83. The site has good existing road and utility infrastructure, and a ferry terminal would be highly compatible with the surrounding industrial uses.

Chesapeake Beach

The representative area for Chesapeake Beach is located along Bayside Road, approximately 1,500 feet to the south of the intersection of Chesapeake Beach Road (MD 260) and Bayside Road. The only dredged channel leading into Chesapeake Beach is at the mouth of Fishing Creek, along the Chesapeake Bay side of the Bayside Road Bridge. The waterfront property at the mouth of Fishing Creek consists of residential town homes on the north side of the creek and Rod 'N' Reel Dock along the south side, which contains existing bulkheads and piers that could be used for a ferry terminal.

The Chesapeake Beach site is located about mid-way between the Bay Bridge and the Potomac River, and captures a significant portion of cross-Bay traffic from Washington, D. C. and the suburban Maryland portions of the D.C. metro area, as well as all of southeastern Maryland. The road and utility infrastructure is adequate to support a ferry terminal, but the terminal may be incompatible with the adjacent residential uses. In addition, there may be significant dredging required to provide waterside access since the western portion of the Bay is very shallow (less than 8 feet) along the Chesapeake Beach waterfront.

Solomons Island

The representative area for Solomons Island is known as "The Narrows" and is located along Charles Street (MD 2). Two particular sites appeared to be possible locations for a ferry terminal. Both were located near the end of Charles Street and were adjacent to each other.

The first was the University of Maryland (U of M) Center for Environmental Science and the other was an existing dock along Charles Street. Both sites have bulkheads that could be utilized as part of a ferry terminal location. The U of M Center for Environmental Science site is larger than the dock site and appeared to be a more ideal location. Should either site be utilized, a narrow, curved portion of Charles Street may need to be modified to allow for a greater volume of traffic that might be created due to the ferry service.

Located near the southern tip of Maryland on the Patuxent River, Solomons Island is less accessible to the majority of potential Western Shore residents than the other two sites, but is closer to the major north-south through traffic routes via I-95 or US 301. Off-site road improvements would be required to handle increased ferry traffic, but the terminal would be compatible with the surrounding marine and waterfront uses on the Island. There is an adequate channel to the harbor and little or no dredging would be needed.

Eastern Shore Sites

Rock Hall

The representative area for Rock Hall includes the waterfront property along Rock Hall Harbor; the harbor is bounded by mostly commercial and industrial zoned property. Several locations along Bayside Avenue, Hawthorn Avenue, and Chesapeake Avenue could be considered viable locations for a ferry terminal.

Rock Hall does not provide direct highway access to the Ocean City area; patrons will still need to travel approximately 30-45 minutes before reaching US 50, connecting roughly ten minutes away from the Eastern Shore side of the Bay Bridge. However, this location does lend itself as a viable option for patrons of the Rock Hall and central Delaware areas to travel to the Baltimore/Annapolis area, without having to deal with the traffic along US 50.

The off-site road and utility infrastructure appears generally adequate to support the ferry terminal with only minor improvements to the adjacent streets necessary. The water depth is barely sufficient for an 8-foot draft vessel approaching Rock Hall Harbor, and a 200-foot vessel would have difficulty negotiating the Rock Hall channel and harbor. Significant dredging may be required.

Cambridge

The representative area for Cambridge includes the waterfront properties along the Choptank River side of the Market Street Bridge. Possible locations include Commerce Street, Court Lane, Gay Street, Academy Street, and Hayward Street. Several locations appeared to be viable potential sites with existing piers and bulkheads that could be used as part of a ferry terminal. One such site was the future home of the James B. Richardson Maritime Museum on Hayward Street.

In addition to being a major destination itself, Cambridge is centrally located to serve other recreational and business destinations on the Eastern Shore of Maryland. US Route 50 passes within a mile of the Cambridge harbor, and there are also good road connections to southern Delaware and the Cape May – Lewes ferry. There are no major infrastructure improvements required beyond some of the nearby local roads, and only minor dredging would be needed.

Crisfield

The representative areas for Crisfield are off of Maryland Avenue (along Seventh and Tenth Streets). Both locations have plots of land currently for sale. The Seventh Street location has an abandoned fish processing facility that is currently being used as a boat building facility that would need to be demolished or renovated should the site be selected. The Tenth Street location appears to be an old boat-launching site. Existing piers and bulkheads with required water depth are present at each location. Both areas have easy access to Maryland Avenue.

Although Crisfield is a recreational destination itself, its location at the extreme southern end of the Eastern Shore study area means it would serve significantly fewer other destinations than Cambridge. It would, however, provide good access to Ocean City, MD and other beach recreational sites. The road and utility infrastructure in Crisfield appears adequate to serve a ferry terminal, and there is an existing channel into Crisfield harbor from the Bay which is maintained at 9 feet deep by the Corps of Engineers, however, existing docking areas could not accommodate a 200 foot long vessel.

EVALUATION OF DEMONSTRATION FERRY ROUTES

The four demonstration routes were evaluated based on potential ridership, revenues and capital and operating costs. Ridership estimates for each route were developed using a computer spreadsheet model that calculated potential diversion of existing vehicle trips across the Bay Bridge based on comparisons of travel times and costs via the Bridge and the ferry. The model was developed and applied using a survey of Bridge users taken in 2001 by the Maryland Transportation Authority. Rather than speculate on future growth in cross-Bay traffic demand, the ridership estimates used the 2001 annual Bay Bridge volumes as the universe of potential ferry riders, thus providing a highly conservative viewpoint.

Assumptions

The following assumptions were common to the analysis of each of the four demonstration routes.

Operating assumptions

Ferry service may be provided for up to 18 hours during the summer season, up to 16 hours during the shoulder season, and up to 12 hours during the off-season. Due to potentially low traffic demands and to help reduce operating costs, some of the hours of operation suggested may be shorter than the maximum allowable time frames described above.

One truck occupies the space of three cars, and a varying mix of trucks and cars will be allocated to meet the required demands.

An additional half-hour was added to the vessel travel times to allow time for loading and unloading between trips.

The revenue calculations for the four demonstration ferry routes assumed average fares of $25 (low speed ferry) or $37.50 (high-speed ferry) each way for private vehicles (i.e., round trip auto fare would be $50). Large commercial truck fares were assumed to be $75 for a conventional displacement ferry and $112.50 each way for the high-speed ferry. For comparison, the Bay Bridge toll is $2.50 for a car and $10 for a standard 5-axle truck/semi-trailer combination. The toll is collected in the eastbound direction only.

Capital and operating costs

Capital costs for the terminals, including off-site infrastructure and localized navigation improvements (not including potential dredging), ranged from $4.5 to $5.0 million. A conventional displacement hull ferry was estimated at $8.5 million and a high-speed catamaran at $35.0 million.

Annual operating costs for terminals were estimated at $527,000 per year for each terminal. Vessel operating costs were assessed at $545 per vessel hour for a displacement hull ferry (20 to 22 knots operating speed) and $1,060 per vessel hour for a high-speed catamaran (40 to 41 knot operating speed).

Canton (Baltimore) – Rock Hall

The Canton (Baltimore) to Rock Hall demonstration route would be operated with a single vessel for either the 22 knot displacement hull ferry or the 41 knot catamaran. The total one-way trip time would be about 100 minutes for a conventional 22-knot ferry, including loading and unloading time at the terminals, and 87 minutes for the high-speed (41 knot) ferry. The small time savings offered by the high-speed ferry in open water is off-set by the extensive portions of the route subject to speed restrictions due to wake and vessel traffic concerns.

The operating hours for each season were scaled to the projected traffic to avoid running nearly empty boats in low demand periods. Since crewing costs are a significant portion of the operating expenses, care was taken to schedule the operations so that they could be covered with a single shift per day with limited overtime.

The Canton – Rock Hall demonstration route would largely serve trips between the Baltimore metro area and the Upper Eastern Shore. Annual ridership was estimated at 31,000 autos and 3,100 heavy trucks for a conventional ferry and 10,000 autos and 900 trucks for a high-speed ferry.

Capital costs for the Canton to Rock Hall demonstration route would be $17.8 million for the displacement hull ferry scenario and $44.3 million for the high-speed catamaran scenario. A conventional 22 knot ferry would likely generate about $2.8 million in annual operating costs and $1.0 to $1.3 million in revenues for a net operating loss of - $1.5 to -$1.8 million per year. For a high-speed ferry on this route, operating costs would be higher and revenues would be lower than the conventional ferry, resulting in annual operating losses of -$3.3 to -$3.5 million.

Chesapeake Beach – Cambridge

The Chesapeake Beach to Cambridge demonstration route would require two vessels to provide a reasonable level of service under either the conventional or high-speed ferry scenarios. Although two conventional vessels would not be able to accommodate the projected peak summer weekend demand, it was decided not to recommend a third vessel for the analysis of this route because it would not be needed for weekday service, resulting in excessive capital and maintenance costs that could not be recovered by the relatively small increment of additional revenues generated by the weekend service.

Crossing times for this route are estimated at 82 minutes for a conventional ferry and 55 minutes for a high-speed ferry, including terminal times.

The Chesapeake Beach to Cambridge demonstration ferry route generates the highest potential ridership because it provides good access to the Washington D. C. metro area and to recreation destinations in the Lower Eastern Shore. Annual ridership estimates were 365,000 autos and 30,000 heavy trucks for a conventional ferry and 124,000 autos and 12,000 trucks for the high-speed ferry.

Capital costs for the Chesapeake Beach to Cambridge demonstration route would be $26.9 million for conventional ferry service and $79.9 million for high-speed ferry operation. Annual operating costs for this route would be about $7.6 million for a conventional ferry and $8.6 million for a high-speed ferry. Net operating revenues range from near break-even conditions for a conventional ferry (-$79,000 to +$305,000) to net operating losses of -$0.9 million to -$1.6 million for a high-speed ferry.

Solomons Island – Cambridge

The operations for the Solomons Island to Cambridge demonstration route would require two conventional displacement hull ferries or a single high-speed catamaran ferry. As with the Chesapeake Beach to Cambridge demonstration route discussed above, even two conventional ferries would leave some unsatisfied weekend demand. Crossing times between Solomons Island and Cambridge would be about 120 minutes for a conventional ferry and 80 minutes for a high-speed vessel.

The Solomons Island to Cambridge demonstration route would better serve the I-95/US 301 corridor and portions of the Maryland suburbs south of Washington D.C., and most of the recreation destinations on the Lower Eastern Shore. Annual ridership would be 95,000 autos and 21,000 trucks for a conventional ferry, and 39,000 auto and 11,000 trucks for a high-speed vessel.

Capital costs for the Solomons Island to Cambridge demonstration route range from $27 million for the conventional ferry to $45 million for a high-speed catamaran scenario. Annual operating costs and net operating losses would be higher for conventional ferries than for a single high-speed ferry on this route. The two conventional ferries would generate $6.2 million in annual operating costs compared to $5.7 million for the single high-speed catamaran, compared to revenues of $3.6 to $3.7 million and $3.1 to $3.3 million respectively. Net operating revenues would be -$2.5 to -$3.6 million for conventional ferries compared to -$2.4 to -$2.6 million for high-speed operations.

Solomons Island – Crisfield

The relatively low traffic demand on the Solomons Island to Crisfield means that this route could be operated with a single conventional or high-speed vessel, and for only 10 to 12 hours per day compared to the 12 to 18 hour operating days on some of the other routes. These adjustments were incorporated into the operating plan to match service capacities provided with projected traffic demands by season.

The Solomons Island to Crisfield route is the longest of the four demonstration routes with crossing times of 145 minutes for a conventional ferry and 117 minutes for a high-speed ferry.

Ridership is estimated at 21,000 autos and 3,800 trucks for a conventional ferry and 7,500 autos and 1,700 trucks for a high-speed ferry. The basic reasons for the low volumes of demand for the Solomons Island to Crisfield route are that the ferry provides a time savings only to users whose origin or destination, or both, are very close to the terminal locations at either end, and the increased fare with high-speed service is not offset by a corresponding reduction in ferry travel times due to the slow speed portions of the route.

Capital costs for this route range from $18.2 million for conventional ferry to $44.7 million for a high-speed ferry operation. The projections for this route indicate annual operating losses of -$2.3 to -$2.7 million for a conventional ferry to -$3.9 to -$4.4 million for a high-speed ferry.

POTENTIAL PUBLIC BENEFITS

The potential benefits of a ferry route across the Chesapeake Bay were divided into two categories: direct benefits to ferry users and potential economic benefits to ferry communities. Each of the four demonstration routes would result in savings in both travel time and distance for its users; annual savings in vehicle operating costs range from about $350,000 per year for the Canton – Rock Hall and Solomons Island – Cambridge routes to more than $1.7 million per year for the Chesapeake Beach – Cambridge route using conventional ferries. Potential savings in vehicle operating costs for high-speed ferries would be considerably smaller due to the higher fares and lower ridership estimates.

Economic benefits of the demonstration ferry routes fall into four categories:

- Benefits to Eastern Shore businesses due to improved access to western markets,
- Benefits to tourist-related businesses,

- Benefits from direct ferry service expenditures such as salaries and supplies, and
- Lower costs to Eastern Shore residents for goods and services due to increased accessibility to competing retails and wholesale suppliers on the west side of the Bay.

The potential annual economic benefits for each of the demonstration routes would be:

- Canton – Rock Hall: $1.3 million for high-speed ferry to $1.4 million for conventional ferry;
- Chesapeake Beach – Cambridge: $2.4 million to $3.6 million;
- Solomons Island – Cambridge: $1.8 million to $2.5 million; and
- Solomons Island – Crisfield: $1.3 million to $1.6 million.

CONCLUSIONS

The Chesapeake Bay Ferry Evaluation Study identified and examined in detail six potential terminal sites and four potential demonstration ferry routes for cross-Bay ferry service between Maryland's Western and Eastern Shores. The four demonstration routes were:

- Canton (Baltimore) to Rock Hall
- Chesapeake Beach to Cambridge
- Solomons Island to Cambridge
- Solomons Island to Crisfield

Ferry service is physically feasible on each of these four routes, although extensive dredging would likely be required on the Canton to Rock Hall, at the Chesapeake Beach terminal location, and Solomons Island to Crisfield routes to provide adequate safe water depths and channel widths. Beyond the potential impacts associated with dredging, none of the routes appear to have any significant adverse environmental impacts.

It is not likely that any of the capital costs for terminals, vessels and off-site infrastructure improvements could be reimbursed by revenues from ferry fares on any of the routes. Only the Chesapeake Beach to Cambridge route with a conventional ferry appears to have the potential for break-even operation where farebox revenues could match the annual operating costs.

A cross-Bay ferry route may provide some significant economic benefits to the Lower Eastern Shore communities through increased tourist spending, improved access for businesses to new markets in the Baltimore – Washington metro area, and direct expenditures for ferry operations in the form of employee salaries and purchases of supplies from local businesses. There are, however, significant capital and operating costs to confront before these benefits can be realized.

Appendix

SUMMARY OF COUNTY PLANNING DOCUMENTS

Anne Arundel County

Anne Arundel County is located on the Eastern shore of the Chesapeake Bay. The eastern connection of the Bay Bridge is in Anne Arundel County. The County has a strong tourism industry based on the States capital, Annapolis and strong links to water based recreation on the Bay. A number of tourist based Chesapeake Bay cruise boats operate out of Annapolis. Anne Arundel County is also home to Baltimore Washington International Airport – a major employment destination.

Potential Locations
- Major cities/towns/villages:
  - Annapolis
  - Crofton
  - Glen Burnie
  - Laurel
  - Odenton
  - Parole
  - Severn
  - Deale
- Major cities/towns/villages along the shore edge:
  - Annapolis
  - Highland Beach
  - Beverly Beach
  - Edgewater
  - Deale

Area Demographics
- Population (2000): 489,656
- Anticipated population growth (2020)[12]: 541,000 (10.5 percent increase from 2000)
  - Majority on shores or further inland?
  - Age[13]
    - < 5: 6.8%
    - 5 – 19: 20.9%
    - 20 – 44: 38.5%
    - 45 – 64: 23.8%
    - > 65: 9.1%
  - Employment status[14]
    - Labor Force: 258,673

[12] Preliminary Population Projections for Maryland's Jurisdictions (revised_2 July, 2001) Maryland Department of Planning http://www.mdp.state.md.us/MSDC/popproj/cntrlsforweb.pdf
[13] Profile of General Demographic Characteristics, http://www.census.gov/prod/cen2000/dp1/2kh24.pdf
[14] Regional Data - 1990 TO 2000 Annual Averages Civilian Labor Force, Employment and Unemployment by Place of Residence http://www.dllr.state.md.us/lmi/laus/9097avg.htm

- Employment: 251,197
- Unemployment: 7,476 (2.9 percent)

- Occupations[15]

Government	34,415
Private Sector	164,846
Services	58,479
Retail	42,885
Finance, Ins., Real Estate	6,029
Non-Durable Mfg	4,822
TCPU	16,474
Wholesale Trade	9,333
Construction	13,017
Durable Mfg.	11,069
Agriculture	2,049

- Employment centers and locations[16]
  - BWI Airport
  - Annapolis – State Capital

Tourism and effect on local economy

- Geographic Distribution of Tourist Volumes
- Tourist Volumes
- Opportunities

Relevant Plan sections relating to:

- Land Use
  - Marine Activity Centers
  - Commercial Revitalization Areas
  - Low/Low-Medium Residential Areas
  - Industrial Parks/Light Industrial Areas
- Zoning
- Environment
- Social
- Access

[15] Employment by Industry, 2000, Snap Shot 2001, Anne Arundel County http://www.dhr.state.md.us/pi/pdf/aa.pdf
[16] Major Private and Public Sector Employers in Anne Arundel County, BMC Online http://www.baltometro.org/content.asp?id=41

Baltimore City

Baltimore City fronts onto the Patapsco River off the Chesapeake Bay. Baltimore City is a major employment and tourism destination for the State. Private water taxis offer transportation between the Inner Harbor, Fells Point, Canton and Fort McHenry. The south eastern Baltimore neighborhoods on the Patapsco River have a strong maritime industrial history.

Potential Locations

- Major neighborhoods along the shore edge:
  - Brooklyn Park
  - Canton
  - Cherry Hill
  - Curtis Bay
  - Fells Point
  - Hawkins Point
  - Locust Point
  - Wagners Point
  - Westport

Area Demographics

- Population (2000): 651,154
- Anticipated population growth (2020)[17]: 661,100 (1.5 percent increase from 2000)
  - Majority on shores or further inland? Further inland
  - Age[18]
    - < 5: 6.9%
    - 5 – 19: 23.0%
    - 20 – 44: 36.3%
    - 45 – 64: 23.3%
    - > 65: 10.5%
  - Employment status[19]
    - Labor Force: 293,059
    - Employment: 269,277
    - Unemployment: 23,782 (8.1 percent)
  - Occupations[20]
    - Government 82,156
    - Private Sector 308,151
    - Services 153,913
    - Retail 42,268
    - Finance, Ins., Real Estate 32,739
    - Non-Durable Mfg 18,403
    - TCPU 19,240

[17] Preliminary Population Projections for Maryland's Jurisdictions (revised_2 July, 2001) Maryland Department of Planning http://www.mdp.state.md.us/MSDC/popproj/cntrlsforweb.pdf
[18] Profile of General Demographic Characteristics, http://www.census.gov/prod/cen2000/dp1/2kh24.pdf
[19] Regional Data - 1990 TO 2000 Annual Averages Civilian Labor Force, Employment and Unemployment by Place of Residence http://www.dllr.state.md.us/lmi/laus/9097avg.htm
[20] Employment by Industry, 2000, Snap Shot 2001, Baltimore City http://www.dhr.state.md.us/pi/pdf/bc.pdf

- Wholesale Trade 17,157
- Construction 13,633
- Durable Mfg. 8,845
- Agriculture 1,373

- Employment centers and locations
  - Downtown Baltimore
  - Johns Hopkins Bayview Medical Campus
  - Southeast Baltimore
    - Canton Industrial Park
    - Holabird Industrial Park
    - Pulaski Industrial Area

Tourism and effect on local economy
- Tourist Volumes[21]
  - 2.9 million overnight leisure visitors (1999)
    - 1st Quarter: 10%
    - 2nd Quarter: 31%
    - 3rd Quarter: 37%
    - 4th Quarter: 22%
  - Economic Impact[22]
    - Revenue generated: $1.08 billion (1999)
    - Visitors spend about $541 per visit (1999)
- Geographic Distribution of Tourist Volumes
- Opportunities

Relevant Plan sections relating to:
- Land Use
- Zoning
- Environment
- Social
- Access

[21] Press Room: Visitor Statistics, Baltimore Area Convention and Visitors Association http://www.baltimore.org/pages/press_visitorstat.htm
[22] Ibid.

Baltimore County

Baltimore County has frontage to the Chesapeake Bay on the Western shore between the Patapsco River and the Aberdeen proving grounds. There are several State Parks and Recreation areas on the County's foreshores. The waterfront communities along the Patapsco River, such as Dundalk and Sparrows Point, have a strong industrial maritime history. There are several areas within the County that are being planned for development, including recent concept plans for the Middle River area including restaurants, retail shops, office space and upgraded marina facilities.

Potential Locations

- Major cities/towns/villages:
  - Catonsville
  - Dundalk
  - Essex
  - Hunt Valley
  - Lutherville
  - Towson
  - Timonium
  - White Marsh
  - Woodlawn

- Major cities/towns/villages along the shore edge:
  - Chase
  - Dundalk
  - Essex
  - Middle River
  - North Point
  - Rocky Point
  - Sparrows Point
  - Turner Station

Area Demographics

- Population (2000): 754,292
- Anticipated population growth (2020)[23]: 797,900 (5.8 percent increase from 2000)

  - Majority on shores or further inland?
  - Age[24]
    - < 5: 6.0%
    - 5 – 19: 20.3%
    - 20 – 44: 35.8%
    - 45 – 64: 23.4%
    - > 65: 14.7%
  - Employment status[25]

[23] Preliminary Population Projections for Maryland's Jurisdictions (revised_2 July, 2001) Maryland Department of Planning http://www.mdp.state.md.us/MSDC/popproj/cntrlsforweb.pdf

[24] Profile of General Demographic Characteristics, http://www.census.gov/prod/cen2000/dp1/2kh24.pdf

[25] Regional Data - 1990 TO 2000 Annual Averages Civilian Labor Force, Employment and Unemployment by Place of Residence http://www.dllr.state.md.us/lmi/laus/9097avg.htm

- Civilian Labor Force: 398,590
- Employment: 381,352
- Unemployment: 17,238 (4.3 percent)

- Occupations[26]

Government	57,637
Private Sector	307,806
Services	116,553
Retail	76,589
Finance, Ins., Real Estate	24,329
Non-Durable Mfg	15,186
TCPU	14,508
Wholesale Trade	16,559
Construction	21,851
Durable Mfg.	18,306
Agriculture	3,235

- Employment centers and locations (according to Baltimore County's Urban Land Management Areas Map)
  - Dundalk
  - Hunt Valley/Timonium
  - Loveton
  - Middle River
  - North Point
  - Perry Hall/White Marsh
  - Philadelphia/Pulaski
  - Southwest Industrial Corridor
  - Towson
  - Woodlawn/Security

Tourism and effect on local economy

- Tourist Volumes
- Geographic Distribution of Tourist Volumes
- Opportunities

Relevant Plan sections relating to:

- Land Use
  - Policy Measures
    - Promote & facilitate the development and redevelopment of vacant or deteriorated waterfront parcels for "upscale" projects that would improve the image of the area
    - Promote and facilitate a special waterfront destination project
    - Capitalize upon the waterfront parks and recreational opportunities as an attraction from both water and land
    - Promote the development of smaller waterfront destination points along the shoreline that offer commercial and recreational amenities

[26] Employment by Industry, 2000, Snap Shot 2001, Baltimore County http://www.dhr.state.md.us/pi/pdf/bcc.pdf

- East side waterfront concept plan for Middle River was recently developed for Essex and Middle River including residential, restaurants, retail shops, office space and upgraded marina facilities.

- Zoning
- Environment
- Social
- Access

Calvert County

Located on the Eastern shore in Southern Maryland, Calvert County has a large frontage onto the Chesapeake Bay. Characterized by low density rural communities, the region is rich in environmental and heritage resources including the Calvert Cliffs along the southern edges of the County.

Potential Locations

- Major cities/towns/villages:
  - Chesapeake Beach
  - North Beach
  - Port Republic
  - Prince Frederick
  - Saint Leonard

- Major cities/towns/villages along the shore edge:
  - Chesapeake Beach
  - North Beach
  - Port Republic
  - Solomon's Island

Area Demographics

- Population (2000): 74,563
- Anticipated population growth (2020)[27]: 95,600 (28 percent increase from 2000)
  - Majority on shores or further inland?
  - Age[28]
    - < 5: 6.8%
    - 5 – 19: 25.1%
    - 20 – 44: 35.8%
    - 45 – 64: 23.4%
    - > 65: 8.9%
  - Employment status[29]
    - Civilian Labor Force: 38,571
    - Employment: 37,558
    - Unemployment: 1,013 (2.6 percent)
  - Occupations[30]
    - Government
    - Private Sector
    - Services
    - Retail
    - Finance, Ins., Real Estate
    - Non-Durable Mfg
    - TCPU

[27] Preliminary Population Projections for Maryland's Jurisdictions (revised_2 July, 2001) Maryland Department of Planning http://www.mdp.state.md.us/MSDC/popproj/cntrlsforweb.pdf
[28] Profile of General Demographic Characteristics, http://www.census.gov/prod/cen2000/dp1/2kh24.pdf
[29] Regional Data - 1990 TO 2000 Annual Averages Civilian Labor Force, Employment and Unemployment by Place of Residence http://www.dllr.state.md.us/lmi/laus/9097avg.htm
[30] Ibid.

    - Wholesale Trade
    - Construction
    - Durable Mfg.
    - Agriculture
- Employment centers and locations

Tourism and effect on local economy

- Tourist Volumes
- Geographic Distribution of Tourist Volumes
- Opportunities

Relevant Plan sections relating to:

- Land Use
- Zoning
- Environment
- Social
- Access

<u>**Cecil County**</u>

Cecil County is in the north east of Maryland at the northern end of the Chesapeake Bay. Route 95 and 40, the main road based alternatives to the Bay Bridge, passes through Cecil County.

Potential Locations
- Major cities/towns/villages:
  - Cecilton
  - Charlestown
  - Chesapeake City
  - Elkton
  - North East
  - Perryville
  - Port Deposit
  - Rising Sun

- Major cities/towns/villages along the shore edge:
  - Charlestown
  - Chesapeake City
  - Elkton
  - North East
  - Perryville
  - Port Deposit
  - Stemmers Run

Area Demographics
- Population (2000): 85,951
- Anticipated population growth (2020)[31]: 103,300 (20 percent increase from 2000)
  - Majority on shores or further inland?
  - Age[32]
    - < 5: 6.9%
    - 5 – 19: 23.0%
    - 20 – 44: 36.3%
    - 45 – 64: 23.3%
    - > 65: 10.5%
  - Employment status[33]
    - Civilian Labor Force 42,078
    - Employment: 39,741
    - Unemployment: 2,337 (5.5 percent)
  - Occupations[34]
    - Government 5,150
    - Private Sector 18,472

[31] Preliminary Population Projections for Maryland's Jurisdictions (revised_2 July, 2001) Maryland Department of Planning http://www.mdp.state.md.us/MSDC/popproj/cntrlsforweb.pdf
[32] Profile of General Demographic Characteristics, http://www.census.gov/prod/cen2000/dp1/2kh24.pdf
[33] Regional Data - 1990 TO 2000 Annual Averages Civilian Labor Force, Employment and Unemployment by Place of Residence http://www.dllr.state.md.us/lmi/laus/9097avg.htm
[34] Ibid.

        - Services 5,020
        - Retail 4,410
        - Finance, Ins., Real Estate 1,402
        - Non-Durable Mfg 2,546
        - TCPU 1,169
        - Wholesale Trade 579
        - Construction 1,293
        - Durable Mfg. 1,375
        - Agriculture 508
    - Employment centers and locations (according to Cecil County Comprehensive Plan)
        - Elkton
        - North East
        - Perryville
        - Port Deposit

Tourism and effect on local economy

- Tourist Volumes
- Geographic Distribution of Tourist Volumes
- Opportunities

Relevant Plan sections relating to:

- Land Use
- Zoning
- Environment
- Social
- Access

Dorchester County

Dorchester County is on the Western shore of the lower Chesapeake Bay. The County has a strong maritime tourism and economic base focused around the major center at Cambridge. Route 50 links Cambridge to the Eastern Shore beaches and the Bay Bridge.

Potential Locations

- Major cities/towns/villages:
  - Brookview
  - Cambridge
  - Church Creek
  - East New Market
  - Eldorado
  - Galestown
  - Hurlock
  - Secretary
  - Vienna

- Major cities/towns/villages along the shore edge:
  - Cambridge
  - Cocheron Wharf
  - Kirwins Wharf
  - Madison
  - Ragged Point
  - Taylor Island

Area Demographics

- Population (2000): 30,674
- Anticipated population growth (2020)[35]: 31,450 (2.5 percent increase from 2000)
  - Majority on shores or further inland? Further inland
  - Age[36]
    - < 5: 5.4%
    - 5 – 19: 20.1%
    - 20 – 44: 31.5%
    - 45 – 64: 25.5%
    - > 65: 17.8%
  - Employment status[37]
    - Civilian Labor Force: 14,804
    - Employment: 13,639
    - Unemployment: 1,165 (7.8 percent)
  - Occupations[38]

[35] Preliminary Population Projections for Maryland's Jurisdictions (revised_2 July, 2001) Maryland Department of Planning http://www.mdp.state.md.us/MSDC/popproj/cntrlsforweb.pdf
[36] Profile of General Demographic Characteristics, http://www.census.gov/prod/cen2000/dp1/2kh24.pdf
[37] Regional Data - 1990 TO 2000 Annual Averages Civilian Labor Force, Employment and Unemployment by Place of Residence http://www.dllr.state.md.us/lmi/laus/9097avg.htm
[38] Ibid.

▪ Government	1,847
▪ Private Sector	9,421
▪ Services	1,914
▪ Retail	1,847
▪ Finance, Ins., Real Estate	517
▪ Non-Durable Mfg	1,750
▪ TCPU	382
▪ Wholesale Trade	340
▪ Construction	550
▪ Durable Mfg.	1,841
▪ Agriculture	277

- Employment centers and locations
  - Cambridge
  - Hurlock

Tourism and effect on local economy
- Tourist Volumes
- Geographic Distribution of Tourist Volumes
- Opportunities
  - Link maritime industries into the county's overall economic development program including boating and tourism. (p. 3-13)

Relevant Plan sections relating to:
- Land Use
  - Development Districts
  - Town Districts/Incorporated Areas
  - Town/Adjoining Areas
- Zoning
  - M-A-R (Maritime-Agricultural-Residential) Zone
- Environment
  - 200 miles of tidal shoreline
  - Five rivers contribute substantially to agriculture, industry, and recreation
- Social
  - Several community activities themed around maritime activities
    - Chesapeake City Canal Day
    - North East Water Festival
- Access
  - C&D Canal provides access to the Delaware Bay

Harford County

Harford County is on the north western shore of the Chesapeake Bay. The majority of waterfront land is Army proving grounds. Route 95 and 40, the main northern road based alternatives to the Bay Bridge, travel through Harford County.

Potential Locations

- Major cities/towns/villages:
  - Aberdeen
  - Bel Air
  - Havre de Grace

- Major cities/towns/villages along the shore edge:
  - Aberdeen
  - Havre de Grace
  - Willoughby Beach

Area Demographics

- Population (2000): 218,590
- Anticipated population growth (2020)[39]: 256,800 (17.5 percent increase from 2000)
  - Majority on shores or further inland?
  - Age[40]
    - < 5: 7.2%
    - 5 – 19: 22.9%
    - 20 – 44: 36.0%
    - 45 – 64: 23.6%
    - > 65: 10.2%
  - Employment status[41]
    - Civilian Labor Force: 115,486
    - Employment: 111,358
    - Unemployment: 4,128 (3.6 percent)
  - Occupations[42]
    - Government 16,684
    - Private Sector 55,462
    - Services 17,635
    - Retail 17,991
    - Finance, Ins., Real Estate 2,846
    - Non-Durable Mfg 5,097
    - TCPU 2,322
    - Wholesale Trade 2,141
    - Construction 2,893

[39] Preliminary Population Projections for Maryland's Jurisdictions (revised_2 July, 2001) Maryland Department of Planning http://www.mdp.state.md.us/MSDC/popproj/cntrlsforweb.pdf
[40] Profile of General Demographic Characteristics, http://www.census.gov/prod/cen2000/dp1/2kh24.pdf
[41] Regional Data - 1990 TO 2000 Annual Averages Civilian Labor Force, Employment and Unemployment by Place of Residence http://www.dllr.state.md.us/lmi/laus/9097avg.htm
[42] Employment by Industry, 2000, Snap Shot 2001, Kent County http://www.dhr.state.md.us/pi/pdf/ha.pdf

▪ Durable Mfg.	3,505
▪ Agriculture	826

- Employment centers and locations
    - Aberdeen
    - Aberdeen Proving Grounds
    - Bel Air
    - Havre de Grace

Tourism and effect on local economy
- Tourist Volumes
- Geographic Distribution of Tourist Volumes
- Opportunities

Relevant Plan sections relating to:
- Land Use
- Zoning
- Environment
- Social
- Access

Kent County

Kent County is located on the north Eastern shore of the Chesapeake Bay between Cecil and Queen Anne's Counties. Route 301 passes through the eastern edge of the County. Kent County has a long history of ferry services to locations such as Rock hall and Chestertown. These towns now have growing tourism industries.

Potential Locations

- Major cities/towns/villages:
  - Betterton
  - Chestertown
  - Galena
  - Millington
  - Rock Hall

- Major cities/towns/villages along the shore edge:
  - Betterton
  - Chestertown (along the Chester River)
  - Fairlee Landing
  - Green Point
  - Rock Hall
  - Tolchester Beach

Area Demographics

- Population (2000): 19,197
- Anticipated population growth (2020)[43]: 20,650 (7.5 percent increase from 2000)
  - Majority on shores or further inland?
  - Age[44]
    - < 5: 4.6%
    - 5 – 19: 19.9%
    - 20 – 44: 30.9%
    - 45 – 64: 25.2%
    - > 65: 19.3%
  - Employment status[45]
    - Civilian Labor Force: 10,044
    - Employment: 9,631
    - Unemployment 413 (4 percent)
  - Occupations[46]
    - Government 989
    - Private Sector 6.804
    - Services 2,528
    - Retail 1,405

[43] Preliminary Population Projections for Maryland's Jurisdictions (revised_2 July, 2001) Maryland Department of Planning http://www.mdp.state.md.us/MSDC/popproj/cntrlsforweb.pdf
[44] Profile of General Demographic Characteristics, http://www.census.gov/prod/cen2000/dp1/2kh24.pdf
[45] Regional Data - 1990 TO 2000 Annual Averages Civilian Labor Force, Employment and Unemployment by Place of Residence http://www.dllr.state.md.us/lmi/laus/9097avg.htm
[46] Employment by Industry, 2000, Snap Shot 2001, Kent County http://www.dhr.state.md.us/pi/pdf/ke.pdf

    - Finance, Ins., Real Estate 454
    - Non-Durable Mfg 462
    - TCPU 354
    - Wholesale Trade 301
    - Construction 508
    - Durable Mfg. 519
    - Agriculture 273
- Employment centers and locations

Tourism and effect on local economy

- Tourist Volumes
- Geographic Distribution of Tourist Volumes
- Opportunities
    - Receives state funding toward development in the tourism industry

Relevant Plan sections relating to:

- Land Use
- Zoning
- Environment
- Social
- Access

Queen Anne's County

Queen Anne's County is located on the Eastern shore of the Chesapeake Bay and is the landing of the eastern connection of the Bay Bridge. The population of Queen Anne's County is focused in the locations with convenient access to the Bridge and significant levels of population growth are expected into the future.

Potential Locations

- Major cities/towns/villages:
  - Centreville
  - Chester
  - Church Hill
  - Ingleside
  - Queenstown
  - Sudlersville
  - Templeville

- Major cities/towns/villages along the shore edge:
  - Chester
  - Kent Narrows
  - Love Point
  - Queenstown

Area Demographics

- Population: (2000): 40,563
- Anticipated population growth (2020)[47]: 55,800 (37 percent increase from 2000)
  - Majority on shores of further inland?
  - Age[48]
    - < 5: 6.4%
    - 5 – 19: 21.1%
    - 20 – 44: 33.7%
    - 45 – 64: 35.8%
    - > 65: 12.9%
  - Employment status[49]
    - Civilian Labor Force: 21,541
    - Employment: 20.884
    - Unemployment: 2,753 (12.7 percent)
  - Occupations[50]
    - Government 2,075
    - Private Sector 8,773
    - Services 3,532

[47] Preliminary Population Projections for Maryland's Jurisdictions (revised_2 July, 2001) Maryland Department of Planning http://www.mdp.state.md.us/MSDC/popproj/cntrlsforweb.pdf
[48] Profile of General Demographic Characteristics, http://www.census.gov/prod/cen2000/dp1/2kh24.pdf
[49] Regional Data - 1990 TO 2000 Annual Averages Civilian Labor Force, Employment and Unemployment by Place of Residence http://www.dllr.state.md.us/lmi/laus/9097avg.htm
[50] Employment by Industry, 2000, Snap Shot 2001, Anne Arundel County http://www.dhr.state.md.us/pi/pdf/aa.pdf

  - Retail 1,716
  - Finance, Ins., Real Estate 476
  - Non-Durable Mfg 896
  - TCPU 396
  - Wholesale Trade 307
  - Construction 596
  - Durable Mfg. 592
  - Agriculture 255
- Employment centers and locations

Tourism and effect on local economy
- Tourist Volumes
- Geographic Distribution of Tourist Volumes
- Opportunities

Relevant Plan sections relating to:
- Land Use
- Zoning
- Environment
- Social
- Access

Somerset County

Located on the Eastern shore of the Chesapeake Bay, Somerset County is the Southern most region of Maryland. Waterfront locations are home to wildlife management areas rich in natural resources facing onto the Tangier Sound. The County has an abundance of waterfront amenities especially in the maritime town of Crisfield.

Potential Locations

- Major cities/towns/villages:
  - Crisfield
  - Deal Island
  - Princess Anne
  - Smith Island

- Major cities/towns/villages along the shore edge:
  - Crisfield
  - Deal Island
  - Rumbley
  - Smith Island

Area Demographics

- Population (2000): 24,747
- Anticipated population growth (2020)[51]: 26,700 (7.8 percent increase from 2000)
  - Majority on shores or further inland?
  - Age[52]
    - < 5: 4.8%
    - 5 – 19: 18.6%
    - 20 – 44: 40.2%
    - 45 – 64: 22.3%
    - > 65: 14.2%
  - Employment status[53]
    - Civilian Labor Force: 11,445
    - Employment: 10,577
    - Unemployment: 868 (7.8 percent)
  - Occupations[54]
    - Government 2,879
    - Private Sector 4,286
    - Services 1,179
    - Retail 981
    - Finance, Ins., Real Estate 360
    - Non-Durable Mfg 782
    - TCPU 172

[51] Preliminary Population Projections for Maryland's Jurisdictions (revised_2 July, 2001) Maryland Department of Planning http://www.mdp.state.md.us/MSDC/popproj/cntrlsforweb.pdf
[52] Profile of General Demographic Characteristics, http://www.census.gov/prod/cen2000/dp1/2kh24.pdf
[53] Regional Data - 1990 TO 2000 Annual Averages Civilian Labor Force, Employment and Unemployment by Place of Residence http://www.dllr.state.md.us/lmi/laus/9097avg.htm
[54] Employment by Industry, 2000, Snap Shot 2001, Somerset County http://www.dhr.state.md.us/pi/pdf/so.pdf

- Wholesale Trade 147
- Construction 263
- Durable Mfg. 265
- Agriculture 125

- Employment centers and locations
    - Crisfield
    - Princess Anne

Tourism and effect on local economy
- Tourist Volumes
- Geographic Distribution of Tourist Volumes
- Opportunities
    - Lower Eastern Shore Heritage Committee promotes heritage conservation and tourism
    - Rich in waterfront amenities
    - County working to develop attractions, events and regional promotion

Relevant Plan sections relating to:
- Land Use
- Zoning
- Environment
- Social
- Access

Saint Mary's County

St Mary's County is in Southern Maryland, on the Western shore of the Chesapeake Bay between the Patuxent River and the Potomac River. The area is rich in natural and cultural heritage and promotes a strong tourism industry based on these foundations. Expected to see significant population growth into the future, St Mary's main access corridor is Route 5 providing access to Washington and Route 301 to Baltimore, the Bay Bridge and South to Virginia.

Potential Locations

- Major cities/towns/villages:
  - Hollywood
  - Leonardtown
  - Lexington Park
  - Mechanicsville
  - New Market
  - Piney Point

- Major cities/towns/villages along the shore edge:
  - Clark's Landing
  - Forest Landing
  - Piney Point
  - Point Lookout

Area Demographics

- Population (2000): 86,211
- Anticipated population growth (2020)[55]: 114,800 (33 percent increase from 2000)
  - Majority on shores of further inland?
  - Age[56]
    - < 5: 7.2%
    - 5 – 19: 23.7%
    - 20 – 44: 38.5%
    - 45 – 64: 21.4%
    - > 65: 9.0%
  - Employment status[57]
    - Civilian Labor Force: 52,784
    - Employment: 51,147
    - Unemployment 1,637 (3 percent)
  - Occupations[58]
    - Government 10,828
    - Private Sector 22,995
    - Services 10,986

[55] Preliminary Population Projections for Maryland's Jurisdictions (revised_2 July, 2001) Maryland Department of Planning http://www.mdp.state.md.us/MSDC/popproj/cntrlsforweb.pdf
[56] Profile of General Demographic Characteristics, http://www.census.gov/prod/cen2000/dp1/2kh24.pdf
[57] Regional Data - 1990 TO 2000 Annual Averages Civilian Labor Force, Employment and Unemployment by Place of Residence http://www.dllr.state.md.us/lmi/laus/9097avg.htm
[58] Employment by Industry, 2000, Snap Shot 2001, Baltimore County http://www.dhr.state.md.us/pi/pdf/bcc.pdf

Retail	6,047
Non-Durable Mfg	2,263
Durable Mfg.	1,431
Construction	769
Finance, Ins., Real Estate	472
TCPU	427
Wholesale Trade	276
Agriculture	244

- Employment centers and locations

Tourism and effect on local economy

- Tourist Volumes
- Geographic Distribution of Tourist Volumes
- Opportunities

Relevant Plan sections relating to:

- Land Use
  - Promotion of outdoor recreation goods and service providers, such as hiking, biking, boating tours for birding, fishing, history and Civil War enthusiasts, kayak and canoe liveries, etc.
- Zoning
  - Development District
    - Growth center focused on providing moderate-density res., com., and ind., developments support from community facilities
    - There are no priority funding areas on the County's waterfront locations

- Environment
- Social
- Access

Talbot County

Talbot County is on the Eastern shore of the Chesapeake Bay and has a strong maritime history told in the Maritime Museum in St Michaels. The main town center, Easton, has Route 50 – the major road connection between the Bay Bridge and the Eastern Shore beaches passing through it. Talbot County's waterfront locations are rich in natural resources and contain several creeks and rivers. A small vehicular ferry still operates between Oxford and Bellevue providing access for the small communities and tourists.

Potential Locations

- Major cities/towns/villages:
  - Easton
  - Oxford
  - Queen Anne
  - St Michaels
  - Trappe
- Major cities/towns/villages along the shore edge:
  - Oxford
  - St Michaels

Area Demographics

- Population (2000): 33,812
- Anticipated population growth (2020)[59]: 37,525 (11 percent increase from 2000)
  - Majority on shores or further inland?
  - Age[60]
    - < 5: 5.2%
    - 5 – 19: 18.3%
    - 20 – 44: 29.0%
    - 45 – 64: 27.1%
    - > 65: 20.4%
  - Employment status[61]
    - Labor Force: 18,862
    - Employment: 18,280
    - Unemployment: 582 (3 percent)
  - Occupations[62]
    - Government 1,801
    - Private Sector 16,616
    - Services 6,099
    - Retail 4,234
    - Finance, Ins., Real Estate 682
    - Non-Durable Mfg 1,471
    - TCPU 611

[59] Preliminary Population Projections for Maryland's Jurisdictions (revised_2 July, 2001) Maryland Department of Planning http://www.mdp.state.md.us/MSDC/popproj/cntrlsforweb.pdf
[60] Profile of General Demographic Characteristics, http://www.census.gov/prod/cen2000/dp1/2kh24.pdf
[61] Regional Data - 1990 TO 2000 Annual Averages Civilian Labor Force, Employment and Unemployment by Place of Residence http://www.dllr.state.md.us/lmi/laus/9097avg.htm
[62] Employment by Industry, 2000, Snap Shot 2001, Talbot County http://www.dhr.state.md.us/pi/pdf/ta.pdf

- Wholesale Trade 499
- Construction 1,276
- Durable Mfg. 1,400
- Agriculture 312

- Employment centers and locations
  - Easton
  - Oxford
  - Queen Anne
  - Saint Michaels
  - Trappe

Tourism and effect on local economy
- Tourist Volumes
- Geographic Distribution of Tourist Volumes
- Opportunities
  - Chesapeake Bay Maritime Museum

Relevant Plan sections relating to:
- Land Use
  - Chesapeake Bay Critical Area
  - Development Areas
    - Resource Conservation areas
    - Intensely Developed areas
- Zoning
- Environment
- Social
- Access

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