M-495 Commuter Fast Ferry Project Development Phase Woodbridge to JBAB/National Harbor/Southwest DC

Northern Virginia Regional Commission

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NELSON
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EXECUTIVE SUMMARY

Project Description:

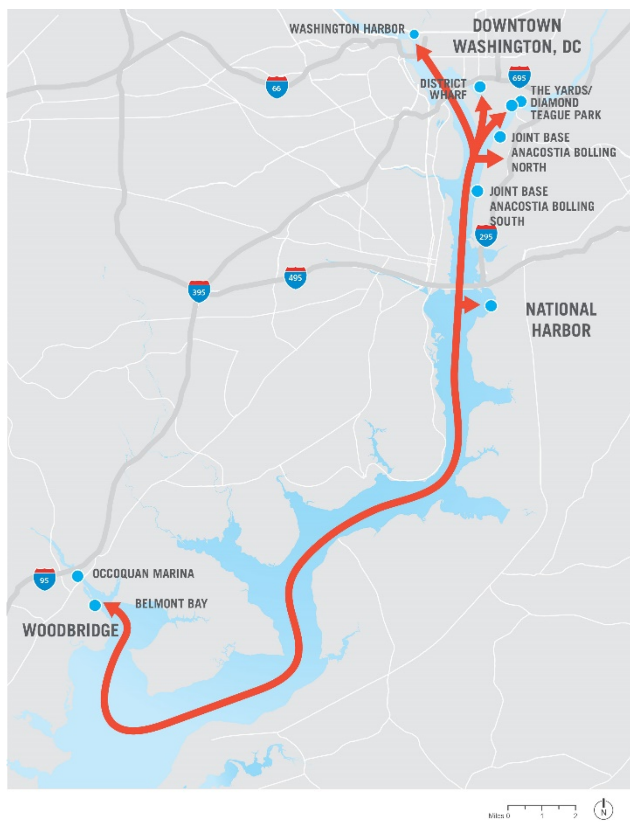
This project would introduce fast commuter ferry service from Virginia to Maryland and/or the District of Columbia, with potential landing sites in Woodbridge, VA, Joint Base Anacostia/Bolling, The Wharf, Navy Yard, and National Harbor. The Gap Analysis attempts the following:

- Identification of feasible terminal locations and the associated land side infrastructure improvements required to conduct operations
- Evaluation of transit connectivity at each site
- Estimation of costs and potential demand
- Assessment of potential jurisdictional partnerships
- Working with local partners to revise the FTA grant application
- Development of project description information to include the ferry project in the regional Transportation Improvement Program (TIP) as an active project

Evaluated Corridors/Terminals

The candidate sites in this gap analysis include origin sites at Occoquan Harbour Marina in Woodbridge, and three distinct sites at the Belmont Bay development in Woodbridge. These sites include George Mason University's Potomac Science Center, the current harbor marina, and a former restaurant site. Destination sites include the docks at National Harbor in Maryland, two sites at Joint Base Anacostia-Bolling (a decommissioned dock and their recreational marina), and four commercial docks located at Washington Harbour (Georgetown), The Wharf, Diamond Teague Park, and The Yards.

Figure 1 Potential Routes and Terminals



Project Outreach

Three public events were held as part of the M-495 Commuter Fast Ferry project development phase. The first, a Fast Ferry Summit, was hosted at Occoquan Harbour Marina in Woodbridge on September 21, 2017. A presentation encapsulating initial travel demand modeling, information from the Federal Transit Administration regarding technical details of the grant application process, and potential ferry terminal site visit summaries was given by the study team. Preliminary infrastructure gap analysis, potential vessel/terminal design, and operations considerations were also presented.

The second of three public events, a project Open House and panel discussion, took place in the Sunset Room at National Harbor, Maryland on October 26, 2017. Questions from the public involved other potential service markets, hours of operation, fare payment, project outreach, and next steps.

The third event, a Public Meeting at the District Wharf drew more than 75 people to the Dockmaster Building, including elected officials, transportation agencies, private businesses, and citizens, to discuss draft conclusions of the infrastructure gap analysis.

Complete details of each public outreach event and each question and answer session are found in the Appendix of this document.

TERMINAL EVALUATION

Infrastructure gaps with respect to commuter ferry operation manifest themselves as the difference between existing facilities and the facilities necessary to implement a functional ferry operation within five years. This study seeks to identify ferry terminal sites that are eligible to receive grant funds for physical improvements as well as sites that meet the needs of the identified commuting population.

Terminal sites were rated on a series of criteria, with certain sub-criteria to develop a final determination of a site's suitability to receive FTA funds for commuter ferry operational infrastructure improvements. The criteria cover topics related to site access, facility quality, economic development opportunity, and ongoing cost.

- Location Suitability for Commuter Market
- Transit Connections
- Transit Access Improvements
- Parking
- Docking Facilities
- Shoreside Pedestrian Access Upgrades
- Degree of Passenger Amenity Improvements
- Compatible Adjacent Land Uses
- Compatible Adjacent Marine Activities
- Degree of Site Control Possible
- Dredging Needed
- Cost of Access

Selection for Conceptual Design

Occoquan River Sites

The Occoquan Harbour Marina site may be the most suitable from an adjacent land use and future development perspectives, but suffers from a ten-minute longer run time to the main river channel. More specifically, this site can act as one of the corners of a transportation triangle. One corner of the triangle, the VDOT Park and Ride Lot adjacent to I-95, is served with Omni-Ride bus service as well as being an informal carpooling (aka "slugging") pick-up location. The next corner of the triangle is the Woodbridge Station for the Virginia Railway Express (VRE). The third corner would be the proposed ferry terminal site. From any location within this triangle, residents of current and future high-density housing can access a large variety of commuting destinations into the greater DC area. Prince William County is currently targeting between 5,000 and 10,000 housing units for this specific area. This implies a potential local population of 10,0000 to 20,000 people all within non-motorized access distance to the corners of the triangle, including the proposed ferry terminal which lies in the center of that area.

The other advantages to this site relate to current usage. The site is presently fully developed and is a motorized marine activity center. Creation of a ferry terminal site at this location would entail a refurbishment of a small portion of the existing marina. Furthermore, the present land owner is fully supportive of development of a ferry terminal on this site and is ready to not just cooperate, but actively create an opportunity to develop the ferry terminal. That is not the case at any of the other sites examined along the Occoquan, where there are property owner concerns about interference with existing marina uses and/or the need to develop a green field for the ferry terminal facility.

From a start-up, permitting, and grant applicability perspective, the Occoquan Harbour Marina site, despite the additional distance challenge, is the most appropriate along the Occoquan River.

Occoquan Harbour Marina

It is recommended that a terminal be located on the property on the northeast corner side of the marina property (see Figure 26). The terminal will consist of a steel float with basic dimensions of approximately 20 feet by 250 feet. The float will be captured by 12 or more steel pipe piles. The float will be oriented with its long axis perpendicular to the river flow. The catamaran ferry will lay alongside with a freeboard of approximately 5 to 6 feet. The float will be equipped with basic handrails around three of the four sides. Safety lighting will be provided for passenger safety. The float will have a concrete deck for good traction in wet and icy weather. The concrete will also add mass to the float and thereby reduce its response/motions due to other vessel wakes. Care must be taken to minimize the intrusion of the float and adjacent vessel into the navigation channel due to the narrow width of the river at this point.

The float will be connected to shore via an aluminum gangway with a clear passage of approximately 48" to allow two persons abreast. The gangway will be designed to accommodate the normal range of river stages, flood to low water. The gangway will have ADA compatible transition plates at both ends and will be equipped with appropriate handrails and lighting. The proposed length of the gangway also enables ADA compliant slopes at all tidal and water level conditions. It is recommended that passengers wait on shore rather than on the landing float. On shore there will be a minimal "shelter" to provide limited weather protection. Electronic signage indicating vessel schedule/arrival times should be adjacent to shelter. An accessible pathway must connect the shelter to the proposed transit parking area with appropriate wayfaring signage and safety lighting.

A rough order of magnitude estimated cost for a terminal installed at this location is $3 to $3.5 million, an accounting of which is described in Figure 27. Because of the site location adjacent to a wetland and along a navigation channel, the permitting is expected to be challenging.

Washington, DC Sites

Sites evaluated on the Southeast and Southwest DC waterfront are adaptable to commuter operations. In this case, a more critical consideration is potential market demand. Chapter 5 describes the market conditions and clearly indicates that development of a ferry terminal site that serves Joint Base Anacostia-Bolling (JBAB) and the Department of Homeland Security Headquarters (DHS) campus has very high potential for success. This is mostly due to the difficulty of accessing these sites through today's transit system from Prince William County. The most ideal location for development of a ferry terminal is at the north end site on JBAB due to its proximity to DHS and the more populated employment sites on JBAB. However, the Army Corp of Engineers has recently begun a project to address the seawall at the north end of JBAB. While this may, ultimately, be the best location for development of a ferry terminal, the potential conflict with the Army Corps project, makes early development of a terminal questionable.

Secondary terminals at sites along the Southeast and Southwest DC waterfront in would not require extensive site re-development. Less well understood is the availability of these facilities and more specifics regarding market strength. When primary service begins, an assessment should be made of the market potential/feasibility of extending service to one or more suitable DC waterfront sites.

In summary, the south site on JBAB was chosen for development of conceptual plans and cost estimates for a ferry terminal. Development of this site is supported by DHS, the Navy, and the command at JBAB.

Joint Base Anacostia-Bolling South

It is recommended that a terminal be located on the property on the north side of the yacht basin entrance (see Figure 30). The terminal would consist of a steel float with basic dimensions of approximately 35 feet by 60 feet. The float will be captured by two to four steel pipe piles. A trash/ice deflector will be installed on the upstream side of the float for protection of the float. The float will be oriented for use by a bow-loading catamaran ferry with a freeboard of approximately 5 to 6 feet. The float will be equipped with basic handrails around three of the four sides. Safety lighting will be provided for passenger safety. The float will have a concrete deck for good traction in wet and icy weather. The concrete will also add mass to the float and thereby reduce its response/motions due to other vessel wakes.

The float will be connected to shore via an aluminum gangway with a clear passage of approximately four feet to allow two persons abreast. The gangway will be designed to accommodate the normal range of river stages, flood to low water. The gangway will have ADA compatible transition plates at both ends and will be equipped with appropriate handrails and lighting. The proposed length of the gangway also enables ADA compliant slopes at all tidal and water level conditions.

It is recommended that passengers wait on shore rather than on the landing float. On shore there will be a minimal “shelter” to provide limited weather protection. Electronic signage indicating vessel schedule/arrival times should be adjacent to shelter. An accessible pathway must connect the shelter to the shuttle bus parking with appropriate wayfaring signage and safety lighting.

The floating ice/trash barrier is made of six steel floats, approximately 4 feet by 4 feet by 40 feet. The shore end will be anchored by chains to a pile dead man. The sections will be connected by chains. There will be four pile supports on the downstream side of the last two sections (2 each). There will be overlapping transition plates between the sections to prevent river trash from fouling the barrier. A solar powered flashing light will be placed on the outer end as a navigational warning. This barrier is designed to handle ice of up to 6” thick. Barriers like this are in common use at hydropower dams to keep trash and ice away from the turbine intakes and the necessary design parameters are well tested in real world conditions.

A rough order of magnitude estimated cost for a terminal installed at this location is $3 to $4 million, described in greater detail in Figure 31.

TRAVEL DEMAND ANALYSIS

Markets

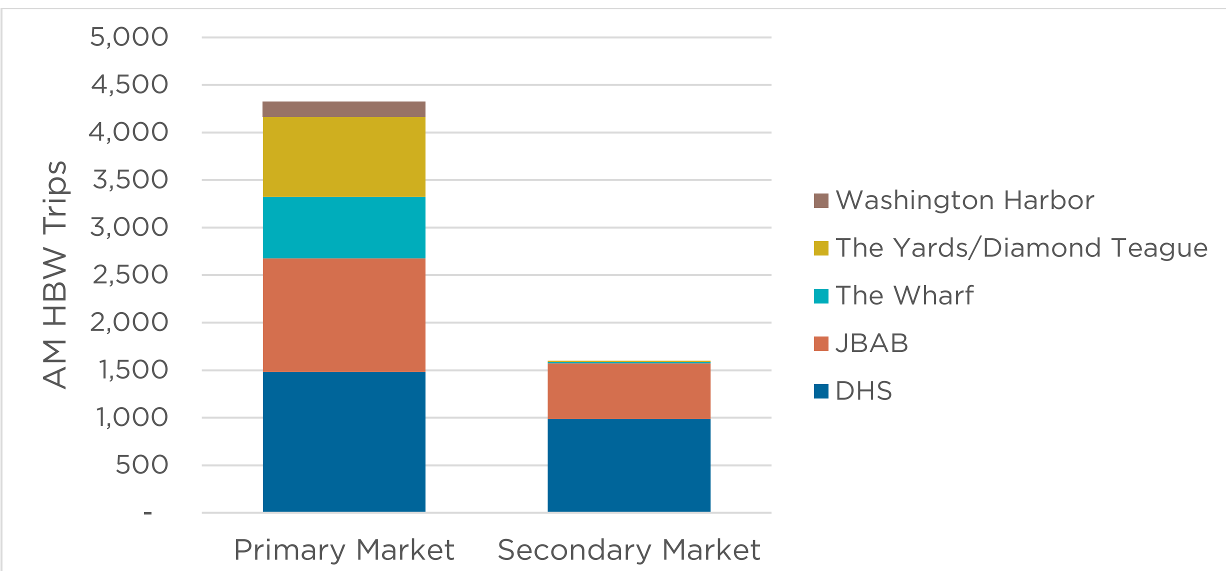
The primary market is defined as the set of Traffic Analysis Zones (TAZ) located within a 30-minute AM peak hour drive to Woodbridge, colored in blue and red in Figure 35. The secondary market is defined as the set of TAZ located within the study area, but not included in the primary market, and displayed as brown in Figure 35.

Existing Home-Based Commute Trip Demand

According to several data sources, there are 4,325 home-based to work (HBW) a.m. trips from the primary market to ferry catchment areas and 870 HBW a.m. trips from the secondary market to these same destinations. These include current a.m. trips from both markets to JBAB, The Wharf, The Yards/Diamond Teague Park, and the projected number of a.m. trips bound for DHS once all DHS employees are relocated to the St. Elizabeth's Campus.

Basing this projection on the home location of current employees, it is estimated that there will be 2,326 a.m. trips to the new DHS campus, 1,481 of which would come from the primary market. The current a.m. trip volume to JBAB from both markets is 1,196, all from the primary market. The current number of a.m. trips from the market areas to The Yards/Diamond Teague Park, The Wharf, and Washington Harbor catchment areas are 657 trips, 855 trips, and 161 trips, respectively.

Figure 2 AM Home-Based Work Trips to Ferry Terminal Catchment Areas



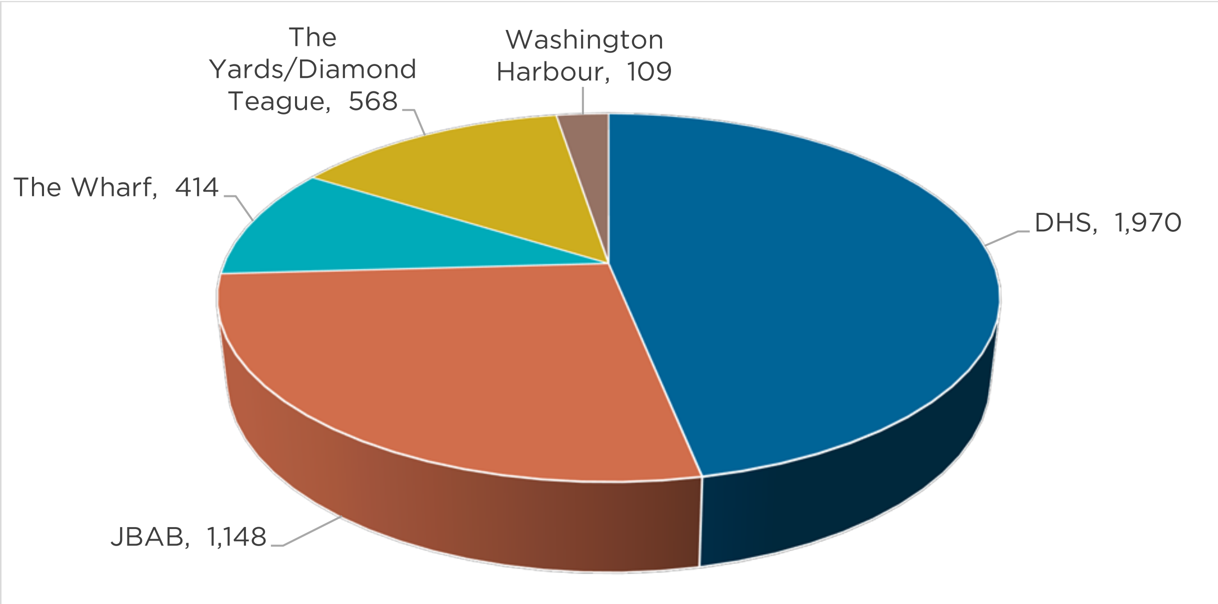
Demand Estimation Methods

Based On Travel Time Reduction

In this method, ridership during the a.m. peak is estimated by identifying the a.m. HBW trips that currently drive, but would save travel time by using a ferry. Included in the ferry time calculations are in-vehicle travel time and five minutes of boarding time.

From both markets, 700 a.m. trips would save travel time to the ferry terminal catchment areas in a scenario with ferry running at standard speed (26 mph). Almost 4,500 trips would save time utilizing a ferry that operates at an optimum speed (35 mph). These are trips whose a.m. peak driving time is higher than the a.m. driving time to Woodbridge plus the in-vehicle time on the ferry while adding 5 minutes of boarding time. A commuter taking the ferry running at optimum speed could save as many as 20 minutes per trip, depending on the origin and destination.

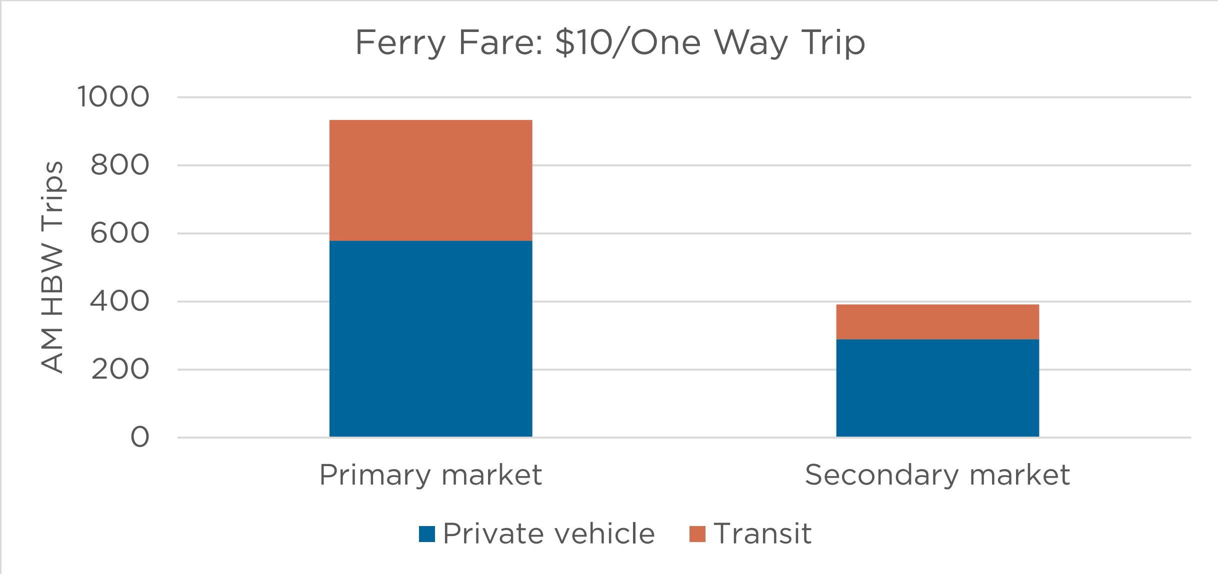
Figure 3 AM Driving Commutes Longer Than Optimum Ferry Travel Time



Based On Generalized Cost Reduction

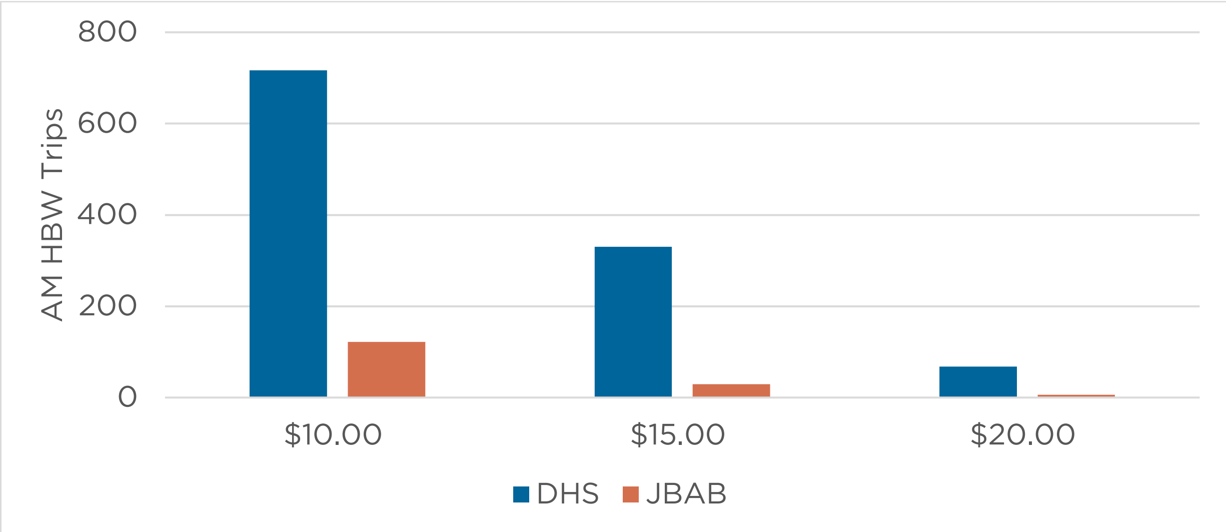
A frequent approach to modelling is to formulate the model as predicting changes relative to a base-year situation. Such approaches are called "pivot-point" method or incremental models. This methodology estimates ridership that could be captured by the ferry from private automobiles and other transit modes by normalizing all generalized costs of each mode into a single utility function. The generalized cost of travelling is the sum of monetary and non-monetary costs of a journey. Monetary or "out-of-pocket" costs might include the transit fare versus the costs of fuel, parking, and tolls. Conversely, non-monetary costs refer to the time spent in travel, including in-vehicle time, wait time, access time, and transfer time. Time is monetized using a valuation of time, which usually varies according to the traveler's income and the purpose of the trip.

Figure 4 AM HBW Trips Captured from Other Modes Based on Cost



Over 900 home-based work trips could be captured from the primary market and almost 400 from the secondary market in Northern Virginia if the ferry one-way fare was set at $10 (see Figure 4 above). Figure 5 shows the potential ridership to select terminals captured from current private vehicle and transit trips based on the difference in the generalized cost between ferry service and other modes. Results prove to be sensitive to fares ranging from $10 to $20 per trip. The estimated demand drops by 65% on average when the fare increases by 50%. Demand drops by 90% when fares double.

Figure 5 Effect of Ferry Fare on Forecast Demand – Optimum Travel Time



Key Findings

The ferry market between Woodbridge and the Joint Base/Department of Homeland Security is attractive from a time savings standpoint. While the market appears to have commercial viability, actual demand is very time and cost sensitive, meaning that ferry travel time reliability will be a very important decision factor for riders.

Most potential riders currently commute by driving alone. Thus, the primary market area appears to realize the greatest benefit, reinforcing the decision of the Occoquan River as an origin terminal location. The market for other DC waterfront destinations is not substantial enough at present to survive as a singular market, though adding those stops could add strength to the primary ferry route.

Further Study

The Gap Analysis has exhausted available data sources and utilized all up-to-date information possible. Further analysis of the market needs to be direct surveying of potential riders. Some factors that could be explored to refine the demand forecast model include:

- Fare pricing vis-à-vis federal commuting subsidies (presently $255 per month, about $12 per day)
- Travel time sensitivity – is the market as sensitive as the model suggests?
- Travel time reliability – data suggests the regional expressway system not is not reliable. How will ferry travel time reliability affect travel decision-making?

NEXT STEPS

This study has identified feasible terminal locations and a viable market for fast commuter ferry operations.

Terminal Development

The two locations identified in this study are feasible as terminals, but considerable work remains to create the infrastructure necessary to launch commuter fast ferry service. The two activities remaining with the highest potential to delay, or even derail, the implementation of commuter fast ferry service are environmental assessment and permitting. The waters and shorelines of the Potomac River are both some of most regulated and protected waters in the United States. There are multiple agencies at local, state, and federal levels that either claim, or have been given legal jurisdiction over use of the waterway and shore side development. Any one of these agencies could create a barrier that is financially infeasible to overcome or even claim a regulatory role that may require litigation and involvement of the courts to reach a resolution. Each terminal site features a unique set of development requirements and details.

Terminal Site – Occoquan Harbour Marina

The Potomac and Rappahannock Transportation Commission has accepted the lead role as grantee of the existing FTA discretionary ferry grant. The agency is in the process of amending the grant and working through FTA NEPA requirements to apply grant funds to upgrading the Occoquan Harbour Marina to support ferry service. Once the FTA grant is secured, issues of design and engineering, permitting, and construction remain. The FTA grant requires that the project appear in the MWCOG Transportation Improvement Plan (TIP) as well as the Virginia State TIP. Prince William County is taking the lead in amending the TIP.

Terminal Site – Joint Base Anacostia-Bolling

The United States Navy is accepting the lead role for development of the terminal at JBAB. The Navy will also have an environmental process for the terminal development. Other remaining steps include securing funding for the terminal (a grant application is pending with MARAD for development of this terminal), design and engineering, permitting, and construction.

Public Agency Responsibility and Vessel Operations

From an environmental regulatory framework perspective, it is unclear which agency or agencies are making the decision to allow fast commuter ferries on the Potomac. Coast Guard jurisdiction is satisfied, without requirement of environmental clearance, by any operator whose vessel meets regulatory requirements, passes inspection, is granted a Certificate of Inspection, and is operated by licensed personnel in a manner consistent with the navigational and pollution rules for inland waters.

At least one regional operator has recognized this issue based on recent experience in expanding water taxi operations along the DC waterfront. Their specific request was to identify and establish an agency that would be responsible for a decision approving operation of a commuter fast ferry. It is presumed that this agency would conduct some form of environmental documentation to ensure their decision was fully informed on the impacts of establishing ferry service. It should be recognized that without a full understanding of environmental requirements, the decision to start a ferry service could be a violation of the National Environmental Policy Act of 1967.

Business Plan

Part of the business plan is to establish a method to select a private partner that will provide and operate the vessels. This part is required regardless of the configuration of the overseeing public authority. This private partner may be contracted at any stage of the process, but it is advantageous to finalize this arrangement as soon as possible. There are multiple potential ways to satisfy this step. A private carrier may step forward to take control of the service. More often, the lead public agency solicits a private operator by offering to "franchise" the terminals to that operator. This provides the most control for the operator, but also introduces the greatest risk to the public agency. The public agency would realize more control by establishing minimum service levels, fare levels, and other operating parameters before allowing private operators to submit proposals highlighting their ability to meet those criteria. This method provides more control to the public agency, but may also trigger the need for an operating subsidy to attract private providers to the partnership.

Regardless of the method chosen to select a private operator another necessary step is to establish a business plan. Elements of that plan include:

- Determining optimal vessel characteristics, particularly the top speed necessary to ensure ferry travel times are competitive with other modes, and that wake height and energy generation have been carefully considered.
- Setting fares (See Chapter 5 section on demand, travel times, and costs). Determine the portions of the market that have access to the federal transit commuting subsidy and understand how the existence of that subsidy should be accounted for in setting fare to ensure a self-sustaining operation.
- Setting schedules and days of service (e.g. Monday through Friday, seven days per week, holidays, service levels that vary by season, etc.)
- Establishing alternative commute options for times when the ferry cannot operate. This is mostly intended to address times when ice or drift on the river impedes safe navigation, although the same plan could also be used for unforeseen service disruptions like mechanical breakdowns. This plan could involve working with commuter bus providers to provide back-up bus service.
- Special attention paid to market forces:
  - What will the recently announced siting of Amazon's HQ2 at Crystal City mean for this service?
  - Is it a positive development or will it detract from the potential market?

  - Will the commuter fast ferry be integrated into package delivery within the region?
  - Other market interests might include operations to National Harbor and the MGM Grand Casino.
- Prioritizing development of a marine maintenance facility that is closer to DC for a more reliable and sustainable service.

1 PROJECT INTRODUCTION

In an April 2017 Request for Proposals, the Northern Virginia Regional Commission (NVRC) sought a ferry infrastructure gap analysis that would build on market analysis performed for NVRC in 2015. The analysis would identify shore-side infrastructure needs at selected key sites to support planning, policy, and budgetary decisions for the future of commuter ferry as a transportation mode choice in the National Capital Region.

PURPOSE AND NEED STATEMENT

Purpose

Waterways remain an untapped resource in the Washington, DC region's multi-modal transportation system. Previous studies undertaken by the Northern Virginia Regional Commission and other entities have demonstrated the market and feasibility of launching commuter ferry service on the Potomac River as a way to alleviate highway congestion and enhance connectivity, security, and livability in the DC-Maryland-Virginia (DMV) metropolitan area. The Potomac River Fast Ferry is a proposal to introduce commuter ferry service from Virginia to Washington DC, providing a reliable, if not relaxing and enjoyable, alternative to driving and traditional public transit. The purpose of the Infrastructure Gap Analysis is to identify key infrastructure elements that would be necessary to implement a fast ferry operation, including site selection, station area planning (including parking and transit connectivity), demand modeling, and environmental compliance.

This project supports at least three of the seven goals articulated for investment by the Northern Virginia Transportation Authority, the authorized Metropolitan Planning Organization, in TransAction, the Regional Transportation Plan for Northern Virginia:

- Provide an integrated, multimodal transportation system.
- Respect historical and environmental factors.
- Enhance Northern Virginia relationships among jurisdictions, agencies, the public and the business community.

Project Description:

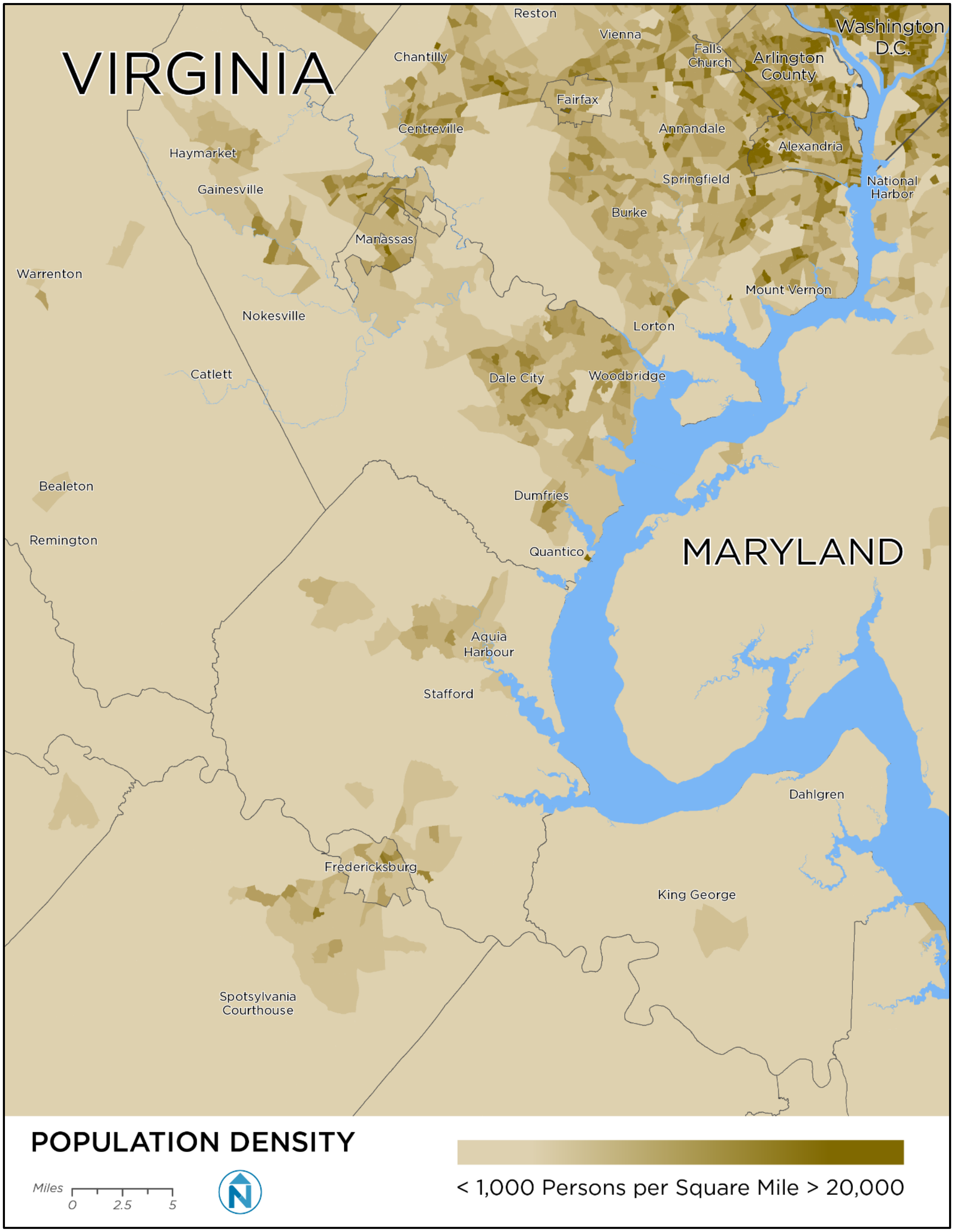
This project would introduce commuter fast ferry service from Virginia to Maryland and/or the District of Columbia, with potential landing sites in Woodbridge, VA, Joint Base Anacostia/Bolling, The Wharf, Navy Yard, and National Harbor. The Gap Analysis identifies feasible terminal locations and the associated land side infrastructure improvements required to conduct operations, evaluate transit connectivity at each site, estimate costs and potential demand, assess the jurisdictional partnerships, revise framework for the FTA grant application, work with MWCOG to include ferry corridors in the regional travel model, and develop project description information in order to include the ferry project in the regional Transportation Improvement Program (TIP) as an active project.

Area Description

Northern Virginia is the most populated region in the state, with about 2.4 million residents across Arlington, Fairfax, Loudoun and Prince William counties, as well as the cities of Alexandria, Falls Church, Fairfax, Manassas and Manassas Park. Its proximity to Washington D.C. and the federal government drives business growth in not only policy-related sectors, but also in technology and healthcare. The Tysons Corner development, for example, has contributed to Fairfax County having the largest suburban office market in the Washington, D.C. area and the second largest in the country. This strong job growth drives the region to have some of the highest average median incomes in the U.S., as well as 7.7% regional population growth from 2010 to 2016, according to Census estimates. Some jurisdictions in particular, Prince William County (10.4%) and the City of Fredericksburg (14.7%), are experiencing double digit growth.

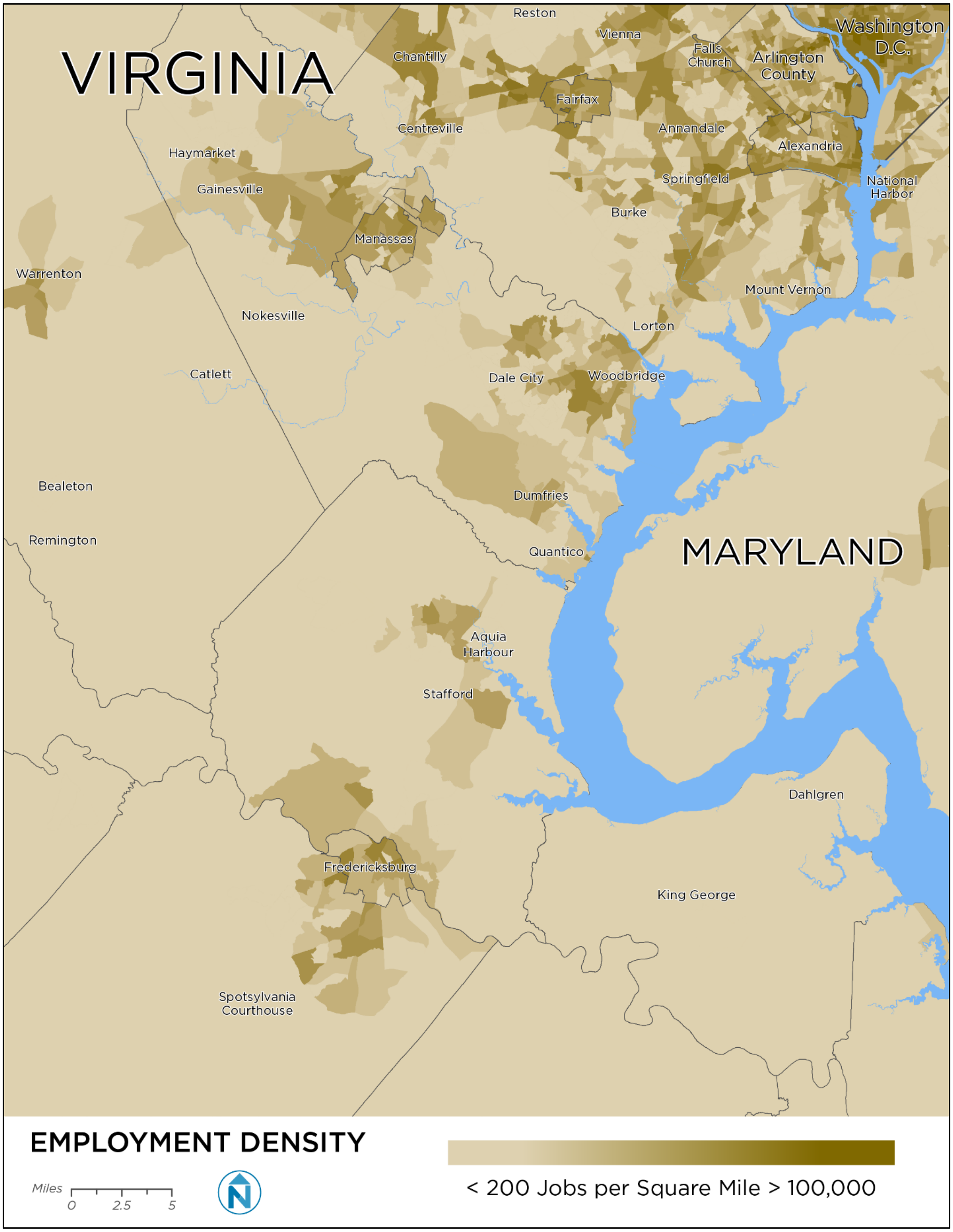
Figure 6 Study and Market Area

Figure 7 Study Area Population Density



Source: U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates

Figure 8 Study Area Employment Density



Source: U.S.Census Bureau, Center for Economic Studies, 2015 Work Area Profile Analysis

Figure 9 Regional Population Trends

Location	2010[1]	2013 Estimate[2]	2016 Estimate[3]	Change 2010-2016
City of Alexandria	139,966	143,684	151,473	8.2%
Fairfax County	1,081,726	1,101,071	1,132,887	4.7%
Prince William County	402,002	416,668	443,630	10.4%
Stafford County	128,961	131,885	139,548	8.2%
City of Fredericksburg	24,286	25,931	27,853	14.7%
Washington-Arlington-Alexandria Metro Area	5,582,170	5,759,330	6,011,752	7.7%

Figure 10 Regional Employment Trends

Location	2010[4]	2015[5]	Change 2010-2016
Washington, D.C.	621,524	677,094	8.9%
Arlington County	134,414	151,123	12.4%
National Harbor, MD	2,776	4,858	75.0%
Washington-Arlington-Alexandria Metro Area	2,797,061	2,955,571	5.7%

Accommodating economic and demographic growth has impacted the region's transportation infrastructure. Washington Metropolitan Area Transit Authority's (WMATA) Metrorail system serves a population of four million people over a 118-mile rail network of six lines, three of which serve Northern Virginia. It has the second-largest public transit system in the country in terms of passenger ridership (second only to New York City MTA), contributing to a 45% mass transit mode share for people commuting to downtown Washington, D.C. and parts of Arlington County. Northern Virginia is also served by Virginia Railway Express commuter rail, OmniRide, Arlington Transit, Metrobus, Fairfax Connector, Alexandria Dash, and a substantial collection of private dedicated shuttle services that typically connect Metro rail stations with specific work sites. Fairly unique to the region is the concept of "slugging," where individuals headed for common destinations informally carpool. Walking and biking accessibility varies greatly within the region, but is particularly an issue in the part of this area where the commute shed of this project is focused, Prince William County.

[1] U.S. Census Bureau, 2010 Source File 1
[2] U.S. Census Bureau, 2009-2013 American Community Survey 5-Year Estimates
[3] U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates
[4] U.S.Census Bureau, Center for Economic Studies, 2010 Work Area Profile Analysis
[5] U.S.Census Bureau, Center for Economic Studies, 2015 Work Area Profile Analysis

Major highways in Northern Virginia include the Capital Beltway and I-95, both of which have implemented variable priced tolling and HOV lanes to manage congestion. Despite having low average daily trip distances, auto commuters in Northern Virginia have average commute times of over 30 minutes. Average commute times in the corridor that is the focus of this project are 90 minutes and longer per one-way trip. Multiple traffic studies have shown the Washington, D.C. region to be have commute traffic delays that are among the worst traffic delays/waits/stoppages/setbacks in the country.

Needs

Mobility options from Northern Virginia to DC are largely limited to commuter transportation. While Arlington County has a wide range of multi-modal options, other areas in the region have greater auto dependency, leading to unpredictable travel times and regular delays on regional freeways. In Northern Virginia, 18.5% of interstate miles traveled at peak times were congested in 2014, as compared to 2.4% in the rest of the Commonwealth. Despite having some of the shortest commute distances (under 10 miles), residents of Northern Virginia have some of the longest commute times (over 30 minutes), indicating a need for more commuting options.

- The I-95 freeway operates at, or above, capacity during peak periods, with higher than average travel times as compared to the greater DMV metro region. The average auto commute time from areas within a 15-minute drive of potential ferry terminals in the Woodbridge area to Washington, DC was 90 minutes, according to the MWCOG Regional Travel Demand Model.
- Despite the addition of variable toll and HOV lanes, capacity on freeways continues to reach its limit. To further alleviate congestion along I-95 and I-495, the Virginia Department of Transportation has expanded the reach of its Express Lane program, converting existing 2-person HOV lanes to high-occupancy toll lanes (HOT)—where vehicles with three or more people can use the express lanes free, while vehicles with fewer than three people can choose to pay a variable toll—and has added active traffic management to accommodate growing traffic.
- Washington Metropolitan Transit Authority (WMATA), which provides public transit service from the District east to Vienna, Wiehle-Reston East and south to Franconia-Springfield, has experienced numerous system failures in recent years, resulting in decreased customer satisfaction and residual service shut downs as the agency was forced to embark on a long-term repair program known as SafeTrack. In the wake of reduced service during repairs, many commuters are forced to turn to alternatives, such as ride-sharing, driving, and/or working remotely. In recent years, MetroRail's vulnerability to federal budget cuts and safety incidents has shown that redundancy of transportation options will be needed in the future for the security and growth of the capital region.
- Additional long-haul bus service in Prince Williams County is operated by the Potomac and Rappahannock Transportation Commission (PRTC) in conjunction with Virginia Railway Express (VRE). PRTC provides commuter bus service along the I-95 and I-66 corridors, as well as local bus service in Prince William County and the Cities of Manassas and Manassas Park. Eight OmniRide routes provide commuter bus service between Washington DC and Northern Virginia, including six in Woodbridge and its surrounding area and two in Manassas-Manassas Park. One route, the Cross County Collector, runs service between Mansassas' Transit Center and the PRTC Transit Center. An additional three lines (Linton Hall Metro Direct, Manassas Metro Direct and Prince William Metro Direct) connect to Metrorail stations for service into Washington, DC and beyond. Park and Ride/commuter lots are located throughout PRTC's service area.

Potomac Commuter Ferry - Goals and Objectives

- Mitigate congestion on the region's highway, rail, and bus systems and offer additional capacity to the increasingly gridlocked road system;
- Accommodate regional population growth;
- Offer a new alternative, affordable commuter public transportation option for residents;
- Enable flexible and less vulnerable immediate emergency preparedness capabilities on the river system;
- Resiliency and redundant transportation service in the case of a regional hazard event;
- Enhance military and homeland security vessel and shore side capacity needed to conduct an evacuation or to mobilize military personnel and supplies.

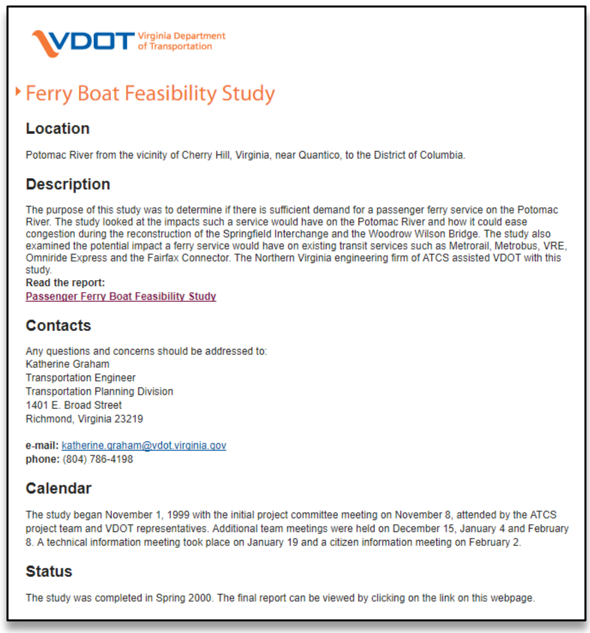
2 REVIEW OF PREVIOUS STUDIES

The feasibility of ferry service on the Potomac River has been the topic of studies beginning in 1999. Work on topic began due to a desire to determine whether sufficient demand exists for service and how that service might ease congestion during various interchange and bridge reconstructions. Work resumed years later to analyze technical and financial feasibility of operations, followed by an effort to quantify the characteristics of potential service markets and more accurately define feasible and sustainable service model alternatives.

Subsequent sections summarize highlights and key findings of each preceding study.

2001 VDOT FERRY FEASIBILITY STUDY

United States Congressmen Frank Wolf and Tom Davis sponsored legislation in October 1998 for grant funding to study the development of a high-speed passenger ferry boat service on the Potomac River between Woodbridge, Virginia and the District of Columbia. This grant initiative was based on continuing interest in utilizing the Potomac River for transportation service, the desire to alleviate significant impacts on motorists during the planned I-95 Springfield Interchange and Woodrow Wilson Bridge reconstruction, and the potential for private ferry operators to access public funding.


VDOT Virginia Department of Transportation

Ferry Boat Feasibility Study

Location

Potomac River from the vicinity of Cherry Hill, Virginia, near Quantico, to the District of Columbia.

Description

The purpose of this study was to determine if there is sufficient demand for a passenger ferry service on the Potomac River. The study looked at the impacts such a service would have on the Potomac River and how it could ease congestion during the reconstruction of the Springfield Interchange and the Woodrow Wilson Bridge. The study also examined the potential impact a ferry service would have on existing transit services such as Metrorail, Metrobus, VRE, Omniride Express and the Fairfax Connector. The Northern Virginia engineering firm of ATCS assisted VDOT with this study.
Read the report:
Passenger Ferry Boat Feasibility Study

Contacts

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Transportation Planning Division
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Richmond, Virginia 23219

e-mail: katherine.graham@vdot.virginia.gov
phone: (804) 786-4198

Calendar

The study began November 1, 1999 with the initial project committee meeting on November 8, attended by the ATCS project team and VDOT representatives. Additional team meetings were held on December 15, January 4 and February 8. A technical information meeting took place on January 19 and a citizen information meeting on February 2.

Status

The study was completed in Spring 2000. The final report can be viewed by clicking on the link on this webpage.

The study accounted for the existing travel conditions in Northern Virginia, ongoing construction activities, and documented projections of increased travel in the corridor. It also explored the role of passenger ferry boat service as an integral and economically sustainable component of the region's transportation system. A phased implementation plan was recommended that provides for public activities to facilitate establishment and operation of a private ferry venture.

After alternatives analysis, the Woodbridge to Navy Yard route was selected as the recommended service for initial operation and a ferry service plan developed that featured the following service attributes:

- 30-minute headway
- 45-minute one-way travel time
- 27 miles per hour Average Speed
- 12 daily trips
- Significant subsidy per passenger
  - Base year farebox recovery: 19.9%
  - Fifth year farebox recovery: 32.6%

Concluding, the 2001 study notes that to attract projected patronage, the ferry service would have to operate at a speed that is competitive with other modes of travel. Based on obtaining speed waivers as well as identifying a private ferry operator, the following major implementation recommendations are made.

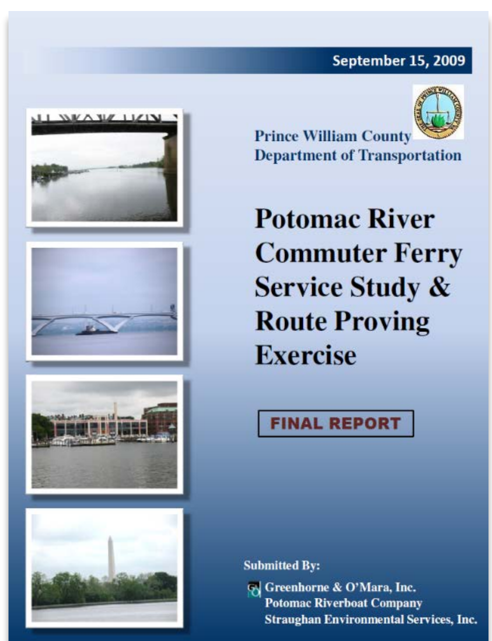
- VDOT support of private operation by:
  - Posting ferry advertisement signage
  - Public information efforts
  - Improvements to VDOT facilities that would enhance access to docking sites
  - Assisting local agencies with planning and grant preparation
- Integration into local public transportation infrastructure through:
  - A common fare medium
  - Alternative service provisions due to weather or other interruptions
  - Supporting shuttle bus service to/from terminals
- If necessary, a technical proving and demonstration project to further assist the private sector in establishing service

2009 PRINCE WILLIAM COUNTY SERVICE STUDY AND ROUTE PROVING EXERCISE

The Prince William County Department of Transportation conducted a route proving exercise and feasibility study of proposed commuter ferry services on the Potomac River between April 1, 2009 and July 31, 2009. The primary goal of this project was to determine likely ferry service travel times between potential docking locations, assess potential environmental impacts resulting from a ferry service, prepare preliminary capital and operational costs of a ferry service, and define the operational parameters necessary to provide optimal ferry service between points in Virginia, Maryland, and Washington DC. Another project goal was to preliminarily estimate ferry travel demand and operational revenue as well as to assess the need for further travel demand analysis.

A total of thirteen potential terminal sites were tested during the exercise:

- Quantico Marine Base
- Southwest Waterfront – Washington
- Anacostia Waterfront – Washington
- Harbor Station, VA
- Prince William Marina
- Occoquan Harbor Marina
- Belmont Bay Marina
- Marshall Hall, MD
- Fort Belvoir
- NSF Indian Head
- Old Town Alexandria
- National Harbor, MD
- National Airport



The proving exercise included a schedule of runs on the Potomac, allowing for unanticipated delays and for the inclusion of passengers. The project team prepared a timing plan that included the use of GPS monitoring to capture run times at five second intervals. The exercise also included wave/wake and noise testing.

Based on data collected, the project team developed proposed characteristics for a ferry vessel on the Potomac River. The ideal Potomac ferry vessel would be multi-hulled, have a draft of no more than 3.5 feet, have an average cruising speed of 34 mph, be single deck and hold 99 people. Slower than anticipated travel times were recorded during the trials for two primary reasons:

- Relatively shallow water depths on the Occoquan River prevented the ferry vessel from operating at cruising speed.
- Wake restrictions on the Potomac River along the Alexandria, Virginia waterfront and on the Anacostia River and Washington Channel in Washington D.C. obligated the ferry vessel to slow to speeds of 5 to 10 mph.

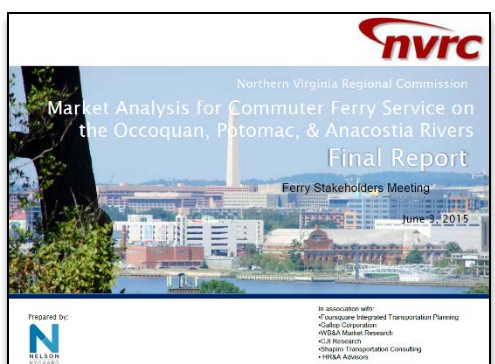
The results of this study and the following conclusions and recommendations were put forth:

- The commuter ferry service will require public financial support.
- A Potomac River ferry operation has the potential to be competitive with those commuter services offered by PRTC and VRE in terms of travel time and service between the area of Occoquan, Virginia and SE Washington DC.
- Additional analysis of travel demands through market studies and a new trip generation model is warranted. A more rigorous market analysis should be undertaken to analyze prospective demand by market in order to account for all significant variables.
- No significant noise or wave impacts associated with ferry service are anticipated.
- Coordination with the proper authorities to obtain speed restriction waivers along the Potomac River should be initiated.
- Continued coordination with local governments and military installations that front the Potomac River should be pursued.
- Initial investigations into an authority to oversee ferry operations should also be discussed with counties and cities that may have an interest in commuter ferry service.

2015 NVRC MARKET ANALYSIS REPORT

At the recommendation of the 2009 proving exercise, a more rigorous modeling and analysis of travel demand was performed in 2015 to define feasible service model alternatives. The initial assessment eliminated a number of terminal locations and reduced the analysis to final candidate corridors evaluated based on market size and travel time saved. The following market areas were identified for further study:

- Southwest Waterfront – Washington
- Anacostia Waterfront – Washington
- Alexandria
- Eastern Prince William County
- National Airport/Crystal City
- Southern Maryland
- National Harbor



The study team proceeded to conduct a household telephone survey of 1,200 participants. Key findings included:

- 53% of area travelers who currently travel parallel to a potential ferry route do so to get to work
- Of those travelers who make their way parallel to a ferry route 60% are driving alone
- Major concerns of these drivers –traffic congestion followed by total travel time and parking cost
- 30% of people surveyed are likely to try a ferry, but familiarity with mode is an issue for many
- People making trip by car are more likely to try a ferry than those who commute by another transit mode

In conjunction with the household survey, the study team employed the MWCOG regional travel demand model, projected to 2020, to further assess market area suitability. Terminal access quality was based on pedestrian, transit, and park-and-ride accessibility factors. Modeling identified six final corridors with potentially sustainable markets:

- Old Town Alexandria to Southwest Waterfront
- Old Town Alexandria to Southeast Waterfront
- National Airport to Southwest Waterfront
- National Airport to Southeast Waterfront
- Alexandria – Wilson Bridge to Joint Base Anacostia Bolling (JBAB)
- Woodbridge, VA to Southeast Waterfront

The consideration of the joint base in this study involved additional factors not previously considered, including participation by the U.S. Navy, U.S. Air Force, the Department of Homeland Security, and the U.S. Coast Guard. Likewise, using the joint base as a terminal would require a closed system. Only those with a security clearance would be able to disembark at JBAB. A challenge would be encountered as federal agencies would need to collaborate to provide shuttles to destinations on shore though identifying the base could provide an opportunity to branch service to The Pentagon.

Overall the study found that shorter connections between Alexandria/National Airport and Washington have enough market potential to be pursued. Additionally, with some amount of public subsidy to establish adequate shore-side facilities and assist in service start-up, the markets identified are very likely to become long-term, viable commercial markets, adding depth to multi-modal transportation options in the metropolitan area.

3 INFRASTRUCTURE GAP ANALYSIS

Infrastructure gaps with respect to commuter ferry operation manifest themselves as the difference between existing facilities and the facilities necessary to implement a functional ferry operation within five years. This study seeks to identify ferry terminal sites that are eligible to receive grant funds for physical improvements as well as sites that meet the needs of the identified commuting population.

The candidate sites in this gap analysis include origin sites at Occoquan Harbour Marina in Woodbridge, and three distinct sites at the Belmont Bay development in Woodbridge. These sites include George Mason University's Potomac Science Center, the current harbor marina, and a former restaurant site. Destination sites include the docks at National Harbor in Maryland, two sites at Joint Base Anacostia-Bolling (a decommissioned dock and their recreational marina), and four commercial docks located at Washington Harbour (Georgetown), The Wharf, Diamond Teague Park, and The Yards.

Figure 11 Potential Terminal Sites

POTENTIAL TERMINAL SITE CHARATERISTICS

From a shore side and marine infrastructure perspective, the ideal terminal site features an adequate navigation channel for daytime and nighttime operation. Sufficient width, depth, navigation markers, and capacity for other vessel traffic are all important factors in defining adequacy.

The docking structure itself must be suitable for anticipated vessels. This suitability includes the strength to resist docking impacts, the ability to operate at different river stages and under different environmental factors, and the ability to offer protection from waves or wake wash. Regardless of vessel loading condition and trim, the docking structure should possess geometry compatible with safe transfer of passengers between the ferry and dock and a safe egress path for passengers to move from vessel to shore with features such as walking surface, railings, lighting, and signage that meet ADA requirements.

The terminal facility must include a waiting area of sufficient capacity either on dock or on shore which provides partial or full protection from rain and wind. The waiting facility should feature a reader board with real time information on vessel arrivals and departures as well as static information pertaining to the system such as fares and schedules. Seating for the elderly and persons with disabilities should be provided along with lighting for nighttime or low visibility conditions and security elements such as cameras and call boxes for passenger safety.

To provide a viable commute alternative, connections to other transportation modes at the terminal site are essential. These connections should include on-site bus access, walking and bicycle paths to nearby transit facilities or vehicle parking areas, and bicycle parking facilities.

Should a terminal site be used for overnight storage of vessels before their return to service, additional infrastructure would be required. In addition to mooring hardware, fendering would be required to protect the moored vessel. Shore power, basic supply storage, and waste disposal to support cleaning operations should also be provided. If fueling, oil changes, and/or other maintenance is to occur on site, the availability of oil spill containment supplies becomes of high importance. Finally, ferry operators should consider security measures that protect against unauthorized access to the vessels.

The characteristics are condensed into key attributes used to simplify the description of the suitability of each individual site. For each site, a color-coded table describes whether that site fully (green) or partially (yellow) provides the suite of sub characteristics for each key attribute. Facilities deficient in a key attribute are coded in red.

Figure 12 Site Characteristic Summary

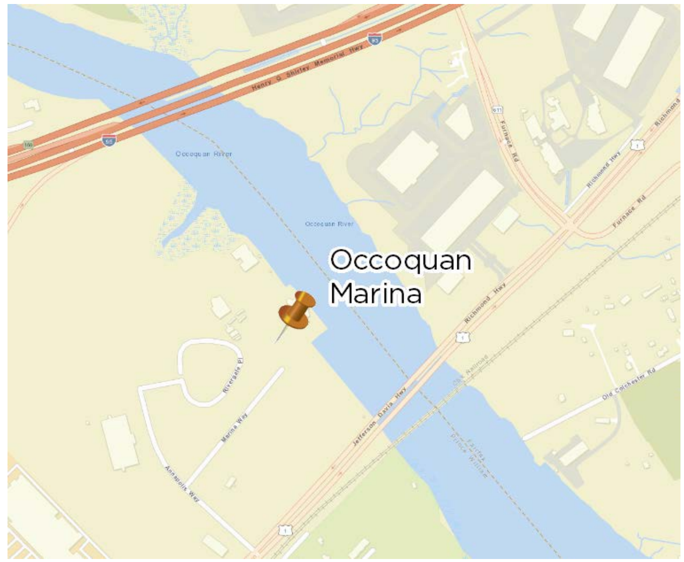
Key Attribute	Sub Characteristics
Adequate Navigation Channel	Sufficient width and depth
	Navigation markers
	Vessel traffic capacity
Suitable Docking Structure	Docking impact strength
	Operation under environmental factors
	Wave protection
	Safe passenger transfer geometry
	Safe egress path
Sufficient Waiting Area	Protection from weather
	Real time information
	System information
	Seating for persons with disabilities/seniors
	Lighting for low visibility conditions
	Security elements
Connections to Other Modes	Bus access
	Pedestrian pathways to transit/parking
	Bicycle parking and access
Site Control	Ownership/Lease status
	No interference to site access at any time

Occoquan Harbour Marina

13180 Marina Way

Woodbridge, VA 22191

Figure 13 Occoquan Harbour Marina Potential Terminal Location



Key Attributes
Adequate navigation channel
Suitable docking structure
Sufficient waiting area
Connections to other modes
Site Control

Belmont Bay

570 Harbor Side St

Woodbridge, VA 22191

Figure 14 Belmont Bay Potential Terminal Locations

GMU Site Attributes
Adequate navigation channel
Suitable docking structure
Sufficient waiting area
Connections to other modes
Site Control

Harbor Marina Site Attributes
Adequate navigation channel
Suitable docking structure
Sufficient waiting area
Connections to other modes
Site Control

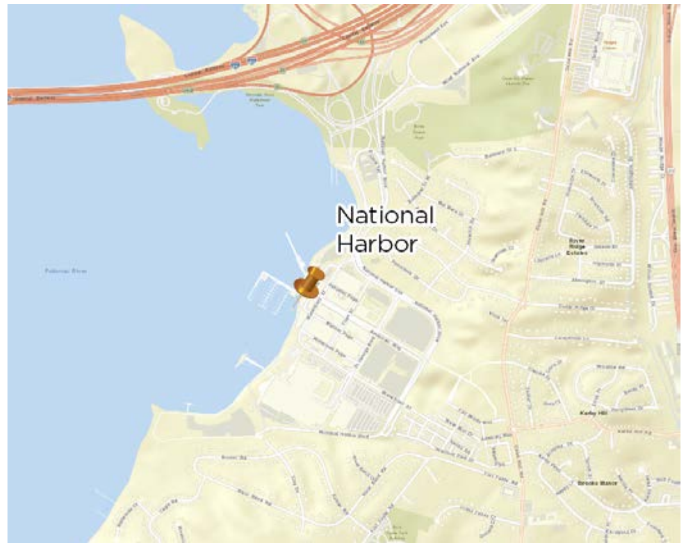
Restaurant Site Attributes
Adequate navigation channel
Suitable docking structure
Sufficient waiting area
Connections to other modes
Site Control

National Harbor

116 Waterfront St

Oxon Hill, MD 20745

Figure 15 National Harbor Potential Terminal Location



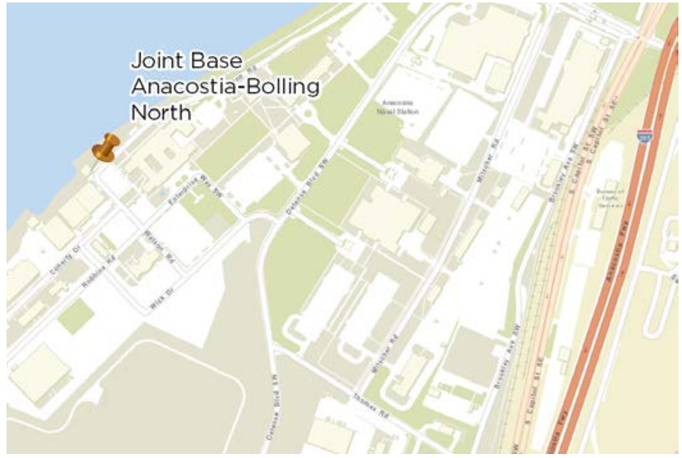
Key Attributes
Adequate navigation channel
Suitable docking structure
Sufficient waiting area
Connections to other modes
Site Control

JBAB North

Robbins Road

Washington, DC 20373

Figure 16 JBAB North Potential Terminal Location

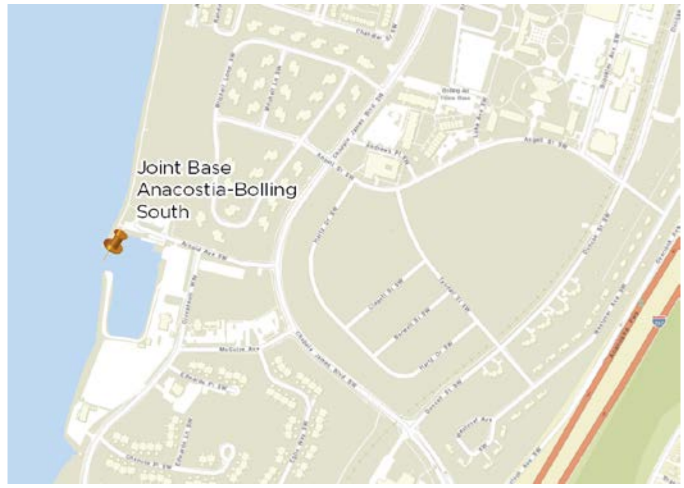


Key Attributes
Adequate navigation channel
Suitable docking structure
Sufficient waiting area
Connections to other modes
Site Control

JBAB South

Giovannoli Street SW and Arnold Avenue SW
Washington, DC 20032

Figure 17 JBAB South Potential Terminal Location



Key Attributes
Adequate navigation channel
Suitable docking structure
Sufficient waiting area
Connections to other modes
Site Control

The Wharf

690 Water St SW

Washington, DC 20024

Figure 18 The Wharf Potential Terminal Location

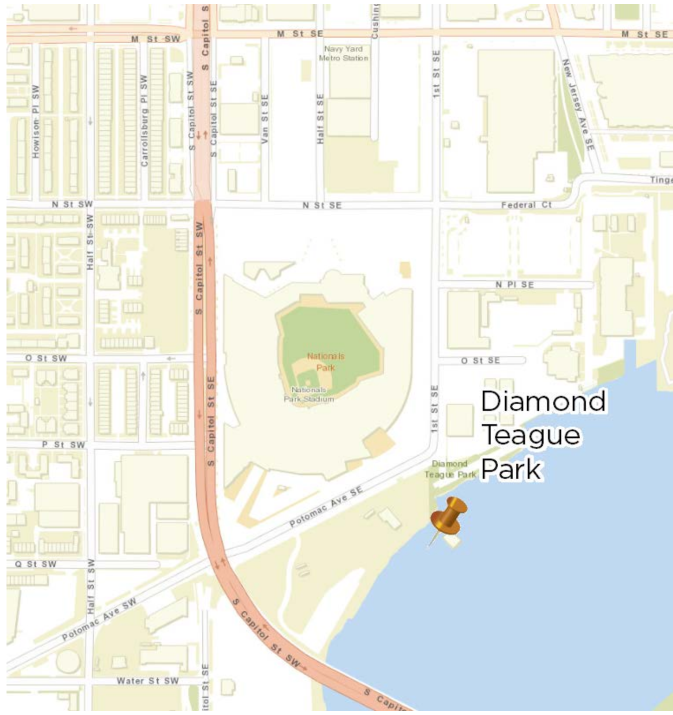
Key Attributes
Adequate navigation channel
Suitable docking structure
Sufficient waiting area
Connections to other modes
Site Control

Diamond Teague Park

1520 First St SE

Washington, DC 20020

Figure 19 Diamond Teague Park Potential Terminal Location



Key Attributes
Adequate navigation channel
Suitable docking structure
Sufficient waiting area
Connections to other modes
Site Control

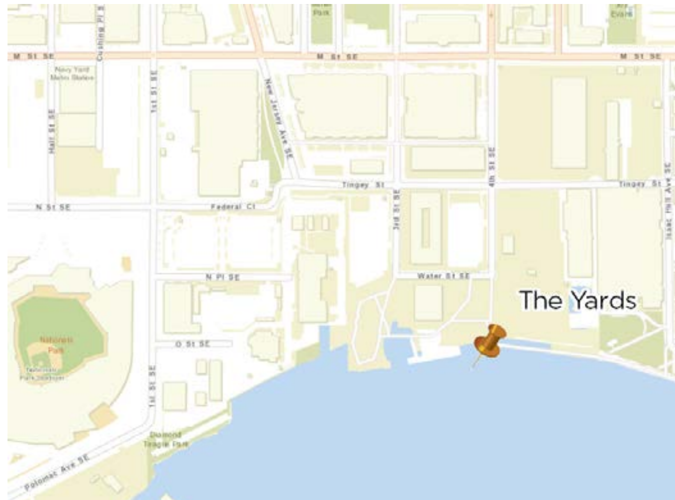
The Yards Marina

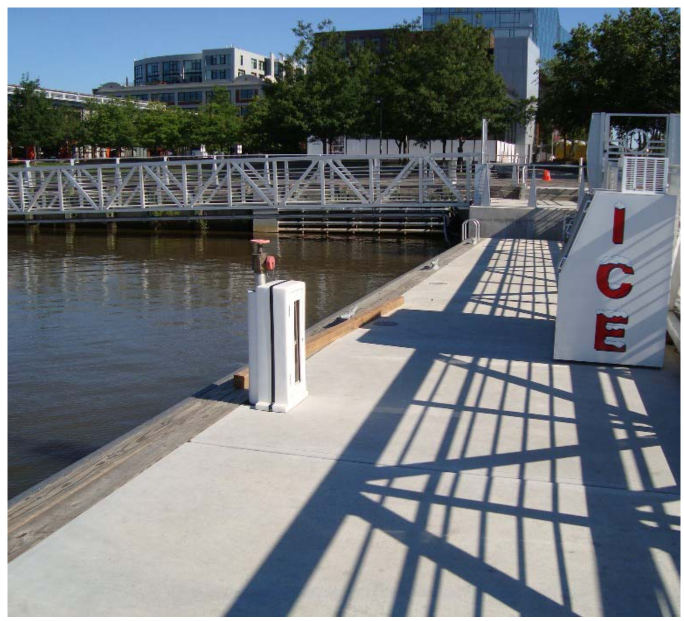
1492 4th St SE

Washington, DC 20003

Key Attributes
Adequate navigation channel
Suitable docking structure
Sufficient waiting area
Connections to other modes
Site Control

Figure 20 The Yards Marina Potential Terminal Location



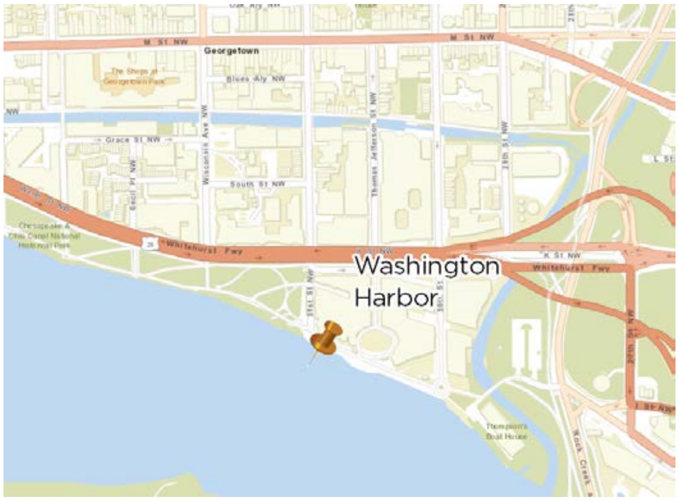


Washington Harbour

3050 K St NW

Washington, DC 20007

Figure 21 Washington Harbour Potential Terminal Location

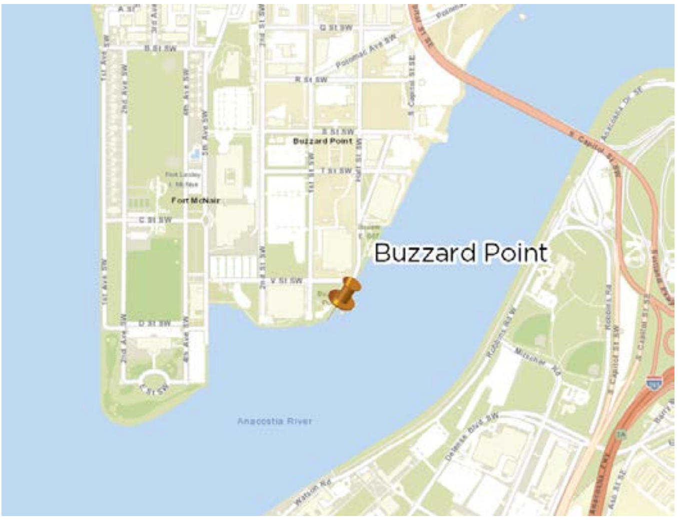


Key Attributes
Adequate navigation channel
Suitable docking structure
Sufficient waiting area
Connections to other modes
Site Control

Buzzard Point

Washington, DC 20003

Figure 22 Buzzard Point Potential Terminal Location



Key Attributes
Adequate navigation channel
Suitable docking structure
Sufficient waiting area
Connections to other modes
Site Control

TERMINAL SITE SUITABILITY ASSESSMENT

Terminal sites were rated from 1-5 on a series of 13 criteria, with certain sub-criteria in order to develop a final determination of a site's suitability to receive FTA funds for commuter ferry operational infrastructure improvements. The criteria cover topics related to site access, facility quality, economic development opportunity, and ongoing cost.

Location Suitability for Commuter Market

The terminal site should be located such that it serves the origin or destination of a commuting market significant enough to ensure sustainable operation.

Transit Connections

The terminal site should be well connected to transit, whether for commuters arriving at the origin terminal or those whose destination requires the use of another mode (Eg. Metro to Downtown Washington). Present conditions as well as the level of improvement and investment required to improve transit links to a higher level of service are examined.

Transit Access Improvements

Transit vehicles should be able to operate within or immediately adjacent to the terminal site. The level of current transit operational access as well as the potential to implement improved transit vehicle access comprise this composite category.

Parking

The origin terminal site should meet the parking needs of commuters proportionate to ridership and the number of daily voyages. Sites are assessed on their present parking availability, how much increased supply is needed, and whether these additions are feasible.

Docking Facilities

Terminal sites must include a dock that can properly accommodate the design vessel. In addition to assessing needs related to in-water construction, any dock facility must feature adequate navigational space leading to and immediately adjacent to the dock.

Shoreside Pedestrian Access Upgrades

Pedestrians and the disabled community should be able to access the terminal via high quality pedestrian and handicapped facilities. Sites are assessed regarding needed facility implementation or improvement.

Degree of Passenger Amenity Improvements

Terminal sites should include amenities commensurate with long-haul commute modes. Desired on-site amenities include an indoor waiting area with seating, a sheltered loading area, adequate ingress/egress paths, ticketing agents/machines, and service information. Higher level amenities may include targeted retail and electronic charging stations.

Compatible Adjacent Land Uses

A terminal site is more desirable if it integrates nearby land uses that provide a captive market effect. For example, the market feasibility strength of an origin terminal is enhanced by proximity to higher-density residential development. A destination terminal realizes an advantage from a close by employment concentration.

Compatible Adjacent Marine Activities

Terminal sites that already accommodate, or are proximate to, comparable marina activity are desirable as they demonstrate the ability to serve as host to vessels of comparable class to a commuter ferry as well as signify that marine restrictions are unlikely to be a factor constraining eventual operation. At the same time, adjacent marine activity should not be so dense as to interfere with the ability to access and disembark from the terminal site during normal ferry operation.

Degree of Site Control Possible

The commuter ferry service operator should have full control over the terminal site. As such, ownership of the site is preferred to a lease arrangement. Control includes unfettered access to the site as required without any possible interference due to events/sharing arrangements/etc.

Dredging Needed

Terminal sites should feature sufficient water depth at dockside so that dredging operations are not required. This includes future requirements due to factors associated with the design vessel as is examined in a subsequent section of this report.

Cost of Access

Terminal sites may require a purchase or lease agreement before they may be integrated into a ferry service and/or accept federal funds for infrastructure improvement. In some cases, new public roads may need to be created to accommodate vehicular access to the site.

Figure 23 Terminal Site Evaluation Matrix

Evaluation Criteria	Terminal Site	Occoquan Harbour Marina	Belmont Bay (1) George Mason	Belmont Bay (2) Current Marina	Belmont Bay (3) Restaurant Site	National Harbor	JBAB South	JBAB North	The Wharf	Diamond Teague Park	The Yards	Washington Harbor	Buzzard Point
Location suitability for commuter market		5	4	4	3	5	4	5	5	5	5	5	2
Transit connections													
Present		1	1	1	1	4	1	1	4	4	5	5	2
Degree of improvement required		1	1	1	1	3	1	1	5	3	4	2	2
Transit Access Improvements													
Needed		1	1	1	1	5	1	1	5	5	5	5	2
Feasible		4	4	4	1	5	4	5	5	5	5	5	4
Parking													
Present		3	1	2	1								
Degree of improvement needed		3	2	3	1								
Access improvements feasible		3	4	4	1								
Docking Facilities													
Adequate navigational space		3	5	5	5	5	4	5	5	5	4	3	5
Substantial in-water construction required		1	1	3	1	5	1	2	5	5	5	3	1
Shoreside pedestrian access upgrades		3	1	1	1	5	4	3	5	5	5	5	3
Degree of passenger amenity improvements		3	1	2	1	5	2	2	5	4	4	4	1
Compatible adjacent land uses		5	4	4	2	5	4	5	5	5	5	5	5
Compatible adjacent marine activities		5	5	2	5	5	2	5	5	5	5	3	5
Degree of site control possible (lease/own)		5	5	3	1	1	5	5	3	4	4	4	2
Significant additional ferry run time		1	4	4	5	1	4	5	4	5	5	2	5
Dredging needed		2	2	5	5	3	5	5	5	5	5	5	5
Cost of access		2	2	1	1	2	3	3	3	5	3	4	2
Suitability for application of FTA funds		3	4	3	2	1	5	5	1	4	1	3	2

PREFERRED TERMINAL SITE IDENTIFICATION

The preferred terminal site can be grouped into two sub-groups, those on the Occoquan River and those closer to Washington, DC.

Occoquan River Sites

All sites evaluated have strengths and weaknesses. The Occoquan Harbour Marina site may be the most suitable from an adjacent land use and future development perspective, but suffers from the longer run times to the main river channel. More specifically, this site can act as one of the corners of a transportation triangle. One corner of the triangle, the VDOT Park and Ride Lot adjacent to I-95, is served with Omni-Ride bus service as well as being an informal carpooling (aka "slugging") pick-up location. The next corner of the triangle is the Woodbridge Station for the Virginia Railway Express (VRE). The third corner would be the proposed ferry terminal site. From any location within this triangle, residents of current and future high-density housing can access a large variety of commuting destinations into the greater DC area. Prince William County is currently completing a small area plan for this specific area that will encourage dense residential development. At the time this report was written, the precise target for the number of future residential units was still in development, but the proposed target is approximately 15,000 additional residential units. This implies a potential local population of 20,000 to 30,000 people within non-motorized access distance of the corners of the triangle, including the proposed ferry terminal which lies at the centroid of the area.

The other advantages to this site relate to current usage. The site is presently fully developed and is a motorized marine activity center. Creation of a ferry terminal site at this location would entail a refurbishment of a small portion of the existing marina. Furthermore, the present land owner is fully supportive of development of a ferry terminal on this site and is ready to not just cooperate, but actively create an opportunity to develop the ferry terminal. That is not the case at any of the other sites examined along the Occoquan, where there are property owner concerns about interference with existing marina uses and/or the need to develop a green field for the ferry terminal facility.

In the long range, development of more than one terminal along the Occoquan may be the most appropriate course of action. However, from a start-up, permitting, and grant applicability perspective the Occoquan Harbour Marina site, despite the additional ten-minute running time challenge, appears to be the most appropriate. As such, it was selected as the site for development of a conceptual terminal design including a cost estimate.

Washington, DC Sites

Many of the sites evaluated in the greater Washington, DC area, particularly those on the Southeast and Southwest waterfront, are adaptable to commuter operations. In this case, the critical part of the discussion is potential market demand. Chapter 5 describes the market conditions and clearly indicates that development of a ferry terminal site that serves Joint Base Anacostia-Bolling (JBAB) and the Department of Homeland Security Headquarters (DHS) campus has very high potential for success. This is mostly due to the difficulty of accessing these sites through today's transit system from Prince William County. The most ideal location for development of a ferry terminal is at the north end site on JBAB due to its proximity to DHS and the more populated employment sites on JBAB. However, the Army Corp of Engineers has recently begun a project to address the seawall at the north end of JBAB. While this may, ultimately, be the best location for development of a ferry terminal, the potential conflict with the Army Corps project, makes early development of a terminal questionable. Therefore, the south site on JBAB was chosen for development of conceptual plans and cost estimates for a ferry terminal. This is also important as development of this site is supported by DHS, the Navy, and the command at JBAB.

Secondary terminals at sites along the Southeast and Southwest Waterfront in Washington, DC are more an issue of availability and potential market desire as extensive re-development of these sites is not required. At the time service to JBAB begins, an assessment will be made of the market potential/feasibility of extending the Woodbridge to JBAB service to one, or more, of the suitable sites along the Washington, DC waterfront. Little, if any additional construction or development will be necessary to facilitate the start-up of this service and would act as a natural complement to the service to JBAB.

CONCEPTUAL TERMINAL SITE DEVELOPMENT AND COST ESTIMATE

Occoquan Harbour Marina

Site

The site of the landing is adjacent to the Occoquan Harbor Marina (see Figure 24). The Occoquan River is a small tributary to the Potomac River with its headwaters near Manassas, Virginia. The head of navigation is at Occoquan where the Highway 123 bridge spans the river. Approximately one nautical mile downriver from Occoquan is the Occoquan Harbour Marina. It is sited between two highway bridges that span the river: I-95 and Route 1 (see Figure 25). The northern boundary of the property is adjacent to a wetland area. The southern boundary is adjacent to a gravel operation. A chart of the river shows the main channel of the river lies just to the east of the proposed terminal location, with water depths of 11 to 14 feet.

Figure 24 Potomac River and Occoquan Harbour Marina

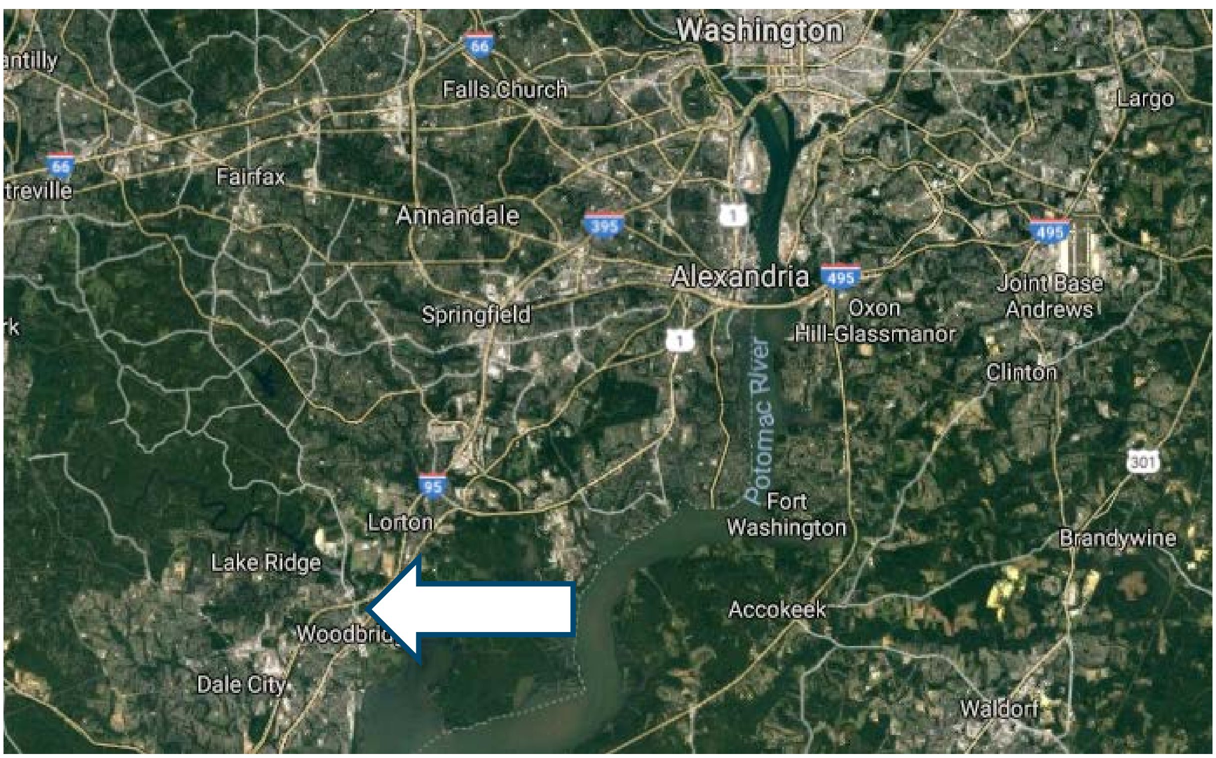
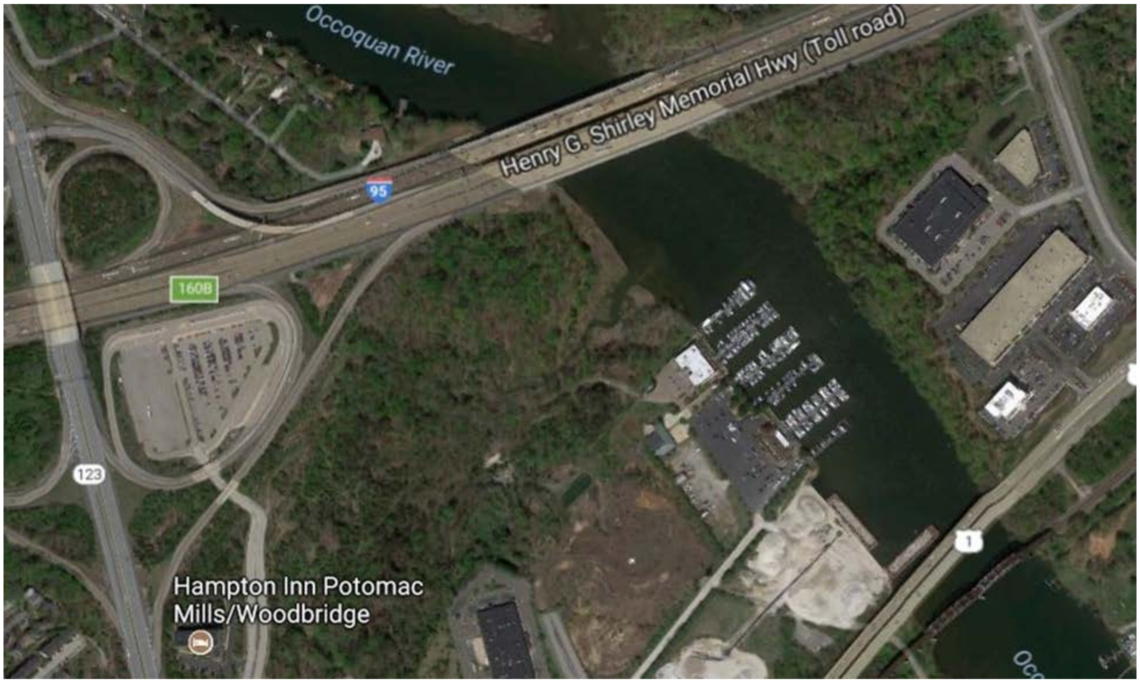


Figure 25 Occoquan Harbour Marina



Terminal Considerations

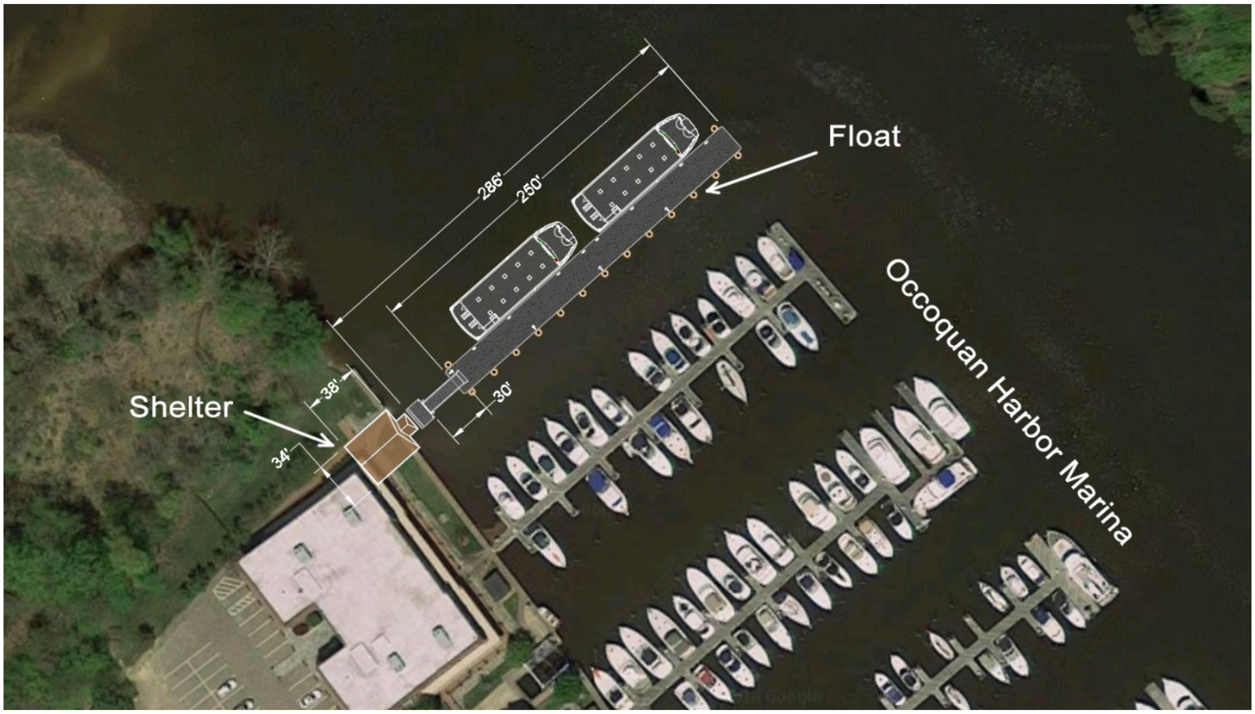
There are key factors that need to be considered when siting a terminal:

- Minimize interference with pleasure boat operations
- Expedite approach and departure from the main channel
- Provide access to other modes of transit
- Provide limited parking for pick-up and drop-off operations
- Access to electrical utilities
- Limited weather protection for waiting passengers
- Compatible with ADA requirements for path of travel, signage, and communications
- Compatible with range of vessel sizes and freeboards

Recommendations

It is recommended that a terminal be located on the property on the northeast corner side of the marina property (see Figure 26). The terminal will consist of a steel float with basic dimensions of approximately 20 feet by 250 feet. The float will be captured by 12 or more steel pipe piles. The float will be oriented with its long axis perpendicular to the river flow. The catamaran ferry will lay alongside with a freeboard of approximately 5 to 6 feet. The float will be equipped with basic handrails around three of the four sides. Safety lighting will be provided for passenger safety. The float will have a concrete deck for good traction in wet and icy weather. The concrete will also add mass to the float and thereby reduce its response/motions due to other vessel wakes. Care must be taken to minimize the intrusion of the float and adjacent vessel into the navigation channel due to the narrow width of the river at this point.

Figure 26 Occoquan Harbour Marina Proposed Ferry Landing



The float will be connected to shore via an aluminum gangway with a clear passage of approximately 48" to allow two persons abreast. The gangway will be designed to accommodate the normal range of river stages, flood to low water. The gangway will have ADA compatible transition plates at both ends and will be equipped with appropriate handrails and lighting. The proposed length of the gangway also enables ADA compliant slopes at all tidal and water level conditions. It is recommended that passengers wait on shore rather than on the landing float. On shore there will be a minimal "shelter" to provide limited weather protection. Electronic signage indicating vessel schedule/arrival times should be adjacent to shelter. An accessible pathway must connect the shelter to the proposed transit parking area with appropriate wayfaring signage and safety lighting.

Cost Estimate

A rough order of magnitude estimate for a terminal installed at this location is $3 to $3.5 million, as shown in Figure 27. Because of the site location adjacent to a wetland and along a navigation channel, the permitting is expected to be challenging.

Figure 27 Occoquan Harbour Marina Terminal Cost Estimate

Item	Estimate	Comments
Floats	$820,000	Two each @ 20' x 125'
Spuds	$975.000	Assume weak soils, deep – 13 each @ $75,000
Gangway	$60,000	
Mobilization	$74,200	4%
Permitting	$250,000	
Contingency	$871,680	40%
Total	$3,050,880	

Joint Base Anacostia – Bolling South

Site

The site of the landing is close to the marina on Joint Base Anacostia Bolling (JBAB) (see Figure 28). On the south portion of JBAB there is on-base housing and recreational facilities for military personnel. This includes a small yacht basin (see Figure 29) and some surrounding "park" lands. Within the marina are floating docks for small pleasure craft as well as a station for a small USCG patrol craft. The entrance into the marina is approximately 80 to 90 feet wide. During the summer, especially on weekends, there is considerable traffic in and out of the basin. The basin is protected from most boat wakes and from seasonal ice and other debris in the river. The marina has good road connections to the south entrance of JBAB and to I-295. A chart of the river shows the main channel of the river lies just to the west of the basin entrance, with water depths of 25 to 30 feet.

Figure 28 Potomac River and Joint Base Anacostia Bolling

Figure 29 JBAB Marina

Terminal Considerations

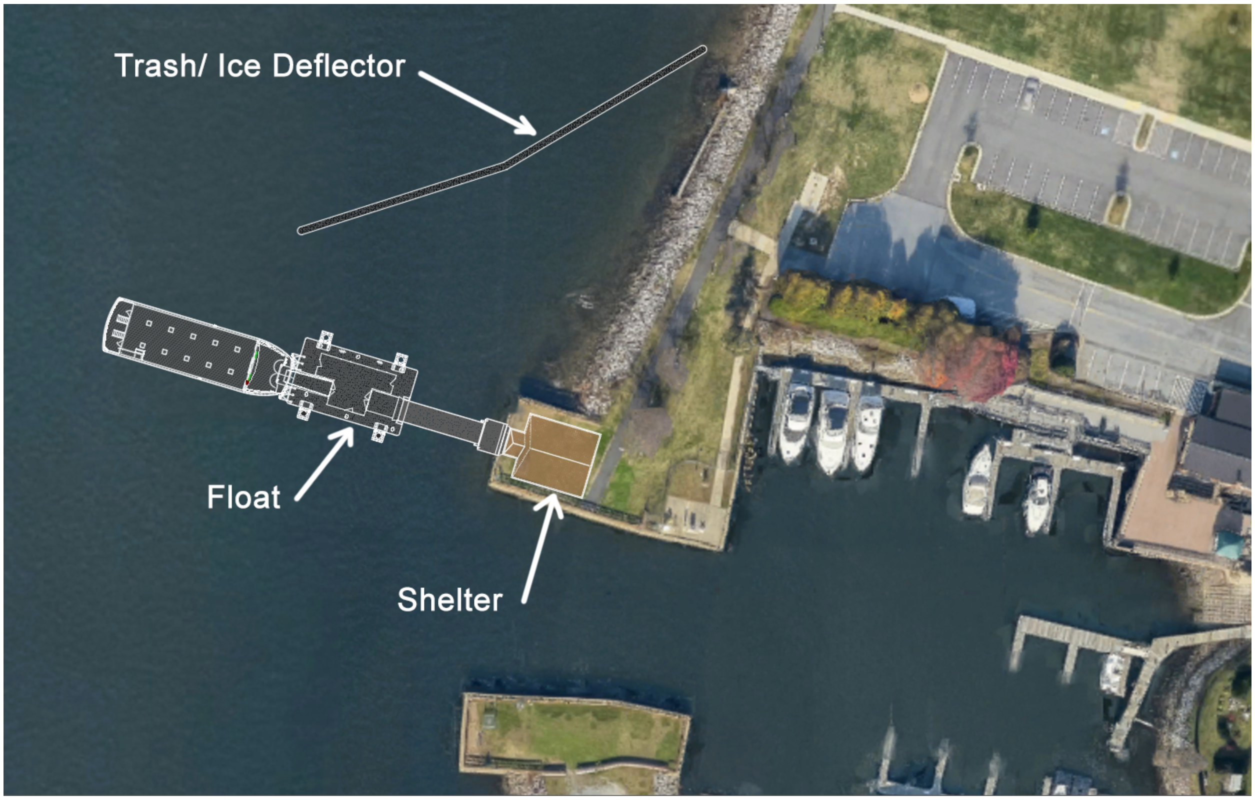
There are key factors that need to be considered when siting a terminal:

- Minimize interference with pleasure boat operations
- Expedite approach and departure from the main channel
- Provide transit connections in the form of a shuttle bus
- Provide limited parking for pick-up and drop-off operations
- Access to electrical utilities
- Limited weather protection for waiting passengers
- Compatible with ADA requirements for path of travel, signage, and communications
- Compatible with range of vessel sizes and freeboards

Recommendations

It is recommended that a terminal be located on the property on the north side of the yacht basin entrance (see Figure 30). The terminal would consist of a steel float with basic dimensions of approximately 35 feet by 60 feet. The float will be captured by two to four steel pipe piles. A trash/ice deflector will be installed on the upstream side of the float for protection of the float. The float will be oriented for use by a bow-loading catamaran ferry with a freeboard of approximately 5 to 6 feet. The float will be equipped with basic handrails around three of the four sides. Safety lighting will be provided for passenger safety. The float will have a concrete deck for good traction in wet and icy weather. The concrete will also add mass to the float and thereby reduce its response/motions due to other vessel wakes.

Figure 30 Proposed Ferry Landing – JBAB Marina



The float will be connected to shore via an aluminum gangway with a clear passage of approximately four feet to allow two persons abreast. The gangway will be designed to accommodate the normal range of river stages, flood to low water. The gangway will have ADA compatible transition plates at both ends and will be equipped with appropriate handrails and lighting. The proposed length of the gangway also enables ADA compliant slopes at all tidal and water level conditions.

It is recommended that passengers wait on shore rather than on the landing float. On shore there will be a minimal "shelter" to provide limited weather protection. Electronic signage indicating vessel schedule/arrival times should be adjacent to shelter. An accessible pathway must connect the shelter to the shuttle bus parking with appropriate wayfaring signage and safety lighting.

The floating ice/trash barrier is made of six steel floats, approximately 4 feet by 4 feet by 40 feet. The shore end will be anchored by chains to a pile dead man. The sections will be connected by chains. There will be four pile supports on the downstream side of the last two sections (2 each). There will be overlapping transition plates between the sections to prevent river trash from fouling the barrier. A solar powered flashing light will be placed on the outer end as a navigational warning. This barrier is designed to handle ice of up to 6" thick. Barriers like this are in common use at hydropower dams to keep trash and ice away from the turbine intakes and the necessary design parameters are well tested in real world conditions.

Cost Estimate

A rough order of magnitude cost estimate for a terminal installed at this location is $3 to $4 million. An approximate cost breakdown is as follows:

Figure 31 JBAB Marina Terminal Cost Estimate

Item	Estimate	Comments
Floats	$650,000	25' x 30'
Spuds	$300.000	Assume weak soils, deep – 4 each @ $75,000
Gangway	$60,000	
Trash/Ice Deflector	$250,000	
Upland Improvements	$700,000	Seawall modifications, gate, landscaping, finishes, lights, etc.
Shelter	$250,000	
Mobilization	$88,400	4%
Permitting	$125,000	
Contingency	$969,360	40%
Total	$3,392,760	

IMPACT OF VESSEL DESIGN ON SITE SUITABILITY AND COST

This and prior studies have identified bank erosion and dredging as on-going issues in the development of suitable terminal sites. Mitigating or avoiding these issues increases the likelihood of success of the project. A vessel whose wake is small and carries less energy can offset millions of dollars of project costs with respect to required wave attenuation or channel dredging.

LOCAL SUPPORT FACILITY

The Washington DC metropolitan area is not currently home to a nautical vessel support facility of a size that can accommodate larger ferry vessels. This is important as service grows and it becomes necessary to perform timely repairs on the ferry fleet. Currently any larger vessel requiring service must travel to Baltimore or Norfolk. The main feature of such a facility would be the capability to maintain multiple vessels in an out of water environment. Should a local support facility act as overnight harbor for ferry vessels, lay berths on site would require the same features as outlined in the introduction to potential terminal site descriptions on Page 27, including shore power, waste disposal, fueling and maintenance capability. Figure 32 is a photo of a new ferry maintenance facility in Alameda, CA for the Water Emergency Transportation Agency (WETA) that shows the water side development.

Figure 32 WETA Central Bay Maintenance Facility

4 PUBLIC OUTREACH

Three public events were held as part of the M-495 Commuter Fast Ferry project development phase. The first, a Fast Ferry Summit, was hosted at Occoquan Harbour Marina in Woodbridge on September 21, 2017. A presentation encapsulating initial travel demand modeling, information from the Federal Transit Administration regarding technical details of the grant application process, and potential ferry terminal site visit summaries was given by the study team. Preliminary infrastructure gap analysis, potential vessel/terminal design, and operations considerations were also presented. Open discussion and Q&A highlights are in the Appendix.

Figure 28 Fast Ferry Summit – September 21, 2017 – Woodbridge, VA

The second of three public events, a project Open House and panel discussion, took place in the Sunset Room at National Harbor, Maryland on October 26, 2017. The panel was composed of:

- Tim Pickering – Office of Marine Highways and Passenger Service of the U.S Department of Transportation's Maritime Administration
- Willem Polak – Previous CEO of Potomac Riverboat Company
- Marc Oliphant – Community Planning Liaison Officer at Joint Base Anacostia-Bolling
- Tim Payne – Principal, Nelson\Nygaard Consulting and Development Phase Project Manager

Questions from the public involved other potential service markets, hours of operation, fare payment, project outreach, and next steps. Complete details are found in the Appendix of this document.

Figure 33 Panel Discussion – October 26, 2017 – National Harbor, MD

The third event, a Public Meeting at the District Wharf drew more than 75 people to the Dockmaster Building, including elected officials, transportation agencies, private businesses, and citizens, to discuss draft conclusions of the infrastructure gap analysis. A detailed summary of the question and answer session is found in the Appendix.

Figure 34 Public Meeting – June 4, 2018 – District Wharf, DC

5 POTENTIAL RIDERSHIP FORECASTING

Transportation options between some location in Northern Virginia and Washington, DC are limited and result in constrained access and opportunities for residents of the area.

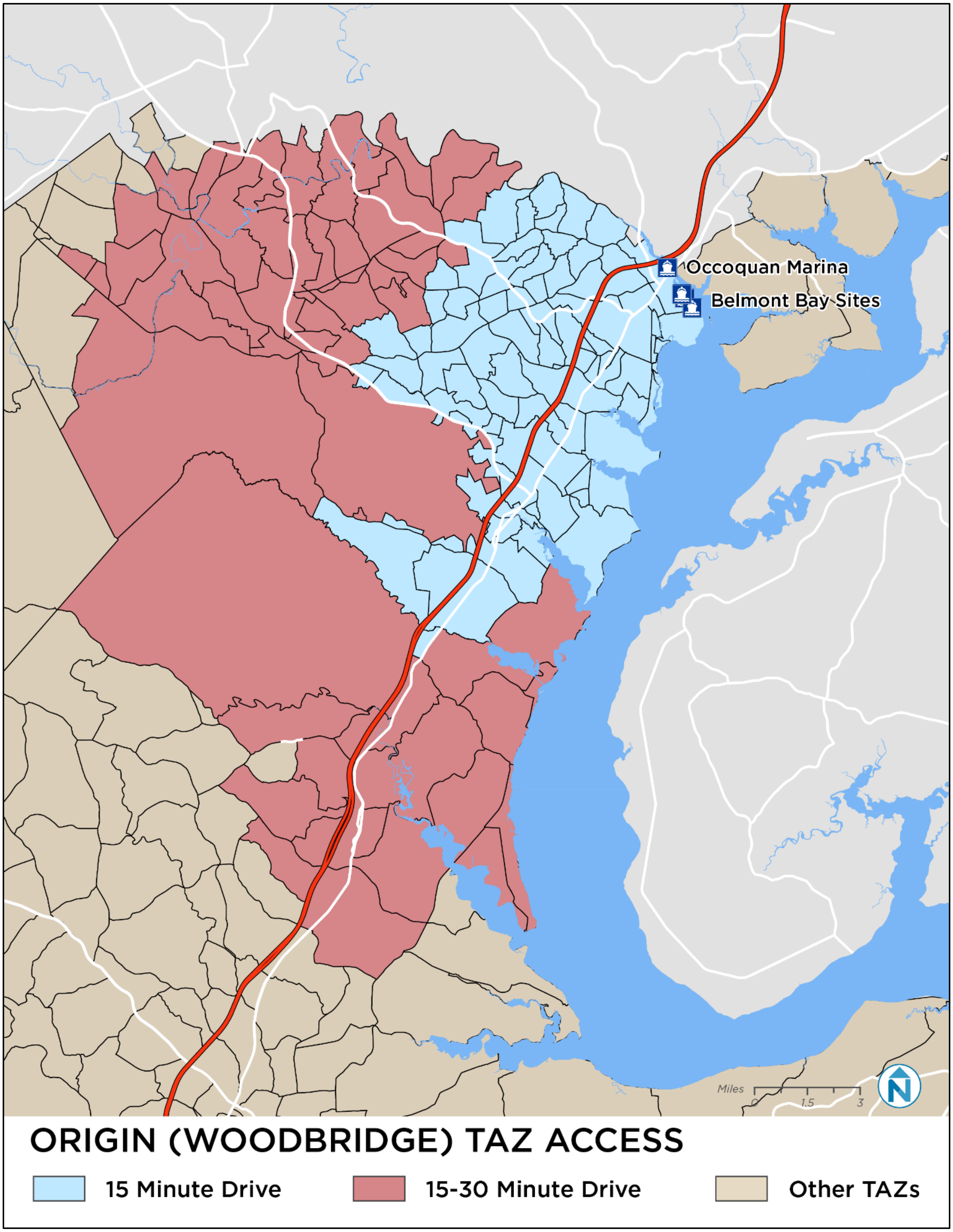
- The high-capacity road network operates at, or above, capacity during peak periods. Despite the extensive network of HOV lanes, travel times are unpredictable and delays for those on buses and in cars are common. These delays lead to increased time and financial costs. From I-95, access to Washington DC is provided via I-495, I-295, and I-395; all facilities operate at chronically congested levels during a.m. peak and are among the most congested corridors in the area.[6]
- Several transit alternatives serve the northeast Virginia cities. Several commute buses connect these cities with key destinations in Washington DC and Metrorail stops. The Virginia Rail Express (VRE) and Amtrak offer commute and regional services between Virginia and the District of Columbia. However, there are no direct transit options from Woodbridge to the ferry catchment areas and all transit alternatives require transfers to the Metrorail/Metrobus system.

Primary and Secondary Markets

The primary market is defined as the set of Traffic Analysis Zones (TAZ) located within a 30-minute AM peak hour drive to Woodbridge, colored in blue and red in Figure 35. The secondary market is defined as the set of TAZ located within the study area, but not included in the primary market, and displayed as brown in Figure 35.

[6] https://www.mwcog.org/assets/1/28/NCR_Congestion_Report_2016Q1.pdf

Figure 35 Areas within a 30-minute AM Drive from Occoquan Terminals

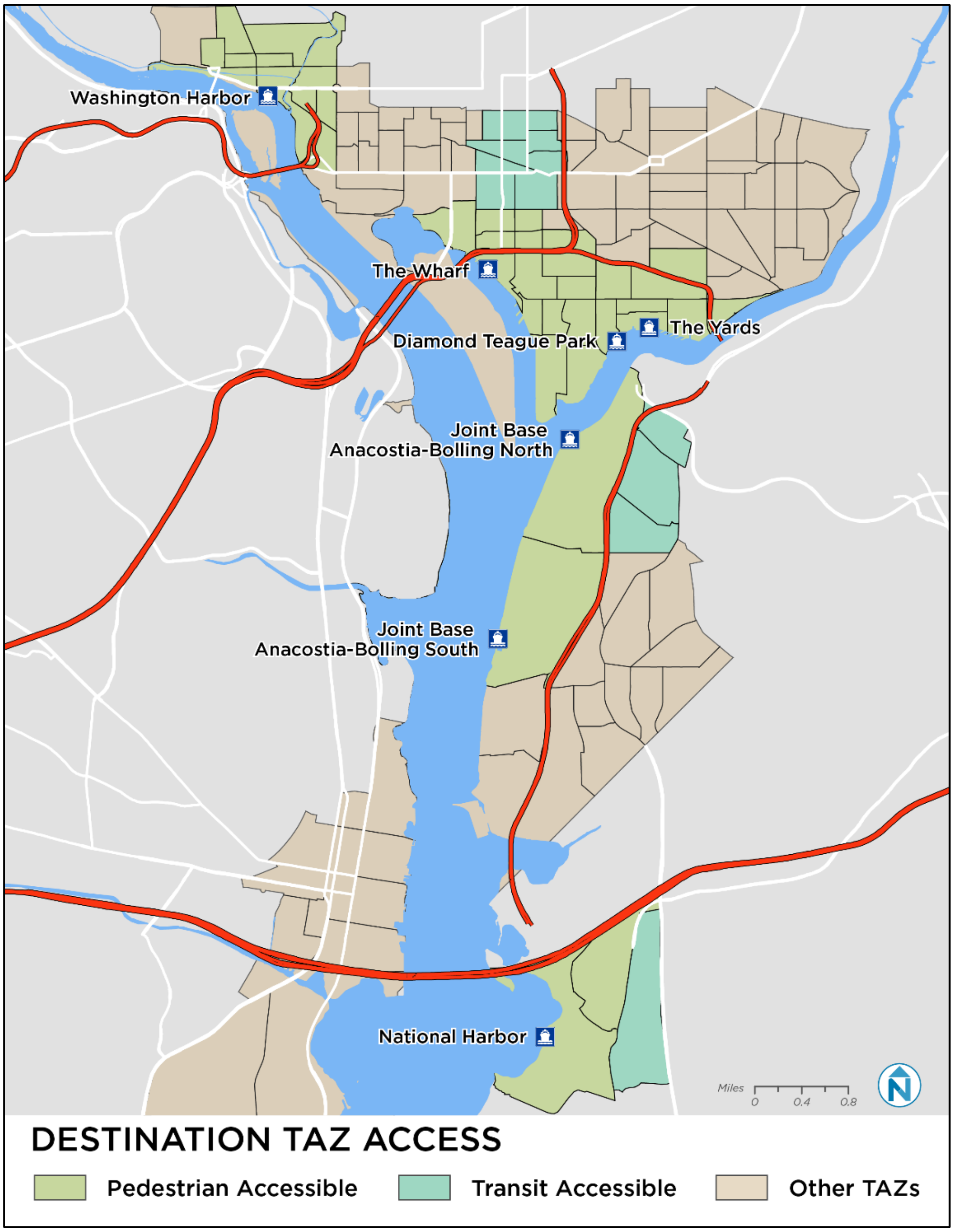


Washington Terminals

The following terminals and the surrounding areas accessible within 15-minutes on foot and via transit are analyzed (Figure 36):

- Joint Base Anacostia-Bolling (JBAB), North and South Terminals
- The Yards
- Diamond Teague Park
- The Wharf
- Washington Harbor

Figure 36 Walk and Transit Access from Washington Ferry Terminals



EXISTING TRANSPORTATION OPTIONS AND TRAVEL PATTERNS

There are several transportation modes available for travel from the primary and secondary market areas to the ferry terminal catchment areas under study, including private automobile, bus, and commuter rail. The following sections describe in-vehicle times and out-of-pocket travel costs by mode under existing conditions. In-vehicle times are used in place of travel times because they correspond to scheduled transit departures and arrivals or, in the case of private vehicle travel, travel times to reach the driver's destination before any search for parking begins. This approach assumes that actual, door-to-door travel times of commuter trips may be longer than in-vehicle times due to additional walking and/or parking search time that each mode requires to reach the traveler's destination. Only a.m. peak period commute trips were reviewed in this analysis.

Travel Times and Costs

The costs used in estimating demand in this work are those that accrue to an individual rider and do not represent the actual cost of producing the ride. There are many variables in estimating the cost to deliver ferry service on a per rider basis. Those operating costs are yet to be fully determined. The definition of the present project is based on the concept that a passenger market can be developed to support a fully private ferry operator. The fare levels modeled in this work are within a range that supports that operation arrangement. The determination of the actual costs and potential profitability of operating a ferry route to serve this market will continue to evolve and be refined.

Private Vehicle

Travel times during the a.m. peak period from the primary and secondary markets to the ferry terminal catchment areas can be twice the travel time in free-flow conditions, equaling the time required to use transit modes due to roadway congestion.

The Travel Time Index (TTI), defined as the ratio of actual travel time to free-flow travel time, measures the intensity of congestion as 1.30 on Interstates within the MWCOG area, 1.16 for all roadways. The higher the index, the higher the represented traffic congestion, e.g. TTI = 1.00 means free flow conditions while TTI = 1.30 indicates the actual travel time is 30% longer than the free-flow travel time.

Figure 37 Average Private Vehicle In-vehicle Travel Time, AM Peak

	Primary Market		Secondary Market	
Ferry Terminal	Average In-Vehicle Time (min)	Average Distance (miles)	Average In-Vehicle Time (min)	Average Distance (miles)
DHS	91.1	32.6	138.3	56.8
JBAB	84.4	29.5		
The Wharf	93.1	28.4	149.2	57.2
The Yards/Diamond Teague Park	98.9	31.3	139.9	53.7
Washington Harbor	92.9	28.5		

Bus

There are several commuter bus services from major commuter lots in eastern Prince William County along the I-95 corridor to destinations that include The Pentagon, Crystal City, Rosslyn/Ballston, Tysons Corner, Downtown Washington, D.C., and the Washington Navy Yard.[7] While some buses serve the catchment area of certain ferry terminals, some riders use the WMATA Metrorail system to arrive at their final destination. Most direct buses stop at the Franconia-Springfield Metrorail Station where transfers are made. While the Metrorail system has stations near Washington Harbor and the Wharf, it requires one transfer to get to The Yards, and two to get to DHS and JBAB.

The average in-vehicle travel time of those commute services varies depending on the departure time and the intermediate stops. As an example, it takes 84 minutes in the a.m. for the commuter bus to cover the 30.5 miles from Dale City Park & Ride Lot to Washington Navy Yard, departing at 5 a.m., and 93 minutes when departing at 6.45 a.m. The one-way cash fare is $9.20, $6.90 if using a SmarTrip card. Headways on this route range from 19 minutes to 40 minutes, and the last inbound trip departs at 6.45 a.m.

Rail

There are several opportunities to travel by rail to the ferry terminal catchment areas. The Fredericksburg line of Virginia Railway Express (VRE) connects Fredericksburg with Washington DC, serving locales along the river, and offering park and ride lots for those driving to meet the train.[8] Fares vary depending on the number of zones traveled through. Inbound trains to Washington DC operate from 5 a.m. to 8 a.m., with headways of 10-12 minutes on the Fredericksburg line.

A trip from Woodbridge to L'Enfant Plaza in Washington DC, with the option to transfer to Metrorail, takes from 35 minutes to 44 minutes, with a $6.22 per-ride monthly pass fare or a $9.10 single ride fare. VRE offers a combined ticket with Metro for $355.70 a month (approximately $8.89 per ride).

Figure 38 One-Way Travel Time and Expenses from Woodbridge to DHS Campus

	In-vehicle Time (min)	Transit Fare or Approved Mileage Reimbursement	Tolls, Parking Expenses	Total One-way Travel Cost
Drive Alone	80	IRS mileage: $14.40	Parking: $4.45 Toll $0	$18.85
Carpool	80	IRS mileage: $7.20	Parking: $2.23 Toll: $0	$9.43
Bus/Metro	75 to 95	Bus fare: $9.20 Metro fare: $2.00 IRS mileage: $4.01	Park & Ride: $0	$15.21
VRE/Metro	107	VRE Zones 1 to 5 ticket: $8.22 IRS mileage: $2.05	Park & Ride: $0	$10.05
Amtrak/Metro	107	Amtrak ticket: $21.00 Metro fare: $2.00 IRS mileage: $2.05	Park & Ride: $0	$24.05

[7] http://www.prtctransit.org/system-map/index.html
[8] http://www.virginiadot.org/travel/parkride/home.asp

Travel Time Reliability

Private Vehicle

Recurring congestion on area Interstate Highways during a.m. peak hours on a weekday negatively impacts travel time reliability compared to alternatives like rail, which travel in a dedicated right of way, or ferry, which does not encounter congestion.

MWCOG's Congestion Report (2017) evaluates travel time reliability through the Planning Time Index (PTI), defined as the ratio of 95th percentile travel time to free flow travel time. According to this report, the PTI for all roads of the MWCOG area was 1.41 in the 4th quarter of 2017 during a.m. peak and p.m. peak periods and 1.40 for the preceding four quarters. If looking only at the Interstate System, these numbers increase to 1.94 and 1.85 respectively.[9] This means that a traveler must budget 41% (94% in the Interstate System) longer than the uncongested travel time to arrive at their destination on time. Peak periods are defined as 6 a.m. to 10 a.m. and 3 p.m. to 7 p.m. In addition, the I-95 corridor from Newington to Fredericksburg is among the 10 most congested road segments in the MWCOG area during these same periods.

The Federal Highway Administration defines the level of travel time reliability (LOTTR) travel as the ratio of a "normal" travel time (50th percentile) to an 80th percentile travel time, expressed as a percentage. VDOT, using 2017 INRIX data, reported that the LOTTR ratio was 53.1 for Interstate roads within Fredericksburg Area MPO boundaries, 85.5 for non-interstate roads, and 56.1 and 72.1, respectively within the MWCOG MPO boundaries.[10]

Rail

VRE on-time performance for May 2018 was 80% for the Fredericksburg Line.[11] Performance ranged from 80% to 95% per month for the first half of 2018. Delays are determined by the train's actual arrival time at the final destination versus scheduled times. The 80% figure implies that these delays affect passengers in about one out of every five trips.

Comparable Ferry Service (New York Waterway Belford Ferry)

No commuter ferry currently exists in the study area, so no current data exists to estimate the travel time reliability of this mode. New York Waterway reports on-time performance of 98% on their Belford line, which is a comparable line to the proposed services.[12] Most common causes of ferry delay are tidal currents and interference from other boats. The 98% figure implies that these delays affect passengers in about one out of 50 trips (about once a month).

Travel Patterns and Mode Split

According to several data sources, there are 4,325 home-based to work (HBW) a.m. trips from the primary market to ferry catchment areas and 870 HBW a.m. trips from the secondary market to these same destinations. These include current a.m. trips from both markets to JBAB, The Wharf, The

[9] https://www.mwcog.org/congestion/

[10] http://www.ctb.virginia.gov/resources/2018/apr/1_performance_measures_combined.pdf

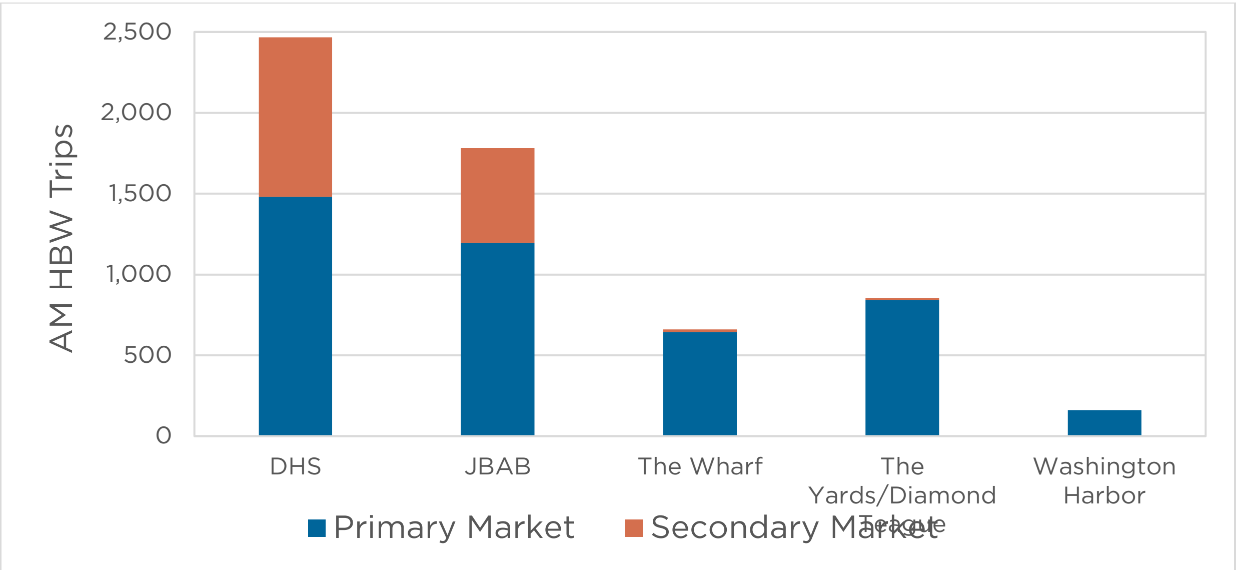
[11] https://www.vre.org/service/daily-performance/archives/2018/May/

[12] https://www.app.com/story/news/traffic/commuting/2015/08/21/ferry-commute-alternative-belford/32113351/

Yards/Diamond Teague Park, and the projected number of a.m. trips bound for DHS once all DHS employees are relocated to the St. Elizabeth's Campus.

Basing this projection on the home location of current employees, it is estimated that there will be 2,326 a.m. trips to the new DHS campus, 1,481 of which would come from the primary market. The current a.m. trip volume to JBAB from both markets is 1,196, all from the primary market. The current number of a.m. trips from the market areas to The Yards/Diamond Teague Park, The Wharf, and Washington Harbor catchment areas are 657 trips, 855 trips, and 161 trips, respectively.

Figure 39 AM Home-based Work Trips to Ferry Terminal Catchment Areas



Data sources: Nelson\Nygaard, using data from Streetlight Data 2017, MWCOG Travel Demand Model, DHS employee residency data, MWCOG gate counts to JBAB and DHS 2012, and University of Maryland Highway Travel Demand Model.

The 2016 American Community Survey showed that on average, drive alone commute mode share ranges from 70% to 75% within the study area, carpools attract 10-13%, while transit is used for only 5% of Prince William County commutes.

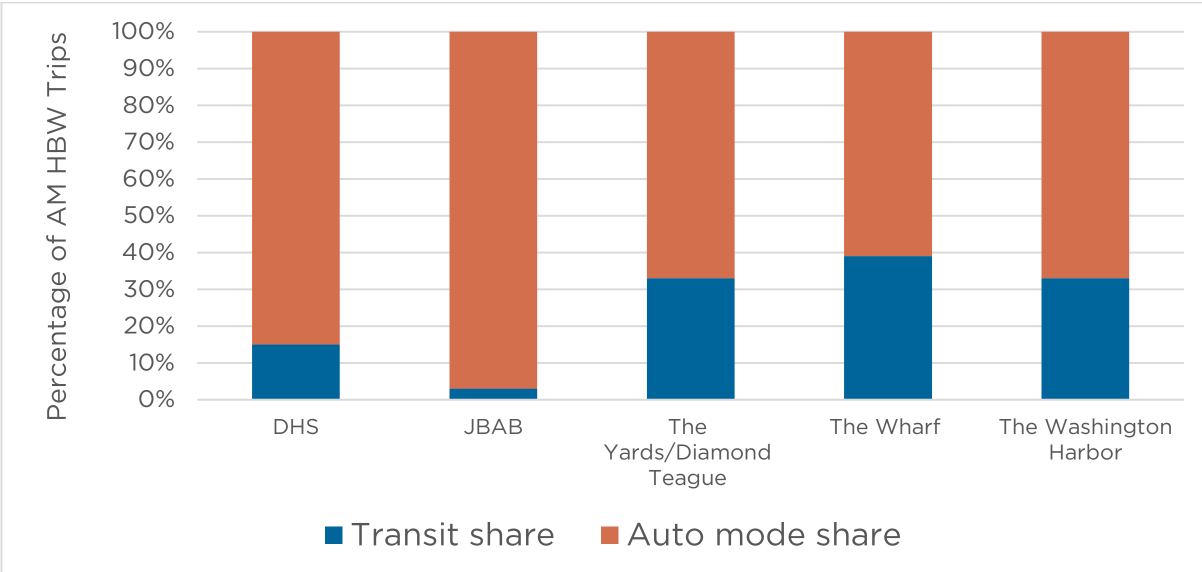
Figure 40 Commute Mode Share

	Drive Alone	Carpool	Public Transit	Walk	Other	Telework
Prince William County	75%	13%	5%	1%	1%	4%
Manassas City	78%	12%	3%	2%	1%	4%
National Capital Region	70%	10%	11%	2%	2%	6%

Source: American Community Survey, 2016

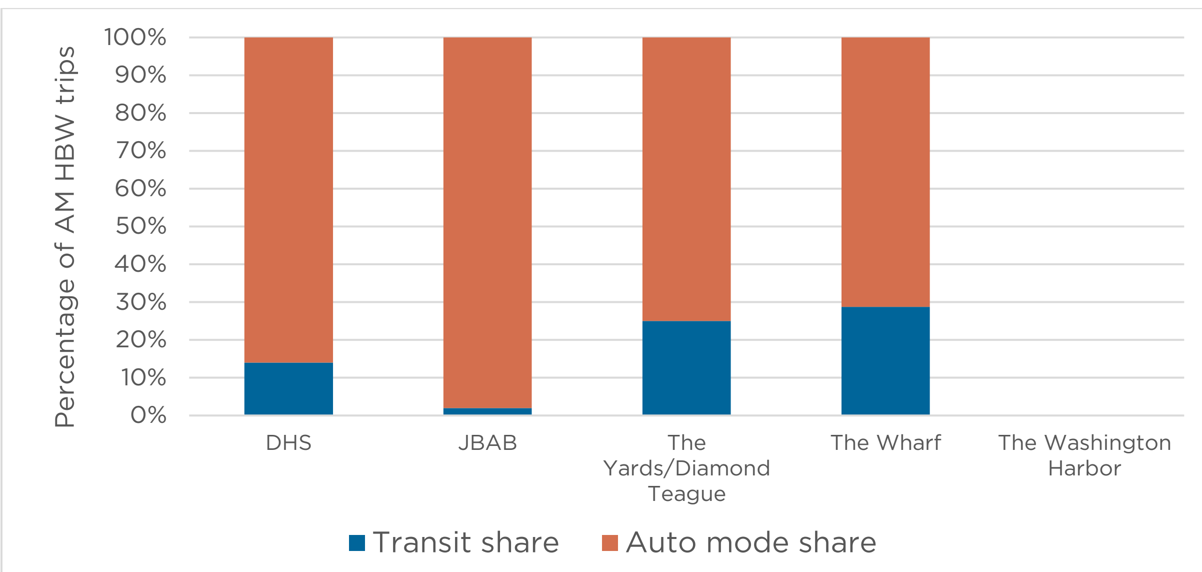
According to MWCOG, transit is used in 33-39% of the trips between the primary market area and The Wharf, The Yards, and Washington Harbor, while the share decreases significantly when the destinations are DHS and JBAB. Transit share is even lower in trips from the secondary market. Those that use transit from the primary market use mainly bus or a combination of bus and metro to get to their destination, while commuter rail is the primary transit mode used by the secondary market.

Figure 41 Mode Share – Primary Market HBW Trips to Terminal Catchment Areas



Source: MWCOG Travel Demand Model

Figure 42 Mode Share – Secondary Market HBW Trips to Terminal Catchment Areas



Source: MWCOG Travel Demand Model

ESTIMATING FERRY RIDERSHIP

Methodology

Option 1: Estimated Ridership Based On Travel Time Reduction

In this method, ridership during the a.m. peak is estimated by identifying the a.m. HBW trips that currently drive, but would save travel time by using a ferry. Included in the ferry time calculations are in-vehicle travel time and five minutes of boarding time.

Figure 43 Ferry Service Corridor Characteristics

Route	Distance (miles)	Minimum In-vehicle Time (min)*	Standard In-vehicle Time (min)**
Woodbridge – Washington Harbor	31.64	54	73
Woodbridge – The Wharf	29.64	51	68
Woodbridge – The Yards/Diamond Teague Park	29.49	51	68
Woodbridge – DHS	28.44	49	66
Woodbridge - JBAB	26.44	45	61

Source: MWCOG 2020 Travel Demand Model skims

* Average vessel speed: 26 mph

** Average vessel speed: 35 mph

Option 2: Estimated Ridership Based On Generalized Cost Reduction (Pivot-Point Model)

A frequent approach to modelling is to formulate the model as predicting changes relative to a base-year situation. Such approaches are called "pivot-point" method or incremental models. This methodology estimates ridership that could be captured by the ferry from private automobiles and other transit modes by normalizing all generalized costs of each mode into a single utility function. The generalized cost of travelling is the sum of monetary and non-monetary costs of a journey. Monetary or "out-of-pocket" costs might include the transit fare versus the costs of fuel, parking, and tolls. Conversely, non-monetary costs refer to the time spent in travel, including in-vehicle time, wait time, access time, and transfer time. Time is monetized using a valuation of time, which usually varies according to the traveler's income and the purpose of the trip.

A sensitivity analysis of potential ferry ridership to fare pricing has been performed using the fare range required to support a private ferry operator and based on the size of the rider market.

Demand Captured from Private Vehicle Trips

The general steps of the pivot-point procedure to estimate the demand that the ferry could capture from the private automobile mode are described below.

1. Quantify existing demand between the identified market areas and the ferry terminal catchment areas;
2. Determine the generalized ravel cost of the private vehicle and existing transit in the existing scenario, including in-vehicle time, wait time, walk time, drive access time, and fare/cost;

3. Determine the generalized travel cost of private vehicle and the proposed transit mode (ferry) in a scenario with ferry service, including in-vehicle time, wait time, walk time, drive access time, and fare/cost;
4. Calculate the utility (general cost) of each mode (private vehicle and transit) in the existing scenario;
5. Calculate the utility (general cost) of each mode (private vehicle and transit) in the scenario with ferry;
6. Calculate the share of trips that will choose a specific mode, transit or private automobile, based on exponentiated utility;
7. Calculate the elasticity between the difference in the generalized cost of private and transit modes with the probability of choosing one of these modes;
8. Using that elasticity, calculate the increment of the share of one of these modes based on the variation of the cost of this mode; any increment of transit trips will be ferry trips, as the assumption is that private vehicle and other mode costs will remain the same.

A more detailed explanation of the methodology can be found in the Appendix.

Demand Captured from Transit Modes

The general steps of the pivot-point procedure to estimate the demand that the ferry could capture from other transit modes is described below.

9. Quantify existing demand between the identified market areas and the ferry terminals catchment areas;
10. Determine the travel generalized cost of all transit modes in the existing scenario, including in-vehicle time, wait time, walk time, drive access time, and fare/cost;
11. Determine the travel generalized cost of transit modes in the scenario with ferry service, including in-vehicle time, wait time, walk time, drive access time, and fare/cost;
12. Calculate the utility (generalized cost) of the transit mode in the existing scenario;
13. Calculate the utility (generalized cost) of the transit mode in the scenario with ferry;
14. Using that elasticity estimated previously, calculate the increment of the transit share in the build scenario versus the no-build scenario (existing conditions); any increment of additional transit trips will be ferry trips, as the assumption is that the other transit modes will remain the same.

Total Estimated Ridership

Ridership Estimate Based On Travel Time Savings

From both markets, 700 a.m. trips would save travel time to the ferry terminal catchment areas in a scenario with ferry running at standard speed (26 mph). Almost 4,500 trips would save time utilizing a ferry that operates at an optimum speed (35 mph). These are trips whose a.m. peak driving time is higher than the a.m. driving time to Woodbridge plus the in-vehicle time on the ferry while adding 5 minutes of boarding time.

As shown in Figure 47, a commuter taking the ferry running at optimum speed could save as many as 20 minutes per trip, depending on the origin and destination. If the ferry runs with standard speed, however, the average time savings per trip drops to less than 1 minute.

Figure 44 HBW Trips to Terminal Catchment Areas that Save Time by Using a Ferry

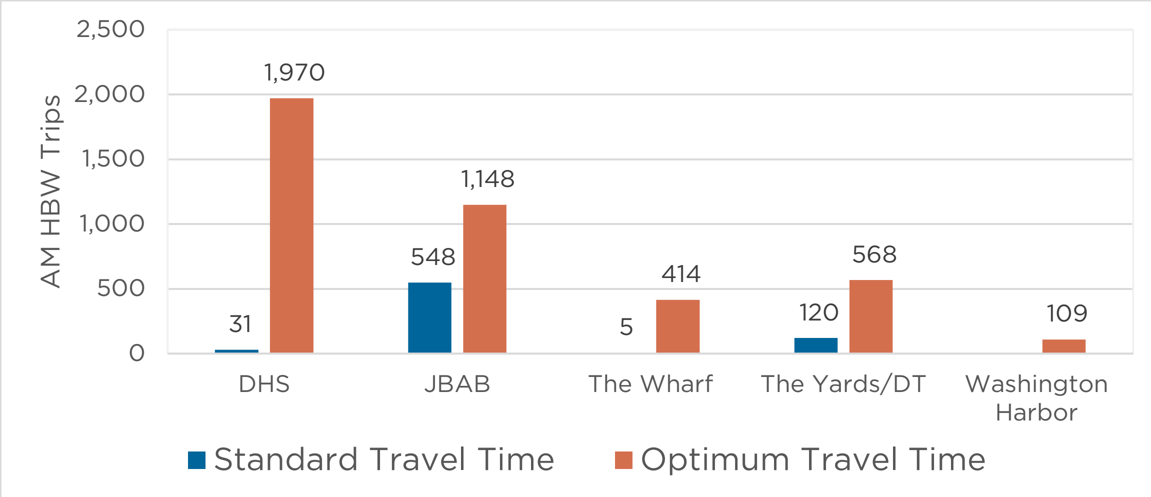


Figure 45 HBW Trips to Terminal Catchment Areas that Save Time by Using an Optimal Speed Ferry by Market

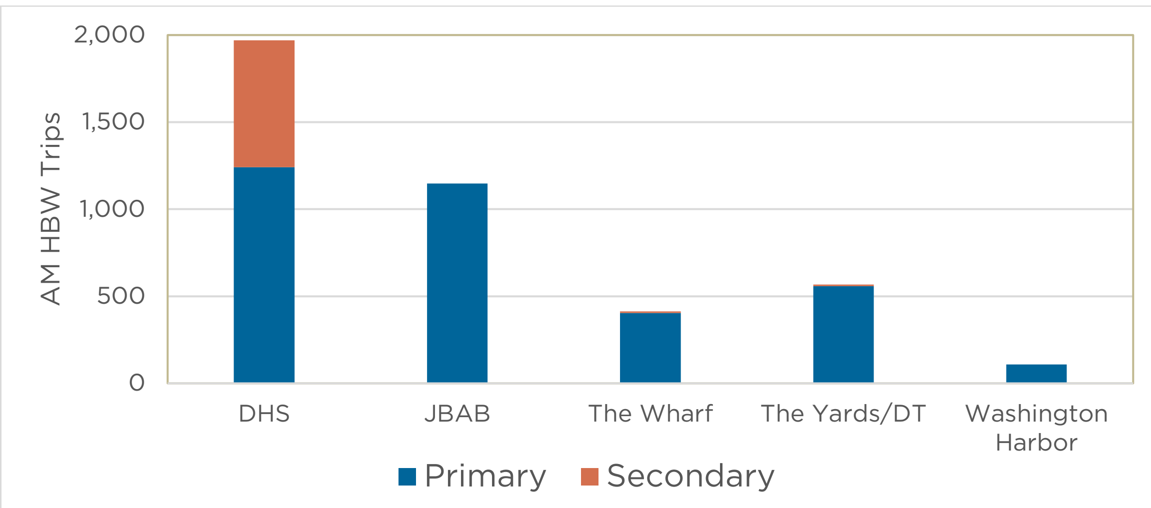


Figure 46 HBW Trips from Primary Market to Terminal Catchment Areas that Save Time by Using a Standard Speed Ferry

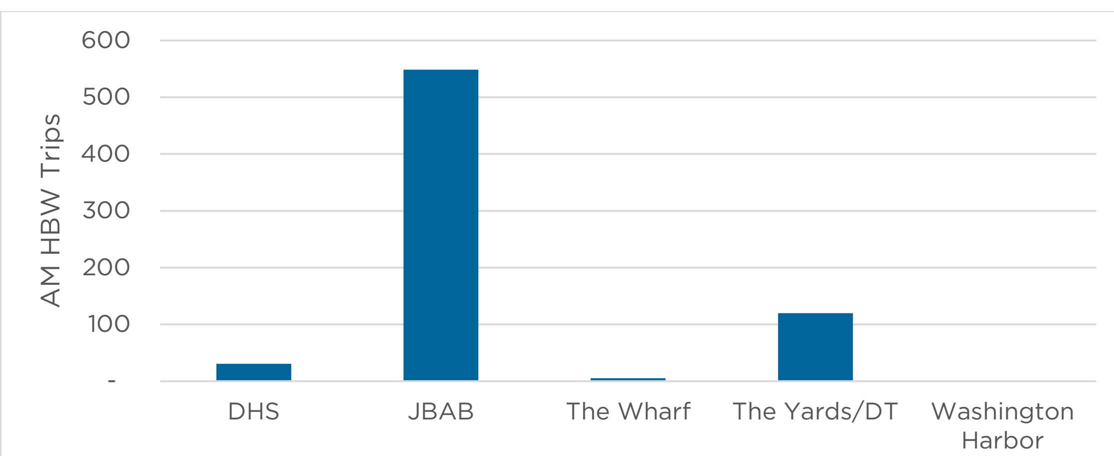
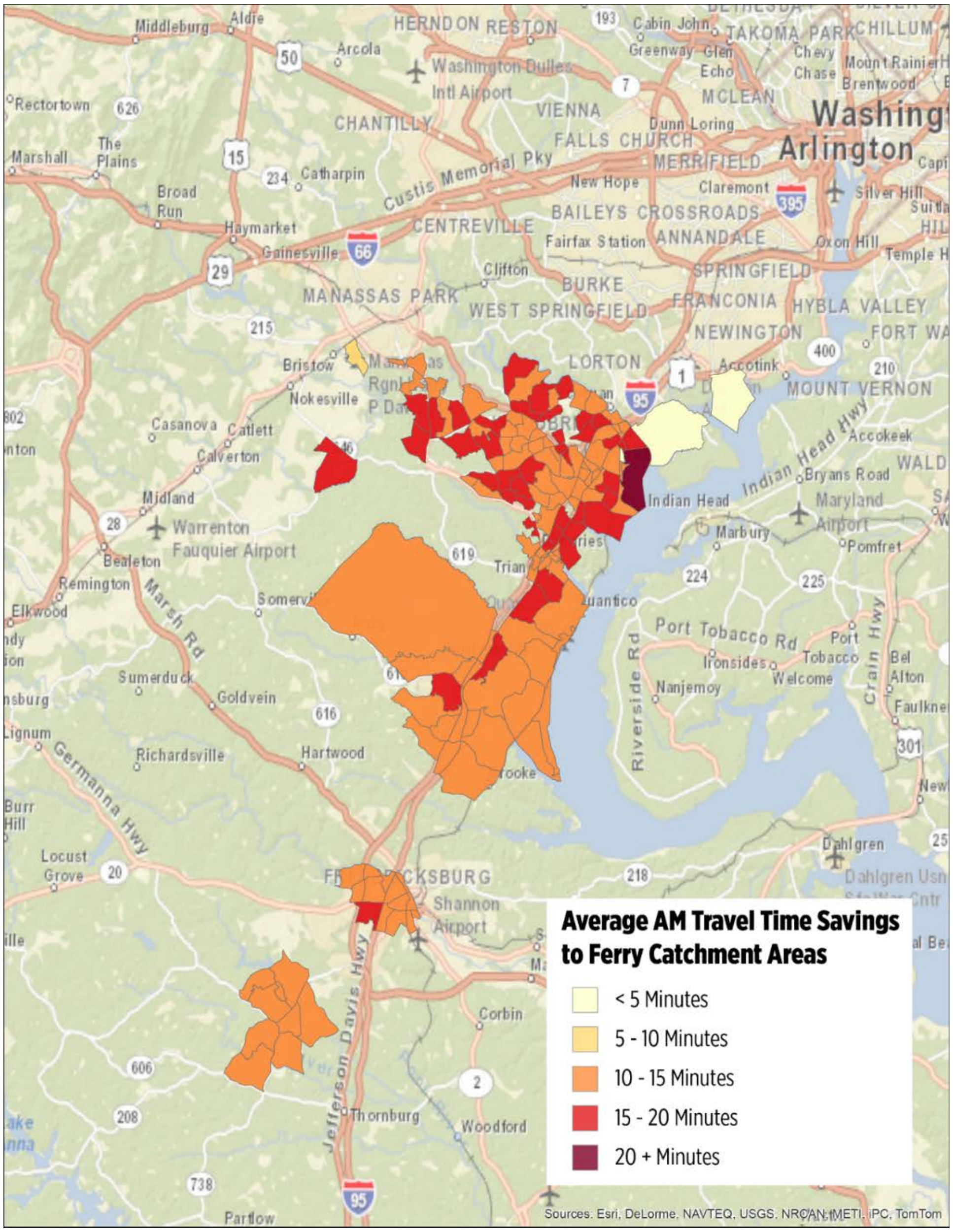


Figure 47 Average Time Savings of HBW Trips to Ferry Catchment Areas – Optimum Speed Ferry



Ridership Estimate Based On Improved Transit Options

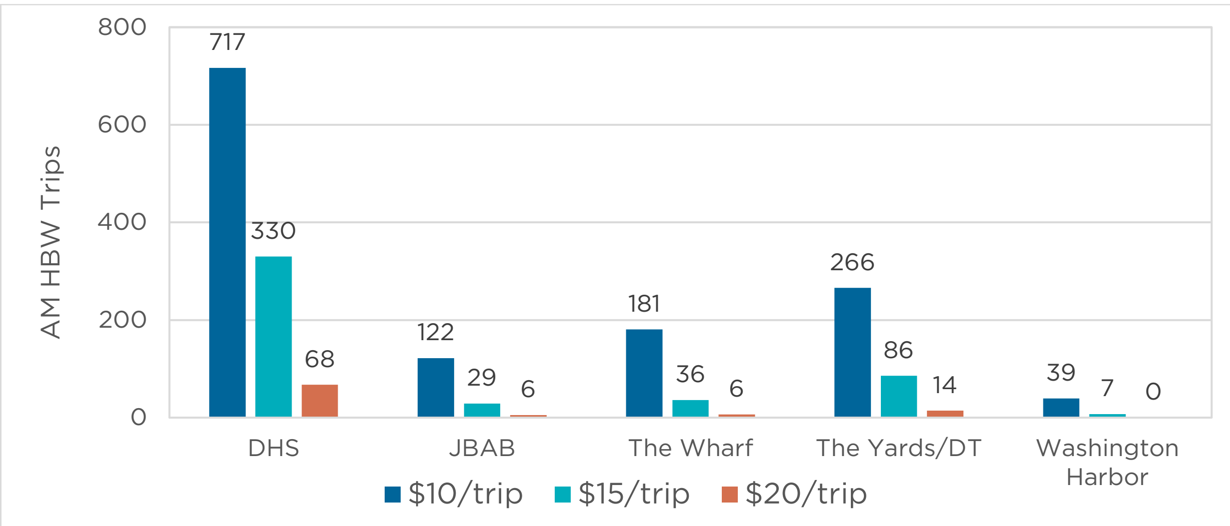
Figure 48 shows a subset of the potential ridership captured from current private vehicle and transit trips based on the elasticity of private automobile mode share versus the difference of generalized cost between transit and driving alone. The results have been filtered for those origin-destination pairs whose generalized transit cost with ferry is lower than 1.25 the generalized cost of the private vehicle. The demand captured from transit has been estimated using the same elasticity.

Results prove to be sensitive to ferry in-vehicle travel time and fares ranging from $10 to $20 per trip. The estimated demand drops by half when ferry running times reduce 25%, and the demand reduces by 65% on average when the fare increases by 50%. Demand drops by 90% when fares double.

Many commuters in this market have access to federal government commute subsidy programs that subsidize transit fares to a maximum of $260 per month. That subsidy is NOT included in this analysis except to the extent that a rider considering one transit mode versus another is considered to have access to the same subsidies. For example, if a rider on VRE sees a one-way fare of $8.22, their actual out of pocket cost may be considerably less if that person is eligible for the commute subsidy program. The same would be true of an individual choosing to ride a ferry trip. Thus, ferry service may be even more attractive to this group, which makes up a significant portion of the potential market demand along this corridor, than the evaluating model suggests.

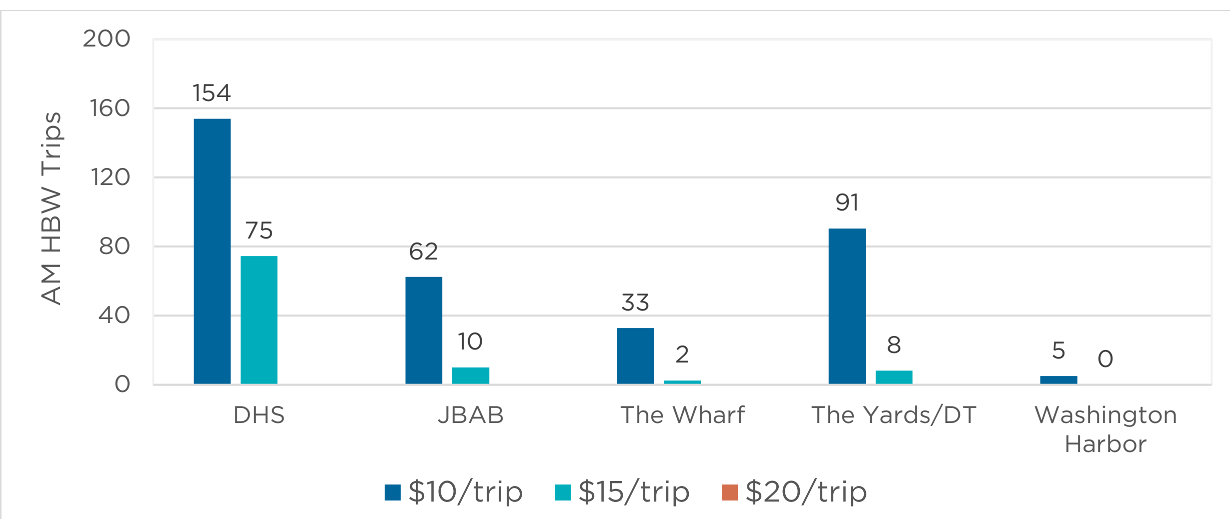
Note that those who drive a single occupancy vehicle (SOV) to work frequently do not benefit from the commuting subsidy. This group represents a high percentage of commuters in the market of interest.

Figure 48 HBW Trips to Terminal Catchment Areas that reduce their travel generalized cost by Using an Optimal Speed Ferry



In a scenario where the ferry operates at a standard speed, the potential demand is significantly reduced, and only a fare of $10/trip or lower would competitively attract users from other modes. See Figure 49.

Figure 49 HBW Trips to Terminal Catchment Areas that reduce their travel generalized cost by Using a Standard Speed Ferry



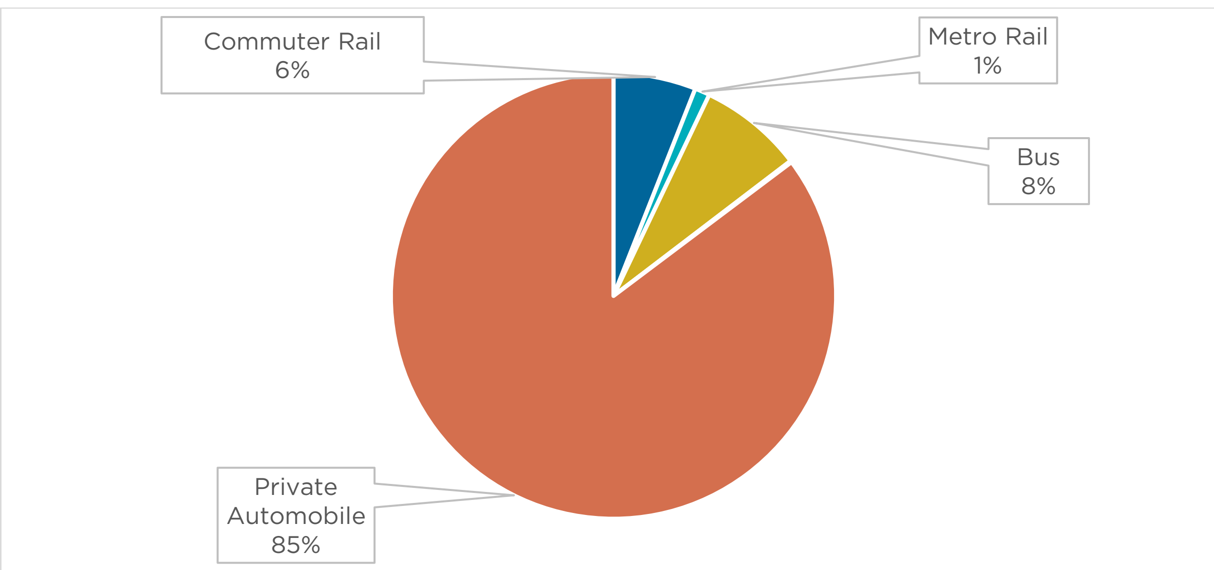
Commuters to the New Department of Homeland Security Campus

There are currently 2,300 DHS employees living in the ferry market area, 1,200 of which live in the primary market. The estimation of ferry ridership to the new DHS campus is based DHS's intention to relocate all employees to this location in the near future.

Travel options from the market area to the new campus are the private automobile and several transit modes that are dependent on the origin of the trip. Commuter buses depart from some locations in the market area bound for Metrorail stations (e.g. Pentagon Station), which allows for connections to the Anacostia Metrorail Station and transfer to the DHS shuttle to reach the final destination. Alternatively, some market areas are served by VRE, which connects to the Metrorail system at L'Enfant Plaza.

On average, travel time by car during the a.m. peak ranges from 90 minutes from the primary market to over 2 hours (130 minutes on average) from the secondary market, while transit travel times are over 2 hours from any origin point in both markets. As a result, only 13% of the current trips from both the primary and secondary market areas to the DHS catchment area are made via transit modes. Areas with VRE stations have higher commuter rail mode share, while bus is the second most used transit mode to access DHS.

Figure 50 Mode Share for AM HBW Trips to DHS



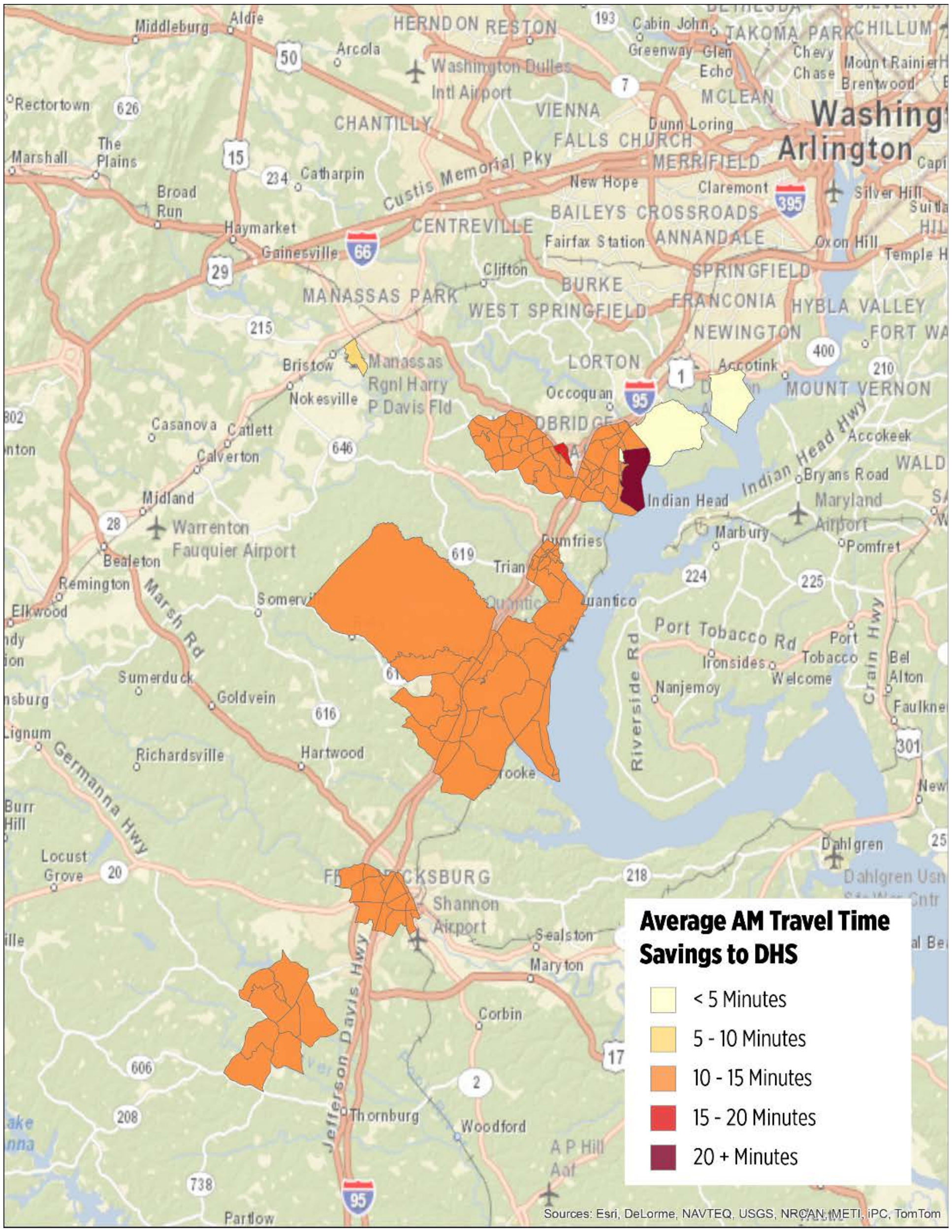
Source: MWCOG Travel Demand Model 2020

In a scenario with a ferry service from Woodbridge to JBAB North, there would be 1,970 a.m. trips that are currently made via private automobile that would save travel time if ferry in-vehicle time were 49 minutes. Only 31 a.m. trips would save travel time if the ferry in-vehicle time were to increase to 66 minutes. The average travel time savings of a ferry that would take riders from Woodbridge to JBAB North in 49 minutes would be 11.5 minutes per trip and would particularly benefit the areas adjacent to the ferry terminal in Woodbridge. See Figure 51.

Accounting for the generalized costs of trips, a fast ferry (49 minutes from Woodbridge to JBAB North), could capture 717 a.m. trips from the other modes (including private automobiles) with a fare of $10/trip, 330 trips with a fare of $15/trip, and 68 a.m. trips with a fare of $20/trip.

The potential demand with a ferry that would complete the same route in 66 minutes is significantly lower, with 154 a.m. trips captured from other modes at a $10 fare, and half of that if the fare was $15/trip, mostly captured from current transit users. Under this condition, a fare of $20/trip would not be competitive in attracting demand. See Figure 52 and Figure 53.

Figure 51 Average Time Savings per HBW trip to DHS (JBAB North)



Note: Highlighted TAZ correspond to home locations of current DHS employees.

Figure 52 HBW Trips to DHS Captured from All Modes Based on Travel Cost

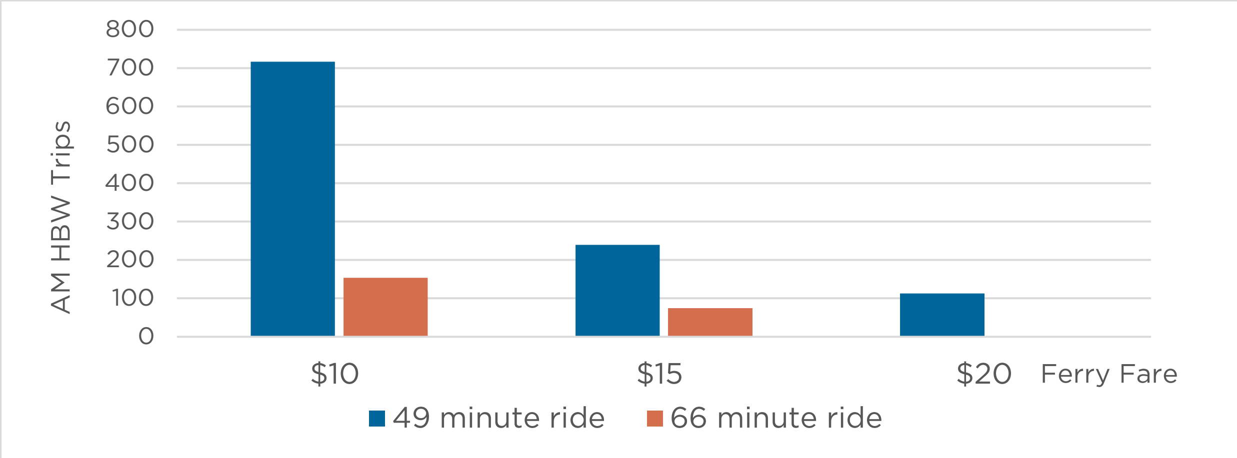


Figure 53 HBW Trips to DHS Captured from All Modes Based on Travel Cost – Optimal Speed Ferry by Market

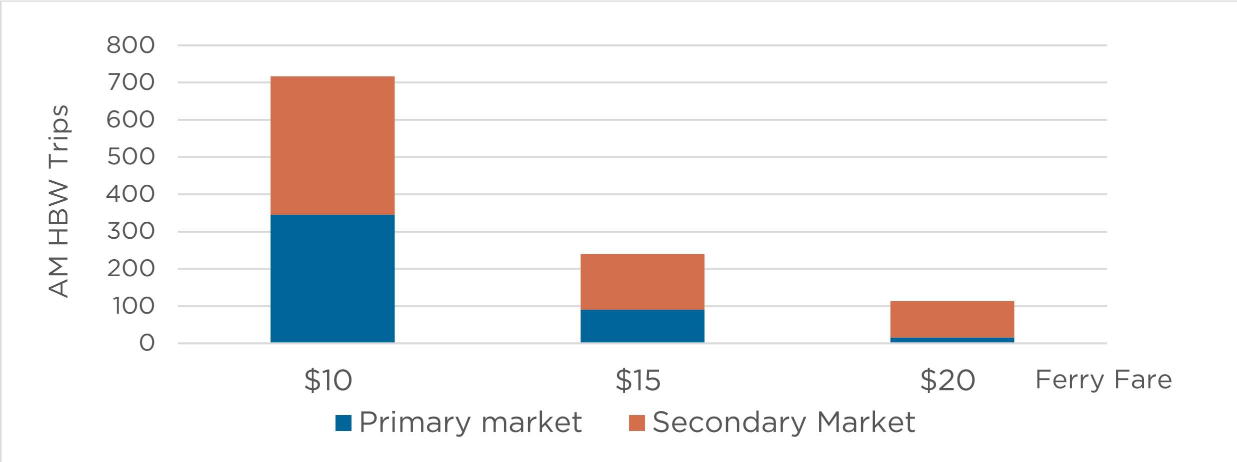


Figure 54 HBW Trips to DHS Captured Based on Travel Cost – Optimal Speed Ferry, $10 Fare by Mode and Market

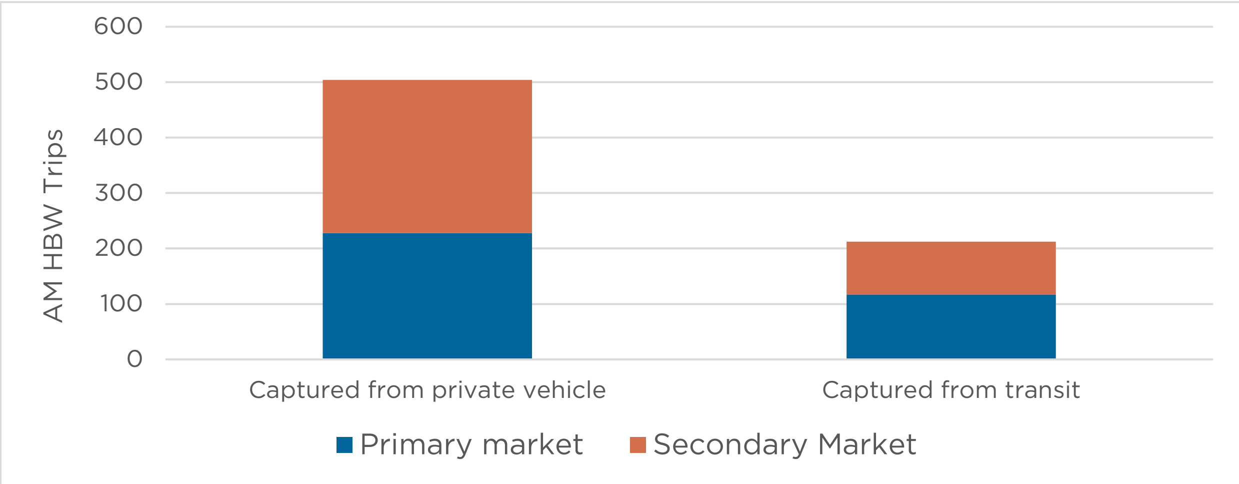


Figure 55 HBW Trips to DHS Captured Based on Travel Cost – Optimal Speed Ferry, $15 Fare by Mode and Market

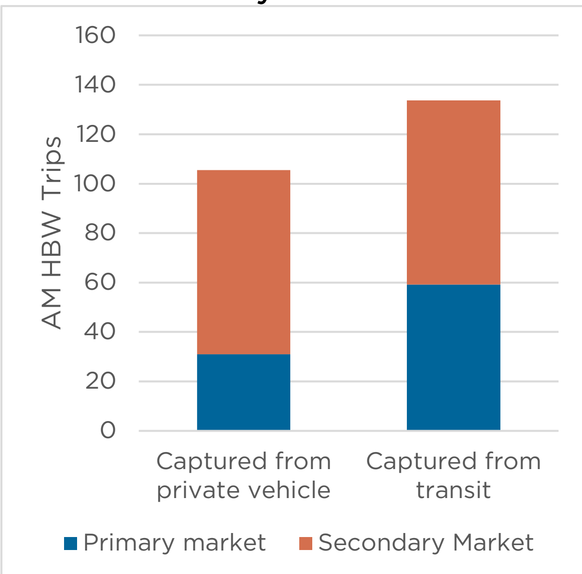


Figure 56 HBW Trips to DHS Captured Based on Travel Cost – Optimal Speed Ferry, $20 Fare by Mode and Market

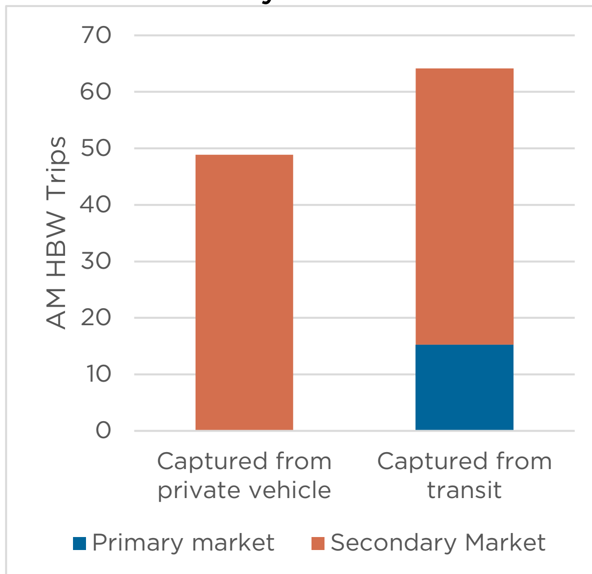


Figure 57 HBW Trips to DHS Captured Based on Travel Cost – Standard Speed Ferry, $10 Fare by Mode and Market

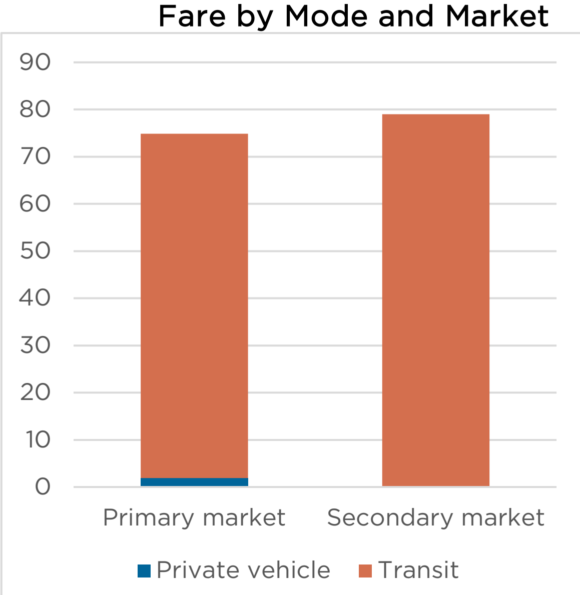
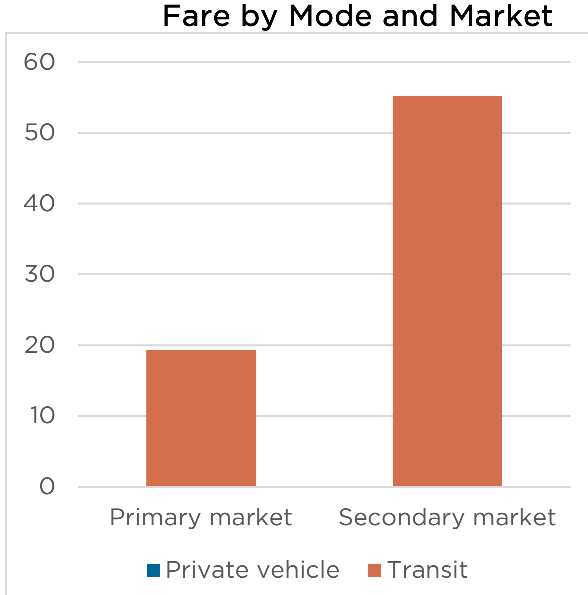


Figure 58 HBW Trips to DHS Captured Based on Travel Cost – Standard Speed Ferry, $15 Fare by Mode and Market



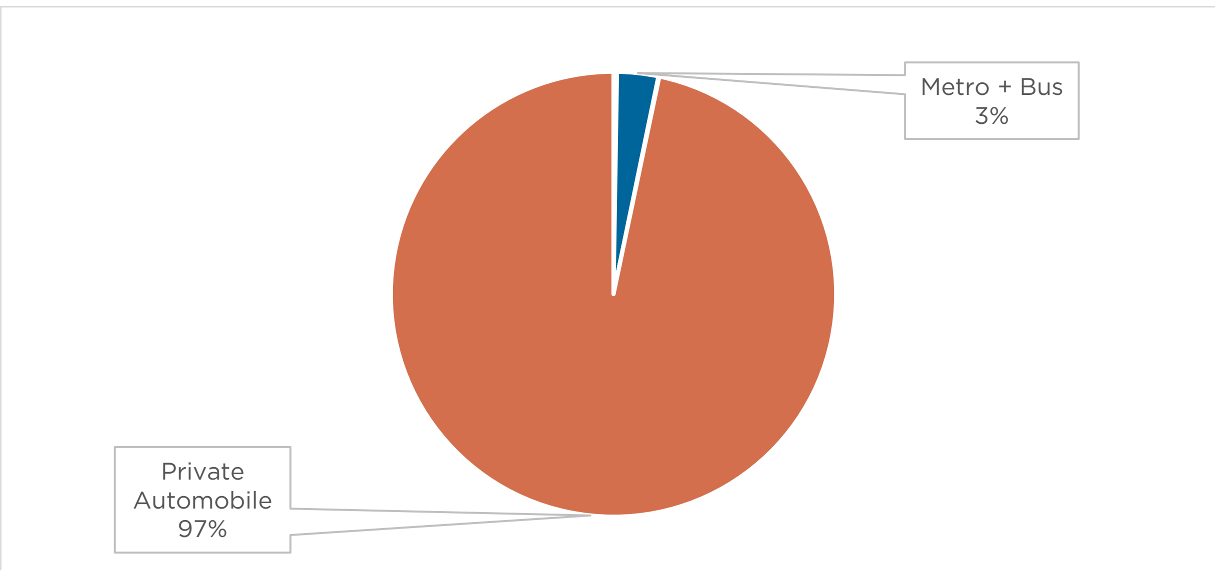
Commuters to Joint Base Anacostia-Bolling

Nearly 14,000 employees serving approximately 50 different Federal agencies currently work at JBAB. The base is home to approximately 8,000 parking spaces, with 75% of JBAB employees driving alone to their jobs and 78% of employees accessing the base using I-295 during peak periods. 13% of employees who enter the site travel from the ferry market area, 1,196 of which live in the primary market. Estimating ferry ridership destined for JBAB is based on the 2012 MWCOG gate counts and 2017 Streetlight data trip distribution.

Travel options and times described in the section regarding DHS also apply regarding JBAB. Travel time by car during the a.m. peak ranges from 90 minutes (primary market) to over 2 hours (secondary market). Transit times are once again over 2 hours from any origin point in both markets. Despite the length of car commutes, less than 15% of current trips from both the primary and secondary markets to the JBAB catchment area are made via transit modes.

A 45-minute ferry service from Woodbridge to JBAB South would benefit 1.299 a.m. HBW commute trips, all from the primary market. If the ferry in-vehicle travel time were to increase to 61 minutes, the number of commuters currently driving to JBAB that would benefit drops to 548.

Figure 59 Mode Share for AM HBW trips to JBAB



Source: MWCOG Travel Demand Model 2020

Figure 60 HBW Trips to JBAB Captured from All Modes Based on Travel Cost

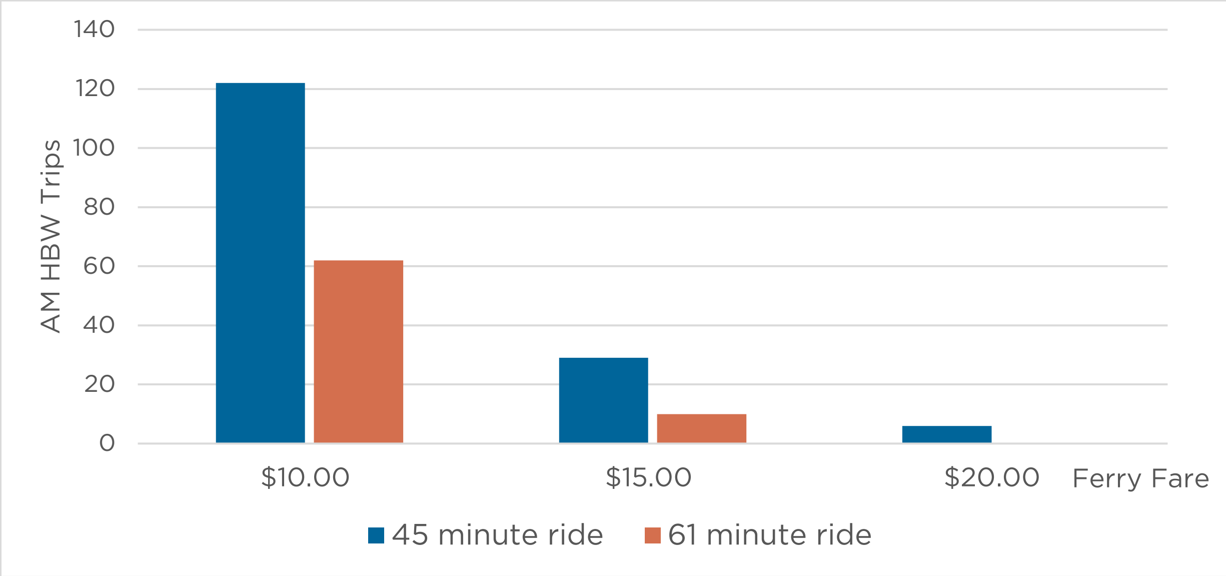


Figure 61 HBW Trips to JBAB Captured Based on Travel Cost – Optimal Speed Ferry, $10 Fare by Mode and Market

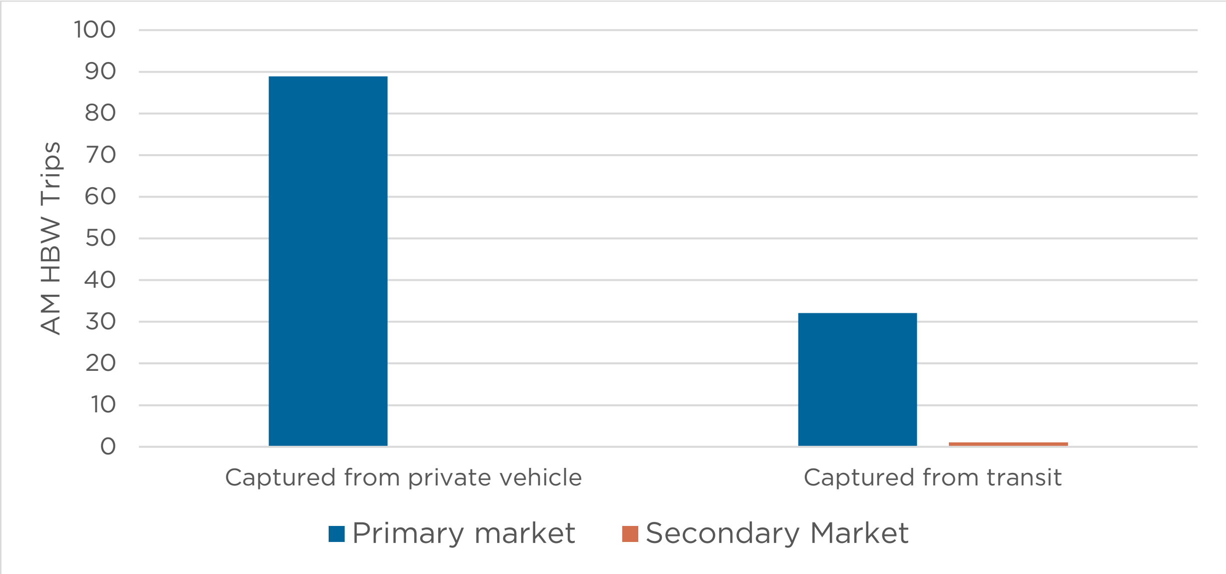
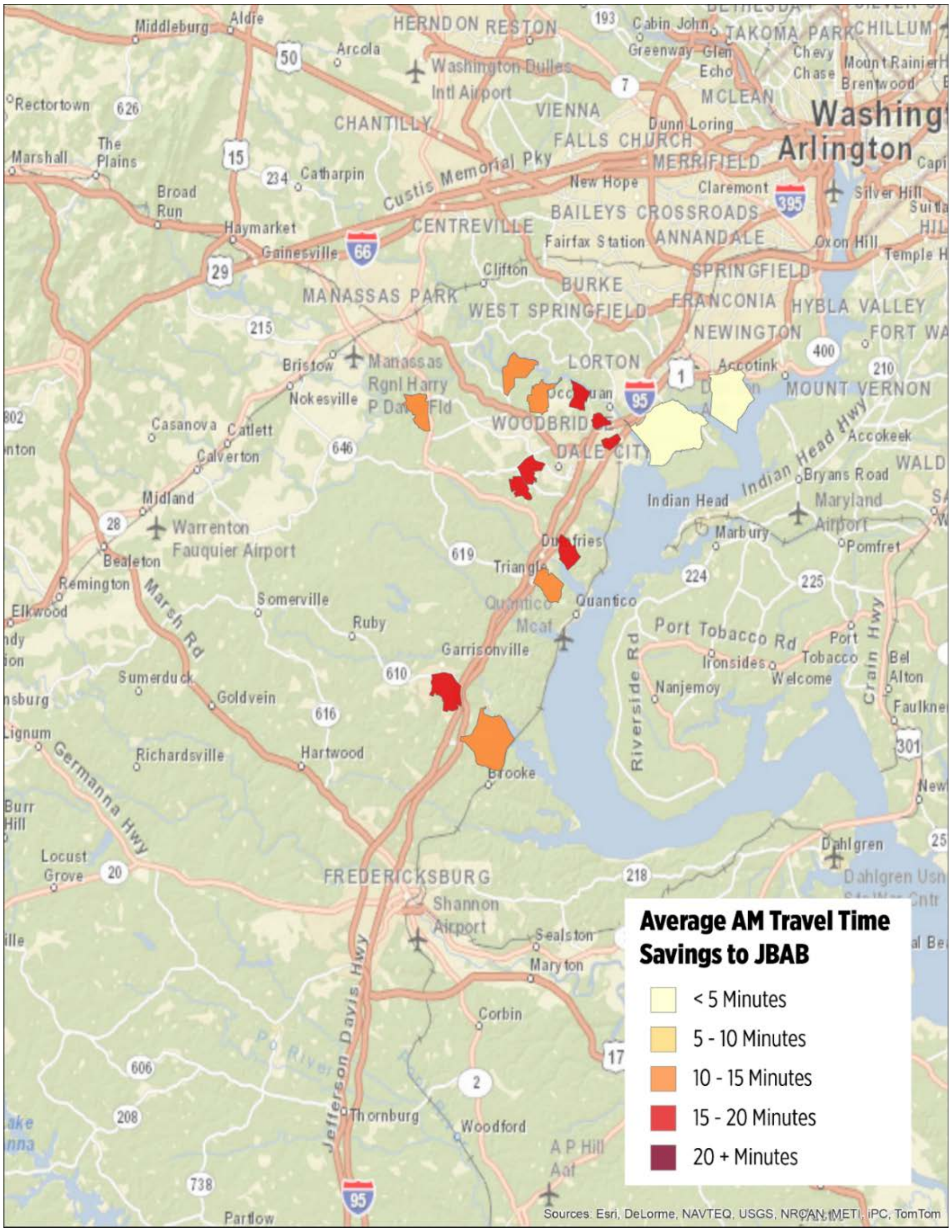


Figure 62 Average Time Savings per HBW trip to JBAB (JBAB South)



Note: Highlighted TAZ represent areas that currently generate a.m. trips to the JBAB South catchment area according to 2017 Streetlight data.

Commuters to The Wharf Catchment Area

There are currently 660 a.m. HBW trips that travel mostly from the primary market to the catchment area of the Wharf, including both the 15-minute walkshed and 15-minute transit shed. The route from Woodbridge to this ferry terminal can be covered in a little over an hour by transit, using commute bus services that cover the distance from I-95 in Woodbridge to the US Holocaust Memorial Museum, leaving the rider a 12-minute walk from the ferry terminal. Alternative transit options would require 15 additional travel minutes, including a transfer between a commuter bus and Metrorail and a 10-minute walk from the Smithsonian/National Hall Metrorail station to the final destination. Average driving time during the a.m. peak is 82 minutes, slightly higher than that of transit. Still, driving mode share is higher than transit, capturing 60% of the commute trips from the market areas to The Wharf catchment area.

All commuters currently driving from the primary market and secondary market to The Wharf would save travel time using a ferry requiring 51 minutes to reach The Wharf from Woodbridge, but a ferry requiring 68 minutes to cover the route would not represent a travel time improvement. When considering the generalized cost of the trip, including fare and parking costs in addition to the travel time, it is estimated that a 51-minute ferry ride could capture over 180 a.m. HBW trips with a fare of $10, but the demand would reduce significantly if the fare is raised to $15 and above and/or the ferry in-vehicle travel time increases. Approximately 55% of this ridership would be captured from automobile drivers, mostly from the primary market.

Figure 63 HBW Trips to The Wharf Captured from All Modes Based on Travel Cost

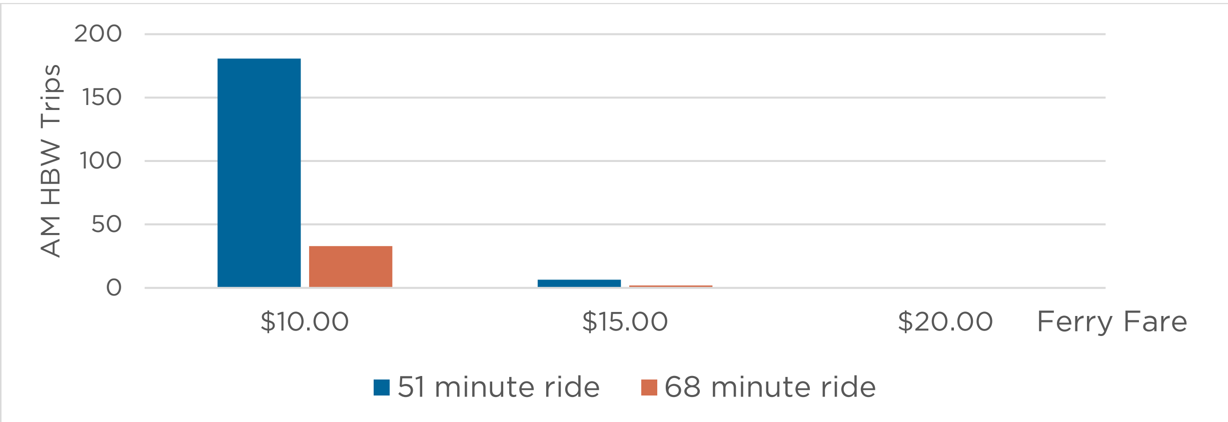


Figure 64 HBW Trips to The Wharf Captured Based on Travel Cost – Optimal Speed Ferry, $10 Fare by Mode and Market

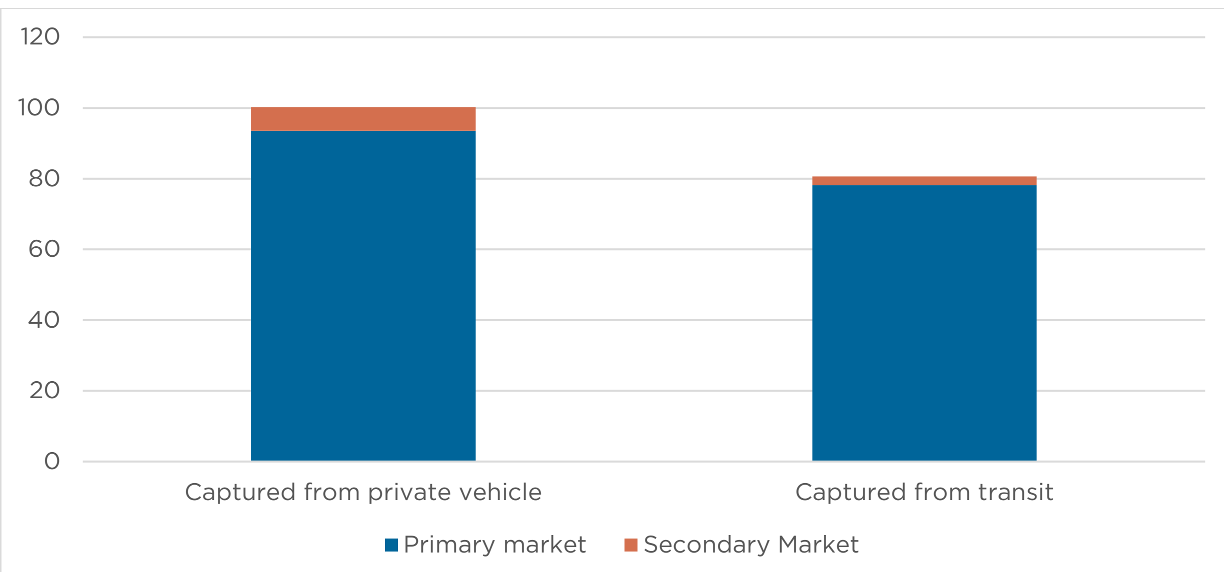
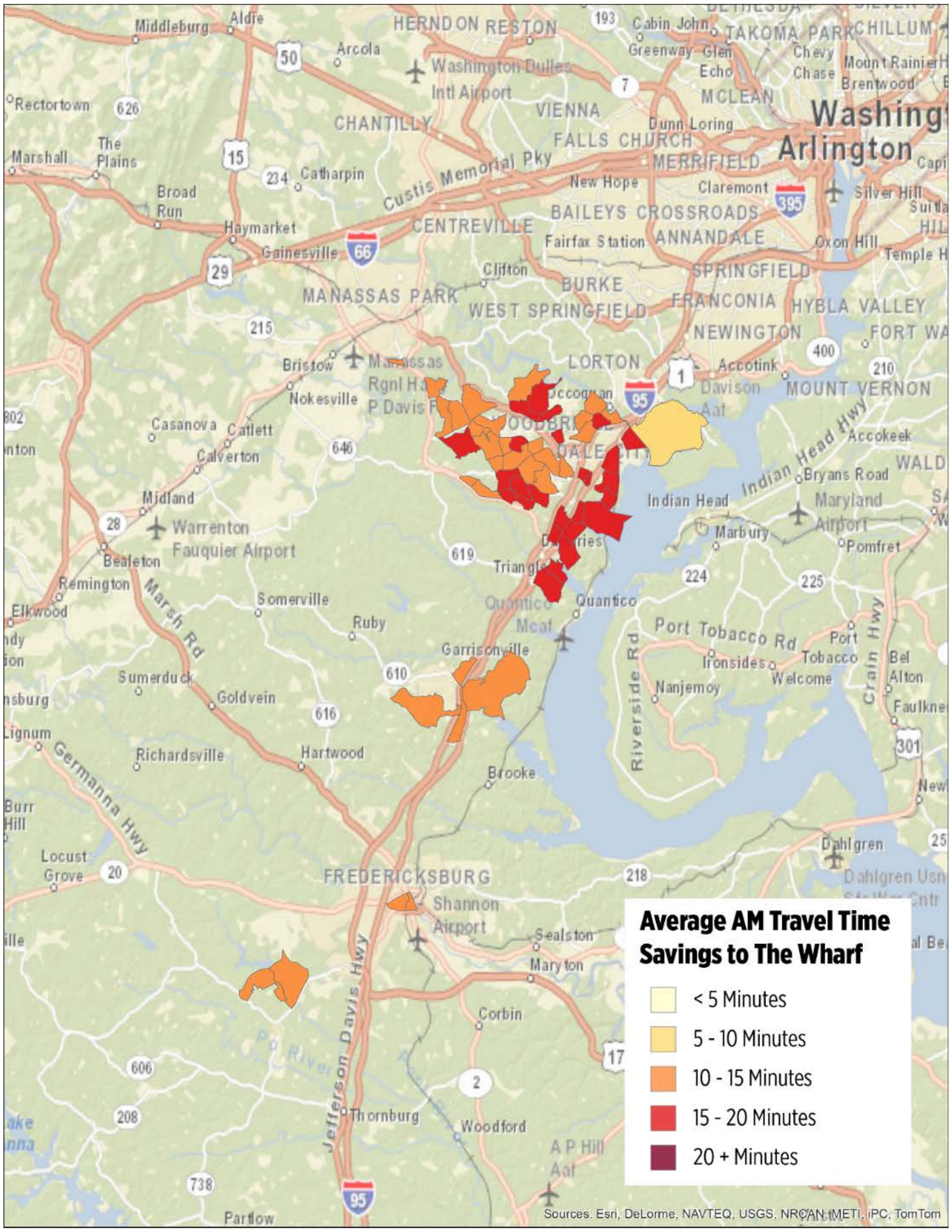


Figure 65 Average Time Savings per HBW trip to The Wharf

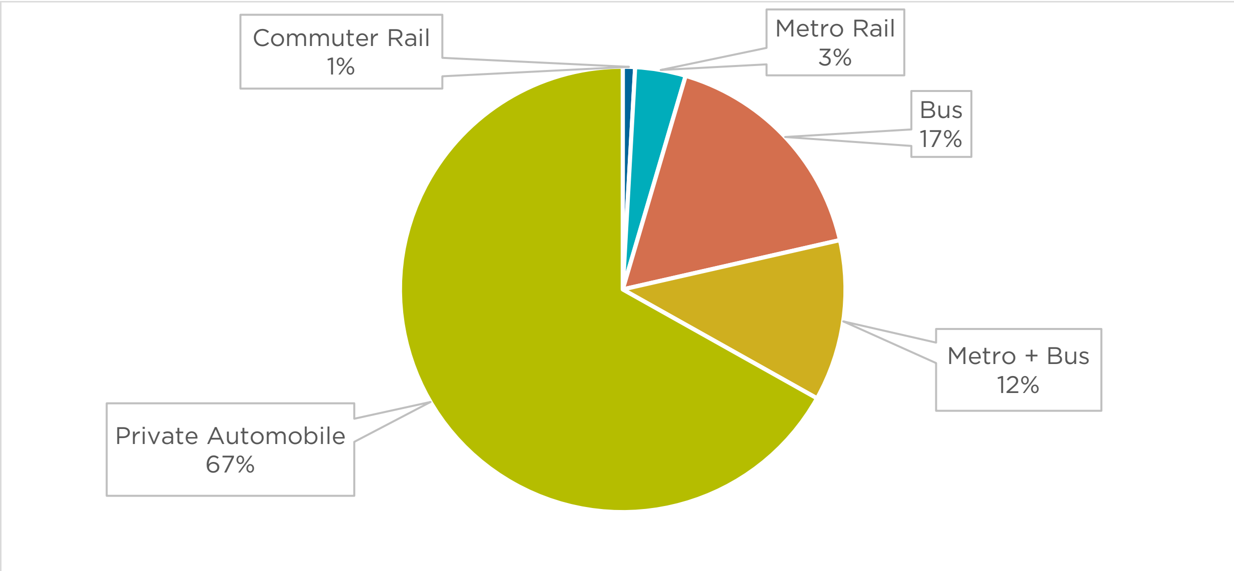


Note: Highlighted TAZ represent areas that currently generate a.m. trips to The Wharf catchment area according to 2017 Streetlight data.

Commuters to the Washington Harbor Catchment Area

The Washington Harbor catchment area currently attracts 161 a.m. HBW trips from the primary market, and none from the secondary market. Commuters use transit in 33% of their trips to this destination (Figure 66), which can be accessed using VRE or Amtrak, transferring to Metrorail at Alexandria. Foggy Bottom-GWU station is located within a 14-minute walk of the harbor. Travel time is estimated at 80 minutes using this combination, but can increase up to 95 minutes using commuter bus for the first leg of the trip. Driving time from Woodbridge to Washington Harbor averages 89 minutes during the a.m. peak.

Figure 66 Mode Share for AM HBW trips to the Washington Harbor Catchment Area



Source: MWCOG Travel Demand Model 2020

A ferry service connecting Woodbridge and the Washington Harbor in 54 minutes would benefit on average 100 commuters currently driving from the primary market, with travel time savings of 11.7 minutes per trip. With a travel time 35% higher, though, the ferry would not attract any commuter currently driving, as the travel time would not be competitive in relation to the driving time. Accounting for the fare and parking costs in addition to the travel time, a ferry service traveling from Woodbridge to Washington Harbor in 54 minutes and a fare of $10 per ride would be attractive for 39 commuters from the primary market, 55% of those current private automobile drivers.

Figure 67 HBW Trips to Washington Harbor Captured from All Modes Based on Travel Cost

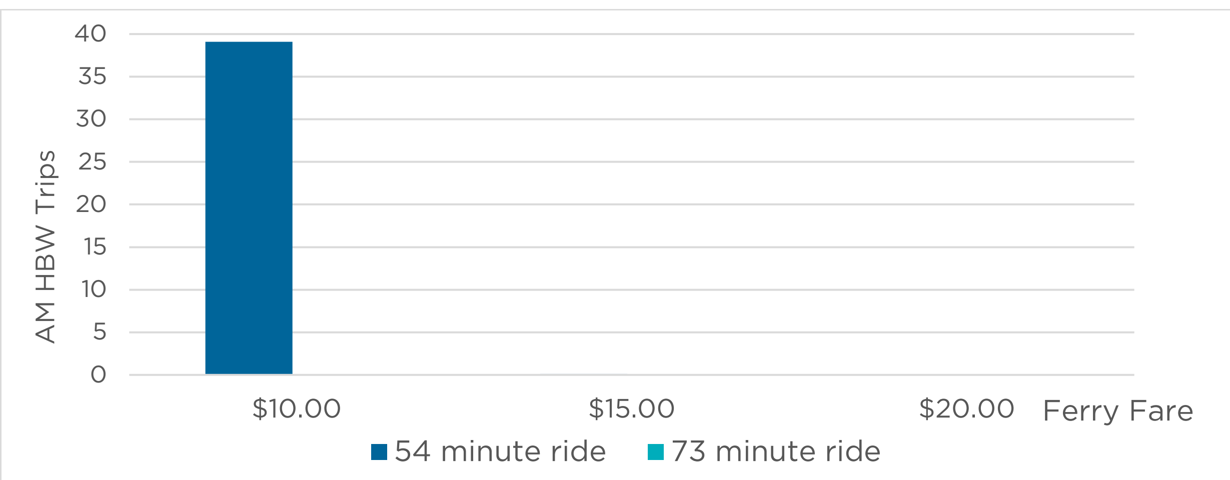


Figure 68 HBW Trips to Washington Harbor Captured Based on Travel Cost – Optimal Speed Ferry, $10 Fare by Mode and Market

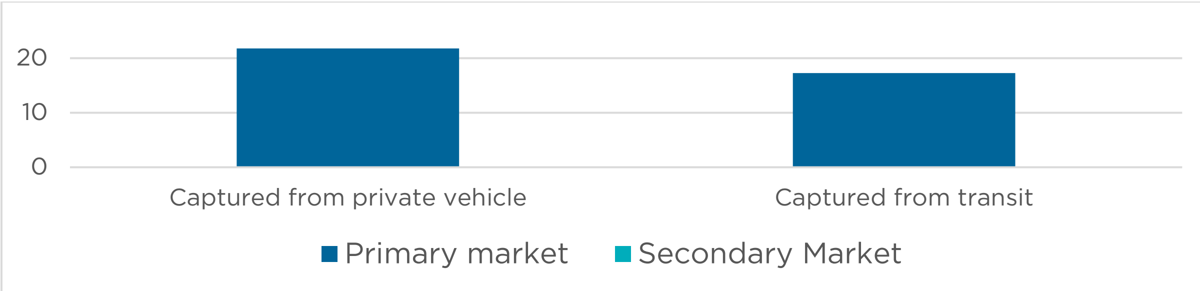
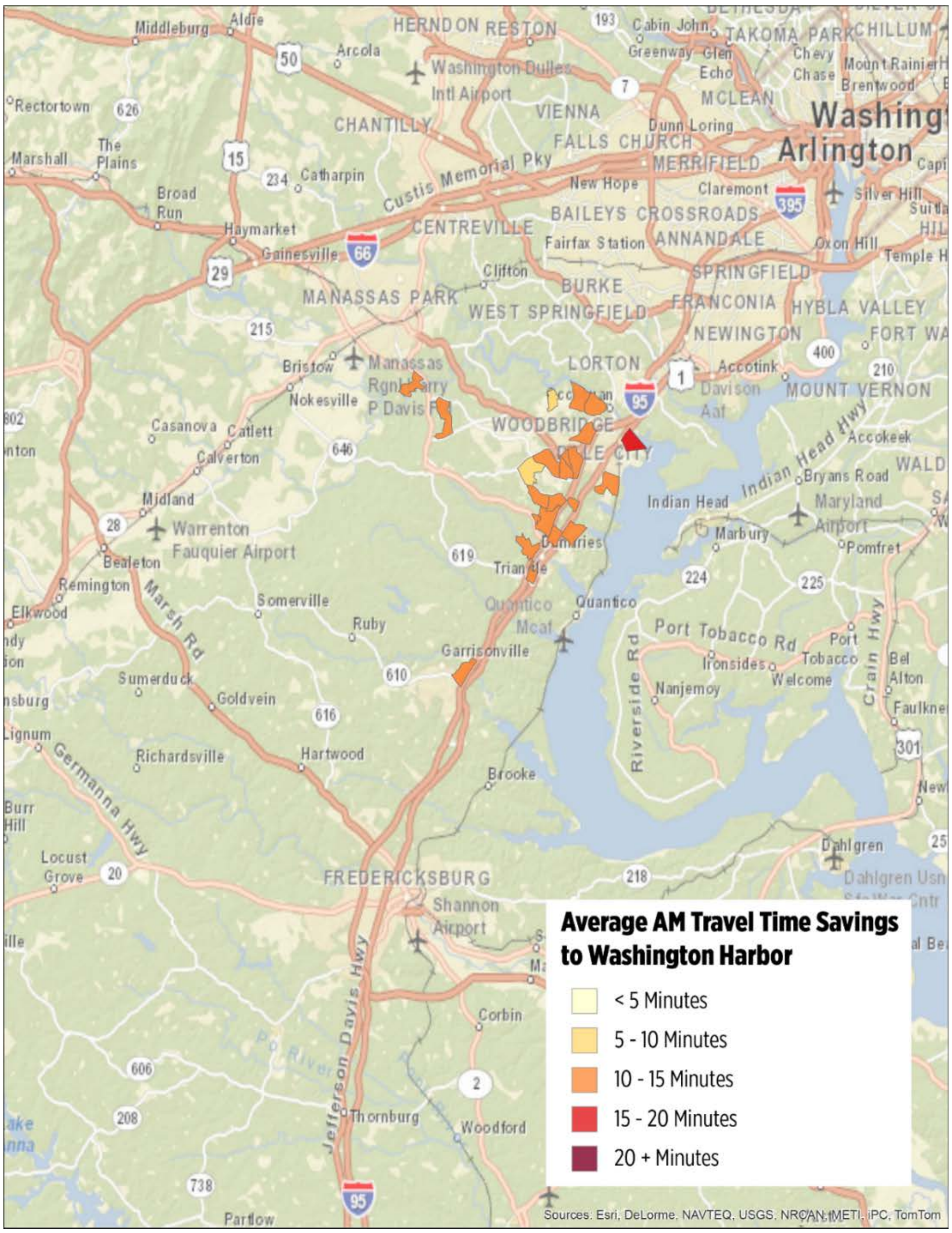


Figure 69 Average time savings per a.m. HBW trip to Washington Harbor

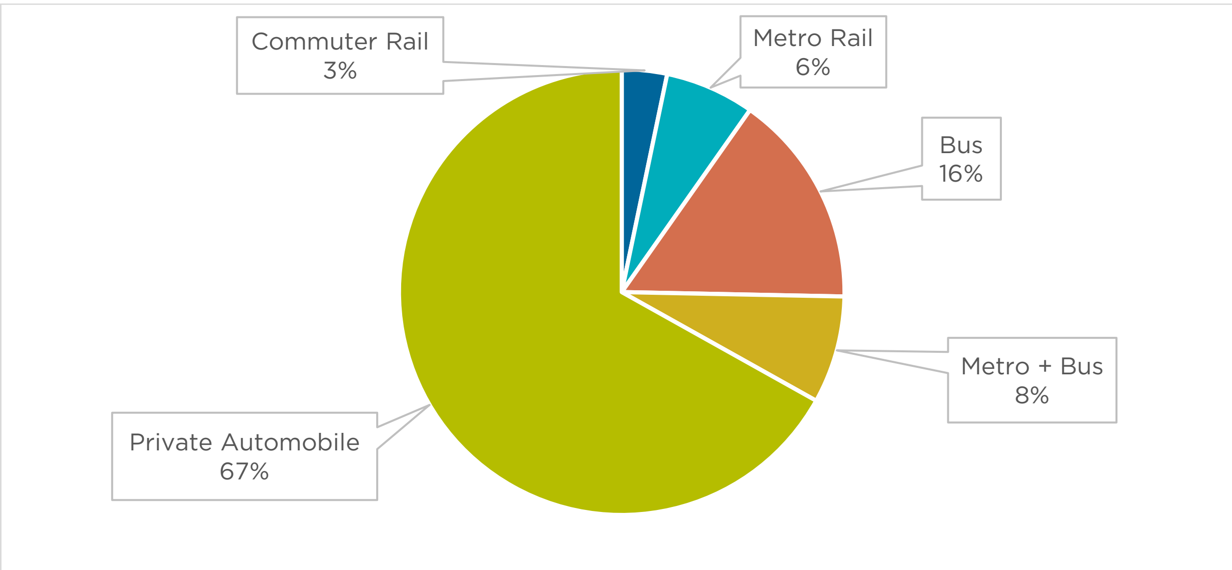


Note: Highlighted TAZ represent areas that currently generate a.m. trips to the Washington Harbor catchment area according to 2017 Streetlight data.

Commuters to The Yards/Diamond Teague Park Catchment Area

Diamond Teague Park and The Yards catchment area is roughly coextensive and jointly attracts 855 a.m. commuters, most of them reside in the primary market. Similar to commuters traveling to the Washington Harbor catchment area, transit mode share is 33% of trips to this destination (Figure 70), with several combinations of commuter rail, bus, and Metrorail comprising this cohort. Commuting by transit from Woodbridge to The Yards takes 95 minutes on average while driving takes 88 minutes during the a.m. peak. Transit options include taking a commuter bus to a Metrorail station or going all the way to Columbus Circle in Washington DC and transferring to a local bus. A 7-minute walk separate the Navy Yard-Ballpark Metrorail station from the potential ferry terminals.

Figure 70 Mode Share for AM HBW trips to The Yards/Diamond Teague Park Catchment Area



Source: MWCOG Travel Demand Model 2020

In a scenario with ferry service from Woodbridge to The Yards/Diamond Teague, there would be 568 a.m. HBW trips that are currently made via private automobile that would save travel time on a 51-minute ferry ride, but none of them would save travel time if the ferry in-vehicle time increases to 68 minutes. The average travel savings for a ferry that would take riders from Woodbridge to The Yards in 51 minutes would be 16.9 min/trip and would particularly benefit the areas adjacent to high-capacity roadways (Figure 73).

Accounting for the generalized costs of trips, a fast ferry (51 minutes from Woodbridge to The Yards/Diamond Teague Park), could capture 266 a.m. HBW trips from all modes with a fare of $10/trip, 86 trips with a fare of $15/trip, and 14 trips with a fare of $20/trip. Almost 60% of this demand would be captured from current drivers.

The potential demand for a ferry that would complete the same route in 68 minutes is significantly lower, with 50 a.m. trips that would be captured from other modes if the ferry fare was $10/trip. Under this condition, a fare of $20/trip would not be competitive to attract demand.

Figure 71 HBW Trips to The Yards/Diamond Teague Park Captured from All Modes Based on Travel Cost

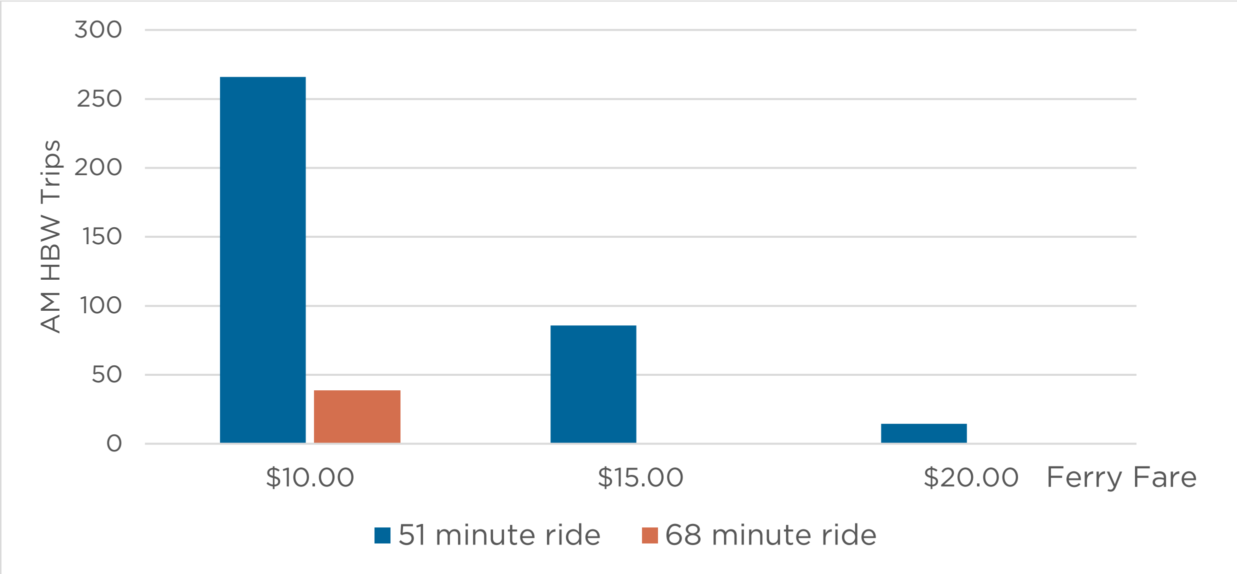


Figure 72 HBW Trips to The Yards/Diamond Teague Park Captured Based on Travel Cost – Optimal Speed Ferry, $10 Fare by Mode and Market

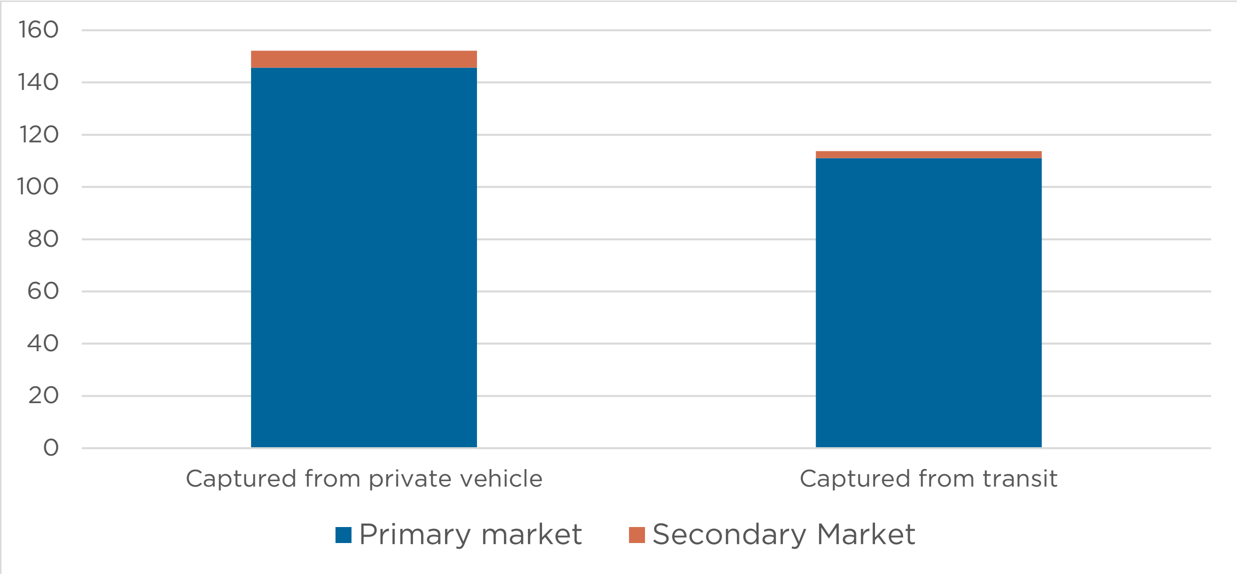
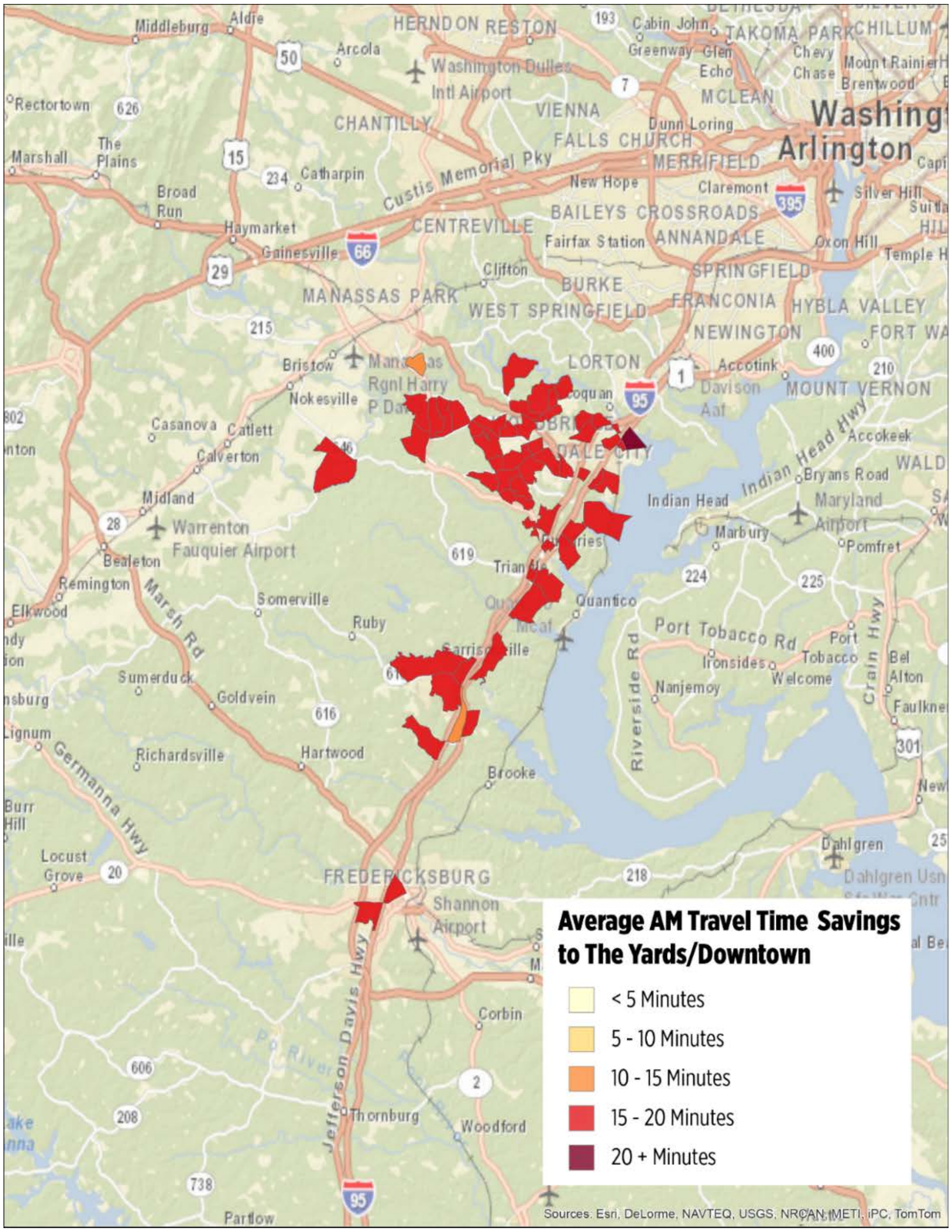


Figure 73 Average Time Savings per HBW Trip to The Yards/Diamond Teague Park



Note: Highlighted TAZ represent areas that currently generate a.m. trips to The Yards/Diamond Teague Park catchment area according to 2017 Streetlight data.

6 NEXT STEPS

This study has identified feasible terminal locations and a viable market for fast commuter ferry operations. This chapter is intended to outline activities that would be necessary to implement a ferry service between these two points.

Terminal Development

In the simplest of terms, if there are not two terminals from which to operate a ferry, there is no ferry. The two locations identified in this study are feasible as terminals, but considerable work remains to create the infrastructure necessary to launch commuter fast ferry service. The steps that follow are not comprehensive–each of these actions may require additional sub steps.

The two activities remaining with the highest potential to delay, or even derail, the implementation of commuter fast ferry service are environmental assessment and permitting. The waters and shorelines of the Potomac River are both some of most regulated and protected waters in the United States. There are multiple agencies at local, state, and federal levels that either claim, or have been given legal jurisdiction over use of the waterway and shore side development. Any one of these agencies could create a barrier that is financially infeasible to overcome or even claim a regulatory role that may require litigation and involvement of the courts to reach a resolution. Each terminal site features a unique set of development requirements and details.

Terminal Site – Occoquan Harbour Marina

The Potomac and Rappahannock Transportation Commission has accepted the lead role as grantee of the existing FTA discretionary ferry grant. The agency is in the process of amending the grant and working through FTA NEPA requirements to apply grant funds to upgrading the Occoquan Harbour Marina to support ferry service. Once the FTA grant is secured, issues of design and engineering, permitting, and construction remain. The FTA grant requires that the project appear in the MWCOG Transportation Improvement Plan (TIP) as well as the Virginia State TIP. Prince William County is taking the lead in amending the TIP.

Terminal Site – Joint Base Anacostia-Bolling

The United States Navy is accepting the lead role for development of the terminal at JBAB. The Navy will also have an environmental process for the terminal development. Other remaining steps include securing funding for the terminal (a grant application is pending with MARAD for development of this terminal), design and engineering, permitting, and construction.

Public Agency Responsibility and Vessel Operations

At present, there is no single public regulatory agency that has claimed the project, nor has an agency been established to operate ferries on the Potomac River. This provides an opportunity, but also a great vulnerability and considerable risk for a private ferry operator. From an environmental regulatory framework perspective, it is unclear which agency or agencies are making the decision to allow fast commuter ferries on the Potomac. The United States Coast Guard has safety and navigational jurisdiction, but there is no true decision-making authority vested in the Coast Guard from an environmental perspective. Coast Guard jurisdiction is satisfied, without requirement of environmental clearance, by any operator whose vessel meets regulatory requirements, passes inspection, is granted a

Certificate of Inspection, and is operated by licensed personnel in a manner consistent with the navigational and pollution rules for inland waters.

At least one DMV regional operator has recognized this issue based on recent experience in expanding water taxi operations along the DC waterfront. Their specific request was to identify and establish an agency that would be responsible for a decision approving operation of a commuter fast ferry. It is presumed that this agency would conduct some form of environmental documentation to ensure their decision was fully informed on the impacts of establishing ferry service. This situation is not without precedent. In Hawaii, the State had decided to establish inter-island ferry service. Terminal sites were identified and constructed, vessels were acquired, all Coast Guard regulatory requirements were satisfied, and the service was started before operation ceased. While there were multiple factors behind the stoppage, one of the most notable issues was injunctive relief granted to plaintiffs who made the case that the State had erred by not conducting an environmental evaluation of the impacts of operating a ferry between the islands. Therefore, the decision to start the service was a violation of the National Environmental Policy Act of 1967. This should be recognized and addressed as part of next steps.

Business Plan

Part of the business plan is to establish a method to select a private partner that will provide and operate the vessels. This part is required regardless of the configuration of the overseeing public authority. This private partner may be contracted at any stage of the process, but it is advantageous to finalize this arrangement as soon as possible. There are multiple potential ways to satisfy this step. A private carrier may step forward to take control of the service. More often, the lead public agency solicits a private operator by offering to "franchise" the terminals to that operator. This provides the most control for the operator, but also introduces the greatest risk to the public agency. The public agency would realize more control by establishing minimum service levels, fare levels, and other operating parameters before allowing private operators to submit proposals highlighting their ability to meet those criteria. This method provides more control to the public agency, but may also trigger the need for an operating subsidy to attract private providers to the partnership.

Regardless of the method chosen to select a private operator another necessary step is to establish a business plan. Elements of that plan include:

- Determining optimal vessel characteristics, particularly the top speed necessary to ensure ferry travel times are competitive with other modes, and that wake height and energy generation have been carefully considered.
- Setting fares (See Chapter 5 section on demand, travel times, and costs). Determine the portions of the market that have access to the federal transit commuting subsidy and understand how the existence of that subsidy should be accounted for in setting fare to ensure a self-sustaining operation.
- Setting schedules and days of service (e.g. Monday through Friday, seven days per week, holidays, service levels that vary by season, etc.)
- Establishing alternative commute options for times when the ferry cannot operate. This is mostly intended to address times when ice or drift on the river impedes safe navigation, although the same plan could also be used for unforeseen service disruptions like mechanical breakdowns. This plan could involve working with commuter bus providers to provide back-up bus service.
- Special attention paid to market forces:
  - What will the recently announced siting of Amazon's HQ2 at Crystal City mean for this service?
  - Is it a positive development or will it detract from the potential market?

  - Will the commuter fast ferry be integrated into package delivery within the region?
  - Other market interests might include operations to National Harbor and the MGM Grand Casino.
- Prioritizing development of a marine maintenance facility that is closer to DC for a more reliable and sustainable service.

7 TECHNICAL APPENDICES

PUBLIC COMMENTS, DISCUSSION, Q&A

Fast Ferry Summit – September 21, 2017 – Woodbridge, VA

- **Observations**
  - National Harbor could be a potential contender for a reverse commute in the long term.
  - Local ferries can be difficult to operate.
  - Since facilities are brand new, vessels will not require much maintenance in the beginning.
- *What type of fuel will the ferry use?*
  - Diesel. Natural gas is more challenging for smaller vessels.
- **Funding Discussion**
- *FTA Application deadlines are next month. Will information and assistance be available?*
  - The bigger challenge is that TIGER projects need to be shovel ready, including NEPA clearance.
  - Options should not require extensive environmental disturbance.
  - FTA is the ultimate federal authority in determining the level of environmental restrictions.
  - The shelf life for these grants is approximately 5 years to obligate the funding, and another 5 years to spend the funding.
  - FTA funding will require a 20-40% local match minimum, but more is preferred. Department of Defense funding is not allowed to contribute towards the local match.
- **Cost Estimates**
  - 300 passenger boats are estimated to cost $10 million per vessel, with an additional $5 million for infrastructure.
  - This could include $4-$5 million in infrastructure dock costs and $2-3 million for dock costs.
- **Operational Agency**
  - Time wise, it is better to have this ferry service operated privately rather than through a transit agency. The public sector may take longer to implement and start the process.

Open House – October 26, 2017 – National Harbor, MD

- *What about service from Indian Head?*
  - There is interest and the Town of Indian Head was involved during the market analysis, but it's a matter of working with the Navy to get the property turned over and a road built down to the waterfront. There is an unused bulkhead that could be used, but at the time was cost prohibitive. The bank is very susceptible to erosion and so a lot of work would need to be done. It is an ideal point, but there is also great cost and time involved in securing the site from the Navy.
- *What about Indian Head to National Harbor to relieve traffic on 210?*
  - Once terminals are in place, there are many possibilities because boats can travel in any direction, but again land side costs and the market size must be reasonable.

- *What about Ft. Washington Marina?*
  - It's run by the National Parks Service in a residential area and shallow water. It is unclear what the Parks Service's plans are for the site. Probably not as viable from a commuter or economic perspective.
- *Charles County EDC is interested, but the political branch is pro-environmental and would be concerned about developing parking lots for commuters.*
  - Waterfront development is gaining momentum, so it's possible that a developer can come into the community and try to resolve some of the congestion issues.
- *How would you engage with smaller businesses that want to bring in smaller vessels?*
  - MARAD opens granting opportunities as service for P3; the business partner must find a public partner to submit the application for review; if it's vetted, most likely it will be approved. No funding comes with the approval, but it comes with MARAD seal of approval. Then those that are accepted (up to 19 per year), then you are eligible for grant funds. FY17 is $5M and generally awards less than $1 million per award. MARAD will host a webinar in Mid-November to explain the process.
  - The MARAD website can be reviewed for grants that were approved
- *What would be the hours of operation?*
  - Possibly start at 5 AM for AM Rush and go until 8 PM for PM Rush, but ridership would dictate changes/refinements
- *Has the system for using Smartrip been worked out?*
  - Not yet, but it is the most logical thing to do once the project moves forward.
- *We seem to use different terms for the service – fast ferry, taxi ferry, commuter fast ferry; what's the difference?*
  - Best to call this a commuter fast ferry service. Water taxi might be used interchangeably as the market analysis is conducted.
  - Also depends on the type vessel being used. Smaller boats can be used as taxi's.
  - Main reason that this should be P3 is so that the private sector can figure out additional markets for how to use ferries, such as freight.
- *What are we doing to make sure the information is getting out to the public?*
  - An outreach event was held in Woodbridge, with a good turn out, but more needs to be done to engage communities in MD and DC.
- *What are the next steps for service to start in Woodbridge?*
  - The market will determine to ensure coverage of cost, fuel, number vessels, size, etc.; once the market analysis is done, we'll know what we need to invest in.
  - Second piece is land acquisition to develop the terminal sites and a year to build the boats.
- *What is a realistic timeframe for this to actually happen?*
  - Could be 2 years or less
  - Point of study is to make sure that it's all running within 5 years
  - Jones Act prevents buying a vessel from Europe or Asia

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- *How much money needs to be raised to finance the first route?*

  - Funds would be raised from both the private and public sectors. The studies have shown that there is a viable market for commuter ferry service between Woodbridge and D.C., and supports the private sector making a return on investments on the commuter service. The estimated cost of the vessels is $5M (used) and $10 million (new). As envisioned by the stakeholder group, the public sector (local, state, and/or federal government) would be requested to invest in the shoreside infrastructure, e.g., docks, passenger terminals, lighting, parking (where required). The one-time capital costs would vary based on the infrastructure already in place at the location. A fast ferry dock is estimated at $500,000 while a more extensive passenger terminal station could price at $2M. The total land side investment would range from $3 million to $5 million. Supervisor Prinicipi said that if they can show the private sector that there is a viable market, they will want to make the investment. Consider that a year ago the current facilities at The Wharf were not here, so things move quickly.

- *Would daily fast ferry operations need to be subsidized?*
  - It is ultimately dependent on the market whether a public subsidy would be required for service between Woodbridge and the Department of Homeland Security (Saint Elizabeth Campus) and Joint Base Anacostia Bolling (JBAB). This study concluded that there is a strong business case to move forward with service between these three destinations. Prior studies have concluded that a public subsidy is not required for shorter routes. In fact, Entertainment Cruises' four new fast ferry vessels are operating between the Wharf, National Harbor, Georgetown, and Old Town Alexandria without a subsidy.
  - The General Services Administration has informed the stakeholder group that the existing federal government commuter benefit would be authorized for use on-board fast ferries. The Department of Defense offers its employees a $250 a month travel subsidy for transportation and has confirmed that employees who use fast ferry would qualify for this subsidy. Other subsidies will also be explored as the market for ferry service is price sensitive. The primary market is single occupancy vehicle commuters who are not as aware as the cost of their commute as those who use public transportation, there is a tendency to underestimate the costs. To engage this market, it will be important to make use of available subsidies to keep the price attractive.

- *When will the Potomac Commuter Fast Ferry Service be operational?*
  - At this point in time, the launch of fast ferry service could be accomplished within 5 years. The construction of vessels is estimated at one year. If everything were to line up perfectly, it could take as little as two years, but there are still many hurdles to overcome. With the conclusion of this study, efforts are now focused on establishing a small stakeholder group of public and private organization that will partner for the Woodbridge-DHS-JBAB service. With these two steps completed, the launch of the service could be done quickly. This approach is designed to ensure long-term sustainability of the program. A key factor in this timetable is whether the stakeholder group will draw down an existing grant award of $4M from the Federal Transit Administration and whether FTA will require an Environmental Impact Statement (EIS).

- *Does the Infrastructure Gap Analysis Study consider future development and future transportation projects along the I-95 corridor?*
  - The study is based on current conditions, as the objective is to focus on the desired timeframe for implementing the service. In Prince William County there is constant debate about whether future projections should be included given that they have chosen to invest in buses and railroads. Future development will increase the need for more transportation options and past studies have shown that the ferry will supplement, not compete with, other mass

transit services. Fast ferry service from Woodbridge to DHS and JBAB does not compete with existing VRE and PRTC service, as those systems do not offer service to these locations.

- A survey of households in the under 15-minute and 15-30-minute vicinity of the proposed locations reveal that the primary market is not currently mass transit users, but rather single occupancy vehicle users that have not identified a mass transit service that works for them. This suggests that future expansion of current transit operations will not affect the market for commuter ferry service.

- *There are several recreational uses of the Potomac River, including boaters and kayakers. Will the ferry service have a negative impact on the recreational use of the waterway?*
  - There are multiple areas across the country where commercial and recreational activities coexist in the waterway. This includes the New York Harbor, Seattle Waterfront, and San Francisco Bay. Ferry service and recreational activities are regulated and monitored by the U.S. Coast Guard to prevent interference with one another and allow waterways to be utilized for different purposes. Safety will also be the number one priority for all involved.
- *The study bases the travel time of the ferry between Woodbridge, DHS, and JBAB on a speed of 35 knots. Is this realistic?*
  - The majority of the route is open channel where the ferry can travel at speeds greater than 35 knots. In the “no wake” zones the ferry will need to travel at slower speeds. 35 knots is an average speed used for planning purposes and is realistic given current conditions. Depending on the location of the docks, the travel time could increase but this is not anticipated to have a large impact on the market. The single most important benefit of commuting by ferry over single occupancy vehicles is reliability. The travel time of a ferry commute is consistent, whereas travel time on the interstate can vary considerably based on traffic conditions.
- *The wake caused by ferries can be problematic as they cause disruptions for residents living and using the water and could cause erosion. How will the wake and wash of the vessels be mitigated?*
  - Wake and wash is a big concern on the part of ferry operators as it is a liability issue. Newer vessels are now using technology that allows the vessel to travel at high speeds without causing a wake to mitigate their impact without affecting service. The Prince William ferry study demonstrated a wake and wash of three inches. Boaters are just as concerned by the underwater energy generated by ferries, particularly in narrow channels. This matter will continue to be examined as the project moves forward.
- *Will you be requesting changes to the current “no wake” zones?*
  - The stakeholder group has no plans to seek waivers from no wake zones on the Occoquan River, under the Woodrow Wilson Bridge, or through Old Town Alexandria. The stakeholder group intends to use vessel design opportunities and may consider wake attenuator technology to manage wake concerns.
- *The on-going studies have been funded by numerous organizations – private, public, and non-profit over the years. Will more funding become available and to what extent will Congressional funds be available for this project?*
  - The stakeholder group has raised nearly $1M in study funds from more than a dozen organizations since 2009. The stakeholder group has also been awarded a nearly $4M capital grant from the FTA (currently held by VDOT). Operational funds are awarded annually by the Federal Maritime Administration (US Department of Transportation) to “designated” ferry systems around the country on a formula-based approach. Given that MARAD has

"designated" our project as a federal waterway (M495), we anticipate that upon launch, the service would receive formula funds.

- *Did the study analyze the impact of the planned construction of the Fredrick Douglass Memorial Bridge on future fast ferry service in the area?*
  - The study did not specifically analyze the proposed bridge construction on this project, but the design plans have been reviewed and as long as clearance remains consistent, there are no long-term issues that would affect ferry service. There may be short-term disruptions to service caused during the construction period.
- *What data was used for this study? Did you factor in modal connections?*
  - This study drew from four different sets of transportation user data. Sources include the Metropolitan Washington Council of Governments, Maryland Department of Transportation, StreetLight Data (a San Francisco-based private firm), and a Nelson Nygaard ferry client. These four sources provided reliable commuter travel patterns to and from Woodbridge, DHS, and JBAB.
  - The large data sets demonstrated that more than 6,000 commuters travel to and from these three locations daily. The study concluded that more than 1,300 commuters would use this service if the trip time was under an hour (including travel to/from home) and the out-of-pocket cost are $10 per trip, $20 roundtrip. This fare assumes commuters would also use the transit subsidy provided by their employer – federal government and private sector.
- *Employees of Joint Base Anacostia Bolling rely on their private vehicles to get around the base. Since the ferries will not transport vehicles, will this deter employees from commuting by ferry?*
  - Joint Base Anacostia-Bolling is considering implementing an internal shuttle system to transport employees around the base. This would alleviate on base traffic and parking constraints and encourage employees to use mass transit for commuting.
- *How would ice on the river system impact fast ferry service?*
  - The last study conducted by the stakeholder group specifically looked at the impact of ice and debris on service. The study found that ice would impact service but there is a high level of predictability regarding when these conditions would occur. A ferry app on a smart phone could forewarn passengers with significant lead-time and enable them to use other means to get to and from work. A household survey done as part of the last study concluded that more than 90% of respondents reported that the occasional closing of ferry service due to river conditions would not affect their usage if they are given advanced notice.

TRAVEL DATA SOURCES

Several data sources have been analyzed to understand the travel patterns from both the primary and secondary markets to the target ferry terminals.

Figure 74 Commute Trips Data Sources

Data Source	Description
MWCOG Travel Demand Model	▪ Daily trips created from household survey, calibrated against screen lines in highways and ridership in transit stations ▪ 2020 projections ▪ Trips by mode ▪ Skims by mode (travel cost, including travel time, distance, toll, and transit fare)
Streetlight Data 2017	▪ Based on trips associated with any location-based service device in the Streetlight sample that meets the criteria (within the study area) ▪ Weekday and AM peak (6 a.m. – 10 a.m.) averages for the period of May-October 2017 ▪ Mode agnostic
MWCOG 2012 Base Realignment and Closure / Federal Employment Consolidation Impact Analysis Travel Monitoring Report	▪ Gate counts by mode, from 5 a.m. to 10 a.m.
DHS	▪ Number of employees and place of residence
University of Maryland Highway Travel Demand Model	▪ Weekday and AM peak (6:30 a.m. – 9:30 a.m.) ▪ Transportation zones are different from those of MWCOG ▪ Private mode only ▪ 2015 and 2030 projections

Travel Patterns

Figure 75 contains total trips between different subsets of the study area. Results differ between data sources but remain with a comparable range when comparing weekday daily trips attracted by the catchment areas of potential ferry terminals. Differences grow when narrowing the query to trips starting within the primary market area.

The MWCOG Travel Demand Model and Streetlight Data agree that the daily weekday commute market from the primary market to The Wharf, Washington Harbor, and The Yards/Diamond Teague Park catchment areas is approximately 3,500. Both data sources indicate that there are around 600 daily trips from the primary market area to DHS, while DHS data indicates that 2,302 of their employees reside in the primary market area. This is an artifact of the present situation where only the United States Coast Guard has occupied the new headquarters at the Saint Elizabeth's campus. The remaining employees will migrate to the new site over the next several years so that by 2025 all DHS employees will be on site. Similarly, the same sources indicate there are roughly 1,000 daily trips to JBAB, while there are 13,800 on-site employees. In this case there are different reasons for the variance in results. It is coincidental that they happen to yield similar numbers. The MWCOG model is reflecting travel patterns that were pre-BRAC based on model validation that was completed in 2007 and has not been updated since that time. Streetlight harvests data from GPS enabled devices, such as cell phones and auto navigation systems, and is reflective of the fact that many JBAB employees travel through the gate without these devices enabled due to national security measures related to data suppression.

Figure 75 Comparison of Trip Data Sources

	MWCOG 2020 Weekday	Streetlight 2017 Weekday	Streetlight 2017 Weekday AM Peak	U. of MD 2015 Weekday AM Peak
Trips from All Origins				
Trips to JBAB	720	1,197	495	
Trips to New DHS Campus	676	644	266	
Trips to The Yards/Diamond Teague Park	7,702	9,451	4,420	
Trips to The Wharf	5,037	5,589	2,695	
Trips to Washington Harbor	2,485	2,600	687	
Trips from Market Area Origins				
Trips from the primary market to JBAB	14	168	62	51
Trips from the primary market to DHS	29	274	23	165
Trips from the primary market to The Yards/Diamond Teague Park	1,734	1,510	777	933
Trips from the primary market to The Wharf	1,090	1,299	595	697
Trips from the primary market to Washington Harbor	674	365	148	597
Trips from the primary market to all ferry terminal catchment areas	3,541	3,616	1,605	2,197

Private Automobile Travel Times

Figure 76 Private Automobile In-vehicle Travel Time and Distance to Ferry Terminal Catchment Areas

	DHS		JBAB		The Wharf		The Yards/Diamond Teague Park		Washington Harbor	
Municipality(ies)	Avg. In-vehicle Time (min)	Avg. Distance (miles)	Avg. In-vehicle Time (min)	Avg. Distance (miles)	Avg. In-vehicle Time (min)	Avg. Distance (miles)	Avg. In-vehicle Time (min)	Avg. Distance (miles)	Avg. In-vehicle Time (min)	Avg. Distance (miles)
Aquia	111	43	114	45	116	40	117	41		
Berkeley	153	65								
Berkeley, Livingston	153	64								
Brentsville							116	41		
Coles	93	33	100	37	102	32	107	34	108	37
Coles, Neabsco	92	32			99	30	100	31		
Coles, Potomac							101	31		
Fredericksburg	132	54			137	51	140	54		
Garrisonville	112	42	115	43			119	41		
Garrisonville, Aquia	113	45								
Garrisonville, Rock Hill	116	44			121	42				
Griffis-Widewater	109	41			117	39	116	39	117	41
Griffis-Widewater, Aquia	110	42			116	40				
Hartwood	115	45					123	44		
Livingston	151	63			157	61				
Manassas	110	38								
Neabsco	88	30	90	30	94	28	97	30	90	28
Occoquan	86	28	84	28	86	26	89	27	85	25
Occoquan, Neabsco									88	26
Potomac	95	33	92	32	97	30	100	31	96	30
Rock Hill, Griffis-Widewater	111	42					122	41		

	DHS		JBAB		The Wharf		The Yards/Diamond Teague Park		Washington Harbor	
Municipality(ies)	Avg. In-vehicle Time (min)	Avg. Distance (miles)	Avg. In-vehicle Time (min)	Avg. Distance (miles)	Avg. In-vehicle Time (min)	Avg. Distance (miles)	Avg. In-vehicle Time (min)	Avg. Distance (miles)	Avg. In-vehicle Time (min)	Avg. Distance (miles)
Woodbridge	76	26	69	25	87	25	88	26	89	26
Woodbridge, Neabsco	82	28								
Woodbridge, Potomac									89	26

DEVELOPMENT OF THE BASE ORIGIN-DESTINATION MATRIX

The base Origin-Destination (O-D) matrix is composed by submatrices, which collects all one-way commute trips from 5 am to 10 am from each of the markets to each of the ferry terminal catchment areas, as defined in the Study Area chapter, at the TAZ level. Below is a summary of the assumptions taken to build each of the submatrices.

Figure 77 O-D Matrix Creation Assumptions

Ferry Terminal	Trip Distribution Source	Daily Distribution
DHS	DHS data (Figure 78)	Convert daily trips to AM peak trips based on the distribution of trips to JBAB during AM peak period from the MWCOG gate counts, 2012, which indicates that 69% of the employees enter the site during this time on a weekday
JBAB	AM peak hour Streetlight matrix	Expansion to the total number of employees entering the site from 6 am to 10 am according to the 2012 counts, and then expand that to 5 am to 10 am according to that same data source.
The Wharf, The Yards/Diamond Teague Park, Washington Harbor	AM peak Streetlight matrix	Expansion of the AM peak SL to 5 am according to the JBAB 2012 counts.

Figure 78 Residences of DHS Employees

Municipality	DHS Employees	Primary Market	Secondary Market
Woodbridge*	1,215	x	
Stafford	683	x	
Fredericksburg	654		x
Gainesville	254		x
Dumfries	241	x	
Lorton	208		x
Manassas	545		x
Spotsylvania	115		x
Dale City	91	x	
Triangle	71	x	
Fort Belvoir	11		
Manassas Park	44		
Quantico	1	x	
Total Employees	**4,133**	**2,302**	**1,533**

Source: DHS
* Woodbridge, Potomac, Neabsco and Occoquan Magisterial Districts

Figure 79 Summary of Persons Entering JBAB

Persons entering from 6 a.m. to 10 a.m.	Persons entering from 5 a.m. to 10 a.m.
8,894	9,644

Source: MWCOG, 2012

PIVOT-POINT MODEL METHODOLOGY

The percentage (or share) of trips choosing a given mode "a" from a choice of "m" modes is equal to the exponentiated utility associated with mode "a" divided by the sum of the exponentiated utility for all "m" modes. The equation is:

$$P_a = \frac{e^{U_a}}{\sum_{i=1}^{m} e^{U_i}}$$

where,

P_a is the probability of a traveler choosing mode a;
U_a is the utility (or attractiveness) of mode a; and
ΣU_i is the sum of the utilities for all m modes.

The utility equation, Ua, is mode-specific and can be represented in the following general form:

$$U_a = c_1 \times Distance_a + c_2 \times Fare_a + c_3 \times InVehicleTime_a + \ldots + C_a$$

where,

U_a is the utility (or attractiveness) of mode a;

$Distance_a$
$Fare_a$
In-Vehicle Time_a
$\ldots_a$ are level of service variables of mode a for this trip

c1,c2,.. are coefficients estimated for each of the terms based on survey results

c_a is the constant for mode a – obtained through calibration

The expression can also be expressed as follows, and Ci would be the generalized costs per mode (or utilities):

$$P_1 = \frac{EXP(-\lambda \cdot (C_1 + \delta))}{EXP(-\lambda \cdot (C_1 + \delta)) + EXP(-\lambda \cdot C_2)}$$

$$P_2 = \frac{EXP(-\lambda \cdot C_2)}{EXP(-\lambda \cdot (C_1 + \delta)) + EXP(-\lambda \cdot C_2)}$$

This would be equivalent to the following expression, which allows to calibrate both lambda and delta by a lineal regression:

$$LN\left(\frac{P_1}{1-P_1}\right) = \lambda \cdot (C_2 - C_1) + \lambda \cdot \delta$$

The model can also be applied to increments with the following expression, which allows to instead of calibrating the model, do a strategic analysis by testing different logic lambda values (elasticity between the cost variation and the variation of the model split between an O pair). That way, the model will only be applied to the cost variations, which will affect incrementally the mode split of the current scenario.

$$LN\left(\frac{P_1}{1-P_1}\right)_{futur} = LN\left(\frac{P_1}{1-P_1}\right)_{actual} + \lambda \cdot (\Delta C_2 - \Delta C_1)$$

Generalized Cost Private vehicle:

GCPV = AM Travel time * VT + Parking fare + Toll + Walking Time to final destination

Generalized Cost Transit:

GCT = (Access Time + Waiting time M1 + In-Vehicle Time M1 + Transfer time M12 + Waiting time M2 + In-Vehicle Time M2 + Transfer time M23 + Waiting time M3 + In-Vehicle Time M3 + Walking Time to final destination) *VT + Parking Fee + Fare M1 + Fare M2 + Fare M3

VT is $16/hr, and is been taken from the University of Maryland Travel demand model.