CITYWIDE FERRY STUDY 2013

Preliminary Report

NYCEDC
New York City Economic Development Corporation

WAVES
Waterfront Vision & Enhancement Strategy

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TABLE OF CONTENTS

1 Summary of Findings

In 2010, New York City Economic Development Corporation (NYCEDC) completed the Comprehensive Citywide Ferry Study (CFS2010), which provided an overview of potential for passenger ferry transportation throughout New York City. Building on the recommendations of the CFS2010, the City of New York launched several ferry initiatives, including the implementation of the East River Ferry.

Given the success of the East River Ferry's first two years of service and dramatic development changes on New York City's waterfront, NYCEDC commissioned a consultant team to complete an updated and expanded Citywide Ferry Study (CFS2013).

The goals of this effort were to identify new ferry service opportunities, increase understanding of ferries' economic impacts, and evaluate the full potential of this emerging transportation resource in New York City. The main findings of the CFS2013 are as follows:

- The East River Ferry carried over 3,200 average daily riders during weekdays and served 1.2 million total riders in 2013. The service generated considerable user benefits in terms of travel time savings, travel comfort, reliability, and increased accessibility.
- The CFS2013 analyzed over 50 sites—15 more than CFS2010. A resulting short list of most promising commuter and leisure routes includes locations in all five boroughs of the City.
- Fast-growing locations on the Brooklyn and Queens waterfront are forecast to generate significant ridership, and can potentially operate with modest public funding support.
- Ferry service to LaGuardia Airport holds considerable promise, offering travelers reliable and convenient access, particularly during peak periods.
- Routes serving more distant locations, while providing accessibility benefits, generate higher operating costs requiring greater funding support if they are to maintain fares similar to other transit modes.
- Residential property values within 1/8 mile of East River Ferry stops in Brooklyn and Queens increased 8.0% over comparable property values further from the stops; for all residential properties within one mile of a ferry stop in Brooklyn and Queens, ferry service increased total property values by $0.5 billion.
- Areas near East River Ferry stops in Brooklyn and Queens realized over 600,000 square feet of additional residential and commercial building space, a 4.9% increase over development rates in comparable areas further from the stops.
- Given both funding constraints and the demonstrated benefits created by the East River Ferry, the CFS2013 proposes potential value capture mechanisms to generate funding from private sector partners

- These are the most promising new ferry routes, with their associated costs:

Route	Annual Weekday Subsidy Requirement ($ Millions)	Capital Cost Requirements ($ Millions)	Peak Period Vessel Requirements
Route 2B: Astoria, Roosevelt Island, Long Island City North, East 34th St, Pier 11 / Wall St	$2.7	$23	4
Route 3B: Soundview, East 90th St, East 62nd St, Pier 11 / Wall St	$4.3	$20	3
Route 4: East 34th St, East 23rd St, Grand St, Pier 11 / Wall St	$2.0	$14	3
Route 4B: Long Island City North, East 34th St, East 23rd St, Grand St, Pier 11 / Wall St	$1.0	$14	3
Route 5: St George, Pier 79	0	$6	1

2 Introduction and Project Purpose

In 2010 New York City Economic Development Corporation (NYCEDC) completed the Comprehensive Citywide Ferry Study (CFS2010), which provided an overview of development potential for passenger ferry transportation throughout New York City. That planning study analyzed and prioritized potential routes drawn from a group of over forty waterfront sites in the five boroughs. Building on the recommendations of the CFS2010, the City of New York launched several ferry initiatives, including the implementation of the East River Ferry. The East River Ferry provides rapid and frequent service between several Brooklyn and Queens locations, Downtown Manhattan at Pier 11, and Midtown Manhattan at East 34th Street. Begun in June 2011 as a three-year pilot project, the East River Ferry today carries approximately 3,200 riders on a typical weekday, well above initial expectations.

Following the success of the East River Ferry, and in consideration of continuing and sometimes dramatic development changes on New York City's waterfront, NYCEDC set out to complete an updated and expanded Citywide Ferry Study (CFS2013). The goals of this effort are to identify new ferry service opportunities and to increase understanding of the economic impacts and potential of this emerging transportation resource in New York City. The CFS2013 is also intended to develop a planning framework based on several transportation models that can be used on an ongoing basis by public or private sector stakeholders to assess future ferry service opportunities.

This Preliminary Report is a precursor to the Final Report that is anticipated to be released by NYCEDC early next year.

Several developments since the CFS2010 provided additional impetus for this follow-up planning work: First, the East River Ferry is now an ongoing service, and as such provides a wealth of information regarding the local ferry market in New York City. A second factor is the recent development of modeling tools specifically designed for passenger ferry transportation in New York City. Finally, the past two years of East River Ferry operations provide a strong data set to quantify the economic value created by ferry service.

The CFS2013 provides detailed analyses to guide the evolution of ferry service in New York over the coming years. Below is a summary of the study's main work products

- Analysis of the potential viability of 58 locations in the five boroughs for commuter and leisure passenger ferry service, including relevant demographic, geographic and physical considerations of each site
- Estimates of potential ridership for 35 of the most promising locations, analyzed as point-to-point services, using an econometric mode choice model
- Grouping of 17 of the 35 locations into six potential route configurations
  - Feasibility study of potential passenger ferry service to LaGuardia Airport
  - Estimate of potential revenues, operating and capital costs, and subsidy requirements for commuter and leisure ferry routes and LaGuardia service

- Review of differential service and fare levels, including an analysis of revenue-maximizing fares and headways

In addition, the CFS2013 addresses several important policy considerations, including:

- Economic value derived from ferry service. A detailed analysis of the real estate and development benefits attributable to the East River Ferry
- Value capture approaches. Strategic recommendations for capturing some of the considerable value created by new passenger ferry service into potential funding streams to support ferry transit systems
- Direct and indirect benefits. An economic analysis of both direct user benefits (travel time savings, reliability, safety, comfort) as well as a discussion of likely external benefits attributable to an expanded ferry network
- Ferries' role in transportation resiliency. An assessment of the role that passenger ferries can play after disruptive events in transportation system redundancy
- Environmental considerations. An analysis of environmental impacts engendered by service expansion, including current and future emissions impacts of passenger ferries and local wake impacts
- Fare collection enhancements. Assessment of potential for improved fare collection or increased non-fare revenues, drawing in part on observed "best practices" of other ferry systems

The report builds on the work contained in the CFS2010, as well as the growing understanding of the regional ferry market, including the inventory of ridership, cost and revenue models designed specifically for New York City.

3 Passenger Ferries in New York Harbor: Past and Present

Historical Context

The 20th Century saw extensive construction of bridges and tunnels to connect Manhattan with the rest of New York City and New Jersey. As a result, the use of passenger ferries declined rapidly in the region. By the early 1980s, all that remained of the once significant network of regularly scheduled waterborne transit was the publicly-run Staten Island Ferry. As the decade progressed, however, there was a revitalization of privately-operated ferry services in the region. These independently financed ferry services generally served several (sometimes overlapping) market niches, including:

- Locations where ferry service provides a clear travel cost advantage over alternative transit (where cost is meant to include travel and wait time, fare and service quality). Services from Monmouth County or Weehawken to Manhattan fall into this category;
- Corridors with significant congestion or crowding. This was especially true for Hudson County PATH commuters, or for motorists using the cross-Hudson bridges and tunnels; Areas where the provision of ferry service went hand-in-hand with the development of waterfront residential density, as was the case in Weehawken and Jersey City.

Private operators implemented a variety of services between New Jersey and New York City, with a relatively stable "core" network (detailed in APPENDIX IV: EXISTING NJ TO NYC AND CROSS HUDSON FERRY SERVICES) which are run for the most part without operating subsidies. Some important service characteristics enable unsubsidized operations, such as:

- Primarily point-to-point routes that serve great densities at the origin and destinations;
- The routes are generally short and cost-effective in terms of fuel usage;
- Significant time savings over otherwise lengthy transit alternatives, and a generally high-income ridership of commuters to Manhattan willing to pay cost-covering fares

Although these services generally do not utilize direct operating subsidies, these services benefit from indirect capital subsidies provided through public infrastructure, such as ferry landings, located at either end of the service routes.

Current New Jersey to New York City and Cross-Hudson Routes

The current New Jersey to New York City passenger ferry system in the region is detailed in APPENDIX IV: EXISTING NJ TO NYC AND CROSS HUDSON FERRY SERVICES. As described and illustrated in earlier reports[1], census data reveals that the core market for the existing inter-state ferry system tends to be commuters living close to the waterfront and pier facilities. Further analysis shows that ferry passenger employment is concentrated in the Lower and Midtown Manhattan Central Business Districts, which are well-served by these ferry routes.

This part of the regional ferry network is discussed extensively in a recent report by the PANYNJ[2]. The report finds that passenger ridership on these routes has been strongly correlated with employment growth in New York City, particularly in sectors such as finance and business services. Following ridership declines due to the recession of 2007-2008 and recent cost-driven fare increases, this inter-state ferry market is essentially stable today, with growth closely tied to inter-state commutation.

Current New York City Routes

Until recently, the passenger ferry market within New York City was considerably more limited than the inter-state market. Several routes were established serving locations along the East River, but the scale of service and ridership remained modest. Two key constraints to robust ferry ridership in New York City are as follows:

- New York City is served by a widespread, frequent and affordable subway and bus network. To be competitive, passenger ferry service must generally match these characteristics as well. This requirement for success has meant that unsubsidized services have had a difficult time competing, particularly if fares were significantly above the subway fare, or if headways were lengthy.
- Waterfront residential density had been limited as a result of New York City's historic use of the waterfront for industrial purposes.

The last two decades have seen adaptation of waterfront land for residential or mixed uses, including retail, recreation and high tech employment. The attractiveness of these locations has resulted in sometimes significant growth in residential and employment densities (for example, Williamsburg and DUMBO on the Brooklyn waterfront), as well as leisure use at specific locations (notably Governors Island, Brooklyn Bridge Park, DUMBO, Four Freedoms Park on Roosevelt Island and Noguchi Museum / Socrates Sculpture Park on the Queens waterfront).

As discussed below, the policy decision to provide a limited operating subsidy for the East River Ferry combined with these land use changes to create favorable conditions for a robust New York City service. Table 3.1 summarizes the current New York City services, which include the East River Ferry, a service between Manhattan and the IKEA store in Brooklyn's Red Hook neighborhood[3], and a service between the Rockaway Peninsula in Queens, Brooklyn Army Terminal and Pier 11 in Lower Manhattan.

[1] Vilain, P., J. Cox and V. Mantero, 2012."Public Policy Objectives and Urban Transit: The Case of Passenger Ferries in the New York City Region", *Transportation Research Record*, No. 2274.

[2] Halcrow, Inc., 2010. *Study of Regional Private Passenger Ferry Services in the New York Metropolitan Area: Route and Service Analysis and Public Policy Goals*. Report Submitted to the Port Authority of New York and New Jersey.

[3] In addition to the routes outlines in Table 3.1, a temporary route serving Red Hook was established following Hurricane Sandy and the extensive damage to this part of the Brooklyn waterfront as a tool to encourage economic

The Staten Island Ferry, due to its distinct function and market, is seen as distinct and not included here. At nearly 70,000 daily riders it is the largest single ferry system nationally. The privately operated ferry system described in Table 3.1 and APPENDIX IV serves roughly 34,500 riders on a typical weekday, putting it on par with the ferry system operated by Washington State Ferries.

Of the services currently operating regularly on the East River, the IKEA shuttle has been in existence the longest. The shuttle started soon after the store opened at its Red Hook location in 2008, traveling between Erie Basin and Pier 11. The ferry service to the Rockaways was started as a post-Hurricane Sandy alternative for Rockaway commuters affected by disruption of A-train service. In August 2013, the Rockaway commuter service added a stop at the Brooklyn Army Terminal to serve Sunset Park and Bay Ridge commuters affected by the R-train service modifications caused by Hurricane Sandy tunnel repairs[4]. This service to the Rockaways and Brooklyn Army Terminal includes similarities to a 2008 pilot service to the same areas, but also incorporates significant differences, including fare, travel time, and service frequency.

Table 3.1: Existing New York City Ferry Services

Route	Weekday One-Way Fare	Headway (Peak)	2011 Weekday Ridership	2012 Weekday Ridership	2013 Weekday Ridership	2006-2011 Annual Growth	2011-2012 Annual Growth
East River Ferry	$4.00	20	1,235	2,727	3,257	NA	120.9%
IKEA - Pier 11	$5.00	40	475	375	387	NA	-20.9%
Rockaway - Pier 11	$2.00	35	NA	NA	746	NA	NA

recovery. Through a partnership between the City of New York, NY Water Taxi, Billybey Ferry Company, Fairway Market, IKEA and the O'Connell Organization, a stop at Van Brunt St was added to the IKEA weekend route. The addition of a stop and an additional boat to the route allowed the service to run every 25 minutes from 10am to 9pm during the weekend. The route operated from May 25th 2012 – Sept 2nd 2012.

[4] The IKEA ferry currently runs from 2-8pm on weekdays and 11:20am-9:20pm on weekends with 40 minute headways. New York Waterways operates the service and charges $5 each way during the week. The weekend service remains free and passengers who spend more than $10 in IKEA during the week will have the round trip fare deducted from their store total. . The Rockaway service operates from Beach 108th St to Pier 11 with five departures during the morning commute and five return trips in the evening. The fare for one-way trips is $2.

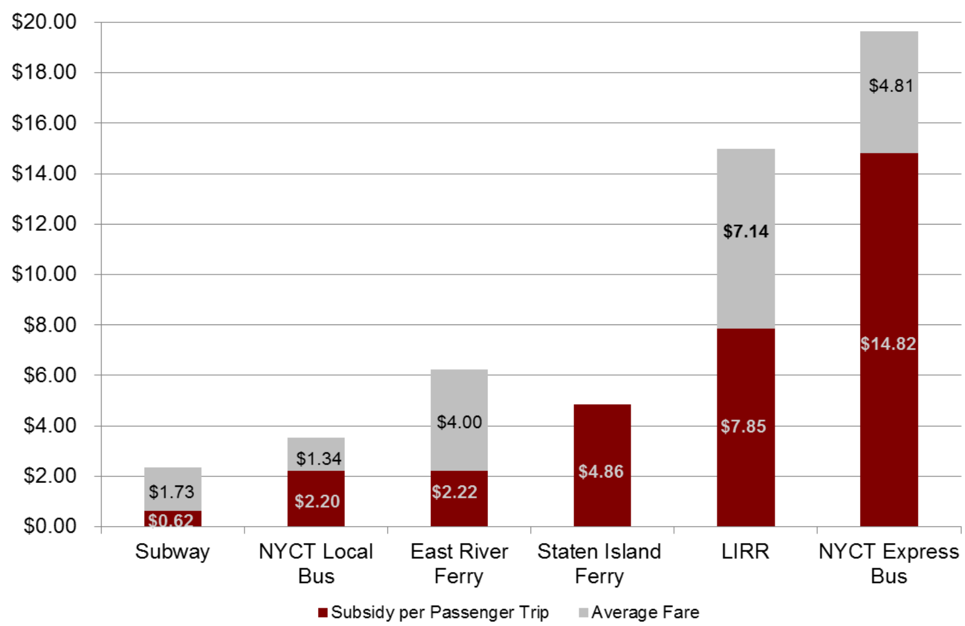
The East River Ferry

The East River Ferry is the most heavily used of the ferry services operating on the East River. Initiated in June 2011, it currently serves approximately 1.2 million passengers annually. A ladder service, it links Pier 11 at Wall St, then DUMBO, Williamsburg South, Williamsburg North and Greenpoint on the Broooklyn waterfront, Long Island City on the Queens waterfront, and East 34th St in Manhattan.

The service was the primary recommended route in CFS2010, and over the last two years, it has become an integral part of inter and intra-borough transportation along the East River.

The East River Ferry has been successful in attracting a dedicated base of riders, with a current average of over 3,000 daily riders in the 12 month period from July 2012 to June 2013 (or over 3,250 daily). At the current $4 fare the service's farebox revenue covers 64% of the services operating costs. The $2.22 subsidy per passenger trip is on par with the subsidy levels of the New York City Transit local bus services. Figure 3.1 illustrates the fares and subsidies per passenger trip across the various public transportation modes in New York. When compared to the non-subway transportation options in New York, the East River Ferry is competitive in terms of subsidy levels.

Figure 3.1: Transit Fares and Subsidy per Passenger Trip



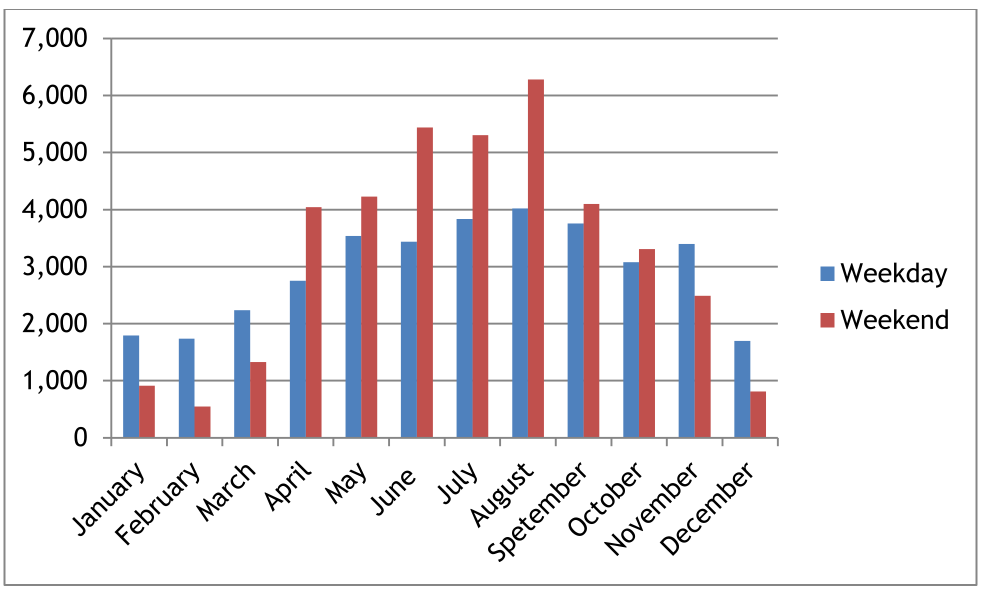
Source: Information for Subway, NYCT Local Bus, NYCT Express Bus, and LIRR is based on 2012 data provided to NYCEDC by the Metropolitan Transportation Authority (MTA) in July and October 2013. Information for Staten Island Ferry provided by the NYC Department of Transportation (NYCDOT) in September 2013.

Two markets make up the current East River Ferry ridership: the commuter market, which is made up of users who commute to and from their place of employment, and the recreational market. Recreational riders use the ferry for non-work-related trips. These two markets operate in very different ways: the commuter market makes up a large amount of the weekday ridership, while recreational riders are mostly responsible for weekend ridership.

Weekend and weekday seasonal rider counts confirm the differences between the two groups of ferry users: weekday trips are largely made up of commuters who need to make their trip to work regardless of season. On the other hand, weekend users, primarily recreational in purpose, exhibit far greater seasonal variation; winter weekends see only a fraction of the summer weekend riders. This difference between weekday and weekend trips can be seen in Figure 3.2, which shows the average daily boarding by month for both weekday and weekend trips[5]. The seasonal variations generally illustrate the greater sensitivity to weather conditions than found on alternative modes. This sensitivity is only accentuated for discretionary trips, again due to weather but also to the reduced number of water front activities and events during winter months.

Based on proven demand and resulting impacts over the course of the pilot program, the City recently announced its commitment to extend East River Ferry service into 2019.

Figure 3.2: Average Daily Boardings by Month, July 2012-June 2013



[5] To improve farebox operating coverage efficiencies, weekend and off-peak service frequencies vary by season.

4 Impacts of Passenger Ferries in New York Harbor

Introduction

One expects that transportation generates positive economic impacts. This study developed a systematic assessment of impacts attributable to potential new ferry service, including when possible the quantification of these benefits.

The benefit measures which are analyzed in the report include the following:

- Real estate and development benefits
- Direct user benefits
- Wider economic benefits
- Transit system benefits
- System redundancy

It is important to measure these various economic impacts, as the benefits of transit services have been typically shown to be considerably greater than the farebox revenue attributable to them[6]. The current report provides the results of an analysis of real estate impacts attributable to the existing East River Ferry Service. For potential new services considered as part of the CFS2013, direct user benefits are quantified including travel time savings, safety benefits and general comfort accruing to ferry users. Wider economic benefits refer to the impacts on accessibility and productivity attributable to proposed ferry services, while transit system benefits are concerned with the potential for decongesting non-ferry transit services suffering from crowding.

System redundancy provided by passenger ferries has proven to be an extremely important issue for the New York City region. In several very notable instances the passenger ferry fleet in New York Harbor has played a crucial role in providing emergency support. As the potential value of future system redundancy is difficult to quantify, the CFS2013 provides a qualitative discussion of the aspect of passenger ferry service.

Real Estate Benefits

The CFS2013 provides the first estimate of the impact of the East River Ferry service on residential property values and real estate development. The research draws on experience modeling the impacts of public transit on real estate outcomes. The following summarizes the key results of the East River Ferry's measured impacts (with

[6] See Parry, W. H. and K. A. Small, 2009. "Should Urban Transit Subsidies be Reduced?" *American Economic Review*, Vol. 99 (3), 700-724.; Guerra, E., 2011. "Valuing Rail transit: comparing Capital and Operating Costs with Consumer Benefits." *Transportation Research Record*, No. 2219, 50-58; Halcrow, Inc., 2010. *Study of Regional Private Passenger Ferry Services in the New York Metropolitan Area: Route and Service Analysis and Public Policy Goals*. Report Submitted to the Port Authority of New York and New Jersey.

a detailed discussion contained in APPENDIX I: REAL ESTATE DEVELOPMENT INPACT OF THE EAST RIVER FERRY):

- Residential property values within 1/8 mile of the closest ferry stop increased by 8.0%;
- For all residential properties within one mile of a ferry stop, the ferry service increased total property values by $0.5 billion;
- Higher real estate values also coincided with an increase in residential and commercial building space of over 600,000 square feet, a 4.9% increase of space within 1/4 mile. This includes:
  - An increase in the nearby supply of residential housing by 487,238 square feet, or over 7%; and
  - An increase in the supply of retail space within 1/4 mile by over 20,000 square feet, or 4.2%.

East River Ferry ridership, described above, has exceeded expectations since the service commenced in June 2011. The popularity of the ferry illustrates a strong demand for this service and suggests the high value that users place on it. Urban economic theory predicts that this higher demand for ferry service should lead to higher residential prices and rents as homes with access to ferry stops now come bundled with access to the ferry network. In addition, the increase in real estate prices should spur new residential development by increasing the value of building new properties relative to development costs, which on the margin should spur new residential development.

The CFS2013 focuses on residential real estate prices rather than the prices of commercial real estate leases. This is because the long-term nature of commercial leases would yield relatively sparse data and slower price changes that would be difficult to measure. Using publically available data on housing transactions and following well-established methods for determining the real estate impacts of transit services, the CFS2013 estimated the impact of the new ferry services on house prices and rates of real estate development in locations benefitting most from proximity to East River Ferry service.

Based on a comparison of trends in real estate prices for locations benefitting from the East River Service and similar properties that did not enjoy this access, analysis shows that the ferry service has a positive and statistically significant impact on house prices. The regression analysis shows that, after controlling for pre-existing conditions and building quality, including differences in proximity to the waterfront, the value of being close to a ferry stop increased real estate values.

Specifically, the ferry service increased the value of homes that were within a band extending to 1/8 mile away by 8.0%, and 2.5% for all homes within a 1/8 of a mile to 1/4 mile band away. The impact falls to less than 1% for homes a mile or more away[7].

[7] Impacts within this walking distance area are consistent with a survey performed on over 1,300 East River Ferry riders, in which over 75% of ferry riders reported that they walk to and from the ferry at either end of the trip.

These results imply that the ferry service has increased the average home value within one mile of the ferry by over 1.2%, and has increased residential value by roughly one half billion dollars in aggregate. The average impact of 8.0% within 1/8 mile is consistent with the results found in the wider literature on the impact of public transit on house prices. Overall, the East River Ferry increased house values by nearly half a billion dollars in the Brooklyn and Queens areas of New York City.

Table 4.1: Property value impact by distance from ferry stop

Distance from ferry stop (in miles)		Total value ($m)	Relative impact (%)	Absolute impact ($m)	Cumulative impact ($m)
Lower bound	Upper bound				
0.000	0.125	1,298	8.0%	92	92
0.125	0.250	2,872	2.5%	74	166
0.250	0.375	6,249	1.6%	98	264
0.375	0.500	5,557	1.1%	63	327
0.500	0.625	5,117	0.9%	47	374
0.625	0.750	7,897	0.7%	56	431
0.750	0.875	5,204	0.6%	32	463
0.875	1.000	5,468	0.5%	29	492

The analysis also confirms that the ferry service has a positive impact on the pace of development. The results from the construction impact analysis are consistent with the impact on prices: for most measures, there was a statistically and economically significant impact on development in the immediate area, and a declining impact at farther distances. The analysis controls for other factors that may affect development by looking at changes in the pace of development at the block level prior to the ferry service compared to the pace of development in those same blocks after the ferry service. This makes the results more robust by accounting for pre-existing differences between areas near the ferry and those farther away. Table 4.2 below shows the amount of new developments within 1/4 mile that can be attributed to the East River Ferry service. The largest impact was on residential development, which increased by nearly 350 additional residential units and 487,238 residential square feet.

Table 4.2: Change in construction with East River Ferry stop within a quarter mile

Development Type	Stock in 2009	New construction	Percent increase
Buildings	732	9	1.2%
Residential Units	6,051	350	5.8%
Building Area	12,300,000	608,615	4.9%
Commercial Area	5,466,094	183,963	3.4%
Office Area	953,887	948	0.1%
Retail Area	485,488	20,284	4.2%
Residential Area	6,745,500	487,238	7.2%

User Benefits

User benefits include a wide range of changes in travel characteristics, including travel time and cost, as well as convenience and comfort. The established approach to calculating user benefits is to convert these characteristics into monetary equivalents, or the *generalized cost* of the trip. One can then compare the generalized costs for a given journey under different scenarios and the change in cost is the benefit to the traveler.

It is important to measure user benefits in cases where prices or fares are not a good reflection of the total benefits users are deriving from using a particular mode or service. The CFS2013 developed estimates of total user benefits attributable to each of the routes that were considered most promising, a process described in detail below. For several of the highest ridership routes considered user benefits are considerable and as expected outweigh, in monetary terms, the fare revenue.

In several cases the total user benefits are greater than total operating costs, meaning that the subsidy is basically less than the total net benefit for users after paying the fare.

In short, an analysis of user benefits attributable to passenger ferry services in New York City confirms that user benefits are greater than fare revenue and reinforces the view that the positive effects of ferry service outweigh farebox revenues.

Wider Economic Benefits

Recent research in transportation economics has identified the existence of economic gains from improving connectivity beyond those captured by user benefits. The most significant of these is *agglomeration economies*.

Agglomeration economies are productivity gains enjoyed by firms that are located in areas of dense economic activity. These gains arise because such locations offer a high level of interaction between firms and workers, access to large and diverse labor markets and access to large and diverse suppliers and customers. Agglomeration economies are the principal reason for the existence of big cities – otherwise why would companies be willing to pay premium rents, wages and transport costs for city locations?

One frequently used method for approximating the wider economic benefits of transportation projects is to develop an indicator of the agglomeration benefits based on measures of connectivity. This entails identifying for each proposed ferry route the number of workers and jobs falling within the ferry stop catchment areas and then calculating each catchment area's *accessibility*, essentially connectivity between workers and employment. The CFS2013 then compares the accessibility with and without the ferry extensions to identify the routes which deliver the greatest impact. Those with a greater increase in worker accessibility are likely to generate larger wider economic benefits.

This suggests that several promising routes would be expected to deliver a large impact on worker accessibility and, thereby, generate considerably wider economic benefits to New York City.

Transit System Benefits

Ferries can close gaps in the transit network, making transit more convenient for many users. The improved service may divert drivers to transit or allow people to make trips they would not have otherwise made. When these additional travelers connect from the ferry to other transit systems, they boost the other system's ridership and revenue. If the other transit system is severely congested, however, these additional trips may incur costly expansion investments.

In addition to connecting new riders to other transit systems, ferries can divert ridership from other transit lines. If the alternative transit lines, or the stations that serve them, are overcrowded, then the marginal cost of accommodating travelers is high and may exceed the marginal revenue. The ferry creates a benefit by easing the load on the alternative system. Those who remain on the alternative mode will have more space, and there will be less congestion to interrupt service. If the alternative transit system is not crowded, however, the ferry will be diverting fares and ridership from the alternative system.

The transit system in New York City is extensive, and often overcrowded. There are few gaps for ferries to close, so ferries are unlikely to create significant benefits by inducing transit trips. However, they are likely to create significant benefits by easing congestion at overcrowded subway stations. Because this is a benefit of ferry service that does not accrue to ferry users themselves it can be described as an *external benefit*. In a recent study of passenger ferries in the New York City region, it was found that reducing crowding on the Port Authority Trans Hudson (PATH) service was the major external benefit attributable to cross-Hudson ferry services[8].

A simple assessment of the impact of potential ferry service expansion on other transit services was completed for the CFS2013. The analysis relied on the ridership modeling,

[8]Halcrow, Inc., 2010. *Study of Regional Private Passenger Ferry Services in the New York Metropolitan Area: Route and Service Analysis and Public Policy Goals*. Report Submitted to the Port Authority of New York and New Jersey.

which is described in detail below. The modeling assumes that all ferry riders divert from transit[9], and each route modeled generates estimates of ferry riders diverted from specific competing transit services. The CFS2013 was then able to compare the transit trips diverted to ferry by station with MTA station boarding data to generate a general impression of the effect on crowding relief at specific subway stations.

Table 4.3 below summarizes the diversion impact at specific stations if the three most promising proposed ferry routes were implemented. The routes link various locations on the Brooklyn, Queens and Bronx waterfront to Midtown and Lower Manhattan.

Table 4.3: Diversion of Station Boardings due to Ferry Service

Station (Train Lines)	Total station boardings	Daily station boardings diverted by new ferry service		Percent of station boardings diverted by ferry	
		Assumed Ferry Fare: $5.00	Assumed Ferry Fare: $5.00	Assumed Ferry Fare: $5.00	Assumed Ferry Fare: $5.00
23 St (6)	32,189	829	334	3%	1%
59 St (N,R)	13,100	514	201	4%	2%
Broad St (J,M,Z)	5,011	348	147	7%	3%
Roosevelt Island (F)	7,703	405	171	5%	2%
Vernon Blvd (7)	36,429	3,206	1,294	9%	4%
Wall St (4,5)	46,208	6,706	2,682	15%	6%

In order to assess the potential system impacts when ferry ridership would be at its "steady state" level 2018 ridership forecasts were used, since they take into account demand from new developments at proposed ferry sites[10].

As shown in Table 4.3, Broad Street, Vernon Boulevard and Wall Street subway stations would all experience decrease in station boardings of over 5% thanks to the ferry. While a precise quantification of the value of this crowding relief is not included here, it is possible that this diversion could improve comfort and on-time-performance for subway users.

New services to Staten Island, such as route 5 between St George to Pier 79 at W 38th St modeled in this study, could benefit the heavily utilized Staten Island Ferry in a similar manner, without draining revenue since the SIF does not charge a fare.

[9]This assumption is based on previous work carried out by Steer Davies Gleave. In the PANYNJ study referred to previously, analysis using the two regional travel demand models available for the New York City region modeling results confirmed that ferry services in New York City with Manhattan destinations draw the near-totality of ridership from other transit modes (see Halcrow, Inc., 2010. *Study of Regional Private Passenger Ferry Services in the New York Metropolitan Area: Market Modeling of Ferry Routes West and East of the Hudson - Analysis Using Regional Models*. Report Submitted to the Port Authority of New York and New Jersey).

[10] The trip demand from these developments was added to the projected MTA station boardings data.

System Redundancy

Passenger ferry service offers redundancy to the New York City transportation system, which has proven to be critical during several recent crisis situations. During the terrorist attacks of September 11, 2001, the Northeast blackout of August 14, 2003, or the emergency Hudson River landing of US Airways Flight 1549 on January 15, 2009, the passenger ferry fleet played an invaluable role in providing emergency assistance. Following the destruction caused by Hurricane Sandy, passenger ferry services to Staten Island, Red Hook and the Rockaways was set up in a matter of days, demonstrating the manner in which ferry service can be established relatively easily and flexibly to respond to transit service disruptions.

The future potential value of ferry service in terms of system redundancy or emergency preparedness is difficult to quantify: The events referred to previously are thankfully rare and impossible to predict, as are the total extent of the potential ferry system response. In general, in keeping with other recent assessments of the value of system redundancy, the CFS2013 concludes that the denser the ferry vessel and service network, the greater the potential ability to respond to emergency situations.

5 Opportunities for Ferry Service Expansion

2010 Citywide Ferry Study Site Assessments

The CFS2010 evaluated 43 sites for potential ferry service. The ridership analysis contained in that study was not able to benefit from models, nor data sources that are now available. In addition to several mode choice models[11] recently developed in the context of separate studies for the PANYNJ, the last several years have also seen the release of the 2010 Census and the American Community Survey (ACS), providing socio-demographic information down to the census tract level.

The timely availability of these models and data allowed the CFS2013 to update the work done in the CFS2010 as well as consider 15 entirely new sites.

Sites Assessed in the 2013 Citywide Ferry Study

The CFS2013 assessed a total of 58 sites, including the 44 sites considered in the 2010 study. The potential of a site for ferry service depends on a variety of factors including but not limited to the number of residents commuting to Midtown or Lower Manhattan, existing transportation options, potential travel time savings, future development plans and the physical viability of the site. In order to assess the feasibility of ferry service from the study sites the CFS2013 team first produced a comprehensive site profiles for each of the 58 study locations. The sites studied by the CFS2013 can be seen in Figure 5.1: CFS2013 Study Sites.

The profiles were compiled from a variety of sources to understand each site's demographic make-up, market size, transportation options, future development plans and physical characteristics. By compiling this information for all 58 sites, the CFS2013 was able to consistently evaluate the sites against similar criteria. Each profile contains the following information from the following sources:

- Population - 2000 and 2010 Census
- Employment Characteristics – 2000 Census & 2007-2011 5 year ACS
- Journey-to-work – 2000 Census
- Planned Developments – NYC Department of City Planning
- Travel Time comparison – Google Maps
- Transit Access – Google Maps and MTA
- Water Depths – NOAA navigation charts[12]
- The site's suitability for emergency use – site visits

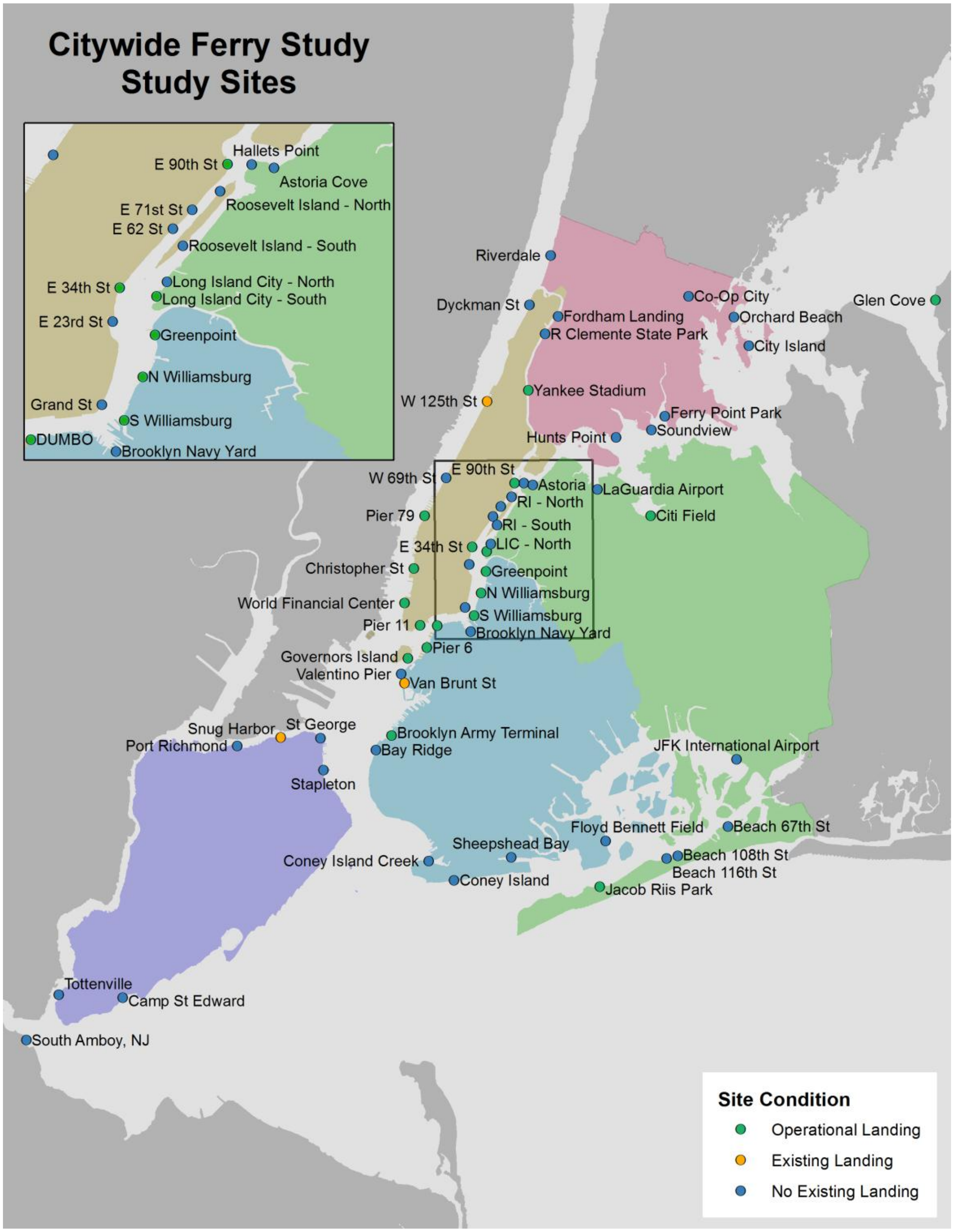
By comparing each site's current population and employment characteristics, the CFS2013 was able to identify areas experiencing high levels of growth. Growth trends

[11] Mode choice models predict a market capture rate for a specific mode based on its characteristics (such as fare, travel time and frequency) compared to those same characteristics for competing modes.

[12] NOAA navigation charts provide a useful approximation of navigation conditions in the context of a screening exercise. Further analysis, such as surveys, would be required for certain in individual locations considered for ferry service.

were highly varied by location, with some locations exhibiting slow growth while other locations (for example Long Island City North and North Williamsburg) saw nearly a doubling of their residential populations in a decade.

Figure 5.1: CFS2013 Study Sites



In addition to the sites from the 2010 study that were revisited, a number of new sites were taken into consideration. These added sites are listed in Table 5.1.

Table 5.1: New Sites Analyzed in the CFS2013

Locations		
Brooklyn Navy Yard, Brooklyn	Coney Island Creek, Brooklyn	Long Island City North, Queens
Valentino Pier, Red Hook, Brooklyn	Christopher St, Manhattan	Grand St, Manhattan
Astoria Cove, Queens	Beach 67th St, Queens	Beach 108th St, Queens
Beach 116th St, Queens	Port Richmond, Staten Island	St George, Staten Island
Glen Cove, Long Island	South Amboy, New Jersey	

Site Prioritization

The site profiles were used to guide the selection of sites for the first phase of ridership modeling. Information gained from various site visits was used to supplement the information contained in each site profile. The site visits yielded invaluable information in terms of understanding the physical area around the study sites. The visits and the site profiles allowed the study to assess several important factors for sites, including:

- **Ridership potential:** The study developed detailed assessments of both current commutation potential (using the various data described previously) as well as leisure ridership potential for sites. Leisure potential was determined for various waterfront attractions, including Four Freedoms Park on Roosevelt Island, Brooklyn Bridge Park and the proposed New York Wheel on Staten Island, based on existing visitation data or projections.
- **Proximity to competing existing transit service:** Several sites, such as Fordham Landing, are very near Metro North commuter rail stops. An analysis of comparative travel times and frequency in these instances revealed that passenger ferry service to Midtown or Lower Manhattan would not be expected to be competitive.
- **Physical limitations of the sites:** Physical limitations assessed included shallow water at the bulkhead that would require dredging. While these limitations can be overcome, the capital and environmental mitigation costs required to do so may be prohibitively high. Other physical considerations included passenger accessibility to the waterfront, navigational obstacles, and parking availability in areas with reliance on personal vehicles to reach a ferry landing.
- **Limited potential for network connectivity:** Glen Cove, Long Island and South Amboy, New Jersey have often been discussed as potential origins for ferry service to Manhattan. Both locations have had prior service and, in the case of Glen Cove, are currently completing extensive capital investments in ferry facilities. These sites are included because of the potential to leverage these sites to support longer distance ferry routes. However, both these locations would serve primarily non-

New York City residents, even if the services could be combined with stops at New York City locations on the way to Midtown or Lower Manhattan. There would be limited incentive for the operators of these services to consider stops within New York City given the additional travel time and operating costs involved in doing so.

Based on this multi-level assessment, the extensive list of 58 sites was reduced to 35 potential sites that were carried through to the first phase of ridership modeling. A list of the sites used in the first phase of modeling is shown in Figure 5.2.

The first phase of ridership modeling consisted of modeling the potential ridership between each of the selected sites to the key employment centers of Midtown and Lower Manhattan focusing on the weekday peak period. The ferry landings at Pier 11 and the World Financial Center (WFC) were used as lower Manhattan destinations, while Pier 79 and E 34th St were used at midtown destinations (east and west). These point-to-point forecasts helped the CFS2013 to identify the locations with the greatest potential to be combined into possible routes for the next phase of modeling.

Route Identification

The point-to-point ridership forecasts allowed the CFS2013 to rank the site pairs by the competitiveness of the ferry alternative, number of overall commuters to the destination and forecasted ferry ridership. The results of the point-to-point ridership forecasts were the basis for the definition of six routes, each incorporating several locations into a service to Midtown and/or Lower Manhattan[13].

In addition to weekday ridership projections, the CFS2013 also developed detailed estimates of vessel operating costs for each route. The ridership and operating costs were then used to develop revenue and subsidy estimates for each route under various fare and service frequency scenarios. Besides operating costs, the CFS2013 produced order-of-magnitude capital costs needs for each location included in a route that requires new ferry landing infrastructure.

[13] The CFS2013 developed a model for each of the six routes taking into account the effects of linking multiple sites together in a single route. When sites are combined in a route there are two distinct effects: First, operating costs per passenger will tend to be reduced as one vessel is serving multiple stops each with its own ridership base. On the other hand, the addition of stops along a route translates into increased time spent maneuvering into and away from the dock as well as time spent waiting for passengers to board or depart the ferry. The increase in travel time for users from most locations results in an inevitable decrease in ridership.

Figure 5.2: Summary of Ridership Modeling Process

Site Prioritization:
Site profiles
Sites:
City Island
Co-Op City
Ferry Point Park
Fordham Landing
Hunts Point
Orchard Beach
Riverdale
Roberto Clemente State Park
Soundview
Yankee Stadium
Bay Ridge
Brooklyn Army Terminal
Brooklyn Navy Yard
Coney Island Beach
Coney Island Creek
DUMBO/Fulton Ferry
Floyd Bennett Field
Greenpoint
North Williamsburg
Pier 6 - Brooklyn Bridge Park
Sheepshead Bay
South Williamsburg
Valentino Pier - Red Hook
Van Brunt St - Red Hook
Christopher St
Dyckman St
E 23rd St
E 34th St
E 62 St
E 71st St
E 90th St
Grand St
Pier 11/Wall Street
Pier 79
Roosevelt Island - North
Roosevelt Island - South
W 69th St
W 125th St
World Financial Center
Astoria Cove
Beach 67th St
Beach 108th St
Beach 116th St
Citi Field
Hallets Point
Jacob Riis Park
JFK International Airport
Long Island City - North
Long Island City - South
Camp St Edward
Port Richmond
Snug Harbor
St George
Stapleton
Tottenville
Governors Island
Glen Cove
South Amboy, NJ

⇨

Modeling Phase 1: Point-to-Point ridership forecasts produced
Sites:
Ferry Point Park
Soundview
Bay Ridge
Brooklyn Army Terminal
Brooklyn Navy Yard
Coney Island Beach
Coney Island Creek
Pier 6 - Brooklyn Bridge Park
Valentino Pier - Red Hook
Van Brunt St - Red Hook
Christopher St
Dyckman St
E 23rd St
E 34th St
E 62 St
E 90th St
Grand St
Pier 11/Wall Street
Pier 79
Roosevelt Island - North
Roosevelt Island - South
W 69th St
W 125th St
World Financial Center
Astoria Cove
Beach 67th St
Beach 108th St
Beach 116th St
Hallets Point
Long Island City - North
Camp St Edward
Port Richmond
St George
Stapleton
Governors Island

⇨

Modeling Phase 2: Route ridership forecasts produced and capital costs were developed
Sites:
Soundview
Bay Ridge
Brooklyn Army Terminal
Pier 6 - Brooklyn Bridge Park
Van Brunt St - Red Hook
E 23rd St
E 34th St
E 62 St
E 90th St
Grand St
Pier 11/Wall Street
Pier 79
Roosevelt Island - South
Astoria Cove
Beach 116th St
Long Island City - North
St George

Color Key:
Bronx - Red
Brooklyn - Blue
Manhattan - Orange
Queens - Green
Staten Island - Purple
Other - Black

Potential Future Waterfront Developments

The experience of the East River Ferry illustrates the degree to which waterfront residential and employment growth has increased the value of waterborne transit options[14]. New York City is currently seeing an unprecedented amount of waterfront growth and rebuilding in and around its numerous waterfront communities, aided in part by a widespread rezoning initiative by the City.

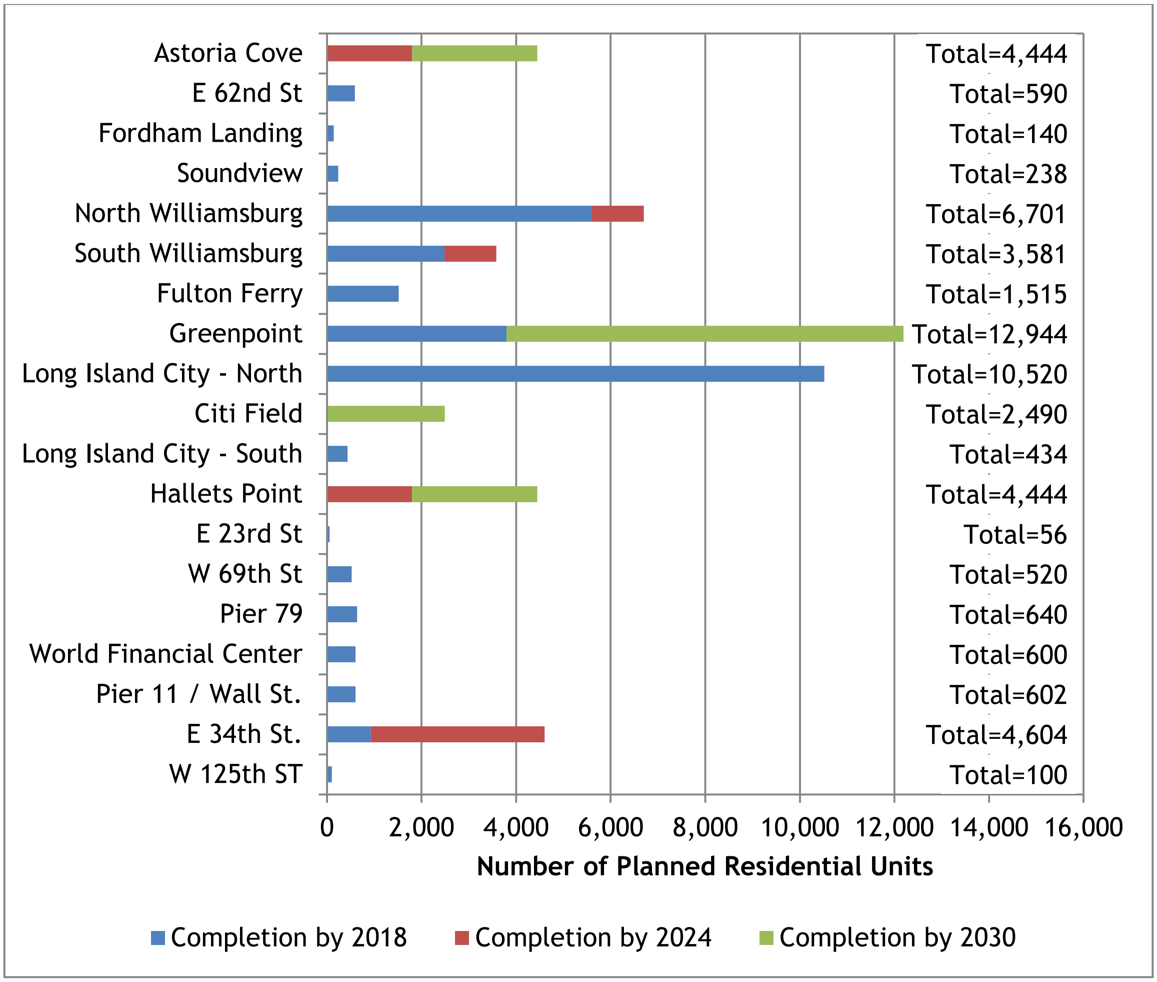
Given dynamic and fast-changing conditions on the waterfront, it was imperative to have precise and up-to-date data and forecasts of residential development to develop ridership forecasts. For many locations, such as Long Island City North or Astoria Cove, rapid growth meant that 2010 Census data was essentially obsolete and even misleading as a basis for ridership forecasting.

To address these shortcomings, the CFS2013 obtained development data compiled by the New York City Department of City Planning. These data outline all known recent, current and future developments within the catchment areas for each study site[15]. Figure 5.3 summarizes the planned residential development project within the catchment area of a study site.

[14] See New York City Economic Development Corporation, 2013, Ferry Policy and Planning in New York City: Considerations for a Five-Borough Ferry System. December, 2013.

[15] The CFS2013 produced ridership forecasts for two years, 2013 and 2018. The 2018 forecasts accounted for the number of residential units that projected to be built by 2018.

Figure 5.3: Planned Residential Units



Stakeholder Outreach

Similar to the CFS2010, the current study included an extensive stakeholder outreach component. As part of the current update, the CFS2013 conducted targeted briefings and interviews with the following stakeholders:

- City Council district members and staff
- Ferry operators

Motivations for the outreach were twofold: First, a public sector transportation initiative such as an expansion of passenger ferry service needs to elicit input from elected officials to best understand local needs and constituent concerns. Second, outreach to ferry operators is important to better understand opportunities and challenges stemming from factors such as operating costs, technology and evolving market conditions.

City Council Districts

Outreach briefings were hosted by borough for City Council Members and their representatives on October 29th and 30th, 2013. All council members whose districts include (or will include with the new 2014 district boundaries) ferry study sites and passenger catchment areas were invited.

The briefings included a discussion of findings from the prior study and lessons learned from the East River Ferry pilot. The goal of the briefings, however, was to collect information to inform the CFS2013. Specifically, the CFS2013 sought information on the following:

- Any density changes in the district?
- Any proposed or planned land use changes, e.g. industrial to residential?
- Any new commercial, residential or recreational projects that will impact demand?
- Any proposed or planned changes in nearby transit modes that will impact ferry ridership? For example, are there any new bus lines, increased service frequency or temporary station closures due to subway reconstruction projects in the district?

Feedback from City Council members and staff included:

- Information on new upcoming residential developments in various districts
- Connectivity needs between transit and ferry sites
- Need to evaluate uniform payment method, i.e., use of MetroCard for ferry rides
- New and/or expanded recreational opportunities that may enhance recreational ridership in the Bronx, Staten Island and Far Rockaway.

Additional information from this process directly related to potential ridership modeling is included in the individual site profiles in the full report. More qualitative feedback was used to inform policy perspectives in the report.

Ferry Operators

To provide updated operator information for the City, interviews were conducted with all current private providers of ferry service in New York Harbor. The providers interviewed include:

- Port Imperial Ferry Corporation
- Billybey Ferry Company
- New York Water Taxi
- Seastreak
- T.W.F.M. Ferry Company
- Statue Cruises, A Hornblower Company

To encourage candor, the operators’ comments are not directly attributed, and are therefore confidential., Operators were asked for their perspectives on the following topics:

- State of current service
- Opportunities for new services
- Emergency response and disaster recovery - lessons learned from Sandy
- Amenities to increase ridership
- Potential funding and/or management ideas

- General feedback for the City

The main issues identified are the following:

- The ferry industry needs a dedicated forum to discuss issues with public agencies and waterfront organizations. Current venues are ineffective for addressing operator concerns. For example, meetings with ferry operators are often combined with non-motorized boating groups
- Multiple agencies with jurisdiction over ferry operations and multiple landing owners are inefficient
- Fuel costs are a major concern, and operators are interested in solutions to refuel within New York (rather than New Jersey) without significant fuel tax implications. In addition to costs, there are concerns with the lack of refueling locations within New York City
- Under many current ferry service structures, operators feel that they take on the majority of risk while property owners benefit from the majority of rewards
- Longer-term contract opportunities are necessary to allow operators to finance the construction of new boats that may be required for expansion of service. In addition, public assistance to purchase vessels could be helpful
- Sometimes public financial support of ferries weakens the private industry, and the City should minimize subsidies in order to maintain the strength and sustainability of unsubsidized services. However, in other instances, a subsidy is needed when ferries are competing with other modes of transportation which are also subsidized
- Intermodal connections are important; opportunities to improve ferry service connectivity with buses should be pursued
- Amenities with potential to increase ridership include: improved weather protection through shelters, fare integration (MetroCard), and strong cellular networks to support operation
- Parking is an important consideration in certain areas where potential riders rely on personal vehicles and do not live within walking distance of a landing

6 Ridership Modeling and Analysis

Commuter and Leisure Models

Background

The ridership modeling for the CFS2013 relied extensively on an existing set of models developed recently for the PANYNJ[16]. The models are described in detail in APPENDIX II, and the key features of the models are the following:

- The models are forecasting tools that generate estimates of transit market capture for passenger ferry services at specific locations. The capture rate is based on the ferry service characteristics (such as fare, travel time and frequency) and the resulting attractiveness of the ferry option relative to the transit alternatives at that location.
- The models have been developed separately for subway users or express bus users. As mentioned previously, earlier research on ferry use in New York City suggests that ferry service to Midtown or downtown Manhattan will draw overwhelmingly from existing transit, hence the appropriateness of focusing exclusively on capture from transit in the modeling.
- Forecasts generated by the PANYNJ models are for weekday peak-period users, primarily commuters. Weekday off-peak usage is forecast separately using observed relationships for the East River Ferry, and weekend ridership can be forecast using a separate econometric model developed by the CFS2013 which ties weekend usage to weekday usage as well as a measure of the site's attractiveness as a weekend destination.
- The PANYNJ mode choice models are shown to predict ferry demand very well. A calibration exercise using East River Ferry data is described in APPENDIX II.

Model Development

Until the PANYNJ models were developed, there was a lack of understanding of the ferry passenger market in New York City. For this reason, a comprehensive stated preference (SP) survey was completed in 2010 to better understand the travel preferences of potential ferry riders originating in the New York City's five boroughs and to serve as the empirical basis for a predictive passenger ferry demand model.

The estimation of the two mode choice models is described in detail in the PANYNJ report, but the most salient facts are the following:

- The estimation was based on a large number of responses and produced a model with strong statistical significance.

[16] Halcrow, Inc., 2010. *Study of Regional Private Passenger Ferry Services in the New York Metropolitan Area: Interim Report 7 Stated Preference Survey and Ridership Forecasts for Potential Routes*. Report Submitted to the Port Authority of New York and New Jersey.

- As expected, the models predict that ferry ridership would decline with increases in fare, in-vessel time, wait time and access time. The model estimation also revealed a lower probability of choosing ferries for female respondents[17].
- Respondents also exhibited an inherent preference for the ferry mode over their current subway or express bus option. The preference for ferry is a measure of how much respondents would be willing to pay for a ferry option if all characteristics were equal to the current option. For subway users (who face a generally shorter commute) the willingness-to-pay for a ferry option was equal to $1.15; for express bus users (who typically face a longer commute) the valuation of the ferry option was $1.92)[18].
- The model coefficients have expected signs. For example, increasing ferry travel time relative to subway decreases the probability that patrons would adopt ferry as a mode of choice. Similarly, increases in fare or headway decreases the probability that ferry would be adopted as a mode of choice. Across most specifications the mode choice constant is positive, implying that ferries are preferred by users as a mode of travel compared to subway. In Model 1, the mode choice is negative and in Model 5, the mode constant is indistinguishable from zero; this is largely due to the integrated fare option being highly correlated with mode choice.

In initial applications, the Subway/Ferry Mode Choice Model was used to test demand for a then hypothetical ferry service between several locations (notably Williamsburg) and Pier 11 or 34th Street in Manhattan. The assumed characteristics were not identical to the current East River Ferry, but resulting ridership forecasts were comparable to current East River Ferry ridership, suggesting that the model would be a robust tool for forecasting ridership of proposed passenger ferry services in New York Harbor. A more complete validation exercise was carried out in the context of the current project based on actual East River Ferry characteristics and ridership results.

LaGuardia Airport Model

Background

A privately-operated ferry service to LaGuardia Airport operated from 1988 to 2000. This service, connecting ferry terminals at Pier 11 and East 34th Street in Manhattan with the Marine Air Terminal at LaGuardia Airport, was sponsored by Delta Airlines and was marketed as the “Delta Water Shuttle” to provide a connection to Delta’s flights to Washington D.C. and Boston. Since the service was sponsored solely to support flights leaving from the Marine Air Terminal (Terminal A), connections to other terminals were not marketed. In interviews with ferry operators familiar with the service, it was described as a “nice service”, “consistent” for customers, but one that

[17] An alternative formulation of the mode choice models also revealed that high-income users (with income over $100,000) were more likely to choose the ferry *all other factors being equal*, and respondents also were more likely to choose the ferry option if it were part of an integrated fare structure. These model formulations proved to have lower predictive power and were therefore abandoned in favor of model formulations incorporating only fare, headway, access time, and gender.

[18] Note that this preference is for a ferry service, which, as presented to respondents in the SP survey, is a premium service such as the East River Ferry.

"lost money" for the operator as well as for Delta, which provided a fuel subsidy for their sponsorship.

There was no public subsidy for this service. Fares at one point in time were $15 one way and $25 round trip and were reported to be up to $19 one way when the service was operated most recently by New York Waterway. Data from four years of ridership indicate the following patterns:

- Average daily ridership was 130 passenger trips per day.
- January was consistently the lowest month for ridership.
- June usually has the highest ridership.
- Daily highs were reported anecdotally as up to 200 per day.

In looking at what it may take to reactivate this service, it is worth examining what has changed to make the service a more attractive option since the prior ferry service ceased operations. There have been numerous developments to both ferry services as well as at LaGuardia Airport that may support the viability of a revived ferry service.

Model Development

The potential for ferry service to and from LaGuardia Airport from Manhattan's East Side was studied in 2006, and a mode choice model was developed by the PANYNJ for this purpose[19]. This model, which was made available to the CFS2013, relied heavily on customer satisfaction data provided by the PANYNJ that included additional information on how passengers accessed the airport. For the CFS2013, the econometric model from that prior study was updated with 2011 customer satisfaction survey data, and no SP surveys were conducted as part of this effort.

To develop a mode choice model, a probability model was developed whereby riders are presented choices from their origin to LaGuardia Airport based on time and cost combinations. Cost, access fares and distances were estimated using zip code-level trip origins, which were then used to supplement the data set.

Total market size of LaGuardia Airport is 25.7 million passengers/year. Of that, 50% of LaGuardia Airport users are destined to Manhattan, 10% are destined to Brooklyn, and the remainder of LaGuardia Airport users are dispersed throughout the region.

Ferry market potential was limited to LaGuardia Airport users who currently access the airport by taxis, car services, shared-van service (e.g. Super Shuttle), or public transit such as the MTA bus. All users that drive their own vehicles or are dropped-off by a non-commercial vehicle were excluded. All users carrying two or more bags are ruled out from potential ridership pool because of inconvenience of moving luggage to and from a ferry. A flow chart summarizes this process in Figure 1.4. More details on the modelling methodology are provided in the APPENDIX II to the full report.

[19] See The Louis Berger Group, 2006. *Ridership projections for Proposed LaGuardia - Manhattan Ferry Service*. Report submitted to the PANYNJ.

Citywide Ridership Modeling Results: Point-to-Point Service Potential for Commuter and Leisure Services

Point-to-point ferry service is unlikely to be viable in most cases within New York City, unlike services between New Jersey and New York City. The transit alternatives within New York City are more numerous, service frequency is high and fares are relatively low. As discussed in APPENDIX II, this transit competition will tend to restrict the market size (and demand high service frequencies) for any single ferry site, reducing the viability of most locations for point-to-point service.

The CFS2013 therefore forecasted point-to-point ridership primarily to identify station pairs that could potentially be served by a multiple stop ferry route. The analysis demonstrated significant variability in ridership demand between station pairs, and this preliminary ridership demand was the primary input in the design of routes.

In forecasting point-to-point ridership the CFS2013 developed input assumptions that would permit a balanced comparison between sites: the CFS2013 assumed 20-minute headways and $5 fare for ferry service between all station pairs.

As mentioned above the mode choice models are weekday peak-period models. Analysis of the East River Ferry ridership data revealed that AM peak ridership accounts for 30% of overall ridership, a relationship that is quite stable irrespective of the origin pier. Building off of this insight, the model divides AM peak ridership by 0.3 to produce a daily ridership estimate that takes into account intra-borough and return trips. In this way, the model does not require modeling of intra-borough station pairs, but rather only station pairs for which the destination is one of the four major Manhattan sites: East 34th St, Pier 11/Wall St, World Financial Center, and Pier 79/W 39th St.

For each station pair a calculation of potential demand was developed, which was based on an estimate of the existing journey-to-work movements between the origin and destination pairs. For the origin location, the ridership potential was usually drawn from relatively circumscribed market areas: a Primary Market Area (PMA) defined by a 1/4 mile radius from the ferry pier, and a Secondary Market Area (SMA) described by a radius extending from the 1/4 mile to a 1/2 mile boundary. On the destination side a similar "market" definition was used. For less dense locations, for example several on Staten Island, an Extended Market Area (EMA) was also incorporated to reflect the observed patterns of commutation involving private vehicles and feeder bus routes.

For each station pair the relevant costs (fare, travel time, headway, and access time) for both the proposed ferry service and the competing subway or express bus service were carefully calculated from a series of data and mapping sources. The mode choice models were then applied to calculate the market capture rate for ferries based on the relative attractiveness of the ferry option.

Table 6.1 shows the station pairs with at least 120 daily forecasted passenger trips, a benchmark minimum in previous studies, ranked by forecasted ridership. As mentioned, it is the relative attractiveness of the ferry option that determines the capture rate, and hence the capture rate will not necessarily decline with route distance. Further, a high capture rate will not necessarily ensure high forecasted ridership, and a low capture rate will not necessarily generate low ridership: It is the combination of capture rate and its application to various journey-to-work markets that together determine ridership.

To illustrate, Long Island City North to Pier 11 at Wall Street generates a capture rate of less than 9% despite the rapid travel time offered by the hypothetical service. The relatively low capture rate reflects the fact that Long Island City North has good subway connections, and even a two-seat ride to Lower Manhattan can be accomplished fairly quickly. However, the tremendous growth at Long Island City North mentioned previously means that the estimated daily commutation base to Lower Manhattan in 2018 will be well over 5,000 in the Primary Market Area and Secondary Market Area: Applying a 9% capture rate to this volume generates the highest peak period and daily ridership of any station pair.

Likewise, St George to East 34th St produces a high projected capture rate for the ferry as the alternative transit option to Midtown requires a two-seat ride involving the Staten Island Ferry and local subway. However, applying this high capture rate to the smaller observed commutation base yields ridership estimates that are far below those generated for Long Island City North.

Table 6.1: Forecasted Ridership by Station Pair

Origin	Destination	2018 Daily Trip Potential	Capture Rate	2018 Daily Forecasted Trips
Long Island City North	Pier 11 / Wall St	17,266	9%	1,542
Stapleton	Pier 11 / Wall St	4,750	29%	1,374
Port Richmond	Pier 11 / Wall St	7,806	9%	702
Soundview	Pier 11 / Wall St	2,638	22%	577
Brooklyn Army Terminal	Pier 11 / Wall St	15,086	4%	540
Coney Island Creek	Pier 11 / Wall St	1,313	34%	444
E 90th St	Pier 11 / Wall St	6,798	6%	424
St George	East 34th St	489	81%	397
E 23rd St	Pier 11 / Wall St	5,703	7%	386
Stapleton	East 34th St	611	58%	356
East 34th St	Pier 11 / Wall St	6,290	6%	348
Port Richmond	World Financial Center	2,477	14%	347
Beach 108th/116th St	Pier 11 / Wall St	2,048	17%	344
Stapleton	World Financial Center	1,403	23%	330
St George	Pier 11 / Wall St	2,870	11%	305
E 62nd St	Pier 11 / Wall St	4,686	6%	266
Coney Island Creek	World Financial Center	669	39%	263
Long Island City North	East 34th St	3,394	7%	244
Brooklyn Army Terminal	World Financial Center	5,931	4%	237
E 90th St	East 34th St	2,864	8%	216
Bay Ridge (69th St)	Pier 11 / Wall St	1,287	16%	208
E 62nd St	East 34th St	3,034	7%	199
E 23rd St	East 34th St	5,596	3%	185
Pier 6	Pier 11 / Wall St	3,042	6%	184
Port Richmond	East 34th St	793	23%	180
Roosevelt Island	Pier 11 / Wall St	1,125	13%	150
Brooklyn Army Terminal	East 34th St	3,111	5%	147
Beach 108th/116th St	East 34th St	701	20%	138

Several ferry sites stand out in their potential to attract significant ridership. Pier 11/Wall St is the most attractive destination, with East 34th St also attracting significant ridership. Amongst the origins, Long Island City North produces the most demand, as mentioned, due in part to the ambitious development projects to be completed there by 2018. Otherwise, there are promising ferry sites in all five boroughs with no particularly dominant region.

Ridership Results: Potential Commuter Service Corridors

Based on the point-to-point ridership results, and with the stated interest in the most promising routes incorporating all five boroughs, the CFS2013 developed six ferry routes. Also instrumental in the definition of the routes were important policy considerations:

- It was decided that ferry service that directly competed with the Staten Island Ferry would produce an inefficient and duplicative use of limited transit funding for commuter service. This meant that ferry service between St George and Lower Manhattan was eliminated from consideration
- Similarly, ferry service from Stapleton to Lower Manhattan would also draw ridership heavily from the Staten Island Ferry and therefore would not be considered in the context of the CFS2013 (though such a route could be considered at a later date with the realization of planned residential developments)
- Although Port Richmond resulted in relatively high point-to-point ridership estimates, these levels are insufficient to sustain a stand-alone service given the distances involved. As Port Richmond is difficult to link with other sites to add ridership and reduce per passenger operating costs, it is also not considered further in the CFS2013
- There was a concerted attempt to match some routes with lower overall ridership potential with others showing much higher potential. This is meant to permit the extension of ferry service as widely as possible, while maintaining the anticipated subsidy levels of any single route at sustainable levels. Higher ridership locations essentially support service to lower ridership locations, often at minimal added cost, and support opportunities for growth and accessibility in lower demand areas.

The CFS2013 modeled the proposed routes for 2013 and 2018, with low and high frequency schedules, at a $5.00 and revenue-maximizing (RevMax) fare (with the process for estimating the fare described below)[20]. Table 6.2 summarizes the scenarios modeled for 2018 to best reflect the effects of ongoing and planned residential and employment growth at the various sites.

[20] The choice of a $5 base fare reflected a desire for consistency with CFS2010.

Table 6.2: Summary of Modeled Ferry Services

Route	Stops	Low Frequency Headway	High Frequency Headway
1	Bay Ridge, Red Hook, Pier 6 - Brooklyn Bridge Park, Pier 11- Wall St	30 min (2 boats)	20 min (3 boats)
1b	Red Hook, Pier 6 – Brooklyn Bridge Park, Pier 11 – Wall St	35 min headway (1 boat)	NA
2	Astoria, Roosevelt Island, Long Island City North, East 34th St	24 min (2 boats)	16 min (3 boats)
2B	Astoria, Roosevelt Island, Long Island City North, East 34th St, and Pier 11	41 min (2 boats)	20 min (4 boats)
3	E 90th St, E 62nd St, Pier 11- Wall St	26 min (2 boats)	17 min (3 boats)
3B	Soundview, E 90th St, E 62nd St, Pier 11	44 min (2 boats)	29 min (3 boats)
3B - Select	Soundview, E 90th St, E 62nd St, Pier 11 – Wall St	89 min (Soundview)/19min (E 90th)	44 min (Soundview)/22min (E 90th)
4	East 34th St, East 23rd St, Grand St, Pier 11 – Wall St	27 min (2 boats)	18 min (3 boats)
4B	Long Island City North, East 34th St, East 23rd St, Grand St, Pier 11 – Wall St	34 min (2 boats)	22 min (3 boats)
5	St George, Pier 79	53 min (1 boat)	27 min (2 boats)
6	Rockaway Mid-Peninsula, Brooklyn Army Terminal, Pier 11 – Wall St	60 min (2 boats)	40 min (3 boats)

Ridership modeling clearly revealed that shorter headway scenarios resulted in higher ridership and revenues that more than compensated for the higher operating costs associated with operating more boats, requiring lower subsidies in all cases other than the LaGuardia Airport service. As a result, forecast results of the longer headway scenarios are omitted from discussion since they are always less preferable in terms of cost. Table 6.3 contains journey-to-work (referred to as JTW), capture rate and forecasted daily ridership for all routes at a $5.00 fare.

Table 6.3: 2018 Forecasted Ridership with $5.00 Fares

Route	Stops	Headway (minutes)	Daily JTW potential (passenger trips)	Capture rate	Daily passenger trips
1	Bay Ridge, Red Hook, Pier 6 - Brooklyn Bridge Park, Pier 11- Wall St	20	6,717	9%	388
1b	Bay Ridge, Red Hook, Pier 6, Pier 11	35	5,430	3%	112
2	Astoria, Roosevelt Island, Long Island City – North, East 34th St	16	4,669	16%	496
2B	Astoria, Roosevelt Island, Long Island City – North, East 34th St, and Pier 11	20	30,065	10%	1,902
3	E 90th St, E 62nd St, Pier 11	17	11,484	11%	857
3B	Soundview, E 90th St, E 62nd St, Pier 11	29	14,122	7%	658
3B - Select	Soundview E 90th St, E 62nd St, Pier 11	44 Soundview /22 other	14,122	8%	772
4	East 34th St, East 23rd S., Grand St, Pier 11	18	20,326	9%	1,149
4B	Long Island City – North, East 34th St, East 23rd St, Grand St, Pier 11	22	40,986	8%	2,071
5	St George, Pier 79	27	88	91%	75
6	Rockaway Mid-peninsula, Brooklyn Army Terminal, Pier 11	40	3,111	2%	146

Table 6.4 contains the capture rates and ridership forecasts with RevMax fares.

Table 6.4: 2018 Forecasted Ridership with RevMax Fares

Route	Stops	Headway	Daily JTW potential	Fare (USD 2013)	Capture rate	Daily trips
1	Bay Ridge, Red Hook, Pier 6 - Brooklyn Bridge Park, Pier 11- Wall St	20	6,717	$2.75	14%	939
1b	Bay Ridge, Red Hook, Pier 6, Pier 11	35	5,430	$2.50	6%	325
2	Astoria, Roosevelt Island, Long Island City – North, East 34th St	16	4,669	$2.75	25%	1,146
2B	Astoria, Roosevelt Island, Long Island City – North, East 34th St, and Pier 11	20	30,065	$2.75	16%	4,699
3	E 90th St, E 62nd St, Pier 11	17	11,484	$2.75	18%	2,073
3B	Soundview, E 90th St, E 62nd St, Pier 11	29	14,122	$2.75	11%	1,590
3B - Select	Soundview E 90th St, E 62nd St, Pier 11	44/22	14,122	$2.75	13%	1,855
4	East 34th St, East 23rd St, Grand St, Pier 11	18	20,326	$2.75	14%	2,853
4B	Long Island City – North, East 34th St, East 23rd St, Grand St, Pier 11	22	40,986	$2.50	14%	5,744
5[1]	St George, Pier 79	27	88	$5.50	6%[21]	843
6	Rockaway Mid-peninsula, Brooklyn Army Terminal, Pier 11	56	3,111	$2.50	31%	959

(1) Route 5 ridership results detailed above are mostly developed outside the mode choice models. Table 5.3 details commutation estimates only, but Route 5 is seen as primarily serving leisure purposes, namely visitors to the planned and approved New York Wheel and Empire State Outlets, and the reported ridership and capture reflect the ridership required (along with the commuter ridership) to ensure operating cost coverage from the farebox.

[21] 6% capture rate assumed for projected 2.4 million annual visitors traveling from Manhattan to St George.

The results of the route-based ridership forecasts eliminated a majority of scenarios from consideration. Routes 1, 1b, 2, 3, and 3B – Select proved to require increased subsidies over the other routes in Table 5.4, so they are not recommended. Route 5 ridership reported here is not a forecast of future commutation ridership alone. Rather, the route is primarily anticipated to serve visitation to the future New York Wheel and associated shopping destinations while reducing strains on the existing Staten Island Ferry service schedule. Forecasting this demand is extremely challenging given the preliminary nature of the visitation estimates and the inapplicability of the mode choice models to this very specific market. Given this constraint, the ridership for Route 5 is essentially an estimate of required ridership and New York Wheel visitation capture required to ensure service at financial break-even levels.

Route 3B was preferred over Route 3 even though the latter performs well in terms of required subsidies. The difference in the routes is the extension to Soundview, and it is felt that creating wider accessibility to the Bronx waterfront is an important policy consideration. Route 3B, as shown in Figure 6.1, serves areas of the Bronx, via Soundview, and Manhattan, via East 90th St and East 62nd St, that suffer from low connectivity. The Second Avenue Subway, currently under construction, will eventually provide superior connectivity for eastern Manhattan, but Soundview would likely benefit from ferry service for a longer period. Additionally, there is opportunity for connecting Bronx residents to hospital and other job centers in the Upper East Side. This route would require construction of two new ferry landings, approximately valued at $19.6 million in capital expenditures.

Figure 6.1: Route 3B

Table 6.5: Route 3B Detailed Ridership Forecast at $2.75 with 29 Minute Headways

Origin	Destination	Daily JTW potential	Capture rate	Daily forecasted trips
E 90th St	Pier 11 / Wall St	6,798	9%	606
E 62nd St	Pier 11 / Wall St	4,686	11%	514
Soundview	Pier 11 / Wall St	2,638	18%	470

Three new routes exhibit significant ridership and would require relatively little public support to operate: 2B, 4 and 4B. Route 4B, as shown in Figure 6.2, which connects Pier 11/Wall St to Long Island City North via Grand St, East 23rd St and East 34th St, is estimated to attract over 5,700 daily trips. With an unremarkable capture rate of 14%, the higher ridership forecast is mainly due to the addition of commuters in new developments in Long Island City North and their demand to reach Pier 11, making Route 4B an attractive option. This route would require construction of three new ferry landings, approximately valued at $20.5 million in capital expenditures.

Figure 6.2: Route 4B

Table 6.6: Route 4B Detailed Ridership Forecast at $2.75 with 22 Minute Headways

Origin	Destination	Daily JTW potential	Capture rate	Daily forecasted trips
E 23rd St	East 34th St	5,596	9%	497
Grand St	East 34th St	679	16%	109
Pier 11 / Wall St	East 34th St	431	7%	29
Long Island City North	East 34th St	3,394	19%	645
Long Island City North	Pier 11 / Wall St	17,266	15%	2,540
East 34th St	Pier 11 / Wall St	6,290	14%	865
E 23rd St	Pier 11 / Wall St	5,703	13%	744
Grand St	Pier 11 / Wall St	1,627	19%	314

Route 4, shown in Figure 6.3, does not serve Long Island City North, but has roughly half the journey-to-work potential as Route 4B. With the same capture rate, the model therefore forecasts half the ridership. Both Routes 4B and 2B provide access from Long Island City North to Pier 11. If only one route were to serve Long Island City North (preventing service overlap), Route 4B is more viable without Long Island City North than Route 2B. One benefit of Route 4 is that ridership, shown in Table 6.7, is distributed relatively evenly amongst station pairs, so the service is less likely to be limited by capacity. Route 4 would require construction of two new ferry landings, approximately valued at $13.9 million in capital expenditures.

Figure 6.3: Route 4

Table 6.7: Route 4 Detailed Ridership Forecast at $2.75 with 18 Minute Headways

Origin	Destination	Daily JTW potential	Capture rate	Daily forecasted trips
E 23rd St	East 34th St	5,596	10%	558
Grand St	East 34th St	679	18%	121
Pier 11 / Wall St	East 34th St	431	8%	33
East 34th St	Pier 11 / Wall St	6,290	15%	964
E 23rd St	Pier 11 / Wall St	5,703	15%	829
Grand St	Pier 11 / Wall St	1,627	21%	348

Route 2B, shown in Figure 6.4, serves Astoria, Roosevelt Island, Long Island City North, East 34th St, and Pier 11/Wall St, thereby connecting three rapidly growing sites with the two most attractive commuter destinations. Astoria and Long Island City North will gain tens of thousands of commuters by 2018 as a result of planned developments currently underway. Roosevelt Island will become both a destination and generator of commuter trips as Cornell University develops its applied science campus. This route would require construction of three new ferry landings, approximately valued at $22.7 million in capital expenditures.

Figure 6.4: Route 2B

As shown in Table 6.8, both Astoria and Roosevelt Island produce less ridership than Long Island City North despite robust capture rates, reflecting a lower base of potential riders[22].

[22] A downside to impressive ridership is the risk of reaching capacity on boats in operation, which would limit revenue and create costly delays for passengers. The CFS2013 analyzed recent East River Ferry ridership data, and discovered that ridership is far from evenly distributed throughout the peak period. The most crowded boat left at 8:20 AM and served 16.8% of all AM peak trips, compared to the 7:00 AM departure that served just 5.3% of all AM peak trips. Distributing the AM-peak ridership forecast according to this same boarding pattern revealed that both routes 2B and 4B would reach capacity after 7:40 AM with 149-passenger boats. The operator can mitigate the risk of reaching capacity in three ways: increase the fare to lower ridership, increase the frequency of service, or increase the capacity of the boats. Increasing

Table 6.8: Route 2B Detailed Ridership Forecast at $2.75 with 20 Minute Headways

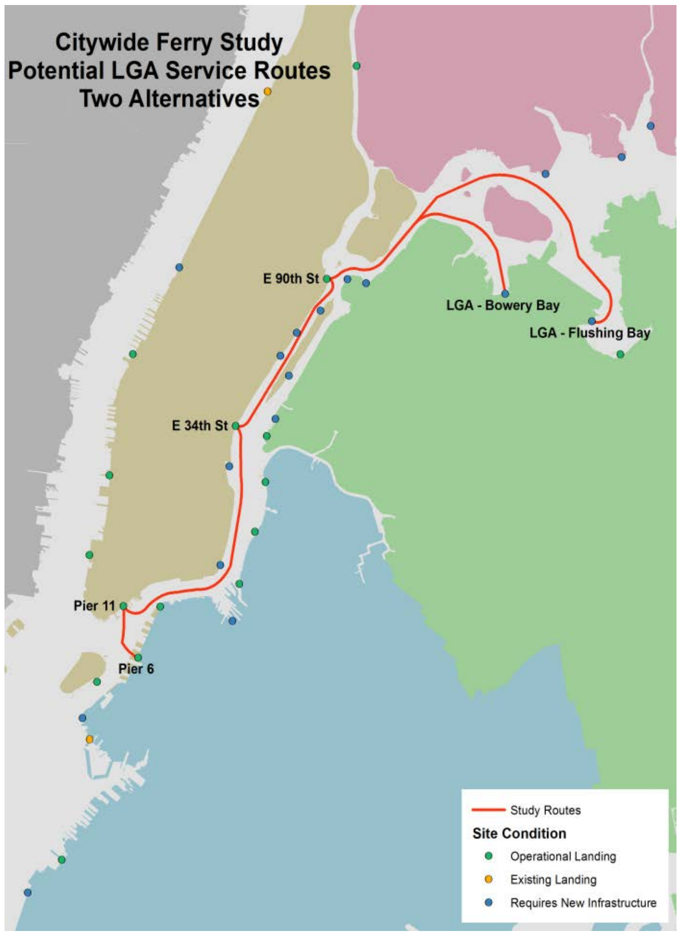
Origin	Destination	Daily JTW potential	Capture rate	Daily forecasted trips
Astoria	East 34th St	427	21%	90
Roosevelt Island	East 34th St	848	25%	214
Long Island City North	East 34th St	3,394	19%	649
Astoria	Pier 11 / Wall St	714	18%	128
Roosevelt Island	Pier 11 / Wall St	1,125	17%	192
Long Island City North	Pier 11 / Wall St	17,266	15%	2,556
East 34th St	Pier 11 / Wall St	6,290	14%	870

the fare lowers ridership and thus reduces the wider economic benefits of the service. Increasing the frequency of service can actually attract more ridership than the addition capacity, thus failing to resolve the issue. The CFS2013 forecasted 4-boat and 5-boat scenarios, and found that they still faced capacity issues and required higher subsidies per passenger. The best solution, therefore, is to expand the capacity of the boats. Retrofitting boats with new engines could increase their capacity, while also lowering operating expenses through use of more fuel-efficient propulsion systems.

Ridership Results: Potential LaGuardia Airport Service

Two potential ferry landing sites at LaGuardia Airport include one at Bowery Bay and the other at Flushing Bay. Potential ferry routes were developed to serve each airport ferry landing. The CFS2013 examined market potential from ferry sites at Pier 11 Wall Street, East 34th Street and East 90th Street – each site had previously had ferry services to LaGuardia.

Figure 6.5: LaGuardia Airport Service



In addition, a new site in Brooklyn was examined for potential ridership. A stop at Pier 6 in Brooklyn was added for analysis given its 15-minute walking access to the neighborhoods of Brooklyn Heights to the north and Cobble Hill to the south. Access to the site from Atlantic Avenue may also be efficient for drop offs from private vehicles as well as service from the MTA B63 bus.

North Williamsburg in Brooklyn was also considered. The analysis, however, did not show significant ridership at this location. This may result from the fact that the neighborhood still growing and the LaGuardia Airport survey sample size was not sufficiently robust. The low ridership may also be attributed to a relatively a short cab ride such that the ferry market is less competitive than other transportation options. North Williamsburg should not be ruled out for future LaGuardia service as its population grows.

The Queens waterfront was not analyzed. Given its proximity to LaGuardia Airport and highly competitive car service options to the airport, it was not considered a viable ferry airport market. For example, a taxi fare from Gantry State Park in Long Island City to LaGuardia Airport is estimated at $23 and may take only 16 minutes door-to-door. On a ferry, travel time from Gantry State Park would be greater than 15 minutes to the LaGuardia Airport ferry terminal and longer to the air terminals, and the fare modeled is $25.

The careful estimate of travel speeds is essential to the ridership forecasting exercise. To model travel times, a speed analysis was prepared for the route using the most cost-efficient speeds with the majority of the fleet available within the harbor. Travel speeds of 20 to 25 miles per hour were assumed for more cost-efficient operations. To maximize fuel efficiency, this is the predominant range of speeds for many of the current East River and Hudson River routes. While there are vessels that travel at higher speeds, this analysis focuses on examining what may be possible with the region's existing vessels. Vessels capable of traveling more than 30 MPH require much greater fuel usage and therefore have higher operating costs, and ultimately a higher ridership break-even threshold.

The tables below show modeled travel times from the airport to the following stops.

Bowery Bay Service

- 10. 7 miles, 55 minutes route time

LaGuardia Airport Bowery Bay	Depart
▪ East 90th Street	Arrive in 15 minutes
▪ East 34th Street	28 minutes
▪ Pier 11 Wall Street	44 minutes
▪ Pier 6 Brooklyn	51 minutes

Flushing Bay Service

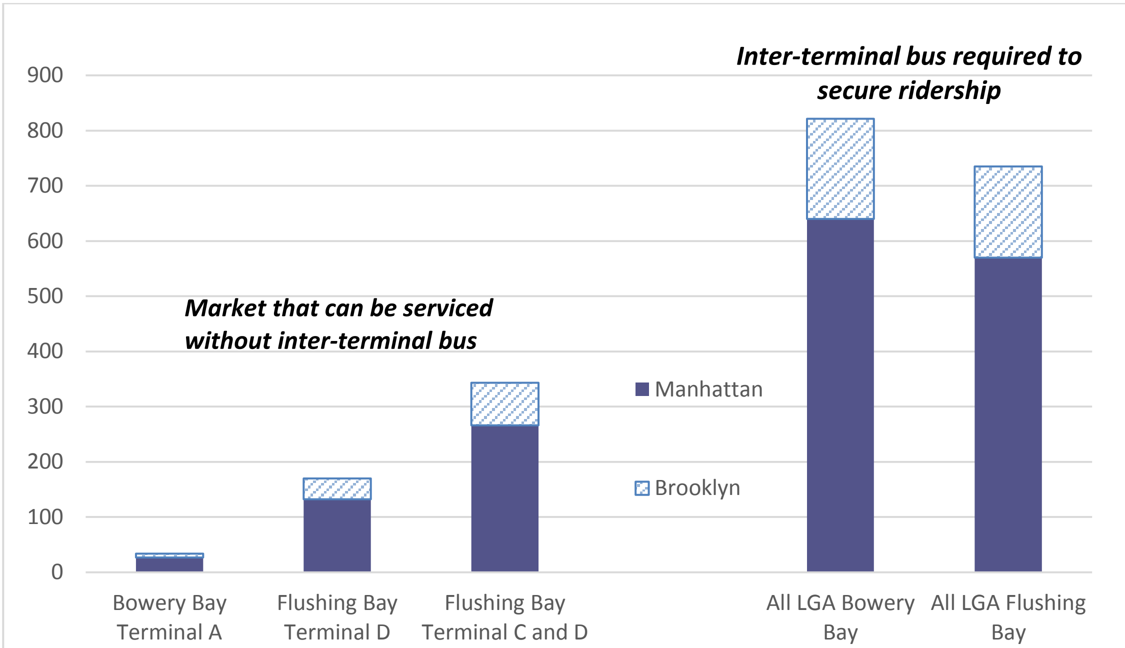
- 15 miles, 65 minutes route time

LaGuardia Airport Flushing Bay	Depart
▪ East 90th Street	Arrive in 27 minutes
▪ East 34th Street	40 minutes
▪ Pier 11 Wall Street	57 minutes
▪ Pier 6 Brooklyn	63 minutes

A ridership forecast was developed for a number of scenarios. Ridership for an hourly service to LaGuardia Airport at a cost of $25 was examined for both the Bowery Bay and the Flushing Bay sites. A fare of $25 was chosen for analysis as this fare level was raised by ferry operators as a possible market competitive fare. Taxi fare, for example, to Lower Manhattan's Wall Street is estimated to be $40 and for Grand Central Midtown, $30 (taxifarefinder.com).

The two landing destinations will generate different ridership estimates due to their travel times. As Flushing Bay is on the eastern portion of LaGuardia Airport, this landing site requires an additional thirteen minutes in travel time compared to a Bowery Bay landing. The longer travel duration is an important service consideration as it will compete with other modes based on time of travel, as well as cost. Once at the LaGuardia Airport, both sites also present different travel time from ferry to air terminal via an inter-terminal bus connection.

Figure 6.6: 2018 Forecast of Potential Daily Ferry Passengers by LaGuardia Airport Ferry Landing Location



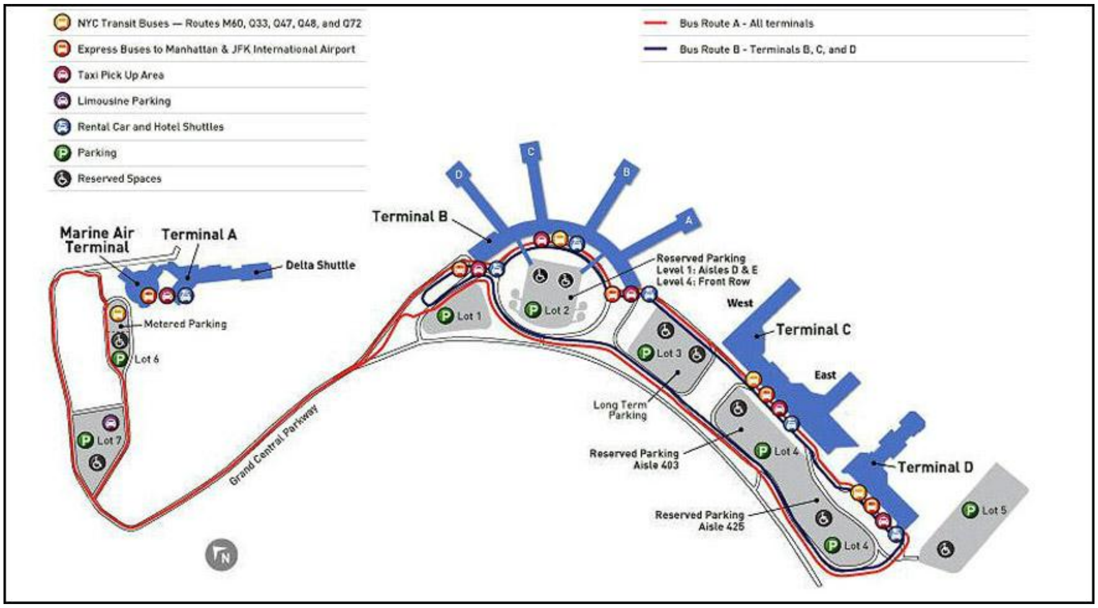
The above diagram shows that an intermodal connection is needed from ferry to the air terminal to sustain necessary ridership. A key finding is that the prior ferry service, while having a dedicated following, did not have sufficient reach to the rest of the LaGuardia Airport market apart from the Marine Air Terminal. The prior service was marketed solely as a Marine Air Terminal service and likely did not attract riders to other air terminals. Interviews and prior reports confirmed that there were few, if any, observed transfers from Terminal A to other terminals from the prior ferry service. However, ridership to Terminal A alone is not sufficient to cover the cost of providing that operation.

If a service were to be reactivated at Bowery Bay, without an efficient and seamless bus connection to the rest of the LaGuardia Airport market, the likelihood of success is low. Likewise, if a service at Flushing Bay were to be developed by Terminal D, without a connecting and seamless inter-terminal bus, that service would also likely have slim success margins. Moreover, even though Terminals C and D are now connected with a moveable walkway, and that market is within walking distance from a Flushing Bay Terminal, that combined market is still insufficient for a successful operation. Ridership to the remaining half of LaGuardia Airport at Terminal B, the Central Terminal Building, is needed for a ferry service to be viable.

In short, in order for a ferry service to work at LaGuardia Airport, an attractive and seamless intermodal connection to the air terminals is required. The connection bus may be as important to the success of the ferry as the waterside operation itself as riders will not deem themselves to have arrived at the airport until they get to their required air terminal, not the LaGuardia Airport ferry landing itself.

LaGuardia Airport currently operates two bus routes, one that connects all terminals, and another that connects all terminals except for Terminal A. See Figure 6.7 below.

Figure 6.7: LaGuardia Airport Bus Routes



Source: www.panynj.gov/airports/LaGuardia Airport-airport-map.html

The team examined the current bus routes and their capacity using data from the PANYNJ.

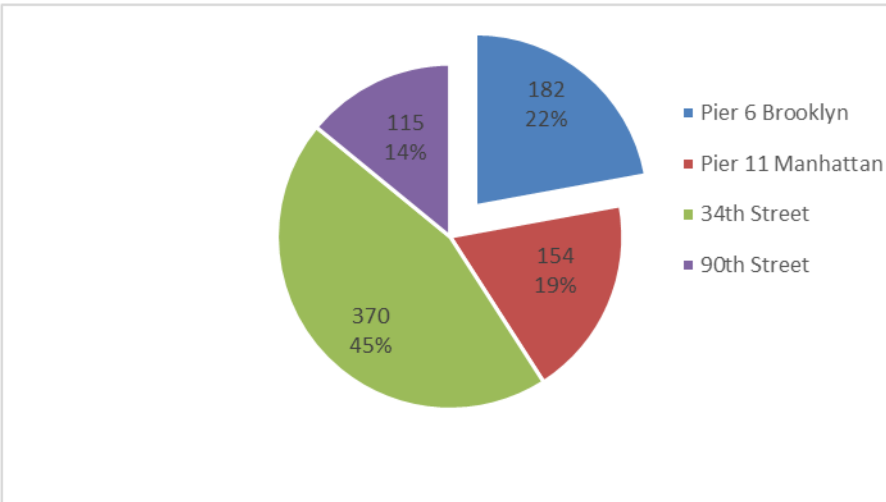
- Route A (Serves all terminals)
  - 2 buses run every 15 minutes with a 30 minute roundtrip
  - Average passengers per hour: 21
  - Capacity: 35-foot buses with seating capacity of 24 and 10-15 standing
  - Current Utilization: 17% (average daily passengers/daily seats)
- Route B (Serves terminals B, C, D)
  - 2 buses run every 10 minutes with a 15 minute roundtrip
  - Average passengers per hour: 45
  - Capacity: 35-foot buses with seating capacity of 24 and 10-15 standing
  - Current Utilization: 26% (average daily passengers/daily seats)

Both bus routes appear to operate with sufficient excess capacity to absorb the forecasted number of riders from a ferry service. Moreover, the current excess capacity will increase as plans are underway at LaGuardia Airport to shift to use of JFK's 40-foot buses, which have the larger seating capacity of 31 and standing capacity for 15-20 passengers.

Ferry riders will expect a bus to meet the ferry upon arrival. Also, if there are ways to ensure the consistency of the connecting bus ride to the air terminal, such as use of any non-public roads separated from the potential traffic of public drop-off and pick-ups areas that a taxi, car service or bus would be subjected to, its reliability would strengthen the overall service.

Forecast of daily riders by terminal stop is shown below with a caveat on the potential Brooklyn ridership. Of the percentages shown below, the Brooklyn forecast warrants additional analysis as the forecasted size of the potential market is not consistent with the actual proportional share of riders of current Manhattan and Brooklyn LaGuardia Airport users. Reasons for this potential forecast distortion may be due to the smaller size of the Brooklyn sample in the survey data as well as unknowns with existing latent preferences for existing modes for airport access. Car service plays a larger role in airport access in Brooklyn than in Manhattan. The team recommends further analysis with a stated preference survey to better gauge Brooklyn ridership.

Figure 6.8: 2018 Forecast of Daily Ferry Riders to Bowery Bay by Stop for Service every 30 Minutes



Estimating Revenue-Maximizing Fares

As discussed above revenue-maximizing fares play an important role in the analysis of the CFS2013. For the scenarios examined in the CFS2013, operating costs are nearly always constant in the fare scenarios tested, which means that revenue maximization is akin to subsidy minimization. Forecasting models were used extensively to calculate revenue-maximizing fare levels for all routes analyzed[23], and major findings included the following:

[23] The logit model has an important attribute that allows it to calculate revenue-maximizing fares for proposed ferry services. The logit model's structure is one where elasticities, such as fare elasticities, are non-constant, and will tend tend to increase with price. Demand elasticity measure are defined as % change in demand / % change in price, which will be a negative number since demand decreases as prices rise. As long as the elasticity is less than 1 in absolute value, increasing fares will increase revenues. Once the elasticity measure is greater than 1 in absolute value this is no longer the case, and fare is now at a level above the revenue maximizing fare level.

- Revenue-maximizing fare levels on the current East River Ferry route are estimated to be roughly at current levels, or $3.75.
- Revenue maximizing fares on the proposed new routes are generally lower, in the $2.75 range. St George to Pier 79 is a notable exception at $5.75.

Why the discrepancy between current and proposed routes? The answer is found in the following factors:

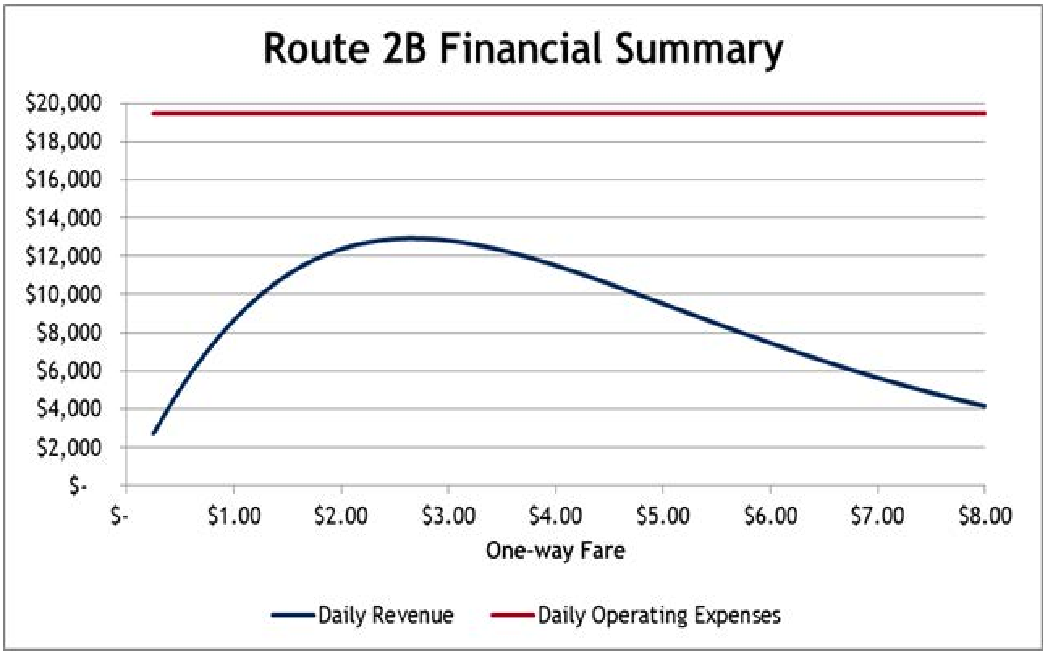
- Logit model demand elasticities incorporate all variables in the calculations, so the fare elasticity at a particular fare level will also be affected by other aspects of travel costs, such as travel time, headway, and access time.
- Fundamentally, *relative* travel cost (including travel time, wait time and access time) in comparison to the alternative mode will determine the response of ridership to a change in fare. In the routes modeled here there is a correlation between the total ferry travel cost and the relative travel cost in comparison to the transit alternative - with several notable exceptions - and ferry routes with higher absolute travel costs tend to be less competitive with the alternative mode. This in turn results in a greater ferry demand response to a given change in fare.
- The newly proposed East River Ferry routes tend to have higher ferry travel costs than existing East River Ferry locations: They are further from Pier 11 and 34th Street, and the average commuter in the relevant market area has a longer access time to the ferry. Most important, the relative advantage to the alternative mode is less than for current East River Ferry locations, leading to significantly lower capture rates[24].
- The lower capture rate is indicative of how the higher total travel costs for proposed routes results in a less competitive position for ferries relative to the alternative mode. A given fare increase for ferries will engender a greater reduction in demand than would be the case for a ferry route that is more competitive relative to the alternative mode. In other words, routes that have a low capture rate tend to be at a level where fare is elastic, and there is a potential for increasing revenues by decreasing fares.
- While travel costs for St George to Pier 79 are high, they are very competitive with the alternative transit option, resulting in both demand that is relatively inelastic and a revenue maximizing fare above the initial modeled level of $5.

In short, several factors are at play with revenue-maximizing fare levels. In general, the less competitive the ferry option relative to its alternative, the greater the proportional impact of a given fare change. If the resulting decrease in demand is greater, in percentage terms, than the revenue from a fare increase, then the revenue-maximizing fare has been exceeded. Further, routes with significantly different capture rates at a given fare level should be expected to display different revenue maximizing fares. Revenue-maximizing fares are highly dependent on the characteristics of alternate transit modes, including the competing fare level set on alternate modes.

[24] For example, ½ radius market capture rates for Williamsburg and Greenpoint locations are over 24%, while predicted capture rates for sites such as Pier 6 Brooklyn Bridge Park are closer to 5%.

Figure 5.8 illustrates the issues discussed above. The figure outlines the relationship between fare levels, daily revenues and operating costs for Route 2B (Astoria, Roosevelt Island South, Long Island City North, 34th Street, Pier 11/Wall St). As shown, the revenue maximizing fare is in the $2.75 to $3.00 range, at the point where the total revenue curve peaks. At $2.75 daily revenues are nearly $12,400, while operating costs (which are independent of fare levels) are $19,458 per day. In contrast, the $5 fare is estimated to yield revenues of $9,517 despite the much higher fare level, illustrating that at that level demand is highly elastic. Not surprisingly given the previous discussion, the market capture rate at $5 is relatively low at 6%.

Figure 6.9: Revenue-Maximizing Fare for Route 2B



7 Route Prioritization

Ridership, Operating Costs and Subsidies

Introduction

This section describes financial performance of the routes modeled and discussed in Section 6, Ridership Results: Potential Commuter Service Corridors. As reported in Figure 3.1, current subsidies for the East River Ferry average $2.21 per passenger, are above levels for subways, close to current levels for regular scheduled bus service and well below levels for commuter rail or express bus service.

The role of public subsidies in route prioritization is a prime public policy consideration. Operating subsidy funding is limited and must compete with competing transit initiatives. The discussion below addresses the CFS2013 team's findings with respect to operating costs, ridership and revenue and resulting operating subsidies under two different fare scenarios: A $5 fare and a revenue-maximizing fare that will vary somewhat by route.

Vessel Operating Cost Model

The CFS2013 team developed a vessel operating cost model as a crucial input into the analysis of financial viability of routes. This cost model includes only those costs directly associated with vessel operations, and does not include ancillary costs such as shuttle buses, terminal agents, or landing fees. These ancillary costs are calculated separately for inclusion in the overall system cost model.

The existing private ferry fleet and routes in New York Harbor were assessed to define typical vessel types that are likely to serve the new routes identified as part of this study. The vessels assessed range from small monohulls carrying less than 100 passengers cruising at less than 20 miles per hour to large catamarans carrying over 400 passengers at over 30 miles per hour. These vessels serve routes that vary in length from less than one mile to over 20 miles. From this analysis, five different vessel types were identified for the purposes of developing typical hourly operating costs. The general characteristics of these five types are listed in APPENDIX V: .

The CFS2013 included the following components of operating costs:

- Fuel costs
- Labor (including out-of-service labor)
- Maintenance (including hull maintenance and haul out)
- Lease or depreciation
- Insurance, administration, and overhead

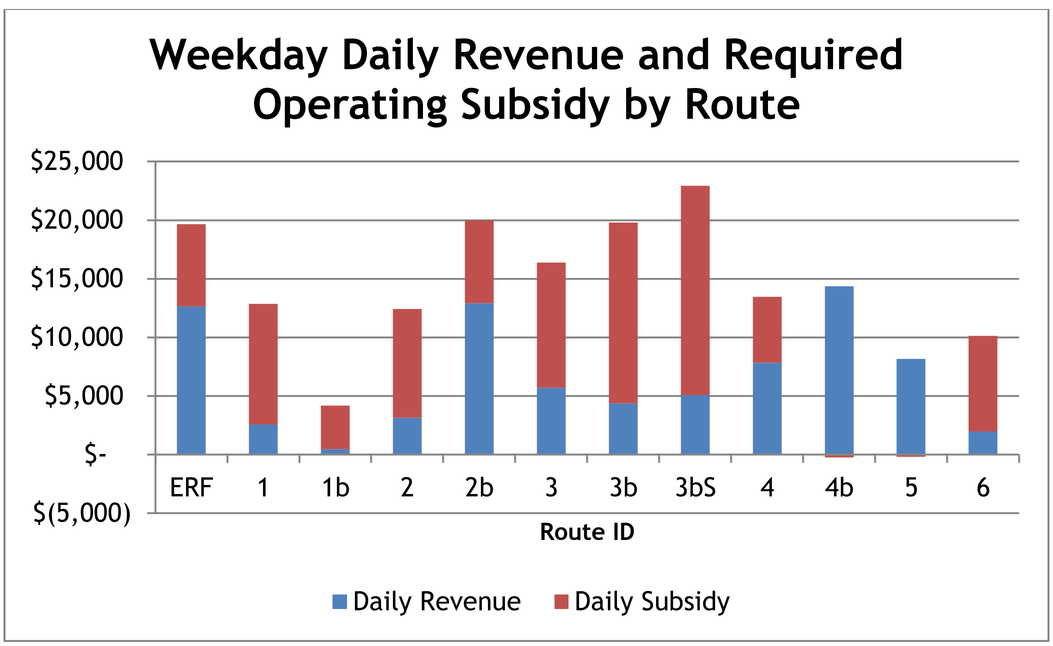
Based on the factors discussed above, typical hourly operating costs estimates were developed for the five vessel classes and typical route profiles defined previously. These estimates are intended to be used for initial route evaluations and comparisons only. When specific routes are identified, more refined annual operating costs estimates should be developed based on the planned operating schedule, anticipated annual ridership, and whether the new route will be operated by a new (small) organization or be part of a larger fleet. The typical hourly costs are provided in APPENDIX V: , and the operating models used costs for a Medium Catamaran operating at Medium speeds (Vessel Type E, $570 per hour) as the default operating scenario assumed in the CFS2013's analysis.

Revenues, Net Revenues and Subsidy Levels per Passenger for Commuter and Leisure Routes

As reported in the Section 6, all routes benefitted from extensive ridership modeling (with Route 5, St George to Pier 79, being analyzed in a separate manner given data constraints). An extensive analysis of operating costs, revenues and subsidies was carried out, revealing that of the new potential ferry service configurations, Routes 1, 1b, 2, 3, and 3B – Select (see page 37 for route descriptions) proved to require considerable subsidies and were not recommended for further consideration at the present time.

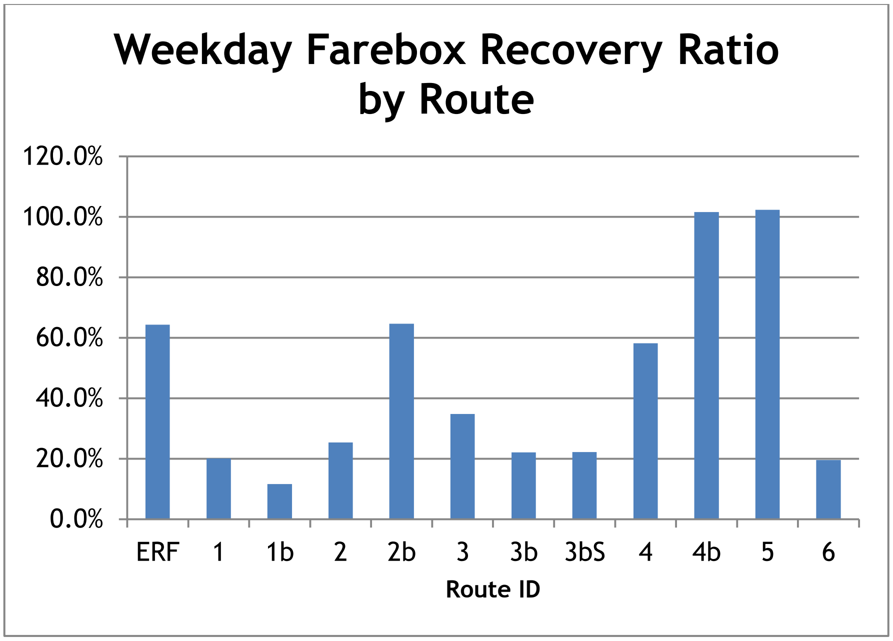
Summary financial outcomes for the routes are detailed in Figure 7.1 and Figure 7.2 below (operating costs only--capital costs are discussed separately below). The figures reflect outcomes under revenue maximizing fares in 2018 (typically in the $2.50 to $2.75 range). The choice of revenue maximizing fare will produce the optimal financial outcome expected, but even in this situation, scenarios such as Route 1 (Bay Ridge, Red Hook, Pier 6 - Brooklyn Bridge Park, Pier 11/Wall St) or Route 1b (Red Hook, Pier 6 – Brooklyn Bridge Park, Pier 11/Wall St) per passenger subsidy levels reach nearly $11 and $19, respectively.

Figure 7.1: Summary Financial Outcomes by Route: 2018 Weekday Revenue and Required Operating Subsidy Levels at Revenue Maximizing Fare



Note: Route outcome based on revenue maximizing fares except East River Ferry which reflects current daily revenues and subsidies

Figure 7.2: Summary Financial Outcomes by Route: 2018 Weekday Farebox Recovery at Revenue Maximizing Fare



Note: Route outcome based on revenue maximizing fares except East River Ferry, which reflects current daily revenues and subsidies

The preceding analysis led to the narrowing of routes to a group that includes

- Route 2B: Astoria, Roosevelt Island, Long Island City North, East 34th St, Pier 11
- Route 3B: Soundview, East 90th St, East 62nd St, Pier 11
- Route 4: East 34th St, East 23rd St, Grand St, Pier 11
- Route 4B: Long Island City North, East 34th St, East 23rd St, Grand St, Pier 11
- Route 5: St George, Pier 79

The tables below present more detailed financial outcomes for each, comparing outcomes under a $5 or revenue maximizing fare and headways typically close to those of the East River Ferry. As shown:

- **Route 2B** is one of the most successful routes, achieving nearly 65% farebox coverage of operating costs and per passenger subsidy levels close to those experienced by the East River Ferry. Route 2B operating costs are relatively high, reflecting the length of the route which extends to Astoria.
- **Route 3B** is the most successful route that incorporates service to the Bronx waterfront. Route 3B allows the bundling of Soundview service with stops at East 90th St and East 62nd St towards Pier 11, with the Upper East Side stops helping to defray per passenger operating costs. At revenue maximizing fares Soundview ridership is close to 250 daily weekday riders, and overall per passenger subsidies approach $10.
- **Route 4** produces significant ridership while also serving Grand St, a location characterized by more diverse income levels than many other waterfront locations.

Under $2.75 fares that maximize revenues Route 4 generates per passenger subsidies for a typical 2018 weekday below $2.

- **Route 4B** adds A Long Island City North stop to Route 4, greatly increasing potential ridership. Here farebox revenues cover operating costs under the revenue optimizing fare, and are below $2 at a $5 fare. However, Route 4B cannot be combined in an expansion including Route 2B as both serve Long Island City North demand to reach Pier 11.
- **Route 5** presents a different analysis than used for the preceding routes: The route, which would serve New York Wheel visitors as well as a small population of commuters, would achieve self-sufficiency at a $10 fare (with local commuters charged $5 through monthly or weekly passes) if 6% of New York Wheel visitors originating in Manhattan were attracted to the ferry service. Determining whether this outcome is realistic will require further study focused on projected New York Wheel visitors.

Table 7.1: Route 2B Revenue Analysis (Astoria, Roosevelt Island, Long Island City North, East 34th St, Pier 11)

	20 Minute Headway/$5 Fare	20 Minute Headway/$2.75 Fare**
2013 Daily Ridership	660	1620
2013 Daily Revenue	$3,300	$4,455
2018 Daily Ridership	1903	4700
2018 Daily Revenue	$9,517	$12,925
2018 Daily Operating Expenses	$19,976	$19,976
2018 Daily Net Revenue	-$10,460	-$7,051
2018 Farebox Coverage	47.6%	64.7%
2018 Subsidy / Passenger	$5.50	$2.50

*Note: **indicates fare is revenue maximizing fare*

Table 7.2: Route 3B Revenue Analysis (Soundview, East 90th St, East 62nd St, Pier 11)

	29 Minute Headway/$5 Fare	29 Minute Headway/$2.50 Fare**
2013 Daily Ridership	517	1427
2013 Daily Revenue	$2,583	$3,567
2018 Daily Ridership	660	1590
2018 Daily Revenue	$3,300	$4,373
2018 Daily Operating Expenses	$19,795	$19,795
2018 Daily Net Revenue	-$16,495	-$15,422
2018 Farebox Coverage	16.7%	22.1%
2018 Subsidy / Passenger	$24.99	$9.70

*Note: **indicates fare is revenue maximizing fare*

Table 7.3: Route 4 Revenue Analysis (East 34th St, East 23rd St, Grand St, Pier 11)

	18 Minute Headway/$5 Fare	18 Minute Headway/$2.75 Fare**
2013 Daily Ridership	970	1723
2013 Daily Revenue	$4,850	$4,308
2018 Daily Ridership	1150	1853
2018 Daily Revenue	$5,750	$5,097
2018 Daily Operating Expenses	$13,476	$22,933
2018 Daily Net Revenue	-$7,726	-$17,836
2018 Farebox Coverage	42.7%	22.2%
2018 Subsidy / Passenger	$6.72	$9.62

*Note: **indicates fare is revenue maximizing fare; Daily Operating Expenses differ by fare scenario as larger boats required for the $2.75 fare*

Table 7.4: Route 4B Revenue Analysis (Long Island City North, East 34th St, East 23rd St, Grand St, Pier 11)

	22 Minute Headway/$5 Fare	22 Minute Headway/$2.50 Fare**
2013 Daily Ridership	960	2670
2013 Daily Revenue	$4,800	$6,675
2018 Daily Ridership	2070	5743
2018 Daily Revenue	$10,350	$14,358
2018 Daily Operating Expenses	$14,130	$14,130
2018 Daily Net Revenue	-$3,780	$228
2018 Farebox Coverage	73.2%	101.6%
2018 Subsidy / Passenger	$1.83	- $0.04

*Note: **indicates fare is revenue maximizing fare*

Table 7.5: Route 5 Revenue Analysis (St George, Pier 79)

	60 Minute Headway/$5 Fare (commuter) or $10 Fare (other)
2018 Daily Ridership Commuter	53
2018 Daily Commuter Revenue	$267
2018 Daily Ridership Visitors (= 789 trips)***	395
2018 Daily Visitation Revenue	$7,890
2018 Daily Operating Expenses	$7,970
2018 Daily Net Revenue	$187
2018 Farebox Coverage	102%
2018 Subsidy / Passenger	-$0.05

*Note: **indicates fare is revenue maximizing fare*

******Ridership by visitors assumes a 6% capture rate of visitors originating in Manhattan***

Revenues, Net Revenues and Subsidy Levels per Passenger for LaGuardia Airport Service

In serving LaGuardia Airport by ferry, an hourly service and a service every 30 minutes have been discussed over the years. The prior defunct ferry service to LaGuardia Airport was an hourly service. A service every half hour has been proposed in the past but never implemented. Two vessels would be needed to provide an hourly service. To provide a more attractive service every 30 minutes, four vessels would be needed. This makes a service every half hour twice the operational cost of an hourly service.

The prior Delta Water Shuttle, at one time during its 12-year run, operated on a split schedule with a morning service of 6am to 10am and an afternoon service of 3pm to 7pm. This schedule was likely timed with the Delta shuttle service, which had a morning peak and afternoon peak for a Washington D.C. - New York City – Boston travel market. However, in attempting to serve the whole LaGuardia Airport market which offers 1,000 daily landings and take-offs to destinations nationwide as well as Canada and the Caribbean, there are not the same morning and afternoon peaks. Therefore, an analysis for a split service is not presented below.

For a consecutive12-hour operation, conclusions from the farebox recovery analysis are:

- For both scenarios, the Bowery Bay landing alternative is the less expensive to operate.
- Ridership for Bowery Bay is also more robust compared to Flushing Bay given the shorter ferry travel times.
- For an hourly service, which requires two vessels, routes to either Bowery Bay or Flushing Bay may achieve sufficient ridership to be self-sustaining without operating subsidies.
- Anticipated revenues from service every 30-minutes, which requires four vessels, would be insufficient towards covering operational costs and would require a subsidy.

The analysis does not incorporate an added cost for the required inter-terminal bus connection as there is an existing inter-terminal bus system in place that has capacity to accommodate added ridership from a ferry mode. However, that system would need to be modified to meet the ferry upon arrival and be sufficiently reliable to be attractive to riders.

Table 7.6: Farebox Recovery for 2-Vessel Operating Scenario at fare of $25

2 vessels for hourly service	Bowery Bay 55 min headway	Flushing Bay 65 min headway
Daily Ridership	626	574
Daily Revenue	$15,650	$14,350
Daily Operating Expense	$12,649	$12,859
Daily Net Revenue	$3,000	$1,491
Farebox Coverage	124%	116%
Subsidy / Passenger	0	0

Table 7.7: Farebox Recovery for 4-Vessel Operating Scenario at fare of $25

4 vessels for service every half hour	Bowery Bay 28 min headway	Flushing Bay 33 min headway
Daily Ridership	729	652
Daily Revenue	$18,225	$16,300
Daily Operating Expense	$25,299	$25,718
Daily Net Revenue	-$7,074	-$9,418
Farebox Coverage	72%	63%
Estimated Subsidy / Passenger	$9.70	$14.44

For a service that does not break even, there are a number of areas where the public sector may provide support if the service provides a public benefit, such as reduced congestion on crowded highways accessing LaGuardia Airport.

- Operating assistance
  - Direct subsidy - East River Ferry model

    - Operating agreement - MTA model for Ossining-Haverstraw ferry service where MTA commissions service for a defined period
    - Fuel – Delta Water Shuttle model where Delta provided fuel subsidy for sponsorship

- Non-operating assistance
    - Marketing – Unlike marketing commuter service to a targeted, local audience, the airport access market is broader and would require more extensive marketing efforts and reach to raise awareness that such a service exists. Operators have noted that the City's extensive marketing efforts by NYCEDC and NYC & Company, which included the placement of street banners on major thorough fares, generated significant awareness of the East River Ferry pilot and contributed to its success. Identifying ferry terminals and their routes and connections on widely-used transportation resources, such as the MTA Subway Map, would help raise awareness of a LaGuardia Airport ferry, as well as other long-term ferry services.

Staffing of LaGuardia Airport ferry terminal site – The ferry terminal site should be staffed with personnel to answer questions from passengers, similar to the staffing of the platforms at the AirTrain terminals at JFK, and to assist in coordinating the ferry-bus connection.

Capital Costs

In order to accurately assess the viability of a ferry route, capital costs must be taken into account. The useful life associated with ferry landing infrastructure is generally 25 to 30 years, allowing for cost amortization over a similar time period. The CFS2013 team produced planning level estimates for the construction of the needed infrastructure improvements for study sites that were incorporated into each proposed route. The estimates for new infrastructure include upland amenities which encompass shelters, benches, bike racks and ticketing machines. The estimates all plan for a two-slip barge, however if a site is located at the terminus of a route a single-slip barge may be used. Table 7.8 contains a summary of capital costs for each proposed site that needs infrastructure improvements and is included in a modeled route.

Table 7.8: Summary Capital Costs

Route	Site Name	Project Cost
1/1B	Van Brunt Street – Red Hook	$5.6M
1	Bay Ridge	$6.2M
2/2B	Astoria Cove	$7.68M
2/2B	Roosevelt Island South	$8.6M
2/2B	Long Island City North	$6.6M
3/3B	Soundview	$10.8M
3/3B	E 62nd Street	$8.8M
4/4B	E 23rd Street	$7.3M
4/4B	Grand Street	$6.7M
5	St George	$6.1M
6	Beach 108th/116th Street	$6.3M

The detailed estimates produced by the CFS2013 will be included in the final CFS2013 report. The estimates often include a new pier at sites with an existing pier or bulkhead. This was done for a few reasons.

- To allow placing the float at an acceptable location due to site constraints.
- To provide space for queued ferry riders such that adjacent landside uses are not impacted.
- To bridge across, or locate the gangway away from existing shore protection (riprap).

The estimates also show dredging at a few sites that may require it due to existing water depths. It could well be that it is not required, which can be confirmed with a bathymetric survey. It is also possible that dredging may not present serious permitting issues if the site was already permitted for a deeper dredge depth in the past and has merely silted in from lack of use in more recent years.

In addition to the infrastructure costs, as mentioned previously, improvements to vessel capacity are needed for route 2B to perform optimally. The two ways to increase vessel capacity are to procure larger vessels or to reconfigure existing vessels for higher passenger capacity. In order to accommodate the capacity demands on route 2B while maintaining 20 minute headways, at least one of the vessel capacities would need to be increased. The most cost effective way to do this is through vessel reconfiguration.

The medium catamarans with 149 passenger capacity make up most of the ferry fleet that operates in New York. The four engines on the vessels can be replaced with two Tier 2 IMP/EPA compliant engines. The engines upgrades allow the vessels to be reconfigured to increase the passenger capacity to 240. When combined with changes to the propulsion system, converting from jet engines to props, the changes reduce the vessel's emissions, increase fuel efficiency, reduce overall noise levels and increase the useful life of the vessels by at least five years. The cost to reconfigure each vessel is approximately $700k, however operators generally do a full overhaul of a vessel while it is undergoing modifications. The full cost to retrofit a vessel when including the cost to do a full overhaul is approximately $1M. This is significantly lower than the costs to procure new high capacity vessel which range between $3.5M and $5M.

Table 7.9: Summary Characteristics of Priority Routes

Route	Annual Weekday Subsidy Requirement ($ Millions)	Capital Cost Requirements ($ Millions)	Peak Period Vessel Requirements
Route 2B: Astoria, Roosevelt Island, Long Island City North, East 34th St, Pier 11 / Wall St	$2.7	$23.0	4
Route 3B: Soundview, East 90th St, East 62nd St, Pier 11 / Wall St	$4.3	$20.0	3
Route 4: East 34th St, East 23rd St, Grand St, Pier 11 / Wall St	$2.0	$14.0	3
Route 4B: Long Island City North, East 34th St, East 23rd St, Grand St, Pier 11 / Wall St	$1.0	$14.0	3
Route 5: St George, Pier 79	0	$6.1	1

Funding Potential: Private Sector

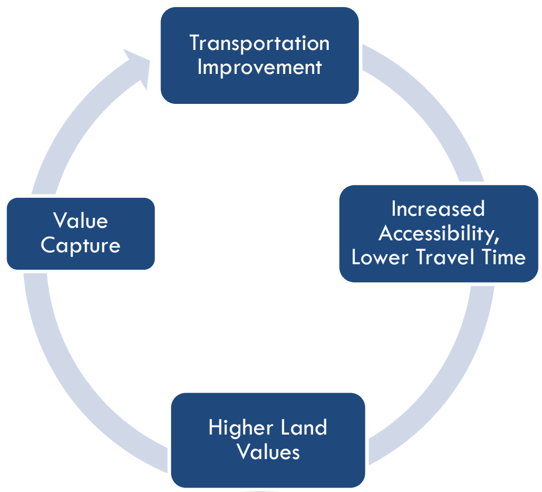
Introduction

Expanding passenger ferry service within New York City will require both capital and operating funds that will not be generated from fare revenues. The CFS2013 examined the potential for generating funding from private sector partners. The findings are summarized here and detailed in the Final Report.

The Concept of Value Capture

Ferry service improves the accessibility of waterfront land, creating value for users, landowners, and developers. For example, the CFS2013 found that the East River Ferry improved home values within 0.25 miles of a ferry landing (see Section 4 and

APPENDIX I: for further detail). As such, there is an opportunity to capture the value created for residents and business that stand to benefit from expanded ferry service to help fund ferry investment and operations. Four value capture mechanisms – negotiation exactions, special assessment districts, tax increment financing, and development bonuses – are available for use with ferry service in New York City.



Value Capture Mechanisms

Developer Contribution: Developers can directly deliver or fund new ferry infrastructure and/or service. The flexibility of developer contribution and the lack of a lengthy legal process for implementation make this value capture mechanism appealing. Increased development costs to support ferries may discourage development, and participating developers may insist on locating ferry stops on or adjacent to their property, though other locations may better serve the neighborhood.

Special Assessment Districts: Special assessment districts generate funds from a special tax placed on property owners and/or businesses within a formally defined area. Business Improvement Districts (BIDs), a type of special assessment district, have been used extensively in New York City to fund maintenance, security, district promotion, amenities, and, rarely, transportation. BIDs can provide an ongoing funding source well-suited for operational funding. However, the BID creation process is time- and resource-intensive, requiring significant upfront investment, buy-in from property owners and businesses, and City approvals. Funding of ferry service using Special Assessment Districts in New York City will inevitably compete against other district priorities, potentially limiting available resources.

Tax Increment Financing: Tax increment financing (TIF) allocates new, incremental property tax revenues in a designated area to fund improvement projects that will benefit property values in that area. Future taxes beyond a baseline amount are allocated towards a special purpose entity and can be used to fund or finance transportation improvements or operations. Tax increment financing is authorized by state legislation in New York, but has been challenging to implement in New York City under this statute; a potentially more viable alternative is to utilize payments in lieu of taxes (PILOTs) and allocate these PILOTs towards a special purpose entity that can raise funds from dedicated PILOT payments. An example is the Hudson Yards District where PILOTs from new development are allocated to the Hudson Yards Investment Corporation to repay bonds that were issued to finance the extension of the subway. Bond proceeds from TIF can provide immediately available funds for ferry investment, while tax allocations can provide ongoing proceeds suited for operational investment. However, establishing a TIF or PILOT financing district requires Office of Management and Budget (OMB) and/or City Council approval, and raising funds from TIF proceeds is dependent on investor confidence in the ongoing revenue stream.

Development Bonuses: Development bonuses allow a developer to build additional density in exchange for funding of new transit improvements. In addition to providing funding or in-kind contributions for ferry service, bonuses can create higher densities, thus increasing potential demand for ferry operation. However, bonuses are effective primarily in core markets where the additional floor area has value, and will not be applicable where bonus floor area cannot be absorbed by the market. Development bonuses to fund ferry improvements would require a zoning change, subject to the City's Uniform Land Use Review Procedure (ULURP). Similar to negotiating exactions with developers, using development bonus proceeds for ferry service could lead to developer pressure to site landings in non-ideal locations. In any case of developer-led investment in ferry infrastructure, standards for ferry landing construction and maintenance should be defined and enforced by a City agency.

Other Mechanisms: Other value capture mechanisms include joint development and air rights development, but they are unlikely to be applicable in the case of ferry investment. Joint development requires the unique case of private real estate development of publicly owned land. Unlike subway and train stops, ferry landings rarely include significant air rights. Additional mechanisms include development impact fees and a transportation utility fee, but they would require a change in City and/or State legislation, and thus face limited applicability to the case of value capture for ferry service in New York City.

Value Capture Mechanism	Capital or Operations	City Action Required	Application
Developer Contribution	Capital or Operations (via lockboxing of funds)	Negotiations with developer	Project-level
Special Assessment Districts	Operations	NYC Small Business Services coordination with local organizers; City Council approval	District-level
Tax Increment Financing	Capital or Operations (via lockboxing of funds)	Creation of special purpose entity; OMB and/or City Council approval for allocation of PILOT revenue	District-level
Development Bonus	Capital or Operations (via lockboxing of funds)	Assessment of appropriate price or service provision; ULURP approval	Project-level or District-level

8 Conclusions and Next Steps

The CFS2013 involved an extensive analysis of potential opportunities to expand passenger ferry service in New York City. Starting with over 50 potential sites, the CFS2013 identified the following as the most promising new routes:

- Route 2B: Astoria, Roosevelt Island, Long Island City North, East 34th St, Pier 11/Wall St
- Route 3B: Soundview, East 90th St, East 62nd St, Pier 11/Wall St
- Route 4: East 34th St, East 23rd St, Grand St, Pier 11/Wall St
- Route 4B: Long Island City North, East 34th St, East 23rd St, Grand St, Pier 11/Wall Street
- Route 5: St George, Pier 79
- LaGuardia Airport Service

The ridership potential of these routes is considerable: At a fare of $5, routes 2B, 3B, 4 together could achieve daily ridership close to that seen by the current East River Ferry.

However, the new routes tend to be longer and more expensive to operate, while mostly serving locations whose densities are less than those on the East River Ferry: With the exception of Route 4B, all are estimated to require operating subsidies per passenger above those of the East River Ferry.

Several of the locations also require considerable capital investments, as described in the report. In short, the study has focused on identifying the most promising potential routes, but these routes require considerable capital and operating subsidies: An extended network including the East River Ferry, Route 2B, Route 3B and Route 4 would be estimated to require an annual subsidy for weekday service of close to $10 million.

Extending service to the Bronx entails challenges due to the distances involved and the generally modest ridership generated. The subsidy levels mentioned above are immediately reduced by 40% if Route 3B (which includes service to Soundview) is not included in a service expansion.

The next steps in the development of an expanded ferry network include:

Pursue revenue enhancing fares: The extensive ridership modeling in the CFS2013 suggested that, while the East River Ferry may well be operating at a revenue maximizing fare, optimal fares could be lower for most other potential routes. Based on the ridership modeling, charging a uniform lower fare in the $3 range for a broader ferry network including multiple routes would be essentially revenue neutral in comparison to the $5 fare, while potentially generating ridership close to double that under the $5 fare. Keeping in mind the uncertainty attached to any ridership modeling, the characteristics of the potential new routes do lend credence to this finding. The potential benefits in terms of accessibility would suggest that at the very least the potential for ferry network expansion at a lower uniform fare should be further explored.

Develop value capture mechanisms: the study carefully estimated the real estate benefits of the East River Ferry and found them to be considerable, as both economic theory and the experience of numerous other transit systems would suggest. As described in the report, there is no single value capture mechanism that can be easily applied without some challenges, but the potential benefits in terms of increasing available funding for passenger ferry services make it imperative to identify and pursue potential value capture strategies.

Ultimately, the information and analysis contained in this preliminary report are provided as a planning tool for elected decision-makers, private ferry operators, and stakeholders at large. As demand for ferries continues to increase and New York City's relationship with its waterfront evolves, it is important to pursue thoughtful planning solutions to identify opportunities to fill transit gaps through waterborne transportation.

9 APPENDIX I: REAL ESTATE DEVELOPMENT INPACT OF THE EAST RIVER FERRY

Economic Development Impacts - Executive Summary

This study provides the first estimate of the impact of the East River Ferry service on house values and real estate development. The research draws on the considerable experience modeling the impacts of amenities, including public transit, on real estate outcomes, and follows methodologies consistent with the broad literature. The following summarizes the key results:

- Property values within 1/8 mile of the closest ferry stop increased by 8.0%,
- For all residential properties within one mile of a ferry stop, the ferry service increased property values by $0.5 billion;

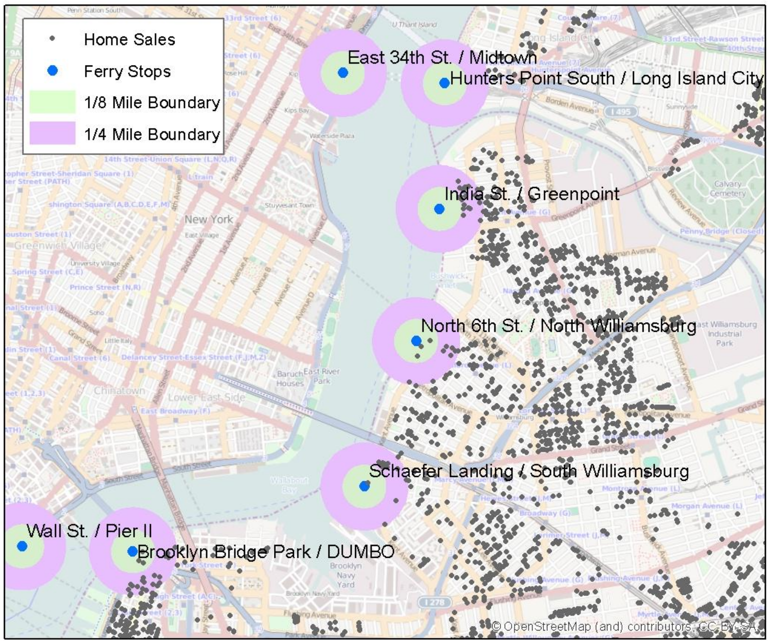
The higher real estate values also coincided with an increase in residential and commercial building space of over 600,000 square feet, a 4.9% increase of space within 1/4 mile. This includes:

- An increase in the nearby supply of residential housing by 487,238 square feet, or over 7%; and
- An increase in the supply of retail space within ¼ mile by over 20,000 square feet, or 4.2%.

Since its opening in 2011, demand for New York City's East River Ferry has exceeded expectations. The service provides a way for residents of Brooklyn and Queens to access Manhattan, and is for many a faster and more pleasant mode of transportation than other available options. The popularity of the ferry illustrates a strong demand for this service and suggests the high value that households place on it. Economic theory predicts that this higher demand for ferry service should lead to higher residential prices and rents as homes with access to ferry stops now come bundled with the amenity of access to the ferry network. Furthermore, the increase in real estate prices should spur new residential development by increasing the value of building new properties relative to development costs, which on the margin should spur new residential development.

The CFS2013 focuses on residential real estate prices rather than the prices of commercial real estate leases due to the long-term nature of commercial leases, which would make the data relatively sparse and price changes occur at a slow pace that would be difficult to measure. Using publically available data on housing transactions and following well-established methods for determining the real estate impacts of transit services, the CFS2013 team estimated the impact of the new ferry services on house prices and rates of real estate development. The data set contains a sufficiently large sample of 8,827 condo sales that are within two miles of the closest ferry stop between 2003 and 2012. Figure 9.1 below shows the home sales data along with the East River Ferry stops:

Figure 9.1: New York City Home Sales and Ferry Stops



The CFS2013 finds that the ferry service has a positive and statistically significant impact on house prices. The regression analysis shows that, after controlling for pre-existing conditions and building quality, value of being close to a ferry stop increased after November 2010, and therefore the introduction of the ferry has a positive amenity value Specifically, the ferry service increased the value of homes that were 1/8 mile away by 4.2%, and 2.1% for homes 1/4 mile away. The impact falls to less than 1% for homes a mile or more away. Impacts within this walking distance area are consistent with a survey performed on over 1,300 East River Ferry riders, in which over 75% of ferry riders reported that they walk to and from the ferry at either end of the trip.

These results imply that the ferry service has increased the average value of a house within one mile of the ferry by over 1.2%, and has increased residential value by roughly one half billion dollars in aggregate. Within 1/8 mile the average impact is 8.0%, which is consistent with the results found in the wider literature on the impact of public transit on house prices.

Table 9.1: Property Value Impact by distance from Ferry Stop

Distance (miles)					
From	To	Total Value (millions)	% Impact	$ Impact (millions)	Cumulative Impact (millions)
0.000	0.125	$ 1,298	8.0%	$ 92	$ 92
0.125	0.250	$ 2,872	2.5%	$ 74	$ 166
0.250	0.375	$ 6,249	1.6%	$ 98	$ 264
0.375	0.500	$ 5,557	1.1%	$ 63	$ 327
0.500	0.625	$ 5,117	0.9%	$ 47	$ 374
0.625	0.750	$ 7,897	0.7%	$ 56	$ 431
0.750	0.875	$ 5,204	0.6%	$ 32	$ 463
0.875	1.000	$ 5,468	0.5%	$ 29	$ 492

Overall, the East River Ferry Service increased house values by nearly half a billion dollars in the Brooklyn and Queens areas of New York City. The largest impact, of over $90 million, was in the immediate 1/8 mile vicinity.

Our analysis also confirms that the ferry service has a positive impact on the pace of development. The results from the construction impact analysis are consistent with the impact on prices: for most measures, there was a statistically and economically significant impact on development in the immediate area, and a declining impact at farther distances. The analysis controls for other factors that may affect development by looking at changes in the pace of development at the block level prior to the ferry service compared to the pace of development in those same blocks after the ferry service. This makes the results more robust by accounting for pre-existing differences between areas near the ferry and those farther away. Table 9.2 below shows the amount of new developments within 1/4 mile that can be attributed to the East River Ferry service. The largest impact was on residential development, which increased by nearly 350 additional residential units and 487,238 residential square feet.

Table 9.2: Change in Construction from Having East River Ferry Stop within a Quarter Mile

Type	Stock In 2009	Additive Square Footage	Percent Increase
Buildings	732	9	1.2%
Residential Units	6,051	350	5.8%
Building Area	12,300,000	608,615	4.9%
Commercial Area	5,466,094	183,963	3.4%
Office Area	953,887	948	0.1%
Retail Area	485,488	20,284	4.2%
Residential Area	6,745,500	487,238	7.2%

The East River Ferry and Economic Development

A crucial feature of urban economic models is that the demand for real estate in a particular area is, in part, a function of the transportation access in that area. Easy transportation in and out of a neighborhood lowers the travel time cost for households to live in the neighborhood and work elsewhere. In addition, it lowers the cost for consumers to travel into the neighborhood to shop, thus facilitating the supply of local retail and jobs that serves as an additional amenity. Finally, it reduces the cost of locating in that area for businesses that require the movement of employees to and from the office.

Additionally, the value of the East River Ferry can be seen in its impact on travel times. Table 9.3 below shows the travel time going from residential areas in neighborhoods near ferry stops to Broad Street and Wall Street in Manhattan Downtown Central Business District. The two times reported are for using ferry travel and using the next best public transportation option. The results illustrate that the time spent in transit is lower using the ferry, saving travelers between 3 and 14 minutes one-way.

Table 9.3: Travel Time between Neighborhoods and the New York Stock Exchange (minutes)

	LIC	Greenpoint	N. Wbrg	S. Wbrg	DUMBO
Ferry	32	27	22	17	12
Pub Trans	35	41	31	31	17
Time Savings	3	14	9	14	5

In addition to saving time, anecdotal evidence suggests a perceived quality difference, with the ferry being a more pleasant trip than the subway. The service allows for an open air ride, or a seat inside, and also offers a view of the city.[25] A 2012 rider survey showed that 85% of riders are local residents, and two-thirds use the ferry to commute to and from work, which suggests the value of the service is not just as a novelty for tourists, but as a neighborhood amenity for residents.

The desirability of the ferry service is backed up by empirical evidence as well. The CFS2013 team's research involving a mode choice model developed for the Port Authority shows that, even after statistically controlling for fare and travel time considerations, travelers have an inherent preference for using the ferry over the subway.

The popularity of the East River Ferry illustrates a strong demand for this service and the high value that households place on it. Economic theory predicts that this higher demand should lead to higher house prices and rents as houses with access to ferry stops now come bundled with the amenity of access to these stations. These higher prices then increase the value of building new properties relative to development costs, which on the margin should spur new residential development.

Economic theory therefore provides two testable predictions about the East River Ferry: (1) that house prices near the ferry stops should increase after the introduction of the ferry, and (2) new construction near the ferry stops should increase as well.

[25] http://www.dnainfo.com/new-york/20121227/long-island-city/east-river-ferry-service-stay-afloat-through-2019

Previous Research

Public transportation can bring a variety of benefits to the communities they provide access to, including lower congestion, decreased travel time, lower fuel consumption, fewer traffic accidents, and expanded labor markets for employers and employees. Despite the range of possible outcomes that can be measured, the majority of public transit impact studies have focused on property values. One reason for this focus is that some of the beneficial improvements in other outcomes should be reflected in increased property values. Therefore property values can serve as a lower bound summary measure for overall improvement in a neighborhood's desirability arising from a disparate range of benefits.

While there is extensive research on the impact of public transportation, such as fixed rail, on real estate outcomes, there are no empirical studies examining the impact of ferry service. However, there are commonalities across public transportation impact studies that provide guidance on the general approach and magnitude of likely impacts for ferries.

Within the broad literature on public transportation's impact on real estate outcomes, examples can be found of studies showing positive, negative, and insignificant results, although the preponderance of evidence suggests a positive impact. Some overall conclusions can be drawn from the large body of literature.

- A recent meta-analysis of studies on the effects of railway stations on property values looked at 75 estimates from a variety of studies and found an average impact on residential prices within a quarter mile of 8.1% (Debrezion et al, 2007). The estimated standard deviation of 0.263 confirms the large degree of variation in estimated impacts. For residential properties the effect is typically lower than for commercial, with the former averaging 4.6% and the latter at 19.1%.
- Another summary of the literature on public transit impacts from Fogarty et. al (2008) reports a range of impacts for single-family homes from 2% to 32%, and 2% to 18% for condominiums. In addition, the meta-analysis of Debrezion et. al (2007) showed that the effects varied by type of railway station. Table 4 below shows the average estimated impact from the sampled studies on real estate prices within a quarter mile of each station. The impacts range from a low of 1.7% for bus rapid transit (BRT) to a high of 18.7% for commuter rail transit (CRT).
- In addition to a higher simple mean of estimated impacts, the meta-analysis suggests that after controlling for other study characteristics, CRT transit has a statistically significantly larger impact than other types.

Table 9.4: Average Price Impact of Transit Stations by Type

Station type	Average Impact
Light Rail Transit	7.1%
Heavy Rail Transit	2.1%
Commuter Rail Transit	18.7%
Bus Rapid Transit	1.7%

Source: Debrezion et al, 2007

While there is variation in the specifics of the models used, the most common econometric approach in the literature is hedonic regression. This is a statistical technique that models the prices for a good as a function of that good's characteristics. In studies of public transportation's impact on housing the hedonic model estimated is usually specified using the logarithm of house sale prices as the dependent variable, while the independent variables are physical and geographic characteristics of the sold property. For example, square footage of a building and the number of bedrooms are common physical characteristics used in these studies, and the Census Tract or zip codes are common geographic variables. The impact of public transportation is captured by including measures of transit access as independent variables. In a fixed-rail study, for example, this might include a variable indicating whether a house was within 1/8 mile of a station stop.

While most studies share the broad econometric approach of hedonic analysis, there is variation in how access to public transportation is measured. The meta-analysis of Debrenzion reports that a dummy variable indicating whether a property is within 1/4 mile of a station stop is a prominent measure. Other measures include linear distance, log-linear distance, and other discrete distance categorical variables. Fogarty et al (2008) lists five studies that use distances of 500 feet or less as categorical access variables. Garrett (2004) measures access to the St. Louis light rail system as being within 100 feet. At the other end of the spectrum, Fogarty lists four studies that define access to a transit stop using a distance of ½ of a mile.

In general, several conclusions can be drawn from the literature.

- The property impacts of public transportation typically range from the single digit percentages to the mid-teens.
- The most common empirical approach taken in the literature is the use of hedonic regression that measures the log of property sale prices as a function of building and neighborhood characteristics and a measure of transit access.
- The independent variable measuring transit access can either be a continuous distance measure or a discrete measure of distance ranging from as little as 100 feet to up to a ½ of a mile.

Econometric Analysis

To test the theories that the East River Ferry increased house values and real estate development, publicly available data from several sources was used. Data on property sales comes from the New York City Department of Finance ACRIS system. These data are matched to property characteristics from the NYC Department of City Planning's Public Land Use Tax Lot Output (PLUTO) dataset and their Public Address Directory (PAD) dataset, including geographic information.[26] The resulting dataset contains information on the sale date, sale price, and property characteristics for owner-occupied homes in Brooklyn and Queens, the areas of New York City identified as most likely to be impacted. The analysis includes arms-length residential sales of units in condominium buildings.[27] To estimate the value of East River Ferry service, the distance is measured between each home sale and the closest ferry stop. The sample was restricted to observations within two miles of the closest ferry stop, thereby excluding portions of New York City in order to maximize sample heterogeneity but retain enough observations to retain sufficient statistical power to test the hypothesis. The resulting sample size is 9,015 sales between 2003 and 2012.

A simple analytical approach would be to include this distance measure as an independent variable in the hedonic model to capture the value of being close to a ferry stop on house prices. The following equation illustrates this simple model:

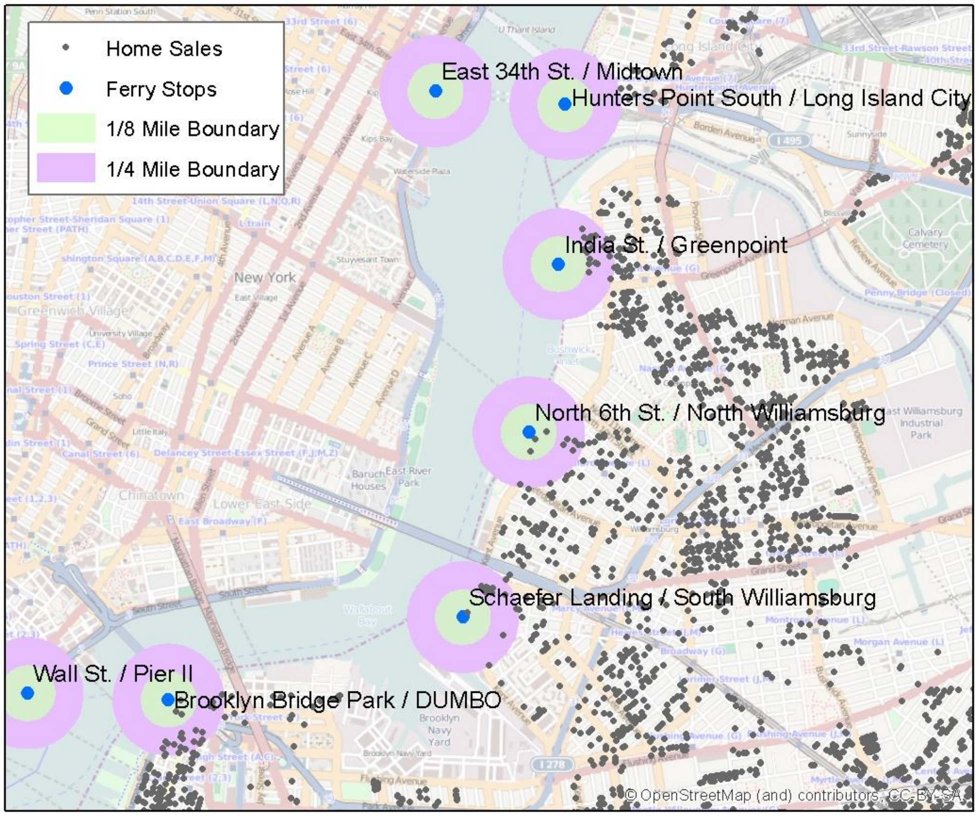
$$\ln(Y_i) = f(X_i) + \beta_1 \frac{1}{D_i} + \varepsilon_i$$

Where Y_i is the price of housing unit i, X_i is a vector of property characteristics for unit i, $\varepsilon_i$is an error term, and D_i represents the distance between unit i and the closest ferry stop. In this formula, if the estimated coefficient β_1 has a positive coefficient in the regression it would suggest that those housing units farther away from the ferry have lower prices, all else equal, and therefore that being near a ferry stop has a positive impact on prices. This implies that ferries are a positive amenity, and β_1 indicates the marginal value of being closer to a ferry strop.

[26] PLUTO and PAD datasets are available at the NYC Department of City Planning's website. http://www.nyc.gov/html/dcp/html/bytes/applbyte.shtml

[27] Sales with prices less than $5,000 were dropped from the analysis. In addition, the analysis does not include any unit that includes commercial square footage.

Figure 9.2: New York City Home Sales and Ferry Stops



However, it may be the case that for reasons that are not captured in the model, higher quality homes simply happen to be built closer to the ferry stop, and that a positive coefficient on this variable would be due to these omitted quality variables. To control for this, two measures are used in the regression: distance to closest ferry stop D_i, and distance to closest ferry stop interacted with a dummy I_{POST} that is equal to one if the house sale is in the post-Ferry period, e.g. the sale occurred after the ferry was formally announced on November, 2010, and equal to zero otherwise. While the existence of a ferry service was under discussion for throughout the mid-2000s, the most plausible date after which prices are likely to be impacted is November, 2010 when the service was formally announced.

$$\ln(Y_i) = f(X_i) + \beta_1 D_i + \beta_2 \frac{1}{D_i} I_{POST} + \varepsilon_i$$

The β_2 coefficient then represents the change in the amenity/disamenity of being near a ferry stop location after the ferry was announced. By including both the distance measure and the distance measure interacted with a post-ferry dummy, the omitted variable effects of being located near a ferry stop are controlled for with D_i and the causal effect of the ferry is captured by the interaction $D_i I_{POST}$.

Despite controlling for omitted variables using the distance and distance interacted with the post-period dummy, there is a possibility that homes with higher unmeasured quality sold relatively closer to the ferry in the post-period than in the pre-period. This would bias upward the estimate of the impact of ferry service on home prices. As an additional robustness test, a building level fixed effects estimation can be used. This uses a dummy variable for every borough, block, and lot combination in the dataset. The fixed effect therefore controls for the average quality of units within a condo building. To allow estimation of the fixed effects, only units or buildings with five or more sales in the dataset are used, which reduces the sample size to 8,827 sales.

Table 5 below provides the results of the regression analysis. The positive and statistically significant coefficient of $\beta_2$suggest in both OLS and fixed-effects regressions that the value of being close to a ferry stop increased after November 2010, and therefore the introduction of the ferry has a positive amenity value. Specifically, the fixed-effect coefficient estimate of .005 suggests that ferry service increased the value of homes 1/8 mile away by 4.2%, and 2.1% for homes a quarter of a mile away. The impact falls further to less than 1% for homes a mile or more away.

Table 9.5: Property Value Impacts by Distance, Regression Results

		Base Model	**Fixed-Effects**
β_1: Miles from closest ferry	Coeff.	0.006	N/A
	P-Value	0.000	N/A
β_2: Miles from closest ferry x Post ferry dummy	Coeff.	0.004	0.005
	P-Value	0.039	0.026
Adj. R-squared		0.310	0.501
Sample size		9,015	8,827
Impact on 1/8 mile properties		3.1%	4.2%
Impact on 1/4 mile properties		1.5%	2.1%
Impact on 1/2 mile properties		0.8%	1.1%
Impact on 1 mile properties		0.4%	0.5%

These impacts are within the range found in the literature of public transportation's effects on property values. The ferry estimates are below the average impact of 8.1% reported Debrezion et al, (2007), however this represents the impact on properties that are exactly 1/8 mile away and not the average impact within 1/8 mile. The average impact will depend on the distribution of housing within the 1/8 mile boundary.

Robustness Test

A robustness test and alternative econometric analysis can be used that follows the existing literature by utilizing a hedonic regression that models the log of house prices as a function of building characteristics. The variables used in the regression model to "explain" house prices include the following:

- number of floors in the building;
- quarter sold;
- dummy indicating if the building is a walkup or elevator type condo unit,;
- geographic controls (latitude and longitude);
- recent alteration dummy;
- zip code dummies; and
- property tax exemption amount.

Number of floors enters the regression both linearly and in square and cubic terms, and the geographic controls enter linear and in square terms, to allow for non-linear impacts on prices.

Finally, to ensure that distance from closest ferry is not picking up the amenity value of distance from the waterfront, the distance between each home sale and the closest point on the water front is also calculated and included in the regression as an independent variable.

A difference-in-difference approach was then utilized to control for pre-existing differences in prices for homes near a ferry stop. The base model is then defined as:

$$\ln(Y_i) = f(X_i) + \beta_1 I_{FERRY} + \beta_2 I_{POST} + \varepsilon_i$$

The difference-in-difference estimation is captured using a dummy variable I_{FERRY} equal to one if the sale occurs within 1/8 mile of a ferry stop, and another dummy variable I_{POST} equal to one if the sale occurs within 1/8 mile of a ferry stop and in the post-Ferry period. This difference-in-difference approach examines whether the relative difference between prices within the affected area and the control area changed after the ferry service began. This type of estimate thereby accounts for pre-existing differences in the areas with ferry service.

The base model was estimated using ordinarly least squares results. The results in Table 6 suggest that being within 1/8 mile of a ferry stop in any time period has been associated with a higher sales price of 14.1% overall. In the period since the announcement of the East River Ferry service, the effect of being within a ferry stop has been an additional 11.5% higher price.

As shown in Table 9.6 below, the fixed-effect model suggests a statistically significant impact of 13.5% impact of the ferry service on prices within 1/8 mile. Given the large degree of freedom loss from the estimation of building level fixed effects, the statistically significant coefficient with a value close to the baseline difference-in-difference estimate represents strong evidence in favor of a positive impact on prices.

Table 9.6: Regression Results

		Base Model	Fixed Effect
Within 1/8 mile of ferry stop	Coeff.	0.141	N/A
	P-Value	0.000	N/A
Within 1/8 mile of ferry stop X effected period	Coeff.	0.115	0.135
	P-Value	0.004	0.006
Adj. R-squared		0.31	0.50
Sample size		9,015	8,827

The impact of 13.5% is within the 2% to 18% range of transit impacts reported in Fogarty et al (2008), and within one standard deviation of the average 8.1% impact reported by Debrezion et al (2007).

However, to the extent that this estimate is larger than expected given the prior availability of subway and bus transit in the area is explainable by the use of a 1/8 mile dummy rather than the 1/4 mile average more commonly used. Repeating the fixed-effects regressions using 1/4 mile produces a 6% impact with a marginally statistically significant p-value of 9%.[28] This estimate is below the 8.1% quarter mile average reported by Debrezion et al (2007) and would be consistent with a marginal increase in transit availability.

Econometric Summary

Overall, the results suggest that the ferry service has had a positive impact on the value of nearby housing units. Within 1/8 mile, the data suggests an impact between 4.2% and 13.5%. The combined fixed-effects and difference-in-difference approaches likely control for a large amount of unobserved quality differences. Fixed effects controls for unobserved overall building quality, and difference-in-difference controls for unmeasured quality differences between those within the 1/8 mile area and those outside it. However, it may be the case that areas falling within 1/8 mile benefitted from coincidental improvements in market conditions, which would bias the coefficient upward. One challenge in relying on the 1/8 mile estimate is that over 98% of the sales in the post-ferry period that are within 1/8 of a mile of a ferry stop are located near the North 6th St. / North Williamsburg ferry stop.

Utilizing the continuous distance measure, in contrast, brings in far more observations with varying levels of exposure to the ferry service. In addition, this estimate makes more robust assumptions that unmeasured quality does not exist along a non-linear continuous plane rather than within a small discrete area. Given the more robust

[28] When the sample size is expanded to include observations within five or six miles of the closest ferry stop, the p-value falls to 5.7% and 4.7% respectively, while the coefficient is largely unchanged at 6.0% and 6.2%.

assumptions, the 4.2% 1/8 mile estimated derived from the continuous distance measure is considered the most reliable.

Overall it is important to emphasize that the above analysis represents a more rigorous estimation approach than is commonly employed in the literature, where a distance measure is often used without building fixed-effects or differences-in-differences. The 1/8 mile impact of 4.2% is therefore a conservative estimate.

Estimated Overall Impact

The above analysis provides coefficients that can be used to provide a dollar value estimate of how ferry service has impacted nearby property prices. As a baseline estimate, the assessment values from the New York City Department of Finance's PLUTO dataset are used to impute a market value.[29] Table 9.7 below summarizes the impacts for areas within a mile of the closest ferry stop. Within 1/8 mile the average impact is 8.0%, which is nearly identical to the average found in the literature of 8.1% (Debrezion et al., 2007).

Table 9.7: Property Value Impact by distance from Ferry Stop

Distance (miles)					
From	To	Total Value (millions)	% Impact	$ Impact (millions)	Cumulative Impact (millions)
0.000	0.125	$ 1,298	8.0%	$ 92	$ 92
0.125	0.250	$ 2,872	2.5%	$ 74	$ 166
0.250	0.375	$ 6,249	1.6%	$ 98	$ 264
0.375	0.500	$ 5,557	1.1%	$ 63	$ 327
0.500	0.625	$ 5,117	0.9%	$ 47	$ 374
0.625	0.750	$ 7,897	0.7%	$ 56	$ 431
0.750	0.875	$ 5,204	0.6%	$ 32	$ 463
0.875	1.000	$ 5,468	0.5%	$ 29	$ 492

Overall, the East River Ferry Service increased house values by nearly half a billion dollars in the Brooklyn and Queens areas of New York City. The largest impact, of over $90 million, was in the immediate 1/8 mile vicinity.

[29] The Department of Finance used an assessed to market value of 6% for Tax Class 1 properties and 45% for Tax Class 2 properties. The assessments were compared to recent sales and these ratios are accurate for Tax Class 1 and conservative for Tax Class 2. To remain conservative, these ratios were utilized.

Induced Quantity of Development

There is far less literature on public transit's impact on the quantity of real estate development than on its impact on real estate prices. Studies on the impact of BART, a rapid transit and commuter rail system in California's San Francisco Bay area, have found positive impacts on redevelopment and employment growth (Cervero and Landis, 1997). However, a study of Atlanta's MARTA rapid transit system found no impact on population and employment density (Bollinger and Ihlanfeldt, 1997). While the existing literature is therefore mixed, the positive impact of ferry service on prices demonstrates an increase in the willingness to pay for housing in the area. Economic theory predicts that a secondary result of this increase in prices is an increase in the quantity of property supplied in the area. Econometric analysis can be used to test this theory, and to quantify the impact of ferry services on real estate development.

The PLUTO data utilized in the property value impact analysis was also used to estimate the amount of new construction in the Brooklyn and Queens area near ferry stops. Using the variable on year built for each property, a panel dataset was constructed that measured the total amount in each city block of the following measures:

- Number of buildings;
- Count of residential units;
- Total building square footage;
- Total retail square footage;
- Total office square footage;
- Total residential square footage; and
- Total other commercial square footage.

The dataset was limited to blocks within two miles of the nearest ferry stop, with the resulting sample consisting of the annual stock and change in each of the above measures for 1,854 neighborhood blocks from 2000 through 2012.[30]

[30] Because the data does not track the demolition of real estate stock, the measures only capture new supply and not net new supply. However, for the purposes of measuring investment in real estate this measure is more relevant than net new, since a building that is demolished and replaced by a new building of equal size is still new real estate investment despite not increasing the net stock.

Table 9.8: Average Annual New Construction Summary By Block From 2000 to 2012

Type	Percent Of Blocks With New Each Year	Average Amount New
Buildings	6.7%	0.11
Residential Units	5.8%	1.6
Building Area (sf)	6.6%	2,284
Office Area (sf)	0.7%	182
Retail Area (sf)	0.8%	75
Other Commercial Area (sf)	2.9%	637
Residential Area (sf)	5.7%	1,646

As expected given the small geographic size of blocks, the data show that new construction happens only periodically. Table 9.8 reports the percent of blocks that receive new construction of each kind in a given year, and the average amount of new construction in each block in each year. The average tract gets a new residential space 5.7% of the time, so that in any given year a block on average gets 1,646 new residential square feet every year.

The low percent of blocks that receive new construction each year leads to a panel dataset predominated by zeroes and large values, which would generate problematic heteroskedasticity and outliers for a regression analysis. To prevent this, the data is aggregated into total block level development for two periods: the pre-ferry period (2000 through 2009), and the post-ferry period (2010 through 2012). Table 9.9 below shows the percent of blocks with new development in the pre and post time periods:

Table 9.9: Percent of Blocks With New Construction by Time Period

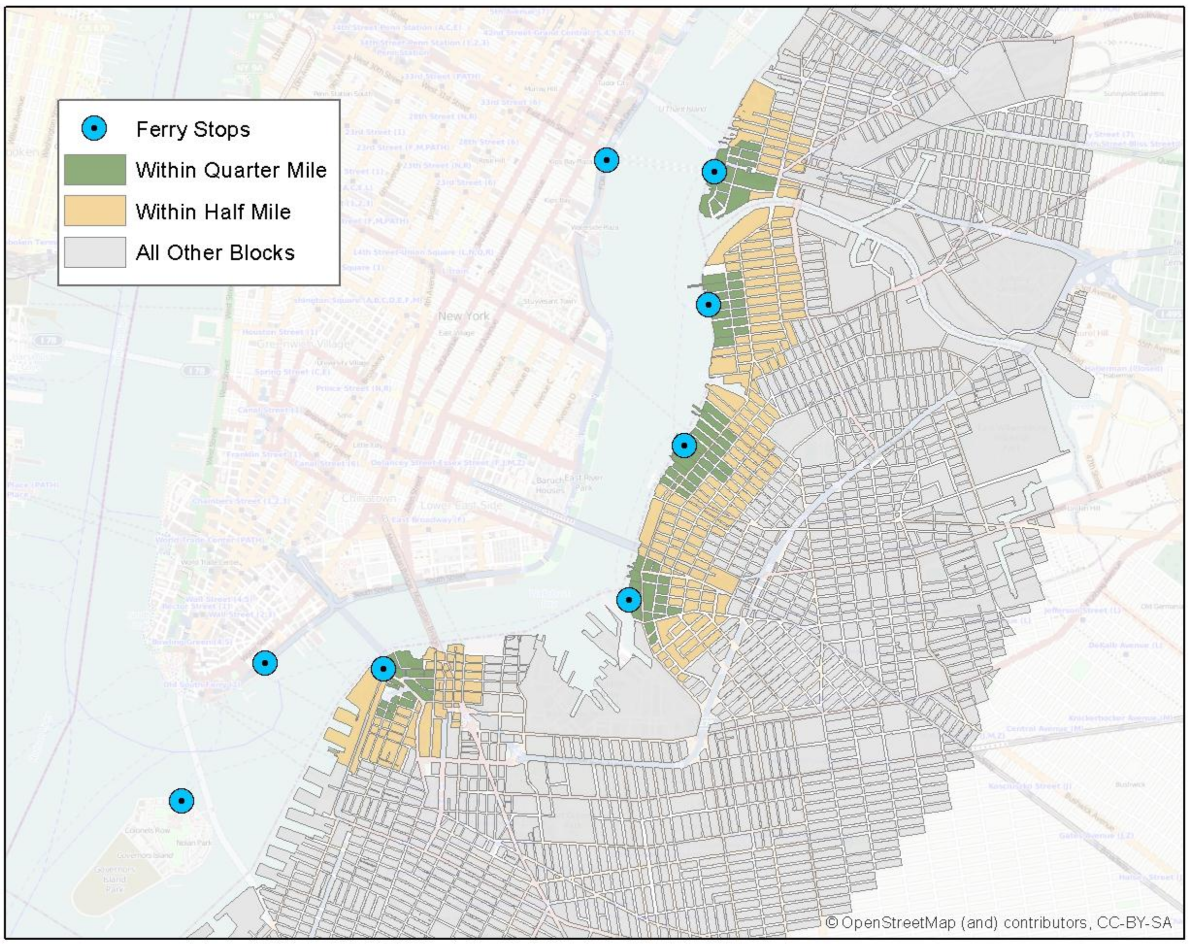
Type	Pre: ‘00-‘09	Post: ’10-‘12
Buildings	40.2%	11.1%
Residential Units	33.7%	9.1%
Building Area	40.1%	10.7%
Office Area	7.1%	1.1%
Retail Area	8.0%	2.0%
Other Commercial Area	23.6%	5.8%
Residential Area	33.4%	9.0%

However, after controlling for pre-existing development trends, is development in the post period higher in areas near the ferry? Specifically, the following models are estimated:

$$Z_{post} = \alpha Z_{pre} + \delta_1 I_{quarter} + \delta_2 I_{half} + \omega$$

Where for a given block Z_{post} is a measure of new development in the post period, $Z_{pre}$is that same measure in the pre period, $I_{quarter}$ and I_{half} are dummy variables indicating of the block is within a 1/4 mile or within ½ of a mile (and outside of 1/4 mile) of a ferry stop, and ω is an error term. [31] Figure 9.3 below shows the sample of blocks used in the analysis and those that are within ½ of a mile, within 1/4 mile, or in the control group.

Figure 9.3: Blocks Used in Regression Analysis



[31] To be more consistent with the evidence on price impacts and 1/8 mile would be more desirable, but the necessity of using blocks rather than properties, as with the previous analysis, leads to a small sample of observations within 1/8 mile. There are 18 blocks within a 1/4 mile, but 76 and 284 within 1/4 and 1/2, respectively.

The regression results, shown in Table 9.10 below, suggest that the ferry is associated with increases in development near ferry stops.[32] The largest impact is on residential development, which increased by over 6,400 square feet and 4.6 additional units in blocks within 1/4 mile from the stops. The least affected property type was office space, which increased but not by a statistically significant amount.

Table 9.10: Development Regression results

		Buildings	Residential Units	Building Area	Commercial Area	Office Area	Retail Area	Residential Area
δ_1: Quarter mile	b	0.1	4.6	8,008.1	2,420.6	12.5	266.9	6,411.0
	p	0.02	0.01	0.00	0.00	0.28	0.00	0.00
δ_2: Half mile	b	0.1	2.4	2,095.4	143.9	8.1	103.9	2,260.1
	p	0.04	0.04	0.17	0.74	0.26	0.03	0.06

Impacts can be expressed in percentage increase in total development by combining the above coefficients with the existing stock prior to the opening of the ferry. These results for all blocks within 1/4 mile are shown in Table 9.11 below. This translates to an overall impact on residential development of nearly 350 additional residential units and 487,238 residential square feet.

Table 9.11: Construction Impact in Inducing Square Feet of Development due to East River Ferry Stop Within A Quarter Mile

Type	Stock In 2009	Additive Sq footage	Percent Increase
Buildings	732	9	1.2%
Residential Units	6,051	350	5.8%
Building Area	12,300,000	608,615	4.9%
Commercial Area	5,466,094	183,963	3.4%
Office Area	953,887	948	0.1%
Retail Area	485,488	20,284	4.2%
Residential Area	6,745,500	487,238	7.2%

Overall, the results from the construction impact analysis are consistent with the impact on prices: there was a statistically and economically significant impact on prices and development in the immediate area, and a declining impact at farther

[32] Even using the larger time period aggregation, there exist a small number of outliers that influence the estimates. Each regression was run once and residuals with absolute values more than five standard deviations from the mean were removed. The coefficients presented are for the second regression with outliers excluded.

distances. The plausibility of the results is supported by the variation in effects by property type. The ferry is primarily used by households, and therefore the strongest effect was on residential units and square footage. Office space is the least affected, with retail, other commercial, and overall measures, like total buildings and building square footage, in between. This is also consistent with the admittedly limit evidence on the effect of public transit on development, which at least suggests that positive impacts can occur.

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10 APPENDIX II: RIDERSHIP MODEL DESCRIPTIONS

Commuter and Leisure Models

Background

The ridership modeling for the Project relied extensively on an existing set of models developed recently for the PANYNJ[33]. These models focused specifically on the portions of the New York City transit market which would be potential users of passenger ferries in New York Harbor, namely residents living close to the water or able to access ferry landings with ease.

Prior to the work to develop the PANYNJ models, there was a lack of understanding of the ferry passenger market in New York City. For this reason a comprehensive stated preference (SP) survey was completed to better understand the travel preferences of potential ferry riders originating in the five New York City boroughs and to serve as the empirical basis for a predictive passenger ferry demand model.

The SP exercise is a standard tool for transit planners in developing demand models for planned services. The process for the PANYNJ models involved developing a large random sample of respondents, and then presenting each with a series of options for completing a hypothetical trip, either by ferry or by their current mode of transit (in this case, subway or bus). Respondent mode choices when presented with varying hypothetical mode characteristics (such as frequency, travel time, access time, and applicable fare) then form the basis for a predictive model[34].

Developing the Mode Choice Models

Survey data were then used to develop predictive models for two distinct New York City markets, current subway users and current express bus users. For each market a mode choice model based on the logit estimator was developed to predict changes in travel behavior given changes in mode characteristics (such as travel time, access time, wait time, fare and frequency)[35].

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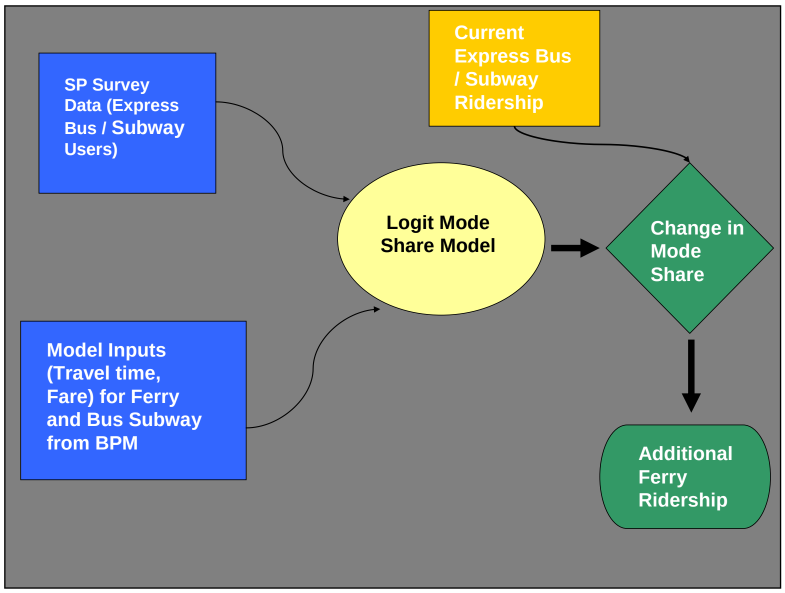
[33] Halcrow, Inc., 2010. *Study of Regional Private Passenger Ferry Services in the New York Metropolitan Area: Interim Report 7 Stated Preference Survey and Ridership Forecasts for Potential Routes*. Report Submitted to the Port Authority of New York and New Jersey.

[34] The SP exercise involved intercepting travelers at various bus and subway locations and encouraging their participation in a web-based survey. The results of the survey generated a very large set of responses that were then used to estimate a mode choice model which predicts how users will opt for a passenger ferry option in response to characteristics such as travel time, headway and fare. The five intercept locations which provided the survey respondents included Staten Island (intercepts occurred at select express bus stops in Manhattan with destinations in the Mariners Harbor area of Staten Island) Williamsburg, Brooklyn (intercepts occurred at the entrances to the Bedford Avenue station on the L Line), Astoria, Queens (intercepts occurred at the entrances to the 30th Avenue Station on the N/W Lines), Upper East Side of Manhattan (intercepts occurred along the eastern stretch of 86th Street), AND Soundview, Bronx (intercepts occurred at the Parkchester, Elder Avenue, Morrison/Soundview Avenue, and St Lawrence Avenue stations on the 6 Line).

[35] The simplest form of the logit model (and the one used for most of the analysis here) involves a binary form, where the model – based on the survey data - estimates market share of ferry and express bus/subway ridership. Thus, for

Mode choice models also can incorporate characteristics of users, for example choosing a particular mode might be dependent on a person's income, age group or gender. These models can then be used to predict the probability that an individual with certain characteristics would adopt a given mode of transport. Generalized over a market (such as a half-mile radius around a ferry pier) the models then predict a market capture of a mode for users. This predicted capture rate is then applied to the relevant population (such as commuters between the pier and a Manhattan destination) to generate predicted demand for the ferry service.

Figure 10.1: Modeling Approach



Source: Halcrow (2010) op. cit.

The estimation of the two mode choice models (referred to henceforth as the *Subway/Ferry Mode Choice* Model and the *Bus/Ferry Mode Choice Model)* is described in detail in a recent PANYNJ report[36], but the most salient facts are the following:

- The estimation was based on a large number of responses and produced a model with very strong statistical significance

purposes of using the survey results, only two modes of travel between each origin and destination are assumed to exist. Mathematically such models can be expressed as

$$P_n(Ferry) = \frac{e^{v(ferry)}}{e^{v(ferry)} + e^{v(Bus)}}$$

Where the function *V(ferry)* is referred to as a systematic component of the user's "utility", which can be written as $\Sigma_j x_j \beta_j$ where x_j are the different attributes of the mode and other relevant characteristics of individuals (such as income).

The usefulness of the model described by (1) is that it allows the calculation of predicted market share changes based on changes in the relative attributes of the different modes.

[36] PANYNJ (2010) op. cit.

- As expected, the models predict that ferry ridership would decline with increases in fare, in-vessel time, wait time and access time. The model estimation also revealed a lower probability of choosing ferries for female respondents[37].
- Respondents also exhibited an inherent preference for the ferry mode over their current subway or express bus option. The preference for ferry is a measure of how much respondents would be willing to pay for a ferry option if all characteristics were equal to the current option. For subway users (who face a generally shorter commute) the willingness-to-pay for a ferry option was equal to $1.15; for express bus users (who typically face a longer commute) the valuation of the ferry option was $1.92)[38].
- The model coefficients have expected signs. For example, increasing ferry travel time relative to subway decreases the probability that patrons would adopt ferry as a mode of choice. Similarly, increases in fare or headway decreases the probability that ferry would be adopted as a mode of choice. Across most specifications the mode choice constant is positive, implying that ferries are preferred by users as a mode of travel compared to subway. In Model 1 the mode choice is negative and in Model 5 the mode constant is indistinguishable from zero; this is largely due to the integrated fare option being highly correlated with mode choice.

In initial applications the Subway/Ferry Mode Choice Model was used to test demand for a then hypothetical ferry service between several locations (notably Williamsburg) and Pier 11 or 34th Street in Manhattan. The assumed characteristics were not identical to the current East River Ferry, but resulting ridership forecasts were comparable to current East River Ferry ridership, suggesting that the model would be a robust tool for forecasting ridership of proposed passenger ferry services in New York Harbor. A more complete validation exercise was carried out in the context of the current project based on actual East River Ferry characteristics and ridership results.

Validation Tests

The East River Ferry has been in service for over two years and the detailed ridership data provided a unique opportunity to validate the Sub/Ferry Mode Choice Model. In particular, an assessment was made to see how well the Model predicted current East River Ferry ridership by location given the actual fare, travel time, headway of each mode, as well as the calculated access times for specific locations. As shown in Figure 2, the process involved defining a relevant market area (usually a Primary Market Area and a Secondary Market Area) with relevant costs (fare, travel time, headway, access time) for both the East River Ferry and the competing subway service.

Figure 10.2: Validation Approach Based on Comparing East River Ferry Service to Transit Alternatives

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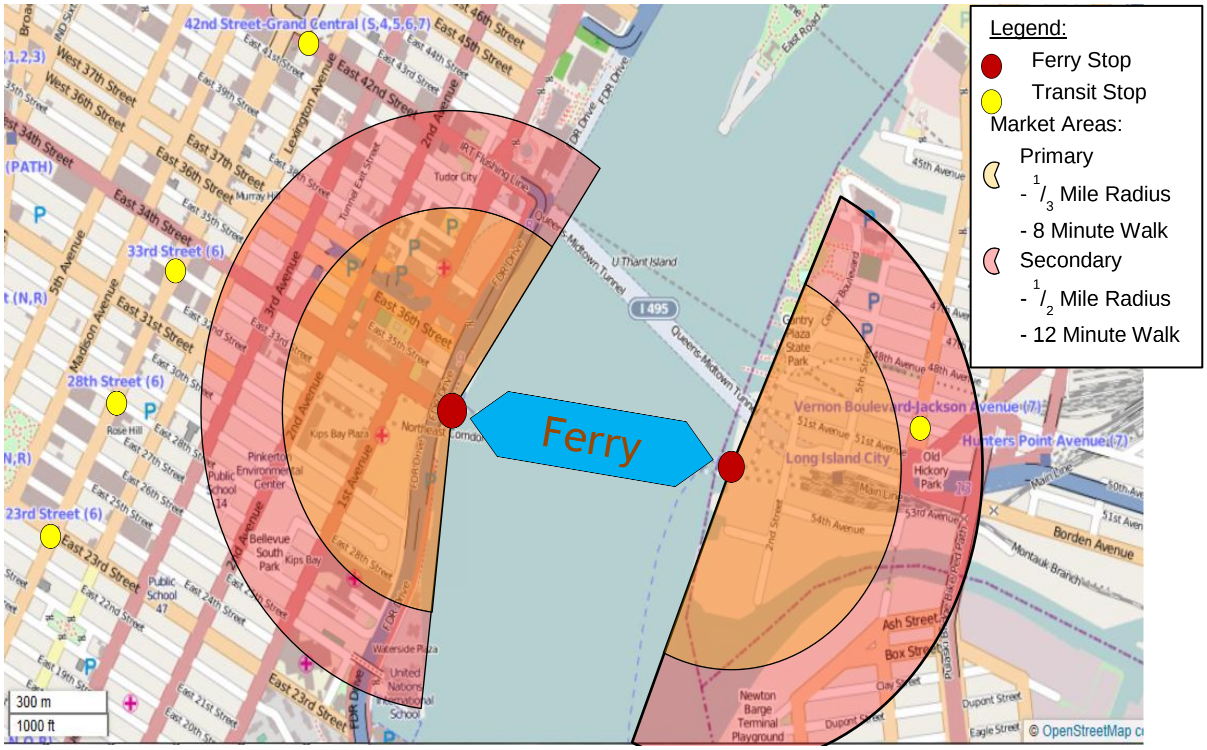
[37] An alternative formulation of the mode choice models also revealed that high-income users (with income over $100,000) were more likely to choose the ferry *all else equal*, and respondents also were more likely to choose the ferry option if it were part of an integrated fare structure. These model formulations proved to have lower predictive power and were therefore abandoned in favor of model formulations incorporating only fare, headway, access time, and gender.

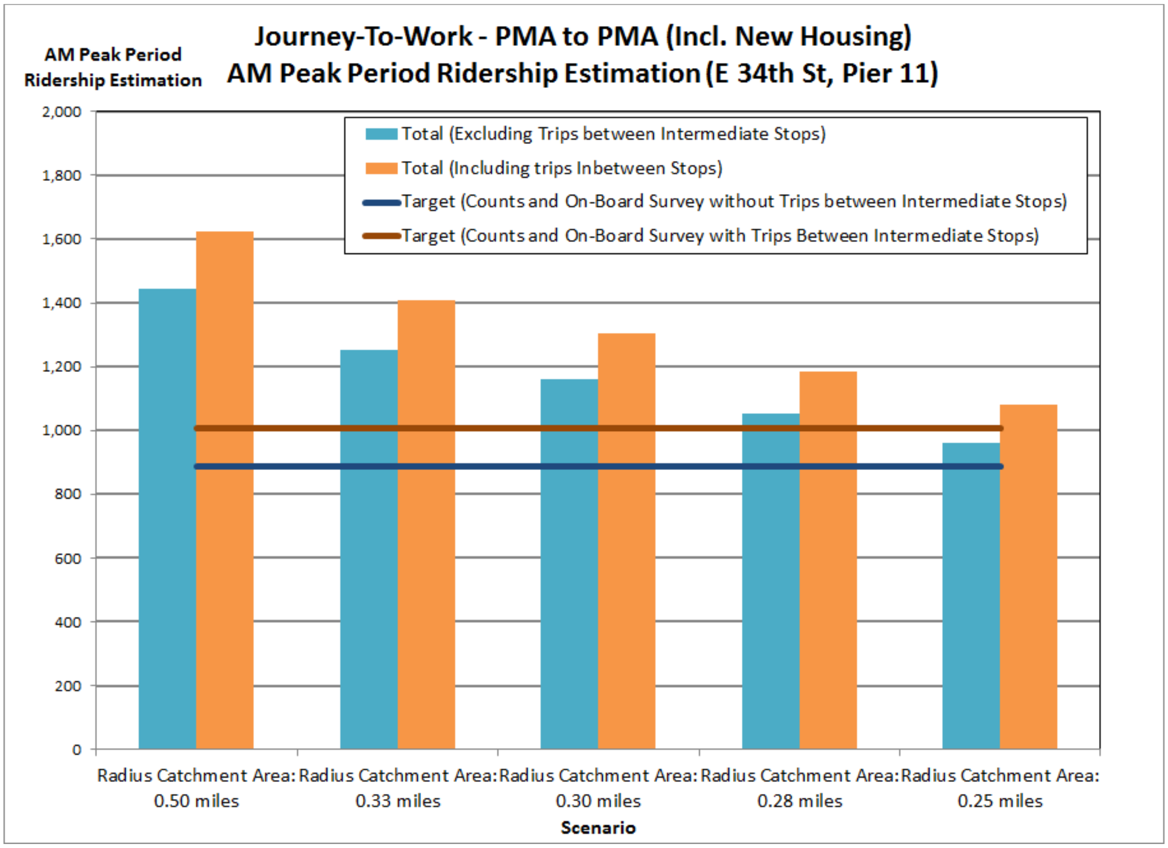
[38] Note that this preference is for a ferry service which, as presented to respondents in the SP survey, is a premium service such as the East River Ferry.



Map Background: © OpenStreetMap contributors

The validation process revealed that given a definition of the market area for East River Ferry stops based on a ½ mile radius (with a ¼ mile radius primary market area) the Subway/Ferry Mode Choice Model replicates current East River Ferry ridership very closely.

Figure 10.3: Validation Results Comparing East River Ferry Service to Transit Alternatives



LaGuardia Airport Model

Background

There was a privately-operated ferry service to LaGuardia Airport from 1988 to 2000. This service, connecting ferry terminals at Pier 11 and East 34th Street in Manhattan with the Marine Air Terminal at LaGuardia Airport, was sponsored by Delta Airlines and was marketed as the *Delta Water Shuttle* to provide a connection to Delta's flights to Washington D.C. and Boston. Since the service was sponsored solely to support flights leaving from the Marine Air Terminal (Terminal A), connections to other terminals were not marketed. In interviews with ferry operators familiar with the service, it was described as a "nice service", "consistent" for customers, but one that "lost money" for the operator as well as for Delta, which provided a fuel subsidy for their sponsorship.

There was no public subsidy for this service. Fares at one point in time were $15 one way and $25 roundtrip, and were reported to be up to $19 one way when the service was operated most recently by New York Waterway. Data from four years of ridership show some patterns:

- Average daily ridership was 130 passengers per day.

- January was consistently the lowest month for ridership.
- June is almost consistently the highest ridership month.
- Daily highs were reported anecdotally as up to 200 per day.

In looking at what it may take to reactivate this service, it is worth examining what has changed since the prior ferry service ceased operations. There have been numerous developments to both ferry services as well as at LaGuardia Airport that may support the viability of a revived ferry service.

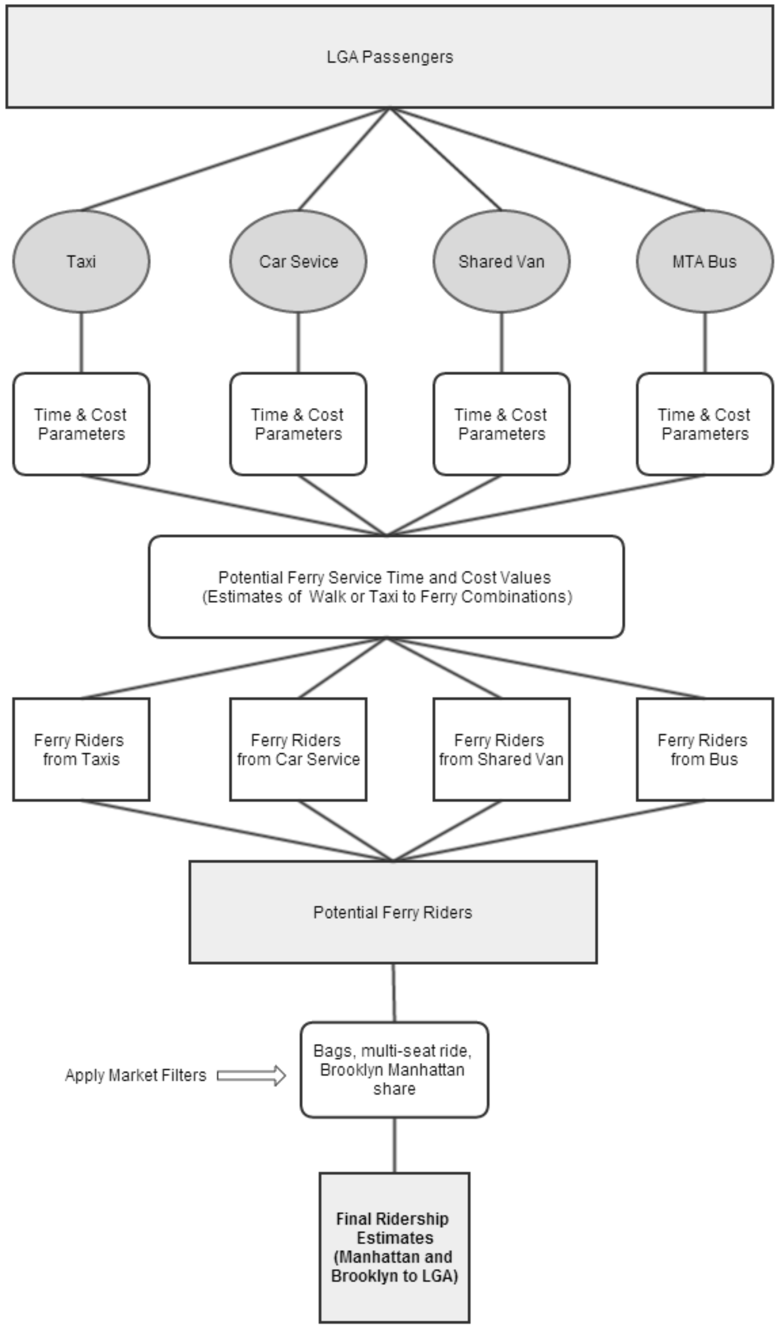
The potential for a water taxi or ferry service to and from LaGuardia Airport from Manhattan's East Side was studied in 2006. The 2006 study relied heavily on customer satisfaction data provided by the PANYNJ that included additional information on how passengers accessed the airport. For this analysis, the econometric model from that prior study was updated with 2011 customer satisfaction survey data. No stated preference surveys were conducted as part of this effort. There were also no current or historical surveys available to the study on customer perceptions of the prior service, or surveys on the current East River Ferry customers regarding their likelihood of taking a ferry to LaGuardia Airport.

Developing the Mode Choice Model

To develop a mode choice model, a probability model was developed whereby riders are presented choices from their origin to LaGuardia Airport based on time and cost combinations. Cost, access fares and distances were estimated using zip code-level trip origins, which were then used to supplement the data set. Total market size of LaGuardia Airport is 25.7 million passengers/year. Of that, 50% of LaGuardia Airport users were destined to Manhattan, 10% are destined to Brooklyn, and the remainder of LaGuardia Airport users are dispersed throughout the region.

Ferry market potential was limited to LaGuardia Airport users who currently access the airport by taxis, car services, shared-van service (e.g. Super Shuttle), or public transit such as the MTA bus. All users that drive their own vehicles or are dropped-off by a non-commercial vehicle were excluded. All users carrying two or more bags are ruled out from potential ridership pool because of inconvenience of moving luggage to and from ferry. A flow chart summarizing this process is on the following page. More details on the modelling methodology is provided in the APPENDIX III to the full report.

Figure 10.4: Flowchart of LaGuardia Airport Modelling Methodology



11 APPENDIX III: ANALYSIS OF FERRY SERVICE TO LAGUARDIA AIRPORT

As part of the update to the Citywide Ferry Study, the study evaluated the potential of ferry service to LaGuardia Airport (LaGuardia Airport). Considerations for travel to and from one of the region's major airports are different in nature than a journey-to-work commute or a leisure trip. Hence a ridership model specific to LaGuardia Airport access mode choice was created for this analysis. In addition to market potential, a number of questions needed to be addressed as part of this effort:

- What is the history of the prior ferry service to LaGuardia Airport?
- Why is that service no longer in operation?
- What, if anything, has changed since the cessation of that service that may hold promise for the success of a revived service?
- Where could a ferry terminal be located at LaGuardia Airport? What is the estimated cost of that facility?
- What would the potential ridership be? What is the anticipated farebox recovery of that service? Would a subsidy be required?

The results of this analysis reveal five primary findings:

- The likely reason for the failure of the prior ferry service was insufficient market reach to other LaGuardia Airport terminals. The Terminal A market was inadequate to support two vessels with hourly service. An inter-terminal connection was never promoted with the ferry service, as it was sponsored by one airline as an added amenity to its aviation shuttle services located in Terminal A.
- For a LaGuardia Airport ferry service to be viable, it must be combined with an attractive and efficient inter-terminal bus connection to attract and serve riders.
- Hourly service with two vessels is estimated to have a positive operating margin and may be self-sustaining without subsidies.
- Service every half hour with four vessels to Bowery Bay has a significantly slimmer profit margin and may not break even with higher fares than the $25 fare modelled.
- If a new ferry landing were to be developed at LaGuardia Airport to accommodate a reactivated service, development at Bowery Bay is recommended at this point in time over Flushing Bay.

The analysis is discussed in further detail below.

History

There was a privately-operated ferry service to LaGuardia Airport from 1988 to 2000. This service, connecting ferry terminals at Pier 11, East 34th Street and 90th Street in Manhattan with the Marine Air Terminal at LaGuardia Airport, was sponsored by Delta

Airlines and was marketed as the "Delta Water Shuttle" to provide a connection to Delta's flights to Washington D.C. and Boston. Since the service was sponsored solely to support flights leaving from the Marine Air Terminal (Terminal A), connections to other terminals were not marketed. In interviews with ferry operators familiar with the service, it was described as a "nice service", "consistent" for customers, but one that "lost money" for the operator as well as for Delta, which provided a fuel subsidy for their sponsorship.

There was no public subsidy for this service. Fares at one point in time were $15 one way and $25 roundtrip, and were reported to be up to $19 one way when the service was operated most recently by New York Waterway. Data from four years of ridership show some patterns:

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In looking at what it may take to reactivate this service, it is worth examining what has changed since the prior ferry service ceased operations. There have been numerous developments to both ferry services as well as at LaGuardia Airport that may support the viability of a revived ferry service.

Ferry

- Tremendous waterfront development along East River / Increased density of waterfront population with access to ferry
- Success of East River Ferry Pilot and reawakening of the waterways as a mode of transportation
- Extensive ferry commutation market on the Hudson River with connections from NJ to NYC
- Larger ferry fleet and added ferry companies

Airport

- Growth of LaGuardia Airport activity – passengers up 25% from 1996
- Post 9/11 security screening of passengers adds travel time
- Marine Air Terminal share of LaGuardia Airport market reduced – decrease to 4% of all LaGuardia Airport passengers from 9% in the 1990s
- Delta makes hub at LaGuardia Airport – invests $160M to connect and modernize Terminals C and D.

On the ferry side, the increased level of ferry activity may make it easier for an operator to market a service. And for commuters already accustomed to using ferries for their journey-to-work, using a ferry to reach LaGuardia Airport may be an easier "sell" now than in the past. On the airport side, the continued growth of LaGuardia Airport provides a bigger market for a ferry operator to tap into for ridership. Investments by Delta in connecting Terminals C and D may provide easier access between these terminals for ferry riders. The emergence of a larger single air carrier at LaGuardia Airport with customers at multiple terminals may present a ferry operator with a larger private-sector partner with interest in serving all terminals at the airport. These aspects will be discussed further.

Site Evaluation

Two sites were evaluated as potential ferry landing areas: one on the west end of LaGuardia Airport in Bowery Bay, the second in Flushing Bay on the east end. The prior ferry service operated out of Bowery Bay. That infrastructure was privately owned and has been removed. A northern site was not evaluated as it would be cost prohibitive to construct a passenger tunnel underneath runways that would provide non-conflicting passenger access from the waterside to the terminals. See map below.

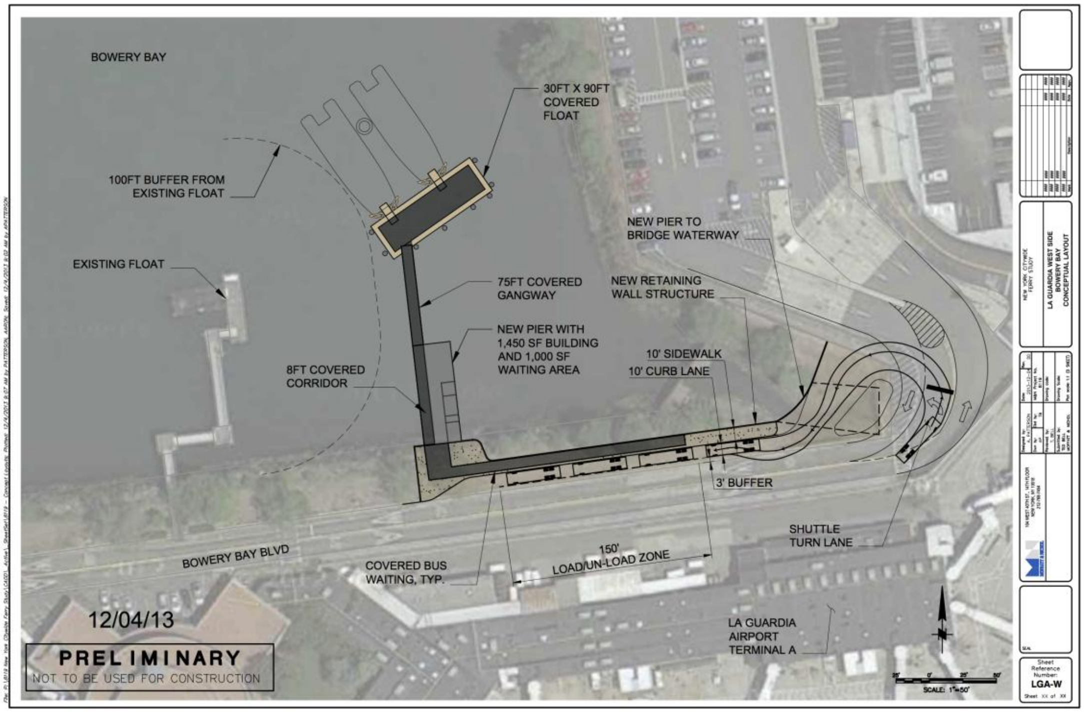
The CFS2013 developed a conceptual site plan and preliminary cost estimates for both sites. To attract a steady customer base and business travelers, costs for both facilities were estimated with the following amenities:

- Covered walkways and gangways to provide continuous weather protection from inter-terminal bus to ferry

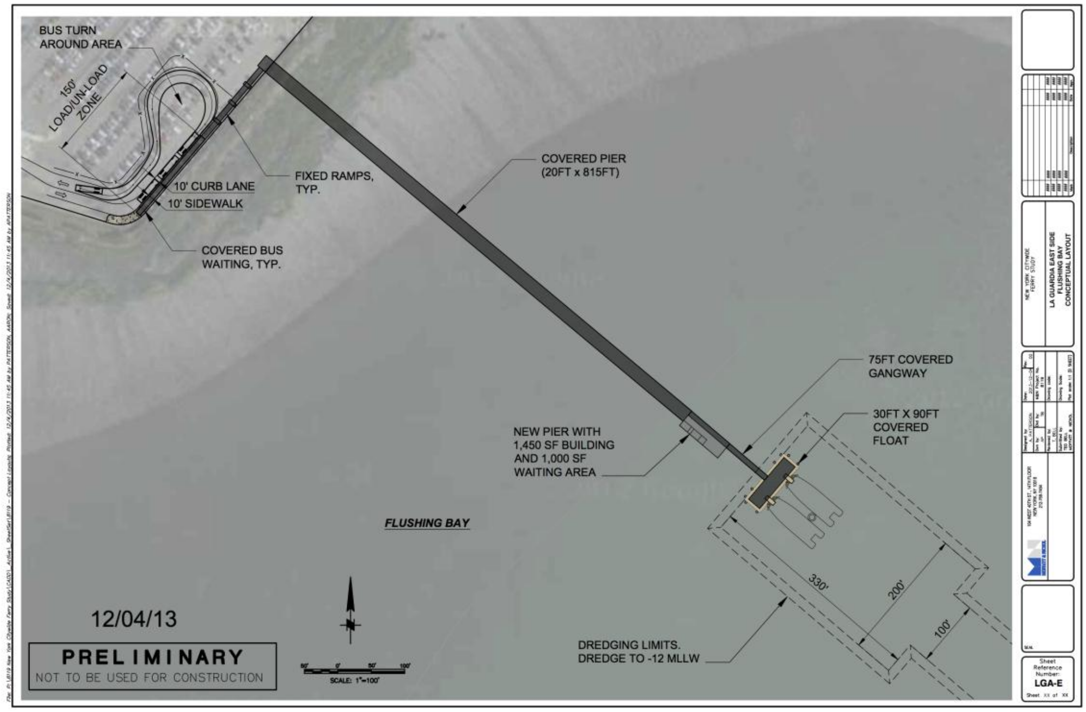
- Enclosed waiting area for weather protection
- Heated restrooms
- Heated staff area for either ticket sales or information both.
- Turn-around areas for inter-terminal bus.

Conceptual designs are shown below for Bowery Bay and Flushing Bay.

Bowery Bay Terminal concept design. Estimated cost: $16 million



Flushing Bay Terminal Conceptual Design. Estimated cost: $47.6 million



The advantages and disadvantages of both sites are summarized below:

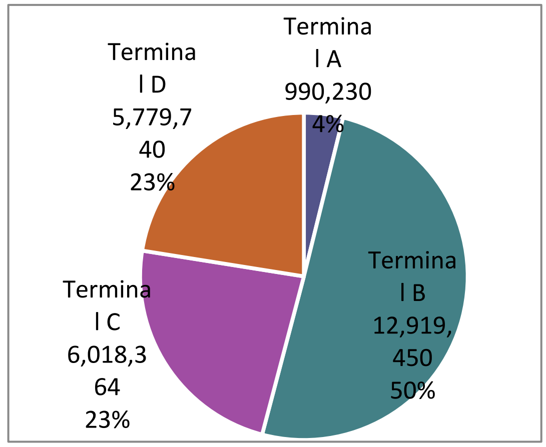
Bowery Bay (West End of LaGuardia Airport)

- Pros
  - Adequate water depth
  - No disturbance to vegetated wetlands
  - Less expensive ferry operations
  - Less expensive terminal construction at $16 million
- Con
  - Not walking distance to 97% of market
  - Greater need for efficient bus connections to other terminals
  - Immediate environs detract from image -adjacent to fuel farm

Flushing Bay (East End of LaGuardia Airport)

- Pros
  - Proximity to half of LaGuardia Airport customers. Walk access to Terminals C and D
- Cons
  - Longer travel time for riders
  - More expensive ferry operation than Bowery Bay by 25% due to longer route distance
  - More expensive terminal needed at $47.6 million (three times cost of Bowery Bay)
  - Requires dredging and environmental mitigation
  - Loss of some parking in Lot 5
  - Longer walk from ferry to shoreline of over 800 feet.

LaGuardia Airport Terminal Characteristics



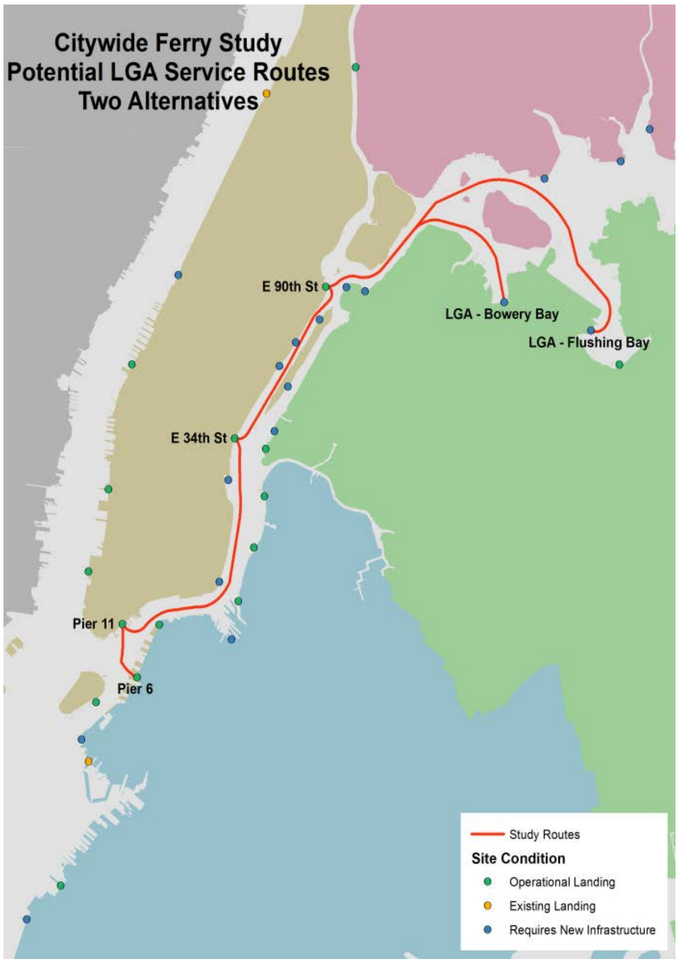
Source: PANYNJ 2012 Annual Traffic Report

Given that the potential ferry terminals are at opposite ends of the airport, it is worth looking at the passenger markets that would be most accessible to each ferry site. A western landing site at Bowery Bay would be walking distance to Terminal A, which is also referred to as the Marine Air Terminal. An eastern landing site at Flushing Bay would be most proximate to Terminal D. See terminal map below. The annual passenger market of each terminal differs in passenger ridership size as shown in the graph below. The potential market within walking distance of a Bowery Bay site is only 3% of the ridership market of LaGuardia Airport. Conversely, the potential market within walking distance of an eastern site at Flushing Bay represents 47% of the airport passenger market. In order for a ferry service to be effective towards servicing the entire airport, an efficient land transportation, such as bus connection, will be required and is discussed subsequently.

Routes Analyzed

With two potential ferry landing sites at LaGuardia Airport defined, the ferry routes to LaGuardia Airport were developed. The CFS2013 examined markets from existing ferry sites that were previously served by these locations to LaGuardia Airport, Pier 11 Wall Street, East 34th Street and East 90th Street.

Origin and destination information from surveys of LaGuardia Airport users indicate that 50% of passengers are destined to Manhattan and 10% to Brooklyn. To potentially capture a portion of the 10% of LaGuardia Airport passengers destined for Brooklyn, a Brooklyn site was examined for potential ridership.



A stop at Pier 6 in Brooklyn was added for analysis given its 15-minute walking access to the neighborhoods of Brooklyn Heights to the north and Cobble Hill to the south. Access to the site from Atlantic Avenue may also be efficient for drop offs from private vehicles as well as service from the MTA B63 bus.

North Williamsburg in Brooklyn was also considered. The analysis, however, did not show significant ridership at this location. This may be due to the fact that the neighborhood is still growing and the LaGuardia Airport survey sample size was not sufficiently robust for Brooklyn data points or perhaps as North Williamsburg is a relatively a short cab ride away, the ferry market is simply less competitive than other choices. Hence, North Williamsburg should not be ruled out of future planning as it can be easily revisited, particularly if a service proceeds with the first key development of a LaGuardia Airport landing site.

The Queens waterfront was not analyzed separately. Given its proximity to LaGuardia Airport and highly competitive car service options to the airport, it was not considered a viable ferry airport market. For example, a taxi fare from Gantry State Park in

Long Island City to LaGuardia Airport is estimated at $23 and may take only 16 minutes door-to-door. On a ferry, travel time from Gantry State Park would be greater than 15 minutes to the LaGuardia Airport ferry terminal and longer to the air terminals, and the fare modeled is $25.

To model travel times, a speed analysis was prepared for the route using the most cost-efficient speeds with the majority of the fleet available within the harbor. Travel speeds of 20 to 25 miles per hour were assumed for more cost-efficient operations. To maximize fuel efficiency, this is the predominant range of speeds for many of the current East River and Hudson River routes. While there are vessels that travel at higher speeds, this analysis focuses on examining what may be possible with the region's existing vessels. Vessels capable of traveling more than 30 MPH require much greater fuel usage and therefore have higher operating costs, and ultimately a higher ridership break-even threshold.

The tables below show modeled travel times from the airport to the following stops.

Bowery Bay Service

- 10. 7 miles, 55 minutes planning time

▪ LaGuardia Airport Bowery Bay	Depart
▪ East 90th Street	Arrive in 15 minutes
▪ East 34th Street	28 minutes
▪ Pier 11 Wall Street	44 minutes
▪ Pier 6 Brooklyn	51 minutes

Flushing Bay Service

- 15 miles, 65 minutes planning time

▪ LaGuardia Airport Flushing Bay	Depart
▪ East 90th Street	Arrive in 27 minutes
▪ East 34th Street	40 minutes
▪ Pier 11 Wall Street	57 minutes
▪ Pier 6 Brooklyn	63 minutes

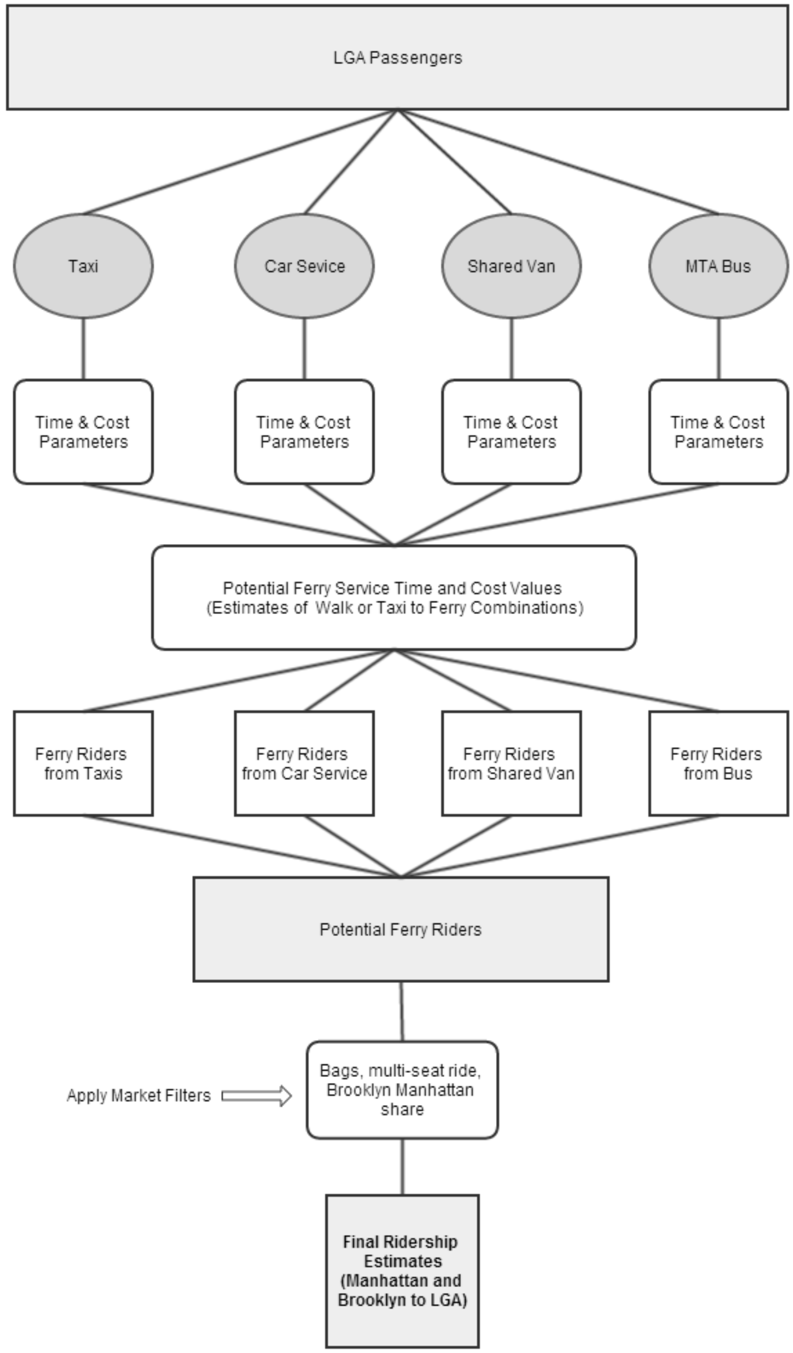
Ridership Modeling and Analysis

The potential for a water taxi or ferry service to and from LaGuardia Airport from Manhattan's East Side was studied in 2006. The 2006 study relied heavily on customer satisfaction data provided by the PANYNJ that included additional information on how passengers accessed the airport. For this analysis, the econometric model from that prior study was updated with 2011 customer satisfaction survey data. No stated preference surveys were conducted as part of this effort. There were also no current or historical surveys available on customer perceptions of the prior service, or surveys on the current East River Ferry customers regarding their likelihood of taking a ferry to LaGuardia Airport.

To develop a mode choice model, a probability model was developed whereby riders are presented choices from their origin to LaGuardia Airport based on time and cost combinations. Cost, access fares and distances were estimated using zip code-level trip origins, which were then used to supplement the data set. Total market size of LaGuardia Airport is 25.7 million passengers/year. Of that, 50% of LaGuardia Airport users were destined to Manhattan, 10% are destined to Brooklyn, and the remainder of LaGuardia Airport users are dispersed throughout the region.

Ferry market potential was limited to LaGuardia Airport users who currently access the airport by taxis, car services, shared-van service (e.g. Super Shuttle), or public transit such as the MTA bus. All users that drive their own vehicles or are dropped-off by a non-commercial vehicle were excluded. All users carrying two or more bags are ruled out from the potential ridership pool because of inconvenience of moving luggage to and from a ferry. A flow chart summarizing this process is on the following page. More details on the modelling methodology is provided in the APPENDIX III to the full report.

Flowchart of Modelling Methodology

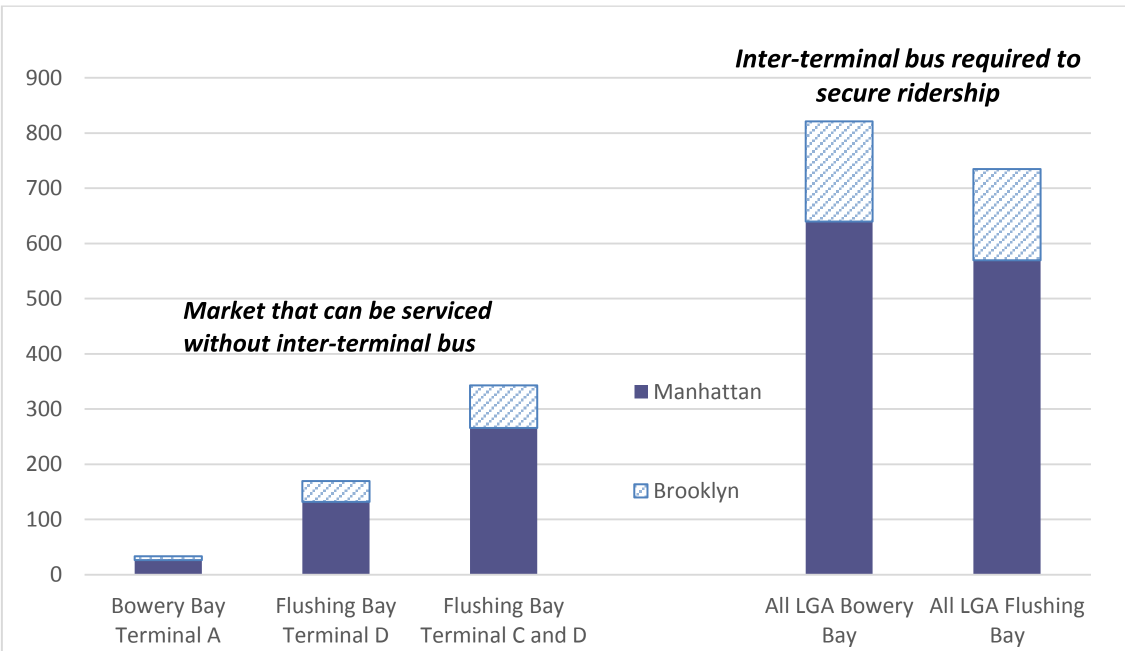


Ridership Forecast

A ridership forecast was developed for a number of scenarios. Ridership for an hourly service to LaGuardia Airport at a price point of $25 was examined for both the Bowery Bay and the Flushing Bay sites. A fare of $25 was chosen for analysis as this fare level was raised by ferry operators as a possible market competitive fare. Taxi fare, for example, to Lower Manhattan's Wall Street is estimated to be $40 and for Grand Central Midtown, $30 (taxifarefinder.com).

The two landing destinations will generate different ridership estimates due to their travel times. As Flushing Bay is on the eastern portion of LaGuardia Airport, this landing site requires an additional thirteen minutes in travel time compared to a Bowery Bay landing. The longer travel duration is an important service feature as it will compete with other modes based on time of travel, as well as cost. Once at the LaGuardia Airport, both sites also present different travel time from ferry to air terminal via an inter-terminal bus connection.

2018 Forecast of Potential Daily Ferry Passengers by LaGuardia Airport Ferry Landing Location

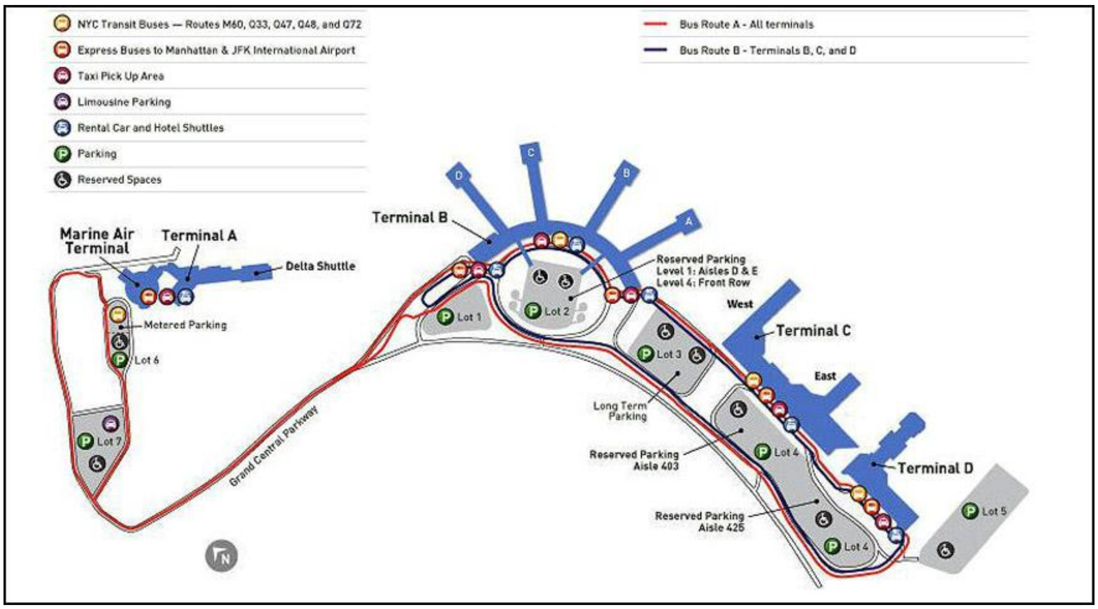


The above diagram shows that an intermodal connection is needed from ferry to the air terminal to sustain necessary ridership. A key finding is that the prior ferry service, while having a dedicated following, did not have sufficient reach to the rest of the LaGuardia Airport market apart from the Marine Air Terminal. The prior service was marketed solely as a Marine Air Terminal service and likely did not attract riders to other air terminals. Interviews and prior reports confirmed that there were few, if any, observed transfers from Terminal A to other terminals from the prior ferry service. However, ridership to Terminal A alone is not sufficient to cover the cost of providing that operation.

If a service were to be reactivated at Bowery Bay, without an efficient and seamless bus connection to the rest of the LaGuardia Airport market, the likelihood of success is low. Likewise, if a service at Flushing Bay were to be developed by Terminal D, without a connecting and seamless inter-terminal bus, that service would also likely have slim success margins. Moreover, even though Terminals C and D are now connected with a moveable walkway, and that market is within walking distance from a Flushing Bay Terminal, that combined market is still insufficient for a successful operation. Ridership to the remaining half of LaGuardia Airport at Terminal B, the Central Terminal Building, is needed for a ferry service to be viable.

In short, in order for a ferry service to work at LaGuardia Airport, an attractive and seamless intermodal connection to the air terminals is required. The connection bus may be as important to the success of the ferry as the waterside operation itself as riders will not deem themselves to have arrived at the airport until they get to their required air terminal, not the LaGuardia Airport ferry landing itself.

LaGuardia Airport currently operates two bus routes, one that connects all terminals, and another that connects all terminals except for Terminal A. See diagram below.



Source: PANYNJ website

The CFS2013 examined the current bus routes and their capacity using data from the PANYNJ.

- Route A (Serves all terminals)
  - 2 buses run every 15 minutes with a 30 minute roundtrip
  - Average passengers per hour: 21
  - Capacity: 35-foot buses with seating capacity of 24 and 10-15 standing
  - Current Utilization: 17% (average daily passengers/daily seats)
- Route B (Serves terminals B, C, D)
  - 2 buses run every 10 minutes with a 15 minute roundtrip
  - Average passengers per hour: 45
  - Capacity: 35-foot buses with seating capacity of 24 and 10-15 standing

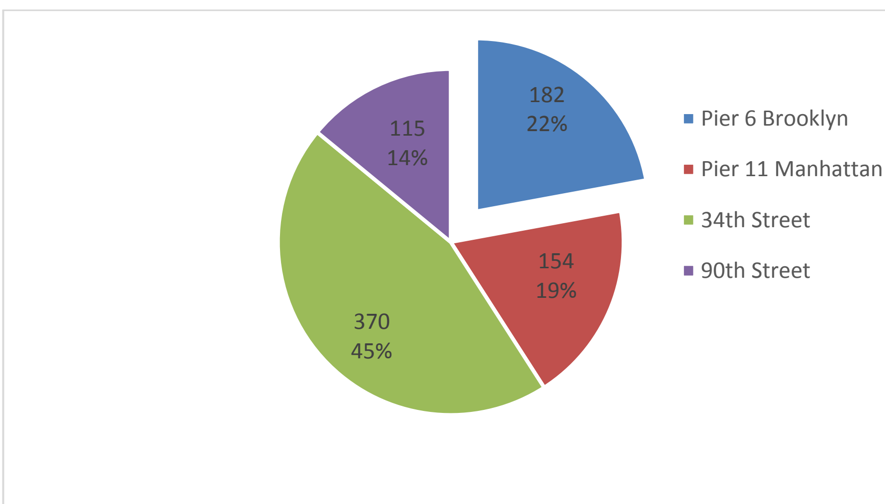
- Current Utilization: 26% (average daily passengers/daily seats)

Both bus routes appear to operate with sufficient excess capacity to absorb the forecasted number of riders from a ferry service. Moreover, the current excess capacity will increase as plans are underway at LaGuardia Airport to shift to use of JFK's 40-foot buses, which have the larger seating capacity of 31 and standing capacity for 15-20 passengers.

Ferry riders will expect a bus to meet the ferry upon arrival. Also, if there are ways to ensure the consistency of the connecting bus ride to the air terminal, such as use of any non-public roads separated from the potential traffic of public drop-off and pick-ups areas that a taxi, car service or bus would be subjected to, its reliability would strengthen the overall service.

Forecast of daily riders by terminal stop is shown below with a caveat on the potential Brooklyn ridership. Of the percentages shown below, the Brooklyn forecast warrants additional analysis as the forecasted size of the potential market is not consistent with the actual proportional share of riders of current Manhattan and Brooklyn LaGuardia Airport users. Reasons for this potential forecast distortion may be due to the smaller size of the Brooklyn sample in the survey data as well as unknowns with existing latent preferences for existing modes for airport access. Car service plays a larger role in airport access in Brooklyn than in Manhattan. The CFS2013 recommends further analysis with a stated preference survey to better gauge Brooklyn ridership.

2018 Forecast of daily ferry riders to Bowery Bay by stop for service every 30 minutes



Farebox Recovery Analysis

The above forecast represents an estimate of potential riders over the course of a full day. So out of the potential of all daily riders, the market was parsed for a 12-hour operational slot of riders using LaGuardia Airport between 6am to 6pm.

In serving LaGuardia Airport by ferry, an hourly service and a service every 30 minutes have been discussed over the years. The prior defunct ferry service to LaGuardia Airport was an hourly service. A service every half hour has been proposed in the past but never implemented. Two vessels would be needed to provide an hourly service. To provide a more attractive service every 30 minutes, four vessels would be needed. This makes a service every half hour twice the operational cost of an hourly service.

The prior Delta Water Shuttle, at one time during its 12-year run, operated on a split schedule with a morning service of 6am to 10am and an afternoon service of 3pm to 7pm. This was likely timed with the Delta shuttle service which had a morning peak and afternoon peak for a Washington D.C. - New York City – Boston travel market. However, in attempting to serve the whole LaGuardia Airport market which offers 1,000 daily landings and take-offs to destinations nationwide as well as Canada and the Caribbean, there are not the same morning and afternoon peaks. Therefore, an analysis for a split service is not presented below.

For a consecutive12-hour operation, conclusions from the farebox recovery analysis are:

- For both scenarios, the Bowery Bay landing alternative is the less expensive to operate.
- Ridership for Bowery Bay is also more robust compared to Flushing Bay given the shorter ferry travel times.
- For an hourly service, which requires two vessels, routes to either Bowery Bay or Flushing Bay may achieve sufficient ridership to be self-sustaining.
- Anticipated revenues from service every 30-minutes, which requires four vessels, would be insufficient towards covering operational costs and would require a subsidy.

The analysis does not incorporate an added cost for the required inter-terminal bus connection as there is an existing inter-terminal bus system in place that has capacity to accommodate added ridership from a ferry mode. However, that system would need to be modified to meet the ferry upon arrival and be sufficiently reliable to be attractive to riders.

Farebox Recovery for 2-Vessel Operating Scenario at fare of $25

2 vessels for hourly service	**Bowery Bay** 55 min headway	**Flushing Bay** 65 min headway
Daily Ridership	626	574
Daily Revenue	$15,650	$14,350
Daily Operating Expense	$12,649	$12,859
Daily Net Revenue	$3,000	$1,491
Farebox Coverage	**124%**	**116%**
Subsidy / Passenger	0	0

Farebox Recovery for 4-Vessel Operating Scenario at fare of $25

4 vessels for service every half hour	**Bowery Bay** 28 min headway	**Flushing Bay** 33 min headway
Daily Ridership	729	652
Daily Revenue	$18,225	$16,300
Daily Operating Expense	$25,299	$25,718
Daily Net Revenue	**-$7,074**	**-$9,418**
Farebox Coverage	**72%**	**63%**
Estimated Subsidy / Passenger	$9.70	$14.44

For a service that does not break even, there are a number of areas where the public sector may provide support if the service provides a public benefit, such as reduced congestion on crowded highways accessing LaGuardia Airport.

- Operating assistance

  - Direct subsidy - East River Ferry model
  - Operating agreement - MTA model for Ossining-Haverstraw ferry service where MTA commissions service for a defined period
  - Fuel – Delta Water Shuttle model where Delta provided fuel subsidy for sponsorship

- Non-operating assistance
  - Marketing – Unlike marketing commuter service to a targeted, local audience, the airport access market is broader and would require more extensive marketing efforts and reach to raise awareness that such a service exists. Operators have noted that the City's extensive marketing efforts from NYCEDC and NYC & Company, which included the placement of street banners on major thorough-fares, generated significant awareness of the East River Ferry pilot and contributed to its success. Identifying ferry terminals and their routes and connections on widely-used transportation resources, such as the MTA Subway Map, would help raise awareness of a LaGuardia Airport ferry, as well as other long-term ferry services.
  - Staffing of LaGuardia Airport ferry terminal site – The ferry terminal site should be staffed with personnel to answer questions from passengers, similar to the staffing of the platforms at the AirTrain terminals at JFK, and to assist in coordinating the ferry-bus connection.

Factors that Affect LaGuardia Airport Ferry Demand

There are numerous factors that may affect ferry demand that is not reflected in the forecast analysis above.

- Time of year/ weather. Historical information shows that ridership in winter months may be half the ridership in warmer months.
- Waterfront population growth Manhattan/Brooklyn. Continued residential development on the waterfront and increased use of the East River Ferry may foster a ferry commuter base amenable to using a ferry to LaGuardia Airport.
- Traffic congestion to LaGuardia Airport. Increasing road congestion may lengthen vehicular access times and decrease reliability of those trip times, which may increase the attractiveness of a ferry option.
- Express bus service. New efficient airport access services, such as the limited stop Q70 bus from Jackson Heights/Woodside Queens to LaGuardia Airport, could take some market share away from all modes to LaGuardia Airport, including a ferry. These are likely to be more price sensitive customers.
- Fuel prices/taxi fares/tolling. Increased taxi fares or tolls on East River Bridges would increase cost of taxi and car service options compared to ferry.
- Airport passenger growth and capacity limits on LaGuardia Airport parking (employees and passengers). Continued growth at LaGuardia Airport compared to limitation in parking may increase potential ridership for all airport access modes, including ferry.

- Ferry branding/marketing/advertising. Marketing will be an important for the success of a service as the wide target audience, as some users will not be residents of the New York metropolitan region.
- Operators' suggestion: Adding an amenity to an LaGuardia Airport Ferry Terminal, such as security screening, to avoid lines at terminals could be a highly valued amenity to business travelers and enhance the attractiveness of a ferry option.

LaGuardia Airport Ferry: Conclusions and Next Steps

This analysis regarding the reactivation a LaGuardia Airport ferry service presents five primary conclusions.

- The likely reason for the failure of the prior ferry service was insufficient market reach to other LaGuardia Airport terminals. The Terminal A market was inadequate to support two vessels with hourly service. An inter-terminal connection was never promoted with the ferry service, as it was sponsored by one airline as an added amenity to its aviation shuttle services located in Terminal A.
- For a LaGuardia Airport ferry service to be viable, it must be combined with an attractive and efficient inter-terminal bus connection to attract and serve riders.
- Hourly service with two vessels is estimated to have a positive operating margin and may be self-sustaining without subsidies.
- Service every half hour with four vessels to Bowery Bay has a significantly slimmer profit margin and may not break even with higher fares than the $25 fare modelled.
- If a new ferry landing were to be developed at LaGuardia Airport to accommodate a reactivated service, Bowery Bay is recommended at this point in time. The Flushing Bay terminal option has some clear disadvantages compared to the Bowery Bay site:
  - With a 25% higher operating costs due to longer route distance, a Flushing Bay landing places more financial stress on the service.
  - Additional transit time of 13 minutes per trip yields a smaller ridership market.
  - Given a longer water route, the potential market is limited to only a few stops with the same number of vessels.
  - At an estimated cost of $47 million for the landing, it is three times the capital cost of Bowery Bay.
  - The required dredging and wetland mitigation would lengthen service implementation.
  - While within reasonable walking distance to 47% of the LaGuardia Airport passenger market, it is still insufficient to form the basis of a self-supporting service without an inter-terminal bus.

However, the analysis also illuminates areas for further research needed for next steps on LaGuardia Airport ferry planning. Time and budget considerations in this study precluded conducting a stated preference survey to test a potential ferry to LaGuardia Airport. The data used for the LaGuardia Airport analysis differs from the quality and depth of data used to develop the commutation forecast for the remainder of the Citywide Ferry Study. For commutation, the CFS2013 was able to use a stated-preference survey findings specific to ferries in this region from a recent PANYNJ study. As such, the CFS2013 recommends additional research to guide decision-making as it relates to potential ferry service to LaGuardia Airport. Below are topics worth further examination:

- What are the mode preferences of people getting to and from LaGuardia Airport?
  - Conduct stated preference survey specific for LaGuardia Airport access to gauge attractiveness of ferry option, willingness-to-pay for ferry options, and sensitivity to other service characteristics.
  - Gather data and examine how LaGuardia Airport workers travel to and from the airport.
- What are NYC-specific latent mode preferences to NYC airports?
  - Examine actual revealed preferences towards multi-seat rides for airport access for a mature service. As JFK AirTrain has been in operation for 10 years, with growth that exceeded forecasting estimates, information from actual users on behavior and mode choices could shed light on the attractiveness of various LaGuardia Airport access options.
  - Evaluate the degree to which the amount of baggage carried impacts mode choice for multi-seat ride customers, as baggage use may be changing given airline travel pricing policies.
- What are characteristics of the future competing mode choices?
  - Conduct highway network modeling to examine mode options over time, particularly with a model updated to incorporate the density changes along the waterfront. Taxi access times to LaGuardia Airport are likely to change. A network modeling analysis will provide an improved comparison of airport access mode competition, including faster bus options such as the new limited-stop Q70 service.
- Evaluate LaGuardia Airport inter-terminal transfers, the required frequency of service and appropriate amenity level for travelers.
- Examine if there is opportunity to provide added amenities to a ferry terminal, e.g. TSA security screening.
- With the above data, undergo detailed site evaluation of Bowery Bay versus Flushing Bay. Current ridership modeling is inconclusive as to differences between sites, but operational and capital costs suggest Bowery Bay as the preferred location.

12 APPENDIX IV: EXISTING NJ TO NYC AND CROSS HUDSON FERRY SERVICES

Route	One-Way Fare	Headway (Peak)	2006 Weekday Ridership	2011 Weekday Ridership	2012 Weekday Ridership	2013 Weekday Ridership	2006-2011 Annual Growth	2011-2012
Atlantic Highlands - Pier 11/34th St	$26.00	30	1,120	1,482	1,450	1,143	5.8%	-2.2%
Belford - Pier 11	$21.50	30	2,144	1,813	1,749	1,830	-3.3%	-3.5%
Edgewater - Pier 79	$10.25	30	NA	563	622	657	NA	10.5%
Haverstraw - Ossining	$3.75	30	490	438	467	487	-2.2%	6.6%
Hoboken - Pier 11	$7.00	15	4,472	3,188	2,628	2,236	-6.5%	-17.6%
Hoboken - Pier 79	$9.00	20	1,754	1,872	181	2,287	1.3%	-90.3%
Hoboken - WFC	$10.75	18	3,774	2,297	2,886	2,460	-9.5%	25.7%
Liberty Harbor - Pier 11	$7.00	15	2,830	665	603	548	-25.1%	-9.4%
Liberty Harbor - WFC	$7.00	30		360	417	560	NA	15.9%
Lincoln Harbor - Pier 79	$9.00	18	2,830	1,681	1,717	1,735	-9.9%	2.1%
Newburgh - Beacon	$1.75	17	280	297	300	252	1.2%	0.9%
Newport - Pier 79	$8.00	30	NA	211	222	122	NA	5.1%
Paulus Hook - Pier 11	$7.00	13	NA	1,562	1,516	1,403	NA	-2.9%
Paulus Hook - Pier 79	$8.00	30	NA	445	477	573	NA	7.3%
Paulus Hook - WFC	$6.00	6	NA	3,067	3,358	3,001	NA	9.5%
Port Liberté - Pier 11	$10.00	40	516	395	367	308	-5.2%	-7.1%
Weehawken - Hoboken No. - WFC	$13.00	23	717	788	871	891	1.9%	10.5%
Weehawken - Pier 11	$13.00	20	1,238	904	815	768	-6.1%	-9.9%
Weehawken - Pier 79	$9.00	10	6,501	5,476	5,308	5,193	-3.4%	-3.1%

Note: WFC = World Financial Center; This table includes two cross-Hudson routes entirely within New York State (Newburgh - Beacon and Haverstraw - Ossining)

13 APPENDIX V: VESSEL OPERATING COSTS

Table 13.1: Vessel Type General Characteristics

Type	Description	Passengers	Crew	Length (ft)	Cruise Speed (mph)	Installed Power (hp)
A	Small Monohull	100	2	65	24	1,800
B	Large Monohull	400	5	90	12	1,350
C	Small Catamaran	80	2	55	18	1,200
D	Medium Catamaran (Slow)	149	3	80	15	2,500
E	Medium Catamaran (Medium)	149	3	80	20	2,500
F	Medium Catamaran (Fast)	149	3	80	25	2,500
G	Large Catamaran	400	5	140	32	8,000

Table 13.2: Hourly Operating Costs

Type	Description	Fuel	Labor	Machinery & Hull Maintenance	Lease Cost	Admin / Insurance / Overhead	Total Hourly Cost
A	Small Monohull	$176	$56	$34	$42	$80	$388
B	Large Monohull	$112	$123	$34	$59	$81	$408
C	Small Catamaran	$118	$56	$26	$36	$60	$295
D	Medium Catamaran (Slow)	$136	$116	$34	$52	$86	$423
E	Medium Catamaran (Medium)	$239	$116	$44	$52	$120	$570