

Supplemental Freight on Ferries: Case Study of Operations and Cost Comparisons

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Presented in this paper is a case study conducted in the Boston, Massachusetts, area that describes existing and required operational features of potential supplemental freight scenarios associated with passenger ferries. A basic, approximate comparison of economic costs associated with each scenario is presented to assist in developing more detailed marketing and demand analyses and possible implementation of a pilot project. Despite technological advances in waterborne transportation and, in many cases, a considerable passenger demand for ferry travel, provision of services frequently needs to be subsidized by public agencies so that fares remain competitive with alternative modes. In Boston, recently inaugurated shuttle and commuter passenger ferry services are currently meeting a significant portion of their operating costs, and other important transportation system advantages are evident in terms of modal diversity. However, in order to augment farebox revenues and reduce passenger fare subsidies, other sources of revenue are being investigated. Supplemental freight items that can be carried aboard regular passenger ferries so that passenger service is not disrupted or made less attractive are seen as a possible means of obtaining this additional revenue.

The potential for passenger ferry services in a number of metropolitan areas of the United States appears to be growing as congestion of land-based transportation increases. Yet, despite technological advances in waterborne transportation and, in many cases, a considerable passenger demand for ferry travel, provision of services frequently needs to be subsidized by public agencies so that fares remain competitive with alternative modes. In Boston, Massachusetts, recently inaugurated shuttle and commuter passenger ferry services are currently meeting a significant portion of their operating costs, and other important transportation system advantages are evident in terms of modal diversity.

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more detailed marketing and demand analyses and possible implementation of a pilot project.

OVERVIEW OF EXISTING FERRY AND TRANSPORTATION CHARACTERISTICS

Passenger Ferry Services in the Boston and South Shore Areas

Extensive interest in passenger ferry services in the Boston Harbor area and South Shore communities has given added impetus to provision of commuter, shuttle, and excursion services, and cruises and charters (1-8 and various internal studies, Massachusetts Port Authority, Boston, 1970-1985). Key features of the area and route locations are shown in Figures 1 and 2. The inner harbor is connected with the South Shore communities by services operating from either Rowes Wharf or Long Wharf in Boston to Hingham, Hull, and Quincy, south of the city. These services operate predominantly during the peak periods on weekdays, with travel lengths of up to approximately 10 mi, travel times of approximately 40 min, and 30-min headways. The ferries used on the Boston-Logan Airport shuttle are typically 20-seat vessels of 40-ft length, and those on the South Shore commuter routes have a capacity of more than 150 passengers and may be more than 100 ft long.

Of the two scheduled shuttle services within the inner harbor, the Boston-Logan Airport service has been very successful and carried more than 350,000 passengers in 1986. This service operates at a 15-min headway during daylight hours year-round. A private service operates to and from the World Trade Center and Long Wharf. A service has recently been inaugurated between Boston and Charlestown (Pier 4) during peak hours. Four round trips are made in the a.m. peak period and three in the p.m. peak period.

Other ferry services include private ferries used by contractors for the transfer of personnel, materials, and equipment associated with construction projects. These ferry services are not included in this study because they would not typically be associated with supplemental freight transport.

In terms of future development, various agencies, including those of the Commonwealth of Massachusetts and the City of Boston, are promoting ferry services within the inner harbor area, particularly as a means of alleviating current traffic congestion and improving access and environmental conditions. Although many of these plans are tentative, approximately 15 additional sites are under consideration.

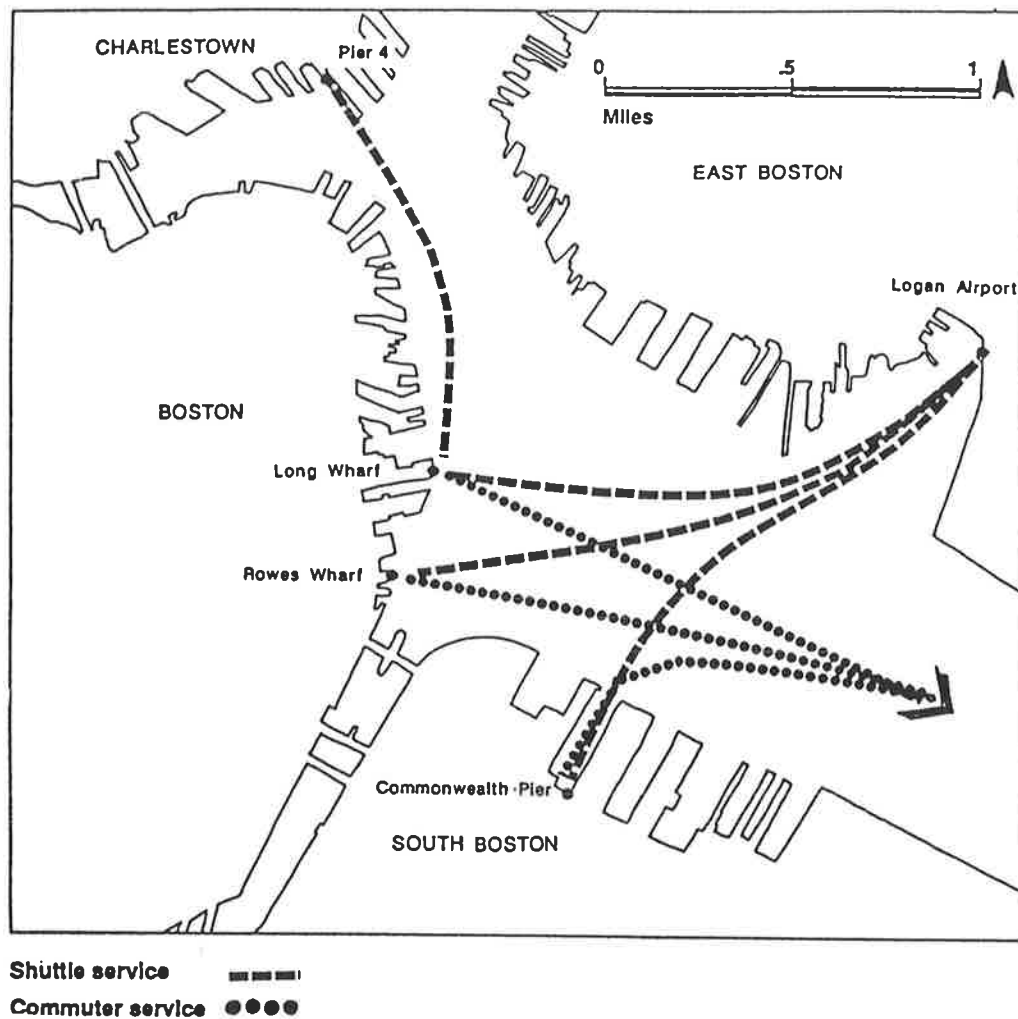


FIGURE 1 Existing Inner Harbor ferry routes (9).

Waterborne Facilities: Screening

Essentially, the type of freight would consist predominantly of packages weighing up to about 20 to 30 lb and capable of being carried by one person. Screening of the ferry services was conducted to concentrate the investigations on the ferry service and competing facilities that are relevant to carrying this type of supplemental freight.

Accordingly, a number of criteria were developed and applied in a three-stage screening process.

Initial Screening by Type of Ferry Services

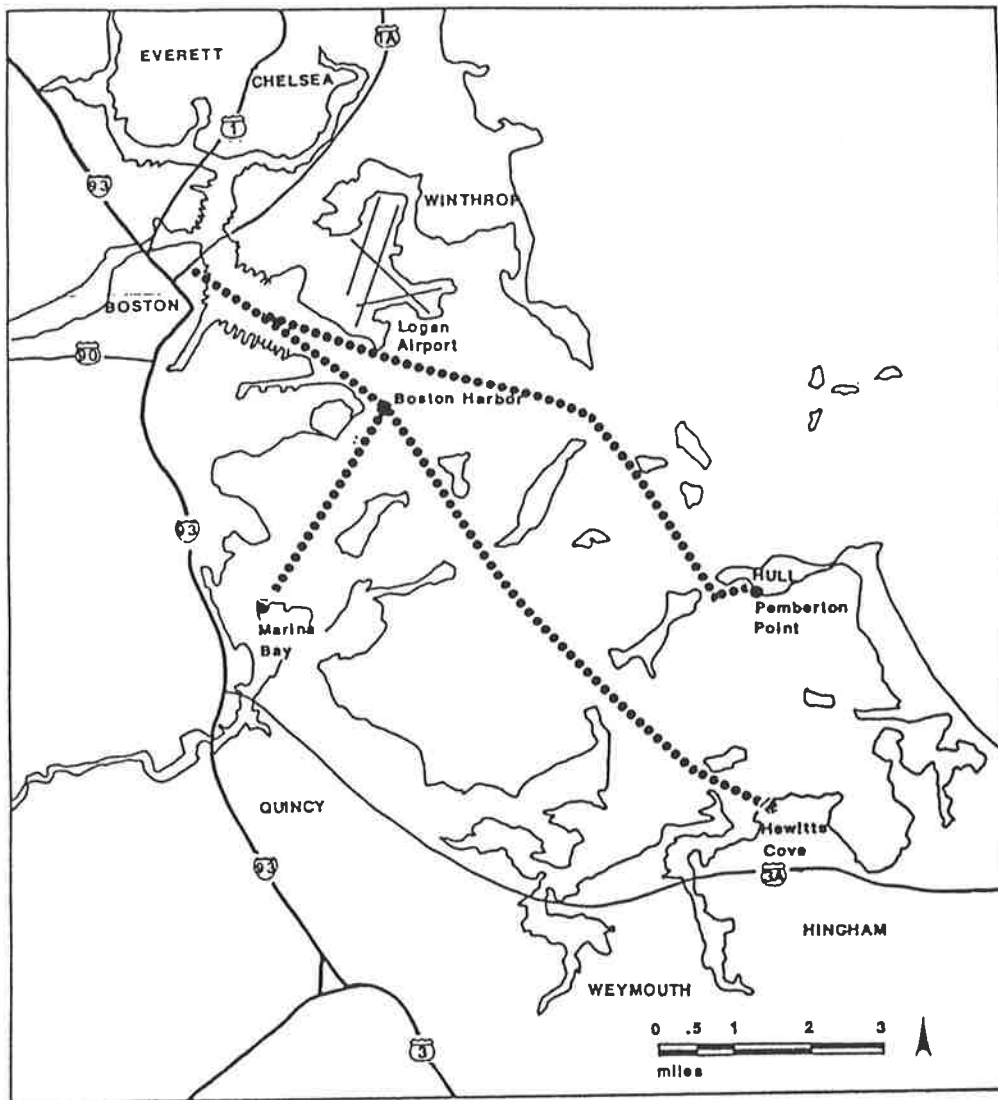
The major categories of ferry services were identified as follows:

1. Commuter service: Operates between downtown Boston and suburban localities.
2. Shuttle service: Terminal locations predominantly within Boston's inner harbor. May include on-demand (taxi) service between mainland terminals.
3. Excursion services: Predominantly recreational trips, including fixed-schedule trips between the harbor islands and other places of interest such as the USS *Constitution*.

4. Cruises and charters: Primarily specialty trips, including dinner and concert trips as well as recreational trips such as whale watches and trips to Provincetown and Gloucester.

The criteria considered important in this initial screening were:

1. Physical facilities. These must be suitable for carrying light freight. Unless the wharf and vessel characteristics appear to be suitable for transporting freight of the kind described earlier, or appear to be fairly readily adaptable to this purpose, the service would not be a candidate for further investigation at this stage.
2. Year-round service. If only seasonal service were offered, the disruption, rescheduling, and lack of continuity would be unacceptable for consistent supplemental freight transportation.
3. Schedule. Scheduled operation—or the potential for it—should be evident, otherwise the logistics of carrying supplemental freight, and possible gaps in the service, are likely to result in unsatisfactory operating service.
4. Time and cost advantages. Unless a clear time or cost advantage over land transportation is evident from the use of waterborne transportation, it is unlikely that the freight services will be acceptable.



Commuter service ●●●●

FIGURE 2 Existing commuter ferry routes (9).

The results of this initial screening were to include only commuter transportation and shuttle-taxi services in the inventory and ensuing analysis.

Second Screening of Existing Ferry Services

The commuter and shuttle services were next examined for their specific physical and operating characteristics, including

1. Terminal locations,
2. Schedule,
3. Land access, and
4. Approximate travel time advantage over land routes,

Most services offer frequent travel during the peak periods. Only the Boston airport shuttle, however, offers full service throughout the day. Land access in general is adequate but some improvements may be needed in several instances (see

later evaluations of specific land terminals). In most cases the travel times by ferry appear to be within the same approximate range as those for corresponding land routes, based on approximate evaluation of existing modal options. More detailed travel time and cost studies for alternative modes are described later in this paper.

Final Screening

Two services were eliminated from further consideration because of uncertain future service and a varied schedule of the service for private commercial activities. As a result of the final screening, the following services were considered in the subsequent analysis for the case study:

1. Boston-Hingham (Hewitts Cove),
2. Boston-Hull (Pemberton Point),
3. Boston-Quincy,

4. Boston-Logan Airport, and
5. Boston-Charlestown (Pier 4).

Categories of Freight Examined in This Study

The package freight movements throughout the study area are differentiated by a wide array of service options for customers. A review of these options and the associated charges provides a major basis, together with considerations of future development, for identifying and structuring a service within which passenger ferries might play a useful and financially feasible role.

Freight Service Categories

Several categories of potential freight of the type described earlier in this paper are of interest in ferry freight operations in the Boston Harbor area: package delivery ("for hire" carriers), private goods transportation, and air cargo. The main points concerning their selection for consideration in this study are discussed as follows.

Package Delivery

Several types of package delivery are offered by commercial operators. Their main features are

- Overnight package delivery. This service offers "next day" delivery for packages of a size similar to those in the "same day" category. In some cases, however, packages may be deposited in each firm's pick-up boxes, using the appropriate package and labeling supplied by the firm. The United States Post Office and private firms handle a considerable volume of this type of package transportation. Another feature of this kind of service is that the predominant movement of the packages is to and from other cities by dedicated aircraft, thus necessitating a local destination (for purposes of this study) to be Logan Airport.

- Same-day package delivery or courier service. Packages are typically picked up and delivered by means of one or a combination of modes, which include pedestrian, bicycle, van, taxi, subway, or bus. The packages are usually of a size that can be easily transported by one person, and range in size from letters to small boxes averaging 20 to 30 lb, which can be moved by means of a small handcart if necessary. This form of package service operates throughout the Boston area.

Because of the physical characteristics of the packages and the fact that the delivery routes coincide with current and future possible ferry routes (discussed in more detail later in this paper), this type of service is of considerable interest in this study.

Private Freight Carriage

Many firms carry their own freight in and around the Boston area and conduct their own pickup and delivery service between a variety of origins and destinations. Typically, these orga-

nizations use a van or truck, and the origins and destinations tend to be fairly constant as a result of providing service to a large proportion of established customers. Often, the use of the firm's own vehicles and labor force ensures that the firm has continuous control over the movements of the goods and that their shipping costs are minimized. Examples of the kind of goods shipped include small boxes of high unit-cost such as seafood being shipped by air package services, and small machinery and electronic equipment for air shipment and for local customers.

Although the characteristics of the current freight movements being made by private carriers appear to have some disadvantages from the point of view of control over the shipment, the potential for using ferries for a certain portion of the trip may be possible, and this type of movement is considered to have the potential for supplemental ferry freight services.

Air Cargo

A considerable amount of air cargo originates in and is destined for the Boston area. However, it is considered that the potential for ferries participating in portions of the total air cargo movement (except for the overnight service already mentioned) would be insignificant. The main reasons for this are that

- Individual items of freight would be of a size and weight that would render handling without the use of special equipment difficult and time-consuming. This could have an adverse effect on ferry schedules, with resulting lower levels of service to passengers and consequent reductions in fare revenues.
- Time differential between land and ferry routes is not as important as it is with the time-sensitive delivery of packages for same day or express mail services mentioned previously.

Types of Freight Not Included

Because the focus of this paper is on supplemental freight only, it does not include consideration of large items of freight that may require special loading equipment or roll-on, roll-off operations. These activities are likely to interfere with frequent, timely passenger service.

Summary

From these considerations of the various types of freight, the most appropriate services suitable for detailed investigation are

- Same-day delivery services in which a time or cost advantage over the equivalent land route can be demonstrated.
- Certain segments of the overnight package delivery service in which time and cost are competitive with equivalent land routes.
- Private delivery of freight in which cost and control factors are advantageous.

Transportation Elements: Route Evaluations

The suitability of the existing ground and waterborne transportation facilities for supplemental freight movement was examined in this inventory to identify existing conditions and provide a guide for identifying improvements. To do this, each of the selected routes was observed from the place of origin of the freight through to its destination, including all land- and water-based transportation elements. Many of the main features that were considered are illustrated conceptually in Figure 3.

Road Access

The characteristics of the street and highway access to and from the vicinity of the wharf area are important because of the effects on travel times, costs, and convenience. In general, the name, functional classification, number of lanes, availability of curb parking, and an indication of traffic volumes and speeds were noted for off-peak and peak travel periods.

Vehicle Loading and Unloading Facilities

For the freight to be loaded or unloaded from a van or other vehicle, adequate parking or waiting areas must be available for periods of up to 15 min or longer. A possible means of carrying small freight items is by use of bicycle courier services using the ferries. To facilitate this, areas for temporary storage of bicycles at the wharf, or facilities for carrying bicycles on the ferries, or both, would be required. The observations addressed parking regulations, potential availability of spaces, parking rates, and other factors that might affect the ease and safety of vehicle parking and waiting.

Access Between Parking and Wharf

For the freight to be either carried manually or transported on a handcart between the parking areas and the wharf, adequate facilities suitable for pedestrian movement must be available. In some cases, it is possible to bring the van or other delivery vehicle to the wharf where freight can be loaded

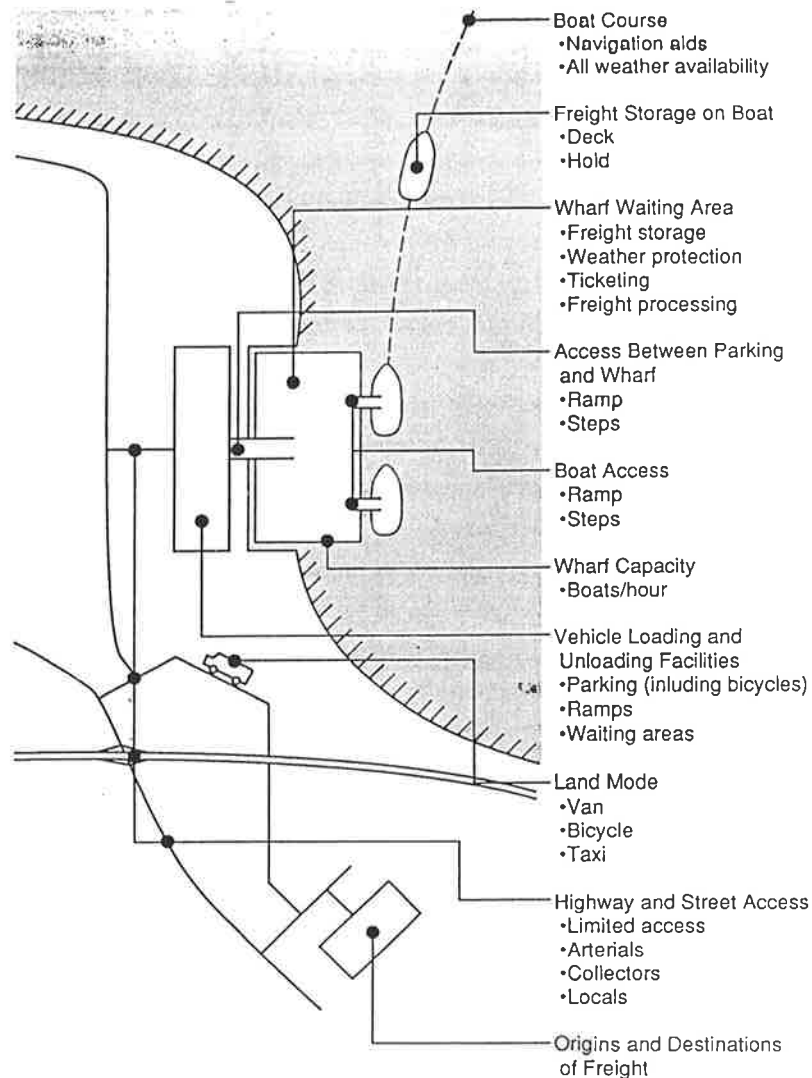


FIGURE 3 Key factors in supplemental freight route feasibility analysis: generic diagram (9).

or unloaded directly. However, this situation is infrequent. It appears more likely that small packages will be delivered by hand or by using a handcart, implying the need for a ramp with suitable grades, adequate widths, and other features that permit easy movement along this segment of the total trip.

Wharf Waiting Area

In most cases, goods must be delivered to the wharf to make use of ferry services with minimal delay. Thus, some form of storage or waiting area is useful. This area may range in extent from 2yd² to 3yd² to larger areas, depending on the expected freight traffic. Also noted, in addition to a description of the available space, were the presence and type of protection from inclement weather for the courier, handler, and the freight itself. Also, that some form of security should be provided if the freight is left unattended for any length of time.

Ticketing or Check-In Facilities

Unless some form of prior payment is employed, such as a contract for a specific number of trips or freight items, payment and checking of the freight at the embarkation point may be necessary. The extent of ticketing available was noted for each of the inventoried routes.

Wharf-to-Ship Movement

Moving the freight between the surface of the wharf and the deck of the vessel may be achieved in several ways. Some form of ramp may be available or, as was sometimes evident, several steps may be used to make up the difference between the levels between the wharf and the deck. Difficulties in carrying out this maneuver with various kinds of freight or handcarts may be an important source of delay or may cause safety problems. Therefore, an indication of the currently available method was included as part of the evaluation.

Shipboard Facility for Freight

Once the freight is aboard the vessel, there must be adequate space for its storage during the trip. In many cases, only limited space is available on passenger ferries, and this must sometimes be shared with passengers or crew. In the evaluation, an indication was given of the amount of deck space available, together with any other obvious problems in using it.

In general, because no unusual problems such as depth and navigation were apparent with the waterborne segments of the services selected in earlier screening, they are not discussed further in this overview.

Results of Wharf and Related Land Access Inventory

The following comments summarize the relevant findings for all but the Logan Airport wharf:

- Road access and parking/waiting areas range from moderately good and accessible to instances such as that at Rowes and Long wharfs where access and parking are likely to be adversely affected by peak-hour traffic and restricted parking areas.

- Access between parking/waiting areas and the wharf almost always requires negotiation of a ramp, the grade of which may be excessive during low tides. Also, ramps often have a step at one end, making movement of a handcart difficult.

- Wharf waiting areas are in general not protected from weather, which presents serious disadvantages during rain, snow, and icy conditions, particularly when these result in slippery, unsafe surfaces.

- Ticketing, except at Long Wharf and for some cases at Hingham, is conducted aboard the ferry. A ticket booth is used at Long Wharf. This procedure may have to be further examined because of possible delays during busy periods.

- Boarding and alighting between the boat and the wharf surface are accomplished largely by means of one or two steps and sometimes by use of a short ramp. This could cause delays, especially if a handcart is used for transporting the freight.

- Most of the boats currently used on passenger ferry service have no special area for freight carrying. Usually, however, there is sufficient space on deck for a limited amount of freight, and additional space may be available during periods of light passenger traffic.

At the Logan Airport wharf, most of the waiting areas for vehicles are adequate; a passenger shelter is provided at the parking/shuttle stop; ramps to the wharf are approximately 4 ft wide, although the grades may be excessive during low tides; treads on the ramps appear to give good traction; and the waiting area on the wharf is covered but not enclosed.

CHARACTERISTICS OF CURRENT (1988) FREIGHT MOVEMENT

Transportation of current land mode freight that could be a candidate for supplemental freight aboard ferries is affected by various factors. These include travel times, costs, reliability, and availability of the modal elements involved in the total trip, as well as the shipper's control over the security and level of service offered to customers. Outlined in this section are some of the major characteristics of existing freight movement in the Boston area, including routes, charges, and modal combinations, to assist in the formulation and evaluation of the scenarios described later in this paper.

Market Characteristics of Freight Services

Within the categories of freight described above, the existing route structure and service characteristics reflect the demand, prices, infrastructure, and modal options that may be assumed to be the most efficient available under current conditions. To explore further the nature of the services offered, a comparison was made for selected origin and destination pairs of the modal elements involved and the associated prices. This provided a useful basis for comparison with the future service scenarios.

Current Service Characteristics

Six major origin and destination pairs were selected as being representative of the current and likely future needs, based on their observed existing activity or future potential. These are

- Boston-Airport
- Boston-Inner Harbor
- Boston-South Shore
- Airport-South Shore
- Airport-Inner Harbor
- Inner Harbor-South Shore

For each of the service categories (same day, overnight, and private), the modes considered included pedestrian, bicycle, automobile, bus, subway, and ferry. It is assumed that any movement within Logan Airport that relies on ferry or subway will also include use of the internal airport shuttle buses or vans.

The service characteristics are summarized in Table 1 and Figure 4. The usual mode is the van or truck, with a significant involvement of pedestrian couriers in the downtown-airport-inner harbor area. Charges to customers for these deliveries range from approximately \$3 for areas within the downtown and inner harbor areas to \$28 for an individual package transported between the South Shore and the airport. It should

be noted that overnight charges (express mail) of \$14 include the cost of delivering a package nationwide but also apply if the package is being delivered locally, and that discounts for certain types and quantities of mail may reduce the customer's cost to about 65 percent of the basic charge. Some of these characteristics are discussed briefly in the following section.

Several features often distinguish the types of freight service, and have been mentioned as part of the preceding profiles. They include

- Price to customer. A regular rate for occasional customers may be charged or discount rates may be offered to regular customers or for higher volumes of freight shipped. Charges will also vary depending on the items described later in this paper.
- Time for delivery. These features may include same day, rush, overnight, or guaranteed time delivery.
- Type of collection and delivery. The shipping firm may pick up the package at the customer's premises or the customer may deliver the package to a collection box or to offices of the shipping firm.
- Security. Special security precautions may be taken with valuable freight, together with appropriate insurance arrangements if necessary.

In addition to these considerations, which apply directly to customer options, a delivery firm itself will adapt its opera-

TABLE 1 CHARACTERISTICS OF SELECTED CURRENT (1988) FREIGHT MOVEMENT OF POTENTIAL INTEREST AS SUPPLEMENTAL FREIGHT (9)

ORIGIN (2) DESTINATION	TYPE OF SERVICE	USUAL LOCAL TRANSPORTATION ELEMENTS								EXAMPLES OF CHARGES TO SENDER (4)
		Pede- strian	Bic- ycle	Auto	Van Truck	Taxi	Bus	Sub- way	Ferry (5)	
Boston - Airport	Same-day	●		○	○	○		○	○	\$10.00 Delivered to airline package office
	Overnight				●	●				\$14.00 regular charge
	Private (3)			○	●	○		○	○	Cost is part of sender's operations
Boston - Inner harbor area	Same-day	●	●	○	●	●		○		\$6.00 - \$10.00, approximately
	Overnight				●	●				\$14.00 regular charge
	Private (3)			○	●	○		○	○	Cost is part of sender's operations
Boston - South shore	Same-day	○		○	●	○		○	○	\$20.00 - \$24.00, approximately
	Overnight				●	○				\$14.00 regular charge
	Private (3)			○	●	○		○	○	Cost is part of sender's operations
Airport - South shore	Same-day			○	●	○				\$24.00 - \$28.00, approximately
	Overnight				●	○				\$14.00 regular charge
	Private (3)			○	●	○		○	○	Cost is part of sender's operations
Airport - Inner harbor area	Same-day	●		○	●	○		●	○	\$10.00 - \$13.00, approximately
	Overnight				●	○				\$14.00 regular charge
	Private (3)			○	●	○				Cost is part of sender's operations
Inner Harbor - South shore	Same-day	○		○	●	○		○	○	\$20.00 - \$24.00, approximately
	Overnight				●	○				\$14.00 regular charge
	Private (3)			○	●	○				Cost is part of sender's operations

Key : ● Frequent use ○ Occasional use

Source : Discussions with courier and express mail firms in the Boston area

- 1) Freight included in this table includes letters, small packages and items of a size and weight suitable for possible transportation as supplemental freight on ferries.
- 2) "Boston" refers to downtown, Rowes, Long Wharf area; "Inner harbor" refers to other parts of the Boston, Charlestown, Revere, South and East Boston areas; "South Shore" refers to points south of approximately Dorchester Bay.
- 3) "Private" means transportation provided by the sender's own organization. Costs are not detailed because of their wide variation due to freight volume variations and joint use of equipment and personnel.
- 4) Discounts for volume and customer service agreements may reduce these charges to as little as approximately 65% of the charges stated here.
- 5) This service is often based upon verbal understandings between the sender, ferry operator and receiver. Usually, the sender transports the goods to the ferry terminal and the pick-up is made by the recipient. Charges may typically be the cost of one passenger fare.

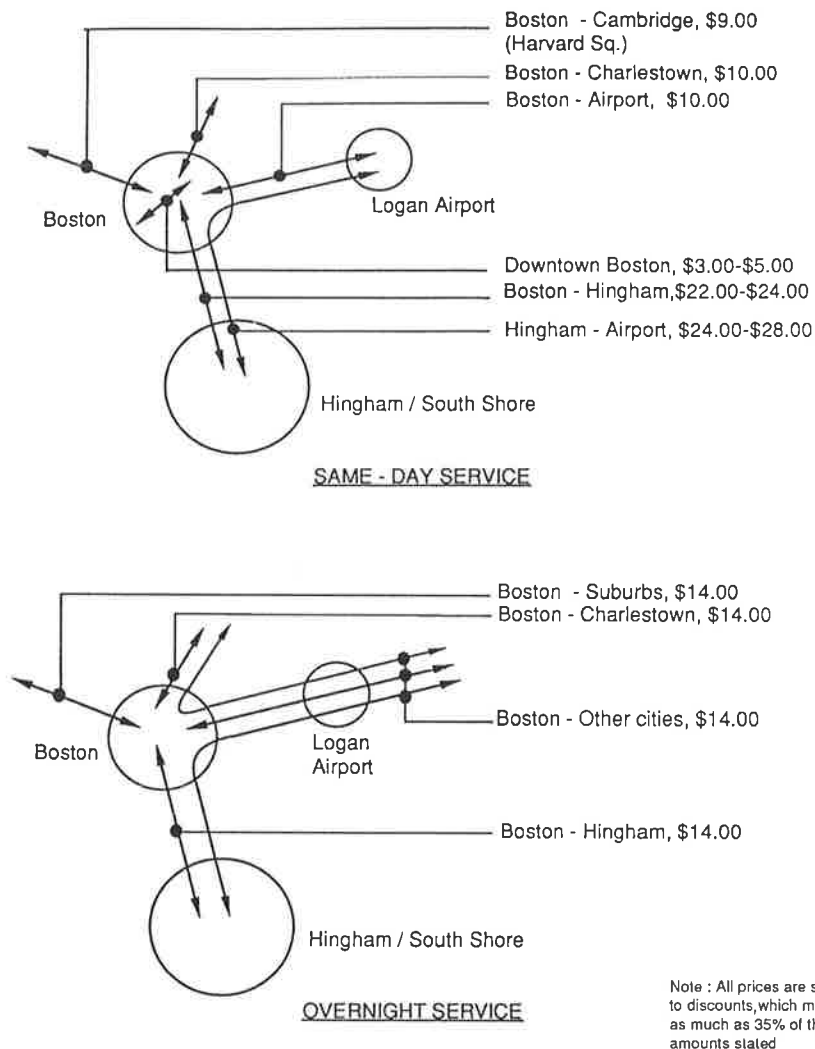


FIGURE 4 Examples of package delivery prices in the Boston area (9).

tions to the transportation environment. A typical example is one in which several firms that handle overnight mail ensure that most of their movements avoid peak-hour traffic congestion.

Travel Time and Cost Considerations

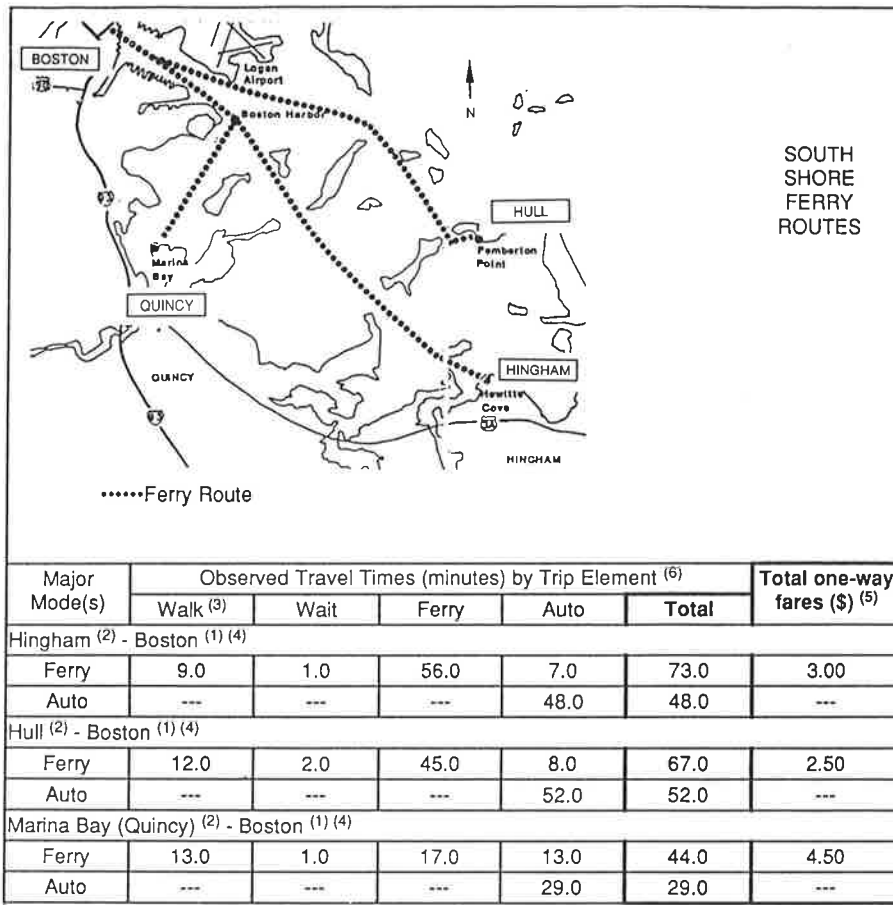
Two primary determinants of the feasibility of providing ferry freight services, in terms of the competitiveness with land-based facilities, are travel time and cost. Unless these factors combined can be shown to be superior to land-based services, it is unlikely that any significant demand for ferry freight services can be expected. Although the other features of the service are important, it is usually the case that these less-crucial determinants can be accommodated within certain limits once the essential determinants are established.

In examining the existing conditions, therefore, the major emphasis was placed on the travel time and cost characteristics associated with current ferry transportation in and around the Boston Harbor area. The times are examined here in greater detail to identify the elements of importance in structuring potential ferry services, together with comparative costs.

Example of Travel Time and Cost Comparison: Boston-South Shore

These routes are between Boston and Hingham, Hull and Quincy. The comparison of routes was made between ferry and automobile, the latter being representative of van and bus service, as shown in Figure 5. For the ferry trip, an automobile element (also representative of a van) was included at both ends of the trip to simulate the fact that packages typically would originate at some point other than the ferry terminal itself. All of the runs took place during the morning peak-traffic period, experience having shown that approximately the same total travel times obtained during the afternoon peak.

The results of these observations indicate that for each of the origin-destination pairs, the use of the automobile resulted in the least overall travel time. The greatest time difference resulted for the Hingham route, for which the ferry time of 73 min contrasted with the 48 min by automobile. The Hingham route is the longest of the three. For the Quincy route—the shortest—the difference was smaller: 44 min by ferry versus 29 min by automobile. From Hull, the ferry distance is about the same as that from Hingham, whereas the land distance is



Notes:

- 1) Boston destination is the intersection of Federal and Franklin Streets.
- 2) •Hingham origin is the intersection of Main and South Streets.
•Hull origin is the intersection of Nantasket Avenue and Kenberra Street.
•Quincy origin is the intersection of Sea Street and Southern Artery (Rte. #A).
- 3) Walking time at Boston destination only is about 6 - 8 minutes.
- 4) Rowes Wharf is used for the Hingham ferry terminal in Boston, Long Wharf for the Hull and Quincy ferries.
- 5) Fares are based upon one-way, regular adult fare.
- 6) Travel times shown above are the result of a single run, and should not be considered to be average values. Each run was made during the AM peak traffic period, inbound to Boston.

FIGURE 5 Travel time and fare comparisons, South Shore communities to downtown Boston (1988) (9).

longer. The quicker Quincy trip is caused in part by a shorter distance and also by the use of a smaller and much faster boat that is possible because its route is better protected than the Hingham and Hull routes.

Summary of Findings

The results of these observations show that nowhere in the existing transportation system in the Boston area is ferry transportation a superior mode (in terms of travel time and cost) to normal day-to-day land-based operations, and would be unlikely to offer any appreciable advantages in direct route competition with the available land modes. In considering the use of ferries for transporting supplemental freight, however, several points are pertinent to future possibilities; these include the following:

- It is possible that, for a limited number of origins and destinations in close proximity to a ferry terminal, the ferry may be superior.
- Some types of freight movement are not time sensitive within a range of several hours, and ferry service may be advantageous where the cost of transportation may be reduced for these types of freight.
- Future changes in the frequency, speed, and routing of a ferry may render the service more attractive.
- If land-based transportation becomes excessively congested or disrupted, ferry services may be appropriate.

Future Ferry Services

Although tentative at present, several proposals have been made for improvements to the existing ferry services. From

the standpoint of supplemental freight transportation, these are important for the following reasons:

1. Ferry operations would continue throughout the day between the South Shore and Boston, thus offering the possibility of reduced travel costs over land-based vehicle transportation.

2. Direct, all-day service between the South Shore and the airport would be inaugurated, thus reducing peak hour and daytime travel times between these points over that required by land vehicles, and introducing possible cost savings.

POTENTIAL FERRY FREIGHT SCENARIOS AND ECONOMIC ANALYSIS

Outlined in this section, using the information about current and future freight transportation discussed earlier, are the relative merits of supplemental freight services that would be competitive with land-based services. Also included is a description of an initial economic analysis to estimate likely cost savings of using ferry transportation.

Identification of Candidate Freight Services

Examination of existing and improved ferry services indicates that reductions in travel time and identification of cases for

which travel time may not be crucial between certain limits for the various origins and destinations may assist the feasibility of carrying supplemental freight. Furthermore, because of the potential improvements in ferry service and terminals, it is probable that some cost reductions in freight movement may be made by using ferries instead of land-based modes in selected cases. The routes on which potential savings exist, based on the travel time and approximate cost analyses, are summarized in Table 2. Key points are presented as follows to identify specific origin/destination pairs for more detailed examination.

Boston-Airport

Although future plans describe more frequent ferry service between Boston and the airport, it is unlikely that significant time or cost savings may be expected. For example, for the downtown Boston-Airport route, the Blue Line subway connection was shown to be faster and much less expensive than the airport shuttle operation. Similarly, a future ferry connection between North Station and the airport would not be expected to be significantly faster than that of the Green and Blue Line subway connection, and plans for the former do not yet include tentative schedules.

However, for certain kinds of priority or "rush" services, this route may have some potential, but is not considered further here.

TABLE 2 POTENTIAL SAVINGS OVER CURRENT (1988) FREIGHT CHARGES FOR SPECIFIC ORIGIN-DESTINATIONS (9)

ORIGIN (2) DESTINATION	TYPE OF SERVICE	EXAMPLES OF CHARGES TO SENDER(4)	POTENTIAL SAVINGS RESULTING FROM IMPROVED FERRY SERVICE
Boston - Airport	Same-day	\$10.00 Delivered to airline package office	} No significant savings - land routes better, except for special or priority service
	Overnight	\$14.00 regular charge	
	Private (3)	Cost is part of sender's operations	
Boston - Inner harbor area	Same-day	\$6.00 - \$10.00, approximately	} Some possible savings due to more frequent service
	Overnight	\$14.00 regular charge	
	Private (3)	Cost is part of sender's operations	
Boston - South shore	Same-day	\$20.00 - \$24.00, approximately	} Some possible savings due to more frequent service
	Overnight	\$14.00 regular charge	
	Private (3)	Cost is part of sender's operations	
Airport - South shore	Same-day	\$24.00 - \$28.00, approximately	} Good possibility of savings due to considerable reduction in travel time
	Overnight	\$14.00 regular charge	
	Private (3)	Cost is part of sender's operations	
Airport - Inner harbor area	Same-day	\$10.00 - \$13.00, approximately	} Some possible savings due to new routes and more frequent service
	Overnight	\$14.00 regular charge	
	Private (3)	Cost is part of sender's operations	
Inner Harbor - South shore	Same-day	\$20.00 - \$24.00, approximately	} Same as for Boston - South Shore
	Overnight	\$14.00 regular charge	
	Private (3)	Cost is part of sender's operations	

- Freight included in this table includes letters, small packages and items of a size and weight suitable for possible transportation as supplemental freight on ferries.
- "Boston" refers to downtown, Rowes, Long Wharf area; "Inner harbor" refers to other parts of the Boston, Charlestown, Revere, South and East Boston areas; "South shore" refers to points south of approximately Dorchester Bay.
- "Private" means transportation provided by the sender's own organization. Costs are not detailed because of their wide variation due to freight volume variations and joint use of equipment and personnel.
- See Table 2.1.
- This service is often based upon verbal understandings between the sender, ferry operator and receiver. Typically, the sender transports the goods to the ferry terminal and the pick-up is made by the recipient.

Boston-Inner Harbor Area

The inner harbor area appears to have the potential for increased ferry shuttle and water taxi service. However, several points should be noted:

1. All-day passenger demand is not extensive at present and, accordingly, ferry schedules also reflect mostly peak-hour trips.

2. Use of the existing ferry services for transporting small items of freight during the day with only minimal passenger patronage is unlikely to cover the costs of operating most of the current ferry vessels.

3. The extent of future land use development and associated passenger and freight demand is difficult to estimate. However, with such development and the expansion of water taxi service, using smaller, less expensive vessels for shorter runs in the more congested Inner Harbor area, the implementation of all-day (or "on demand") service may well be financially feasible, and the passenger and supplemental freight services may be complementary.

For these reasons, it is suggested that potential options for Inner Harbor supplemental freight be kept open, but that detailed estimates and operations planning be deferred until more information is available.

Boston-South Shore

At present, when costs of overnight mail are considered, ferry transportation may result in reduced costs for the service, thereby making it competitive with current land routes. This situation is expected to obtain in future also, and so it is investigated in greater detail. Same day freight service is currently unfeasible on this route because service is offered only during peak periods. In future, if the proposed services are implemented, same day freight service could be a feasible operation because the proposed frequency of service would render it competitive with land-based routes. Accordingly, it is examined in greater detail.

Airport-South Shore

As is the case for the Boston-South route already discussed, there may be some potential for overnight mail using current peak-period ferry services, and this possibility is examined in greater detail (10). Currently, same day service is not possible because of the lack of off-peak passenger ferry service.

Future same day service appears to offer the greatest potential for future ferry service because of the planned frequency of all-day service, and this possibility is investigated in greater depth.

Airport-Inner Harbor Area

The same comments apply here as they do to the Boston-Inner Harbor area already described.

Inner Harbor-South Shore

This route is examined in the following paragraphs as a part of the Boston-South Shore route.

Analysis of Potential Supplemental Ferry Freight Scenarios

Each of the possible supplemental freight services selected for detailed study in this review of candidate services was examined for operating and cost feasibility compared with existing and future land-based transportation. As determined in the foregoing review, three groups of scenarios were identified, as follows:

South Shore-Boston Scenarios (Group 1)

1A1: Overnight mail with no collection from sender's premises

1A2: Overnight mail with pickup

1B: Same-day service with pickup

South Shore-Airport Scenarios (Group 2)

2A1: Overnight mail with no pickup from sender's premises

2A2: Overnight mail with pickup

2B: Same-day service with pickup

Boston-Airport Scenarios (Group 3)

As indicated earlier, the land routes for these terminal areas appear to be superior. However, one potential case in which supplemental freight on this route may be possible is where the delivery service contracted to the airlines currently charges \$15 to customers for "rush" delivery between the airport and destinations in and beyond Boston. This price is \$5 more than the regular fee and some reductions could be made if the ferry were used, with some portion of the savings being allocated to the ferry service. It appears that the success of these services would be dependent on a number of factors related to the detailed logistics of the operators. Because of several uncertainties associated with this scenario, it was not considered further at this stage.

Economic Evaluation

The objective of conducting an economic analysis was to determine the approximate cost savings likely to accrue from specific scenarios such as those outlined earlier in this paper. The results of this analysis, in turn, will help to indicate which scenarios are likely to be most beneficial from a financial feasibility analysis and would help in selecting possible demonstration projects.

In this investigation, because of the nature of the scenarios and the assumptions about package collection methods, a simplified, approximate estimate of cost savings was adopted.

It consisted essentially of estimating the savings in land transportation costs if ferry operation were implemented, as outlined in the scenarios already described. The major assumptions in conducting these estimates of cost savings were the following:

1. At the collection and delivery portions of the trip, as opposed to the line-haul portion, the resource costs of the totally land-based methods are approximately the same as those for the ferry-based services. This assumption appears generally valid because the route taken by collection/delivery vehicles, the provision of collection boxes, and the administration costs would not be significantly different.

2. The major savings in resource costs will accrue from the line-haul portion of the freight movements. For the current and future land routes between the South Shore and the airport, the costs are those for a van or other vehicle and the driver. For the ferry system, the resource costs for the line-haul portion of the costs are negligible because the freight would be supplemental to the ferry passengers, and this cost should therefore be significantly lower than current overnight mail operations. Also, no personnel are required in addition

to those operating the regular passenger ferry service within the limits of package volumes investigated for these scenarios.

Because of the additional handling of the packages at the transfer point between land and ferries, the ferry route land costs may be somewhat higher than the all-land routes. This difference is expected to be small and is within the levels of approximation considered acceptable.

In order to present an illustrative level of demand believed to be realistic that would also be convenient for comparison purposes, a volume of 100 packages daily (50 each way) was assumed between the origin and destination points considered for each South Shore-Boston scenario, and 50 packages daily for each South Shore-airport scenario. The difference between the volumes reflects some relative difference between the total business activity in Boston versus the airport.

The results of this illustrative cost evaluation are summarized in Table 3. The assumptions concerning travel times, speeds, and costs are stated in the table. The results show that although some savings (approximately \$12,000 per year) may accrue from Scenarios 1A1 and 1A2, and 2A1 and 2A2 (overnight services) the greatest savings would accrue for the

TABLE 3 ILLUSTRATIVE, ESTIMATED ANNUAL SAVINGS IN LAND-BASED LINE-HAUL PACKAGE FREIGHT TRANSPORTATION FOR SELECTED SCENARIOS⁽⁷⁾ (9)

SCENARIO	ASSUMED NUMBER OF PACKAGES PER DAY (2-WAY)	ESTIMATED DAILY LAND TRANSPORTATION COST SAVINGS				
		Number of line-haul 2-way van trips	Round trip Distance (Miles)	Average 2-way trip time(Hr) ⁽³⁾	Daily cost saving (\$) ⁽⁵⁾	Annual cost savings (\$) ⁽⁶⁾
South Shore - Boston						
1A1, 1A2 (Overnight, present, and future)	100	1 ⁽¹⁾	20	1.5	28	7,280
1B (Same-day, Future only)	100	20 ⁽²⁾	20	1.5	560	145,600
South Shore - Airport						
2A1, 2A2 (Overnight, present, and future)	50	1 ⁽¹⁾	26	2	19	4,810
2B (Same-day, Future only)	50	10 ⁽²⁾	26	2	370	92,600

Notes:

- (1) For overnight service, assumes that all packages would be consolidated and carried in one van load.
- (2) For same-day delivery, assumes 5 packages per 1-way van trip.
- (3) For overnight mail, assumes 0.75 hour average 1-way trip time during evening hours (i.e. after approximately 7:00 pm); for same day service, assumes 1.0 hours average 1-way trip time during daytime, including some peak-hour traffic.
- (4) \$12.00 per hour, including benefits for driver, 50c per mile for van and operating costs.
- (5) (Distance x 50c x No. trips) + (12.00 x Trip time x No. trips)
- (6) Daily cost multiplied by 260 working days per year, exclusive of interest amounts.
- (7) Highway costs are not included and would be insignificant due to the low vehicle volumes (max. 12 vehicles per day).

future same day services where the number of packages per vehicle would be expected to be relatively low, with a correspondingly higher cost saving per package. Consequently, scenarios 1B and 2B in the future are estimated to save about \$240,000 per year. For other amounts of packages, these savings would vary accordingly.

CONCLUSIONS

From the results of the economic analysis, it appears that significant cost savings exist for the transportation of supplemental freight on certain of the existing and planned ferry routes in the Boston area. From this, it can be seen that each of the potential services may contribute to the overall effectiveness of ferry service, as long as the financial feasibility and profitability for ferry operators and associated service providers can be assured. Consideration of this latter requirement is beyond the scope of this paper and is the subject of ongoing investigations. Although detailed demand estimates and more accurate estimates of costs and revenues will have to be made in conjunction with operators of the service to determine financial feasibility, the investigations indicate that more detailed analysis leading to inauguration of supplemental freight services may prove beneficial to operators, passengers, and agencies that provide subsidies for passenger travel.

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