# Executive Summary

## E.1 Background and Purpose of the Study

In late 2000, the Federal Railroad Administration (FRA) designated the Boston to Montreal rail route as one of the nation's two new High-Speed Rail Corridors. The designation was in response to a joint application by the states of Vermont, New Hampshire, and Massachusetts that identified the desire to study the feasibility of development of a rail transportation alternative for service between the major metropolitan cities of Boston, Massachusetts and Montreal, Quebec, Canada and intermediate points.

Designation of High-Speed Rail (HSR) corridors has been established by the U.S. Federal Railroad Administration to facilitate planning for alternative travel modes in specific regions. In the application letter to FRA, the potential for use of HSR to reduce congestion on major highway and air corridors within the Boston to Montreal High-Speed Corridor route was cited as a principal reason to evaluate the feasibility of HSR service. As with any long term transportation project, planning and implementation requires a comprehensive series of steps to first determine the feasibility of a proposed transportation alternative and then, if appropriate, progress to implementation of a project. The feasibility analysis used for this study generally follows the methodology utilized in the 1997 FRA Report *High-Speed Ground Transportation for America*[1] and in the 2002 FRA publication *Railroad Corridor Transportation Plans, A Guidance Manual*.

The purpose of the Boston to Montreal High-Speed Rail (BMHSR) Corridor Feasibility and Planning Study is to employ appropriate methodologies to determine if a HSR service is feasible within the BMHSR Corridor. To address all the criteria needed to fully evaluate the feasibility of the BMHSR, the Study has been divided into two phases. This report documents the findings of Phase I of the Study.

## E.2 Study Overview

The Boston to Montreal High-Speed Rail Feasibility and Planning Study (Study) is managed by the Vermont Agency of Transportation (VTrans) through a cooperative agreement with the FRA, and directed in partnership with the New Hampshire Department of Transportation (NHDOT), and the Massachusetts Executive Office of Transportation and Construction (EOTC). A steering committee, comprised of representatives of the three

[1] U.S. Department of Transportation, September 1997.

partner States, the Quebec Ministry of Transportation, the Metropolitan Community of Montreal, and the FRA has provided oversight, direction and primary product review for the Study.

The scope of Phase I is to provide information on three primary tasks:

- Identification of institutional and policy issues,
- Development of preliminary service ridership projections, and
- Inventory of basic corridor infrastructure elements.

The scope of Phase II will include study of the remaining elements of High-Speed Rail evaluation criteria. The major items to be studied in Phase II include:

- Detailed operational analysis and planning,
- Assessment of alignment, infrastructure, and environmental requirements,
- Determination of projected capital and operating costs and revenue, and
- Comparison of benefits and costs.

The objective of dividing the Study in two Phases was to assess if sufficient ridership potential exists to warrant additional study of train operations, revenue, and costs required for a HSR service. Also, the investigation of institutional and policy issues during Phase I was intended to document potential "fatal flaws" that could prevent implementing a BMHSR service. The findings of Phase I were, therefore, expected to be either that the BMHSR service was not feasible in the foreseeable future; or that sufficient evidence was developed to support progression to Phase II of the Study.

Included in Phase I Study efforts was the development and implementation of a significant public awareness program. The purpose of this program was to make individuals and public and private organizations aware of the objectives of the Study and the potential issues associated with the BMHSR service; and to seek input that would aid in identifying benefits and impacts for the potential BMHSR service. Activities included establishing a Study website (www.bostonmontrealhsr.org), holding public meetings at the beginning and end of the Phase I Study, and holding two focus group meetings with representation from specific public and private interests.

## Description & Definition of High-Speed Rail

High-Speed Rail is often described as a subset of the more general term, High-Speed Ground Transportation (HSGT). HSGT has been documented most thoroughly in the FRA report, *High-Speed Ground Transportation for America*.[2] According to the report, HSGT can be defined in terms of travel market and performance characteristics as:

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[2] Ibid.

> "…a self-guided intercity passenger ground transportation – by steel-wheel rail-road or magnetic levitation (Maglev) – that is time-competitive with air and/or auto for travel markets in the approximate range of 100 to 500 miles."[3]

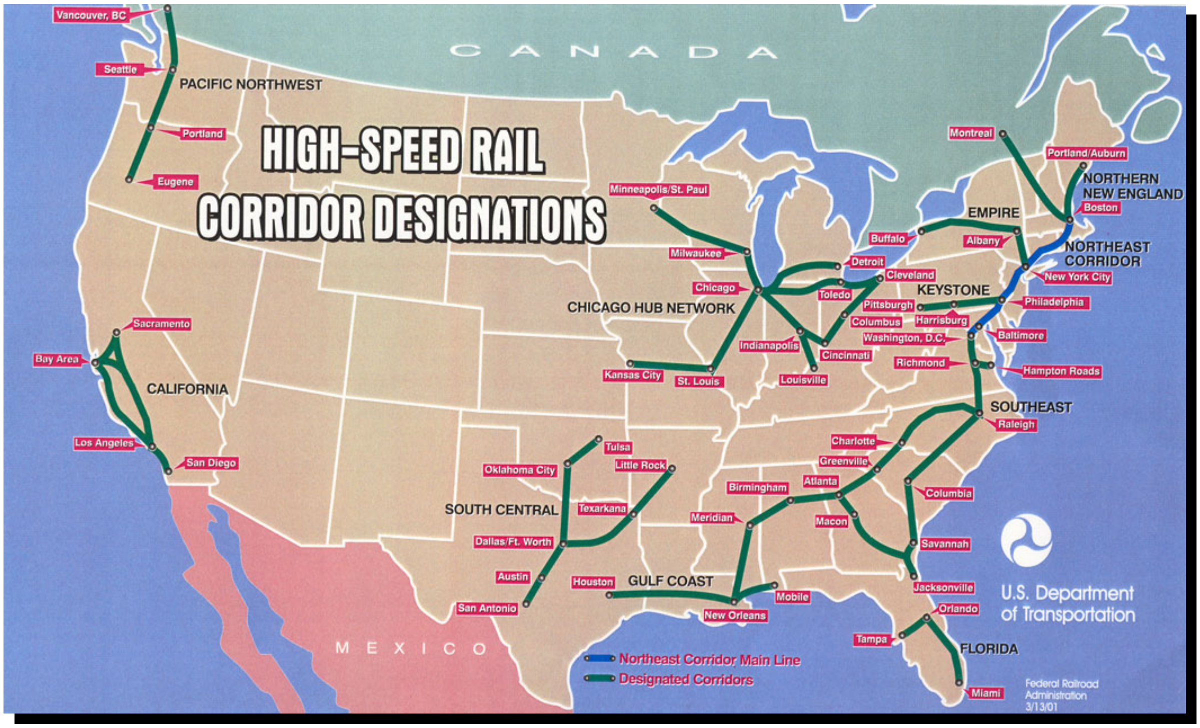
This is a market-based, not a speed based definition. However, to provide time-competitive travel times, high-speed trains must operate at maximum speeds that result in an average speed that corresponds to competitive travel times. When considering if a rail route could qualify for designation as a high-speed corridor, the Secretary of Transportation is required to consider whether railroad speeds of 90 miles per hour or more are occurring or can reasonably be expected to occur in the future. For the BMHSR Corridor it is anticipated that speeds within segments of the route in excess of 90 mph would be possible. This assumption was utilized in developing estimated trip times used to support development of the ridership forecasts projected in Chapter 3. The detailed analysis of operations, including development of specific operating speed limits, will be included in Phase II of the Study.

## Designated High-Speed Rail Corridors

The FRA has designated high-speed corridors under section 1010 of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and Section 1103(c) of the Transportation Equity Act for the 21st Century of 1998 (TEA-21). The designation allows states through which the corridor passes to receive earmark funding for study, design, and construction as well as receive specially targeted funding for highway-rail grade crossing safety improvements, and recognizes that the corridor has a potential for HSR activity. The BMHSR Corridor was designated by U.S. Transportation Secretary Rodney E. Slater on October 11, 2000 as a high-speed rail corridor as part of the "Northern New England Corridor," with a hub at Boston and two spokes: one to Montreal, Quebec, Canada, via Concord, New Hampshire, and Montpelier, Vermont; and the other to Portland/Lewiston-Auburn, Maine. The BMHSR Corridor is shown with other corridors in Figure E.1.

[3] Ibid.

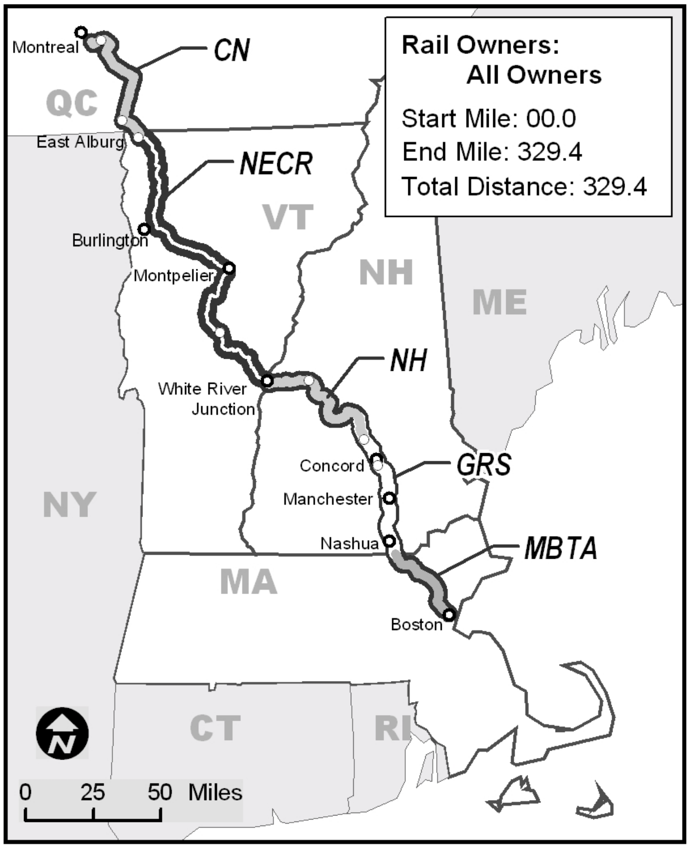
### Figure E.1 - FRA High-Speed Rail Corridor Designations




## Current Rail Services

The BMHSR Corridor is owned by the Canadian National Railroad (CN), New England Central Railroad (NECR), State of New Hampshire, Guilford Rail System (GRS), and the Massachusetts Bay Transportation Authority (MBTA) as shown in Figure E.2. Six railroads operate on right of way in the BMHSR Corridor: the Canadian National, New England Central Railroad, Claremont Concord Railroad (CCRR), New England Southern (NEGS), Guilford Rail System, and the Massachusetts Bay Transportation Authority. The majority of the segment owned by the State of New Hampshire is not operated. There are freight operations on all active corridor segments. Also, passenger services on the BMHSR Corridor include commuter rail operations serving Boston and Montreal, and intercity Amtrak service in Vermont from White River Junction to St. Albans and VIA Rail in the area of Montreal. The study team met with representatives from railway owners and operators of the proposed high-speed route to develop information concerning existing rail services on the proposed BMHSR Corridor. A detailed description of the current services provided by each operator is included in Chapter 2 of this report. As noted in the report, operators of the service in some segments of the BMHSR Corridor are not the owners of the railroad.

**Figure E.2 – BMHSR Corridor Owners**

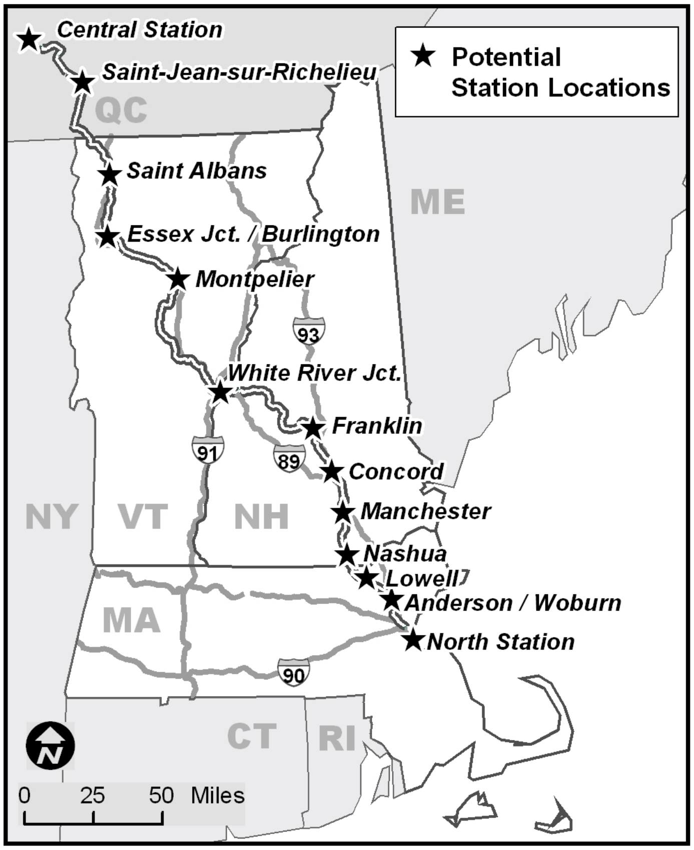



## Stations

A passenger train station comprises a number of elements that support the arrival and departure of passengers utilizing a specific rail service. Principal elements include station platforms, station buildings, parking areas, pickup and drop off areas, and intermodal connections. How each of these elements are designed and implemented has a substantial impact on the experience of passengers.

Thirteen potential station service areas have been identified for conceptual service design. Spacing between station sites varies between seven and sixty miles. Primary stations are spaced on average 15 to 18 miles apart on the south end of the BMHSR Corridor and generally further apart on the north end. The criteria used to identify station service areas includes proximity to key population and employment centers, proximity to high growth areas and/or major tourism and recreational areas, potential to serve key travel markets or city pairs, accessibility by auto, connectivity to other modes (transit, air) and station spacing. Figure E.3 illustrates potential station locations.

**Figure E.3 – Potential Station Locations**




## Terminal Stations

The two endpoint terminal stations of the BMHSR route are large multi-tracked stations in the Montreal and Boston downtown areas.

### *Central Station - Montreal*

CN's Central Station in Montreal is a substantial subterranean rail passenger terminal with 19 tracks and 8 passenger platforms serving 16 tracks. The passenger concourse at street level is above the passenger platforms. A service concourse below the track level is used for automobile parking, baggage handling and logistics. No freight trains use this station.

### *North Station – Boston*

Serving communities north of Boston, the MBTA-owned North Station provides rail service with ten tracks and five platforms. The MBTA uses the station to serve four different commuter rail lines. Amtrak uses the station for the southern terminus of its Downeaster service to Maine. On a normal weekday, 188 passenger trains serve North Station. No freight trains use this station. Currently North Station provides service for diesel locomotives only.

## Track Configuration

### *Physical Characteristics*

The 329-mile long corridor that connects Boston and Montreal is a composite of five different railroad properties. As part of Phase I of the Study, an initial inventory of the physical characteristics of the BMHSR Corridor was conducted. This effort was made to support development of travel time estimates. Detailed evaluation of the physical characteristics of the line will be made during Phase II of the study. Current right-of-way conditions that have impact on the potential feasibility of high-speed train operations include curvature, grade crossings, right-of-way width, and grades. Current track conditions are indicative of the opportunities and challenges associated with upgrading the track.

Track conditions vary from the MBTA's New Hampshire Main Line (Boston to Lowell), currently maintained at FRA Classes 3 and 4 (maximum passenger operating speed 60 mph and 80 mph, respectively), and a section of CN's St. Hyacinthe Sub maintained at the equivalent of FRA Class 6 (maximum passenger speed 110 mph), to sections of track operated at a maximum speed of 10 mph, or indeed, no track at all. It should be noted that since much of the line would require track and signal improvements, current track conditions are less important to the development of a high-speed rail operation than are other right-of-way characteristics such as curvature, grade crossings, right-of-way width, and grades.

#### Railroad-Highway Grade Crossings

Rail/highway crossings at-grade are a safety issue, especially at high train speeds. Conditions at each crossing must to be addressed individually. Options to provide adequate safety at the grade crossings include crossing elimination, grade separation, active warning systems and limiting speed.

Three hundred sixty (360) grade crossings have been identified on the BMHSR Corridor. The grade crossings are classified as public, private, and farm. The warning systems for the public crossings from Boscawen, New Hampshire to Lebanon, New Hampshire, where the tracks have been removed, have been either deactivated or removed. Virtually all the private and farm crossings have no active warning systems. Some are equipped with passive sign-type warning devices, but most have no warning devices. Many of the public crossings over active tracks have active warning systems, but are not equipped with gates.

## ■ E.3 Ridership Analysis

### Overview

A train simulation model was developed to determine train travel times. A travel demand model was developed that utilized the train travel times and included mode choice analysis based on traveler preference surveys. These efforts enabled the development of ridership estimations for various scenarios. Each of these steps is outlined below.

### Train Operations Planning and Modeling

A computer rail network simulation model of the study area for the BMHSR Corridor was developed to simulate anticipated train operations. The model was utilized to establish potential BMHSR trip times required to support the ridership forecasting.

The network simulation model for the study area between North Station in Boston and Central Station in Montreal was constructed using available track charts and timetable special instructions to replicate the physical characteristics of the infrastructure, including track distances, speeds, geometry, grades and curvature.

Three different infrastructure "case" characteristics were defined to test in the simulation model, as summarized below:

- Low Speed: Present alignment was utilized including existing track conditions, existing track geometry and existing timetable running speeds for passenger service on time respective lines. For the abandoned BMHSR Corridor segment between Concord, New Hampshire and White River Junction, Vermont, the last available published timetable was utilized. Maximum train speed is 60 mph. This would be similar to the existing Amtrak intercity service on the BMHSR Corridor.
- Mid Speed: FRA Class 6 with improved curve speeds: Present alignment was utilized with a 110 mph maximum speed with curve speeds restricted by track geometry. Non-geometric timetable speed restrictions were maintained. Existing grades were maintained
- High Speed: FRA Class 6 with no speed restrictions: A 110 mph maximum speed was utilized with no speed restrictions through curves. Existing grades were maintained.

An upper limit of 110 mph was identified to correlate with the likely maximum operating speed over the majority of the BMHSR Corridor. One reason for this is that for train speeds from 111 mph to 125 mph highway grade crossings must be either grade separated or have a sophisticated FRA-approved warning/barrier; and for speeds above 125 mph, no at-grade highway crossings, public or private, are permitted. Furthermore, the High Speed case requires that all restrictions for curves be eliminated. This approximates construction within a new and dedicated right of way such as was done for the French TGV train. As the BMHSR Corridor will utilize the existing right of way, it is deemed unlikely that all curve restrictions could be removed. Therefore, it is assumed that the Mid Speed case represents the maximum practical operating condition that could be obtained for the BMHSR Corridor.

## Market Analysis

### *BMHSR Corridor Overview*

The BMHSR Corridor is roughly equal in length to the Northeast Corridor between Boston and Philadelphia. The project's study area links key population centers of northern New England and connects the major economic centers of Boston and Montreal.

The BMHSR Corridor traverses three states: Massachusetts, New Hampshire and Vermont, and the southern part of Quebec. Combined, these states and the Montreal metropolitan area have a population of approximately 11.6 million people. In the U.S. portion of the BMHSR Corridor, the population is concentrated in the southern end of the corridor, close to the Boston area, declining in density as the distance from Boston increases, until Chittenden County (Burlington), another population center. Similarly, population in the Quebec province is concentrated in Montreal and its density decreases as the distance from the city increases.

### *BMHSR Corridor Travel Options*

The travel options within the BMHSR Corridor can be broken down into essentially three modes: private automobiles, motor coach (bus), and airplane. Each of these modes offers trade-offs in the level of convenience, flexibility, or price.

Three U.S. border gates exist in the vicinity of the BMHSR Corridor: Champlain-Rouses Pt., New York, Highgate Springs, Vermont and Richford, Vermont. Over 2 million vehicle crossings occur annually at these three border crossings. Additional information regarding travel demand in the BMHSR Corridor is provided in Chapter 3 of this Study.

In the U.S., personal vehicles are used as the primary mode of transportation for eight out of 10 trips greater than 100 miles in length. In the U.S. BMHSR Corridor, however, this number increases to nearly 97 percent. Massachusetts had the highest use of modes other than automobile, with about 5 percent of long-distance trips being made by airplane, bus or train.

As a component of the travel demand model, four individual surveys were conducted within the BMHSR Corridor. Two surveys, one at the Hooksett tolls and the other at the Highgate Welcome Center near the Canadian border, targeted interstate automobile traffic. One survey focused on intercity bus passengers as they traveled in the BMHSR Corridor and a final survey was conducted at Logan Airport in Boston with airline passengers traveling to Montreal. The combined results of the surveys provided an overview of both typical traveler characteristics and stated preference with regard to service characteristics of current and potential travel modes in the BMHSR Corridor.

A key component in determining the feasibility of high-speed rail service from Boston to Montreal is the development of reliable forecasts for intercity rail travel in the BMHSR Corridor. For this Study, an integrated discrete choice model was developed to reliably predict ridership for a series of intercity rail alternatives. The projected ridership consists of both diverted trips (trips currently being made on other modes that would be made by rail if it were available) and induced trips (trips that will be made only if the proposed rail service is available).

### *Model Assumptions and Travel Times*

The project steering committee reviewed seven alternative service scenarios to determine the potential ridership range of the BMHSR service. The scenarios utilized the three operating cases developed for the network simulation model for low speed, mid speed, and high-speed. The ridership model utilized information on the comparable costs and travel time for auto, air, and bus operations. The cost for auto was established at $0.12/mile. This cost has been used in similar studies and reflects the perceived cost for a motorist deciding to make a trip. The costs for air and bus, based on the current fares for travel between Boston and Montreal, were established at $0.31/mile and $0.14/mile, respectively. Round trips available per day for the air and bus service were assumed to be eight and six, respectively. The test fares for rail were selected based on the range of fares between existing regional lower speed intercity trains and new and existing high-speed trains. The actual rates would be set to optimize ridership and revenue that maximizes the benefits of the BMHSR Corridor. The detail fare analysis will be included in Phase II of the Study.

Currently, trains traveling between U.S. and Canada are required to stop at the border for customs and immigration inspections and clearance. Discussions with customs and immigration staff indicate that efforts are underway to improve and expedite the inspection and clearance procedures to enable trains to be operated without stopping at the border. Thus, the ridership modeling assumed that the trains would not be required to stop at the border.

### *Diverted and Induced Trips*

Most of the projected trips within the BMHSR Corridor are diverted from other modes. That is, the trips would have occurred without the construction of the BMHSR but would have used another mode, in this case mainly automobile. Furthermore, each alternative also produces some additional induced trips that would be taken only with the availability of HSR. Forecasts of ridership for combined induced and diverted trips and revenues for each scenario were developed as shown in the Table E.1.

**Table E.1 – 2025 Summary Table of BMHSR Ridership**

| | Low Speed | Mid Speed | Mid Speed High Fare | Mid Speed Low Frequency | Mid Speed All Stations | Mid Speed Low Fare | High Speed |
|---|---|---|---|---|---|---|---|
| Annual Ridership | | | | | | | |
| Total Corridor | 213,276 | 446,710 | 330,097 | 86,962 | 588,630 | 683,667 | 644,232 |
| Boston-Montreal | 13,469 | 129,508 | 84,428 | 27,143 | 129,508 | 221,227 | 200,564 |
| Annual Passenger Revenue | | | | | | | |
| Total Corridor | $4,784,504 | 27,893,059 | 22,559,907 | 5,724,020 | 32,291,348 | 34,614,601 | 59,062,561 |
| Boston-Montreal | $744,341 | 11,619,093 | 8,739,297 | 2,434,820 | 11,619,093 | 15,271,257 | 24,917,799 |
| Cost per Passenger-Mile (fare) | | | | | | | |
| HSR (Varies by scenario) | $0.16 | $0.26 | **$0.30** | $0.26 | $0.26 | **$0.20** | $0.36 |
| Round trips per day | | | | | | | |
| HSR (Varies by scenario) | 4 | 6 | 6 | **2** | 6 | 6 | 8 |
| Number of Stations | 12 | 8 | 8 | 8 | **12** | 8 | 6 |
| Boston to Montreal Total Trip Time – Vehicle and Terminal (hours: mins) | | | | | | | |
| HSR (Varies by scenario) | 8:55 | 5:48 | 5:48 | 5:48 | 5:48* | 5:48 | 4:31 |
| Air (Same all scenarios) | 3:20 | 3:20 | 3:20 | 3:20 | 3:20 | 3:20 | 3:20 |
| Bus (Same all scenarios) | 6:20 | 6:20 | 6:20 | 6:20 | 6:20 | 6:20 | 6:20 |
| Auto (Same all scenarios) | 5:52 | 5:52 | 5:52 | 5:52 | 5:52 | 5:52 | 5:52 |

* Travel trip time was not increased to test only the sensitivity of number of stations stops at this level of the analysis

### *Summary of Results*

The ridership forecasts predict that a significant number of riders would use the service. As noted above, the Mid Speed scenario represents the maximum practical operating condition that could be obtained for the BMHSR Corridor. Therefore, the results of the Mid Speed scenarios are of principal interest. The maximum ridership forecast of 683,667 was derived from the Mid Speed scenario with the lowest fare rate. In addition, the Mid Speed scenario with the lowest fare rate also realized the maximum revenue from fares of $34,614,601. Therefore, the results indicate that a competitively priced HSR service would have both the greatest ridership and the highest operating revenue.

## E.4 Government and Policy Issues

The U. S. Secretary of Transportation has recently outlined the Administration's goals with respect to national intercity passenger rail services. Essentially, the emerging policy suggests that a national system should be regionally based, be shaped by market forces, and receive support of state government to meet operating costs that exceed revenue.

Thus, the multi-state and international structure of the BMHSR Corridor is reflective of this emerging policy as it is a state-led initiative, focused on regional connectivity. The response of the Quebec government that indicates support for the continuation of the Study to determine if the BMHSR service is feasible underscores the appropriateness of evaluating the BMHSR Corridor. Chapter 4 of this study identifies the federal and state laws that are applicable to the proposed BMHSR service. Environmental considerations, followed by more specific regulatory and permit issues, and U.S. and Canada customs and immigration regulations for border crossings, are assessed. Both U.S. and Canadian Customs and Immigration officials expressed optimism that new technology and new agreements would help to provide for safe, effective and efficient border crossing for train passengers. Therefore, the Study assumes that methods will be developed that will eliminate the need for stopping the BMHSR train at the border.

In future Study phases, site-specific issues related to environmental permitting, historic and archeological resources, will need to be addressed. International issues must also be considered in terms of both opportunity and challenge. However, the BMHSR Corridor has long served as a transportation corridor, and this current level of analysis indicates that all legal and regulatory requirements can be met.

## E.5 Conclusion

Based on this initial assessment of existing operations, infrastructure, and institutional issues, and consideration of alternative service scenarios, it is concluded that, given the potential ridership of the BMHSR service, the further study of associated operational, engineering and cost/revenue factors is warranted.

The BMHSR Corridor would require substantial rail infrastructure improvements to support high-speed rail service. However, the service is expected to be compatible with existing and future passenger and freight rail operations. Further, an initial assessment of environmental and institutional issues indicates that with appropriate planning and design, environmental and institutional requirements can be satisfied.

Sufficient potential ridership and fare revenue exists to warrant the implementation of Phase II of the Study for evaluation of the operating and capital costs, and associated benefits, of implementing a high-speed rail service between Boston and Montreal.