Rhode Island Intrastate Commuter Rail: *Feasibility Study*

Final Report

June 30, 2009
Prepared For:
The Providence Foundation

SPONSORED BY:

The Providence Foundation

City of Woonsocket

Federal Highway Administration

U.S. Department of Transportation
Federal Highway Administration

Rhode Island Statewide Planning

Prepared By:

JACOBS™

Jacobs Engineering Group
Boston, MA

With:

Oak Square RESOURCES, LLC

Oak Square Resources
Brighton, MA

REPORT NAME: Rhode Island Intrastate Commuter Rail: *Feasibility Study*

PREPARED FOR: The Providence Foundation

PREPARED BY: Jacobs Engineering Group
Oak Square Resources

DATE: June 30, 2009

Woonsocket to Warwick Intrastate Commuter Rail Feasibility Study
Steering Committee Members

Name	Organization
John Aubin	Town of Cumberland
Dan Baudouin	The Providence Foundation
Catherine Ady Bell	City of Woonsocket
Bob Billington	Blackstone Valley Tourism Council
Annette Bourne	Rhode Island Housing
Mark Carruolo	City of Warwick
Bernard Cartier	Providence and Worcester Railroad
Mike Cassidy	City of Pawtucket
Ann Clarke	Rhode Island Airport Corporation
Steve Devine	Rhode Island Department of Transportation
Kevin Dillon	Rhode Island Airport Corporation
David Farmer	McMahon Transportation
John Flaherty	Grow Smart Rhode Island
John Gregory	Northern Rhode Island Chamber of Commerce
Melanie Jewett	City of Providence
Jennifer Kilsey	City of Pawtucket
Simon Kue	Rhode Island Department of Administration
Peter Lapolla	City of Cranston
Gary Leib	Town of Cumberland
Thomas Mann, Jr.	Pawtucket Foundation
Paul Ouellette	Northern Rhode Island Chamber of Commerce
Al Ranaldi	Town of Lincoln
Ralph Rizzo	Federal Highway Administration
Everett Stuart	Rhode Island Association of Railroad Passengers
Mark Therrien	Rhode Island Public Transit Authority
Sharon Traficante	Rhode Island Airport Corporation
Katherine Trapani	Rhode Island Department of Administration
Robert Vanderslice	Rhode Island Department of Health
Mike Walker	Rhode Island Economic Development Corporation
Paula Watt	City of Cranston
Dan Webber	Rhode Island Department of Transportation

Questions or comments for members of the Steering Committee should be directed to Mr. Dan Baudouin of the Providence Foundation at dbaudouin@provfoundation.com

INTRASTATE COMMUTER RAIL FEASIBILITY STUDY: PROJECT OVERVIEW

Under the auspices of a Rhode Island Statewide Planning Challenge Grant, the Providence Foundation worked with the City of Woonsocket, other affected communities, RIDOT, RIPTA, RIAC and Jacobs Engineering to explore the potential for an attractive intrastate passenger rail service operating between Woonsocket and TF Green Airport in Warwick. The study found that intrastate commuter rail would serve two-thirds of Rhode Island's population and most major employment centers by operating on two active lines: Amtrak's Northeast Corridor (NEC) and the Providence and Worcester's (P&W) mainline. Directly served communities would include Warwick, Cranston, Providence, Pawtucket, Cumberland and Woonsocket. Four travel markets would be served: Providence, Boston, Air Travelers, and Airport Employees.

The intrastate service would leverage and strengthen the state's substantial infrastructure investment constructed for the MBTA *South County I* project opening in 2010. The *South County I* initiative will extend Providence commuter rail service south with 16 daily trains between Boston and Warwick/Wickford. The intrastate service would dramatically increase rail travel opportunities at the airport. Most intrastate infrastructure upgrades would be required along the P&W mainline between Pawtucket and Woonsocket. Necessary upgrades along the NEC are minimal, and are primarily associated with station development.

With the high population density in the study corridor, the close proximity of multiple travel markets, and relatively short forecast trip lengths, the intrastate service is forecast to attract substantial ridership with modest capital investments. For planning purposes it is assumed that P&W could operate the intrastate service under contract to RIDOT or RIPTA.

The forecast performance of the Rhode Island intrastate service compares very favorably with other projects receiving federal funds through the Federal Transit Administration's (FTA) *New Starts* process. The forecast operating costs and ridership are attractive compared with the eight smallest commuter railroads currently operating in the United States.

Metric	Rhode Island Intrastate Service (Option 2)	Peer Group Average
Estimated Capital Cost ($ millions)	$149	$896
Annual Operating Cost ($ millions)	$6.7	$24.9
Forecast Daily Ridership	6,000	17,760
Capital Cost per Weekday Passenger Boarding (000s)	$25	$46
Operating Cost per Passenger Trip	$3.96	$13.16
Forecast Passenger Revenue per Passenger Trip	$2.45	$3.62
Farebox Recovery Ratio (Fares/Operating Cost)	62%	29%
Required Annual Operating Support ($ millions)	$2.6	$16.73
Operating Subsidy per Passenger Trip	$1.51	$9.54

The relatively low forecast operating cost (and its associated metrics) for the Rhode Island intrastate service reflects the relatively modest extent of the proposed network, small vehicle fleet, sharing infrastructure with other carriers and operators, and serving multiple travel markets with a single service. Together, these factors make the proposed service a potentially very attractive fixed guideway transit investment.

The next steps for implementation of this project include:

- Integrating the service proposal into the state's transportation development plans including formal inclusion in Rhode Island's next Transportation Improvement Program (TIP).

- Completing the *South County I* project with associated NEC infrastructure improvements and rail station at TF Green Airport *(underway)*

- Reopening Pawtucket Station for passenger rail service to Boston *(in process)*

- Continuing dialogue with the Providence and Worcester Railroad concerning its potential cooperation and support for operation of passenger rail service along its mainline between Woonsocket and Pawtucket.

- Continue planning for the service in the context of the Federal Transit Administration's multi-step *New Starts* process including a formal Alternatives Analysis, followed by a formal Environmental Study with Preliminary Engineering, followed by Final Design and Construction.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Introduction

This study sponsored by the Providence Foundation, City of Woonsocket, the Federal Highway Administration, and the Rhode Island Department of Statewide Planning explores the potential for intrastate passenger rail service serving two-thirds of Rhode Island's population and many of its major employment centers (e.g., Providence, TF Green Airport). The study builds upon earlier work (2007) that identified an intrastate service linking Woonsocket with Providence as a promising future passenger rail service. The study seeks to leverage the state's substantial investment in rail facilities to extend Boston-Providence commuter rail service. The Rhode Island Department of Transportation is presently constructing new commuter rail stations at TF Green Airport in Warwick and at the Wickford Junction mixed use development in North Kingston along Amtrak's Northeast Corridor (NEC).

The intrastate service would require cooperation with the Providence and Worcester Railroad (P&W), Amtrak, and the MBTA. A high level of cooperation would be required with the P&W which would share long sections of right-of-way with the proposed Woonsocket-Warwick passenger service. Given the frequent intercity and commuter trains already serving Providence Station, cooperation with Amtrak and the MBTA would also be critical to coordinate the operation of trains into Providence Station via the shared Amtrak NEC Track 3.[1]

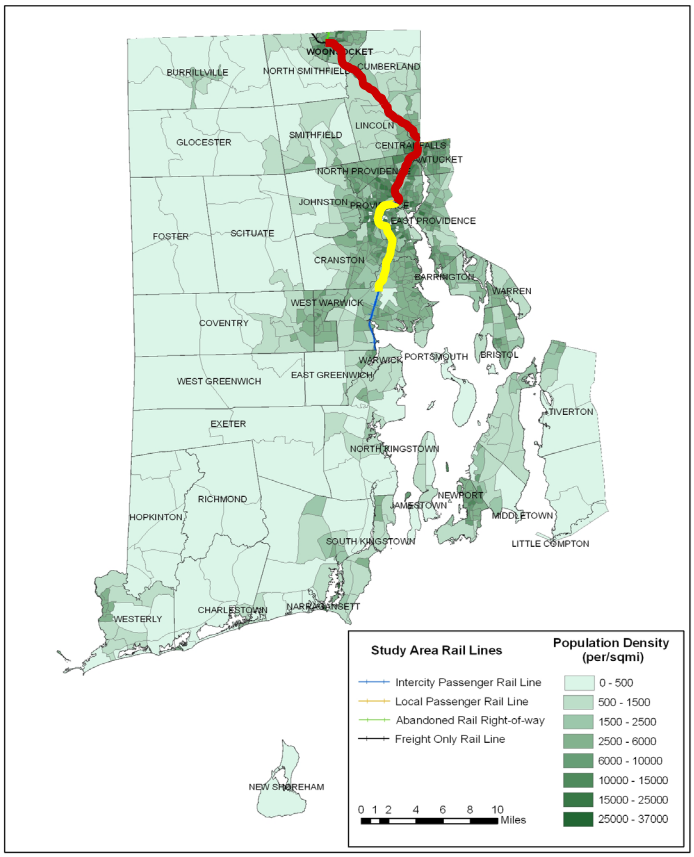


Figure ES.1:
Study Corridor

For planning purposes, it is anticipated that the new passenger trains could be operated by P&W under contract to RIDOT or RIPTA.[2] The use of the P&W to operate passenger services in conjunction with their freight operations would create synergies that would not be possible with a third party passenger rail operator. Elsewhere in the United States, owner-operators provide passenger rail service in Chicago, Seattle, and Portland, Oregon.

[1] Also known as the Freight Rail Improvement Project (FRIP) Track
[2] P&W has expressed interesting in possibly operating the service under contract to RIPTA or RIDOT.

Objectives
This project addresses several concerns relating to a possible extension of intrastate rail service to TF Green Airport. These analytic objectives include the 10 topics listed below:

1. Determine the physical feasibility of developing the proposed extension of service from Providence to Warwick.
2. Identify conflicts between existing and future planned rail services.
3. Develop feasible operational plans for a potential rail service with infrastructure improvements necessary to integrate the new service with other passenger and freight railway services in operation or development.
4. Identify the most appropriate rolling stock and mode of train operation.
5. Forecast potential ridership for the proposed new service.
6. Forecast capital and operating costs of the Providence and Warwick intrastate service extension.
7. Evaluate possible passenger stations in Providence (Olneyville) and Cranston.
8. Explore Transit Oriented Development (TOD) opportunities around the existing and planned stations.
9. Explore the economic, mobility and environmental benefits of the intrastate rail service with state and local planning officials.
10. Encourage smart growth in the study corridor by bringing municipalities and transit agencies together to meet their goals.

Corridor Travel Markets
The potential travel market includes the thirteen communities which are geographically aligned to directly benefit from commuter rail service. The route would serve more than two-thirds of Rhode Island's population. Employment and transit trends along the corridor indicate that:

- Over the *entire* study corridor more than one third of all workers are employed in the City of Providence. In every corridor community at least one in ten workers (10%) are employed in Providence.

- Forty to fifty-five percent of the households in every corridor community have a household income of $35,000 to $100,000. This income range is typical for commuter rail passengers.

- Eighty percent of corridor residents drive alone to work. Communities with large low income populations tend to form more carpools. The transit riding habit appears strongest in Providence (7%), Pawtucket (4%), and Central Falls (3%).

Intrastate commuter rail service would directly serve four travel markets:
- Providence – Intrastate travel to Providence from Woonsocket, Cumberland, Pawtucket, Cranston and Warwick.
- Boston – Interstate travel to Boston from Woonsocket, Cumberland and Cranston
- Airport Travelers – Air passengers to or from Rhode Island using T.F. Green Airport
- Airport Employees – Local airport employees to and from work at T.F. Green.

Since 1991, Providence Station has seen a positive growth in passenger traffic when the MBTA reported 692 daily boardings. Ridership is forecast to grow to almost 1,500 daily boardings by 2025.

Potential Stations
The intrastate service would traverse 25 miles on two active rail corridors: 11 miles of the P&W mainline from Woonsocket to Boston Switch (Pawtucket), and 14 miles of Amtrak's NEC from Boston Switch to Warwick. Most stops would be located on the Amtrak line.

MP	Station	Location	Status
0.0	Woonsocket	P&W	Planned
9.2	Cumberland	P&W	Planned
11.7	Pawtucket	NEC	Preliminary Design
16.2	Providence	NEC	Existing
17.8	Olneyville	NEC	Planned
21.2	Cranston	NEC	Planned
24.9	Warwick	NEC	Under Construction

Transit Oriented Development (TOD)
The project team identified many attractive TOD opportunities associated with new or expanded stations along the route. Municipal officials in the vicinity of every potential station (except Lincoln) expressed favorable opinions regarding intrastate service. The local planners see the implementation of intrastate service as a catalyst for economic growth, and a way to reuse and revitalize extant buildings near each station.

At this early feasibility stage in the project development process, it is premature to explore TOD opportunities in great detail. However, the study team did find broad and deep interest among public officials in pursuing TOD and the Smart Growth objectives at station areas should the intrastate passenger rail service prove financially and physically feasible.

Opportunities and Constraints
The study team identified several clear opportunities and constraints relative to developing an economically attractive intrastate commuter rail service. Six opportunities favor implementation of intrastate service:

- Local interest and support
- Active rail corridors
- Existing stations
  - Warwick
  - Providence
  - Pawtucket (planned)
- New line capacity (the FRIP and improvements necessary for MBTA Warwick service)
- Three complimentary passenger rail travel markets
  - Travel to Providence
  - Travel to Boston
  - T.F Green Airport travel including both air passengers and employees

Five constraints limit the development of intrastate service

- Zero tolerance for Amtrak conflicts
- Sharing the single FRIP track with MBTA and P&W
- Preserving capacity for ambitious P&W and Amtrak future growth
- Providence Station capacity
- Warwick track configuration
- Limited interest in Lincoln

Possible Services

Based on these opportunities and constraints, five objectives guided the development and preliminary evaluation of service options.

Objective 1: Enable passengers to travel between Woonsocket and Warwick Station via Providence.

Objective 2: Maximize connections to MBTA Boston service for Woonsocket and Cumberland passengers.

Objective 3: Avoid conflicts with current and planned future services on the line, including services operated by Amtrak, the P&W, and MBTA.

Objective 4: Avoid travel on the Northeast Corridor (NEC) mainline (e.g., Tracks 1 and 2).

Objective 5: Create conditions to foster Transit Oriented Development and Smart Growth in the communities along the line

Operationally, the most substantial challenge faced in designing workable service options was the 14 miles of single track available for service between Boston Switch and Warwick.

All intrastate passenger services options are designed and configured to limit operations to the third diesel-only track on the west side of the Amtrak right-of-way. Under normal circumstances, no intrastate trains would use the electrified mainlines. However, in the event of unusual or extraordinary circumstances, such as equipment malfunctions or accidents, it may be necessary to route intrastate trains onto the NEC mainlines to relieve conflicts and reduce delays.

Options 1 and 2 respond to the MBTA's 2010 South County schedule and current levels of Amtrak and P&W traffic. Both options provide 17 roundtrips between Woonsocket and Warwick with 17 daily connections to MBTA Boston service at Pawtucket. Option 2 includes adjustments that allow 14 MBTA South County trains to provide direct service between Cranston and Boston.

Options 1A and 2A respond to Amtrak and P&W 2030 expansion plans. The ambitious plans call for a 100% increase in freight train movements along the shared track segments increasing the number of weekday freight trains to 16. The increased level of freight traffic would require one midday passenger trip to be dropped. The number of daily MBTA connections would be

reduced to 15. Should the ambitious growth forecast for the P&W fail to materialize Options 1 and 2 could be operated.

Table ES.1:
Intrastate Service Overview

Option No.	Weekday Intrastate Trains	Weekday Intrastate Trains to Woonsocket	Weekday Trains Serving Providence	Weekday Trains Serving Cranston	Weekday Intrastate Trains to Warwick	Woonsocket Connections to Boston	Woonsocket Connections from Boston
Option 1	34	17	34	34	17	8	9
Option 2	34	17	34	34	17	8	9
Option 1A	32	16	32	32	16	7	8
Option 2A	32	16	32	32	16	7	8

Each of these services would make the 8.7 mile trip between Warwick and Providence in 14 minutes making stops at Cranston and Olneyville. The 16.2 mile trip between Woonsocket and Providence would take 22 minutes making stops in Cumberland and Pawtucket. With the introduction of intrastate service, the increase in daily train traffic at Providence would be substantial, as shown below.

Table ES.2:
Total Trains Serving Major Destinations

Option No.	Weekday Intrastate Trains Operated	Amtrak Trains Serving Providence	MBTA Trains Serving Providence	Total Trains Serving Providence[3]	MBTA Trains Serving Cranston	Total Trains Serving Cranston[4]	MBTA Trains Serving Warwick	Total Trains Serving Warwick[5]
Baseline	0	36	32	68	0	0	16	16
Option 1	34	36	32	102	0	34	16	50
Option 2	34	36	32	102	14	48	16	50
Option 1A	32	50	32	114	0	32	16	48
Option 2A	32	50	32	114	16	48	16	48

Passenger Forecasts

Details for the 2030 forecast weekday intrastate service boardings for all the service options are shown in Table ES.3.

[3] Amtrak, MBTA and Intrastate Trains
[4] MBTA and Intrastate trains
[5] MBTA and Intrastate trains. (16 MBTA trains stopping at Warwick and 17 intrastate trains stopping at Warwick.)

Table ES.3:
2030 Forecast Intrastate Service: Inbound Weekday Boardings by Station

	To Providence	To Boston	Air Travelers	Airport Employees	Total Boardings
Woonsocket	197	222			419
Cumberland	357	16			373
Pawtucket	456				456
Providence	NA	NA		NA	NA
Olneyville	40				40
Cranston[6]	571	212[7]			783
Warwick	495[8]		89[9]	344[10]	928
Totals (Options 1 & 1A)	2,116	238	89	344	2,787
Totals (Options 2 & 2A)	2,116	450	89	344	2,999

Overall, the 2030 forecast for expanded intrastate service would be approximately 2,800-3,000 weekday riders (inbound boardings). Total forecast boardings for the mix of intrastate and MBTA trains serving the line would be in the range of 5,600 to 6,000 passenger trips. Compared with earlier estimates the new ridership forecasts are somewhat greater.

- Ridership forecasts from a previous Woonsocket commuter rail feasibility study[11] indicate that overall forecast ridership from the northern leg of the service (Woonsocket to Pawtucket) increased 10% from 1,132 boardings in 2007 to 1,248 total boardings due two factors:
    1. ~10% higher automobile driving costs due to fuel price increases
    2. Lower fares for travel on the intrastate service to maintain consistency with intrastate fares that are planned for the Warwick and Wickford Junction services that will open in 2011.
- Ridership forecasts of airport employee travel from 1998[12] are increased to reflect higher levels of airport activity than had been forecast in 1998.
- Forecast travel by air travelers is increased from an earlier study[13] to reflect
    1. Higher levels of airport activity than had been forecast in 1998,
    2. More attractive intrastate service than had been under consideration in 1998
    3. More attractive MBTA service than had been assumed in 1998.

[6] In Option 2, this travel flow would be served by a mix of ~16 MBTA and ~32 intrastate trains.
[7] Forecast for new direct MBTA service to Boston. No intrastate passengers to Boston
[8] This travel flow would be served by a mix of 16 MBTA and ~32 intrastate trains. The 495 passengers would be in addition to the 398 forecast for MBTA service only.
[9] Does not include the 83 air travelers that would use the MBTA for travel to Boston.
[10] It is assumed that all airport employees would use the intrastate service.
[11] Jacobs Edwards and Kelcey. (2007) *Woonsocket Commuter Rail Feasibility Study*. Prepared for the City of Woonsocket, pp. 33 – 34.
[12] Edwards and Kelcey. (May 1999). *Warwick Intermodal Station at T.F. Green Airport, Warwick, Rhode Island: Environmental Assessment.* Prepared for United States Department of Transportation, Federal Highway Administration, and the Rhode Island Department of Transportation. Derived from tables presented on pages A-9 and A-10.
[13] Ibid

It is forecast that the addition of 32 to 34 weekday trains between Warwick and Providence would stimulate 495 more weekday trips by commuters between Warwick and Providence. These new riders would supplement the commuters that would use the 16 daily MBTA trains already running between Warwick and Providence.

The forecast travel for the five mile trip between Cranston and Providence is consistent in scale with the forecasts for travel from Woonsocket, Cumberland, and Pawtucket.

Assuming the intrastate service would carry two thirds of all intrastate commuters from stations served by both MBTA and intrastate trains, the total daily commuter flow to Providence on the intrastate service would be in the range of 2,022 to 2,210. It is assumed that all airport employees using rail service would use the intrastate service. Under these assumptions the total intrastate ridership would entail ~5,500 to 6,000 weekday boardings.

It is likely that one third of the intrastate travelers would travel in the peak morning hour. Under that condition the peak load point on the service would be between Pawtucket and Providence with a peak hourly flow of approximately 450 passengers.

Fleet Requirements

All options would use two three-car trains operating all day. Diesel Multiple Units (DMU) vehicles were chosen to operate the intrastate service due to lower maintenance and operating costs for short train lengths. Using locomotives to haul push-pull coaches would slightly increase running times and overall operating costs. Each consist will comprise two DMUs and one coach. Including spares, a total fleet of nine vehicles would be required. If locomotives and coaches were employed, nine coaches and three locomotives would be required.

It is assumed that Amtrak would allow the use of compliant DMUs on the Northeast Corridor. The State of Vermont had been collaborating with Amtrak to purchase a small fleet of DMUs for its state supported Amtrak service between New Haven and St. Albans, VT. DMU's have historically operated on the corridor in Massachusetts, Rhode Island and Connecticut. The lone supplier currently constructing DMUs for unrestricted use on the national railway network recently ceased operations due to financial difficulties. Several other firms however have expressed in building DMUs for this and similar domestic markets.

Infrastructure

Upgrades and improvements would be necessary. For Options 1 and 2 on the P&W, the railway would be double tracked in the vicinity of P&W's Valley Falls Yard in Cumberland. Also near the P&W yard a station siding would be required at Cumberland station allowing passenger trains to meet at this location while the P&W freight occupies one of the two main tracks. In Woonsocket, a stub station track would allow the P&W to run through Woonsocket while a passenger train is waiting in the station. The entire line would be signalized and four new interlockings constructed.

Necessary upgrades along the Northeast Corridor would be minimal since this segment of the route has been upgraded for *South County Phase I* service. Infrastructure improvements along

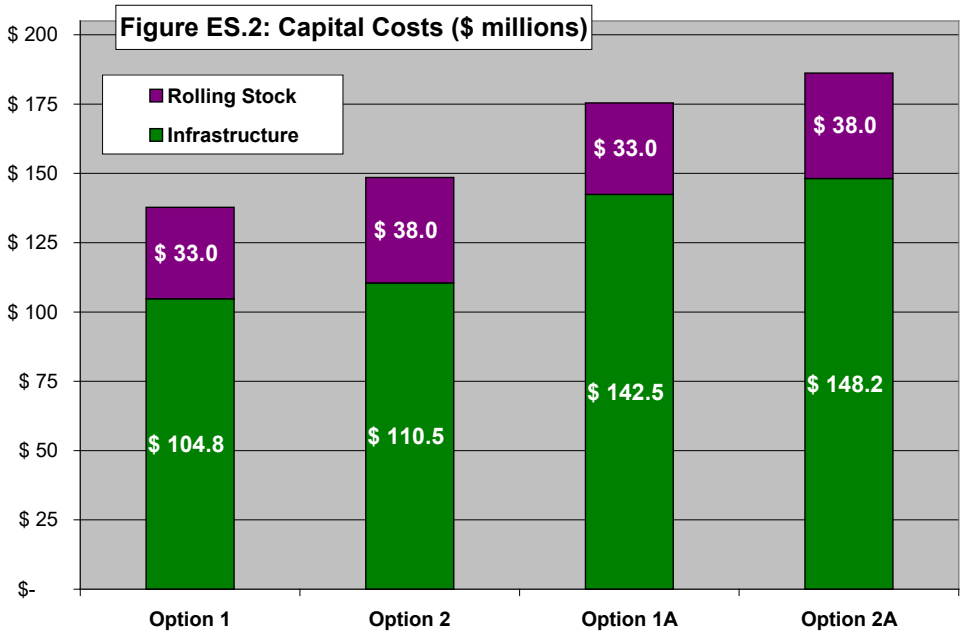
the Northeast Corridor account for less than one-quarter of the total forecast costs. Most costs along the Northeast Corridor are for stations and parking.

Track upgrades north of Providence Station would be required to allow intrastate passenger service from the P&W into station Tracks 3 and 5 without being routed onto the NEC mainline. Stations platforms would be constructed at Cranston and Olneyville. The mainline Track 1 platform at Pawtucket would be widened to become an island platform that would also serve intrastate trains on Track 7. Track 7 north of Providence would be signalized from Orms to Boston Switch. Two new interlockings would be built at Cranston.

Options 1A and 2A would build upon the infrastructure developed for Options 1 and 2. With a possible 100% increase in the frequency of P&W freight trains, it would be necessary to fully double track the P&W for the remaining 8.4 miles between Cumberland to Woonsocket. This double tracking would include a long bridge span over the Blackstone River in Woonsocket.

Capital Costs

The differences in infrastructure costs for Options 1 and 2 are minimal. Option 2 would require a longer station platform and additional parking at Cranston making it somewhat more expensive than Option 1. Options 1A and 2A would entail the additional cost of double tracking eight additional miles along the P&W.



Assuming that DMU's would be employed, a fleet of six power cars and three coaches would be required. The MBTA would also likely require up to four new bi-level coaches to carry the additional 238 Boston commuters that would board MBTA trains at Pawtucket and the 212 commuters that would travel between Cranston and Boston.

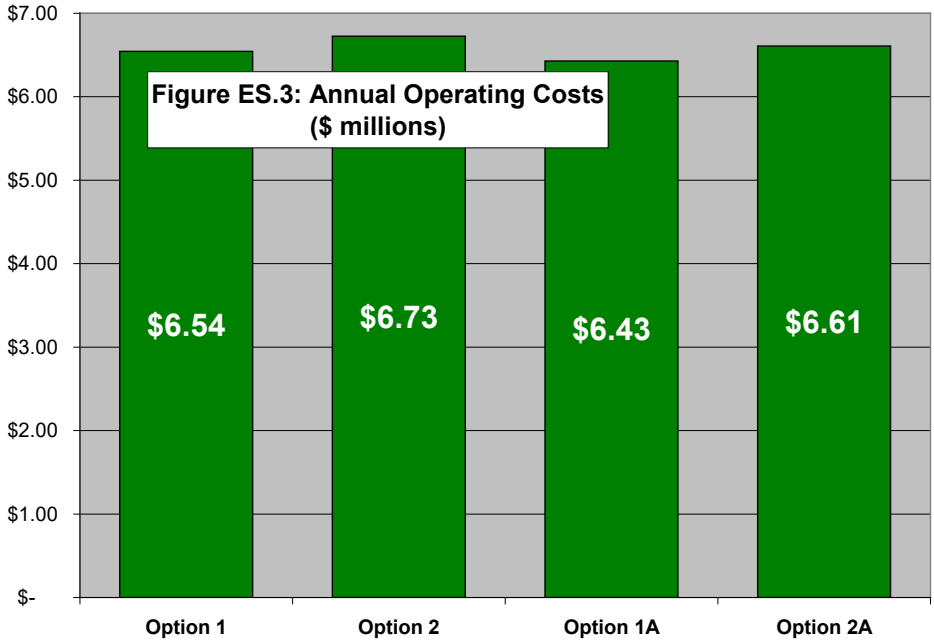
Rolling stock is estimated to cost $27.9 million for six DMUs and three coaches, plus $5.1 to $10.1 million for two to four new MBTA bi-level coaches.

A summary of the total capital costs is shown below. The total capital cost for implementation of intrastate service ranges from $138 million to $186 million.

Table ES.4: **Forecast Capital Costs** ($ millions)			
Option	**Infrastructure**	**Rolling stock**	**Total**
1	$ 104.8	$ 33.0	$ 137.8
2	$ 110.5	$ 38.0	$ 148.5
1A	$ 142.5	$ 33.0	$ 175.5
2A	$ 148.2	$ 38.0	$ 186.2

Operating Costs

All options would employ two consists operating throughout the service day. Options 1 and 2 would operate 34 weekday trips between Woonsocket and Warwick. Options 1A and 2A would offer 32 trips. Options 1 and 1A include the cost of maintenance for the two MBTA bi-level coaches. Options 2 and 2A include the cost of maintenance for the four MBTA bi-level coaches



Forecast Passenger Revenue

In forecasting revenue for the new service, the study assumed that all intrastate fares would be modeled on the MBTA's interzone fares and fares to Boston would also be consistent with current MBTA tariffs. To allow for discounted passes and tickets, each passenger trip is assumed to garner 80% of the full one-way fare. Air passengers are assumed to pay the full interzone fare.

The forecast annual Rhode Island Intrastate Service (RIIS) revenue for each option is $2.74 million. The MBTA revenue ranges from $0.8 million to $1.29 million. Total revenue for the service ranges from $3.5 million to $4.0 million.

Table ES.5: **Forecast Annual Revenue** ($ millions)			
Option	**RIIS**	**MBTA**	**Total**
1	$ 2.74	$ 0.80	$ 3.54
2	$ 2.74	$ 1.29	$ 4.03
1A	$ 2.74	$ 0.80	$ 3.54
2A	$ 2.74	$ 1.29	$ 4.03

Evaluation

Evaluation of potential services is an important step towards making the most cost effective use of limited resources. Five key evaluation metrics were analyzed in this analysis:

- Capital Cost per Weekday Inbound Passenger
- Operating Cost per Annual Passenger Trip
- Forecast Revenue per Passenger Trip
- Farebox Recovery Ratio
- Required Annual Operating Support
- Required Operating Support per Passenger

Table ES.6:
Evaluation Metrics

Option	Capital Cost per Weekday Passenger Boarding	Operating Cost per Annual Passenger Trip	Forecast Passenger Revenue Per Passenger Trip	Fare Recovery Ratio	Required Annual Operating Support	Operating Subsidy per Passenger Trip
1	$ 24,715	$ 4.13	$ 2.31	56%	$ 2.89	$ 1.82
2	$ 24,763	$ 3.96	$ 2.45	62%	$ 2.57	$ 1.51
1A	$ 31,471	$ 4.06	$ 2.31	57%	$ 2.77	$ 1.75
2A	$ 31,041	$ 3.89	$ 2.45	63%	$ 2.45	$ 1.44

In calculating the metrics, the study team combined the forecast MBTA and RIIS costs and revenues.

Capital Cost per Weekday Passenger Boarding – It is assumed that virtually all of the forecast riders on the proposed services would be new transit riders. The forecast capital cost to divert these travelers from the highway to the transit network would range from $24,000 and $32,000 per rider. This range of capital costs per passenger lies compares favorably with the range of projected performance for other similar planned projects that have been funded by the FTA New Starts Program.

Operating Cost per Passenger Trip – The forecast operating cost per passenger trip for all service packages ranges between $3.89 and $4.13 per boarding. This range is *very* favorable when compared to the operating costs per annual passenger trip reported for the eight smallest US commuter railroads. The proposed service initiative scores well due to its relatively short passenger and vehicle trip lengths in the compact Ocean State.

Forecast Passenger Revenue per Passenger Trip – The forecast operating passenger revenue per passenger trip for all service alternatives ranges between $2.31 and $2.45 per passenger trip. This is below the average passenger revenue per passenger trip for the eight smallest commuter railroads at $3.62. The low forecast revenue per passenger reflects the relatively short passenger trips this service is designed to attract.

Farebox Recovery Ratio – The fraction of operating costs covered by passenger fare revenue would range between approximately 56% and 63%. This range compares very favorably with

typical farebox recovery ratios achieved by comparable services, based on figures reported by the eight smallest US commuter railroads. The high farebox recovery ratio reflects synergies in sharing costs with other users of the rail lines and healthy revenues anticipated from service to multiple travel markets with a single service.

Required Annual Operating Support – All of the service packages would require a substantial level of annual support from sources other than passenger revenues to fund operations. The required operating support estimated by the study team ranges from $2.6 and $2.9 million. Compared with the eight smallest operating US commuter railroads, the required annual operating support required for the Rhode Island intrastate is quite low, reflecting the relatively low costs of the modest 25 mile service.

Operating Subsidy per Passenger Trip – The operating subsidy per passenger trip for the four service options ranges from $1.44 to $1.82 per trip. This range is quite low when compared among the eight smallest commuter rail systems, at $9.54. This low level of subsidy reflects the confluence of favorable cost conditions and multiple travel markets along the service corridor.

Overall Evaluation and Recommendation

The analyses indicate that an intrastate rail service linking Woonsocket and Warwick via Providence would be an attractive addition to the mobility options offered for travel in the State of Rhode Island. The service would be readily accessible to two-thirds of the state's residents and leverage the state's current investments in rail infrastructure along the Northeast Corridor to serve new travel markets that would be underserved by *South County I* and not served until *South County II* (e.g., Cranston Station) is fully operational.[14] New markets would include a variety of travelers:

Table ES.7:
Forecast 2030 New Transit Travelers by Travel Market

Travelers from the Woonsocket-Pawtucket Corridor to Providence	1,010
Travelers from Woonsocket and Cumberland areas to Boston	238
Additional travelers from Warwick to Providence	495
Travelers from Cranston & Olneyville to Providence	611
Travelers from Cranston to Boston	212
Rhode Island Air Travelers	89
Airport Employees	344
Total	**2,999**

The service would also improve and strengthen the infrastructure for freight movements along the P&W mainline enhancing the balance in regional freight services and maintaining the pubic-private partnership between the state and the freight railroad.

It is recommended that intrastate service be developed incrementally in cooperation and coordination with the P&W, Amtrak and MBTA once the *South County Phase I* services are

[14] *South County II* will add two new stations at East Greenwich and Cranston, while extending commuter rail service from Wickford Junction to Kingston and Westerly. South County II would not serve Pawtucket, Cumberland or Woonsocket.

fully operational and the restored Pawtucket Station is operational. Early action items in the incremental service development might include:

- Development of Cranston Station for MBTA service to Providence and Boston
- Contracting with the P&W to use its existing passenger rollingstock to offer a demonstration revenue service between Woonsocket and Warwick making stops at Pawtucket, Providence and Cranston with limited connections to MBTA trains at Pawtucket.
- Add service density (more trains) to the demonstration service as the market for service matures and grows
- Add stations at Cumberland and Olneyville as local interest and funding permits.

Next Steps

The technical analysis described in this report identifies an attractive transit service option for the State of Rhode Island. Next steps for implementation of this project include:

- Integrating the service proposal into the states transportation development plans including formal inclusion in Rhode Island's next Transportation Improvement Program (TIP).
- Continuing dialogue with the Providence and Worcester Railroad concerning its potential cooperation and support for operation of passenger rail service along its mainline between Woonsocket and Pawtucket.

CHAPTER 1: INTRODUCTION, GOALS AND OBJECTIVES

Introduction

This study sponsored by the Providence Foundation, City of Woonsocket, the Federal Highway Administration, and the Rhode Island Department of Statewide Planning explores the potential for intrastate passenger rail service serving two-thirds of Rhode Island's population and many of its major employment centers (e.g., Providence, TF Green Airport). The study builds upon earlier work completed in 2007 that identified an intrastate service linking Woonsocket with Providence as the most promising future passenger rail service for Woonsocket. The study seeks to leverage the state's substantial investment in rail facilities to extend Boston-Providence commuter rail service south to new stations that Rhode Island DOT is constructing along the Amtrak Main Line at TF Green Airport in Warwick and at the Wickford Junction mixed use development in North Kingston.

This chapter provides background information and discusses planning and service objectives to be advanced by the planning study.

Background

In 2007, the City of Woonsocket, with technical assistance from the Jacobs Engineering Group explored options for development of commuter rail service to Woonsocket. A number of line and service options were considered and evaluated. Ultimately the study identified one dominant alternative: Woonsocket-Providence Service with connections to MBTA-Boston service at Pawtucket Station.

Five stations were proposed. Three of the five proposed passenger stations, Woonsocket, Pawtucket and Providence, are extant, with Providence being the only station currently in use. Woonsocket station platforms would be upgraded for the passenger service. Pawtucket/ Central Falls station, it is assumed, would be restored to service under the aegis of its own passenger rail project. Two new stations Manville (Lincoln) and Berkeley (Cumberland) were proposed.

The recommended service would entail a collaborative arrangement with the Providence & Worcester Railroad Company (P&W) allowing the passenger service to share track and facilities with the private owner over the 11.3 miles between Woonsocket and Central Falls. At Central Falls, passenger trains would continue for five miles on the non-electrified third track of Amtrak's Northeast Corridor (aka Track 7) to access downtown Providence. The proposed service would stop at three stations between Woonsocket and Providence: Manville, Berkeley and Pawtucket.

Compared with other options considered in the Woonsocket Study, this service was especially attractive because both the P&W and Amtrak are active railroads. All the necessary right-of-way is completely intact and currently employed for rail operations. However, track and signal upgrades would be required to operate the new passenger service. The signal improvements would be quite extensive along the presently unsignalled route. The track upgrades would be more modest focusing on providing the capacity of passenger trains to meet and pass at strategic locations along the P&W.

Table 1.1: **Proposed Station Locations**		
Station	**MP**	**Proposed Station Address**
Woonsocket	16.2	Main Street & Railroad Street, Woonsocket
Manville (Lincoln)	14.2	Main Street Manville & Railroad Street, Lincoln
Berkeley (Cumberland)	8.8	Martin Street & Mendon Road, Cumberland
Pawtucket	4.5	Broad Street & Clay Street, Central Falls
Providence	0.0	100 Gaspee Street, Providence

Operation of this service would require cooperation with the P&W, Amtrak, and the MBTA. A high level of cooperation would be required with the P&W which would share the longest sections of right-of-way with the proposed Woonsocket-Providence passenger service. Given the frequent intercity and commuter trains already calling at Providence station, cooperation with Amtrak and the MBTA would be critical to coordinate the operation of trains into Providence station via the shared Amtrak NEC Track 1. It is anticipated that the new passenger trains could be operated by P&W under contract to RIDOT or RIPTA.

Having the P&W freight railroad operate the intrastate service is a good strategy, and would not be uncommon. Elsewhere in the United States, freight railroads already operate commuter railroads for cities. For example, in Portland, OR, the Westside Express Service is operated by the Portland & Western Railroad.

An important opportunity offered by the route to Providence is the ability to connect to MBTA Boston services at a restored Pawtucket Station. The Boston service, operated by the MBTA, would provide access to Back Bay Station and South Station in Boston. Service between Providence and Woonsocket would be scheduled to allow for timed transfers at Pawtucket station to trains to or from Boston, providing a convenient transit option for commuters from Woonsocket, Lincoln and Cumberland to Boston.

The 2007 study prepared a preliminary schedule that would offer a total of 28 weekday trips with 14 trips in each direction. Three morning peak trips would arrive in Providence between 7:00 am and 9:00 am, and three afternoon peak trips would depart Providence between 5:00 pm and 7:00 pm. Service would begin at

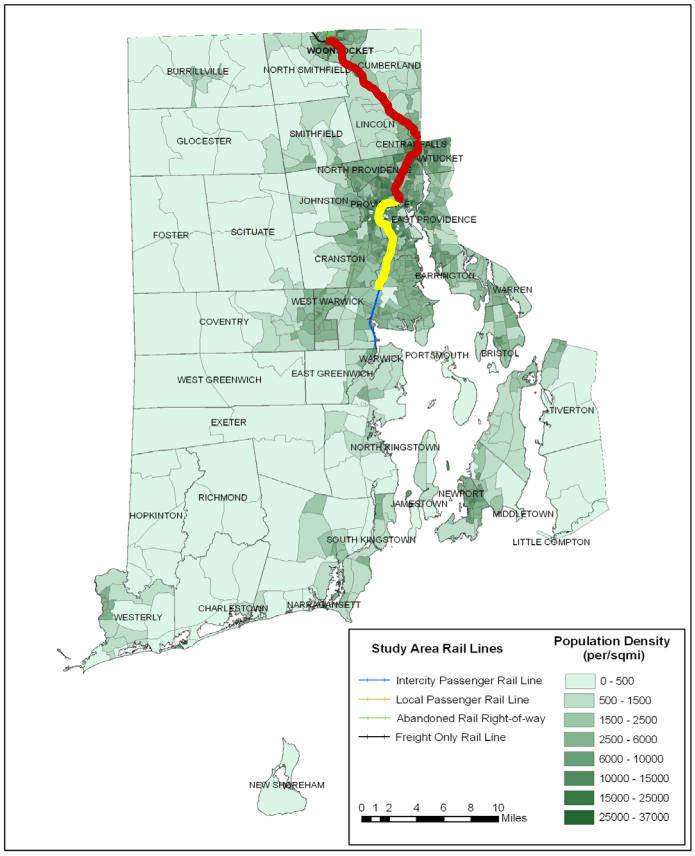


Figure 1.1:
Proposed Service Corridor

approximately 5:00 am and run until approximately 10:30 pm. Rail travel time between Woonsocket and Providence would be under 30 minutes. The schedule would provide timed connections to 17 MBTA commuter trains, with three of these trains arriving in Boston between 7:00 am and 9:00 am, and three departing Boston between 4:00 pm and 7:00 pm.

Possible Extension to Warwick

As the findings and recommendations of the study were reviewed with stakeholders including senior officials from RIDOT and Statewide Planning, a possible extension of the proposed service was recommended for evaluation. The extension would route the southbound trains from Woonsocket beyond Providence to T.F Green Airport (in Warwick) and potentially serve communities along the 10 mile route between Providence and Warwick.

As shown in Figure 1.1, the extended intrastate service would serve nearly all of the densely populations portions of the state, providing a new intrastate mobility option for travel along this 26 mile corridor of dense development with the state's highest concentrations of population and economic activity as illustrated in Figure 1.1.

This extension would complement the Boston-Providence-Warwick-Wickford Junction commuter rail service that RIDOT is presently developing with the MBTA and Amtrak. The MBTA-operated Boston-Providence-Warwick-Wickford Junction service (aka "South County") has been under planning and engineering for more than ten years. The service calls for a major intermodal stations in Warwick and North Kingston (Wickford Junction).

- **Warwick Station** – On Route 1 at TF Green Airport this intermodal station will be connected to air terminal by an overhead moving walkway. The station platform will be integrated into a large 3,200 parking structure (800 for commuter parking and 2,400 for other purposes) for that will be used by commuters, air travelers, and car rental agencies.[15] All car rental operations at the airport will be based at this new facility. From a railroad operations perspective, the station that will soon be under construction will be served by a single track off the Amtrak Main Line. For the foreseeable future, no Amtrak trains will stop at Warwick.

- **Wickford Junction Station** – On Route 4 in North Kingston, the station is planned to offer 1,000 dedicated commuter parking spaces and will be adjacent to a new 300,000 square footmixed use development including retail, office, service, and commercial development on a 63-acre site. As at Warwick, the station will be on siding adjacent to the Amtrak Main Line. Only MBTA service will stop at the new station. No Amtrak service is planned in the foreseeable future.

It is anticipated that the Warwick-Wickford service will start in 2010. Present plans (shown below) have the MBTA making eight weekday revenue round trips between Wickford and Boston.

[15] Telephone Conversation with Tom Cabana of Jacobs Engineering. February 20, 2009.

Table 1.2:
Tentative MBTA Wickford Junction Timetable

Wickford Turn - Weekdays - Inbound

Departure Times	Train	804 a.m.	806 a.m.	808 a.m.	812 a.m.	816 p.m.	820 p.m.	New2 p.m.	822 p.m.
87.4 Westerly									
70.6 Kingston									
62.8 Wickford		L5:46	L6:12	L6:51	L7:49	L12:03	L3:03	L4:17	L5:12
52.2 Warwick		5:58	6:24	7:03	8:01	12:15	3:14	4:27	5:24
43.5 Providence		6:07	6:33	7:12	8:10	12:25	3:22	4:35	5:33
37.0 S Attleboro		6:16	6:42	7:22	8:20	12:35	3:35	4:48	5:46
31.9 Attleboro		6:26	6:52	7:32	8:30	12:45	3:46	4:59	6:01
24.9 Mansfield		6:38	7:04	7:44	8:38	12:53	3:54	5:07	6:10
18.1 Sharon		6:48	7:13	7:50	8:47	1:01	4:02	5:15	6:18
14.9 Canton Jct		6:55	7:18	7:55	8:54	1:08	4:10	5:22	6:25
11.6 Rte 128		6:58	7:24	8:00	8:59	1:13	4:12	5:24	6:30
8.5 Hyde Park		7:02	7:25	8:04	9:04	1:18	4:16	5:28	6:35
2.4 Ruggles		7:10	7:32	8:09	9:14	m1:28	4:20	5:32	6:41
1.5 Back Bay		7:14	7:40	8:11	9:18	1:33	4:23	5:35	6:46
0.0 S Station		A7:19	A7:45	A8:16	A9:23	A1:38	A4:28	A5:40	A6:51
Total time:		1:33	1:33	1:25	1:34	1:35	1:25	1:23	1:39

Wickford Turn - Weekdays - Outbound

Departure Times	Train	805 a.m.	809 p.m.	New1 p.m.	811 p.m.	815 p.m.	817 p.m.	819 p.m.	825 p.m.
0.0 S Station		L10:25	L1:25	L2:37	L3:40	L5:00	L5:40	L6:10	L9:05
1.5 Back Bay		10:30	1:30	2:42	3:45	5:05	5:45	6:15	9:10
2.4 Ruggles		10:33	1:33	2:45	3:48	5:09	5:49	6:19	9:13
8.5 Hyde Park		10:39	1:39	2:51	3:54	5:16	5:56	6:26	9:21
11.6 Rte 128		10:44	1:44	2:56	3:59	5:19	5:59	6:29	9:26
14.9 Canton Jct		10:49	1:49	3:01	4:02	5:22	6:02	6:32	9:31
18.1 Sharon		10:55	1:54	3:06	4:07	5:27	6:07	6:37	9:37
24.9 Mansfield		11:03	2:02	3:14	4:16	5:36	6:18	6:46	9:45
31.9 Attleboro		11:12	2:10	3:22	4:26	5:49	6:26	6:55	9:53
37.0 S Attleboro		11:19	2:19	3:31	4:32	5:57	6:33	7:02	10:00
43.5 Providence		11:27	2:27	3:39	4:41	6:06	6:42	7:11	10:09
52.2 Warwick		11:38	2:38	3:50	4:52	6:18	6:54	7:23	10:21
62.8 Wickford		A11:48	A2:48	A4:00	A5:02	A6:29	A7:05	A7:34	A10:32
70.6 Kingston									
87.4 Westerly									
Total time:		1:23	1:23	1:23	1:22	1:29	1:25	1:24	1:27

Service to Warwick with 16 weekday trips along the Warwick-Providence-Boston service addresses three distinct local travel markets. Penetration of these markets is somewhat limited by the scale of the local service under consideration. Year 2020 forecasts call for approximately 550 daily local boardings at Warwick, including local trips to Boston and Providence in addition to air travelers and airport employees.

- Warwick to Boston (local travel) ~150 boardings
- Warwick to Providence (local travel) ~100 boardings
- TF Green to local destinations (air travelers & airport employees) ~300 boardings

Rhode Island state and local officials are very interested in the possibility of extending the proposed Woonsocket-Providence service to Warwick to possibly create new synergies with the South County service with a particular focus on the Providence and TF Green markets. This study is designed to explore how extending the proposed Woonsocket-Providence Intrastate Service would:

- Create new mobility operations for four travel markets:
  - Providence – Intrastate travel to Providence from Woonsocket, Cumberland, Pawtucket, Cranston and Warwick.
  - Boston – Interstate travel to Boston from Woonsocket, Cumberland and Cranston
  - Airport Travelers – Air passengers to or from Rhode Island using T.F. Green
  - Airport Employees – Local airport employees to and from work at T.F. Green.
- Stimulate non-automotive travel among Rhode Island communities
- Supplement the planned MBTA options for travel to Providence and Massachusetts, and
- Improve rail passenger travel volumes to and from the Warwick Intermodal Station.

Project Goals and Objectives

This project, is designed to resolve several concerns relating to a possible extension of Intrastate State Rail Service to TF Green Airport. These analytic objectives include the nine topics listed below.

1. The physical feasibility of developing the proposed extension of service Providence to Warwick
2. Conflicts between existing and future planned rail services
3. Feasible operational plans for a potential rail service with infrastructure improvements necessary to integrate the new service with other passenger and freight railway services in operation or development.
4. Identification of the most appropriate rolling stock and mode of train operation.
5. Potential ridership for the proposed new service
6. Capital and operating costs of the Providence and Warwick intrastate service extension
7. Possible passenger stations in Providence (Olneyville) and Cranston.
8. Transit Oriented Development (TOD) opportunities around the existing and planned stations
9. Explore the economic, mobility and environmental benefits of the intrastate rail service with state and local planning officials.
10. Encourage smart growth in the study corridor by bringing municipalities and transit agencies together to meet their goals.

Other Goals and Objectives

In June 2008, the study team met with study leadership from the Providence Foundation, the City of Woonsocket and the projects' Technical Advisory Committee to review project plans and develop further information concerning project goals and objectives. The Technical Advisory Committee roster includes the Providence Foundation, RIDOT, RI Statewide Planning, RIPTA, the Providence and Worcester Railroad, and planning officials from all communities along the proposed line of service including: Warwick, Cranston, Providence, Pawtucket, Central Falls, Cumberland, Lincoln and Woonsocket.

Group discussions with persons representing these interests indicated the following additional concerns and objectives to be considered by the study:

- Design of a typical station and associated parking facility
- Recommendations on station locations and station spacing
- Discussion of economies of scale from extension of Woonsocket-Providence service to Warwick
- Estimation of required operating subsidies
- Discussion concerning how TOD can strengthen proposed service and its role as a design and evaluation criteria
- Integration and coordination of the study effort and findings with the three other projects presently considering future transit service in the corridor: RI Intrastate Commuter Rail, RIDOT's South County Phase II, and RI Transit 2020.

CHAPTER 2: EXISTING AND FUTURE CONDITIONS

This chapter presents the current and forecast future conditions relating to the potential new railway service. This chapter is divided into three sections. The first section reviews demographics and travel patterns in the study corridor. The second section presents the ridership trends, existing forecasts, and the current and planned rail service in the study area. The third section discusses the current and future state of the rail infrastructure.

I. Demographics, Travel Patterns and Demand

The potential market includes the thirteen communities which are geographically aligned to directly benefit from commuter rail service.

Demographics

The study team assembled key demographic data for the potential commuter rail market. Figure 2.1 shows the population density and Table 2.1 lists the population information for each of the thirteen communities in the study corridor.

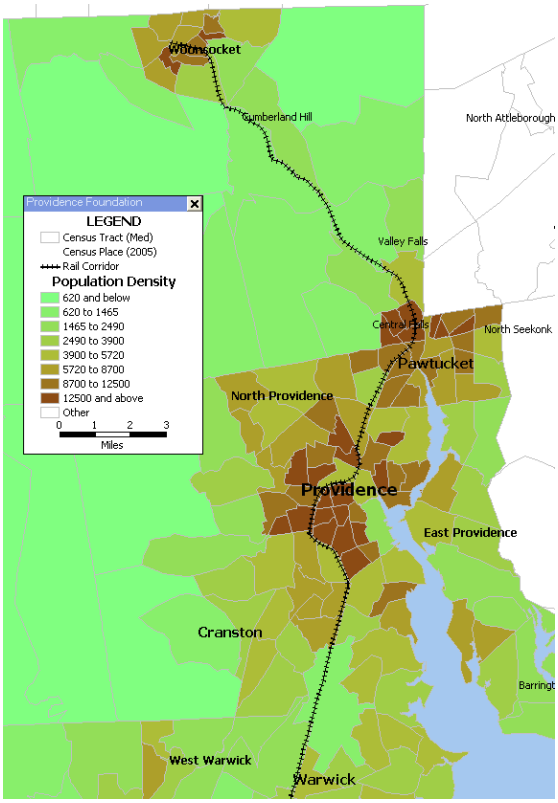


Figure 2.1:
Population Density in Study Area

Table 2.1:
Population and Households in Study Area[i]

	Total Population	Total Households	Household Population	Non-Household Population	Average Household Size
Burrillville	15,796	5,559	15,303	493	2.75
Woonsocket	43,224	17,750	42,149	1,075	2.37
North Smithfield	10,618	3,954	10,320	298	2.61
Cumberland	31,840	12,198	31,599	241	2.59
Lincoln	20,898	8,243	20,704	194	2.51
Smithfield	20,613	7,194	17,778	2,835	2.47
Central Falls	18,928	6,696	18,340	588	2.74
Pawtucket	72,958	30,047	72,301	657	2.41
Providence	173,618	62,389	159,970	13,648	2.56
Cranston	79,269	30,954	74,610	4,659	2.41
Warwick	85,808	35,517	84,817	991	2.39
East Greenwich	12,948	4,960	12,815	133	2.58
West Warwick	29,581	12,498	29,394	187	2.35
Total	616,099	237,959	590,100	25,999	2.48

Household Income

Incomes in the study area tend to be evenly distributed across communities. The commuter rail demographic generally reflects a typical household income of $35,000 to $100,000. In most of the communities, this income range accounts for 40% to 55% of households. Providence and Central Falls are the exceptions with more households in the lower income bracket. Table 2.2 shows the income distributions for the thirteen communities in the study area.

Table 2.2:
Household Income Distributions[ii]

	Median Income	$0 to $14,999	$15,000 to $24,999	$25,000 to $34,999	$35,000 to $49,999	$50,000 to $74,999	$75,000 to $99,999	$100,000 to $149,999	Over $150,000
Burrillville	$52,587	10%	8%	11%	17%	27%	14%	10%	3%
Woonsocket	$30,819	27%	15%	14%	18%	16%	6%	3%	1%
North Smithfield	$58,602	10%	11%	8%	13%	25%	15%	12%	5%
Cumberland	$54,656	10%	10%	10%	15%	23%	14%	12%	6%
Lincoln	$47,815	13%	11%	12%	16%	20%	12%	12%	5%
Smithfield	$55,621	10%	11%	8%	15%	23%	15%	13%	5%
Central Falls	$22,628	34%	19%	14%	16%	11%	3%	2%	0%
Pawtucket	$31,775	25%	15%	14%	16%	17%	7%	3%	2%
Providence	$26,867	31%	16%	13%	14%	13%	6%	4%	3%
Cranston	$44,108	14%	13%	13%	16%	21%	12%	8%	4%
Warwick	$46,483	13%	11%	12%	18%	24%	12%	8%	3%
East Greenwich	$70,063	10%	7%	8%	11%	18%	12%	14%	20%
West Warwick	$39,505	17%	13%	13%	19%	21%	10%	5%	2%

Low household incomes are associated with a propensity to use public transportation service. The density of households with annual incomes less than $25,000 is greatest in the densely settled communities of Woonsocket, Providence, Pawtucket and Central Falls, with at least 40% of all households in each community earning less than $25,000. The density of lower income households is lowest in North Smithfield,

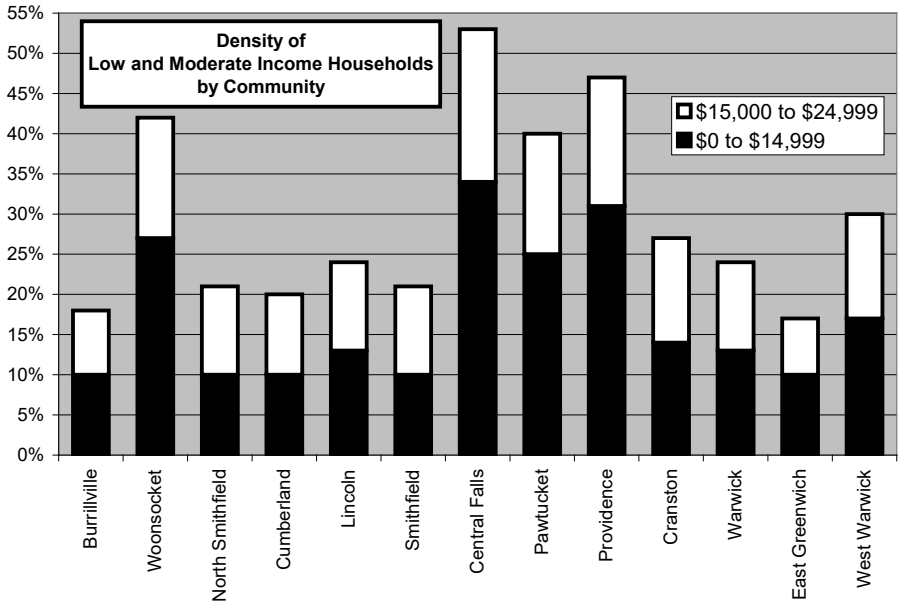


Figure 2.2

Cumberland, Lincoln, Smithfield and East Greenwich all in the neighborhood of 20% or less. The density of lower income households is somewhat greater in Cranston and Warwick.

Travel Patterns and Demand

Commuting Mode

Residents in the study area tend to drive alone to work accounting for 80% of all work trips. Communities with large low income populations tend to have more carpoolers. Public transportation in the study area is currently limited to bus service and has a low market share. The transit riding habit appears strongest in Providence (7%), Pawtucket (4%), and Central Falls (3%). A large fraction of Providence commuters walk to work (12%). Table 2.3 shows the mode split for work trips from each community.

Table 2.3:
Mode of Travel to Work[iii]

	Total Workers[1]	Drive Alone	Carpool	Public Transport	Walk	Other Means	Work at Home
Burrillville	8,930	86%	10%	1%	1%	0%	2%
Woonsocket	20,650	79%	14%	1%	3%	1%	1%
North Smithfield	5,582	89%	7%	1%	1%	1%	2%
Cumberland	17,217	87%	8%	1%	1%	1%	2%
Lincoln	10,874	87%	8%	2%	1%	1%	2%
Smithfield	11,059	86%	6%	2%	4%	1%	1%
Central Falls	7,813	62%	27%	**3%**	5%	3%	1%
Pawtucket	35,804	76%	14%	**4%**	4%	1%	1%
Providence	76,833	61%	15%	**7%**	12%	2%	3%
Cranston	39,060	85%	9%	2%	1%	1%	2%
Warwick	46,074	87%	9%	2%	1%	1%	2%
East Greenwich	6,449	87%	5%	2%	2%	0%	4%
West Warwick	15,831	84%	12%	1%	2%	1%	1%
Total	302,176	81%	11%	2%	3%	1%	2%

Origin and Destination of Commuters

Table 2.4 shows the daily work trips to and from each town in the study area. Unsurprisingly, the most popular work destination is Providence with nearly one-third of all study area work trips terminating in that city. Approximately 15,000 people commute from the north to Providence and more then 20,000 commute from the south. Warwick and Cranston are the second and third largest trip work trip destinations.

[1] Includes households and workers who are not in households. Each household counts as an entity, as does each worker not in a household.

Table 2.4:
Origin and Destination of Work Trips[17]

TO / FROM	Burrillville	Woonsocket	North Smithfield	Cumberland	Lincoln	Smithfield	Central Falls	Pawtucket	Providence	Cranston	Warwick	East Greenwich	West Warwick	TOTAL
Burrillville	1,957	787	451	154	416	348	6	233	**938**	248	144	17	30	5,729
Woonsocket	170	6,400	857	495	729	280	67	444	**1,229**	308	266	19	57	11,321
North Smithfield	52	924	907	157	246	208	91	173	**539**	157	192	13	9	3,668
Cumberland	96	937	191	3,268	949	278	412	1,292	**2,039**	545	431	0	79	10,517
Lincoln	54	590	223	719	2,138	223	275	810	**1,864**	455	295	40	69	7,755
Smithfield	62	369	64	152	379	2,158	66	350	**2,342**	621	519	55	57	7,194
Central Falls	18	180	52	393	472	132	983	1,228	**963**	269	199	31	46	4,966
Pawtucket	71	505	150	914	969	342	934	9,057	**5,801**	1,188	1,081	118	143	21,273
Providence	133	1,065	378	624	1,216	856	403	2,962	33,938	6,272	3,481	290	551	52,169
Cranston	90	456	129	250	662	506	105	835	**10,010**	8,708	4,879	435	874	27,939
Warwick	65	286	120	202	494	455	69	1,106	**8,130**	3,690	16,067	1,455	1,503	33,642
East Greenwich	0	44	19	43	106	34	12	103	**1,145**	358	1,013	1,235	139	4,251
West Warwick	81	90	23	102	162	137	28	241	**1,962**	1,095	3,398	786	2,515	10,620
TOTAL	2,849	12,633	3,564	7,473	8,938	5,957	3,451	18,834	70,900	23,914	31,965	4,494	6,072	201,044

[17] United States Census Bureau. "County-to-County Worker Flow Files," http://www.census.gov/population/www/cen2000/commuting/files/2kresmcd_RI.xls Accessed: June 26, 2008.

Over the entire study corridor more than one third of all workers are employed in Providence. It is notable that in every community along the corridor at least one in ten workers (10%) are employed in Providence. This suggests that a premium transit service oriented toward Providence could be potentially attractive and successful in the study corridor.

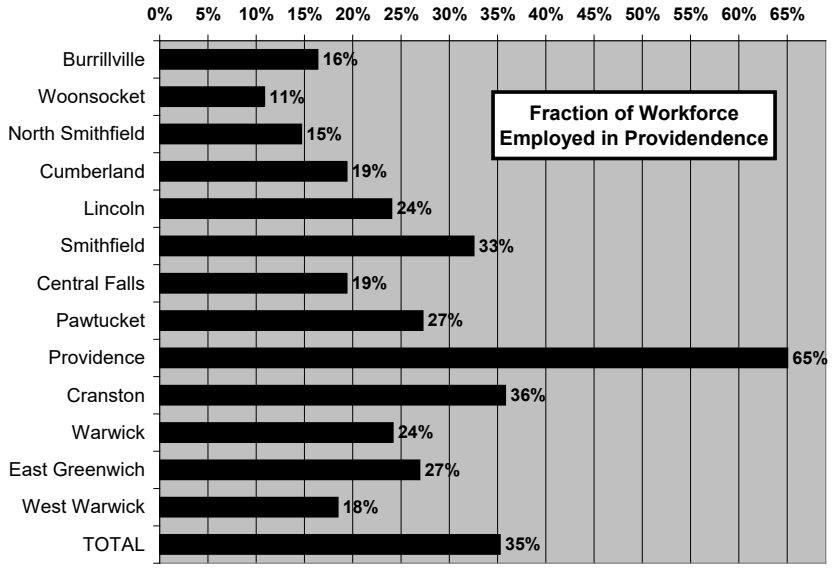


Figure 2.3

The study is also concerned with potential transit travel to and from Boston. The northbound market would be served through timed-transfers to northbound MBTA trains. The demand could be derived from the number of people living in the study area and commuting to Boston. Table 2.5 shows that study corridor work travel to Boston is strongest from Providence, Pawtucket, Cranston, Cumberland and Warwick.

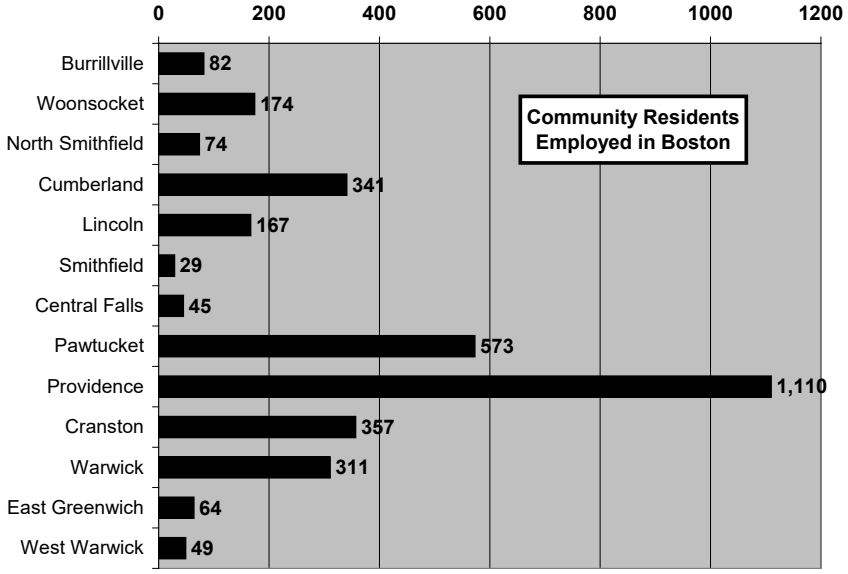


Figure 2.4

Table 2.5:
Daily Work Trips to Boston[18]

Community	Trips to Boston
Burrillville	82
Woonsocket	174
North Smithfield	74
Cumberland	341
Lincoln	167
Smithfield	29
Central Falls	45
Pawtucket	573
Providence	1,110
Cranston	357
Warwick	311
East Greenwich	64
West Warwick	49
Total	3,376

[18] Jacobs Edwards and Kelcey. (2007). *Woonsocket Commuter Rail Feasibility Study*. Prepared for the City of Woonsocket, pp. 19.

Forecast Population and Employment

Population projections for the study corridor communities have been prepared by Rhode Island's Department of Statewide Planning. The forecasts integrate information on the current demographics factors (e.g., age distribution, of present inhabitants) with anticipated new development (e.g., new house and households.) The populations of the towns along the corridor are forecast to fluctuate over the coming years. Most of the towns within in the study area are expected to experience growth with a few key exceptions. Both Woonsocket and Warwick's populations are expected to decrease by the year 2030. The 2030 projections for population appear in Table 2.6.

Table 2.6:
2030 Population Projections[19]

Community	2000 Population	2030 Population	Change in Population
Burrillville	15,796	18,195	15%
Woonsocket	43,224	40,772	**-6%**
North Smithfield	10,618	11,207	6%
Cumberland	31,840	36,189	14%
Lincoln	20,898	24,498	17%
North Providence	32,411	35,349	9%
Smithfield	20,613	24,011	16%
Central Falls	18,928	20,690	9%
Pawtucket	72,958	74,557	2%
Providence	173,648	188,947	9%
Cranston	79,269	85,903	8%
Warwick	85,808	84,764	**-1%**
East Greenwich	12,948	15,443	19%
West Warwick	29,581	31,755	7%
Totals	**648,540**	**692,280**	**7%**

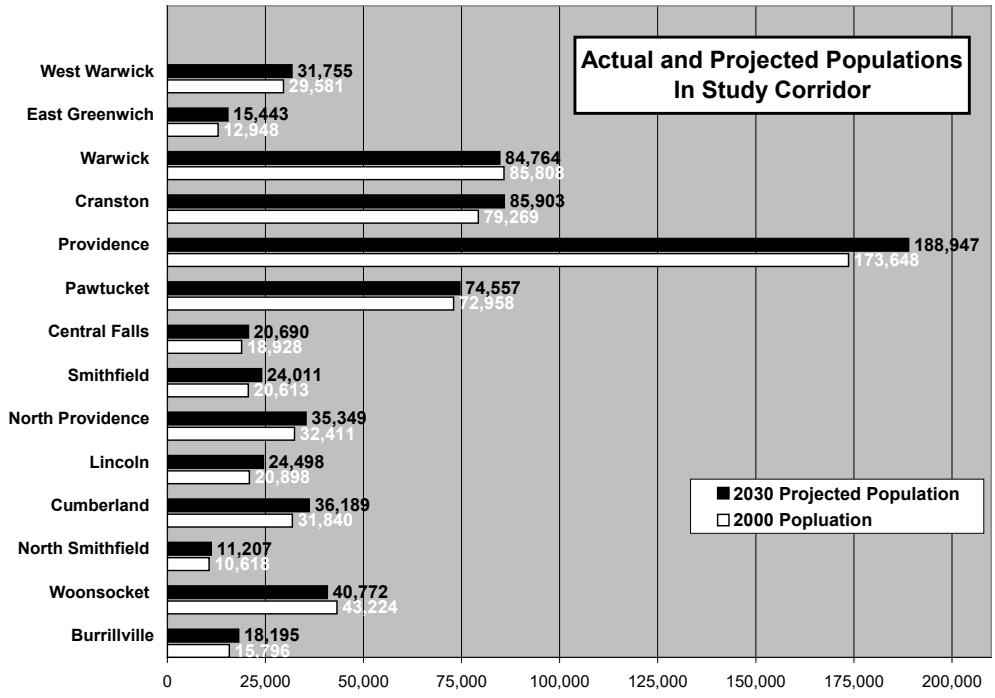


Figure 2.5

[19]Ibid, pp. 16.

Employment in both Boston and Providence is expected to grow over the next twenty years. According to the MPO's of both cities, employment should increase by 8-9% in the two areas. The details of projected employment growth appears in **Table 2.7**.

Table 2.7:
Projected Employment Growth[20]

	2000	2030	Growth
Providence	121,937	132,720	9%
Greater Boston	783,141	847,425	8%

II. Passenger Rail Service and Ridership

Trends on MBTA Providence Service

Since 1991, Providence Station has seen a positive growth in passenger traffic. (see Figure 2.6). In 1991, the MBTA reported 692 daily boardings. Ten years later, that number had increased by over 15% to 800. By 2006, total daily boardings reported by the MBTA crossed the 1,000 threshold, marking a 60% increase since 1991. Ridership is forecast to grow to almost 1,500 daily boardings by 2025 (shown in red in Figure 2.6). [21]

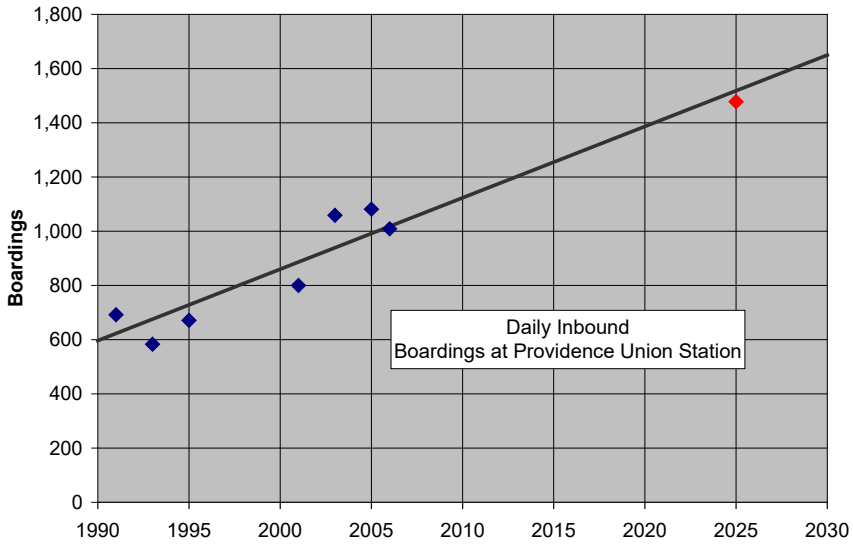


Figure 2.6

Forecasts of Future Ridership from Previous Studies

As RIDOT has been planning to implement passenger rail services along the Northeast Corridor from Warwick and Wickford numerous ridership forecasts have been prepared.[22] A summary of three forecasts for Warwick (T.F. Green Airport) Station is found in Table 2.8. Year 2020 forecast ridership from Warwick to Providence has ranged between 281 and 1,006 weekday boarding passengers. Forecast ridership to Boston has ranged between 209 to 694 weekday boarding passengers.

[20] City of Providence MPO, and City of Boston MPO.
[21] KKO and Associates and Vanasse Hangen Brustlin, Inc. (2005) *Commuter Rail Infrastructure Needs Assessment Study*. Prepared for the Massachusetts Bay Transportation Authority, pp. 6-14.
[22] Edwards and Kelcey. (January 2002). *South County Commuter Rail Ridership Briefing*. Prepared for Rhode Island Department of Transportation, pp. 30.

Table 2.8: Previous Ridership Forecasts from Warwick Station						
	Vanasse Hangen Brustlin (2001)		**Cambridge Systematics Inc (1995)**		**Barton-Ashman (1994)**	
Year	To Providence	To Boston	To Providence	To Boston	To Providence	To Boston
2000	734 - 861	554 - 650	259	195	927	296
2010	764 - 897	577 - 677	270	203	966	308
2020	796 - 934	591 - 694	281	209	1,006	316

In 1998, Edwards and Kelcey prepared a detailed forecast of potential Warwick passenger rail travel by carrier and trip purpose. The findings of this forecast are summarized in Table 2.9.[23]

Table 2.9: Warwick Station Previous Ridership Forecasts		
	Year 2000	**Year 2020**
Amtrak	228	524
Amtrak (Airport Related)	66	152
Commuter Rail	454	558
Commuter Rail (Airport Related)	232	598
Total Rail Station	980	1,832
Total Airport Related	298	750

No previous studies have prepared ridership forecasts for possible stations between Providence and Warwick (e.g. Cranston and Olneyville).

Southbound ridership to Providence from stations along the study corridor to the south was forecast in the 2007 Jacobs Edwards and Kelcey *Woonsocket Commuter Rail Feasibility Study*.[24] This forecast indicated that 266 to 315 riders would ride from Woonsocket Station to Boston via a timed transfer to MBTA service at Pawtucket Station.

Table 2.10: Previous Ridership Forecasts from North of Providence		
	To Providence	**To Boston**
Pawtucket Station	411 - 445	
Berkeley Station	291 - 323	24-25
Manville Station	29 - 32	27-28
Woonsocket Station	107 - 121	145-158

[23] Edwards and Kelcey. (May 1999). *Warwick Intermodal Station at T.F. Green Airport, Warwick, Rhode Island: Environmental Assessment.* Prepared for United States Department of Transportation, Federal Highway Administration, and the Rhode Island Department of Transportation, pp. 41.
[24] Jacobs Edwards and Kelcey. (2007) *Woonsocket Commuter Rail Feasibility Study, Task 2: Ridership Forecasts.* Prepared for the City of Woonsocket, pp. 33 – 34.

Current and Future Planned Passenger Services

Current MBTA Service - Under an agreement with the Rhode Island Department of Transportation, the Massachusetts Bay Transportation Authority presently operates fifteen weekday trains in each direction between Boston and Providence. Service from Providence to Boston begins at 5:07 am with approximately half-hour headways until 8:10 am. Service from Boston to Providence during the pm peak also operates on approximately half-hour headways between 4:30 and 6:50 pm. Off-peak service in both directions operates a minimum headway of 1 hour. The last train of the day departs Providence at 11 pm and Boston at 12 midnight (see Table 2.11).

Table 2.11:
Current Weekday MBTA Providence Line Schedule[25]

Monday through Friday

Inbound to South Station

Train No.	800	802	902	804	904	806	832	808	906	810	908	812	834	910	814	912	816	818	914	916	820	976	918	920	822	824	922	924	926	826	928	930	828	932
	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.
Providence	5 07	5 25	—	6 07	—	6 33	—	7 12	—	7 35	—	8 10	—	—	9 43	—	11 42	1 30	—	—	3 20	—	—	—	5 10	6 00	—	—	—	8 12	—	—	9 42	—
South Attleboro	5 17	5 35	—	6 16	—	6 42	—	7 22	—	7 45	—	8 20	—	—	9 52	—	11 52	1 42	—	—	3 35	—	—	—	5 23	6 10	—	—	—	8 23	—	—	9 52	—
Attleboro	5 27	5 45	—	6 28	—	6 52	—	7 32	—	7 55	—	8 30	9 00	—	10 02	—	12 02	1 51	—	—	3 46	—	—	—	5 33	6 18	—	—	—	8 31	—	—	10 08	—
Mansfield	5 36	5 55	—	6 38	—	7 04	7 26	7 44	—	8 05	—	8 38	9 09	—	10 10	—	12 10	1 58	—	—	3 55	—	—	—	5 42	6 26	—	—	—	8 38	—	—	10 17	—
Sharon	5 44	6 04	—	6 48	—	7 13	7 35	—	—	8 14	—	8 47	9 17	—	10 19	—	12 18	2 06	—	—	4 03	—	—	—	5 50	6 34	—	—	—	8 45	—	—	10 24	—
Stoughton	—	—	6 28	—	6 56	—	—	—	7 48	—	8 28	—	—	9 40	—	10 40	—	—	2 20	3 23	—	—	5 00	5 45	—	—	6 42	7 19	7 35	—	8 50	9 50	—	11 53
Canton Center	—	—	6 36	—	7 04	—	—	—	7 57	—	8 36	—	—	9 49	—	10 49	—	—	2 27	—	—	4 16	5 08	—	—	—	6 49	—	—	—	—	—	—	—
Canton Junction	5 51	6 11	6 39	—	7 08	—	7 41	—	8 01	8 24	8 40	8 54	9 24	9 52	10 26	10 52	12 25	—	2 30	3 33	—	4 19	5 10	—	5 57	—	6 52	—	7 45	8 52	9 00	10 00	—	f 12 03
Route 128	5 56	6 16	6 44	6 58	7 14	7 24	7 47	—	8 07	8 30	8 45	8 59	9 26	9 57	10 31	10 57	12 30	2 16	—	3 38	4 14	—	5 16	—	6 02	6 47	6 57	7 33	—	8 57	9 05	—	10 35	f 12 08
Hyde Park	6 01	6 21	6 49	—	7 19	—	7 52	—	8 13	8 36	8 49	9 04	—	10 02	10 36	11 02	12 35	—	2 39	3 43	—	4 24	—	—	6 07	—	7 02	—	7 54	9 02	9 10	—	10 40	—
Ruggles	6 11	6 31	—	7 10	—	—	—	—	8 23	—	—	9 14	9 41	—	10 46	11 12	12 45	2 29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
BACK BAY	L 6 15	L 6 35	L 6 59	L 7 14	L 7 28	L 7 40	L 8 02	L 8 11	L 8 27	L 8 46	L 8 58	L 9 18	9 44	10 12	10 50	11 15	12 50	2 33	2 49	3 53	4 25	4 38	5 27	6 08	6 18	6 58	7 12	7 44	8 04	9 10	9 18	10 17	10 50	12 20
SOUTH STATION	6 20	6 40	7 04	7 19	7 33	7 45	8 07	8 16	8 32	8 51	9 03	9 23	9 49	10 17	10 55	11 20	12 55	2 38	2 54	3 58	4 30	4 43	5 32	6 13	6 23	7 03	7 17	7 49	8 09	9 15	9 23	10 22	10 55	12 25

Outbound from South Station

Train No.	901	903	801	831	905	907	833	803	909	911	805	807	913	809	915	975	811	917	813	919	815	921	817	923	819	925	821	927	823	929	825	827	931	829
	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.
SOUTH STATION	5 15	5 35	6 25	6 35	7 02	7 40	7 50	8 30	8 50	9 45	10 25	12 10	1 20	2 00	2 25	3 30	3 45	4 05	4 35	4 50	5 00	5 15	5 40	5 45	6 10	6 30	6 50	7 45	8 15	8 55	9 05	10 25	11 00	11 59
BACK BAY	—	5 40	6 30	6 40	7 07	7 45	7 55	8 35	8 55	9 50	10 30	12 15	1 25	2 05	2 30	3 35	3 50	4 10	4 40	4 55	5 05	5 20	5 45	5 51	6 15	6 35	6 55	7 50	8 20	9 00	9 10	10 30	11 05	12 04
Ruggles	—	—	6 33	—	—	—	7 58	8 38	—	—	—	12 18	—	2 08	2 33	3 38	3 53	4 13	4 43	4 59	5 09	5 24	5 49	5 56	6 19	6 38	6 58	7 53	8 23	9 03	9 13	10 33	11 08	12 07
Hyde Park	—	—	—	—	—	—	—	—	—	—	10 41	12 28	1 41	2 17	2 43	3 46	—	4 21	—	—	—	5 34	—	—	—	6 48	7 08	8 03	8 33	9 13	9 23	10 43	11 17	12 16
Route 128	—	5 51	6 45	—	—	7 57	8 10	8 49	9 07	—	10 46	12 32	1 47	2 23	2 49	3 52	—	4 27	4 54	5 10	—	5 40	—	6 08	6 29	—	7 13	8 08	8 38	9 18	9 28	10 48	11 22	12 21
Canton Junction	—	—	—	—	7 23	8 02	8 15	8 54	9 13	10 07	—	12 37	1 53	2 28	2 55	3 58	—	4 33	—	5 17	—	5 48	—	6 14	—	6 57	7 18	8 14	8 43	9 24	9 33	10 53	11 28	12 26
Canton Center	5 38	5 59	—	—	7 26	8 07	—	—	9 16	10 10	—	—	1 56	—	2 58	4 01	—	4 36	—	5 20	—	5 52	—	6 17	—	7 00	—	8 17	—	9 27	—	—	11 31	—
Stoughton	5 46	6 10	—	—	7 34	8 15	—	—	9 24	10 18	—	—	2 04	—	3 06	—	—	4 45	—	5 30	—	6 01	—	6 26	—	7 09	—	8 26	—	9 35	—	—	11 39	—
Sharon	—	—	6 54	—	—	—	—	9 00	—	—	10 57	12 43	—	2 34	—	—	4 12	—	5 05	—	5 27	—	6 07	—	6 37	—	7 24	—	8 49	—	9 39	10 59	—	12 31
Mansfield	—	—	7 01	7 08	—	—	8 28	9 08	—	—	11 05	12 51	—	2 42	—	—	4 21	—	5 14	—	5 36	—	6 18	—	6 46	—	7 33	—	8 57	—	9 47	11 07	—	12 39
Attleboro	—	—	7 10	—	—	—	8 37	9 15	—	—	11 14	12 59	—	2 50	—	—	4 31	—	5 24	—	5 49	—	6 26	—	6 55	—	7 42	—	9 05	—	9 55	11 15	—	12 48
South Attleboro	—	—	7 16	—	—	—	—	9 21	—	—	11 21	1 06	—	3 00	—	—	4 37	—	5 33	—	5 57	—	6 33	—	7 02	—	7 49	—	9 12	—	10 02	11 22	—	12 56
Providence	—	—	7 25	—	—	—	—	9 30	—	—	11 30	1 15	—	3 09	—	—	4 46	—	5 42	—	6 06	—	6 42	—	7 11	—	7 58	—	9 21	—	10 11	11 32	—	1 06

[25] Schedule Effective as of Monday, April 07, 2008.

Future MBTA Service - In late 2010 or early 2011, MBTA service will be extended southward under Phase I of RIDOT's "South County" rail project. Under the agreement that will govern the extension of MBTA service to Warwick and Wickford, the MBTA will extend 8 northbound and 8 southbound of the Providence revenue trains southward to serve Warwick and Wickford Junction (see Table 2.12.).

Table 2.12(a):
Tentative Weekday MBTA Inbound Schedule from Wickford Junction

Inbound Service	PVD	PVD	WCK	WCK	WCK	PVD	WCK	PVD
Train No.	800	802	804	806	808	810	812	814
Wickford			5:46 AM	6:12 AM	6:51 AM		7:49 AM	
Warwick			5:58 AM	6:24 AM	7:03 AM		8:01 AM	
Providence	5:07 AM	5:25 AM	6:07 AM	6:33 AM	7:12 AM	7:40 AM	8:10 AM	9:43 AM
South Attleboro	5:17 AM	5:35 AM	6:16 AM	6:42 AM	7:22 AM	7:50 AM	8:20 AM	9:52 AM
Attleboro	5:27 AM	5:45 AM	6:26 AM	6:52 AM	7:32 AM	7:58 AM	8:30 AM	10:02 AM
Mansfield	5:36 AM	5:55 AM	6:38 AM	7:04 AM	7:44 AM	8:07 AM	8:38 AM	10:10 AM
Sharon	5:44 AM	6:04 AM	6:48 AM	7:13 AM		8:16 AM	8:47 AM	10:19 AM
Canton Junction	5:51 AM	6:11 AM				8:23 AM	8:54 AM	10:26 AM
Rte 128	5:56 AM	6:16 AM	6:58 AM	7:24 AM		8:29 AM	8:59 AM	10:31 AM
Hyde Park	6:01 AM	6:21 AM				8:34 AM	9:04 AM	10:36 AM
Ruggles	6:11 AM	6:31 AM	7:10 AM				9:14 AM	10:46 AM
Back Bay	6:15 AM	6:35 AM	7:14 AM	7:40 AM	8:11 AM	8:44 AM	9:18 AM	10:50 AM
South Station	6:20 AM	6:40 AM	7:19 AM	7:45 AM	8:16 AM	8:49 AM	9:23 AM	10:55 AM

Inbound Service	WCK	PVD	WCK	WCK	WCK	PVD	PVD	PVD
Train No.	816	818	820	8XX	822	824	826	828
Wickford	12:03 PM		3:03 PM	4:17 PM	5:12 PM			
Warwick	12:15 PM		3:14 PM	4:27 PM	5:24 PM			
Providence	12:25 PM	1:30 PM	3:22 PM	4:35 PM	5:33 PM	6:00 PM	8:30 PM	9:42 PM
South Attleboro	12:35 PM	1:42 PM	3:35 PM	4:48 PM	5:46 PM	6:10 PM	8:41 PM	9:52 PM
Attleboro	12:45 PM	1:51 PM	3:46 PM	4:59 PM	6:01 PM	6:18 PM	8:49 PM	10:08 PM
Mansfield	12:53 PM	1:58 PM	3:54 PM	5:07 PM	6:10 PM	6:26 PM	8:56 PM	10:17 PM
Sharon	1:01 PM	2:06 PM	4:02 PM	5:15 PM	6:18 PM	6:34 PM	9:03 PM	10:24 PM
Canton Junction	1:08 PM				6:25 PM		9:10 PM	
Rte 128	1:13 PM	2:16 PM	4:12 PM	5:24 PM	6:30 PM	6:47 PM	9:15 PM	10:35 PM
Hyde Park	1:18 PM				6:35 PM		9:20 PM	10:40 PM
Ruggles	1:28 PM	2:29 PM			6:41 PM			
Back Bay	1:33 PM	2:33 PM	4:23 PM	5:35 PM	6:46 PM	6:58 PM	9:28 PM	10:50 PM
South Station	1:38 PM	2:38 PM	4:28 PM	5:40 PM	6:51 PM	7:03 PM	9:33 PM	10:55 PM

Table 2.12(b):
Tentative Weekday MBTA Inbound Schedule from Wickford Junction

Outbound Service	PVD	PVD	WCK	PVD	WCK	WCK	WCK	PVD
Train No.	801	803	805	807	809	8XY	811	813
South Station	6:25 AM	8:30 AM	10:25 AM	12:05 PM	1:25 PM	2:37 PM	3:40 PM	4:35 PM
Back Bay	6:30 AM	8:35 AM	10:30 AM	12:10 PM	1:30 PM	2:42 PM	3:45 PM	4:40 PM
Ruggles	6:33 AM	8:38 AM		12:13 PM	1:33 PM	2:45 PM	3:48 PM	4:43 PM
Hyde Park			10:39 AM	12:23 PM	1:39 PM	2:51 PM		
Rte 128	6:45 AM	8:49 AM	10:44 AM	12:27 PM	1:44 PM	2:56 PM		4:54 PM
Canton Junction		8:54 AM		12:32 PM	1:49 PM	3:01 PM		
Sharon	6:54 AM	9:00 AM	10:55 AM	12:38 PM	1:54 PM	3:06 PM	4:07 PM	5:05 PM
Mansfield	7:01 AM	9:08 AM	11:03 AM	12:46 PM	2:02 PM	3:14 PM	4:16 PM	5:14 PM
Attleboro	7:10 AM	9:15 AM	11:12 AM	12:54 PM	2:10 PM	3:22 PM	4:26 PM	5:24 PM
South Attleboro	7:16 AM	9:21 AM	11:19 AM	1:01 PM	2:19 PM	3:31 PM	4:32 PM	5:33 PM
Providence	7:25 AM	9:30 AM	11:27 AM	1:10 PM	2:27 PM	3:39 PM	4:41 PM	5:42 PM
Warwick			11:38 AM		2:38 PM	3:50 PM	4:52 PM	
Wickford			11:48 AM		2:48 PM	4:00 PM	5:02 PM	

Outbound Service	WCK	WCK	WCK	PVD	PVD	WCK	PVD	PVD
Train No.	815	817	819	821	823	825	827	829
South Station	5:00 PM	5:40 PM	6:10 PM	7:10 PM	8:15 PM	9:05 PM	10:25 PM	11:59 PM
Back Bay	5:05 PM	5:45 PM	6:15 PM	7:15 PM	8:20 PM	9:10 PM	10:30 PM	12:04 AM
Ruggles	5:09 PM	5:49 PM	6:19 PM	7:18 PM	8:23 PM	9:13 PM	10:33 PM	12:07 AM
Hyde Park				7:27 PM	8:31 PM	9:21 PM	10:41 PM	12:15 AM
Rte 128			6:29 PM	7:32 PM	8:36 PM	9:26 PM	10:46 PM	12:20 AM
Canton Junction				7:37 PM	8:41 PM	9:31 PM	10:51 PM	12:25 AM
Sharon	5:27 PM	6:07 PM	6:37 PM	7:43 PM	8:47 PM	9:37 PM	10:57 PM	12:30 AM
Mansfield	5:36 PM	6:18 PM	6:46 PM	7:52 PM	8:55 PM	9:45 PM	11:05 PM	12:38 AM
Attleboro	5:49 PM	6:26 PM	6:55 PM	8:01 PM	9:03 PM	9:53 PM	11:13 PM	12:47 AM
South Attleboro	5:57 PM	6:33 PM	7:02 PM	8:08 PM	9:10 PM	10:00 PM	11:20 PM	12:55 AM
Providence	6:06 PM	6:42 PM	7:11 PM	8:17 PM	9:19 PM	10:09 PM	11:30 PM	12:05 AM
Warwick	6:18 PM	6:54 PM	7:23 PM			10:21 PM		
Wickford	6:29 PM	7:05 PM	7:34 PM			10:32 PM		

Planning and engineering for the South County service has been underway for more than a decade. The 2010 service will be less extensive than originally planned. The original service concepts included Amtrak service to the TF Green Station in Warwick and an intrastate shuttle operating between the airport and downtown Providence. Plans for the Amtrak and intrastate shuttle service have been shelved until after the MBTA service is operational.

Current Amtrak Service - Amtrak currently operates 18 weekday Acela and Regional trains in each direction through this corridor. All 36 of these trains stop at Providence. Presently, Amtrak does not serve any other stations in the study corridor. As noted above, Amtrak service to Warwick (T.F. Green) had been contemplated in planning for the South County services, but is not planned at this time.

Over the course of planning for the South County service, Amtrak's principal concern regarding MBTA service to new stations at Warwick and Wickford was maintaining capacity for intercity and Acela trains. With that objective in mind, both of the new stations are off the Amtrak mainline so that MBTA trains dwelling at these stations cannot conflict with Amtrak express services. The new services are also designed so that MBTA trains are largely confined to the non-electrified FRIP third track when and where possible to avoid potential conflicts with Amtrak's through services.[26]

[26] The FRIP track was built by RIDOT initially to provide high clearance freight access to the intermodal port at Quonset Point.

It is anticipated that the intrastate service considered by this study would be subject to the same constraints as the MBTA service avoiding stops on the Amtrak main line and largely confined to the non-electrified freight tracks. Service design options for the intrastate service would be further constrained by the need to avoid conflicts with the MBTA service to and from Boston.

Potential future Amtrak service to either Warwick or Wickford station would entail significant additional track, signal and power investments that are not in the present project budgets.

Time and space diagrams also known as "stringlines" show the current and future planned Amtrak, MBTA, and proposed Woonsocket to Providence services in the study corridor. (Amtrak: blue, MBTA: purple, and Woonsocket Intrastate: red/green) The two colors of the Woonsocket-Providence service represent the two planned train consists. Stations are indicated by black triangles. Served stops are indicated by a dot along the stringline.

Throughout the morning peak (shown in Figure 2.7), the southbound Woonsocket to Providence service is timed to facilitate transfers to the northbound MBTA service to Boston (highlighted by circles). Note that the two consists are not sufficient to make a connection to every MBTA northbound train through the morning peak. There are four trains arriving into Providence between 6 and 9 am with four timed transfers scheduled for MBTA trains at Pawtucket.

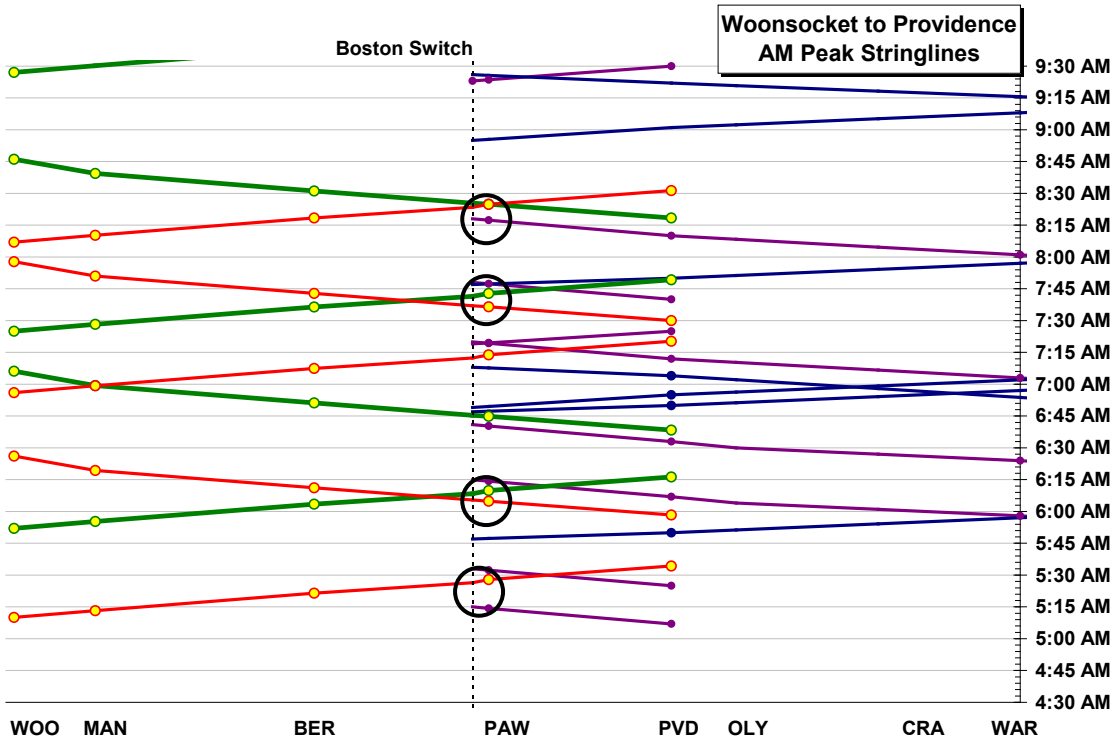


Figure 2.7

In the midday time period, timed-transfers shift to matching southbound MBTA trains to northbound Woonsocket-bound trains. Only one consist is used in the midday period as the headway increases to more than one hour.

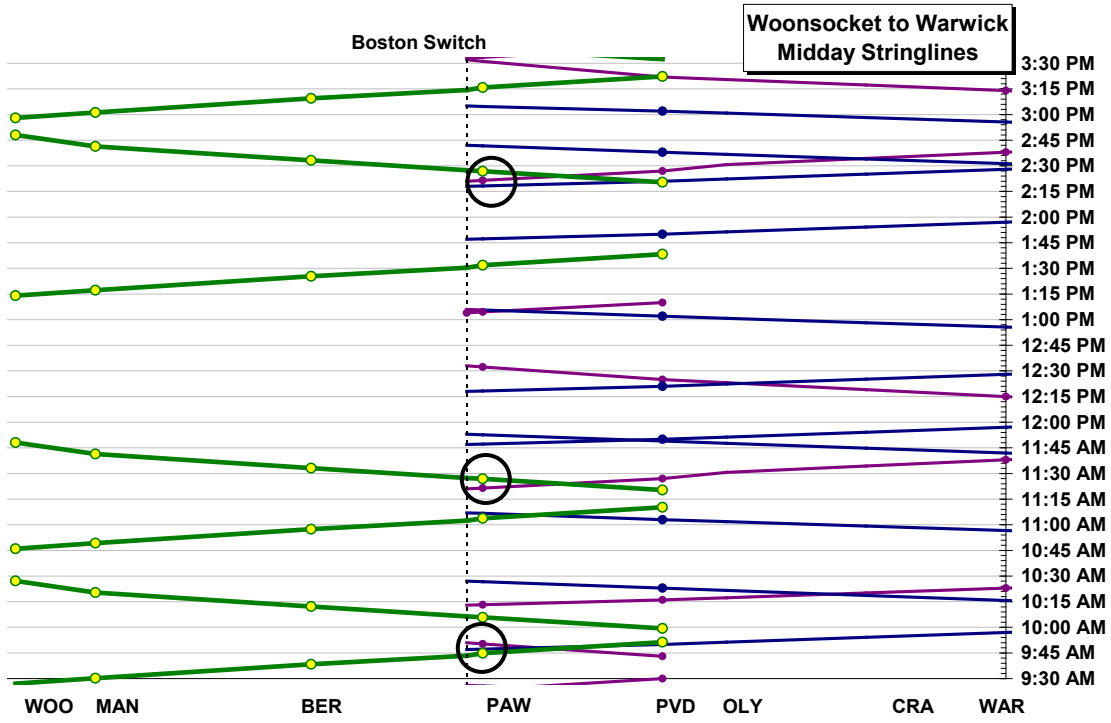


Figure 2.8

In the evening peak, the second consist is again used to provide four trips from Providence between 5 and 8:30 pm. All four of those trips also serve as timed transfers (highlighted by circles) from southbound MBTA service out of Boston.

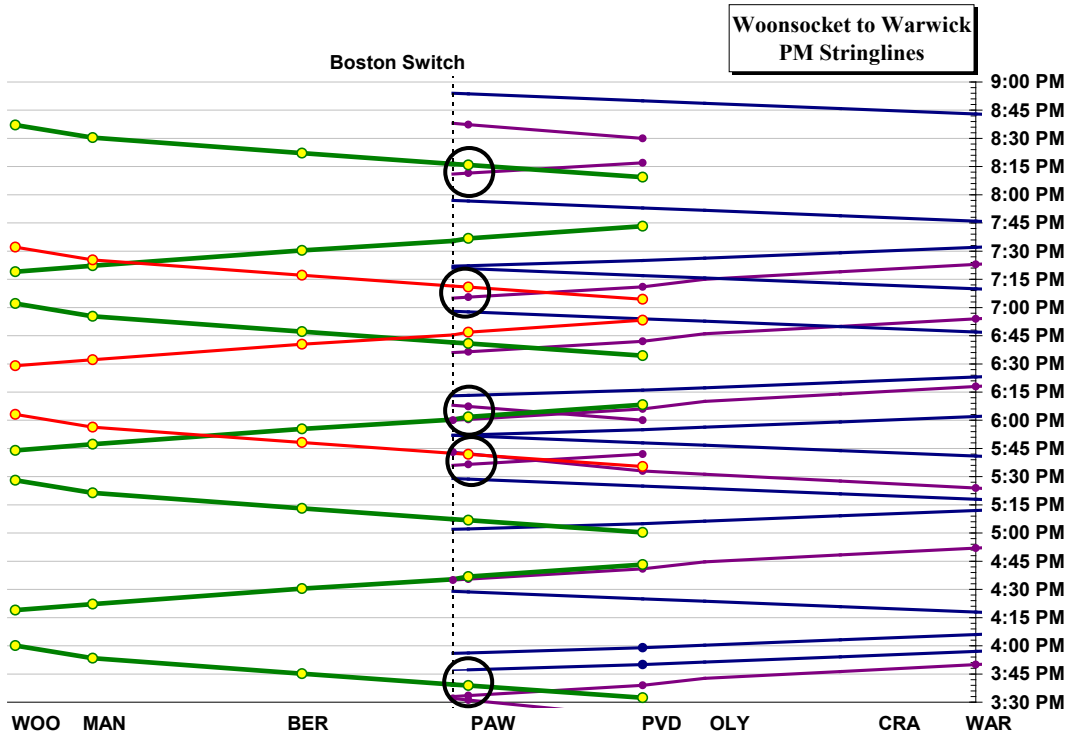


Figure 2.9

Future Amtrak Service - Amtrak recently announced their planned 2030 operating schedule. Amtrak is planning to run 50 trips (25 roundtrips) along its Northeast Corridor in 2030 between New Haven and Boston. This represents an increase of 40% from the 36 trains operated in 2009. Of these 50 trips, 60% (32 trips) will be Acela trips and 18 trips will be Northeast Regional trips. All trips will stop at Providence Station. All Northeast Regional trips will call on Kingston in addition to Providence. See Table 2.13 for a comparison of the current and future Amtrak schedules. Note, shaded columns represent *new* Acela trips.

Currently, Amtrak operates 36 trips on the NEC between Boston and New York. Half of the 36 trips (18) are Acela trips and the remaining 18 trips are Northeast Regional service. This schedule provides for bi-hourly Acela service and bi-hourly Northeast Regional service. In 2030, 14 new Acela trips will be added between New York and Boston.[27] The introduction of the 14 new trips will provide hourly Acela service between Boston and New York. Northeast regional service will remain bi-hourly.

Amtrak also plans to reduce the Acela trip time between New Haven and Boston by up to 10 – 15 minutes per trip. As of January 2009, it is unknown where the time savings will be achieved. The schedule shown in Table 2.13 was developed assuming 15 saved over

[27] Amtrak train #86 would no longer terminate at South Station, but will be re-routed to Springfield, MA, its new terminal. Amtrak plans to replace the #86 with the #150.

150 miles between Boston and New Haven will be uniformly allocated across the entire route segment.

Table 2.13:
Amtrak 2030 Northeast Corridor Schedule

North (East) Service	NE Reg.	NE Reg.	Acela	Acela	NE Reg.	Acela	Acela	NE Reg.	Acela	Acela	NE Reg.	Acela	Acela
Train No.	**66**	**150**	**2190**	**2192**	**190**	**2150**	**2152**	**170**	**2154**	**2156**	**172**	**2158**	**2160**
New Haven	5:00 AM	7:11 AM	7:25 AM	8:25 AM	9:11 AM	9:25 AM	10:25 AM	11:11 AM	11:25 AM	12:25 PM	1:11 PM	1:25 PM	2:25 PM
Kingston	6:27 AM	8:32 AM			10:27 AM			12:21 PM			2:21 PM		
Providence	6:59 AM	8:53 AM	8:43 AM	9:43 AM	10:57 AM	10:43 AM	11:43 AM	12:42 PM	12:43 PM	1:43 PM	2:42 PM	2:43 PM	3:43 PM
Boston South Station	7:43 AM	9:37 AM	9:18 AM	10:18 AM	11:41 AM	11:18 AM	12:18 PM	1:26 PM	1:18 PM	2:18 PM	3:26 PM	3:18 PM	4:18 PM

North (East) Service	NE Reg.	Acela	Acela	Acela	NE Reg.	Acela	NE Reg.	Acela	Acela	Acela	NE Reg.	Acela
Train No.	**174**	**2162**	**2164**	**2166**	**176**	**2168**	**94**	**2170**	**2172**	**2174**	**178**	**2176**
New Haven	3:11 PM	3:25 PM	4:16 PM	5:18 PM	5:29 PM	6:22 PM	7:27 PM	7:20 PM	8:22 PM	9:22 PM	9:29 PM	10:22 PM
Kingston	4:21 PM				6:39 PM		8:37 PM		9:31 PM		10:40 PM	
Providence	4:42 PM	4:43 PM	5:34 PM	6:36 PM	7:00 PM	7:40 PM	8:58 PM	8:38 PM	9:40 PM	10:40 PM	11:00 PM	11:40 PM
Boston South Station	5:26 PM	5:18 PM	6:09 PM	7:11 PM	7:44 PM	8:15 PM	9:42 PM	9:13 PM	10:15 PM	11:15 PM	11:44 PM	12:15 AM

South (West) Service	Acela	NE Reg.	Acela	Acela	NE Reg.	Acela	Acela	NE Reg.	Acela	Acela	NE Reg.	Acela	Acela
Train No.	**2151**	**95**	**2153**	**2155**	**171**	**2157**	**2159**	**93**	**2161**	**2163**	**173**	**2165**	**2167**
Boston South Station	5:30 AM	6:20 AM	6:30 AM	7:30 AM	8:20 AM	8:30 AM	9:30 AM	10:20 AM	10:30 AM	11:30 AM	12:20 PM	12:30 PM	1:30 PM
Providence	6:05 AM	7:04 AM	7:05 AM	8:05 AM	9:04 AM	9:05 AM	10:05 AM	11:04 AM	11:05 AM	12:05 PM	1:04 PM	1:05 PM	2:05 PM
Kingston		7:24 AM			9:24 AM			11:24 AM			1:24 PM		
New Haven	7:30 AM	8:54 AM	8:26 AM	9:26 AM	10:54 AM	10:26 AM	11:26 AM	12:54 PM	12:26 PM	1:26 PM	2:54 PM	2:26 PM	3:26 PM

South (West) Service	NE Reg.	Acela	Acela	NE Reg.	Acela	Acela	NE Reg.	Acela	Acela	NE Reg.	Acela	NE Reg.
Train No.	**137**	**2169**	**2171**	**175**	**2173**	**2175**	**177**	**2191**	**2193**	**179**	**2195**	**67**
Boston South Station	2:20 PM	2:30 PM	3:30 PM	4:20 PM	4:30 PM	5:30 PM	6:20 PM	6:30 PM	7:30 PM	8:20 PM	8:30 PM	10:02 PM
Providence	3:04 PM	3:05 PM	4:05 PM	5:04 PM	5:05 PM	6:05 PM	7:04 PM	7:05 PM	8:05 PM	9:04 PM	9:05 PM	10:46 PM
Kingston	3:24 PM			5:24 PM			7:24 PM			9:24 PM		11:10 PM
New Haven	4:54 PM	4:26 PM	5:26 PM	6:54 PM	6:26 PM	7:26 PM	8:54 PM	8:26 PM	9:26 PM	10:54 PM	10:26 PM	12:40 AM

Current and Future P&W Service - Working with Amtrak's long range planning efforts, the Providence and Worcester (P&W) railroad recently unveiled their proposed 2030 operating schedule. The P&W is planning to run 32 freight trains along Amtrak's Northeast Corridor (16 in each direction) in 2030. Of these 32 trips, 16 trips will use Rhode Island's FRIP track (shown below) running between the Davisville interlocking serving Quonset and the Atwells interlocking just south of Providence Station.

Table 2.14 shows the P&W's proposed Westbound (South) 2030 operating schedule, the composition of each consist, its cargo, and the time slot for operation along the FRIP, and location for each train to begin and end its trip. Trains that are presently operated are shown in italics.

Table 2.14: **Providence and Worcester Railroad 2030 Westbound Operations Using the FRIP Track**					
Direction: West (South)	**Cargo**	**Start**	**End**	**Composition**	**FRIP Time Slot**
WODA-3	Merchandise	Worcester	Davisville	2 Diesels-30 Cars	2:00 AM
AUTO-1	Automobiles	Worcester	Davisville	2 Diesels-30 Cars	3:00 AM
WODA-1	*Merchandise*	*Worcester*	*Davisville*	*2 Diesels-30 Cars*	*8:00 AM*
PR-3	*Coal and Merchandise*	*Worcester*	*Kingston*	*3 Diesels-30 Cars*	*8:00 AM*
UNIT-1	Ethanol	Worcester	Davisville	2 Diesels-30 Cars	10:00 AM
AUTO-2	Automobiles	Worcester	Davisville	2 Diesels-30 Cars	11:00 AM
WODA-2	*Merchandise*	*Worcester*	*Davisville*	*2 Diesels-30 Cars*	*2:00 PM*
UNIT-2	Ethanol	Worcester	Davisville	2 Diesels-30 Cars	8:00 PM

Table 2.15 shows the P&W's proposed Eastbound (North) 2030 operating schedule, the composition of each consist, its cargo, and the time slot for operation along the FRIP and location for each train to begin and end its trip. Trains that are presently operated are shown in italics.

Table 2.15: **Providence and Worcester Railroad 2030 Eastbound (North) Operations**					
Direction: East (North)	**Cargo**	**Start**	**End**	**Composition**	**FRIP Time Slot**
AUTO-1	Automobiles	Davisville	Worcester	2 Diesels-30 Cars	6:00 AM
PR-3	*Coal and Merchandise*	*Kingston*	*Worcester*	*3 Diesels-50 Cars*	*11:00 AM*
DAWO-1	*Merchandise*	*Davisville*	*Worcester*	*2 Diesels-30 Cars*	*1:00 PM*
UNIT-1	Ethanol	Davisville	Worcester	2 Diesels-30 Cars	1:00 PM
AUTO-2	Automobiles	Davisville	Worcester	2 Diesels-30 Cars	3:00 PM
DAWO-2	*Merchandise*	*Davisville*	*Worcester*	*2 Diesels-30 Cars*	*5:00 PM*
DAWO-3	Merchandise	Davisville	Worcester	2 Diesels-30 Cars	7:00 PM
UNIT-2	Ethanol	Davisville	Worcester	2 Diesels-30 Cars	11:00 PM

Compared with current operations, the P&W anticipates a substantial increase in its freight activity. When the study team spoke with the P&W in July and October 2008[28], the P&W was operating currently eight daily trains between Worcester and Davisville.

The 2030 schedule will double the freight trips over the next 20 years. See Table 2.16 for more information on P&W's current and future operations. The anticipated growth primarily arises from the development of new markets at Davisville for automobile and ethanol traffic. Given recent developments in the automobile and energy markets, the prospects for such traffic growth is far from certain.

[28] Bernard Cartier, telephone conversation, July 15, 2008.

Table 2.16
Comparison of Current and Future P&W Operations in Study Area

Westbound (South)			Eastbound (North)		
Train ID	**2008 Service**	**2030 Service**	**Train ID**	**2008 Service**	**2030 Service**
PR-3	x	x	PR-3	x	x
PR-2	x		PR-2	x	
WODA-1	x	x	DAWO-1	x	x
WODA-2	x	x	DAWO-2	x	x
WODA-3		x	DAWO-3		x
AUTO-1		x	AUTO-1		x
AUTO-2		x	AUTO-2		x
UNIT-1		x	UNIT-1		x
UNIT-2		x	UNIT-2		x

2030 Mainline and FRIP Schedule

Employing the P&W's 2030 operating plan, and the MBTA's 2025 South County Commuter Rail schedule, a daily FRIP track schedule was developed as shown in Table 2.17.[29] In developing the schedule, it was assumed that a wall separating Providence Station Track 7 and Track 5 would be completed. Completion of this wall would remove restrictions on the timing of hazardous cargo movements through the station.[30]

[29] This schedule was developed so that all freight movements would use the FRIP track and not Track 1 south of Providence Station.

[30] Currently, all hazardous cargo that travels through Providence Station must stop and wait for all passenger trains to be clear of the station before proceeding through.

Table 2.17:
2030 P&W Mainline and FRIP Schedule

South (West) Service	P&W	P&W	MBTA	MBTA	P&W	P&W	P&W	P&W	MBTA
Train No.	WODA-3	AUTO-1	DH1	DH2	PR-3	WODA-1	UNIT-1	AUTO-2	805
Woonsocket	2:02 AM	2:47 AM			8:03 AM	8:13 AM	9:33 AM	10:35 AM	
Cumberland	2:18 AM	3:03 AM			8:19 AM	8:29 AM	9:49 AM	10:51 AM	
Pawtucket	2:22 AM	3:07 AM	4:50 AM	6:00 AM	8:23 AM	8:33 AM	9:53 AM	10:55 AM	11:22 AM
Providence	2:30 AM	3:15 AM	4:55 AM	6:05 AM	8:31 AM	8:41 AM	10:01 AM	11:03 AM	11:28 AM
Olneyville	2:33 AM	3:18 AM	4:58 AM	6:07 AM	8:34 AM	8:44 AM	10:04 AM	11:06 AM	11:31 AM
Cranston	2:39 AM	3:24 AM	5:02 AM	6:11 AM	8:40 AM	8:50 AM	10:10 AM	11:12 AM	11:28 AM
Warwick ~ TF Green	2:45 AM	3:30 AM	5:06 AM	6:16 AM	8:46 AM	8:56 AM	10:16 AM	11:18 AM	11:31 AM
Packard - FRIP Track	2:49 AM	3:34 AM	5:09 AM	6:18 AM	8:50 AM	9:00 AM	10:20 AM	11:22 AM	11:35 AM
Davisville	3:00 AM	3:45 AM	5:13 AM	6:25 AM	9:01 AM	9:11 AM	10:31 AM	11:33 AM	11:41 AM
Wickford			5:15 AM	6:27 AM					11:43 AM

South (West) Service	P&W	MBTA	MBTA	MBTA	MBTA	MBTA	MBTA	P&W	MBTA
Train No.	WODA-2	809	811	8XY	815	817	819	UNIT-2	825
Woonsocket	1:50 PM							8:02 PM	
Cumberland	2:06 PM							8:18 PM	
Pawtucket	2:10 PM	2:21 PM	4:35 PM	3:33 PM	5:59 PM	6:35 PM	7:05 PM	8:22 PM	10:02 PM
Providence	2:18 PM	2:27 PM	4:41 PM	3:39 PM	6:06 PM	6:42 PM	7:11 PM	8:30 PM	10:09 PM
Olneyville	2:21 PM	2:30 PM	4:44 PM	3:42 PM	6:09 PM	6:45 PM	7:14 PM	8:33 PM	10:12 PM
Cranston	2:27 PM	2:27 PM	4:48 PM	3:46 PM	6:13 PM	6:49 PM	7:18 PM	8:39 PM	10:24 PM
Warwick ~ TF Green	2:33 PM	2:30 PM	4:53 PM	3:52 PM	6:18 PM	6:53 PM	7:23 PM	8:45 PM	10:21 PM
Packard - FRIP Track	2:37 PM	2:34 PM	4:56 PM	3:54 PM	6:21 PM	6:56 PM	7:26 PM	8:49 PM	10:24 PM
Davisville	2:48 PM	2:40 PM	5:05 PM	4:01 PM	6:27 PM	7:03 PM	7:35 PM	9:00 PM	10:30 PM
Wickford		2:42 PM	5:07 PM	4:03 PM	6:29 PM	7:05 PM	7:37 PM		10:32 PM

North (East) Service	MBTA	MBTA	P&W	MBTA	MBTA	P&W	MBTA	P&W	P&W
Train No.	804	806	AUTO-1	808	812	PR-3	816	DAWO-1	Unit-1
Wickford	5:46 AM	6:12 AM		6:51 AM	7:49 AM		12:03 PM		
Davisville	5:48 AM	6:14 AM	6:20 AM	6:53 AM	7:51 AM	11:38 AM	12:05 PM	11:45 AM	1:00 PM
Packard - FRIP Track	5:56 AM	6:22 AM	6:31 AM	7:01 AM	7:59 AM	11:49 AM	12:13 PM	11:56 AM	1:11 PM
Warwick ~ TF Green	5:58 AM	6:29 AM	6:35 AM	7:08 AM	8:06 AM	11:54 AM	12:20 PM	12:00 PM	1:15 PM
Cranston	6:02 AM	6:28 AM	6:41 AM	7:07 AM	8:05 AM	12:00 PM	12:19 PM	12:06 PM	1:21 PM
Olneyville	6:06 AM	6:32 AM	6:47 AM	7:11 AM	8:09 AM	1:07 PM	12:23 PM	12:12 PM	1:27 PM
Providence	6:08 AM	6:34 AM	6:50 AM	7:13 AM	8:11 AM	1:10 PM	12:25 PM	12:15 PM	1:30 PM
Pawtucket	6:13 AM	6:39 AM	6:58 AM	7:18 AM	8:16 AM	1:18 PM	12:30 PM	12:23 PM	1:38 PM
Cumberland			7:02 AM			1:22 PM		12:27 PM	1:42 PM
Woonsocket			7:18 AM			1:38 PM		12:43 PM	1:58 PM
						Stop at Cranston Yard (12PM-1PM)			

North (East) Service	MBTA	P&W	MBTA	P&W	MBTA	MBTA	P&W	MBTA	P&W
Train No.	820	AUTO-2	8XX	DAWO-2	822	DH3	DAWO-3	DH4	Unit-2
Wickford	3:03 PM		4:17 PM		5:12 PM	7:25 PM		10:52 PM	
Davisville	3:05 PM	3:07 PM	4:19 PM	4:55 PM	5:14 PM	7:27 PM	7:37 PM	10:54 PM	11:30 PM
Packard - FRIP Track	3:13 PM	3:18 PM	4:27 PM	5:06 PM	5:22 PM	7:31 PM	7:48 PM	10:58 PM	11:41 PM
Warwick ~ TF Green	3:15 PM	3:22 PM	4:29 PM	5:10 PM	5:24 PM	7:34 PM	7:52 PM	11:01 PM	11:45 PM
Cranston	3:18 PM	3:28 PM	4:31 PM	5:16 PM	5:28 PM	7:39 PM	7:58 PM	11:06 PM	11:51 PM
Olneyville	3:22 PM	3:34 PM	4:35 PM	5:22 PM	5:32 PM	7:43 PM	10:02 PM	11:10 PM	11:57 PM
Providence	3:24 PM	3:37 PM	4:37 PM	5:25 PM	5:34 PM	7:45 PM	10:04 PM	11:12 PM	12:00 AM
Pawtucket	3:29 PM	3:45 PM	4:42 PM	5:33 PM	5:39 PM	7:51 PM	10:12 PM	11:18 PM	12:08 AM
Cumberland		3:49 PM		5:37 PM			10:16 PM		12:12 AM
Woonsocket		4:05 PM		5:53 PM			10:32 PM		12:28 AM
							Stop @ Cranston Yard (8PM-10PM)		

Jacobs understanding of the schedule indicates that PR-3's eastern movement has an hour layover in diversion to Cranston Yard to deliver coal, and that WODA-3 has a two hour layover in Cranston Yard to deliver coal, and leaves a cut of cars on the FRIP.[31] MBTA commuter rail trips south of Providence are considered constant and their arrival and departure times are fixed.

[31] It is currently being investigated whether Wellington siding, located off of the FRIP track could be used for offline vehicle storage for WODA-3. It is recommended that Wellington siding be used by the P&W so as to not foul the FRIP track.

Since only the hour time slot of the freight movements was specified, some operational flexibility in scheduling is possible. This is especially important since the FRIP track is a single track and conflicts must be avoided.

Using these assumptions, freight movements were scheduled to either follow or precede MBTA South County Commuter Rail trips in the direction of travel by 5 – 10 minutes. The process of scheduling trips in this manner is known as fleeting the line. In this case, the line can be fleeted between Atwells and Davisville interlockings. When all movements are clear of the down line interlocking, the traffic direction can be reversed and the line fleeted in the opposite direction.

Northeast Corridor Stringlines: Pawtucket to Wickford Junction

Stringlines corresponding to the 2030 timetables for Amtrak, the MBTA, and the P&W are shown in the proceeding figures. The eastern (northern) limit of the stringlines is the location of the future Pawtucket MBTA station, and the western (southern) limit is the MBTA Wickford Station. Note, only MBTA South County trains and P&W freight trains are labeled.

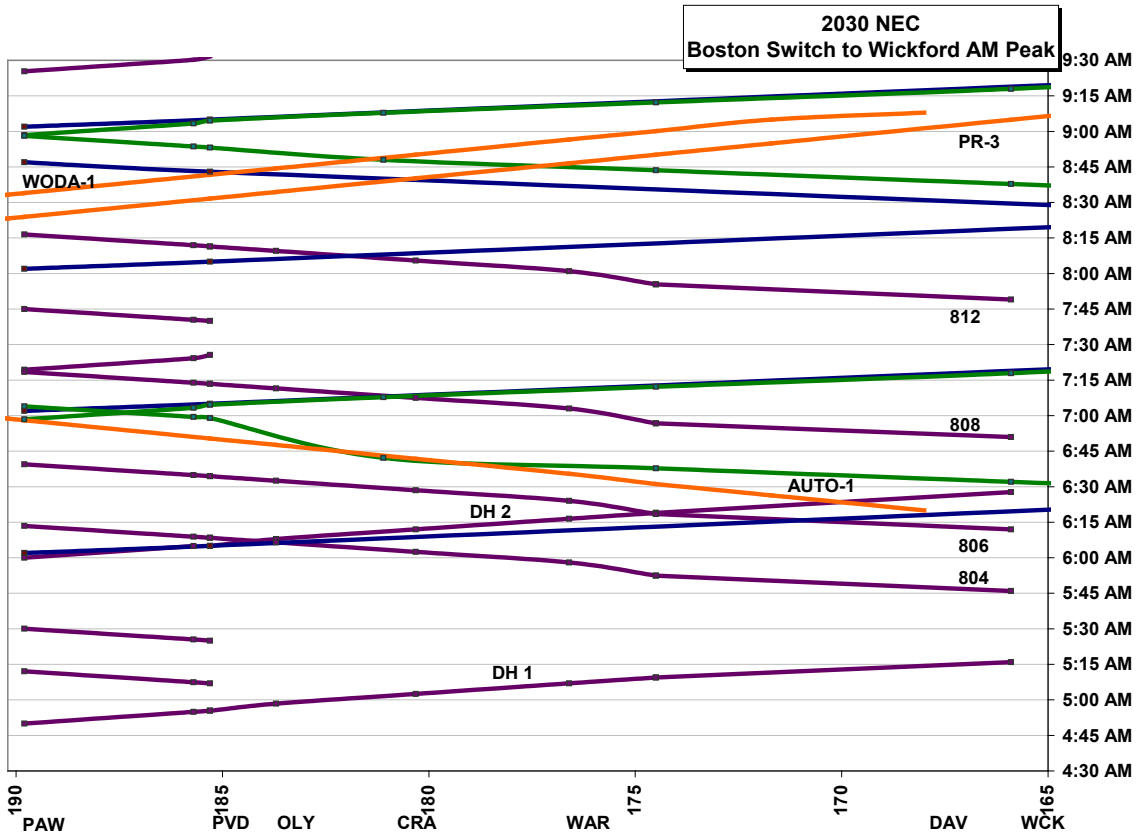


Figure 2.10

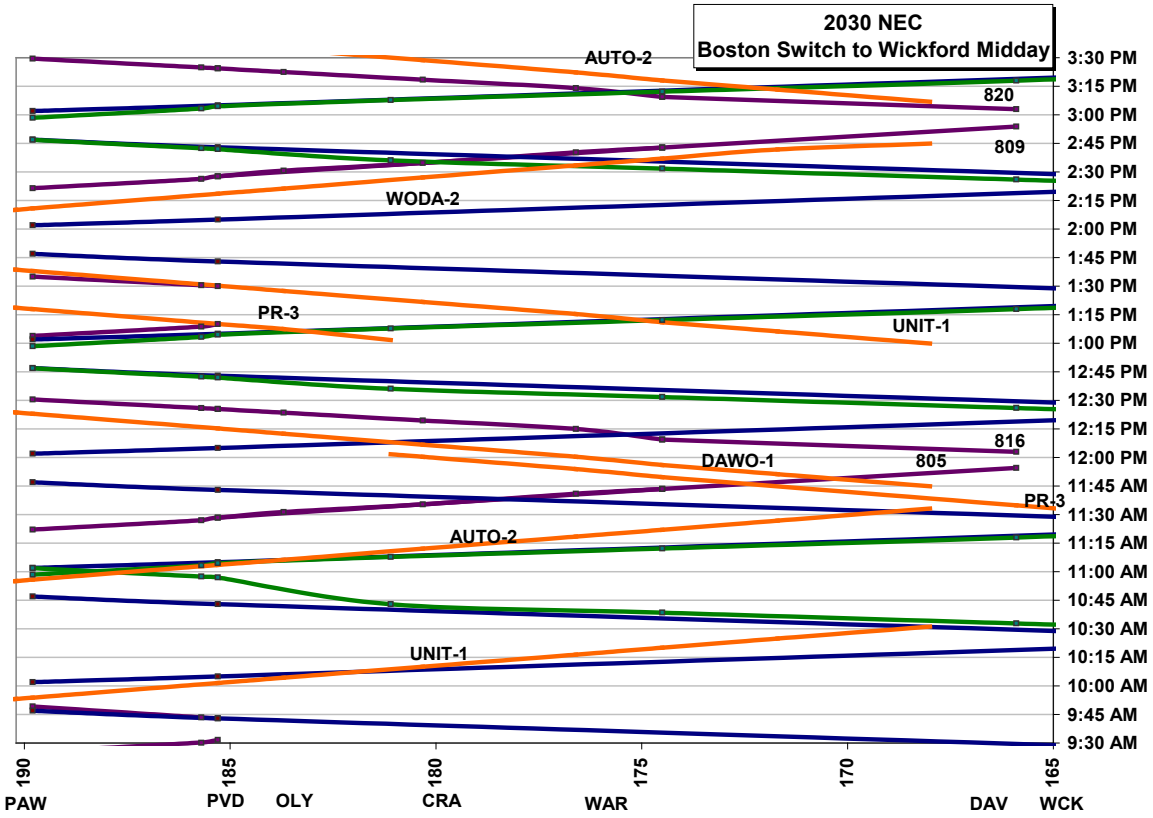


Figure 2.12

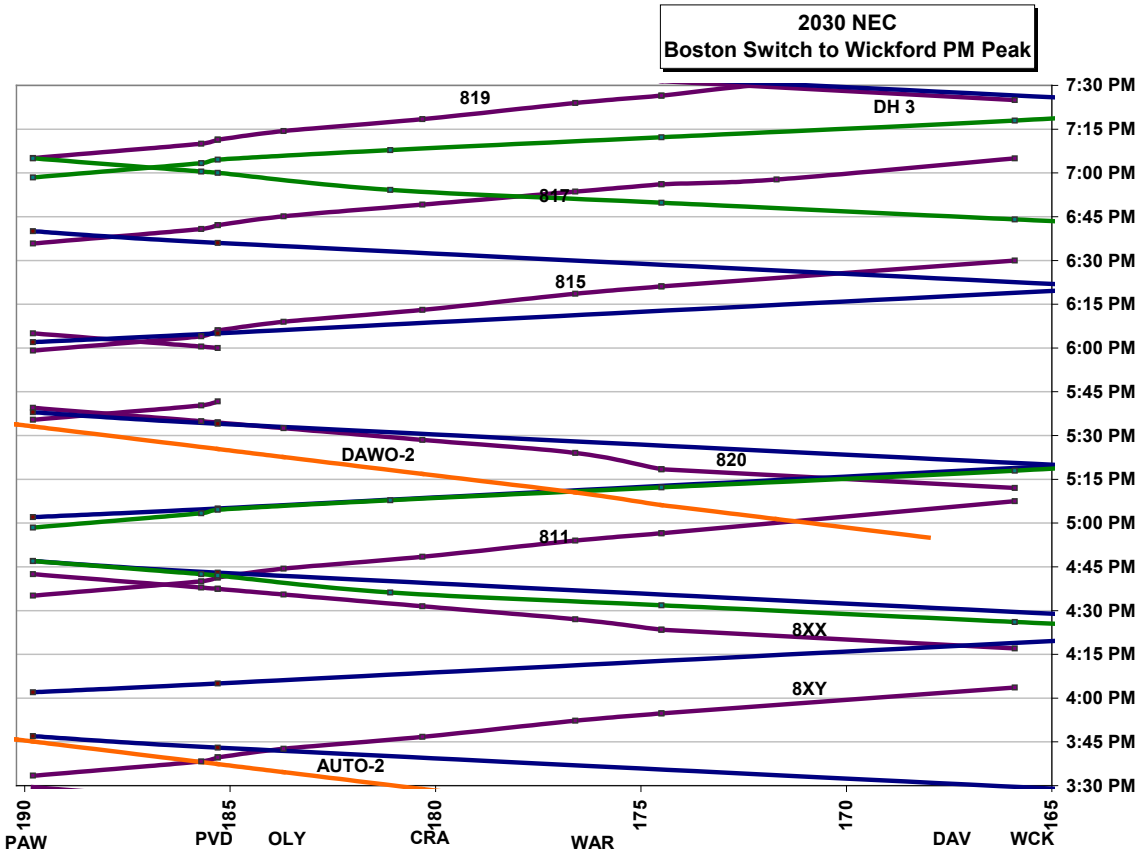


Figure 2.11

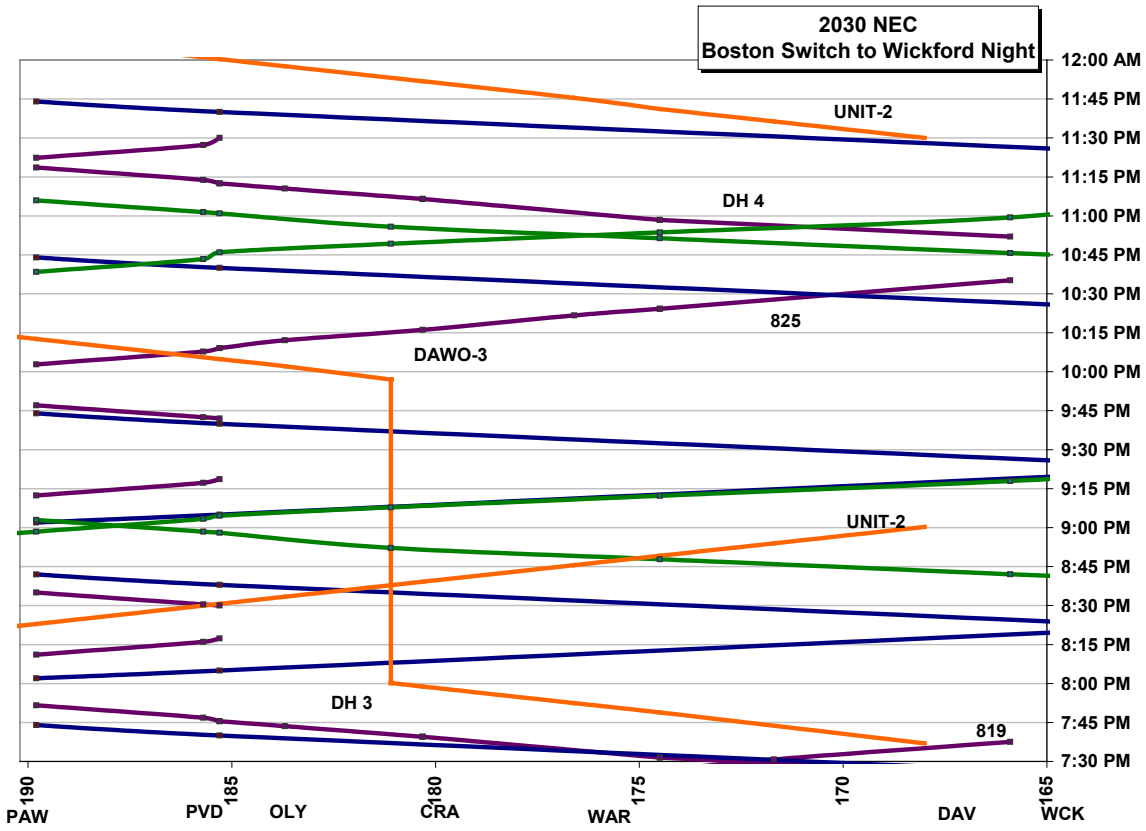


Figure 2.14

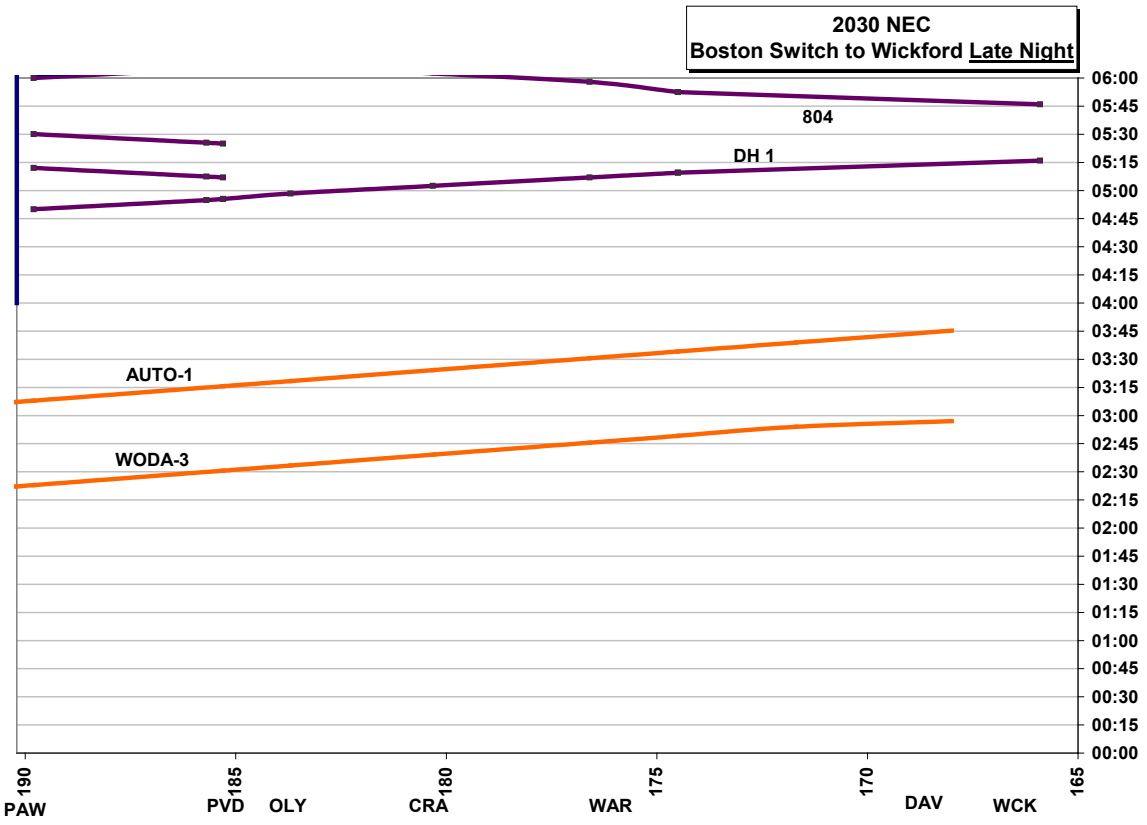


Figure 2.13

Fares

The current MBTA zonal fare structure and associated cost per mile are shown in Table 2.18.

Table 2.18:
Current MBTA Zone Fare Structure[32]

Zone	One-Way Ticket	Monthly Pass	Approximate Cost per Mile	
			One - Way Ticket	Monthly Pass[33]
Zone 1A	$ 1.70	$ 59	$ 0.86	$ 0.70
Zone 1	$ 4.25	$ 135	$ 0.85	$ 0.64
Zone 2	$ 4.75	$ 151	$ 0.48	$ 0.36
Zone 3	$ 5.25	$ 163	$ 0.44	$ 0.32
Zone 4	$ 5.75	$ 186	$ 0.38	$ 0.30
Zone 5	$ 6.25	$ 210	$ 0.35	$ 0.28
Zone 6	$ 6.75	$ 223	$ 0.32	$ 0.25
Zone 7	$ 7.25	$ 235	$ 0.29	$ 0.22
Zone 8	$ 7.75	$ 250	$ 0.26	$ 0.20

The 2007 Woonsocket study used the MBTA zonal fare structure as a model to establish potential zones and fares for the intrastate commuter rail service. Listed in **Table 2.19** are the station zone classifications, assuming that Providence is the focal point of the service.

Table 2.19:
Possible Rhode Island Commuter Rail Fare Zones

Station	Providence
Woonsocket	4
Manville	3
Berkeley	1
Pawtucket	1A
Providence	-
Olneyville	1A
Cranston	1
Warwick	1

When MBTA South County service commences, interzone fares will be used for travel to Providence. Keeping with this convention, all fares to Providence will use the MBTA interzone fare. **Table 2.20** shows the possible one-way fare from the central and terminal stations to Providence Station.

[32] Massachusetts Bay Transportation Authority, "Fares and Passes," http://www.mbta.com/fares_and_passes/rail/. Accessed: August 4, 2008.
[33] Assumes 42 trips per month for monthly pass holders.

Table 2.20: **Suggested Interzone Fares for Commuter Rail Service to Providence**		
Station	**Zone**	**Interzone Fare**
Woonsocket	5	$ 3.00
Manville	4	$ 2.75
Berkeley	2	$ 2.25
Pawtucket	1	$ 1.70
Providence	-	-
Olneyville	1	$ 1.70
Cranston	2	$ 2.25
Warwick	2	$ 2.25

III. Railroad Infrastructure

The proposed route has two distinct segments. First, the P&W segment runs 11.3 miles along the Providence and Worcester's mainline between Woonsocket and the "Boston Switch" where the P&W joins Amtrak's Northeast Corridor. Second, the Amtrak segment runs between Boston Switch and Warwick Station for a distance of approximately 13.6 miles on Amtrak's Northeast Corridor. Table 2.21 lists key route locations.

Table 2.21: **Key Route Locations**				
	Approx Route Miles	**Distance from Providence Station**	**Northeast Corridor MP**	**P&W MP**
Woonsocket	24.9	16.2	-	16.2
Manville	22.9	14.2	-	14.2
Berkeley	17.5	8.8	-	8.8
Boston Switch	13.6	4.9	190.2	4.9
Pawtucket/Central Falls	13.2	4.5	189.8	-
Providence Station	8.7	-	185.3	-
Olneyville	7.1	1.6	183.7	-
Cranston	3.6	5.1	180.2	-
Warwick	0.0	8.7	176.6	-

Providence and Worcester Railroad[34]

The P&W is a regional freight railroad operating in Massachusetts, Rhode Island, Connecticut, and New York. The company is the only interstate freight carrier serving the State of Rhode Island and possesses the exclusive and perpetual right to conduct freight operations over the Northeast Corridor between New Haven, Connecticut and the Massachusetts / Rhode Island border. Figure 2.15 shows a current route map of the P&W railroad.[35]

The company transports a wide variety of commodities for its customers, including automobiles, construction aggregate, iron, various steel products, lumber, coal, ethanol, chemicals, scrap metals, plastic resins, cement, processed foods, and edible food stuffs, such as frozen foods, corn syrup and animal and vegetable oils.

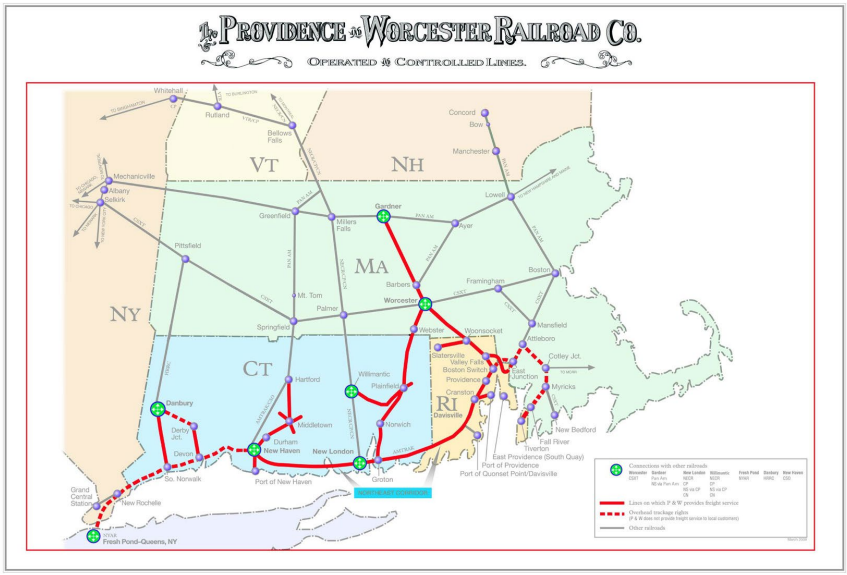


Figure 2.15

The P&W has been very supportive and active in developing rail transportation initiatives with Rhode Island officials. The railway was actively involved in the 2007 Woonsocket Commuter Rail Feasibility Study and has been partnering with Rhode Island and Massachusetts state officials in developing the 48 mile Blackstone River Bikeway between Providence and Worcester.

The P&W and RIDOT recently collaborated on a major railway investment between Providence and Davisville to provide a high clearance double stack freight route from piers at Quonset Point to Providence along Amtrak's Northeast Corridor. This investment provides a route for double stack container trains and high-cube automobile rack cars to serve the Davisville port district with connections to nation's double-stack network including Chicago and Los Angeles via the P&W to Worcester. The freight clearance investment, known as the "Freight Rail Improvement Project" or FRIP is the genesis of the non-electrified third track along the Amtrak's Northeast Corridor between Pawtucket and Davisville. This track is discussed in more detail elsewhere in this chapter.

[34] Providence and Worcester Railroad, "About Us," http://www.pwrr.com/. Accessed: August 4, 2008.
[35] Ibid, "P&W Service Map," http://www.pwrr.com/PWmap2.html. Accessed: August 4, 2008.

Current Speeds

Along this segment the P&W generally maintains its track to FRA Class 3 standards, but track speed along the P&W mainline varies (see Table 2.22). The maximum freight speed is 40 mph. See Figure 2.16 for more information.

Table 2.22:
Maximum Freight Speeds on P&W Mainline[36]

Location (From/To)	P&W MP	Max. Allowable Speed (mph)
Boston Switch / Lonsdale	4.9 – 7.2	10
Lonsdale / Davidson Ave.[37]	7.2 – 15.4	40
Davidson Ave. / River Street	15.4 – 16.7	25

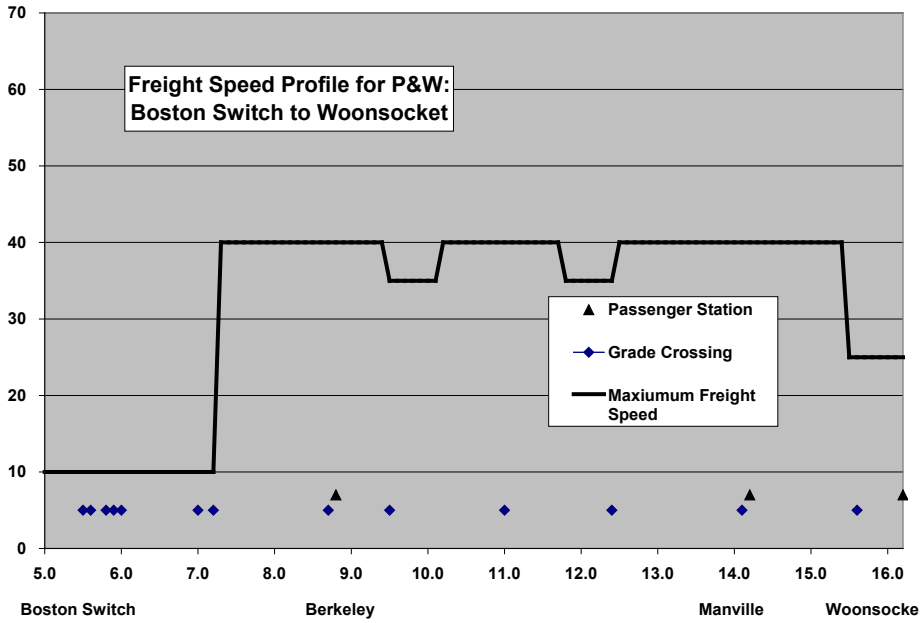


Figure 2.16

[36] Providence and Worcester Railroad Company. (January 1997). *Book of Rules, 6th Edition: Timetable Number 6*., pp. 27.

[37] Due to two sharp curves between MP 7.2 and 15.4, the maximum speed is 35 mph.

Track Configuration

Currently, the P&W track to Woonsocket is single track with jointed rail. The rail itself is comprised of 39 foot sections of 4-bolt 115 pound rail. The track is maintained to FRA Class 3 standards. With only a single track available, the options for developing frequent bi-directional passenger service are limited by the inability of opposing trains to meet and pass (see Figure 2.17).

Signaling and Train Control

The P&W segment is unsignalled and controlled via "Track Permits" (Form D) by the P&W's train dispatcher based in Worcester.

Interlockings, Turnouts, Sidings, and Freight Yards

There are no interlockings along the P&W segment. According to track charts provided by the P&W, there are 11 turnouts along the 11.3 mile segment between Boston Switch and Woonsocket Station. The Valley Falls freight yard is between MP 6.0 and MP 6.6.

Table 2.23:
P&W Freight Yards, Turnouts, and Passing Sidings

No.	Type	MP
1	Turnout	5.9
2	Turnout	5.9
3	Valley Falls Freight Yard	6.0
4	Valley Falls Freight Yard	6.6
5	Turnout	6.7
6	Turnout	8.8
7	Turnout	8.9
8	Turnout	9.0
9	Turnout	9.1
10	Turnout	9.2
11	Turnout	15.4

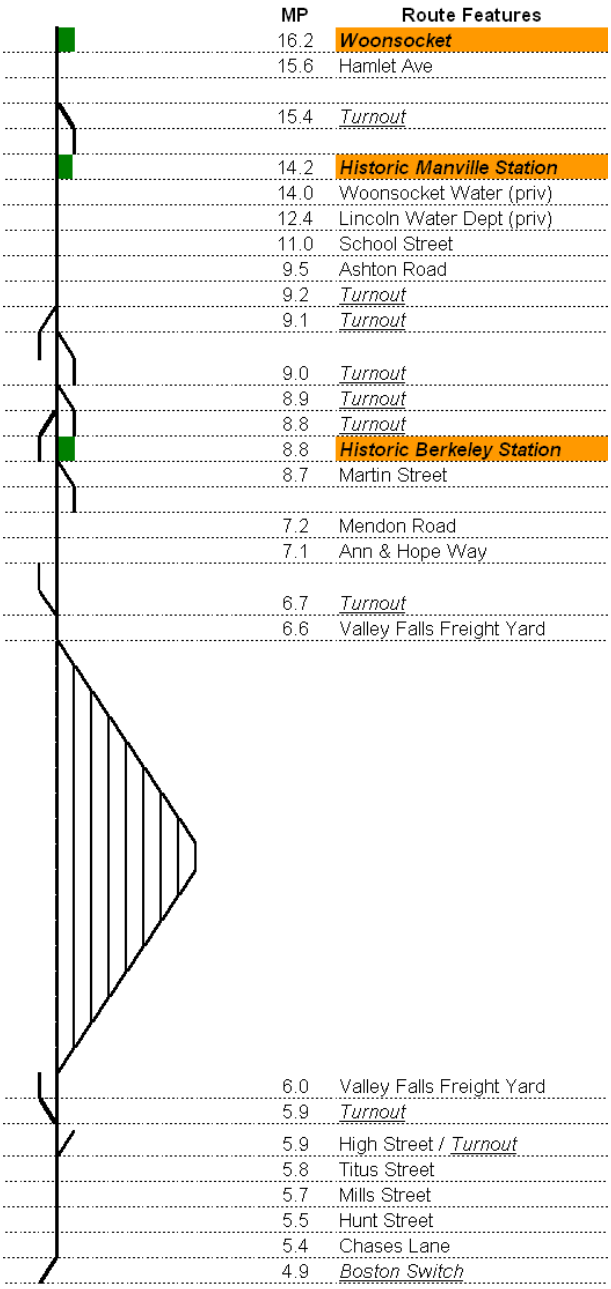


Figure 2.17:
Providence and Worcester Track Diagram from Woonsocket Station to Boston Switch

Grade Crossings
There are 13 grade crossings on the P&W segment as shown in Table 2.24.

Table 2.24:
P&W Segment Grade Crossings

MP	Crossing Name	Protection
5.4	Chases Lane	BFG
5.5	Hunt Street	BFG
5.7	Mills Street	BFG
5.8	Titus Street	BF
5.9	High Street	BF
7.1	Ann & Hope Way	BFG
7.2	Mendon Rd	BFG
8.7	Martin Street	BFG
9.5	Ashton Road	BF
11.0	School Street	BFG
12.4	Lincoln Water Dept (priv)	BFG
14.0	Woonsocket Water (priv)	BFG
15.6	Hamlet Ave	BFG*

KEY: B=Bells *F*=Flashers *G*=Gates
*Crossing warning devices interconnected with traffic signal lights

Traffic and Operations
See section *Current and Future P&W Service* for more information.

Amtrak's Northeast Corridor Segment
Amtrak owns and maintains its main line in Rhode Island. (In Massachusetts, the line belongs to the MBTA. West of New Haven, Connecticut it belongs to the Connecticut DOT.) The 14.4 mile segment between Boston Switch and Warwick that would be used by the Rhode Island Intrastate Commuter Rail Service consists of three tracks. Two tracks are "high speed" passenger tracks with overhead catenary wiring for the operation of electric Acela and Amtrak Regional trains. The FRIP track (discussed earlier) is maintained to a lower standard without electrification, designed primarily for use by freight trains. The "freight track" south of Providence is newly constructed to provide the P&W with a high clearance route to the Davisville (Quonset Point) waterfront intermodal and automobile terminal south of Warwick.

South of Providence, construction of the third track was funded by RIDOT as its "Freight Rail Improvement Project (FRIP). It is hoped that this FRIP route will spur economic development in Rhode Island by providing a double-stack container route from the Rhode Island waterfront to the national double stack freight network. The Davisville facility on Quonset Point is the only New England port with double stack freight clearances.

The freight track plays a key role in Rhode Island's plans for commuter rail service south of Providence. MBTA trains extended to Warwick will call on stations built along the FRIP with no service from Amtrak trains on the electrified mainline tracks. By limiting MBTA service to stations off the electrified mains, the potential for conflicts between local and long distance passenger services are much reduced. It is anticipated that the intrastate commuter rail service would be subject to the concerns and constraints when is operates along the Northeast Corridor.

The two electrified track are numbered 1 and 2. The track number of the freight route varies along the segment as shown in Table 2.25.[38]

[38] Between Malcom interlocking and Warwick Station, the FRIP track does not exist. As previously mentioned, mainline clearances were raised to allow double stack freight traffic to use Tracks 1 and 2 along this segment.

Table 2.25:
Track Number of the FRIP Track

From	To	NEC MP	FRIP Track Number
Davisville Interlocking	Malcom Interlocking	168 – 170	4
Malcom Interlocking	Packard Interlocking	170 – 174	None
Packard Interlocking	Brayton Interlocking	174 – 185	3
Brayton Interlocking	Boston Switch	185 – 191	7

Amtrak owns and maintains all tracks along the NEC in the corridor, but shares the cost of maintenance with other users, including both the MBTA and P&W. Track maintenance between Providence Station to the Massachusetts State Line is apportioned by the "Attleboro Agreement" between the MBTA and Amtrak. FRIP track maintenance is funded by the P&W Railroad. The mechanism for allocating expenses to MBTA trains operating south of Providence towards Warwick is still under development and discussed in Chapter 8.

Track Configuration

As noted above, Amtrak's NEC provides two electrified tracks throughout Rhode Island. Track 1 is primarily used as the southbound track; Track 2 is generally the northbound track, although the signal system on the tracks does allow for full speed bi-directional operation. See Figure 2.18 for a track diagram of the Northeast Corridor from Pawtucket to "Orms" interlocking, and from "Atwells" interlocking to Warwick Station. Detail in the vicinity of Providence Station is shown in Figure 2.19.

Between the proposed Warwick Station and Providence Station, the NEC has three tracks. As previously noted, Track 3 was recently constructed and is entirely unelectrified.

Brayton interlocking provides a full crossover between Tracks 1 and 2. A switch at Brayton connects Track 1 with Track 3. Northbound freight service on Track 3 switches to Track 7 at Brayton interlocking and bypasses the passenger platforms at Providence Station (see Figure 2.19).

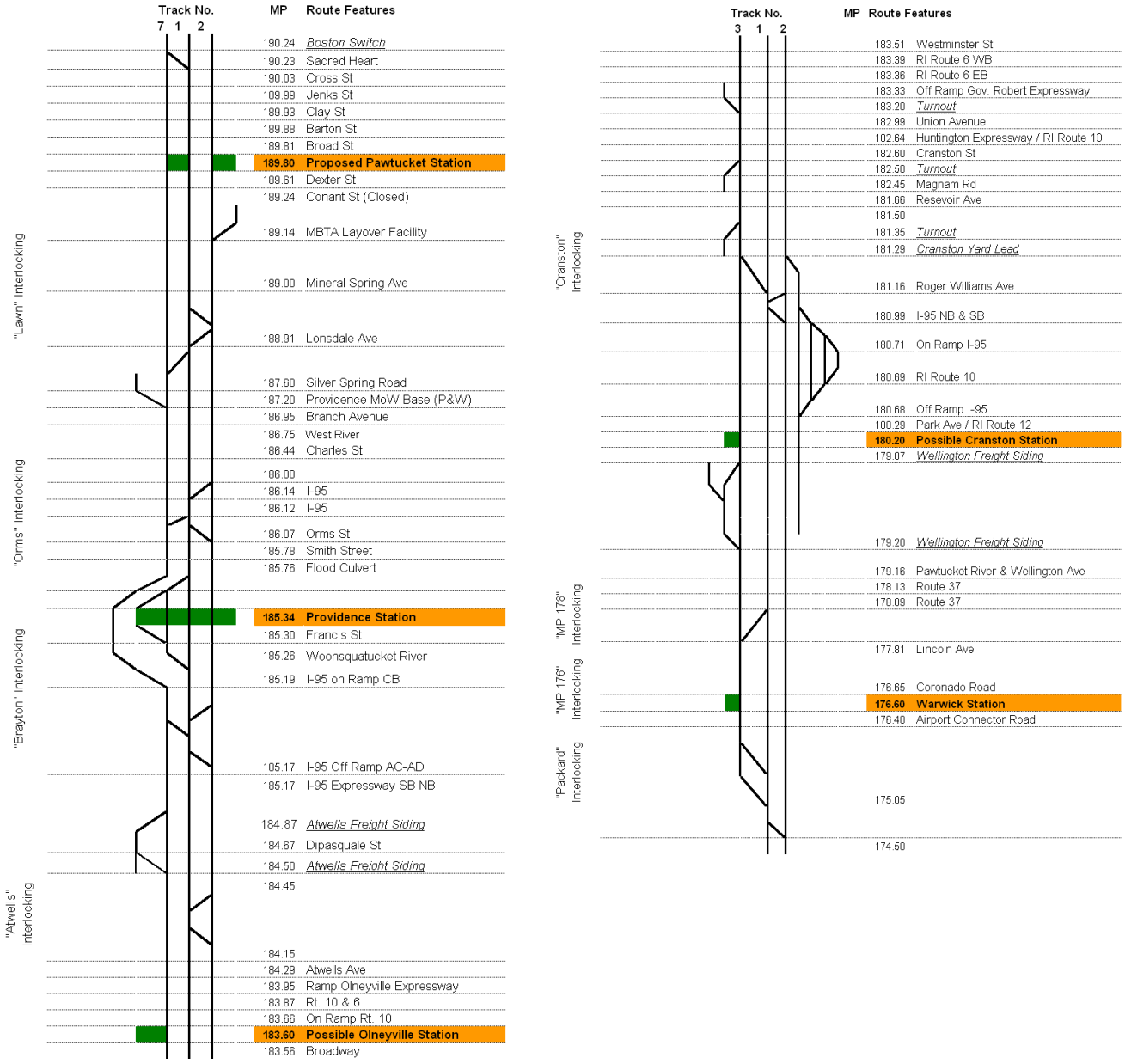


Figure 2.18:
Northeast Corridor Track Diagram from Warwick Station to Boston Switch

North of Providence Station, there is no crossover linking station Tracks 3 or 5 with Track 7. As noted in the previous Woonsocket Study, in order to implement new service, a switch connecting Station Tracks 3 and 5 with Track 7 north of Providence Station would need to be installed.[39] A switch connecting Track 7 to Station Tracks 3 and 5 have the least impact on Amtrak and MBTA services on the NEC.[40] This improvement would

[39] Jacobs Edwards and Kelcey. (2007). *Woonsocket Commuter Rail Feasibility Study*. Prepared for the City of Woonsocket, pp.55.
[40] Ibid.

be required for intrastate service to Woonsocket, and allow intrastate service to operate independent of Amtrak's NEC. The proposed track change is highlighted in red. See Figure 2.20.

Figure 2.19:
Current Track Configuration at Providence

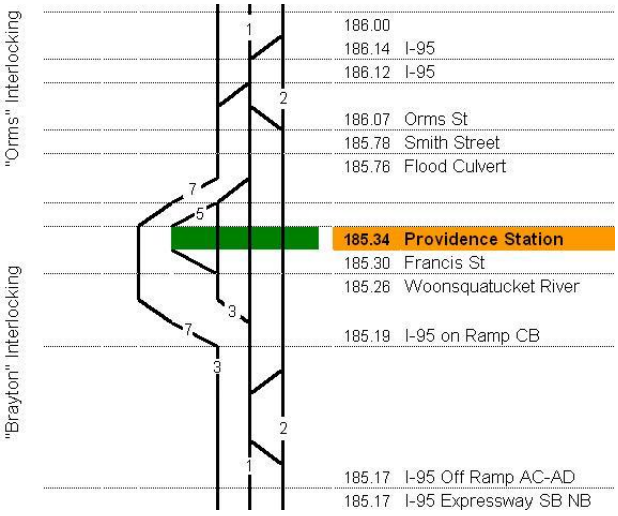
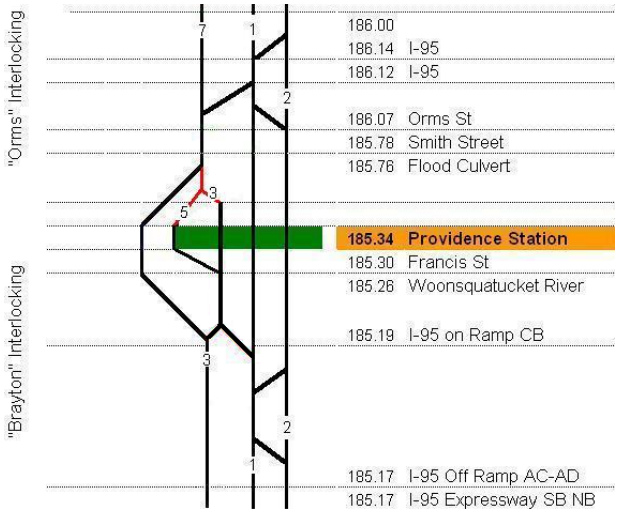


Figure 2.20:
Proposed Track Configuration near Providence Station



The southern improvement shown in Figure 2.20 is being constructed by the South County Phase I Project. When complete, it will allow passenger service using Track 3 south of Providence Station to enter the station without crossing onto Track 1.

Traffic and Operations

Amtrak service along this segment is confined to the electrified tracks (1 and 2). In Union Station, Tracks 1, 2, 3 and 5 are electrified and used by Amtrak trains. Presently all 15 southbound MBTA trains from Boston turn for their return trip at Providence, generally on Tracks 3 and 5.

Freight traffic generally operates on a combination of Tracks 7 and 3 (Track 3 south of Providence Station) which form an un-electrified high clearance route between Packard interlocking and Boston Switch. These tracks are not used by Amtrak revenue trains. South of Packard interlocking, the P&W freight trains share track with Amtrak intercity trains on Tracks 1 and 2. Freight trains to the Davisville waterfront intermodal terminal access Track 4 (also constructed by FRIP) at Malcom interlocking for travel to the waterfront. Through freight trains continue to share track with Amtrak all the way south to New Haven and beyond.

When MBTA service is extended to Wickford via Warwick, it is anticipated that most MBTA trains will use the unelectrified Track 3 from Providence to reach Warwick Station. Warwick's only passenger platform will be on Track 3. Between Packard interlocking south of Warwick and the new Wickford Station, the MBTA will share

Tracks 1 and 2 with Amtrak intercity trains. Wickford Junction Station will be built on a stub siding west of Track 1.

Maximum Allowable Speeds

The maximum authorized speed varies along the NEC. Table 2.26 shows the current maximum allowable speeds on Track 1 and Track 2, based on vehicle type. The five vehicle types (A-D) are listed below:[41]

- **A:** Acela: High Speed Trainsets (HST) with tilt system active
- **B:** Trains that are:
  - Acela HST with tilt system disabled
  - Amtrak Regional: Trains consisting exclusively of HHP-8 or AEM-7 engines and Amfleet cars.
- **C:** MBTA: Passenger trains that do not meet the criteria for train types **A**, **B**, or **D**
- **D:** Mixed: Passenger trains with mail, baggage or express cars in consist.
- **E**: Freight Trains

Table 2.26:
Amtrak Mainline Maximum Authorized Operating Speed (mph) [42]

		Train Type				
From	**To**	**A**	**B**	**C**	**D**	**E**
MP 174.5	MP 180.5	150	125	110	90	50
MP 180.5	MP 181.7	100	90	90	80	30
MP 181.7	PU	70	60	60	60	15
PU	MP 186.4	70	70	70	70	15
MP 186.4	MP 190.5	70	70	70	70	30
MP 190.5	Boston Switch	125	125	110	90	30

However, due rules and regulations governing track speed, or curves in the alignment, the maximum authorized operating speed cannot always be attained. Shown in Table 2.27 are speed restrictions at curves between Warwick Station and the Boston Switch which regulate train speeds.

Table 2.27:
Amtrak Mainline Maximum Allowable Curve Speed (mph)

Curve Location		Train Type				
From	**To**	**A**	**B**	**C**	**D**	**E**
MP 181.7	MP 181.9	55	50	45	45	30
MP 182.3	MP 182.8	65	50	50	50	15
MP 184.3	MP 184.8	60	55	45	45	15

[41] National Railroad Passenger Corporation. (April 2005). *Amtrak Northeast Corridor Timetable*, pp 106.
[42] Ibid, pp 108 - 111.

Table 2.27: **Amtrak Mainline Maximum Allowable Curve Speed (mph)**						
Curve Location		**Train Type**				
From	**To**	**A**	**B**	**C**	**D**	**E**
Near West Providence	Providence	30	30	30	30	15
Providence	Near East Providence	30	30	25	25	15
MP 185.4	MP 186.4	60	55	N/A	N/A	15
MP 188.7	MP189.2	60	55	N/A	N/A	30
MP 189.5	MP 190.5	60	55	N/A	N/A	30

The speed on Track 3 also varies. The current maximum allowable speed on the FRIP Track is 50 mph (south of Warwick only). Jacobs estimates that it is possible to raise the speed limit to 60 mph on Track 3. The speed would be lower between 181.7 to Providence Station due to curve restrictions**.** Table 2.28 shows the current maximum allowable speed on the FRIP track. As previously mentioned, the FRIP track is not always the same track number.

Table 2.28: **Current Maximum Speed on FRIP Track**[43]			
From	To	Track No.	Current Maximum Speed (mph)
Davisville Interlocking	Malcom Interlocking	4	45
Malcom Interlocking	Packard Interlocking	3	50
Packard Interlocking	MP 181.7	3	45
MP 181.7	MP 183.1	3	30
MP 183.1	MP 183.6	3	25
MP 183.6	Atwells Interlocking	7	25
Atwells Interlocking	Providence Station	7	25
Providence Station	Boston Switch[44]	7	25

[43] Ibid, pp. 108 - 111.
[44] Jacobs Rail Engineers estimate that a maximum speed of 50 mph is possible in contrast to 25mph listed in the *Amtrak Northeast Corridor Timetable*.

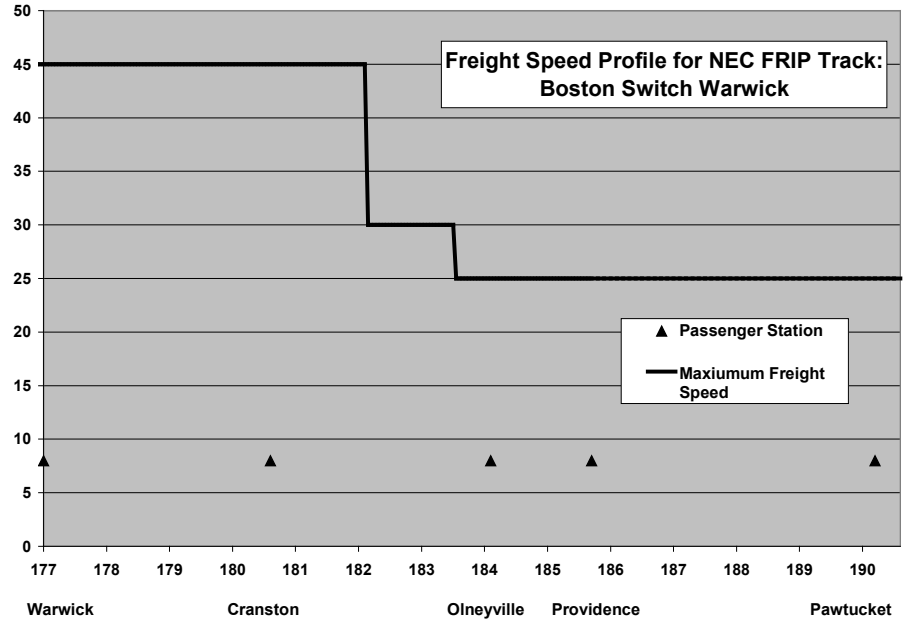


Figure 2.21

Tie and Rail Conditions
From Warwick Station to Brayton interlocking, Tracks 1, 2, and 3 are all 136 pound Continuous Welded Rail (CWR) with concrete ties. From Brayton interlocking to the Boston Switch, Track 7 is predominantly 130 pound relay welded rail.

Signaling and Train Control
In the 1980s, a major overhaul and improvement of the signaling system between Washington, D.C. and Boston was undertaken as part of the Northeast Corridor Improvement Project (NECIP). This project included safety improvements and modernization of the signaling system to the Centralized Electrification and Traffic Control (CETC). Its monitoring centers are located in Philadelphia, New York and Boston. CETC allows trains traveling on the NEC to run faster and closer together.

Track 3 is signalized from Packard interlocking to Brayton interlocking. Track 7 is currently unsignalled. A design project is currently underway that will signalize Track 7 from Brayton interlocking to Orms interlocking, north of Providence Station.

The "Orms" and "Lawn" interlockings on Track 7 are currently signalized.

Interlockings, Turnouts, Sidings, and Other Track Features
Track charts and plans indicate that when MBTA Commuter Rail service to South County begins, there will be 11 interlockings between Davisville and the Boston Switch (see Table 2.29).

Table 2.29:
Interlockings from Davisville to the Boston Switch

No.	Name	MP
1	Davisville	168
2	Malcom	170
3	Packard	174
4	MP 176	176*
5	MP 177[45]	177*
6	MP 178	178*
7	Cranston	181
8	Atwells[46]	184
9	Brayton	185
10	Orms	186
11	Lawn	188
* Future Interlockings		

Four turnouts are located off Track 3 and 7 between Warwick and the Boston Switch. One turnout is located off of Track 2, and one turnout is located off Wellington Siding built adjacent to Track 3 near MP 180 (see Figure 2.18).[47] North of Providence, near MP 187 a turnout provides access to the Providence Amtrak Maintenance of Way Base. MP 189 a turnout provides access to the new MBTA Pawtucket Layover Facility.

Grade Crossings
There are no grade crossings along the Northeast Corridor in the study area.

Bridges
See Table 2.30 for a list of the 50 structures that the railroad passes over and under between Warwick Station and the Boston Switch.

[45] Will be built if Track 4 is built at Warwick to allow for Amtrak intercity service.
[46] According to JEG Engineers, Amtrak is considering combining the Atwells interlocking with Brayton interlocking.
[47] The purpose of this siding is to allow the P&W to provide local freight service to customers without fouling the mainline.

Table 2.30:
List of NEC Structures in Study Corridor

No.	MP	Structure Name	Type		No.	MP	Structure Name	Type
1	176.65	Coronado Road	OH		26	184.67	Dipasquale St	OH
2	177.81	Lincoln Ave	UG		27	185.17	I-95 Off Ramp AC-AD	OH
3	178.09	Route 37	OH		28	185.17	I-95 Expressway SB NB	OH
4	178.13	Route 37	OH		29	185.19	I-95 on Ramp CB	OH
5	176.16	Pawtucket River & Wellington Ave	UG		30	185.26	Woonsquatucket River	UG
6	180.12	Park Ave / RI Route 12	OH		31	185.34	Francis St	OH
7	180.29	Off Ramp I-95	OH		32	185.76	Flood Culvert	UG
8	180.68	RI Route 10	OH		33	185.78	Smith Street	OH
9	180.69	On Ramp I-95	OH		34	186.07	Orms St	OH
10	180.71	I-95 NB & SB	OH		35	186.12	I-95	OH
11	180.99	Roger Williams Ave	OH		36	186.14	I-95	OH
12	181.16	Resevoir Ave	OH		37	186.44	Charles St	OH
13	181.66	Magnam Rd	OH		38	186.75	West River	UG
14	182.45	Cranston St	OH		39	186.95	Branch Avenue	OH
15	182.60	Huntington Expressway / RI Route 10	OH		40	187.60	Silver Spring Road	OH
16	182.64	Union Avenue	OH		41	188.91	Lonsdale Ave	OH
17	182.99	Off Ramp Gov. Robert Expressway	OH		42	189.00	Mineral Spring Ave	OH
18	183.33	RI Route 6 EB	OH		43	189.24	Conant St (Closed)	OH
19	183.36	RI Route 6 WB	OH		44	189.61	Dexter St	OH
20	183.39	Westminster St	OH		45	189.81	Broad St	OH
21	183.51	Broadway	OH		46	189.88	Barton St	OH
22	183.66	On Ramp Rt. 10	OH		47	189.93	Clay St	OH
23	183.87	Rt. 10 & 6	OH		48	189.99	Jenks St	OH
24	183.95	Ramp Olneyville Expressway	OH		49	190.03	Cross St	OH
25	184.29	Atwells Ave	OH		50	190.23	Sacred Heart	OH

Corridor Speed Overview

For the purposes of this feasibility study, intrastate passenger rail is assumed to travel at speeds up to 60 mph, unless constrained by curves or other restrictions. Figure 2.22 summarizes the projected speed profile, station locations, and grade crossings for the proposed route. The red line in Figure 2.15 shows the *potential* passenger speeds. The black line represents the *current* freight speeds and was previously shown in discussions about the P&W and NEC segments. The black triangles indicate where the stations would be located and the blue diamonds show the locations grade crossings on the P&W mainline.

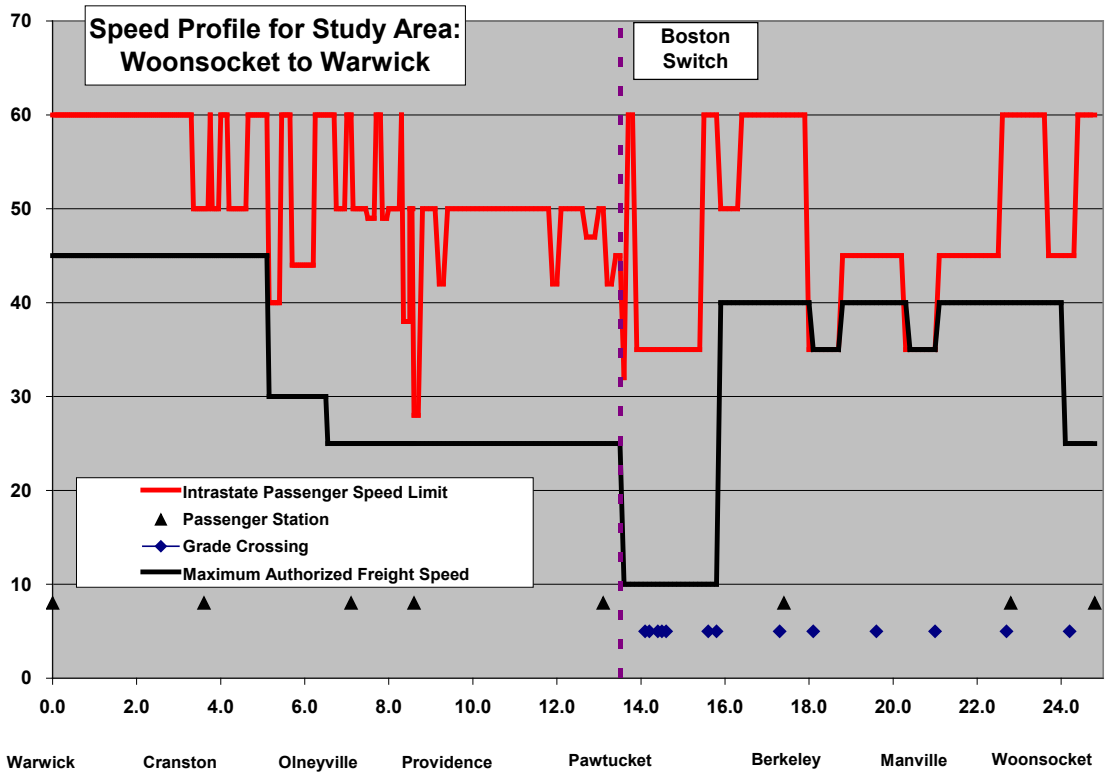

Speed Profile for Study Area:
Woonsocket to Warwick
Boston
Switch
70
60
50
40
30
20
10
0
Intrastate Passenger Speed Limit
Passenger Station
Grade Crossing
Maximum Authorized Freight Speed
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
22.0
24.0
Warwick
Cranston
Olneyville
Providence
Pawtucket
Berkeley
Manville
Woonsocket

Figure 2.22

Chapter 3: Transit Oriented Development

In September 2008, the planning team met with municipal planners along the study corridor to discuss potential station locations, and any Transit Oriented Development (TOD) opportunities that an intrastate commuter rail would provide to these communities.

At this early feasibility study stage of the project development process, it is premature to explore TOD and Smart Growth opportunities in great detail. However, the study team did find broad and deep support among public officials in pursuing TOD and Smart Growth opportunities that would arise should the intrastate passenger service prove feasible and be slated for development.

Woonsocket Station

Meeting Date
September 15, 2008

Meeting Participants
Catherine Ady
Deputy Director of Community Planning

City of Woonsocket
169 Main Street, PO Box B
Woonsocket, RI 02896
(401) 767 – 1418
cady@woonsocketri.org

Adam Streit
Jacobs Engineering Group

Susan Bregman
Oak Square Resources

Figure 3.1:
Proposed Woonsocket Station

The proposed site location is the extant historic station at One Depot Square, near the intersection of High Street and Main Street.

Surrounding Land Use
The station is located in the heart of downtown Woonsocket. Surrounding land uses are generally commercial, and many buildings are vacant. The station currently houses the offices of the John H. Chafee Blackstone River Valley National Heritage Corridor offices.

Several mill buildings have been converted into residential uses near the riverfront. These include the Lofts at Allen Street (64 condominium units) and the Bernon Mills (40 units approved).

Advantages and Disadvantages
The City has identified multiple benefits to restoring rail service to Woonsocket. First, rail service would benefit existing businesses in the area and help attract new ones. The City believes that commuter rail service is a key element in its plan to revitalize the City. Further, providing rail connections, especially to Boston, would support the city's condominium market, which seeks to attract young professionals. Similarly, with future development of Woonsocket's commercial base, individuals from other localities could use to train to access jobs in Woonsocket. Finally, reusing the extant historic station would be, in a word, "cool."

The site has several potential disadvantages. First, the one-way traffic circulation around the station could become a bottleneck and should be reviewed carefully. Second, the station does not have good pedestrian connections to the new residential developments. Because of a grade differential, the most direct access is via a staircase between Truman Drive and Main Street. Finally, restoring rail service would require relocating personnel from the Blackstone River Valley National Heritage Corridor.[48]

Potential Transit Oriented Development
The station provides opportunities for transit-oriented development in downtown Woonsocket and throughout the city. The zoning code does not include specific provisions for TOD – in part because these documents pre-date the concept – but there may be opportunities to focus on infill development and adaptive reuse.

Station Features and Amenities
The city would support small retail and service uses near the train station, such as a coffee shop and/or small restaurant, bank or ATM kiosk, or a pharmacy/convenience store. In addition, the rail station should include secure bicycle parking to support the Blackstone River Bikeway (currently under construction).

Two RIPTA routes already stop along Main Street near the station; Route 54 (Woonsocket/Providence) and Route 87 (Fairmount/Walnut Hill). RIPTA also operates the reservation-based Flex service in the city.

The City believes that the downtown area has sufficient parking to serve current uses. However, because the parking supply is not centralized, officials believe there is a misperception of a parking shortage. Looking ahead, however, additional parking would be required to support economic growth. The City has identified several potential parcels for commuter parking near the rail station. These include a site adjacent to the school administration building on High Street or, as an alternative, a new parking deck over the municipal parking lot on Main Street. A multi-use garage would be desirable to support future development throughout downtown Woonsocket.

[48] One possible alternative would be to relocate this office to a restored Pawtucket / Central Falls station. This option was raised briefly in an information conversation with Pawtucket planners and has not been proposed as a formal alternative.

Local Support

The City of Woonsocket actively supports restoration of commuter rail service and considers it a critical component in efforts to revitalize the city.

Figure 3.2:
Woonsocket Station

Figure 3.3:
New Housing in Woonsocket

Figure 3.4:
Vacant Commercial Space on Main Street

Figure 3.5:
Potential Site for Commuter Parking on High Street

Manville Station

Meeting Date
September 15, 2008

Meeting Participants
Albert V. Ranaldi, Jr. AICP
Town Planner

Town of Lincoln
100 Old River Road
Lincoln, RI 02865
(401) 333 – 8433
aranaldi@lincolnri.org

Adam Streit
Jacobs Engineering Group

Susan Bregman
Oak Square Resources

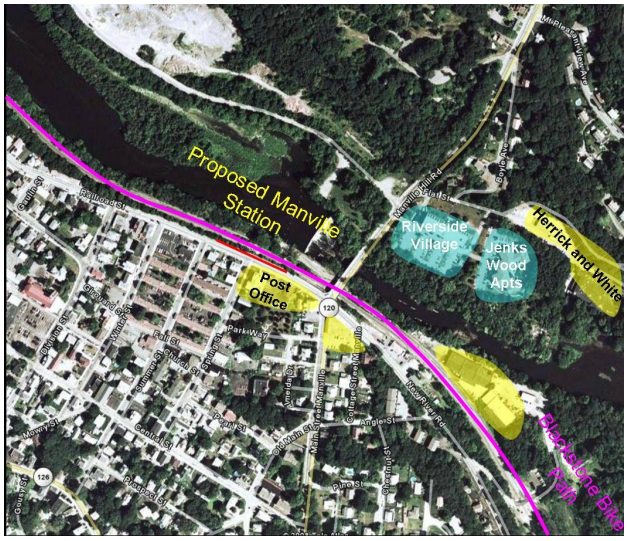


Figure 3.6:
Proposed Manville Station

The proposed station site is located at the intersection of Main Street and Railroad Street in Lincoln and is easily accessible from Cumberland, across the Blackstone River, via Manville Hill Road.

Surrounding Land Use
Manville is a blue-collar neighborhood in Lincoln. The area immediately adjacent to the station location has several small retail/commercial uses, including a post office. Across the Blackstone in the Town of Cumberland, Riverside Village (88 units) and Jenks Wood Apartments (61 units) both provide housing for seniors and people with disabilities on Flat Street. Also on Flat Street across the Blackstone is Herrick & White, a specialty woodworking shop. Also in Lincoln, about eight miles south of Manville station site, Twin River offers video lottery terminals.

There is a substantial grade differential between the roadway network and the proposed station location. The tracks run along the Blackstone River and the Blackstone River Bikeway; vehicular access to the proposed station site is limited.

Advantages and Disadvantages
The proposed Manville site is located near a low-income neighborhood, where residents could typically be expected to benefit from additional transit services. However, commuter rail – with its peak-oriented services – may not be a good fit for these residents who tend to work at jobs with nontraditional schedules. Moreover, the town planner in Lincoln indicated the most town residents were not interested in a new commuter rail station. Lincoln residents who worked in Boston could easily access the Attleboro MBTA station, via I-295, and those who worked in Providence could easily drive to work

along State Route 146. Consequently, planners in Lincoln and Cumberland both believed that a Manville station was not convenient for most residents in their respective towns and that new and existing rail commuters would prefer to access commuter rail at other locations – either the MBTA Attleboro station or a new site at Ann & Hope Way.

The potential station location is extremely constrained and there are few opportunities for commuter parking. In addition, there is a substantial grade difference between the tracks and the road network, which limits vehicular and pedestrian access.

Development plans are already in place and do not depend on rail access to success. If anything, there is a perception that rail service is noisy and would have a negative impact on area residents.

Potential Transit Oriented Development
Various development projects have been proposed for this area, primarily on the Cumberland side of the Blackstone River. Proposed uses in the Town of Cumberland include a recreational area near Manville Hill Road, including a walkway along the river. Forty-two units of senior housing (all affordable) have been proposed for a town-owned parcel. Housing would occupy about four acres of the 25-acre site; the remainder would be used as a town park. About 380 residential units have been proposed for the Manville Gravel Quarry site; about 25% of the units would be affordable.

The Lonsdale Bleachery site is located along the Blackstone River in the Lonsdale village of Lincoln. This mixed use redevelopment project incorporates multiple mill buildings on 30 acres and would include housing, artist lofts, river-related recreational activities, and commercial, retail, and industrial uses.

Station Features and Amenities
Planners believed that other locations were more desirable for a commuter rail station and did not identify any specific amenities for the Manville location.

Local Support
Although located in the Manville village of Lincoln, the proposed station has the potential to serve commuters in Lincoln and Cumberland. Nevertheless, both municipalities expressed only limited support for this location.

The Cumberland town planner believed that a station at the Ann & Hope complex near Broad Street in Cumberland would better serve community residents than the Manville location. The Lincoln town planner offered a similar perspective and indicated that residents who wanted to use the proposed rail service could more easily access a station at the Ann & Hope location than at Manville. In general, the Lincoln town planner did not anticipate major benefits from new rail service. As indicated earlier, Lincoln residents commuting into Boston can access commuter rail service at the MBTA Attleboro station, and residents commuting into Providence have an easy drive along Route 146. However, the town would be willing to reserve the right-of-way and potential rail location in Manville so that service could be implemented if demand warranted.

Figure 3.7:
Proposed Manville Station site

Figure 3.8:
Blackstone River Bikeway and Manville Dam

Figure 3.9:
Manville Post Office

Figure 3.10:
Commercial uses near Manville Station

Berkeley (Cumberland) Station

Meeting Date
September 15, 2008

Meeting Participants
John J. Aubin III
Director, Office of Planning and Community Development

Town of Cumberland
45 Broad Street
Cumberland, RI 02864
(401) 728 – 2400 x142
jaubin@cumberlandri.org

Adam Streit
Jacobs Engineering Group

Susan Bregman
Oak Square Resources

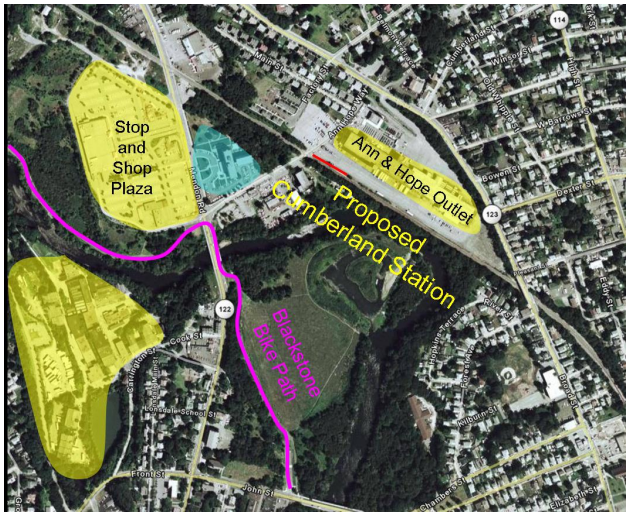


Figure 3.11:
Proposed Cumberland Station site

The station was initially proposed for the historic station site at 30 Martin Street in Cumberland. After conversations with planners in Lincoln and Cumberland, however, the proposed station site was moved to the old Ann & Hope headquarters in Lonsdale village.

Surrounding Land Use
The station would be located on Ann & Hope Way between Broad Street and Mendon Road. The site is currently under-utilized and includes an outlet for bed and bath products and a seasonal nursery.

Advantages and Disadvantages
Although the Ann & Hope site does not have good highway access, the location is easily accessible to Cumberland and Lincoln residents. The Blackstone River Bikeway is near the site.

The site is currently a "blank slate" according to town planners, and could support approximately 500,000 square feet of mixed use development.

Planners did not identify any major disadvantages to the Town or its residents with this location. However the site is roughly 2.5 miles from the Pawtucket/Central Falls station, which may be a disadvantage in terms of efficient rail operations.

Potential Transit Oriented Development
The Town anticipates working with the property owners to redevelop the Ann & Hope site. The owners consider rail as an amenity to businesses on the site, now and in the future.

Detailed plans have not yet been developed, but town planners envision about 500,000 square feet of new office, service, and small retail uses on the site, along with multi-family mixed income housing. The property owners believe that rail would benefit businesses located on the site.

No specific zoning incentives are in place to support transit oriented development. However, the Town would consider incorporating a density bonus into the zoning code. This would allow the town to transfer a density bonus to the Lonsdale Drive-In site, which is slated for redevelopment.

Station Features and Amenities
Vehicular parking is readily available on the site; surface and structured parking would both be feasible. Secure bicycle parking would also be desirable, especially given the site's proximity to the Blackstone River Bikeway. In addition, the town would support a community circulator to provide access to the site, especially given potential cuts in RIPTA service.

Local Support
Planners from the towns of Cumberland and Lincoln both see advantages to locating a commuter rail station at the Ann & Hope site, especially in relation to the proposed Manville site. The Ann & Hope site is more easily accessible to residents from both towns, and parking would be readily available. Rail service would help support efforts to redevelop the Ann & Hope site, whereas development near the Manville site is expected to take place independently of rail service. Despite the advantages of the Ann & Hope site for commuters in Cumberland and Lincoln, Lincoln planners were willing to reserve the right-of-way for a future station in Manville should local conditions change.

Figure 3.12:
Proposed Station near Ann & Hope facility

Figure 3.13:
Potential Surface Parking Availability near Ann & Hope Station site

Pawtucket Station

Meeting Date
September 16, 2008

Meeting Participants
Jennifer K. Kilsey
Home Program Manager

City of Pawtucket
Department of Planning & Redevelopment
175 Main Street
Pawtucket, RI 02860
(401) 724 – 5200
kilseyj@psdri.net

Michael D. Cassidy
Director of Planning and Redevelopment

City of Pawtucket
Department of Planning & Redevelopment
175 Main Street
Pawtucket, RI 02860
(401) 724 – 5200
cassidym@psdri.net

Susan A. Mara
Senior Planner

City of Pawtucket
Department of Planning & Redevelopment
175 Main Street
Pawtucket, RI 02860
(401) 724 – 5200
maras@psdri.net

Adam Streit
Jacobs Engineering Group

Susan Bregman
Oak Square Resources

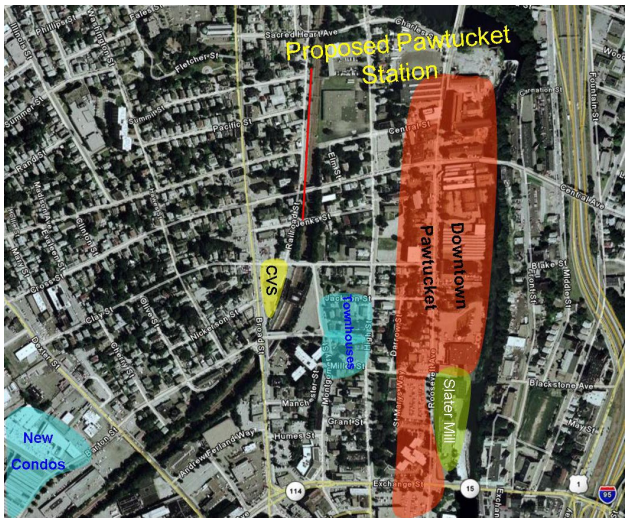


Figure 3.14:
Proposed Pawtucket Station

Figure 3.15:
Extant Pawtucket / Central Falls Station

The Pawtucket station would be located approximately 200 feet north of the extant Pawtucket / Central Falls terminal. The site is bounded by Broad Street to the west, Montgomery Street to the east, Broad Street to the north and Barton Street to the south.

Surrounding Land Use
The station structure itself was abandoned about 30 years ago and has fallen into disrepair. The current property owners are building a CVS at the intersection of Broad Street and Clay Street.

The Broad Street area is a blue-collar multi-ethnic neighborhood with a mix of small-scale commercial activities. The City supports and encourages this vibrant mix of locally-based activities. Barton Street, south of the proposed station site, previously was characterized by absentee landlords and undesirable activities; over the last 10 years the neighborhood has transitioned to owner-occupancy. The community development corporation recently built 14 townhouses in the area.

Advantages and Disadvantages
The City studied two potential locations for a rail station – the extant station site and an active freight yard further south of the existing station. The proposed Broad Street site was determined to be the more cost effective alternative.

Restoring rail service would have multiple benefits for the City. First, the potential for transit-oriented development would encourage economic growth and new housing construction, as is evidenced with the current mill redevelopment. Second, rail service would improve access to employers within Pawtucket and improve access to jobs for City residents.

Potential rail passengers include young working professionals in the new condominium developments. One study estimated that up to 27% of rail passengers would walk or bicycle to the train station, although the City used a more conservative 10% estimate in its calculations.

One potential disadvantage is the need for continued inter-agency coordination for the site. Reaching consensus among agencies with differing goals has been a challenge.

Potential Transit Oriented Development
The City of Pawtucket considers commuter rail service an important element of its economic development program. Most of the downtown area is located within one half mile of the proposed station location and would benefit from rail service.

Throughout Pawtucket, mill conversions are creating new housing and other uses, and this trend is expected to continue. Recent developments include the Union Wadding Lofts (90 units under construction of approximately 250 total), Slater Cotton (125 units), Bayley Street Lofts (25 units), River Front Lofts (60 units). The Coats and Clark Complex is a series of mill buildings in Pawtucket and Central Falls; the developer anticipates converting about 1 million square feet of the property into an urban village.

Station Features and Amenities
Based on the 2007 MBTA Providence Line schedule, 23 trains a day (out of 30) could stop at Pawtucket. A 900-foot long high-level platform is proposed for this location; use of a high platform would minimize dwell time. Because of the curvature of the track, the platform cannot be located at the historic station and must be situated farther north. Regulations for handicapped accessibility require high platforms to be located on a straight section of track.

The station will incorporate bicycle and pedestrian access into its design. The site will accommodate RIPTA buses, but the City's transit hub will remain in its current downtown location. The City has identified a site near the intersection of Central Street and High Street that would be suitable for commuter parking on an interim basis..

The City has separated the question of renovating the extant station from the question of restoring rail service. Although renovation would be too expensive for the City to undertake, the current property owner has made the commitment to get the property listed on the National Register within five years and to find a re-use opportunity for the station. One possible use, discussed informally with Pawtucket officials, would be to relocate the Blackstone River Valley National Heritage Corridor staff, currently located in the Woonsocket station. Another option would be to incorporate the historic station into the new station as a headhouse.

Local Support
The City is extremely motivated to restore commuter rail service to Pawtucket and is clear about its priorities. The primary goal is to restore passenger service. ("This is the biggest economic development opportunity in this city since Samuel Slater started his mill, according to one planner.) Trains to other destinations are already running through Pawtucket, but they are not serving the City. The City of Pawtucket wants those trains to stop within the City and to serve its residents and businesses. Restoring the historic station structure would be desirable, but it is secondary to obtaining service.

Figure 3.16:
Pawtucket / Central Falls Station

Figure 3.16:
Townhouses under construction

Figure 3.17:
RIPTA transit center in downtown Pawtucket

Olneyville Station

Meeting Date
September 22, 2008 (via telephone)

Meeting Participants
Melanie A. Jewett, AICP
Principal Planner

City of Providence
Department. of Planning and Development
400 Westminster Street
Providence, RI 02903
(401) 351 – 4300 ext. 522
mjewett@providenceri.com

Susan Bregman
Oak Square Resources

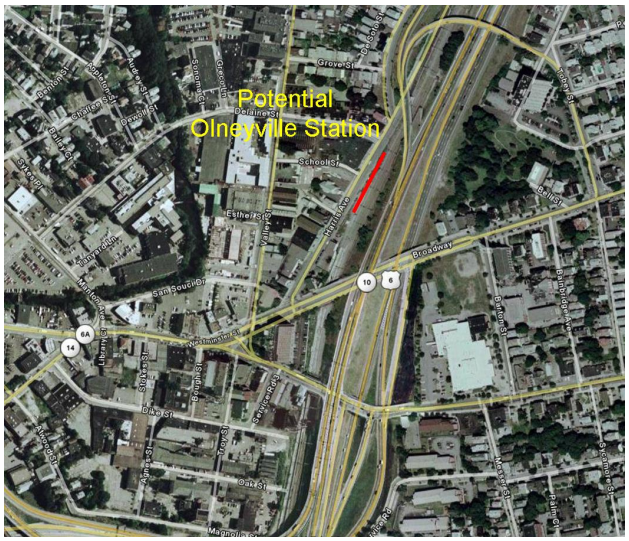


Figure 3.18:
Proposed Olneyville Station

The proposed station site is located in the Olneyville neighborhood of Providence at 715 Harris Avenue.

Surrounding Land Use
Once considered Providence's second downtown, Olneyville has historically been a stopping point for the city's immigrant communities. Currently, Olneyville has a largely blue-collar Hispanic population, and the area immediately adjacent to the historic rail station is a mix of commercial, industrial, and residential uses. Several mill redevelopments and related new construction along the Woonsquatucket River include loft apartments, artist live/work space, offices, restaurants, and community space. A PriceRite grocery store is located in the Eagle Square shopping center.

Advantages and Disadvantages
A proposed Olneyville site could serve two potential transit markets – workers who lost their jobs when the mills relocated and new residents at those mills who work in Boston. Many local residents lost their jobs when the mills were redeveloped. Industrial jobs moved to other communities in Rhode Island, including Woonsocket and Central Falls; rail service could help these workers access jobs at these new locations.

Potential Transit Oriented Development
The City of Providence has a general redevelopment plan, and is currently preparing a neighborhood plan for Olneyville. While supporting opportunities to bring economic development to Olneyville, the City is not taking active or aggressive steps to attract new development. Most of the recent projects have resulted from market forces, and city planners expect that trend to continue over time.

Station Features and Amenities
In addition to secure bicycle storage at the station, city planners would like the trains to allow commuters to take their bicycles on board. Many neighborhood residents do not have cars, and taking their bicycles on the train would give them better access to jobs at their destination. It would also be desirable for RIPTA to modify its routes to serve the station; coordinating bus and rail schedules would create a transit hub in Olneyville. City planners recognize the importance of having parking associated with a rail station, but they do not want "seas of parking." No parking site has been identified.

The City would strongly support developing small locally owned businesses and entrepreneurial activities near the station, such as a local bank or restaurant. Planners would not support national chain stores.

Local Support
Providence officials strongly support providing a range transit alternatives, including rail, but they are not in a position to fund transit improvements directly. The City's primary goal is to help local residents get access to jobs. When the mills were redeveloped, a lot of the small manufacturers moved out of the city to industrial spaces in Woonsocket, Pawtucket, and Central Falls. Residents lost their jobs if they did not have cars. The City would support transportation services to help these residents get access to jobs in these locations.

Figure 3.19:
Tracks at site of proposed Olneyville Station

Figure 3.20:
Commercial use at site of proposed Olneyville Station

Cranston Station

Meeting Date
September 16, 2008

Meeting Participants
Peter S. Lapolla
Planning Director

City of Cranston
869 Park Avenue
Cranston, RI 02910
(401) 780 – 3222
plapolla@cranstonri.org

Marie Sorman
Director, Department of Community Development

City of Cranston
1090 Cranston Street
Cranston, RI 02929
(401) 461 – 1000 Ext. 7201
msorman@cranstonri.org

Adam Streit
Jacobs Engineering Group

Susan Bregman
Oak Square Resources

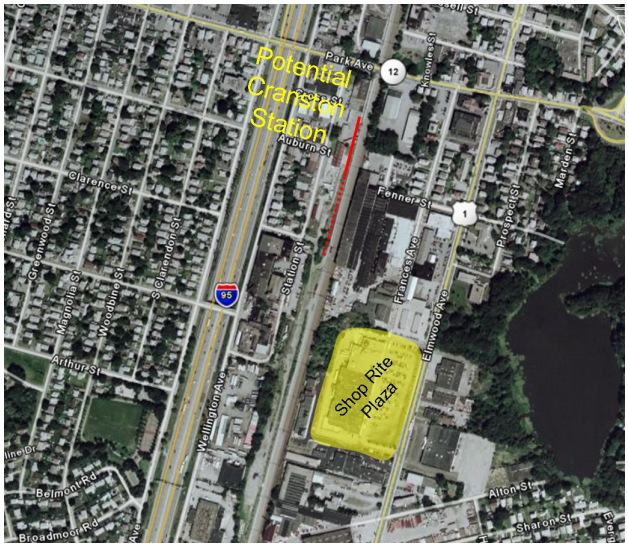


Figure 3.21:
Proposed Cranston Station

Figure 3.22:
Right-of-way at proposed Cranston Station

The proposed station site is located in an industrial section of Cranston near Station Street and Park Avenue.

Surrounding Land Use
The area is bounded by Elmwood Avenue to the east and I-95 and Wellington Avenue to the west. Park Street is the major cross street through the site. The immediate area is primarily industrial with a few houses scattered throughout the site. A PriceRite supermarket is located on Elmwood Avenue. Two residential neighborhoods are located in the vicinity of the site. South Elmwood is east of Elmwood Avenue and Auburn is across I-95. In addition to the main track, a rail spur is located on the site.

Advantages and Disadvantages
A new station in Cranston would support the City's economic development goals for transit oriented development in this under-utilized industrial area. Planners anticipate that property values would increase substantially with new development.

In addition to providing access to jobs in Providence and Boston, the site could serve as an intermodal transportation hub. City planners believe that new commuter rail service could also provide a catalyst to expanding regional bus services.

Site access is limited to Park Avenue or Wellington Avenue. East-west links are needed for vehicles and pedestrians. The City would consider demolishing the houses located within the industrial site and relocating the residents. Site development would require substantial inter-agency coordination.

Potential Transit Oriented Development
Detailed plans have not yet been drawn up, but city planners envision residential uses with ancillary services and low-intensity office uses. The site would include a percentage of affordable units, but residential units would be marketed to young professionals and empty-nesters.

Most of the site is zoned M2 (heavy manufacturing) and is located within an enterprise zone. The City would consider creating an overlay district to support mixed-use development on the site.

Station Features and Amenities
The City would support a community shuttle to improve access to the station site. New rail service could also serve as a catalyst to improve RIPTA service throughout the community. In particular, a cross-town route would be desirable; currently Cranston residents accessing the jobs in the Howard Industrial Park or Garden City Shopping Center have to take the bus into Providence and transfer to a bus that takes them back to their destination in Cranston. The trip takes about one hour each way.

New pedestrian connections are required. The site is not currently integrated into the surrounding neighborhoods, and pedestrian access is limited.

Secure bicycle storage at the site would be desirable. There is an opportunity to provide a connection with the posted bicycle path on Allen Avenue.

Local Support
The City of Cranston strongly supports commuter rail service. Building a station at the proposed location would support mixed-use development at an underutilized industrial site and also provide access to jobs for city residents. The city has reached out to local business owners, and they are generally supportive of the redevelopment plans.

Figure 3.23:
Industrial use near proposed Cranston Station

Figure 3.24:
Retail grocery operation near proposed Cranston Station

Figure 3.24:
Homes adjacent to commercial uses near proposed Cranston Station.

THIS PAGE LEFT INTENTIONALLY BLANK

CHAPTER 4: OPPORTUNITIES AND CONSTRAINTS

Based on the goals and objectives articulated Task 1 and the interviews and documentation assembled to frame existing and future conditions along the study corridor, the study team identified several clear opportunities and constraints relative to developing an economically attractive intrastate commuter rail service

OPPORTUNITIES

Based on the information developed in Chapters 1 through 3, the following six circumstances favor implementation of intrastate rail service.

1. **Local Interest and Support** – State and municipal officials are in general unified support for the expansion of the passenger rail service in Rhode Island including possible intrastate service linking Warwick, Providence and Woonsocket.

2. **Active Rail Corridors** –The proposed project would use existing active rail lines.

    - Between Woonsocket and Pawtucket the service would use the P&W mainline. The P&W is a presently an unsignalled single track railway but could be expanded to provide where necessary to provide capacity for a local passenger service. The current track is in a state of good repair maintained to FRA Class 3 standards. It presently hosts several freight trains each weekday but no passenger services.

    - Between Pawtucket and Warwick the service would use a segment of Amtrak's Northeast Corridor. This segment of the NEC consists of three mainline tracks. Two of the tracks are maintained for high speed electric passenger rail service with speeds up to 100 mph depending upon the rolling stock. One track was constructed to provide a high and wide freight clearance route between Pawtucket and Davisville Rhode Island. Once the MBTA service to Wickford Junction is implemented this non-electrified freight track will be maintained for passenger speeds up to 60 mph. It is planned that the MBTA service south of Providence will primarily operate on the slower freight track to avoid any potential conflicts with Amtrak trains.

3. **Stations** – The proposed service would use several stations that are presently in operation, construction or planning.

    - **Providence** station is an existing five track facility with station platforms on four tracks and a high-wide clearance freight track.

    - **Warwick** station is currently under construction and will be called on by trains heading to and from Wickford. It will be linked to the TF Green Airport via an overhead moving walkway and provide the most convenient direct air-rail link available along the Northeast Corridor. When it opens the

station will be served by 16 weekday MBTA trains. Amtrak is not planning to call on the station in the foreseeable future.

- The City of Pawtucket is exploring the prospect of restoring passenger service to the historic Pawtucket/Central Falls Depot on the NEC. As presently planned, the station would have platforms on the two electrified passenger tracks. But one of the platforms could be expanded to also service connection to the P&W main immediately north of Pawtucket. The City anticipates that MBTA service will call on the station starting in 2016.

Only four completely "new" stations would be required to implement to most ambitious manifestation of the proposed service: Woonsocket, Cumberland, Olneyville and Cranston. The remaining three stations (Wickford, Providence, and Pawtucket) are in various states of operation, planning or construction.

4. **New Line Capacity –** Upgrades to the NEC primarily focused on the non-electrified freight track are planned to create the capacity for MBTA passenger service south to Wickford Junction. These upgrades increase the line capacity potentially available for intrastate service south to the airport.

5. **Passenger Rail Travel Markets** – The proposed service would provide direct passenger rail service for most of densely settled communities in Rhode Island. Two-thirds of the state's population would live within the service area of the new intrastate service. The proposed service would address several distinct travel markets for that population.

    a. Travel to Providence – Providence, the state's largest concentration of employment and economic activity, is an attractive commuter rail transit market with rising highway congestion and parking fees.

    b. Airport Travel – TF Green is a dynamic and growing market with the potential to serve air traveler and employee trips via passenger rail service.

    c. **Travel to Boston** – The intrastate service would improve access and increase the availability of MBTA service to Boston from communities such as Cranston, Woonsocket, Cumberland and Olneyville.

CONSTRAINTS

Based on the information developed in Chapters 1 through 3, the following five circumstances limit the development of intrastate rail service along the NEC and P&W railroads.

1. **Zero tolerance for Amtrak conflicts** – Amtrak, the owner of the NEC will not permit any service to operate on its track that would create conflicts with its signature intercity service. The need to avoid such conflicts is a strong consideration in the design of any viable service option.

2. **Sharing the single freight track with MBTA and P&W** – Sharing the single freight track with P&W and MBTA will create the potential for conflicts. The planned MBTA South County extension is expected to mostly operate on the freight track between Warwick and Providence. During the morning and evening peaks four MBTA trains are planned to use this track. The P&W has a growing service along the NEC that requires access to the freight track for service to Davisville and points south.

3. **Preserving Capacity for Ambitious Future Growth –** Both Amtrak and P&W recently unveiled ambitious plans to grow their NEC services over the next two decades. These developments are exciting as they represent substantial improvements in intercity and freight rail service to Rhode Island but do represent a substantial constraint on Rhode Island's ability to develop additional services along this line as any feasible plans for an intrastate service must respect these key stakeholder's plans for future expansion.

4. **Providence Station** – Providence Station has four station tracks and one freight run-through track. As more extensive intrastate services are considered the prospect that Providence Station could be a bottleneck is increased. In particular, the track configuration north of the station makes access from and to the P&W especially problematic, since it is not presently possible to access any of the station tracks without fouling the NEC mainline trackage. Some reconfiguration of track north of the station would probably be necessary to eliminate this conflict.

5. **Warwick Track Configuration** – As currently configured Warwick Station will only be accessible from non-electrified freight track and designed to facilitate run-through MBTA to and from Wickford Junction. Adjustments in the track configuration surrounding the station will likely be necessary to accommodate an intrastate service to terminates at the airport for returns trips to the north.

6. **Limited interest in Lincoln** – Municipal officials in Lincoln are not interested in developing a passenger rail station in their community at this time. It is locally perceived that local residents could be better served by a single station in the adjacent community of Cumberland.

THIS PAGE LEFT INTENTIONALLY BLANK

CHAPTER 5: SERVICE OPTIONS

Introduction

This chapter describes the service options developed by the study team in consultation with the Providence Foundation Steering Committee members. Five options were developed for preliminary analysis and evaluation. After a preliminary review of the options, this chapter identifies the options recommended for formal evaluation.

Development of each service option centered around four objectives:

Objective 1: Enable passengers to travel between Woonsocket and Warwick Station via Providence.

Objective 2: Maximize connections to MBTA Boston service for Woonsocket and Cumberland passengers.

Objective 3: Avoid conflicts with current and planned future services on the line, including services operated by Amtrak, the P&W, and MBTA.

Objective 4: Avoid travel on the Northeast Corridor (NEC) main (e.g., Tracks 1 and 2).

Objective 5: Create conditions to foster Transit Oriented Development and Smart Growth in the Communities along the line.

Service Options

Five preliminary service options were developed and summarized in Table 5.1. Each of these options offers more offpeak service than had been planned in the 2007 Woonsocket-Providence service design; Up from 28 weekday trips in the previous study report to 32 to 58 weekday trips.

Table 5.1:
Service Options

Option	Weekday Intrastate Trips	Connections for Service to Boston	Connections for Service from Boston	Total Daily Intrastate and MBTA Connections	MBTA Trains Serving Cranston	Year
1	34	8	9	17	0	2010
2	34	8	9	17	14	2010
3	58	12	12	24	0	2010
1A	32	7	8	15	0	2030
2A	32	7	8	15	14	2030

Option 1: Two Consists Running All Day Between Woonsocket and Warwick

Option 1 provides all-day service between Woonsocket and Warwick using two trainsets. A map of the proposed route, the stations served, and the MBTA's South County Commuter Rail extension is shown in Figure 5.1.

The Rhode Island Intrastate Service (RIIS) would operate on P&W's mainline from Woonsocket to the former Boston Switch, and then on the NEC FRIP track between Boston Switch and Warwick station.

Passengers from Woonsocket and Cumberland heading to Boston would be provided with a five minute timed transfer to MBTA service at Pawtucket station for 17 trips each day. **Table 5.2** shows a list of stations served by the RI Intrastate service and MBTA service in the study corridor.

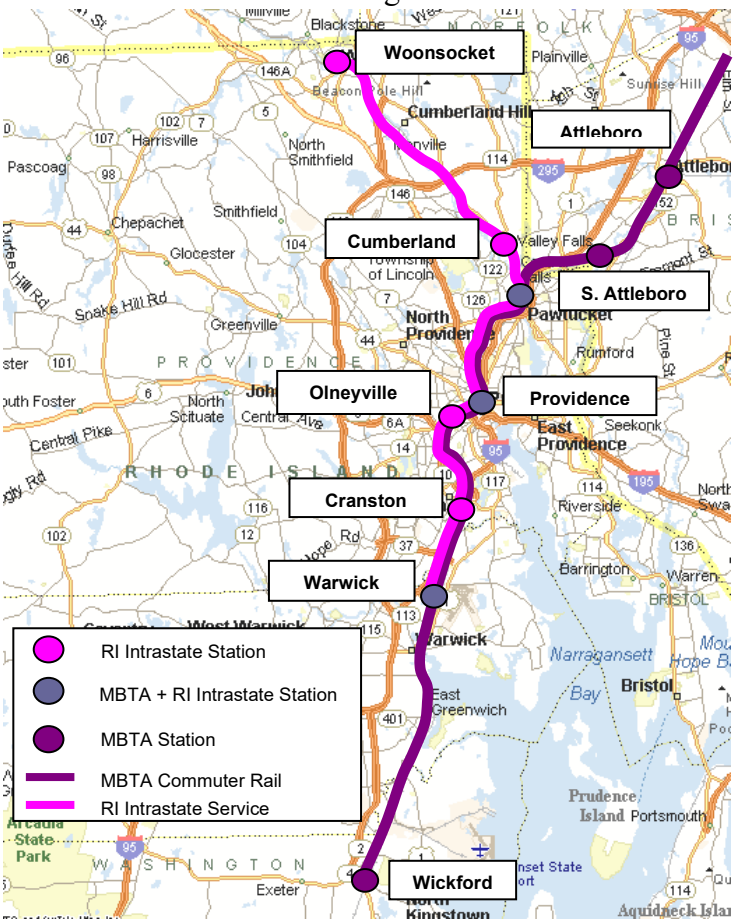


Figure 5.1:
Map of the Proposed Option 1 Route

Table 5.2:
Option 1 Stations Served

Stations	RI Intrastate	MBTA
Woonsocket	x	
Cumberland	x	
Pawtucket	x	x
Providence	x	x
Olneyville	x	
Cranston	x	
Warwick	x	x

Schedule and Service Design – A sketch operating plan indicates that there would be 34 weekday trips between Woonsocket and Warwick (17 roundtrips), with eight connections in Pawtucket for *northbound* MBTA service to Boston (four in the morning peak) from Woonsocket, and nine *southbound* MBTA connections in Pawtucket (three in the evening peak) for service to Woonsocket.[1]

Table 5.3 and Table 5.4 show a preliminary weekday service schedule for Option 1. Columns shaded gray indicate intrastate trains that connect with MBTA trains in Pawtucket. Note, only South County MBTA trains are shown.

[1] This does not include the meets in Pawtucket where the timed transfer is longer then 5 minutes.

Table 5.3:
Preliminary Southbound Weekday Service Schedule for Option 1
(Showing Intrastate and MBTA South County Trains)

South (West) Service		MBTA	RIIS	MBTA	RIIS	RIIS	RIIS	RIIS	RIIS	MBTA
Train No.		**DH1**	**1**	**DH2**	**3**	**5**	**7**	**9**	**11**	**805**
Cycle	**MP**		**d**		**c**	**d**	**c**	**d**	**c**	
Woonsocket	201.5		5:10 AM		5:52 AM	6:56 AM	7:56 AM	9:30 AM	10:10 AM	
Cumberland	192.3		5:22 AM		6:04 AM	7:08 AM	8:08 AM	9:42 AM	10:22 AM	
Pawtucket/Central Falls	189.8	4:50 AM	5:27 AM	6:05 AM	6:09 AM	7:13 AM	8:13 AM	9:47 AM	10:27 AM	11:21 AM
Providence	185.3		5:34 AM		6:18 AM	7:20 AM	8:20 AM	9:54 AM	10:34 AM	11:27 AM
Olneyville	183.7		5:37 AM		6:21 AM	7:23 AM	8:23 AM	9:57 AM	10:37 AM	
Cranston	180.2		5:42 AM		6:26 AM	7:28 AM	8:28 AM	10:02 AM	10:42 AM	
West Warwick ~ T.F. Green	176.6		5:50 AM		6:34 AM	7:36 AM	8:36 AM	10:10 AM	10:50 AM	11:38 AM
Wickford	165.8	5:15 AM		6:35 AM						11:48 AM
Boston South Station			**6:40 AM**		**7:19 AM**	**8:16 AM**	**9:23 AM**	**10:55 AM**		
Connecting MBTA Train No.			**802**		**804**	**808**	**812**	**814**		

South (West) Service		RIIS	RIIS	MBTA	RIIS	MBTA	RIIS	MBTA	RIIS	RIIS
Train No.		**13**	**15**	**809**	**17**	**8XY**	**19**	**811**	**21**	**23**
Cycle	**MP**	**d**	**c**		**d**		**c**		**d**	**c**
Woonsocket	201.5	12:10 PM	1:15 PM		2:15 PM		3:26 PM		4:25 PM	5:25 PM
Cumberland	192.3	12:22 PM	1:27 PM		2:27 PM		3:38 PM		4:37 PM	5:37 PM
Pawtucket/Central Falls	189.8	12:27 PM	1:32 PM	2:21 PM	2:32 PM	3:33 PM	3:43 PM	4:35 PM	4:42 PM	5:42 PM
Providence	185.3	12:34 PM	1:39 PM	2:27 PM	2:39 PM	3:39 PM	3:50 PM	4:41 PM	4:49 PM	5:49 PM
Olneyville	183.7	12:37 PM	1:42 PM		2:42 PM		3:53 PM		4:52 PM	5:52 PM
Cranston	180.2	12:42 PM	1:47 PM		2:47 PM		3:58 PM		4:57 PM	5:57 PM
West Warwick ~ T.F. Green	176.6	12:50 PM	1:55 PM	2:38 PM	2:55 PM	3:50 PM	4:06 PM	4:52 PM	5:05 PM	6:05 PM
Wickford	165.8			2:48 PM		4:00 PM		5:02 PM		
Boston South Station		**1:38 PM**	**2:42 PM**							**6:51 PM**
Connecting MBTA Train No.		**816**	**818**							**822**

South (West) Service		MBTA	RIIS	MBTA	MBTA	RIIS	RIIS	RIIS	RIIS	MBTA
Train No.		**815**	**25**	**817**	**819**	**27**	**29**	**31**	**33**	**825**
Cycle	**MP**		**d**			**c**	**d**	**c**	**d**	
Woonsocket	201.5		6:10 PM			7:10 PM	8:10 PM	8:51 PM	9:58 PM	
Cumberland	192.3		6:22 PM			7:22 PM	8:24 PM	9:03 PM	10:10 PM	
Pawtucket/Central Falls	189.8	6:00 PM	6:27 PM	6:36 PM	7:05 PM	7:27 PM	8:29 PM	9:08 PM	10:15 PM	10:03 PM
Providence	185.3	6:06 PM	6:34 PM	6:42 PM	7:11 PM	7:34 PM	8:35 PM	9:15 PM	10:22 PM	10:09 PM
Olneyville	183.7		6:37 PM			7:37 PM	8:38 PM	9:18 PM	10:25 PM	
Cranston	180.2		6:42 PM			7:42 PM	8:43 PM	9:23 PM	10:30 PM	
West Warwick ~ T.F. Green	176.6	6:18 PM	6:50 PM	6:54 PM	7:23 PM	7:50 PM	8:51 PM	9:31 PM	10:38 PM	10:21 PM
Wickford	165.8	6:29 PM		7:05 PM	7:34 PM					10:32 PM
Boston South Station										
Connecting MBTA Train No.										

Table 5.4:
Preliminary Northbound Weekday Service Schedule for Option 1
(Showing Intrastate and MBTA South County Trains)

North (East) Service		MBTA	RIIS	MBTA	RIIS	MBTA	RIIS	MBTA	RIIS	RIIS
Boston South Station										
Connecting MBTA Train No.										
Train No.		**804**	**2**	**806**	**4**	**808**	**6**	**812**	**8**	**10**
Cycle	**MP**		**d**		**c**		**d**		**c**	**d**
Wickford	165.8	5:46 AM		6:12 AM		6:51 AM		7:49 AM		
West Warwick ~ T.F. Green	176.6	5:58 AM	6:05 AM	6:24 AM	6:45 AM	7:03 AM	7:47 AM	8:01 AM	8:46 AM	10:19 AM
Cranston	180.2		6:09 AM		6:49 AM		7:51 AM		8:50 AM	10:23 AM
Olneyville	183.7		6:14 AM		6:54 AM		7:56 AM		8:55 AM	10:28 AM
Providence	185.3	6:07 AM	6:17 AM	6:33 AM	6:57 AM	7:12 AM	7:59 AM	8:10 AM	8:58 AM	10:31 AM
Pawtucket/Central Falls	189.8	6:14 AM	6:24 AM	6:40 AM	7:04 AM	7:19 AM	8:06 AM	8:17 AM	9:05 AM	10:38 AM
Cumberland	192.3		6:28 AM		7:10 AM		8:10 AM		9:09 AM	10:42 AM
Woonsocket	201.5		6:45 AM		7:26 AM		8:27 AM		9:26 AM	10:59 AM

North (East) Service		RIIS	MBTA	RIIS	RIIS	MBTA	MBTA	MBTA	RIIS	RIIS
Boston South Station		**10:25 AM**			**1:25 PM**		**2:37 PM**		**3:40 PM**	**4:35 PM**
Connecting MBTA Train No.		**805**			**809**		**8XY**		**811**	**815**
Train No.		**12**	**816**	**14**	**16**	**820**	**18**	**8XX**	**20**	**22**
Cycle	**MP**	**c**		**d**	**c**		**d**		**c**	**d**
Wickford	165.8		12:03 PM			3:03 PM		4:03 PM		
West Warwick ~ T.F. Green	176.6	11:06 AM	12:15 PM	1:00 PM	2:06 PM	3:14 PM	3:18 PM	4:14 PM	4:36 PM	5:14 PM
Cranston	180.2	11:10 AM		1:04 PM	2:10 PM		3:22 PM		4:40 PM	5:18 PM
Olneyville	183.7	11:15 AM		1:09 PM	2:15 PM		3:27 PM		4:45 PM	5:23 PM
Providence	185.3	11:18 AM	12:25 PM	1:14 PM	2:18 PM	3:22 PM	3:30 PM	4:22 PM	4:48 PM	5:26 PM
Pawtucket/Central Falls	189.8	11:25 AM	12:32 PM	1:20 PM	2:25 PM	3:31 PM	3:37 PM	4:31 PM	4:55 PM	5:33 PM
Cumberland	192.3	11:29 AM		1:27 PM	2:29 PM		3:41 PM		4:59 PM	5:37 PM
Woonsocket	201.5	11:46 AM		1:43 PM	2:46 PM		3:58 PM		5:16 PM	5:54 PM

North (East) Service		MBTA	RIIS	RIIS	MBTA	RIIS	RIIS	RIIS	MBTA	RIIS
Boston South Station			**5:40 PM**	***6:10 PM***		***7:10 PM***	**8:15 PM**	**9:05 PM**		**10:25 PM**
Connecting MBTA Train No.			**817**	***819***		***821***	**823**	**825**		**827**
Train No.		**822**	**24**	***26***	**DH3**	***28***	**30**	**32**	**DH4**	**34**
Cycle	**MP**		**c**	***d***		***c***	**d**	**c**		**d**
Wickford	165.8	5:12 PM			7:20 PM				10:52 PM	
West Warwick ~ T.F. Green	176.6	5:24 PM	6:21 PM	7:01 PM		8:02 PM	9:01 PM	9:47 PM		11:09 PM
Cranston	180.2		6:25 PM	7:05 PM		8:06 PM	9:05 PM	9:51 PM		11:13 PM
Olneyville	183.7		6:30 PM	7:10 PM		8:11 PM	9:10 PM	9:56 PM		11:18 PM
Providence	185.3	5:33 PM	6:33 PM	7:13 PM		8:14 PM	9:13 PM	9:59 PM		11:21 PM
Pawtucket/Central Falls	189.8	5:42 PM	6:40 PM	7:20 PM	7:45 PM	8:21 PM	9:20 PM	10:06 PM	11:17 PM	11:28 PM
Cumberland	192.3		6:44 PM	***7:24 PM***		***8:25 PM***	9:24 PM	10:10 PM		11:32 PM
Woonsocket	201.5		7:01 PM	***7:41 PM***		***8:42 PM***	9:41 PM	10:27 PM		11:49 PM
				15 minute connection		11 minute connection				

Connections to SB MBTA: **9**

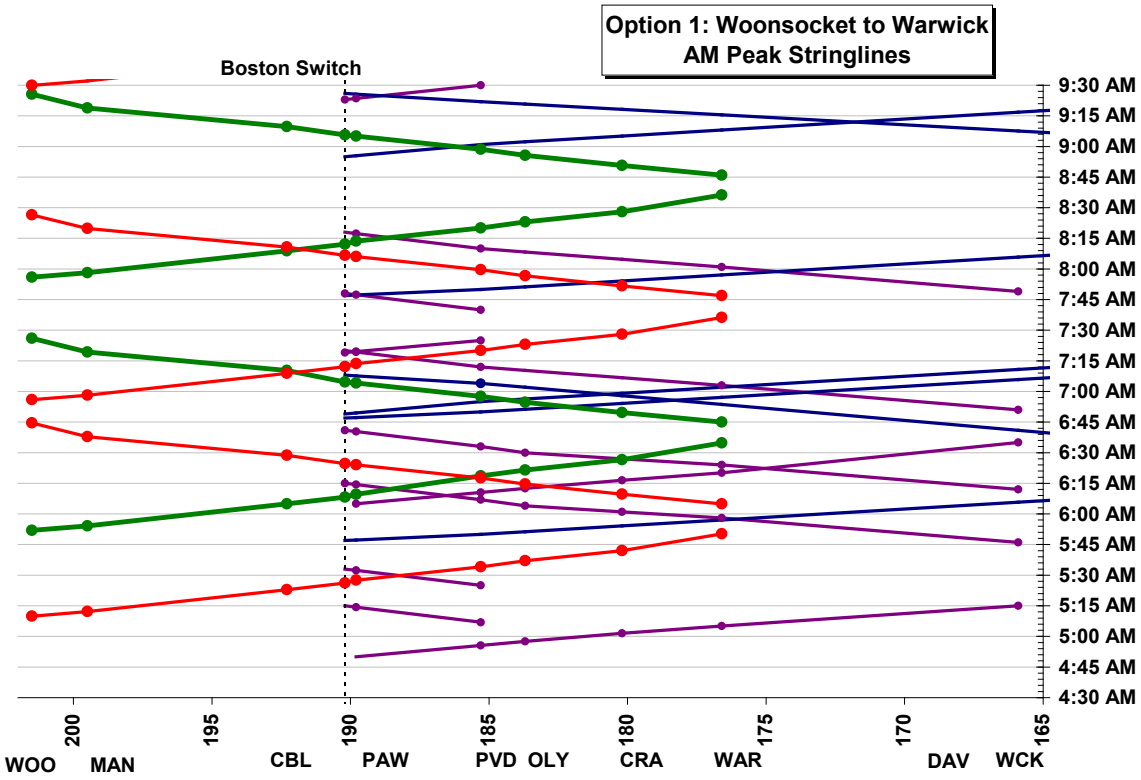


Figure 5.2

Figure 5.2 shows the morning peak stringlines corresponding to the schedule shown in **Table 5.3**. A minimum turn time of ten minutes is used at each terminal station.

Based on the objectives listed at the beginning of the chapter, there are three intrastate conflicts with MBTA trains using the FRIP track.

Conflict 1
MBTA #806 traveling northbound to Boston conflicts with intrastate train #3 traveling southbound to Warwick near Cranston Station at 6:25 AM. This conflict is resolved by rerouting the MBTA #806 onto the NEC north of Warwick Station. A crossover from Track 1 to Track 2 in the vicinity of Interlocking 178 is required to resolve this conflict. This move will not cause any conflicts with Amtrak service.

Conflict 2
Southbound MBTA #819 conflicts with northbound intrastate #26 between Olneyville Station and Cranston at 7:15 PM. This conflict is resolved by routing MBTA #819 onto Track 1 immediately south of Providence Station. The #819 can be routed back onto the Track 3 to serve Warwick Station prior to the station using an existing Track 1 to Track 3 crossover near MP 177. This move will not cause any conflicts with Amtrak service.

Conflict 3
Northbound MBTA DH #3 (Deadhead) conflicts with southbound intrastate #27 south of Providence Station and north of Olneyville Station at 7:38 PM. This conflict is resolved by running MBTA DH #3 on Track 2 and not the FRIP. This move will not cause any conflicts with Amtrak service.

There are no intrastate conflicts with Amtrak.

Meets between northbound and southbound intrastate trips are scheduled at either Providence or Cumberland stations. Providence Station was chosen because it has the capacity to hold up to four trains in the station at the same time. Cumberland was chosen because it located off of the NEC. Meets in this location will not interfere with MBTA or Amtrak operations. Infrastructure upgrades to enable meets on the P&W mainline will be less expensive then upgrades on the NEC.

Due to Cumberland's proximity to the P&W Valley Falls Freight Yard, the mainline would be tripled tracked in this vicinity. One track will be a yard lead for the P&W Freight Yard. The remaining two tracks will be mainline tracks to allow meets.

Although only weekday schedules were developed, it was assumed that each weekend service day would be slightly less than the 50% of weekday service to allow for all roundtrips to terminate in Woonsocket.[2] From the weekday service estimates, weekly service characteristics are derived shown in **Table 5.5**.

Table 5.5:
Summary of Option 1 Weekly Service Characteristics

	Route Miles	**Daily Trips**	**Daily Rev. Miles**	**Daily Rev. Hours**	**Consists in Service**
Weekday Service	24.9	34	847	35:14	2
Weekend Service	24.9	16	398	15:12	1
		Weekly	***5,030***	206:34	

[2] Using MBTA schedules effective in December 2008 on the Providence line, the ratio of Saturday trips to weekday trips was calculated to be 0.60 (18 trips / 30 trips). The ratio of Sunday trips to weekday trips was calculated to be 0.47 (14 trips / 30 trips). The average of these two ratios is 0.53 (rounded to 0.50), and was used inform weekend service statistics.

Option 2: Two consists with MBTA service to Cranston

Option 2 is essentially the same as Option 1 except that MBTA trains would call on Cranston in addition to serving Warwick.

Figure 5.3 shows a map of the proposed route and **Table 5.6** lists the stations served by the RI Intrastate and MBTA.

Table 5.6:
Option 2 Stations Served

Stations	RI Intrastate	MBTA
Woonsocket	x	
Cumberland	x	
Pawtucket	x	x
Providence	x	x
Olneyville	x	
Cranston	x	x
Warwick	x	x

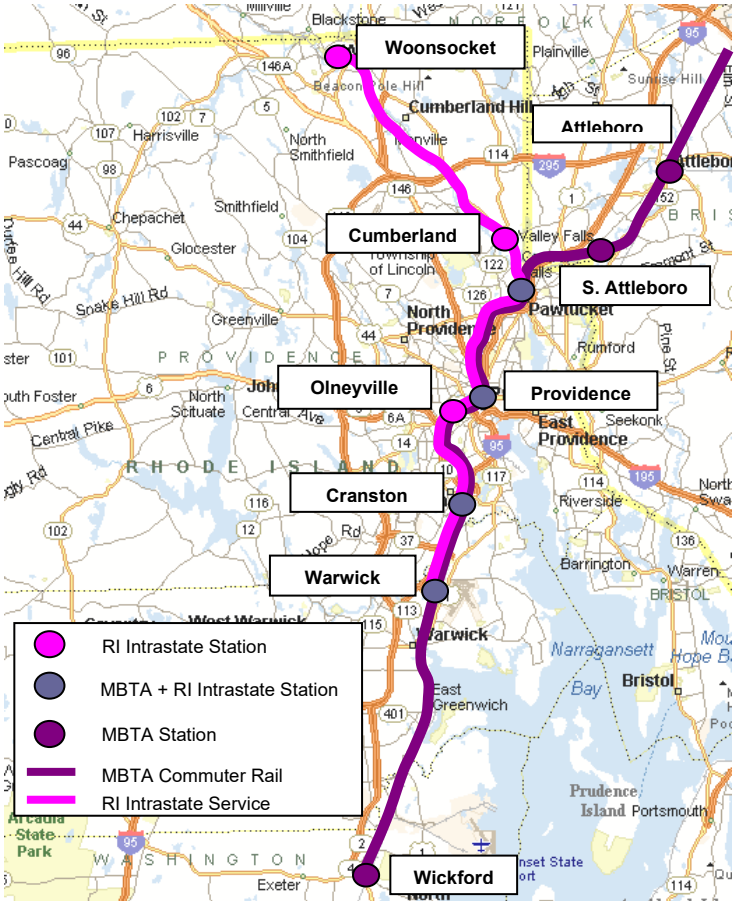


Figure 5.3:
Map of the Proposed Option 2 Route

Schedule and Service Design – **Like Option 1, 34 trips are offered between Woonsocket and Warwick, with 17 connections to MBTA Boston service for Woonsocket and Cumberland passengers. However, with the MBTA now stopping at Cranston Station, some intrastate trips have been adjusted to allow the MBTA to serve Cranston.**

Table 5.7 and Table 5.8 show preliminary weekday service schedules for Option 2. Columns shaded gray indicate intrastate trains that offer connections to MBTA trains in Pawtucket. There are nine MBTA connections for inbound service to Boston (four in the morning peak) and eight connections for outbound service from Boston (three in the evening peak).[3] In this option, 14 of the 16 weekday MBTA trains would offer direct service between Cranston and Boston. Note, only South County MBTA trains are shown.

Table 5.7:

[3] This does not include the meets in Pawtucket where the timed transfer is longer then 5 minutes.

Preliminary Weekday Southbound Service Schedule for Option 2
(Showing Intrastate and MBTA South County Trains)

Southbound (West) Service		MBTA	RIIS	MBTA	RIIS	RIIS	RIIS	RIIS	RIIS	MBTA
Train No.		**DH1**	**1**	**DH2**	**3**	**5**	**7**	**9**	**11**	
Cycle	**MP**		**d**		**c**	**d**	**c**	**d**	**c**	805
Woonsocket	201.5		5:10 AM		5:50 AM	6:57 AM	7:58 AM	9:31 AM	10:11 AM	
Cumberland	192.3		5:22 AM		6:02 AM	7:09 AM	8:10 AM	9:43 AM	10:23 AM	
Pawtucket/Central Falls	189.8	4:50 AM	5:27 AM	6:05 AM	6:10 AM	7:14 AM	8:15 AM	9:48 AM	10:28 AM	11:21 AM
Providence	185.3		5:34 AM		6:16 AM	7:21 AM	8:22 AM	9:55 AM	10:35 AM	11:27 AM
Olneyville	183.7		5:37 AM		6:19 AM	7:24 AM	8:25 AM	9:58 AM	10:38 AM	
Cranston	180.2		5:42 AM		6:24 AM	7:29 AM	8:30 AM	10:03 AM	10:43 AM	11:33 AM
West Warwick ~ T.F. Green	176.6		5:50 AM		6:32 AM	7:37 AM	8:39 AM	10:11 AM	10:51 AM	11:38 AM
Wickford	165.8	5:15 AM		6:35 AM						11:48 AM
Boston South Station			**6:40 AM**		**7:19 AM**	**8:16 AM**	**9:23 AM**	**10:55 AM**		
Connecting MBTA Train No.			**802**		**804**	**808**	**812**	**814**		

Southbound (West) Service		RIIS	RIIS	MBTA	RIIS	MBTA	RIIS	MBTA	RIIS	RIIS
Train No.		**13**	**15**	**809**	**17**	**8XY**	**19**	**811**	**21**	**23**
Cycle	**MP**	**d**	**c**		**d**		**c**		**d**	**c**
Woonsocket	201.5	12:11 PM	1:16 PM		2:15 PM		3:27 PM		4:24 PM	5:27 PM
Cumberland	192.3	12:23 PM	1:28 PM		2:27 PM		3:39 PM		4:36 PM	5:39 PM
Pawtucket/Central Falls	189.8	12:28 PM	1:33 PM	2:21 PM	2:32 PM	3:33 PM	3:44 PM	4:35 PM	4:41 PM	5:44 PM
Providence	185.3	12:35 PM	1:40 PM	2:27 PM	2:39 PM	3:39 PM	3:51 PM	4:41 PM	4:48 PM	5:51 PM
Olneyville	183.7	12:38 PM	1:43 PM		2:42 PM		3:54 PM		4:51 PM	5:54 PM
Cranston	180.2	12:43 PM	1:48 PM	2:33 PM	2:47 PM	3:45 PM	3:59 PM	4:47 PM	4:56 PM	5:59 PM
West Warwick ~ T.F. Green	176.6	12:51 PM	1:56 PM	2:38 PM	2:55 PM	3:50 PM	4:07 PM	4:52 PM	5:04 PM	6:07 PM
Wickford	165.8			2:48 PM		4:00 PM		5:02 PM		
Boston South Station		**1:38 PM**	**2:42 PM**							**6:51 PM**
Connecting MBTA Train No.		**816**	**818**							**822**

Southbound (West) Service		MBTA	RIIS	MBTA	MBTA	RIIS	RIIS	RIIS	MBTA	RIIS
Train No.		**815**	**25**	**817**	**819**	**27**	**29**	**31**	**825**	**33**
Cycle	**MP**		**d**			**c**	**d**	**c**		**d**
Woonsocket	201.5		6:11 PM			7:11 PM	8:10 PM	8:52 PM		9:58 PM
Cumberland	192.3		6:23 PM			7:23 PM	8:24 PM	9:04 PM		10:10 PM
Pawtucket/Central Falls	189.8	6:00 PM	6:28 PM	6:36 PM	7:05 PM	7:28 PM	8:29 PM	9:09 PM	10:03 PM	10:15 PM
Providence	185.3	6:06 PM	6:35 PM	6:42 PM	7:11 PM	7:35 PM	8:35 PM	9:16 PM	10:09 PM	10:22 PM
Olneyville	183.7		6:38 PM			7:38 PM	8:38 PM	9:19 PM		10:25 PM
Cranston	180.2	6:13 PM	6:43 PM	6:49 PM		7:43 PM	8:43 PM	9:24 PM	10:16 PM	10:30 PM
West Warwick ~ T.F. Green	176.6	6:18 PM	6:51 PM	6:54 PM	7:23 PM	7:51 PM	8:52 PM	9:32 PM	10:21 PM	10:38 PM
Wickford	165.8	6:29 PM		7:05 PM	7:34 PM				10:32 PM	
Boston South Station										
Connecting MBTA Train No.										

Connections to NB MBTA Trains 8

Table 5.8:
Preliminary Weekday Northbound Service Schedule for Option 2
(Showing Intrastate and MBTA South County Trains)

Northbound (East Service)		MBTA	RIIS	MBTA	RIIS	MBTA	RIIS	MBTA	RIIS	RIIS
Boston South Station										
Connecting MBTA Train No.										
Train No.		**804**	**2**	**806**	**4**	**808**	**6**	**812**	**8**	**10**
Cycle	**MP**		**d**		**c**		**d**		**c**	**d**
Wickford	165.8	5:46 AM		6:12 AM		6:51 AM		7:49 AM		
West Warwick ~ T.F. Green	176.6	5:58 AM	6:03 AM	6:24 AM	6:45 AM	7:03 AM	7:47 AM	8:01 AM	8:48 AM	10:21 AM
Cranston	180.2	6:03 AM	6:07 AM		6:49 AM	7:08 AM	7:51 AM	8:06 AM	8:52 AM	10:25 AM
Olneyville	183.7		6:12 AM		6:54 AM		7:56 AM		8:57 AM	10:30 AM
Providence	185.3	6:07 AM	6:15 AM	6:33 AM	6:57 AM	7:12 AM	7:59 AM	8:10 AM	9:00 AM	10:33 AM
Pawtucket/Central Falls	189.8	6:14 AM	6:22 AM	6:40 AM	7:04 AM	7:19 AM	8:06 AM	8:17 AM	9:07 AM	10:40 AM
Cumberland	192.3		6:26 AM		7:10 AM		8:10 AM		9:11 AM	10:44 AM
Woonsocket	201.5		6:43 AM		7:26 AM		8:27 AM		9:28 AM	11:01 AM

Northbound (East Service)		RIIS	MBTA	RIIS	RIIS	MBTA	RIIS	MBTA	RIIS	RIIS
Boston South Station		**10:25 AM**			**1:25 PM**		**2:37 PM**		**3:40 PM**	**4:35 PM**
Connecting MBTA Train No.		**805**			**809**		**8XY**		**811**	**815**
Train No.		**12**	**816**	**14**	**16**	**820**	**18**	**8XX**	**20**	**22**
Cycle	**MP**	**c**		**d**	**c**		**d**		**c**	**d**
Wickford	165.8		12:03 PM			3:03 PM		4:03 PM		
West Warwick ~ T.F. Green	176.6	11:06 AM	12:15 PM	1:00 PM	2:06 PM	3:14 PM	3:18 PM	4:14 PM	4:36 PM	5:14 PM
Cranston	180.2	11:10 AM	12:20 PM	1:04 PM	2:10 PM	3:19 PM	3:22 PM	4:19 PM	4:40 PM	5:18 PM
Olneyville	183.7	11:15 AM		1:09 PM	2:15 PM		3:27 PM		4:45 PM	5:23 PM
Providence	185.3	11:18 AM	12:25 PM	1:14 PM	2:18 PM	3:22 PM	3:30 PM	4:22 PM	4:48 PM	5:26 PM
Pawtucket/Central Falls	189.8	11:25 AM	12:32 PM	1:20 PM	2:25 PM	3:31 PM	3:37 PM	4:31 PM	4:55 PM	5:34 PM
Cumberland	192.3	11:29 AM		1:27 PM	2:29 PM		3:41 PM		4:59 PM	5:39 PM
Woonsocket	201.5	11:46 AM		1:43 PM	2:46 PM		3:58 PM		5:16 PM	5:55 PM

Northbound (East Service)		MBTA	RIIS	RIIS	MBTA	RIIS	RIIS	RIIS	MBTA	RIIS
Boston South Station			**5:40 PM**	***6:10 PM***		***7:10 PM***	**8:15 PM**	**9:05 PM**		**10:25 PM**
Connecting MBTA Train No.			**817**	***819***		***821***	**823**	**825**		**827**
Train No.		**822**	**24**	***26***	**DH3**	***28***	**30**	**32**	**DH4**	**34**
Cycle	**MP**		**c**	***d***		***c***	**d**	**c**		**d**
Wickford	165.8	5:12 PM			7:20 PM				10:52 PM	
West Warwick ~ T.F. Green	176.6	5:24 PM	6:21 PM	7:01 PM		8:02 PM	9:04 PM	9:47 PM		11:09 PM
Cranston	180.2	5:29 PM	6:25 PM	7:05 PM		8:06 PM	9:08 PM	9:51 PM		11:13 PM
Olneyville	183.7		6:30 PM	7:10 PM		8:11 PM	9:13 PM	9:56 PM		11:18 PM
Providence	185.3	5:33 PM	6:33 PM	7:13 PM		8:14 PM	9:16 PM	9:59 PM		11:21 PM
Pawtucket/Central Falls	189.8	5:42 PM	6:40 PM	7:20 PM	7:45 PM	8:21 PM	9:23 PM	10:06 PM	11:17 PM	11:28 PM
Cumberland	192.3		6:44 PM	***7:24 PM***		***8:25 PM***	9:27 PM	10:10 PM		11:32 PM
Woonsocket	201.5		7:01 PM	***7:41 PM***		***8:42 PM***	9:44 PM	10:27 PM		11:49 PM
				15 minute connection		11 minute connection				

Connections to SB MBTA Trains 9

Figure 5.4 shows the morning peak stringlines corresponding to the schedule shown in Table 5.7 and **Table 5.9**. A minimum turn time of ten minutes is used at each terminal station.

The conflicts that arise with Option 2 are the same as in Option 1. Please see the Option 1 *Conflicts* section. Also like Option 1, meets between northbound and southbound intrastate would occur either at Providence or Cumberland stations.

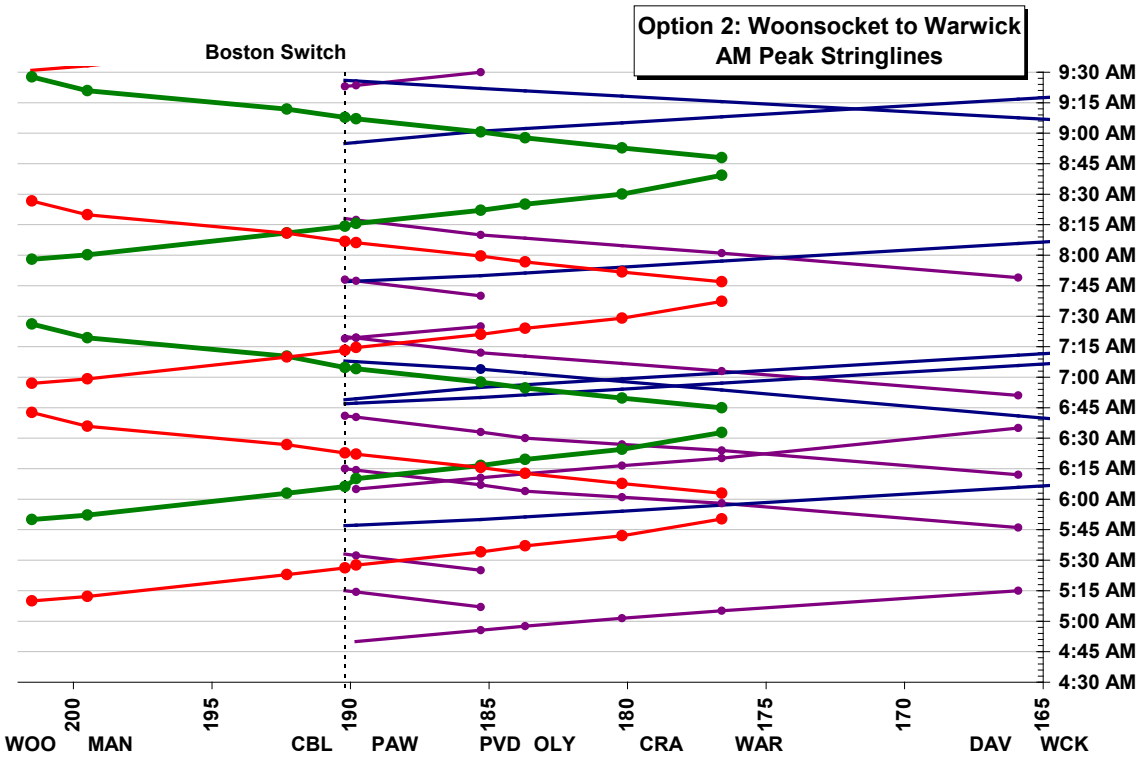


Figure 5.4:
Option 2 Morning Peak Stringlines

Although only weekday schedules were developed, it was assumed that weekend service be slightly less than 50% of weekday service to allow for all roundtrips to terminate in Woonsocket.[4] **Table 5.9** shows a preliminary weekday service schedule for Option 2.

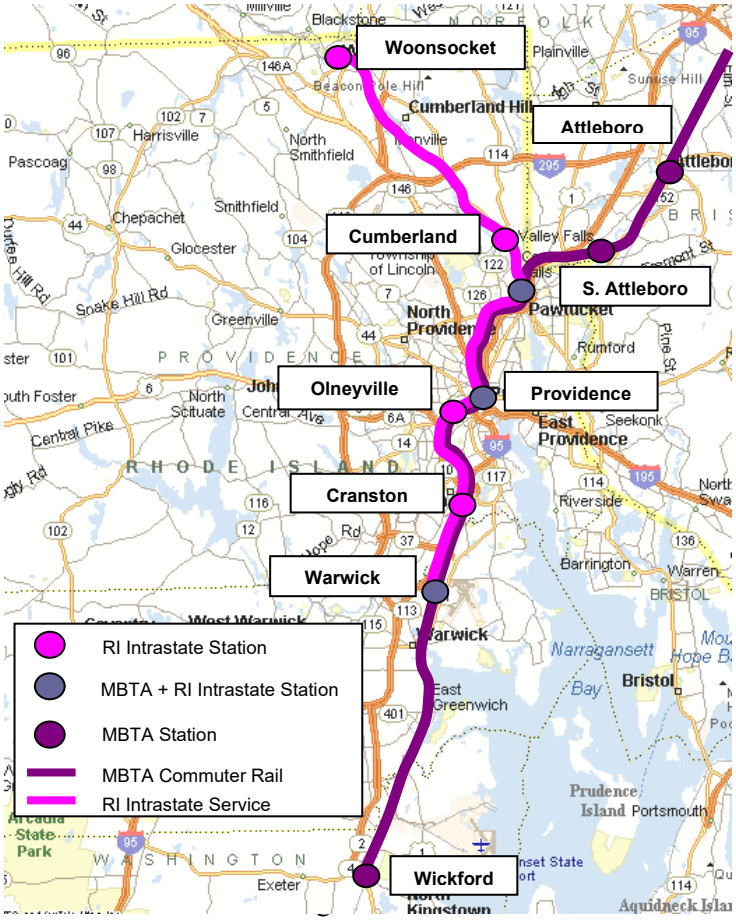
Table 5.9:
Summary of Option 2 Weekly Service Characteristics

	Route Miles	Daily Trips	Daily Rev. Miles	Daily Rev. Hours	Consists in Service
Weekday Service	24.9	34	847	35:14	2
Weekend Service	24.9	16	398	15:12	1
		Weekly	***5,030***	206:34	

[4] Using MBTA schedules effective in December 2008 on the Providence line, the ratio of Saturday trips to weekday trips was calculated to be 0.60 (18 trips / 30 trips). The ratio of Sunday trips to weekday trips was calculated to be 0.47 (14 trips / 30 trips). The average of these two ratios is 0.53 (rounded to 0.50), and was used to inform estimates of weekend service.

Option 3: Three consists all day Between Woonsocket and Providence/Warwick

Option 3 provides all-day service between Woonsocket and Providence/Warwick using three trainsets. Due to the high volume of intrastate trains providing service, some southbound intrastate trips would be truncated in Providence, while other trips would travel through to Warwick. Truncated trips would occur mostly during peak periods of travel. **Figure 5.5** shows a map of the proposed route. See **Table 5.10** for a list of stations served by the RIIS and MBTA.



Map of the Proposed Option 3 Route

Table 5.10:
Option 3 Stations Served

Stations	RI Intrastate	MBTA
Woonsocket	x	
Cumberland	x	
Pawtucket	x	x
Providence	x	x
Olneyville	x	
Cranston	x	
Warwick	x	x

Schedule and Service Design – A sketch operating plan indicates that there would be 58 trips between Woonsocket and Providence/Warwick (29 roundtrips). There would be 12 connections in Pawtucket for northbound MBTA service to Boston (seven in the morning peak) from Woonsocket and 12 southbound MBTA connections(four in the evening peak) for service to Woonsocket. Of the 58 trips, 16 trips are truncated in Providence, and 42 trips run through to Warwick.

Table 5.11 and **Table 5.13** shows a preliminary weekday service schedule for Option 3. Columns shaded gray indicate intrastate trains that connect with MBTA trains in Pawtucket. Note, only South County MBTA trains are shown.

Table 5.11:
Preliminary Southbound Weekday Service Schedule for Option 3
(Showing Intrastate and MBTA South County Trains)

South (West) Service			RIIS	RIIS	MBTA	RIIS	RIIS	RIIS	RIIS	RIIS	RIIS	RIIS	RIIS	RIIS
STATION		DH1	1	3	DH2	5	7	9	11	13	15	17	19	21
Cycle	MP		g	d		c	g	d	c	g	d	c	g	d
Woonsocket	201.5		4:53 AM	5:11 AM		5:53 AM	6:19 AM	6:58 AM	7:27 AM	7:58 AM	8:18 AM	9:29 AM	10:16 AM	10:48 AM
Cumberland	192.3		5:05 AM	5:23 AM		6:05 AM	6:31 AM	7:10 AM	7:39 AM	8:10 AM	8:30 AM	9:41 AM	10:28 AM	11:00 AM
Pawtucket/Central Falls	189.8	4:50 AM	5:10 AM	5:28 AM	6:05 AM	6:10 AM	6:36 AM	7:15 AM	7:44 AM	8:15 AM	8:35 AM	9:46 AM	10:33 AM	11:05 AM
Providence	185.3		5:20 AM	5:35 AM		6:20 AM	6:43 AM	7:25 AM	7:54 AM	8:22 AM	8:42 AM	9:53 AM	10:40 AM	11:12 AM
Olneyville	183.7			5:38 AM						8:25 AM	8:45 AM	9:56 AM	10:43 AM	11:15 AM
Cranston	180.2			5:43 AM			6:50 AM			8:30 AM	8:50 AM	10:01 AM	10:48 AM	11:20 AM
West Warwick ~ T.F. Green	176.6			5:51 AM			6:58 AM			8:38 AM	8:58 AM	10:09 AM	10:56 AM	11:28 AM
Wickford	165.8	5:15 AM			6:35 AM									
Boston South Station			**6:20 AM**	**6:40 AM**		**7:19 AM**	**7:45 AM**	**8:16 AM**	**8:49 AM**	**9:23 AM**		**10:55 AM**		
Connecting MBTA Train No.			**800**	**802**		**804**	**806**	**808**	**810**	**812**		**814**		

South (West) Service		MBTA	RIIS	RIIS	RIIS	RIIS	RIIS	MBTA	RIIS	MBTA	RIIS	RIIS	MBTA	RIIS
STATION		805	23	25	27	29	31	809	33	8XY	35	37	811	39
Cycle	MP		c	g	d	c	g		d		c	g		d
Woonsocket	201.5		11:29 AM	12:11 PM	12:45 PM	1:18 PM	1:54 PM		2:54 PM		3:30 PM	3:56 PM		4:29 PM
Cumberland	192.3		11:41 AM	12:23 PM	12:57 PM	1:30 PM	2:06 PM		3:06 PM		3:42 PM	4:08 PM		4:41 PM
Pawtucket/Central Falls	189.8	11:21 AM	11:46 AM	12:28 PM	1:02 PM	1:35 PM	2:11 PM	2:21 PM	3:11 PM	3:33 PM	3:47 PM	4:13 PM	4:35 PM	4:46 PM
Providence	185.3	11:27 AM	11:54 AM	12:35 PM	1:09 PM	1:42 PM	2:18 PM	2:27 PM	3:21 PM	3:39 PM	3:54 PM	4:20 PM	4:41 PM	4:53 PM
Olneyville	183.7		11:57 AM	12:38 PM	1:12 PM	1:45 PM	2:21 PM				3:57 PM	4:23 PM		4:56 PM
Cranston	180.2		12:02 PM	12:43 PM	1:17 PM	1:50 PM	2:26 PM				4:02 PM	4:28 PM		5:01 PM
West Warwick ~ T.F. Green	176.6	11:38 AM	12:10 PM	12:51 PM	1:25 PM	1:58 PM	2:34 PM	2:38 PM		3:50 PM	4:10 PM	4:36 PM	4:52 PM	5:09 PM
Wickford	165.8	11:48 AM						2:48 PM		4:00 PM			5:02 PM	
Boston South Station				**1:38 PM**		**2:38 PM**								**5:56 PM**
Connecting MBTA Train No.				**816**		**818**								**8XX**

South (West) Service		RIIS	MBTA	RIIS	MBTA	RIIS	MBTA	RIIS	RIIS	RIIS	RIIS	RIIS	MBTA	RIIS
STATION		41	815	43	817	45	819	47	49	51	53	55	825	57
Cycle	MP	c		g		d		c	g	d	c	g		d
Woonsocket	201.5	5:20 PM		5:47 PM		6:26 PM		7:06 PM	7:29 PM	8:05 PM	8:55 PM	9:28 PM		10:19 PM
Cumberland	192.3	5:32 PM		5:59 PM		6:38 PM		7:18 PM	7:41 PM	8:17 PM	9:07 PM	9:40 PM		10:31 PM
Pawtucket/Central Falls	189.8	5:37 PM	6:00 PM	6:04 PM	6:36 PM	6:43 PM	7:05 PM	7:23 PM	7:46 PM	8:22 PM	9:12 PM	9:45 PM	10:03 PM	10:36 PM
Providence	185.3	5:47 PM	6:06 PM	6:14 PM	6:42 PM	6:53 PM	7:11 PM	7:30 PM	7:53 PM	8:29 PM	9:19 PM	9:52 PM	10:09 PM	10:43 PM
Olneyville	183.7							7:33 PM	7:56 PM	8:32 PM	9:22 PM	9:55 PM		10:46 PM
Cranston	180.2							7:38 PM	8:01 PM	8:37 PM	9:27 PM	10:00 PM		10:51 PM
West Warwick ~ T.F. Green	176.6		6:18 PM		6:54 PM		7:23 PM	7:46 PM	8:09 PM	8:45 PM	9:35 PM	10:08 PM	10:21 PM	10:59 PM
Wickford	165.8		6:29 PM		7:05 PM		7:34 PM						10:32 PM	
Boston South Station												**10:55 PM**		
Connecting MBTA Train No.												**828**		

Connections to NB MBTA **12**

Table 5.12:
Preliminary Northbound Weekday Service Schedule for Option 3
(Showing Intrastate and MBTA South County Trains)

North (East) Service		RIIS	MBTA	RIIS	RIIS	MBTA	MBTA	RIIS	RIIS	RIIS	MBTA	RIIS	RIIS	RIIS
STATION		2	804	4	6	806	808	8	10	12	812	14	16	18
Cycle	MP	g		d	c			g	d	c		g	d	c
Boston South Station													8:30 AM	
Connecting MBTA Train No.	-												803	
Wickford	165.8		5:46 AM			6:12 AM	6:51 AM				7:49 AM			
West Warwick ~ T.F. Green	176.6		5:58 AM	6:02 AM		6:24 AM	7:03 AM	7:09 AM			8:01 AM	8:47 AM	9:10 AM	10:19 AM
Cranston	180.2			6:06 AM				7:13 AM				8:51 AM	9:14 AM	10:23 AM
Olneyville	183.7			6:11 AM				7:18 AM				8:56 AM	9:19 AM	10:28 AM
Providence	185.3	5:30 AM	6:07 AM	6:14 AM	6:30 AM	6:33 AM	7:12 AM	7:21 AM	7:35 AM	8:03 AM	8:10 AM	8:59 AM	9:22 AM	10:31 AM
Pawtucket/Central Falls	189.8	5:36 AM	6:14 AM	6:21 AM	6:36 AM	6:40 AM	7:19 AM	7:28 AM	7:41 AM	8:09 AM	8:17 AM	9:06 AM	9:29 AM	10:38 AM
Cumberland	192.3	5:41 AM		6:25 AM	6:41 AM				7:46 AM	8:14 AM		9:10 AM	9:33 AM	10:42 AM
Woonsocket	201.5	5:58 AM		6:42 AM	6:57 AM			7:47 AM	8:03 AM	8:30 AM		9:26 AM	9:50 AM	10:58 AM

North (East) Service		RIIS	RIIS	MBTA	RIIS	RIIS	RIIS	RIIS	RIIS	MBTA	RIIS	MBTA	RIIS	RIIS
STATION		20	22	816	24	26	28	30	32	820	34	8XX	36	38
Cycle	MP	g	d		c	g	d	c	g		d		c	g
Boston South Station		10:25 AM						1:25 PM			2:37 PM		3:40 PM	
Connecting MBTA Train No.	-	805						809			8XY		811	
Wickford	165.8			12:03 PM						3:03 PM		4:03 PM		
West Warwick ~ T.F. Green	176.6	11:06 AM	11:43 AM	12:15 PM	12:20 PM	1:00 PM	1:35 PM	2:08 PM	2:43 PM	3:14 PM		4:14 PM	4:20 PM	4:47 PM
Cranston	180.2	11:10 AM	11:47 AM		12:24 PM	1:04 PM	1:39 PM	2:12 PM	2:47 PM				4:24 PM	4:51 PM
Olneyville	183.7	11:15 AM	11:52 AM		12:29 PM	1:09 PM	1:44 PM	2:17 PM	2:52 PM				4:29 PM	4:56 PM
Providence	185.3	11:18 AM	11:55 AM	12:25 PM	12:32 PM	1:12 PM	1:47 PM	2:20 PM	2:55 PM	3:22 PM	3:35 PM	4:22 PM	4:32 PM	4:59 PM
Pawtucket/Central Falls	189.8	11:25 AM	12:02 PM	12:32 PM	12:39 PM	1:19 PM	1:54 PM	2:27 PM	3:02 PM	3:31 PM	3:41 PM	4:31 PM	4:39 PM	5:06 PM
Cumberland	192.3	11:29 AM	12:06 PM		12:43 PM	1:23 PM	1:58 PM	2:31 PM	3:08 PM		3:46 PM		4:43 PM	5:10 PM
Woonsocket	201.5	11:45 AM	12:22 PM		12:59 PM	1:39 PM	2:14 PM	2:49 PM	3:24 PM		4:02 PM		4:59 PM	5:26 PM

North (East) Service		MBTA	RIIS	RIIS	RIIS	RIIS	MBTA	RIIS	RIIS	RIIS	RIIS	RIIS	MBTA	RIIS
Outbound Service		822	40	42	44	46	DH3	48	50	52	54	56	DH4	58
STATION	MP		d	c	g	d		c	g	d	c	g		d
Boston South Station			4:35 PM	5:00 PM	5:40 PM	6:10 PM		7:10 PM			9:05 PM			10:25 PM
Connecting MBTA Train No.	-		813	815	817	819		821			825			827
Wickford	165.8	5:12 PM					7:20 PM						10:52 PM	
West Warwick ~ T.F. Green	176.6	5:24 PM	5:21 PM					7:56 PM	8:18 PM	8:58 PM	9:47 PM	10:18 PM		11:09 PM
Cranston	180.2		5:25 PM					8:00 PM	8:22 PM	9:02 PM	9:51 PM	10:22 PM		11:13 PM
Olneyville	183.7		5:30 PM					8:05 PM	8:27 PM	9:07 PM	9:56 PM	10:27 PM		11:18 PM
Providence	185.3	5:33 PM	5:33 PM	5:58 PM	6:34 PM	7:03 PM		8:08 PM	8:30 PM	9:10 PM	9:59 PM	10:30 PM		11:21 PM
Pawtucket/Central Falls	189.8	5:42 PM	5:40 PM	6:04 PM	6:43 PM	7:09 PM	7:45 PM	8:15 PM	8:37 PM	9:17 PM	10:06 PM	10:37 PM	11:17 PM	11:28 PM
Cumberland	192.3		5:44 PM	6:09 PM	6:47 PM	7:14 PM		8:19 PM	8:41 PM	9:21 PM	10:10 PM	10:41 PM		11:32 PM
Woonsocket	201.5		6:00 PM	6:25 PM	7:03 PM	7:30 PM		8:35 PM	8:59 PM	9:37 PM	10:26 PM	10:58 PM		11:48 PM

Connections to SB MBTA 12

The morning peak stringlines for Option 3 are shown in **Figure 5.6**. A minimum turn time of ten minutes is used at each terminal station. Review of Option 3 reveals numerous conflicts. Based on the objectives listed at the beginning of the chapter, there is such a density of conflicts that this service is not feasible unless intrastate trains are allowed to travel and stop on the NEC mainlines (Tracks 1 and 2). Based on this finding, Option 3 was dropped from further consideration. Some key conflicts are discussed below.

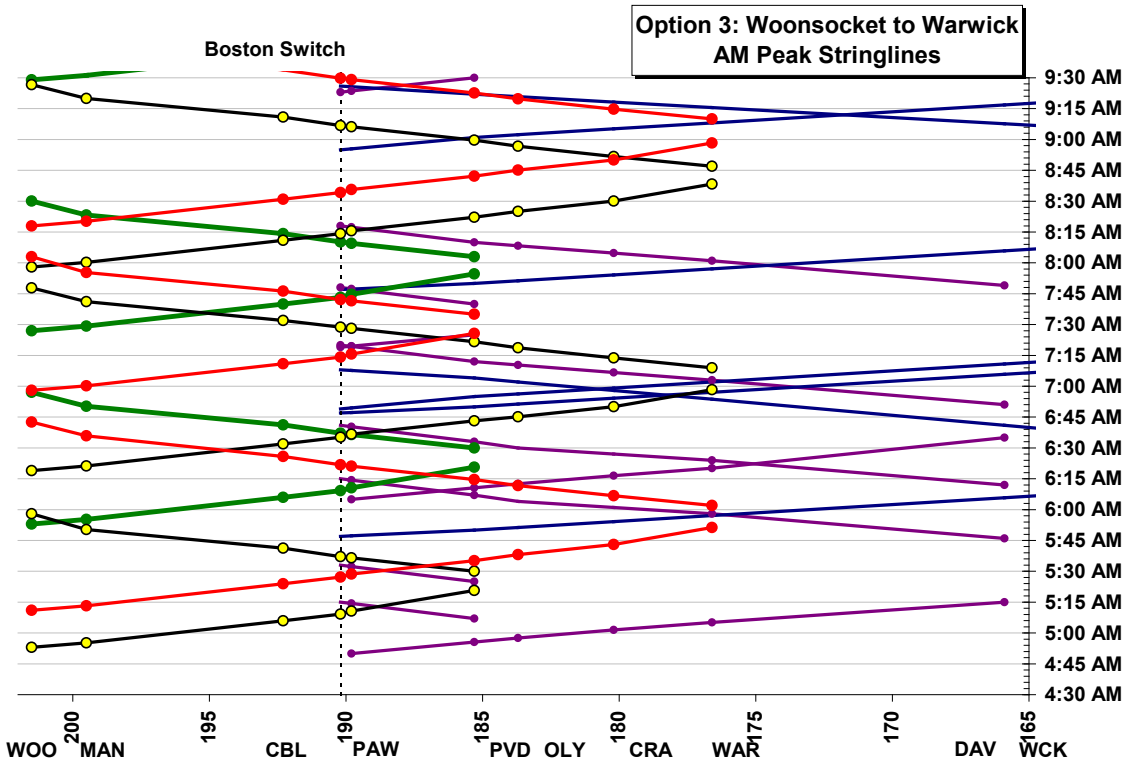


Figure 5.6

Northeast Corridor Conflicts

Conflict 1

Southbound intrastate #3 and northbound intrastate #2 conflict south of Pawtucket Station at 5:30 AM. This conflict is resolved by routing intrastate #3 onto NEC Track 1 to serve to Pawtucket Station. No infrastructure improvements are needed since a turnout from Track 7 to Track 1 exists south of Boston Switch, north of Pawtucket station. A Track 1 to Track 7 turnout exists between Pawtucket and Providence station and can be used to reroute intrastate #3 onto the FRIP. This conflict resolution violates Objective 4 about remaining on the FRIP, but it resolves the conflict with no new infrastructure. This move will not cause any obvious conflicts with Amtrak or MBTA service.

Conflict 2

Southbound MBTA DH #2 traveling and northbound intrastate train #4 conflict at Olneyville Station at 6:12 AM. South of Providence, both trains are on the FRIP at the same time. This conflict can be resolved by routing DH #2 onto Track 1. When the two meet, the intrastate train will be on the FRIP and the deadhead on Track 1. This move will not cause conflicts with Amtrak or MBTA service.

Conflict 3
Northbound intrastate #4 conflicts with southbound intrastate #5 north of Providence Station at 6:20 AM. This conflict is similar to Conflict 1. It could be resolved by routing southbound intrastate #5 onto NEC Track 1 north of Pawtucket station, and then routing it back to Track 7 south of Pawtucket. This move will not cause any obvious conflicts with Amtrak or MBTA service, and violates Objective 4.

Conflict 4
Southbound intrastate #7 conflicts with northbound intrastate #6 at Pawtucket Station at 6:36 AM. Two intrastate trains meet each other at Pawtucket. It cannot be resolved by putting southbound intrastate #7 onto Track 1 at Boston Switch because by routing intrastate #7 onto the NEC, it conflicts with Amtrak Acela #2155, operating on Track 1, and also with MBTA #810 on Track 2 heading north towards Boston.[5]

Conflict 5
Southbound intrastate #9 conflicts with northbound intrastate #8 north of Providence Station at 7:23 AM. This conflict could be resolved by routing southbound intrastate #9 onto Track 1 at Boston Switch. South of Pawtucket Station, train #9 would return to Track 7. No Amtrak or MBTA conflicts result from this conflict resolution.

Conflict 6
Northbound intrastate #14 conflicts with southbound intrastate #15 at Cranston Station at 8:50 AM. This conflict is resolved by routing southbound intrastate #15 onto NEC Track 1 at Cranston interlocking and bypassing Cranston Station completely. Intrastate #15 would return to Track 3 at 178 interlocking. No conflicts with MBTA or Amtrak would occur.

P&W Mainline Conflicts

Several conflicts on the P&W mainline result from this service option. All conflicts result from inbound and outbound intrastate meets on the P&W mainline. These conflicts can be resolved by double tracking most of the P&W mainline. The morning peak conflicts and resolution are described below.

Conflict 1
Northbound intrastate #2 and southbound intrastate #5 conflict south of Woonsocket Station at 5:51 AM. This is resolved by double tracking south of Woonsocket Station to the vicinity of Manville.

Conflict 2
Southbound intrastate #7 and northbound intrastate #4 conflict north of Cumberland Station at 6:36 AM. This conflict is resolved by building a three mile passing siding in the vicinity of the meet (P&W MP 16).

[5] This train can be scheduled to depart Providence at a different time to avoid a conflict at Pawtucket, but it is not recommended.

Conflict 3
Southbound intrastate #11 conflicts with northbound intrastate #8 north of Cumberland Station at 7:36 AM. Like Conflict #2, this conflict is resolved by building a three mile passing siding in the vicinity of the meet.

Conflict 4
Northbound intrastate #10 and southbound intrastate #13 conflict south of Woonsocket Station at 7:58 AM. This conflict is resolved by double tracking from the Woonsocket Station south to the vicinity of Manville.

Conflict 5
Southbound intrastate #15 conflicts with and northbound intrastate #12 south of Manville at 8:20 AM. This conflict is resolved by extending south double track from Manville by 3 miles.

Although only weekday schedules were developed, it was assumed that weekend service is ~50% of weekday service.[6] **Table 5.13** shows a preliminary weekday service schedule for Option 3.

Table 5.13:
Summary of Option 3 Weekly Service Characteristics

	Route Miles	Daily Trips	Daily Rev. Miles	Daily Rev. Hours	Consists in Service
Weekday Service	24.9	58	1,444	53:17	3
Weekend Service	24.9	30	747	28:30	2
		Weekly	***8,715***	323:25	

[6] Using MBTA schedules effective in December 2008 on the Providence line, the ratio of Saturday trips to weekday trips was calculated to be 0.60 (18 trips / 30 trips). The ratio of Sunday trips to weekday trips was calculated to be 0.47 (14 trips / 30 trips). The average of these two ratios is 0.53 (rounded to 0.50), and was used to inform estimates of weekend service statistics.

Option 1A: Option 1 with 2030 Amtrak and P&W Service Levels

Option 1A is the same as Option 1, except that it incorporates the P&W's and Amtrak's 2030 operating plans. Due to the increased volume of freight trains operating on the NEC and FRIP, two passenger trips have been eliminated: Option 1 southbound trip #19 and northbound trip #18. Northbound #18 provides a connection for MBTA service to Woonsocket. Southbound #19 does not provide connections to MBTA service. Afternoon intrastate service is shifted slightly when compared with Option 1 to preserve peak connections with the MBTA, and results in one less MBTA connection.

Figure 5.7 shows a map of the proposed route and **Table 5.14** lists stations served by the RIIS and MBTA.

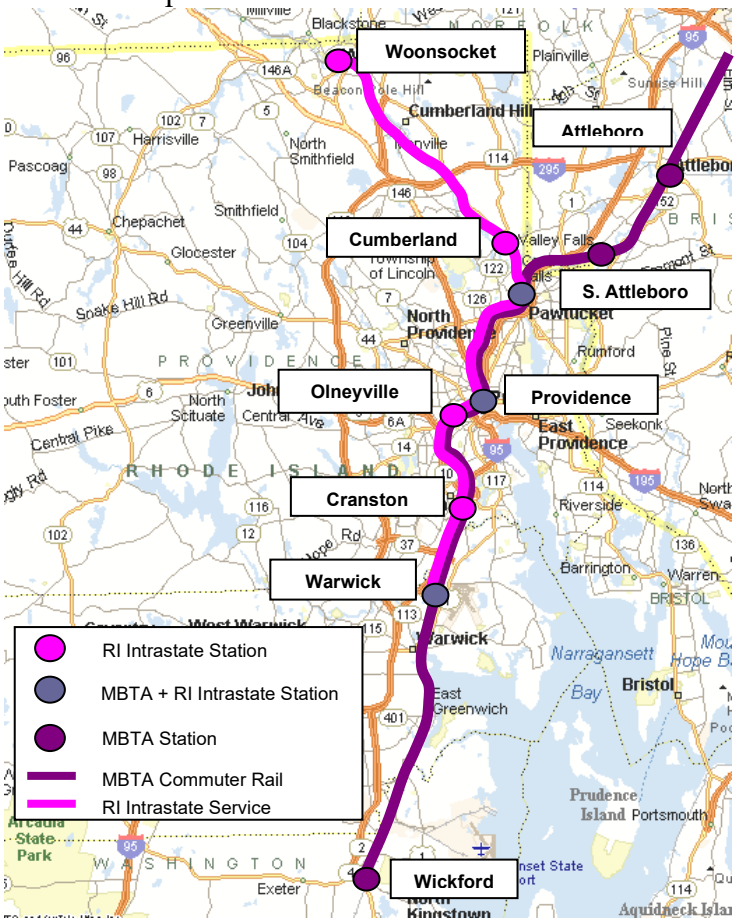


Figure 5.7:
Map of the Proposed Option 3 Route

Table 5.14:
Option 3 Stations Served

Stations	RI Intrastate	MBTA
Woonsocket	x	
Cumberland	x	
Pawtucket	x	x
Providence	x	x
Olneyville	x	
Cranston	x	
Warwick	x	x

Schedule and Service Design – A sketch operating plan indicates that there would be 32 weekday trips between Woonsocket and Warwick (16 roundtrips), with seven connections in Pawtucket for *northbound* MBTA service to Boston (four in the morning peak) from Woonsocket, and eight *southbound* MBTA connections in Pawtucket (three in the evening peak) for service to Woonsocket.[7]

Table 5.15 and Table 5.16 shows a preliminary weekday service schedule for Option 1A. Columns shaded gray indicate intrastate trains that meet MBTA trains in Pawtucket.

[7] The northbound count does not include the meet with MBTA #819, which has an estimated 12 minute timed transfer between MBTA and the Rhode Island Intrastate Service.

Table 5.15:
Preliminary Southbound Weekday Service Schedule for Option 1A
(Showing Intrastate, MBTA South County, and P&W Trains)

South (West) Service		P&W	P&W	MBTA	RIIS	MBTA	RIIS	RIIS	RIIS	P&W	P&W	RIIS	P&W
Station	MP	WODA-3	AUTO-1	DH1	1	DH2	3	5	7	PR-3	WODA-1	9	UNIT-1
Woonsocket	201.5	2:02 AM	2:47 AM		5:08 AM		5:51 AM	6:56 AM	7:54 AM	8:03 AM	8:13 AM	9:27 AM	9:33 AM
Cumberland	192.3	2:18 AM	3:03 AM		5:20 AM		6:03 AM	7:08 AM	8:06 AM	8:19 AM	8:29 AM	9:39 AM	9:49 AM
Pawtucket	189.8	2:22 AM	3:07 AM	4:50 AM	5:25 AM	6:05 AM	6:08 AM	7:13 AM	8:11 AM	8:23 AM	8:33 AM	9:44 AM	9:53 AM
Providence	185.3	2:30 AM	3:15 AM		5:32 AM		6:15 AM	7:20 AM	8:18 AM	8:31 AM	8:41 AM	9:51 AM	10:01 AM
Olneyville	183.7	2:30 AM	3:18 AM		5:35 AM		6:18 AM	7:23 AM	8:21 AM	8:34 AM	8:44 AM	9:54 AM	10:04 AM
Cranston	180.2	2:30 AM	3:24 AM		5:40 AM		6:23 AM	7:28 AM	8:26 AM	8:40 AM	8:50 AM	9:59 AM	10:10 AM
Warwick ~ TF Green	176.6	2:30 AM	3:30 AM		5:48 AM		6:31 AM	7:36 AM	8:34 AM	8:46 AM	8:56 AM	10:07 AM	10:16 AM
Wickford	165.8			5:15 AM		6:32 AM							
Boston South Station					**6:40 AM**		**7:19 AM**	**8:16 AM**	**9:23 AM**			**10:55**	
Connecting MBTA Train No.					**802**		**804**	**808**	**812**			**814**	

South (West) Service		RIIS	P&W	MBTA	RIIS	RIIS	P&W	MBTA	RIIS	MBTA	MBTA	RIIS
Station	MP	11	AUTO-2	805	13	15	WODA-2	809	17	8XY	811	19
Woonsocket	201.5	10:30 AM	10:35 AM		12:08 PM	1:30 PM	1:50 PM		2:15 PM			4:24 PM
Cumberland	192.3	10:42 AM	10:51 AM		12:20 PM	1:42 PM	2:06 PM		2:27 PM			4:39 PM
Pawtucket	189.8	10:47 AM	10:55 AM	11:22 AM	12:25 PM	1:46 PM	2:10 PM	2:21 PM	2:32 PM	3:33 PM	4:35 PM	4:44 PM
Providence	185.3	10:54 AM	11:03 AM	11:28 AM	12:32 PM	1:53 PM	2:18 PM	2:27 PM	2:39 PM	3:39 PM	4:41 PM	4:50 PM
Olneyville	183.7	10:57 AM	11:06 AM		12:35 PM	1:56 PM	2:21 PM		2:42 PM			4:53 PM
Cranston	180.2	11:02 AM	11:12 AM		12:40 PM	2:01 PM	2:27 PM		2:47 PM			4:58 PM
Warwick ~ TF Green	176.6	11:10 AM	11:18 AM	11:31 AM	12:48 PM	2:09 PM	2:33 PM	2:30 PM	2:55 PM	3:52 PM	4:52 PM	5:07 PM
Wickford	165.8			11:43 AM				2:42 PM		4:03 PM	5:03 PM	
Boston South Station					**1:38 PM**							
Connecting MBTA Train No.					**816**							

South (West) Service		RIIS	MBTA	RIIS	MBTA	MBTA	RIIS	P&W	RIIS	RIIS	MBTA	RIIS
Station	MP	21	815	23	817	819	25	UNIT-2	27	29	825	31
Woonsocket	201.5	5:32 PM		6:11 PM			7:10 PM	8:02 PM	8:13 PM	8:52 PM		10:05 PM
Cumberland	192.3	5:44 PM		6:23 PM			7:22 PM	8:18 PM	8:25 PM	9:04 PM		10:17 PM
Pawtucket	189.8	5:49 PM	5:59 PM	6:28 PM	6:35 PM	7:05 PM	7:27 PM	8:22 PM	8:30 PM	9:09 PM	10:02 PM	10:22 PM
Providence	185.3	5:56 PM	6:06 PM	6:35 PM	6:42 PM	7:11 PM	7:34 PM	8:30 PM	8:37 PM	9:16 PM	10:09 PM	10:29 PM
Olneyville	183.7	5:59 PM		6:38 PM			7:37 PM	8:33 PM	8:40 PM	9:19 PM		10:32 PM
Cranston	180.2	6:04 PM		6:43 PM			7:42 PM	8:39 PM	8:45 PM	9:24 PM		10:37 PM
Warwick ~ TF Green	176.6	6:12 PM	6:18 PM	6:51 PM	6:53 PM	7:23 PM	7:50 PM	8:45 PM	8:53 PM	9:32 PM	10:21 PM	10:45 PM
Wickford	165.8		6:29 PM		7:05 PM	7:37 PM					10:32 PM	
Boston South Station									**9:33 PM**			
Connecting MBTA Train No.									**826**			

Connections to NB MBTA: 7

Table 5.16:
Preliminary Northbound Weekday Service Schedule for Option 1A
(Showing Intrastate, MBTA South County, and P&W Trains)

North (East) Service		MBTA	RIIS	MBTA	P&W	RIIS	MBTA	RIIS	MBTA	RIIS	RIIS	RIIS	MBTA
Station	MP	804	2	806	AUTO-1	4	808	6	812	8	10	12	816
Boston South Station										8:30 AM			
Connecting MBTA Train No.										803			
Wickford	165.8	5:46 AM		6:12 AM			6:51 AM		7:49 AM				12:03 PM
Warwick ~ TF Green	176.6	5:58 AM	6:02 AM	6:24 AM	6:35 AM	6:47 AM	7:02 AM	7:47 AM	8:01 AM	9:11 AM	10:22 AM	11:47 AM	12:15 PM
Cranston	180.2		6:06 AM		6:41 AM	6:51 AM		7:51 AM		9:15 AM	10:26 AM	11:51 AM	
Olneyville	183.7		6:11 AM		6:47 AM	6:56 AM		7:56 AM		9:20 AM	10:31 AM	11:56 AM	
Providence	185.3	6:08 AM	6:14 AM	6:34 AM	6:50 AM	6:59 AM	7:13 AM	7:59 AM	8:10 AM	9:23 AM	10:34 AM	11:59 AM	12:25 PM
Pawtucket	189.8	6:13 AM	6:21 AM	6:39 AM	6:58 AM	7:06 AM	7:18 AM	8:06 AM	8:16 AM	9:30 AM	10:41 AM	12:06 PM	12:30 PM
Cumberland	192.3		6:26 AM		7:02 AM	7:11 AM		8:11 AM		9:35 AM	10:46 AM	12:11 PM	
Woonsocket	201.5		6:38 AM		7:18 AM	7:27 AM		8:27 AM		9:51 AM	11:02 AM	12:27 PM	

North (East) Service		P&W	P&W	RIIS	P&W	MBTA	P&W	RIIS	RIIS	MBTA	P&W	RIIS
Station	MP	DAWO-1	PR-3	12	Unit-1	820	AUTO-2	14	16	8XX	DAWO-2	18
Boston South Station									3:40 PM			4:35 PM
Connecting MBTA Train No.									811			813
Wickford	165.8					3:03 PM				4:17 PM		
Warwick ~ TF Green	176.6	12:52 PM	11:57 AM	1:10 PM	1:15 PM	3:14 PM	3:22 PM	3:05 PM	4:21 PM	4:29 PM	5:10 PM	5:19 PM
Cranston	180.2	12:58 PM	12:03 PM	1:14 PM	1:21 PM		3:28 PM	3:09 PM	4:25 PM		5:16 PM	5:23 PM
Olneyville	183.7	1:04 PM	1:10 PM	1:19 PM	1:27 PM		3:34 PM	3:14 PM	4:30 PM		5:22 PM	5:28 PM
Providence	185.3	1:07 PM	1:13 PM	1:22 PM	1:30 PM	3:22 PM	3:37 PM	3:17 PM	4:33 PM	4:37 PM	5:25 PM	5:31 PM
Pawtucket	189.8	1:15 PM	1:21 PM	1:29 PM	1:38 PM	3:27 PM	3:45 PM	3:24 PM	4:40 PM	4:42 PM	5:33 PM	5:40 PM
Cumberland	192.3	1:19 PM	1:25 PM	1:34 PM	1:42 PM		3:49 PM	3:29 PM	4:45 PM		5:37 PM	5:45 PM
Woonsocket	201.5	1:35 PM	1:41 PM	1:50 PM	1:58 PM		4:05 PM	3:45 PM	5:01 PM		5:53 PM	6:01 PM

North (East) Service		MBTA	RIIS	*RIIS*	MBTA	P&W	RIIS	RIIS	RIIS	MBTA	RIIS	P&W
Station	MP	822	20	*22*	DH3	DAWO-3	24	26	28	DH4	30	Unit-2
Boston South Station			5:40 PM	*6:10 PM*			7:10 PM	8:15 PM	9:05 PM		10:25 PM	
Connecting MBTA Train No.			817	*819*			821	823	825		827	
Wickford	165.8	5:12 PM			7:30 PM					10:52 PM		
Warwick ~ TF Green	176.6	5:24 PM	6:22 PM	6:59 PM	7:44 PM	7:53 PM	7:58 PM	9:03 PM	9:48 PM		11:08 PM	11:45 PM
Cranston	180.2		6:26 PM	7:03 PM		7:59 PM	8:02 PM	9:07 PM	9:52 PM		11:12 PM	11:51 PM
Olneyville	183.7		6:31 PM	7:08 PM		10:02 PM	8:07 PM	9:12 PM	9:57 PM		11:17 PM	11:57 PM
Providence	185.3	5:34 PM	6:34 PM	7:11 PM		10:04 PM	8:10 PM	9:15 PM	10:00 PM		11:20 PM	12:00 AM
Pawtucket	189.8	5:39 PM	6:41 PM	7:18 PM	7:56 PM	10:12 PM	8:17 PM	9:22 PM	10:07 PM	11:18 PM	11:27 PM	12:08 AM
Cumberland	192.3		6:46 PM	***7:23 PM***		10:16 PM	8:22 PM	9:27 PM	10:12 PM		11:32 PM	12:12 AM
Woonsocket	201.5		7:02 PM	***7:39 PM***		10:32 PM	8:38 PM	9:43 PM	10:28 PM		11:48 PM	12:28 AM
Connections to SB MBTA:	**8**			14 minute connection		Stop @ Cranston Yard (8pm-9:57)						

The corresponding morning peak stringlines based on Table 5.15 are shown in **Figure 5.8**.

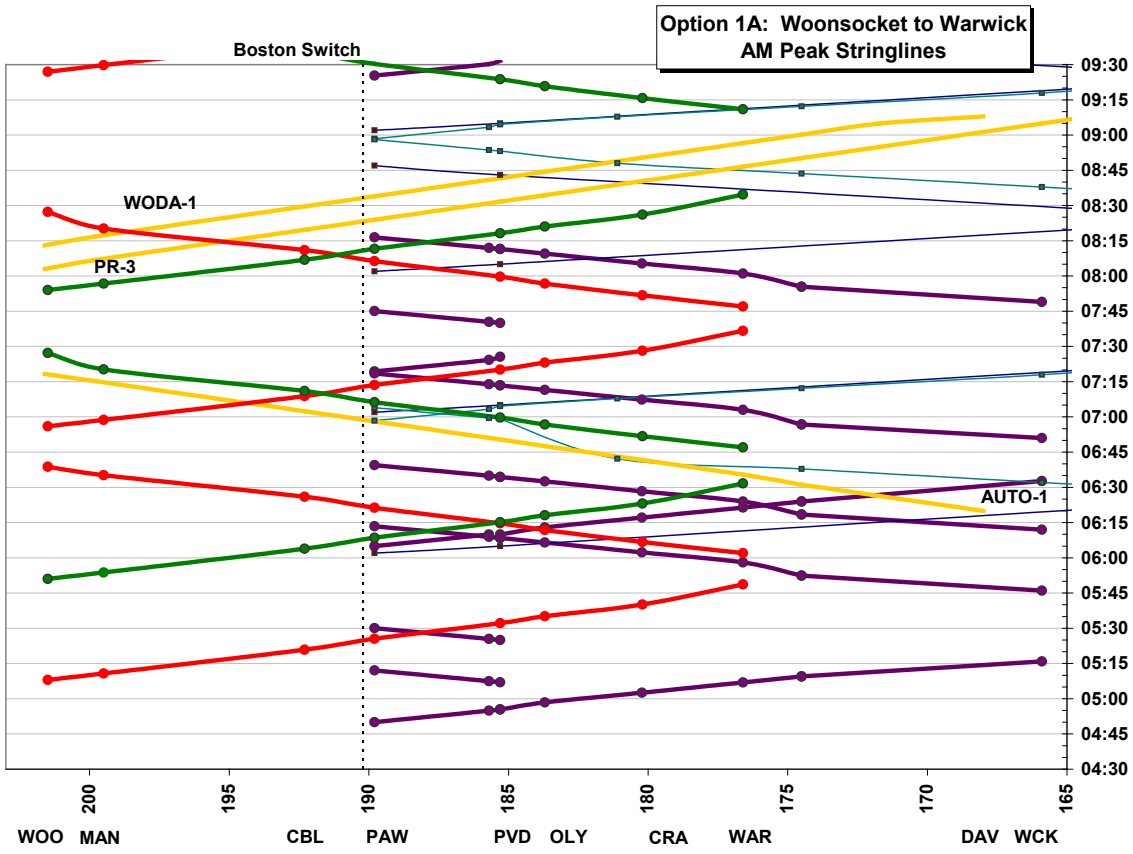


Figure 5.8:
Option 1A 2030 Morning Peak Stringlines

As described in Chapter 2, P&W only specified the hour long time slot for freight in its 2030 operating plan. This provides some operational flexibility with regards to scheduling freight departures. In order to accommodate the MBTA, P&W and intrastate service on the FRIP track, *all* freight movements were scheduled to either follow or precede a passenger, *in the direction* of travel by 5 – 10 minutes.

The process of scheduling trips in this manner is known as fleeting the line. In this case, the line was fleeted for 15.7 miles of single track between the Boston Switch and Packard interlockings. When all movements are clear of the FRIP, the traffic direction is then reversed and the line fleeted in the opposite direction.

By fleeting the line, all intrastate passenger train meets with P&W freight trains occur on the P&W mainline. In Option 1A and 2A, when P&W freight volumes are forecast to double, the remaining 8.4 miles of track between Cumberland and Woonsocket stations that was not double tracked in Option 1 will now be double tracked to accommodate the increased freight traffic. Double tracking the line will eliminate conflicts on the P&W mainline, and will be more cost effective to implement than upgrading the infrastructure on the NEC.

All scheduled service meets between intrastate trains occur either in Providence Station or on the P&W mainline. All P&W freight meets occur on the P&W mainline or south of Packard interlocking. In this area, the NEC is double tracked with adequate clearances provided for freight service.

Despite the recommended infrastructure enhancements, unforeseen events may cause service perturbations that would disrupt normal operations. Under such circumstances, the NEC's track configuration would allow the Amtrak dispatcher to route intrastate trains off of the FRIP onto Tracks 1 and 2 to bypass the disruption should such measures prove necessary.

Conflicts

To fleet the FRIP track and not create conflicts with Amtrak, MBTA, P&W or intrastate service, one adjustment to P&W freight service is required.

P&W's DAWO-1 timeslot has been adjusted to operate earlier in the 12 – 1 pm window from the 1 – 2pm window. This change will enable the FRIP to be fleeted in the eastbound direction and not interfere with PR-3 which is understood to have a 1 hour stop Cranston Yard (see Chapter 2) and is currently scheduled to leave Cranston Yard at 1:04 PM. This change will not create a conflict with Amtrak or MBTA service.

No additional infrastructure requirements above and beyond those described in Option 1 are needed to resolve any of conflicts on the Northeast Corridor.

Like the other options, only weekday schedules were developed. It was assumed that weekend service is 50% of weekday service.[8] **Table 5.13** shows a preliminary weekday service schedule for Option 4.

Table 5.17:
Summary of Option 1A Weekly Service Characteristics

	Route Miles	Daily Trips	Daily Rev. Miles	Daily Rev. Hours	Consists in Service
Weekday Service	24.9	32	797	33:10	2
Weekend Service	24.9	16	398	16:35	1
		Weekly	***4,781***	199:00	

[8] Using MBTA schedules effective in December 2008 on the Providence line, the ratio of Saturday trips to weekday trips was calculated to be 0.60 (18 trips / 30 trips). The ratio of Sunday trips to weekday trips was calculated to be 0.47 (14 trips / 30 trips). The average of these two ratios is 0.53 (rounded to 0.50), and was used to estimate weekend service statistics.

Option 2A: Option 2 at 2030 Amtrak and P&W Service Levels

Option 2A is the same as Option 2 with MBTA service to Cranston, except it fully incorporates the P&W's and Amtrak's 2030 operating plans. **Figure 5.7** shows a map of the proposed route and **Table 5.14** for a list of stations served by the RIIS and MBTA.

Table 5.18:
Option 2A Stations Served

Stations	RI Intrastate	MBTA
Woonsocket	x	
Cumberland	x	
Pawtucket	x	x
Providence	x	x
Olneyville	x	
Cranston	x	x
Warwick	x	x

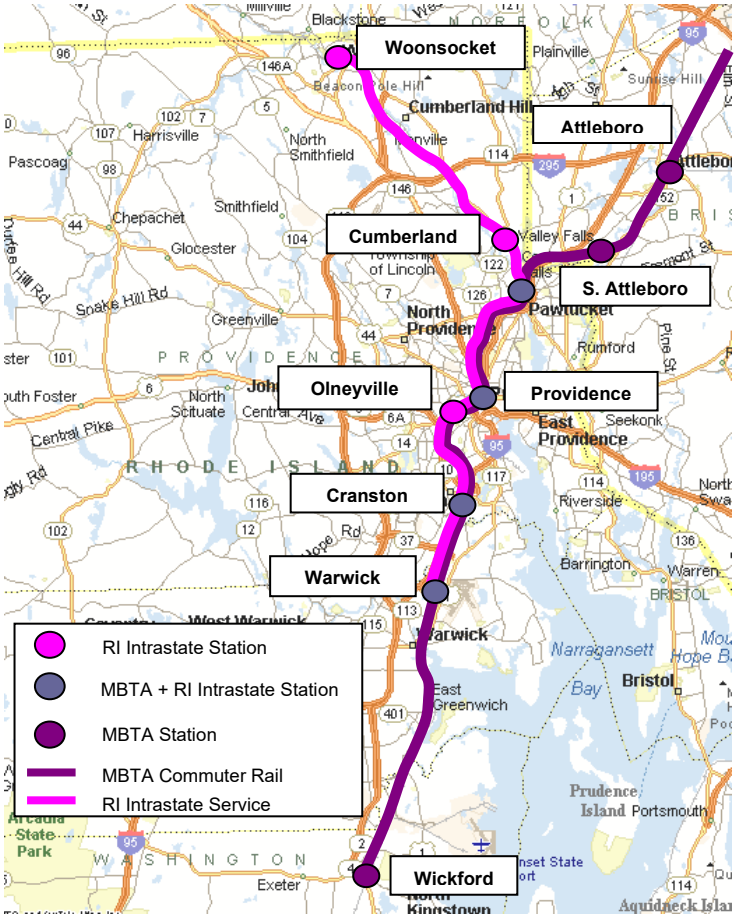


Figure 5.9:
Map of the Proposed Option 3 Route

Schedule and Service Design – The sketch operating plan for Option 2A is identical to the operating plan described in Option 1A. See Table 5.13 for the Option 2A schedule.

The corresponding morning peak stringlines based on Table 5.13 and **Table 5.16** are shown in Figure 5.10.

As in Option 1A, operation on the FRIP track has been fleeted so that no conflicts occur with MBTA, P&W, or intrastate service. The same changes to eliminate conflicts on the NEC are used for Option 2A

Table 5.19:
Preliminary Southbound Weekday Service Schedule for Option 2A
(Showing Intrastate, MBTA South County, and P&W Trains)

South (West) Service		P&W	P&W	MBTA	RIIS	MBTA	RIIS	RIIS	RIIS	P&W	P&W	RIIS	P&W
Station	MP	WODA-3	AUTO-1	DH1	1	DH2	3	5	7	PR-3	WODA-1	9	UNIT-1
Woonsocket	201.5	2:02 AM	2:47 AM		5:08 AM		5:52 AM	6:57 AM	7:54 AM	8:03 AM	8:13 AM	9:27 AM	9:33 AM
Cumberland	192.3	2:18 AM	3:03 AM		5:20 AM		6:04 AM	7:09 AM	8:06 AM	8:19 AM	8:29 AM	9:39 AM	9:49 AM
Pawtucket	189.8	2:22 AM	3:07 AM	4:50 AM	5:25 AM	6:05 AM	6:09 AM	7:14 AM	8:11 AM	8:23 AM	8:33 AM	9:44 AM	9:53 AM
Providence	185.3	2:30 AM	3:15 AM		5:32 AM		6:16 AM	7:21 AM	8:18 AM	8:31 AM	8:41 AM	9:51 AM	10:01 AM
Olneyville	183.7	2:30 AM	3:18 AM		5:35 AM		6:19 AM	7:24 AM	8:21 AM	8:34 AM	8:44 AM	9:54 AM	10:04 AM
Cranston	180.2	2:30 AM	3:24 AM		5:40 AM		6:24 AM	7:29 AM	8:26 AM	8:40 AM	8:50 AM	9:59 AM	10:10 AM
Warwick ~ TF Green	176.6	2:30 AM	3:30 AM		5:48 AM		6:32 AM	7:37 AM	8:34 AM	8:46 AM	8:56 AM	10:07 AM	10:16 AM
Wickford	165.8			5:15 AM		6:32 AM							
Boston South Station					**6:40 AM**		**7:19 AM**	**8:16 AM**	**9:23 AM**			**10:55**	
Connecting MBTA Train No.					**802**		**804**	**808**	**812**			**814**	

South (West) Service		RIIS	P&W	MBTA	RIIS	RIIS	P&W	MBTA	RIIS	MBTA	MBTA	RIIS
Station	MP	11	AUTO-2	805	13	15	WODA-2	809	17	8XY	811	19
Woonsocket	201.5	10:30 AM	10:35 AM		12:09 PM	1:30 PM	1:50 PM		2:15 PM			4:25 PM
Cumberland	192.3	10:42 AM	10:51 AM		12:21 PM	1:42 PM	2:06 PM		2:27 PM			4:40 PM
Pawtucket	189.8	10:47 AM	10:55 AM	11:22 AM	12:26 PM	1:46 PM	2:10 PM	2:21 PM	2:32 PM	3:33 PM	4:35 PM	4:45 PM
Providence	185.3	10:54 AM	11:03 AM	11:28 AM	12:33 PM	1:53 PM	2:18 PM	2:27 PM	2:39 PM	3:39 PM	4:41 PM	4:51 PM
Olneyville	183.7	10:57 AM	11:06 AM		12:36 PM	1:56 PM	2:21 PM		2:42 PM			4:54 PM
Cranston	180.2	11:02 AM	11:12 AM	11:28 AM	12:41 PM	2:01 PM	2:27 PM	2:27 PM	2:47 PM	3:47 PM	4:49 PM	4:59 PM
Warwick ~ TF Green	176.6	11:10 AM	11:18 AM	11:31 AM	12:49 PM	2:09 PM	2:33 PM	2:30 PM	2:55 PM	3:53 PM	4:55 PM	5:08 PM
Wickford	165.8			11:44 AM				2:43 PM		4:04 PM	5:08 PM	
Boston South Station					**1:38 PM**							
Connecting MBTA Train No.					**816**							

South (West) Service		RIIS	MBTA	RIIS	MBTA	MBTA	RIIS	P&W	RIIS	RIIS	MBTA	RIIS
Station	MP	21	815	23	817	819	25	UNIT-2	27	29	825	31
Woonsocket	201.5	5:35 PM		6:10 PM			7:10 PM	8:02 PM	8:13 PM	8:49 PM		10:05 PM
Cumberland	192.3	5:47 PM		6:22 PM			7:22 PM	8:18 PM	8:25 PM	9:01 PM		10:17 PM
Pawtucket	189.8	5:52 PM	5:59 PM	6:27 PM	6:35 PM	7:05 PM	7:27 PM	8:22 PM	8:30 PM	9:06 PM	10:02 PM	10:22 PM
Providence	185.3	5:59 PM	6:06 PM	6:34 PM	6:42 PM	7:11 PM	7:34 PM	8:30 PM	8:37 PM	9:13 PM	10:09 PM	10:29 PM
Olneyville	183.7	6:02 PM		6:37 PM			7:37 PM	8:33 PM	8:40 PM	9:16 PM		10:32 PM
Cranston	180.2	6:07 PM	6:12 PM	6:42 PM	6:49 PM	7:19 PM	7:42 PM	8:39 PM	8:45 PM	9:21 PM	10:25 PM	10:37 PM
Warwick ~ TF Green	176.6	6:15 PM	6:18 PM	6:50 PM	6:53 PM	7:25 PM	7:50 PM	8:45 PM	8:53 PM	9:29 PM	10:21 PM	10:45 PM
Wickford	165.8		6:29 PM		7:05 PM	7:38 PM					10:32 PM	
Boston South Station									**9:33 PM**			
Connecting MBTA Train No.									**826**			

Connections to NB MBTA: 7

Table 5.20:
Preliminary Northbound Weekday Service Schedule for Option 2A
(Showing Intrastate, MBTA South County, and P&W Trains)

North (East) Service		MBTA	RIIS	MBTA	P&W	RIIS	MBTA	RIIS	MBTA	RIIS	RIIS	RIIS	MBTA
Station	MP	804	2	806	AUTO-1	4	808	6	812	8	10	12	816
Boston South Station										8:30 AM			
Connecting MBTA Train No.										803			
Wickford	165.8	5:46 AM		6:12 AM			6:51 AM		7:49 AM				12:03 PM
Warwick ~ TF Green	176.6	5:58 AM	6:03 AM	6:24 AM	6:35 AM	6:47 AM	7:02 AM	7:47 AM	8:01 AM	9:11 AM	10:22 AM	11:47 AM	12:15 PM
Cranston	180.2	6:03 AM	6:07 AM	6:29 AM	6:41 AM	6:51 AM	7:08 AM	7:51 AM	8:05 AM	9:15 AM	10:26 AM	11:51 AM	12:20 PM
Olneyville	183.7		6:12 AM		6:47 AM	6:56 AM		7:56 AM		9:20 AM	10:31 AM	11:56 AM	
Providence	185.3	6:09 AM	6:15 AM	6:35 AM	6:50 AM	6:59 AM	7:14 AM	7:59 AM	8:11 AM	9:23 AM	10:34 AM	11:59 AM	12:26 PM
Pawtucket	189.8	6:14 AM	6:22 AM	6:40 AM	6:58 AM	7:06 AM	7:19 AM	8:06 AM	8:16 AM	9:30 AM	10:41 AM	12:06 PM	12:31 PM
Cumberland	192.3		6:27 AM		7:02 AM	7:11 AM		8:11 AM		9:35 AM	10:46 AM	12:11 PM	
Woonsocket	201.5		6:43 AM		7:18 AM	7:27 AM		8:27 AM		9:51 AM	11:02 AM	12:27 PM	

North (East) Service		P&W	P&W	RIIS	P&W	MBTA	RIIS	P&W	RIIS	MBTA	P&W	RIIS
Station	MP	DAWO-1	PR-3	12	Unit-1	820	14	AUTO-2	16	8XX	DAWO-2	18
Boston South Station									3:40 PM			4:35 PM
Connecting MBTA Train No.									811			813
Wickford	165.8					3:03 PM				4:17 PM		
Warwick ~ TF Green	176.6	12:52 PM	11:57 AM	1:10 PM	1:15 PM	3:15 PM	3:19 PM	3:22 PM	4:21 PM	4:29 PM	5:10 PM	5:19 PM
Cranston	180.2	12:58 PM	12:03 PM	1:14 PM	1:21 PM	3:20 PM	3:23 PM	3:28 PM	4:25 PM	4:34 PM	5:16 PM	5:23 PM
Olneyville	183.7	1:04 PM	1:10 PM	1:19 PM	1:27 PM		3:28 PM	3:34 PM	4:30 PM		5:22 PM	5:28 PM
Providence	185.3	1:07 PM	1:13 PM	1:22 PM	1:30 PM	3:26 PM	3:31 PM	3:37 PM	4:33 PM	4:40 PM	5:25 PM	5:31 PM
Pawtucket	189.8	1:15 PM	1:21 PM	1:29 PM	1:38 PM	3:31 PM	3:38 PM	3:45 PM	4:40 PM	4:45 PM	5:33 PM	5:40 PM
Cumberland	192.3	1:19 PM	1:25 PM	1:34 PM	1:42 PM		3:43 PM	3:49 PM	4:45 PM		5:37 PM	5:45 PM
Woonsocket	201.5	1:35 PM	1:41 PM	1:50 PM	1:58 PM		3:59 PM	4:05 PM	5:01 PM		5:53 PM	6:01 PM

North (East) Service		MBTA	RIIS	*RIIS*	MBTA	RIIS	RIIS	RIIS	P&W	RIIS	MBTA	P&W
Station	MP	822	20	*22*	DH3	24	26	28	DAWO-3	30	DH4	Unit-2
Boston South Station			5:40 PM	*6:10 PM*		7:10 PM	8:15 PM	9:05 PM		10:25 PM		
Connecting MBTA Train No.			817	*819*		821	823	825		827		
Wickford	165.8	5:12 PM			7:30 PM						10:52 PM	
Warwick ~ TF Green	176.6	5:24 PM	6:22 PM	6:59 PM		7:58 PM	9:00 PM	9:48 PM	7:53 PM	11:09 PM		11:45 PM
Cranston	180.2	5:29 PM	6:26 PM	7:03 PM		8:02 PM	9:04 PM	9:52 PM	7:59 PM	11:13 PM		11:51 PM
Olneyville	183.7		6:31 PM	7:08 PM		8:07 PM	9:09 PM	9:57 PM	10:02 PM	11:18 PM		11:57 PM
Providence	185.3	5:35 PM	6:34 PM	7:11 PM		8:10 PM	9:12 PM	10:00 PM	10:04 PM	11:21 PM		12:00 AM
Pawtucket	189.8	5:40 PM	6:41 PM	7:18 PM	7:56 PM	8:17 PM	9:19 PM	10:07 PM	10:12 PM	11:28 PM	11:18 PM	12:08 AM
Cumberland	192.3		6:46 PM	***7:23 PM***		8:22 PM	9:24 PM	10:12 PM	10:16 PM	11:33 PM		12:12 AM
Woonsocket	201.5		7:02 PM	***7:39 PM***		8:38 PM	9:40 PM	10:28 PM	10:32 PM	11:49 PM		12:28 AM
Connections to SB MBTA:	8			14 minute connection					Stop @ Cranston Yard (8pm-9:57)			

In addition to eliminating conflicts on the FRIP, fleeting the FRIP now allows for all MBTA trains to call on Cranston without any additional infrastructure improvements. As noted in Option 2, there was one inbound trip (MBTA #806) and one outbound trip (MBTA #819) that were unable to call on Cranston without requiring infrastructure upgrades to Track 1 and Track 3. By fleeting the track, these two trips can now stop at Cranston.

To minimize delays, any service perturbations would be handled the same as in Option 1A.

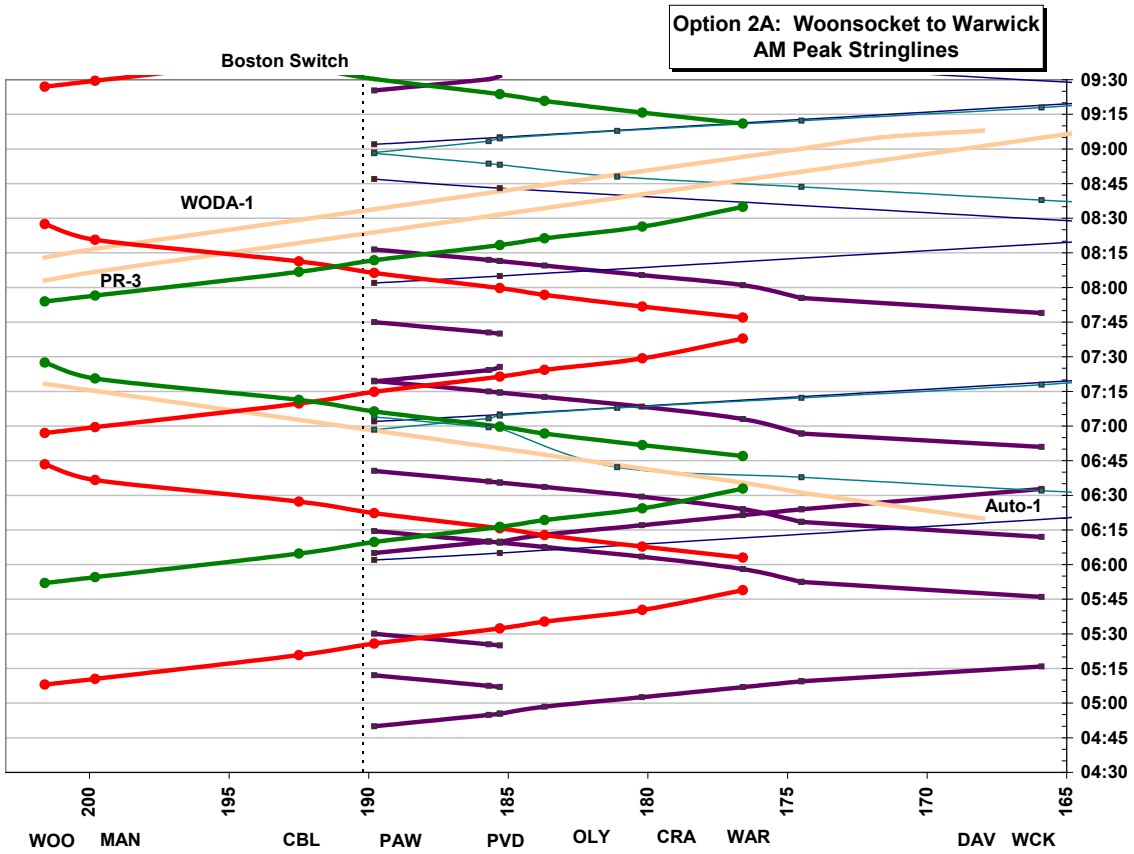


Figure 5.10:
Option 2A 2030 Morning Peak Stringlines

Like Option 4, all intrastate service meets occur either in Providence Station or on the P&W mainline. All freight meets occur either on the P&W mainline or between Packard and Davisville interlockings.

A minimum turn time of ten minutes is used at each terminal station.

Conflicts

The conflicts for Option 2A are the same as in Option 1A. Please see the Option 1A conflicts for more information.

Since only weekday schedules were developed, it was assumed that weekend service is 50% of weekday service.[9] **Table 5.13** shows a preliminary weekday service schedule for Option 4.

[9] Using MBTA schedules effective in December 2008 on the Providence line, the ratio of Saturday trips to weekday trips was calculated to be 0.60 (18 trips / 30 trips). The ratio of Sunday trips to weekday trips was calculated to be 0.47 (14 trips / 30 trips). The average of these two ratios is 0.53 (rounded to 0.50), and was used to estimate weekend service statistics.

Table 5.21: Summary of Option 2A Weekly Service Characteristics					
	Route Miles	**Daily Trips**	**Daily Rev. Miles**	**Daily Rev. Hours**	**Consists in Service**
Weekday Service	24.9	32	797	33:10	2
Weekend Service	24.9	16	398	16:35	1
		Weekly	***4,781***	199:00	

Comparison of the Service Options

Table 5.22 lists the number trips each service scenario provides to connecting MBTA service in, Pawtucket and the number of trips to Providence, Cranston, Warwick and Woonsocket.

Options 1 and 2 provide 34 intrastate trips to Providence each day and have 17 connections with MBTA Boston service (eight for northbound and nine for southbound MBTA service). Option 3 provides the most trips to Providence of any of the service options at 58 trips per day. It also provides the most MBTA connections with 24 per day (12 for northbound MBTA service and 12 for southbound MBTA service.) However, ⅓ of all trips terminate in Providence and do not run through to Warwick.

Options 1A and 2A provide 32 trips to Providence each day and have 15 connections with MBTA Boston service (seven for northbound and eight for southbound MBTA service). The smaller number of trips in these options reflects the increased volume of P&W freight traffic projected to operate on the line using the FRIP. Consequently, one midday roundtrip was eliminated from the schedule to accommodate the increase in traffic.

Table 5.22: Intrastate Service Overview							
Option No.	**Weekday Intrastate Trains**	**Weekday Service to Woonsocket**	**Weekday Trains Serving Providence**	**Weekday Trains Serving Cranston**	**Weekday Trains Serving Warwick**	**Woonsocket Connections for Boston Service**	**MBTA Connections for Woonsocket Service**
Option 1	34	17	34	34	17	8	9
Option 2	34	17	34	34	17	8	9
Option 3	58	29	58	42	21	12	12
Option 1A	32	16	32	32	16	7	8
Option 2A	32	16	32	32	16	7	8

The increase of intrastate traffic on total train traffic in RI would be substantial. The increase in traffic would be most substantial at Providence Station. Without the implementation of intrastate service, 68 trains will call on Providence each weekday (Amtrak and MBTA trains) by 2010. In Options 1 and 2, 102 trains would stop at Providence each weekday. In Options 1A and 2A, up to 114 trains would stop at Providence each weekday.

Table 5.23:
Total Trains Serving Major Destinations

Option No.	Weekday Intrastate Trains Operated	Amtrak Trains Serving Providence	MBTA Trains Serving Providence	Total Trains Serving Providence [10]	MBTA Trains Serving Cranston	Total Trains Serving Cranston [11]	MBTA Trains Serving Warwick	Total Trains Serving Warwick [12]
Baseline (2010)	0	36	32	68	0	0	16	16
Option 1	34	36	32	102	0	34	16	50
Option 2	34	36	32	102	14	48	16	50
Option 1A	32	50	32	114	0	32	16	48
Option 2A	32	50	32	114	16	48	16	48

Recommended Service Options

As previously mentioned, Option 3 will not be formally evaluated. A preliminary review of Option 3 sketch operating plans, the infrastructure upgrades needed to support each option and the line capacity of confirmed the study team's decision to not evaluate Option 3. Only Option 1, Option 2, Option 1A, and Option 2A will be evaluated.

[10] Amtrak, MBTA and Intrastate Trains
[11] MBTA and Intrastate trains
[12] MBTA and Intrastate

THIS PAGE LEFT INTENTIONALLY BLANK

CHAPTER 6: RIDERSHIP AND REVENUE

This chapter reviews previous forecasts for new commuter rail services to be offered in the corridor then provides an integrated forecast of ridership and revenue for the proposed intrastate commuter rail service linking Woonsocket, Providence and Warwick.

Previous Forecasts

Woonsocket-Providence Forecasts

The 2007 Woonsocket Commuter Rail Feasibility Study ridership forecasts are summarized below in Table 6.1.

Table 6.1:
Forecast 2030 Weekday Inbound Boardings by Station[1]

Station	To Providence	To Boston	Total
Woonsocket	121	158	279
Manville	32	28	60
Berkeley	323	25	348
Pawtucket	445	NA	445
Total	921	211	1,132

South County Commuter Rail Extension

RIDOT is presently working with the MBTA and Amtrak to extend Providence Commuter Rail service southward 19 miles to serve stations at Warwick (Airport) and Wickford Junction. Two forecasts of future ridership have been prepared for that service.

Table 6.2:
Warwick Station 2020 Commuter Rail Forecasts: Weekday Northbound Boardings

	VHB (2001)	CSI (1995)
To Providence	398	141
To Boston	296	105
Total	694	246

Source: Edwards and Kelcey **South County Commuter Rail Ridership: Briefing Paper** January 2002 Page 29

The older and more conservative CSI forecasts have been employed for the purpose of financing the South County Extension. The newer and more aggressive VHB forecasts are shown here because the sketch planning methodology employed by VHB is essentially the same as the method employed to derive the 2007 Woonsocket forecasts and the updated forecasts presented here.

[11] Jacobs Edwards and Kelcey. (2007) *Woonsocket Commuter Rail Feasibility Study*. Prepared for the City of Woonsocket, pp. 33 – 34.

Warwick Airport Traffic
In addition to the commuter travel forecast above, T.F. Green Airport is expected to be an independent travel generator for the Warwick Station. The last forecast of that potential traffic was prepared in 1998. The 1998 forecast assumed that Warwick would be served by ten daily MBTA trains, twenty daily intrastate trains, and half of all Amtrak trains passing the station.

Table 6.3:
2020 Airport Boardings Forecasts[2]

	MBTA and RI Rail Services	Amtrak	Total
Air Passengers	23	76	99
Airport Employees	200	0	200
Total	223	76	299

Woonsocket-Providence – Warwick Forecasts

New Mobility Options
The proposed intrastate service providing 16 or 17 round trips per day between Woonsocket and Warwick (*with 15 to 17 daily connections for MBTA commuter rail servic*e) would create several new or enhanced mobility options for Rhode Island travelers compared with current plans.

1. A higher frequency of passenger rail service would be offered between Warwick and Providence up from 16 trains per weekday to 48 to 50 trains per weekday.

2. New commuter rail service to Providence would be offered from new stations in Cranston and Olneyville (32 to 34 trains per weekday)

3. A new option for rail travel between Woonsocket and Cumberland Stations and T. F. Green Airport would be created. (32 to 34 trips per weekday)

4. Direct MBTA commuter rail service from Cranston to Boston could be offered. (14 to 16 trips per weekday)

The forecasts presented below reflect the anticipated ridership response to these new travel opportunities.

New Market Outlook
The forecasts also represent adjustments to previous forecasts to reflect changed market outlooks since the earlier forecasts were prepared. Changed market conditions reflected in the updated forecasts include:

[2] Edwards and Kelcey. (May 1999). *Warwick Intermodal Station at T.F. Green Airport, Warwick, Rhode Island: Environmental Assessment.* Prepared for United States Department of Transportation, Federal Highway Administration, and the Rhode Island Department of Transportation. Derived from tables presented on pages A-9 and A-10.

1. Higher average automotive fuel prices since preparation of the 2007 Woonsocket forecasts (up 10%)

2. Elimination of proposed Manville and Berkeley Stations

3. Addition of proposed Cumberland Station
4. Higher than anticipated growth of air traffic at T.F. Green Airport (58% higher than 1998 forecasts)

5. Revised assumptions concerning intrastate fares to be consistent with plans for MBTA Warwick to Providence service. (Intrastate service offered at MBTA interzone fare rather than full fare to Boston).

6. Various minor adjustments in service frequencies and speeds from earlier forecasts

7. Elimination of anticipated direct Amtrak service to Warwick.

Integrated Ridership Forecast
Table 6.4 below details the forecast 2030 weekday intrastate service boardings for all service options developed in this report.

Table 6.4:
2030 Forecast Intrastate Service: Inbound Weekday Boardings by Station

	To Providence	To Boston	Air Travelers	Airport Employees	Total Boardings
Woonsocket	197	222			419
Cumberland	357	16			373
Pawtucket	456				456
Providence	NA	NA		NA	NA
Olneyville	40				40
Cranston[3]	571	212[4]			783
Warwick	495[5]		89[6]	344[7]	928
Totals (Options 1 & 1A)	2,116	238	89	344	2,787
Totals (Options 2 & 2A)	2,116	450	89	344	2,999

Discussion
Overall, the 2030 forecast for expanded intrastate service would be approximately 2,800 weekday riders. Total forecast boardings for the mix of intrastate and MBTA trains

[3] In Option 2, this travel flow would be served by a mix of ~16 MBTA and ~32 intrastate trains.
[4] Forecast for new direct MBTA service to Boston. No intrastate passengers to Boston
[5] This travel flow would be served by a mix of 16 MBTA and ~32 intrastate trains. The 495 passengers would be in addition to the 398 forecast for MBTA service only.
[6] Does not include the 83 air travelers that would use the MBTA for travel to Boston.
[7] It is assumed that all airport employees would use the intrastate service.

serving the line would be in the range of 5,600 to 6,000 passenger trips. Compared with earlier estimates the new ridership forecasts are somewhat greater.

Forecast overall ridership from the northern leg of the service (Woonsocket to Pawtucket) increased 10% from 1,132 boardings in 2007 to 1,248 total boardings due two factors:

1. ~10% higher automobile driving costs due to fuel increases
2. Lower fares for travel on the intrastate service to maintain consistency with intrastate fares that are planned for the Warwick and Wickford Junction services that will open in 2011.

Forecast travel by airport employees is increased to reflect higher levels of airport activity than had been forecast in 1998. *It is expected that all of this employee travel would be carried on intrastate trains.*

Forecast travel by air travelers is increased to reflect

1. Higher levels of airport activity than had been forecast in 1998,
2. More attractive intrastate service than had been under consideration in 1998
3. More attractive MBTA service than had been assumed in 1998.

The airport travelers would use a mix of MBTA and intrastate service.

Forecast travel of 893 commuter boardings from Warwick to Providence includes travel on mix of MBTA and intrastate trains. The previous high forecast had been 398 boarding for MBTA service only. The addition of 32 to 34 additional intrastate trains would be expected to stimulate ridership further ridership as the station would be served by up to 50 passenger trains per day between Providence and Warwick. *These trips would be served by a mix of MBTA and intrastate trains.*

The forecast travel for the five miles between Cranston and Providence is consistent in scale with the forecasts for travel between is consistent in scale with forecasts for travel from Woonsocket, Cumberland and Pawtucket.

The modest travel forecast for the two mile trip from Olneyville to Providence is not unexpected due the short distance between this urban neighborhood and downtown Providence.

Assuming the intrastate service would carry two-thirds of all intrastate commuters served by both MBTA and intrastate trains, the total daily commuter flow to Providence on the intrastate service would be in the range of 5,380 to 5,757. Assuming that half the air passengers would use the MBTA service and that half would use the intrastate service, number of air travelers on the intrastate service would be 89. It is assumed that all airport employees would use the intrastate service. Under these assumptions the total intrastate ridership would entail ~5,500 to 6,000 weekday boardings.

If it is assumed that one-third of the intrastate travelers would travel in the peak hour and that all of the airport employees using the service would live north of Providence, the

peak load point on the service would between Pawtucket and Providence with a peak hourly flow of approximately 450 passengers.

Details on development of the ridership forecasts are presented in Appendix A of this report.

Estimated Revenue

The expected revenues were estimated using ridership forecasts and the current MBTA zonal and interzone fare structure. Annual revenue estimates are based on the MBTA service schedule in February 2009. Accordingly, there are 250 weekday, 52 Saturday and 63 Sunday service days (includes holidays). Saturday ridership was estimated to be 20% of weekday ridership and Sunday ridership was estimated to be 15% of weekday.[8]

For trips to Boston from north of Pawtucket, a Zone 9 fare is used.[9] The average fare revenue from Zone 9 to Boston, which accounts for passengers traveling with discounted passes, is estimated at 80% of a one-way fare. A Zone 8 one-way ticket is $8.25. The estimated fare revenue is $6.60.[10]

The revenue associated with air travelers between Warwick and Providence was assumed to be the cost of a full interzone Zone 1 fare ($2.25).

For commuter trips within Rhode Island, the fare structure was modeled after the MBTA interzone fare structure that will be employed for South County service and is shown in Table 6.5. The fare revenue for the interzone fares was also assumed to be 80% of the cost of a one-way interzone ticket.

Table 6.5:
Estimated Fare Revenue per Passenger

	To Providence			To Boston			Air Travelers			Airport Employees		
Station	**Zone**	**Fare**	**Rev.**	**Zone**	**Fare**	**Rev.**	**Zone**	**Fare**	**Rev.**	**Zone**	**Fare**	**Rev.**
Woonsocket	5	$3.00	$2.40	9	$8.25	$6.60				8	$4.50	$3.60
Cumberland	2	$2.25	$1.80	9	$8.25	$6.60				5	$3.00	$2.40
Pawtucket	1	$1.70	$1.36							4	$2.75	$2.20
Providence							2	$ 2.25	$ 2.25[11]			
Olneyville	1	$1.70	$1.36									
Cranston	2	$2.25	$1.80	9	$8.25	$6.60						
Warwick	2	$2.25	$1.80									

[8]Jacobs Edwards and Kelcey. (2007) *Woonsocket Commuter Rail Feasibility Study, Task 2: Ridership Forecasts.* Prepared for the City of Woonsocket, pp. 29

[9] KKO and Associates, LLC (Sep 2003). Pawtucket/Central Falls Rail Station, Draft, Stage 2: Ridership Forecasts. Prepared for Pawtucket Foundation: Pawtucket, RI.

[10] MBTA Railroad Operations (FY2009). Average Fare Calculation. MBTA: Boston, MA.

[11] The full interzone fare

Table 6.6:
One-way Fares to Providence and Pawtucket, Annual Inbound Boardings and Revenue

		Annual Inbound Boardings				Fares and Zone Used									
						Providence		Boston		Air Travelers		Airport Employees			
	Station	To Providence	To Boston	Air Travelers	Airport Employees	Zone	Fare Rev.	Zone	Fare Rev.	Zone	Fare Rev.	Zone	Fare Rev.	Annual RI Revenue	Annual MBTA Revenue
Option 1 and 1A	Woonsocket	53,160	59,907		30,943	5	$2.40	9	$6.60			8	$3.60	$533,655	$790,768
	Cumberland	96,336	4,318		30,943	2	$1.80	9	$6.60			5	$2.40	$532,468	$56,992
	Pawtucket	123,052			30,943	1	$1.36					4	$2.20	$563,951	
	Providence			24,017		-				1	$2.25	2		$108,075	
	Olneyville	10,794				1	$1.36					2		$34,541	
	Cranston	154,084				2	$1.80					1		$554,704	
	Warwick	133,576				2	$1.80					-		$480,873	
	Totals	571,003	64,224	24,017	92,828									$2,808,266	$ 847,761
											RI & MBTA Total				**$3,656,027**
Option 2 and 2A	Woonsocket	53,160	59,907		30,943	5	$2.40	9	$6.60			8	$3.60	$533,655	$790,768
	Cumberland	96,336	4,318		30,943	2	$1.80	9	$6.60			5	$2.40	$532,468	$56,992
	Pawtucket	123,052			30,943	1	$1.36					4	$2.20	$563,951	
	Providence			24,017		-				1	$2.25	2	$1.80	$108,075	
	Olneyville	10,794				1	$1.36					2	$1.80	$34,541	
	Cranston	154,084	57,208			2	$1.80	9	$6.60			1	$1.36	$554,704	$498,398
	Warwick	133,576				2	$1.80					-		$480,873	
	Totals	571,003	121,433	24,017	92,828									$2,808,266	$ 1,346,159
											RI & MBTA Total				**$ 4,154,425**

Based on the fares shown above in Table 6.5, Rhode Island's estimated annual fare revenue for Options 1 and 1A is $2.8 million. Since the service would offer a connection to MBTA service to Boston, the MBTA would derive $0.8 million in annual revenue for new trips on MBTA services, where the entire fare between Pawtucket and Boston is retained by the MBTA. Total combined passenger revenue for RIIS and MBTA would be approximately $3.7 million.

For Options 2 and 2A, Rhode Island's estimated annual fare revenue is also $2.8 million. However, since the MBTA will now stop at Cranston in addition to the intrastate service, the MBTA revenue is estimated to increase to $1.3 million. The total combined passenger revenue for RIIS and MBTA would be approximately $4.2 million.

Parking fees are not included in the fare revenue estimation.

CHAPTER 7: INFRASTRUCTURE AND ROLLING STOCK REQUIREMENTS

P&W Mainline Infrastructure Requirements: Option's 1 & 2

Track Work and Upgrades

A series of track upgrades and improvements along the P&W mainline would be needed to offer intrastate commuter rail service. Figure 7.1 illustrates the required infrastructure upgrades (shown in red) for intrastate service.

In Woonsocket, the extant Woonsocket Station would need to be converted into a two track station with an island platform. One track would be a stub-end track located on the western side of the platform, and the east side of the platform would be the obstruction free path for P&W freight movements through the station. It is estimated that 0.1 miles of new track is required.

Between Titus Street and the Cumberland Station, there will be two through tracks providing a platform free route around Valley Falls Freight Yard. To accommodate two tracks in this area without acquiring land, Yard Track 1 would need to be converted into a mainline track. It is not anticipated that this would cause any operational or logistical problems for the P&W since Valley Falls is currently an eight track yard and many of the existing tracks could be lengthened within the existing

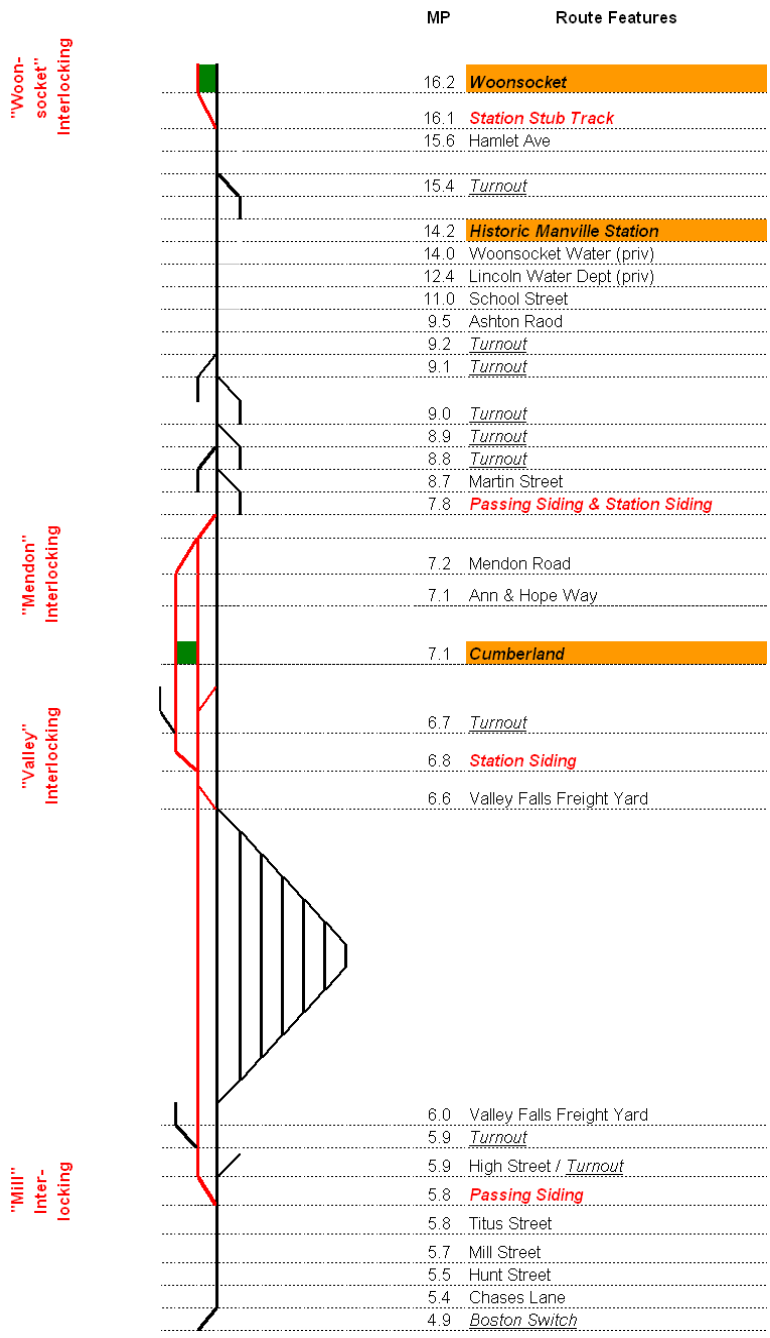


Figure 7.1:
Option 1 and Option 2 Required Track Upgrades along P&W Mainline

right-of-way. The mainline would be double tracked through Cumberland Station to approximately 0.6 miles north of Mendon Road. This will provide 2.2 miles of double tracked mainline.

Double tracking the mainline in this vicinity would provide both the P&W and intrastate trains with additional operational flexibility. It would also enable passenger movements to bypass the Valley Falls Yard and not interfere with P&W freight operations. Meets between intrastate trains and P&W freight trains could now occur in this vicinity.[1]

To allow intrastate meets at Cumberland Station, while providing the P&W an obstruction free route through Cumberland, a one mile station siding would be required at Cumberland Station. A passing siding of this length will allow commuter trains to approach Cumberland Station at track speed.

A full crossover would be required north of the Valley Falls Yard but south of Cumberland Station. The full crossover would provide intrastate service with additional operational flexibility and allow P&W access to the turnout near MP 6.7.

A total of 11.9 miles of single track will need to be upgraded to allow for 60 mph speeds.[2] Approximately 2.2 miles of new track will need to be constructed in the vicinity of Cumberland Station, and 0.1 miles of new track for the terminal stub at Woonsocket.

Stations

Two new stations would need to be constructed for the proposed service along the P&W mainline. One station would be in downtown Woonsocket near the extant Woonsocket Station and the other would be located in Cumberland at Ann and Hope Way.[3] Each station would have a 300 foot island platform. Two ticket machines would be provided for passengers at each station and each station will be monitored by a Closed Circuit TV (CCTV) security system.

Constructing an island platform provides access to two tracks with only one platform and would minimize overall capital costs. To allow passengers access on and off of platforms, pedestrian crosswalks over the tracks are necessary. The P&W has stated that crosswalks would be permitted, so long as full crossing protection is provided.[4] A pedestrian overpass or underpass would eliminate the need for a crosswalk over the track, but would cost more to build. One crosswalk would be required at Woonsocket and one at Cumberland.

[1] The P&W mentioned to the study team in October 2008 that they sometimes run switchers from Valley Falls up to Ann and Hope Way when making up consists.
[2] 11.3 miles from Boston Switch to Woonsocket Station and the 0.6 miles of Yard Track 1 at Valley Falls.
[3] The town of Lincoln is willing to set aside land for the purpose of building a potential train station in the vicinity of the village of Manville in the future.
[4] Telephone conversation with Bernie Cartier, December 18, 2008.

Woonsocket Station

In Woonsocket, physical constraints on the eastern side of the track limit the location of the platform. Keeping the P&W mainline in its current location minimizes the amount of land required to the west.[5,6] Parking could be developed in the vicinity of Woonsocket Station. Approximately 65,000 square feet of parking would be needed possible for 400 parking spaces.[7]

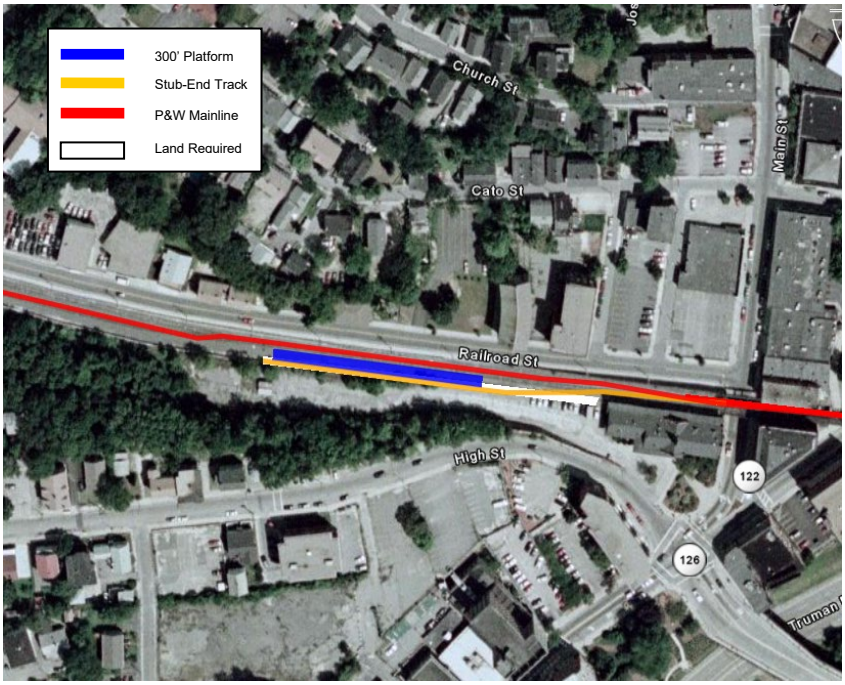


Figure 7.11:
Aerial View of Woonsocket Station

Cumberland Station

An estimated 49,000 square feet would be required for up to 300 parking spaces. A parking lot could be located in the vicinity of platform in the Ann and Hope Building parking lot. See Figure 7.12 for an aerial view of the station and vicinity.

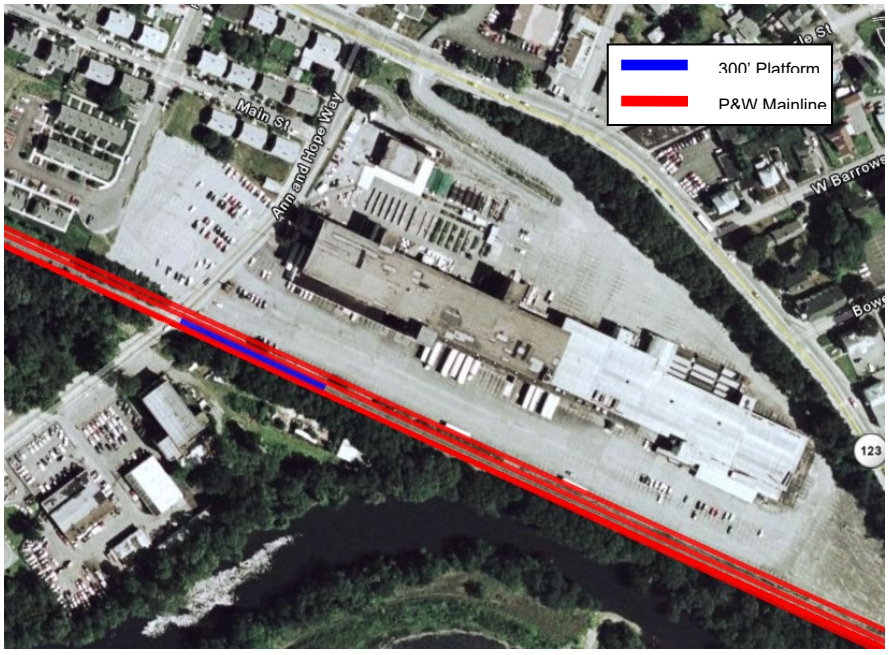


Figure 7.12:
Aerial View of Cumberland Station

[5] It is understood that the State of Rhode Island currently owns the land needed for this platform and track and that they would be willing to allow Woonsocket to develop a platform and track with it.
[6] Email from Catherine Ady. December 30, 2008.
[7] Assumes the average parking space is 162 square feet in size.

Signals and Train Control

Currently, the entire P&W mainline is unsignalled with train movements governed by "Track Permits" (Form D) from the P&W's train dispatcher based in Worcester. Passenger service on the P&W mainline would necessitate the installation of CTC (Centralized Traffic Control) signal system to allow for full bi-directional operation. In total, 14.2 miles of track will be signalized.[8]

In addition to the CTC system, four interlockings would be required along the line. One interlocking would be located at Woonsocket, and the remaining three would be located between Mendon Road in Cumberland and Mill Road in Central Falls.

The four interlockings would govern the movement of trains at intersections with other tracks. Table 7.24 shows a list of the four new interlockings. For the sake of clarity in this analysis, the interlockings are named according to the closest cross-street or other landmark.

Table 7.24:
List of Interlockings and Locations

Name	MP	Characteristics
"Mill"	5.9	Railroad east of Valley Falls Yard
"Valley"	6.5	Railroad West of Valley Falls Yard and East of Cumberland
"Mendon"	7.8	Railroad West of Cumberland
"Woonsocket"	16.0	Railroad East of Woonsocket

Additionally, in the wake of the recent Chatsworth train accident on Los Angeles' Metrolink system, an ATS (Automatic Train Stop) system to enforce stop signals on passenger trains would provide an additional measure of operation safety. Costs for an ATS system are *not* included in this analysis.

Grade Crossings

The proposed service would travel over 13 grade crossings between Woonsocket and the former Boston Switch. Three grade crossings at High Street, Ann & Hope Way, and Mendon Road would be upgraded to two track service. The grade crossing at Middle Street would be improved to have gate protection in addition to its current Bells and Flashers.[9] The remaining 10 grade crossings would be upgraded for intrastate service to reduce the likelihood of collisions between rail and highway vehicles.

[8] 14.2 miles is the sum of 11.3 miles from Woonsocket Station to Boston Switch, 2.3 miles of new track associated with Cumberland Station and the Woonsocket terminal stub, and 0.6 miles of Yard Track 1 at Valley Falls.

[9] The crossings at Titus Street and High Street currently have only Bells and Flashers for protection. It is assumed that when these crossings are upgraded for two track service, a gate will be added as protection.

Summary

A summary of the P&W infrastructure upgrades is shown in Table 7.25.

Table 7.25:
Summary of Infrastructure Upgrades to P&W Mainline

Track and Signaling	**Quantity**	**Units**
New Track[10]	2.3	mi
Track Upgrade[11]	11.9	mi
Terminal Stub Track (excluding Platform)	1	ea
Bumper	1	ea
Grade X-ings to Upgrade	10	ea
Grade X-ings to Reengineer (for Double Track)	3	ea
Interlocking Plant	4	ea
CTC Signaling	14.2	mi
Stations		
High Level Platform	2	ea
Parking Spaces[12]	700	ea
Site Development	2	ea
Ticket Vending Machines	4	ea
CCTV	2	ea
Pedestrian Crossing	2	ea

[10] 2.3 miles is the sum of the 2.2 miles of new track in the vicinity of Cumberland station, and the 0.1 miles of track needed at Woonsocket.

[11] 11.3 miles of track between Boston Switch and Woonsocket Station and 0.6 miles of Yard Track 1 at Valley Falls

[12] 400 spaces at Woonsocket and 300 spaces at Cumberland

P&W Mainline Infrastructure Requirements: Option 1A & 2A

Track Work and Upgrades

Options 1A and 2A build upon the preliminary investment required to offer interstate service in Options 1 and 2. The 8.4 miles of single track between Cumberland Station and Woonsocket Station in Options 1 and 2 would be double tracked to accommodate the P&W's 2030 freight operations and intrastate service. Figure 7.13 illustrates the required infrastructure upgrades (shown in red) for intrastate service. Note, the Option 1 and Option 2 improvements are shown in black.

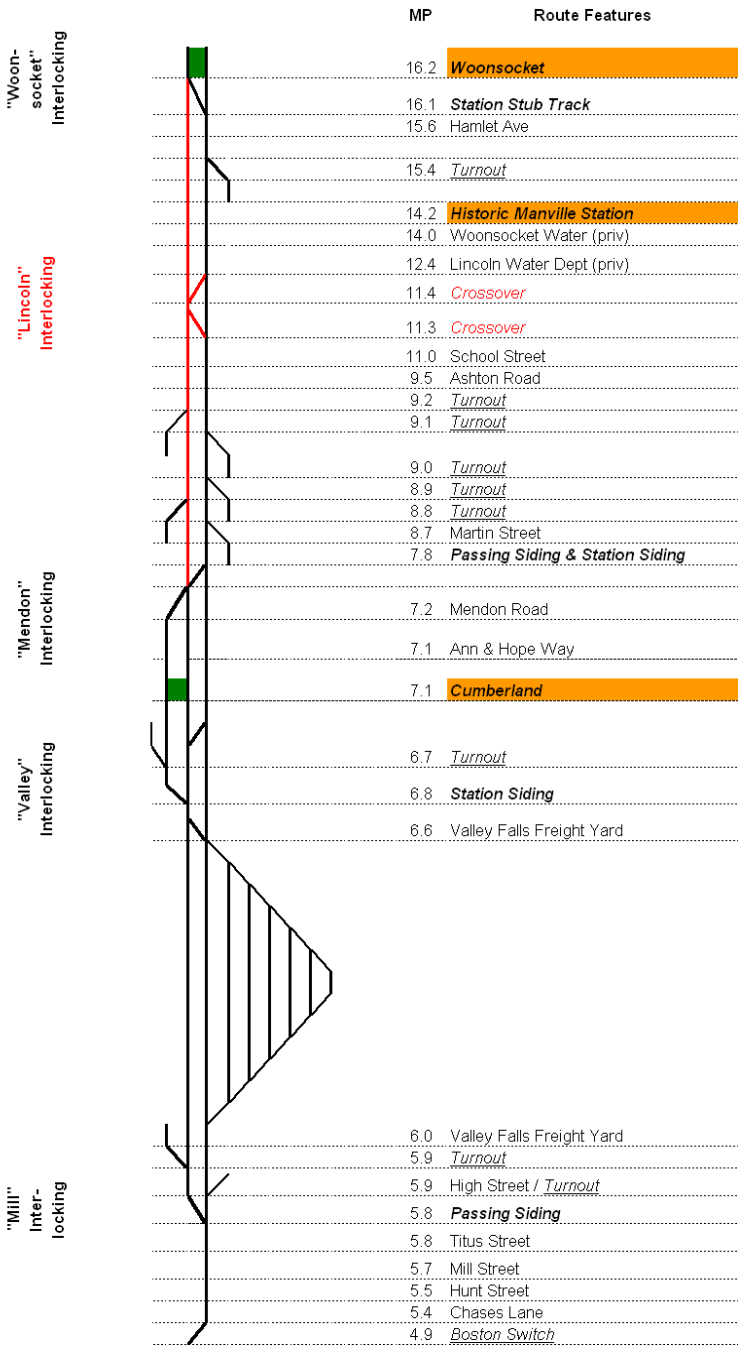


Figure 7.13:
Track Upgrades for Options 1A and 2A

Upgrades to the P&W mainline would not require any additional land outside of the existing right-of-way owned by P&W. P&W has identified one location where a second mainline track on its right-of-way would likely have an adverse impact the bike path. At the Sneeds Brooke Bridge the bike path uses the second track bridge. According to P&W, it has been agreed that the bike path must be at least 18 feet from the track. Under this constraint it would be a tight fit to carry two tracks and the bike path across the bridge on existing structures.[13] Further study would be required to find the best way to mitigate potential problems in this location and verify that there are no other impacts on the bike path.

[13] Telephone conversation with Bernard Cartier. April 14, 2009.

The most expensive element of double tracking is the rehabilitation of the P&W Bridge across the Blackstone River in Woonsocket. Aerial photography and site visits indicate that the bridge was designed as a two track structure, but that one span has been removed. Depending on the condition of the bridge piers, a completely new bridge may not be needed. An engineering inspection is required to determine whether or not this is required. For the purposes of this analysis, it is assumed that the bridge will need to be completely rebuilt to allow for two track capacity.

On double track railroads, crossovers provide the mechanism to overtake disabled trains and to run around M-of-W crews working on the track. One or more universal crossovers are recommended for any track configuration with double track. The density of crossovers recommended for each double track option was derived based on running times, route length, and service frequency as described below. A commonly used formula to determine the optimal distance between crossovers along a double track route is shown below: [14]

$$\left(\frac{\text{Average Operating Speed}}{60}\right)\left(\frac{\text{Base Headway}}{2}\right)(0.8) = \text{Optimal Distance Between Crossovers}$$

According to this formula, the optimal distance between crossovers is 8.4 miles, which is the amount of track to be double-tracked. This suggests that only one crossover is needed between Cumberland and Woonsocket stations. This crossover has been placed in approximately 4.2 miles from Woonsocket and Cumberland stations.

Stations

No new stations will be built between Woonsocket and Cumberland. Additional station parking may be required, but is not included in this analysis.

Signals and Train Control

The new 8.4 miles of double track will need to have CTC signaling signal system installed.

In addition to the CTC signaling, one additional interlocking would be required along the line, for the new crossover. This crossover will be located at MP 20.0 and is given the name “Lincoln.”

Grade Crossings

The grade crossings at High Street, Ann & Hope Way, and Mendon Road were upgraded to accommodate two-track service in Option 1 and Option 2. The six grade crossings between Cumberland and Woonsocket stations would need to re-engineered to for double track.

[14] Recently cited by Parsons Brinckerhoff Quade & Douglas (December 2003). MOS-3 Northern Branch & Northern Branch Extension Operations Planning Report, page 7. Submitted to the NJ Transit Corporation Office of New Rail Construction. Newark, NJ.

Summary

A summary of the P&W infrastructure upgrades for Options 1A and 2A are shown in Table 7.25.

Table 7.26:
Summary of Infrastructure Upgrades to P&W Mainline

	Options 1 – 2		**Option 1A – 2A**	
Track and Signaling	**Quantity**	**Units**	**Quantity**	**Units**
New Track	2.3	mi	8.4	mi
Track Upgrade[15]	11.9	mi	0	mi
Terminal Stub Track (excluding Platform)	1	ea	0	ea
Bumper	1	ea	0	ea
Grade Crossings to Upgrade	10	ea	4[16]	ea
Grade Crossings to Re-engineer	3	ea	6	ea
Interlocking Plant	4	ea	1	ea
CTC Signaling	14.2	mi	8.4	mi
Bridge				
Survey			1	ea
New Bridge Deck			925	Track Foot
Stations				
High Level Platform	2	ea	0	ea
Parking Spaces	700	ea	0	ea
Site Development	2	ea	0	ea
Ticket Vending Machines	4	ea	0	ea
CCTV	2	ea	0	ea
Pedestrian Crossing	2	ea	0	ea

[15] This includes the approximately 1 mile of P&W Yard Track 1 that would be acquired to allow for double operations through Valley Falls.

[16] Four grade crossings between Boston Switch and Valley Falls that would not be double tracked.

NEC Infrastructure Requirements: Options 1, 1A, 2, 2A

New Track and Upgrades

Track upgrades to the Northeast Corridor for this service are minimal, since many of the required upgrades will be built as part of Rhode Island's *South County Phase I* project. Figure 7.14 and Figure 7.15 shows the required infrastructure upgrades for the intrastate service (in red) for all service options.

Between Boston Switch and Providence Station, 5.65 miles of Track 7 will need to be upgraded to allow intrastate service to travel at 60 mph.

A crossover would be located north of Warwick Station and would link Track 1 and Track 2. This turnout would enable MBTA trains stopping at Warwick Station to travel north on Track 2 and leaving Track 3 available for intrastate service. South of Cranston Station, a crossover from Wellington siding to Track 3 would enable northbound intrastate trains and P&W freight trains to access Wellington siding from Track 3 and not interfere with the Amtrak M-of-W base at the southern end of Wellington Siding. It would be approximately 0.5 miles north of the southern lead for Wellington Siding. Construction in this location would provide full crossover capabilities at Wellington Siding and increase operational flexibility for Amtrak, intrastate, P&W and any future MBTA operations.

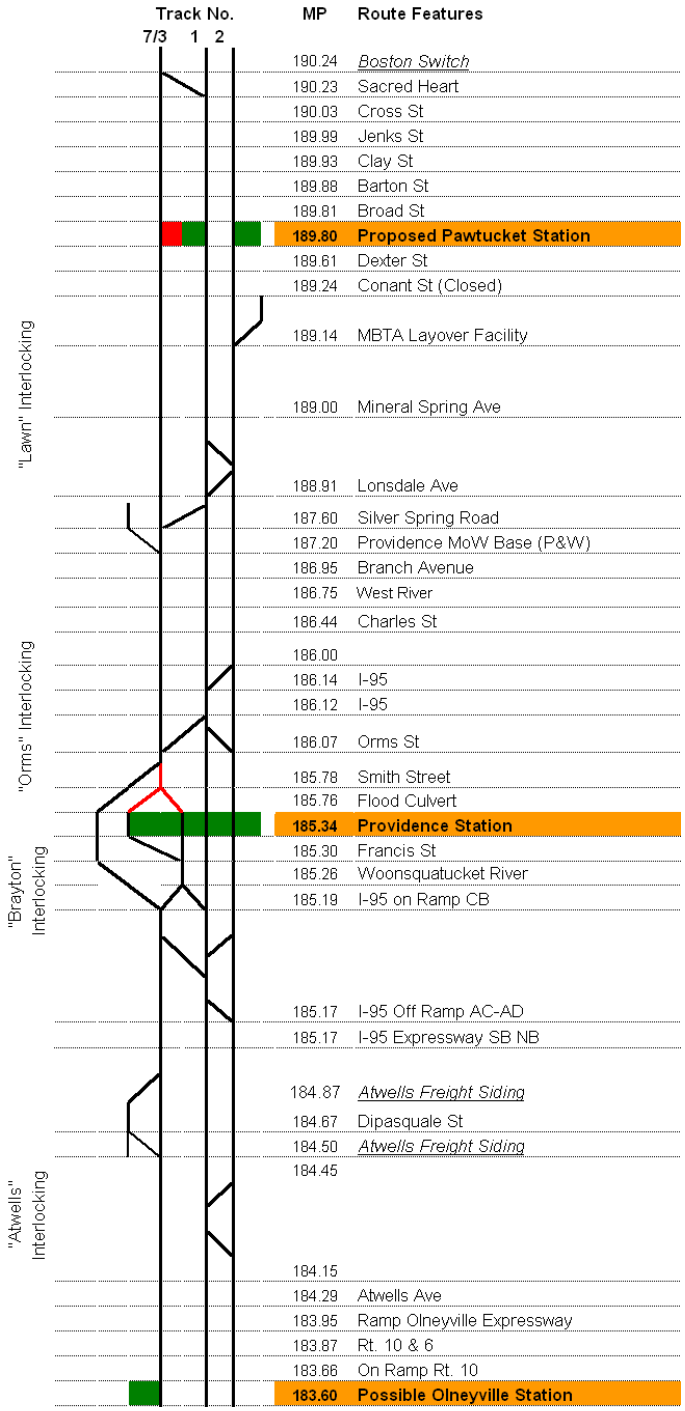


Figure 7.14:
Options 1 – 2A Required Track Upgrades to NEC Mainline between Pawtucket and Providence

A 1,000 foot turnback track would be necessary south of the Airport connector Bridge at Warwick. The turnback track would allow intrastate and MBTA trains to change directions offline without fouling the FRIP track. It also provides intrastate service with an offline location to wait as freight and MBTA trains pass. It is assumed that the turnback track would be integrated into the "MP 176" interlocking.

Providence Station Trackwork

Trackwork immediately north of Providence Station would allow intrastate trains direct access to Providence Station from the FRIP without fouling Track 1. An equilateral turnout located north of Providence Station would provide Track 7 with access to Station Tracks 3 and 5 without using Track 1. This enhancement would increase the overall operational flexibility of Providence Station physical plant.

Signals, Train Control, and Interlockings

Signal upgrades on the NEC would be necessary for Track 7 between "Orms" interlocking and the Boston Switch. The track in this segment is "dark" and needs to be upgraded to CTC signaling to allow for bi-directional train operations.

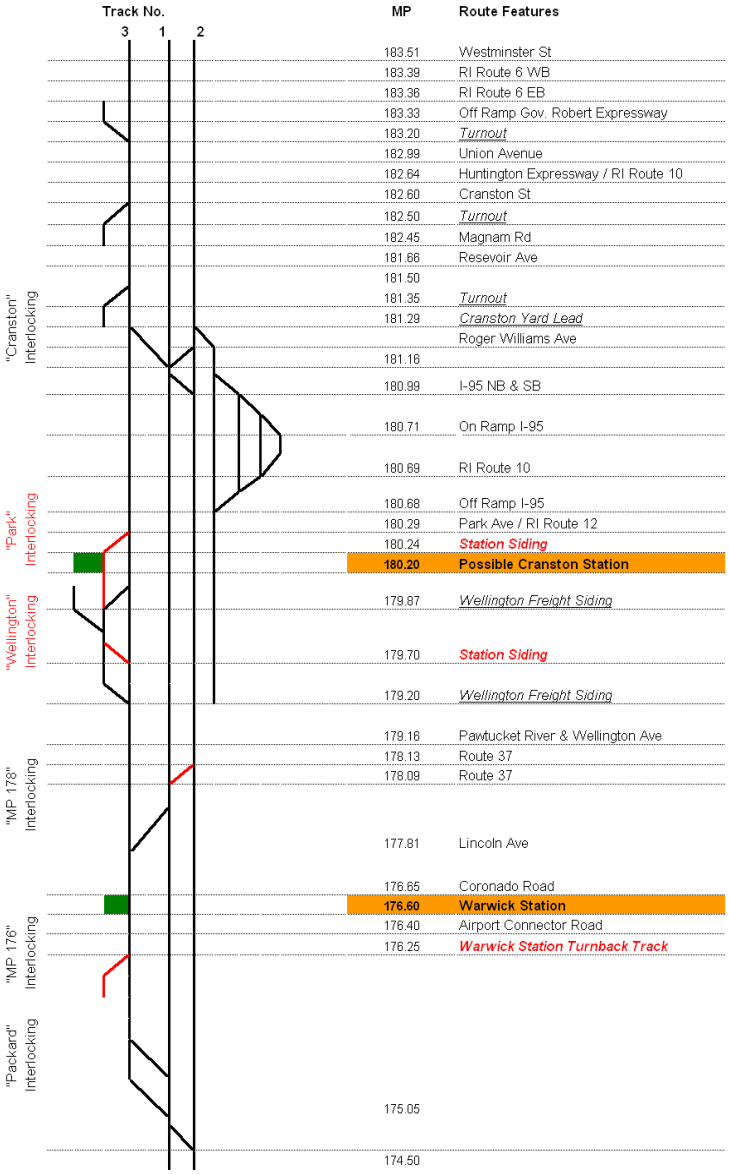


Figure 7.15:
Options 1 – 2A Required Track Upgrades to NEC Mainline between Providence and Warwick

According to Jacobs Engineers, two new interlockings in the vicinity of Cranston Station would be required.

Grade Crossings

No grade crossing upgrades are necessary since there are no grade crossings on the NEC in the study corridor.

Stations

Two ticket machines would be provided for passengers at each station on the NEC, and monitored by a Closed Circuit TV (CCTV) security system. New platforms would be needed at Pawtucket, Olneyville, and Cranston.

Parking would be required at Cranston. Potential parking could be located across Park Avenue and on the eastern side of the NEC. For Option 1 and 1A, 200 parking spaces would be required. For Option 2 and 2A, 500 spaces (300 above and beyond the Option 1 and 1A requirements) would be needed to accommodate passengers.

Pawtucket Station

Engineering for a new Pawtucket Station is underway by a separate team.[17] Jacobs assumes that the new station will be constructed by the time intrastate service commences. The proposed Track 2 platform would be widened to Track 7 allowing intrastate trains to stop on the west side of the platform. Only 300 feet of the new platform would be built from Track 2 over to Track 7. To allow wide P&W freight movements through Pawtucket on Track 7, the platform would have ramps to allow passengers to board and alight intrastate trains.

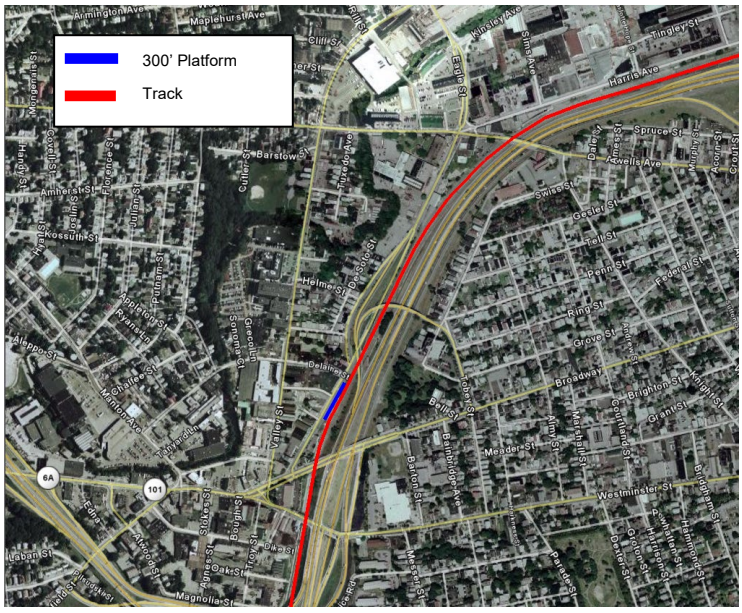


Figure 7.16:
Aerial view of Olneyville Station and the Surrounding Neighborhood

Olneyville Station

In the 1920s, the Olneyville neighborhood of Providence had a train station. However, over the course of time, the station fell into disuse and was eventually removed. The proposed intrastate service would re-establish at station in Olneyville in the vicinity of the historical station.[18] To allow wide P&W freight movements through Olneyville on Track 3, the platform would have ramps to allow passengers to board and alight intrastate trains.

[17] Vanasse Hangen Brustlin, Inc. (June 2007). *Pawtucket Central Falls Commuter Rail Feasibility Facility: Feasibility Study and Site Analysis*. Prepared for the City of Pawtucket Department of Planning and Redevelopment.

[18] The land requirements for this option are limited mostly to the land needed for the platform. The land required for the platform and physical plant is understood to be partially owned by the City of Providence.

Cranston Station

It is anticipated that Cranston Station would be built as part of Rhode Island's *South County Phase II* project. However, at the time this feasibility study was written, the City of Cranston has only identified a general area where a station could be situated. This area is bounded by Park Avenue to the north, I-95 to the west, Wellington Avenue to the south, and Elmwood Avenue to the east (see yellow shaded area in Figure 7.17).

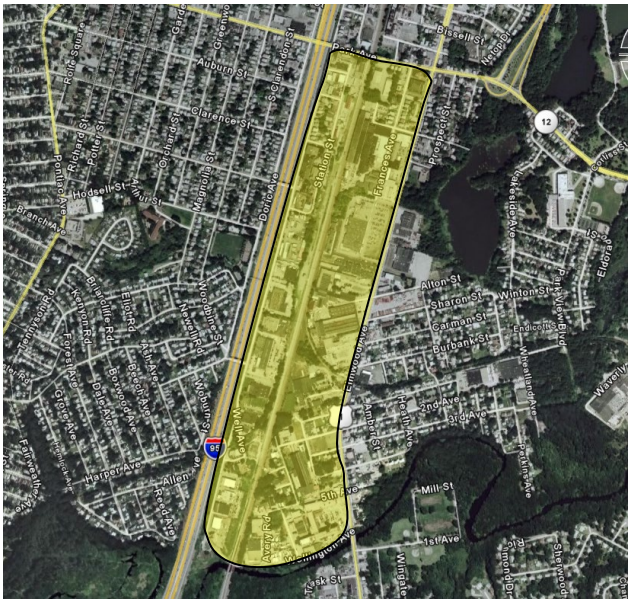


Figure 7.17:
Aerial view of Cranston Station Area

The study team identified a potential site within the city's desired area, and determined how known modifications and uses to the area by Amtrak, the P&W, and its freight customers could affect a potential station. After consulting with P&W, a solution was developed that should satisfy all parties.

The platform would be approximately 300 feet railroad west of the Park Avenue on privately owned land. This location will allow an eight-car MBTA Commuter Rail consist to completely berth at Cranston, providing level boarding while preserving the clearance for P&W freight trains on the FRIP.[19,20] Since the platform is located offline, no ramping would be needed for passenger boardings and alightings at the platform.

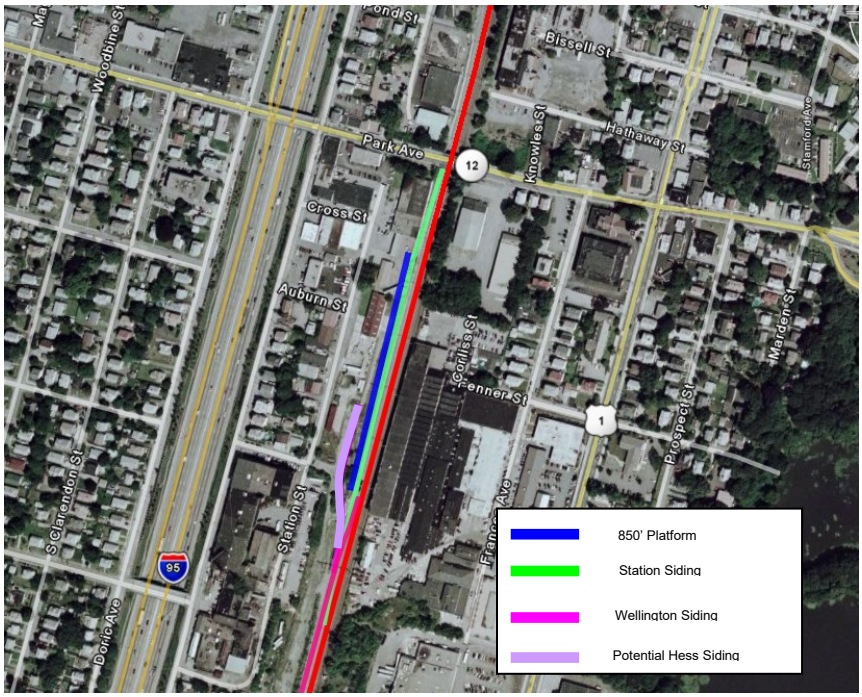


Figure 7.18:
Aerial of Cranston Station Location and Potential Modifications

[19] In Option 1 and Option 1A, it is assumed that only a 300 foot platform is built.

[20] Up to 264 parking spaces would be located on the eastern side of the railroad on land owned by the city of Cranston. The area of the parcel of land is 43,000 square feet. Assuming that the typical parking space is 162 square feet, up to 264 parking spaces are available. The City of Cranston owns this land and has indicated that they would be develop as a parking lot for Cranston Station.

It is recommended that the station siding be extended south to Wellington Siding. The eastbound Wellington lead should remain intact, and a new crossover located 300 feet west of the platform be constructed. This would provide for full crossover capabilities at Wellington, and provide the P&W and Amtrak with additional operational flexibility for any future operations.

It is **strongly** recommended that all stakeholders involved in a potential Cranston Station come together to establish a more definite plan regarding their future plans, and how it could affect a station.

Summary

A summary of the NEC infrastructure upgrades is shown in Table 7.27

Table 7.27:
Summary of Infrastructure Upgrades to NEC Mainline

Track and Signaling	**Options 1 & 1A**		**Options 2 & 2A**	
New Track[21]	0.49	mi	0.49	mi
Track Upgrade[22]	5.65	mi	5.65	mi
Equilateral (North of Providence Station)	1	ea	1	ea
Terminal Stub Track (excluding Platform)	0	ea	0	ea
Bumper	1	ea	1	ea
Grade Crossings to Upgrade	0	ea	0	ea
Grade Crossings to Re-Engineering	0	ea	0	ea
Turnout (No. 20)	1	ea	1	ea
Interlocking Plant	2	ea	2	ea
CTC Signaling[23]	5.48	mi	5.48	mi
Stations				
300’ High Level Platform	3	ea	2	ea
850’ High Level Platform	0	ea	1	ea
Parking Spaces	200	ea	500	ea
Site Development	2	ea	2	ea
Ticket Vending Machines	10	ea	10	ea
CCTV	5	ea	5	ea
Pedestrian Crossing	0	ea	0	ea

[21] The station siding at Cranston Station and the turnback track at Warwick.
[22] Track 7 between Providence Station and Boston Switch.
[23] Track between Orms interlocking and Boston Switch, the siding at Cranston, and the turnback track.

Equipment

The proposed service for both options will be operated by two consists, each with the capacity for 300 passengers and will accommodate the peak hour flow of 450 passengers between Pawtucket and Providence. Two equipment alternatives are considered: DMU trains (comprised of a mix of powered cars and unpowered trailers) and Push-Pull trains (similar to MBTA equipment). The Push-Pull option is included to demonstrate the economic efficiencies that can be achieved by employing DMUs instead of Push-Pull train sets.

The performance characteristics (e.g., acceleration and deceleration) of typical Push-Pull trains and DMUs were used to estimate running times between stations. Dwell times were estimated at 30 seconds per station. This approach allows for an allowance for human factors and other perturbations in the operation of the trains. A four-minute pad is added to the arrival time of each train at its destination terminal to ensure schedule adherence.

Figure 7.19:
Colorado Railcar DMU

Table 7.28 shows the estimated one-way travel times for both DMU and Push-Pull Equipment. As shown, the DMU estimated travel times are faster than the estimated push-pull options.

Table 7.28:
Estimated One-Way Travel Times (minutes)[24]

Station	MP	DMU	PP
Woonsocket	24.9	00:00	00:00
Cumberland	15.7	12:56	13:29
Pawtucket/Central Falls	13.2	17:38	18:36
Providence	8.7	24:09	25:42
Olneyville	7.1	27:04	29:12
Cranston	3.6	32:03	34:50
Warwick	0.0	36:47	40:22

It is assumed that Amtrak would allow the use of compliant DMUs on the Northeast Corridor. The State of Vermont had been collaborating with Amtrak to purchase a small fleet of DMUs for its state supported Amtrak service between New Haven and St. Albans, VT. DMU's have historically operated on the corridor in Massachusetts, Rhode Island and Connecticut. The lone supplier currently constructing DMUs for unrestricted use on the national railway network recently ceased operations due to financial difficulties. Several other firms however have expressed in building DMUs for this and similar domestic markets.

[24] Time shown does not include the four minute "pad" time to ensure schedule adherence.

Compliant DMU Vehicles

A Diesel Multiple Unit (DMU) is a passenger rail car with a self-contained, on-board source of motive power, making reliance on a locomotive or electric power distribution system unnecessary. Historically, nearly all DMUs have used on-board diesel engines for propulsion power and have been capable of operation as a single train with multiple cars. While motive power may be a diesel internal combustion engine or an alternative self-contained, on-board source, all DMUs in common use rely on diesel propulsion.

Figure 7.20:
United Transit Systems DMU

Colorado Railcar Aero DMU: The single level Aero DMU seats 92 and is capable of pulling one or two commuter rail coaches. Colorado Railcar also offers a bi-level DMU that seats 188, and unpowered "dummy" coaches that seat 92 and 218 for the single level and bi-level versions. The Aero has been purchased for use on Florida's low density Tri-Rail service as part of the FRA DMU Demonstration Project along with a bi-level DMU and a bi-level coach. In addition, three DMUs have been delivered to the Washington County Commuter Rail line in Portland, Oregon, which starts service in Spring 2009. (Colorado Rail Car ceased manufacturing operations at the end of 2009 due to a host of financial problems.)

United Transit Systems DMU: United Transit Systems (a consortium of Tokyo-based Sojitz Corp. and Seoul-based Rotem Co.) was chosen to build 28 Category 1 DMUs for North Carolina. The North Carolina cars were expected to be fully compliant with all FRA regulations with 2x2 seating for 80 passengers and capacity for up to 200. Rotem has several decades of DMU and EMU experience worldwide in the United Kingdom, Ireland and Korea. Other manufacturers including Siemens, Sumitoma, and Bombardier have indicated a willingness to build DMUs for the US market.

Recent FRA-Compliant DMU Offerings from Major Equipment Manufacturers	United Transit Systems	Sumitomo/ Nippon Sharyo	Bombardier DMU (2 cars)	Siemens Desiro USA (2 cars)
				
Configuration	Single Unit	Single Unit	Married-Pair	Married-Pair
First Year of Service	2008	NA	NA	NA
Passenger Capacity (Seats)				
Seated with 2 x 2 Seating	80	87		
Seated with 2 x 3 Seating	96	104	199	160
Standees[25]	120	NA	174	210

[25] Standee figures are those reported by manufacturers (and are generally those for 2 x 2 seating) and are higher than those that are used by most transit systems, including the MBTA.

Recent FRA-Compliant DMU Offerings from Major Equipment Manufacturers	United Transit Systems	Sumitomo/ Nippon Sharyo	Bombardier DMU (2 cars)	Siemens Desiro USA (2 cars)
				
Total	200	NA	373	370
Capital Cost (millions)	$3.5	$3.6	NA	$8.5
Capital Cost/Seat (3 x2)	$36,500	$34,600	NA	$53,100
Engines	2	2	4	2
Total Horsepower	950	690	1,320	1,120
Drive Train	Diesel-Hydraulic	Diesel-Hydraulic	Diesel-Electric	Diesel-Electric
Max Operating Speed (mph)	65	80	100	79
Max Acceleration (mphps)	1.5	0.8	1.5	1.3
Weight (tons)	65	71	129	134
Tons/Seat	0.8	0.8	0.6	0.8
HP/Ton	16	10	10	8
Length (feet)	85	85	170	167
Height (feet)	14.4	13.1	13.0	14.4

Any of the vehicles described above would be adequate for the intrastate DMU services. For the purposes of this plan, it is assumed that each DMU train would consist of two powered DMUs with an unpowered trailer coach.

Push-Pull Locomotives and Coaches

Locomotive-hauled diesel push-pull operations characterize most of the commuter railroads in North America. In this configuration, a diesel electric locomotive is employed to provide propulsion, lighting and HVAC power for the train. The diesel engine drives an electric generator that supplies power to electric motors on the locomotive's drive-wheels. A separate diesel engine and generator typically provides electric power to heat, cool and light the passenger coaches. The typical minimum length for a push-pull train is a locomotive and three coaches. Trains with two cars are occasionally deployed, but are not favored. The typical diesel locomotive is 60 to 70 feet long and weighs 125 tons. The maximum practical train length for a single passenger locomotive is typically 8 or 9 cars.

Figure 7.21:
Push-Pull Consist

The locomotive hauls the train in pull configuration. When the consist reaches the end of its trip and turns to head back toward its origin, the engineman shifts the locomotive into push mode and changes his seating position from the locomotive to a work station at the far end of the last car in the consist. This work station provides

a throttle, brakes, and other controls that allow him to operate the locomotive and the train in the push configuration.

The passenger coaches are unpowered trailers. Coaches can be either single-level or bi-level. Regardless of height, the typical coach is 85 feet long. A single-level car generally weighs about 50 tons. A bi-level weighs approximately 60 tons. The Massachusetts Bay Transportation Authority (MBTA) in Boston operates a mix of single-level and bi-level equipment.

For shorter commuter type trips each single-level coach typically seats 100 to 125 passengers. Higher seating capacities are achieved by narrowing the center aisle of the car and providing five seats in every row - two seats on one side of the aisle and three on seats on the other (3-2 seating).

THIS PAGE LEFT INTENTIONALLY BLANK

Chapter 8: Capital and Operating Costs

The study team evaluated four alternatives and estimated the infrastructure costs, vehicle costs, and operating costs associated with each option.

Capital Costs
To understand the feasibility of the services identified, the cost of infrastructure construction required for each alternative was estimated. Jacobs used a simple three-step process to estimate capital infrastructure costs.

Step 1) Estimated Quantities
The study team established the current corridor conditions through site visits, inspection of track charts, Val maps, and review of aerial photography as documented in Chapter 2.[1] The extent of track upgrades, construction, signaling, and land requirements were obtained from these sources. Potential station sites were determined from meetings with municipal planners. The number of grade crossings requiring signal upgrades and re-engineering were derived from track charts.

Step 2) Unit Costs
The unit costs used to estimate the capital construction costs of each alternative were gathered from a variety of sources. The majority of cost estimates were achieved through consultation with Jacobs' Rail Engineers and cost estimates from the 2007 Woonsocket Planning Study.[2] The unit cost estimates have been assembled and their sources are listed in **Table 8.1**.

Unit costs for land requirements were based on the 2008 assessed property value. For most municipalities, this information was readily available online at the city or towns local government website. When it was not available, the team obtained information directly from municipal planners.

[1] Google Earth.
[2] Jacobs Edwards and Kelcey. (2007). *Commuter Rail Feasibility Study*. Prepared for the City of Woonsocket.

Table 8.1:
Capital Cost Elements

Category	Cost Item(s)	Unit	Cost	Source
Track and Signal	New Track	Track Foot	$ 250	JEG Rail Engineers
	Track Upgrade	Track Foot	$ 25	JEG Rail Engineers
	Terminal Stub Track	Each	$ 1,350,000	GO Transit Report[3]
	Bumper	Each	$ 15,000	JEG Rail Engineers
	Grade X-ing Upgrade	Each	$ 250,000	JEG Rail Engineers
	Grade X-ing to Re-Engineer	Each	$ 1,000,000	JEG Rail Engineers
	Turnout (No. 20)	Each	$ 175,000	JEG Rail Engineers
	Interlocking Plant	Each	$ 3,500,000	GO Transit Report[4]
	CTC Signaling	Track Foot	$ 189	JEG Rail Engineers
Stations	High Level Platform	Each	$ 300,000	JEG Rail Engineers
	NEC 800' High Level Platform	Each	$ 2,224,000	GO Transit Report[5]
	Parking Lot (100 spaces)	Each	$ 500,000	JEG Rail Engineers
	Site Development	Each	$ 500,000	JEG Rail Engineers
	Ticket Vending Machines	Each	$ 87,000	JEG Rail Engineers
	CCTV	Each	$ 350,000	JEG Rail Engineers
	Pedestrian Crossing	Each	$ 100,000	JEG Engineers
Other	MoE Facility	Vehicle	$ 538,000	JEG Rail Engineers
	Bridge Work			
	Survey	Lump Sum	$ 20,000	JEG Engineers
	New Deck	Lin. Ft	$ 15,000	JEG Rail Engineers
	Turnout North of Providence	Lump Sum	$ 5,000,000	JEG Engineers[6]

Note, all costs are shown in 2008 values. Since inflation between 2007 and 2008 was minimal, the costs shown above are the same as those in the 2007 Woonsocket Study.

Step 3) Contingency and Support Costs

A 30% contingency factor was applied to estimates of property acquisition to reflect the variability in land value and uncertainty relating to litigation and other acquisition costs. (Costs for land acquisition vary according whether the MBTA will call on Cranston.)

A 15% contingency factor was applied to the relatively predictable costs for track and signal upgrades and new track construction. In addition to the contingency, various engineering and support costs were added to the cost estimates and are listed in **Table 8.2**.

[3] Jacobs, Edwards and Kelcey (2008). *Consulting Services for a Light Rail Feasibility Study on the Stouffville Corridor*. Prepared for GO Transit, pp. 95.
[4] Ibid.
[5] Ibid.
[6] This cost **includes** the cost of signalizing the turnout, tying into existing interlockings, track realignment, and any land that may be required.

Table 8.2: Various Support Costs	
Cost Item	**Budgeted Amount**
Engineering and construction management	15% of construction cost
Administration	4% of construction cost
Insurance and permitting	3% of construction cost

Infrastructure

Using the operational and infrastructure needs described in Step 1 of the cost estimation process, the study team was able to calculate the expected capital costs for infrastructure construction and land acquisition. Note, station parking, ticket vending machines, CCTV system, and pedestrian crossing are included in the station costs. The findings of the three step estimation method are presented in **Table 8.3**.

Table 8.3: Estimated Infrastructure Costs by Alternative				
	Option 1	**Option 2**	**Option 1A**	**Option 2A**
P&W Infrastructure Upgrades				
Track	$ 5,971,800	$ 5,971,800	$ 17,059,800	$ 17,059,800
Grade Crossings	$ 5,500,000	$ 5,500,000	$ 10,000,000	$ 10,000,000
Signal and Interlockings	$ 28,200,000	$ 28,200,000	$ 40,100,000	$ 40,100,000
Stations	$ 6,348,000	$ 6,348,000	$ 6,348,000	$ 6,348,000
P&W Subtotal	$ 46,019,800	$ 46,019,800	$ 73,507,800	$ 73,507,800
NEC Infrastructure Upgrades				
Track	$ 6,406,800	$ 6,406,800	$ 6,406,800	$ 6,406,800
Grade Crossings	$ 0	$ 0	$ 0	$ 0
Signal & Interlockings	$ 12,479,394	$ 12,479,394	$ 12,479,394	$ 12,479,394
Stations	$ 5,520,000	$ 8,770,000	$ 5,520,000	$ 8,770,000
NEC Subtotal	$ 24,406,194	$ 27,656,194	$ 24,406,194	$ 27,656,194
Other Costs				
MofE Facility	$ 5,084,100	$ 5,084,100	$ 5,084,100	$ 5,084,100
Land Acquisition	$ 2,562,253	$ 3,707,726	$ 2,562,253	$ 3,707,726
Direct Costs	**$ 78,072,347**	**$ 82,467,820**	**$ 105,560,347**	**$ 109,955,820**
Contingency (15% Track & Signal)	$ 8,783,699	$ 8,783,699	$ 12,906,899	$ 12,906,899
Land Acquisition Contingency (30%)	$ 768,676	$ 1,112,318	$ 768,676	$ 1,112,318
Engineering & Construction Mgt (15%)	$ 11,710,852	$ 12,370,173	$ 15,834,052	$ 16,493,373
Administration (4%)	$ 3,122,894	$ 3,298,713	$ 4,222,414	$ 4,398,233
Insurance & Permitting (3%)	$ 2,342,170	$ 2,474,035	$ 3,166,810	$ 3,298,675
Total	**$ 104,800,639**	**$ 110,506,757**	**$ 142,459,199**	**$ 148,165,317**

The estimated infrastructure costs for the four options range from $105 million to $148 million. The largest single cost driver for all capital costs are those associated with

upgrades and improvements to the P&W mainline (42% to 52% across all options). Upgrades and improvements to the NEC constitute only 17% to 25% of all capital costs.[7]

Comparing each alternative's infrastructure cost per route mile, the costs per mile range from $4.2 million to $5.9 million per mile. Option 1 has the lowest infrastructure cost per mile of all the alternatives and Option 2A has the highest. The costs for Option 1A and Option 2A per route mile are higher than Option 1 and Option 2, since they are the more capital intensive of the options.

Table 8.4:
Infrastructure Costs per Route Mile (000s)

	Option 1	Option 2	Option 1A	Option 2A
Route Miles	24.9	24.9	24.9	24.9
Estimated Infrastructure Costs	$104,801	$110,507	$142,459	$148,165
Infrastructure Cost per route mile	$ 4,208	$ 4,438	$ 5,721	$ 5,950

Infrastructure costs per forecast weekday inbound boarding range from $37,600 to $51,116. Option 2 has the lowest infrastructure cost per inbound boarding of all the alternatives and Option 1A has the highest per inbound boarding cost. The costs for Option 1A and Option 2A per inbound boarding are higher then Option 1 and Option 2, since they are the most capital intensive of all the options.

Table 8.5:
Infrastructure Costs per Forecast Inbound Boarding (000s)

	Option 1	Option 2	Option 1A	Option 2A
Forecast Inbound Boardings	2,787	2,999	2,787	2,999
Estimated Infrastructure Costs	104,801	110,507	142,459	148,165
Infrastructure Cost per Inbound Boarding	$ 37,603	$ 36,848	$ 51,116	$ 49,405

Rolling Stock

Self-propelled Diesel Multiple Units (DMU) would be employed to operate the service between Woonsocket and Warwick. DMUs can achieve more operational efficiencies than Push-Pull consists. Table 8.6 shows the unit costs for DMUs used in this analysis.

Table 8.6:
Rollingstock Unit Costs

Unit Type	Cost	Source
DMU	$ 4,000,000	JEG Calculated Industry Average
Coach	$ 1,300,000	JEG Calculated Industry Average
MBTA Bi-Level Coach	$ 2,530,000	MBTA Fairmount Report[8]

Two consists would operate the proposed intrastate service for all alternatives. One additional consist would be used as a spare. Each consist would be composed of three

[7] This includes the cost of new bridge crossing the Blackstone River in Woonsocket. The costs listed for Option 1A and 2A represents the high-end of capital investment required. Depending on the results of an engineering survey, the infrastructure costs may be significantly lower.

[8] Jacobs Edwards and Kelcey. (August 2007) *Fairmount Line Corridor Improvements Project Service Enhancement Project*. Prepared for the Massachusetts Bay Transportation Authority.

vehicles: two DMUs and one coach. The total fleet size would be nine vehicles (6 DMUs and 3 coaches). In addition to the DMU equipment, additional MBTA bi-level coaches would be required to carry the additional forecast passengers attracted to MBTA service. The number of coaches required varies whether or not the MBTA serves Cranston. Table 8.7 summarizes the fleet requirements for all alternatives.

Table 8.7:
Required Fleet Size

Option	RIIS Fleet Requirements		Add'l MBTA Coaches
	DMU	Coaches	
1	6	3	2
2	6	3	4
1A	6	3	2
2A	6	3	4

For each option, the total DMU fleet cost is $27.9 million. The addition of MBTA rolling stock required for the additional passengers increases the equipment costs by $5.1 million to $10.1 million. The total rolling stock costs, including the incremental MBTA coach costs range from $33.0 million to $38.0 million.

Table 8.8:
Total Fleet Costs (000s)

Option	Fleet Requirements			Total DMUs Cost	Total Coaches Cost	MBTA Bi-Level Coaches Cost	Total Rolling Stock Cost
	DMU	Coaches	MBTA Bi-Level Coaches				
1	6	3	2	$ 24,000	$ 3,900	$ 5,060	$ 32,960
2	6	3	4	$ 24,000	$ 3,900	$10,120	$ 38,020
1A	6	3	2	$ 24,000	$ 3,900	$ 5,060	$ 32,960
2A	6	3	4	$ 24,000	$ 3,900	$10,120	$ 38,020

Combining the rolling stock costs shown in Table 8.8 and the required infrastructure costs in **Table 8.3**, total capital costs for the four alternatives can be determined, and are shown in Table 8.9. For intrastate service, the total capital costs range from $138 million to $186 million. Option 1A and 2A are substantially higher since it was assumed a new bridge crossing the Blackstone River would be required.

Table 8.9:
Total Capital Costs ($ millions)

Option	Infrastructure Cost	Equipment Cost	Total Capital Cost
1	$ 104.8	$ 33.0	$ 137.8
2	$ 110.5	$ 38.0	$ 148.5
1A	$ 142.5	$ 33.0	$ 175.5
2A	$ 148.2	$ 38.0	$ 186.2

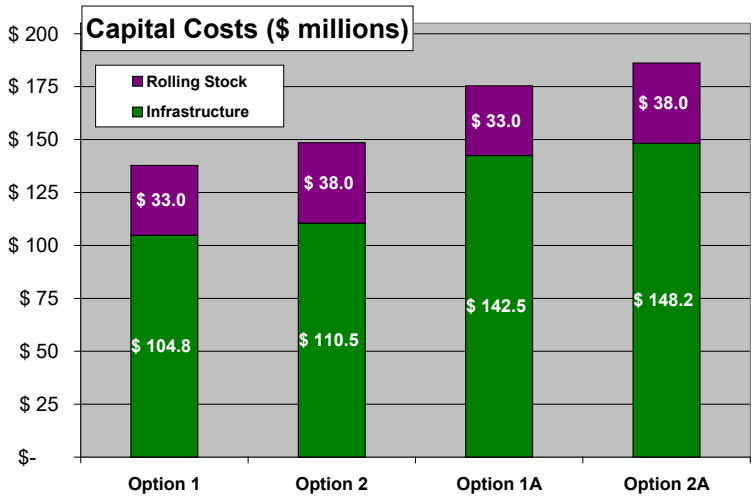


Figure 8.1

Operating Costs

For the intrastate service, five categories of operating costs were estimated:

- Rail Transportation (Crews, Fuel, Supervision, Dispatching)
- Maintenance of Equipment
- Maintenance of Way (MoW)
- Trackage Fees
- Administration

For planning purposes, it was assumed that the P&W freight railroad would operate the passenger service under contract to the State of Rhode Island.[9] The use of the P&W to operate passenger services in conjunction with their freight operations would create synergies that would not be possible with a third party passenger rail operator. Elsewhere in the United States, owner-operators provide passenger rail service in Chicago, Seattle, and Portland, Oregon.

It is expected that the P&W would continue to dispatch the mainline between Woonsocket and Boston Switch, and that Amtrak would dispatch between Boston Switch and Warwick.

Estimating Transportation Expense

Transportation costs include the direct costs for service provision including train crews, supervisors and dispatchers, propulsion energy and train supplies. Although only weekday schedules were developed, the costs for weekend services were estimated based on a 16 hour service day each Saturday, Sunday and holiday. The following was assumed for transportation cost estimation:

[9] During the course of the 2007 Woonsocket Study, the P&W indicated interest in operating intrastate service on their line.

- Operators and conductors would cost a fully loaded rate of $42.96/staff hour, a figure based on the operator rate for a Midwestern regional carrier adjusted to reflect the Rhode Island area cost of living. Overtime is charged at 1.5 times the hourly wage, or $28.50/staff hour. Absentee coverage is charged at two times the hourly wage, or $38.00/staff hour.
- Four full-time field supervisors (one chief supervisor and three assistant supervisors) would be responsible for all aspects of the commuter rail operations providing full coverage for the daily operation, seven days a week, at a fully-loaded hourly rate of $51.55 for the supervisor and $42.96 for each assistant supervisor. They are assumed to each work a standard 2,080 hours per year.
- Four crews per day are required to operate the service.
- Dispatching would be provided by the P&W, owner of the line, for an annual fee of $100,000
- Costs for NEC dispatching, maintenance of way and trackage fees are combined into a rate of $2.89 per car mile.
- Diesel fuel costs are based on the MBTA's 2007 contract price for diesel fuel ($1.92).
- Fuel efficiency for two DMUs hauling a trailer is 0.62 mpg.[10]
- All consists would be Two Person Train Operation consisting of one engineer and one conductor.

Estimating Mechanical Expense (MOE)

The mechanical costs associated with rolling stock include labor and materials for vehicle maintenance. It is assumed that the private operator would maintain the selected vehicles at costs approximating productivity observed elsewhere in the United States.

Table 8.10:
Maintenance of Equipment Costs

Cost Element	Vehicle Type	Annual Cost
Labor Cost	DMU[11]	$ 73,099
	Coach[12]	$ 28,203
Supplies Cost	DMU[13]	$ 57,635
	Coach[14]	$ 15,235

[10] Jacobs Edwards and Kelcey. (August 2007) *Fairmount Line Corridor Improvements Project Service Enhancement Project*. Prepared for the Massachusetts Bay Transportation Authority.
[11] NJ TRANSIT commuter rail maintenance labor rates in 2002 calculated from NTD 2002 figures for vehicle maintenance labor costs and hours. Result was inflated to 2007 dollars by 5% annually and then adjusted by the urban cost of living difference between Newark, NJ and Providence, RI.
[12] Based on MBTA locomotive maintenance labor costs estimated in 2000 and inflated to 2007 dollars, factored by Metro-North's ratio of coach to locomotive maintenance costs and then adjusted by urban cost of living difference between Boston, MA and Providence, RI.
[13] Based on 1995 KKO survey of SPRC manufacturers inflated to 2007 dollars

Table 8.10: Maintenance of Equipment Costs		
Cost Element	**Vehicle Type**	**Annual Cost**
MBTA Labor and Supplies	Bi-Level Coaches[15]	$ 78,593

Using these figures, the estimated annual DMU consist maintenance cost is $304,906 for a three vehicle consists (2 DMU and 1 coach). The total annual maintenance of equipment cost, including spares and MBTA bi-level coaches, range from $1.07 million to $1.23 million.

Table 8.11:
Estimated Annual Maintenance of Equipment Costs

	Equipment Requirements			Total Labor		Total Supplies			
Option	DMUs	Coaches	MBTA Bi-Level Coaches	DMUs	Coaches	DMUs	Coaches	MBTA Bi-Level Coaches	Total Cost
1	6	3	2	$438,594	$84,609	$345,810	$45,705	$157,186	$1,071,904
2	6	3	4	$438,594	$84,609	$345,810	$45,705	$314,372	$1,229,090
1A	6	3	2	$438,594	$84,609	$345,810	$45,705	$157,186	$1,071,904
2A	6	3	4	$438,594	$84,609	$345,810	$45,705	$314,372	$1,229,090

Estimating P&W Maintenance of Way (MOW) Expense

MOW costs include the everyday direct costs for inspection and maintenance of the infrastructure, including labor and materials. The following assumptions were used in calculation of the P&W MoW Expense:

- Two supervisors and one Chief engineer, two signal maintainers and four track, bridge and station maintainers would be responsible for the maintenance of way. The Chief Engineer would earn a fully-loaded hourly rate of $51.55 while all other personnel earn $42.96/hour.[16]
- It is assumed that the MOW materials cost would mirror typical commuter rail agency experiences as reported to the National Transit Database. The average materials cost per MOW labor hour, escalated to reflect costs in 2008, was estimated at $11.85.

Estimating P&W Trackage Fees

Since the P&W mainline is privately owned, it is assumed that the state of Rhode Island would pay the owner trackage fees for use on all tracks. The trackage fees were assumed to be $0.392 per car-mile based on trackage fees charged elsewhere to operate passenger trains on privately owned freight routes in New England. The annual trackage fees range from $122,789 to $129,247. The trackage fees for Option 1A and 2A are lower than Option 1 and Option 2 because they operate one less roundtrip each weekday.

[14] Based on MBTA locomotive maintenance costs estimated in 2000 and inflated to 2007 dollars and factored by Metro-North's ratio of coach to locomotive maintenance costs.
[15] Estimated annual maintenance cost of MBTA Bi-Level Coaches for South County Service.
[16] Assuming P&W maintenance, rates were derived from reported hourly rates for shortline force account work elsewhere in the United States adjusted to reflect 2007 conditions in the area of Woonsocket, RI.

Table 8.12: Estimated Annual P&W Trackage Fees		
Option	**Annual Vehicle Miles**	**Annual Fee**
1	329,711	$ 129,247
2	329,711	$ 129,247
1A	313,236	$ 122,789
2A	313,236	$ 122,789

NEC Dispatching, Maintenance of Way and Trackage Fees
As part of the MBTA South County I Commuter Rail extension, Amtrak will charge RIDOT $2.45 million in 2014 for access and shared use of its track between Providence and Wickford on the NEC.[17] This *includes* dispatching, maintenance of way, and trackage fees. Using this fee and based on the future MBTA South County schedule, the cost per vehicle mile was calculated to be $2.89.[18]

The team used the cost per vehicle mile to calculate the Northeast Corridor costs for intrastate service. For Option 1 and 2, annual NEC fees are estimated to be $1,145,724. For Option 1A and 2A, annual NEC fees are estimated to cost $1,088,473.

Table 8.13: NEC Trackage Fees, Dispatching, and MoW		
Option	**Annual Vehicle Miles**	**Estimated NEC Fee**
1	396,821	$ 1,145,724
2	396,821	$ 1,145,724
1A	376,992	$ 1,088,473
2A	376,992	$ 1,088,473

Estimating Administrative Expense
Administrative costs include revenue collection and accounting, marketing, personnel, training and safety. These costs are estimated at 15% of the Transportation, MOE and MOW costs.

Annual Operating Costs
Annual operating costs are shown in **Table 8.14**. Annual operating costs are fairly consistent for the four options. Option 1 is estimated to cost $6.54 million and Option 1A will cost $6.43 million. Option 2 would cost $6.73 million annually and Option 2A would cost $6.61 million. The differences in operating costs result from the additional

[17] South County Commuter Rail and Warwick Intermodal Station: Project Update and Issues, January 20, 2009. Received by Jacobs Engineering, January 21, 2009, Slide 9.
[18] This includes all deadhead trips and assumes that each consist traveling on the NEC is a 9 car consist (8 coaches and 1 locomotive)

MBTA coaches requiring maintenance and the two fewer trips run in Option 1A and 2A. The two fewer trips impact the fuel requirements and the estimated costs for NEC dispatching, maintenance of way, and trackage fees.

Table 8.14:
Estimated Annual Operating Costs

Rail Transportation	**Option 1**	**Option 2**	**Option 1A (2030)**	**Option 2A (2030)**
Train Crews	$ 1,188,722	$ 1,188,722	$ 1,188,722	$ 1,188,722
Supervision	$ 375,294	$ 375,294	$ 375,294	$ 375,294
(P&W) Dispatching	$ 100,000	$ 100,000	$ 100,000	$ 100,000
Fuel	$ 749,969	$ 749,969	$ 712,493	$ 712,493
Mechanical				
Labor	$ 523,203	$ 523,203	$ 523,203	$ 523,203
Materials	$ 391,515	$ 391,515	$ 391,515	$ 391,515
MBTA Coaches	$ 157,186	$ 314,372	$ 157,186	$ 314,372
P&W Maintenance of Way				
Labor	$ 732,722	$ 732,722	$ 732,722	$ 732,722
Materials	$ 197,184	$ 197,184	$ 197,184	$ 197,184
P&W Trackage Fees	$ 129,247	$ 129,247	$ 122,789	$ 122,789
NEC Dispatching, MoW, & Trackage	$ 1,145,724	$ 1,145,724	$ 1,088,473	$ 1,088,473
Direct Costs	**$ 5,690,765**	**$ 5,847,951**	**$ 5,589,581**	**$ 5,746,767**
Administration (15%)	$ 853,615	$ 877,193	$ 838,437	$ 862,015
Total	**$ 6,544,380**	**$ 6,725,144**	**$ 6,428,018**	**$ 6,608,782**

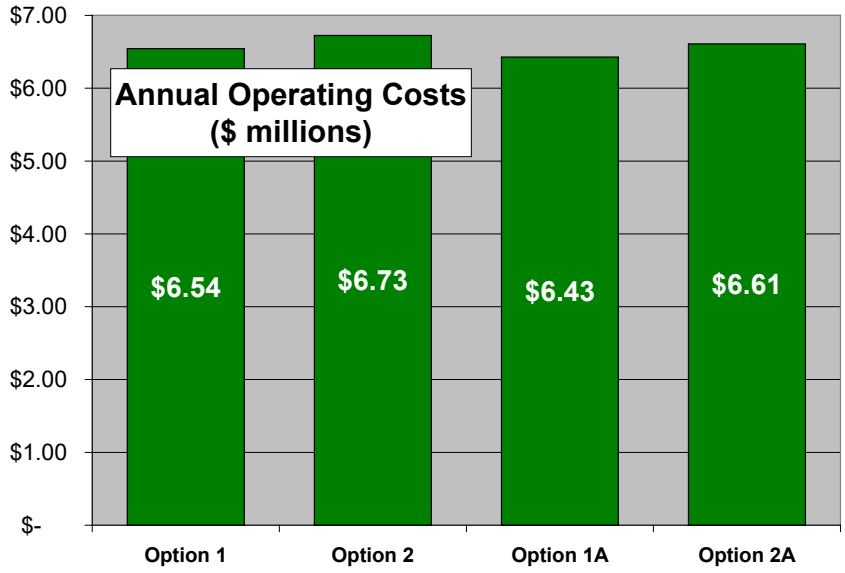


Figure 8.2

Summary

A summary of the capital cost and operating costs is shown in **Table 8.15**.

Table 8.15:
Summary of Capital Costs and Annual Operating Costs ($ millions)

Option	Capital Costs	Annual Operating Costs
1	$ 137.8	$ 6.54
2	$ 148.5	$ 6.73
1A	$ 175.5	$ 6.43
2A	$ 186.2	$ 6.61

THIS PAGE LEFT INTENTIONALLY BLANK

CHAPTER 9: EVALUATION AND RECOMMENDATION

Evaluation

This portion of the report integrates information from the passenger and revenue forecasts with estimates of operating and capital costs to calculate five key measures to rank and evaluate the alternative service regimes:

- Capital Cost per Weekday Inbound Passenger
- Operating Cost per Annual Passenger Trip
- Forecast Passenger Revenue per Passenger Trip
- Farebox Recovery Ratio
- Required Annual Operating Support
- Operating Subsidy per Passenger Trip

Table 9.1:
Summary of Performance Metrics

Option	Capital Cost per Weekday Passenger Boarding	Operating Cost per Annual Passenger Trip	Forecast Passenger Revenue Per Passenger Trip	Fare Recovery Ratio	Required Annual Operating Support ($ millions)	Operating Support per Passenger Trip
1	$ 24,715	$ 4.13	$ 2.31	56%	$ 2.89	$ 1.82
2	$ 24,763	$ 3.96	$ 2.45	62%	$ 2.57	$ 1.51
1A	$ 31,471	$ 4.06	$ 2.31	57%	$ 2.77	$ 1.75
2A	$ 31,041	$ 3.89	$ 2.45	63%	$ 2.45	$ 1.44

Capital Cost per Weekday Passenger Boarding

It is assumed that virtually all of the forecast riders on the proposed services would be new transit riders. The forecast capital cost to divert these travelers from the highway to the transit network would range between $24,000 and $32,000 per rider. This range of capital costs per weekday passenger boardings lies compares very favorably with the performance for similar planned projects that are participating in the FTA New Starts Program as shown in Table 9.2 and Figure 9.1.

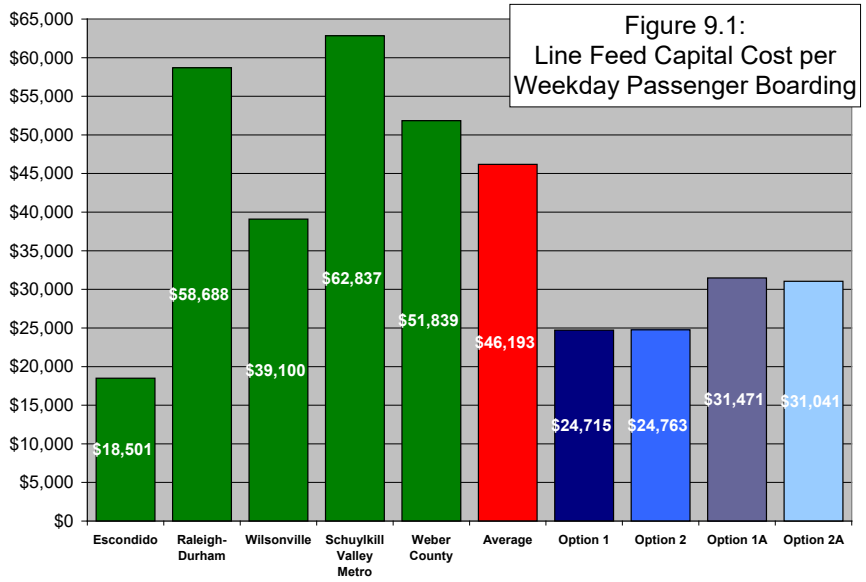


Figure 9.1:
Line Feed Capital Cost per Weekday Passenger Boarding

When compared with the other New Starts projects, the

proposed Rhode Island Intrastate service scores favorably in terms of capital cost per rider for two reasons:

- First, the service very effectively leverages prior investment in infrastructure along the Northeast Corridor.
- Second, due to the relatively short forecast trip lengths, the service is able to carry a large number of riders with a very modest rolling stock investment.

Table 9.2:
Projected Capital Costs and Ridership for Comparable Projects in FTA New Starts Program

State	Project	Projected Capital Cost ($ Millions)	Estimated Daily Ridership	Capital Cost Per Daily Boarding	Status
CA	Oceanside Escondido Rail Corridor	$ 351.5	19,000	$ 18,501	Operational
NC	Raleigh Durham Regional Rail	$ 809.9	13,800	$ 58,688	Discontinued
OR	Wilsonville/Beaverton Commuter Rail	$ 117.3	3,000	$ 39,100	Operational
PA	Schuylkill Valley Metro	$ 2,588.9	41,200	$ 62,837	Preliminary Engineering
UT	Weber County to Salt Lake Com. Rail	$ 611.7	11,800	$ 51,839	Operational
RI	Intrastate (Option 2)	$ 148.5	6,000	$ 24,763	Feasibility Study

Source: FTA Annual Report on New Starts 2005: Appendix A.

Table 9.3 shows annual operating statistics for eight of the smallest commuter rail systems in the United States.[115] All operating metrics will be compared to these eight commuter railroads.

Table 9.3:
Operating Statistics for Eight Smallest Commuter Railroads in the United States

		(A)	(B)	(B) / (A)	(C)	(D) = (B)-(C)	(D) / (A)	(C) / (A)	(C) / (B)
Agency	City, State	Annual Boardings	Annual Operating Cost	Operating Cost per Annual Passenger Boarding	Annual Revenue	Required Operating Subsidy	Operating Subsidy per Boarding	Psgr Rev. per Psgr Trip	Farebox Recovery
NICTD	Chicago, IL	4,245,922	$36,361,248	$8.56	$18,735,287	$17,625,961	$4.15	$4.41	52%
NCTD	San Diego, CA	1,560,729	$17,783,628	$11.39	$6,368,048	$11,415,580	$7.31	$4.08	36%
TRE	Dallas, TX	999,407	$8,736,117	$8.74	$968,590	$7,767,527	$7.77	$0.97	11%
VRE	Alexandria, VA	3,386,974	$46,192,429	$13.64	$19,685,561	$26,506,868	$7.83	$5.81	43%
Sounder	Seattle, WA	2,156,652	$24,631,997	$11.42	$6,622,730	$18,009,267	$8.35	$3.07	27%
ACE	San Jose, CA	706,858	$10,879,259	$15.39	$3,988,042	$6,891,217	$9.75	$5.64	37%
Tri-Rail	Miami, FL	3,408,486	$43,306,781	$12.71	$7,263,465	$36,043,316	$10.57	$2.13	17%
SLE	New Haven, CT	466,406	$10,917,972	$23.41	$1,333,213	$9,584,759	$20.55	$2.86	12%
	Average	**2,116,429**	**$24,851,179**	**$13.16**	**$8,120,617**	**$16,730,562**	**$9.54**	**$3.62**	**29%**

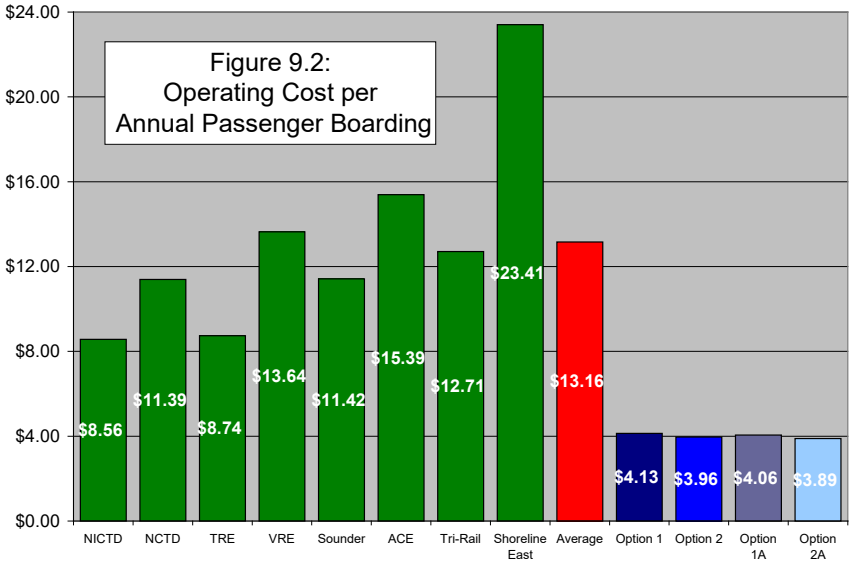
[115] National Transportation Database. "Data – Reporting Year 2007 Database," http://www.ntdprogram.gov/ntdprogram/datbase/2007_database/2007NTDxls.exe. Accessed: February 10, 2009.

Table 9.3:
Operating Statistics for Eight Smallest Commuter Railroads in the United States

		(A)	(B)	(B) / (A)	(C)	(D) = (B)-(C)	(D) / (A)	(C) / (A)	(C) / (B)
Agency	City, State	Annual Boardings	Annual Operating Cost	Operating Cost per Annual Passenger Boarding	Annual Revenue	Required Operating Subsidy	Operating Subsidy per Boarding	Psgr Rev. per Psgr Trip	Farebox Recovery
	Max	4,245,922	46,192,429	$23.41	$19,685,561	$19,685,561	$20.55	$5.81	52%
	Min	466,406	8,736,117	$8.56	$968,590	$968,590	$4.15	$0.97	11%

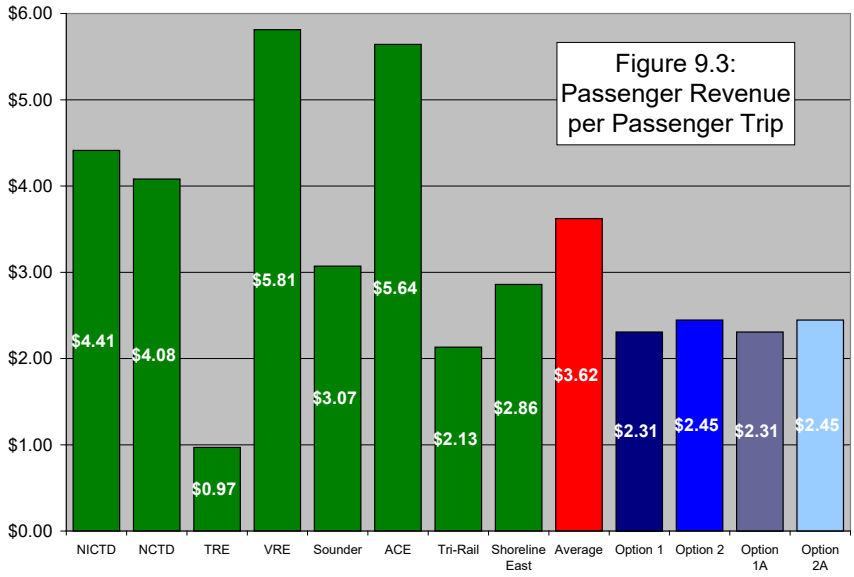
Operating Cost per Annual Passenger Trip

The forecast operating cost per annual passenger trip for all intrastate commuter rail service alternatives ranges between $3.89 and $4.13 per boarding. This range is *very* favorable when compared to the operating costs per annual passenger trip reported for the eight smallest US commuter railroads. Among the eight smallest commuter railroads the average operating cost per passenger boarding in 2007 was $11.69, with a maximum of $23.41 (Shoreline East) and a minimum of $8.56 (NICTD). The proposed Rhode Island initiative scores well because the passenger trip lengths and vehicle trip lengths tend to be smaller than the peer services.



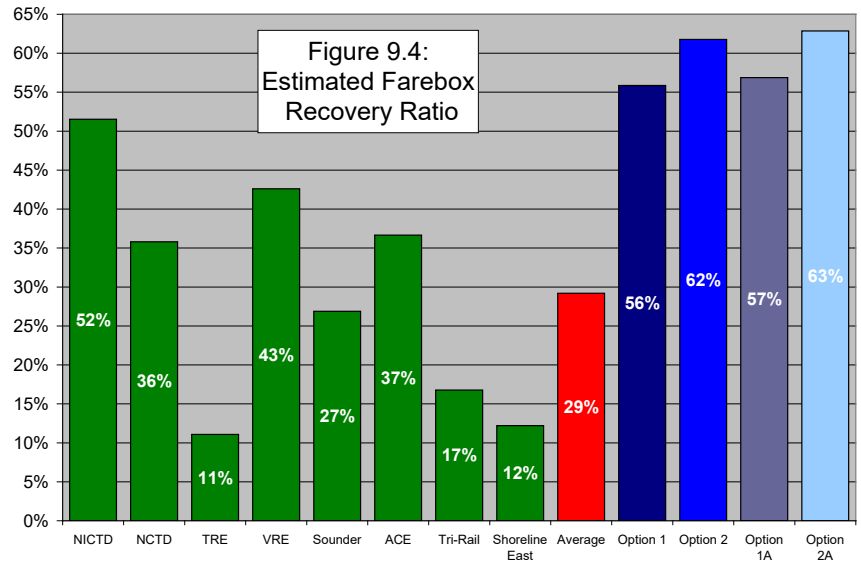
Forecast Passenger Revenue per Passenger Trip

The forecast operating passenger revenue per passenger trip for all service alternatives ranges between $2.32 and $2.45 per passenger trip. This is below the average passenger revenue per passenger trip for the eight smallest commuter railroads at $3.62. The maximum revenue per trip was $5.81 (VRE) and the minimum revenue per trip was $0.97 per trip (TRE). The relatively low forecast revenue per passenger trip for the Rhode Island service reflects the relatively short trip lengths forecast for the intrastate service.



Farebox Recovery Ratio

The fraction of operating costs covered by passenger fare revenue would range between 56% and 63% for all options. This range compares *very* favorably with typical farebox recovery ratios achieved by comparable services. Among the eight smallest commuter railroads the average farebox recovery ratio in 2007 was 29%, with a maximum of 52% (NICTD) and a minimum of 11% (TRE).



The high forecast farebox recovery ratio for the intrastate service reflects synergies in sharing costs with Amtrak, the P&W, and the MBTA on the delivery of service. It also reflects healthy forecasts of future ridership and revenues derived by serving multiple travel markets with the same service and

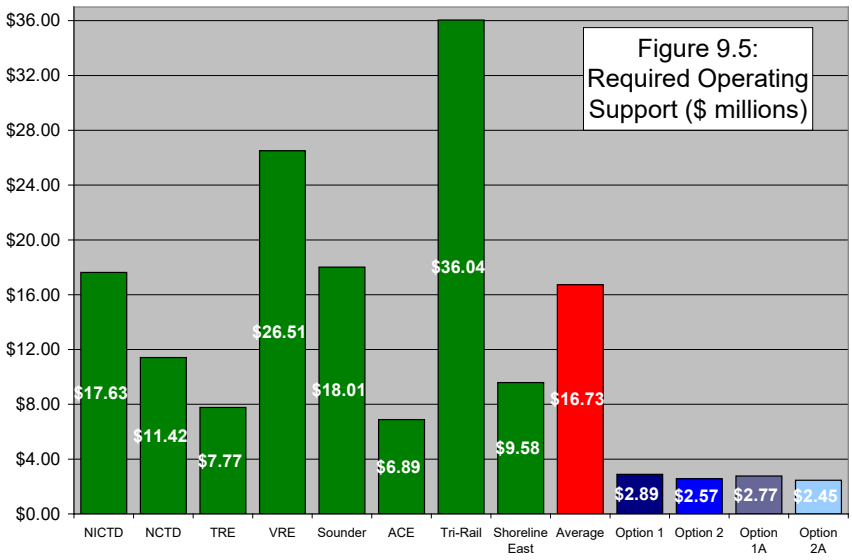
equipment. The multiple travel markets includes commuter travel to Providence, commuter travel to Boston, air travelers to TF Green Airport, and airport employees.

Required Annual Operating Support (Subsidy)

All of the service packages would require some level of annual support from sources other than passenger revenues to fund operations. The required operating support estimated by the study team ranges from $2.45 million to $2.89 million.

Compared with the eight smallest operating US commuter railroads, the required annual operating support required for the intrastate service is quite low. Among the eight comparable systems the average annual level of required operating support was $16.7 million, with a maximum of $36.0 (Tri-Rail) and a minimum of $6.9 (ACE), in 2007. None of the eight operating systems require less annual operating support than would be projected for the Woonsocket to Warwick service regimes.

The very low levels of operating support (subsidy) forecast for the Rhode Island intrastate service reflects the relatively modest extent of the proposed network, small vehicle fleet, sharing infrastructure with other carriers and operators, and serving multiple travel markets. Together, these factors make the proposed service a potentially very attractive fixed guideway transit investment.



Operating Subsidy per Passenger Trip

The operating subsidy per passenger trip for the four service options ranges from $1.44 to $1.82 per trip. This range is quite low when compared among the eight smallest commuter rail systems, at $9.54. The maximum operating subsidy per boarding is $20.55 (Shoreline East) and the minimum is $4.15 (NICTD). The low levels of forecast subsidy per passenger trip reflects the confluence of favorable cost conditions and travel markets along the study corridor.

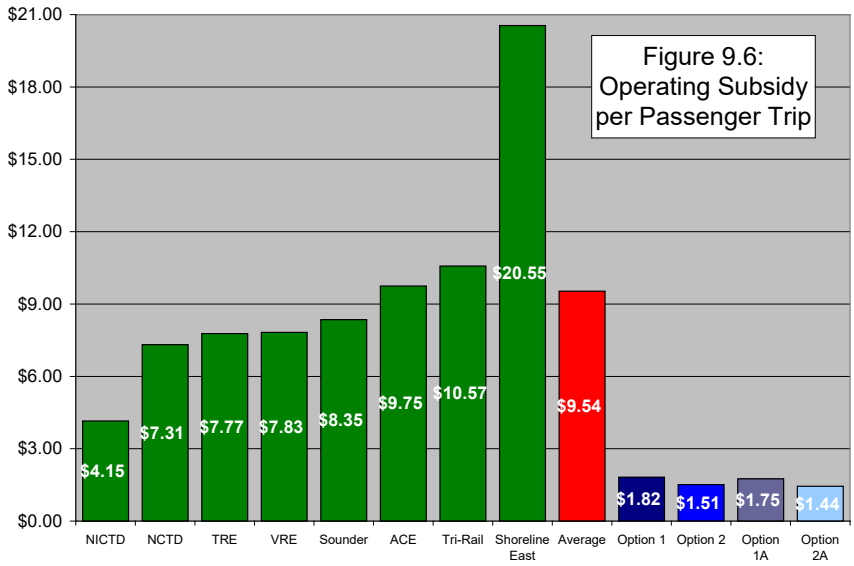


Figure 9.6: Operating Subsidy per Passenger Trip

Recommendations

The analyses indicate that an intrastate rail service linking Woonsocket and Warwick via Providence would be an attractive addition to the mobility options offered for travel in the State of Rhode Island. The service would be readily accessible to two-thirds of the state's residents and conveniently leverage the state's current investments in rail infrastructure along the Northeast Corridor New markets would include a variety of travelers:

Table 9.4:
Forecast 2030 New Transit Travelers by Travel Market

Travelers from the Woonsocket-Pawtucket Corridor to Providence	1,010
Travelers from Woonsocket and Cumberland areas to Boston	238
Additional travelers from Warwick to Providence	495
Travelers from Cranston & Olneyville to Providence	611
Travelers from Cranston to Boston	212
Rhode Island Air Travelers	89
Airport Employees	344
Total	**2,999**

The service would also improve and strengthen the infrastructure for freight movements along the P&W mainline enhancing the balance in regional freight services and maintaining the pubic-private partnership between the state and the freight railroad.

It is recommended that intrastate service be developed incrementally in cooperation and coordination with the P&W, Amtrak and MBTA once the *South County Phase I* services are fully operational and the restored Pawtucket Station is operational. Early action items in the incremental service development might include:

- Development of Cranston Station for MBTA service to Providence and Boston
- Contracting with the P&W to use its existing passenger rollingstock to offer demonstration revenue service between Woonsocket and Warwick making stops at Pawtucket, Providence and Cranston with limited connections to MBTA trains at Pawtucket.
- Adding service density (more trains) to the demonstration service as the market for service matures and grows
- Adding stations at Cumberland and Olneyville as local interest and funding permit

Next Steps

The technical analysis described in this report identifies an attractive transit service option for the State of Rhode Island. Next steps for implementation of this project include:

- Integrating the service proposal into the states transportation development plans including formal inclusion in Rhode Island's next Transportation Improvement Program (TIP).
- Continuing dialogue with the Providence and Worcester Railroad concerning its potential cooperation and support for operation of passenger rail service along its mainline between Woonsocket and Pawtucket.

THIS PAGE LEFT INTENTIONALLY BLANK

APPENDIX A – RIDERSHIP FORECASTS DEVELOPMENT

A widely used ridership-forecasting tool was employed to forecast potential ridership on the three sub corridors. The National Cooperative Highway Research Program (NCHRP) formulated a modeling process, presented in NCHRP Report 187: Quick-Response Urban Travel Estimation Techniques and Transferable Parameters[1], which forecasts ridership by determining the travel market share of a transit service through analysis of key parameters in automobile and transit travel.

The NCHRP model provides a concise process to generate useful output statistics with limited data input requirements. While Report 187 documents techniques for calculating auto occupancy, trip distribution and trip generation, the technique for mode-choice analysis was of most interest for calculating potential ridership. Mode-choice analysis generates market share estimations that can be used with journey to work data to forecast potential ridership.[2]

The mode-choice analysis technique employed is mathematically based on a logistic distribution (logit) formulation[3]. Specifically, this technique estimates transit percent use from the ratio of transit impedance to a gravity exponential, B, and automobile impedance to a gravity exponential:

$$\% \text{ Commuters using rail} = 1/\left(1+\left(\text{Transit Impedance}^{B}/\text{Automobile Impedance}^{B}\right)\right)$$

Impedance values, which represent the traveler's perception of a mode's utility for a specific trip, are calculated using simple travel characteristics. The model estimates the impedance for automobile and transit use based on the following parameters:

- Automobile
  - Travel time
  - Travel cost
  - Parking fee
- Transit
  - Travel time to transit station
  - Travel cost to transit station
  - Parking fee
  - Transit wait time

Table A.1:
Model Bs by Destination

[1] Sosslau, A. B., Hassam, A. B., Carter, M. M., & Wickstrom, G. V. (1978). *National Cooperative Highway Research Program Report 187: Quick Response Urban Travel Estimation Techniques and Transferable Parameters, User's Guide*. Transportation Research Board, National Research Council: Washington DC.

[2] See, for details, Edwards and Kelcey (Jan 2007) "Woonsocket Commuter Rail Feasibility Study: 2030 Journey to Work Forecasts". Prepared for the City of Woonsocket: Woonsocket, RI.

[3] See, for example, Ben Akiva, M. E. & Lerman, S. R. (1985). *Discrete Choice Analysis: Theory and Application to Travel Demand*. MIT Press: Cambridge, MA.

- Transit travel time
- Transit fare
- Travel time from alighting transit to destination
- Transfer penalty

Destination	B
Providence	1.99
Boston	2.00

The gravity exponential, B, was determined empirically by the NCRHP and takes into account the population of the attraction area and the trip purpose. The travel characteristics may then be adjusted to produce different impedances to generate alternative scenarios.[4]

Impedance Input Data & Assumptions

A key element of ridership analysis was developing the data required for calculation of impedances.

Travel Time

Origin Community Centroids - For the purposes of evaluating automobile trip times from study area communities to rail stations and to downtown destinations, the starting point for all trips within a community was assumed to be one central location. Maps depicting residential density were reviewed to establish each community's centroid. Centroid locations were used as the starting point for all trips from that community, except in the case where a proposed rail station and a community's centroid were in close proximity.

For instance, in Woonsocket, although the geographical centroid of all residences is in downtown, it would be unreasonable to expect the average access times from all household to the rail station to be very short based on the fact that the rail station is also located downtown. In these cases, a location that was of "average distance" from residences to the proposed rail station was used as the starting point for transit access trips.

[4] This model is not constrained by the number of parking spaces available for transit park and ride services. However, it can be limited to zero parking and require entirely walking access

Table A.2(a): **Included Communities for Service to Providence**	
Station	**Included Community**
Woonsocket	Woonsocket
	Burriville
Cumberland	Cumberland
	Lincoln
	Smithfield
Pawtucket	Pawtucket
	Central Falls
Olneyville	Olneyville
Cranston	Cranston
Warwick	East Greenwich
	Warwick
	West Warwick

Table A.2(b): **Included Communities for Service to Boston**	
Station	**Included Community**
Woonsocket	Woonsocket
	Burriville
	Millville
	Douglas
	Blackstone
Cumberland	North Smithfield
Cranston	Cranston

Automobile Travel to Employment Destinations – Once the origin locations had been established, automobile travel times were determined, using a traffic routing tool[5] to find the shortest path from study area communities to the two downtown destinations (Boston and Providence). For Boston and Providence, estimates of free-flow travel time were inflated to reflect minutes of delay experienced by commuters traveling during peak periods. For travel to Boston, 25 delay minutes were added to free-flow travel times, for travel to Providence 10 minutes were added.

Automobile Travel to Rail Stations – Using approximate locations of proposed rail stations (see Table A.3)[6], rail access times from each origin community were determined based on a manual assignment process. Selection of the rail station accessed by a given community depended on two factors (1) the access movement was in the same general direction as the commute, and (2) the rail station was reasonably close to the originating community. A traffic routing tool[7] was employed to determine the travel time between the centroid of the origin community and the rail station accessed.

Transit Transferring and Waiting Time – In order to avoid the penalty of missing a train, commuters must arrive at the train station before their train departs. For this study, the estimated rail wait time was 20% of the forecast automobile travel time to the origin station plus a constant of five minutes. Additionally, five minutes of transfer time was included in the travel time for journeys that entailed a transfer between transit routes. In

[5] 2007 Google – map data 2007 NAVTEQ, Maplink/Teleatlas
[6] Rail station locations within Rhode Island derived from: Rhode Island Department of Transportation (1994). *Rail Corridor Feasibility Study*. Prepared for the State of Rhode Island.
[7] 2007 Google – map data 2007 NAVTEQ, Maplink/Teleatlas

impedance calculations, waiting and transfer times were weighted by a factor of two to account for the inconvenience perceived by commuters.

Rail Travel to Downtown Terminal – Forecast commercial and rail travel times between stations were used to estimate the duration of origin stations and the downtown terminals in Boston and/or Providence. For Boston routings, current MBTA schedules were utilized to estimate travel times on existing services.

Travel to Employment Destinations from Downtown Terminals – Destination access time from the downtown stations in Boston and Providence was included in travel time estimates for rail trips. Table A.3 lists the destination access travel times input into the model for each downtown destination. Walking access time is weighted by a factor of three to account for the inconvenience perceived by commuters.

Table A.3:
Average Destination Access Times

Destination City	Average Destination Access Time
Boston	16 minutes
Providence	15 minutes

Costs

Driving Costs – In order to estimate the cost of driving to rail stations or downtown destinations, a cost per mile driven was selected. The 2009 average cost for driving, according to the U.S. General Service Administration is $0.55/mile[8]. This cost was applied to both the transit access leg for the rail mode, and the entire trip for the private auto mode.

Parking Costs – Daily parking costs for a regular commuter were estimated for both the automobile and rail modes (see Table A.4).

A survey of parking garages in each of the three downtown destinations revealed average daily parking rates as shown in Table A.4. However, previous work has shown that commuters working in cities comparable to Providence enjoy free or company-subsidized employee parking with only 27% of automobile commuters paying out-of-pocket for parking. This finding was taken into account when determining the average cost of parking for commuters driving to Providence.

Table A.4:
Average Parking Rates by Destination

Destination City	Average Parking Rate
Boston	$10.00
Providence	$7.14

It was assumed that the daily parking rate at commuter rail stations would be $1.00. For both Park-and-Ride and Downtown parking rates, half of the average daily costs of parking was attributed to each direction of a commute.

[8] US General Services Administration (2007). *Privately Owned Vehicle (POV) Mileage Reimbursement Rates*. Retrieved January 24, 2007 from http://www.gsa.gov/Portal/gsa/ep/contentView.do?contentId=9646&contentType=GSA_BASIC

Rail Fares – Using the MBTA's zonal fare structure, fare zones were estimated for each origin station and destination pair as shown in Table A.5. Current fares for the associated zones were used to represent the cost of rail trips.

Table A.5:
Station Locations and Fare Zones

Station Name	Station Address	Zonal Fares to Providence (Interzone)	Zonal Fares to Boston (Zonal)
Woonsocket	Main St & Railroad St, Woonsocket, RI	4	9
Cumberland	1 Ann & Hope Way, Cumberland, RI	1	9
Pawtucket	Broad St & Clay St, Central Falls, RI	1	N/A
Providence	100 Gaspee St, Providence, RI	-	8
Olneyville	Sydney Court and Harris Av, Providence, RI	1	N/A
Cranston	Cross Street and Station Street, Cranston, RI	2	9[9]
Warwick	Jefferson Boulevard and Coronado Rd, Warwick, RI	2	9

Determining Employee Value-of-Time – For the NCHRP model, each parameter included in a mode's impedance must be expressed in terms of minutes of travel. All costs were converted to travel minutes using a value-of-time conversion factor. The value of an individual's "nonworking" time assumed in the model is equal to one-third of the value associated with an equivalent amount of working time. According to Report 187, the value of working time is estimated based on the median household income and a 2,000 hour work year, so that:

Cost in minutes = Cost ($) / (1/3 * (Median Household Income ($) / 120,000))

Median household incomes for each community in the study area were obtained from 2000 Census data

Once all of the impedance data was compiled, automobile and transit impedances were input into the mode-choice model. For each market, the model predicted the portion of all commuters that would utilize the proposed rail service. These market shares were then applied to forecasts of total work travel from study area communities to either Boston, Providence, or Worcester, to generate base forecasts of ridership.

Adjustments
Once the base forecasts were prepared, adjustments were required to develop accurate estimates of travel.

Long Rail Access Journeys
Experience in the Northeast United States shows that only a very small fraction of commuter rail riders are willing to make a long drive of 20+ minutes to start their rail

[9] For Options 2 and 2A

journey in the morning. For these remote commuters, the introduction of commuter rail is generally irrelevant but the NCHRP model tends to predict healthy mode shares for the rail services from these outer communities. To adjust for this tendency to over predict, the study team adjusted the forecasts from the NCHRP logit model to reflect empirical access-time versus ridership distribution findings.[10] Ridership projections were adjusted using a set of factors shown in Table A.6.

Table A.6:
Access Time Adjustment Factors

Rail Access Time from Origin	Ridership Distribution Adjustment Factor
0-2 minutes	100%
3-7 minutes	59%
8-12 minutes	59%
13-17 minutes	59%
18-22 minutes	37%
23-27 minutes	32%
28-32 minutes	19%
33-37 minutes	12%
38-42 minutes	10%
42 minutes or more	2%

Accessible Employment in Destination City

Because the forecast transit market share was applied to the total amount of work trips, an adjustment to account for the portion of employment in Providence and Worcester not accessible from the downtown rail stations was necessary. Through communication with Rhode Island Statewide Planning, the study team identified 30% as the portion of all employment in Providence that could be easily accessed from the proposed rail service.

Expanding Work Trips to All Travel

The base forecasting methodology focuses on predicting typical weekday commuter travel. Work trip projections were then expanded to include non-work travel by using data from the most recent systemwide MBTA commuter rail survey[11] which contained a distribution of ridership by trip purpose. The systemwide ratio of total travel to work trips acquired from the MBTA survey was 1.19, meaning work trips make up 83.7% of typical weekday commuter rail travel.

The MBTA Systemwide Passenger Survey also contained statistics on average weekend ridership, as shown in Table A.7. The ratio of weekend to weekday ridership was used to estimate Saturday and Sunday ridership based on the forecast of weekday travel.

[10] KKO and Associates L.L.C. (2005). *KKO Lowell Passenger Survey*. Prepared for the Nashua Regional Planning Commission.
[11] Central Transportation Planning Staff (1993). *MBTA Systemwide Passenger Survey: Commuter Rail 1993*. Prepared for the Massachusetts Bay Transportation Authority: Boston, MA.

Table A.7: MBTA Systemwide Ratio of Weekday to Weekend Commuter Rail Riders		
	Systemwide Count	**Ratio to Weekday**
Weekday	67,663	100%
Saturday	13,222	20%
Sunday	10,095	15%
Total	90,980	

Service Frequency

Thirty-two to 34 trains would be operated per day would be operated on the medium quality service. Based on a series of published demand elasticities[12], the ridership forecasts for higher quality alternatives were adjusted upwards. The adjustment is based on the empirical observation that a 50% reduction in the interval between trains generally results in a 20.5% increase in ridership. In this case, only the off-peak ridership was adjusted since only the off-peak frequency is affected.

Forecast Results

Daily Boardings

The forecast ridership figures for the four markets are presented in Table A.8. Based on the analysis, between approximately 2,116 boardings to Providence can be expected on a typical weekday via the intrastate service. In Option 1 and Option 1A, 238 passengers would access the MBTA at Pawtucket via a timed transfer for service to Boston. In Option 2 and 2A, 212 additional passengers in Cranston would use the MBTA to travel to Boston.

There would be approximately 344 airport employees using the intrastate service to go to TF Green Airport. An estimated 89 air travelers using the service to access Providence.

Table A.8: Forecast Daily Inbound Ridership (2030)						
	Weekday		**Saturday**		**Sunday**	
	Option		**Option**		**Option**	
Type of Passengers	**1 & 1A**	**2 & 2A**	**1 & 1A**	**2 & 2A**	**1 & 1A**	**2 & 2A**
Providence Commuter	2,116	2,116	423	423	317	317
Boston Commuter	238	450	48	90	36	68
Airport Employee	344	344	69	69	52	52
Air Travelers	89	89	18	18	13	13
Daily Total	2,787	2,999	557	600	418	450

[12] Richard H Pratt et al. TDRP Web Document 12 (Project B-12): Traveler Response to Transportation System Changes, Interim Handbook. Chapter 9, page 12, "Individual Commuter Rail Elasticities from the Boston Area Demonstration". Quoted from Lago, Mayworm, and McEnroe (1981).

Table A.9 displays the forecast inbound boardings by origin station.

Table A.9:
2030 Forecast Intrastate Service: Inbound Weekday Boardings by Station

	To Providence	To Boston	Air Travelers	Airport Employees	Total Boardings
Woonsocket	197	222			419
Cumberland	357	16			373
Pawtucket	456				456
Providence	NA	NA	89[13]	NA	NA
Olneyville	40				40
Cranston[14]	571	212[15]			783
Warwick	495[16]			344[17]	928
Totals (Options 1 & 1A)	2,116	238	89	344	2,787
Totals (Options 2 & 2A)	2,116	450	89	344	2,999

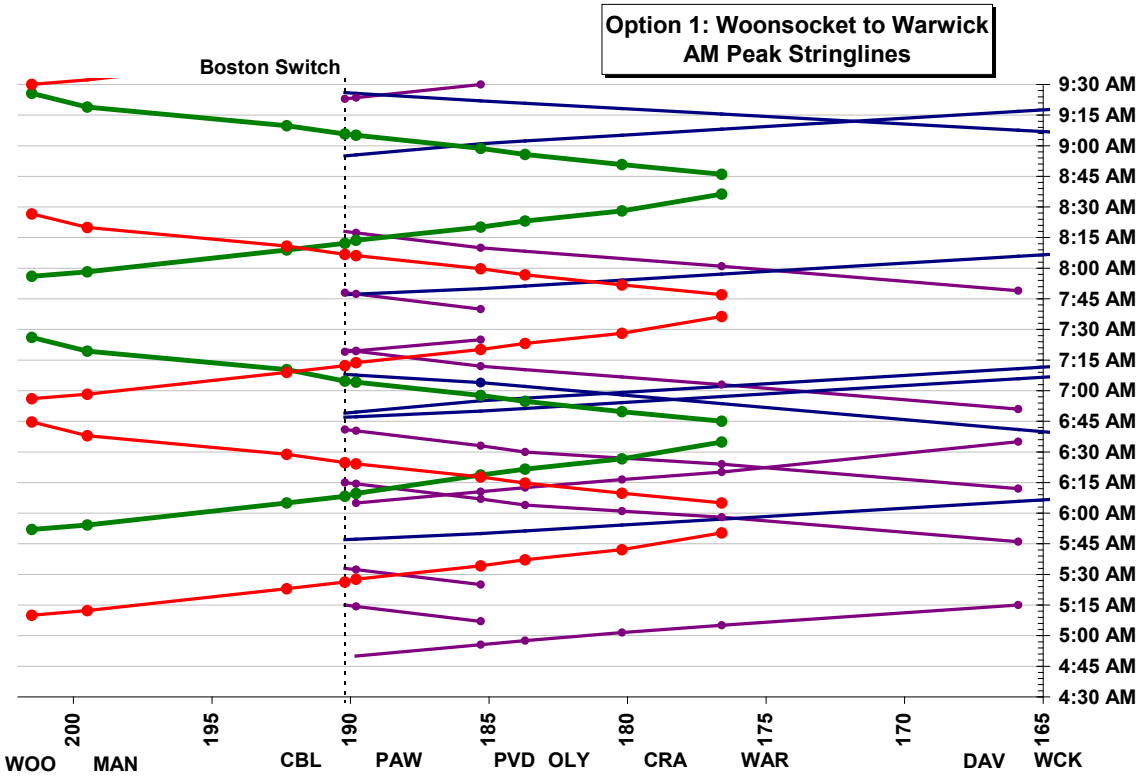
[13] Does not include the 83 air travelers that would use the MBTA for travel to Boston.
[14] In Option 2, this travel flow would be served by a mix of ~16 MBTA and ~32 intrastate trains.
[15] Forecast for new direct MBTA service to Boston. No intrastate passengers to Boston
[16] This travel flow would be served by a mix of 16 MBTA and ~32 intrastate trains. The 495 passengers would be in addition to the 398 forecast for MBTA service only.
[17] It is assumed that all airport employees would use the intrastate service.

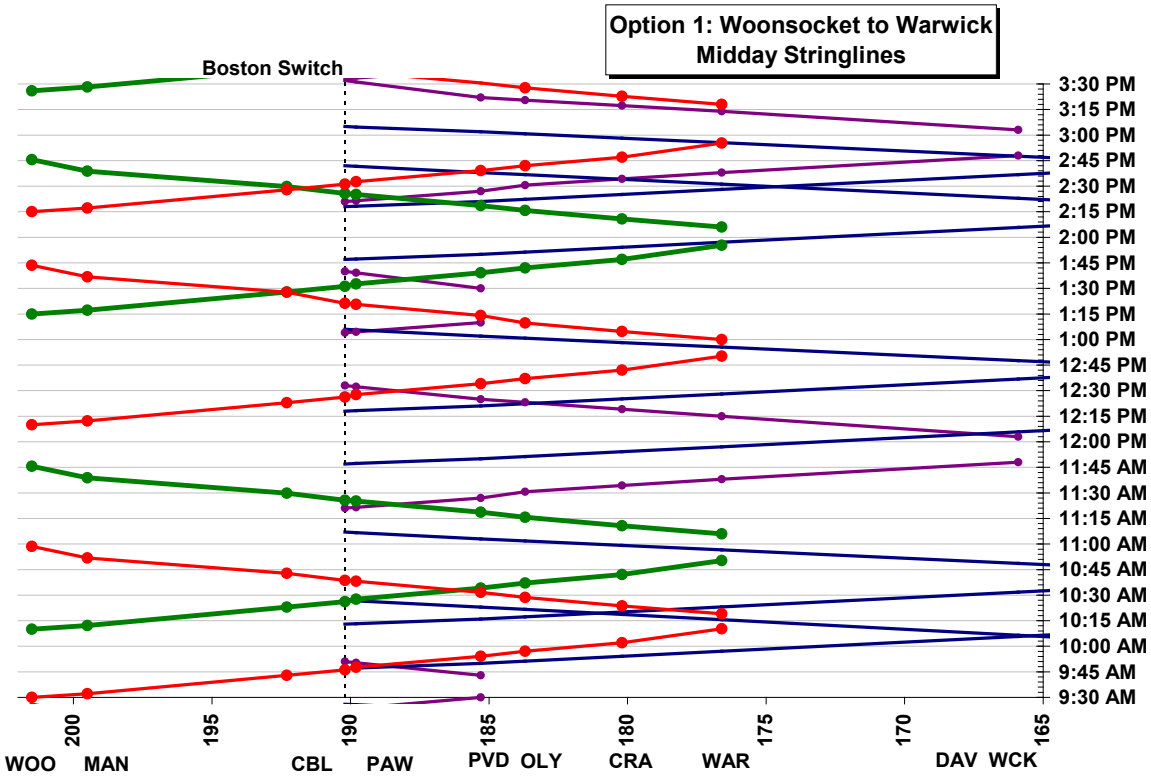
APPENDIX B – STRINGLINES

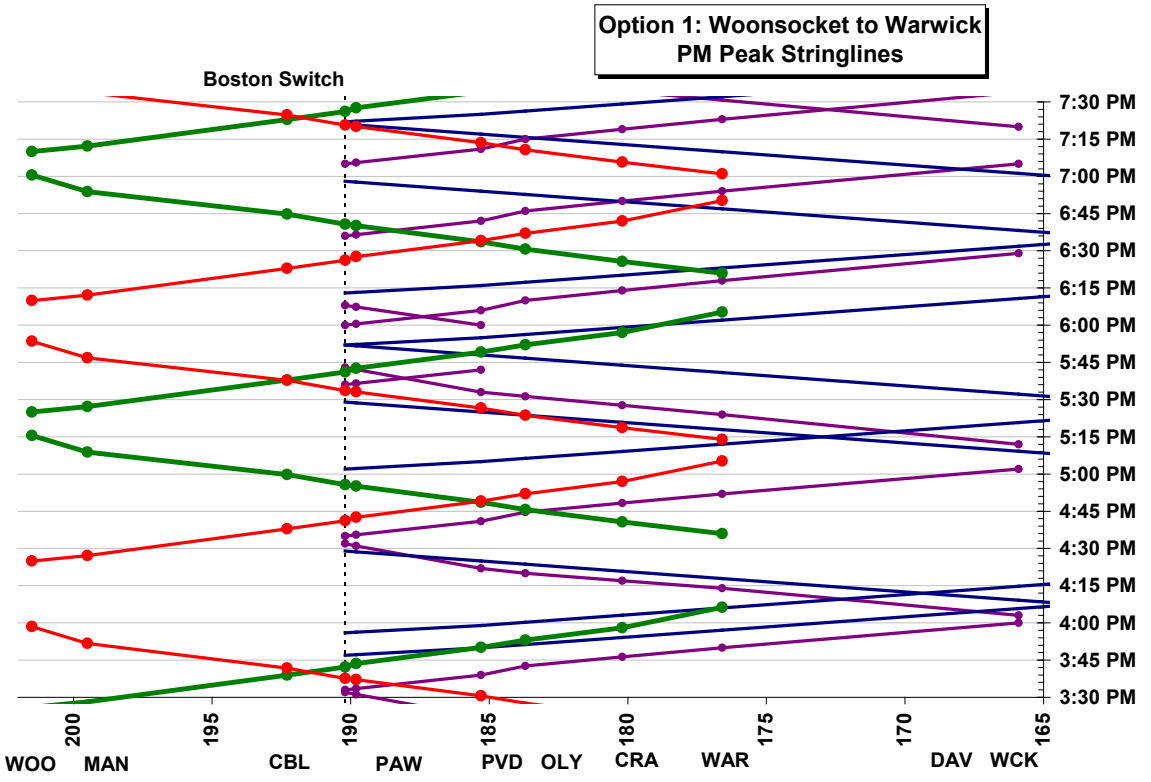
Key to Stations and Important Route Locations

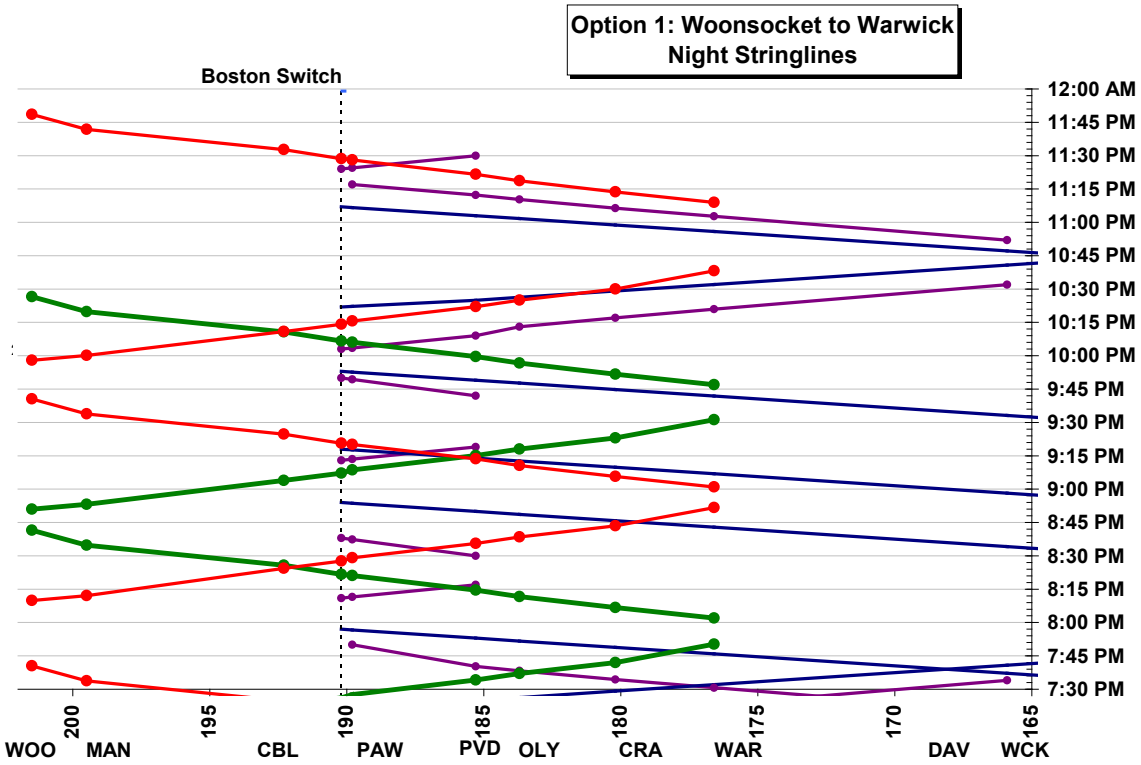
WOO	Woonsocket
MAN	Manville
CBL	Cumberland
PAW	Pawtucket
PVD	Providence
OLY	Olneyville
CRA	Cranston
WAR	Warwick (TF Green Airport)
DAV	Davisville
WCK	Wickford

Option 1

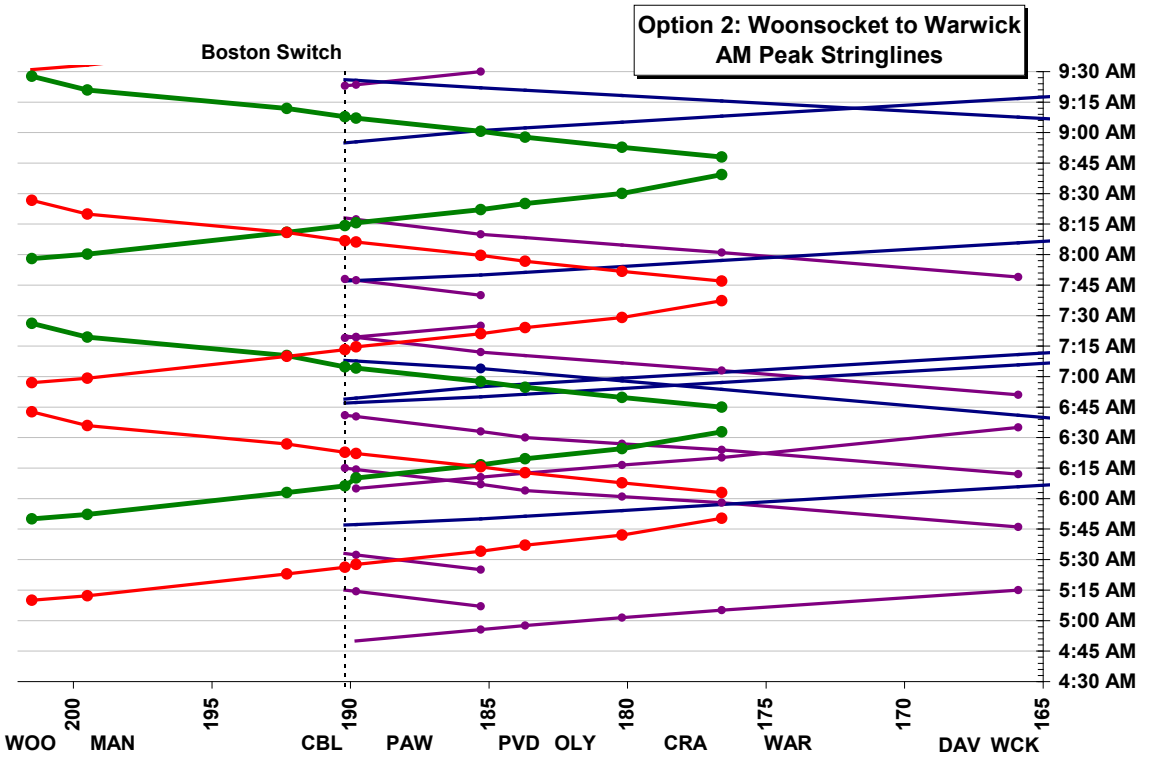


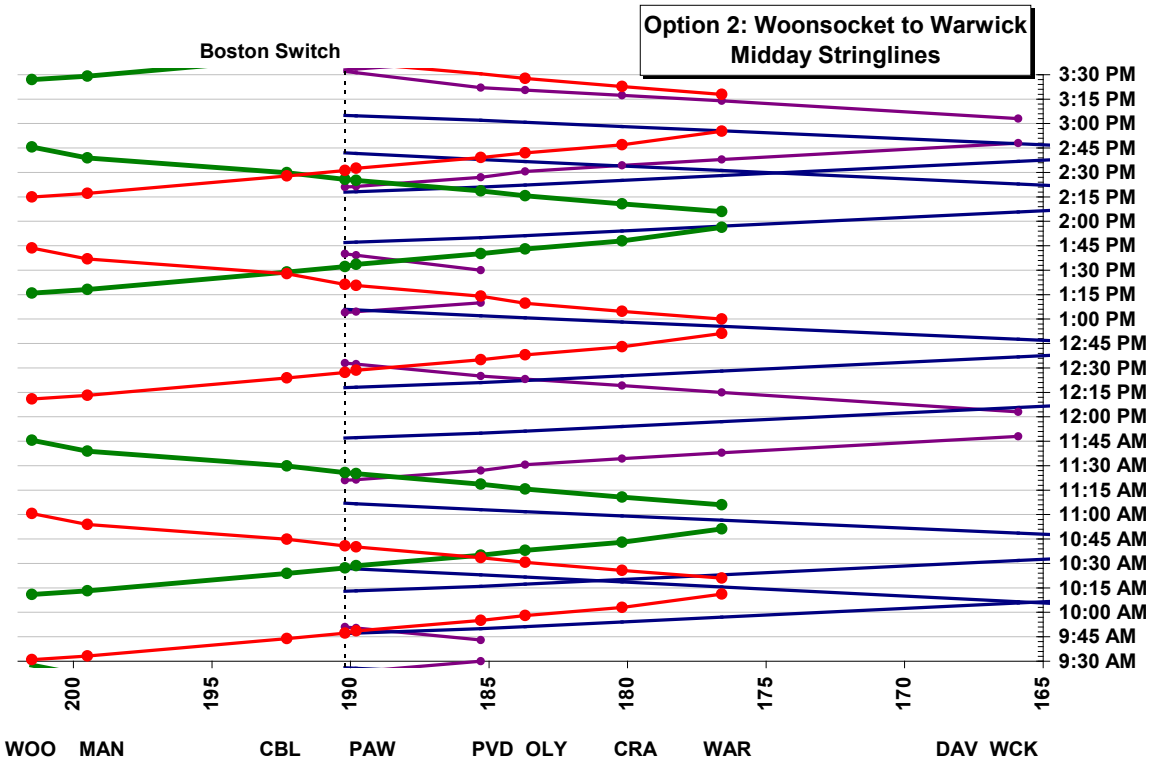

Option 1: Woonsocket to Warwick
Midday Stringlines
Boston Switch
3:30 PM
3:15 PM
3:00 PM
2:45 PM
2:30 PM
2:15 PM
2:00 PM
1:45 PM
1:30 PM
1:15 PM
1:00 PM
12:45 PM
12:30 PM
12:15 PM
12:00 PM
11:45 AM
11:30 AM
11:15 AM
11:00 AM
10:45 AM
10:30 AM
10:15 AM
10:00 AM
9:45 AM
9:30 AM
200
195
190
185
180
175
170
165
WOO
MAN
CBL
PAW
PVD
OLY
CRA
WAR
DAV
WCK

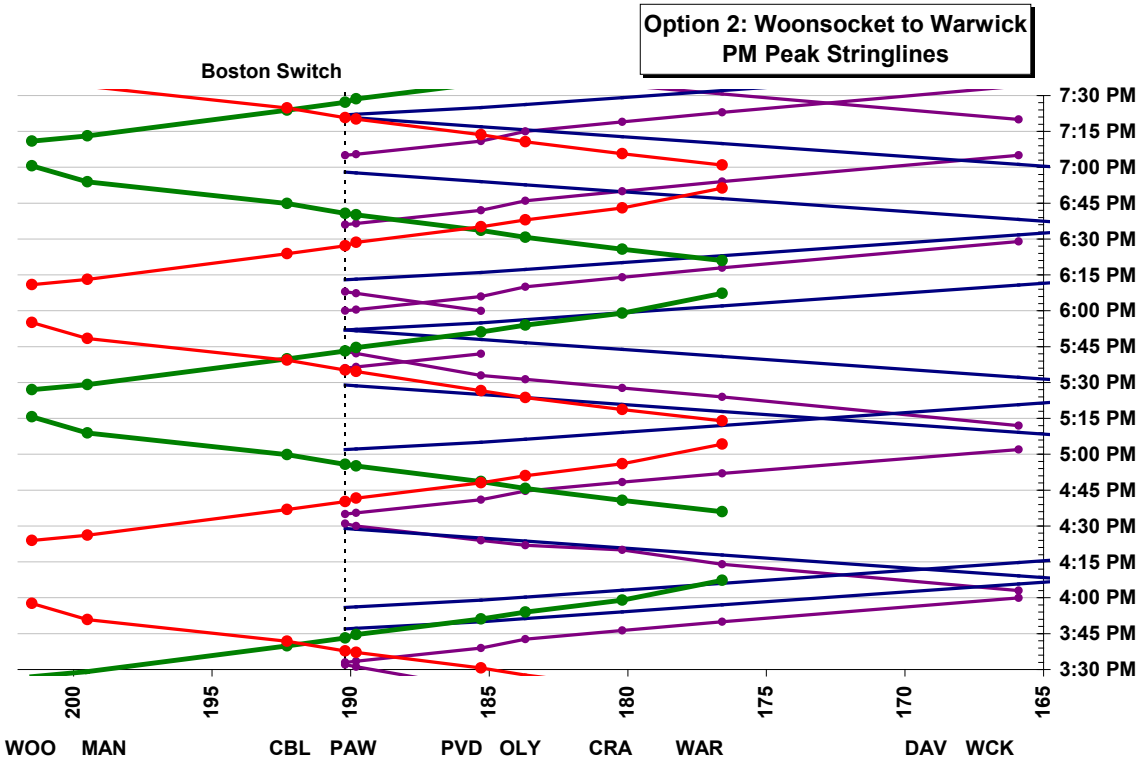

Option 1: Woonsocket to Warwick
PM Peak Stringlines
Boston Switch
7:30 PM
7:15 PM
7:00 PM
6:45 PM
6:30 PM
6:15 PM
6:00 PM
5:45 PM
5:30 PM
5:15 PM
5:00 PM
4:45 PM
4:30 PM
4:15 PM
4:00 PM
3:45 PM
3:30 PM
200
195
190
185
180
175
170
165
WOO
MAN
CBL
PAW
PVD
OLY
CRA
WAR
DAV
WCK

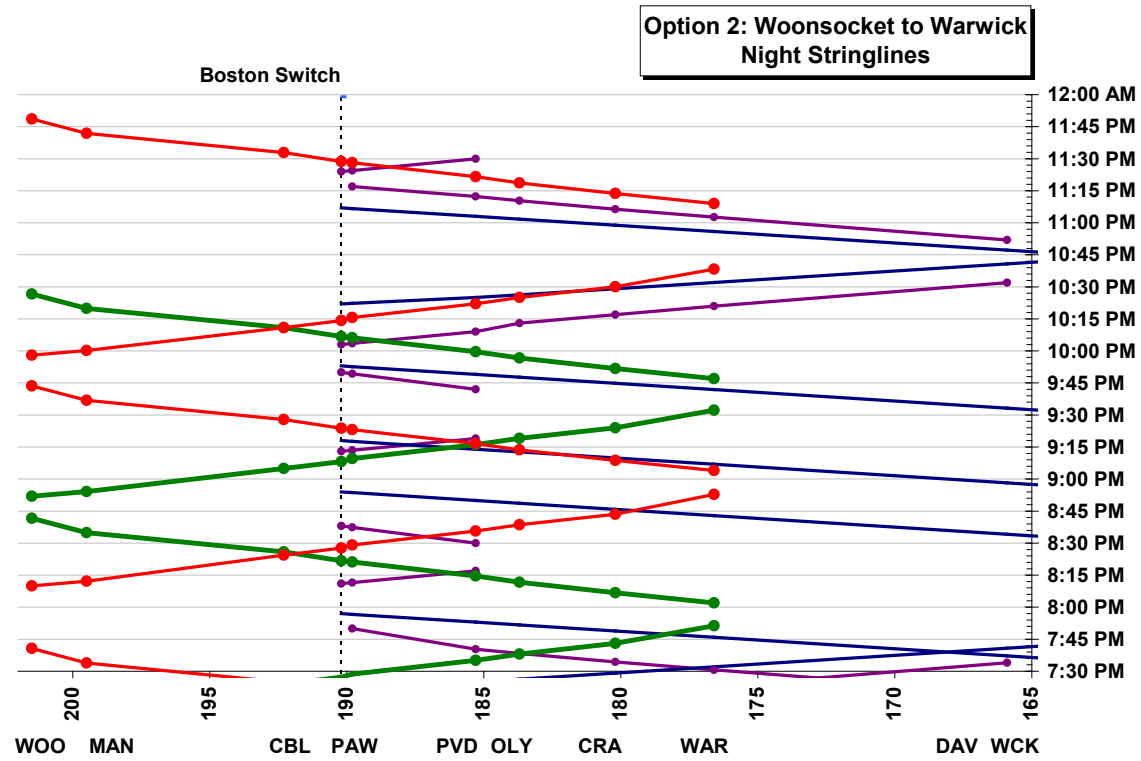

Option 1: Woonsocket to Warwick
Night Stringlines
Boston Switch
12:00 AM
11:45 PM
11:30 PM
11:15 PM
11:00 PM
10:45 PM
10:30 PM
10:15 PM
10:00 PM
9:45 PM
9:30 PM
9:15 PM
9:00 PM
8:45 PM
8:30 PM
8:15 PM
8:00 PM
7:45 PM
7:30 PM
200
195
190
185
180
175
170
165
WOO
MAN
CBL
PAW
PVD
OLY
CRA
WAR
DAV
WCK

Option 2

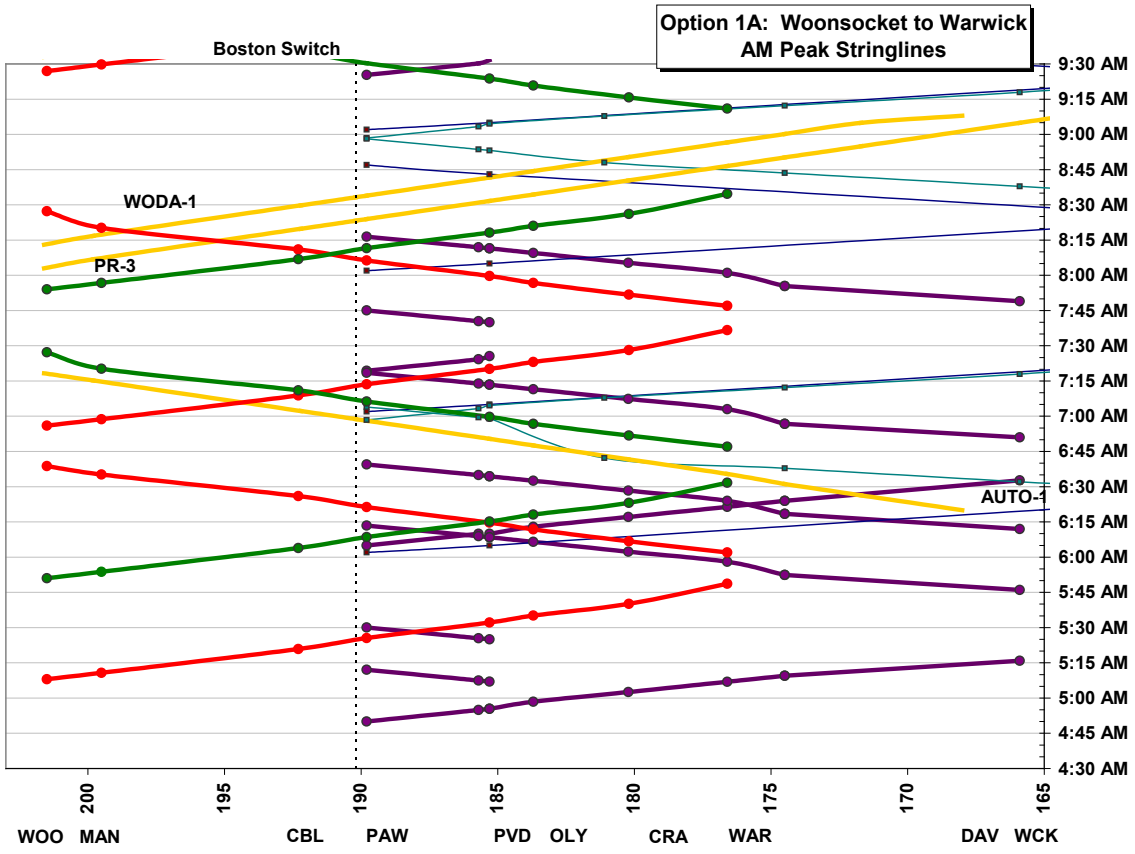

Option 2: Woonsocket to Warwick
AM Peak Stringlines
Boston Switch
9:30 AM
9:15 AM
9:00 AM
8:45 AM
8:30 AM
8:15 AM
8:00 AM
7:45 AM
7:30 AM
7:15 AM
7:00 AM
6:45 AM
6:30 AM
6:15 AM
6:00 AM
5:45 AM
5:30 AM
5:15 AM
5:00 AM
4:45 AM
4:30 AM
200
195
190
185
180
175
170
165
WOO
MAN
CBL
PAW
PVD
OLY
CRA
WAR
DAV
WCK

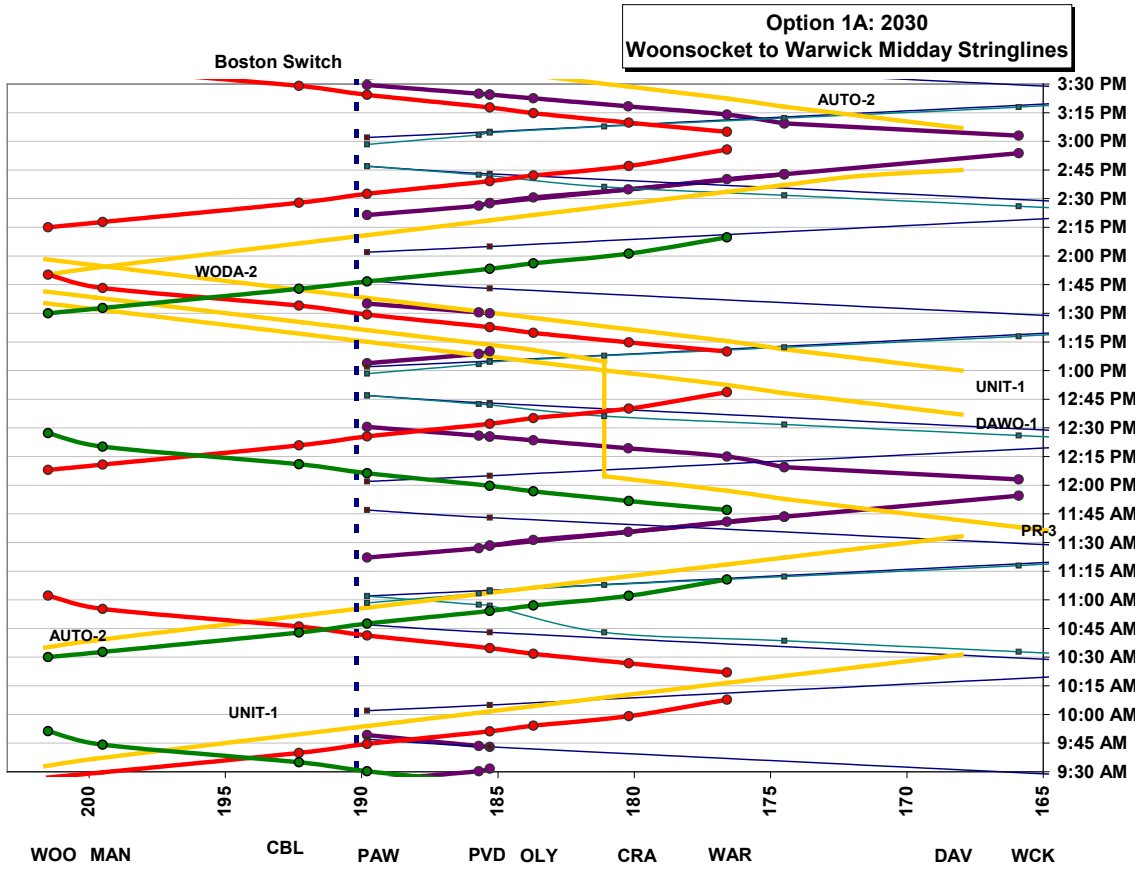

Option 2: Woonsocket to Warwick
Midday Stringlines
Boston Switch
3:30 PM
3:15 PM
3:00 PM
2:45 PM
2:30 PM
2:15 PM
2:00 PM
1:45 PM
1:30 PM
1:15 PM
1:00 PM
12:45 PM
12:30 PM
12:15 PM
12:00 PM
11:45 AM
11:30 AM
11:15 AM
11:00 AM
10:45 AM
10:30 AM
10:15 AM
10:00 AM
9:45 AM
9:30 AM
200
195
190
185
180
175
170
165
WOO
MAN
CBL
PAW
PVD
OLY
CRA
WAR
DAV
WCK

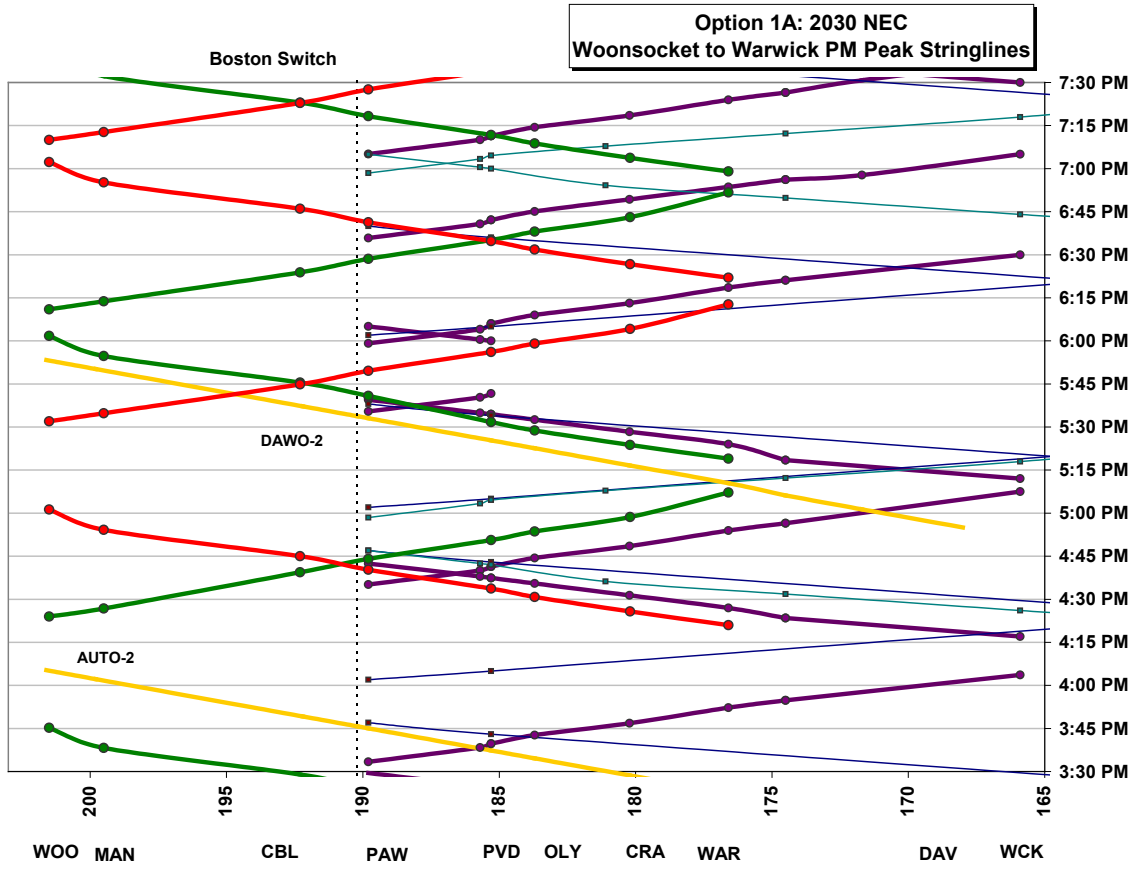

Option 2: Woonsocket to Warwick
PM Peak Stringlines
Boston Switch
7:30 PM
7:15 PM
7:00 PM
6:45 PM
6:30 PM
6:15 PM
6:00 PM
5:45 PM
5:30 PM
5:15 PM
5:00 PM
4:45 PM
4:30 PM
4:15 PM
4:00 PM
3:45 PM
3:30 PM
200
195
190
185
180
175
170
165
WOO
MAN
CBL
PAW
PVD
OLY
CRA
WAR
DAV
WCK

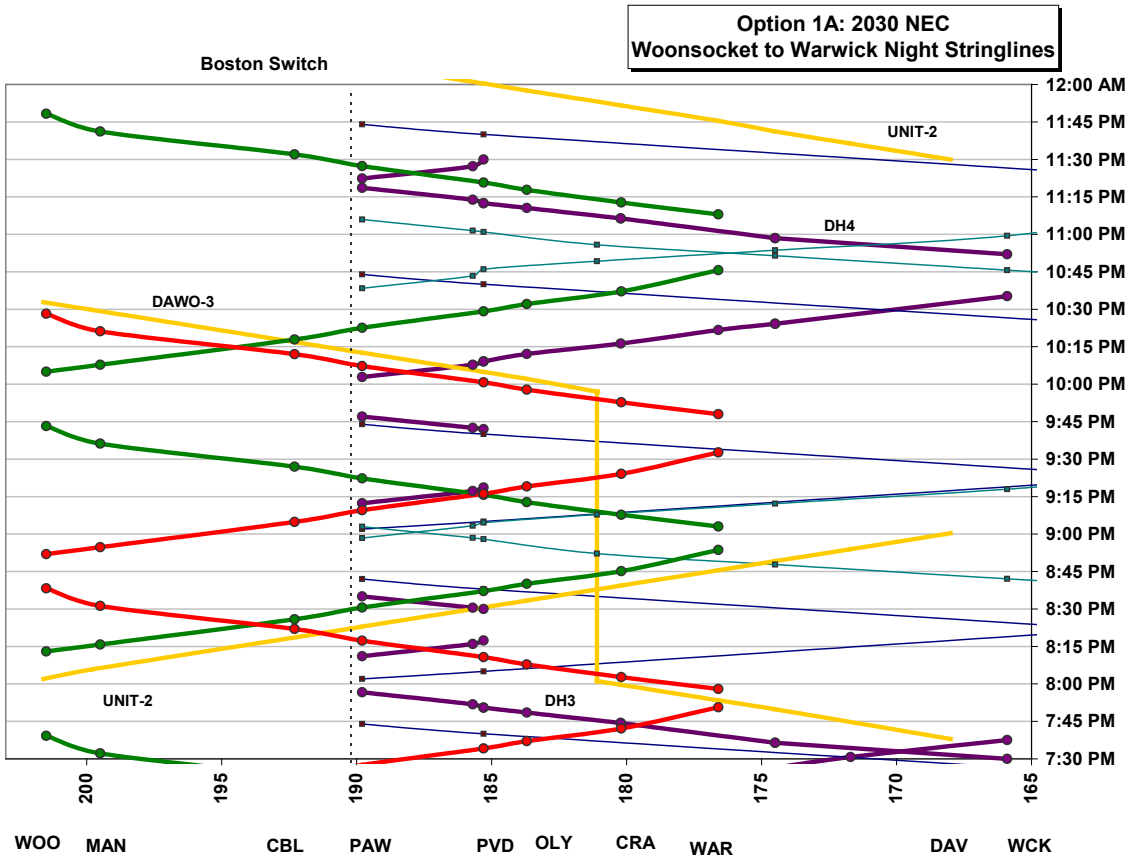

Option 2: Woonsocket to Warwick
Night Stringlines
Boston Switch
12:00 AM
11:45 PM
11:30 PM
11:15 PM
11:00 PM
10:45 PM
10:30 PM
10:15 PM
10:00 PM
9:45 PM
9:30 PM
9:15 PM
9:00 PM
8:45 PM
8:30 PM
8:15 PM
8:00 PM
7:45 PM
7:30 PM
200
195
190
185
180
175
170
165
WOO
MAN
CBL
PAW
PVD
OLY
CRA
WAR
DAV
WCK

Option 1A

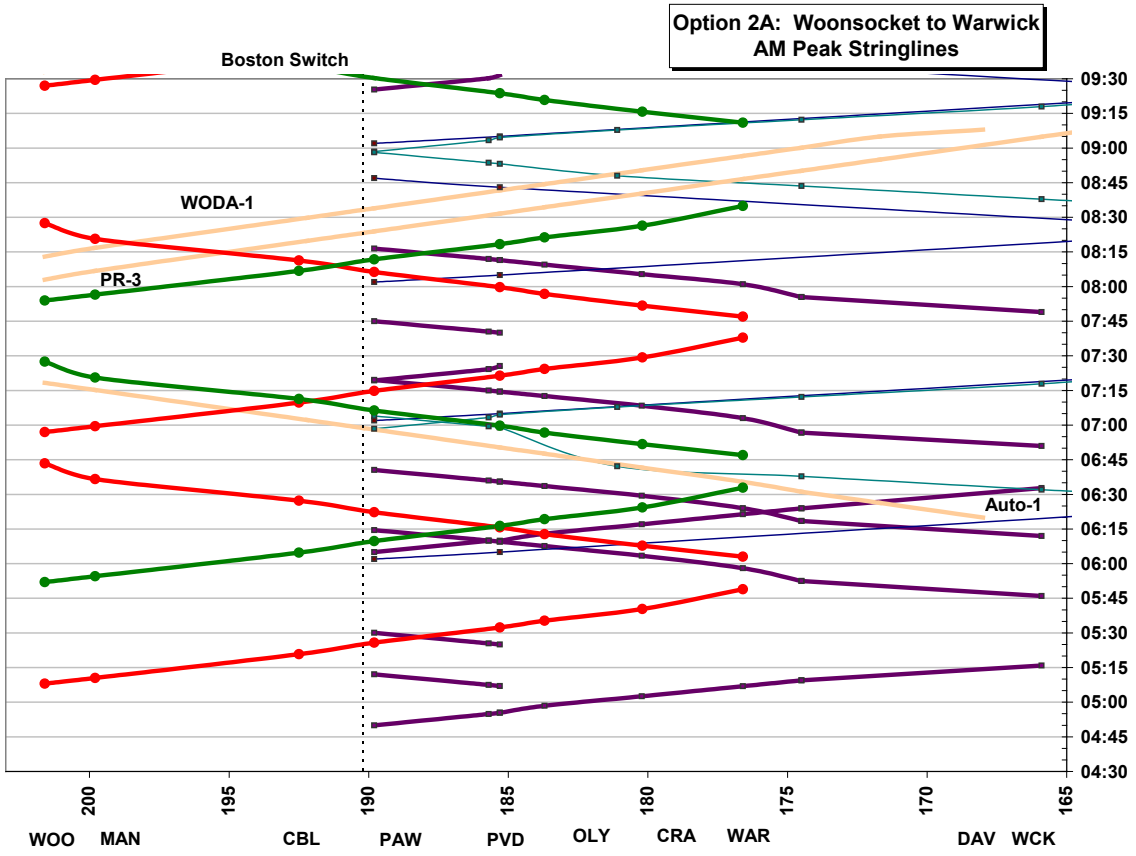

Option 1A: Woonsocket to Warwick
AM Peak Stringlines
Boston Switch
WODA-1
PR-3
AUTO-1
9:30 AM
9:15 AM
9:00 AM
8:45 AM
8:30 AM
8:15 AM
8:00 AM
7:45 AM
7:30 AM
7:15 AM
7:00 AM
6:45 AM
6:30 AM
6:15 AM
6:00 AM
5:45 AM
5:30 AM
5:15 AM
5:00 AM
4:45 AM
4:30 AM
200
195
190
185
180
175
170
165
WOO
MAN
CBL
PAW
PVD
OLY
CRA
WAR
DAV
WCK

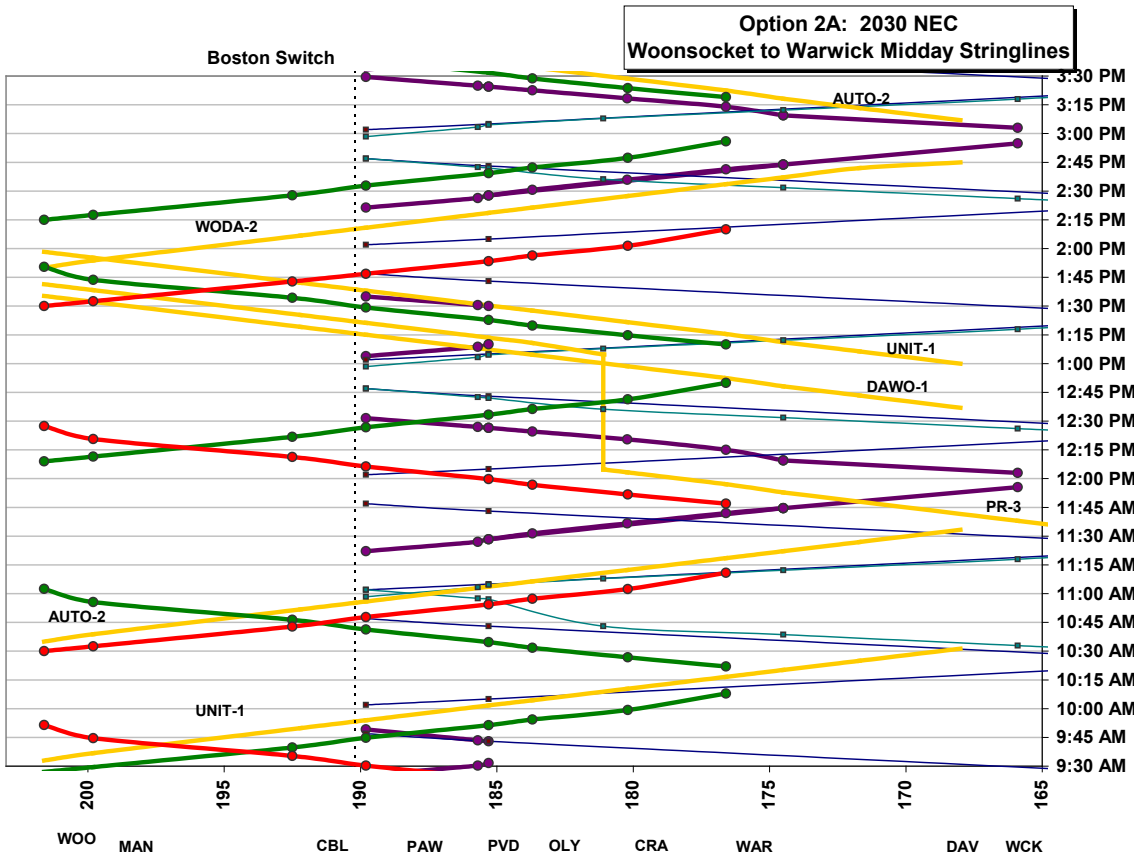

Option 1A: 2030
Woonsocket to Warwick Midday Stringlines
Boston Switch
AUTO-2
WODA-2
UNIT-1
DAWO-1
PR-3
AUTO-2
UNIT-1
3:30 PM
3:15 PM
3:00 PM
2:45 PM
2:30 PM
2:15 PM
2:00 PM
1:45 PM
1:30 PM
1:15 PM
1:00 PM
12:45 PM
12:30 PM
12:15 PM
12:00 PM
11:45 AM
11:30 AM
11:15 AM
11:00 AM
10:45 AM
10:30 AM
10:15 AM
10:00 AM
9:45 AM
9:30 AM
200
195
190
185
180
175
170
165
WOO
MAN
CBL
PAW
PVD
OLY
CRA
WAR
DAV
WCK

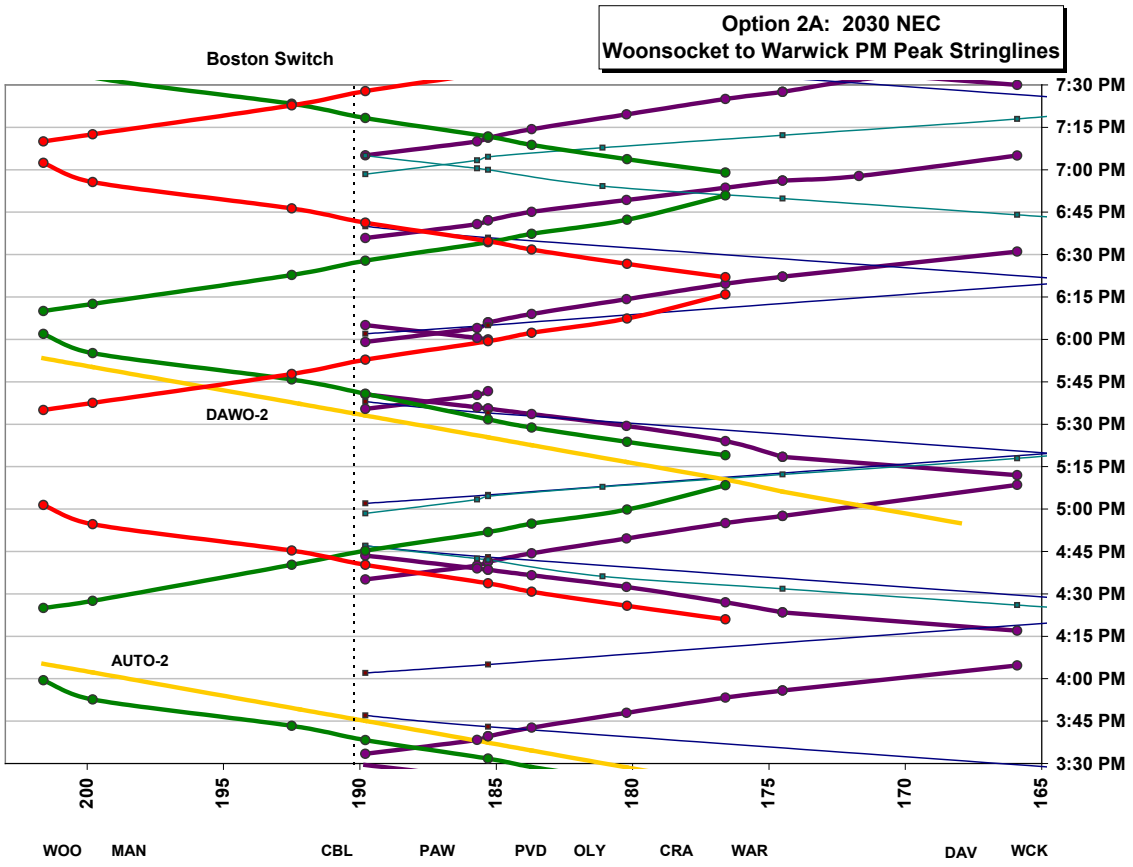

Option 1A: 2030 NEC
Woonsocket to Warwick PM Peak Stringlines
Boston Switch
DAWO-2
AUTO-2
7:30 PM
7:15 PM
7:00 PM
6:45 PM
6:30 PM
6:15 PM
6:00 PM
5:45 PM
5:30 PM
5:15 PM
5:00 PM
4:45 PM
4:30 PM
4:15 PM
4:00 PM
3:45 PM
3:30 PM
200
195
190
185
180
175
170
165
WOO
MAN
CBL
PAW
PVD
OLY
CRA
WAR
DAV
WCK

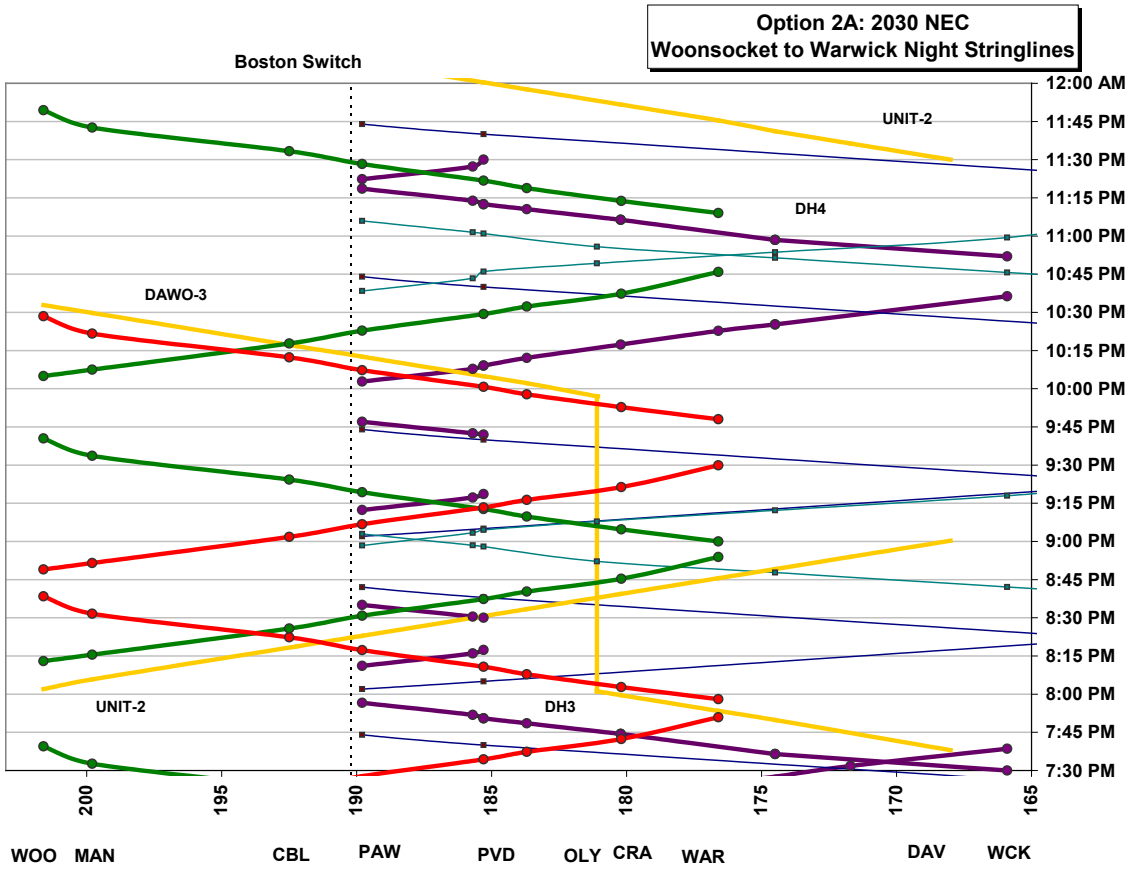

Option 1A: 2030 NEC
Woonsocket to Warwick Night Stringlines
Boston Switch
UNIT-2
DH4
DAWO-3
UNIT-2
DH3
12:00 AM
11:45 PM
11:30 PM
11:15 PM
11:00 PM
10:45 PM
10:30 PM
10:15 PM
10:00 PM
9:45 PM
9:30 PM
9:15 PM
9:00 PM
8:45 PM
8:30 PM
8:15 PM
8:00 PM
7:45 PM
7:30 PM
200
195
190
185
180
175
170
165
WOO
MAN
CBL
PAW
PVD
OLY
CRA
WAR
DAV
WCK

Option 2A


Option 2A: Woonsocket to Warwick
AM Peak Stringlines
Boston Switch
WODA-1
PR-3
Auto-1
09:30
09:15
09:00
08:45
08:30
08:15
08:00
07:45
07:30
07:15
07:00
06:45
06:30
06:15
06:00
05:45
05:30
05:15
05:00
04:45
04:30
200
195
190
185
180
175
170
165
WOO
MAN
CBL
PAW
PVD
OLY
CRA
WAR
DAV
WCK


Option 2A: 2030 NEC
Woonsocket to Warwick Midday Stringlines
Boston Switch
AUTO-2
WODA-2
UNIT-1
DAWO-1
PR-3
AUTO-2
UNIT-1
3:30 PM
3:15 PM
3:00 PM
2:45 PM
2:30 PM
2:15 PM
2:00 PM
1:45 PM
1:30 PM
1:15 PM
1:00 PM
12:45 PM
12:30 PM
12:15 PM
12:00 PM
11:45 AM
11:30 AM
11:15 AM
11:00 AM
10:45 AM
10:30 AM
10:15 AM
10:00 AM
9:45 AM
9:30 AM
200
195
190
185
180
175
170
165
WOO
MAN
CBL
PAW
PVD
OLY
CRA
WAR
DAV
WCK


Option 2A: 2030 NEC
Woonsocket to Warwick PM Peak Stringlines
Boston Switch
DAWO-2
AUTO-2
7:30 PM
7:15 PM
7:00 PM
6:45 PM
6:30 PM
6:15 PM
6:00 PM
5:45 PM
5:30 PM
5:15 PM
5:00 PM
4:45 PM
4:30 PM
4:15 PM
4:00 PM
3:45 PM
3:30 PM
200
195
190
185
180
175
170
165
WOO
MAN
CBL
PAW
PVD
OLY
CRA
WAR
DAV
WCK


Option 2A: 2030 NEC
Woonsocket to Warwick Night Stringlines
Boston Switch
UNIT-2
DH4
DAWO-3
UNIT-2
DH3
12:00 AM
11:45 PM
11:30 PM
11:15 PM
11:00 PM
10:45 PM
10:30 PM
10:15 PM
10:00 PM
9:45 PM
9:30 PM
9:15 PM
9:00 PM
8:45 PM
8:30 PM
8:15 PM
8:00 PM
7:45 PM
7:30 PM
200
195
190
185
180
175
170
165
WOO
MAN
CBL
PAW
PVD
OLY
CRA
WAR
DAV
WCK

End Notes

[i] United States Census Bureau. *2000 U.S. Census Data*. Washington, D.C., 2000. Available: *http://factfinder.census.gov/servlet/DTTable?_bm=y&-context=dt&-ds_name=DEC_2000_SF1_U&-CONTEXT=dt&-mt_name=DEC_2000_SF1_U_P001&-mt_name=DEC_2000_SF1_U_P015&-mt_name=DEC_2000_SF1_U_P016&-mt_name=DEC_2000_SF1_U_P017&-tree_id=4001&-redoLog=false&-all_geo_types=N&-currentselections=DEC_2000_SF3_U_P030&-geo_id=06000US4400322240&-geo_id=06000US4400374300&-geo_id=06000US4400378440&-geo_id=06000US4400711800&-geo_id=06000US4400714140&-geo_id=06000US4400719180&-geo_id=06000US4400720080&-geo_id=06000US4400741500&-geo_id=06000US4400752480&-geo_id=06000US4400754640&-geo_id=06000US4400759000&-geo_id=06000US4400780780&-geo_id=06000US4400951580&-search_results=01000US&-format=&-_lang=en*

[ii] Ibid.

[iii] Ibid.