Northern New England Intercity Rail Initiative

BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

ALTERNATIVE ANALYSIS REPORT

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EXECUTIVE SUMMARY

The Northern New England Intercity Rail Initiative (NNEIRI) examines the implementation and operation of more frequent and higher speed intercity passenger rail service along the NNEIRI Corridor. The Corridor is made up of two overlapping routes, one that connects the cities of Boston, Massachusetts and New Haven, Connecticut via Springfield, Massachusetts, and one that connects the cities of Boston, Massachusetts and Montreal, Quebec via Springfield, Massachusetts.

This Alternatives Analysis Report presents the process and data used to develop three Build Alternatives and a single No Build Alternative. At the beginning of the process, 18 rail service options were developed with ranges of speed, frequency, and equipment. These options were analyzed to assess impacts on ridership and train performance. Documentation of the initial option screening is included the Preliminary Service Options and Performance chapter. Data from the analysis was then used to determine the three Build Alternatives and one No Build Alternative that would be further analyzed in the Alternatives Analysis process.

The Build Alternatives include potential service, speed and equipment improvements that will provide a range of preliminary costs, ridership, and travel times between Corridor locations. The No-Build Alternative was developed based on data from existing and proposed projects that are expected to be in service regardless of NNEIRI implementation. The four alternatives include:

No Build Alternative: Assumes no NNEIRI service on the Corridor. This Alternative is the base case against which each of the Build Alternatives are measured. This Alternative includes existing and anticipated transportation improvements in the NNEIRI Corridor area, including improved New Haven-Hartford-Springfield rail service, Springfield Union Station improvements, Boston South Station expansion, extension of the Amtrak Vermonter to Montreal, and improvements to the Montreal-area rail network.

Alternative 1 – Corridor Service: Improved speeds up to 60 mph, where operations are currently slower, and new passenger service providing six daily departures from Boston, three from Montreal, and 5 from New Haven. Initial capital cost, including infrastructure upgrades and equipment purchases is expected to be $615-785 million. Ridership on Alternative 1 is expected to be 597,000 passengers annually and the service is expected to require $24million in operating funding.

Alternative 2 – Corridor Service with Speed Improvements: Improved speeds up to 79 mph, where operations are currently slower, and new passenger service providing 11 daily departures from Boston, 5 departures from Montreal, and 11 from New Haven. Initial capital costs are expected to be $1.062-1.350 billion. Ridership is expected to be 1,052,500 annually and the service is expected to need $76 million in annual operating funding.

Alternative 3 – Corridor Service with Speed and Equipment Improvements: Improved speeds up to 90 mph, where operations are currently slower, utilization of tilting train equipment, and new passenger service providing 16 daily departures from Boston, 5 from Montreal, and 11 from New Haven. Alternative 3 is notable for the inclusion of 5 additional shuttle trains between Boston and Springfield to provide increase connectivity between city pairs in the Boston to Springfield segment. Capital costs in Alternative 3 are expected to cost $1.255-

1.590 billion. Ridership is expected to be 1,170,700 annual riders and $88 million in operating funding will be required each year.

Additionally, an environmental analysis for all three Build Alternatives was completed and compared with the No Build Alternative. The screening analyzed major environmental issues, including natural resources, human environment, land use, construction impacts, and historical implications. The analysis found that impacts along the Corridor are anticipated to be generally minor and moderate with some increased in impacts in specific locations due to operations and infrastructure needs, however no impacts are anticipated to be significant.

The three Build Alternatives provide significantly different levels of cost, ridership, and required operating funding on the Corridor. Subsequent to the Alternative Analysis Report, a Recommend Alternative will be developed. The Recommend Alternative will be either one of the Build Alternatives or a compilation of the portions of the three alternatives that are most feasible and beneficial and will be determined based on public input, stakeholder input, and final determination of the project management team.

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1 INTRODUCTION

The Northern New England Intercity Rail Initiative (NNEIRI) examines the implementation and operation of more frequent and higher speed intercity passenger rail service along the NNEIRI Corridor. The Corridor is made up of two overlapping routes, one that connects the cities of Boston, Massachusetts and New Haven, Connecticut via the city of Springfield, MA, and one that connects the cities of Boston, Massachusetts and Montreal, Quebec via the city of Springfield, Massachusetts.

The NNEIRI (or the Study) focuses on incremental infrastructure improvement concepts to maximize the use of existing rail corridors between Boston and Springfield, and the segments connecting Springfield to Montreal and Springfield to New Haven. Figure 1.1 provides an overview of the locations of segment of the Corridor and the general study area.

Figure 1.1. NNEIRI Study Area

The Alternative Analysis for the NNEIRI study utilizes data and analysis to create three distinct BUILD Alternatives that analyze a range of speed and frequency possibilities. A No Build Alternative is also developed as a means of comparing the three alternatives. The three Build Alternatives include:

Alternative 1 - Corridor Service: Provides all local service on the Corridor, including four trains between Boston and New Haven, two from Boston to Montreal, and one additional train between New Haven and Montreal. Speeds on the Corridor will be improved to at least 60 mph and standard train equipment will be used.

Alternative 2 - Corridor Service with Speed Improvements: Builds on Alternative 1 with the addition of four express trains between Boston and New Haven, one from Boston to Montreal, and one from New Haven to Montreal. Additionally, speeds will be improved to at least 79 mph and operations and standard train equipment will be used.

Alternative 3 - Corridor Service with Speed and Equipment Improvements: In addition to service in Alternatives 1 and 2, Alternative 3 adds five local roundtrips between Boston and Springfield. Additionally, speeds are improved to at least 90 mph and tilting train sets are utilized.

The three Build Alternatives are supported by operational analysis, preliminary environmental screening, and bottom-up “order of magnitude” cost estimates of capital improvements. The report has been prepared based on currently available existing information and data. The data was gathered from diverse sources, including publically available information, government reports, and partner railroads.

2 PROJECT BACKGROUND

The Northern New England High-Speed Rail Corridor is one of ten federally-designated, high-speed rail corridors in the United States. The Boston to Montreal Corridor was designated by U.S. Transportation Secretary Rodney E. Slater on October 11, 2000 as part of the "Northern New England Corridor," which included a hub at Boston and two spokes: one to Montreal, via Concord, New Hampshire, and the other to Portland/Lewiston-Auburn, Maine. The Inland Route (the rail line connecting Boston-Springfield-New Haven) was designated as an additional part of the Northern New England High-Speed Rail Corridor along with the route between Springfield, and Albany, New York in the Consolidated Appropriations Act, 2005 (PL 108-447) on December 8, 2004.

The original alignment that was federally designated for the Boston to Montreal Corridor consisted of a route via Concord, New Hampshire and through White River Junction, Vermont. An initial study for this alignment was completed in April 2003 and FRA approved a grant for a subsequent, more detailed study effort on September 10, 2003. However, the State of New Hampshire decided at that time to no longer participate in the respective planning effort, which halted progress on Boston to Montreal Corridor study.

The Massachusetts Department of Transportation (MassDOT) and Vermont Agency of Transportation (VTrans) worked with the Federal Railroad Administration (FRA) to revise the project scope to study an alternate alignment for the Boston-to-Montreal Corridor utilizing the Inland Route tracks from Boston to Springfield, with the route then turning north along the Knowledge Corridor (from Springfield to East Northfield, Massachusetts). The corridor continues north to White River Junction, Vermont where the rail line rejoins the original federally designated high speed rail alignment and finally ends north in Montreal. With this new alignment, the Inland Route tracks between Boston and Springfield would be utilized by both the Inland Route corridor service that is being proposed, as well as the Boston-to-Montreal passenger rail service. The study will thus evaluate both of these corridors as a combined corridor. The study of these Corridors is known as the Northern New England Intercity Rail Initiative (NNEIRI).

Improvements along both corridors have been ongoing. The segment of the Inland Route between Springfield and New Haven is the focus of the New Haven-Hartford-Springfield (NHHS) High-Speed Intercity Passenger Rail (HSIPR) Project headed by the Connecticut Department of Transportation (CTDOT). The Federal Railroad Administration (FRA) is the lead federal agency of this project. The proposed capacity, reliability, and safety improvements along the NHHS corridor, which are being funded in part by the FRA's HSIPR Program, will facilitate an increase in the maximum train speed to 110 mph, reduce scheduled travel times, reduce conflicts with freight trains on shared tracks, and increase capacity for additional passenger rail service. Additionally, the segment of the Boston to Montreal Corridor in Vermont has been improved through a program of track upgrades funded through the HSIPR program. Additionally, work on the Massachusetts segment of the right of way, known as the Knowledge Corridor, was recently completed and has facilitated restoration of Amtrak's Vermonter service between Northampton and Greenfield, Massachusetts.

In 2009, a framework was created for improving high speed and intercity rail in New England. This framework, known as the New England Vision for High Speed and Intercity Passenger Rail, was a collaborative effort of the New England states to improve the railroad network connectivity within the region. The vision for this effort is to develop a safe and efficient passenger rail system that seamlessly links the region's communities. It would provide a foundation for economic competitiveness and promote livable communities by connecting every major city in New England with smaller cities and rural areas, as well as provide an international connection to Montreal. This improved system would include faster and more frequent rail service that promotes energy efficiency and environmental quality by providing alternative transportation choices while further enhancing the movement of freight throughout the region.

To advance this overall vision, the NNEIRI study will evaluate the two rail corridors that link in Springfield: the Boston-Springfield-Montreal and Boston-Springfield-New Haven Corridors. The 470 mile route travels through portions of Massachusetts, Connecticut, Vermont, New Hampshire, and Quebec, Canada.

3 PRELIMINARY SERVICE OPTIONS AND PERFORMANCE

This chapter of the Alternatives Analysis Report presents the preliminary set of intercity rail service options considered for the NNEIRI Corridor, the methodology used to assess the performance of those options, the estimated train performance with each option and the estimated ridership that would result from each of the preliminary option.

3.1 PRELIMINARY SERVICE OPTIONS

A total of 18 Preliminary Service Options were developed for consideration and analysis by identifying possible attributes of train operations along the existing Boston to Montreal Corridor. Boston to New Haven service utilizes the Connecticut Department of Transportation plan for the New Haven-Hartford-Springfield (NHHS) service and therefore was not modeled for to determine speed, equipment, and engineering parameters. These options were developed based on consideration of the following criteria:

- **Speed:** Top speeds of 60, 79, 90, 110, 125 mph
- **Equipment:** Tilt and non-tilt train equipment
- **Engineering Specifications:** Track engineering specification modifications that include:
    - Super-elevation
    - Unbalance
- **Number of Locomotives:** Use of more than one locomotive for each trainset.

The set of Preliminary Service Options were selected to identify the range of potential pure train running times achievable with different capital improvements and operating variables. A summary of the primary options developed for analysis include the following:

- **Base Options:**
    - Top speed for most of the alignment is 60 mph using conventional equipment, stopping at 14 stations between Boston and Montreal (local service).
- **Medium Speed Options:**
    - Top speed for the alignment is 79 mph using conventional equipment with local service (14 intermediate stations).
    - Top speed for the alignment is 79 mph using conventional equipment with express service (five intermediate stations).
    - Top speed for the alignment is 90 mph using conventional equipment with local service (14 intermediate stations).
    - Top speed for the alignment is 90 mph using conventional equipment with express service (five intermediate stations).
    - Top speed for the alignment is 90 mph using tilting train equipment with express service (five intermediate stations).

- **High Speed Options:**
  - Top speed for the alignment is 110 mph using tilting train equipment with express service (five intermediate stations).
  - Top speed for the alignment is 125 mph using tilting train equipment with express service (five intermediate stations).

For each of the nine primary options identified above, an assessment in which a single locomotive for each train consist was used and one in which two locomotives per train consist was used. Stations were identified for the Preliminary Service Options for a local type service with stops approximately every 20-25 miles. Comparatively, an express service includes stops in only primary metropolitan areas.

For each preliminary service option, an estimate of station-to-station travel times and velocity profiles were developed. The travel time information was utilized to develop preliminary ridership estimates for both local and express service options. For the segment between Springfield and New Haven, the train performance and service plans developed as part of the New Haven-Hartford-Springfield Project were utilized. Additional detail regarding each option is provided in following sections.

3.2 TRAIN PERFORMANCE CALCULATOR

Using the Train Performance Calculator (TPC) train simulation model within the Berkeley Simulation Software, LLC's Rail Traffic Controller (RTC) software package, travel time estimates were developed for each option. The TPC model calculates the possible train running time over a given route using specific route characteristics.

The TPC calculates pure train running times for each option to permit comparisons of how each option varies from a travel time perspective. Pure train running time is the time a train takes to operate station-to-station, or end-to-end, on a particular route. It does not include station dwell time or schedule recovery time due to conflicts with other trains. TPC results were then modified to consider station dwell time and required schedule recovery time between stations to determine a final estimated run time.

3.2.1 Data and Train Performance

The TPC model for the corridor was constructed using available track charts, timetable special instructions, and other publically available data to replicate the physical characteristics of the infrastructure, including track distances, speeds, geometry, grades, and curvature. With regard to train performance, the primary differences for each of the options included the maximum allowable speed, or top speed, and the track super-elevation assumed and train unbalance permitted around each curve.

As shown in Table 3.1, FRA regulations establish classes of track based on maximum allowable speed. Maximum speeds in each of the options mirror FRA Track Classifications

Maximum Operating Speeds (MAS) for passenger rail. The FRA track safety standards primarily address track geometry, infrastructure conditions, and maintenance standards.[1]

Table 3.1: FRA Track Classifications

Over track that meets the requirements prescribed for:	The maximum allowable speed for freight trains is:	The maximum allowable speed for passenger trains is:
Class 1 Track	10 mph	15 mph
Class 2 Track	25 mph	30 mph
Class 3 Track	40 mph	59 mph*
Class 4 Track	60 mph	79 mph*
Class 5 Track	80 mph	90 mph
Class 6 Track	110 mph	110 mph
Class 7 Track	125 mph	125 mph

*Maximum speed in Class 3 is 60 mph with signal system. Maximum speed in class 4 is 80 mph with a cab signal system.

In developing the infrastructure assumptions for the options, specific consideration was made regarding track super-elevation. Super-elevation is the term used to describe the elevation of the outer rail of curved track above the inner rail. The purpose of super-elevating track is to counter balance the outward resultant centrifugal force created by rail cars navigating a curve by creating a force of tipping of the railcar toward the inside of the curve.

For each option using conventional equipment, a preferred super-elevation was calculated for each curve up to a maximum of four inches. Four inches is the typical maximum allowed on tracks where both freight and passenger trains operate to account for the differences in train speeds. For the options where tilt equipment was included (90 mph, 110 mph, and 125 mph), a maximum of seven inches was allowed to simulate the increased speeds that a tilt train would be capable of making around some curves. This proxy was necessary since the RTC model does not include the capability of calculating speeds for tilt type equipment.

Allowable track super-elevation also needs to take into account train "unbalance." For track that is elevated in a manner that, for a specific speed, the outward centrifugal force is equal to

[1] FRA Track Classification standards also contain specific requirements for higher speed operation. For operation at Class 5 or higher speeds (above 80 mph), trains must be equipped with positive train control and/or cab signal systems. A positive train control system will automatically slow or stop a train if an engineer fails to respond to a signal indication. A cab signal system duplicates signal indications on a display within the locomotive cab.

the inward tipping force, the rail car is said to be in equilibrium. Typically, trains operate over track at speeds greater than the equilibrium speed and the track is said to be unbalanced for that operating speed. Specifically, FRA requires that rail not exceed an unbalance of three inches, except where certain rail cars are allowed to operate with four inches of unbalance, such as Amfleet equipment. For each option that included conventional equipment, a maximum unbalance of three inches was assumed. For the options that included tilt equipment, an unbalance of four inches was allowed.

Additional speed limitations were included in the TPC calculations. In some locations, train speed limits are put in place due to site-specific conditions, such as urban areas, bridges, and environmental factors. At these locations, the speed was not increased over the speed limit until further investigation during the Alternatives Analysis regarding the speed restriction causes and possible changes that could eliminate the restriction.

The total weight of the vehicles, coaches, and persons was also estimated as part of the TPC process. Weight of both vehicles and passengers influences the ability of trains to start, gain speed, and stop. The average passenger weight, including baggage, was estimated at 200 pounds per person. Vehicles and coaches are assumed to be Amfleet coaches and P42 locomotives.

3.2.2 TPC Model Output

The TPC model develops graphical charts of train movements that are plotted to show allowable speed, goal speed, and actual speed. These graphs can be viewed in the TPC model output charts included in Appendix A. These charts graph calculated speeds over distance and time for each option.

The first plot, shown on the graphs as a gray area, is the allowable speed. In the model, the train is allowed to go a certain speed based on track geometry and maximum allowable speed by class of track and set speed limits. Allowable speed based on track geometry was calculated based on degree of curvature, the super-elevation, and unbalance assumptions discussed above.

The next plot, shown on the graphs as a red line, is goal speed, or the maximum speed the train would prefer to go given track grade and geometry. This takes into account the train breaking that is necessary so that the train never exceeds a calculated allowable speed at any location.

The calculated speed plot, shown on the graphs as a green line, is the calculated speed the train can travel, by calculating the possible acceleration and deceleration of the train along the corridor, taking into account, allowable and goal speeds, vertical grades, and station stops.

3.2.3 Service/Performance Options

Three different infrastructure “case” characteristics were defined to test in the train performance model. The TPC section was not intended to include specific infrastructure upgrades but to understand general conditions on the Corridor. Options are summarized below:

- **Base Options:** The Base Option assumed a service similar to that of a typical AMTRAK intercity train operating over existing railroad (i.e. freight) infrastructure. Running speeds were limited to those presented in the current timetables and track charts for the respective subdivisions. This was developed to provide a base understanding of passenger train travel times in the Corridor between Boston, Montreal, and New Haven. Travel times for NHHS services were utilized for the segment between Springfield and New Haven.
  - The present alignment was utilized, including existing track conditions, track geometry, and timetable running speeds for passenger service.
  - The maximum train speed is 59 mph, or FRA Class 3, except where higher speeds are currently allowed.
  - The service would be similar to the existing AMTRAK Vermonter on the Vermont section of the Corridor.
  - It is important to note that the current timetable track speeds include a multitude of restrictions. These slower speed limits are associated with specific track geometry, curve alignment, or a “local” condition such as a grade crossing speed restriction. The TPC model was constructed with the existing published speed restrictions for each segment of track.
- **Medium Speed Options**: Medium Speed Options were developed to examine the effects of significant speed increases on trip time. The maximum running speed for this case was 79 and 90 mph, based upon applying either a FRA Class 4 or 5 standard for track on the Corridor between Boston, Montreal, and New Haven.
  - The present alignment was utilized with a 79 and 90 mph maximum operating speeds and curve speeds restricted by track geometry. FRA Class 4 and or 5 was utilized with improved curve speeds.
  - Significant infrastructure upgrades were assumed so that limitations related to non-geometric timetable speed restrictions were eliminated and existing grades and curves were the primary restraints along the length of the Corridor.
  - Existing horizontal alignment characteristics (degree of curvature) were retained, although speed increases through curves were achieved with increases in unbalance. An unbalance of three inches was applied to the simulation with the conventional trainsets. Additionally, a 90 mph express was added reflecting speeds allowable by a seven inch maximum super-elevation and four inch unbalance as a proxy for speeds possible through use of tilt equipment.

- **High Speed Options:** These options were developed to examine the travel time benefits of increasing top travel speeds without significant realignment of track curvature on the Corridor between Boston and Montreal.
  - A 110 mph maximum operating speed was utilized assuming significant infrastructure upgrades that minimize speed restrictions through curves. FRA Class 6 was utilized with no speed restrictions. This was applied to the length of the Corridor where track geometry allowed for 110 mph operations.
  - Significant infrastructure upgrades were assumed so that limitations related to non-geometric timetable speed restrictions were eliminated and existing grades and curves were the primary restraints along the length of the Corridor. Existing grades were maintained.
  - Speed restrictions for reasons other than track geometry were not applied to this case. Existing horizontal alignment characteristics (degree of curvature) were retained, although speed increases through curves were achieved with increases in unbalance. A maximum seven inch super-elevation and four inch unbalance was utilized as a proxy for speeds possible through use of tilt equipment.
  - It is important to note that although the 125 mph train option was considered, it was never developed after results from the 110 mph option was analyzed and the train only achieved the maximum speed in one location and only de minimus travel time savings.

3.3 PRELIMINARY STATION STOPS

Station stops are key considerations in TPC model options and all existing intercity stations on the Corridor were considered potential station stops.[2] Additionally, select stations on the Corridor route were used to model operations for express service. On many rail corridors, to take advantage of higher operating speeds, express service is necessary to maximize the efficiency of train services. Express stations used in this analysis were considered due to geography, existing and proposed intermodal connections, commercial activity, and population density. Potential express stations on the Corridor include Boston (South Station), Boston (Back Bay), Worcester (Union Station), Springfield (Union Station), White River Junction, Burlington (Essex Junction), and Montreal (Central Station). Express station stops in Connecticut were not defined in the preliminary station stop analysis.

3.4 PERFORMANCE RESULTS

On the Boston to Montreal segment, 18 round trip options were modeled, estimating both northbound and southbound operations and use of train sets with both a single and double locomotive.

[2] St. Lambert Station in St. Lambert, Quebec was the only station omitted from consideration because of the study's assumption that a U.S. Customs and Border Patrol post was already inside Montreal's Central Station; thus precluding any additional stations in Canada.

3.4.1.1.1 Northbound/Southbound Performance

The results of the northbound and southbound services were nearly identical, with a maximum of two minutes separating service times between the two directions. This time is within the margin of error of the estimates and is not considered significant. Therefore, the minimal difference between the northbound and southbound travel times allows discussion of travel times and any future analysis of only one direction to simplify the process.

3.4.1.1.2 Locomotive Configuration Performance

As previously noted, the analysis was developed using trainsets with one locomotive (1P42) and two locomotives (2P42). For both local and express services, the use of two engines saved less than ten minutes over the entire trip. The travel time savings related to the number of locomotives was fairly consistent across options, and therefore use of one or two locomotives would not impact the selection of alternatives. Since identifying the preferred option regarding trainset configuration will include an analysis that also takes into account ridership, revenue, existing service and train equipment, and operational costs, future analysis will be conducted using a single locomotive until additional information is available.

3.4.1.1.3 High-Speed Performance (110 mph and 125 mph)

There are no segments on the Corridor where 125 mph service is feasible with existing right-of-way alignments. As noted in the previous discussion of the high speed options, operation of a train at 110 mph is only possible in two sections of the Corridor and only with the use of two locomotives. One section where 110 mph is achievable is immediately east of Springfield and the other is along a section between Northampton and Greenfield, Massachusetts.

Analysis for the option that allowed for 110 mph maximum speed indicated that, only two minutes were saved in comparison to the 90 mph maximum speed. Thus, the NNEIRI study will not provide further analysis of 110 or 125 mph operations due to the limited utilization ability and significantly higher costs associated with 110 and 125 mph operations.

3.4.1.1.4 Train Equipment Performance

The largest estimated time savings is calculated with the use of tilt equipment in conjunction with a 90 mph maximum allowable speed. This result is due numerous curves along the existing alignment. It is estimated that use of tilt equipment with a service plan that allows for a maximum 90 mph operation consistently saves 15 to 20 minutes over conventional equipment.

Estimated times between the stations on the Boston to Montreal segment based on specific speeds and conditions are provided in Tables 3.2 and 3.3.

Table 3.2: Initial Travel Time Estimates from Boston for Local Service (Boston to Montreal)

City	Base (60 MPH)	79 MPH	90 MPH
Boston (South Station)	0:00	0:00	0:00
Boston (Back Bay)	0:06	0:06	0:06
Suburban Boston (Framingham)	0:30	0:28	0:28
Worcester	0:59	0:52	0:52
Palmer	1:47	1:35	1:34
Springfield	2:04	1:49	1:48
Holyoke	2:17	2:02	2:01
Northampton	2:31	2:15	2:13
Greenfield	2:52	2:33	2:31
Brattleboro	3:22	3:02	3:00
White River Junction	4:44	4:18	4:16
Montpelier	5:55	5:24	5:21
Waterbury	6:06	5:35	5:32
Burlington (Essex Junction)	6:32	5:55	5:52
St. Albans	7:00	6:19	6:16
Montreal	9:11	8:03	8:00

Table 3.3: Initial Travel Time Estimates from Boston for Express Service (Boston to Montreal)

City	Base (60 MPH)	79 MPH	90 MPH	90T MPH	110 MPH
Boston (South Station)	0:00	0:00	0:00	0:00	0:00
Boston (Back Bay)	0:06	0:06	0:06	0:06	0:06
Worcester	0:57	0:52	0:52	0:49	0:49
Springfield	1:59	1:48	1:47	1:37	1:36
White River Junction	4:31	4:13	4:11	3:57	3:55
Burlington (Essex Junction)	6:15	5:47	5:45	5:21	5:19
Montreal	8:48	7:55	7:52	7:23	7:21

3.4.2 Springfield to New Haven Analysis

Analysis of the Springfield-to-New Haven service was completed using existing AMTRAK and CTDOT plans developed as a part of the New Haven-Hartford-Springfield (NHHS) Commuter Rail Study. Amtrak and CTDOT developed extensive scheduling details to support the NHHS Commuter Rail study. It is assumed that some service operating from New Haven and Springfield will continue to Boston while other services will continue north to Montreal. The NNEIRI study assumed that this service plan is the sole alternative for service on this segment of the Corridor.

The service provides for approximately 22 daily round trips between Springfield and New Haven, with an intercity and commuter rail service. The services include:

- Eight round trip New Haven to Springfield Commuter Services;
- Two round trip New Haven to Hartford (only operating between Hartford - New Haven);
- Eight round trip Inland Route Intercity Services between New Haven and Springfield with the potential to continue north; and
- Four round trip Amtrak Regional Services between Springfield and other points on the Northeast Corridor.

Table 3.4: Initial Travel Time Estimates from Springfield to New Haven

City	Base Schedule	Express Schedule
Springfield	0:00	0:00
Enfield	0:10	-
Windsor Locks	0:20	0:20
Windsor	0:25	-
Hartford	0:38	0:32
West Hartford	0:42	-
Newington	0:45	-
Berlin	0:51	-
Meriden	1:01	0:48
Wallingford	1:09	-
North Haven	1:21	-
New Haven	1:30	1:06

For purposes of the NNEIRI study, the ridership estimates are based solely on the "Inland Route" trains, with the remaining trains, such as AMTRAK Regional Service along the corridor seen as existing services.

3.5 SERVICE PLAN OPTIONS

Based on the results of the TPC developed travel time estimates, a number of service plans advanced into the preliminary ridership-estimating phase. The information required to develop preliminary ridership estimates included:

- Train Service Times;
- Daily Frequencies; and
- Station Stops.

The train service times for the ridership phase were developed using the TPC output with additional time added for schedule pad. It is typical to include additional time to a train schedule to account for delays that occur en route; a five percent schedule pad has been added to account for delays to service.

A preliminary set of daily train frequencies options were developed for ridership analysis. For the Boston-to-Springfield segment, it is estimated that 8, 12, or 16 daily round-trip trains would be scheduled. For the Springfield-to-Montreal segment options of 4, 7, and 12 trips per day will be analyzed. The schedule developed for the NHHS program will be utilized for NNEIRI services operating between Springfield and New Haven.

The recommended options include both local and express services. As noted previously, the specific station stops for a local service were designated for order of magnitude travel time and ridership purposes and may be modified as additional information and analysis is available. The train service times include a two minute dwell for each station, as an average value. As with the station stops, this station dwell assumption may change as additional information regarding platform configuration and passenger volumes are available.

3.5.1 Boston to Springfield Segment

The Boston to Springfield segment will utilize the existing MBTA rail right-of-way between Boston and Worcester and the CSX rail right-of-way between Worcester and Springfield.

Option: 8-16 Trains per Day Local Service

As previously stated, this study assumes a range of ridership for the Boston to Springfield. The option assumes service to all stations on the Corridor where service is feasible. Table 3.5 outlines Local Service option travel times between Boston and Springfield.

Table 3.5: Preliminary Travel Time Boston to Springfield Local Service

City	Base (60 MPH)	79 MPH	90 MPH

City	Base (60 MPH)	79 MPH	90 MPH
Boston (South Station)	0:00	0:00	0:00
Boston (Back Bay)	0:06	0:06	0:06
Suburban Boston (Framingham)	0:31	0:29	0:29
Worcester	1:00	0:53	0:53
Palmer	1:39	1:37	1:36
Springfield	2:05	1:50	1:49

Option: 8-16 Trains per Day Express Service

The study assumes low, medium, and high levels of service of 8, 12, or 16 daily roundtrip trains. Conventional equipment and tilt equipment with a maximum allowable speed of 90 mph are considered. Table 3.6 outlines express service options between Boston and Springfield.

Table 3.6: Preliminary Travel Time Boston to Springfield Express Service

City	Base (60 MPH)	79 MPH	90 MPH	90T MPH
Boston (South Station)	0:00	0:00	0:00	0:00
Boston (Back Bay)	0:06	0:06	0:06	0:06
Worcester	1:00	0:53	0:53	0:51
Springfield	2:02	1:51	1:48	1:39

3.5.2 Springfield to Montreal Segment

The Springfield to Montreal segment will utilize the existing Pan Am Southern, NECR, and CN right-of-way between Boston and Montreal. Travel times are estimated using existing track charts, maps, and other charts.

Option: 4-12 Trains per Day Local Service

The study assumes low, medium, and high levels of service of 4, 7, or 12 roundtrip trains will operate between Springfield and Montreal daily utilizing a local service on the NNEIRI. Table 3.7 outlines local service alternatives between Springfield and Montreal.

Table 3.7: Preliminary Travel Time Springfield to Montreal Local Service

City	Base (60 MPH)	79 MPH	90 MPH
Springfield	0:00	0:00	0:00
Holyoke	0:14	0:14	0:14
Northampton	0:28	0:27	0:26
Greenfield	0:49	0:45	0:44
Brattleboro	1:20	1:14	1:13
Claremont*	2:12	2:07	2:06
White River Junction	2:40	2:30	2:29
Montpelier	3:55	3:37	3:33
Waterbury	4:03	3:48	3:44
Burlington (Essex Junction)	4:29	4:07	4:05
St. Albans	4:57	4:33	4:30
Montreal	7:14	6:19	6:16

*Claremont data based on estimates from existing AMTRAK travel times and TPC Analysis

Option: 4-12 Trains per Day Express Service

The study assumes low, medium, and high levels of service of 47, or 12 roundtrip trains will operate between Springfield and Montreal daily. Conventional equipment, and tilt equipment with a maximum allowable speed of 90 mph are considered. Table 3.8 outlines Express Service alternatives between Springfield and Montreal.

Table 3.8: Preliminary Travel Time from Springfield for Express Service (Springfield to Montreal)

City	Base (60 MPH)	79 MPH	90 MPH	90T MPH
Springfield	0:00	0:00	0:00	0:00
White River Junction	2:41	2:33	2:31	2:27
Burlington (Essex Junction)	4:21	4:03	3:49	3:44
Montreal	6:57	6:13	5:52	5:19

3.5.3 Springfield to New Haven Segment

The Springfield to New Haven segment will utilize the existing AMTRAK right-of-way. AMTRAK and CTDOT developed extensive scheduling details to support the NHHS Commuter Rail Study. The NNEIRI study will assume this as the sole alternative for service on this segment of the Corridor.

The service provides for 22 round trips between Springfield and New Haven, with a mix of Intercity Regional Service, Inland Route Service, and Hartford Commuter Service.

3.6 INITIAL RIDERSHIP RESULTS

An intercity passenger rail ridership forecasting model for the Inland Route and Boston to Montreal Corridor was developed to provide details on ridership. The model consists of available travel market data throughout Massachusetts and Connecticut (and Northeast Corridor) and Vermont, historical rail ridership data and trends, and demographic data. Other models providing a foundation for this model include models developed for AMTRAK's Northeast Corridor, Southeast Corridor, California Corridor, Florida, and the Midwest States. Inputs required to complete the analysis include:

- Rail schedules for the Inland Route and Montreal services;
- Geographic zone system covering the entire study area;
- Highway network connecting all the zones, rail stations, and airports in the study area;
- Socio-economic data for the zone system;
- Ridership information for the Massachusetts, Connecticut, and Vermont services; and
- Travel characteristics for auto, air, and rail.

Ridership forecasts were prepared for two forecast years, 2020 and 2035. All Alternatives assume full implementation of the NHHS service at 22 round trips between Springfield and New Haven, with a mix of Intercity Regional Service, Inland Route Service, and Hartford Commuter Service.

3.6.1 Ridership Results

Table 3.9 provides details on Corridor-wide boardings in 2020. Tables 3.9-3.14 provide details of ridership on the Boston to Springfield, Springfield to Montreal, and Springfield to New Haven Corridors in 2020. Tables 3.15-3.19 provide details on the Corridors in 2035. All table numbers represent the incremental increase resulting from NNEIRI service and exclude ridership on existing Vermonter, New Haven to Springfield, Shuttle, Northeast Regional, Lake Shore Limited, and Acela services. The ridership identified in the following tables as additional ridership represents riders originating on complementary services, such as the AMTRAK Vermonter or Lake Shore Limited, at stations where NNEIRI services do not stop and then transferring to NNEIRI service as part of their trip.

Table 3.9: NNEIRI Annual Boardings Corridor-wide

Max Speed	60 MPH	79 MPH	90 MPH	90 T MPH
2020 Local	1,515,300	1,792,800	1,901,500	-
2020 Express	1,293,100	1,450,700	1,528,500	1,640,800
2035 Local	1,739,000	2,060,300	2,185,300	-
2035 Express	1,486,700	1,671,000	1,762,200	1,893,800

Table 3.10: Annual Boardings Boston to Springfield Local Service: 2020

City	60 MPH (8 Trips)	79 MPH (12 Trips)	90 MPH (16 Trips)
Boston (South Station)	97,704	120,835	130,083
Boston (Back Bay)	36,722	45,166	48,059
Suburban Boston (Framingham)	24,576	27,033	27,908
Worcester	48,325	52,478	55,694
Palmer	8,677	9,804	10,643
Springfield	78,100	90,065	100,305
Segment Total:	**294,104**	**345,381**	**372,692**

Table 3.11: Annual Boardings Boston to Springfield Express Service: 2020

City	60 MPH (8 Trips)	79 MPH (12 Trips)	90 MPH (16 Trips)	90 T MPH (16 Trips)
Boston (South Station)	100,093	116,857	123,455	138,318
Boston (Back Bay)	37,799	44,684	47,276	52,813
Worcester	49,384	52,200	55,246	59,436
Springfield	91,620	102,084	108,984	115,545
Segment Total:	**278,896**	**315,825**	**334,961**	**366,112**

Table 3.12: Annual Boardings Springfield to Montreal Local Service: 2020

City	60 MPH (4 Trips)	79 MPH (7 Trips)	90 MPH (12 Trips)
Springfield	78,100	90,065	100,305
Holyoke	40,535	53,425	61,254
Northampton	67,169	82,126	92,432
Greenfield	26,438	33,081	37,238
Brattleboro	28,251	43,183	51,155
Claremont	2,462	3,629	4,202
White River Junction	17,764	27,095	31,726
Montpelier	6,241	9,378	10,934
Waterbury	5,649	8,628	10,084
Burlington (Essex Junction)	18,425	29,170	34,203
St. Albans	3,127	4,878	5,744
Montreal	125,816	185,597	202,597
Segment Total:	**419,977**	**570,255**	**641,874**
Additional Ridership*	**820**	**1,030**	**1,051**

*Additional ridership total includes additional riders from skipped stations where passengers boarded from connecting service, including the Vermonter. The stations include: Randolph, Windsor, and Bellows Falls.

Table 3.13: Annual Boardings Springfield to Montreal Express Service: 2020

City	60 MPH (4 Trips)	79 MPH (7 Trips)	90 MPH (12 Trips)	90 T MPH (12 Trips)
Springfield	91,620	102,084	108,984	115,545
White River Junction	16,254	24,055	29,430	33,257
Burlington (Essex Junction)	13,414	20,345	24,027	26,305
Montreal	105,627	149,306	173,485	205,166
Segment Total	**226,915**	**295,790**	**335,926**	**380,273**
Additional Ridership*	**62,563**	**65,073**	**65,639**	**65,639**

*Additional ridership includes additional riders from skipped stations where passengers boarded from connecting service, including the Vermonter and Shuttle. These stations include: Holyoke, Northampton, Greenfield, Brattleboro, Bellows Falls, Claremont, Randolph, Windsor, Montpelier, Waterbury, and St. Albans.

Table 3.14: Annual Boardings Springfield to New Haven Service: 2020

City	60 MPH	79 MPH	90 MPH	90 T MPH
Springfield	78,100	90,065	100,305	115,545
Windsor Locks	12,739	13,525	13,580	13,576
Windsor	12,633	13,664	13,755	13,335
Hartford	121,601	126,643	127,483	127,980
Berlin	11,180	11,799	11,882	11,874
Meriden	23,911	25,746	25,913	26,088
Wallingford	7,442	7,821	7,878	7,562
New Haven	128,618	137,900	140,056	140,894
Segment Total	**396,224**	**427,163**	**440,852**	**456,854**
Additional Ridership*	**565,291**	**634,017**	**650,557**	**607,916**

*Segment Total includes additional riders from skipped stations where passengers boarded from connecting service, including the Vermonter, Northeast Regional, Shuttle, Lake Shore Limited, and Acela. These stations include: Enfield, West Hartford, Newington, and North Haven. Additionally, segment totals include stops on the Northeast Corridor after New Haven, including Bridgeport, Stamford, New Rochelle, and New York-Penn Station.

Table 3.15: Annual Boardings Boston to Springfield Local Service: 2035

City	60 MPH (8 Trips)	79 MPH (12 Trips)	90 MPH (16 Trips)
Boston (South Station)	114,204	141,204	151,996
Boston (Back Bay)	42,243	51,943	55,268
Suburban Boston (Framingham)	27,943	30,733	31,727
Worcester	55,155	59,888	63,557
Palmer	9,942	11,231	12,192
Springfield	89,378	103,160	114,925
Segment Total	**338,865**	**398,159**	**429,665**

Table 3.16: Annual Boardings Boston to Springfield Express Service: 2035

City	60 MPH (8 Trips)	79 MPH (12 Trips)	90 MPH (16 Trips)	90 T MPH (16 Trips)
Boston (South Station)	117,018	136,594	144,321	161,701
Boston (Back Bay)	43,485	51,392	54,375	60,744
Worcester	56,369	59,577	63,058	67,838
Springfield	104,984	117,146	125,180	132,829
Segment Total	**321,857**	**364,709**	**386,948**	**423,126**

Table 3.17: Annual Boardings Springfield to Montreal Local Service: 2035

City	60 MPH (4 Trips)	79 MPH (7 Trips)	90 MPH (12 Trips)
Springfield	89,378	103,160	114,925
Holyoke	46,518	61,359	70,348
Northampton	77,397	94,646	106,526
Greenfield	30,181	37,771	42,519
Brattleboro	31,547	48,251	57,145
Claremont*	2,838	4,187	4,847
White River Junction	20,667	31,546	36,936
Montpelier	6,863	10,309	12,013
Waterbury	6,279	9,595	11,209
Burlington (Essex Junction)	20,842	32,984	38,665
St. Albans	3,512	5,473	6,442
Montreal	148,219	218,516	238,418
Segment Total	**484,241**	**657,797**	**739,993**
Additional Ridership*	**910**	**1,141**	**1,163**

**Segment Total includes additional riders from skipped stations where passengers boarded from connecting service including the Vermonter. The stations include: Randolph, Windsor, and Bellows Falls.

Table 3.18: Annual Boardings Springfield to Montreal Express Service: 2035

City	60 MPH (4 Trips)	79 MPH (7 Trips)	90 MPH (12 Trips)	90 T MPH (12 Trips)
Springfield	104,984	117,146	125,180	132,829
White River Junction	18,984	28,119	34,439	38,980
Burlington (Essex Junction)	15,295	23,196	27,410	30,057
Montreal	125,015	176,722	205,340	242,813
Segment Total	**264,278**	**345,183**	**392,369**	**444,679**
Additional Ridership*	**71,565**	**74,366**	**75,007**	**75,007**

*Additional ridership includes additional riders from skipped stations where passengers boarded from connecting service, including the Vermonter. These stations include: Holyoke, Northampton, Greenfield, Brattleboro, Bellows Falls, Claremont, Randolph, Windsor, Montpelier, Waterbury, and St. Albans.

Table 3.19: Annual Boardings Springfield to New Haven Service: 2035

City	60 MPH	79 MPH	90 MPH	90 T MPH
Springfield	89,378	103,160	114,925	132,829
Windsor Locks	14,494	15,399	15,463	15,482
Windsor	14,364	15,550	15,654	15,215
Hartford	137,940	143,728	144,685	145,368
Berlin	12,695	13,409	13,504	13,516
Meriden	26,944	29,048	29,239	29,484
Wallingford	8,345	8,777	8,842	8,495
New Haven	144,414	155,015	157,458	158,613
Segment Total	**448,574**	**484,086**	**499,770**	**519,002**
Additional Ridership*	**650,787**	**731,058**	**750,180**	**703,265**

*Additional ridership includes additional riders from skipped stations where passengers boarded from connecting service including the Vermonter, Northeast Regional, Lake Shore Limited, and Acela. These stations include: Enfield, West Hartford, Newington, and North Haven. Additionally, segment totals include stops on the Northeast Corridor after New Haven, including Bridgeport, Stamford, New Rochelle, and New York-Penn Station.

3.6.2 Ridership Results Summary

The initial ridership analysis evaluated speed, number of station stops, frequency of service, and other factors that affect ridership for the segment. For example, ridership on the Boston to Springfield segment of the Corridor is more influenced by speed and express service, while the Springfield to Montreal segment is more influenced by Alternatives that maximize station stops.

The Boston to Springfield segment of the Corridor shows that express service with 90 mph tilting trains provides the highest ridership, especially compared to local services and longer travel times. The 1 hour 37 minutes travel time on express trains with tilting equipment provides speed that is comparable to driving, approximately 1 hour 27 minutes without traffic, and faster than bus travel, which has a scheduled travel times between 1 hour 40 minutes and 2 hours 5 minutes. Additionally, the reliability of well run train service is significantly better than road-based travel during hours of peak congestion and inclement weather.

For the Springfield to Montreal segment, analysis shows that maximum ridership results from Alternatives that maximize the number of stations. The ridership analysis highlights that express service, particularly in Vermont, does not add ridership and potentially shows that a local service would provide higher levels of ridership on the line. The service option with the highest ridership in Vermont is 90 mph local service utilizing tilting trains. Serving all stations on the Springfield to Montreal segment will provide the opportunity to pick up additional passengers and serve more route pairs.

4 ALTERNATIVES ANALYSIS PROCESS

This section describes the process used for developing the NNEIRI Build Alternatives the means used to evaluate the alternatives, and to identity a potential recommendation for implementation.

4.1 ANALYSIS OF INITIAL OPTIONS

Alternatives development was initiated with the consideration of Service Levels and Performance Options, as described in detail in Chapter 3. The output from the Options Analysis included:

- Train Performance at varying Maximum Authorized Speeds,
- Train Performance utilizing varying locomotive configurations,
- Train Performance utilizing different vehicle types,
- Travel Times with various station stop configurations, and
- Ridership response to service level and performance options.

The data developed as part of the Options Analysis provided the basis to assess the 18 initial service options. This data, along with the input provided through stakeholder and public engagement, allowed for the development of three Build Alternatives for further analysis.

4.2 STAKEHOLDER AND PUBLIC ENGAGEMENT

Public and stakeholder input were provided through direct comments and feedback at public and stakeholder meetings. Stakeholders and members of the public were engaged during meetings and direct outreach during the development of Alternatives.

4.2.1 Coordination with Stakeholders and Agencies

Stakeholders, including public and private organizations, were included in defining alternatives. Stakeholders invited to participate included:

- AMTRAK
- Canadian National Railways
- Capitol Region Council of Governments
- Chittenden County Regional Planning Commission
- Central Massachusetts Regional Planning Commission
- Central Vermont Regional Planning Commission
- Town of Claremont, NH
- Connecticut Department of Transportation
- CSX

- Federal Railroad Administration
- Franklin Region Council of Governments
- Office of Congressman Jim McGovern
- Massachusetts Bay Transportation Authority
- Massachusetts Department of Transportation
- Metropolitan Area Planning Council
- Metropolitan Transportation Agency (Montreal)
- MTA Metro North
- New England Central Railroad (Genesee & Wyoming, Inc.)
- New Hampshire Dept. of Transportation
- Northwest Regional Planning Commission
- PanAm/Southern Railroad
- Pioneer Valley Planning Commission
- Quebec Ministry of Transportation
- South Central Region Council of Governments
- Southern Windsor Regional Planning Commission
- Two Rivers-Ottaquechee Regional Commission
- Upper Valley Lake Sunapee Regional Planning Commission
- Vermont Agency of Transportation
- Windham Regional Commission

Stakeholder meetings were held at the Pioneer Valley Planning Commission offices in Springfield, Massachusetts in January, May, and October 2014. At each meeting, findings of analysis were presented and initial alternatives were discussed. Additionally, the project team conducted individual meetings with key stakeholders to understand specific requirements, such as operating on freight railroad tracks.

Additionally, meetings with federal and state officials were held in April 2014 to discuss the NNEIRI study with agencies and to gain feedback. Agencies provided comments during meetings and in the form of written comments. Agencies represented include:

- U.S. Army Corps of Engineers
- Central Massachusetts Regional Planning Commission
- Environmental Protection Agency
- Franklin Regional Council of Governments
- Federal Railroad Administration
- Federal Transit Administration
- Metropolitan Area Planning Council (Boston)
- Massachusetts Department of Transportation
- Vermont Agency of Transportation
- Pioneer Valley Planning Commission

Stakeholder and agency comments provided the project management team with valuable insight into federal, state, and corporate requirements for passenger rail operations on the NNEIRI Corridor.

4.2.2 Public Meetings

Four public meetings were held and opinions solicited from members of the public. The public meetings were held in White River Junction, Vermont and Springfield, Massachusetts in January 2014 and White River Junction, Vermont and Worcester, Massachusetts in October 2014. The meetings were attended by members of the public, government officials, and media. All questions and answers were recorded and comments received subsequently were responded to; notes for public meetings are provided in Appendix J.

The public meetings and follow up comments provided the project management team provided important public input and consultation for the NNEIRI project management team to consider. The public comments were considered as important factors in creating alternatives for the NNEIRI study and will be an ongoing part of the study process.

4.3 DEVELOPMENT OF ALTERNATIVES

Based on analysis of the 18 initial options and the input provided by stakeholders and the public, the initial options were screened down to three Build Alternatives and one No Build Alternative. A No Build Alternative was developed to allow for comparison of the Build Alternatives to a base case.

The three Build Alternatives, which are detailed in Chapter 5, represent the range of potential service and speed options that appeared to be the most feasible and efficient based on the analysis of the initial options. The focus of alternatives development was to identify a range of reasonable and feasible alternatives that would meet the project Purpose and Need in a cost effective manner, without significantly impacting known natural or cultural resources in the Corridor. The three Build Alternatives provide a range of alternatives that when analyzed will provide information related to the following service attributes:

- Required Capital Improvements
- Vehicle Requirements
- Capital Costs
- Operational & Maintenance Costs
- Refined Ridership Estimates
- Environmental Impacts

4.4 RECOMMENDED ALTERNATIVES

The final part of the Alternatives Analysis process will be to determine a recommended alternative. The Recommended Alternative may be one of the three Build Alternatives or a combination of different elements of the three Build Alternatives that appear most feasible and beneficial. The Recommended Alternative will be carried forward for more detailed evaluation in the Tier 1 NEPA (National Environmental Policy Act) document and in the Service Development Plans.

Detailed attribute information for each Alternative that will be utilized in the development of the Recommended Alternative is included in Chapters 6 though 11 of this report. These attributes include capital requirements, service requirements, capital costs, operating and maintenance costs, ridership, revenue and environmental impacts.

The Recommended Alternative and the rationale for its selection will be included in a separate memorandum.

5 ALTERNATIVES DEFINITION

The definition of Alternatives describes the three potential Build Alternatives and one No Build Alternative. The three Build Alternatives are compared against the No Build Alternative for the purposes of ridership, environment, infrastructure necessity, and other factors to determine the state of the Corridor without any NNEIRI actions.

5.1 NO BUILD ALTERNATIVE

The No Build Alternative analyzes the Corridor through 2035 and assumes no added NNEIRI service. This Alternative is the benchmark for comparison of Build Alternatives and the determination of impacts. The No Build Alternative includes all ongoing and currently planned improvements to the Corridor. Passenger rail services that currently operate on the Corridor include:

- MBTA Southside Commuter Rail Services (Boston South Station – Back Bay Station);
- MBTA Worcester Line Service (Boston to Worcester);
- AMTRAK Lakeshore Limited Service (Boston to Chicago via Springfield and Albany);
- AMTRAK Vermonter Service (Washington, D.C to St. Albans, VT via New Haven, Springfield, and White River Junction); and
- AMTRAK Shuttle and Northeast Regional Service (New Haven to Springfield).

The No Build Alternative assumes known capacity and speed upgrades to the right-of-way that are currently in progress or planned to occur. Additional information regarding these projects is included in Section 5.5 Coordinated Projects. The Improvements completed, underway, and planned include:

- CTDOT infrastructure improvements on the NHHS rail line, including double tracking and station improvements;
- MassDOT Knowledge Corridor/Restore Vermonter Project between Springfield and East Northfield, Massachusetts;
- MassDOT Springfield Union Station restoration to improve passenger comfort and rail operations in Springfield, Massachusetts;
- U.S. Customs and Immigration Services and Canada Border Services Agency station at Montreal Central Station Customs Checkpoint for incoming and outgoing trains in Montreal, Quebec; and
- Improvements to infrastructure between the U.S. border and Montreal, Quebec identified in the Quebec Ministry of Transportation study, *Study Of CN And CP's Rail Networks Between Montréal And The U.S. Border* released in 2014.

In addition, new and improved passenger rail operations are anticipated for:

- MassDOT Knowledge Corridor/Restore Vermonter Project service changes between Springfield and East Northfield, Massachusetts;

- CTDOT New Haven-Hartford-Springfield Rail Service between New Haven, Connecticut and Springfield, Massachusetts; and
- AMTRAK Vermonter extension from St. Albans, Vermont to Montreal, Quebec on the NECR and CN Lines.

A significant element of infrastructure needed to support railroad operations is layover facilities for trains. Train sets on the Corridor will be accommodated at layover facilities near terminal stations. Layover facilities will primarily serve as points to store, restock, and perform light maintenance on rail equipment. Additionally, layover facilities will provide crew quarters, including briefing rooms, locker rooms, and break rooms.

Locations of existing or proposed layover facilities include:

- Southampton Street Yard, Boston, MA (AMTRAK);
- Additional layover facility to be included in South Station Expansion Project;
- Proposed Springfield Union Station Layover and Maintenance Facility, Springfield, MA ;
- Springfield Station Sweeny Yard (AMTRAK);
- New Haven Yard, New Haven, CT (AMTRAK);
- St. Albans Yard, St. Albans, VT (NECR); and
- Montreal Area – Assumed to be included in improvements to infrastructure between the U.S. border and Montreal, Quebec identified in the Quebec Ministry of Transportation study released in 2014 Springfield Station Sweeny Yard (AMTRAK).

5.2 ALTERNATIVE 1 – CORRIDOR SERVICE

Alternative 1 provides improved passenger rail service on the Corridor with infrastructure upgrades needed to improve speeds to 60 mph where possible and accommodate the Alternative 1 Service Plan. Infrastructure upgrades include adding sidings and track and bridge improvements. The Alternative 1 service plan provides local service between Boston, Montreal, and New Haven. Alternative 1 includes the improvements and operational changes identified in the No-Build Alternative and infrastructure and operations improvements noted below.

5.2.1 Alternative 1 Service Program

In addition to the rail service in the Corridor identified in the No-Build Alternative, Alternative 1 includes six daily round trips between Boston and Springfield. Four of the six additional trains will be extensions of existing shuttle services that currently operate between New Haven and Springfield. Under Alternative 1, these existing services will be extended to operate between New Haven, Springfield and Boston. Two of the six additional round-trip trains proposed to operate between Boston and Springfield will be through trains that continue north from Springfield to Montreal.

Additionally, Alternative 1 includes one additional round trip train operating between New Haven to Montreal via Springfield. The details of whether this round trip train should continue on the NEC as an additional train, be an extension of an existing train, or have a terminus at New Haven, will be determined as part of the Service Development Plan.

All Alternative 1 additional round trip trains will stop at all existing or proposed intercity rail stations on the Corridor. Service between Boston and Springfield will include stops at:

- Boston (South Station and Back Bay), Massachusetts
- Framingham, Massachusetts
- Worcester (Union Station), Massachusetts
- Palmer, Massachusetts (proposed)
- Springfield (Union Station), Massachusetts

Service between Springfield and Montreal will include stops at:

- Springfield (Union Station), Massachusetts
- Holyoke, Massachusetts
- Northampton, Massachusetts
- Greenfield, Massachusetts
- Brattleboro, Vermont
- Bellows Falls, Vermont
- Claremont, New Hampshire
- Windsor, Vermont
- White River Junction, Vermont
- Randolph, Vermont
- Montpelier, Vermont
- Waterbury, Vermont
- Burlington (Essex Junction), Vermont
- St. Albans, Vermont
- Montreal (Central Station), Quebec

Service between Springfield and New Haven will follow the service plan created by CTDOT for the NHHS service and are assumed to include station stops at:

- Springfield (Union Station), Massachusetts
- Windsor Locks, Connecticut
- Windsor, Connecticut
- Hartford, Connecticut
- Berlin, Connecticut
- Meriden, Connecticut
- Wallingford, Connecticut
- New Haven (Union Station), Connecticut

Table 5.1 identifies the origin and destination times between key station pairs in Alternative 1. Additionally, Figure 5.1 depicts the service of Alternative 1 on the Corridor, with frequency between terminal pairs, and maximum operating speeds.

Table 5.1 Alternative 1 Corridor Service Travel Times (Hours: Minutes)

City	Boston	Springfield	White River Junction	Burlington (Essex Junction)	New Haven	Montreal
Boston	-	2:18	5:16	7:17	3:48	10:08
Springfield	2:18	-	2:58	4:59	1:30	7:50
White River Junction	5:16	2:58	-	2:01	4:28	4:52
Burlington (Essex Junction)	7:17	4:59	2:01	-	6:29	2:51
New Haven	3:48	1:30	4:28	6:29	-	9:20
Montreal	10:08	7:50	4:52	2:51	9:20	-

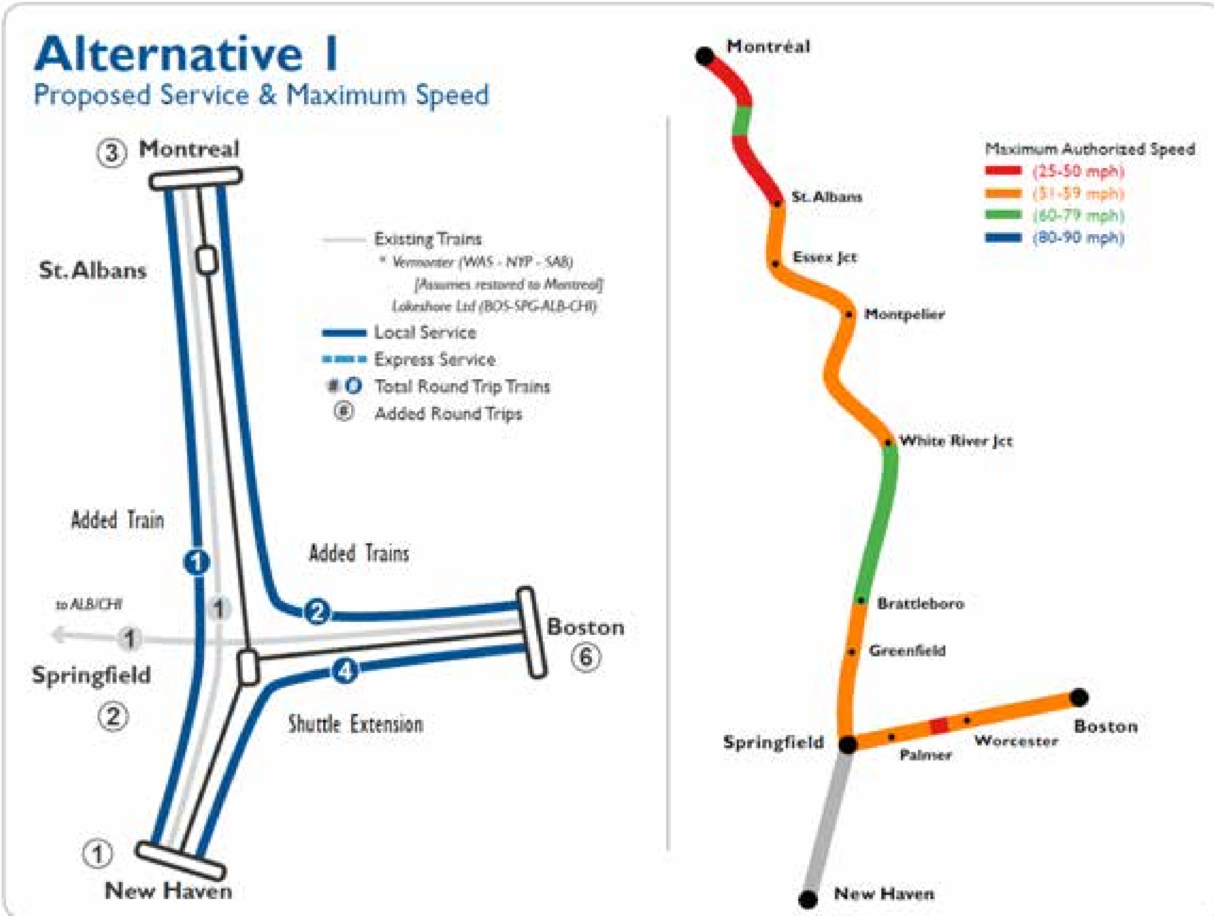

Figure 5.1: Alternative 1 Frequency and Speed Charts

(Daily increased round trip frequencies Boston: 6, Montreal 3; New Haven 1. Max speed 60 mph)

5.2.2 Alternative 1 Infrastructure Program

Alternative 1 will require infrastructure upgrades at some locations on the Corridor to accommodate the additional passenger rail service. Speeds will increase to at least 60 mph where possible and infrastructure upgraded to serve proposed train operations. Maximum operating speeds will be 79 mph where it currently exists.

Layover Facilities

Train sets on the Corridor will access at layover facilities near terminal stations. Layover facilities will primarily serve as points to store, restock, and perform light maintenance on rail equipment. Additionally, layover facilities will provide crew quarters, including briefing rooms, locker rooms, and break rooms. No additional layover facilities from those identified in the No Build Alternative are anticipated as part of Alternative 1.

Right-of-Way

Alternative 1 does not propose any alignment changes to the Right-of-Way and all track work will take place within the existing alignment. However, certain segments of the Right-of-Way anticipate potential improvements. Potential improvements include:

- Brattleboro Station and Vicinity, Brattleboro, Vermont, between Mile Posts 120 and 122
- Grade crossings in the vicinity of Windsor Station, Windsor, Vermont between Mile Posts 0-1
- Hartland, Vermont Speed Restrictions due to switching and siding infrastructure between Mile Posts 4.3-5.1
- Bethel, Vermont Speed Restrictions due to switching and siding infrastructure between Mile Post 37.6-39.6
- Lamoille River Bridge, Georgia, Vermont Speed Restrictions between Mile Posts 122-123
- Swanton, Vermont Speed Restrictions between Mile Post 8-14.9
- Swanton, Vermont Speed Restrictions Trestle and Drawbridge Mile Post 14.9 to 15.6

In multiple segments of the Corridor, only a single track exists or is currently in operation. Single-track segments constrain the number of trains that can operate on a segment for both freight and passenger railroads. Alternative 1 as defined includes adding a second track between Spencer and Brimfield, Massachusetts on CSX and additional sidings between East Northfield and St. Albans on NECR to enable freight and passenger rail to operate more efficiently. Proposed locations will include:

- Worcester to Springfield: Add second track between Mile Posts 64 – 75;
- Additional siding at South Deerfield, MA
- Additional siding at East Northfield, MA at PAS and NECR interchange area
- Additional siding on NECR between Brattleboro, VT and St. Albans, VT at Hartland, South Royalton, Bethel, Roxbury, Montpelier JCT, Oakland, and St Albans
- In East Alburg, VT on NECR add second track from Mile Post 9.9 – 17.4
- Additional areas of proposed right-of-way improvements will be considered as part of Alternative 1 evaluation process

Additional areas of proposed passing track or double track will be considered as part of Alternative 1 evaluation process.

Potential impacts associated with additional needed right-of-way or impacts to resources within existing right-of-way to support proposed infrastructure improvements will be identified based on development of specific criteria.

Signal Systems

The Corridor currently has train control signal systems between Boston and Springfield, Springfield and New Haven, Springfield to East Northfield, sections of the NECR in

Vermont, near Montreal, and other select locations on the right-of-way. Due to the additional trains proposed in Alternative 1, an extensive train control signal system and positive train control systems will be needed in certain parts of the Corridor. Signal systems will include improvements to warning devices at highway-rail grade crossings. Consideration will be given to needed improvements based on increased train frequency, higher operating speeds, or both.

Station Infrastructure

No major improvements to existing stations on the Corridor are planned as part of this project. However, upon further review minor station improvements may be necessary to provide key passenger amenities and meet operational requirements. Currently a major station rehabilitation is currently underway at Springfield Union Station and accessibility based platform improvements were recently completed at stations in Waterbury, Vermont and St. Albans, Vermont.

Additionally, for a station stop in Palmer, Massachusetts it is assumed that new station facilities will be necessary. Despite a historic headhouse and station platforms, Palmer currently lacks any modern passenger rail facility that would meet current operational or passenger standards. Therefore, a location and a new station will need to be built to accommodate rail service in Palmer. Reuse of the existing station maybe possible for Alternative 1, but it would not support service projected in Alternatives 2 and 3.

A potential station in Weston, Massachusetts, in the vicinity of Interstates 90 and 95 was also explored as a part of the NNEIRI process. However, due to technical and environmental concerns, no station in this vicinity was included in any of the Build Alternatives.

As a part of the Knowledge Corridor/Restore Vermonter project, a train station in Holyoke, Massachusetts is assumed built and operational.

5.3 ALTERNATIVE 2 – CORRIDOR SERVICE WITH SPEED IMPROVEMENTS

Alternative 2 considers service with a maximum operating speed of 79 mph utilizing standard train equipment, improved frequencies, and express service. Necessary infrastructure upgrades include improvements to the right-of-way, full signalization, additional sidings/double tracking, and improved station infrastructure.

Alternative 2 includes all of the capital improvements and services indicated in Alternative 1 with the additional and additional infrastructure and operations changes noted in the following sections.

5.3.1 Alternative 2 Service Program

In addition to the rail service in the Corridor identified in Alternative 1, Alternative 2 includes five daily express round trips between Boston and Springfield. One of the five additional trains proposed to operate between Boston and Springfield will be a through-train that continues north from Springfield to Montreal. Four trains would operate as express services between Boston and New Haven.

Additionally, Alternative 2 proposes that one additional train operate from New Haven to Montreal via Springfield. The proposed New Haven to Montreal train would operate as an express service. It will be determined as part of the Service Development Plan if this train would continue on the NEC as an additional train, operate as an extension of an existing train, or terminate at New Haven.

In summary, Alternative 2 Service Program provides services of the No Build Alternative plus eight trains from Boston to New Haven (four express and four local), three trains from Boston to Montreal (two local and one express), and two trains from New Haven to Montreal (one express and two local).

Stations for non-express trains will be the same as in Alternative 1. Alternative 2 includes the addition of express service for certain routes. Ridership data was utilized to determine the stations with the highest ridership potential for express service. Generally, express trains will stop at larger metropolitan centers and other strategic station locations. Assumed express station stops on the Boston to Montreal segment include:

- Boston (South Station and Back Bay)
- Worcester (Union Station)
- Springfield (Union Station)
- Northampton
- Greenfield
- Brattleboro
- White River Junction
- Central Vermont Hub (Montpelier or Waterbury)
- Burlington (Essex Junction)
- Montreal (Central Station)

Express service on the Springfield to New Haven segment will follow CTDOT's service plan for NHHS service.

Tables 5.2 and 5.3 identify the origin and destination times between key station pairs in Alternative 2. Additionally, Figure 5.2 graphically depicts the service of Alternative 2 on the Corridor, with frequency between terminal pairs, and maximum operating speeds.

Table 5.2 Alternative 2 Corridor Service with Speed Improvements Local Travel Times (Hours: Minutes)

City	Boston	Springfield	White River Junction	Burlington (Essex Junction)	New Haven	Montreal
Boston	-	2:03	4:51	6:38	3:32	8:59
Springfield	2:03	-	2:48	4:36	1:30	6:55
White River Junction	4:51	2:48	-	1:48	4:18	4:07
Burlington (Essex Junction)	6:38	4:36	1:48	-	6:06	2:19
New Haven	3:32	1:30	4:18	6:06	-	8:38
Montreal	8:59	6:55	4:07	2:19	8:38	-

Table 5.3 Alternative 2 Corridor Service with Speed Improvements Express Travel Times (Hours: Minutes)

City	Boston	Springfield	White River Junction	Burlington (Essex Junction)	New Haven	Montreal
Boston	-	2:01	4:34	6:02	3:31	8:28
Springfield	2:01	-	2:35	4:03	1:30	6:29
White River Junction	4:34	2:35	-	1:28	4:05	3:54
Burlington (Essex Junction)	6:02	4:03	1:28	-	5:33	2:26
New Haven	3:31	1:30	4:05	5:33	-	7:59
Montreal	8:28	6:29	3:54	2:26	7:59	-

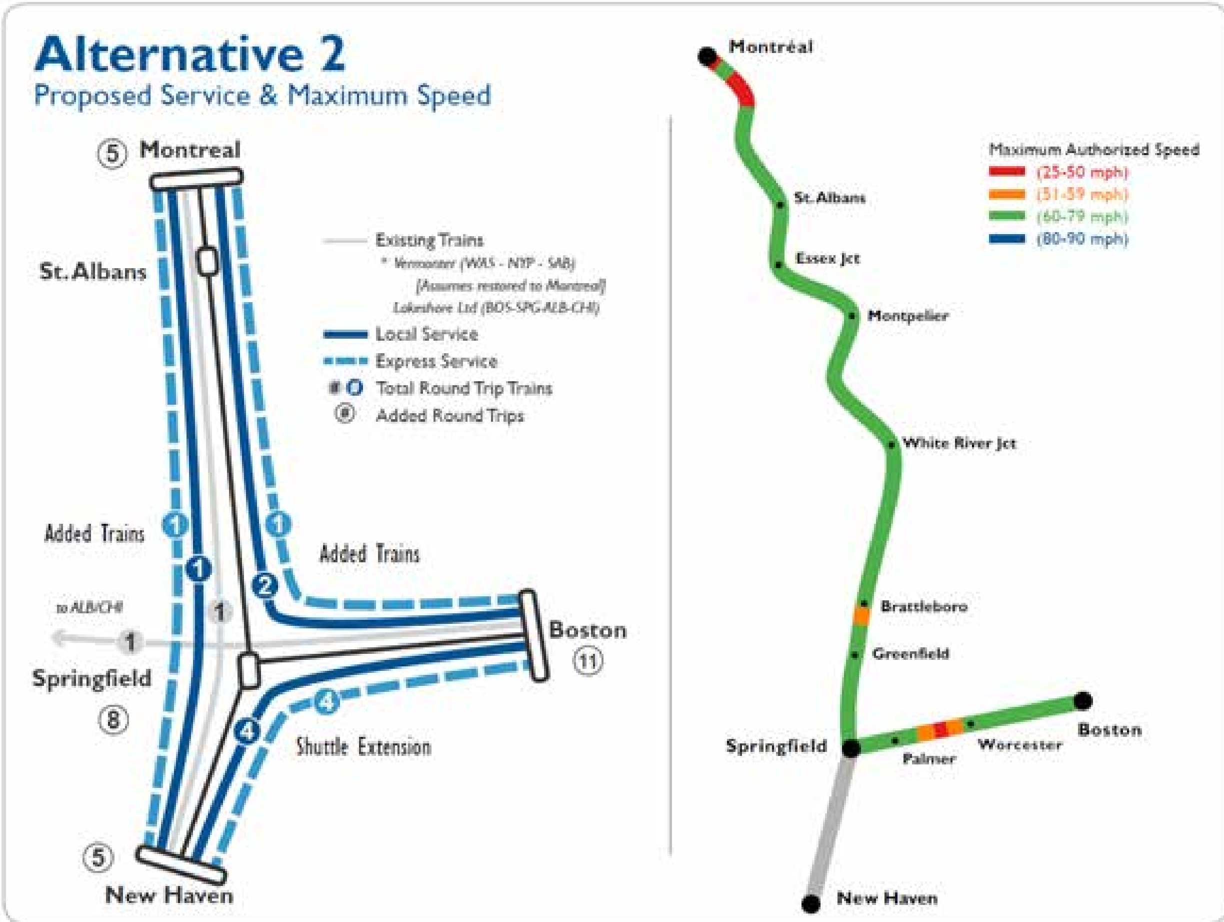

Figure 5.2: Alternative 2 Frequency and Speed Charts

(Daily round trip increased frequencies Boston: 11, Montreal 5; New Haven 5. Max speed 79 mph)

5.3.2 Alternative 2 Infrastructure Program

Alternative 2 will utilize existing infrastructure and include improved infrastructure that increases capacity to meet demands of the Service Program and improves speeds to 79 mph where possible.

Layover Facilities

Train sets on the Corridor will be accommodated at layover facilities near terminal stations. No additional layover facilities from those identified in the No-Build Alternative are anticipated to be needed as part of Alternative 2.

Right-of-Way

Alternative 2 does not propose any alignment changes to the right-of-way and all track work will take place within the existing alignment Speed improvement areas are the same as identified in the Alternative 1 right-of-way analysis.

Alternative 2 will include infrastructure to provide additional capacity on the Corridor with the goal to enable freight and passenger rail to operate efficiently. The capacity improvements include:

- Restoration of the second mainline track between Worcester and Springfield at Mile Post 48.3 – 57.7, Mile Post 64.0 – 79.4, and Mile Post 83.6 – 92.0;
- Additional siding at South Deerfield, MA;
- Additional siding at East Northfield, MA at PAS and NECR interchange area;
- Brattleboro to International Border - add second track at Mile Post 146.8 – 159.9 and Mile Post 9.9 – 17.4;
- Additional siding on NECR between Brattleboro, VT and St. Albans, VT at Hartland, South Royalton, Bethel, Randolph, Roxbury, Montpelier JCT, Bolton, Oakland, and St Albans.

Signal Systems

The Corridor currently has train control signal systems between Boston and Springfield, Springfield and New Haven, sections of Vermont in the vicinity of Montreal, and other select locations on the right-of-way, such as the approach to Springfield from the east. Due to the additional level of service, a full train control signal system is included in Alternative 2 on the full length of the right-of-way.

Signal systems improvements will include upgrades to warning devices at highway-rail grade crossings. Specific improvements at individual crossings will be based on increased train frequency, higher operating speeds, or both.

Station Infrastructure

Station improvements on the Corridor will be the same as outlined in Alternative 1.

5.4 ALTERNATIVE 3 – CORRIDOR SERVICE WITH SPEED AND EQUIPMENT IMPROVEMENTS

Alternative 3 considers service with a maximum operating speed of 90 mph and the use of tilt train equipment. Necessary infrastructure upgrades include improvements to the Right-of-Way, full train signalization, and additional sidings/double tracking. Alternative 3 includes all of the capital improvements and services indicated in Alternative 2 with the additional infrastructure and operations changes noted in the following sections.

5.4.1 Alternative 3 Service Program

In addition to the rail service in the Corridor identified in Alternative1, Alternative 3 includes the addition of five local service round trip trains between Boston and Springfield.

In summary, the Alternative 3 service plan provides service above the No-Build condition consisting of the following: eight trains from Boston to New Haven (four express and four local), three trains from Boston to Montreal (two local and one express), five shuttle local service trains from Boston to Springfield, and two trains from New Haven to Montreal (one express and two local). Stations for non-express trains will be the same as in Alternative 1 and Alternative 2 identifies the stations for express service trains.

Tables 5.4 and 5.5 identify the origin and destination times between key station pairs in Alternative 3. Additionally, Figure 5.3 graphically depicts the service of Alternative 3 on the Corridor, with frequency between terminal pairs, and maximum operating speeds.

Table 5.4 Alternative 3 Corridor Service with Speed and Equipment Improvements Local Travel Times (Hours : Minutes)

City	Boston	Springfield	White River Junction	Burlington (Essex Junction)	New Haven	Montreal
Boston	-	1:58	4:46	6:35	3:28	8:54
Springfield	1:58	-	2:45	4:34	1:30	6:53
White River Junction	4:46	2:45	-	1:49	1:15	4:08
Burlington (Essex Junction)	6:35	4:34	1:49	-	3:04	2:19
New Haven	3:28	1:30	1:15	3:04	-	5:23
Montreal	8:54	6:53	4:08	2:19	5:23	-

Table 5.5 Alternative 3 Corridor Service with Speed and Equipment Improvements Express Travel Times (Hours : Minutes)

City	Boston	Springfield	White River Junction	Burlington (Essex Junction)	New Haven	Montreal
Boston	-	1:46	4:15	5:30	3:16	7:48
Springfield	1:46	-	2:29	3:44	1:30	6:02
White River Junction	4:15	2:29	-	1:15	0:59	3:33
Burlington (Essex Junction)	5:30	3:44	1:15	-	2:14	2:18

City	Boston	Springfield	White River Junction	Burlington (Essex Junction)	New Haven	Montreal
New Haven	3:16	1:30	0:59	2:14	-	4:32
Montreal	7:48	6:02	3:33	2:18	4:32	-

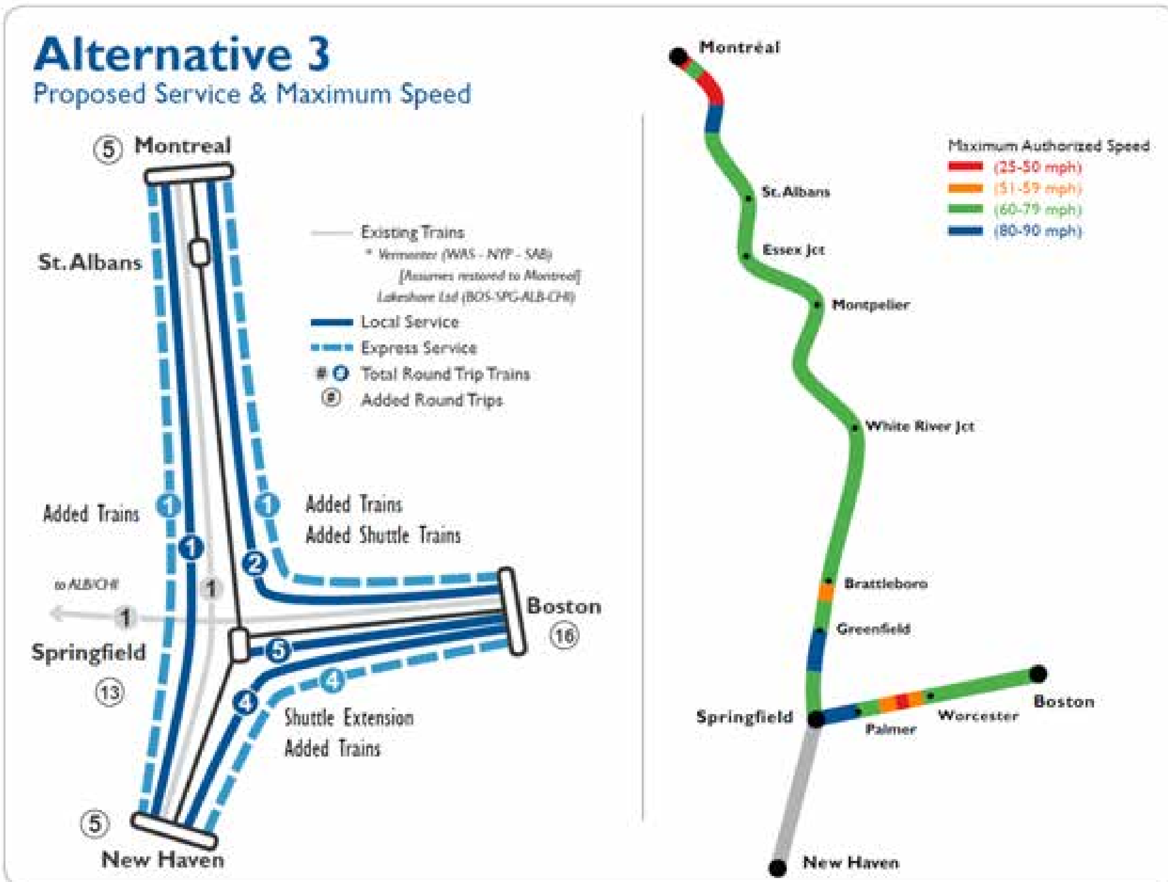

Figure 5.3: Alternative 3 Frequency and Speed Charts

(Daily increased round trip frequencies Boston: 16, Montreal 5; New Haven 5. Max speed 90 MPH)

5.4.2 Alternative 3 Infrastructure Program

Alternative 3 will require infrastructure upgrades and use of existing facilities to accommodate additional passenger rail service, improve speeds to 90 mph where possible, and accommodate tilting train equipment.

Layover Facilities

Train sets on the Corridor will be accommodated at layover facilities near terminal stations. No additional layover facilities from those identified in the No Build Alternative are anticipated as part of Alternative 3.

Right-of-Way

Alternative 3 does not propose any alignment changes to the right-of-way and all track work will take place within the existing alignment. However, certain segments of the right-of-way will be improved to support operations and speed. Areas where improvements are proposed are the same as in Alternative 2.

Signal Systems

As in Alternative 2, Alternative 3 would add significantly more trains to the Corridor, necessitating full signalization and positive train control. Signal systems will include improvements to warning devices at highway-rail grade crossings.

Stations

Station improvements on the Corridor will be the same as outlined in Alternative 1.

5.5 COORDINATED PROJECTS

Within the 470 miles of the NNEIRI Corridor there are a number of interfaces with other projects in Massachusetts, Vermont, Connecticut and Quebec. The NNEIRI project team is actively coordinating with other project management teams to ensure NNEIRI planning and Alternatives account for coordinated project activities. Coordinated projects include:

South Station Expansion

A planned expansion and modernization of the existing rail hub. With only 13 tracks the station is at capacity and lacks the ability to handle growing intercity passenger rail service. This project will increase the number of tracks (and platforms); as well, as provide new amenities that will enhance the travelers' experience, concerning safety, comfort, convenience and accessibility. Additionally, MassDOT is considering significant commercial office, residential, and hotel development for the South Station site.

Springfield Union Station Restoration

Rehabilitation and repurposing of Springfield Union Station to improve passenger capacity and comfort and provide operational efficiencies for existing and future rail service. The program will add track and platform capacity, restore the historic Springfield Union Station headhouse, and add a new layover facility adjacent to the station.

Knowledge Corridor

A project to restore the Vermonter to its original route on the Pan Am Southern Railroad. This more direct route will allow for an overall reduction in travel time of 25 minutes, a reduction of delays and a potential increase in ridership of 24%. This project includes rehabilitating the track on the Pan Am Southern rail line and the construction of new stations in Holyoke, Northampton, and Greenfield. The Knowledge Corridor also potentially includes intercity rail shuttle service between Springfield and Greenfield with stops in Northampton and Holyoke.

Vermonter Extension to Montreal

Extension of the AMTRAK's Vermonter service to Montreal through the CN Line to Central Station Montreal. Related to the Vermonter's restoration, a new U.S. Customs and Immigration checkpoint will be built in Central Station to improve customs clearance for rail passengers.

New Haven-Hartford-Springfield (NHHS)

The NHHS Commuter Rail Program is a new higher speed rail service that will connect these and other cities in Connecticut currently served by both the Vermonter and Amtrak's Shuttle. This extensive project includes the overhaul of track in the corridor and the addition of new stations, 27 miles of double tracking, bridge repairs, positive train control and new passing sidings. This project also calls for the purchase of new trains and equipment. Service is expected to start in late 2016.

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6 SERVICE PLAN

6.1 INTRODUCTION

This section outlines the service plan for the three Build Alternatives defined in previous sections. For the three Build Alternatives, service plans were developed to account for the differing improvements to speeds, frequencies, and equipment (specific improvements are discussed in detail in Chapter 5). The NNEIRI Service Plans provides a preliminary schedule for passenger rail operations, rolling stock options, crew staffing requirements, and maintenance requirements for each Build Alternative. Potential impacts to existing intercity, commuter rail, and freight operations were considered in the development of the service plans, as well as maximizing connections to other rail services.

6.2 ALTERNATIVE 1 CORRIDOR SERVICE

6.2.1 Service Plan

The Alternative 1 Service Plan includes six daily round trips between Boston and Springfield, with four trains continuing to New Haven and two to Montreal. Additionally, one train is scheduled to operate in the morning from New Haven to Montreal via Springfield with a southbound trip in the afternoon. Trains will stop at all existing intercity rail stations on the Corridor. The Alternative 1 Service Plan utilizes the existing New Haven/Springfield shuttle service as a base from which to expand services in the other Corridor segments.

Table 6.1 profiles the Alternative 1 Service Plan schedule, with origin and arrival stations, departure time, and additional information about the service. Although the Lake Shore Limited or extended Vermonter services are not a part of the NNEIRI Study, they are included in the Service Plan description for informational purposes. Other services on the Corridor, such as MBTA Commuter Rail service, and future NHHS service are not included as they primarily serve different travel markets. Headways for the schedules are predicated by each set of equipment's initial departure times and subsequent departures incorporate a minimum 30 minute turnaround.

Table 6.1 Alternative 1 Daily Service Program

Origin	Destination	Depart Origin	Notes
Boston	New Haven	4:48 AM	Extension of AMTRAK Shuttle 495 Regional Service
		8:08 AM	New Regional Service
		11:55 AM	AMTRAK Lake Shore Ltd.(between SPG and BOS)*
		1:02 PM	Extension of AMTRAK Shuttle 493 Regional Service
		5:04 PM	New Regional Service
Boston	Montreal	6:48 AM	New Regional Service
		2:05 PM	New Regional Service
New Haven	Boston	8:40 AM	Extension of AMTRAK Shuttle 490 Regional Service
		9:40 AM	New Regional Service
		3:00 PM	New Regional Service
		5:20 PM	Extension of AMTRAK Shuttle 476 Regional Service*
		5:53 PM	AMTRAK Lake Shore Ltd.(between SPG and BOS)*
New Haven	Montreal	10:47 AM	New Regional Service
		1:25 PM	Extension of AMTRAK Vermonter Service*
Montreal	Boston	10:00 AM	New Regional Service
		1:15 PM	New Regional Service
Montreal	New Haven	6:45 AM	Extension of AMTRAK Vermonter Service*
		3:00 PM	New Regional Service

*Note: AMTRAK Lake Shore Limited and Vermonter Services are shown for informational purposes. Vermonter is assumed extended to Montreal. Lake Shore Limited Services operate from Boston to Chicago through Springfield.

6.2.2 Alternative 1 Maintenance and Layover Facilities

It is assumed that, in addition to Springfield, crew reporting and equipment maintenance may be performed in Boston or New Haven. Further, it is assumed that while crews will be required to layover in Montreal, maintenance services there would only include turnaround servicing and inspections, running repairs, and fueling. Any maintenance work, other than running repairs would only be performed under emergency contract. The Alternative 1 Service Plan assumes that lodging for crew will only be necessary in Montreal; however a final timetable allowing crew development factoring in starting times and hours-of-service mandates may require additional costs for crew reporting facilities and/or lodging services. Additionally, it is assumed that if lodging or maintenance cannot be performed at multiple locations, it may be necessary for crews to deadhead equipment.

6.3 ALTERNATIVE 2 CORRIDOR SERVICE WITH SPEED IMPROVEMENTS

The Alternative 2 Service Plan includes eight round trips between Boston and New Haven and three from Boston to Montreal, and two from New Haven to Montreal all through Springfield. As compared to Alternative 1, this includes four additional express roundtrips between Boston and New Haven, one express roundtrip from New Haven to Montreal, and one express roundtrip from Boston to Montreal. Service will include regional trains making stops at all existing stations and express trains making stops in large hub stations. Similar assumptions to Alternative 1 were included in Alternative 2, including utilizing existing New Haven to Springfield Shuttle service, accounting for existing freight and commuter traffic, and assuming minimum turnaround times for equipment. Table 6.2 profiles the Alternative 2 Service Plan schedule, with origin and arrival stations, departure time, and additional information about the service.

Table 6.2 Alternative 2 Daily Service Program

Origin	Destination	Depart Origin	Notes
Boston	New Haven	5:08 AM	Extension of AMTRAK Shuttle 495 Regional Service
		7:30 AM	New Regional Service
		9:50 AM	New Express Service
		11:19 AM	New Regional Service
		11:55 PM	AMTRAK Lake Shore Ltd.(between SPG and BOS)*
		1:29 PM	New Express Service
		4:20 PM	New Regional Service
		5:58 PM	New Express Service
		8:26 PM	Extension of AMTRAK Shuttle 493 Regional Service
Boston	Montreal	5:43 AM	New Express Service
		6:59 AM	New Regional Service
		2:28 PM	New Regional Service

Origin	Destination	Depart Origin	Notes
New Haven	Boston	6:40 AM	New Express Service
		8:40 AM	Extension of AMTRAK Shuttle 490 Regional Service
		9:51 AM	New Regional Service
		12:50 PM	New Regional Service
		1:30 PM	New Regional Service
		3:00 PM	New Regional Service
		5:20 PM	Extension of AMTRAK Shuttle 476 Regional Service
		5:53 PM	AMTRAK Lake Shore Ltd.(between SPG and BOS)*
		8:40 PM	New Regional Service
New Haven	Montreal	10:47 AM	New Regional Service
		1:25 PM	Extension of AMTRAK Vermonter Service*
		4:10 PM	New Regional Service
Montreal	Boston	8:40 AM	New Regional Service
		1:20 PM	New Regional Service
		4:37 PM	New Express Service
Montreal	New Haven	6:45 AM	Extension of AMTRAK Vermonter Service*
		10:40 AM	New Express Service
		2:50 PM	New Regional Service

*Note: AMTRAK Lake Shore Limited and Vermonter Services are shown for informational purposes. Vermonter is assumed extended to Montreal. Lake Shore Limited Services operate from Boston to Chicago through Springfield.

6.3.1 Alternative 2 Maintenance and Layover Facilities

It is assumed that Alternative 2 will utilize the same layover facilities and other assumptions as Alternative 1.

6.4 ALTERNATIVE 3 CORRIDOR SERVICE WITH SPEED AND EQUIPMENT IMPROVEMENTS

The Alternative 3 Service Plan includes eight round trips between Boston and New Haven, three from Boston to Montreal, and two from New Haven to Montreal all through Springfield. Additionally, five round trip shuttle trains will operate from Boston to Springfield, representing the primary service frequency difference between Alternative 2 and 3. Service will include regional trains making stops at all existing stations and express trains making stops in large hub stations. Similar assumptions to Alternative 1 were included in Alternative 3, including utilizing existing New Haven to Springfield Shuttle service, accounting for existing freight and commuter traffic, and assuming minimum turnaround times for equipment. Table 6.3 profiles the Alternative 3 Service Plan schedule, with origin and arrival stations, departure time, and additional information about the service.

Table 6.3 Alternative 3 Daily Service Program

Origin	Destination	Depart Origin	Notes
Boston	Springfield	5:19 AM	New Regional Service
		5:54 AM	New Regional Service
		7:19 AM	New Express Service
		7:31 AM	New Regional Service
		8:30 AM	New Regional Service
		9:54 AM	New Regional Service
		11:42 AM	New Regional Service
		11:55 AM	AMTRAK Lake Shore Limited Service*
		1:40 PM	New Regional Service
		2:28 PM	New Regional Service
		4:30 PM	New Express Service
		5:30 PM	New Regional Service
		6:30 PM	New Regional Service
		7:30 PM	New Express Service
		8:30 PM	New Regional Service
		9:30 PM	New Express Service
		10:30 PM	New Regional Service

Origin	Destination	Depart Origin	Notes
Springfield	Boston	4:30 AM	New Regional Service
		5:30 AM	New Regional Service
		6:30 AM	New Express Service
		7:30 AM	New Regional Service
		6:50 AM	New Express Service
		8:20 AM	New Regional Service
		10:10 AM	New Regional Service
		11:21 AM	New Regional Service
		2:20 PM	New Regional Service
		3:00 PM	New Regional Service
		3:15 PM	New Regional Service
		4:30 PM	New Regional Service
		5:53 PM	AMTRAK Lake Shore Limited Service*
		6:50 PM	New Regional Service
		7:55 PM	New Express Service
		10:00 PM	New Regional Service
		10:54 PM	New Express Service
Springfield	New Haven	7:00 AM	New Regional Service
		9:22 AM	New Regional Service
		9:00 AM	New Express Service
		11:35 AM	New Regional Service
		1:33PM	New Regional Service
		2:50 PM	Extension of AMTRAK Vermonter Service*
		3:21 PM	New Regional Service
		5:32 PM	New Regional Service
		6:21 PM	New Express Service
		7:11 PM	New Regional Service
		9:25 PM	New Regional Service
		10:21 PM	New Express Service

Origin	Destination	Depart Origin	Notes
New Haven	Springfield	6:50 AM	New Regional Service
		8:40 AM	New Express Service
		9:51 AM	New Regional Service
		10:47 AM	New Regional Service
		12:50 PM	New Regional Service
		1:25 PM	Extension of AMTRAK Vermonter Service*
		1:30 PM	New Regional Service
		3:00 PM	New Regional Service
		4:10 PM	New Regional Service
		5:20 PM	New Regional Service
		8:40 PM	New Regional Service
Springfield	Montreal	7:35 AM	New Express Service
		9:00 AM	New Regional Service
		12:17 PM	New Regional Service
		3:15 PM	Extension of AMTRAK Vermonter Service*
		4:29 PM	New Regional Service
		5:30 PM	New Express Service
Montreal	Springfield	6:45 AM	Extension of AMTRAK Vermonter Service*
		9:11 AM	New Regional Service
		10:40 AM	New Express Service
		1:51 PM	New Regional Service
		3:21 PM	New Regional Service
		5:10 PM	New Express Service

*Note: AMTRAK Lake Shore Limited and Vermonter Services are shown for informational purposes. Vermonter is assumed extended to Montreal. Lake Shore Limited Services operate from Boston to Chicago through Springfield.

6.4.1 Alternative 3 Maintenance and Layover Facilities

It is assumed that Alternative 3 will utilize facilities in Springfield as primary layover and maintenance facilities. Springfield's central location on the Corridor and location as a terminal for some Alternative 3 services will allow equipment to be serviced without significant deadhead runs or other interruptions.

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7 RIDERSHIP FORECASTS

Ridership forecasts were developed for the three Build Alternatives and the No-Build Alternative. The ridership estimates were developed based on the service plan developed for each Alternative. Apart from the alternative-specific schedule, the forecasting process has followed the same methodology as used for the Preliminary Service Options as described in Chapter 3. All forecasts project 2020 conditions and demand. The complete methodology for ridership forecasts is in Appendix D.

7.1 NO-BUILD ALTERNATIVE RIDERSHIP FORECASTS

The No-Build Alternative ridership forecasts assume no ridership from NNEIRI services as NNEIRI services would not be implemented. The existing ridership on the Corridor is attributed to the AMTRAK Vermonter and Lake Shore Limited services.

Table 7.1: No-Build Alternative Ridership Forecasts

Position	Total
Boston to Springfield	8,312
Springfield to Montreal	15,740
BOS/SPG to SPG/MTL Segments	0
BOS/SPG to SPG/NHV-NEC Segments	0
MTL/SPG to SPG/NHV-NEC Segments	46,948
Total Ridership	**71,000**

7.2 ALTERNATIVE 1 RIDERSHIP FORECASTS

Alternative 1 ridership forecasts include 597,900 total annual trips on the Corridor services in 2020, of which 526,900 trips are above the No-Build baseline ridership. Table 7.2 profiles ridership by segment and between segments and Figure 7.1 in graphic form. Notably, trains between the Montreal/Springfield and Springfield/New Haven-Northeast Corridor segments have strong ridership while trains from the Boston/Springfield to the Springfield/Montreal segment have relatively low ridership, with less than 100 people utilizing four trains between the city pairs.

Table 7.2: Alternative 1 Ridership

Position	Total
Boston to Springfield	32,244
Springfield to Montreal	167,707
BOS/SPG to SPG/MTL Segments	32,830
BOS/SPG to SPG/NHV-NEC Segments	137,172
MTL/SPG to SPG/NHV-NEC Segments	223,705
Total Ridership	**597,900**

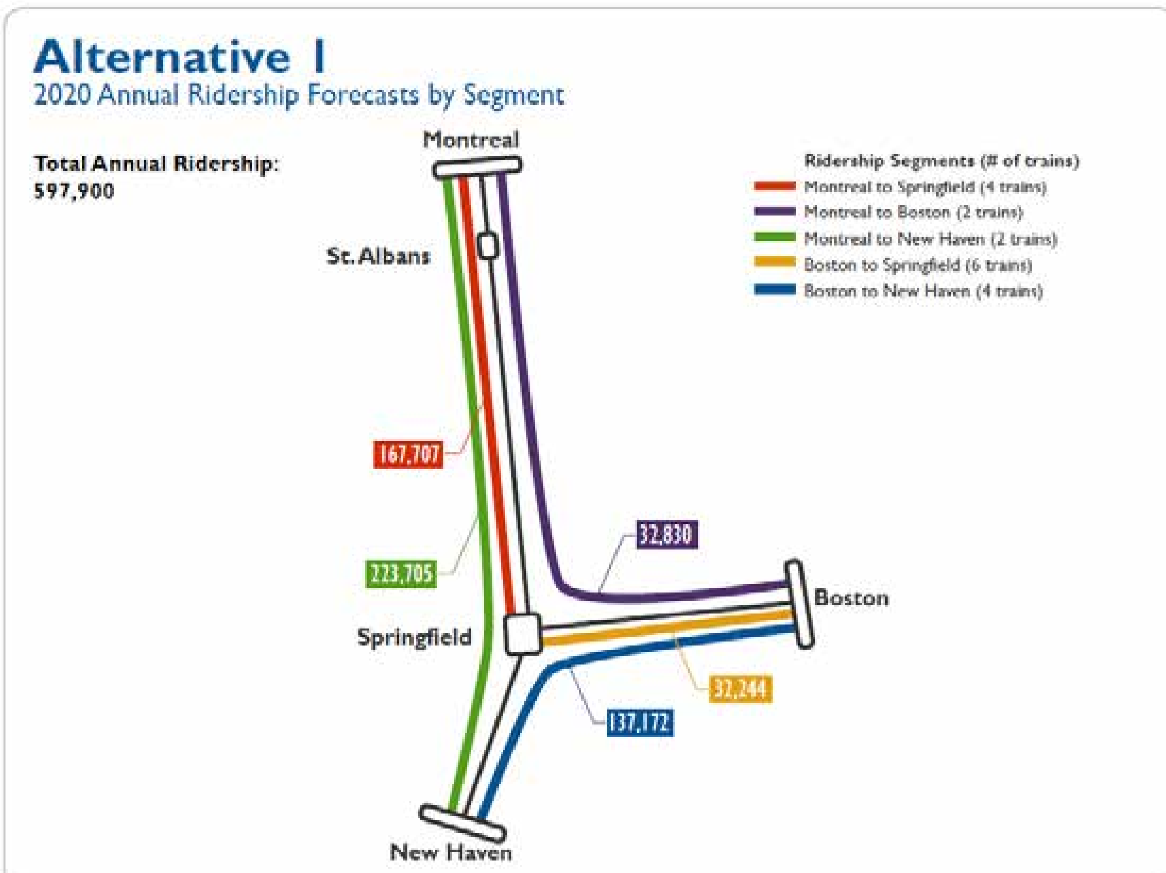


Figure 7.1: Alternative 1 2020 Ridership Forecasts by Segment

7.3 ALTERNATIVE 2 RIDERSHIP FORECASTS

Alternative 2 ridership provides for 1,052,500 annual trips utilizing Corridor services in 2020, including 981,500 trips above the No-Build baseline ridership. Table 7.3 profiles ridership by segment and between segments in and Figure 7.2 in graphic form.

Alternative 2 increases total annual ridership by more than 75% over Alternative 1. All segments see ridership growth. Notably, however, the strongest growth is in the travel market connecting the Boston/Springfield segment to the Springfield/New Haven-Northeast Corridor, where services have a 211% gain in ridership. The Boston to New Haven services appear to benefit significantly from the doubling of services (four to eight trains) and the addition of express services. Additionally, express services appear to provide significant growth in longer-distance travelers, with growth seen in longer distance origin-destination pairs.

Table 7.3 Alternative 2 Ridership

Position	Total
Boston to Springfield	50,335
Springfield to Montreal	221,553
BOS/SPG to SPG/MTL Segments	42,762
BOS/SPG to SPG/NHV-NEC Segments	427,175
MTL/SPG to SPG/NHV-NEC Segments	307,131
Total Ridership	**1,052,500**

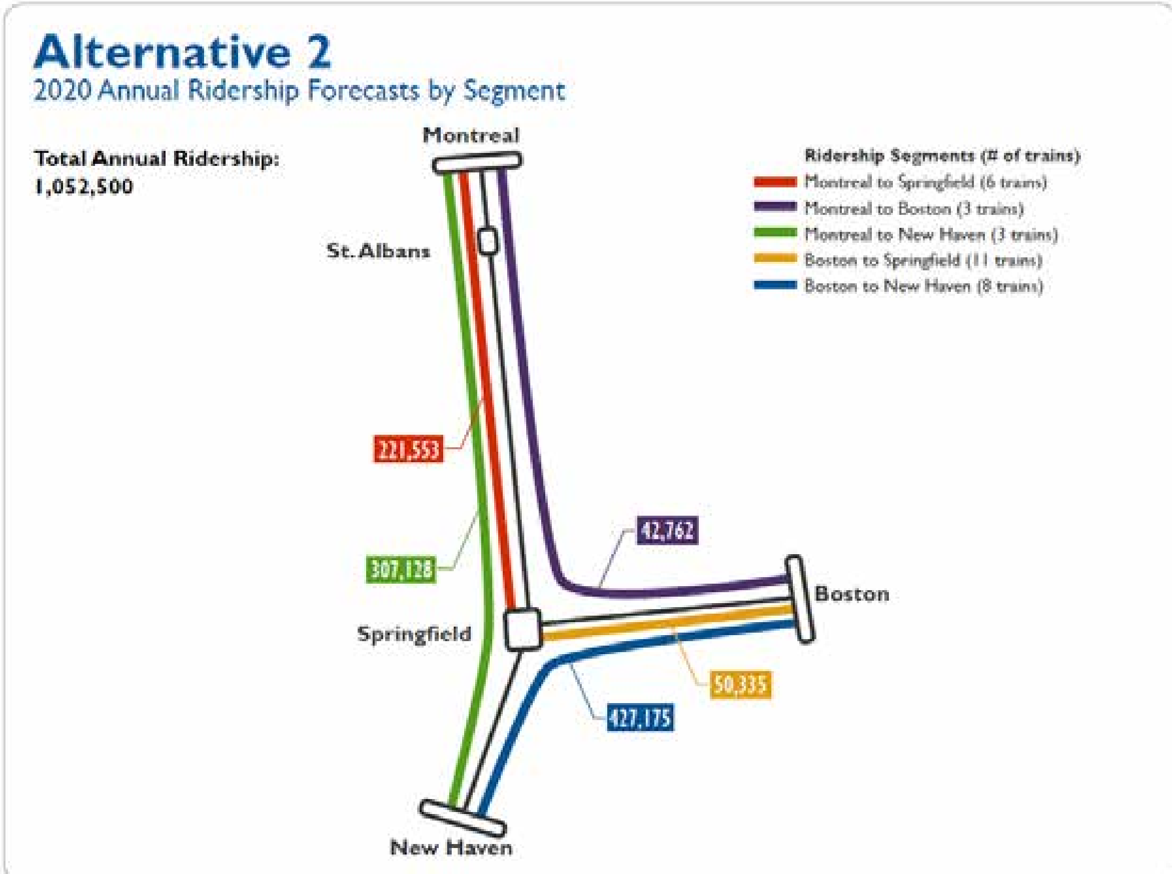


Figure 7.2: Alternative 3 2020 Ridership Forecasts by Segment

7.4 ALTERNATIVE 3 RIDERSHIP FORECASTS

Alternative 3 ridership provides for 1,170,700 annual trips utilizing Corridor services in 2020, including 1,099,700 trips above the No Build baseline ridership. Table 7.4 profiles ridership by segment and between segments and in Figure 7.3 in graphic form.

Notably, Alternative 3 only increases total annual ridership 11% over Alternative 2 despite faster speeds and the addition of more service between Boston and Springfield. All segments see some ridership growth, however, most is relatively limited. For example, despite a 45% increase in train service between Boston and Springfield, the segment only sees an addition of 28% more riders. The relatively flat increase in passenger demand, particularly in the Boston to Springfield segment, suggests that demand is relatively inelastic and will not necessarily increase linearly compared to service increases.

Table 7.4 Alternative 3 Ridership

Position	Total
Boston to Springfield	64,704
Springfield to Montreal	245,157
BOS/SPG to SPG/MTL Segments	49,647
BOS/SPG to SPG/NHV-NEC Segments	469,887
MTL/SPG to SPG/NHV-NEC Segments	338,463
Total Ridership	**1,170,700**

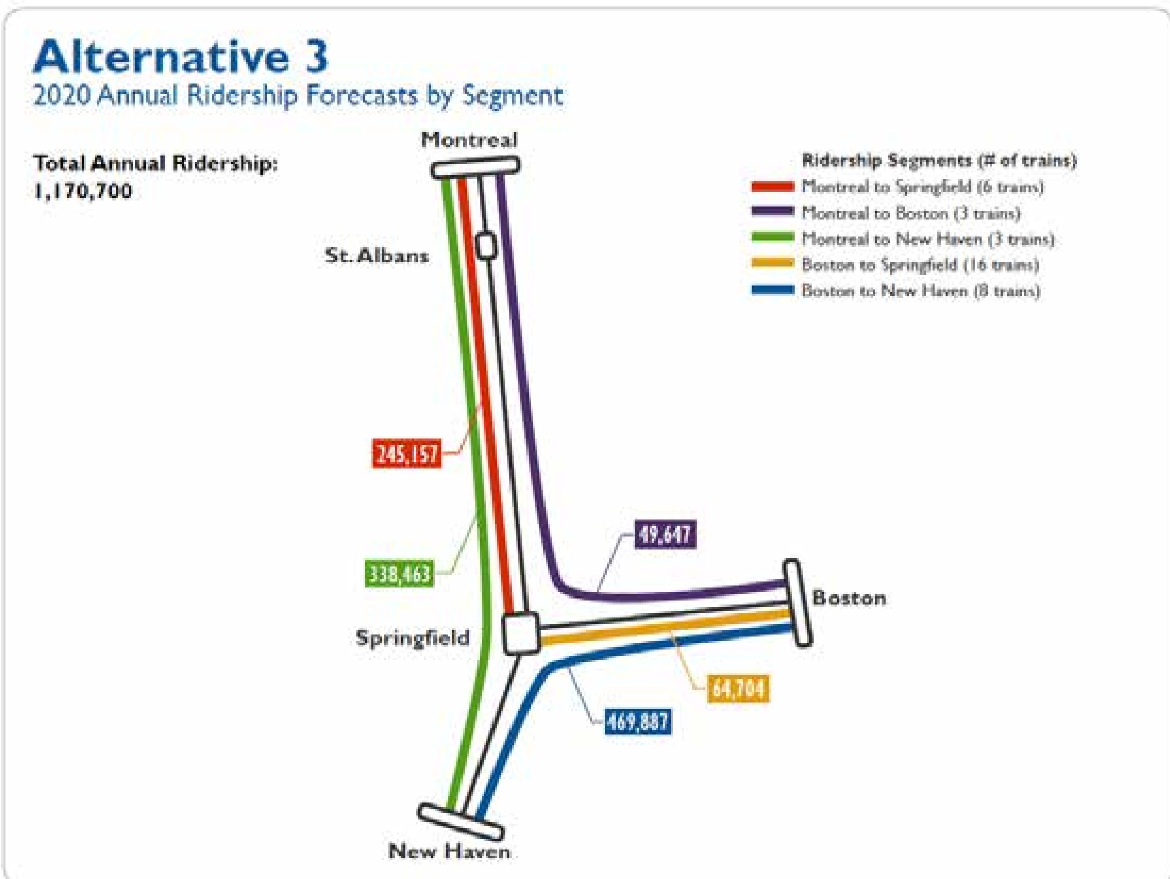


Figure 7.3: Alternative 3 2020 Ridership Forecasts by Segment

7.5 SUPPLEMENTARY RIDERSHIP ANALYSIS

Supplementary analysis of service plans are included in the NNEIRI study to better understand the impact of travel time on ridership and to isolate this variable from the three alternatives. An alternative service plan called Alternative 1A was developed, under which the frequencies were the same as Alternative 1 but the travel times reflect a maximum authorized speed of 79 mph. An alternative service plan called Alternative 2A was developed under which the frequencies were the same as Alternative 2 but the travel times reflect a maximum authorized speed of 79 mph with tilting equipment. Tilting equipment allows trains to travel faster around curves and saves substantial travel time on the NNEIRI Corridor.

Faster speeds in Alternative 1A increased ridership approximately 10% over Alternative 1, increasing from 526,900 to 579,000 annually. Alternative 2A ridership increased approximately 3% from Alternative 2, increasing from 981,500 to 1,019,800 annual riders.

The results were used to test ridership responsiveness to faster travel times compared with service frequencies. Appendix E provides a detailed description of the supplementary ridership travel times and frequencies compared with Alternatives 1, 2, and 3.

7.6 RIDERSHIP RESULTS SUMMARY

The study of alternative ridership reveals significant demand for passenger rail service on the NNEIRI Corridor. Compared with other intercity rail lines in the United States, ridership on Alternative 1 is similar to ridership on the successful AMTRAK Downeaster service between Boston and Brunswick, Maine that carried 559,977 passengers in 2013. Ridership on Alternatives 2 and 3 is comparable to ridership on the AMTRAK Empire Builder service between New York City and Albany/Buffalo that carried 1,081,329 passengers in 2013. NNEIRI services would provide passenger rail services in many regions that historically hosted robust rail service, therefore building on historic infrastructure and travel patterns that saw reduction and elimination of services in the mid-20th Century.

The alternative ridership forecasts also reveal significant differences in response services and demand between the alternatives. In all three Build Alternatives, strong demand for Montreal/Springfield to Springfield/New Haven-Northeast Corridor segment is apparent with ridership ranging from 223,705 to 338,463 annual passengers. The demand between the two segments is primarily driven by riders with origins or destinations in New York City, due to the New York region's large population and employment base and significant rail-oriented infrastructure system.

However, as compared to the Montreal/Springfield to Springfield/New Haven-Northeast Corridor segments, demand between the Boston/Springfield and Springfield/Montreal segments is not as strong. Analysis of origin-destination pairs reveals that a majority of riders between the segments utilize the four southern-most stations on the Springfield to Montreal Corridor (Holyoke, Northampton, Greenfield, and Brattleboro). Travel times from the Boston area to the southern part of the corridor are comparable to travel by bus or auto. However, travel times between the Boston area and points north of Brattleboro are significantly longer by NNEIRI service than by road; for example, NNEIRI service between Boston and White River Junction is slightly under five hours whereas the journey by road is slightly over two hours.

Demand for passenger service in the Boston to Springfield segment does not respond significantly to the larger increases in service. Service levels between Alternative 1 and 3 is increased by 300% (four to 16 daily round trips) however ridership only doubles from 32,244 to 64,704, with most of the gain occurring between Alternatives 1 and 2.

Generally, despite an increase in service and speed, ridership does not necessarily respond between Alternatives 2 and 3. An analysis of all alternatives reveals that the greatest increase in ridership generally occurs between Alternatives 1 and 2 with significantly smaller gains made between Alternatives 2 and 3. The analysis suggests that serious consideration should be given to the significant costs difference between Alternatives 2 and 3, and the relatively lower increase in ridership in development of the final recommended alternative. Similarly, the ridership results for Alternatives 1A and 2A reveal that ridership generally responds to faster speeds up to 79 mph but begins to level off at higher speeds.

8 PRELIMINARY CAPITAL COST

The preliminary capital cost for the three Build- Alternatives is determined by infrastructure upgrades including track work, bridge repair and signal and communication, as well as, train set and equipment cost.

All numbers are in 2014 Dollars and include 35% engineering/construction management costs in the baseline capital costs. A range of costs is established due to the current level of design. The range reflects the addition of 40 to 60 percent contingency over base costs to account for the level of uncertainty about the detail regarding some infrastructure improvements. The alternative's cost assumes vehicle and locomotive design to be consistent with fleet design requirements established by the Passenger Rail Investment and Improvement Act of 2008 (PRIIA). Vehicles costs are provided with a 30% contingency because of a higher degree of certainty around vehicle design and manufacturing costs.

8.1 ALTERNATIVE 1 PRELIMINARY CAPITAL COSTS

Alternative 1 will provide for state of good repair infrastructure improvements, as well as, upgrading infrastructure to accommodate at least 59 MPH operations or FRA Class 3 operations. Additional sidings and double track will be constructed in key locations between Springfield and Worcester and in Vermont. Further, Alternative 1 assumes purchase of 11 train sets to serve fleet requirements for the proposed services. The total capital cost of Alternative 1 is estimated between $615-785 million and is profiled in detail in Tables 8.1-8.3 and in Appendices B and C.

Table 8.1 Alternative 1 Preliminary Capital Costs

Infrastructure	Cost
Track	$220 - 270 Million
Bridge	$5 – 10 Million
Signal and Communication	$95 – 125 Million
Total Infrastructure	**$320 –405 Million**
Trainset & Equipment (11 Trainsets)	**$295 – 380 Million**
TOTAL CAPITAL COSTS	**$615 –785 Million**

Table 8.2 Alternative 1 Preliminary Infrastructure Costs: Boston to Springfield Corridor

Infrastructure	Cost
Track	$120 - 150 Million
Bridge	$5 – 10 Million
Signal and Communication	$25 - 35 Million
Total Infrastructure	**$150 – 195 Million**

Table 8.3 Alternative 1 Preliminary Infrastructure Costs: Springfield to Montreal Corridor

Infrastructure	Cost
Track	$110 - 120 Million
Signal and Communication	$70 -90 Million
Total Infrastructure	**$170 – 210 Million**

8.2 ALTERNATIVE 2 PRELIMINARY CAPITAL COSTS

Alternative 2 will provide for state of good repair infrastructure improvements, as well as, upgrading infrastructure to accommodate at least 79 MPH operations or Class 4 Operating. Double tracking will be implemented between Worcester and Springfield and Vermont will have double tracking and key siding. Further, Alternative 2 assumes purchase of 17 trainsets to serve fleet requirements for the proposed services. The total capital cost of Alternative 2 is estimated between $1.065-1.350 billion and is profiled in detail in Tables 8.4-8.6 and in Appendices B and C.

Table 8.4 Alternative 2 Preliminary Capital Costs

Infrastructure	Cost
Track	$410 – 505 Million
Bridge	$20 – 30 Million
Signal and Communication	$175 –225Million

Infrastructure	Cost
Total Infrastructure	**$610 – 760 Million**
Trainset & Equipment (17 Trainsets)	**$455 – 590 Million**
TOTAL CAPITAL COSTS	**$1065 – 1350 Million**

Table 8.5 Alternative 2 Preliminary Infrastructure Costs: Boston to Springfield Corridor

Infrastructure	Cost
Infrastructure (Inland Route)	
Track	$170 - 190 Million
Bridge	$15 - 20 Million
Signal and Communication	$30 - 40 Million
Total Infrastructure	**$215 - 250 Million**

Table 8.6 Alternative 2 Preliminary Infrastructure Costs

Infrastructure	Cost
Track	$215 - 240 Million
Bridge	$5 – 10 Million
Signal and Communication	$145 - 190 Million
Total Infrastructure	**$365 - 440 Million**

8.3 ALTERNATIVE 3 PRELIMINARY CAPITAL COSTS

Alternative 3 will provide for state of good repair infrastructure improvements, as well as, upgrading infrastructure to accommodate at least 90 mph operations or Class 5 Operating. Double tracking will be implemented between Worcester and Springfield and Vermont will have double tracking and key siding. Further, Alternative 3 assumes purchase of 18 tilt-enabled trainsets to serve fleet requirements for the proposed services. The total capital cost of Alternative 3 is estimated between $1,090-1,350 billion and is profiled in detail in Tables 8.7-8.9 and in Appendices B and C.

Table 8.7 Alternative 3 Preliminary Capital Costs

Infrastructure	Cost
Track	$440 – 540 Million
Bridge	$25 – 30 Million
Signal and Communication	$210 – 270 Million
Total Infrastructure	**$635 – 840 Million**
Trainset & Equipment (18 Trainsets)	**$455 – 590 Million**
TOTAL CAPITAL COSTS	**$ 1,255 – 1,590 Billion**

Table 8.8 Alternative 3 Preliminary Infrastructure Costs: Boston to Springfield Corridor

Infrastructure	Cost
Track	$180 - 200 Million
Bridge	$15 - 20 Million
Signal and Communication	$35 - 45 Million
Total Infrastructure	**$230 - 265 Million**

Table 8.9 Alternative 3 Preliminary Infrastructure Costs: Springfield to Montreal Corridor

Infrastructure	Cost
Track	$230 - 260 Million
Bridge	$5 – 10 Million
Signal and Communication	$170 - 225 Million

Infrastructure	Cost
Total Infrastructure	**$405 - 495 Million**

9 OPERATION AND MAINTENANCE COSTS

Operating and maintenance (OM) costs for the three Build Alternatives are based on an analysis of inputs from existing intercity rail operations in the northeastern United States. Total operating and maintenance costs are the sum of operating cost per train set, operating cost per train hour and operating cost per train mile. A train set is comprised of one locomotive and five coaches.

9.1 METHODOLOGY

9.1.1 Overview

To generate operating costs for the various Alternatives being considered in this study, a flexible OM cost model was developed. The model reflects the cost implications of the following variables:

- Level of service
- Peak fleet requirements
- Operating speed
- Revenue operating hours
- Route length

A complete version of the OM methodology report is found in Appendix G.

9.1.2 Project Alternatives

The model estimates the OM costs of the three Build Alternatives summarized in Table 9.1. These alternatives are differentiated by operating speed, number of stops served (local or express) and type of equipment used (non-tilting or tilting).

Table 9.1 Overview of Project Alternatives

Alternative	Maximum Speed	Equipment Type	Service Type
1	60 MPH*	Standard	Local
2	79 MPH	Standard	Local
			Express
3	90 MPH	Tilt	Local
			Express

* Maximum speed will vary (up to 79 MPH) where existing operating speeds are higher.

9.1.3 Passenger Rail OM Cost Elements

OM costs for intercity passenger rail services are typically divided into six primary cost categories for the purposes of developing a cost model, including train and engine crew, rolling stock maintenance, rolling stock capital depreciation, maintenance of way, maintenance of facilities and administrative costs. For the purpose of the NNEIRI OM model, relevant cost categories have been combined into train, engine and onboard crew costs, maintenance and administrative costs, and rolling stock capitalization costs.

OM cost models are structured to predict operating costs based on a combination of the standard cost drivers, including price per passenger, per mile, per train hour, per trip, per train set, or lump sum based on contract or allocation methodology. This model uses train sets, train hours and train miles as the three variables to predict costs. Additionally, a per track mile maintenance cost is applied for areas with operating speeds of 90 mph because 90 mph operation requires freight carriers to change their track maintenance protocols. Other elements incorporated into the OM cost model include:

- Wages and fringe benefits including locomotive engineers, conductors, assistant conductors and on-board service crew are represented in train hours and include labor associated with terminal yard operations. Train hours were used to estimate labor costs for crew hours
- Host railroad charges, rolling stock preventive maintenance, running repairs and inspections, terminal maintenance of way, station maintenance, fuel, on-board provisions, insurance and administrative costs are reflected in train miles. Administrative costs (unless otherwise accounted for) include marketing, customer service, security, rents and leases and payments for host freight railroad track sharing rights. Fuel, maintenance and administrative costs are affected more by number and distance of trips, rather than train hours. Therefore, these unit elements were incorporated into the OM cost model's train miles variable.
- The cost per train set includes the annual depreciation of the rolling stock required for the service and is defined as an annual cost per peak required train set.

9.1.4 Unit Costs

Peer services operated by AMTRAK on similar corridors, using similar rolling stock, and under similar operating conditions were identified to establish unit costs. The operating costs of the peer services were then broken down into cost per train set, cost per train hour and cost per train mile. The rates of the peer system are represented in Table 9.2.

Once the peer train mile, train hour, train set and track mile rates were identified, the model for the NNEIRI was developed to establish a cost for each speed and equipment alternative and based on the operating characteristics and draft revenue service schedule of each alternative, based on specific units known as OM cost drivers. The units for each of the cost drivers are calculated and include the peak number of train sets, number of daily trips, route length and the operating schedule.

Table 9.2. Unit Costs (2014 Dollars)

Representative Peer	
Ops Cost/Train Set/Year	$827,000
Ops Cost/Train Hour	$793
Ops Cost/Train Mile	$23
Class 5 Maintenance Premium/Track Mile (over Class 4)	$15,000

9.1.5 Cost Methodology

The model considers the following operating characteristics:

- Quantity of coaches and locomotives and type of locomotive, collectively known as rolling stock, used in each train (train set). The number of coaches dictates the amount of rolling stock maintenance that is required to provide the service. Both locomotives and coaches must be inspected and maintenance performed on components on a preventive maintenance schedule, in addition to routine running repairs. Based on the current alternatives being studied, the rates established in the model assume one diesel locomotive pulling five coaches, one of which includes food and beverage service facilities. To establish the equipment requirements, a two-hour lay over was assumed at each station. Vehicles were assigned routes based on the proposed operating schedule to minimize excess layover time to the extent possible. Once the peak vehicle requirements were established, an industry standard 20% spare ratio was assigned so that “ready-spares” were available.
- Length of the route typically defines the hours of operation for each train and the miles over which it must be operated (which in turn determines some maintenance requirements for both the vehicle, station and the track).
- The number and frequency of trips operated impact both train hours and train miles. The number of daily trips helps to define cost of the service, since crew labor (and fringe benefit) costs are assessed based on hours of operation (as crews are paid hourly) and frequency of operation drives the cost of rolling stock maintenance. The more the rolling stock is used, the more maintenance required.
- Speed of operation, number of stops (local or express) and operational schedule or revenue hours which together with the length of the run and the frequency of the runs define the paid time of service for train crews.
- The round trip revenue hours do include a minimum of two hours of layover times at the terminal locations.

The Build Alternatives include operating speeds of 60, 79, and 90 MPH and include either traditional push, pull diesel locomotive equipment for all speeds or tilt equipment. It is assumed that the tilt trains will use passive tilt technology and, as such, have little or no maintenance cost premium versus conventional non-tilting rolling stock.

Tables 9.3 thorough 9.8 include the results of using the model to estimate the annual operating and maintenance costs based on the current proposed operating schedule.

9.1.6 Limitations

The NNEIRI OM Cost model has some limitations that must be considered in evaluating its outputs:

- Track maintenance costs for higher than Class 4 trackage: The model reflects host railroad trackage rights payments based on the host railroad maintaining most of the Corridor trackage to Class 4 (79 mph maximum passenger train speed) standards. For those alternatives that require Class 5 (90 mph maximum passenger train speed) standards, the host railroad would require compensation for additional track maintenance expenses. An annual additive of $15,000 per track mile for each mile of track to be maintained to Class 5 standards has been added based on current design assumptions.
- Train consists exceeding five coaches: The model reflects a standardized diesel locomotive and 5 coaches train consist. Additional operating cost can be expected should longer consists be operated. At this time, it is expected that none of the NNEIRI alternatives' consists will exceed 5 coaches.
- International border operations: The model does not include provisions for reimbursement of United States or Canadian immigration or customs operating costs. A review of current intercity rail cross-border services did not reveal OM cost premiums for such operation, versus intercity rail service entirely within the US. However, it may be appropriate to include an annual "lump sum" figure in all alternatives' costs for international border operations.

9.2 ALTERNATIVE 1 OPERATION AND MAINTENANCE COSTS

Alternative 1 will operate local services between Boston, Montreal and New Haven. Alternative 1 will utilize 11 train sets, including three spares. The operating cost per train set is $827,000, based on an annual estimated operating cost per train hour rate of $793.69 per train hour and a rate of $22.97 per train mile. Therefore, the total annual operating and maintenance cost for Alternative 1 is approximately $66 million. Tables 9.3 and 9.4 detail Alternative 1 operation and maintenance costs.

Table 9.3: Alternative 1 Operation and Maintenance Cost Units

Units	Number of Units
Train Sets	11
Spares (20%)	3
Number of trains with multiple trips	3
Average train turn duration (HH:MM)	2:59
Daily Revenue Hours (HH:MM)	87:13
Annual Operating Days	365
Annual Revenue Hours	31,867
Daily Revenue Miles	3,494
Annual Revenue Miles	1,275,456

Table 9.4: Alternative 1 Operation and Maintenance Costs

Operating Cost	Unit Cost	Total Annual Estimated Cost
Operating Cost/Train Set	$827,000.00	$11,578,000
Operating Cost/Train Hour	$793.69	$25,266,000
Operating Cost/Train Mile	$22.97	$29,302,000
	TOTAL	**$66,146,000**

9.3 ALTERNATIVE 2 OPERATION AND MAINTENANCE COSTS

Alternative 2 will operate both local and express service and will have 17 train sets with 4 spares. The unit costs are the same as those in Alternative 1. The annual OM costs increase due to the need for seven additional train sets, and the increase in annual train hours and annual train miles. The total annual operating and maintenance cost for Alternative 2 is approximately $112 million. Tables 9.5 and 9.6 detail Alternative 2 operation and maintenance costs.

Table 9.5: Alternative 2 Operation and Maintenance Cost Units

Units	Number of Units
Train Sets	17
Spares (20%)	4
Number of trains with multiple trips	9
Average train turn duration (HH:MM)	2:36
Daily Revenue Hours (HH:MM)	142:52
Annual Operating Days	365
Annual Revenue Hours	52,286
Daily Revenue Miles	6,432
Annual Revenue Miles	2,347,680

Table 9.6: Alternative 2 Operation and Maintenance Costs

Operating Cost	Base Rates	Total Annual Estimated Cost
Operating Cost/Train Set	$827,000.00	$17,367,000
Operating Cost/Train Hour	$793.69	$41,388,000
Operating Cost/Train Mile	$22.97	$53,935,000
	TOTAL	**$112,690,000**

9.4 ALTERNATIVE 3 OPERATION AND MAINTENANCE COSTS

Alternative 3 will operate a combination of local and express service and utilize the greatest number of train sets out of the alternatives. The annual OM costs increase as compared to Alternative 2 due to the need for one additional train set, and the increase in annual train hours and annual train miles. The total annual operating and maintenance cost for Alternative 3 is approximately $129 million. Tables 9.7 and 9.8 detail Alternative 3 operation and maintenance costs.

Table 9.7: Alternative 3 Operation and Maintenance Cost Units

Units	Number of Units
Train Sets	18
Spares (20%)	4
Number of trains with multiple trips	18
Average train turn duration (HH:MM)	3:59
Daily Revenue Hours (HH:MM)	154:04
Annual Operating Days	365
Annual Revenue Hours	56,695
Daily Revenue Miles	7,206
Annual Revenue Miles	2,630,190

Table 9.8: Alternative 3 Operation and Maintenance Costs

Operating Cost	Base Rates	Total Annual Estimated Cost
Operating Cost/Train Set	$827,000.00	$18,194,000
Operating Cost/Train Hour	$793.69	$44,633,000
Operating Cost/Train Mile	$22.97	$66,468,000
	TOTAL	**$129,295,000**

10 FARE REVENUE

This section presents ridership and revenue forecasts for future operating alternatives providing passenger rail service within the NNEIRI Corridor. These forecasts were prepared using a travel demand forecasting model process and key input data and assumptions described in the a separate document titled "Inland Route & Boston-to-Montreal High-Speed Rail Corridor: Travel Market Study," located in Appendix F.

10.1 REVENUE ESTIMATION METHODOLOGY

Ridership and revenue forecasts were prepared for the No Build Alternative and each of the three Build-Alternatives. The fare revenue estimates are based on the service plans for each Alternative and the estimate of ridership at the station level for origin-destination pairs.

All Alternatives assume the same average fares, which reflect current average fare values for intercity rail service in the Northeast, extrapolated for new markets based on mileage. For key markets, the resulting average fares are:

- Montreal-Springfield: $49
- Montreal-Worcester: $58
- Montreal-Boston: $64
- Montreal-New Haven: $58
- White River Junction-Springfield: $32
- White River Junction-Worcester: $41
- White River Junction-Boston: $47
- White River Junction-New Haven: $44
- Boston-Springfield: $25
- Boston-New Haven: $45
- Worcester-Springfield: $17
- Worcester-New Haven: $35
- Springfield-New Haven: $20

All Alternatives assume full implementation of the New Haven-Hartford-Springfield service at 23 round trips between Springfield and New Haven regardless of whether those trains extend beyond Springfield. Depending upon the Alternative those services would be a mix of Intercity Regional Service, Inland Route Service (including all of the service to/from New Haven described above), and Hartford Commuter Service. Existing parallel train services provided along the NEC Spine Shoreline Route (Boston-New Haven via Providence) and by the Adirondack (Montreal-New York) remain at current levels of service.

10.2 FARE REVENUE TOTALS

Fare Revenue totals and by segment are defined in Tables 10.1-10.3.

Table 10.1 Alternative 1 Total Estimated Annual Fare Revenue

Position	Total
Boston to Springfield	$741,000
Springfield to Montreal	$4,318,900
BOS/SPG to SPG/MTL Segments	$1,135,100
BOS/SPG to SPG/NHV-NEC Segments	$4,931,400
MTL/SPG to SPG/NHV-NEC Segments	$8,923,600
Total Ridership	**$20,050,000**

Table 10.2 Alternative 2 Total Estimated Annual Fare Revenue

Position	Total
Boston to Springfield	$1,102,900
Springfield to Montreal	$5,697,300
BOS/SPG to SPG/MTL Segments	$1,506,100
BOS/SPG to SPG/NHV-NEC Segments	$15,925,200
MTL/SPG to SPG/NHV-NEC Segments	$12,528,500
Total Ridership	**$36,760,000**

Table 10.3 Alternative 3 Total Estimated Annual Fare Revenue

Position	Total
Boston to Springfield	$1,380,800
Springfield to Montreal	$6,364,300
BOS/SPG to SPG/MTL Segments	$1,769,500
BOS/SPG to SPG/NHV-NEC Segments	$17,649,400
MTL/SPG to SPG/NHV-NEC Segments	$13,726,000
Total Revenue	**$40,890,000**

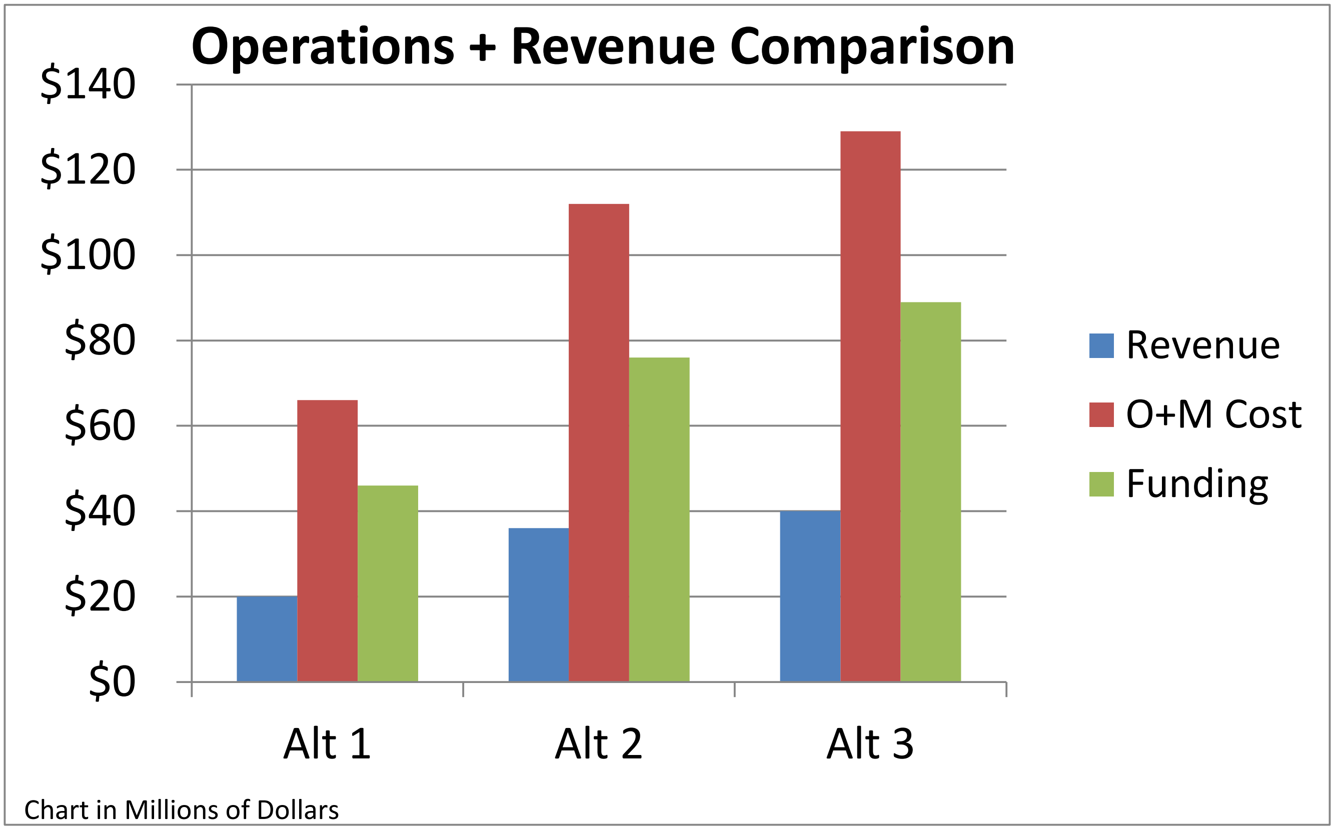
10.3 OPERATIONS FUNDING SUPPORT

Consistent with all intercity passenger rail operations, funding support will be required for each of the alternatives. The estimated level of annual support for planning purposes is the difference between the annual operating and maintenance costs and the annual fare revenue that would be realized for each Alternative. The following is a projection of the annual funding support (in 2014 dollars) that would be necessary for implementation of each Alternative.

- **Alternative 1**
  - Annual Operating and Maintenance: $66 Million
  - Annual Revenue: $20 Million
  - Annual Required Operating Funding: $46 Million
- **Alternative 2**
  - Annual Operating and Maintenance: $113 Million
  - Annual Revenue: $37 Million
  - Annual Required Operating Funding: $76 Million
- **Alternative 3**
  - Annual Operating and Maintenance: $129 Million
  - Annual Revenue: $41 Million
  - Annual Required Operating Funding: $88 Million

Figure 10.1 profiles the comparison of operation and revenue between the three alternatives.

Figure 10.1: Operation and Revenue Comparison



11 ENVIRONMENTAL SCREENING METHODOLOGY

11.1 INTRODUCTION

The National Environmental Policy Act (NEPA) requires federal agencies to integrate environmental values into their decision making process by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions. To comply with NEPA the FRA published Procedures for Considering Environmental Impacts[3] in order to assess environmental impacts of FRA actions. The procedures state that environmental impacts should be a consideration in the early phases of the project and should be incorporated into the alternatives process. This screening considered potential environmental impacts to resources listed in the FRA procedures document and their effect on the selection of a preferred alternative.

11.2 ALTERNATIVES EVALUATION PROCESS

Alternative screening was conducted to determine which Alternative(s) or combination of different elements of Alternatives will be carried forward for detailed evaluation as the Recommended Alternative in the Tier I NEPA document (EIS or EA) that will be completed as part of this Study. During a corridor-level screening, the Alternatives were screened to meet the project Purpose and Need as well as for their ability to offer the most cost effective service with out significant potential impact on the natural and human environment. This section outlines the methodology, including the evaluation criteria or measures of effectiveness for conducting the corridor-level evaluation screening process based on environmental resource criteria.

11.3 EVALUATION CRITERIA

The NNEIRI Alternatives were screened to identify potential major impacts to physical, biological and human resources. Three Build Alternatives were screened by comparing their features to those in the No Build Alternative.

Major environmental challenges are characterized by major impacts that could create significant concern on environmental grounds, such as a substantial impact on a wildlife refuge protected by Section 4(f) or numerous relocations of homes or businesses. An alternative's impacts on sensitive areas can broadly be defined as impacts on wetlands and waterways, existing recreational areas, and the existing built environment, including homes, businesses, farms, and historic properties listed on the National Register of Historic Places (NRHP). An alternative's impacts are defined by the potential for property acquisition along the alternative to accommodate the proposed passenger rail service. Such impacts are often related to existing railroad capacity; where capacity is tight, additional tracks and ROW are potentially required.

[3] Federal Register, Vol. 64, No.101, "Procedures for Considering Environmental Impacts", 5/26/1999

The probable beneficial and adverse effects identified include direct and indirect effects, and cumulative impacts. Direct effects are caused by the action and occur at the same time and place (40 CFR §1508.8). Indirect effects are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Cumulative impact is the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. The screening for indirect and cumulative impacts occurred in consideration of other major projects completed or underway within the corridor that are part of the No-Build Alternative, such as the New Haven-Hartford-Springfield Rail Program and the Knowledge Corridor – Restore Vermonter.

12 ENVIRONMENTAL SCREENING

This Chapter discusses environmental screening results of the three Build Alternatives and their impacts based on the environmental resources criteria within the study Corridor.

12.1 ENVIRONMENTAL SCREENING RESULTS

The three Build Alternatives all follow the same existing active rail corridor over which freight and passenger trains currently operate. The rail lines comprising the Corridor are already expected to see some levels of increased train volumes and speeds based on improvements completed or underway as part of the No-Build Alternative, as described in the preceding sections. Locations where the Build Alternatives provide a second track or passing siding to increase capacity are locations where tow tracks were located in the past, and so the potential impacts on environmental resources resulting from reestablishing the second track are expected to be minor. Moreover, each of the Build Alternatives would utilize layover facilities currently underway or planned as part of the No-Build.

The summary of environmental screening results and potential environmental impacts of each alternative based on environmental resources criteria is summarized in Table 12.1., which is broken up into site specific and corridor wide. Site specific refers to areas along the corridor where installation of a second track would take place. A detailed description of where track work would occur in each alternative can be found in Chapter 5-Alternatives Definition. Outside of these specific locations, existing infrastructure contained in the No-Build Alternative will be utilized with only limited other infrastructure improvements associated with the Build Alternatives. Corridor wide impacts examine the effects of increased train traffic and speeds.

References for environmental resources criteria are included in Table 12.1. Additionally it is noted that subsequent sections contain a notation similar to "further evaluation may be necessary in NEPA Tier 1." This notation is intended to mean that further evaluation of any noted environmental screening elements will be conducted as part of the Tier 1 NEPA document (EA or EIS) for the Recommended Alternative that will be completed as part of this Study.

The primary difference among the Build Alternatives regarding infrastructure improvements is between Alternative 1 and the other Build Alternatives. Alternatives 2 and 3 propose the addition of a second track in all locations between Springfield and Worcester where single track currently exists. Alternative 1 proposes a shorter segment of second track. However, each of the Build Alternatives would utilize the existing rail corridor and right of way. Consequently, the differences between alternatives relative to potential environmental impacts are minor and do not have a major influence on the choice of a Recommended Alternative.

This environmental screening did not review sections of the NNEIRI corridor previously evaluated as part of the New Haven-Hartford-Springfield Rail project or the Knowledge

Corridor – Restore Vermonter project. Both projects received a Finding of No Significant Impact (FONSI) from the FRA after completion of their respective Environmental Assessments (EA). The New Haven-Hartford-Springfield Rail project includes all areas between New Haven and Springfield including the proposed layover facility adjacent to Springfield Union Station. The Knowledge Corridor – Restore Vermonter project covers all areas between Springfield and Northfield, Massachusetts. The following environmental screening table includes only areas not covered by these projects. Screening of the Build Alternatives shows that the limited potential impacts of the NNEIRI Alternatives fit within the FRA's parameters for a NEPA Environmental Assessment (EA) as the appropriate Class of Action.

Table 12.1: Environmental Screening of Alternatives

Environmental Resource	Alternative	Potential Impacts	
		Site Specific	Corridor Wide
Air Quality	All Alternatives	*Minor/Moderate* Construction activities may have some air quality impacts. The addition of passing sidings may, in some areas, result in a minor increase in locomotive idling compared to the No-Build. Further analysis in NEPA Tier 1 will be conducted when the operating plan is further defined.	*Minor/Moderate* The following counties along the corridor are classified as non-attainment for the O_3 1-hour standard: Suffolk, MA; Norfolk, MA; Middlesex, MA; Worcester, MA; Hampden, MA; Cheshire, NH The following counties along the corridor are classified as attainment for the O_3 1-hour standard: Sullivan, NH; Addison, VT; Chittenden, VT; Franklin, VT; Grand Isle, VT; Orange, VT; Washington, VT; Windham, VT; Windsor, VT The entire corridor is classified as attainment for NO_2 (2010 1-hour standard), CO, $PM_{2.5}$, and PB.
Water Quality	Alternative 1	*Minor/Moderate* Track construction within or adjacent to mapped water quality resources at the following locations: Worcester to Springfield Double Tracking (mileposts 64-79.4) 6.4 linear miles of water quality resources including groundwater supply protection areas and an impaired river (Quaboag River) East Northfield Passing Siding (mileposts 110.6-111.8) • 0.6 linear miles of water quality resources including an impaired river (Connecticut River) Brattleboro to Claremont Double Tracking (mileposts 122.5-162) • 23.2 linear miles of water quality resources including groundwater supply protection areas, surface water supply protection areas, and impaired rivers (Connecticut River, Cold	*No Impact* No impacts anticipated outside of site specific track construction areas due to the utilization of existing rail corridor.

Environmental Resource	Alternative	Potential Impacts	
		Site Specific	Corridor Wide
Water Quality (Cont.)	Alternative 1 (Cont.)	River, and Clay Brook) • Construction adjacent to 4 community groundwater wells Randolph Double Tracking (mileposts 144.8-145.4) • 0.6 linear miles of water quality resources including surface water supply protection area and an impaired river St. Albans to Swanton Double Tracking (mileposts 2-10) 0.04 linear miles of water quality resources including an impaired river	
Water Quality (Cont.)	Alternative 2 Alternative 2 (Cont.)	*Minor/Moderate* Track construction within or adjacent to mapped water quality resources at the following locations: Worcester to Springfield Double Tracking (Mileposts 48.3-57.7, 64-79.4, 83.6-92) 12.2 linear miles of water quality resources including groundwater supply protection areas and an impaired river (Quaboag River and Chicopee River) East Northfield Passing Siding (Mileposts 110.6-111.8) • 0.6 linear miles of water quality resources including an impaired river (Connecticut River) Brattleboro to Claremont Double Tracking (Mileposts 122.5-162) • 23.2 linear miles of water quality resources including groundwater supply protection areas, surface water supply protection areas, and impaired rivers (Connecticut River, Cold River, and Clay Brook) • Construction adjacent to 4 community groundwater wells Randolph Double Tracking (Mileposts 144.8-145.4) • 0.6 linear miles of water quality resources including surface water supply protection area and an impaired river St. Albans to Swanton Double Tracking (Mileposts 2-10)	*No Impact* No impacts anticipated outside of site specific track construction areas due to the utilization of existing rail corridor.

Environmental Resource	Alternative	Potential Impacts	
		Site Specific	Corridor Wide
		0.04 linear miles of water quality resources including an impaired River	
Water Quality (Cont.)	Alternative 3 Alternative 3 (Cont.)	*Minor/Moderate* Track construction within or adjacent to mapped water quality resources at the following locations: Worcester to Springfield Double Tracking (Mileposts 48.3-57.7, 64-79.4, 83.6-92) 12.2 linear miles of water quality resources including groundwater supply protection areas and an impaired river (Quaboag River and Chicopee River) East Northfield Passing Siding (Mileposts 110.6-111.8) • 0.6 linear miles of water quality resources including an impaired river (Connecticut River) Brattleboro to Claremont Double Tracking (Mileposts 122.5-162) • 23.2 linear miles of water quality resources including groundwater supply protection areas, surface water supply protection areas, and impaired rivers (Connecticut River, Cold River, and Clay Brook) • Construction adjacent to 4 community groundwater wells Randolph Double Tracking (Mileposts 144.8-145.4) • 0.6 linear miles of water quality resources including surface water supply protection area and an impaired river St. Albans to Swanton Double Tracking (Mileposts 2-10) 0.04 linear miles of water quality resources including an impaired river	*No Impact* No impacts anticipated outside of site specific track construction areas due to the utilization of existing rail corridor.
Noise and Vibration	All Alternatives	*Minor* Any noise and vibration impacts due to site specific track construction are expected to be temporary in nature and limited to the construction phase. Standard track construction procedures will	*Minor/Moderate* The Corridor was screened for potential noise and vibration impacts. Category 3 sensitive receptors were quantified for both noise and vibration and are

<table>
<tr><th rowspan="2">Environmental Resource</th><th rowspan="2">Alternative</th><th colspan="2">Potential Impacts</th></tr>
<tr><th>Site Specific</th><th>Corridor Wide</th></tr>
<tr><td></td><td></td><td>be utilized.</td><td>listed below broken down by geographic area. Category 2 land cover-type is summarized as the percentage of overall acreage within the corridor. More details including specific receptor types can be found in Section 3.2.3.
Noise sensitive receptors- Corridor wide (750’ Buffer)
• Boston to Springfield: 154 receptors (Category 3); 42% developed areas (Category 2)
• New Haven to Springfield: 60 receptors (Category 3); 55% developed areas (Category 2)
• Springfield to Canadian border: 56 receptors (Category 3); 19% developed areas (Category 2)
Noise sensitive receptors- At-grade crossings (1600’ buffer)
• Boston to Springfield: 10 receptors (Category 3); 67% developed areas (Category 2)
• New Haven to Springfield: 39 receptors (Category 3); 58% developed areas (Category 2)
• Springfield to Canadian border 81 receptors (Category 3); 27% developed areas (Category 2)</td></tr>
</table>

Environmental Resource	Alternative	Potential Impacts	
		Site Specific	Corridor Wide
			Vibration sensitive receptors (120' buffer) Boston to Springfield: 21 receptors New Haven to Springfield: 26 receptors Springfield to Vermont border: 9 receptors Vermont border to Canadian border: 26 receptors
Solid Waste Disposal	All Alternatives	*Minor* Typical waste disposal procedures will be followed during track construction phase. Any impact is likely to be minimal and temporary.	*Minor* Additional trains are not anticipated to generate large quantities of solid waste.
Ecological Systems	All Alternatives	*Minor* Any impacts to ecological systems due to track construction are anticipated to be minor and temporary. Track construction will be limited to the existing rail corridor.	*Minor/Moderate* To the extent that existing wildlife corridors cross the existing rail line, an increase in train operations may need to be further evaluated in NEPA Tier 1.
Impacts on Wetland Areas	Alternative 1	*Minor/Moderate* Track construction within or adjacent to mapped NWI Wetlands in the following locations: Worcester to Springfield Double Tracking (Mileposts 64-79.4) 14.8 linear miles East Northfield Passing Siding (Mileposts 110.6-111.8) • 0.2 linear miles Brattleboro to Claremont Double Tracking (Mileposts 122.5-162) • 21.9 linear miles Randolph Double Tracking (Mileposts 144.8-145.4) • 0.6 linear miles	*No Impact* No impacts anticipated outside of site specific track construction areas due to the utilization of existing rail corridor.

Environmental Resource	Alternative	Potential Impacts	
		Site Specific	Corridor Wide
Impacts on Wetland Areas (Cont.)		St. Albans to Swanton Double Tracking (Mileposts 2-10) • 2.8 linear miles	
	Alternative 2 Alternative 2 (Cont.)	*Minor/Moderate* Track construction within or adjacent to mapped NWI Wetlands in the following locations: Worcester to Springfield Double Tracking (Mileposts 48.3-57.7, 64-79.4, 83.6-92) 21.6 linear miles East Northfield Passing Siding (Mileposts 110.6-111.8) • 0.2 linear miles Brattleboro to Claremont Double Tracking (Mileposts 122.5-162) • 21.9 linear miles Randolph Double Tracking (Mileposts 144.8-145.4) • 0.6 linear miles St. Albans to Swanton Double Tracking (Mileposts 2-10) • 2.8 linear miles	*No Impact* No impacts anticipated outside of site specific track construction areas due to the utilization of existing rail corridor.
	Alternative 3	*Minor/Moderate* Track construction within or adjacent to mapped NWI Wetlands in the following locations: Worcester to Springfield Double Tracking (Mileposts 48.3-57.7, 64-79.4, 83.6-92) 21.6 linear miles East Northfield Passing Siding (Mileposts 110.6-111.8) • 0.2 linear miles Brattleboro to Claremont Double Tracking (Mileposts 122.5-162) • 21.9 linear miles Randolph Double Tracking (Mileposts 144.8-145.4) • 0.6 linear miles St. Albans to Swanton Double Tracking (Mileposts 2-10)	*No Impact* No impacts anticipated outside of site specific track construction areas due to the utilization of existing rail corridor.

Environmental Resource	Alternative	Potential Impacts	
		Site Specific	Corridor Wide
		• 2.8 linear miles	
Impacts on Endangered Species or Wildlife	Alternative 1	*Minor/Moderate* Construction within or adjacent to mapped endangered species habitat at the following locations: Worcester to Springfield Double Tracking (Mileposts 64-79.4) • 11.9 linear miles East Northfield Passing Siding (Mileposts 110.6-111.8) • 0.6 linear miles Brattleboro to Claremont Double Tracking (Mileposts 122.5-162) • 6.0 linear miles Randolph Double Tracking (Mileposts 144.8-145.4) • 0.6 linear miles St. Albans to Swanton Double Tracking (Mileposts 2-10) • 1.6 linear miles	*Minor/Moderate* Further analysis of increased train volume on corridor wildlife may be necessary in the NEPA environmental analysis, particularly in Vermont.
Impacts on Endangered Species or Wildlife (Cont.)	Alternative 2	*Minor/Moderate* Construction within or adjacent to mapped endangered species habitat at the following locations: Worcester to Springfield Double Tracking (Mileposts 48.3-57.7, 64-79.4, 83.6-92) • 17.8 linear miles East Northfield Passing Siding (Mileposts 110.6-111.8) • 0.6 linear miles Brattleboro to Claremont Double Tracking (Mileposts 122.5-162) • 6.0 linear miles Randolph Double Tracking (Mileposts 144.8-145.4) • 0.6 linear miles St. Albans to Swanton Double Tracking (Mileposts 2-10) • 1.6 linear miles	*Minor/Moderate* Further analysis of increased train volume and speed on corridor wildlife may be necessary in NEPA Tier 1, particularly in Vermont.

Environmental Resource	Alternative	Potential Impacts	
		Site Specific	Corridor Wide
	Alternative 3	*Minor/Moderate* Construction within or adjacent to mapped endangered species habitat at the following locations: Worcester to Springfield Double Tracking (Mileposts 48.3-57.7, 64-79.4, 83.6-92) • 17.8 linear miles East Northfield Passing Siding (Mileposts 110.6-111.8) • 0.6 linear miles Brattleboro to Claremont Double Tracking (Mileposts 122.5-162) • 6.0 linear miles Randolph Double Tracking (Mileposts 144.8-145.4) • 0.6 linear miles St. Albans to Swanton Double Tracking (Mileposts 2-10) • 1.6 linear miles	*Minor/Moderate* Further analysis of increased train volume and speed on corridor wildlife may be necessary in NEPA Tier 1, particularly in Vermont.
Flood Hazards and Floodplain Management	Alternative 1	*Minor/Moderate* Track construction within or adjacent to mapped floodplains at the following locations: Worcester to Springfield Double Tracking (Mileposts 64-79.4) 14 linear miles East Northfield Passing Siding (Mileposts 110.6-111.8) 0.2 linear miles Brattleboro to Claremont Double Tracking (Mileposts 122.5-162) 19.5 linear miles	*No Impact* Project does not create a need for new or expanded drainage structures. No new impervious surfaces will be created.
	Alternative 2	*Minor/Moderate* Track construction within or adjacent to mapped floodplains at the following locations: Worcester to Springfield Double Tracking (Mileposts 48.3-57.7, 64-79.4, 83.6-92) 17.5 linear miles	*No Impact* Project does not create a need for new or expanded drainage structures. No new impervious surfaces will be created.

Environmental Resource	Alternative	Potential Impacts	
		Site Specific	Corridor Wide
		East Northfield Passing Siding (Mileposts 110.6-111.8) 0.2 linear miles Brattleboro to Claremont Double Tracking (Mileposts 48.3-57.7, 64-79.4, 83.6-92) 19.5 linear miles	
Flood Hazards and Floodplain Management (Cont.)	Alternative 3	*Minor/Moderate* Track construction within or adjacent to mapped floodplains at the following locations: Worcester to Springfield Double Tracking (Mileposts 64-79.4) 17.5 linear miles East Northfield Passing Siding (Mileposts 110.6-111.8) 0.2 linear miles Brattleboro to Claremont Double Tracking (Mileposts 122.5-162) 19.5 linear miles	*No Impact* Project does not create a need for new or expanded drainage structures. No new impervious surfaces will be created.
Coastal Zone Management	All Alternatives	*No Impact* Track construction to take place outside of coastal zones.	*Minor* Majority of the corridor is located outside coastal zones with the exception of Boston, which is currently a busy rail corridor and already double tracked.
Use of Energy Resources	All Alternatives	*Minor* Energy impacts due to track construction are anticipated to be minimal. Standard construction practices will be utilized.	*Minor/Moderate* Assumes diesel locomotives compliant with applicable emission standards. Fuel use by train sets is expected to be offset by reduction in passenger vehicle fuel consumption. Energy use will likely need to be evaluated further as part of NEPA Tier 1.
Use of Other Natural Resources such as Water,	All Alternatives	*Minor/Moderate* Track constriction will likely necessitate the use of additional stone ballast, timber ties, and steel rails.	*No Impact* Increased natural resource use will likely be limited to the construction phase.

Environmental Resource	Alternative	Potential Impacts	
		Site Specific	Corridor Wide
Minerals, or Timber			
Aesthetic and Design Quality Impacts	All Alternatives	*Minor* Track construction is not likely to impact aesthetics and design quality. Any impacts would be temporary.	*Minor* Any impacts anticipated to be minor due to the use of existing rail corridor. Station upgrades may include aesthetic improvements. Possible stations in Palmer will be evaluated for aesthetics and design quality impacts.
Possible Barriers to the Elderly and Handicapped	All Alternatives	*No Impact* Track construction is unlikely to impact the elderly and handicapped.	*Minor/Moderate* Any new station would be ADA compliant. Upgrades to existing stations will include accessibility improvements.
Land Use, Existing and Planned	All Alternatives	*No Impact* Land use is unlikely to be impacted by track construction. Existing track alignment will be utilized.	*Minor* Station and layover facilities are already underway or planned by other projects, which were coordinated with existing and planned land use. Palmer Station location will be coordinated as part of NEPA Tier 1.
Environmental Justice	All Alternatives	*No Impact* Environmental Justice populations are not anticipated to be disproportionately affected by track construction. Further evaluation may be necessary as part of NEPA Tier 1.	*No Impact* Further evaluation may be necessary as part of NEPA Tier 1.
Public Health	All Alternatives	*No Impact* Track construction is not likely to impact public health.	*Minor/Moderate* Improvements in and around stations throughout the corridor will likely improve pedestrian and bicycle access. Increased pedestrian and bicycle usage is likely to have a positive impact on public health.
Public Safety, Including any	All Alternatives	*Minor* Track construction is not adjacent to any documented hazardous	*Minor/Moderate* Increased train traffic at higher speeds has the

Environmental Resource	Alternative	Potential Impacts	
		Site Specific	Corridor Wide
Impacts Attributable to Hazardous Materials		waste release sites.	potential to impact public safety at grade crossings. Project will upgrade crossings based on FRA diagnostic review.
Recreational Opportunities	All Alternatives	*No Impact* Recreation is not likely to be impacted by track construction.	*No Impact* Recreation is not likely to be impacted by increased train operations or speeds.
Use of Section 6(f) Lands	All Alternatives	*No Impact*	*No Impact*
Historic, Archeological, Architectural, and Cultural	All Alternatives	*Minor or No Impact* Little if any impact anticipated due to utilization of existing active rail corridor and addition of second track and passing sidings where second track existed in the past.	*No Impact* Little if any impact anticipated due to utilization of existing active rail corridor.
Use of 4(f) Protected Properties	Alternative 1	*Minor or No Impact* Track construction within or adjacent to mapped 4(f) resources in the following locations: Worcester to Springfield Double Tracking (Mileposts 64-79.4) • 5.0 linear miles Brattleboro to Claremont Double Tracking (Mileposts 122.5-162) • 2.2 linear miles	*No Impact* No impacts anticipated outside of site specific track construction areas due to the utilization of existing rail corridor.
	Alternative 2	*Minor or No Impact* Track construction within or adjacent to mapped 4(f) resources in the following locations: Worcester to Springfield Double Tracking (Mileposts 48.3-57.7, 64-79.4, 83.6-92) • 7.6 linear miles Brattleboro to Claremont Double Tracking (Mileposts 122.5-162) • 2.2 linear miles	*No Impact* No impacts anticipated outside of site specific track construction areas due to the utilization of existing rail corridor.

Environmental Resource	Alternative	Potential Impacts	
		Site Specific	Corridor Wide
	Alternative 3	*Minor or No Impact* Track construction within or adjacent to mapped 4(f) resources in the following locations: Worcester to Springfield Double Tracking (Mileposts 48.3-57.7, 64-79.4, 83.6-92) • 7.6 linear miles Brattleboro to Claremont Double Tracking (Mileposts 122.5-162) • 2.2 linear miles	*No Impact* No impacts anticipated outside of site specific track construction areas due to the utilization of existing rail corridor.
Socioeconomic	All Alternatives	*Minor* Track construction will not likely have significant socioeconomic impacts.	*Minor/Moderate* Communities along the entire corridor would likely benefit from increased mobility and accessibility as a result of additional and improved train service.
Transportation	All Alternatives	*Minor* Track construction may have some temporary impacts on existing freight and passenger rail operations.	*Minor/Moderate* The increased train service will provide an additional transportation mode choice for the corridor. Regional connectivity will be enhanced.
Construction Period Impacts	All Alternatives	*Minor/Moderate* Impacts will be temporary, including possible train speed restrictions, noise, air quality, water quality, disposal of construction waste, contaminated soils, and utility impacts.	*No Impact* See site specific impacts.
Indirect and Cumulative	All Alternatives	*Minor/Moderate* Indirect and cumulative impacts to be examined as part of NEPA Tier 1.	*Minor/Moderate* Indirect and cumulative impacts to be examined as part of NEPA Tier 1.
Topology and Geology	All Alternatives	*No Impact* No new Topology and Geology effects are anticipated due to construction. Track construction limited to historically double tracked locations.	*No Impact* No new Topology and Geology effects are anticipated due to construction.
Designated River	Alternative 1	*Minor/Moderate* Track construction adjacent to the following bodies of water:	*Minor* Any impacts to bodies of water along the corridor

Environmental Resource	Alternative	Potential Impacts	
		Site Specific	Corridor Wide
		Worcester to Springfield Double Tracking (Mileposts 64-79.4) • Quaboag River, Claypit Pond East Northfield Passing Siding (Mileposts 110.6-111.8) • Newton Brook, Connecticut River Brattleboro to Claremont Double Tracking (Mileposts 122.5-162) • Connecticut River, Cold River, Clay Brook St. Albans to Swanton Double Tracking (Mileposts 2-10) • Missiquoi River	are anticipated to be minimal due to the utilization of existing track alignment.
Designated River (Cont.)	Alternative 2	*Minor/Moderate* Track construction adjacent to the following bodies of water: Worcester to Springfield Double Tracking (Mileposts 48.3-57.7, 64-79.4, 83.6-92) • Quaboag River, Claypit Pond, Stoneville Reservoir, Dark Brook Reservoir, French River, Little Nugget Lake, Wee Laddie Pond, Chicopee River East Northfield Passing Siding (Mileposts 110.6-111.8) • Newton Brook, Connecticut River Brattleboro to Claremont Double Tracking (Mileposts 122.5-162) • Connecticut River, Cold River, Clay Brook St. Albans to Swanton Double Tracking (Mileposts 2-10) • Missiquoi River	*Minor* Any impacts to bodies of water along the corridor are anticipated to be minimal due to the utilization of existing track alignment.
	Alternative 3	*Minor/Moderate* Track construction adjacent to the following bodies of water: Worcester to Springfield Double Tracking (Mileposts 48.3-57.7, 64-79.4, 83.6-92) • Quaboag River, Claypit Pond, Stoneville Reservoir, Dark Brook Reservoir, French River, Little Nugget Lake, Wee Laddie Pond, Chicopee River	*Minor* Any impacts to bodies of water along the corridor are anticipated to be minimal due to the utilization of existing track alignment.

Environmental Resource	Alternative	Potential Impacts	
		Site Specific	Corridor Wide
		East Northfield Passing Siding (Mileposts 110.6-111.8) • Newton Brook, Connecticut River Brattleboro to Claremont Double Tracking (Mileposts 122.5-162) • Connecticut River, Cold River, Clay Brook St. Albans to Swanton Double Tracking (Mileposts 2-10) • Missiquoi River	
Prime Farm	All Alternatives	*No Impact* Prime farmlands are not likely to be impacted as a result of the utilization of the existing rail corridor.	*No Impact* Prime farmlands are not likely to be impacted as a result of the utilization of the existing rail corridor.
Permits	All Alternatives	*Minor/Moderate* Permits may be required	*Minor/Moderate* Permits may be required
Displacements and Relocations	All Alternatives	*No Impact* No displacements or relocations due to track construction anticipated.	*No Impact* No displacements or relocations due to track construction anticipated.

12.2 ENVIRONMENTAL SCREENING

12.2.1 Air Quality

The corridor was screened for compliance with National Ambient Air Quality Standards (NAAQS). Six counties along the corridor are classified as non-attainment for the O3 1-hour standard including all counties in Massachusetts and Cheshire County in New Hampshire; all counties in Vermont and Sullivan County in New Hampshire were determined to be in attainment. The corridor is in attainment for all other air quality standards. More details can be found in Table 12-1.

No major air quality impacts are expected because of this project. Any increased emissions from additional trains are likely to be offset by a decrease in passenger vehicle mile traveled. The project is likely to have a positive effect on air quality compared to the No-Build. Further air quality analysis may be needed as part of NEPA Tier 1 to quantify the impacts.

12.2.2 Water Quality

Water quality resources were mapped in GIS along the corridor including groundwater supply protection areas, surface water supply protection areas, impaired rivers/streams, and public water supplies. For areas where track construction will take place the length of rail right-of-way adjacent to the mapped resource was determined. Segments of rail Right-of-Way where the Build Alternatives would reestablish a second track or passing siding are adjacent to the Quaboag and Chicopee Rivers in the Springfield to Worcester corridor and the Connecticut River in the Brattleboro, Vermont to Claremont, New Hampshire corridor. The number of linear miles affected broken down by alternative and location can be found in Table 12.1.

Water quality resources impacts will likely be limited to locations where a proposed second track or passing siding will be installed; otherwise the existing infrastructure will be utilized. Impacts may occur where ballast is installed and/or where earthwork is necessary. Most areas where track work will take place are historically double tracked and have the existing embankment in place. Further investigation will likely be necessary as part of NEPA Tier 1.

12.2.3 Noise and Vibration

The proposed project has the potential to increase noise and vibration surrounding the existing corridor due to an increase in train frequency and speed. A noise and vibration analysis in accordance with FTA guidelines[4] may be necessary as part of subsequent NEPA analysis to quantify the noise and vibration impacts of specific project elements. Sensitive receptors including schools, universities, open spaces, cultural resources, historic buildings, and historic districts were mapped in GIS. The receptors were identified based on available data.

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4 Transit Noise and Vibration Impact Assessment, Report Date: 5/2006. http://www.fta.dot.gov/documents/FTA_Noise_and_Vibration_Manual.pdf

Noise

Noise impacts are a combination of horn noise and wayside noise. Horn noise comes from locomotive horns that must be blown when approaching at-grade crossings to warn motorists and pedestrians of the approaching train. The use of horns is required except in certain communities that have successfully petitioned the FRA to be designated Quiet Zones. No Quiet Zones exist along the NNEIRI Corridor.[5] Wayside noise is the noise that the train makes while travelling along the tracks. The screening distance for horn noise is 1600 feet from at-grade crossings when unobstructed and 1200 feet when obstructed by intervening buildings. The screening distance for wayside noise is 750 feet when unobstructed and 375 feet when obstructed. This screening used the unobstructed buffer distances throughout as a conservative first view of the corridor.

The FTA methodology classifies land uses into three different categories based on sensitivity to noise. Category 1 receptors are tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use. Also included are recording studios and concert halls. Category 2 receptors are residences and building where people normally sleep. This category includes homes, hospitals and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance. Category 3 receptors are institutional land uses with primarily daytime and evening use. This category includes schools, libraries, theaters, and churches where it is important to avoid interference with such activities as speech, meditation and concentration on reading material. Places for meditation or study associated with cemeteries, monuments, museums, campgrounds and recreational facilities can also be considered to be in this category. Certain historical sites and parks are also included.

This screening focused on Category 3 receptors because the additional train service is expected to be generally limited to daytime and evening hours. Category 1 receptors require determination on a case by case basis and will therefore be evaluated in the NEPA phase of the project, as necessary.

As part of this Alternatives Analysis screening, identification of Category 1 uses has been limited to identifying open space areas, historic districts and historic properties that fall within the previously identified corridor distances. Identification of specific locations or individual building uses would occur as part of the NEPA process.

The identification of Category 2 uses at this time is limited to regional land cover-type mapping that identifies developed (primarily residential) uses by intensity with the corridor limits. Category 2 land uses have been identified as a percent of the total acreage within the corridor. As expected, the more developed areas associated with the Boston-to-Springfield and New Haven-to-Springfield corridors will have greater potential for specific Category 2

5 Quiet Zone Locations by City and State. Report Date: 10/17/2013. http://www.fra.dot.gov/eLib/details/L04808

uses than the more rural Springfield-to-Montreal corridor. Again, identification of specific locations or individual building uses would occur as part of the NEPA process. The noise screening information is summarized in Tables 12.2 and 12.3 below.

Table 12.2: Category 2 Noise Sensitive Land Uses- Corridor Wide (750' Buffer)

	Boston-Springfield	New Haven-Springfield	Springfield-Canadian Border
Low Intensity	12%	16%	10%
Medium Intensity	18%	27%	7%
High Intensity	12%	12%	2%
Total	42%	55%	19%

Source: National Land Cover Dataset (NLCD),2011

Table 12.3: Category 2 Noise Sensitive Land Uses-At-Grade Crossings (1600' Buffer)

Development Intensity	Boston-Springfield	New Haven-Springfield	Springfield-Canadian Border
Low Intensity	12%	15%	13%
Medium Intensity	30%	30%	10%
High Intensity	25%	13%	4%
Total	67%	58%	27%

Source: National Land Cover Dataset (NLCD),2011

Category 3 receptors have been identified in the corridor mapping and are summarized in Table 12.4 and 12.5. Table 12.4 shows the number of Category 3 receptors within the 750 feet screening distance throughout the corridor. Table 12.5 shows the number of Category 3 receptors within 1600 feet of at-grade crossings.

Table 12.4: Noise Sensitive Receptors-Corridor Wide (750′ Buffer)

Receptor Type	Boston-Springfield	New Haven-Springfield	Springfield-Canadian Border	Total
Schools	17	10	10	37
Universities	10	3	2	15
Open Space	68	19	30	117
Cultural Resources/ Historic Buildings	32	14	5	51
Historic Districts	27	14	9	50
Total	154	60	56	270

Notes: [a] No hospitals were found within screening distance.

Table 12.5: Noise Sensitive Receptors- At-Grade Crossings (1600′ Buffer)

Receptor Type	Boston-Springfield	New Haven-Springfield	Springfield-Canadian Border	Total
Schools	2	8	28	38
Universities	0	1	3	4
Open Space	4	18	16	38
Cultural Resources/ Historic Buildings	1	8	17	26
Historic Districts	3	4	17	24
Total	10	39	81	130

Notes: No hospitals were found within screening distance. Private crossing included

Locations in the New Haven-Hartford-Springfield portion of the Corridor and the Springfield-to-Vermont border portion of the Corridor have been addressed as part of the separate NEPA EA process completed for each of those projects.

It should be noted that future analysis will focus on the incremental increase in noise not already addressed in the Full Build Alternative of the NHHS and Knowledge Corridor – Restore Vermonter EAs, in portions of the corridor where NNEIRI would create such an increment in noise. In most, if not all, cases, existing train operations will establish the noise baseline: the only impact is likely to be associated with the increase in frequency of train service, rather than an increase in decibels. Furthermore, the proposed service will occur during the normal operating period of existing service: there should be no impacts based upon time-of-day changes. Finally, in the case of the Boston to Springfield corridor, for example, the combination of existing commuter rail trains (20 daily round-trips between Boston and Worcester), and four additional round trips (24 daily round-trips between Boston and Framingham) and existing freight trains is large enough that the proposed increase in service will represent a relatively small percentage of overall train trips in the corridor.

Vibration

Vibration associated with railway movements is usually caused by uneven interactions between the wheels of the train and the railway surfaces. Examples of this include rolling over rail joints and flat spots on wheels that are not true.

The FTA methodology for vibration impacts specifies a 120 feet screening distance throughout the corridor. Similarly to the noise screening, vibration screening classifies land uses based on sensitivity to vibration. Category 1 receptors are buildings where vibration would interfere with operations of the building such as vibration sensitive research and manufacturing facilities. Category 2 receptors are residential buildings or anywhere people generally sleep. Category 3 receptors include intuitional buildings such as schools and churches that are primarily utilized during daytime and evening hours. This screening focused on Category 3 receptors because the additional train service is expected to be limited to daytime and evening hours. Category 1 receptors require determination on a case-by-case basis and will therefore be evaluated in a future phase of the project, as necessary.

Table 12.6 shows the number of Category 3 receptors within 120 feet of the Corridor.

Table 12.6: Vibration Sensitive Receptors (120′ Buffer)

Receptor Type	Boston-Springfield	New Haven-Springfield	Springfield-Canadian Border	Total
Schools	0	0	1	1
Universities	0	0	1	1
Cultural Resources/ Historic Buildings	9	14	9	32
Historic Districts	12	12	24	48
Total	21	26	35	82

Notes: No hospitals were found within screening distance.

As noted earlier in the Noise section, locations in the New Haven-to-Springfield corridor and those in the Springfield-to-Vermont Border corridor have been addressed as part of the NEPA EA process for the New Haven-Hartford-Springfield project and the Knowledge Corridor project, respectively. Furthermore, the same comments relative to incremental increase, baseline conditions and frequency of service apply to vibration as well.

The FTA guidance on screening for vibration impacts indicate that if there are any vibration-sensitive land uses within the screening distances, as summarized above, that the result of the screening procedure is that a General Vibration Assessment should be done as part of the environmental analysis. This is expected to occur as part of the ongoing NEPA process.

12.2.4 Solid Waste Disposal

Typical waste disposal procedures will be followed during track construction phase. Any impacts are anticipated to be minimal and temporary. Additional train service is not anticipated to generate large quantities of solid waste.

12.2.5 Ecological Systems

Any impacts to ecological systems due to track construction would be minimal and temporary. Track construction is anticipated to take place within the existing right-of-way in locations that were historically double tracked. As a result, impacts to flora and fauna along the corridor are anticipated to be minimal. Increased train frequency and speed could pose a somewhat increased barrier to wildlife, particularly in the Green Mountains of Vermont where wildlife may cross the existing rail line to access habitat. Further examination of the potential impacts on wildlife corridors may be necessary as part of NEPA Tier 1.

12.2.6 Impacts on Wetland Areas

Wetland area impacts will likely be limited to locations where a proposed second track or passing siding will be installed; otherwise the existing infrastructure will be utilized. In areas where track construction will take place, impacts will be limited to wetlands within or adjacent to the right-of-way.

National Wetlands Inventory (NWI) Wetlands were mapped in GIS along the full length of the corridor as part of the Existing Conditions Report, and those segments of the corridor where a second track would be added were further mapped as part of this screening. In areas where track construction activity will take place the length of right-of-way adjacent to wetland resources was determined. These areas include corridor segments adjacent to the Quaboag and Chicopee Rivers in the Springfield to Worcester corridor, and the Connecticut River in the Brattleboro, Vermont to Claremont, New Hampshire corridor.

The number of linear miles of right-of-way in proximity to wetland resources is further broken down by alternative and location can be found in Table 12.1. As shown in Table 12.1, all three Build Alternatives have construction adjacent to site-specific wetland areas. Alternative 1 is adjacent to 14.8 linear miles of wetland area from Worcester to Springfield. Alternatives 2 and 3 are adjacent to 21.6 linear miles of wetland areas from Worcester to Springfield. All three Build Alternatives are adjacent to 0.2 linear miles of wetland area in East Northfield, 21.5 linear miles of area from Brattleboro to Claremont, 0.6 linear miles of area in Randolph, and 2.8 linear miles of areas from St. Albans to Swanton.

The reporting of locations of wetlands in proximity to the areas of Right-of-Way where a second track would be added represents a conservative approach. Actual project activity will occur within the existing rail corridor and is unlikely to encroach into adjacent wetland resource areas at all. As specific details of each alternative are further developed including culvert replacement/rehabilitation, bridge improvements, and increases in side slopes these areas will be the focus of further investigation as part of NEPA Tier 1. Federal, state and local regulations and bylaws will be consulted to determine whether permit filings will be required.

12.2.7 Impacts on Endangered Species or Wildlife

Endangered species habitat impacts will likely be limited to areas where a proposed second track or passing siding will be installed; otherwise, the existing infrastructure will be utilized. In locations where track construction will take place, impacts will likely be limited to habitats within or adjacent to the right-of-way.

Endangered species habitats were mapped in GIS along the corridor. In areas where track construction will take place the length of affected right-of-way was determined. A high density of mapped endangered species habitats were found in the vicinity of the Quaboag and Chicopee Rivers in the Springfield to Worcester corridor and the Connecticut River in the Brattleboro, Vermont to Claremont, New Hampshire corridor. The number of linear miles affected broken down by alternative and location can be found in Table 12.1. A more detailed evaluation of endangered species impact may be required as part of NEPA Tier 1.

12.2.8 Flood Hazards and Floodplain Management

Flood zones, defined as areas where the yearly likelihood of flooding is greater than or equal to 1%, i.e. the 100-year storm, were mapped in GIS along the corridor. For areas where track construction will take place the length of affected right-of-way was determined. Flood plains have been identified in the areas adjacent to the Quaboag and Chicopee Rivers in the Springfield Springfield-to to-Worcester corridor and the Connecticut River in the Brattleboro, Vermont to Claremont, New Hampshire corridor. The linear miles where mapped flood zones cross or are adjacent to the rail corridor are broken down by alternative and location in Table 12.1. As shown in the table, all three Build Alternatives are adjacent to site-specific flood zones. Alternative 1 is adjacent to flood plains along 14 linear miles from Worcester to Springfield. Alternatives 2 and 3 are adjacent to flood plains along 17.5 linear miles from Worcester to Springfield. All three Build Alternatives are adjacent to flood plains along 0.2 linear miles in East Northfield, and 19.5 linear miles of areas from Brattleboro to Claremont.

The potential for Flood Zone impacts is limited to areas within the existing rail corridor where construction of a proposed second track or passing siding would involve earthwork that increases the footprint of the existing rail corridor embankment. It is expected that few if any of the areas where second track or passing sidings are built would have such impact because the rail corridor contained a second track in the past. The Build Alternatives are unlikely to create a need for new or expanded drainage structures or to create significant new impervious surfaces. Further evaluation of potential impacts may be necessary as part of NEPA Tier 1.

12.2.9 Coastal Zone Management

The majority of the NNEIRI Corridor is located outside of designated coastal zones with the exception of Boston and New Haven. The New Haven area has previously been assessed as part of the NHHS Environmental Assessment. In the Boston area the route utilizes a rail corridor that is already heavily used for MBTA commuter rail and Amtrak operations, therefore additional impacts to coastal zones are unlikely.

12.2.10 Use of Energy Resources

Additional train sets utilizing the corridor will likely be powered by diesel locomotives. Diesel locomotives will meet applicable emission standards. Any increase in fuel usage by increased number of trains would likely be offset by a reduction in passenger vehicle fuel consumption. The project will likely have net positive impact on energy resources due to the superior fuel efficiency of train travel versus individual motor vehicle travel. Further investigation may be necessary as part of NEPA Tier 1 to quantify the impacts on fuel resources.

12.2.11 Use of Other Natural Resources, Such as Water, Minerals, or Timber

The project proposes the addition of double track and passing sidings in several locations through the corridor. Alternative 1 proposes the addition of 61.1 linear miles of additional track. Alternatives 2 and 3 propose the addition of 78.9 linear miles of additional track. Track construction will necessitate the usage of some natural resources including stone ballast, timber ties, and steel rails.

12.2.12 Aesthetic and Design Quality Impacts

The project will have minimal impacts to aesthetics and design quality outside of station upgrades and potential station in Palmer due to the utilization of the existing rail corridor. All proposed track improvements are anticipated to be with the right-of-way. Station upgrades will enhance aesthetics resulting in a positive impact.

12.2.13 Possible Barriers to the Elderly and Handicapped

The project is not likely to include any barriers to the elderly and handicapped. Station upgrades along the corridor because of this project, The Knowledge Corridor – Restore Vermonter Project, and The NHHS Project will include accessibility improvements. These improvements will be beneficial to elderly and handicapped populations. The design of any potential new station in Palmer will be fully ADA compliant.

12.2.14 Land Use, Existing and Planned

The project is not expected to result in any major changes in land use throughout the corridor due to the utilization of existing rail right-of-way. A detailed inventory of existing land use along the corridor can be found in the Existing Conditions report. A new station in Palmer would be coordinated with local planning to determine the appropriate location, access, and relationship to surrounding land uses.

12.2.15 Environmental Justice

Executive order 12898 requires federal agencies to incorporate consideration of environmental justice into their planning process. The order prohibits federal financial assistance for programs and activities that use criteria, methods, or practices that discriminate on the basis of race, color, or national origin. Environmental justice communities include minority and low income populations. Environmental justice communities along the Corridor were mapped in GIS and none of the Build Alternatives would result in a disproportionate impact on such communities.

12.2.16 Public Health

Improvements in and around stations throughout the corridor will likely improve pedestrian and bicycle access. These upgrades could include improved sidewalk and bike lane infrastructure and increased connectivity to the surrounding community. Those who live and work along the corridor will have increased opportunity to utilize healthier transportation modes resulting in a positive impact to public health.

12.2.17 Public Safety, Including any Impacts Attributable to Hazardous Materials

Increases train traffic at higher speeds could create a potential hazard to vehicles and pedestrians in the vicinity of at-grade crossings. Some upgrades may be necessary to mitigate these dangers such as the installation of gates and warning signals. At-grade crossing will be evaluated based on the FRA diagnostic to determine necessary improvements appropriate to the alternative.

In the Existing Conditions report the corridor was screened for hazardous waste release sites within the existing right-of-way. Hazardous material release sites could only be impacted in areas where a second track or passing siding would be installed. No hazardous material release sites were found in the vicinity of the proposed track construction associated with the Build Alternatives.

12.2.18 Recreational Opportunities

The project is not anticipated to have any negative impacts on recreational opportunities. No takings of recreational land are anticipated due to the utilization of existing rail corridor. The project may improve access from urban areas such as Boston, Springfield, Hartford, and New Haven to recreation areas elsewhere, which can provide a net benefit in recreational opportunities for Corridor residents.

12.2.19 Use of Section 6(f) Lands

Section 6(f) lands are properties purchased using funds from the Land and Water Conservation Act (LWCF). Conversion of 6(f) lands or facilities must be coordinated with the Department of the Interior; typically, a replacement in kind is required. Section 6(f) lands are not likely to be converted in any manner because of this project. Further analysis may be necessary to determine if any properties abut the Right-of-Way in the vicinity of track construction.

12.2.20 Historic, Archeological, Architectural and Cultural

Summary

There are 140 National Register-listed buildings, structures, sites and districts within the project study corridor in the segments between New Haven and Springfield, Boston and Springfield, and Springfield and Montreal. Primarily concentrated in urban areas and village centers, many were historically related to the operation of the railroad. As such, the continuation and enhancement of the railroad functions along the Inland Corridor is consistent with their history and context.

Adverse effects to historic architectural resources resulting from the right-of-way (ROW), siding, and signal improvements are unlikely. Due to planned improvements, there is the potential for a direct effect to the station in Palmer, Massachusetts under each of the action alternatives.

Potential effects to archaeological resources resulting from the project will be identified in consultation with the Massachusetts, New Hampshire, and Vermont State Historic Preservation Offices (SHPOs) as the project progresses.

Methodology

Section 106 of the National Historic Preservation Act (NHPA) of 1966 requires that Federal agencies consider the effect of a project on historic properties listed in or eligible for listing in the National Register of Historic Places. In accordance with the NHPA, cultural resources may include buildings, structures, sites, objects and districts. Effects to cultural resources are further regulated under Section 4(f) of the Department of Transportation Act of 1966 (49 U.S.C. 303). Under Section 4(f), a federal transportation agency may not approve the use of a Section 4(f) property unless it determines that there is no feasible and prudent alternative to avoid the use of the property and the action includes all possible planning to minimize harm resulting from such use, or the project has a *de minimis* impact.

For the purposes of this planning level analysis, cultural resources along the corridor were identified through the National Register of Historic Places Geographic Information System (GIS). This includes properties within 300 feet of the centerline of the corridor and the proposed station sites that are listed in the National Register of Historic Places. No additional data collection was undertaken for the corridor segment between New Haven, Connecticut and Springfield, and Springfield and East Northfield, Massachusetts, as both segments have been the subject of prior NEPA documentation.

As the project advances, coordination with SHPOs will be undertaken to define the Area of Potential Effects for the project and to identify properties that are not yet listed but that may be eligible for the National Register. In addition, archaeological sites and areas of archaeological sensitivity will be identified in consultation with the SHPOs and any historic resources within the Canadian portion of the project study corridor will be documented.

The analysis that follows identifies historic properties by segment, concentrations of such properties, and properties that, due to their proximity to planned improvements, may be the most likely to be affected. Due to irregularities within the National Register GIS, additional analysis to precisely determine impacts to historic resources may be required as the planning process progresses.

Existing Conditions

There are 140 National Register-listed buildings, structures, sites and districts within 300 feet of the centerline of the corridor. The majority of these are concentrated in urban areas and village centers and many were directly related to the operation of the railroad, such as train stations along the corridor. Other properties were developed in response to the access provided by the railroad. As such, the continuation and enhancement of the railroad functions along the Inland Corridor is consistent with their history and context.

12.2.20.1.1 Boston to Springfield

The segments between Boston and Worcester and Worcester and Springfield were chartered in the mid-19th century and by the 1870s were operating as the Boston and Albany Railroad. They were eventually merged into the Penn Central Railroad in the 1960s and were controlled by Amtrak after 1971.

There are 58 National Register-listed buildings, structures, sites and districts within the project study corridor in the segment between Boston and Springfield. Many of these properties are clustered in Springfield, Worcester, and Newton, Massachusetts. Of these properties, six are historic railroad stations, among them the South Station in Boston, Wellesley Farms Railroad Station, the Framingham Railroad Station, Union Station in Worcester, Union Station in Palmer, and Union Station in Springfield, Massachusetts (within the Downtown Springfield Railroad District). Five of the six, the stations in Boston, Wellesley, Framingham, Worcester, and Springfield, continue to function as rail depots; Union Station in Palmer is currently used as a restaurant. An inventory of National Register-listed historic resources within the project study corridor in the Boston to Springfield segment is provided below in Table 12.7. Properties eligible for the National Register, archaeological resources, and areas of potential archaeological sensitivity will be identified in consultation with SHPOs as the project advances.

Table 12.7: National Register Properties within the Springfield to Boston Segment of the Project Study Corridor

Name	Location
Harvard Avenue Historic District	Boston, MA
South Station	Boston, MA
Charles River Reservation Parkways	Boston, MA
Olmsted Park System	Boston, MA
South End District	Boston, MA

Name	Location
Back Bay Historic District	Boston, MA
Sudbury Aqueduct Linear District	Boston, MA
Youth's Companion Building	Boston, MA
Fenway Studios	Boston, MA
House at One Bay Street	Boston, MA
Fenway Park	Boston, MA
Cottage Farm Historic District	Brookline, MA
Irving Square Historic District	Framingham, MA
Concord Square Historic District	Framingham, MA
Framingham Railroad Station	Framingham, MA
Whit's Diner	Framingham, MA
Natick Center Historic District	Natick, MA
Casey's Diner	Natick, MA
Henry Wilson Shoe Shop	Natick, MA
Myrtle Baptist Church Neighborhood Historic District	Newton, MA
Our Lady Help of Christians Historic District	Newton, MA
Webster Park Historic District	Newton, MA
Newtonville Historic District (Boundary Increase)	Newton, MA
West Newton Village Center Historic District	Newton, MA
Jackson Homestead	Newton, MA
John A. Fenno House	Newton, MA
First Unitarian Church	Newton, MA
Newton Street Railway Carbarn	Newton, MA
Whittemore's Tavern	Newton, MA
G. C. Howes Dry Cleaning – Carley Real Estate	Newton, MA
Plummer Memorial Library	Newton, MA
Potter Estate	Newton, MA
Union Station	Palmer, MA
Grafton State Hospital	Shrewsbury, MA
McKnight District	Springfield, MA
Chapin National Bank Building	Springfield, MA
Cutler and Porter Block	Springfield, MA
Hampden Savings Bank	Springfield, MA
Produce Exchange Building	Springfield, MA
Whitcomb Warehouse	Springfield, MA
Julia Sanderson Theater	Springfield, MA
New Bay Diner Restaurant	Springfield, MA
Downtown Springfield Railroad District	Springfield, MA

Name	Location
Warren Town Hall	Warren, MA
Warren Public Library	Warren, MA
Fuller Brook Park	Wellesley, MA
Wellesley Farms Railroad Station	Wellesley, MA
Elm Park and Isaac Sprague Memorial Tower	Wellesley, MA
West Brookfield Center Historic District (Boundary Increase)	West Brookfield, MA
West Main Street Historic District (Boundary Increase III)	Westborough, MA
Union Station	Worcester, MA
East Worcester School – Norcross Factory	Worcester, MA
St. John's Catholic Church	Worcester, MA
Holy Name of Jesus Complex	Worcester, MA
Elizabeth McCafferty Three-Decker	Worcester, MA
Miss Worcester Diner	Worcester, MA
Southbridge-Sargent Manufacturing District	Worcester, MA
Worcester Asylum and Related Buildings	Worcester, MA

Source: National Register of Historic Places GIS, 2014.

12.2.20.1.2 New Haven to Springfield

An inventory of cultural resources within the corridor between New Haven, Connecticut and Springfield, Massachusetts was undertaken for the New Haven-Hartford-Springfield Line High Speed Intercity Passenger Rail Project Environmental Assessment/Environmental Impact Evaluation (NHHS EA/EIE) prepared by the Federal Railroad Administration (FRA) in cooperation with the Federal Transit Administration (FTA) and the Connecticut Department of Transportation (CTDOT) in May 2012. For a discussion of properties within this segment of the corridor, refer to the NHHS EA/EIE.

12.2.20.1.3 Springfield to Montreal

An analysis of cultural resources within the corridor between Springfield, MA and East Northfield, MA was undertaken for the Environmental Assessment for the Knowledge Corridor – Restore Vermonter, Springfield to East Northfield, Massachusetts prepared by FRA and the Massachusetts Department of Transportation. For a discussion of resources within this portion of the project study corridor, refer to the Knowledge Corridor EA.

In the portion of the project study corridor between Vernon and Alburgh, Vermont, there are 33 National Register-listed buildings, structures, sites and districts. Many of these are historic districts in small village centers. In addition, several historic railroad stations lie within the project study corridor, including Union Station in Brattleboro, Vermont; the Bellows Falls Station in Bellows Falls, Vermont (within the Bellows Falls Downtown Historic District); the Central Vermont Railway Station in Windsor, Vermont (within the Windsor Village Historic District); the White River Junction Railroad Station in White River Junction(within the White River Junction Historic District); the Central Vermont Railway Depot in Northfield; the Randolph Railroad Station in Randolph, Vermont (as part of the Depot Square Historic District); the Waterbury Railroad Station in Waterbury, Vermont (as part of the Waterbury Village Historic District); and the Central Vermont Railroad Headquarters in St. Albans City, Vermont (now used as offices of NECR).

An inventory of National Register-listed historic resources within the segment of the project study corridor between Vernon and Alburgh, Vermont is provided below in Table 12.8. Properties eligible for the National Register, archaeological resources, areas of potential archaeological sensitivity, and historic properties within Canada will be identified as the project advances.

Table 12.8: National Register Properties within the Vernon, to Alburgh, Vermont Segment of the Project Study Corridor

Name	Location
Charlestown Main Street Historic District	Charlestown, NH
North Charlestown Historic District	Charlestown, NH
Salmon P. Chase Birthplace	Cornish, NH
Bridge No. 27	Berlin, VT
Bethel Village Historic District	Bethel, VT
McKenstry Manor	Bethel, VT
Preston-Lafreniere Farm	Bolton, VT
Brattleboro Downtown Historic District	Brattleboro, VT
Brooks House	Brattleboro, VT
Union Station	Brattleboro, VT
Downtown Essex Junction Commercial Historic District	Essex, VT
Terraces Historic District	Hartford, VT
White River Junction Historic District	Hartford, VT
West Hartford Village Historic District	Hartford, VT
Central Vermont Railway Depot	Northfield, VT
Lower Cox Brook Covered Bridge	Northfield, VT
Slaughterhouse Covered Bridge	Northfield, VT
East Putney Brook Stone Arch Bridge	Putney, VT
Depot Square Historic District	Randolph, VT
Gray Rocks	Richmond, VT
Bellows Falls Downtown Historic District	Rockingham, VT
William A. Hall House	Rockingham, VT
Bellows Falls Neighborhood Historic District	Rockingham, VT
Roxbury Fish Hatchery	Roxbury, VT
Joseph Fessenden House	Royalton, VT
South Royalton Historic District	South Royalton, VT
Central Vermont Railroad Headquarters	St. Albans City, VT
St. Albans Historic District	St. Albans City, VT
Willard Manufacturing Company Building	St. Albans City, VT
Waterbury Village Historic District	Waterbury, VT
Westminster Village Historic District	Westminster, VT
Twing Buckman House	Windsor, VT
Old Constitution House	Windsor, VT
Windsor Village Historic District	Windsor, VT

Source: National Register of Historic Places GIS, 2014.

Potential Impacts

12.2.20.1.4 No-Build Alternative

Under the No-Build Alternative, the CTDOT infrastructure improvements to the NHHS rail line would be undertaken, including double-tracking and station improvements. In addition, the Knowledge Corridor project between Springfield and East Northfield, Massachusetts would also be completed, as would the Springfield Union Station restoration, improvements to the rail infrastructure between the U.S. border and Montreal, and the Montreal Central Station Customs Checkpoint. Layover facilities would be developed at Springfield Union Station and near South Station, as part of the South Station Expansion Project. No additional impacts to cultural resources beyond those resulting from the above projects are anticipated from the No-Build Alternative.

12.2.20.1.5 Alternative 1 – Corridor Service

Under Alternative 1, additional trains would be added between Boston and Springfield, and New Haven and Montreal. Speeds would be upgraded to 60 mph where possible and infrastructure upgrades would be undertaken to serve the proposed train operations. Although track improvements would be undertaken, no alignment changes are anticipated and all track work would take place within the existing ROW. In addition, no layover facilities are proposed beyond those outlined under the No-Build Alternative.

Right-of-way improvements are planned in the portion of the project study corridor north of East Northfield, MA. These include improvements in the vicinity of the Brattleboro Downtown Historic District, Brooks House, and Union Station in Brattleboro, VT; Old Constitution House and the Windsor Village Historic District in Windsor, VT; and the Bethel Village Historic District in Bethel, VT. However, the improvements would occur within the existing ROW and are not anticipated to affect adjacent historic buildings, sites and districts.

Additional sidings would be added between Brattleboro and St. Albans City, Vermont, and in East Northfield, Massachusetts. These sidings could occur in the vicinity of the Vernon District Schoolhouse No. 4 in East Northfield, Massachusetts; Brooks House and the Brattleboro Downtown Historic District in Brattleboro, Vermont; the Westminster Village Historic District in Westminster, Vermont; the Bellows Falls Neighborhood Historic District, the Bellows Falls Downtown Historic District, and the William A. Hall House in Rockingham, Vermont; the Charlestown Main Street Historic District and the North Charlestown Historic District in Charlestown, New Hampshire; and the St. Albans Historic District, the Central Vermont Railroad Headquarters (now used as offices of NECR), and the Willard Manufacturing Company Historic District in St. Albans City, Vermont. These sidings would occur within the existing ROW and are not anticipated to affect adjacent historic buildings, sites and districts.

Under Alternative 1, station improvements would be undertaken at several sites along the corridor. Four locations are currently under consideration for a new station in Palmer, Massachusetts. At least one of these sites lies in close proximity to the historic Union Station. As such, there is the potential for indirect visual effects. Improvements would also be undertaken at the former Central Vermont Railway Station in Windsor, Vermont. Constructed circa 1905, the Windsor station is a contributing element to the Windsor Village

Historic District. Although the platform serves the Vermonter service, the station itself currently functions as commercial space. Any improvements to the station or the platform should be sensitive to the property's historic character and context. Although not listed in the National Register, the Montpelier Station does appear to be greater than 50 years old. Although not currently planned prior to undertaking any required improvements at the Montpelier Station, the building should be evaluated to determine whether it is eligible for listing in the National Register.

As part of the NEPA and Section 106 compliance for the NHHS project, the entire rail corridor between New Haven and the CT/MA state line was determined eligible for the National Register. Contributing elements include passenger stations, bridges, culverts, freight houses, signal towers, historic archaeological sites, and wayside railroad features. It is noted that the rail line of the NHHS project from the CT/MA state line to Springfield not determined eligible for the National Register. It is recommended that the corridor between Boston and Springfield, Massachusetts, or the corridor between Springfield, Massachusetts and Alburgh, Vermont, be classified as not eligible for the National Register.

12.2.20.1.6 Alternative 2 – Corridor Service with Speed Improvements

Under Alternative 2, additional trains would be added between Boston and Springfield, and New Haven and Montreal. Speeds would be upgraded to 79 mph where possible and infrastructure upgrades would be undertaken to serve the proposed train operations. Although track improvements would be undertaken, no alignment changes are anticipated and all track work would take place within the existing ROW. In addition, no layover facilities are proposed beyond those outlined under the No-Build Alternative.

Like Alternative 1, Alternative 2 does not propose any alignment changes and all track work would take place within the existing ROW. The right-of-way and siding improvements, as well as the anticipated effects, would be the same as those identified above for Alternative 1. In addition, a second track would be added within the ROW in portions of the corridor between Worcester and Springfield, MA. This would occur within the vicinity of Union Station in Palmer, Massachusetts, and the Warren Town Hall and Warren Public Library in Warren, Massachusetts. However, the improvements would occur within the existing ROW and are not anticipated to affect adjacent historic buildings, sites and districts.

Under Alternative 2, signal systems would be added within the ROW. However, the majority of the system elements would not be visible. Where elements are visible they would be placed within the ROW and would be visually consistent with existing elements. Thus, effects to historic properties resulting from the signal systems are unlikely.

The station improvements and associated impacts would be the same as those outlined above for Alternative 1.

12.2.20.1.7 Alternative 3 – Corridor Service with Speed and Equipment Improvements

Under Alternative 3, additional trains would be added between Boston and Springfield, and New Haven and Montreal. Speeds would be increased to 90 mph where possible and infrastructure upgrades would be undertaken to serve the proposed train operations. Although track improvements would be undertaken, no alignment changes are anticipated and all track work would take place within the existing ROW. In addition, no layover facilities are proposed beyond those outlined under the No-Build Alternative.

Like Alternatives 1 and 2, Alternative 3 does not propose any alignment changes and all track work would take place within the existing ROW. The right-of-way and siding improvements, as well as the anticipated effects, would be the same as those identified above for Alternative 2. The signal system is also anticipated to be the same as that required for Alternative 2, and the station improvements are the same as Alternative 1.

12.2.21 Use of 4(f)-Protected Properties

Section 4(f) properties refer to lands protected by Section 4(f) of The Department of Transportation Act of 1966. It states that Department of Transportation agencies cannot approve the use of land from publicly owned parks, recreation areas, wildlife and waterfowl refuges, or public and private historical sites unless the following conditions apply:

- There is no feasible and prudent alternative to the use of land.
- The action includes all possible planning to minimize harm to the property resulting from use.

Section 4(f) protected properties will likely only be impacted where a proposed second track or passing siding will be installed, otherwise the existing infrastructure will be utilized. In locations where track construction will take place it has yet to be determined if use of protected properties will be necessary. Section 4(f) protected properties were mapped in GIS along the corridor. In areas where track construction will take place the length of affected right-of-way was determined. The number of linear miles affected broken down by alternative and location can be found in Table 12.1.

12.2.22 Socioeconomic

The project is anticipated to have a positive socioeconomic impact as a result of increased mobility and accessibility throughout the corridor. Increased mobility provides benefits such as access to employment opportunities and increased regional connectivity. An economic analysis may be necessary to quantify these impacts as part of NEPA Tier 1.

12.2.23 Transportation

Increased passenger train service will benefit the corridor by providing an additional mode choice from travelers. This will provide improved connections between cities. Additional passenger trains will be coordinated with existing freight service in order to minimize conflict. Freight traffic will benefit from proposed track improvements including increased speeds and additional passing sidings.

12.2.24 Construction period impacts

Construction impacts may include train speed restrictions, noise, air quality, water quality, disposal of construction waste, contaminated soils, and utility impacts. These impacts would temporary and limited to areas where track construction will occur. More detailed analysis may be necessary when construction plans are developed.

12.2.25 Indirect and Cumulative

Indirect impacts refer to reasonably foreseeable future consequences that are caused by the proposed action, but that would occur either in the future or in the vicinity of but not at the exact location. Possible cumulative effects of this project include economic growth and transit oriented development (TOD).

Cumulative impacts are defined as the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or persons undertakes such actions. Cumulative effects can result from individually minor but collectively significant actions over a period of time. Further investigation of indirect and cumulative impacts will be conducted as part of NEPA Tier 1.

12.2.26 Topology and Geology

Significant topology and geology impacts due to construction of a second track or passing siding are not anticipated. Significant excavation and earthwork is not likely to be required due to the utilization of existing right of way. Most locations were historically double tracked with much of the existing rail embankment still in place.

12.2.27 Designated River

Track construction will occur adjacent to major rivers including the Quaboag River, the Chicopee River, and the Connecticut River. They may be potential for impacts where it is determined that bridge reconstruction or replacement over water bodies is necessary. Further engineering analysis is needed to make that determination. Table 12.1 displays the water bodies adjacent to areas of construction, organized by alternative. Outside of site specific track construction minimal effects to water bodies are anticipated due to use of the existing rail corridor.

12.2.28 Prime Farm

Prime farmlands are unlikely to be impacted by any of the Build Alternatives. Any effects would be limited to areas where earthwork may occur which will be defined during more detailed engineering. A further examination of prime farm soils may be necessary in NEPA Tier 1 in areas where additional earthwork may take place. Outside of these areas no impacts to soils are expected

12.2.29 Permits

Federal state and local permits may be required particularly in locations proposed track construction will take place. Specific required permits will be identified during the NEPA process.

12.2.30 Displacements and Relocations

There are no displacements or relocations anticipated as a result of this project due to the utilization of existing right of way.

13 SUMMARY AND NEXT STEPS

The Alternative Analysis for the NNEIRI Study examines in detail four potential alternative visions for passenger rail service in the New England region. The alternatives analyzed include:

- **No-Build**: The No-Build Alternative assumes the New England region continues with existing passenger and rail programs excluding NNEIRI service.
- **Alternative 1 – Corridor Service:** Alternative 1 provides significant ridership benefits (597,900 passengers annually) between points in New England for a lower cost capital requirement ($615-785 million) and lower annual operating funding ($46 million).
- **Alternative 2 – Corridor Service with Speed Improvements**: Alternative 2 significantly improves travel times and ridership over Alternative 1. Ridership jumps by more than 75% (to 1,052,500 annually) over Alternative 1 but capital cost ($1,065 – 1,350 million) and annual operating funding ($76 million) are higher than Alternative 1.
- **Alternative 3 – Corridor Service with Speed and Equipment Improvements**: Improves speed and travel times over Alternative 2 but does not see significant ridership growth consummate to the increase in cost and operating funding.

Through further refinement of data and stakeholder and public engagement, a final Recommended Alternative will be developed. The Recommended Alternative will potentially include parts of all three Build Alternatives and the No Build Alternative and incorporate new data and public/stakeholder input. The Recommended Alternative will then be subject to an environmental analysis through the NEPA process. A tiered NEPA analysis is planned, in which the overall Recommended Alternative is assessed at a program (or Tier 1) level, and then additional analysis is conducted as specific plans for individual projects or phases are developed. In addition to the NEPA analysis, a Service Development Plan will be developed for each of the routes (Inland Route and Boston-to-Montreal Route), which will identify phases, projects and implementation plans.

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14. APPENDIX

A. TRAIN PERFORMANCE CALCULATOR RESULTS

B. RIGHT OF WAY CAPITAL COSTS

C. SIGNALS AND COMMUNICATIONS CAPITAL COST METHODOLOGY

D. SUPPLEMENTARY RIDERSHIP ANALYSIS

E. RIDERSHIP FORECASTING METHODOLOGY

F. REVENUE FORECASTING METHODOLOGY

G. OPERATIONS AND MAINTENANCE COST ESTIMATING METHODOLOGY

H. WESTON TOLLS/ROUTE 128 STATION ANALYSIS

I. PALMER STATION ANALYSIS

J. ALTERNATIVE ANALYSIS PUBLIC MEETINGS

A. Train Performance Calculator Results

Figure 1: Northbound Base Local Service One Locomotive

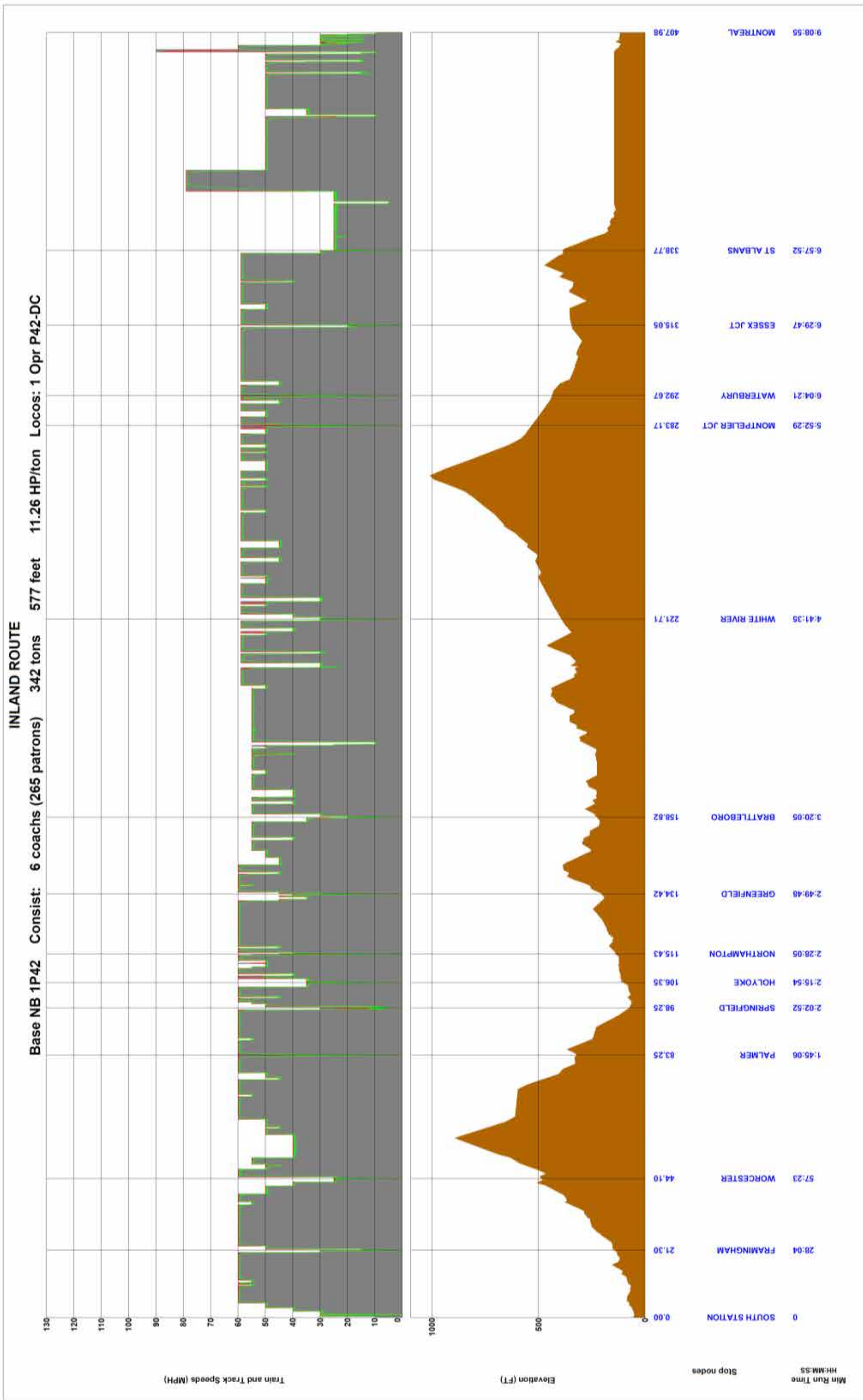


Figure 2: Southbound Base Local Service One Locomotive

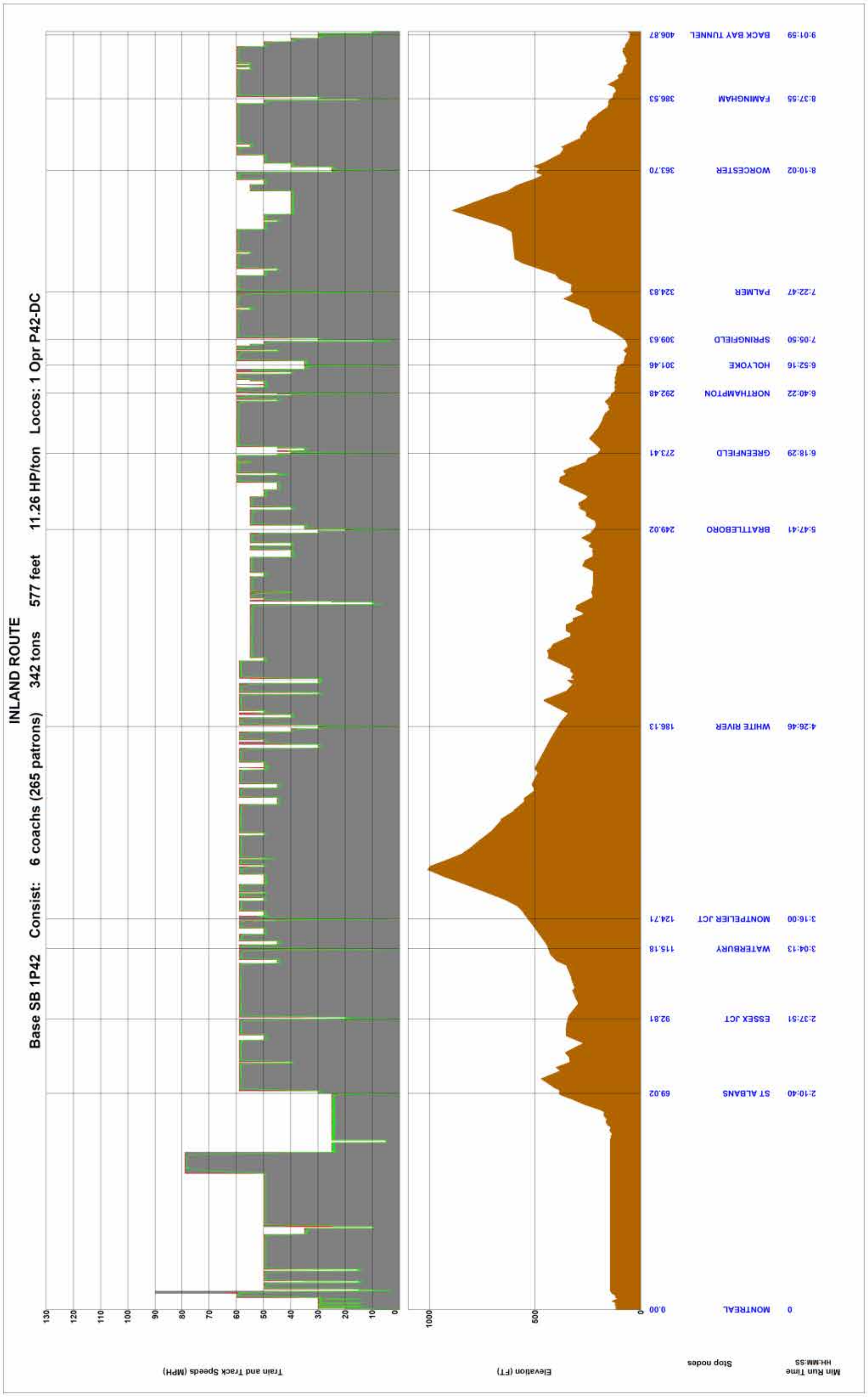


Figure 3: Northbound Base Local Service Two Locomotives

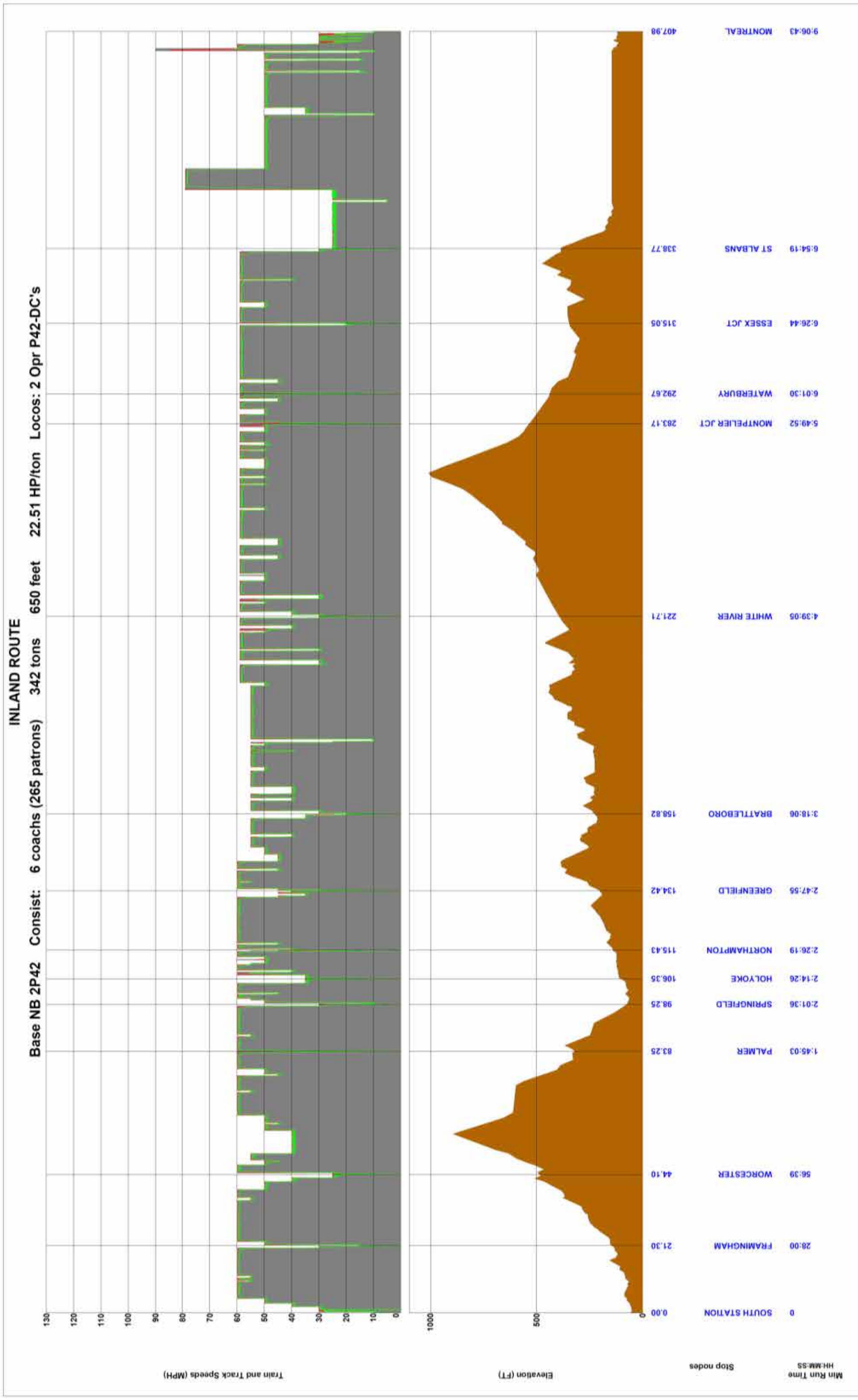


Figure 4: Southbound Base Local Service Two Locomotives

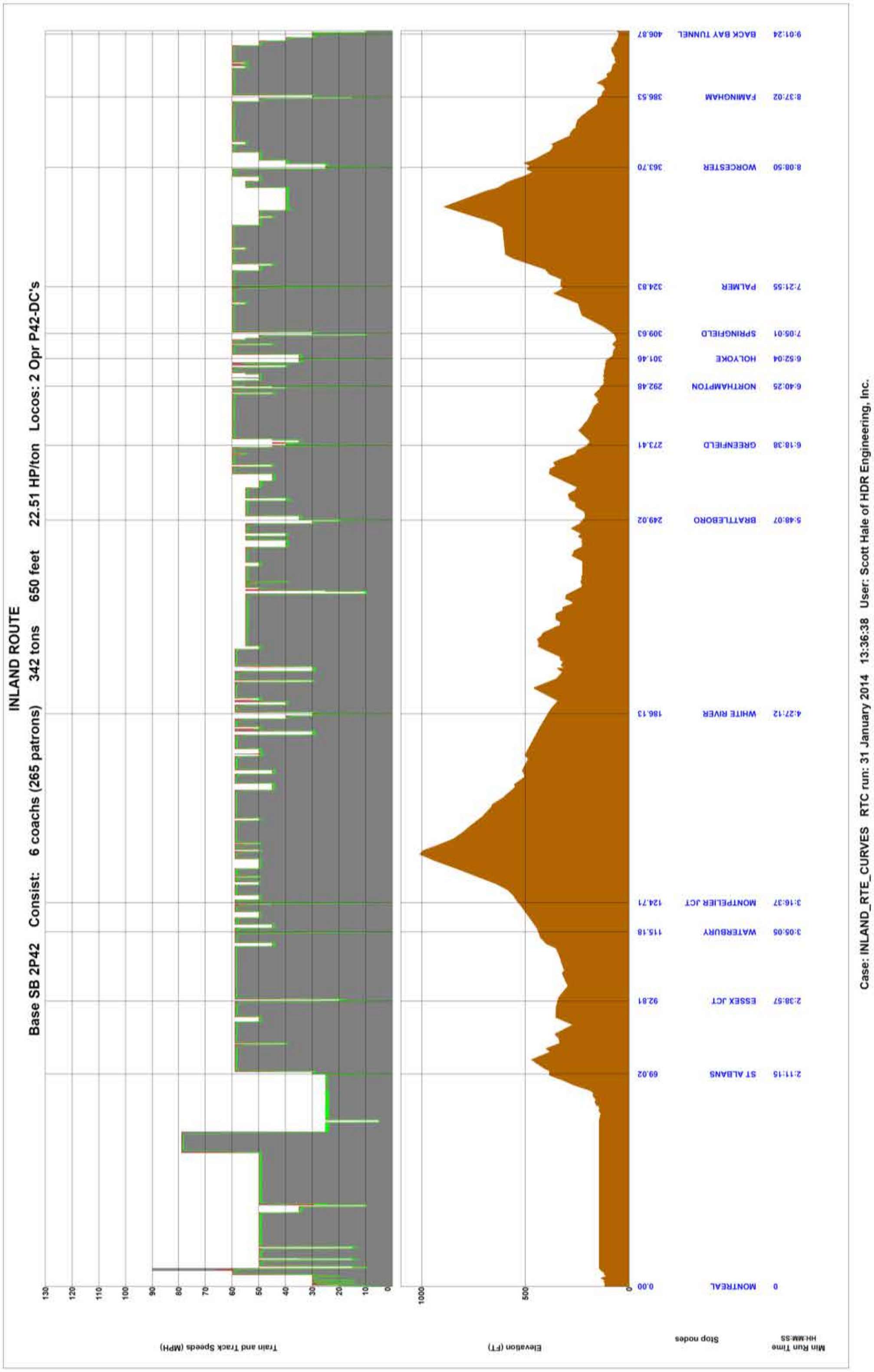


Figure 5: Northbound 79 Local Service One Locomotive

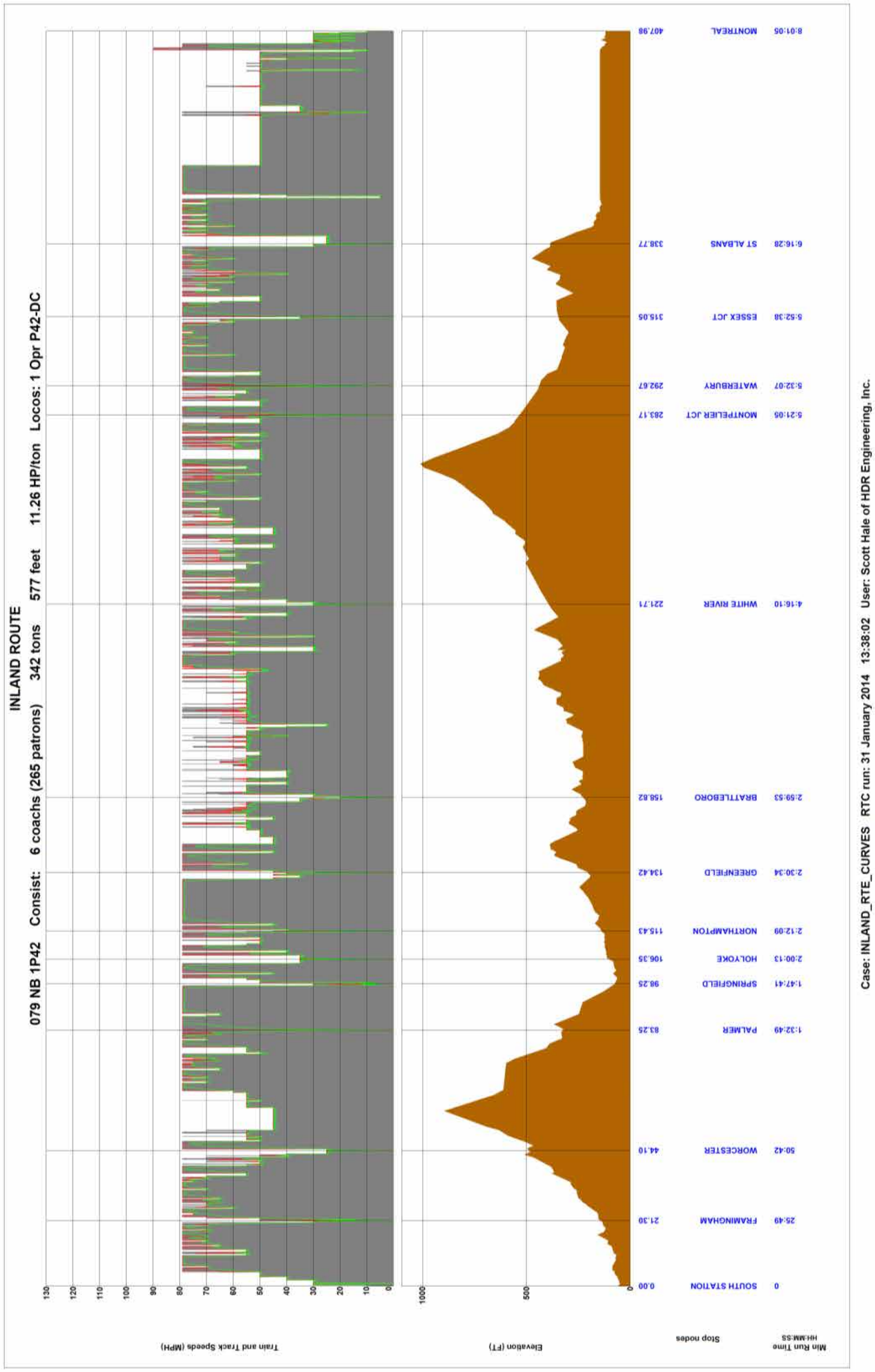


Figure 6: Southbound 79 Local Service One Locomotive

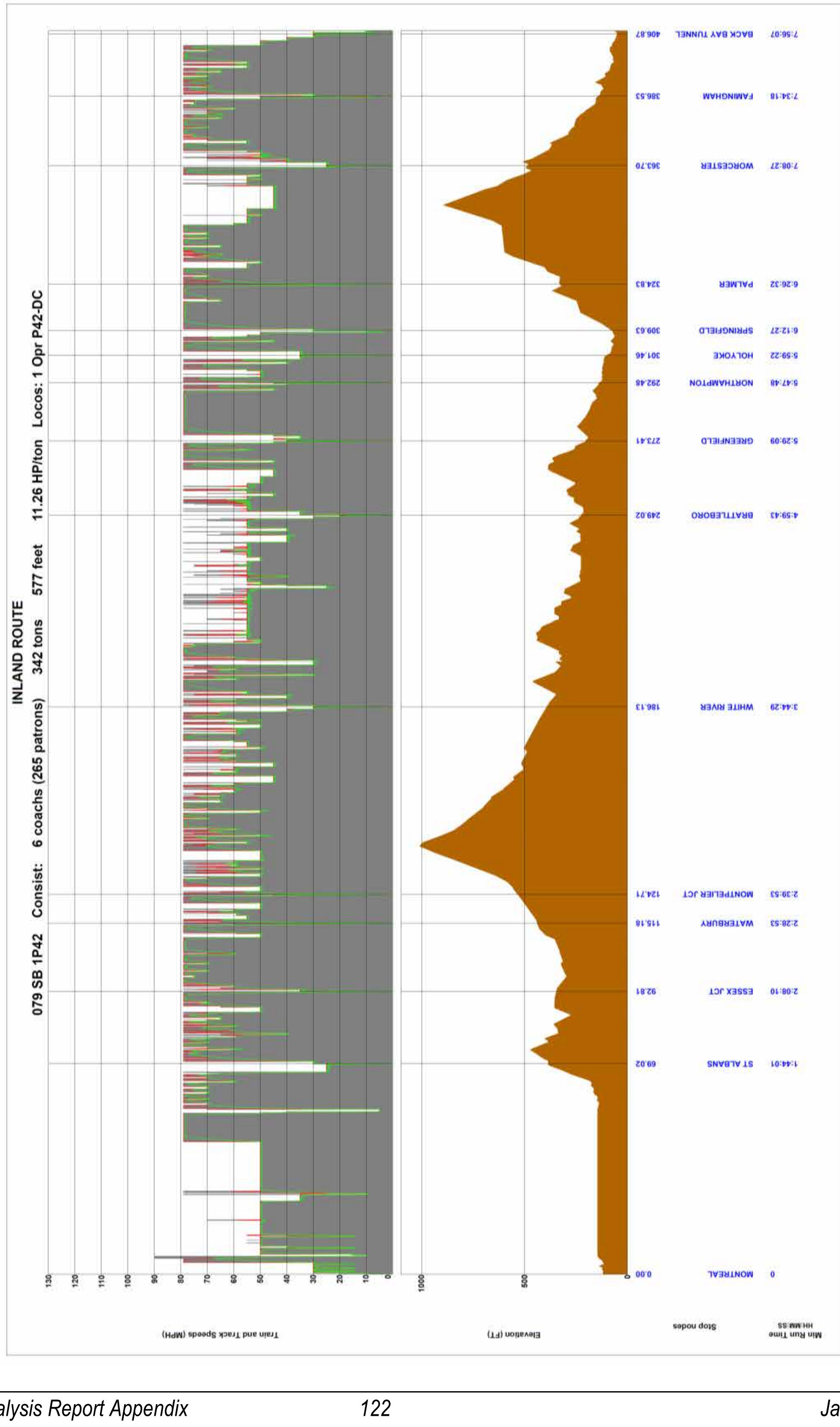


Figure 7: Northbound 79 Local Service Two Locomotives

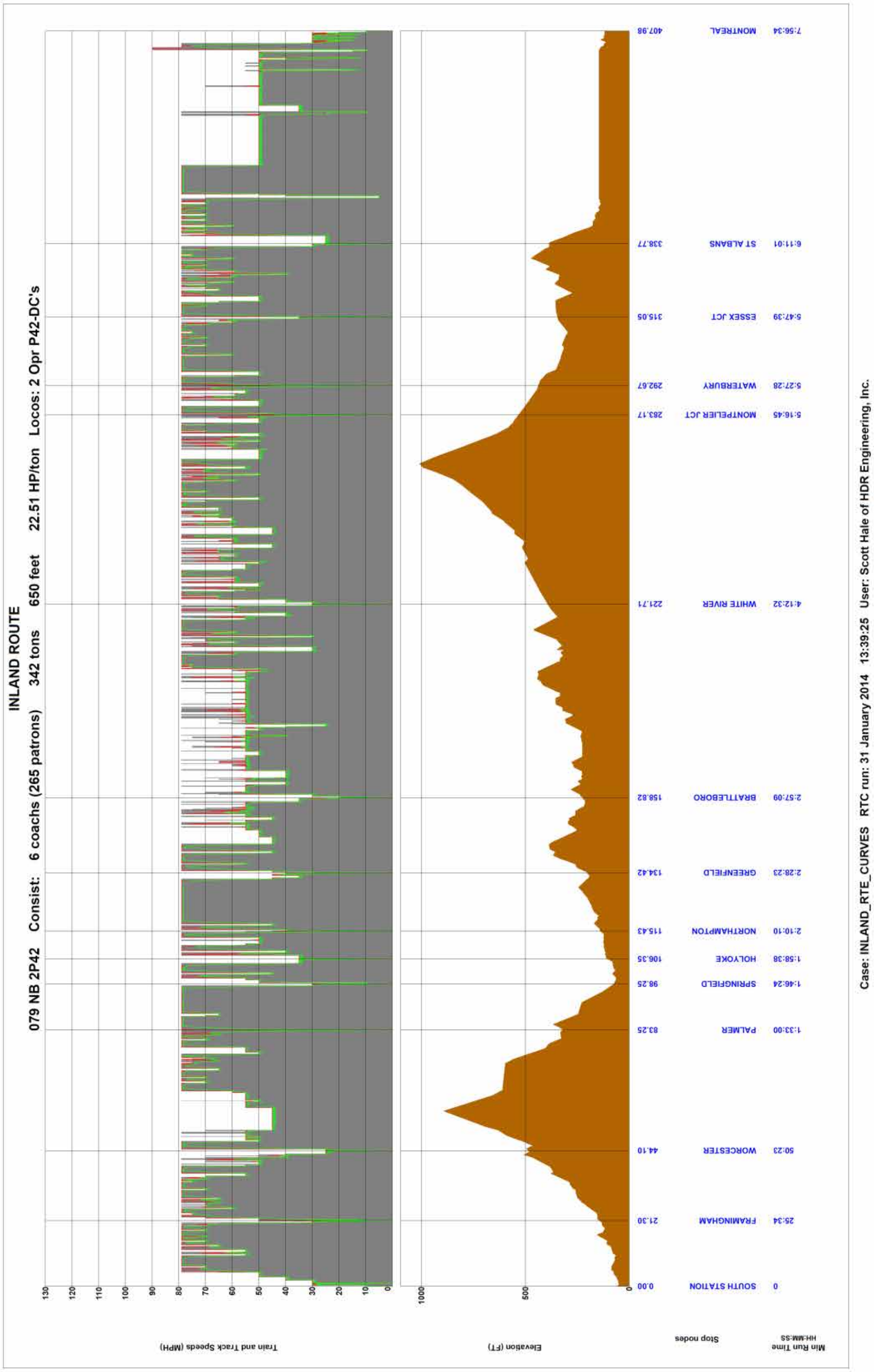


Figure 8: Southbound 79 Local Service Two Locomotives

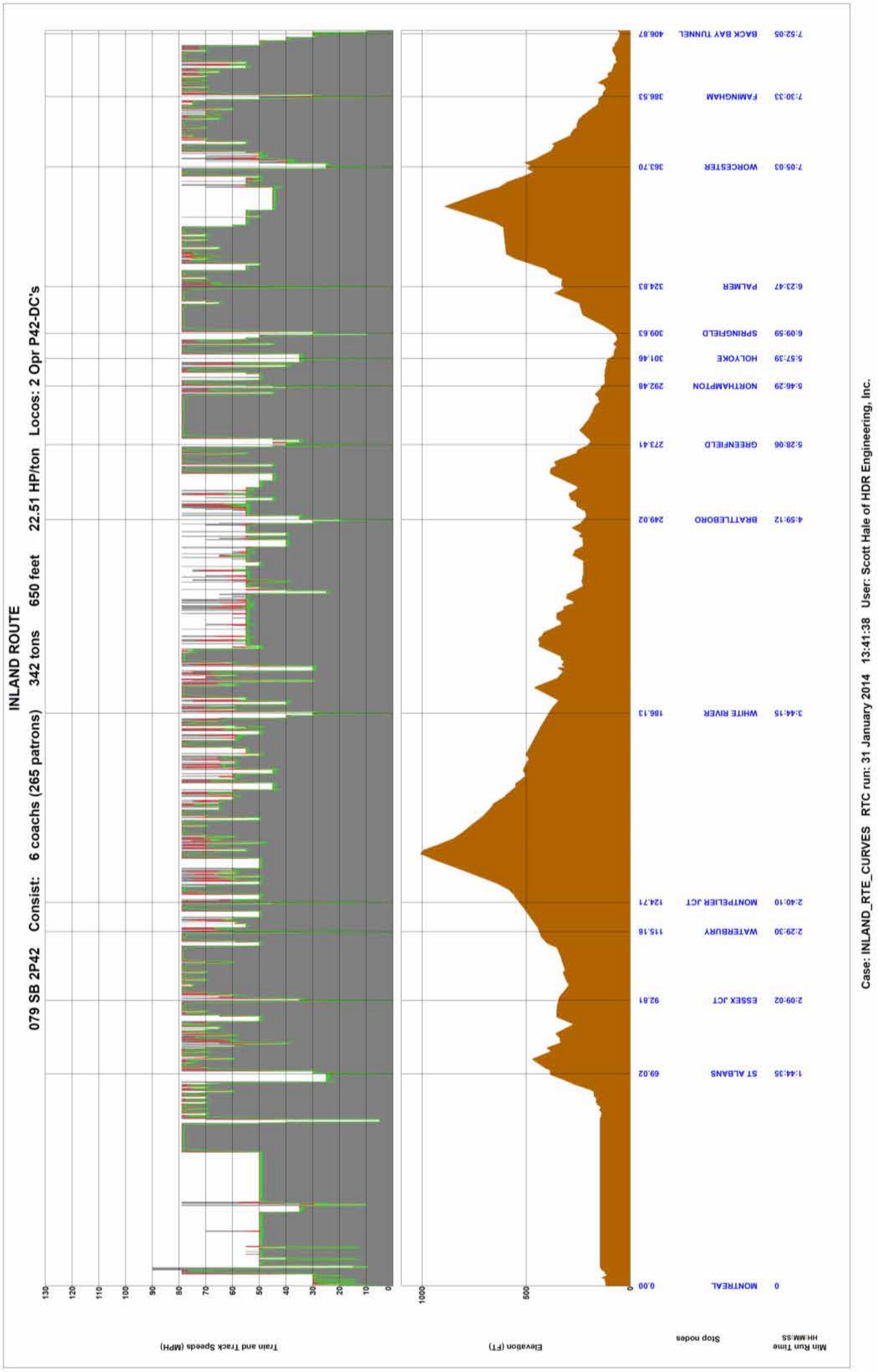


Figure 9: Northbound 90 Local Service One Locomotive

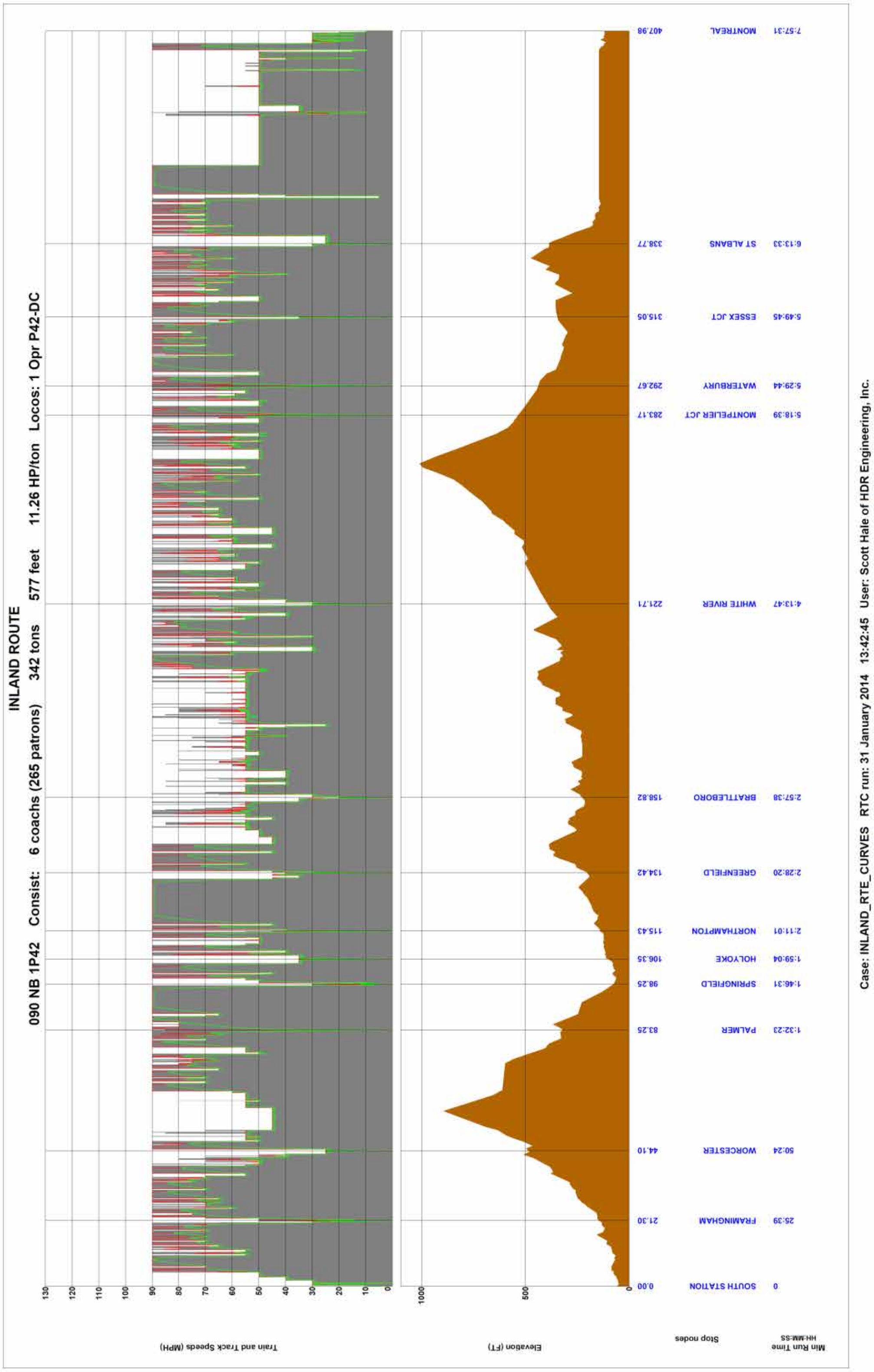


Figure 10: Southbound 90 Local Service One Locomotive

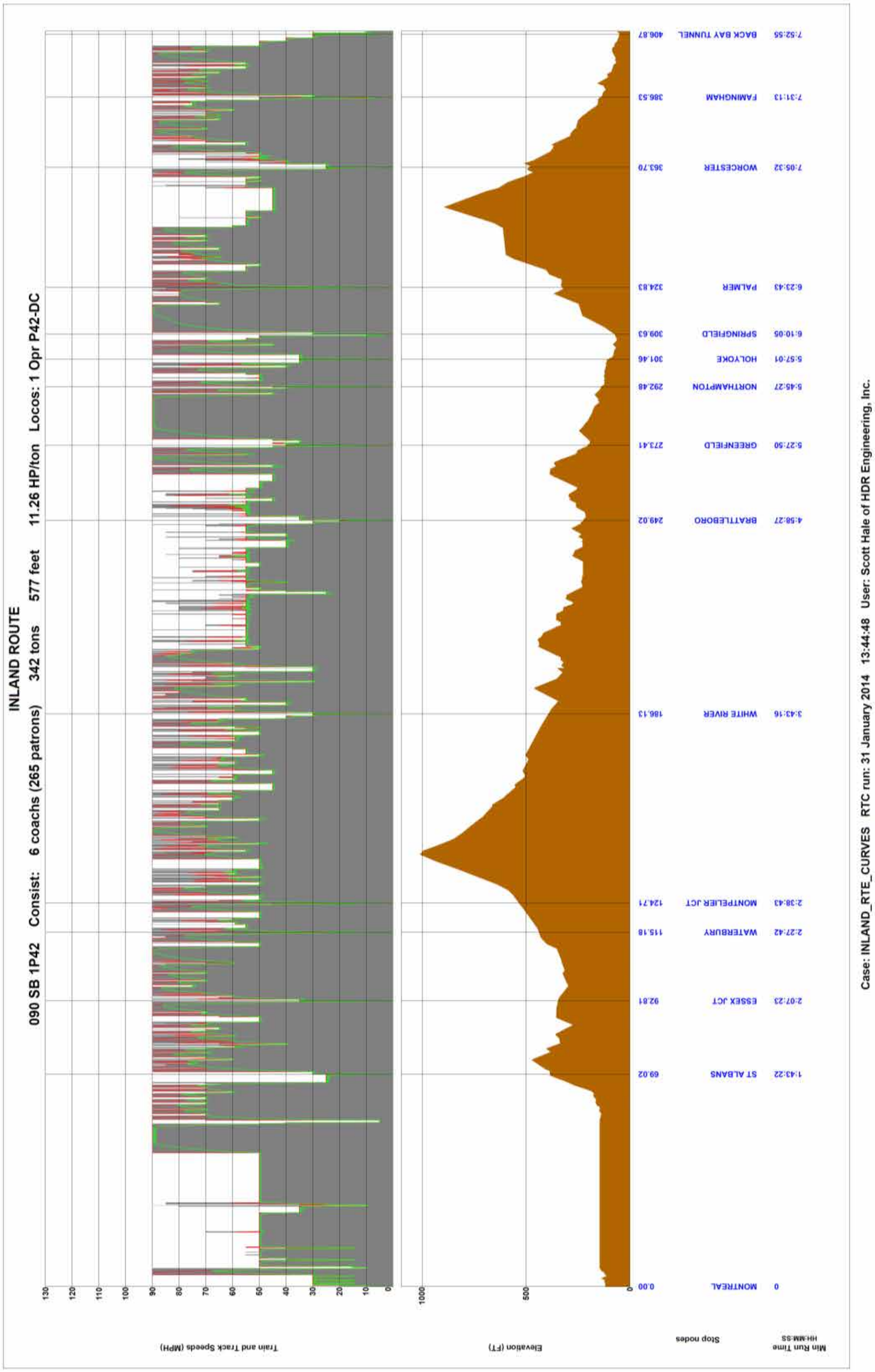


Figure 11: Northbound 90 Local Service Two Locomotives

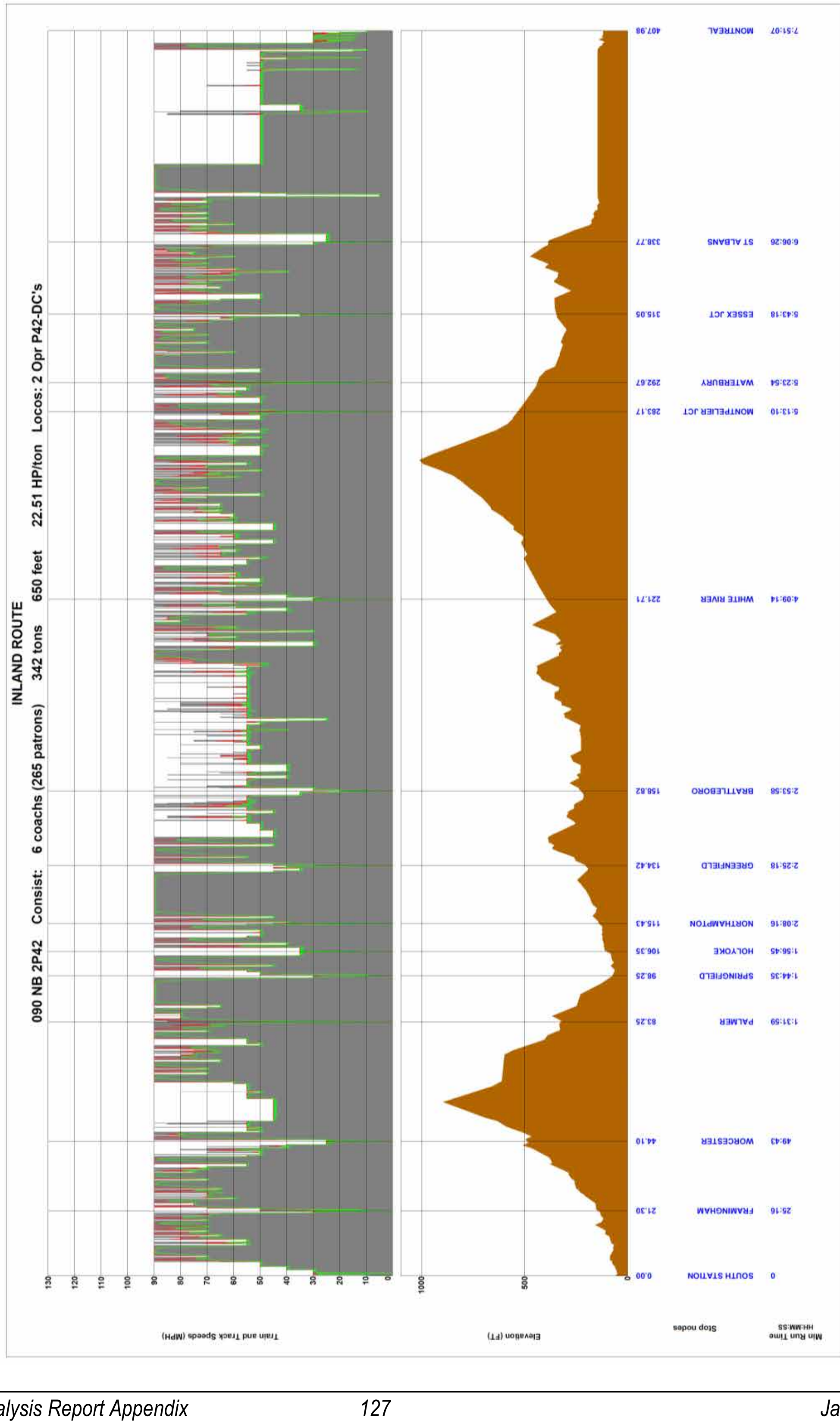


Figure 12: Southbound 90 Local Service Two Locomotives

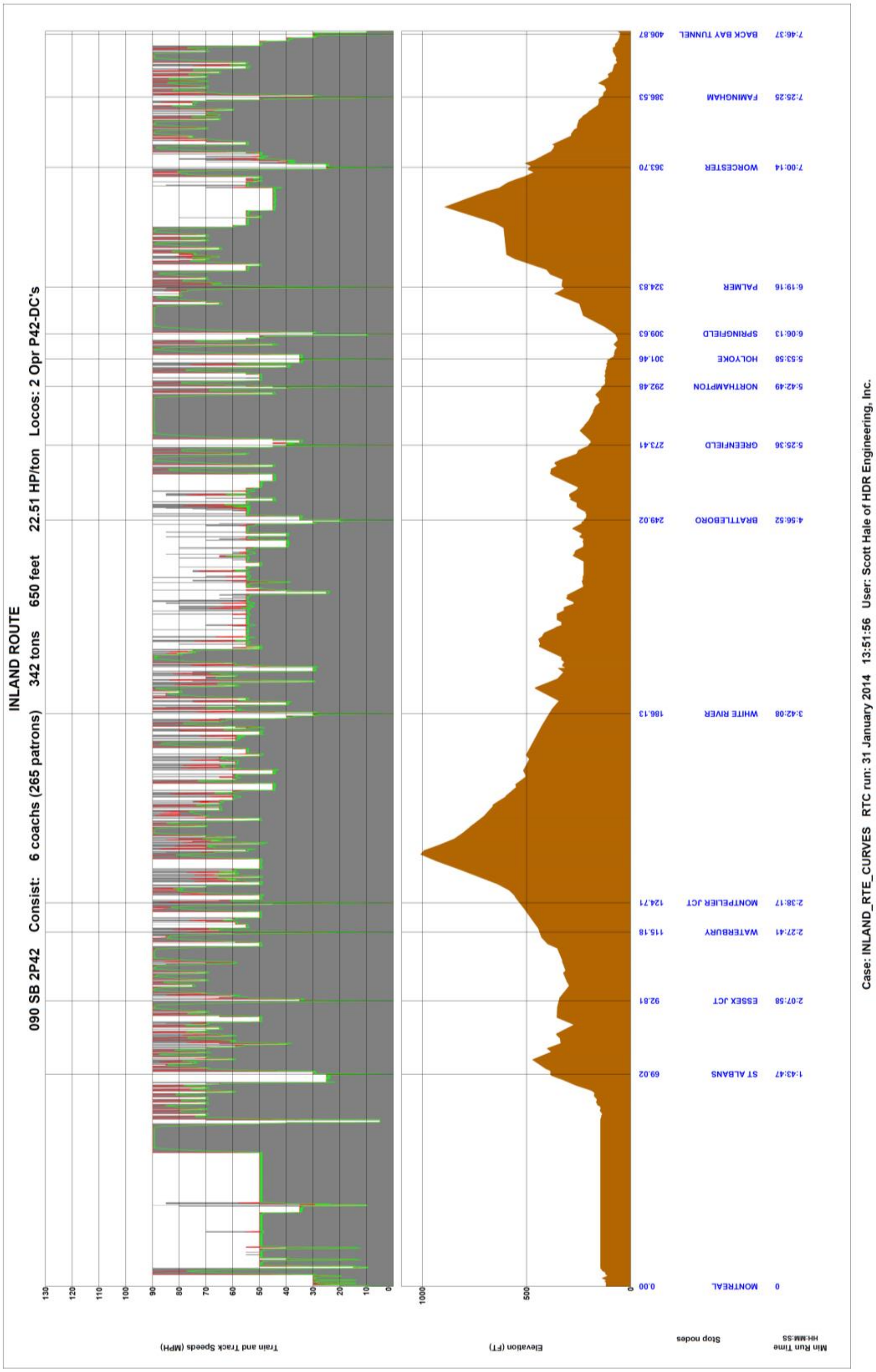


Figure 13: Northbound Base Express Service One Locomotive

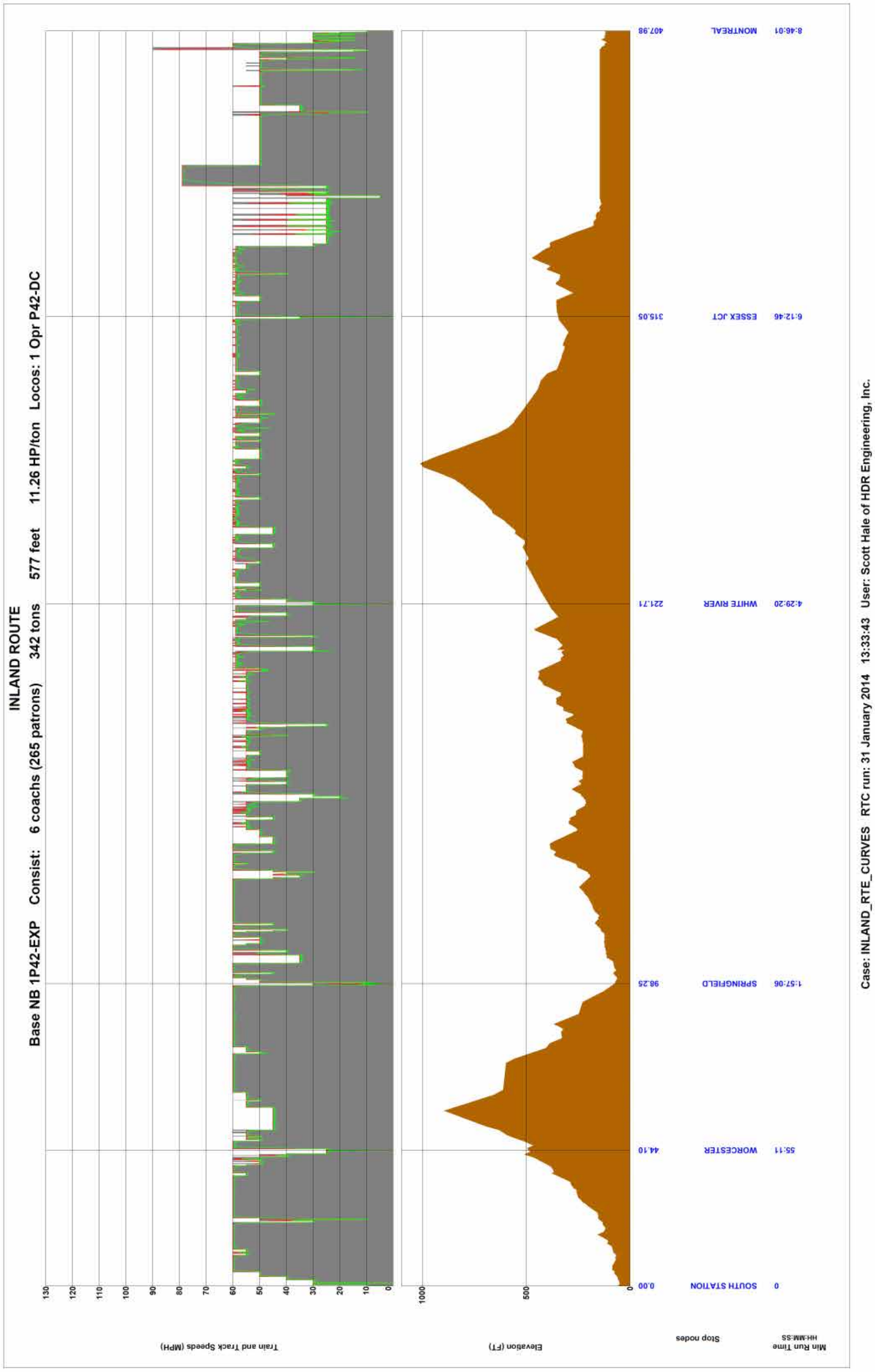


Figure 14: Southbound Base Express Service One Locomotive

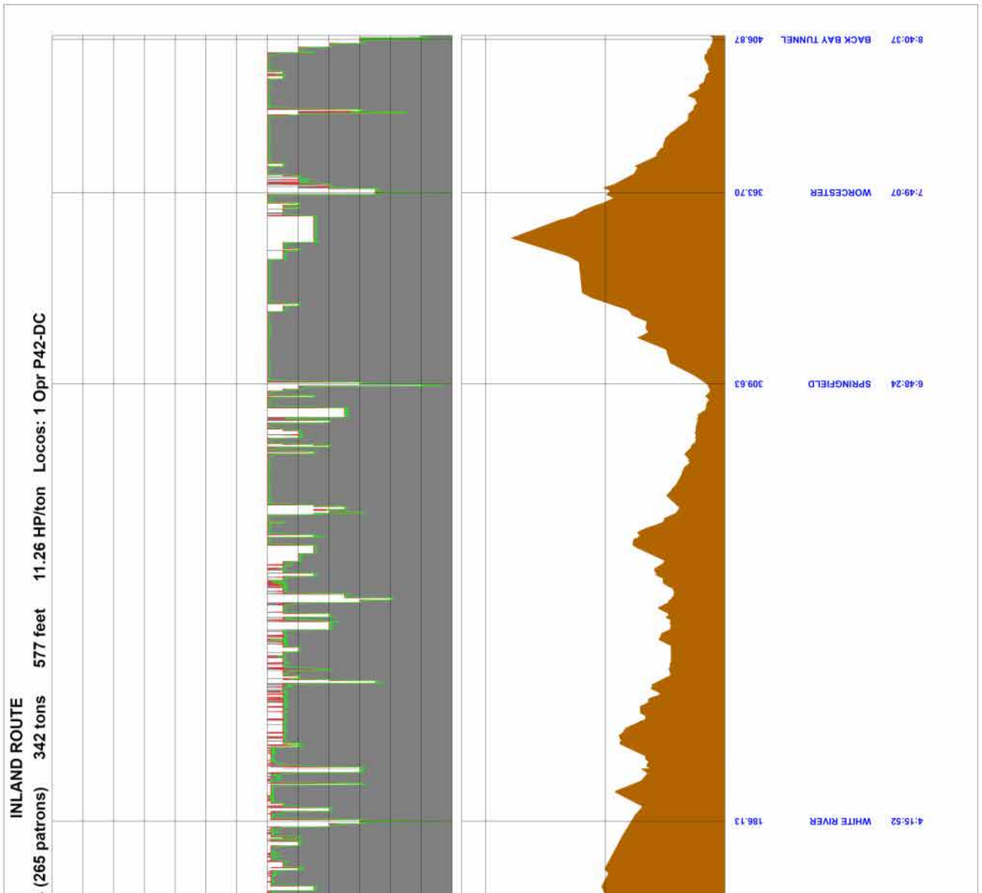


Figure 15: Northbound Base Express Service Two Locomotives

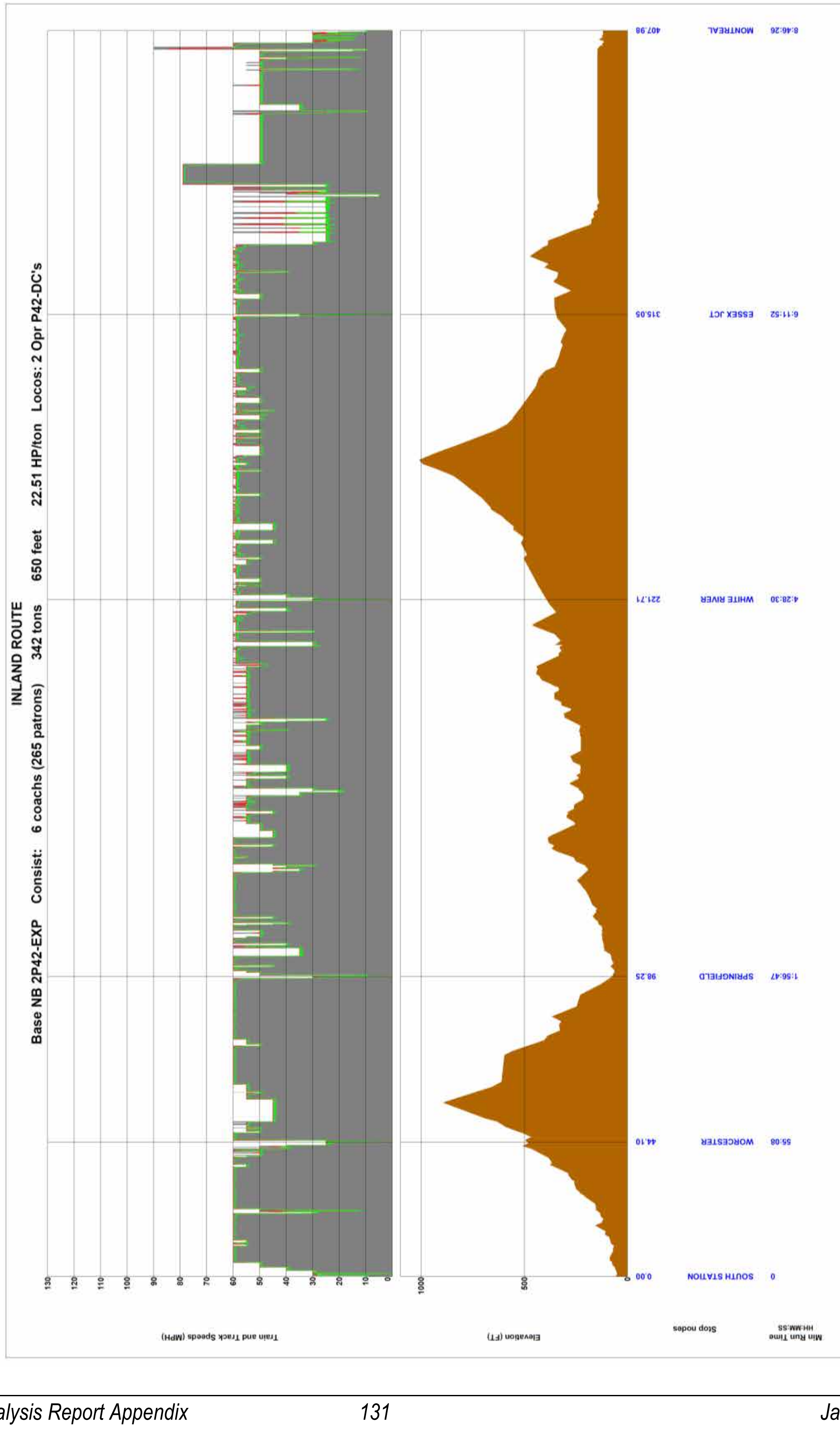


Figure 16: Southbound Base Express Service Two Locomotives

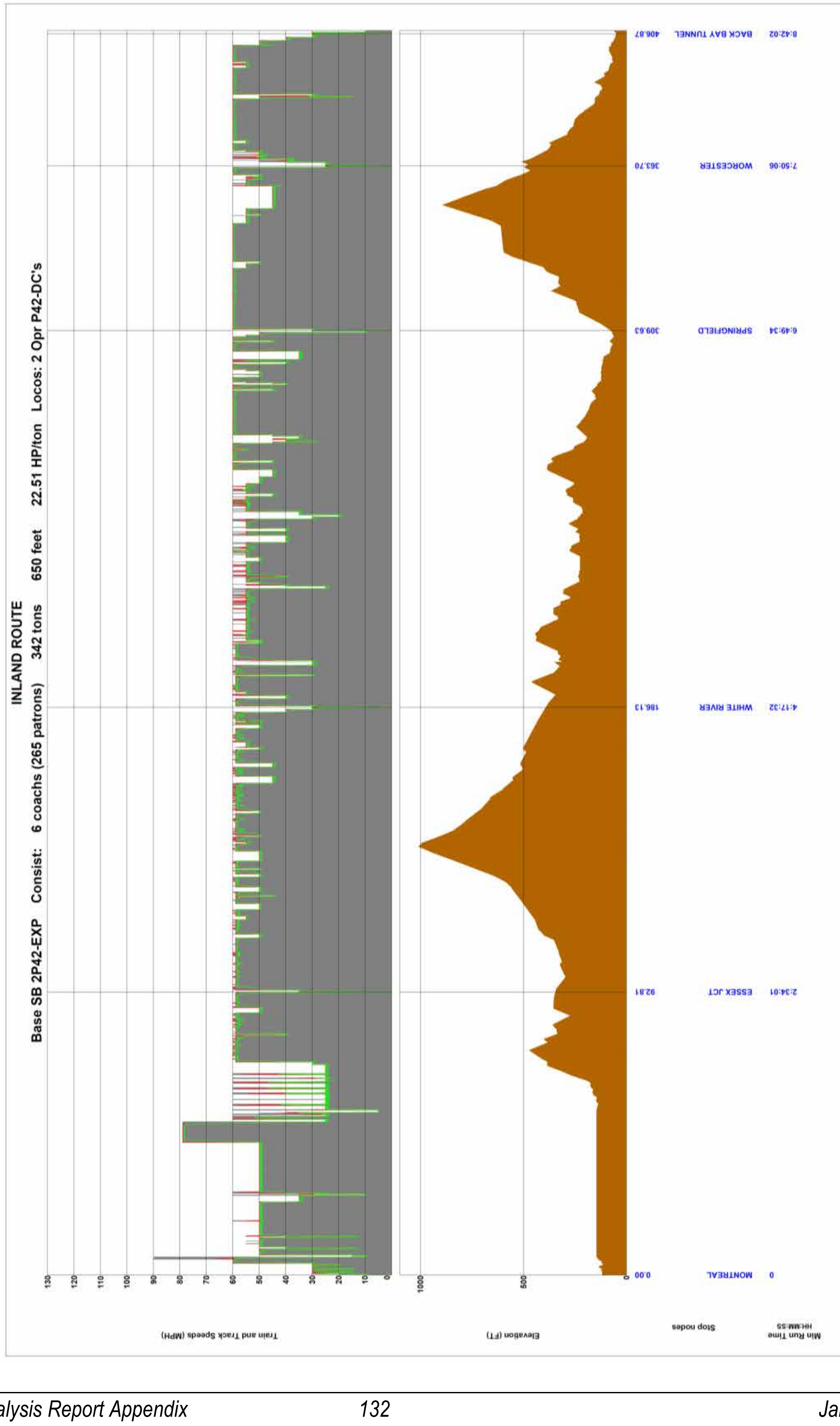


Figure 17: Northbound 79 Express Service One Locomotive

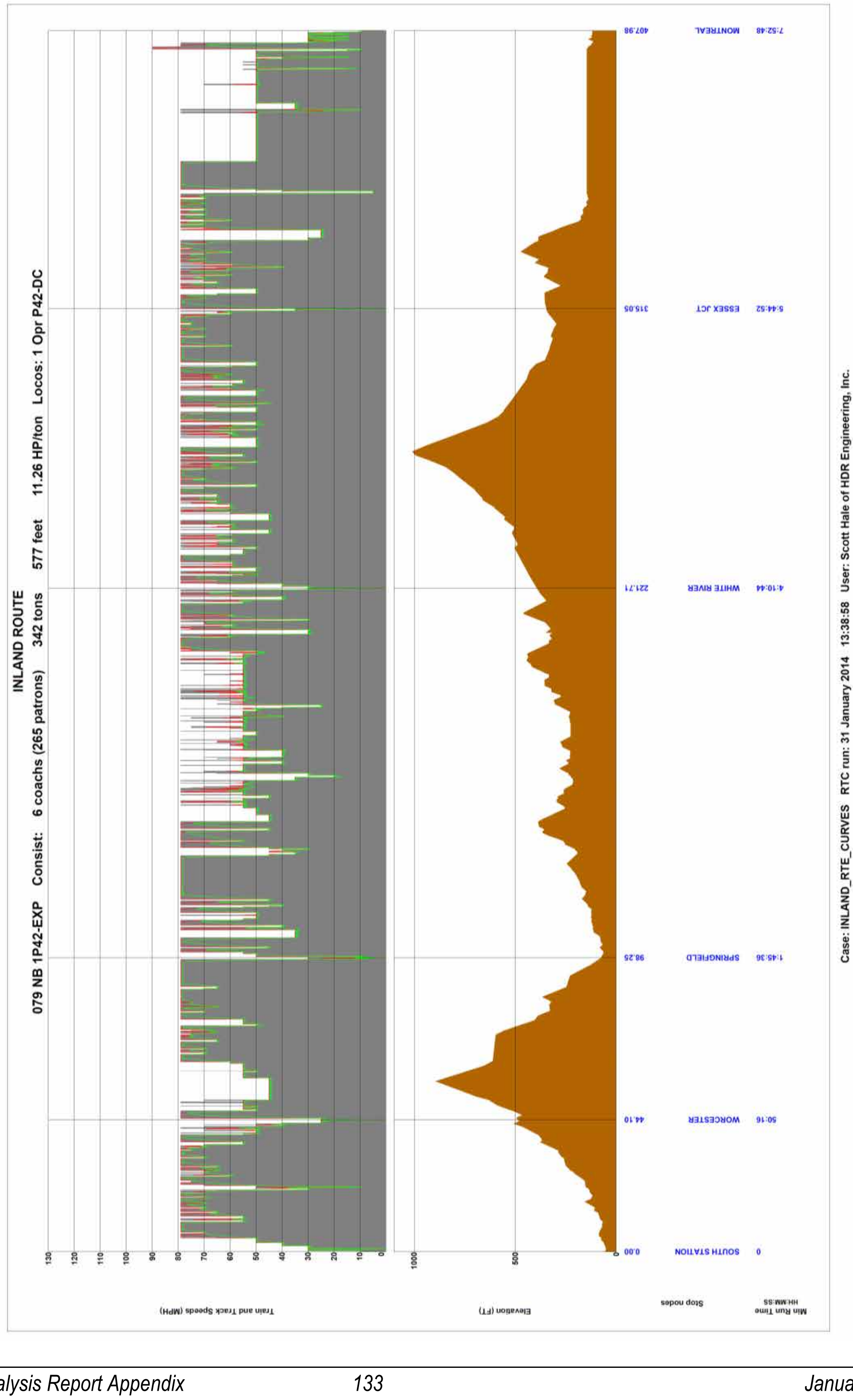


Figure 18: Southbound 79 Express Service One Locomotive

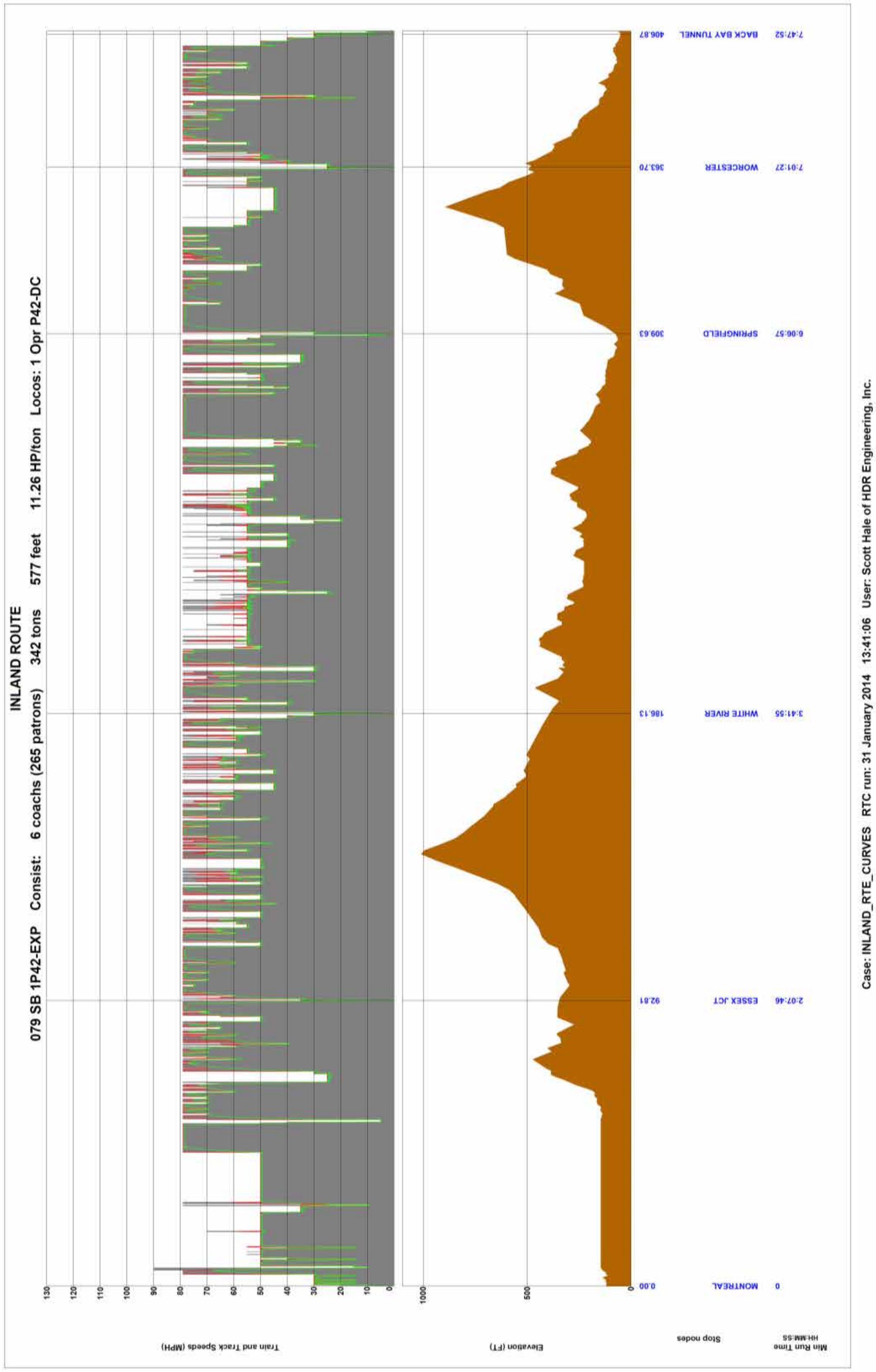


Figure 19: Northbound 79 Express Service Two Locomotives

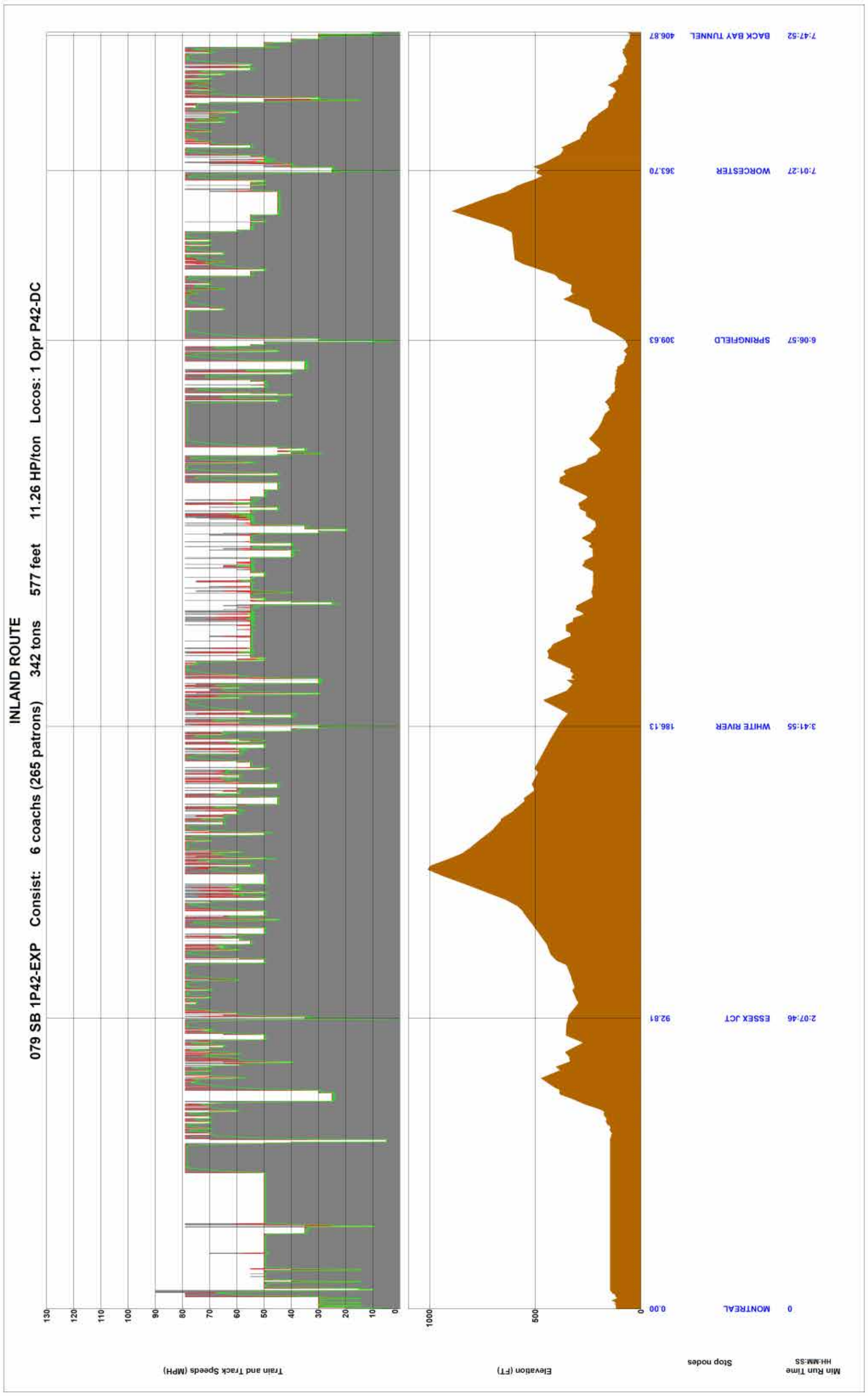


Figure 20: Southbound 79 Express Service Two Locomotives

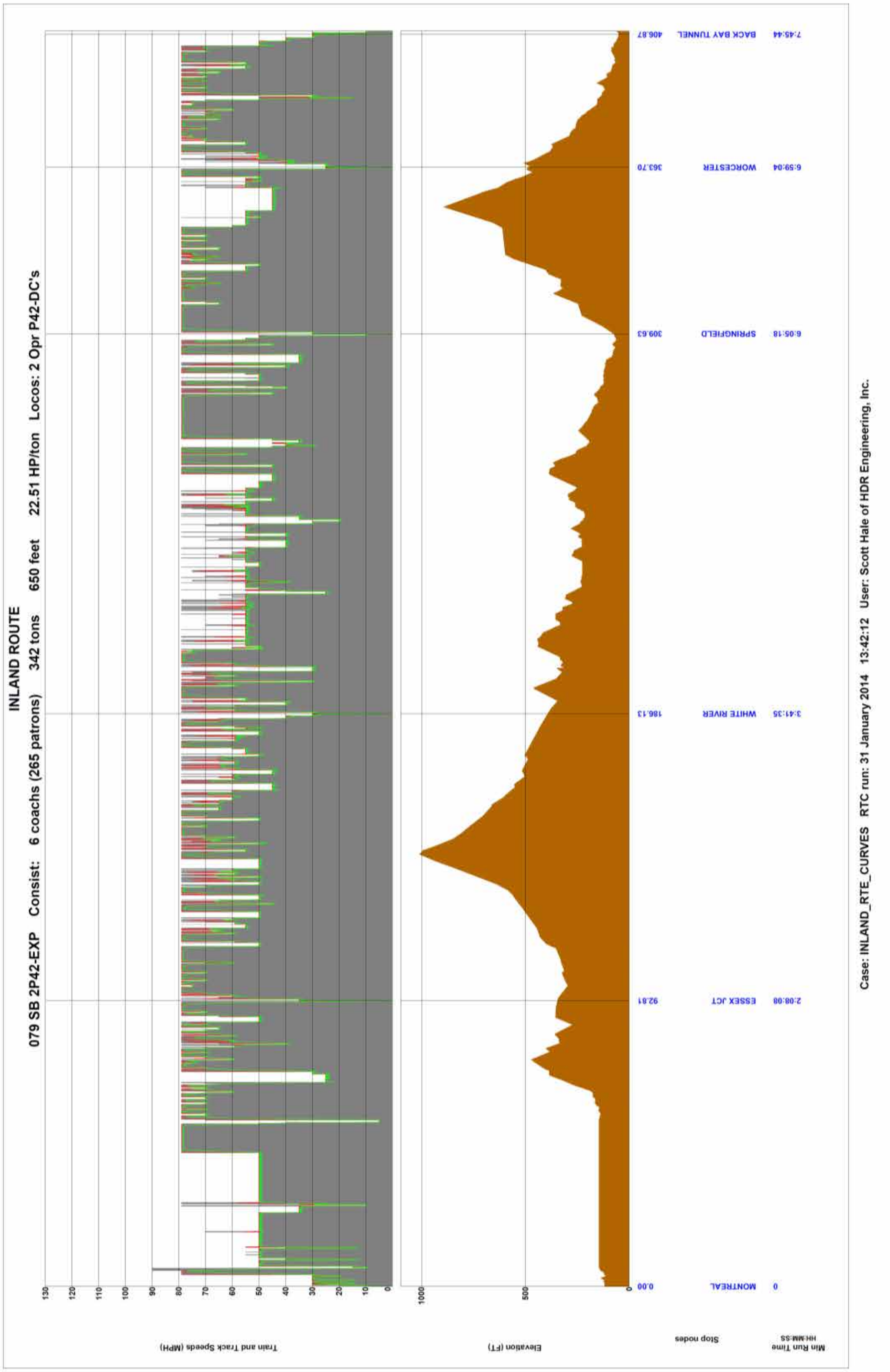


Figure 21: Northbound 90 Express Service One Locomotives

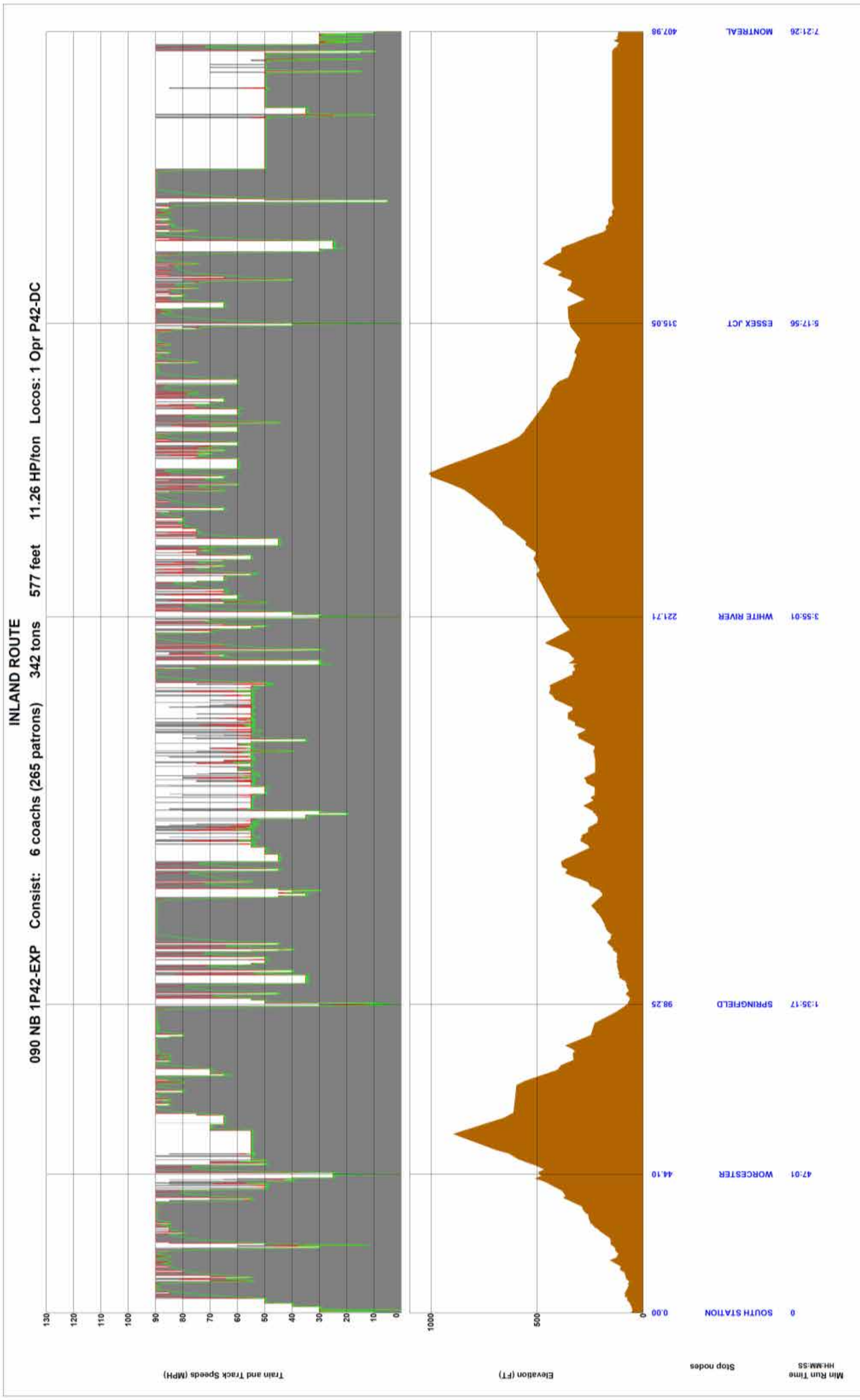


Figure 22: Southbound 90 Express Service One Locomotives

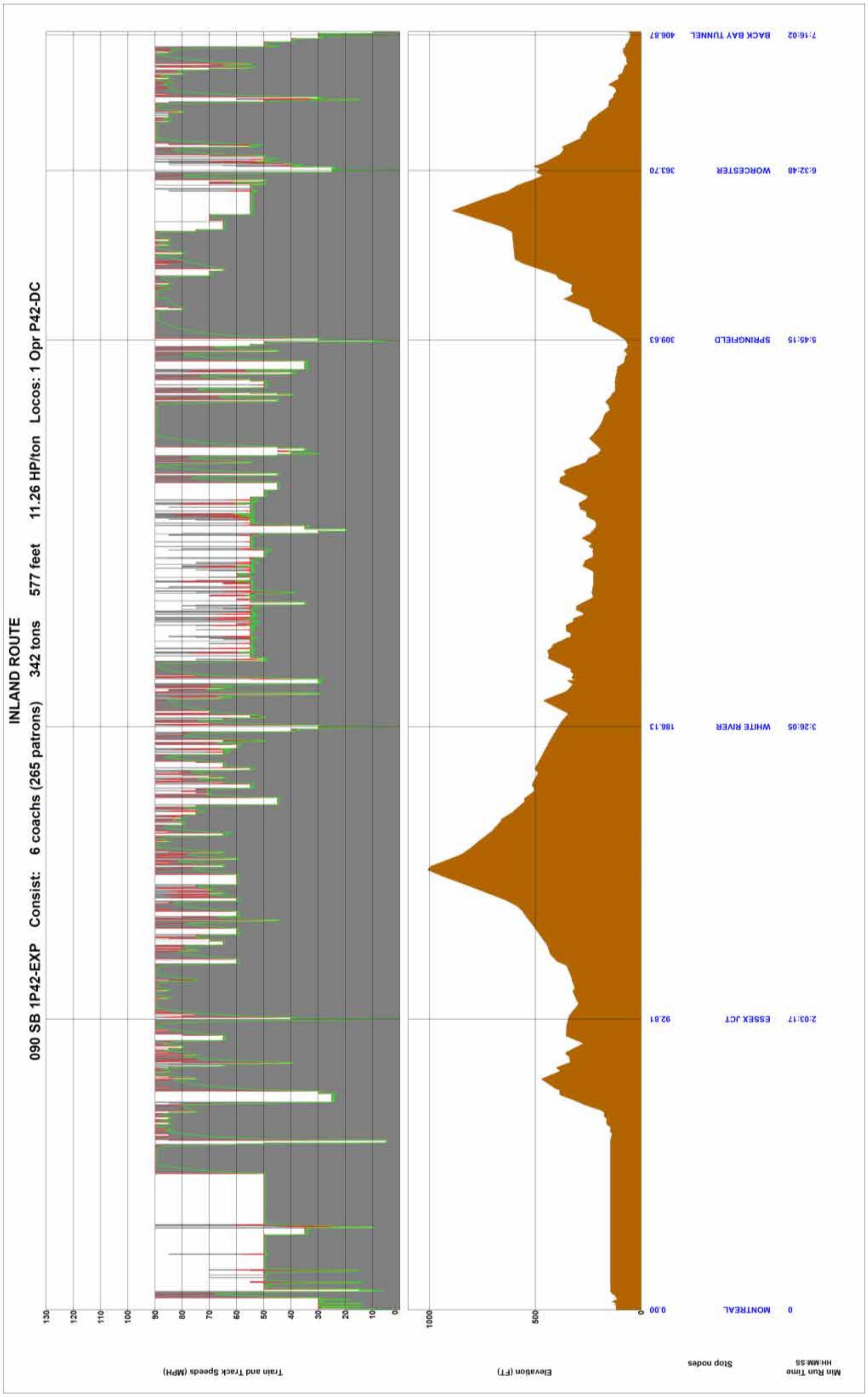


Figure 23: Northbound 90 Express Service Two Locomotives

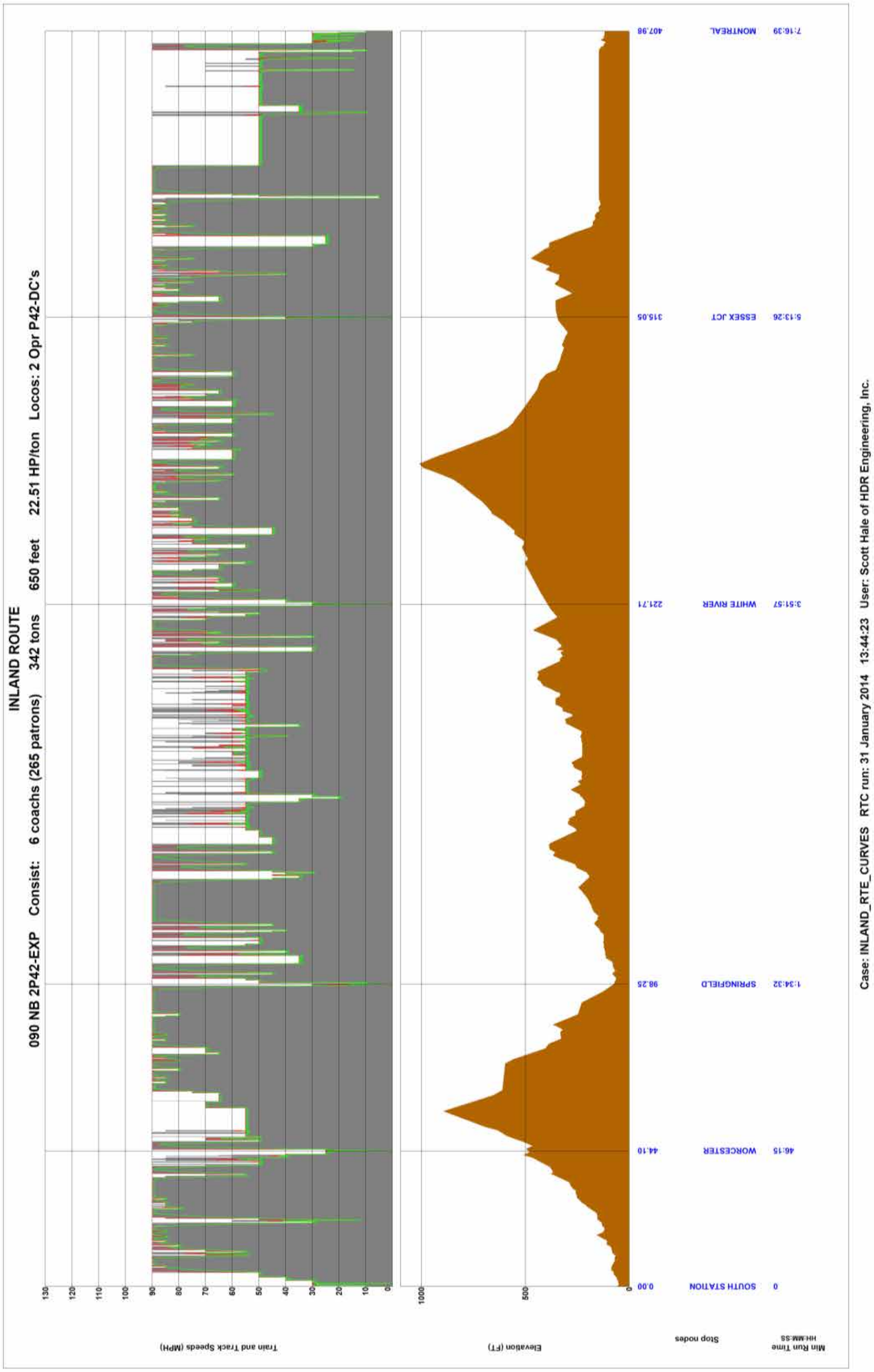


Figure 24: Southbound 90 Express Service Two Locomotives

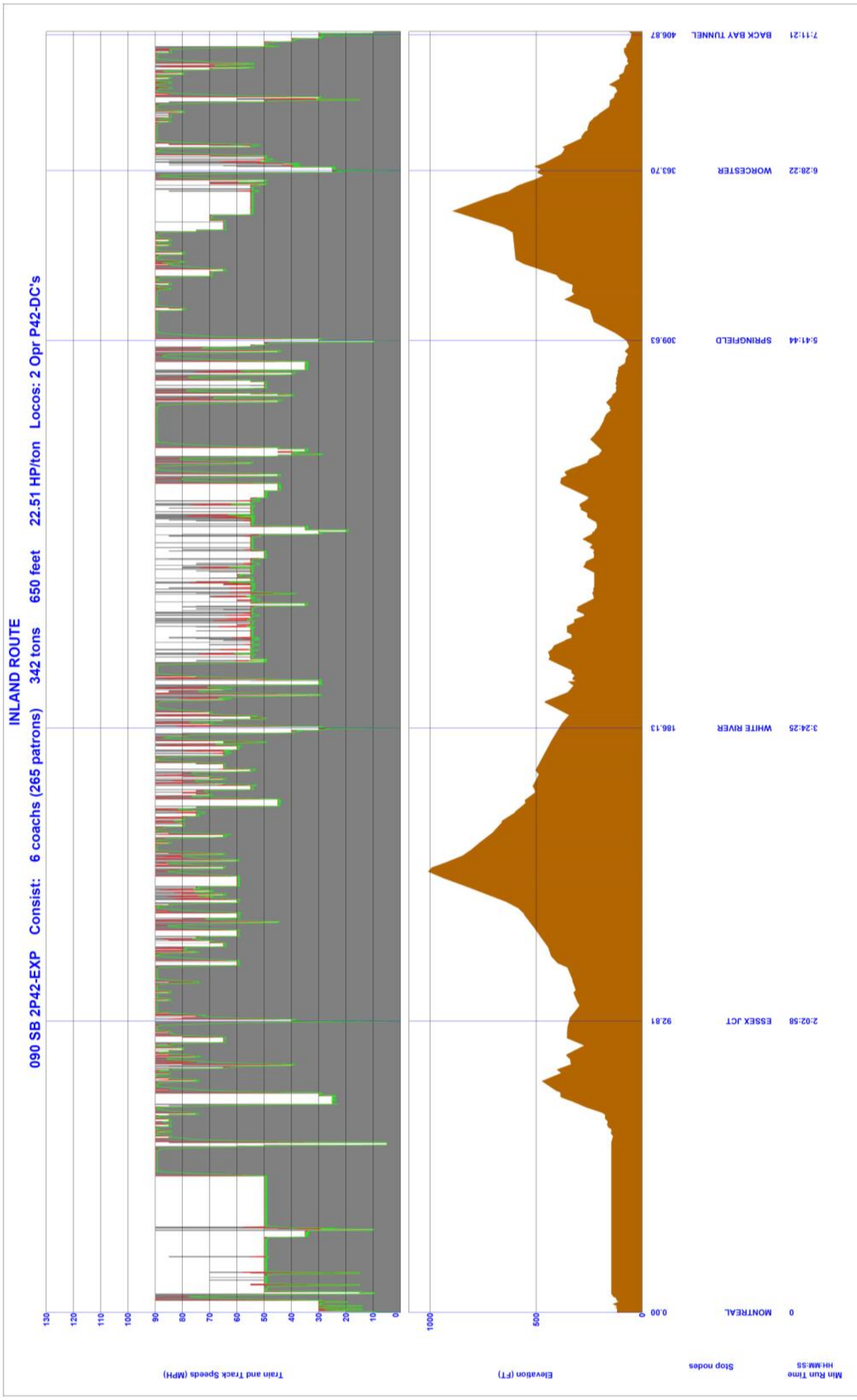


Figure 25: Northbound 90 Express Service One Locomotive

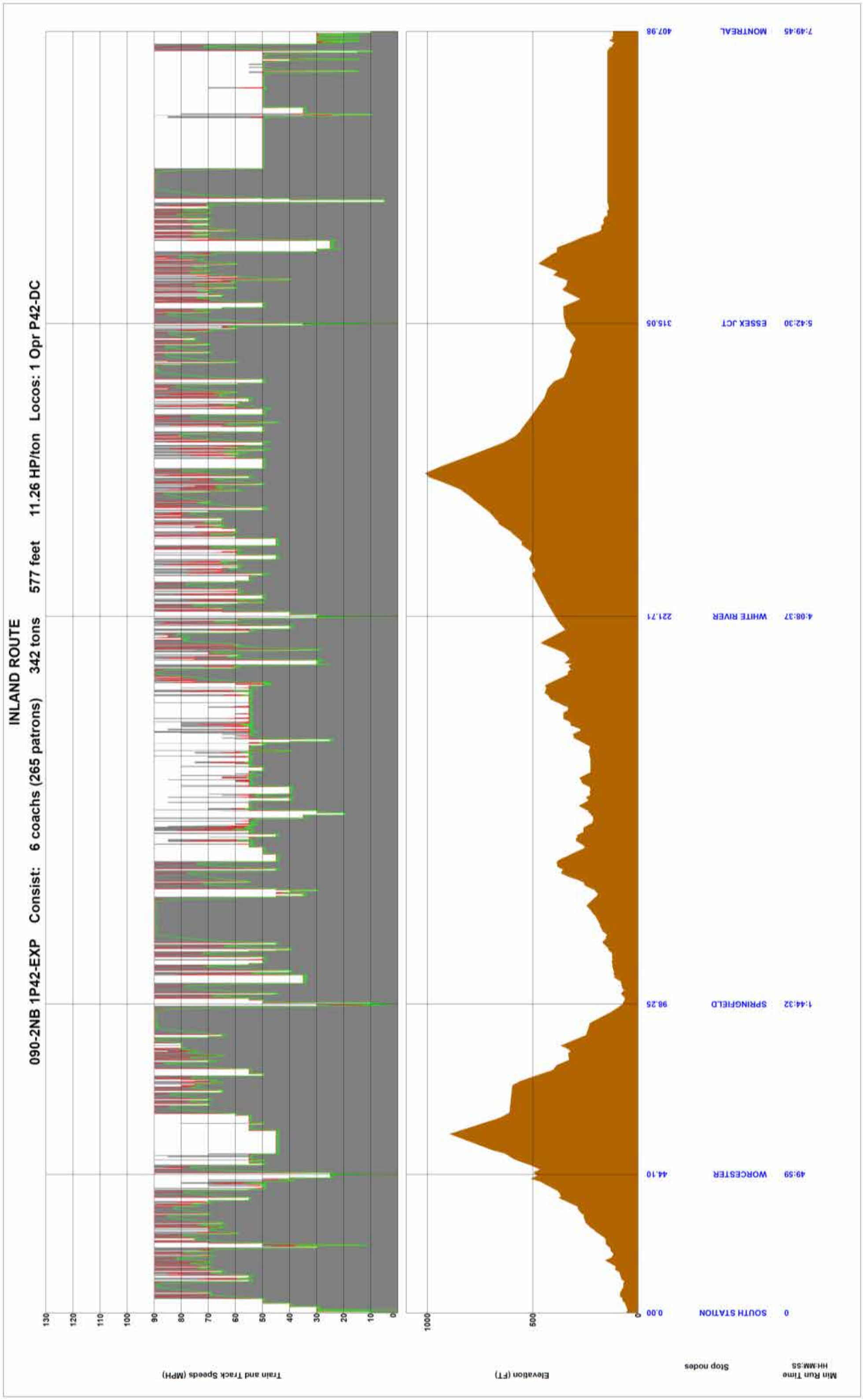


Figure 26: Southbound 90 Express Service One Locomotive

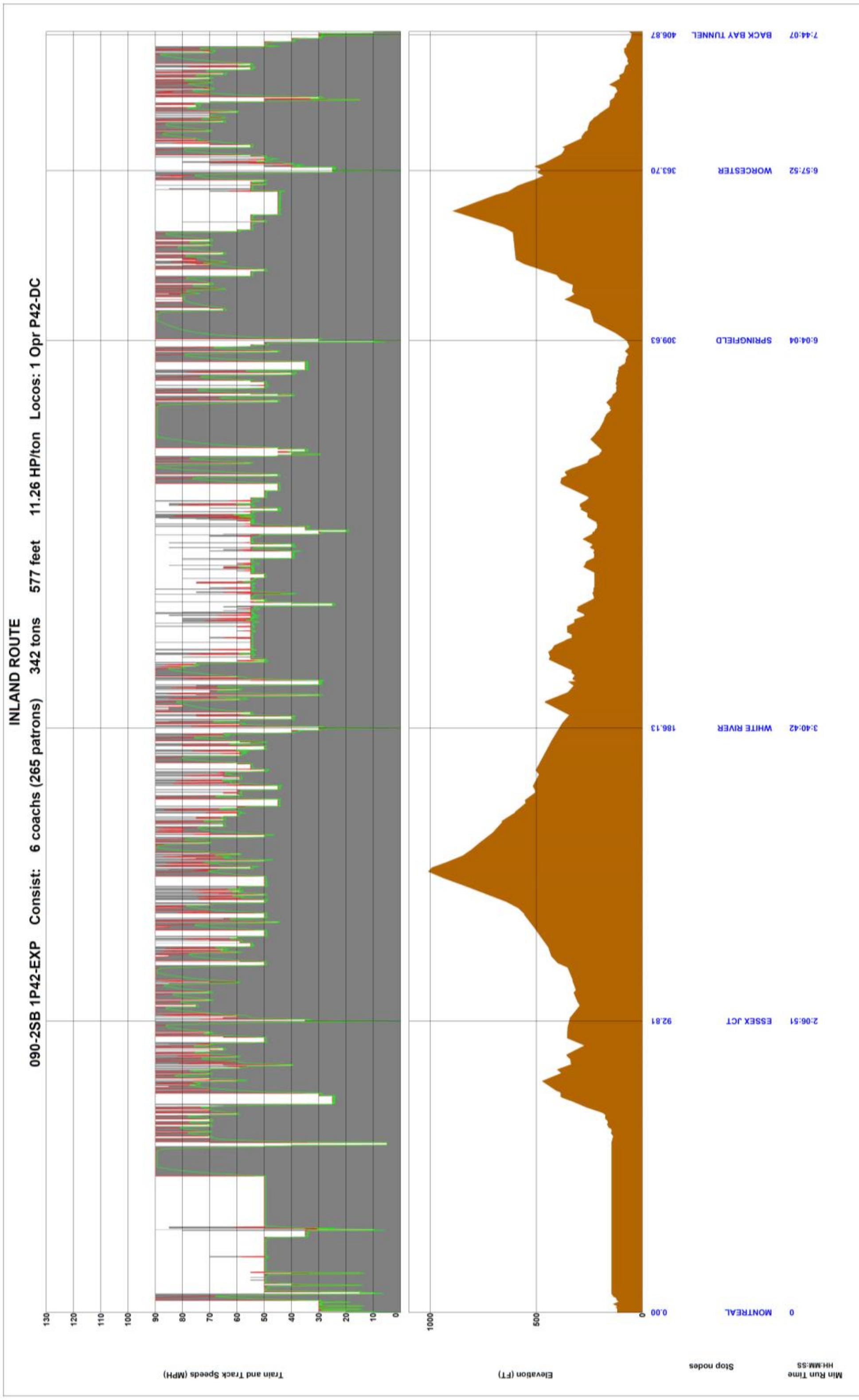


Figure 27: Northbound 90 Express Service Two Locomotives

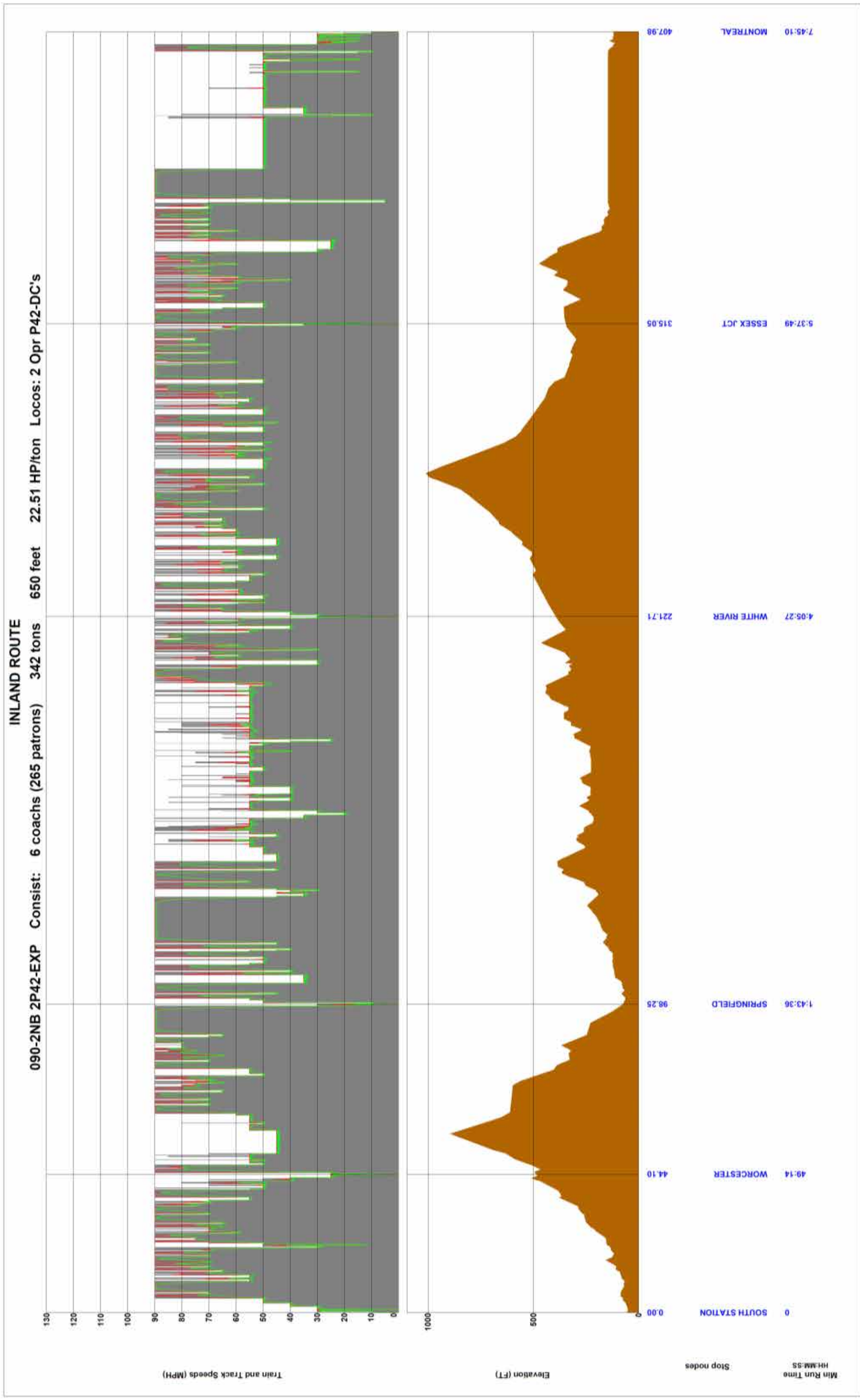


Figure 28: Southbound 90 Express Service Two Locomotives

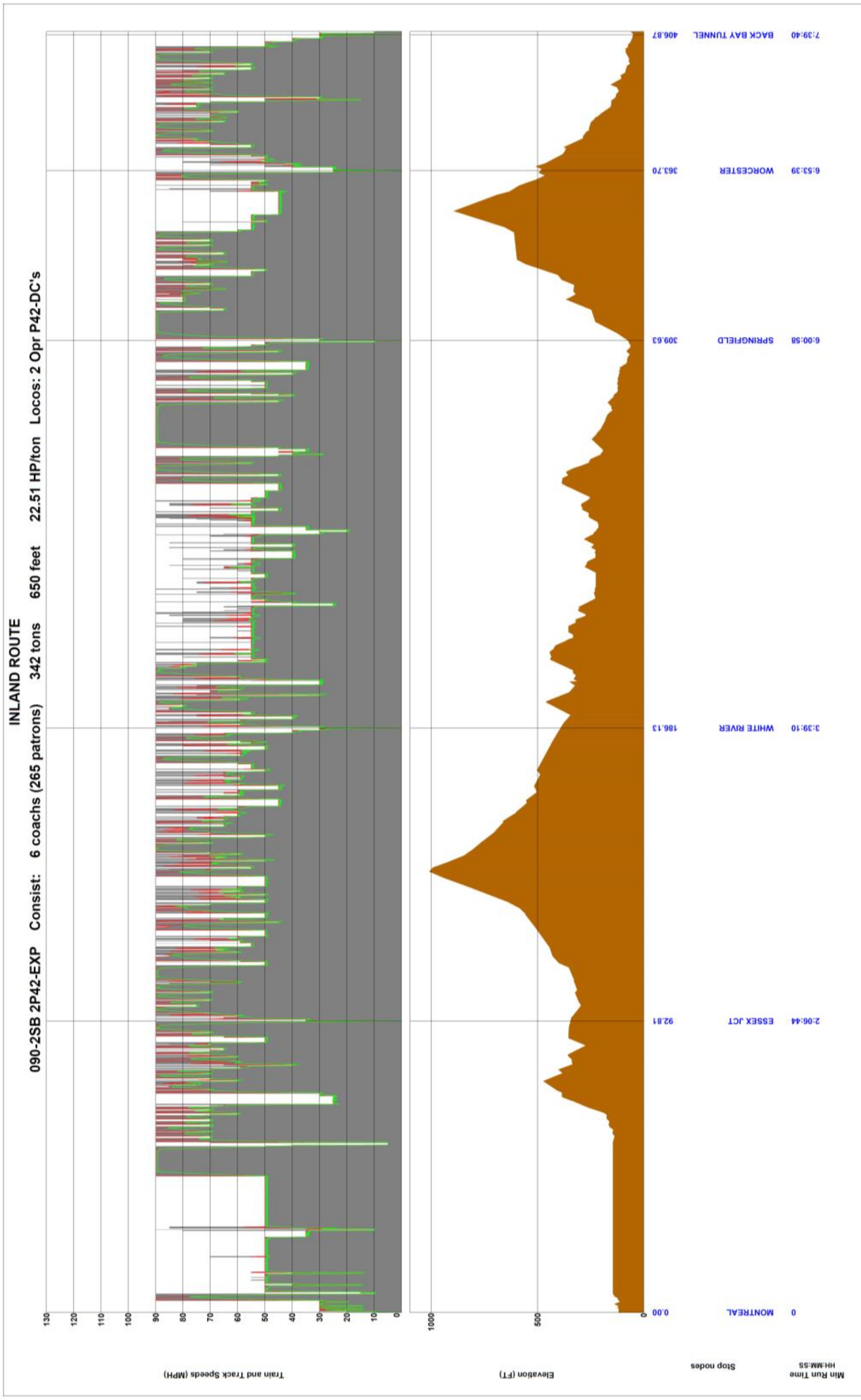


Figure 29: Northbound 110 Express Service One Locomotive

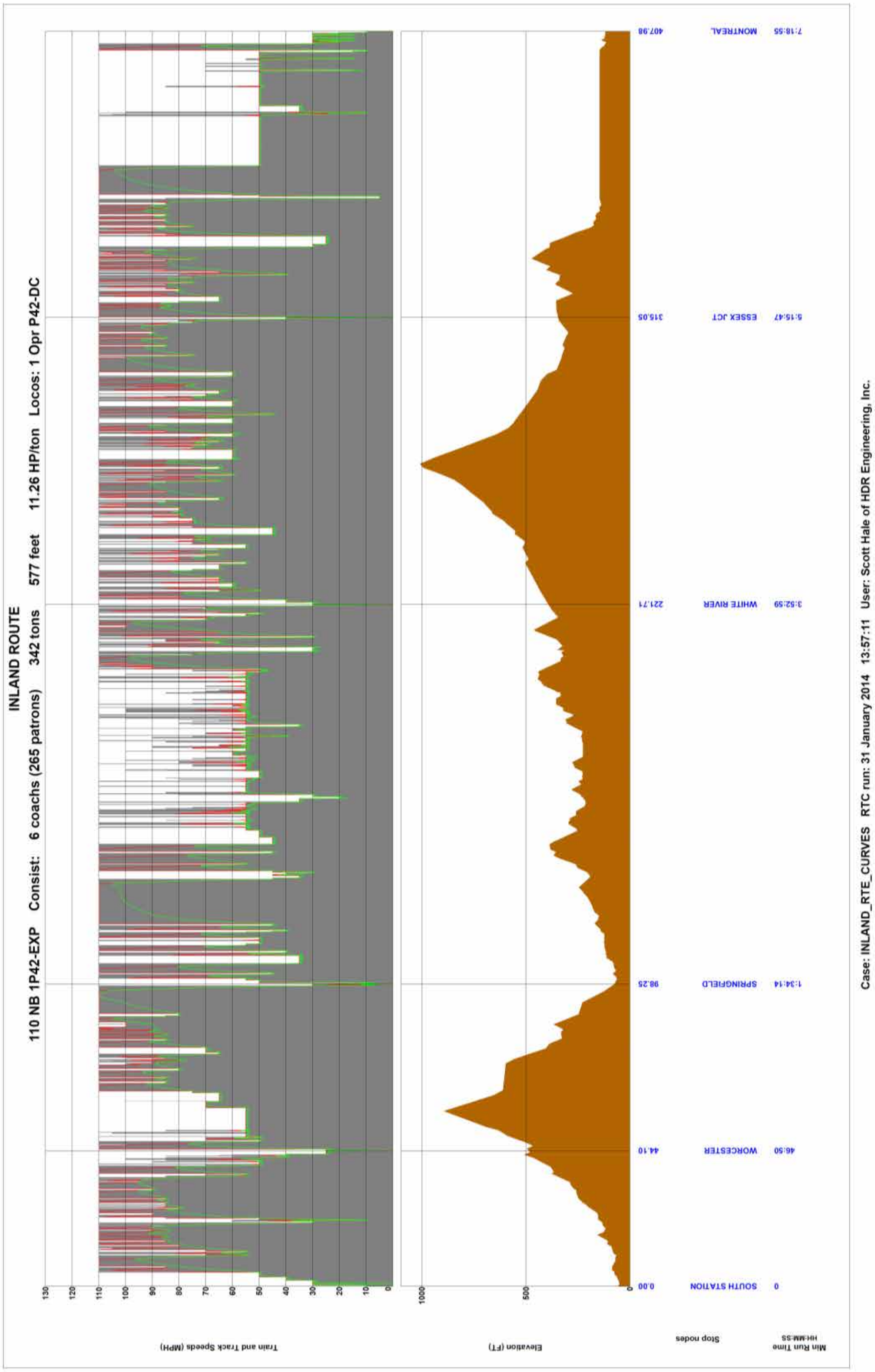


Figure 30: Southbound 110 Express Service One Locomotive

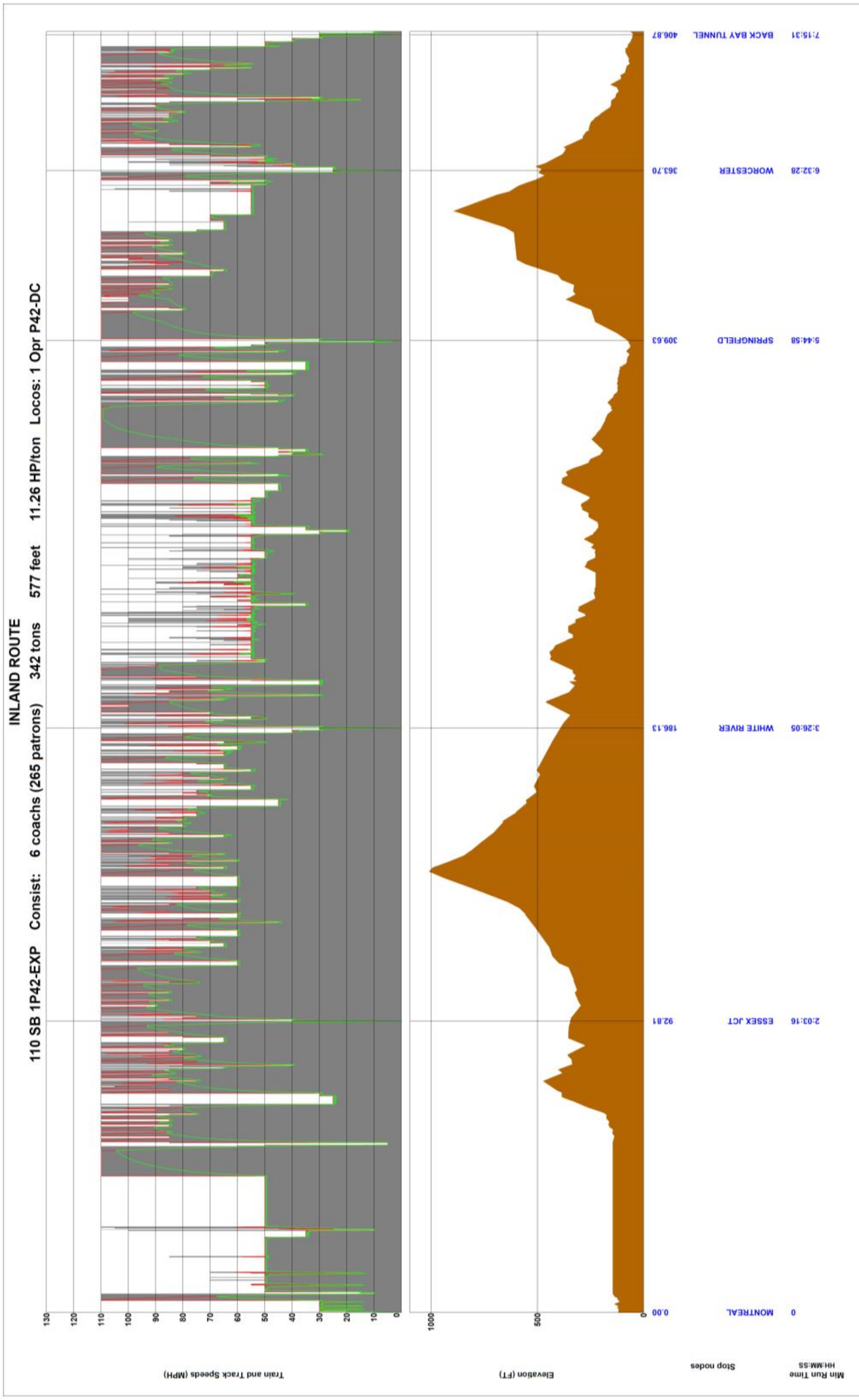


Figure 31: Northbound 110 Express Service Two Locomotives

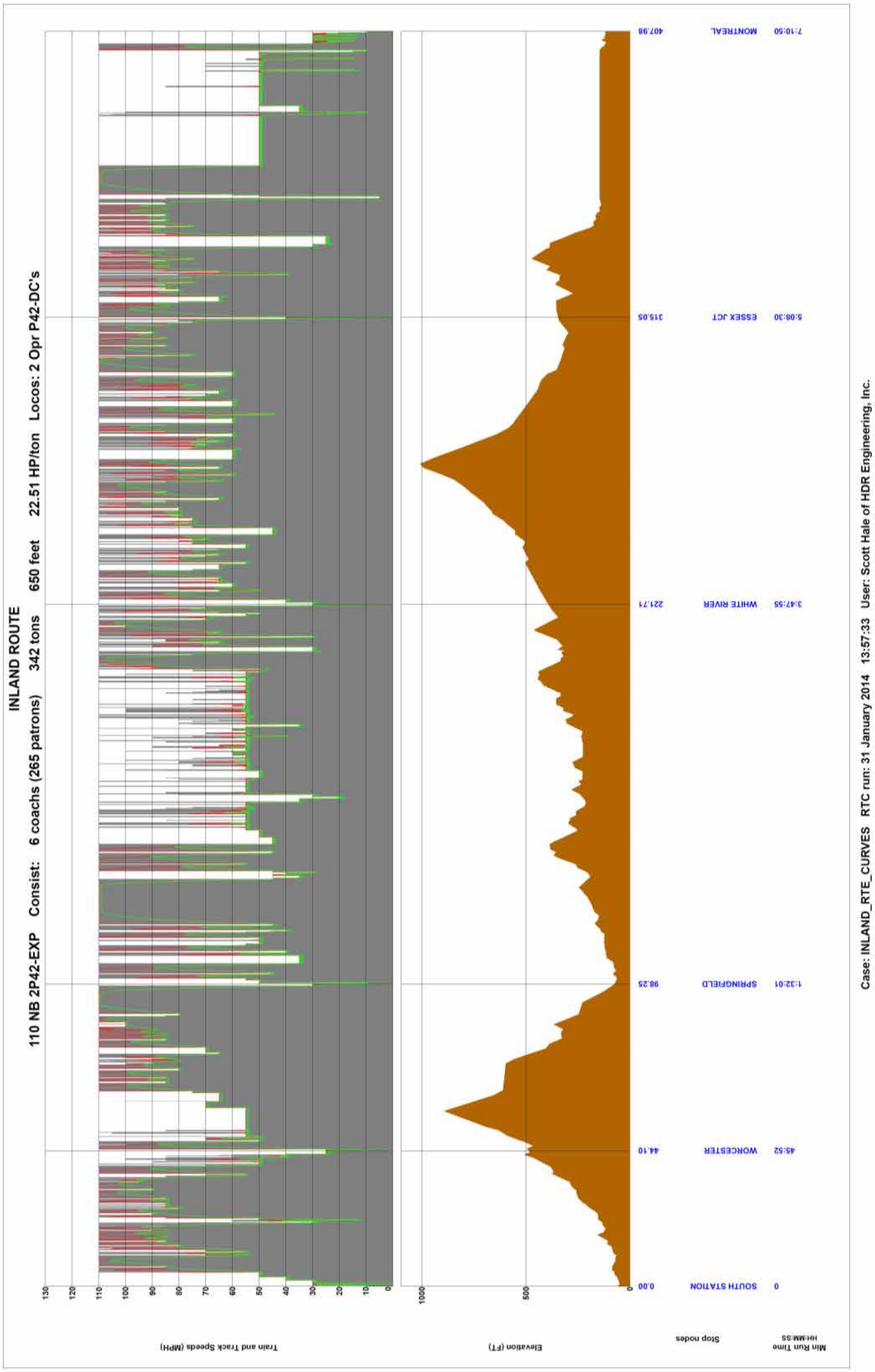
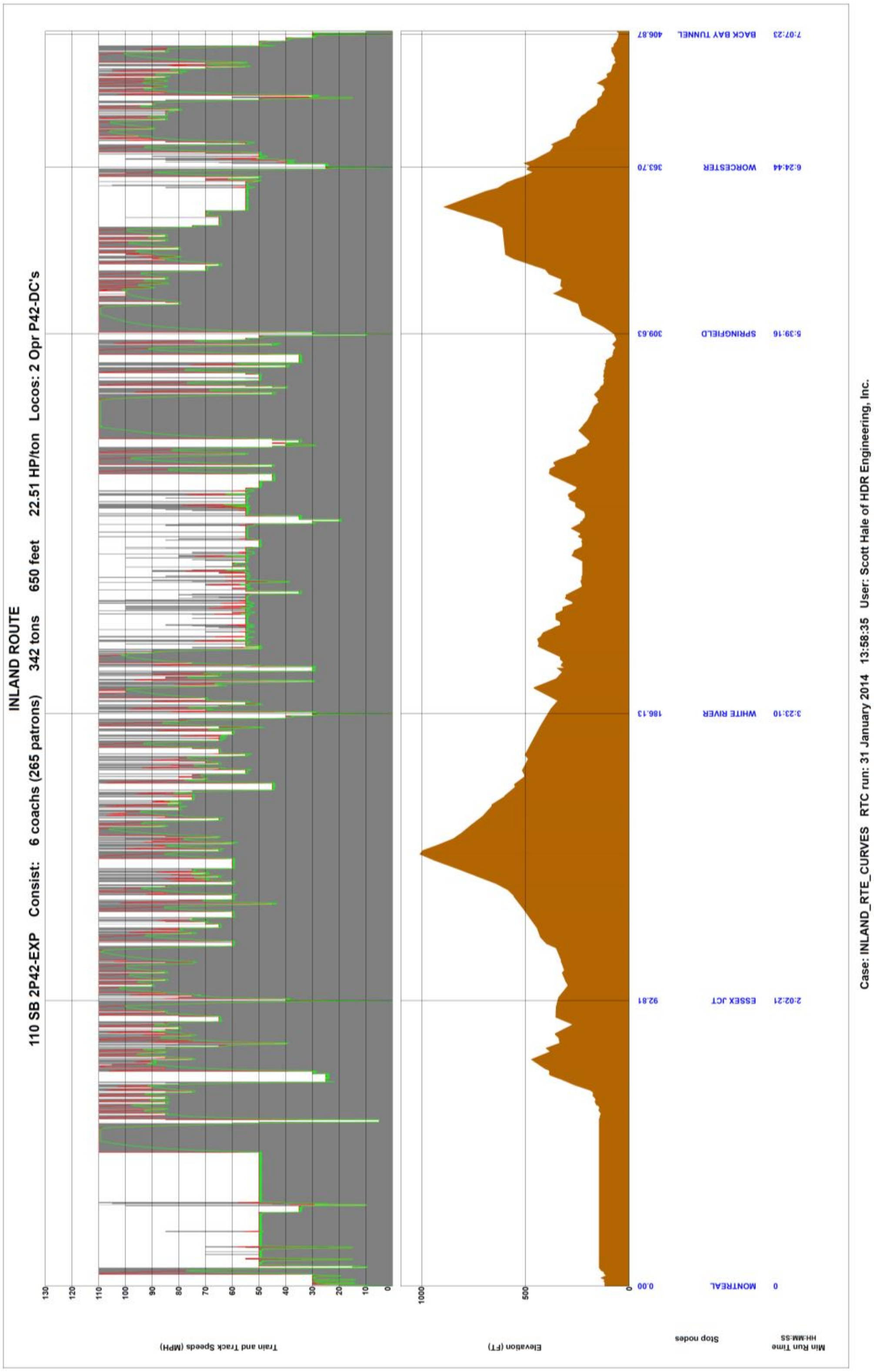


Figure 32: Southbound 110 Express Service Two Locomotives



B. RIGHT OF WAY CAPITAL COSTS

Description of Appendix

The three Alternatives were analyzed based on railroad data, capital improvements, and required maintenance upgrades to determine capital costs. From these criteria, total project costs were estimated. The estimates range from $615-785 million for Alternative One to $1.255-1.590 billion for Alternative Three, with Alternative Two falling in between at $1.065-1.350 billion. The following tables detail each Alternative cost summaries and inputs.

1 ALTERNATIVE ONE

Alternative One proposes to improve corridor service throughout the study area. Preliminary capital costs for the service include $220-270 million for track infrastructure improvement, $5-10 million for bridge infrastructure improvement, and $95-125 million for signal and communication infrastructure improvement. In addition, approximately $295-380 million has been proposed for train set and equipment preliminary capital costs for a total of 11 new train sets (at approximately $27 million per train set). The anticipated equipment capital cost is based on the recent purchase price for PRIIA Fleet design train sets, and includes an up to 30% contingency. The total preliminary capital costs for Alternative One equals $615-785 million. All costs are in 2014 dollars, and a 35% engineering/management cost is included in the fees baseline capital costs. The contingency ranges from 30-60%, and costs do not include any station improvements.

The data for track infrastructure improvement for Alternative One will be displayed in this chapter. Tables 2.1-2.4 provide information on existing railroad data, such as maximum speed, method of operation, signal upgrades, station name, segment mileage, number of tracks, and track miles in segment. The tables are divided by rail segment and operator, with Table 2.1 presenting the segments operated by Amtrak and Keolis Commuter, Table 2.2 presenting the segments operated by CSXT and Pan Am, and Table 2.3 showing the segments operated by NECR. Table 2.4 presents the railroad data summary for all segments.

Table 2.1: Alternative One Railroad Data Existing and With Assumed Infrastructure Improvements for Amtrak and Keolis Commuter Segments

Track Section			Railroad Data					
Operating Railroad	**Low Milepost**	**High Milepost**	**Maximum Speed (P/F)**	**Method of Operation**	**Station Name**	**Segment Mileage**	**Number of Tracks**	**Track Miles in Segment**
Amtrak	0.0	1.1		261	Cove	1.1	2	2.2
Keolis Commuter	1.1	3.1	30/30	261	CP-3	2.0	2	4.06
Keolis Commuter	3.1	4.8	50/40	261	CP-4	1.7	1	1.67
Keolis Commuter	4.8	11.4	60/50	261	CP-11	6.6	2	13.2
Keolis Commuter	11.4	21.3	55/40	261	CP-21	9.9	2	19.8
Keolis Commuter	21.3	21.7	30/30	261	CP-22	0.4	2	0.8
Keolis Commuter	21.7	22.9	50/50	261	CP-23	1.2	2	2.4
Keolis Commuter	22.9	24.6	60/50	261	CP-24	1.7	2	3.4
Keolis Commuter	24.6	28.2	60/50	261	CP-28	3.6	2	7.2
Keolis Commuter	28.2	29.4	60/50	261	CP-29	1.2	2	2.4
Keolis Commuter	29.4	30.5	60/50	261	CP-30	1.1	2	2.2
Keolis Commuter	30.5	33.3	60/50	261	CP-33	2.8	2	5.6
Keolis Commuter	33.3	39.0	55/50	261	CP-39	5.7	2	11.4
Keolis Commuter	39.0	42.6	50/50	261	CP-42	3.6	2	7.2
Keolis Commuter	42.6	43.3	40/40	261	CP-43	0.7	2	1.4
Keolis Commuter	43.3	43.7	25/20	261	CP-44	0.4	2	0.8
Keolis Commuter	43.7	44.2	60/40	261	CP-45	0.5	2	1
Total Keolis						**44.2**		**86.7**

Table 2.2: Alternative One Railroad Data Existing and With Assumed Infrastructure Improvements for CSXT and Pan Am Segments

Track Section			Railroad Data					
Operating Railroad	Low Milepost	High Milepost	Maximum Speed (P/F)	Method of Operation	Station Name	Segment Mileage	Number of Tracks	Track Miles in Segment
CSXT	44.2	48.3	60/40	261	CP-48	4.1	2	8.2
CSXT	48.3	57.7	50/40	261	CP-57	9.4	1	9.4
CSXT	57.7	64.0	45/40	261	CP-64	6.3	2	12.6
CSXT	64.0	79.4	45/40	261	CP-79	15.4	1	15.4
CSXT	79.4	83.6	60/50	261	CP-83	4.2	2	8.4
CSXT	83.6	92.0	60/50	261	CP-92	8.4	1	8.4
CSXT	92.0	96.1	60/50	261	CP-96	4.1	2	8.2
CSXT	96.1	98.1	60/40	261	CP-97	2.0	2	4
CSXT	98.1	98.6	30/30	261	CP-98	0.5	1	0.5
Total CSXT						**54.4**		**75.1**
Pan Am	0.0	0.4	10	261	CPR-1	0.4	1	0.38
Pan Am	0.4	2.0	40/30	261	CPR-2	1.6	2	3.24
Pan Am	2.0	7.2	35/30	261	CPR-7	5.2	1	5.2
Pan Am	7.2	7.9	35/30	261	Holyoke	0.7	2	1.44
Pan Am	7.9	13.0	35/30	261	CPR-13	5.1	1	5.08
Pan Am	13.0	14.9	50/40	261	Mt. Tom	1.9	2	3.8
Pan Am	14.9	16.0	50/40	261	CPR-16	1.1	2	2.22
Pan Am	16.0	17.9	40/30	261	CPR-18	1.9	2	3.84
Pan Am	17.9	27.3	79/40	261	N/A	9.4	1	9.37
Pan Am	27.3	28.4	79/40	261	South Deerfield	1.1	2	2.18
Pan Am	28.4	32.7	79/40	261	CPR-33	4.3	1	4.31
Pan Am	32.7	34.6	50/40	261	CPR-35	1.9	2	3.8
Pan Am	34.6	35.9	35/30	261	CPF-385	1.3	1	1.29
Pan Am	35.9	36.5	35/30	261	CPR-36	0.6	2	1.22
Pan Am	36.5	49.7	45/30	261	East Northfield	13.2	1	13.17
Total Pan Am						**49.7**		**60.54**

Table 2.3: Alternative One Railroad Data Existing and With Assumed Infrastructure Improvements for NECR Segments

Track Section			Railroad Data					
Operating Railroad	Low Milepost	High Milepost	Maximum Speed (P/F)	Method of Operation	Station Name	Segment Mileage	Number of Tracks	Track Miles in Segment
NECR	110.5	120.9	59/40	DCS	Brattleboro	10.4	1	10.4
NECR	120.9	122.2	59/40	261	Brattleboro	1.3	1	1.25
NECR	122.2	130.0	70/40	261	Putney	7.8	1	7.85
NECR	130.0	131.7	70/40	261	East Putney	1.7	1	1.73
NECR	131.7	145.1	79/40	261	Walpole	13.4	1	13.35
NECR	145.1	146.8	79/40	261	Charlestown	1.7	1	1.7
NECR	146.8	159.9	79/40	261	Claremont Jct. S.	13.1	1	13.1
NECR	159.9	162.2	79/40	261	Claremont Jct. Sta.	2.3	1	2.31
NECR	162.2	4.5	79/40	261	White River JCT	11.3	1	11.3
NECR	4.5	5.6	79/40	DCS/ABS	Hartland	1.0	2	2.06
NECR	5.6	14.4	79/40	DCS/ABS	Hartford	1.5	1	1.5
NECR	14.4	16.0	59/40	DCS	Hartford	1.6	2	3.14
NECR	16.0	31.7	59/40	DCS	South Royalton	15.7	1	15.71
NECR	31.7	32.7	59/40	DCS	South Royalton	1.0	2	1.98
NECR	32.7	38.6	59/40	DCS	Bethel	6.0	1	5.99
NECR	38.6	39.4	59/40	DCS	Bethel	0.7	2	1.42
NECR	39.4	45.4	59/40	DCS	Randolph	6.0	1	6.03
NECR	45.4	46.3	59/40	DCS	Randolph	0.9	2	1.84
NECR	46.3	60.2	59/40	DCS	Roxbury	13.9	1	13.88
NECR	60.2	61.2	59/40	DCS	Roxbury	1.0	2	2
NECR	61.2	75.5	59/40	DCS	Montpelier Jct.	14.3	1	14.33
NECR	75.5	76.5	59/40	DCS	Montpelier Jct.	0.9	2	1.9
NECR	76.5	84.8	59/40	DCS	Waterbury	8.3	1	8.34
NECR	84.9	85.8	59/40	DCS	Waterbury	1.0	1	0.99
NECR	85.8	93.0	59/40	DCS	Bolton	7.1	1	7.11
NECR	93.0	93.9	59/40	DCS	Bolton	1.0	1	0.95
NECR	93.9	98.8	59/40	DCS	Richmond	4.9	1	4.89
NECR	98.8	99.9	59/40	DCS	Richmond	1.1	1	1.09
NECR	99.9	118.6	59/40	DCS	Milton	18.7	1	18.72
NECR	118.6	119.5	59/40	DCS	Milton	0.9	1	0.9
NECR	119.5	126.9	59/40	DCS	Oakland	7.4	1	7.42
NECR	126.9	127.9	59/40	DCS	Oakland	1.0	2	1.98
NECR	127.9	132.2	59/40	DCS	St. Albans	4.3	1	4.29
NECR	132.2	1.5	59/40	YD Limits	St. Albans	1.5	2	3
NECR	1.5	9.0	30/25	DCS	Swanton	7.5	1	7.5
NECR	9.0	9.9	30/25	DCS	Swanton	0.9	1	0.9
NECR	9.9	17.4	30/25	DCS	Roogers	7.5	1	7.5
NECR	17.4	18.5	30/25	DCS	Roogers	1.1	2	2.2
NECR	18.5	18.8	30/25	DCS	INTL BDRY	0.3	1	0.3
Total NECR						**202.1**		**212.85**

Table 2.4: Alternative One Summary of Railroad Data Existing and With Assumed Infrastructure Improvements

	Railroad Data						
	Maximum Speed (P/F)	Method of Operation	Station Name	Segment Mileage (Miles)	Segment Mileage (Percent)	Number of Tracks	Track Miles in Segment
Total Inland Corridor	N/A	N/A	N/A	351.5	351.5	N/A	437.4
Percentage AMTK				1	0.31%		0.50%
Percentage Keolis				44	12.58%		19.83%
Percentage CSXT				54.5	15.48%		17.17%
Percentage Pan Am				50	14.13%		13.84%
Percentage NECR				202	57.50%		48.66%

Tables 2.5-2.7 display the data for proposed capital improvements. Data displayed for capital improvements include: number of new turnouts, new track (miles), bridge rehabs, culvert extensions, brush cutting, railroad crossing quadrant brush cutting, railroad crossing upgrades, railroad crossing eliminations, bridge replacement (feet), and bridge redecking (feet). As in Tables 2.1-2.3, the data has been separated by segment and operating railroad. Not all segments include all categories of capital improvements. The Amtrak and Keolis Commuter segments do not include any proposed capital improvements. Therefore those segments are not displayed in table form. Capital improvements that are not proposed on certain segments have also been withheld from being displayed, so not all categories are listed in all tables. Only proposed improvements are included. Table 2.7 displays a summary of all capital improvements per railroad operator.

Table 2.5: Alternative One Capital Improvements for CSXT and Pan Am Segments

Track Section			Capital Improvements				
Operating Railroad	Low Milepost	High Milepost	Number of New Turnouts	New Track (Miles)	Bridge Rehabs	RR Crossing Upgrades	Bridge Redecking (Feet)
CSXT	44.2	48.3					
CSXT	48.3	57.7					
CSXT	57.7	64.0					
CSXT	64.0	79.4	5	12.5	1170	1	400
CSXT	79.4	83.6					
CSXT	83.6	92.0					
CSXT	92.0	96.1					
CSXT	96.1	98.1					
CSXT	98.1	98.6					
Total CSXT			**5**	**12.5**	**1170**	**1**	**400**
Pan Am	0.0	0.4					
Pan Am	0.4	2.0					
Pan Am	2.0	7.2					
Pan Am	7.2	7.9					
Pan Am	7.9	13.0					
Pan Am	13.0	14.9					
Pan Am	14.9	16.0					
Pan Am	16.0	17.9					
Pan Am	17.9	27.3					
Pan Am	27.3	28.4	2	0.2			
Pan Am	28.4	32.7					
Pan Am	32.7	34.6					
Pan Am	34.6	35.9					
Pan Am	35.9	36.5					
Pan Am	36.5	49.7	1	1.7		2	
Total Pan Am			**3**	**1.9**	**0**	**2**	**0**

*Improvements not proposed for these segments include: culvert extensions, brush cutting, railroad crossing quadrant brush cutting, railroad crossing eliminations, and bridge replacement.

Table 2.6: Alternative One Capital Improvements for NECR Segments

Track Section			Capital Improvements					
Operating Railroad	Low Milepost	High Milepost	Number of New Turnouts	New Track (Miles)	Brush Cutting	RR Crossing Quadrant Brush Cutting	RR Crossing Upgrades	Bridge Replacement (Feet)
NECR	110.5	120.9	5	1.3				
NECR	120.9	122.2						
NECR	122.2	130.0						
NECR	130.0	131.7						
NECR	131.7	145.1						
NECR	145.1	ÿ46.8						
NECR	146.8	159.9						
NECR	159.9	162.2						
NECR	162.2	4.5	2					
NECR	4.5	5.6	2	0.2				
NECR	5.6	14.4						
NECR	14.4	16.0						
NECR	16.0	31.7						
NECR	31.7	32.7	2	0.2				
NECR	32.7	38.6						
NECR	38.6	39.4	2	0.2				
NECR	39.4	45.4						
NECR	45.4	46.3						
NECR	46.3	60.2						
NECR	60.2	61.2	2	0.2				
NECR	61.2	75.5						
NECR	75.5	76.5	2	0.2				
NECR	76.5	84.8						
NECR	84.9	85.8						
NECR	85.8	93.0						
NECR	93.0	93.9						
NECR	93.9	98.8						
NECR	98.8	99.9						
NECR	99.9	118.6						
NECR	118.6	119.5						
NECR	119.5	126.9						
NECR	126.9	127.9	2	0.2				
NECR	127.9	132.2						
NECR	132.2	1.5	2	0.2				
NECR	1.5	9.0						
NECR	9.0	9.9						
NECR	9.9	17.4	6	7.6	7.6	10	9	300
NECR	17.4	18.5						
NECR	18.5	18.8						
Total NECR			**27**	**10.3**	**8**	**10**	**9**	**300**

*Improvements not proposed for these segments include: bridge rehabs, culvert extensions, railroad crossing eliminations, and bridge redecking.

Table 2.7: Alternative One Summary of Capital Improvements

	Capital Improvements									
	Number of New Turnouts	New Track (Miles)	Bridge Rehabs	Culvert Extensions	Brush Cutting	RR Crossing Quadrant Brush Cutting	RR Crossing Upgrades	RR Crossing Eliminations	Bridge Replacement (Feet)	Bridge Redecking (Feet)
Total Inland Corridor	**35**	**24.6**	**1170**	**0**	**8**	**10**	**12**	**0**	**300**	**400**
Percentage AMTK	0.00%	0.00%	0.00%	N/A	0.00%	0.00%	0.00%	N/A	0.00%	0.00%
Percentage Keolis	0.00%	0.00%	0.00%	N/A	0.00%	0.00%	0.00%	N/A	0.00%	0.00%
Percentage CSXT	14.29%	50.73%	100.00%	N/A	0.00%	0.00%	8.33%	N/A	0.00%	100.00%
Percentage Pan Am	8.57%	7.59%	0.00%	N/A	0.00%	0.00%	16.67%	N/A	0.00%	0.00%
Percentage NECR	77.14%	41.68%	0.00%	N/A	100.00%	100.00%	75.00%	N/A	100.00%	0.00%

Tables 2.8-2.11 display the data for required maintenance upgrades. Categories of required maintenance upgrades include: ties per mile, total ties, feet of rail, tons per mile (TPM) ballast, total tons of ballast, number of surfacing passes, total surfacing miles, miles of ballast undercutting, number of grinding passes, and passmiles of grinding. As in the previous table sets, data has been divided by operating railroad segments. Categories of upgrades that are not featured for certain segments have also been excluded for clarity sake. Table 2.11 displays the summary for all required maintenance upgrades per railroad operator.

Table 2.8: Alternative One Required Infrastructure Upgrades for Amtrak and Keolis Commuter Segments

Track Section			Required Maintenance Upgrades								
Operating Railroad	**Low Milepost**	**High Milepost**	**Ties Per Mile**	**Total Ties**	**Feet Of Rail**	**TPM Ballast**	**Total Tons of Ballast**	**# of Surfacing Passes**	**Total Surfacing Miles**	**# of Grinding Passes**	**Passmiles of Grinding**
Amtrak	0.0	1.1	250	550		200	440	1	2.2	2	4.4
Keolis Commuter	1.1	3.1	500	2030	24360	400	1624	1	4.06	2	8.12
Keolis Commuter	3.1	4.8	500	835	24360	400	668	1	1.67	2	3.34
Keolis Commuter	4.8	11.4	500	6600	24360	400	5280	1	13.2	2	26.4
Keolis Commuter	11.4	21.3	800	15840	24360	400	7920	1	19.8	2	39.6
Keolis Commuter	21.3	21.7	800	640	24360	400	320	1	0.8	2	1.6
Keolis Commuter	21.7	22.9	1200	2880	24360	400	960	1	2.4	2	4.8
Keolis Commuter	22.9	24.6	900	3060	24360	400	1360	1	3.4	2	6.8
Keolis Commuter	24.6	28.2	900	6480	24360	400	2880	1	7.2	2	14.4
Keolis Commuter	28.2	29.4	900	2160	24360	400	960	1	2.4	2	4.8
Keolis Commuter	29.4	30.5	900	1980	24360	400	880	1	2.2	2	4.4
Keolis Commuter	30.5	33.3	900	5040	24360	400	2240	1	5.6	2	11.2
Keolis Commuter	33.3	39.0	1100	12540	24360	400	4560	1	11.4	2	22.8
Keolis Commuter	39.0	42.6	1100	7920	24360	400	2880	1	7.2	2	14.4
Keolis Commuter	42.6	43.3	600	840	24360	400	560	1	1.4	2	2.8
Keolis Commuter	43.3	43.7	600	480	24360	400	320	1	0.8	2	1.6
Keolis Commuter	43.7	44.2	600	600	24360	400	400	1	1	2	2
Total Keolis				**70475**	**389760**		**34252**		**87**		**173**

* Upgrades not proposed for these segments include: Miles of ballast undercutting

**Upgrades proposed at time of railroad purchase. Some infrastructure improvements may have been completed to date.

Table 2.9: Alternative One Required Infrastructure Upgrades for CSXT and Pan Am Segments

Track Section			Required Maintenance Upgrades							
Operating Railroad	Low Milepost	High Milepost	Ties Per Mile	Total Ties	TPM Ballast	Total Tons of Ballast	# of Surfacing Passes	Total Surfacing Miles	# of Grinding Passes	Passmiles of Grinding
CSXT	44.2	48.3	800	6560	1000	8200	1	8.2	3	24.6
CSXT	48.3	57.7	800	7520	1000	9400	1	9.4	3	28.2
CSXT	57.7	64.0	800	10080	1000	12600	1	12.6	3	37.8
CSXT	64.0	79.4	800	12320	1000	15400	1	15.4	4	61.6
CSXT	79.4	83.6	800	6720	1000	8400	1	8.4	3	25.2
CSXT	83.6	92.0	800	6720	1000	8400	1	8.4	3	25.2
CSXT	92.0	96.1	800	6560	1000	8200	1	8.2	3	24.6
CSXT	96.1	98.1	800	3200	1000	4000	1	4	3	12
CSXT	98.1	98.6	800	400	1000	500	1	0.5	3	1.5
Total CSXT				**60080**		**75100**		**75**		**241**
Pan Am	0.0	0.4	800	304	800	304	2	0.76	2	0.76
Pan Am	0.4	2.0	800	2592	800	2592	2	6.48	2	6.48
Pan Am	2.0	7.2	800	4160	800	4160	2	10.4	2	10.4
Pan Am	7.2	7.9	800	1152	800	1152	2	2.88	2	2.88
Pan Am	7.9	13.0	800	4064	800	4064	2	10.16	2	10.16
Pan Am	13.0	14.9	800	3040	800	3040	2	7.6	2	7.6
Pan Am	14.9	16.0	800	1776	800	1776	2	4.44	2	4.44
Pan Am	16.0	17.9	800	3072	800	3072	2	7.68	2	7.68
Pan Am	17.9	27.3	800	7496	800	7496	2	18.74	2	18.74
Pan Am	27.3	28.4	800	1744	800	1744	3	6.54	2	4.36
Pan Am	28.4	32.7	800	3448	800	3448	2	8.62	2	8.62
Pan Am	32.7	34.6	800	3040	800	3040	2	7.6	2	7.6
Pan Am	34.6	35.9	800	1032	800	1032	2	2.58	2	2.58
Pan Am	35.9	36.5	800	976	800	976	2	2.44	2	2.44
Pan Am	36.5	49.7	800	10536	800	10536	2	26.34	2	26.34
Total Pan Am				**48432**		**48432**		**123**		**121**

* Upgrades not proposed for these segments include: Miles of ballast undercutting and feet of rail

Table 2.10: Alternative One Required Infrastructure Upgrades for NECR Segments

Track Section			Required Maintenance Upgrades									
Operating Railroad	Low Mile-Post	High Mile-Post	Ties Per Mile	Total Ties	TPM Ballast	Total Tons of Ballast	# of Surfacing Passes	Total Surfacing Miles	Miles of Ballast Under-Cutting	# of Grinding Passes	Pass-Miles of Grinding
NECR	110.5	120.9	800	8320	800	8320	1	10.4			0
NECR	120.9	122.2	800	1000	800	1000	1	1.25		1	1.25
NECR	122.2	130.0	800	6280	800	6280	1	7.85		1	7.85
NECR	130.0	131.7	800	1384	800	1384	1	1.73		1	1.73
NECR	131.7	145.1	800	10680	800	10680	2	26.7	0.15	1	13.35
NECR	145.1	146.8	800	1360	800	1360	1	1.7		1	1.7
NECR	146.8	159.9	800	10480	800	10480	1	13.1		1	13.1
NECR	159.9	162.2	800	1848	800	1848	1	2.31		1	2.31
NECR	162.2	4.5	800	9040	800	9040	1	11.3		1	11.3
NECR	4.5	5.6	800	1648	800	1648	2	4.12		1	2.06
NECR	5.6	14.4	800	1200	800	1200	1	1.5		1	1.5
NECR	14.4	16.0	800	2512	800	2512	1	3.14		1	3.14
NECR	16.0	31.7	800	12568	800	12568	1	15.71		1	15.71
NECR	31.7	32.7	800	1584	800	1584	2	3.96		1	1.98
NECR	32.7	38.6	800	4792	800	4792	1	5.99		1	5.99
NECR	38.6	39.4	800	1136	800	1136	2	2.84		1	1.42
NECR	39.4	45.4	800	4824	800	4824	1	6.03		1	6.03
NECR	45.4	46.3	800	1472	800	1472	1	1.84		1	1.84
NECR	46.3	60.2	800	11104	800	11104	1	13.88		1	13.88
NECR	60.2	61.2	800	1600	800	1600	2	4		1	2
NECR	61.2	75.5	800	11464	800	11464	1	14.33		1	14.33
NECR	75.5	76.5	800	1520	800	1520	2	3.8		1	1.9
NECR	76.5	84.8	800	6672	800	6672	1	8.34		1	8.34
NECR	84.9	85.8	800	792	800	792	1	0.99		1	0.99
NECR	85.8	93.0	800	5688	800	5688	1	7.11		1	7.11
NECR	93.0	93.9	800	760	800	760	1	0.95		1	0.95
NECR	93.9	98.8	800	3912	800	3912	1	4.89		1	4.89
NECR	98.8	99.9	800	872	800	872	1	1.09		1	1.09
NECR	99.9	118.6	800	14976	800	14976	1	18.72		1	18.72
NECR	118.6	119.5	800	720	800	720	1	0.9		1	0.9
NECR	119.5	126.9	800	5936	800	5936	1	7.42		1	7.42
NECR	126.9	127.9	800	1584	800	1584	2	3.96		1	1.98
NECR	127.9	132.2	800	3432	800	3432	1	4.29		0	0
NECR	132.2	1.5	1353	4059	800	2400	1	3		0	0
NECR	1.5	9.0	1353	10148	800	6000	1	7.5		0	0
NECR	9.0	9.9	1353	1218	800	720	2	1.8		0	0
NECR	9.9	17.4	1353	10148	800	6000	1	7.5		0	0
NECR	17.4	18.5	1353	2977	800	1760	1	2.2		0	0
NECR	18.5	18.8	1353	406	800	240	1	0.3		0	0
Total NECR				**182114**		**170280**		**238**	**0.15**		**177**

* Upgrades not proposed for these segments include: Feet of rail

Table 2.11: Alternative One Summary of Required Infrastructure Upgrades

	Required Maintenance Upgrades									
	Ties Per Mile	Total Ties	Feet Of Rail	TPM Ballast	Total Tons of Ballast	# of Surfacing Passes	Total Surfacing Miles	Miles of Ballast Under-Cutting	# of Grinding Passes	Passmiles of Grinding
Total Inland Corridor	**N/A**	**361651**	**389760**	**N/A**	**328504**	**N/A**	**526**	**0.15**	**N/A**	**716**
Percentage AMTK		0.15%	0.00%		0.13%		0.42%	0.00%		0.61%
Percentage Keolis		19.49%	100.00%		10.43%		16.50%	0.00%		24.21%
Percentage CSXT		16.61%	0.00%		22.86%		14.28%	0.00%		33.60%
Percentage Pan Am		13.39%	0.00%		14.74%		23.45%	0.00%		16.90%
Percentage NECR		50.36%	0.00%		51.83%		45.35%	100.00%		24.67%

Table 2.12 includes general comments for specific segments on the corridor. Only segments with comments have been displayed.

Table 2.12: Alternative One General Comments

Track Section			Comments
Operating Railroad	Low Milepost	High Milepost	
Total Keolis			Cost to project but may be completed per the MBTA/Keolis Operating Agreement
CSXT	98.1	98.6	1 track shown for Inland Service due to interlocking configuration at Springfield Union Station
Pan Am	27.3	28.4	Need to upgrade #10 HT turnouts to #20 automatic turnouts.
Pan Am	35.9	36.5	LTK Proposed train meet location. No upgrades due to K.C. project.
NECR	120.9	122.2	To UG Bridge, consider lengthening for Alt 2.
NECR	131.7	145.1	Bellows Falls Tunnel.
NECR	162.2	4.5	MP Change 169 Palmer = 0 Roxbury, estimate includes crossing replacement, no signal work.
NECR	38.6	39.4	Geometric constraints, 4deg curve bounded by two open deck bridges.
NECR	119.5	126.9	Construct new bridge.
NECR	9.9	17.4	Swing bridge and trestle repairs required.

Table 2.13 displays the total project costs for Alternative One track infrastructure improvement. Each project task and quantity is taken from Tables 2.7 and 2.11, which display the total amount of infrastructure required from the entire corridor. Each project task is also shown with its unit cost to achieve a total cost for each task. A 30% contingency has been added to these tasks as well. The total Alternative One track infrastructure improvement cost is proposed to be $173,626,296. The final report lists the track infrastructure costs as $220-270 million, which includes an additional 30-60% contingency for inflation.

Table 2.13: Alternative One Track Infrastructure Improvement Costs

Project Cost Totals				
Project Task	**Quantity**	**Units**	**Unit Cost**	**Total Cost**
Install New Turnouts	35	Each	$125,000.00	$4,375,000
Install New Track	25	Mile	$1,500,000.00	$36,960,000
Bridge Rehabilitation	1,170	Track Foot	$4,000.00	$4,680,000
Culvert Extensions	0	Each	$50,000.00	$0
Brush Cutting	8	Mile	$21,120.00	$160,512
RR Crossing Quadrants	10	Each	$25,000.00	$250,000
RR Crossing Surface	12	Each	$125,000.00	$1,500,000
Bridge Replacement	300	Track Foot	$12,000.00	$3,600,000
Bridge Redecking	400	Track Foot	$1,000.00	$400,000
Furnish Ties	361,651	Each	$65.00	$23,507,328
Install Ties	361,651	Each	$35.00	$12,657,792
Furnish Rail and OTM	389,760	Linear Foot	$38.00	$14,810,880
Install Rail	389,760	Linear Foot	$26.00	$10,133,760
Furnish Ballast	328,504	Ton	$25.00	$8,212,600
Install Ballast	328,504	Ton	$15.00	$4,927,560
Surfacing	526	Track Mile	$10,600.00	$5,572,738
Ballast Undercutting	0	Track Mile	$125,000.00	$18,750
Grinding Passes	716	Pass Mile	$2,500.00	$1,791,000
Install New Diamond	0	Each	$500,000.00	$0
Contingency	N/A	N/A	30%	$40,067,376
			Total Alternative 1 Cost	**$173,625,296**

2 ALTERNATIVE TWO

Alternative Two proposes to improve corridor service throughout the study area. Preliminary capital costs for the service include $410-505 million for track infrastructure improvement, $25-30 million for bridge infrastructure improvement, and $175-225 million for signal and communication infrastructure improvement. In addition, approximately $455-590 million has been proposed for train set and equipment preliminary capital costs for a total of 17 new train sets (at approximately $27 million per train set). The anticipated equipment capital cost is based on the recent purchase price for PRIIA Fleet design train sets, and includes an up to 30% contingency. The total preliminary capital costs for Alternative Two equals $1.065-1.350 billion. All costs are in 2014 dollars, and a 35% engineering/management cost is included in the fees baseline capital costs. The contingency ranges from 30-60%, and costs do not include any station improvements.

The data for track infrastructure improvement for Alternative Two will be displayed in this chapter. Information on existing track data is similar to Alternative One, but is displayed below in Tables 3.1-3.4 for clarity sake. Tables 3.1-3.4 provide information on existing railroad data such as maximum speed, method of operation, signal upgrades, station name, segment mileage, number of tracks, and track miles in segment. The tables are divided by segment, with the segments under control of Amtrak and Keolis Commuter displayed in Table 3.1, the segments under control of CSXT and Pan Am presented in Table 3.2, and the segments under control of NECR displayed in Table 3.3. Table 3.4 displays a summary of all railroad data.

Table 3.1: Alternative Two Railroad Data Existing and With Assumed Infrastructure Improvements for Amtrak and Keolis Segments

Track Section			Railroad Data					
Operating Railroad	**Low Milepost**	**High Milepost**	**Maximum Speed (P/F)**	**Method of Operation**	**Station Name**	**Segment Mileage**	**Number of Tracks**	**Track Miles in Segment**
Amtrak	0.0	1.1		261	Cove	1.1	2	2.2
Keolis Commuter	1.1	3.1	30/30	261	CP-3	2.0	2	4.06
Keolis Commuter	3.1	4.8	50/40	261	CP-4	1.7	1	1.67
Keolis Commuter	4.8	11.4	60/50	261	CP-11	6.6	2	13.2
Keolis Commuter	11.4	21.3	55/40	261	CP-21	9.9	2	19.8
Keolis Commuter	21.3	21.7	30/30	261	CP-22	0.4	2	0.8
Keolis Commuter	21.7	22.9	50/50	261	CP-23	1.2	2	2.4
Keolis Commuter	22.9	24.6	60/50	261	CP-24	1.7	2	3.4
Keolis Commuter	24.6	28.2	60/50	261	CP-28	3.6	2	7.2
Keolis Commuter	28.2	29.4	60/50	261	CP-29	1.2	2	2.4
Keolis Commuter	29.4	30.5	60/50	261	CP-30	1.1	2	2.2
Keolis Commuter	30.5	33.3	60/50	261	CP-33	2.8	2	5.6
Keolis Commuter	33.3	39.0	55/50	261	CP-39	5.7	2	11.4
Keolis Commuter	39.0	42.6	50/50	261	CP-42	3.6	2	7.2
Keolis Commuter	42.6	43.3	40/40	261	CP-43	0.7	2	1.4
Keolis Commuter	43.3	43.7	25/20	261	CP-44	0.4	2	0.8
Keolis Commuter	43.7	44.2	60/40	261	CP-45	0.5	2	1
Total Keolis						**44.2**		**86.7**

Table 3.2: Alternative Two Railroad Data Existing and With Assumed Infrastructure Improvements for CSXT and Pan Am Segments

Track Section			Railroad Data					
Operating Railroad	Low Milepost	High Milepost	Maximum Speed (P/F)	Method of Operation	Station Name	Segment Mileage	Number of Tracks	Track Miles in Segment
CSXT	44.2	48.3	60/40	261	CP-48	4.1	2	8.2
CSXT	48.3	57.7	50/40	261	CP-57	9.4	1	9.4
CSXT	57.7	64.0	45/40	261	CP-64	6.3	2	12.6
CSXT	64.0	79.4	45/40	261	CP-79	15.4	1	15.4
CSXT	79.4	83.6	60/50	261	CP-83	4.2	2	8.4
CSXT	83.6	92.0	60/50	261	CP-92	8.4	1	8.4
CSXT	92.0	96.1	60/50	261	CP-96	4.1	2	8.2
CSXT	96.1	98.1	60/40	261	CP-97	2.0	2	4
CSXT	98.1	98.6	30/30	261	CP-98	0.5	1	0.5
Total CSXT						**54.4**		**75.1**
Pan Am	0.0	0.4	10	261	CPR-1	0.4	1	0.38
Pan Am	0.4	2.0	40/30	261	CPR-2	1.6	2	3.24
Pan Am	2.0	7.2	35/30	261	CPR-7	5.2	1	5.2
Pan Am	7.2	7.9	35/30	261	Holyoke	0.7	2	1.44
Pan Am	7.9	13.0	35/30	261	CPR-13	5.1	1	5.08
Pan Am	13.0	14.9	50/40	261	Mt. Tom	1.9	2	3.8
Pan Am	14.9	16.0	50/40	261	CPR-16	1.1	2	2.22
Pan Am	16.0	17.9	40/30	261	CPR-18	1.9	2	3.84
Pan Am	17.9	27.3	79/40	261	N/A	9.4	1	9.37
Pan Am	27.3	28.4	79/40	261	South Deerfield	1.1	2	2.18
Pan Am	28.4	32.7	79/40	261	CPR-33	4.3	1	4.31
Pan Am	32.7	34.6	50/40	261	CPR-35	1.9	2	3.8
Pan Am	34.6	35.9	35/30	261	CPF-385	1.3	1	1.29
Pan Am	35.9	36.5	35/30	261	CPR-36	0.6	2	1.22
Pan Am	36.5	49.7	45/30	261	East Northfield	13.2	1	13.17
Total Pan Am						**49.7**		**60.54**

Table 3.3: Alternative Two Railroad Data Existing and With Assumed Infrastructure Improvements for NECR Segments

Track Section			Railroad Data					
Operating Railroad	Low Milepost	High Milepost	Maximum Speed (P/F)	Method of Operation	Station Name	Segment Mileage	Number of Tracks	Track Miles in Segment
NECR	110.5	120.9	59/40	DCS	Brattleboro	10.4	1	10.4
NECR	120.9	122.2	59/40	261	Brattleboro	1.3	2	2.5
NECR	122.2	130.0	70/40	261	Putney	7.8	1	7.85
NECR	130.0	131.7	70/40	261	East Putney	1.7	1	1.73
NECR	131.7	145.1	79/40	261	Walpole	13.4	1	13.35
NECR	145.1	146.8	79/40	261	Charlestown	1.7	1	1.7
NECR	146.8	159.9	79/40	261	Claremont Jct. S.	13.1	1	13.1
NECR	159.9	162.2	79/40	261	Claremont Jct. Sta.	2.3	1	2.31
NECR	162.2	4.5	79/40	261	White River JCT	11.3	1	11.3
NECR	4.5	5.6	79/40	DCS/ABS	Hartland	1.0	2	2.06
NECR	5.6	14.4	79/40	DCS/ABS	Hartford	1.5	1	1.5
NECR	14.4	16.0	59/40	DCS	Hartford	1.6	1	1.57
NECR	16.0	31.7	59/40	DCS	South Royalton	15.7	1	15.71
NECR	31.7	32.7	59/40	DCS	South Royalton	1.0	2	1.98
NECR	32.7	38.6	59/40	DCS	Bethel	6.0	1	5.99
NECR	38.6	39.4	59/40	DCS	Bethel	0.7	2	1.42
NECR	39.4	45.4	59/40	DCS	Randolph	6.0	1	6.03
NECR	45.4	46.3	59/40	DCS	Randolph	0.9	2	1.84
NECR	46.3	60.2	59/40	DCS	Roxbury	13.9	1	13.88
NECR	60.2	61.2	59/40	DCS	Roxbury	1.0	2	2
NECR	61.2	75.5	59/40	DCS	Montpelier Jct.	14.3	1	14.33
NECR	75.5	76.5	59/40	DCS	Montpelier Jct.	0.9	2	1.9
NECR	76.5	84.8	59/40	DCS	Waterbury	8.3	1	8.34
NECR	84.9	85.8	59/40	DCS	Waterbury	1.0	1	0.99
NECR	85.8	93.0	59/40	DCS	Bolton	7.1	1	7.11
NECR	93.0	93.9	59/40	DCS	Bolton	1.0	2	1.9
NECR	93.9	98.8	59/40	DCS	Richmond	4.9	1	4.89
NECR	98.8	99.9	59/40	DCS	Richmond	1.1	1	1.09
NECR	99.9	118.6	59/40	DCS	Milton	18.7	1	18.72
NECR	118.6	119.5	59/40	DCS	Milton	0.9	1	0.9
NECR	119.5	126.9	59/40	DCS	Oakland	7.4	1	7.42
NECR	126.9	127.9	59/40	DCS	Oakland	1.0	2	1.98
NECR	127.9	132.2	59/40	DCS	St. Albans	4.3	1	4.29
NECR	132.2	1.5	59/40	YD Limits	St. Albans	1.5	2	3
NECR	1.5	9.0	30/25	DCS	Swanton	7.5	1	7.5
NECR	9.0	9.9	30/25	DCS	Swanton	0.9	1	0.9
NECR	9.9	17.4	30/25	DCS	Roogers	7.5	1	7.5
NECR	17.4	18.5	30/25	DCS	Roogers	1.1	2	2.2
NECR	18.5	18.8	30/25	DCS	INTL BDRY	0.3	1	0.3
Total NECR						**202.1**		**213.48**

Table 3.4: Alternative Two Summary of Railroad Data Existing and With Assumed Infrastructure Improvements

	Railroad Data						
	Maximum Speed (P/F)	Method of Operation	Station Name	Segment Mileage (Miles)	Segment Mileage (Percent)	Number of Tracks	Track Miles in Segment
Total Inland Corridor	**N/A**	**N/A**	**N/A**	**351.5**	**351.5**	**N/A**	**438.1**
Percentage AMTK				1	0.31%		0.50%
Percentage Keolis				44	12.58%		19.80%
Percentage CSXT				54.5	15.48%		17.14%
Percentage Pan Am				50	14.13%		13.82%
Percentage NECR				202	57.50%		48.73%

Proposed capital improvements are displayed in Tables 3.5-3.7. Data displayed for capital improvements include: number of new turnouts, new track (miles), bridge rehabs, culvert extensions, brush cutting, railroad crossing quadrant brush cutting, railroad crossing upgrades, railroad crossing eliminations, bridge replacement (feet), and bridge redecking (feet). The tables are divided by segment, with the segments under control of CSXT and Pan Am presented in Table 3.5 and the segments under control of NECR displayed in Table 3.6. Not all segments include all categories of capital improvements. The Amtrak and Keolis Commuter segments do not include any proposed capital improvements. Therefore those segments are not displayed in table form. Capital improvements that are not proposed on certain segments have also been withheld from being displayed, so not all categories are listed in all tables. Only proposed improvements are included. Table 3.7 displays a summary of all capital improvements per railroad operator.

Table 3.5: Alternative Two Capital Improvements for CSXT and Pan Am Segments

Track Section			Capital Improvements						
Operating Railroad	Low Milepost	High Milepost	Number of New Turnouts	New Track (Miles)	Bridge Rehabs.	Culvert Extensions	Brush Cutting	RR Crossing Upgrades	Bridge Redecking (Feet)
CSXT	44.2	48.3							
CSXT	48.3	57.7	8	9.5	340		9.5		220
CSXT	57.7	64.0							
CSXT	64.0	79.4	8	15.6	1170		15.6	1	1170
CSXT	79.4	83.6							
CSXT	83.6	92.0	9	8.6	395	1	8.6		185
CSXT	92.0	96.1							
CSXT	96.1	98.1							
CSXT	98.1	98.6							
Total CSXT			**25**	**33.7**	**1905**	**1**	**34**	**1**	**1575**
Pan Am	0.0	0.4							
Pan Am	0.4	2.0							
Pan Am	2.0	7.2							
Pan Am	7.2	7.9							
Pan Am	7.9	13.0							
Pan Am	13.0	14.9							
Pan Am	14.9	16.0							
Pan Am	16.0	17.9							
Pan Am	17.9	27.3							
Pan Am	27.3	28.4	2	0.2					
Pan Am	28.4	32.7							
Pan Am	32.7	34.6							
Pan Am	34.6	35.9							
Pan Am	35.9	36.5							
Pan Am	36.5	49.7	1	1.7					
Total Pan Am			**3**	**1.9**	**0**	**0**	**0**	**0**	**0**

*Improvements not proposed for these segments include: railroad crossing quadrant brush cutting, railroad crossing eliminations, and bridge replacements

Table 3.6: Alternative Two Capital Improvements for NECR Segments

Track Section			Capital Improvements							
Operating Railroad	Low Mile-Post	High Mile-Post	Number of New Turnouts	New Track (Miles)	Culvert Extensions	Brush Cutting	RR Crossing Quadrant Brush Cutting	RR Crossing Upgrades	RR Crossing Eliminations	Bridge Replacement (Feet)
NECR	110.5	120.9	5	1.3			8			
NECR	120.9	122.2	2	0.2			1			
NECR	122.2	130.0	6	6.5	2		4			
NECR	130.0	131.7								
NECR	131.7	145.1	1	9.5			4	4		50
NECR	145.1	146.8								
NECR	146.8	159.9	5	13.1	3	13.1	5	5	100	
NECR	159.9	162.2								
NECR	162.2	4.5	2							
NECR	4.5	5.6	2	0.2			2			
NECR	5.6	14.4					10			
NECR	14.4	16.0					2			
NECR	16.0	31.7					24			
NECR	31.7	32.7	2	0.2			1			
NECR	32.7	38.6					16			
NECR	38.6	39.4	2	0.2						
NECR	39.4	45.4					10			
NECR	45.4	46.3	2	0.2			2			
NECR	46.3	60.2					21			
NECR	60.2	61.2	2	0.2			2			
NECR	61.2	75.5					26			
NECR	75.5	76.5	2	0.2			3			
NECR	76.5	84.8					5			
NECR	84.9	85.8					3			
NECR	85.8	93.0					11			
NECR	93.0	93.9	2	0.2			1			
NECR	93.9	98.8					4			
NECR	98.8	99.9					3			
NECR	99.9	118.6					35			
NECR	118.6	119.5					2			
NECR	119.5	126.9					10			
NECR	126.9	127.9	2	0.2			1			
NECR	127.9	132.2					10			
NECR	132.2	1.5	2	0.2			5			
NECR	1.5	9.0					14			
NECR	9.0	9.9								
NECR	9.9	17.4	6	7.6		7.6	10	9		300
NECR	17.4	18.5								
NECR	18.5	18.8								
Total NECR			**45**	**40.0**	**5**	**21**	**255**	**18**	**100**	**350**

*Improvements not proposed for these segments include: bridge rehabs and bridge redecking

Table 3.7: Alternative Two Summary of Capital Improvements

	Capital Improvements									
	Number of New Turnouts	**New Track (Miles)**	**Bridge Rehabs.**	**Culvert Extensions**	**Brush Cutting**	**RR Crossing Quadrant Brush Cutting**	**RR Crossing Upgrades**	**RR Crossing Eliminations**	**Bridge Replacement (Feet)**	**Bridge Redecking (Feet)**
Total Inland Corridor	**73**	**75.6**	**1905**	**6**	**54**	**255**	**19**	**100**	**350**	**1575**
Percentage AMTK	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Percentage Keolis	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Percentage CSXT	34.25%	44.59%	100.00%	16.67%	61.95%	0.00%	5.26%	0.00%	0.00%	100.00%
Percentage Pan Am	4.11%	2.51%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Percentage NECR	61.64%	52.89%	0.00%	83.33%	38.05%	100.00%	94.74%	100.00%	100.00%	0.00%

Tables 3.8-3.11 display the data for required maintenance upgrades. Categories of required maintenance upgrades include: ties per mile, total ties, feet of rail, TPM ballast, total tons of ballast, number of surfacing passes, total surfacing miles, miles of ballast undercutting, number of grinding passes, and passmiles of grinding. As in the previous table sets, data has been divided by operating railroad segments. The segments under control of Amtrak and Keolis Commuter are displayed in Table 3.8, the segments under control of CSXT and Pan Am presented in Table 3.9 and the segments under control of NECR displayed in Table 3.10. Categories of upgrades that are not featured for certain segments have also been excluded for clarity sake. Table 3.11 displays the summary for all required maintenance upgrades per railroad operator.

Table 3.8: Alternative Two Required Infrastructure Upgrades for Amtrak and Keolis Commuter Segments

Track Section			Required Maintenance Upgrades									
Operating Railroad	**Low Mile-Post**	**High Mile-Post**	**Ties Per Mile**	**Total Ties**	**Feet Of Rail**	**TPM Ballast**	**Total Tons of Ballast**	**# of Surfacing Passes**	**Total Surfacing Miles**	**# of Grinding Passes**	**Pass-Miles of Grinding**
Amtrak	0.0	1.1	250	550		400	880	1	2.2	2	4.4
Keolis Commuter	1.1	3.1	500	2030	24360	800	3248	1	4.06	2	8.12
Keolis Commuter	3.1	4.8	500	835	24360	800	1336	1	1.67	2	3.34
Keolis Commuter	4.8	11.4	500	6600	24360	800	10560	1	13.2	2	26.4
Keolis Commuter	11.4	21.3	800	15840	24360	800	15840	1	19.8	2	39.6
Keolis Commuter	21.3	21.7	800	640	24360	800	640	1	0.8	2	1.6
Keolis Commuter	21.7	22.9	1200	2880	24360	800	1920	1	2.4	2	4.8
Keolis Commuter	22.9	24.6	900	3060	24360	800	2720	1	3.4	2	6.8
Keolis Commuter	24.6	28.2	900	6480	24360	800	5760	1	7.2	2	14.4
Keolis Commuter	28.2	29.4	900	2160	24360	800	1920	1	2.4	2	4.8
Keolis Commuter	29.4	30.5	900	1980	24360	800	1760	1	2.2	2	4.4
Keolis Commuter	30.5	33.3	900	5040	24360	800	4480	1	5.6	2	11.2
Keolis Commuter	33.3	39.0	1100	12540	24360	800	9120	1	11.4	2	22.8
Keolis Commuter	39.0	42.6	1100	7920	24360	800	5760	1	7.2	2	14.4
Keolis Commuter	42.6	43.3	600	840	24360	800	1120	1	1.4	2	2.8
Keolis Commuter	43.3	43.7	600	480	24360	800	640	1	0.8	2	1.6
Keolis Commuter	43.7	44.2	600	600	24360	800	800	1	1	2	2
Total Keolis				**70475**	**389760**		**68504**		**87**		**173**

* Upgrades not proposed for these segments include: miles of ballast undercutting

**Upgrades proposed at time of railroad purchase. Some infrastructure improvements may have been completed to date.

Table 3.9: Alternative Two Required Infrastructure Upgrades for CSXT and Pan Am Segments

Track Section			Required Maintenance Upgrades							
Operating Railroad	Low Mile-Post	High Mile-Post	Ties Per Mile	Total Ties	TPM Ballast	Total Tons of Ballast	# of Surfacing Passes	Total Surfacing Miles	# of Grinding Passes	Passmiles of Grinding
CSXT	44.2	48.3	1000	8200	1000	8200	1	8.2	3	24.6
CSXT	48.3	57.7	1000	9400	1000	9400	1	9.4	3	28.2
CSXT	57.7	64.0	1000	12600	1000	12600	1	12.6	3	37.8
CSXT	64.0	79.4	1000	15400	1000	15400	1	15.4	4	61.6
CSXT	79.4	83.6	1000	8400	1000	8400	1	8.4	3	25.2
CSXT	83.6	92.0	1000	8400	1000	8400	1	8.4	3	25.2
CSXT	92.0	96.1	1000	8200	1000	8200	1	8.2	3	24.6
CSXT	96.1	98.1	1000	4000	1000	4000	1	4	3	12
CSXT	98.1	98.6	1000	500	1000	500	1	0.5	3	1.5
Total CSXT				**75100**		**75100**		**75**		**241**
Pan Am	0.0	0.4	1000	380	1000	380	2	0.76	2	0.76
Pan Am	0.4	2.0	1000	3240	1000	3240	2	6.48	2	6.48
Pan Am	2.0	7.2	1000	5200	1000	5200	2	10.4	2	10.4
Pan Am	7.2	7.9	1000	1440	1000	1440	2	2.88	2	2.88
Pan Am	7.9	13.0	1000	5080	1000	5080	2	10.16	2	10.16
Pan Am	13.0	14.9	1000	3800	1000	3800	2	7.6	2	7.6
Pan Am	14.9	16.0	1000	2220	1000	2220	2	4.44	2	4.44
Pan Am	16.0	17.9	1000	3840	1000	3840	2	7.68	2	7.68
Pan Am	17.9	27.3	1000	9370	1000	9370	2	18.74	2	18.74
Pan Am	27.3	28.4	1000	2180	1000	2180	3	6.54	2	4.36
Pan Am	28.4	32.7	1000	4310	1000	4310	2	8.62	2	8.62
Pan Am	32.7	34.6	1000	3800	1000	3800	2	7.6	2	7.6
Pan Am	34.6	35.9	1000	1290	1000	1290	2	2.58	2	2.58
Pan Am	35.9	36.5	1000	1220	1000	1220	2	2.44	2	2.44
Pan Am	36.5	49.7	1000	13170	1000	13170	2	26.34	2	26.34
Total Pan Am				**60540**		**60540**		**123**		**121**

* Upgrades not proposed for these segments include: feet of rail and miles of ballast undercutting

Table 3.10: Alternative Two Required Infrastructure Upgrades for NECR Segments

Track Section			Required Maintenance Upgrades									
Operating Railroad	Low Mile-Post	High Mile-Post	Ties Per Mile	Total Ties	Feet Of Rail	TPM Ballast	Total Tons of Ballast	# of Surfacing Passes	Total Surfacing Miles	Miles of Ballast Under-Cutting	# of Grinding Passes	Pass-Miles of Grinding
NECR	110.5	120.9	1350	14040		1000	10400	3	31.2			0
NECR	120.9	122.2	1350	3375	12800	1000	2500	2	5		1	2.5
NECR	122.2	130.0	1000	7850		1000	7850	1	7.85		1	7.85
NECR	130.0	131.7	1000	1730		1000	1730	1	1.73		1	1.73
NECR	131.7	145.1	800	10680		1000	13350	2	26.7	0.15	1	13.35
NECR	145.1	146.8	800	1360		1000	1700	1	1.7		1	1.7
NECR	146.8	159.9	800	10480		1000	13100	1	13.1		1	13.1
NECR	159.9	162.2	800	1848		1000	2310	1	2.31		1	2.31
NECR	162.2	4.5	800	9040		1000	11300	1	11.3		1	11.3
NECR	4.5	5.6	800	1648		1000	2060	3	6.18		1	2.06
NECR	5.6	14.4	800	1200		1000	1500	3	4.5		1	1.5
NECR	14.4	16.0	1350	2120		1000	1570	3	4.71		1	1.57
NECR	16.0	31.7	1350	21209		1000	15710	3	47.13		1	15.71
NECR	31.7	32.7	1350	2673		1000	1980	3	5.94		1	1.98
NECR	32.7	38.6	1350	8087		1000	5990	3	17.97		1	5.99
NECR	38.6	39.4	1350	1917		1000	1420	3	4.26		1	1.42
NECR	39.4	45.4	1350	8141		1000	6030	3	18.09		1	6.03
NECR	45.4	46.3	1350	2484		1000	1840	3	5.52		1	1.84
NECR	46.3	60.2	1350	18738		1000	13880	3	41.64		1	13.88
NECR	60.2	61.2	1350	2700		1000	2000	3	6		1	2
NECR	61.2	75.5	1350	19346		1000	14330	3	42.99		1	14.33
NECR	75.5	76.5	1350	2565		1000	1900	3	5.7		1	1.9
NECR	76.5	84.8	1350	11259		1000	8340	3	25.02		1	8.34
NECR	84.9	85.8	1350	1337		1000	990	3	2.97		1	0.99
NECR	85.8	93.0	1350	9599		1000	7110	3	21.33		1	7.11
NECR	93.0	93.9	1350	2565	10000	1000	1900	3	5.7		1	1.9
NECR	93.9	98.8	1350	6602		1000	4890	3	14.67		1	4.89
NECR	98.8	99.9	1350	1471		1000	1090	3	3.27		1	1.09
NECR	99.9	118.6	1350	25272		1000	18720	3	56.16		1	18.72
NECR	118.6	119.5	1350	1215		1000	900	3	2.7		1	0.9
NECR	119.5	126.9	1350	10017		1000	7420	3	22.26		1	7.42
NECR	126.9	127.9	1350	2673		1000	1980	3	5.94		1	1.98
NECR	127.9	132.2	1350	5791		1000	4290	3	12.87		0	0
NECR	132.2	1.5	1350	4050		1200	3600	3	9		0	0
NECR	1.5	9.0	1350	10125		1200	9000	3	22.5		0	0
NECR	9.0	9.9	1350	1215		1200	1080	3	2.7		0	0
NECR	9.9	17.4	1350	10125		1200	9000	3	22.5		0	0
NECR	17.4	18.5	1350	2970		1200	2640	3	6.6		0	0
NECR	18.5	18.8	1350	405		1200	360	3	0.9		0	0
Total NECR				**259919**	**22800**		**217760**		**549**	**0.15**		**177**

Table 3.11: Alternative Two Summary of Required Infrastructure Upgrades

	Required Maintenance Upgrades									
	Ties Per Mile	Total Ties	Feet Of Rail	TPM Ballast	Total Tons of Ballast	# of Surfacing Passes	Total Surfacing Miles	Miles of Ballast Undercutting	# of Grinding Passes	Passmiles of Grinding
Total Inland Corridor	**N/A**	**466584**	**412560**	**N/A**	**422784**	**N/A**	**836**	**0.15**	**N/A**	**717**
Percentage AMTK		0.12%	0.00%		0.21%		0.26%	0.00%		0.61%
Percentage Keolis		15.10%	94.47%		16.20%		10.38%	0.00%		24.19%
Percentage CSXT		16.10%	0.00%		17.76%		8.98%	0.00%		33.57%
Percentage Pan Am		12.98%	0.00%		14.32%		14.75%	0.00%		16.89%
Percentage NECR		55.71%	5.53%		51.51%		65.63%	100.00%		24.74%

Table 3.12 includes general comments for specific segments on the corridor. Only segments with comments have been displayed.

Table 3.12: Alternative Two General Comments

Track Section			Comments
Operating Railroad	Low Milepost	High Milepost	
Total Keolis			Cost to project but may be completed per the MBTA/Keolis Operating Agreement
CSXT	83.6	92.0	Need to reconfigure the Palmer Diamond
CSXT	98.1	98.6	1 track shown for Inland Service due to interlocking configuration at Springfield Union Station
NECR	120.9	122.2	To UG Bridge, consider lengthening for Alt 2
NECR	131.7	145.1	Bellows Falls Tunnel
NECR	162.2	4.5	MP Change 169 Palmer = 0 Roxbury, estimate includes crossing replacement, no signal work
NECR	38.6	39.4	Geometric constraints, 4deg curve bounded by two open deck bridges
NECR	119.5	126.9	Construct new bridge
NECR	9.9	17.4	Swing bridge and trestle repairs required

Table 3.13 displays the total project costs for Alternative Two track infrastructure improvement. Each project task and quantity is taken from Tables 3.7 and 3.11, which display the total amount of infrastructure required from the entire corridor. Each project task is also shown with its unit cost to achieve a total cost for each task. A 30% contingency has been added to these tasks as well. The total Alternative Two track infrastructure improvement cost is proposed to be $321,385,211. The final report lists the track infrastructure costs as $410-505 million, which includes an additional 30-60% contingency for inflation.

Table 3.13: Alternative Two Track Infrastructure Improvement Costs

Project Cost Totals				
Project Task	**Quantity**	**Units**	**Unit Cost**	**Total Cost**
Install New Turnouts	73	Each	$125,000.00	$9,125,000
Install New Track	76	Mile	$1,500,000.00	$113,355,000
Bridge Rehabilitation	1,905	Track Foot	$4,000.00	$7,620,000
Culvert Extensions	6	Each	$50,000.00	$300,000
Brush Cutting	54	Mile	$21,120.00	$1,148,928
RR Crossing Quadrants	255	Each	$25,000.00	$6,375,000
RR Crossing Surface	19	Each	$125,000.00	$2,375,000
Bridge Replacement	350	Track Foot	$12,000.00	$4,200,000
Bridge Redecking	1,575	Track Foot	$1,000.00	$1,575,000
Furnish Ties	466,584	Each	$65.00	$30,327,960
Install Ties	466,584	Each	$35.00	$16,330,440
Furnish Rail and OTM	412,560	Linear Foot	$38.00	$15,677,280
Install Rail	412,560	Linear Foot	$26.00	$10,726,560
Furnish Ballast	422,784	Ton	$25.00	$10,569,600
Install Ballast	422,784	Ton	$15.00	$6,341,760
Surfacing	836	Track Mile	$10,600.00	$8,860,540
Ballast Undercutting	0	Track Mile	$125,000.00	$18,750
Grinding Passes	717	Pass Mile	$2,500.00	$1,792,575
Install New Diamond	1	Each	$500,000.00	$500,000
Contingency	N/A	N/A	30%	$74,165,818
			Total Alternative 2 Cost	**$321,385,211**

3 ALTERNATIVE THREE

Alternative Three proposes to improve corridor service throughout the study area. Preliminary capital costs for the service include $440-540 million for track infrastructure improvement, $25-30 million for bridge infrastructure improvement, and $210-270 million for signal and communication infrastructure improvement. In addition, approximately $455-590 million has been proposed for train set and equipment preliminary capital costs for a total of 18 new train sets (at approximately $32 million per train set). Alternative Three assumes using tilt equipment and higher speeds, which increase the price. The anticipated equipment capital cost is based on the recent purchase price for PRIIA Fleet design train sets, and includes an up to 30% contingency. The total preliminary capital costs for Alternative Three equals $1.255-1.590 billion. All costs are in 2014 dollars, and a 35% engineering/management cost is included in the fees baseline capital costs. The contingency ranges from 30-60%, and costs do not include any station improvements.

The data for track infrastructure improvement for Alternative Three will be displayed in this chapter. Information on existing track data is similar to Alternative One, but is displayed below in Tables 4.1-4.4 for clarity sake. The four tables provide information on existing railroad data such as maximum speed, method of operation, signal upgrades, station name, segment mileage, number of tracks, and track miles in segment. The tables are divided by segment, with the segments under control of Amtrak and Keolis Commuter displayed in Table 4.1, the segments under control of CSXT and Pan Am presented in Table 4.2, and the segments under control of NECR displayed in Table 4.3. Table 4.4 displays a summary of all railroad data.

Table 4.1: Alternative Three Railroad Data Existing and With Assumed Infrastructure Improvements for Amtrak and Keolis Commuter Segments

Track Segment			Railroad Data					
Operating Railroad	Low Milepost	High Milepost	Maximum Speed (P/F)	Method of Operation	Station Name	Segment Mileage	Number of Tracks	Track Miles in Segment
Amtrak	0.0	1.1		261	Cove	1.1	2	2.2
Keolis Commuter	1.1	3.1	30/30	261	CP-3	2.0	2	4.06
Keolis Commuter	3.1	4.8	50/40	261	CP-4	1.7	1	1.67
Keolis Commuter	4.8	11.4	60/50	261	CP-11	6.6	2	13.2
Keolis Commuter	11.4	21.3	55/40	261	CP-21	9.9	2	19.8
Keolis Commuter	21.3	21.7	30/30	261	CP-22	0.4	2	0.8
Keolis Commuter	21.7	22.9	50/50	261	CP-23	1.2	2	2.4
Keolis Commuter	22.9	24.6	60/50	261	CP-24	1.7	2	3.4
Keolis Commuter	24.6	28.2	60/50	261	CP-28	3.6	2	7.2
Keolis Commuter	28.2	29.4	60/50	261	CP-29	1.2	2	2.4
Keolis Commuter	29.4	30.5	60/50	261	CP-30	1.1	2	2.2
Keolis Commuter	30.5	33.3	60/50	261	CP-33	2.8	2	5.6
Keolis Commuter	33.3	39.0	55/50	261	CP-39	5.7	2	11.4
Keolis Commuter	39.0	42.6	50/50	261	CP-42	3.6	2	7.2
Keolis Commuter	42.6	43.3	40/40	261	CP-43	0.7	2	1.4
Keolis Commuter	43.3	43.7	25/20	261	CP-44	0.4	2	0.8
Keolis Commuter	43.7	44.2	60/40	261	CP-45	0.5	2	1
Total Keolis						**44.2**		**86.7**

Table 4.2: Alternative Three Railroad Data Existing and With Assumed Infrastructure Improvements for CSXT and Pan Am Segments

Track Segment			Railroad Data					
Operating Railroad	Low Milepost	High Milepost	Maximum Speed (P/F)	Method of Operation	Station Name	Segment Mileage	Number of Tracks	Track Miles in Segment
CSXT	44.2	48.3	60/40	261	CP-48	4.1	2	8.2
CSXT	48.3	57.7	50/40	261	CP-57	9.4	1	9.4
CSXT	57.7	64.0	45/40	261	CP-64	6.3	2	12.6
CSXT	64.0	79.4	45/40	261	CP-79	15.4	1	15.4
CSXT	79.4	83.6	60/50	261	CP-83	4.2	2	8.4
CSXT	83.6	92.0	60/50	261	CP-92	8.4	1	8.4
CSXT	92.0	96.1	60/50	261	CP-96	4.1	2	8.2
CSXT	96.1	98.1	60/40	261	CP-97	2.0	2	4
CSXT	98.1	98.6	30/30	261	CP-98	0.5	1	0.5
Total CSXT						**54.4**		**75.1**
Pan Am	0.0	0.4	10	261	CPR-1	0.4	1	0.38
Pan Am	0.4	2.0	40/30	261	CPR-2	1.6	2	3.24
Pan Am	2.0	7.2	35/30	261	CPR-7	5.2	1	5.2
Pan Am	7.2	7.9	35/30	261	Holyoke	0.7	2	1.44
Pan Am	7.9	13.0	35/30	261	CPR-13	5.1	1	5.08
Pan Am	13.0	14.9	50/40	261	Mt. Tom	1.9	2	3.8
Pan Am	14.9	16.0	50/40	261	CPR-16	1.1	2	2.22
Pan Am	16.0	17.9	40/30	261	CPR-18	1.9	2	3.84
Pan Am	17.9	27.3	79/40	261	N/A	9.4	1	9.37
Pan Am	27.3	28.4	79/40	261	South Deerfield	1.1	2	2.18
Pan Am	28.4	32.7	79/40	261	CPR-33	4.3	1	4.31
Pan Am	32.7	34.6	50/40	261	CPR-35	1.9	2	3.8
Pan Am	34.6	35.9	35/30	261	CPF-385	1.3	1	1.29
Pan Am	35.9	36.5	35/30	261	CPR-36	0.6	2	1.22
Pan Am	36.5	49.7	45/30	261	East Northfield	13.2	1	13.17
Total Pan Am						**49.7**		**60.54**

Table 4.3: Alternative Three Railroad Data Existing and With Assumed Infrastructure Improvements for NECR Segments

Track Segment			Railroad Data					
Operating Railroad	Low Milepost	High Milepost	Maximum Speed (P/F)	Method of Operation	Station Name	Segment Mileage	Number of Tracks	Track Miles in Segment
NECR	110.5	120.9	59/40	DCS	Brattleboro	10.4	1	10.4
NECR	120.9	122.2	59/40	261	Brattleboro	1.3	2	2.5
NECR	122.2	130.0	70/40	261	Putney	7.8	1	7.85
NECR	130.0	131.7	70/40	261	East Putney	1.7	1	1.73
NECR	131.7	145.1	79/40	261	Walpole	13.4	1	13.35
NECR	145.1	146.8	79/40	261	Charlestown	1.7	1	1.7
NECR	146.8	159.9	79/40	261	Claremont Jct. S.	13.1	1	13.1
NECR	159.9	162.2	79/40	261	Claremont Jct. Sta.	2.3	1	2.31
NECR	162.2	4.5	79/40	261	White River JCT	11.3	1	11.3
NECR	4.5	5.6	79/40	DCS/ABS	Hartland	1.0	2	2.06
NECR	5.6	14.4	79/40	DCS/ABS	Hartford	1.5	1	1.5
NECR	14.4	16.0	59/40	DCS	Hartford	1.6	1	1.57
NECR	16.0	31.7	59/40	DCS	South Royalton	15.7	1	15.71
NECR	31.7	32.7	59/40	DCS	South Royalton	1.0	2	1.98
NECR	32.7	38.6	59/40	DCS	Bethel	6.0	1	5.99
NECR	38.6	39.4	59/40	DCS	Bethel	0.7	2	1.42
NECR	39.4	45.4	59/40	DCS	Randolph	6.0	1	6.03
NECR	45.4	46.3	59/40	DCS	Randolph	0.9	2	1.84
NECR	46.3	60.2	59/40	DCS	Roxbury	13.9	1	13.88
NECR	60.2	61.2	59/40	DCS	Roxbury	1.0	2	2
NECR	61.2	75.5	59/40	DCS	Montpelier Jct.	14.3	1	14.33
NECR	75.5	76.5	59/40	DCS	Montpelier Jct.	0.9	2	1.9
NECR	76.5	84.8	59/40	DCS	Waterbury	8.3	1	8.34
NECR	84.9	85.8	59/40	DCS	Waterbury	1.0	1	0.99
NECR	85.8	93.0	59/40	DCS	Bolton	7.1	1	7.11
NECR	93.0	93.9	59/40	DCS	Bolton	1.0	2	1.9
NECR	93.9	98.8	59/40	DCS	Richmond	4.9	1	4.89
NECR	98.8	99.9	59/40	DCS	Richmond	1.1	1	1.09
NECR	99.9	118.6	59/40	DCS	Milton	18.7	1	18.72
NECR	118.6	119.5	59/40	DCS	Milton	0.9	1	0.9
NECR	119.5	126.9	59/40	DCS	Oakland	7.4	1	7.42
NECR	126.9	127.9	59/40	DCS	Oakland	1.0	2	1.98
NECR	127.9	132.2	59/40	DCS	St. Albans	4.3	1	4.29
NECR	132.2	1.5	59/40	YD Limits	St. Albans	1.5	2	3
NECR	1.5	9.0	30/25	DCS	Swanton	7.5	1	7.5
NECR	9.0	9.9	30/25	DCS	Swanton	0.9	1	0.9
NECR	9.9	17.4	30/25	DCS	Roogers	7.5	1	7.5
NECR	17.4	18.5	30/25	DCS	Roogers	1.1	2	2.2
NECR	18.5	18.8	30/25	DCS	INTL BDRY	0.3	1	0.3
Total NECR						**202.1**		**213.48**

Table 4.4: Alternative Three Summary of Railroad Data Existing and With Assumed Infrastructure Improvements

	Railroad Data						
	Maximum Speed (P/F)	Method of Operation	Station Name	Segment Mileage (Miles)	Segment Mileage (Percent)	Number of Tracks	Track Miles in Segment
Total Inland Corridor	**N/A**	**N/A**	**N/A**	**351.5**	**351.5**	**N/A**	**438.1**
Percentage AMTK				1	0.31%		0.50%
Percentage Keolis				44	12.58%		19.80%
Percentage CSXT				54.5	15.48%		17.14%
Percentage Pan Am				50	14.13%		13.82%
Percentage NECR				202	57.50%		48.73%

Proposed capital improvements are displayed in Tables 4.5-4.7. Data displayed for capital improvements include: number of new turnouts, new track (miles), bridge rehabs, culvert extensions, brush cutting, railroad crossing quadrant brush cutting, railroad crossing upgrades, railroad crossing eliminations, bridge replacement (feet), and bridge redecking (feet). The tables are divided by segment, with the segments under control of CSXT and Pan Am presented in Table 4.5 and the segments under control of NECR displayed in Table 4.6. Not all segments include all categories of capital improvements. The Amtrak and Keolis Commuter segments do not include any proposed capital improvements. Therefore those segments are not displayed in table form. Capital improvements that are not proposed on certain segments have also been withheld from being displayed, so not all categories are listed in all tables. Only proposed improvements are included. Table 4.7 displays a summary of all capital improvements per railroad operator.

Table 4.5: Alternative Three Capital Improvements for CSXT and Pan Am Segments

Track Segment			Capital Improvements							
Operating Railroad	**Low Milepost**	**High Milepost**	**Number of New Turnouts**	**New Track (Miles)**	**Bridge Rehabs.**	**Culvert Extensions**	**Brush Cutting**	**RR Crossing Quadrant Brush Cutting**	**RR Crossing Upgrades**	**Bridge Redecking (Feet)**
CSXT	44.2	48.3								
CSXT	48.3	57.7	8	9.5	340		9.5			220
CSXT	57.7	64.0								
CSXT	64.0	79.4	8	15.6	1170		15.6		1	1170
CSXT	79.4	83.6								
CSXT	83.6	92.0	9	8.6	395	1	8.6			185
CSXT	92.0	96.1								
CSXT	96.1	98.1								
CSXT	98.1	98.6								
Total CSXT			**25**	**33.7**	**1905**	**1**	**34**	**0**	**1**	**1575**
Pan Am	0.0	0.4					0.4			
Pan Am	0.4	2.0					1.6			
Pan Am	2.0	7.2					5.2	2		
Pan Am	7.2	7.9					0.7	1		
Pan Am	7.9	13.0					5.1	1		
Pan Am	13.0	14.9					1.9	3		
Pan Am	14.9	16.0					1.1	1		
Pan Am	16.0	17.9					1.9			
Pan Am	17.9	27.3					9.4	8		
Pan Am	27.3	28.4	2	0.2			1.1	1		
Pan Am	28.4	32.7					4.3	3		
Pan Am	32.7	34.6					1.9	1		
Pan Am	34.6	35.9					1.3			
Pan Am	35.9	36.5					0.6	6		
Pan Am	36.5	49.7	1	1.7			5.7	2		
Total Pan Am			**3**	**1.9**	**0**	**0**	**42**	**29**	**0**	**0**

*Improvements not proposed for these segments include railroad crossing eliminations, and bridge replacement.

Table 4.6: Alternative Three Capital Improvements for NECR Segments

Track Segment			Capital Improvements							
Operating Railroad	Low Mile-Post	High Mile-Post	Number of New Turnouts	New Track (Miles)	Culvert Extensions	Brush Cutting	RR Crossing Quadrant Brush Cutting	RR Crossing Upgrades	RR Crossing Eliminations	Bridge Replacement (Feet)
NECR	110.5	120.9	5	1.3		7.7	8			
NECR	120.9	122.2	2	0.2			1			
NECR	122.2	130.0	6	6.5	2	7.8	4			
NECR	130.0	131.7				1.7				
NECR	131.7	145.1	1	9.5		13.4	4	4		50
NECR	145.1	146.8				1.7				
NECR	146.8	159.9	5	13.1	3	13.1	5	5	100	
NECR	159.9	162.2				2.3				
NECR	162.2	4.5	2			11.3				
NECR	4.5	5.6	2	0.2		1.0	2			
NECR	5.6	14.4				1.5	10			
NECR	14.4	16.0				1.6	2			
NECR	16.0	31.7				15.7	24			
NECR	31.7	32.7	2	0.2		1.0	1			
NECR	32.7	38.6				6.0	16			
NECR	38.6	39.4	2	0.2		0.7				
NECR	39.4	45.4				6.0	10			
NECR	45.4	46.3	2	0.2		0.9	2			
NECR	46.3	60.2				13.9	21			
NECR	60.2	61.2	2	0.2		1.0	2			
NECR	61.2	75.5				14.3	26			
NECR	75.5	76.5	2	0.2		0.9	3			
NECR	76.5	84.8				8.3	5			
NECR	84.9	85.8				1.0	3			
NECR	85.8	93.0				7.1	11			
NECR	93.0	93.9	2	0.2			1			
NECR	93.9	98.8				4.9	4			
NECR	98.8	99.9				1.1	3			
NECR	99.9	118.6				18.7	35			
NECR	118.6	119.5				0.9	2			
NECR	119.5	126.9				7.4	10			
NECR	126.9	127.9	2	0.2		1.0	1			
NECR	127.9	132.2				4.3	10			
NECR	132.2	1.5	2	0.2		1.5	5			
NECR	1.5	9.0				7.5	14			
NECR	9.0	9.9				0.9				
NECR	9.9	17.4	6	7.6		7.6	10	9		300
NECR	17.4	18.5				1.1				
NECR	18.5	18.8				0.3				
Total NECR			**45**	**40.0**	**5**	**197**	**255**	**18**	**100**	**350**

*Improvements not proposed for these segments include bridge rehabs and bridge redecking.

Table 4.7: Alternative Three Summary of Capital Improvements

	Capital Improvements									
	Number of New Turnouts	New Track (Miles)	Bridge Rehabs.	Culvert Extensions	Brush Cutting	RR Crossing Quadrant Brush Cutting	RR Crossing Upgrades	RR Crossing Eliminations	Bridge Replacement (Feet)	Bridge Redecking (Feet)
Total Inland Corridor	**73**	**75.6**	**1905**	**6**	**273**	**284**	**19**	**100**	**350**	**1575**
Percentage AMTK	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Percentage Keolis	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Percentage CSXT	34.25%	44.59%	100.00%	16.67%	12.34%	0.00%	5.26%	0.00%	0.00%	100.00%
Percentage Pan Am	4.11%	2.51%	0.00%	0.00%	15.45%	10.21%	0.00%	0.00%	0.00%	0.00%
Percentage NECR	61.64%	52.89%	0.00%	83.33%	72.22%	89.79%	94.74%	100.00%	100.00%	0.00%

Tables 4.8-4.11 display the data for required maintenance upgrades. Categories of required maintenance upgrades include: ties per mile, total ties, feet of rail, TPM ballast, total tons of ballast, number of surfacing passes, total surfacing miles, miles of ballast undercutting, number of grinding passes, and passmiles of grinding. As in the previous table sets, data has been divided by operating railroad segments. The segments under control of Amtrak and Keolis Commuter are displayed in Table 4.8, the segments under control of CSXT and Pan Am presented in Table 4.9 and the segments under control of NECR displayed in Table 4.10. Categories of upgrades that are not featured for certain segments have also been excluded for clarity sake. Table 4.11 displays the summary for all required maintenance upgrades per railroad operator.

Table 4.8: Alternative Three Required Infrastructure Upgrades for Amtrak and Keolis Commuter Segments

Track Segment			Required Maintenance Upgrades									
Operating Railroad	Low Milepost	High Milepost	Ties Per Mile	Total Ties	Feet Of Rail	TPM Ballast	Total Tons of Ballast	# of Surfacing Passes	Total Surfacing Miles	# of Grinding Passes	Passmiles of Grinding
Amtrak	0.0	1.1	250	550		400	880	1	2.2	2	4.4
Keolis Commuter	1.1	3.1	500	2030	24360	600	2436	1	4.06	2	8.12
Keolis Commuter	3.1	4.8	500	835	24360	600	1002	1	1.67	2	3.34
Keolis Commuter	4.8	11.4	500	6600	24360	600	7920	1	13.2	2	26.4
Keolis Commuter	11.4	21.3	800	15840	24360	600	11880	1	19.8	2	39.6
Keolis Commuter	21.3	21.7	800	640	24360	600	480	1	0.8	2	1.6
Keolis Commuter	21.7	22.9	1200	2880	24360	1000	2400	1	2.4	2	4.8
Keolis Commuter	22.9	24.6	1100	3740	24360	1000	3400	3	10.2	2	6.8
Keolis Commuter	24.6	28.2	1100	7920	24360	1000	7200	3	21.6	2	14.4
Keolis Commuter	28.2	29.4	1100	2640	24360	1000	2400	3	7.2	2	4.8
Keolis Commuter	29.4	30.5	1100	2420	24360	1000	2200	3	6.6	2	4.4
Keolis Commuter	30.5	33.3	1100	6160	24360	1000	5600	3	16.8	2	11.2
Keolis Commuter	33.3	39.0	1100	12540	24360	1000	11400	3	34.2	2	22.8
Keolis Commuter	39.0	42.6	1100	7920	24360	1000	7200	3	21.6	2	14.4
Keolis Commuter	42.6	43.3	600	840	24360	600	840	1	1.4	2	2.8
Keolis Commuter	43.3	43.7	600	480	24360	600	480	1	0.8	2	1.6
Keolis Commuter	43.7	44.2	600	600	24360	600	600	1	1	2	2
Total Keolis				**74635**	**389760**		**68318**		**166**		**173**

* Upgrades not proposed for these segments include: miles of ballast undercutting

**Upgrades proposed at time of railroad purchase. Some infrastructure improvements may have been completed to date.

Table 4.9: Alternative Three Required Infrastructure Upgrades for CSXT and Pan Am Segments

Track Segment			Required Maintenance Upgrades							
Operating Railroad	Low Milepost	High Milepost	Ties Per Mile	Total Ties	TPM Ballast	Total Tons of Ballast	# of Surfacing Passes	Total Surfacing Miles	# of Grinding Passes	Passmiles of Grinding
CSXT	44.2	48.3	1200	9840	1200	9840	1	8.2	3	24.6
CSXT	48.3	57.7	1200	11280	1200	11280	1	9.4	3	28.2
CSXT	57.7	64.0	1200	15120	1200	15120	1	12.6	3	37.8
CSXT	64.0	79.4	1500	23100	1500	23100	3	46.2	4	61.6
CSXT	79.4	83.6	1500	12600	1500	12600	3	25.2	3	25.2
CSXT	83.6	92.0	1500	12600	1500	12600	3	25.2	3	25.2
CSXT	92.0	96.1	1500	12300	1500	12300	3	24.6	3	24.6
CSXT	96.1	98.1	1500	6000	1500	6000	3	12	3	12
CSXT	98.1	98.6	1500	750	1500	750	3	1.5	3	1.5
Total CSXT				**103590**		**103590**		**165**		**241**
Pan Am	0.0	0.4	1200	456	1200	456	2	0.76	2	0.76
Pan Am	0.4	2.0	1200	3888	1200	3888	2	6.48	2	6.48
Pan Am	2.0	7.2	1200	6240	1200	6240	2	10.4	2	10.4
Pan Am	7.2	7.9	1200	1728	1200	1728	2	2.88	2	2.88
Pan Am	7.9	13.0	1200	6096	1200	6096	2	10.16	2	10.16
Pan Am	13.0	14.9	1200	4560	1200	4560	2	7.6	2	7.6
Pan Am	14.9	16.0	1200	2664	1200	2664	2	4.44	2	4.44
Pan Am	16.0	17.9	1200	4608	1200	4608	2	7.68	2	7.68
Pan Am	17.9	27.3	1200	11244	1200	11244	2	18.74	2	18.74
Pan Am	27.3	28.4	1200	2616	1200	2616	4	8.72	2	4.36
Pan Am	28.4	32.7	1200	5172	1200	5172	4	17.24	2	8.62
Pan Am	32.7	34.6	1200	4560	1200	4560	4	15.2	2	7.6
Pan Am	34.6	35.9	1200	1548	1200	1548	4	5.16	2	2.58
Pan Am	35.9	36.5	1200	1464	1200	1464	4	4.88	2	2.44
Pan Am	36.5	49.7	1200	15804	1200	15804	4	52.68	2	26.34
Total Pan Am				**72648**		**72648**		**173**		**121**

* Upgrades not proposed for these segments include: miles of ballast undercutting and feet of rail

Table 4.10: Alternative Three Required Infrastructure Upgrades for NECR Segments

Track Segment			Required Maintenance Upgrades										
Operating Railroad	Low Mile-Post	High Mile-Post	Ties Per Mile	Total Ties	Feet Of Rail	TPM Ballast	Total Tons of Ballast	# of Surfacing Passes	Total Surfacing Miles	Miles of Ballast Under-Cutting	# of Grinding Passes	Pass-Miles of Grinding
NECR	110.5	120.9	1500	15600		1200	12480	3	31.2		1	10.4
NECR	120.9	122.2	1350	3375	12800	1000	2500	2	5		1	2.5
NECR	122.2	130.0	1000	7850		1200	9420	1	7.85		1	7.85
NECR	130.0	131.7	1000	1730		1200	2076	1	1.73		1	1.73
NECR	131.7	145.1	800	10680		1200	16020	2	26.7	0.15	1	13.35
NECR	145.1	146.8	800	1360		1200	2040	1	1.7		1	1.7
NECR	146.8	159.9	1000	13100		1200	15720	1	13.1		2	26.2
NECR	159.9	162.2	1000	2310		1200	2772	1	2.31		2	4.62
NECR	162.2	4.5	800	9040		1200	13560	1	11.3		1	11.3
NECR	4.5	5.6	800	1648		1200	2472	3	6.18		1	2.06
NECR	5.6	14.4	800	1200		1200	1800	3	4.5		1	1.5
NECR	14.4	16.0	1350	2120		1200	1884	3	4.71		1	1.57
NECR	16.0	31.7	1350	21209		1200	18852	3	47.13		1	15.71
NECR	31.7	32.7	1350	2673		1200	2376	3	5.94		1	1.98
NECR	32.7	38.6	1350	8087		1200	7188	3	17.97		1	5.99
NECR	38.6	39.4	1350	1917		1200	1704	3	4.26		1	1.42
NECR	39.4	45.4	1350	8141		1200	7236	3	18.09		1	6.03
NECR	45.4	46.3	1350	2484		1200	2208	3	5.52		1	1.84
NECR	46.3	60.2	1350	18738		1200	16656	3	41.64		1	13.88
NECR	60.2	61.2	1350	2700		1200	2400	3	6		1	2
NECR	61.2	75.5	1350	19346		1200	17196	3	42.99		1	14.33
NECR	75.5	76.5	1350	2565		1200	2280	3	5.7		1	1.9
NECR	76.5	84.8	1350	11259		1200	10008	3	25.02		1	8.34
NECR	84.9	85.8	1350	1337		1200	1188	3	2.97		1	0.99
NECR	85.8	93.0	1350	9599		1200	8532	3	21.33		1	7.11
NECR	93.0	93.9	1350	2565	10000	1000	1900	3	5.7		1	1.9
NECR	93.9	98.8	1350	6602		1200	5868	3	14.67		1	4.89
NECR	98.8	99.9	1350	1471		1200	1308	3	3.27		1	1.09
NECR	99.9	118.6	1350	25272		1200	22464	3	56.16		1	18.72
NECR	118.6	119.5	1350	1215		1200	1080	3	2.7		1	0.9
NECR	119.5	126.9	1350	10017		1200	8904	3	22.26		1	7.42
NECR	126.9	127.9	1350	2673		1200	2376	3	5.94		1	1.98
NECR	127.9	132.2	1350	5791		1200	5148	3	12.87		0	0
NECR	132.2	1.5	1350	4050		1400	4200	3	9		0	0
NECR	1.5	9.0	1350	10125		1400	10500	3	22.5		0	0
NECR	9.0	9.9	1350	1215		1400	1260	3	2.7		0	0
NECR	9.9	17.4	1350	10125		1400	10500	3	22.5		0	0
NECR	17.4	18.5	1350	2970		1400	3080	3	6.6		0	0
NECR	18.5	18.8	1350	405		1400	420	3	0.9		0	0
Total NECR				**264561**	**22800**		**259576**		**549**	**0.15**		**203**

Table 4.11: Alternative Three Summary of Required Infrastructure Upgrades

	Required Maintenance Upgrades									
	Ties Per Mile	Total Ties	Feet Of Rail	TPM Ballast	Total Tons of Ballast	# of Surfacing Passes	Total Surfacing Miles	Miles of Ballast Under-Cutting	# of Grinding Passes	Passmiles of Grinding
Total Inland Corridor	**N/A**	**515984**	**412560**	**N/A**	**505012**	**N/A**	**1054**	**0.15**	**N/A**	**743**
Percentage AMTK		0.11%	0.00%		0.17%		0.21%	0.00%		0.59%
Percentage Keolis		14.46%	94.47%		13.53%		15.70%	0.00%		23.35%
Percentage CSXT		20.08%	0.00%		20.51%		15.64%	0.00%		32.40%
Percentage Pan Am		14.08%	0.00%		14.39%		16.41%	0.00%		16.30%
Percentage NECR		51.27%	5.53%		51.40%		52.04%	100.00%		27.35%

Table 4.12 includes general comments for specific segments on the corridor. Only segments with comments have been displayed.

Table 4.12: Alternative Three General Comments

Track Segment			Comments
Operating Railroad	Low Milepost	High Milepost	
Total Keolis			Cost to project but may be completed per the MBTA/Keolis Operating Agreement
CSXT	83.6	92.0	Need to reconfigure the Palmer Diamond
CSXT	98.1	98.6	1 track shown for Inland Service due to interlocking configuration at Springfield Union Station
NECR	120.9	122.2	To UG Bridge, consider lengthening for Alt 2
NECR	131.7	145.1	Bellows Falls Tunnel
NECR	162.2	4.5	MP Change 169 Palmer = 0 Roxbury, estimate includes crossing replacement, no signal work
NECR	38.6	39.4	Geometric constraints, 4deg curve bounded by two open deck bridges
NECR	119.5	126.9	Construct new bridge
NECR	9.9	17.4	Swing bridge and trestle repairs required

Table 4.13 displays the total project costs for Alternative Three track infrastructure improvement. Each project task and quantity is taken from Tables 4.7 and 4.11, which display the total amount of infrastructure required from the entire corridor. Each project task is also shown with its unit cost to achieve a total cost for each task. A 30% contingency has been added to these tasks as well. The total Alternative Three track infrastructure improvement cost is proposed to be $342,125,548. The final report lists the track infrastructure costs as $440-540 million, which includes an additional 30-60% contingency for inflation.

Table 4.13: Alternative Three Track Infrastructure Improvement Costs

Project Cost Totals				
Project Task	**Quantity**	**Units**	**Unit Cost**	**Total Cost**
Install New Turnouts	73	Each	$125,000.00	$9,125,000
Install New Track	76	Mile	$1,500,000.00	$113,355,000
Bridge Rehabilitation	1,905	Track Foot	$4,000.00	$7,620,000
Culvert Extensions	6	Each	$50,000.00	$300,000
Brush Cutting	273	Mile	$21,120.00	$5,769,773
RR Crossing Quadrants	284	Each	$25,000.00	$7,100,000
RR Crossing Surface	19	Each	$125,000.00	$2,375,000
Bridge Replacement	350	Track Foot	$12,000.00	$4,200,000
Bridge Redecking	1,575	Track Foot	$1,000.00	$1,575,000
Furnish Ties	515,984	Each	$65.00	$33,538,960
Install Ties	515,984	Each	$35.00	$18,059,440
Furnish Rail and OTM	412,560	Linear Foot	$38.00	$15,677,280
Install Rail	412,560	Linear Foot	$26.00	$10,726,560
Furnish Ballast	505,012	Ton	$25.00	$12,625,300
Install Ballast	505,012	Ton	$15.00	$7,575,180
Surfacing	1,054	Track Mile	$10,600.00	$11,175,156
Ballast Undercutting	0	Track Mile	$125,000.00	$18,750
Grinding Passes	743	Pass Mile	$2,500.00	$1,857,100
Install New Diamond	1	Each	$500,000.00	$500,000
Contingency	N/A	N/A	30%	$78,952,050
			Total Alternative 3 Cost	**$342,125,548**

4 COMPARISON

A comparison was completed on the three alternatives. Each alternative was compared against each other based on quantity of project tasks and total cost. In addition, each alternative was broken down based on the two main segments: Boston to Springfield and Springfield to Montreal. In these breakdowns, the percentage of work for each task and the cost for each percentage are shown for the two segments. A 30% contingency and a 10% engineering/project management fee have been added as well. Tables 5.1 shows the segment breakdown for Alternative One, Table 5.2 shows the segment breakdown for Alternative Two, and Table 5.3 shows the segment breakdown for Alternative Three.

Table 5.1: Alternative One Segment Component Breakdown

Project No.	Task	Boston-Springfield		Springfield-Montreal	
		Percentage of Work	Cost	Percentage of Work	Cost
1	Install New Turnouts (each)	14.29%	$625,000	85.71%	$3,750,000
2	Install New Track (miles)	50.73%	$18,750,000	49.27%	$18,210,000
3	Bridge Rehabilitation (feet)	100.00%	$4,680,000	0.00%	$0
4	Culvert Extensions (each)	0.00%	$0	0.00%	$0
5	Brush Cutting (miles)	0.00%	$0	0.00%	$0
6	RR Crossing Quadrants (each)	0.00%	$0	100.00%	$250,000
7	RR Crossing Surface (each)	8.33%	$125,000	91.67%	$1,375,000
8	Bridge Replacement (feet)	0.00%	$0	0.00%	$0
9	Bridge Redecking (feet)	100.00%	$400,000	0.00%	$0
10	Furnish Ties (each)	36.25%	$8,521,825	63.75%	$14,985,503
11	Install Ties (each)	36.25%	$4,588,675	63.75%	$8,069,117
12	Furnish Rail and OTM (feet)	100.00%	$14,810,880	0.00%	$0
13	Install Rail (feet)	100.00%	$10,133,760	0.00%	$0
14	Furnish Ballast (tons)	33.42%	$2,744,800	66.58%	$5,467,800
15	Install Ballast (tons)	33.42%	$1,646,880	66.58%	$3,280,680
16	Surfacing (miles)	31.20%	$1,738,718	68.80%	$3,834,020
17	Ballast Undercutting (miles)	0.00%	$0	100.00%	$18,750
18	Grinding Passes (miles)	58.43%	$1,046,400	41.57%	$744,600
19	Install New Diamond (each)	0.00%	$0	0.00%	$0
	Contingency		$20,943,581		$17,995,641
	Engineering/Project Management		$6,981,194		$5,998,547
	Total Cost		$97,736,713		$83,979,658

Table 5.2: Alternative Two Segment Component Breakdown

Project No.	Task	Boston-Springfield		Springfield-Montreal	
		Percentage of Work	Cost	Percentage of Work	Cost
1	Install New Turnouts (each)	34.25%	$3,125,000	65.75%	$6,000,000
2	Install New Track (miles)	44.59%	$50,550,000	55.41%	$62,805,000
3	Bridge Rehabilitation (feet)	100.00%	$7,620,000	0.00%	$0
4	Culvert Extensions (each)	34.25%	$102,740	65.75%	$197,260
5	Brush Cutting (miles)	61.95%	$711,744	38.05%	$437,184
6	RR Crossing Quadrants (each)	0.00%	$0	100.00%	$6,375,000
7	RR Crossing Surface (each)	5.26%	$125,000	94.74%	$2,250,000
8	Bridge Replacement (feet)	0.00%	$0	100.00%	$4,200,000
9	Bridge Redecking (feet)	100.00%	$1,575,000	0.00%	$0
10	Furnish Ties (each)	31.32%	$9,498,125	68.68%	$20,829,835
11	Install Ties (each)	31.32%	$5,114,375	68.68%	$11,216,065
12	Furnish Rail and OTM (feet)	94.47%	$14,810,880	5.53%	$866,400
13	Install Rail (feet)	94.47%	$10,133,760	5.53%	$592,800
14	Furnish Ballast (tons)	34.17%	$3,612,100	65.83%	$6,957,500
15	Install Ballast (tons)	34.17%	$2,167,260	65.83%	$4,174,500
16	Surfacing (miles)	19.62%	$1,738,718	80.38%	$7,121,822
17	Ballast Undercutting (miles)	0.00%	$0	100.00%	$18,750
18	Grinding Passes (miles)	58.37%	$1,046,400	41.63%	$746,175
19	Install New Diamond (each)	100.00%	$500,000	0.00%	$0
	Contingency		$33,729,331		$40,436,487
	Engineering/Project Management		$11,243,110		$13,478,829
	Total Cost		$157,403,542		$188,703,608

Table 5.3: Alternative Three Segment Component Breakdown

Project No.	Task	Boston-Springfield		Springfield-Montreal	
		Percentage of Work	Cost	Percentage of Work	Cost
1	Install New Turnouts (each)	34.25%	$3,125,000	34.25%	$3,125,000
2	Install New Track (miles)	44.59%	$50,550,000	55.41%	$62,805,000
3	Bridge Rehabilitation (feet)	100.00%	$7,620,000	0.00%	$0
4	Culvert Extensions (each)	34.25%	$102,740	65.75%	$197,260
5	Brush Cutting (miles)	12.34%	$711,744	87.66%	$5,058,029
6	RR Crossing Quadrants (each)	0.00%	$0	100.00%	$7,100,000
7	RR Crossing Surface (each)	5.26%	$125,000	94.74%	$2,250,000
8	Bridge Replacement (feet)	0.00%	$0	100.00%	$4,200,000
9	Bridge Redecking (feet)	100.00%	$1,575,000	0.00%	$0
10	Furnish Ties (each)	34.65%	$11,620,375	65.35%	$21,918,585
11	Install Ties (each)	34.65%	$6,257,125	65.35%	$11,802,315
12	Furnish Rail and OTM (feet)	94.47%	$14,810,880	5.53%	$866,400
13	Install Rail (feet)	94.47%	$10,133,760	5.53%	$592,800
14	Furnish Ballast (tons)	34.21%	$4,319,700	65.79%	$8,305,600
15	Install Ballast (tons)	34.21%	$2,591,820	65.79%	$4,983,360
16	Surfacing (miles)	31.55%	$3,525,878	68.45%	$7,649,278
17	Ballast Undercutting (miles)	0.00%	$0	100.00%	$18,750
18	Grinding Passes (miles)	56.35%	$1,046,400	43.65%	$810,700
19	Install New Diamond (each)	100.00%	$500,000	0.00%	$0
	Contingency		$35,584,627		$42,504,923
	Engineering/Project Management		$11,861,542		$14,168,308
	Total Cost		$166,061,590		$198,356,308

Table 5.4 displays the comparison of all three alternatives side-by-side. The alternatives are compared based on the quantity and cost of each project task. In addition, a 30% contingency and a 10% engineering/project management fee has been included. The proposed track infrastructure improvement cost for Alternative One is $181,968,007, the cost for Alternative Two is $339,949,666, and the cost for Alternative Three is $361,758,744.

Table 5.4: Cost Comparison for All Alternatives

Project No.	Project Task	Unit Cost	Alt. 1 Quantity	Alt. 1 Cost	Alt. 2 Quantity	Alt. 2 Cost	Alt. 3 Quantity	Alt. 3 Cost
1	Install New Turnouts (each)	$125,000	35	$4,375,000	73	$9,125,000	73	$9,125,000
2	Install New Track (miles)	$1,500,000	25	$36,960,000	76	$113,355,000	76	$113,355,000
3	Bridge Rehabilitation (feet)	$4,000	1,170	$4,680,000	1,905	$7,620,000	1,905	$7,620,000
4	Culvert Extensions (each)	$50,000	0	$0	6	$300,000	6	$300,000
5	Brush Cutting (miles)	$21,120	8	$160,512	54	$1,148,928	273	$5,769,773
6	RR Crossing Quadrants (each)	$25,000	10	$250,000	255	$6,375,000	284	$7,100,000
7	RR Crossing Surface (each)	$125,000	12	$1,500,000	19	$2,375,000	19	$2,375,000
8	Bridge Replacement (feet)	$12,000	300	$3,600,000	350	$4,200,000	350	$4,200,000
9	Bridge Redecking (feet)	$1,000	400	$400,000	1,575	$1,575,000	1,575	$1,575,000
10	Furnish Ties (each)	$65	361,651	$23,507,328	466,584	$30,327,960	515,984	$33,538,960
11	Install Ties (each)	$35	361,651	$12,657,792	466,584	$16,330,440	515,984	$18,059,440
12	Furnish Rail and OTM (feet)	$38	389,760	$14,810,880	412,560	$15,677,280	412,560	$15,677,280
13	Install Rail (feet)	$26	389,760	$10,133,760	412,560	$10,726,560	412,560	$10,726,560
14	Furnish Ballast (tons)	$25	328,504	$8,212,600	422,784	$10,569,600	505,012	$12,625,300
15	Install Ballast (tons)	$15	328,504	$4,927,560	422,784	$6,341,760	505,012	$7,575,180
16	Surfacing (miles)	$10,600	526	$5,572,738	836	$8,860,540	1,054	$11,175,156
17	Ballast Undercutting (miles)	$125,000	0.2	$18,750	0.2	$18,750	0.2	$18,750
18	Grinding Passes (miles)	$2,500	716	$1,791,000	717	$1,792,575	743	$1,857,100
19	Install New Diamond (each)	$500,000	0	$0	1	$500,000	1	$500,000
	Contingency (all costs)	**30%**	**133,557,920**	**$40,067,376**	**247,219,393**	**$74,165,818**	**263,173,499**	**$78,952,050**
	Eng/Prjct. Mgmt	**10%**	**83,427,112**	**$8,342,711**	**185,644,553**	**$18,564,455**	**196,331,959**	**$19,633,196**
	Total Cost			**$181,968,007**		**$339,949,666**		**$361,758,744**

Total costs for track construction and bridge construction are displayed in Table 5.5. Costs are broken down by alternative and route segment. 30% Contingencies and 10% engineering/project management costs have also been included. Total costs for each segment and each alternative are displayed with and without the contingency and fees added on.

Communications and signal costs are estimated in Table 5.6. The costs given are in 2014 dollars and the values include the total estimated costs to upgrade the entire corridor. Alternative One has the least amount of proposed communications and signal upgrades while Alternative Three has the most.

All total final costs are displayed in Table 5.7. Costs are broken down by track construction costs, bridge construction costs, signal costs, and trainset costs. All initial track and bridge costs are referenced from Table 5.5 and communication and signal costs are referenced from Table 5.6. Trainset costs were determined based on the number of trainsets proposed (11 for Alternative One, 17 for Alternative Two, 18 for Alternative Three) multiplied by the estimated base trainset cost ($26.7 million for Alternatives One and Two and $32.1 for the tilt set for Alterative Three). To be conservative, track and bridge costs have 30% and 50% inflation rates added on and are displayed as such. Signal costs and trainset costs have no inflation added for the lower estimated price and a 30% inflation rate added for the higher estimated price. The last row of Table 5.7 displays the total capital costs with 30% and 50% inflation. These are the final values used to assess the cost of each alternative. Total capital costs are approximately $625-800 million for Alternative One, $1.065-1.350 billion for Alternative Two and $1.250-1.590 billion for Alternative Three.

Table 5.5: Track and Bridge Construction Costs

Boston - Springfield	Alt. 1	Alt. 2	Alt.3
Track Construction Costs	$64,731,938	$103,236,102	$109,420,422
Bridge Construction Costs	$5,080,000	$9,195,000	$9,195,000
Contingency	$20,943,581	$33,729,331	$35,584,627
Engineering/Project Management Costs	$6,981,194	$11,243,110	$11,861,542
Total Costs	**$97,736,713**	**$157,403,542**	**$166,061,590**
Springfield - Montreal	**Alt. 1**	**Alt. 2**	**Alt.3**
Track Construction Costs	$60,145,982	$130,588,291	$140,358,077
Bridge Construction Costs	$3,600,000	$4,200,000	$4,200,000
Contingency	$19,123,795	$40,436,487	$43,367,423
Engineering/Project Management Costs	$1,361,517	$7,321,345	$7,771,654
Total Costs	**$84,231,294**	**$182,546,124**	**$195,697,154**
Project Component	**Alt. 1**	**Alt. 2**	**Alt.3**
Track Construction Costs	$124,877,920	$233,824,393	$249,778,499
Bridge Construction Costs	$8,680,000	$13,395,000	$13,395,000
Contingency	$40,067,376	$74,165,818	$78,952,050
Engineering/Project Management Costs	$8,342,711	$18,564,455	$19,633,196
Total Costs	**$181,968,007**	**$339,949,666**	**$361,758,744**

Table 5.6: Communication and Signal Costs

	Communications and Signals Cost Estimate
Alternative 1	$96,777,906
Alternative 2*	$174,145,353.00
Alternative 3	$207,864,393.00

Table 5.7: Total Capital Costs

		Alt 1 + 30% Inflation	Alt 1 + 50% Inflation	Alt 2 + 30% Inflation	Alt 2 + 50% Inflation	Alt 3+ 30% Inflation	Alt 3 + 50% Inflation
Boston to Springfield	Track Construction Costs	$113,604,551	$139,820,986	$170,339,568	$190,986,788	$180,543,696	$202,427,780
	Bridge Construction Costs	$8,915,400	$10,287,000	$15,171,750	$17,010,750	$15,171,750	$17,010,750
	Total Costs	**$122,519,951**	**$150,107,986**	**$185,511,318**	**$207,997,538**	**$195,715,446**	**$219,438,530**
Springfield to Montreal	Track Construction Costs	$99,240,870	$111,270,067	$215,470,681	$241,588,339	$231,590,827	$259,662,443
	Bridge Construction Costs	$5,940,000	$6,660,000	$6,930,000	$7,770,000	$6,930,000	$7,770,000
	Total Costs	**$105,180,870**	**$117,930,067**	**$222,400,681**	**$249,358,339**	**$238,520,827**	**$267,432,443**
Total Track Construction Costs		$219,160,749.6	$269,736,307.2	$410,361,809.72	$505,060,688.88	$438,361,265.39	$539,521,557.41
Total Bridge Construction Costs		$15,233,400.0	$18,748,800.0	$23,508,225.00	$28,933,200.00	$23,508,225.00	$28,933,200.00
Total Signal Cost (not inflated)		$96,777,906.0	$125,811,277.80	$174,145,353.00	$226,388,958.90	$207,864,393.00	$270,223,710.90
Total Infrastructure		**$331,172,055.60**	**$414,296,385.0**	**$608,015,387.7**	**$760,382,847.8**	**$669,733,883.4**	**$838,678,468.3**
Total Trainset cost (not inflated)		$293,700,000	$381,810,000	$453,900,000	$590,070,000	$577,800,000	$751,140,000
Total Capital Cost		**$624,872,055.6**	**$796,106,385.0**	**$1,061,915,387.7**	**$1,350,452,847.8**	**$1,247,533,883.4**	**$1,589,818,468.3**

C. SIGNALS AND COMMUNICATIONS CAPITAL COST METHODOLOGY

These capital cost estimates focus on improvements to the rail line between Boston, MA and Montreal, QC via Springfield, MA. *Alternative 1* involves keeping the existing speeds along the line, and operating three new passenger trains per day in each direction (plus the existing *Vermonter*) on the New England Central (NECR). Improvements include bringing all interlockings and wayside signaling in the United States up to a state of good repair. Based on site visits, 20 signals (78%) along the NECR in Vermont, and five signals (40%) between Worcester, MA and Springfield, MA (CSX) would require replacement to achieve good repair.

Figure 1: Northbound signal at the diamond crossing of the NECR and GMRC in Bellows Falls, VT dates from the 1960s and has reached the end of its useful life.

Centralized Traffic Control (CTC) will be added over the areas of the NECR that are currently under Track Warrant Control (TWC). This includes the section from East Northfield, MA to West River, VT and from White River Jct. VT to the Canadian border at Alburgh, VT. To upgrade to CTC in these Vermont areas, 57 intermediate signals will be installed approximately every two miles along the line and interlocking signals will be added at both ends of seven existing passing sidings intended for use in this area. These sidings are located at St. Albans, Oakland (Georgia), Berlin, Roxbury, Bethel, S. Royalton, and Hartland. Three additional Massachusetts sidings at Northfield, Greenfield, and Deerfield along the Knowledge Corridor (PanAm) from Springfield to East Northfield are also funded as part of Alternative 1 as those improvements are not part of the currently funded Knowledge Corridor project.

Positive Train Control (PTC) is not required under Alternative 1 because the corridor will be equipped with full CTC, will not exceed a 79 mph speed at any location and will not exceed 12 one-way passenger train trips per day.

Figure 2: NECR crossing of Stearns Rd. in Royalton, VT. Five roads converge on the crossing, which is protected by crossbucks.

Alternative 2 involves increasing speeds along the line to 79 mph and increasing new passenger service to three local and two high speed trips per day in each direction. To meet the speed and service goals of Alternative 2, in addition to the upgrades made in Alternative 1, all grade crossings along the corridor will be brought into a state of good repair. This includes replacing grade crossing warning devices that have reached the end of their useful life as well as upgrading unequipped public crossings with active warning devices at 83 locations along the NECR and 3 locations along the CSX section. It also includes installing new passive signage at 161 private crossings of the NECR and 13 private crossings of CSX.

To accommodate increased passenger service, five additional sidings along the NECR were included for signaling upgrades. These sidings are located at: Swanton, Fonda Jct. (Swanton), Bolton Valley, Randolph and, Brattleboro.

Table 1: Corridor C&S State of Good Repair Costs

Railroad	Grade Crossings	Wayside and Interlocking Signaling	Railroad Totals Good Repair
MBTA	$0	$0	$0
CSX	$2,700,000	$7,500,000	$10,200,000
PanAm	$0	$0	$0
CN	Not Included	Not Included	Not Included
Totals	$68,100,000	$29,100,000	$97,200,000

Alternative 3 increases speeds along the line to 90 mph and also increases new passenger service to three local and two high speed trips per day in each direction. The main additional cost element of Alterative 3 is the implementation of Positive Train Control (PTC) along the entire length of the corridor which is required due to operation at speeds greater than 79 mph. According to FRA regulations, trains may not exceed 79 MPH unless they have operative cab signals, which could cause compatibility issues with freight equipment. Therefore, PTC equipment is preferred in Alternative 3. PTC will be funded separately on the MBTA controlled section, but will require implementation on the corridor from Worcester to Alburgh. PTC expenses include new supervisory control systems at each railroad's dispatching office, outfitting locomotives with PTC systems (applies to the NECR only), and outfitting all switch and signal locations with PTC equipment, including industrial sidings. This results in 140 wayside PTC installations (99 of which are along the NECR). The NECR must also add PTC communications to its 17 active locomotives, a cost that the railroad would not incur but for the Alternative 3 operating speed.

Table 1 – Communications and Signals Capital Cost: Alternative 1

	State of Good Repair Costs		Capital Improvements Expenditures: Alternative 1			
Railroad	Grade Crossings*	Wayside and Interlocking Signaling	Grade Crossings	Wayside and Interlocking Signaling	PTC	Railroad Totals Alternative 1
MBTA	$0	$0	$0	$0	$0	$0

CSX	$0	$7,500,000	$0	$18,500,000	$0	$26,000,000
PanAm	$0	$0	$0	$5,400,000	$0	$5,400,000
NECR	$0	$21,600,000	$0	$43,800,000	$0	$65,400,000
CN	Not Included		Not Included			
Totals	$0	$29,100,000	$0	$67,700,000	$0	$96,800,000

*Costs for bringing all public crossings to a State of Good Repair, including active warning devices at all public crossings not currently equipped, were not considered in this alternative.

Table 3 – Communications and Signals Capital Cost: Alternative 2

	State of Good Repair Costs		Capital Improvements Expenditures: Alternative 1			
Railroad	Grade Crossings	Wayside and Interlocking Signaling	Grade Crossings	Wayside and Interlocking Signaling	PTC	Railroad Totals Alternative 1
MBTA	$0	$0	$0	$0	$0	$0
CSX	$2,700,000	$7,500,000	$0	$18,500,000	$0	$28,600,000
PanAm	$0	$0	$0	$5,400,000	$0	$5,400,000
NECR	$65,400,000	$21,600,000	$0	$53,000,000	$0	$140,100,000
CN	Not Included					
Totals	$68,100,000	$29,100,000	$0	$76,900,000	$0	$174,100,000

Table 4 – Communications and Signals Capital Cost: Alternative 3

	State of Good Repair Costs		Capital Improvements Expenditures: Alternative 1			
Railroad	Grade Crossings	Wayside and Interlocking Signaling	Grade Crossings	Wayside and Interlocking Signaling	PTC	Railroad Totals Alternative 1
MBTA	$0	$0	$0	$0	$0	$0
CSX	$2,700,000	$7,500,000	$0	$18,500,000	$6,800,000	$35,500,000
PanAm	$0	$0	$0	$5,400,000	$5,000,000	$10,400,000

NECR	$65,400,000	$21,600,000	$0	$53,000,000	$21,900,000	$162,000,000
CN	Not Included		Not Included			
Totals	$68,100,000	$29,100,000	$0	$76,900,000	$33,700,000	$207,900,000

D. SUPPLEMENTARY RIDERSHIP ANALYSIS

Supplementary ridership alternatives are included in the NNEIRI study to better understand the impact of travel time on ridership and to isolate this variable from service levels in the three alternatives. Variant 1A compares ridership with the service frequencies of Alternative 1 and the speeds of Alternative 2. Variant 2A compares ridership with the service frequencies of Alternative 2 but utilization of tilting equipment.

Table 1 profiles Alternatives 1-3 with the two supplementary ridership analysis variants, including maximum speed, equipment type, service frequencies, and projected operating times on key segment pairs.

Table 1: Comparison of NNEIRI Alternatives with Supplementary Ridership Analysis

Alternative*	Maximum Speed	Equipment Type	Service Type	BOS to SPG Service		BOS to NHV Service		SPG to MTL Service	
				Round Trips	Run Time	Round Trips	Run Time	Round Trips	Run Time
Alt. 1	60 MPH**	Standard	Local	6	2:12	4	3:52	3	7:08
			Express	NA	NA	NA	NA	NA	NA
1A	79 MPH	Standard	Local	6	2:01	4	3:41	3	6:35
			Express	NA	NA	NA	NA	NA	NA
Alt. 2	79 MPH	Standard	Local	5	2:01	4	3:41	3	6:35
			Express	5	1:52	4	3:32	2	6:17
2A	79 MPH	Tilt	Local	5	1:55	4	3:35	3	6:15
			Express	5	1:45	4	3:25	2	5:54
Alt. 3	90 MPH	Tilt	Local	11	1:51	4	3:31	3	6:04
			Express	5	1:41	4	3:21	2	5:44

*Fare structure is consistent among alternatives

**Maximum speed will vary where existing operating speeds are higher

Faster speeds in variant 1A increased ridership approximately 10% over Alternative 1, increasing from 526,900 to 579,000 annually. Variant 2 ridership increased approximately 3% from Alternative 2, increasing from 981,500 to 1,019,800 annual riders. The results were used to test ridership responsiveness to faster travel times compared with service frequencies.

E. RIDERSHIP FORECASTING METHODOLOGY

1. Introduction

This section presents the methodology report of AECOM's development and application of an intercity passenger rail ridership forecasting model for the Inland Route & Boston-to-Montreal High-Speed Rail Corridors. The study was conducted for the Commonwealth of Massachusetts with the participation of the State of Vermont and the State of Connecticut. The Inland Route rail corridor connects the cities of Boston, MA, and New Haven, CT, via the cities of Worcester, MA, and Springfield, MA. The Boston-to-New Haven corridor via Springfield has been identified as the Inland Route to differentiate it from the Northeast Corridor, which also connects the two cities. The study's Boston-to-Montreal rail corridor connects the cities of Boston, MA and Montreal, QC, via the cities of Springfield, MA and White River Junction, VT.

The model is based on travel market data throughout Massachusetts, Connecticut (and Northeast Corridor) and Vermont, historical rail ridership data and trends, and demographic data. Other models providing a foundation for the model development for this study include models developed for Amtrak's Northeast Corridor, Southeast Corridor, California Corridor, Florida and the Midwest States.

Below is a list of inputs required to complete the analysis:

- Rail schedules for the Inland Route & Montreal services.
- Geographic zone system covering the entire study area.
- Highway network connecting all the zones, all the rail stations and all the airports in the study area.
- Socio-economic data for the zone system.
- Ridership information for the Massachusetts, Connecticut and Vermont State services.
- Travel characteristics for auto, air, and rail.

2. Study Area Geography

The study area includes the states of Massachusetts, Connecticut, Vermont and Southern New Hampshire, Montreal, QC metro area (Montreal, Monteregie, Laval) and New York metro area (New York City, Nassau County, Suffolk County, and Bergan County, NJ).

A geographic based zone system was developed for this study area. This zone system defines the geographic level of detail at which the intercity travel demand forecasting process is applied. The zone system is based on census division for the entire study area. The zone system prepared for the Northeast corridor study was used as the starting point to create the zone system for this study. This current study is focused around the geographic area surrounding the Boston-Springfield-Hartford-Montreal-New York metro area. Exhibit 1 shows the study area zone system consisting of a total of 74 zones along the study area corridor and Exhibit 2 shows aggregated system for regions, consisting of groups of zones, with 12 major markets for data display and summary purposes.

Exhibit 1: Study Area Zone System

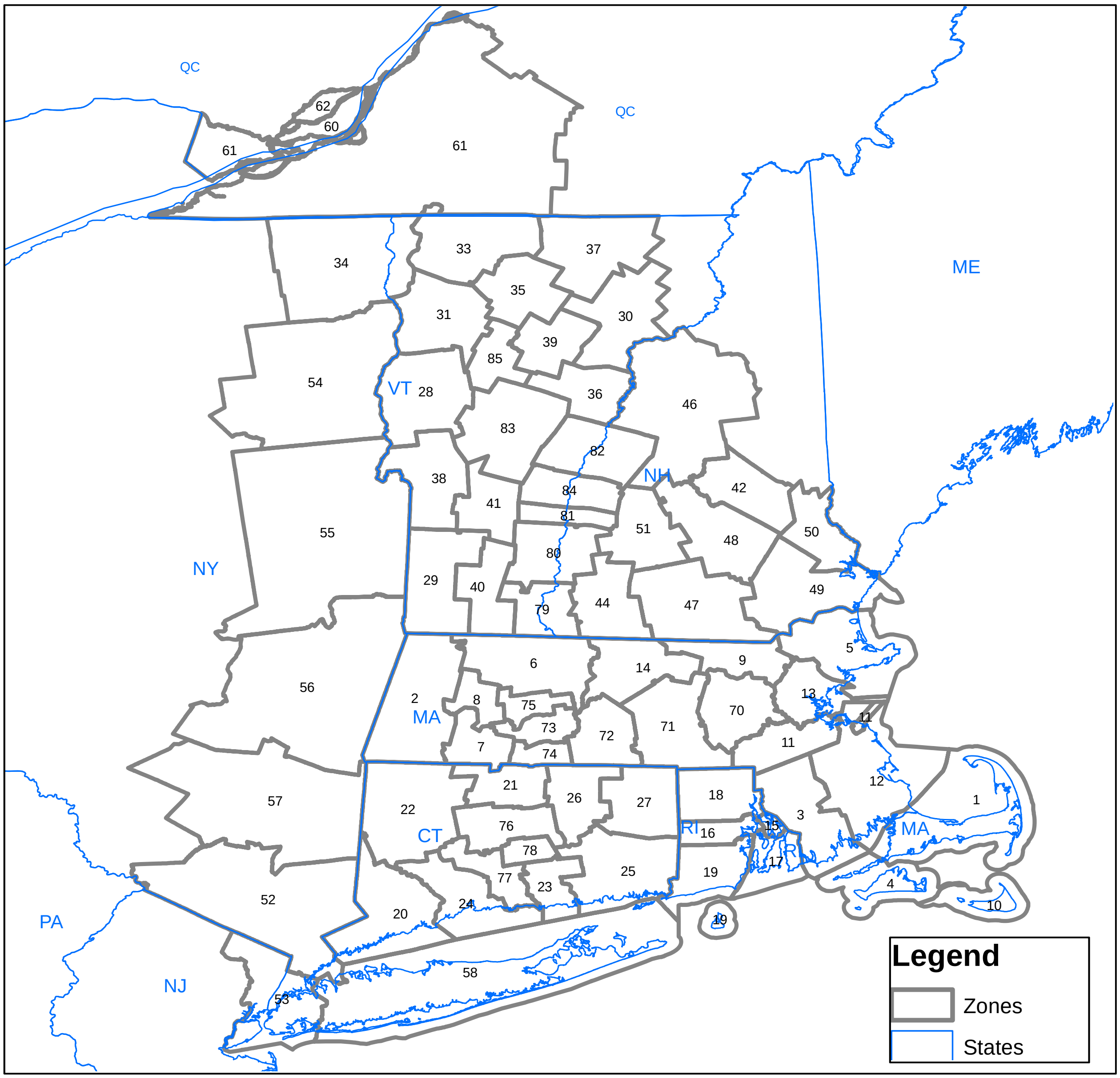


Exhibit 2: Study Area Regions

3. Base Travel Market Data

Intercity passenger travel market data for this study were assembled from a number of different existing sources. These sources include socio-economic and travel related service characteristics for the study markets. The scope of the study included relying as much as possible on existing travel survey data as opposed to collecting new travel survey data. In the current study, travel related service data is collected from the publicly available resources and socioeconomic data was obtained from AECOM's commercial vendor-Economy.com.

4. Base Auto Market Data

Base auto market data was assembled using two sources: a) For the New England major markets, zonal base auto market data was estimated using the NEC Intercity Auto Origin-Destination study provided by Northeast Corridor Commission b) For the rest of study area, zonal base auto market data was estimated using socio-economic characteristics including population, employment and income and travel related service characteristics including distance and travel time. The basis for socio-economic and travel related service data are further described in the following Chapters 4 and 5.2 respectively. The auto market estimation process is also the basis for most of the other nationwide studies conducted for Amtrak.

5. Base Rail Market Data

Amtrak currently provides different types of services in the study area:

- Vermonter trains originating in St Albans, VT providing service to Vermont stations, Springfield, Hartford and New York
- Northeast Regional trains originating in Springfield providing service to Hartford, New Haven, and New York
- Lake Shore trains originating in Boston providing service to Springfield continuing to Chicago, IL

Commuter services included in the study area:

- Hartford Commuter services providing service between Hartford and New Haven

Market data for rail travel were developed from station-to-station Amtrak ridership provided by Amtrak. Exhibit 3 below summarizes existing Amtrak service in the corridor providing the number of daily round trips serving a selection of major stations. The daily round trips in the exhibit provide summary for the different type of services in the corridor.

Table 3: **Summary of Existing Inland Route Corridor Train Services**

Service	Regional	Lakeshore	Vermonter	Total
Boston - Springfield	0	1	0	1
Springfield - New Haven	5	0	1	6
St-Albans - Springfield	0	0	1	1

6. Base Air Market Data

Air market data i.e., airport-to-airport volume data, were developed from the Federal Aviation Administration (FAA) 10 percent ticket sample and other similar sources. Major airports serving the study area include:

- General Edward Lawrence Logan International (BOS)
- Bradley International (BDL)
- Montreal International Airport (YUL)
- Burlington International (BTV)
- Manchester Boston Regional (MHT)
- New York Airports (JFK, EWR, LGA)

Exhibit 4 below summarizes the travel time, distance and average fare for the major market airport pairs.

Exhibit 4: Summary for Major Market Airport Pairs

Origin	Destination	Fare	Time (mins)
BOS	JFK	$128	141
BOS	YUL	$287	75
BDL	YUL	$300	80
EWR	YUL	$200	90
BTV	LGA	$147	204
JFK	BTV	$115	80
JFK	MHT	$165	69

7. Summary of Base Market Data

Exhibit 5 summarizes the total estimated 2012 person trip volumes by trip purpose along the corridor for travel between different regions within the study area. The trip table estimation is based on combination of base auto, rail and air market data described in the above chapter. The trips by purpose are estimated using the NEC Auto Intercity OD Data trip purpose percentage share for the inland region.

Exhibit 5: Summary of 2012 Estimated Total Person Trips

Region to All Other Regions	Total	Business	Recreate	Other
Boston	1,298,103,460	197,557,741	267,448,451	833,097,267
Worcester	87,247,773	13,278,197	17,975,672	55,993,905
Springfield	270,648,342	41,189,841	55,761,719	173,696,782
Hartford	316,541,445	48,174,290	65,217,082	203,150,073
New Haven	340,097,391	51,759,258	70,070,317	218,267,816
New York	1,426,645,887	217,120,551	293,932,067	915,593,268
Southern VT-NH	320,232,510	48,736,032	65,977,552	205,518,926
Northern VT	270,978,027	41,240,016	55,829,644	173,908,367
Montreal	1,583,705,922	241,023,443	326,291,170	1,016,391,310

Note: Trips represent total person trips in both directions

8. Market Growth

Socio-economic data and forecasts were used to estimate market growth. These data were obtained from AECOM's national vendor Economy.com; which provides the forecasting data at annual intervals up to 2040 by county level. The three socio-economic indicators used in this project include:

- Population
- Employment
- Per Capita Income

Socio-economic data were obtained from the following sources:

- Economy.com
- Institute of Statistics of Quebec

Economy.com provided all the population and employment forecast, at the county level, for the study area within the United states region; whereas Institute of Statistics of Quebec was used for the study area within the Quebec, Canada region. The county level forecast was then projected at the census division level to eventually estimate the data at the zonal level.

Exhibit 6 below provides a summary of 2012, 2020 and 2035 socio-economic data for the market regions within the study area.

Exhibit 6: Summary of Socio-Economic Data

	2012			2020			2035		
Market Name	**Pop**	**Emp**	**Per Cap**	**Pop**	**Emp**	**Per Cap**	**Pop**	**Emp**	**Per Cap**
Boston	5,674,830	2,910,242	48,947	5,882,427	3,195,636	60,146	6,050,430	3,343,694	81,244
Worcester	748,537	302,598	39,866	774,491	318,569	48,860	793,879	321,037	65,856
Springfield	789,607	336,977	35,947	813,241	355,439	43,869	825,749	366,427	60,817
Hartford	1,238,716	614,918	46,686	1,263,739	662,729	56,502	1,300,105	666,696	74,141
New Haven	1,029,302	432,847	44,419	1,049,871	459,087	52,683	1,082,200	466,249	66,991
New York	15,418,498	6,956,140	51,386	15,776,480	7,737,659	61,708	16,456,999	8,155,933	80,604
Providence	1,045,991	463,865	39,122	1,062,363	503,659	46,067	1,093,987	515,425	58,872
New London	392,863	170,941	39,304	403,473	186,727	48,203	420,803	191,006	64,427
Southern VT-NH	636,913	309,191	37,807	653,459	340,832	43,877	676,098	357,119	55,899
Nothern VT	527,516	254,236	35,777	540,605	271,773	37,911	555,186	300,784	43,869
Montreal	3,861,642	1,939,300	46,254	4,077,023	2,048,772	46,051	4,480,863	2,254,031	45,721
Barnstable	245,223	112,515	50,703	256,120	117,943	60,070	269,689	125,586	80,915

9. Travel Demand Model and Inputs

The travel demand modeling approach used in this project is based on a model system developed by AECOM and used in many previous applications to evaluate proposed intercity and high speed rail services for several states and Amtrak throughout the country. The travel demand model was originally developed from extensive market research and observed travel volumes and service characteristics by mode, conducted/assembled in the various study corridor markets including Northeast, Southeast and other regions. For application in this study area, data describing travel within the Massachusetts, Connecticut, Vermont and Southern New Hampshire, Montreal, QC metro area and New York metro area was used, including existing person trips by mode and purpose, and population/employment market growth, as described above.

10. Model Structure

The travel demand forecasting approach utilizes a two-stage model system. The first stage forecasts the growth in the total number of person trips in each market, and the second stage predicts the market share of each available mode in each market. Both stages are dependent on the service characteristics of each mode and the socio-economic characteristics of the corridor. The key markets addressed in the forecasting model system are defined by geographical location (i.e., origin-destination zone pair).

The first stage addresses the growth in the total intercity person travel volumes. This includes “natural” growth and “induced” demand. The “natural” growth component is measured by the growth in population and total non-farm employment. The “induced” component is captured by including a measure of the composite level of modal service, represented by the sum of the exponentiated utilities of all available modes as expressed in the mode share model, within the total travel model.

The second stage of the model is the mode share component, which estimates the share of total person travel by mode. Three different modes of travel are considered: auto, rail, and air. Key variables in the mode share model include:

- Line haul travel time for all modes
- Access/egress time for rail and air
- Travel cost or fare
- Frequency of service for rail and air

Total market-to-market frequencies were scaled based on arrival and departure times of each train serving the market. These scaling factors are based on the observed performance of trains in different departure/arrival time slots within rail corridors throughout the US. A train’s utility and market share is determined by the combination of arrival and departure factors along with the time to the previous and subsequent trains, travel time, cost, access/egress times and on-time performance.

11. Network and Service Characteristics

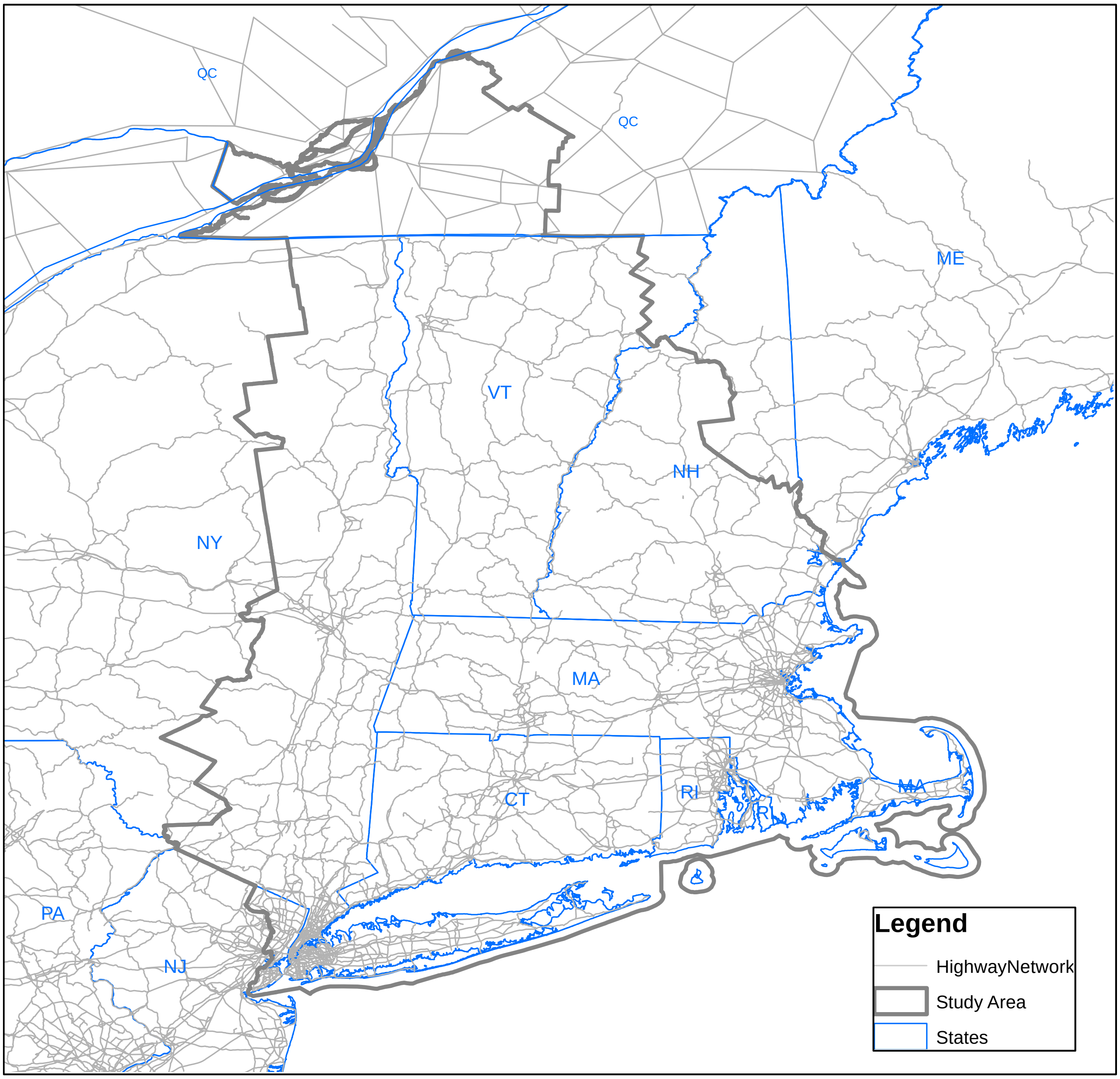
Service characteristics are the key independent variable for the mode choice modeling process. The model in this project uses the following service characteristics:

- Travel time (minutes)
- Travel cost (dollars)
- Frequency (air and rail departures per day)

12. Highway Network and Auto Service Characteristics

The auto service characteristics for each study area zone pair, including time, distance, and cost; were developed using a GIS-based intercity highway network. The network was derived from the Oak Ridge National Laboratory’s existing highway database. Several modifications were made to match the highway network characteristics including functional classification within the study area for the states within the study area. Exhibit 7 shows the resulting highway network, for the study area.

Exhibit 7: Study Area Highway Network


QC
QC
ME
VT
NH
NY
MA
CT
RI
MA
PA
NJ
Legend
HighwayNetwork
Study Area
States

In order to create zone-to-zone minimum travel times, a set of network skims were produced using an ArcGIS based application called Network Analyst. Network Analyst was used to calculate the minimum path, based on minimizing congested travel time, to/from each of the zone centroids in the study area. Each minimum path calculation developed the time, distance, and toll costs associated with the trip. Using the same procedure, access and egress times were calculated for all rail stations and airports within the study area.

This process produced zone-to-zone distance, toll, and time matrices based on the minimum congested travel time route between each study area zone pair. Exhibit 8 below summarizes the auto distance and congested travel time for the key markets in the corridor. It should be noted that the zone-to-zone estimated congested travel times may be higher than the Google/Mapquest travel times because of the in-route traffic congestion delays.

Exhibit 8: Summary of Auto Trip Characteristics for Key Markets

Origin	Destination	Distance (mi)	Avg. Time (mins)*
Boston	Montreal	342	360
Boston	Springfield	95	119
Springfield	Montreal	310	325
Springfield	New York	140	190
Worcester	New Haven	98	122

* includes estimated delays in route due to congestion, etc.

Also in the above summary the origin and the destination for the markets represent the study area zonal centroids not necessarily the exact city center.

13. Rail and Air Service Characteristics

Travel characteristics for rail and air travel were developed for each study area zone pair. The travel characteristics for rail and air were based on published timetables and the highway network. The key characteristics include line haul time, frequency of service, fares, terminal times, access/egress times and costs, and rail on-time performance. The line haul time is the scheduled rail/air time between stations/airports.

Published Amtrak timetables (2013) and airline data (2012), obtained from Bureau of Transportation Statistic (BTS), provide the basis for quantifying the line haul time and frequency of service in each market. Average rail fares were computed by dividing actual Amtrak revenue by ridership and average air fares were computed by the dividing the total market fare by total passengers obtained from BTS.

The access/egress times and costs include the time/cost traveling from the origin zone to the boarding rail station/airport; the time/cost associated with the station, including waiting/boarding times and parking costs; and the time/cost traveling from the destination station/airport to the final destination zone. Access/egress times and costs for travel between zones and stations/airports were developed using the same network procedure and cost per mile rates described above and used for the auto zone-to-zone travel characteristics.

14. Model Calibration

The mode choice model was calibrated to match existing ridership within the study area. The calibration process involved running the model using the time, cost, and frequency characteristics of the existing Amtrak service, with current population, employment and income data. The model parameters were then adjusted until the forecasted output corresponded with the actual ridership data.

F. REVENUE FORECASTING METHODOLOGY

This document presents ridership and revenue forecasts for future operating alternatives providing passenger rail service within the Inland Route & Boston-to-Montreal High-Speed Rail Corridors. These forecasts were prepared using a travel demand forecasting model process and key input data and assumptions described in the a separate document titled “Inland Route & Boston-to-Montreal High-Speed Rail Corridor: Travel Market Study”.

1. Future Rail Service Alternatives

Ridership and revenue forecasts were prepared for Baseline (current service only) and the following five (5) future service improvement alternatives:

- Alternative 1, providing a maximum operating speed of 60 miles-per-hour and the following service frequencies:
  - 7 round trips between Boston and Springfield, including:
    - 4 round trips that operate through Springfield to/from New Haven
    - 2 round trips that operate through Springfield to/from Montreal
    - the Lake Shore Limited
  - 4 round trips between Montreal and Springfield
    - 2 round trips that operate through Springfield to/from New Haven
    - 2 round trips that operate through Springfield to/from Boston
- Alternative 1A, providing a maximum operating speed of 79 miles-per-hour and the following service frequencies:
  - 7 round trips between Boston and Springfield, including:
    - 4 round trips that operate through Springfield to/from New Haven
    - 2 round trips that operate through Springfield to/from Montreal
    - the Lake Shore Limited
  - 4 round trips between Montreal and Springfield
    - 2 round trips that operate through Springfield to/from New Haven
    - 2 round trips that operate through Springfield to/from Boston
- Alternative 2, providing a maximum operating speed of 79 miles-per-hour and the following service frequencies:
  - 12 round trips between Boston and Springfield, including:
    - 8 round trips that operate through Springfield to/from New Haven (4 with local service to all stops; 4 with express limited stop service)
    - 3 round trips that operate through Springfield to/from Montreal (1 with local service to all stops; 2 with express limited stop service)
    - the Lake Shore Limited
  - 6 round trips between Montreal and Springfield
    - 3 round trips that operate through Springfield to/from New Haven (1 with local service to all stops; 2 with express limited stop service)

        - 3 round trips that operate through Springfield to/from Boston (1 with local service to all stops; 2 with express limited stop service)
- Alternative 2A, providing a maximum operating speed of 79 miles-per-hour with tilt equipment and the following service frequencies:
    - 12 round trips between Boston and Springfield, including:
        - 8 round trips that operate through Springfield to/from New Haven (4 with local service to all stops; 4 with express limited stop service)
        - 3 round trips that operate through Springfield to/from Montreal (1 with local service to all stops; 2 with express limited stop service)
        - the Lake Shore Limited
    - 6 round trips between Montreal and Springfield
        - 3 round trips that operate through Springfield to/from New Haven (1 with local service to all stops; 2 with express limited stop service)
        - 3 round trips that operate through Springfield to/from Boston (1 with local service to all stops; 2 with express limited stop service)
- Alternative 3, providing a maximum operating speed of 90 miles-per-hour with tilt equipment and the following service frequencies:
    - 17 round trips between Boston and Springfield, including:
        - 8 round trips that operate through Springfield to/from New Haven (4 with local service to all stops; 4 with express limited stop service)
        - 3 round trips that operate through Springfield to/from Montreal (1 with local service to all stops; 2 with express limited stop service)
        - 5 round trips that do NOT operate beyond Springfield (4 with local service to all stops; 1 with express limited stop service)
        - the Lake Shore Limited
    - 6 round trips between Montreal and Springfield
        - 3 round trips that operate through Springfield to/from New Haven (1 with local service to all stops; 2 with express limited stop service)
        - 3 round trips that operate through Springfield to/from Boston (1 with local service to all stops; 2 with express limited stop service)

All alternatives assume the same average fares, which reflect current average fare values, extrapolated for new markets based on mileage. For key markets, the resulting average fares are:

- Montreal-Springfield: $49
- Montreal-Worcester: $58
- Montreal-Boston: $64
- Montreal-New Haven: $58
- White River Junction-Springfield: $32
- White River Junction-Worcester: $41
- White River Junction-Boston: $47
- White River Junction-New Haven: $44
- Boston-Springfield: $25
- Boston-New Haven: $45

- Worcester-Springfield: $17
- Worcester-New Haven: $35
- Springfield-New Haven: $20

All alternatives also assume full implementation of the New Haven-Hartford-Springfield service at 23 round trips between Springfield and New Haven, with a mix of Intercity Regional Service, Inland Route Service (including all of the service to/from New Haven described above), and Hartford Commuter Service. Existing parallel train services provided along the NEC Spine Shoreline Route (Boston-New Haven via Providence) and by the Adirondack (Montreal-New York) remain at current levels of service.

The exhibits on the following pages provide schematic representations of these future services. Exhibit 1 shows service under Alternatives 1 and 1A, Exhibit 2 shows service under Alternatives 2 and 2A, and Exhibit 3 shows service under Alternative 3.

Exhibit 1: Alternative 1 & 1A Service

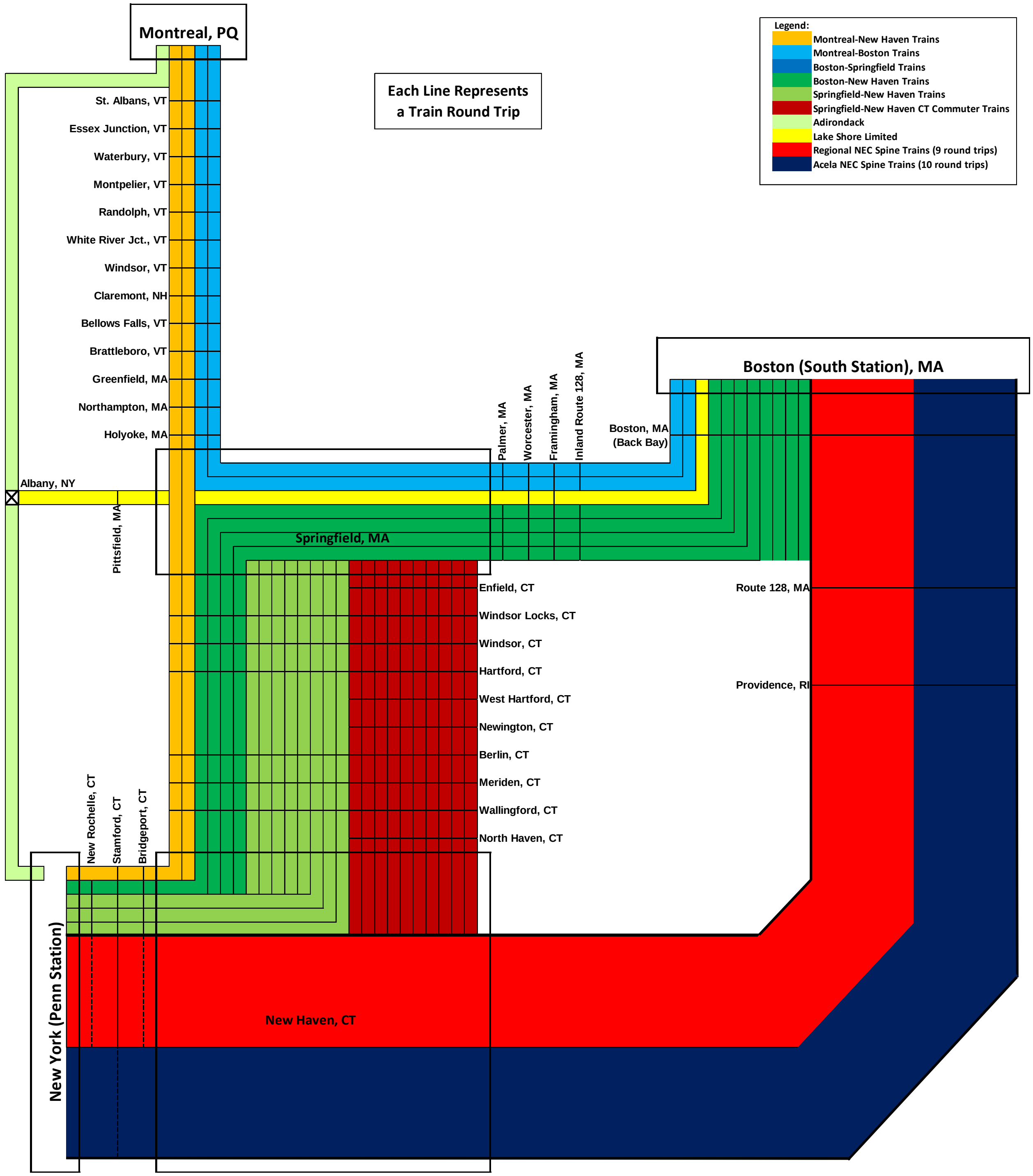


Exhibit 2: Alternative 2 & 2A Service

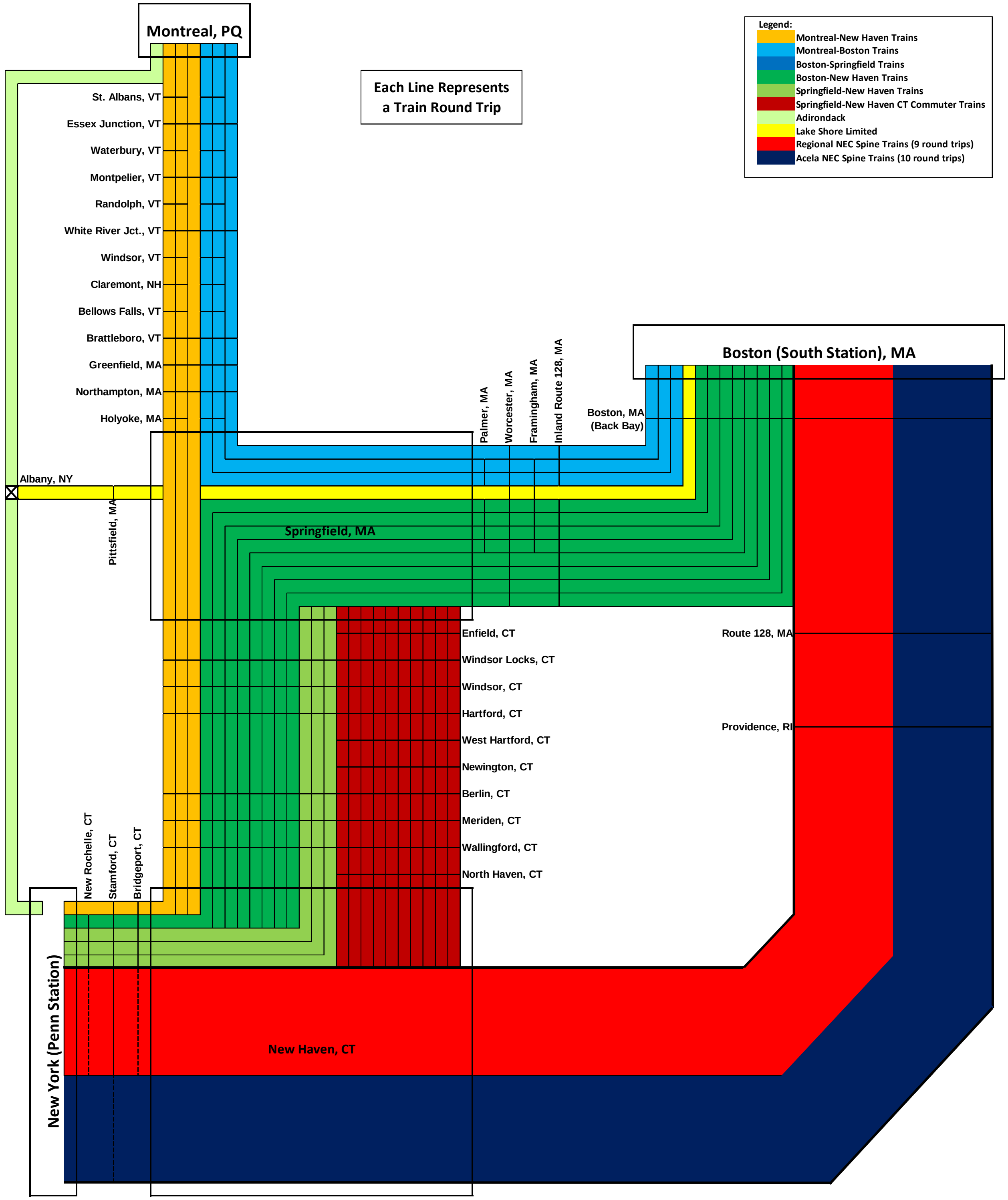
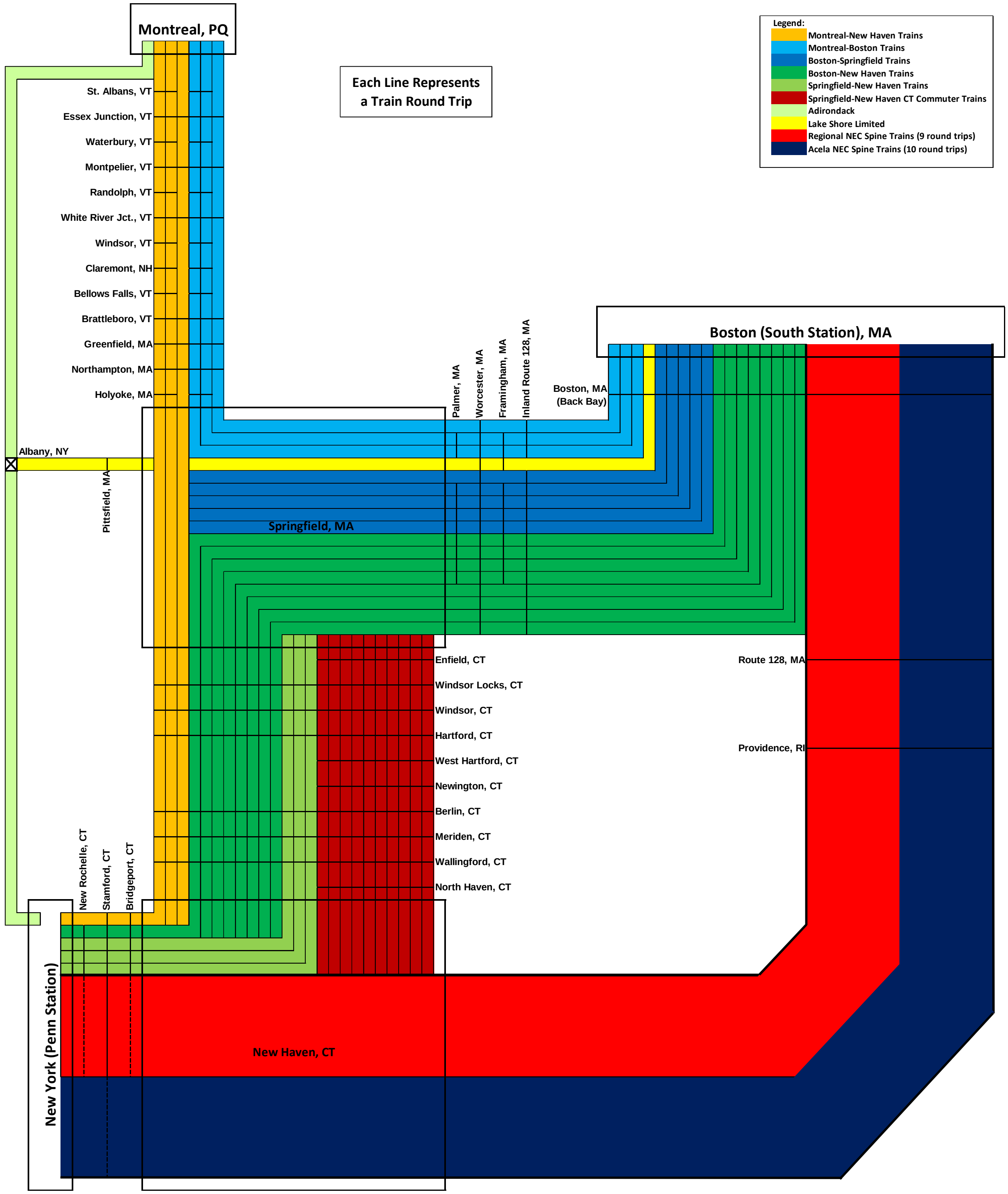


Exhibit 3: Alternative 3 Service



2. Rail Ridership and Revenue Forecasts

Exhibit 4 below summarizes the ridership and revenue forecasts in total and by segment for each alternative for year 2020. Revenue is simply the product of ridership and average fare, by market. As described earlier, all alternatives assume the same fare levels, which reflect current average fare values extrapolated for new markets based on mileage. Where express and local services are provided, fares are likewise the same. Overall train service levels by market are summarized at the top of this exhibit and by segment following the ridership figures (train round trips) for each alternative.

Exhibit 4: 2020 Ridership and Revenue Forecasts

	Baseline Ridership on Inland Trains	Alt 1	Alt 1A	Alt 2	Alt 2A	Alt 3
MAX Speed		60mph	79mph		79 w/ tilt	90 w/ tilt
Stopping Pattern		Local Only	Local Only	Local & Express	Local & Express	Local & Express
Frequency (round trips) BOS-SPG		7	7	12	12	17
BOS-NHV		4	4	8	8	8
MTR-SPG		4	4	6	6	6
MTR-NHV		2	2	3	3	3
TOTAL ANNUAL RIDERSHIP*	71,000	597,900	650,900	1,052,500	1,090,800	1,170,700
INCREMENTAL RIDERSHIP**		526,900	579,900	981,500	1,019,800	1,099,700
TOTAL ANNUAL REVENUE*	$2,530,000	$20,050,000	$21,980,000	$36,760,000	$38,130,000	$40,890,000
INCREMENTAL REVENUE**		$17,520,000	$19,450,000	$34,230,000	$35,600,000	$38,360,000
<u>TOTAL ANNUAL RIDERSHIP & REVENUE BY SEGMENT*</u>						
<u>Within Montreal-Springfield Segment</u>						
Ridership (train round trips)	15,740 (1)	167,707 (4)	190,162 (4)	221,553 (6)	235,179 (6)	245,157 (6)
Revenue	$397,200	$4,318,900	$4,939,900	$5,697,300	$6,087,500	$6,364,300
<u>Between Montreal-SPG Segment and Boston-SPG Segment (thru, not including SPG)</u>						
Ridership (train round trips)		32,830 (2)	37,023 (2)	42,762 (3)	45,877 (3)	49,647 (3)
Revenue		$1,135,100	$1,297,500	$1,506,100	$1,631,500	$1,769,500
<u>Between Montreal-SPG Segment and SPG-New Haven/NEC Segment (thru, not including SPG)</u>						
Ridership (train round trips)	46,948 (1)	223,705 (2)	242,784 (2)	307,131 (3)	316,404 (3)	338,463 (3)
Revenue	$1,996,000	$8,923,600	$9,872,400	$12,528,500	$12,937,800	$13,726,000
<u>Within Boston-Springfield Segment</u>						
Ridership (train round trips)	8,312 (1)	36,486 (7)	39,311 (7)	53,879 (7)	55,248 (7)	67,546 (11)
Revenue	$136,800	$741,000	$798,200	$1,102,900	$1,131,600	$1,380,800
<u>Between Boston-SPG Segment and SPG-New Haven/NEC Segment (thru, not including SPG)</u>						
Ridership (train round trips)		137,172 (4)	141,620 (4)	427,175 (4)	438,092 (4)	469,887 (4)
Revenue		$4,931,400	$5,072,000	$15,925,200	$16,341,600	$17,649,400

<u>NOTES:</u>
* only includes ridership/revenue in markets north/east/thru Springfield; trips south of Springfield (including all trips within Connecticut and trips between Springfield, Connecticut, and New York/NEC) are NOT included; revenue in 2013$
** relative to Baseline (current service only)

Note that all ridership and revenue figures shown in Exhibit 4 and those that follow only include ridership and revenue in markets north/east/thru Springfield; trips south of Springfield (including all trips within Connecticut and trips between Springfield, Connecticut, and New York/NEC) are NOT included. The level of service provided in these markets does NOT change among the alternatives.

Exhibit 5 below summarizes the ridership forecasts in total and by segment and type of service (local versus express) each alternative for year 2020. Once again, the overall train service levels by market are summarized at the top of the exhibit. Likewise, Exhibit 6 on the following pages summarizes the ridership forecasts in total and by station.

Exhibit 5: 2020 Ridership Forecasts with Detail by Segment and Type of Service

	Baseline Ridership on Inland Trains	Alt 1	Alt 1A	Alt 2	Alt 2A	Alt 3
MAX Speed		60mph	79mph		79 w/ tilt	90 w/ tilt
Stopping Pattern		Local Only	Local Only	Local & Express	Local & Express	Local & Express
Frequency (round trips) BOS-SPG		7	7	12	12	17
BOS-NHV		4	4	8	8	8
MTR-SPG		4	4	6	6	6
MTR-NHV		2	2	3	3	3
TOTAL ANNUAL RIDERSHIP*	71,000	597,900	650,900	1,052,500	1,090,800	1,170,700
INCREMENTAL RIDERSHIP**		526,900	579,900	981,500	1,019,800	1,099,700
TOTAL ANNUAL RIDERSHIP* BY SEGMENT AND SERVICE						
Within Montreal-Springfield Segment						
Local (train round trips)	15,740 (1)	167,707 (4)	190,162 (4)	174,625 (4)	184,234 (4)	195,076 (4)
Express (train round trips)	0	0	0	46,928 (2)	50,945 (2)	50,081 (2)
Between Montreal-SPG Segment and Boston-SPG Segment (thru, not including SPG)						
Local (train round trips)	0	32,830 (2)	37,023 (2)	37,711 (2)	40,293 (2)	43,141 (2)
Express (train round trips)	0	0	0	5,051 (1)	5,584 (1)	6,506 (1)
Between Montreal-SPG Segment and SPG-New Haven/NEC Segment (thru, not including SPG)						
Local (train round trips)	46,948 (1)	223,705 (2)	242,784 (2)	230,245 (2)	224,642 (2)	228,711 (2)
Express (train round trips)	0	0	0	76,886 (1)	91,762 (1)	109,752 (1)
Within Boston-Springfield Segment						
Lake Shore Limited	8,312 (1)	4,242 (1)	4,233 (1)	3,544 (1)	3,487 (1)	2,842 (1)
Local (train round trips)	0	32,244 (6)	35,078 (6)	31,298 (6)	31,558 (6)	45,764 (10)
Express (train round trips)	0	0	0	19,037 (5)	20,203 (5)	18,940 (6)
Between Boston-SPG Segment and SPG-New Haven/NEC Segment (thru, not including SPG)						
Local (train round trips)	0	137,172 (4)	141,620 (4)	280,677 (4)	288,478 (4)	300,605 (4)
Express (train round trips)	0	0	0	146,498 (4)	149,614 (4)	169,282 (4)

NOTES:
* only includes ridership in markets north/east/thru Springfield; trips south of Springfield (including all trips within Connecticut and trips between Springfield, Connecticut, and New York/NEC) are NOT included
** relative to Baseline (current service only)

Exhibit 6: 2020 Ridership Forecasts with Station Detail

	Baseline Ridership on Inland Trains	Alt 1	Alt 1A	Alt 2	Alt 2A	Alt 3
MAX Speed		60mph	79mph		79 w/ tilt	90 w/ tilt
Stopping Pattern		Local Only	Local Only	Local & Express	Local & Express	Local & Express
Frequency (round trips) BOS-SPG		7	7	12	12	17
BOS-NHV		4	4	8	8	8
MTR-SPG		4	4	6	6	6
MTR-NHV		2	2	3	3	3
TOTAL ANNUAL RIDERSHIP*	71,000	597,900	650,900	1,052,500	1,090,800	1,170,700
INCREMENTAL RIDERSHIP**		526,900	579,900	981,500	1,019,800	1,099,700
BOARDINGS BY STATION*	TOTAL	INCREMENTAL RIDERSHIP (BOARDINGS) BY STATION				
Montreal, PQ	0	90,426	110,029	135,239	141,813	147,615
St. Albans, VT	1,493	2,168	2,378	2,389	2,641	2,829
Essex Junction, VT	7,880	12,927	14,678	20,039	21,985	23,426
Waterbury, VT	2,205	3,632	4,111	4,098	4,432	4,732
Montpelier, VT	2,936	3,414	3,789	5,521	6,086	6,735
Randolph, VT	826	2,130	2,529	2,484	2,651	2,818
White River Jct., VT	5,754	11,499	13,282	18,355	19,812	21,389
Windsor, VT	422	1,435	1,703	1,672	1,784	1,900
Claremont, NH	889	1,414	1,607	1,598	1,711	1,819
Bellows Falls, VT	2,028	4,348	4,992	4,963	5,320	5,662
Brattleboro, VT	8,046	20,551	23,586	31,421	33,839	36,222
Greenfield, MA	0	17,598	18,394	23,046	24,007	26,198
Northampton, MA	0	43,854	45,243	56,612	58,655	64,138
Holyoke, MA	0	29,284	31,088	31,628	32,829	34,065
Amherst, MA	4,916	-4,916	-4,916	-4,916	-4,916	-4,916
Boston (South Station), MA	2,073	47,476	50,363	118,745	123,005	137,435
Boston (Back Bay), MA	792	15,735	16,626	41,882	43,328	46,051
Route 128, Inland, MA	0	9,666	10,195	31,384	32,129	34,120
Framingham, MA	233	6,255	6,603	15,162	15,420	16,235
Worcester, MA	1,273	17,640	18,421	45,936	46,869	50,755
Palmer, MA	0	3,597	3,934	6,363	6,431	7,037
Springfield, MA	5,760	29,781	32,552	44,200	46,180	52,714
Windsor Locks, CT	190	1,953	2,136	3,082	3,228	3,284
Windsor, CT	0	2,251	2,443	3,464	3,617	3,683
Hartford, CT	1,366	15,335	16,378	24,699	25,719	26,328
Berlin, CT	198	2,670	2,881	4,270	4,443	4,548
Meriden, CT	281	3,888	4,198	6,177	6,414	6,556
Wallingford, CT	155	1,700	1,798	2,703	2,801	2,865
New Haven, CT	2,164	18,167	19,322	30,313	31,521	32,631
Bridgeport, CT	755	2,387	2,558	3,588	3,603	4,168
Stamford, CT	1,408	5,629	5,952	14,193	14,566	16,210
New Rochelle, NY	0	2,066	2,157	3,897	4,034	6,158
New York, NY	16,957	100,940	108,890	247,293	253,843	274,290

NOTES:

* only includes ridership in markets north/east/thru Springfield; trips south of Springfield (including all trips within Connecticut and trips between Springfield, Connecticut, and New York/NEC) are NOT included

** relative to Baseline (current service only)

All station-level ridership figures represent boardings at the station noted; approximately the same number of riders would also be getting off at each station. For example, someone making a round trip between Boston and Springfield would count a two riders, one boarding at Boston and one boarding at Springfield.

G. OPERATIONS AND MAINTENANCE COST ESTIMATING METHODOLOGY

To generate operating costs for the various scenarios being considered in this study, a flexible O&M cost model is required. The model needs to reflect the cost implications of the following variables:

- Level of service,
- Peak fleet requirements,
- Operating speed,
- Revenue operating hours, and
- Route length.

1. Project Alternatives

The model estimates the operations and maintenance costs of three project alternatives as depicted in Table 1. These alternatives are differentiated by operating speed, number of stops served (local or express) and type of equipment used (Standard or Talgo).

Table 1: Project Alternatives

Alternative	Maximum Speed	Equipment Type	Service Type
1	60 MPH*	Standard	Local
2	79 MPH	Standard	Local and Express
2	79 MPH	Standard	Local and Express

* Maximum speed will vary (up to 79 MPH) where existing operating speeds are higher.

2. Passenger Rail O&M Cost Elements

O&M costs for intercity passenger rail services are typically divided into six primary cost categories for the purposes of developing a cost model – Train and Engine Crew, Rolling Stock Maintenance, Rolling Stock Capital Depreciation, Maintenance of Way, Maintenance of Facilities and Administrative Costs. For the purposes of this model, the relevant cost categories have been combined into Train, Engine and On-Board Crew costs, Maintenance and Administrative costs and Rolling Stock Capital costs.

O&M cost models can be structured so as to predict operating costs based on some combination of the following cost drivers: per passenger, per mile, per train hour, per trip, per train set or lump sum based on contract or allocation methodology. This model uses trainsets, train hours and train miles as the three variables to predict costs. Additionally, a per track mile maintenance cost is applied for areas with operating speeds of 90 MPH because this will require freight carriers to change their track maintenance protocols from FRA Class 4 track to FRA Class 5 track.

- Wages and fringe benefits including locomotive engineers, conductors, assistant conductors and on-board service crew are represented in train hours and include labor associated with terminal yard operations. Train hours were used to estimate labor costs because of the impact of varying average operating speed on crew hours.
- Host railroad charges, rolling stock preventive maintenance, running repairs and inspections, terminal maintenance of way, station maintenance, fuel, on-board provisions, insurance and administrative costs are reflected in train miles. Administrative costs (unless otherwise accounted for) include marketing, customer service, security, rents and leases and payments for host freight railroad track sharing rights. Fuel, maintenance and administrative costs are affected more by number and distance of trips, rather than train hours. Therefore, these unit elements were incorporated into the O&M cost model's train miles variable.
- The cost per train set includes the annual depreciation of the rolling stock required for the service and is defined as an annual cost per peak required train set.

3. Unit Costs

A peer system operated by Amtrak on a similar corridor, using similar rolling stock, and under similar operating conditions was identified to establish unit costs. The operating costs of the peer system were then broken down into cost per train set, cost per train hour and cost per train mile. The rates of the peer system are represented in Table 2.

Once the peer train mile, train hour, train set and track mile rates were identified, the model for the NNEIRI was developed to establish a cost for each speed and equipment alternative and based on the operating characteristics and draft revenue service schedule of each alternative. The model provides-annualized costs based on the peak number of train sets, number of daily trips, route length and the operating schedule to generate O&M costs for each alternative.

Table 2: Unit Costs (2014 Dollars)

Representative Peer	Grade Crossings
Ops Cost/Train Set/Year	$827,000.00
Ops Cost/Train Hour	$793.69
Ops Cost/Train Mile	$22.97
Class 5 Maintenance Premium/Track Mile (over Class 4)	$15,000
Ops Cost/Train Set/Year	$827,000.00

4. Cost Methodology

The model considers the following operating characteristics:

1. Quantity of coaches and locomotives and type of locomotive, collectively known as rolling stock, used in each train (train set). The number of coaches and locomotives impacts the value of the capital lease payment for the rolling stock plus dictates the amount of rolling stock maintenance that is required to provide the service. Both locomotives and coaches must be inspected and maintenance performed on components on a preventive maintenance schedule, in addition to routine running repairs. Based on the current alternatives being studied, the rates established in the model assume one diesel locomotive pulling five coaches, one of which includes food and beverage service facilities. To establish the equipment requirements, a two-hour layover was assumed at each terminal station. Vehicles were assigned routes based on the proposed operating schedule to minimize excess layover time to the extent possible. Once the peak vehicle requirements were established, an industry standard 20% spare ratio was assigned and the entire required fleet (service + spares) is included as inputs to the O&M cost model.
2. Length of the route typically defines the hours of operation for each train and the miles over which it must be operated (which in turn determines some maintenance requirements both for the vehicle, station and the track).
3. The number and frequency of trips operated impact both train hours and train miles. The number of daily trips helps to define cost of the service, since crew labor (and fringe benefit) costs are assessed based on hours of operation (as crews are paid hourly) and frequency of operation drives the cost of rolling stock maintenance. The more the rolling stock is used, the more maintenance required.
4. Speed of operation, number of stops (local or express) and operational schedule or revenue hours which together with the length of the run and the frequency of the runs define the paid time of service for train crews.

The alternatives include operating speeds of 60, 79, and 90 MPH and include traditional push, pull diesel locomotive equipment for all speeds and tilt equipment at 79 and 90 MPH. The use of tilt equipment in the 79 and 90 MPH scenario is expected to have higher vehicle maintenance costs so the model calculates a higher train mile rate than the peer rate provided to account for the increased equipment maintenance costs.

The costs vary amongst alternatives varies despite similarities. For example, the speed of the train and the number of stations served impacts the revenue hours of operation and associated labor costs; thereby showing a variation in the annual labor costs for train and engine crew, terminal yard operations and on-board service crew.

5. Limitations

The NNEIRI O&M Cost model has some limitations which must be considered in evaluating its outputs:

- Track maintenance costs for higher than Class 4 trackage: The model reflects host railroad trackage rights payments based on the host railroad maintaining most of the Corridor trackage to Class 4 (79 MPH maximum passenger train speed) standards. For those alternatives that require Class 5 (90 MPH maximum passenger train speed) standards, the host railroad would require compensation for additional track maintenance expenses. An annual additive of $15,000 per track mile for each mile of track to be maintained to Class 5 standards has been added based on current design assumptions.

- Train consists exceeding five coaches: The model reflects a standardized diesel locomotive + 5 coaches train consist. Additional operating cost can be expected should longer consists be operated. At this time, it is expected that none of the NNEIRI alternatives' consists will exceed 5 coaches. Some of the NNEIRI alternatives feature tilt train technology. It is assumed that such tilt trains use "passive tilt" technology and, as such, have little or no maintenance cost premium versus conventional non-tilting rolling stock.
- International border operations: The model does not include provisions for reimbursement of United States or Canadian immigration or customs operating costs. A review of current intercity rail cross-border services did not reveal O&M cost premiums for such operation, versus intercity rail service entirely within the US. However, it may be appropriate to include an annual "lump sum" figure in all alternatives' costs for international border operations.

H. WESTON TOLLS/ROUTE 128 STATION ANALYSIS

The vicinity of the Interstate 95/90 interchange in the western suburbs of Boston, Massachusetts is a potential station stop on segment owned by the MBTA. Currently, the AMTRAK Lake Shore Limited service passes through the area but does not stop and the MBTA Commuter Rail Worcester Line passes through and stops at several stations in the vicinity of the interchange.

Therefore, as a part of the Northern New England Intercity Rail (NNEIRI), a station on the Corridor in the Interstate 95/90 interchange is considered for infrastructure and ridership analysis. Locating a suburban hub station in close proximity to the Interstate 95/90 Interchange is a logical location for a station due to the regional accessibility afforded by both major Interstate highways and significant business clusters, particularly high-technology firms, located in the region. The purpose of this analysis is to identify potential sites for a station in the vicinity of the Interstate 95/90 interchange and assess the feasibility of service in the area.

1. Station Requirements

Any new or rebuilt station should be consistent with standards outlined in the NNEIRI station guide, which includes an overview of industry and government requirements. Specific to this site, as a suburban hub station, station access is anticipated to be primarily by automobile and local bus services, making substantial parking and vehicular access points paramount. The station will also require vehicular access and drop off points, including roadways to reach the site and points for vehicles to drop off and pick up passengers. Vehicles accessing the site are anticipated to include private automobiles, public and private busses, and taxis.

Initially, three basic criteria were utilized to identify potential station sites:

- Maximum horizontal curvature of 1.5° for 2000’
- Minimal Impact on environmental resources
- Proximity to the Interstate 95/90 Interchange and regional access

Subsequently, five potential sites were identified and refined. Section 2 describes the methodology for initial station identification and Sections 3 and 4 describe conditions at two existing stations, and 5 and 6 describe costing and engineering for the three new alternative station sites. The report will not recommend a final station site due to the necessary public, environmental, and costing analysis that must accompany this decision.

2. Methodology for Initial Selection

Suburban hub stations have proven successful for intercity rail service in the United States, with stations such as Route 128 Station in suburban Boston, Massachusetts, Emeryville Station in suburban San Francisco, California, and Metropark Station in suburban New Jersey among the busiest intercity rail stations the Amtrak network. Major suburban hub stations are located in close proximity to major metropolitan centers, providing suburban riders an alternative to congested central city train stations, and in close proximity to major circumferential highways or other transportation nodes, providing regional accessibility. The stations have been successful in attracting significant suburban populations due to locations near major highways, incorporating parking facilities into station complexes, and drawing from existing multi-modal connections.

The NNEIRI Study analyzed potential station sites in the vicinity of the Interstate 95/90 Interchange as a potential site for a suburban hub station on the NNEIRI Corridor using metrics developed in the Station Guide. Due to access to major highways and locations near or in major population centers, five potential sites were identified for a west-suburban NNEIRI station. The sites include two existing stations:

- West Newton Station
- Wellesley Hills Station

Three new station sites in the vicinity of the Weston Tolls/Route 128 were also identified:

- Liberty Mutual Campus East
- Liberty Mutual Campus West
- Leo T. Martin Memorial Golf Course

3. West Newton Station, Newton, Massachusetts—Alternative A

West Newton Station is passenger rail station in Newton, Massachusetts. The station is served by the MBTA's Framingham/Worcester Commuter Rail Line and local bus service and is owned and managed by the MBTA. AMTRAK's Lakeshore Limited service also passes through the station without stopping. The station is located in a neighborhood commercial center near the intersection of Interstate 90 and Route 16, a major local road that connects suburbs to the north and west of Boston. The station currently consists of a single low-level platform with a 45 space parking facility. Picture 1 shows the existing station and vicinity.

Picture 1: Aerial View of the Existing West Newton Station (Source: maps.google.com)

The station could serve as a stop for NNEIRI service due to it's proximity to major roadways west of Boston and existing bus routes. The station is served by an exist from Interstate 90 and is less than two miles from Exit 21 on Interstate 95/Route 128. If the station were selected for NNEIRI service, signage could be developed for Interstates 90 and 95 to direct traffic to the facility and the station improved with ticketing kiosks to facilitate NNEIRI service. Future improvements could add new station infrastructure, including high-level station platforms, improved vehicular drop off/pick up areas, and high level platforms to accommodate ADA access. To the west of the station is MassDOT owned land that currently is a large parking lot. A parking facility and high-level station platform could be built to better accommodate a large number of commuters and NNEIRI rail passengers, which would ease the impact of such a facility at the existing location. If a high-level platform is built, a specific station track might have to be built to accommodate freight movements in the area.

However, the station is located in a suburban neighborhood center with significant traffic issues. Additionally, a major intercity rail station in a primarily low-density suburban commercial and residential neighborhood might pose environmental and community concerns.

4. Wellesley Hills Station, Wellesley, Massachusetts—Alternative B

Wellesley Hills Station is a passenger rail station in Wellesley, Massachusetts. The station is located in a dense suburban neighborhood commercial center near the intersection of Routes 9 and 16. Both Routes 9 and 16 provide connectivity from Interstates 90 and 95 and are major east-west connections in the western suburbs of Boston. The station is served by the MBTA's Framingham/Worcester Commuter Rail Line and local bus service and is owned and managed by the MBTA. The station has 51 parking spaces, two low-level platforms, and a historic station headhouse. Picture 14.3.2 provides an aerial view of the site.

Picture 2: Aerial View of the Wellesley Hills Station (Source: maps.google.com)

The station has the potential to serve NNEIRI service due to its proximity to Routes 16 and 9 and the connectivity they provide to the wider-Boston suburban area. Service could be initiated utilizing existing station infrastructure, which is similar to other existing stations on the NNEIRI Corridor. Additionally, signage could be developed to direct motorists from nearby Interstates and other major roads and ticketing kiosks added for the service. Future improvements could add a parking garage large enough to provide at least 166 parking spaces, improved vehicular drop off/pick up areas, and high-level platforms to accommodate ADA access. If a high-level platform is built, a specific station track might have to be built to accommodate freight movements in the area.

However, the station is located in a suburban neighborhood center with significant traffic issues. The station is not connected to any major interstate highways, resulting in indirect accessibility from outside the western-suburban region. Additionally, a major intercity rail station in a primarily low-density suburban commercial and residential neighborhood might pose environmental and community concerns.

5. Weston Tolls/Route 128—Alternatives C, D, E Overview

A potential station site is located near the Weston Tolls on Interstate 90/Massachusetts Turnpike, immediately west of Interstate 95/Route 128. Due to a combination of track geometry, existing infrastructure, and natural features, the Liberty Mutual campus and Leo J. Martin Golf Course, are assumed to be the only potential locations for a station in the immediate vicinity of the Weston Tolls/Route 128 area. The potential Weston Tolls/Route 128 station sites are located in Weston, Massachusetts – south of Interstate 90, west of Interstate 95, east of Park Road, and north of the Leo T. Martin Golf Course and Recreation Road. The surrounding district is primarily parkland, golf course land, commercial office, low density residential development, and highway infrastructure. The site is less than one mile from Exit 23 on Interstate 95 and Exit 15 on Interstate 90. Picture 14.4 provides an aerial view of the site. A station build for intercity rail would likely also host MBTA Commuter Rail trains but further analysis would be necessary to refine the impact to MBTA operations.

Picture 4: Aerial View of the Weston Tolls/Route 128 Station Site (Source: maps.google.com)

The Liberty Mutual and golf course sites are considered the only feasible sites for a station in this area due to sharp curves immediately east and west that preclude station development beyond a narrow right of way immediately west of where the Corridor passes over Interstate 95. The curves are too sharp to allow for a high-level station consistent with modern station design.

The Massachusetts Turnpike Authority proposed an MBTA Commuter Rail station and 600-car park and ride on the site of the Liberty Mutual corporate park in 1998. However, the site was leased by Liberty Mutual for 99 years and the company developed 80,000 square feet of office space and 224 parking spaces in the early 2000s. The Leo J. Martin Memorial Golf Course, south of the right of way, is an alternative site for a station in this location. Constructing a station on this site would require redevelopment of the golf course and possibly realignment and expansion of Recreation Road and the Recreation Road off-ramp from Interstate 95 to accommodate increased traffic.

6. Liberty Mutual Campus East and West—Alternatives C and D

The Liberty Mutual Campus site currently consists of parking lots, commercial office buildings, and undeveloped land adjacent to the NNEIRI Corridor to the south, Interstate 95 to the east, Interstate 90 to the north, and a residential neighborhood to the west. The Liberty Mutual campus has two sites that could potentially accommodate a parking garage, bus and car drop off facilities, headhouse facilities, and adjacent high-level station platform without demolishing existing office buildings, as illustrated in Pictures 14.3.4 and 14.3.5.

Picture 4: Alternative C

The eastern site, Alternative C, would be adjacent to Interstate 95 and north of the NNEIRI Corridor would sit on existing parking lots and undeveloped land. Traffic would enter the Liberty Mutual Campus on Riverside Road and drive the length of the campus before entering the garage/drop off area. The station headhouse would then be connected to the station site via walkways. The cost for this concept is outlined in Table 1.

Table 1: Breakdown of Costs for Alternative C

Item	Estimated Cost
LED Station & Site Lighting	$400,000
Site Work (Parking, Landscaping, Sidewalks, Asphalt Paving)	$600,000
(1) 815’ Platform (Pre-Cast Concrete, Railings, Tactile Warning Strip)	$2,250,000
(1) 300’ Steel Canopy	$450,000

ADA Accessible Ramps & Staircases	$200,000
(1) ADA Accessible Walkway (garage to platform)	$1,250,000
Other (Signage, Benches, Trash Receptacles)	$125,000
3 Level Parking Garage (180 Spots, Indoor, Lighting, ADA Accessible, Ramps)	$3,600,000
Land Acquisitions	$2,000,000
Trackwork (Siding, Turnouts)	$1,000,000
TOTAL COST	**$11,875,000**

The western site, Alternative D, would be adjacent to Park Road and provide more direct access to area streets. Traffic would enter the site from Riverside Road, make a quick right into the garage area, and the garage/headhouse would provide a pathway to the adjacent station platform. The garage and headhouse would be built over an existing parking lot. It is assumed that lost parking spaces for the Liberty Mutual Campus could be included in the new station garage.

Picture 5: Alternative D

In addition to track, platform, and other station infrastructure, additional road infrastructure will be necessary for either Liberty Mutual Campus site. Due to increased traffic volumes entering the station site, Park and Riverside Roads would likely have to be improved. To accommodate the additional traffic entering and exiting the station, a traffic signal on Riverside Road inside the Liberty Mutual site with pedestrian crosswalks would likely be necessary. Additionally, at the intersection of Park and Riverside Roads, a new signaled intersection would likely be needed to accommodate both commuter and intercity rail traffic accessing the site. The cost for this concept is outlined in Table 2.

Table 2: Breakdown of Costs for Alternative D

Item	Estimated Cost
LED Station & Site Lighting	$400,000
Site Work (Parking, Landscaping, Sidewalks, Asphalt Paving)	$600,000
(1) 815' Platform (Pre-Cast Concrete, Railings, Tactile Warning Strip)	$2,250,000
(1) 300' Steel Canopy	$450,000
ADA Accessible Ramps & Staircases	$200,000
(1) ADA Accessible Walkway (garage to platform)	$1,200,000

Other (Signage, Benches, Trash Receptacles)	$125,000
3 Level Parking Garage (180 Spots, Indoor, Lighting, ADA Accessible, Ramps)	$3,600,000
Land Acquisitions	$2,000,000
Trackwork (Siding, Turnouts)	$1,000,000
TOTAL COST	**$11,825,000**

Either of the Liberty Mutual Campus sites would require purchase of the affected parcel and an easement allowing access to the site, disrupting a functional commercial office park. Access to the site would be provided by local roads that currently experience congestion at peak periods. Additionally, construction of a new station would be environmentally disruptive to the surrounding community and parkland. Therefore, a station on the Liberty Mutual Campus would be difficult to construct due to commercial, community, and parkland impacts.

7. Leo J. Martin Memorial Golf Course Site—Alternative E

Leo J. Martin Memorial is a municipal golf course managed and owned by Commonwealth of Massachusetts Department of Conservation and Recreation. The Golf Course is an 18-hole site that includes a club house with a pro shop and snack bar, golf practice facilities, and and parking for patrons.

If station facilities were built on the site, the most appropriate site would be near the intersection of Park and Recreation Roads, near the northwest corner of the golf course. The northwest corner site would enable traffic from the garage to exit directly onto either Recreation or Park Roads and have less an affect on the Golf Course site. A station platform and station track would be built east of the station garage, requiring a walkway to reach the site. The alignment on a tangent track east of the garage would be necessary to account for the curve west of the site. Picture 6 shows the proposed footprint of the garage, station platform, and access roads leading to it. The costs for this concept are outlined in Table 3.

Picture 6: Alternative E

The Leo T. Martin Golf Course is subject to Section 4(f) regulations for golf courses, which stipulate that "golf courses that are owned operated and managed by a public agency for the primary purpose of public recreation and determined to be significant."[1] The Section 4(f) provides for enhanced protection for parkland and other protected public facilities against development unrelated to recreational and other park-related uses. Construction of an intercity rail station garage and headhouse on the Golf Course site would pose significant impacts to the public golf course operations and change the character of the facility.

Table 3: Breakdown of Costs for Alternative E

Item	Estimated Cost
LED Station & Site Lighting	$400,000
Site Work (Parking, Landscaping, Sidewalks, Asphalt Paving)	$700,000
(1) 815' Platform (Pre-Cast Concrete, Railings, Tactile Warning Strip)	$2,250,000
(1) 300' Steel Canopy	$450,000
ADA Accessible Ramps & Staircases	$200,000
(1) ADA Accessible Walkway (garage to platform)	$1,250,000
Other (Signage, Benches, Trash Receptacles)	$150,000
3 Level Parking Garage (180 Spots, Indoor, Lighting, ADA Accessible, Ramps)	$3,600,000
Land Acquisitions	$2,000,000
Trackwork (Siding, Turnouts)	$1,000,000
TOTAL COST	**$12,000,000**

[1] http://www.environment.fhwa.dot.gov/4f/4fpolicy.asp#addex18, accessed July 3, 2014

I. PALMER STATION ANALYSIS

Palmer, Massachusetts is a proposed station stop on the Corridor between Springfield and Worcester, Massachusetts, on segment owned by CSX Transportation. Historically, Palmer had a station located in its city center, immediately east of the intersection of the CSX and NECR Mainlines. However, the station was abandoned and the historic headhouse is currently used as a restaurant. The AMTRAK Lake Shore Limited service passes through Palmer but does not stop in the city currently. The purpose of this evaluation is to identify and screen candidate locations for a Palmer Station, comparing them with each other for suitability.

1. Station Requirements

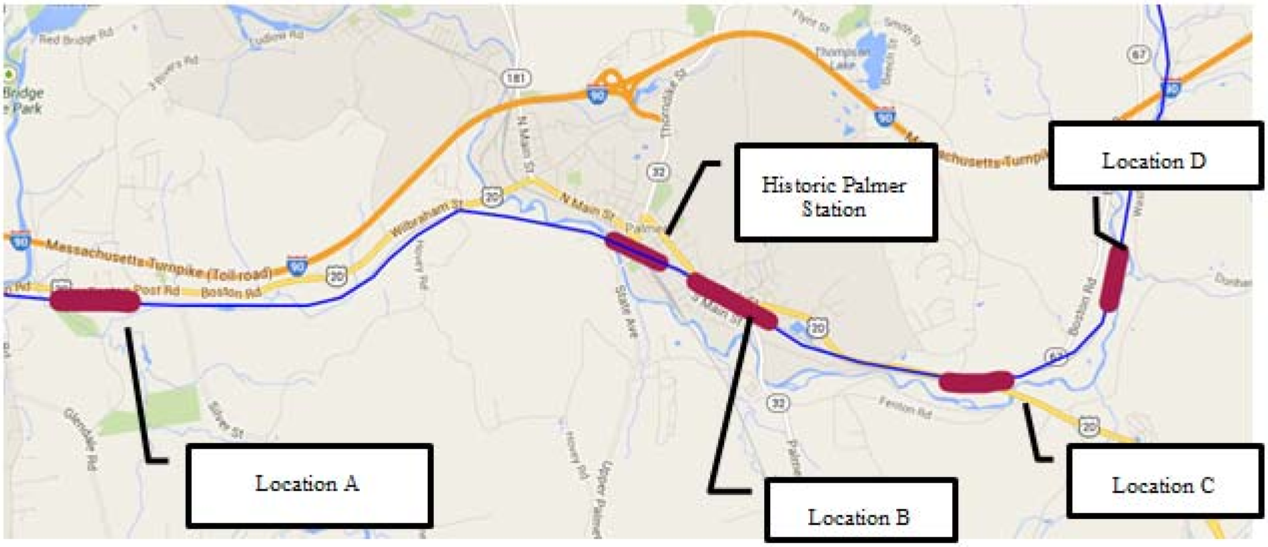
Any new or rebuilt station should be consistent with standards outlined in the NNEIRI station guide, which includes an overview of industry and government requirements. Initially, three basic criteria were utilized to identify potential station sites:

- Maximum horizontal curvature of 1.5° for 2000’
- Minimal Impact on environmental resources
- Proximity to Palmer and regional access

Subsequently, five potential sites were identified and refined based on a scoring metric that included engineering, environmental, and transportation access and connectivity. Two sites were deemed to be unfeasible and three were then further refined with station concept layouts and costs. The report will not recommend a final station site due to the necessary public, environmental, and costing analysis that must accompany this decision.

2. Methodology for Initial Selection

The process of selecting the station began with analyzing existing data for optimal train locations based on the three criteria for initial screening, described above. Track charts were utilized to check the horizontal alignment and environmental resource mapping was used to check for locations with minimal impacts. A total of four alternative station locations were analyzed for engineering impacts, environmental resource impacts, and accessibility. The four alternative locations were compared to the historic train station structure in downtown Palmer. Map 1.1 shows each analyzed location in relation to the historic Palmer Station. Table 1 shows the approximate milepost limits of each location.



Map 1: Potential Palmer Station Locations Analyzed

Table 1: Mile Post Potential Station Locations

Location	Approximate Mileposts
Location A	87.2 - 87.6
Historic Location	83.4 - 83.7
Location B	82.5 - 83.1
Location C	80.9 - 81.4
Location D	79.6 - 80.1

The alternative locations were compared based on three major categories including engineering, resource impacts, and access. Engineering criteria includes the horizontal track radius, length, topography, and freight operations impacts. Track radius evaluates the horizontal curvature of the site; sites adjacent to relatively straight track are more favorable for stations. The length evaluates the site's ability to meet the minimum overall length requirement of 2,000', which includes the station track, platform, and the transitions to/from the mainline at each end. The layout is assumed to require a separate station track and platform for the inbound and outbound sides of the mainline. The site topography criteria considers the extent to which major earthwork would be required to build the station. For example, if there is a major grade differential between existing tracks and the proposed station tracks and platforms, cuts and/or fill would be required.

Resource impact criteria include the natural environment and the built environment. Natural environment includes wetlands, flood zones, and endangered species habitats. Built environment refers to nearby historic districts, homes, and commercial properties. Alternatives were evaluated based on their relative impact across each category. The locations were also checked for consistency with local planning and zoning. The zoning maps for the City of Palmer and Town of Wilbraham were also viewed.

Access criteria include road access, proximity to downtown Palmer, I-90 access, walkability, and bicycle access. Road access evaluates the ease of connecting each site to a nearby major road. Each location was evaluated based on its distance to downtown Palmer and to the nearest I-90 interchange. Access to each location for bicycles and pedestrians was evaluated based on distance and existing pedestrian/bike infrastructure in each area.

A rating of 1, 2, or 3 was given for each criterion with 1 being the most favorable and 3 the least. Ratings are relative and meant to compare the alternatives to each other. The ratings for all of the criteria were summed in order to determine a final score for each with the lowest being the preferred alternative.

3. Result of Analysis

Table 1.2 summarizes the results of the location analysis. Sites A and D were deemed sufficiently environmentally damaging and provided poor transportation accessibility. The Historic Location, Location B, and Location C were determined to be the most favorable sites for a future station based on a ranking system that considered engineering, resource impacts, and transportation access.

Table 2: Mile Post Potential Station Locations

Category	Criteria	Historic Location	Location A	Location B	Location C	Location D
Engineering	Horizontal Radius	3	1	2	2	1
Engineering	Length	3	1	1	1	2
Engineering	Topography	1	3	1	2	1
Engineering	Freight Operations Impacts	3	2	3	1	1
Engineering	Length	3	1	2	2	1
Resource Impacts	Natural Environment	2	2	3	1	2
Resource Impacts	Built Environment	3	2	3	1	2
Resource Impacts	Consistency with Local Planning and Zoning	1	3	2	2	3
Access	Road Access	1	2	2	1	3
Access	Proximity to downtown Palmer	1	3	2	2	2
Access	I-90 Access	1	1	2	2	3

Access	Walkability	1	3	1	3	3
Access	Bicycle Access	1	3	1	2	3
	Score	21	26	23	20	26

Key: Based on A rating of 1, 2, or 3 was given for each criterion with 1 being the most favorable and 3 the least.

4. Palmer Station Platform Alternatives Description

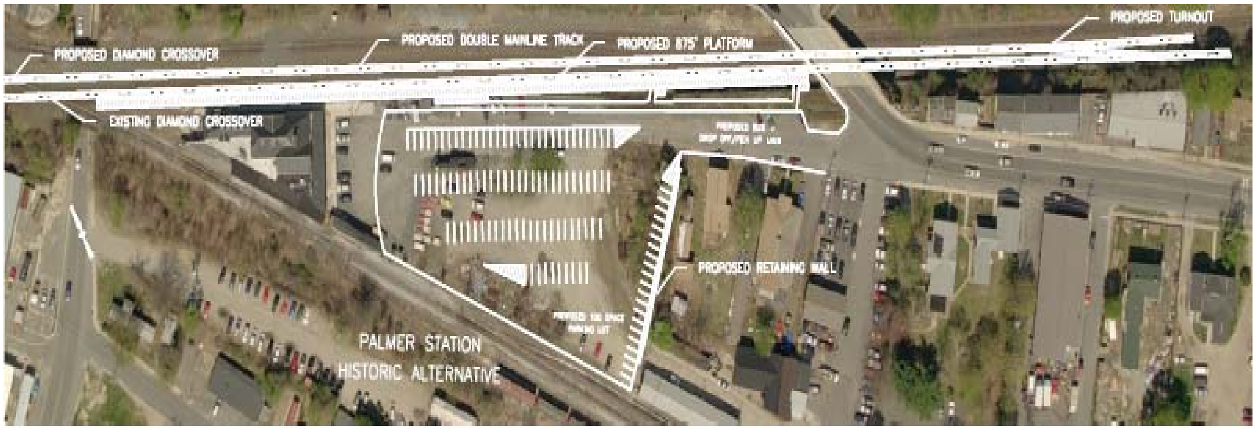
The three alternative sites identified for further analysis were refined from an initial analysis of potential sites in the Palmer area. The first location is on a parcel of land adjacent to the Steaming Tender in downtown Palmer (Depot Street). The second alternative is located on South Main Street just west of the Route 32 overpass and the third alternative is located on Route 20 near Mason Street.

5. Historic Station Location

The Historic Station Location provides a single 875 ft. precast concrete platform with metal railings, one ADA accessible ramp and staircases. The length of the platform is limited due site constraints, and this single platform would serve both east and westbound trains. This alternative is located adjacent to the Steaming Tender Restaurant at 28 Depot Street in the middle of Downtown Palmer.

Sliver-takings of land will be needed along with the land leading up to the Steaming Tender Restaurant for the parking lot—this land is also owned by the operators of the Restaurant. The approximant area of land acquisition will be around 1.68 acres. No buildings or personal dwellings will be impacted by the construction of this Alternative.

Additional features of this Alternative include a parking lot that can accommodate over 100 vehicles, walkways, drop off/pick-up zones and a busway for local buses. The station will be outfitted with LED lighting, benches, signage, and a 300 ft. canopy. The canopy will be designed to incorporate elements of the former nine-tenth century Palmer Station designed by Henry Hobson Richardson (now the Steaming Tender Restaurant) with wrought-iron steel, stone and stained wood. Track work will also need to be done for this Alterative; this includes the addition of a new passenger siding, turnouts and the construction of a new diamond. Signaling will also need to be installed and incorporated into the existing system. A retaining wall will also be constructed along the houses that line the east side of the parking lot. Picture 1.1 provides an overview of the proposed station, including platforms, passenger drop off/pick up locations, and parking.



Picture 1: Aerial View of the Historic Station Location

The estimated cost to construct this Alternative is $7,012,500.00—this price is all inclusive (including land purchases and track work). A detailed breakdown of costs can be found in Table 1.1.

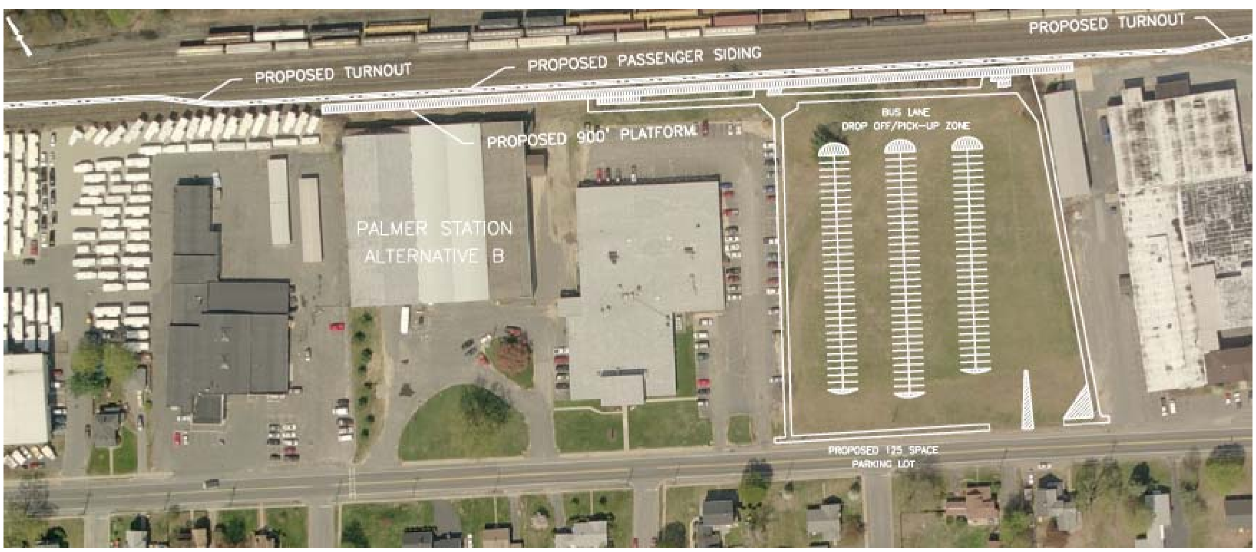
Table 1.1: Breakdown of Costs for Historic Station

Item	Estimated Cost
LED Station & Site Lighting	$275,000
Site Work (Parking, Landscaping, Sidewalks, Asphalt Paving)	$500,000
(1) 875' Platform (Pre-Cast Concrete, Railings, Tactile Warning Strip)	$2,187,500
(1) 300' Steel Canopy	$450,000
ADA Accessible Ramp	$100,000
Staircases	$150,000
Retaining Wall	$250,000
Other (Signage, Benches, Trash Receptacles)	$100,000
Track work (Diamond, Passenger Siding, Turnouts)	$2,000,000
Land Acquisitions	$1,000,000
TOTAL COST	$7,012,500

6. Alternative B Location

Alternative B provides for one (1) full length 900 ft. precast concrete platform to serve both east and westbound trains. The platform will be outfitted with metal railings, benches, LED lighting, signage and a 300 ft. galvanized steel canopy. The station will be constructed on an 8 acre parcel of land at 1199 South Main Street just west of the Route 32 overpass. The site is owned and partially occupied by Sanderson Macleod Inc. (a local twisted wire brush manufacturer). None of their buildings will be impacted by this Alternative, as the majority of the station and it's over 100 spot parking lot and entrance will be built on a 3.5 acre parcel of land that is currently unoccupied adjacent to the business.

This location provides convenient access to a major road, sufficient width and length to construct a passenger siding and ample vacant land to construct a parking lot and drop-off facility without demolishing existing structures. This Alternative is also close to downtown Palmer—at a distance of roughly ½ mile from the historic Palmer Station. This Alternative also calls for the construction of a 100 spot parking lot, walkways, drop off/pick-up zones and a busway for local buses. Two ADA accessible ramps and staircases will also be constructed. A passenger siding and turnouts will also be installed, as well as signaling. Picture 1.3 provides an overview of the proposed station, including platforms, passenger drop off/pick up locations, and parking.



Picture 2: Aerial View of Alternative B Station Location

The estimated cost to construct this Alternative is $7,050,00.00—this price is all inclusive (including land purchases and track work). A detailed breakdown of costs can be found in Table 2.

Table 2: Breakdown of Costs for Alternative B

Item	Estimated Cost
LED Station & Site Lighting	$300,000
Site Work (Parking, Landscaping, Sidewalks, Asphalt Paving)	$750,000

(1) 900’ Platform (Pre-Cast Concrete, Railings, Tactile Warning Strip)	$2,250,000
(1) 300’ Galvanized Steel Canopy	$350,000
ADA Accessible Ramps	$150,000
Staircase	$100,000
Track work (Passenger Siding, Turnouts)	$1,500,000
Other (Signage, Benches, Trash Receptacles)	$150,000
Land Acquisitions	$1,500,000
TOTAL COST	$7,050,000

7. Alternative C Location

Alternative C provides for two (2) full length 900 ft. precast concrete platforms. The platforms will be outfitted with metal railings, benches, LED lighting, signage and a 300 ft. galvanized steel canopy. The station will be constructed on a 1.5 acre parcel of land at 1511 Park Street (Route 20) currently occupied by an Agway hardware store—this location provides convenient access to a major road, sufficient space for a passenger siding all while being located just east of downtown Palmer. The location also provides sufficient length of tangent track (in excess of 1200 ft.) and track turnouts for the passenger siding.

This Alternative also calls for the construction of a 100 spot parking lot, walkways, drop off/pick-up zones and a busway for local buses. A headhouse will also be constructed and a passenger (ADA accessible) crossover will also be installed with stairs and two elevators connecting the platforms. A second (non-accessible) crossover will also be installed on the east end of the platform to serve as a second means of egress from the second platform. Necessary track work will also need to be performed to support the passenger siding. Signaling will also need to be installed and incorporated into the existing system. Picture 1.2 provides an overview of the proposed station, including platforms, passenger drop off/pick up locations, and parking.

Although situated along the Quaboag River, the 1% annual flood zone doesn’t impede in the construction of this alternative.

Picture 3 Aerial View of Alternative C Station Location

The estimated cost to construct this Alternative is $12,750,000.00—this price is all inclusive (including land purchases and track work). A detailed breakdown of costs can be found in Table 3.

Table 3: Breakdown of Costs for Alternative C

Item	Estimated Cost
LED Station & Site Lighting	$350,000
Site Work (Parking, Landscaping, Sidewalks, Asphalt Paving)	$600,000
(2) 900’ Platform (Pre-Cast Concrete, Railings, Tactile Warning Strip)	$4,500,000
(2) 300’ Galvanized Steel Canopies	$750,000
Headhouse	$950,000
ADA Accessible Crossover (2 Elevators)	$1,900,000
Stair Crossover	$500,000
Other (Signage, Benches, Trash Receptacles)	$200,000
Track work (Passenger Siding, Turnouts)	$1,500,000
Land Acquisitions	$1,500,000
TOTAL COST	$12,750,000

J. ALTERNATIVE ANALYSIS PUBLIC MEETINGS

In November 2014 two public meetings were held in White River Junction, Vermont and Worcester, Massachusetts to present findings from the Alternative Analysis process. During the public meetings, a presentation was made and a comment and answer session was held. Public comments and questions are italicized and answers are in standard text.

1. November 17, 2014, 7-9 PM: Hotel Coolidge, White River Junction, Vermont

The Vermont Agency of Transportation and Massachusetts Department of Transportation hosted a public meeting in White River Junction, VT to provide an update on the Northern New England Intercity Rail Initiative (NNEIRI), including a review of three alternatives to improve rail service currently being evaluated by the study team.

Scott Bascom (Vermont Agency for Transportation) welcomed attendees. Scott explained how Vermont and Massachusetts had provided to local match for the study which is primarily funded by the Federal Rail Administration.

Ron O'Blenis (HDR), project manager for the consultant team hired to conduct the NNEIRI study made a 45 minute presentation that was followed by public discussion. The presentation provided an overview of NNEIRI. The rail corridors under study include 470-route miles and cover two primary segments that overlap in Springfield, MA – Boston to Springfield, MA and New Haven, CT to Montreal Canada. While the study is a partnership of VTrans and MassDOT, it is being done in collaboration the Connecticut Department of Transportation, the New Hampshire Department of Transportation and the Ministère des Transports du Québec with support from the Federal Rail Administration.

The study examined 18 preliminary options with variations of speeds (79, 90, 110, 125 MPH), equipment (tilt and non-tilt), track engineering specification modifications (super-elevation and unbalance) and number of locomotives per train set (one or two).

The methodology used to assess initial options included: a train performance calculator, station stopping patterns, daily frequencies, train service times, ridership and infrastructure requirements.

The study identified three alternatives, with an additional No Build alternative as a benchmark for evaluating the options. Alternative 1 has additional local and express trains, with speeds up to 59 mph, with projected ridership at 597,900, operating and maintenance cost of $42 million and requires $24 million in funding. Alternative 2 has more local and express trains to the Alternative 1 level and has speeds up to 79 mph, with projected ridership at 1,052,500, operating and maintenance cost of $73 million and requires $39 million in funding. Alternative 3 offers more local and express trains than Alternative 2 and has speeds up to 90 mph, with projected ridership at 1,170,700, operating and maintenance cost of $86 million and requires $48 million in funding

Using the No Build Alternative as a benchmark, an environmental screening of the three alternatives was conducted that included natural, historical and human resources, land use, and construction impacts. The analysis found minor and moderate impacts on the corridor overall and in specific locations. The screening results concluded a Tier 1 EA is the appropriate National Environmental Policy Act (NEPA) Class of Action, subject to Federal Rail Administration concurrence.

The next steps of the study will include the conclusion of the analysis of alternatives, with a determination of a preferred alternative that will be reviewed at a stakeholder committee meeting and public meetings in early 2015. The team will complete a Tier 1 NEPA Analysis and final Service Development Plan by September 2015.

Questions and Comments

Following the presentation, attendees asked several questions and offered comments (see italics). Responses to the questions were made primarily by Ron O'Blenis and John Weston of the study team.

Bus service & airport connections

Do you know how many people are riding the buses today?

We do not have the numbers tonight but intercity bus service was used as a factor in the creation of the study's ridership model.

Intercity bus should be included in this study and how it can be built to provide passenger rail with good connectivity.

An important aspect of the next phases of this study is how this service impacts towns and station areas and what can be done to leverage this new infrastructure. We are going to take a look at investments and lessons learned from places around the nation to show what has been done elsewhere, including bus connections, economic development, etc. It's not a single approach that works, but there are many different ideas that are successfully used in individual cities and towns.

You should show the existing intercity bus connections now. Show how these can tie into what is being proposed.

We will look at examples from around the country and will provide a guidebook on how to leverage investment to show connections. A good example is Amtrak's Downeaster and services in other parts of the nation where bus and train tickets are interchangeable. This is a long-term project; we are planning for 15-20 years in the future while bus services can change at any time. In this corridor, we are excited about the rebuilding of the train station in Springfield, MA as it will become an intermodal center when connections can be more easily made.

Would there be any attempt to connect NNEIRI service to airports? I fly all the time to the Midwest and frankly there isn't a good way of getting to a major airport without driving.

This study is not focused on people coming into airports. The majority of riders will be using this service to get around New England and New York.

As far as the busses and local infrastructure to connect to the rails – once the improvement is done, the infrastructure will follow. Around Vermont there's a consciousness of transportation and how it works. Also, I believe Greyhound is not a great form of transportation and I would prefer a train to a bus.

Costs

The train costs, $22 million per set, seem astronomical. I believe actual numbers are lower. We're not getting good deal. Let's buy used equipment from China. Could you please clarify the origin of these numbers?
Equipment is not cheap. A new locomotive costs about $5 million. Even refurbished cars cost $2.5-3 million each. Therefore, for a six car trainset with a locomotive, these numbers are appropriate. We also factored in a contingency into these numbers.

Who would be buying the cars?
This study is not determining an operator at this point. There is an ongoing national discussion about the future of Amtrak.

Could a large contract drive down the costs of these trains?
The numbers are based on train sets that are being procured around the nation. They represent costs for recent purchases of train equipment from around the country.

These operating costs get progressively more expensive. Is there any attempt to split how these are going to be allocated between states?
That will be the next step. We eventually need to have a policy type discussion. We are not seeking to create an expectation before we complete the analysis and create unrealistic expectations.

Was the Vermonter factored into these costs?
No, the Vermonter was above that cost.

Would the federal government be kicking in some funding for this project?
The expectation is the federal government might provide some capital funding. There are numerous examples around New England of this already occurring. It's a balance between what is available on the federal level and funding needs across the nation.

Regarding train sets, we see numerous examples of where transit authorities used old trains to save costs, MARC in Maryland for example. Also, people are less time sensitive on trains than in cars because they can use a lap top and have a more comfortable ride than a car or bus; therefore, does the cost of the infrastructure need to be so high? Do we really need very high speed trains?
We could certainly use restored equipment, but what we are looking at here is a project that could be 25 years out. Therefore, it is important to understand the full capital costs and implications of this service. We are not creating new right of way because this corridor will enable us to utilize an existing and in-use right of way. These costs are so high because we want reliability. A significant amount of the costs here represent state of good repair projects and federally required signaling.

Was there any consideration given to sharing costs with freight? Do these costs include paying freight operating companies to use their right of way? Is there a cost associated here?
The assumptions assume that we will be using the freight right of way. We anticipate that future negotiations with freight operators will produce more concrete figures.

Claremont, NH

We are very appreciative of all the efforts of the consulting team. Now that you've included Claremont on the station list and taken our thoughts into account, we are happy with the work done.

I am a Claremont citizen, on the Amtrak committee, and a member of the city council. Claremont Station has a huge population surrounding it. We appreciate your analysis and inclusion of Claremont as a station for the service.

Study assumptions and presentation

No-build statistics should be better represented here and presented in the same manner as the other alternatives. We need to know what is the current operating situation and this should be presented clearly and effectively.

The alternatives are extremely conservative and this is because you're looking backwards and not forwards and this hurts the process. There needs to be analysis of the benefits of this project to a greater degree. Also the environmental analysis is conservative. The reality is that carbon is extremely important going forward. It's a matter of decades before carbon is regulated. There is a measurable sizable tonnage of carbon that will be saved.
The study will be looking at other impacts than were presented tonight. Future analysis will include issues surrounding air quality and secondary impacts such as economic development. The Tier 1 analysis will look at positive impacts, not just avoiding negative impacts.

We need to take into account the logic of bringing high speed rail from the NEC to the Upper Valley of Vermont. The question is, do we really want to be just three hours from New York? Do we want to be the next Westchester County?

Does this study include the resumption of service to Montreal? Does this include a station in Downtown Montreal?
Vermont's Congressional delegation has been working closely with Canada and U.S. Immigration and Customs Enforcement (ICE) to get a sealed station in Montreal, with no station stops from the border to Montreal. There's a tremendous amount of work that's being done. It will take an international treaty and an act of Congress to approve the facility. We expect to have a customs clearing unit with Central Station, Montreal up and running in three years. It's moving forward and it's a goal of the Vermont governor and that State of Vermont to resume service to Montreal.

There are two assumptions that worry me in the long run. The mythical business traveler will not take this service from Boston to Montreal. They will drive. Also, Wifi is critical. We should build something cheap and go from there.
Our ridership analysis shows that there is very little ridership from Boston to Montreal. Most of the ridership is getting around New England rather than between these two cities, point to point. The model is calibrated to Amtrak service around the nation. This is not the same business traveler as the 1950s version. The model looks travelers across the Northeast to determine the ridership profile. This study is a vision of what could be done around New England. Next we're creating a service

development plan. In the plan we will identify lots of little incremental steps of how we can get to that vision. The great thing about developing rail in this way is that it can be done bit by bit by bit rather than as a gigantic project.

The alternatives presented seem more like phases rather than true alternatives. Could you please explain how these are different than phases?
We are looking into different alternatives and what they would generate for costs and ridership. These alternatives are distinct because they present different long-term visions for the Corridor, with different frequencies.

We do not need high speed. We just need more trains. All that we need is simple trains with WiFi. If you provide more service, the ridership will increase. Train is preferred way even though it takes a bit longer.

Safety

Safety has not been mentioned once in this presentation. Massachusetts has a very strong rail trespassing law. There's no law enforcement in Vermont to send out to look at these people. Hartford is only community in Vermont that enforces trespassing. The more trains you have, the more the issue. How will Vermont address this?
We are doing things on the Knowledge Corridor to improve safety. There's an effort within these projects to respond to safety.

There are trained police officers at Windsor Station. There is a safety element at our system.

At grade crossings that are private infrastructure, such as farm crossings, is there a plan or concept of what might be done on farm road type crossings?
Securing the crossings with gates that are locked is important. There could be some policing of that to make sure it's done. We are looking at providing gates, where the farmer has the key to the gate to be able to unlock it as needed. Sometimes if a private crossing has a lot of use, we can put public funds into it. We are not taking a one-size fits all to addressing this concern.

If we are going to have high speed rail, then we are going to need to have more public education.

2. November 19, 2014, 7-9 PM: Union Station, Worcester, Massachusetts

The Massachusetts Department of Transportation and Vermont Agency of Transportation hosted a public meeting in Worcester, MA to provide an update on the Northern New England Intercity Rail Initiative (NNEIRI), including a review of three alternatives to improve rail service currently being evaluated by the study team.

Ammie Rogers (Massachusetts Department of Transportation) welcomed attendees. Ron O'Blenis (HDR), project manager for the consultant team hired to conduct the NNEIRI study made a 45 minute presentation that was followed by public discussion. The presentation provided an overview of NNEIRI. The rail corridors under study include 470-route miles and cover two primary segments that overlap in Springfield, MA – Boston to Springfield, MA and New Haven, CT to Montreal Canada. While the study is a partnership of VTrans and MassDOT, it is being done in collaboration the Connecticut Department of Transportation, the New Hampshire Department of Transportation and the Ministère des Transports du Québec with support from the Federal Rail Administration.

The study examined 18 preliminary options with variations of speeds (79, 90, 110, 125 MPH), equipment (tilt and non-tilt), track engineering specification modifications (super-elevation and unbalance) and number of locomotives per train set (one or two).

The methodology used to assess initial options included: a train performance calculator, station stopping patterns, daily frequencies, train service times, ridership and infrastructure requirements.

The study identified three alternatives, with an additional No Build alternative as a benchmark for evaluating the options. Alternative 1 has additional local and express trains, with speeds up to 59 mph, with projected ridership at 597,900, operating and maintenance cost of $42 million and requires $24 million in funding. Alternative 2 has more local and express trains to the Alternative 1 level and has speeds up to 79 mph, with projected ridership at 1,052,500, operating and maintenance cost of $73 million and requires $39 million in funding. Alternative 3 offers more local and express trains than Alternative 2 and has speeds up to 90 mph, with projected ridership at 1,170,700, operating and maintenance cost of $86 million and requires $48 million in funding

Using the No Build Alternative as a benchmark, an environmental screening of the three alternatives was conducted that included natural, historical and human resources, land use, and construction impacts. The analysis found minor and moderate impacts on the corridor overall and in specific locations. The screening results concluded a Tier 1 EA is the appropriate National Environmental Policy Act (NEPA) Class of Action, subject to Federal Rail Administration concurrence.

The next steps of the study will include the conclusion of the analysis of alternatives, with a determination of a preferred alternative that will be reviewed at a stakeholder committee meeting and public meetings in early 2015. The team will complete a Tier 1 NEPA Analysis and final Service Development Plan by September 2015.

Questions and Comments
Following the presentation, attendees asked several questions and offered comments (see italics). Responses to the questions were made primarily by Ron O'Blenis of the study team.

Alternatives
I live in Connecticut and, given what has happening with Metro North, is it better to go slower and know that you won't kill your passengers?
The groundwork for a safe operation is through better infrastructure, such as signals. The speeds we are talking about are not very high speeds and the infrastructure would support a very safe operation.

I think many of us have had the experience of enjoying European high speed trains. It's marvelous. I live in Hartford and much in tune with Metro North comings and goings. We are told that the North East Corridor is the most heavily used part of the Amtrak system. We are also told the volume of

activity of the New Haven Division of Metro North is the most heavily used in the nation. We have also heard that the infrastructure is showing signs of old age. If we're going to revive the rail system from Washington to Boston and up to Montreal, is there any point in going half way or should be looking at Alternative 3 as the most appropriate means of investment. As I look at your other alternatives, they don't seem to go far enough. Has this been addressed?
The total costs that we believe need to be invested are significant but will ensure that the system is safe and reliable and has a long life. The numbers that we are estimating support "reliable service." Many of the connections you mentioned are part of the master planning for the new Connecticut service. We are extending service into Boston. These trains are already planned.

Is there any point in trying to make greater speed and not replace the century old tracks? Don't we have to upgrade tracks if we're going to do anything meaningful?
Yes, that's what we're going to do through these alternatives. All have a state of good repair mandate built into them.

Why bother with Alternatives 1 and 2 when we really need new tracks?
Alternatives 1 and 2 have substantive improvements to track infrastructure and make state of good repair a priority.

There were other options presented in the Springfield public meeting. Why were they eliminated?
Most were related to the higher speeds and variations on service. All were based on using the existing infrastructure. Infrastructure constraints are key to why many of the options were eliminated.

You weren't looking at other possible routes?
No, the footprint has always been the existing rail corridor for this study.

Ridership
Do you have the ridership for the Boston to Worcester MBTA commuter service?
We do not have numbers for the Boston to Worcester *MBTA commuter* market. The numbers available right now are just the forecast Boston to Springfield intercity market. The Boston to Worcester market is also a different demographic than what we are looking at here. We are looking into intercity rail as opposed to commuter rail. The one comparison could be people using Amtrak to travel from Providence to Boston since these people would be paying extra for a premium service.

Shouldn't you study Amtrak's Providence-Boston route as a way of marketing this rail service?
Obtaining federal dollars usually requires this and will be a major piece for getting federal dollars.

Regarding local trains from Boston to Springfield, does it make sense to have these in the MBTA system? Also, do you think there's a market for trains to go into North Station?
South Station is being evaluated by an ongoing study. We're assuming that this program will be in place by the start of NNEIRI service. But, we do not have details for the Grand Junction question. All intercity service is now Amtrak service and we don't know who would operate this necessarily. There is some opportunity to integrate intercity and commuter rail systems but more information on this would be developed through the Service Development Plan.

This isn't a commuter operation? We have a lot of people worried about getting to work. People want to get rid of cars. Really, how much ridership will be going to Montreal every day? How much will Vermont, New Hampshire and Montreal be willing to kick into this? If we had time to get into this, we could discuss the origin-destination pairs. There's strong ridership in the pairs in between but not between Boston and Montreal.
We believe there are substantive numbers of people who will take this service. The targeted demographic are intercity riders as opposed to commuters, though there are some commuters who might utilize this service.

How much will Vermont, New Hampshire and Montreal be willing to kick into this?
The contribution of each state has not been determined.

As far as the assessment goes for usage of the lines, will there be some sharing in the maintenance costs?
We recognize that there could be some cost sharing with the rail owners and there will need to be future negotiations on this point. This is going on at a national level right now and will require nationwide solutions.

What is environmental impact of rail? Where are these people coming from? Can we talk about savings from people getting on a train as opposed to plans or cars?
We have to calculate this figure. We do know the ridership isn't necessarily a business core market or commuters. Some people from Providence to Boston are willing to pay a premium fare to use it. We are looking at ridership on the segment. We can get into details and provide this.

When will the locally preferred alternative be presented? Where and when will it be held?
We anticipate presenting a preferred alternative at public meetings in early 2015. Those meetings have not been scheduled.

How long are you taking comments?
The end of 2014 will be the cut off dates for comments on the three alternatives.

Is there a plan to solicit support through better outreach?
Yes, we are talking about this.

Cost
I have a question about the costs for prospective bridges and I have a background in the bridge inspections. Your numbers seem low. Could you please explain them?
We are not looking to put sidings where bridges do not exist. Also, most of the double track has existing bridge structures. There are a limited number of new structures. We used average figures based on the lengths of the bridges.

Some of the bridges are aged and fatigued. There might already be speed restrictions. I am suggesting that you look more deeply into this.
The freight railroads do not want to give this info out. We attempted to plan for this by providing a range of contingency.

Who will be responsible for maintenance of the bridges?
It will depend on the owner. For example, the Knowledge Corridor is planned to be purchased by MassDOT. We didn't make any major specific assumptions for how this will be handled.

As far as the assessment goes for usage of the lines, will there be some sharing in the maintenance costs? I have concerns about the overall costs. There is also gross underfunding of existing bridges by the MBTA.
The numbers in our projections are large; the investment will be significant to get to a point where passenger rail service is possible.

In terms of the cost of the different alternatives, did any of them express cost per rider?
There are different metrics. Obviously this is fairly easy to divide. Importantly, we are also looking into the possibilities and capabilities of the infrastructure and these could be more important metrics

What's the inflation factor?
The budget was compiled in 2014 dollars. Inflation will be factored in later.

We still have some areas where there are grade crossings. My impression is that grade crossings must be eliminated.
We have considered grade crossings as a part of this study and will continue to do so.

Public outreach

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