4. Preferred Alternative

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4. Preferred Alternative

This chapter summarizes the Preferred Alternative development process, and describes the Preferred Alternative assessed in the remainder of this Tier 1 Final Environmental Impact Statement (Tier 1 Final EIS). Additionally, this chapter summarizes the No Action Alternative used for comparison in the evaluation of the Preferred Alternative. Appendix BB, Technical Analysis on the Preferred Alternative, also provides further details and supporting documentation related to the Preferred Alternative.

The Federal Railroad Administration (FRA) developed the Preferred Alternative through a comprehensive and collaborative evaluation process that reflects the Tier 1 Draft Environmental Impact Statement (Tier 1 Draft EIS) evaluation of the Action Alternatives, extensive stakeholder and public comments, and FRA policy objectives. Ultimately, the technical analysis and diverse perspectives led the FRA to a Preferred Alternative that defines a path forward to efficient passenger rail service that meets the FRA policy objectives and establishes a roadmap for corridor development for future generations.

In the Tier 1 Draft EIS, the FRA recognized that a **Preferred Alternative would likely be a combination of elements included in the Action Alternatives** to respond to comments and variation in needs across the region. Refinements to reflect regional or local needs and concerns were considered as a part of the process.

As explained in the Tier 1 Draft EIS (Volume 2, Chapter 4), the FRA considered a broad range of alternatives to respond to future travel market trends and passenger service needs:

- For the Tier 1 Draft EIS, the FRA developed Action Alternatives (described in Volume 2, Chapter 4).
- The Action Alternatives represent different visions regarding the role of rail in the Northeast Corridor (NEC) (i.e., maintain, grow, transform); each Alternative has the ability to meet that vision with a mix of different infrastructure and representative routing options.
- The FRA defined the Action Alternatives to a level of detail consistent with a Tier 1 or programmatic EIS and sufficient to evaluate the relative benefits and effects to both the built and natural environments when compared to the No Action Alternative.

4.1 APPROACH TO DEVELOPING THE PREFERRED ALTERNATIVE

For NEC FUTURE, the FRA followed an iterative process to decide on a Preferred Alternative. This approach allowed the FRA to consider various aspects of this decision—from the overall "vision" for the role of rail to the Representative Route and how urban centers would be connected—in a holistic manner. The FRA's decision-making process provided the flexibility necessary to evaluate various factors together and better understand the interrelationships between markets, service, infrastructure, and environmental considerations. The FRA decision-making process evolved as data or comments suggested complementary or conflicting direction; overall, the FRA remained

committed to a fact-based decision-making process. To that end, the iterative process incorporated the following steps:

- Consider the Tier 1 Draft EIS findings relative to the Purpose and Need.
- Consider comments received from stakeholders and the public and identify areas with strong support or opposition.
- Consider applicable U.S. Department of Transportation (U.S. DOT) and FRA policy objectives regarding transportation infrastructure investments and the development of a national passenger rail network.
- Synthesize the information available from both the Tier 1 Draft EIS evaluation and stakeholder and public comments.
- Revisit specific characteristics or geographic areas where environmental sensitivities were identified or where benefits and costs were not well aligned.
- Identify areas where available information was inconclusive or where there were significant external factors that might influence future outcomes.

The FRA synthesized the ideas emerging from the Tier 1 Draft EIS findings and comments received and considered how these findings aligned with broader U.S. DOT and NEC Commission goals and policy objectives (see Section 4.2.3). This process was used to prioritize some of the key findings, particularly with regard to those evaluation factors that aligned with broader U.S. DOT policy.

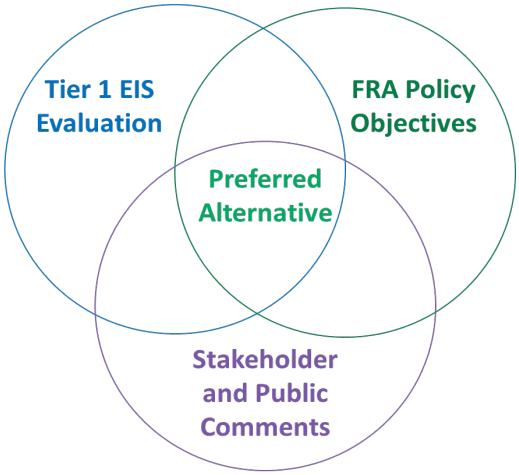
The FRA's decision-making framework allowed for flexibility in both the assessment of individual components of the alternatives as well as the timing for decision-making on those components. As cornerstones of this process, the FRA recognized the highly conceptual nature of the alternatives and sought to avoid making decisions that were too prescriptive or that limited opportunities to respond to change in the future.

4.2 FACTORS CONSIDERED IN DEVELOPING THE PREFERRED ALTERNATIVE

The FRA's decision-making framework incorporated the following key factors (Figure 4-1):

- **Tier 1 Draft EIS Findings.** As evaluated in the Tier 1 Draft EIS, what do the results of analysis show about the alternatives? What is the ridership, trip time, frequency of service they support? What would be the environmental and economic impacts?
- **Stakeholder and Public Comments.** What did we hear from the public and stakeholders about NEC FUTURE throughout the process, particularly about the alternatives evaluated in the Tier 1 Draft EIS?

Figure 4-1: Decision-Making Framework



What do the public, the states, and the railroads want for the NEC in the future and how can that be achieved?

- **Policy Objectives.** How well do the alternatives address goals of the U.S. DOT and the FRA? For example, do they create opportunities for enhanced service and operating efficiencies for the operating railroads?

4.2.1 Tier 1 Draft EIS Findings

As a first step, the FRA considered the quantitative and qualitative evaluation of the Action Alternatives presented in the Tier 1 Draft EIS. The evaluation factors correspond to each element of the Purpose and Need and include environmental effects, costs, and constructability. The results of this evaluation were presented in the Tier 1 Draft EIS in Chapter 9 and are included in this Tier 1 Final EIS in both Volumes 1 and 2, Chapter 9. Table 4-1 summarizes the assessment of the Action Alternatives in relation to these evaluation factors. Further detailed descriptions of each of the evaluation factors are summarized in Table 4-2 and further discussed in Chapter 9.[1]

The evaluation presented in the Tier 1 Draft EIS showed that Action Alternatives have the potential to improve passenger rail service, expand connections, serve new markets, and introduce efficiencies not possible on today's rail network. It also showed that the alternatives with more off-corridor route miles allow for more travel-time savings, resiliency, and opportunities for future growth, but would have greater environmental effects and require higher levels of investment. While there were many differences across the Action Alternatives relative to the No Action Alternative, the key findings that informed the FRA's decision-making are described in Sections 4.2.1.1 through 4.2.1.7. Service frequency, capacity, and annual passenger trips increase as the service objectives for each Action Alternative increase, demonstrating the range of possibilities for the role of rail in the Study Area. Metrics that capture changes in service frequency and travel times demonstrate how each Action Alternative would change travel from both a local and end-to-end perspective.

Table 4-1: NEC FUTURE Evaluation Factors

Factors	Action Alternatives		
	Alternative 1	Alternative 2	Alternative 3
NEC FUTURE NEEDS			
Aging Infrastructure	▪ Brings the NEC to a state of good repair	▪ Brings the NEC to a state of good repair	▪ Brings the NEC to a state of good repair
Insufficient Capacity	▪ Meets demand in 2040 except at the Hudson River between New York and New Jersey ▪ Capacity limitations constrain growth of connecting corridor trips	▪ Meets demand at all locations in 2040 ▪ Accommodates additional trips or future growth post 2040 except between New York and points south, measured at the Hudson River	▪ Provides excess capacity in 2040 at all locations ▪ Accommodates trips and future growth post 2040

[1] Data presented in Table 4-2 reflects an updated NEC FUTURE Interregional Model; these numbers are therefore modified from the data presented in Volume 2. Further explanation of the ridership updates is presented in Chapter 5.

Table 4-1: NEC FUTURE Evaluation Factors (continued)

Factors	Action Alternatives		
	Alternative 1	Alternative 2	Alternative 3
NEC FUTURE NEEDS (cont'd)			
Gaps in Connectivity	▪ Metropolitan service improves connectivity for interregional markets. ▪ Improves NEC connectivity at airports.	▪ Substantially increases connectivity to interregional markets with frequent Metropolitan service. ▪ Improves connectivity to Connecting Corridors, especially Keystone Corridor and New Haven–Hartford–Springfield. ▪ Advances integrated network of rail services emphasizing best practices in operating efficiencies. ▪ Improves connectivity to additional airports.	▪ Expands on connectivity of Alternative 2 with additional express services and new stations. ▪ Connects to multiple new markets, especially in Connecticut, Massachusetts, and/or Long Island. ▪ Improves connectivity to most major Northeast airports.
Compromised Performance	▪ Provides top Intercity-Express operating speeds of 160 mph. ▪ Travel-time savings for long-distance Intercity trips.	▪ Provides top Intercity-Express operating speeds of 160 mph. ▪ Greater travel-time savings for long-distance Intercity trips. ▪ Travel-time savings for Regional travel.	▪ Provides top Intercity-Express operating speeds of 220 mph. ▪ Greatest travel-time savings for long-distance Intercity trips. ▪ Travel-time savings for Regional travel.
Lack of Resiliency	▪ Includes improvements to make the NEC more resilient to climate change effects. ▪ Creates redundant rail infrastructure at key chokepoints.	▪ Includes improvements to make the NEC more resilient to climate change effects. ▪ Adds redundant rail infrastructure from New York City to Boston; improves redundancy at key locations between Washington, D.C., and New York.	▪ Includes improvements to make the NEC more resilient to climate change effects. ▪ Creates redundant rail infrastructure from Washington, D.C., to Boston in the form of a complete second spine.
Environmental Sustainability	▪ Reduces net emissions of criteria pollutants and greenhouse gases (GHG). ▪ Supports development around existing station areas.	▪ Greater reductions in net emissions of criteria pollutants and GHGs. ▪ Supports development around station areas and expands to new off-corridor markets between Hartford and Providence. ▪ Potential increase in environmental effects associated with Representative Route footprint between Hartford, CT, and Providence, RI.	▪ Best reductions in net emissions of criteria pollutants and GHGs. ▪ Supports development around station areas and strengthens growth opportunities to new markets between New York City and Boston. ▪ Potential increase in environmental effects associated with Representative Route footprint, particularly in off-corridor segments between New York City and Boston, MA.

Table 4-1: NEC FUTURE Evaluation Factors (continued)

Factors	Action Alternatives		
	Alternative 1	Alternative 2	Alternative 3
NEC FUTURE NEEDS (cont'd)			
Continued Economic Growth	▪ Provides minimal travel-time and emission savings. ▪ Improves access to more jobs especially in existing urban center such as New York City, New Haven.	▪ Provides greater travel-time and emission savings. ▪ Greater access to more jobs along the NEC and to new markets, especially in markets north of New York City. ▪ Improves connectivity for Hub and Major Hub stations; strengthens connections to existing urban centers. ▪ Creates opportunities for improved connectivity to new markets.	▪ Provides best travel-time and emission savings. ▪ Best access to more jobs for all markets especially in New York, Connecticut, Massachusetts. ▪ Improves connectivity for Hub and Major Hub stations; strengthens connections to existing urban centers. ▪ Creates opportunities for improved connectivity to new markets.
BENEFITS, COSTS, AND OTHER FACTORS			
Environmental Impacts	▪ Least amount of footprint-based environmental impacts.	▪ More footprint-based environmental impacts compared to Alternative 1. ▪ Crosses the John Heinz National Wildlife Refuge in Delaware and Philadelphia Counties, PA.	▪ More footprint-based environmental impacts compared to Alternative 2. ▪ Affects the greatest number of parks and acres of parklands. ▪ Affects the greatest number of cultural and historic resources.
Capital/O&M Costs	▪ Carries the lowest capital cost and lowest O&M costs.	▪ Carries capital cost greater than Alternative 1 and less than Alternative 3. ▪ O&M costs are more than Alternative 1 and less than Alternative 3.	▪ Carries the largest capital cost and the lowest net revenue. ▪ O&M costs are the highest of the Action Alternatives.
Constructability	▪ Adds some new segments and new track adjacent to the NEC at construction types similar to the NEC. ▪ Greatest increase in percentage of route miles of more complex and costly tunnel and aerial structure construction types compared to the No Action Alternative.	▪ Adds new segments and new track adjacent to the NEC using construction types similar to the NEC. ▪ New segment in Connecticut connects New Haven, Hartford, and Providence, providing more route miles than Alternative 1. ▪ Greater percentage of route miles are more complex and costly tunnel and aerial construction types than Alternative 1.	▪ Second NEC spine from Washington, D.C., to Boston provides the greatest number of route miles. ▪ New segment in Connecticut connects New York to Hartford, and Hartford to Boston via lengthy off-corridor segments. ▪ Greater percentage of route miles are more complex and costly tunnel and aerial construction types than Alternative 2.

Source: NEC FUTURE team, 2016

4.2.1.1 Aging Infrastructure

Insufficient levels of investment in the NEC are the fundamental cause of inadequate rail service, and simply maintaining the status quo with the No Action Alternative fails to meet the NEC FUTURE Purpose and Need. All Action Alternatives would bring the NEC to a state of good repair, eliminating the backlog of infrastructure requiring replacement, and enabling future capital upgrades to be planned and implemented according to a regular replacement cycle.

4.2.1.2 Insufficient Capacity

Demand for Intercity and Regional rail service exceeds practical capacity under the No Action Alternative across the NEC. The greatest unmet demand is in New York measured at the Hudson River where the NEC connects New Jersey to New York City. Alternative 1 achieves its objective of maintaining the role of rail by meeting 2040 demand for all areas of the NEC, except in the New York metropolitan area between Trenton, NJ, and Stamford, CT, where the NEC is most constrained. Demand for Regional rail service in this area is high and growing at a faster pace than other portions of the NEC. Two additional tracks in tunnel under the Hudson River are added in Alternative 1. However, Alternative 1 does not include additional track capacity in New Jersey necessary to provide sufficient capacity to accommodate the robust demand for Regional rail in the New York/ North Jersey metropolitan area in 2040, where the peak-hour ridership demand would exceed available capacity by 20 percent.

NEC FUTURE Intercity Service Types:

- **Intercity-Express** – Premium Intercity rail service operating at speeds of 160–220 miles per hour (mph), making limited stops and only serving the largest markets. Intercity-Express service offers the shortest travel times for Intercity trips, higher-quality onboard amenities, at a premium price, using high-performance trainsets.
- **Intercity-Corridor** – Intercity services that operate both on the NEC and on connecting corridors that reach markets beyond the NEC. These trains provide connectivity and direct one-seat service to large and mid-size markets on the NEC.
- **Metropolitan** – New Intercity service envisioned in NEC FUTURE with high-performance trainsets that operate on infrastructure tailored to regular service patterns (clockface headways), Metropolitan trains can provide faster journeys stopping at more destinations more frequently, at a lower cost and with timed connections with express Intercity and Regional train services.

Alternative 2 supports growth in the role of rail with the addition of the necessary infrastructure in New Jersey, New York, and Connecticut. It accommodates the robust demand for Regional rail service in the New York metropolitan area by adding through-service capability with two additional East River tracks in tunnel (6 tracks total) in addition to the added Hudson River track capacity (4 tracks total) into New York. As such, Alternative 2 provides sufficient capacity to accommodate demand in the New York metropolitan area and provides excess capacity at other locations along the corridor to accommodate additional off-corridor trips or future growth post 2040.

Alternative 3, with six Hudson River and East River tracks and a separate end-to-end spine, creates excess capacity at all locations on the NEC that can support both substantial growth in Regional rail service beyond projected 2040 demand and also a large expansion of Intercity rail service.

Regional rail service in Alternatives 1 and 2 continues to operate at up to 100 percent utilization of available capacity. Alternative 3 has the greatest increase in capacity utilization over the No Action Alternative, especially in the largest metropolitan areas. For New York City, Alternative 3 provides up to five times more peak-hour Intercity trains than does the No Action Alternative, compared to Alternative 1, which provides up to two times more peak-hour Intercity trains, and Alternative 2, which provides up to four times more Intercity trains. This is primarily due to the new rail infrastructure that creates a second spine between Washington, D.C., and Boston.

All Action Alternatives would increase total rail trips consistent with their respective vision. However, the effects that the Action Alternatives would have on Intercity travel are fairly consistent, especially between Alternative 2 and Alternative 3. Compared to the No Action Alternative, Intercity passenger-miles traveled would increase 148 percent in Alternative 2, and an average of 152 percent across the Alternative 3 route options. In Alternative 1, Intercity-Express passenger-miles would decrease compared to the No Action Alternative due to improved Intercity-Corridor services (e.g., Metropolitan service). This shows that in Alternative 1, some passenger trips shift from Intercity-Express to Metropolitan service.

Incorporating operational efficiencies—from Metropolitan service to slot-based and pulse-hub operations—requires sufficient capacity to support changes in the way trains operate across the NEC. Each of the Action Alternatives creates some capacity for these operational efficiencies. Alternative 1 lacks sufficient capacity to achieve significant efficiencies, and this alternative would not include the ability for run-through service at major stations, pulse-hub operations, or regularized clockface headways. Alternative 2 provides sufficient additional capacity on the existing spine to support run-through service at major stations, pulse-hub operations, and regular headway-based services. Alternative 3 also provides additional capacity overall to achieve efficiencies with the use of an expanded rail network.

Operating Efficiencies used in the Preferred Alternative:

- **Clockface Headways** are regular schedules for all train services operating on the NEC in which individual service patterns repeat every hour.
- **Slot-Based Operations** are a way to operate trains including regular service planning principals featuring regular clockface headways and simplified operations to reduce variability that can cause delays in day-to-day operations by setting up a repeating schedule of "slots" every hour throughout the day.
- **Pulse Hub Operations** are a way to operate trains from different lines and service tiers to coordinate arrival at a Hub station concurrently or in close succession. Passengers can then transfer to a range of services during the simultaneous dwell of these multiple trains. Trains then leave the station in close intervals.

4.2.1.3 Gaps in Connectivity

The introduction of Intercity service, especially Metropolitan service, at select rail stations greatly improves connectivity to Regional markets in all Action Alternatives. Alternatives 2 and 3 support

significant growth in the number of trains serving smaller markets that lack Intercity service today and in the No Action Alternative. This is achieved with the introduction of Metropolitan service, with up to 4 trains per hour (tph) in Alternative 2, and up to 6 to 8 tph in Alternative 3. Without the addition of new segments, capacity in Alternative 1 is insufficient to fully employ Metropolitan service, limiting it to up to 2 tph in each direction. As a result, Alternative 1 supports a service profile similar to that of today, albeit one with additional and more-reliable service, whereas Alternatives 2 and 3 provide the capacity to add new types of service connecting to new markets on and off the NEC.

Alternatives 2 and 3 reach additional markets with opportunities for supplemental off-corridor routing to markets underserved today, such as Hartford, CT. Alternatives 2 and 3 also offer Intercity service to intermediate markets not served today such as Odenton, MD; and Bayview, MD; and North Brunswick, NJ. Alternative 2 better accommodates Regional rail with improvements focusing on the NEC and existing markets with established Regional rail service. Alternative 3 provides more Intercity rail service utilizing a second spine and connecting to new markets. These connectivity data indicate that Alternative 2 does more to improve Regional rail connectivity than Alternative 3, whereas Alternative 3 improves Intercity rail connectivity more than Alternative 2.

In comparing Action Alternatives against the No Action Alternative, Alternative 1 improves connectivity at airport stations the least, adding the fewest number of daily passenger trains. Alternative 2 offers a new air-rail connection to Philadelphia International Airport, and enhanced connections to Bradley International Airport in Connecticut[2] and T.F. Green Airport in Providence, RI. Alternative 3 adds the most number of daily passenger trains to these airport stations and to additional airports, including JFK and Long Island MacArthur Airports. At Baltimore/Washington International Thurgood Marshall Airport, Alternative 3 would provide 309 more trains per day than the No Action Alternative, a 219 percent increase. See Table 4-2 for additional connectivity metrics and results.

4.2.1.4 Compromised Performance

Passenger rail performance, as measured by travel time and reliability, would improve in the Action Alternatives when compared to the No Action Alternative. Operating speeds on the NEC today are slower than what they would be in all Action Alternatives. South of New York City, the top operating speed is 125 to 135 mph. North of New York City the top operating speed is 125 mph except for a length of track between New London, CT, and Providence, RI, with a top operating speed of 150 mph.

The Action Alternatives would achieve higher operating speeds for greater distances as compared to the No Action Alternative. Only Alternative 3 would provide top Intercity-Express operating speeds of 220 mph between Philadelphia, PA, and Hartford, CT. Alternative 1 and Alternative 2 would have top Intercity-Express operating speeds of 160 mph. In Alternative 1, top operating speeds of 160 mph would be possible only between Philadelphia and New York City and Old Saybrook, CT and Providence, RI. In Alternative 2, segments where trains could achieve top operating speeds of 160 mph would be expanded from Alternative 1; top speeds of 160 mph would

[2] Connection to Bradley International Airport requires a transfer to bus service at Hartford Station.

be possible not only between Washington, D.C., and New York City, but also between New Haven, CT, and Boston via Hartford, CT.

Intercity-Express travel-time savings are greatest over longer-distance city-pairs, and where trains can operate longer distances on new segments. Alternative 3 would provide the fastest Intercity-Express travel times between Washington, D.C., and Boston, approximately 2 hours 35 minutes faster than the No Action Alternative; and roughly 1 hour 30 minutes and 1 hour faster than Alternatives 1 and 2, respectively. City-pairs not connected by new rail infrastructure or city-pairs that would be served only by Intercity-Corridor service would have much smaller savings in travel time.

Survey data collected by the FRA for NEC FUTURE revealed that reliability, frequency of service, and fare options are more important to many travelers than train speed (see Volume 2, Appendix B, Alternatives Documentation). The ridership response to improved travel time and frequency for Intercity service offered by Alternative 3 is modest as demand for fast Intercity service is largely satisfied by Alternative 2. Construction of a second spine, as proposed in Alternative 3, offering dramatic travel-time savings and more than doubling service compared to Alternative 2, results in the addition of only 1.9 million Intercity passengers.

4.2.1.5 Lack of Resiliency

The addition of new segments and off-corridor route miles provides greater redundancy and resilience benefits. The Action Alternatives would also provide opportunities to harden or adapt the NEC to reduce vulnerability to climate change effects such as sea level rise, flooding, or heat-related events. The resiliency of the NEC today is constrained by poor infrastructure, lack of capacity, and lack of redundancy, which limits opportunities to maintain operations during unplanned disrupting events. Building the flexibility to adapt service in response to changes in travel patterns or during unanticipated outages, catastrophic, or weather-related events is primarily capacity driven – the more capacity, the more flexibility to change service patterns.

All Action Alternatives provide some degree of resiliency by adding various new segments along the corridor to provide capacity and redundancy. Furthermore, all of the Action Alternatives would provide resilient infrastructure: the construction and design of new or modified rail assets would include adaptation measures to reduce effects of weather-related events, such as flooding, or would be located within inland portions of the Study Area. The Action Alternatives would reduce the risk of flooding, consistent with the amount of new infrastructure built in each Action Alternative.

As shown in Table 4-2, Alternative 1 is less flexible to support service changes due to the limited additional capacity under this alternative. However, the new segment from Old Saybrook, CT, to Kenyon, RI, adds redundancy to one of the most vulnerable segments of the NEC. Compared to the No Action Alternative, coastal storm surge flooding risk for this new segment is reduced by 19 percent and riverine flooding risk is reduced by 20 percent.

Alternative 2 significantly enhances redundancy through addition of tracks, replacement of bridges, and new tunnels and the New Haven-Hartford-Providence inland route segment. There are fewer

places along the NEC that are vulnerable under Alternative 2. Compared to the No Action Alternative, coastal storm surge flooding risk is reduced by 7 percent and riverine flooding risk is reduced by 11 percent.

Alternative 3 provides the greatest benefits through construction of a second NEC spine, which provides redundancy across the railroad and all areas at risk from storm surge. Compared to the No Action Alternative, coastal storm surge flooding risk is reduced by 20–21 percent (depending on routing option selected) and riverine flooding risk is reduced by 5–9 percent. Of the Alternative 3 route options, Alternative 3 via Central Connecticut and Worcester (Alternative 3.4) has the fewest number of acres at risk from riverine flooding, and Alternative 3 via Long Island/Providence (Alternative 3.2) has the most number of acres at risk.

4.2.1.6 Environmental Sustainability

Improvements to rail service result in a shift of riders from both highways and air, resulting in a decrease in total energy usage and emissions. All Action Alternatives would reduce net emissions of criteria pollutants and GHGs. The Action Alternatives would increase emissions of criteria pollutants and GHGs from power plants because of the increased electrical requirements of the trains under the Action Alternatives. However, the net reduction in emissions of GHGs and criteria pollutants from roadways would offset the increase in emissions from power plants, resulting in an overall net decrease in emissions.

Overall, the Action Alternatives each would reduce total energy use, with Alternative 3 decreasing energy use the most and Alternative 1 decreasing total energy use the least. Of the Alternative 3 options, the option via Long Island and Worcester would decrease total energy use the most and the option via Central Connecticut and Worcester would decrease total energy use the least.

Consistent with the goals and objectives of state and metropolitan planning organizations within the Study Area related to transit-oriented development, the Action Alternatives have the potential to support development around stations. The Action Alternatives both positively impact and disadvantage Environmental Justice (EJ) communities – impacts from construction and added train activities present challenges, but significant increases in service and station connectivity enhance travel opportunities. Alternative 3 has the greatest potential for growth and development around stations.

4.2.1.7 Continued Economic Growth

Construction and rail operation employment effects are derivative of the level of investment. Opportunities for growth generally rise incrementally across Alternatives 1 through 3. As such, Alternative 3, which has the most rail capital investment, has the greatest employment growth in construction and rail operations.

As shown in Table 4-2, diversions to Intercity rail provide positive transportation market effects in all Action Alternatives. Alternative 1 and Alternative 2 would provide annual Intercity travel-time savings benefits of approximately $625 million and $892 million, respectively. Alternative 3 would provide the most travel-time savings benefits, primarily due to diverting travelers from auto and intercity bus modes to Intercity rail, resulting in travel-time savings of approximately $1,207 million

annually.[3] (See Chapter 6, Economic Effects and Growth, and Indirect Effects, for additional details of monetized value for changes in travel time.) In addition, the net change in value of travel-time and travel cost savings for travelers shifting to rail from other modes (i.e., air, auto, bus) are greatest in Alternative 3 and smallest in Alternative 1. Travel cost savings represent real gains in disposable income that are available for other types of expenditures or saving.

All Action Alternatives would expand the number of places reachable by rail within 30 minutes of train travel time compared to the No Action Alternative. Alternatives 2 and 3 provide greater access to jobs than Alternative 1, particularly north of New York City. Alternative 2 would provide significant gains at Hartford and New Haven Stations; doubling access to jobs accessible at New Haven Station and roughly 80 percent more at Hartford Station. Alternative 3 route options through Long Island would create access to about 55 percent more jobs around Penn Station New York than route options through Central Connecticut.

4.2.1.8 Environmental Impacts

Potential acquisitions of undeveloped and developed land cover in the Study Area can result in fragmentation of wetlands and ecologically sensitive habitats; dredging and filling of wetlands; encroachment of floodplains; and conversion of recreational resources, prime farmland, and timberlands to a transportation use. Construction of new passenger rail infrastructure would increase the number of acres of potential acquisition. As such, Alternative 3 has the greatest number of acres of potential acquisition, while Alternative 1 has the least amount of acres of potential acquisition.

Of the Action Alternatives, Alternative 3 has the potential to affect the greatest number of parks and most acres of parkland. Considering the potential environmental consequences of the alternatives, Alternative 2 is the only Action Alternative that crosses the John Heinz National Wildlife Refuge in Delaware and Philadelphia Counties, PA. Alternative 3 diverts from the NEC and would cross the Patuxent Research Refuge in Anne Arundel County, MD, and Pelham Bay Park in the Bronx, NY. There is one wild and scenic river—White Clay Creek in New Castle, Delaware—that all of the Action Alternatives cross.

There are no known National Priorities List (NPL) Superfund sites that intersect Alternatives 1 and 2 and one known NPL Superfund Site in Alternative 3. Alternatives 2 and 3 include more route options off the NEC and have the highest potential to encounter Brownfield sites.

[3] The Action Alternative travel time savings presented in Volume 1 are revised from the estimates for the Action Alternatives in the Tier 1 Draft EIS. For comparison with the Preferred Alternatives, travel time savings for the Action Alternatives were re-estimated using the updated NEC FUTURE Interregional Ridership Model prepared for the Tier 1 Final EIS analyses. As such, travel time savings, operating costs, and emissions savings metrics for the Action Alternatives presented in Table 4-2 may vary from those estimates presented in Volume 2. Revisions to the NEC FUTURE Interregional Model are further described in Chapter 5 and Appendix BB. Revisions to the O&M cost model are also described in Appendix BB.

4.2.1.9 Capital/O&M Costs

Of the Action Alternatives, Alternative 1 carries the lowest capital costs, followed by Alternative 2 and Alternative 3. Alternative 3 has the highest operating costs. Operating costs for Alternative 2 are greater than Alternative 1, but less than Alternative 3.

4.2.1.10 Constructability

The Action Alternatives include the construction of significant new rail infrastructure—tunnels, bridges, embankments, new stations and ancillary roads and support facilities—across the NEC over an extended period. Alternative 1 includes new construction on the NEC to eliminate chokepoints. New construction separate from NEC is confined to the Baltimore, MD, and New York City, metropolitan areas, and coastal Connecticut and Rhode Island. Alternative 2 includes new construction on the NEC to remove speed restrictions and a new segment separate from the NEC between New Haven and Hartford, CT, and Providence, RI. Alternative 3 includes construction of new segments operating between Washington, D.C., and Boston, separate from the NEC to create a second spine, including new route options between New York City, Hartford, and Boston.

Tunnel construction increases the most (as a percentage) in the Action Alternatives. The amount of new tunnel in Alternative 3 is much greater than either of the other alternatives. All of the Action Alternatives would include approximately 2 miles of new tunnels in Baltimore, and approximately 3 miles of new tracks in tunnel crossing the Hudson River from New Jersey to New York. In Alternative 3, new track in tunnel would account for approximately 18 percent of the construction types, of which one route option would include approximately 22 miles of tracks in tunnel across the Long Island Sound, and another route option would include approximately 55 miles of tracks in tunnel from New York City to Hartford via Central Connecticut.

4.2.1.11 Summary of Tier 1 Draft EIS Findings

The FRA considered these key findings in its deliberation on a Preferred Alternative. Key findings include that the No Action Alternative does not address the NEC FUTURE Needs, and that Alternative 1, while effective in some regards, falls short in providing sufficient capacity to meet demand in 2040 except in the New York area measured at the Hudson River and does not provide sufficient capacity for growth beyond 2040. Alternative 1 also has limited possibilities for implementing operating efficiencies corridor-wide. Alternatives 2 and 3 would achieve desired traveler benefits, address the stated needs, but have greater effects on the natural and built environment. Together, these findings highlight the importance of balancing concerns for the natural and built environment with the value of more-efficient service to more places for more people.

4.2.2 Public and Stakeholder Comments

Approximately 3,200 comment submissions were received during the Tier 1 Draft EIS comment period. A detailed listing of the comments received, along with responses, is provided in Appendix JJ. Additional information about the comment period and comments received is provided in Volume 1, Chapter 11 and Appendix FF. The FRA published a Comment Summary Report in July 2016. The Comment Summary Report, included in Appendix FF, provided stakeholders and the public with a

thematic summary of comments received. While the public and stakeholders offered comments on a wide range of topics, these could be generally organized into seven themes:

- Overall vision for passenger rail in the Northeast
- Importance of enhancing connections and mobility at all levels of the system
- Maintaining the region's economy
- Environmental benefits and impacts
- Cost of improvements, funding, and phasing implementation
- Data and methodologies used in the Tier 1 Draft EIS
- Study process and public outreach

Stakeholder and public comments received indicated a clear preference for a Preferred Alternative that would bring the NEC to a state of good repair. Other priorities emerging from comments received included the importance of a continued emphasis and investment along the NEC with more-reliable service and improved connections between urban centers. Together with the Tier 1 Draft EIS findings, the comments received provided an invaluable lens on expectations of a Preferred Alternative.

4.2.2.1 The Overall Vision for Passenger Rail in the Northeast

The FRA received numerous comments on the alternative visions. Commenters stressed the importance of **achieving a state of good repair**, with clear support for going **beyond the No Action Alternative**. While there was some support for a transformative vision that would create a "world class" rail system, most commenters preferred a less ambitious approach, and many called on the FRA to **fix the existing NEC before undertaking any expansion**. Commenters also sought to ensure that improved Regional rail service be an integral part of the vision.

There was no consensus on a route for a second spine north of New York. Comments indicated considerable opposition to a Long Island routing, as well as disappointment that a second spine routing through Springfield, MA to Boston was not advanced in the Tier 1 Draft EIS.

Overall, stakeholder and public comments did indicate some support for the end-to-end transformation vision defined for Alternative 3; potential mobility benefits were frequently offset with concerns for environmental effects. Many considered Alternatives 1 and 2 to be more realistic to implement than Alternative 3.

4.2.2.2 Enhancing Connections and Mobility

The FRA received a wide variety of suggestions for improving connections between cities along the NEC. Some of these addressed travel time (such as a desire for a 60-minute ride between New Haven and New York City). Others urged that service be upgraded in specific locations, such as Chester, PA, and Secaucus, NJ. Still others advocated connections to new markets along the new segments in the Action Alternatives, such as a connection to the University of Connecticut at Storrs, as envisioned in Alternatives 2 and 3.

Some commenters were concerned that their cities not be bypassed by a new high-speed route. For example, there was concern from various stakeholders in Delaware about the lack of a connection at Wilmington to the second spine route proposed in Alternative 3. Similar concerns were expressed about Providence.

Agencies and individuals commented on the importance of improving service on connecting passenger rail corridors. Comments received supported the need for expansion within the NEC and beyond to markets in Virginia, upstate New York, New England, and Pennsylvania. Many commenters voiced support for including connections via the Hartford/Springfield Line, which connects Hartford, CT, and Springfield, MA to the NEC at New Haven, CT. Interest in integrating connecting corridor service into the improved NEC was expressed for both electrified and non-electrified corridors. The importance of coordinating with ongoing planning efforts was noted with regard to each of the connecting corridors (southeast to Virginia; the Keystone, Empire, and New Haven–Hartford–Springfield corridors; the Inland Route; and the Downeaster north of Boston).

Overall, comments stressed the importance of improving mobility through better connections at all levels of the system: on the NEC, to connecting corridors, to potential new markets, and to other modes of transportation. There were supporters for each of the Action Alternatives with regard to the opportunities to improve connectivity of the rail network. Many commenters expressed interest in seeing a more integrated, affordable, customer-friendly NEC, with features such as a common-fare card for greater convenience and improved bicycle access. Strong support was expressed for improved service to Hartford, CT, and Springfield, MA via the Hartford/Springfield Line. Commenters addressed both Intercity and Regional travel needs and encouraged the FRA to consider both in defining the Preferred Alternative.

4.2.2.3 Maintaining the Region's Economy

Another topic of concern to many commenters is the importance of passenger rail to the Northeast economy. Comments on this theme addressed the role of rail in retaining the region's existing jobs and workforce, as well as the growth opportunities that significant rail service improvements could create. The importance of continued service on the shore line in Connecticut was also emphasized, as well as the importance of enabling growth in freight rail. Many comments addressed the economic importance of continued investment in the NEC along the coastline in Connecticut between New Haven and New London; others addressed the potential of new or improved service to expand labor markets and spur economic development in cities along the NEC.

Many commenters expressed the importance of prioritizing improvements to the NEC and the urban centers served today. Alternatives 1 and 2 were both preferred over Alternative 3 in this regard, particularly in Connecticut. While some commenters prioritized the improved travel times and mix of services possible in Alternative 3, others were equally concerned with potential sprawl associated with a second spine.

4.2.2.4 Environmental Benefits and Impacts

The FRA received a broad range of comments regarding both environmental benefits and potential effects associated with the No Action Alternative and Action Alternatives. Many articulated support

for the air quality, transportation, and economic development benefits of improved passenger rail services. Several comments suggested methods for minimizing overall impacts through the use of existing transportation corridors. Others noted potential mitigation measures and opportunities to use green infrastructure.

A significant number of commenters (over 700) raised concerns with a proposed aerial structure in Old Lyme, CT, on a proposed new segment between Old Saybrook, CT, and Kenyon, RI. Others raised concerns with a possible routing via Long Island. Due to the significant concerns raised, the FRA met with local representatives and revised the Representative Route in the Preferred Alternative to avoid the use of an aerial structure in the historic district of Old Lyme with a change in construction method from aerial structure to tunnel.

Commenters raised concern with potential routings through both the Patuxent Refuge in Maryland and the John Heinz Refuge in Pennsylvania. Some supported a central Connecticut routing to connect new markets, while others raised concern with the effect on open space and other natural features. The FRA also heard from individuals concerned with the environmental effects of the proposed routing for Alternatives 2 and 3 between Hartford and Providence. Areas of concern included effects to the rural character of the area as well as potential effects on environmental resources including The Last Green Valley Heritage Corridor, Connecticut State Route 169 (a Scenic Byway), and the Willimantic and Quinebaug Rivers.

While some supported proposed off-corridor representative routes, commenters asked questions about potential land use changes and effects to open space, forested and agricultural lands. Other environmental resources of concern include wetlands and marshes; wildlife and bird habitat; ecology; waterways, estuaries, and rivers. Several comments raised concerns about potential effects on Environmental Justice (low-income or minority) communities.

4.2.2.5 The Cost of Improvements, Funding, and Phased Implementation

Another common theme in the comments is the cost of capital improvements and the feasibility of obtaining funding for any of the visions outlined. Many commenters felt that Alternative 3 was too costly. Others were most concerned about how funding would be secured for the near-term improvements necessary to achieve a state of good repair and for continued maintenance. Given fiscal constraints, many stakeholders urged that the FRA's primary focus be on the near-term implementation of an initial phase of priority projects.

4.2.2.6 Data and Methodologies

The FRA also received comments about the methodologies and data used in the various analyses conducted for the Tier 1 Draft EIS. These comments principally addressed the ridership estimates, including underlying assumptions about pricing and demographic data. Comments were also received on the capital cost estimates and methodology. Based on this feedback, the FRA did review the Intercity ridership methodology and assumptions and made updates to the model subsequent to the Tier 1 Draft EIS for use in evaluating the Preferred Alternative (see Appendix BB, Technical Analysis on the Preferred Alternative).

4.2.2.7 The Study Process and Public Outreach

The FRA also heard from a variety of organizations and individuals with concerns about the NEC FUTURE study process. These comments primarily addressed the need for more public outreach in potentially affected communities, the need for more time to consider the information, and the difficulty of evaluating alternatives without more-detailed information.

The FRA received requests for an extension of the public comment period, which originally ran from November 13, 2015 to January 30, 2016. In response, the FRA extended the comment period until February 15, 2016, resulting in a 95-day comment period.

Following the close of the comment period on the Tier 1 Draft EIS, the FRA did meet with stakeholders to discuss some of the areas of concern, including agency and elected officials along the Hartford/Springfield Line, residents, and elected officials in Old Lyme, CT, and Springfield, MA, and the states and railroad operators. These meetings further informed the FRA's deliberative process in selecting the Preferred Alternative.

4.2.3 FRA Policy Objectives

As described in Section 4.1, the FRA considered a set of policy objectives as a construct for decision-making. These policy objectives provide a benchmark for ensuring that the Preferred Alternative is consistent with and supportive of broader U.S. DOT[4] and NEC Commission policy goals to provide safe and efficient passenger rail.[5] Collectively, these broader policies prioritize safety, state of good repair, economic competitiveness, quality of life in communities, and environmental sustainability. These policies strongly correlate with the needs identified for NEC FUTURE and feedback received from stakeholder and public comments. These broader policy goals were an overlay to inform the FRA's decision-making, particularly in light of the long-term nature of NEC FUTURE and its far-reaching implications for other passenger rail efforts.

The following policy objectives evolved from the synthesis of the Tier 1 Draft EIS findings and public and stakeholder comments:

- Meet market demand and expand services to new markets.
- Provide flexibility to respond to future changes in the Northeast region.
- Advance new approaches to delivering NEC services.
- Increase resiliency and redundancy.
- Reduce the negative impacts of transportation.
- Provide positive economic opportunities for the NEC region.

[4] *Transportation for a New Generation: Strategic Plan | Fiscal Years 2014-18.* U.S. Department of Transportation, Office of Policy, Final Report, February 2015. Accessed at *https://www.transportation.gov/administrations/office-policy/fy-2014-2018-strategic-plan* and *Vision for High Speed Rail in America*, April 2009 at *http://www.fra.dot.gov/eLib/Details/L02833*

[5] Northeast Corridor Commission, Mission and Goals statement, Access at *http://www.nec-commission.com/resources/mission/*

These policy objectives first informed the FRA in decision-making about a vision for the NEC and second on how to best combine elements of the three Action Alternatives to achieve that vision in the near- and longer-term. Prominent among the policies that informed the FRA's decision-making was **safe and reliable transportation, which advances new approaches to delivering NEC services** to maximize the value of a large capital investment with operating efficiencies. Balancing operating efficiencies and right-sizing the capital investment was an important consideration in the packaging of the Preferred Alternative.

4.2.3.1 Meet Market Demand and Expand Services to New Markets

This objective focuses on how the Action Alternatives provide capacity to respond to estimated 2040 demand along all portions of the corridor and responsiveness to growth beyond the anticipated 2040 demand. Fulfillment of this policy objective requires that the Preferred Alternative not only meets 2040 forecast demand but also incorporates services to new markets and provides opportunities for future growth in these markets. New market opportunities include enhanced services to existing markets that enable better connections, more-frequent and safer services, and access to new markets not served today. Enhancing rail access to and integration with airports and intermodal connections was also evaluated under this objective. Of technical analyses completed, the FRA considered demand, capacity, connectivity, and new services in evaluating each alternative.

The Action Alternatives were developed with the objective of meeting 2040 demand, at a minimum, based on the role that passenger rail plays in the transportation system of the Northeast today. Alternatives that provide additional residual capacity beyond this base 2040 level can support growth beyond 2040. This increased capacity, however, would need to be developed incrementally in response to demand.

Alternatives 2 and 3 best respond to this policy objective, with Alternative 1 providing less opportunity for future expansion.

4.2.3.2 Provide Flexibility to Respond to Future Changes

This policy objective focuses on building flexibility into the Preferred Alternative to respond to future demands. This objective has two primary components:

- Ensuring sufficient capacity to give the operators flexibility to change service and schedules as demand changes. Over long-time horizons, flexibility is needed to respond to shifts in the travel patterns, markets, and ability to incrementally implement the program.
- Preserving opportunities to consider additional route segments, development of new technologies, and future transportation innovations.

A key question is whether or not it is possible that in future decades there may be heightened need for additional capacity and performance improvement that could justify adding additional segments of a second spine to the existing rail network, such as those proposed in Alternative 3. Alternative 2 best provides the flexibility required to fulfill this policy objective, with sufficient capacity to accommodate operational flexibility and ability to be further expanded in the future with additional segments that improve existing, or serve new markets.

4.2.3.3 Advance New Approaches to Delivering Services

The adoption of global best practices for operating rail services is an opportunity for some of the greatest potential benefits to the public and passengers in the Study Area. Incorporating operating standards and efficiencies (pulse-hub, common-fare medium, coordinated schedules, etc.) would provide dramatic improvements to passenger experience and value by greatly enhancing convenience, reliability, travel-time savings, and travel choices. Improvements proposed with the Preferred Alternative could be leveraged to improve connecting corridor services and enhance the benefits to the larger integrated network.

The FRA is developing new safety standards for Tier III equipment[6] (locomotive and coaches) and operations. These standards represent a new national standard for high-speed rail operations which are assumed for the Preferred Alternative. The seamlessly integrated rail services possible with operational efficiencies and improved operating equipment will make more effective use of public investments in infrastructure and will create greater transportation and economic benefits than continuing conventional separate operations. As part of NEC FUTURE, Metropolitan service was identified as a promising service type which could attract many new passengers to rail service for a broader range of trips.

Alternatives 1, 2, and 3 offer opportunities to implement new service delivery approaches, but those opportunities are limited in Alternative 1 because of its limited capacity. Both Alternatives 2 and 3 focus on creating an integrated network of rail services emphasizing best practices in operating efficiencies and delivering customer-friendly and cost-effective improvements.

4.2.3.4 Increase Resiliency and Redundancy

Resiliency of the NEC rail network includes adapting or hardening existing and new infrastructure that is vulnerable to extreme weather conditions or other unforeseen events. This includes constructing new rail infrastructure that is less vulnerable to risk of inundation, and locating rail infrastructure in areas less vulnerable to sea level rise flooding, storm surge flooding, or riverine flooding. Resiliency is also a function of the NEC rail network's ability to recover from inundation, utilizing redundant infrastructure that provides alternative routings and minimizes the ripple effects felt throughout the network resulting from delayed trains.

System redundancy is needed to support the reliability of the transportation system and to ensure that it is resilient and adaptable to changing circumstances. New segments constructed separate from but connecting to the NEC provide redundant network connections to existing markets. Alternatives 2 and 3, with multiple routings between New York City and Boston, provide greater redundancy than Alternative 1. The addition of a second spine between Washington, D.C., and Boston in Alternative 3 provides the most redundant infrastructure among all Action Alternatives.

At-grade or trench construction types have a greater risk of inundation than above-grade construction types (e.g., embankment or aerial structure). When considering construction types, Alternative 3 provides greater resilience benefits than Alternatives 1 and 2. Overall, the route miles of Alternative 3 include 43 percent at-grade and trench construction types, compared to 48 percent

[6] Additional information on Tier III equipment can be found in Section 4.5.7.

for Alternative 2, and 52 percent for Alternative 1. The decrease in the percentage of route miles of at-grade and trench construction types in Alternative 3 is due to the construction of new route segments, which include fewer at-grade and trench construction types in areas at risk of sea level rise flooding, storm surge flooding, or riverine flooding.

4.2.3.5 Reduce the Negative Impacts of Transportation

This objective considers the extent to which the Action Alternatives reduce emissions of pollutants and GHGs, impact environmental resources, decrease energy consumption, and support land development patterns that limit sprawl by concentrating development around transportation corridors.

New segments separate from the NEC present challenges to the natural and built environments. Action Alternatives with more off-corridor route miles have the potential to affect surrounding ecosystems (water resources, forestlands, threatened and endangered species), and aesthetic or cultural resources.

Conversely, segments separate from the NEC offer the greatest opportunity to achieve efficiencies in construction work and to mitigate disruption to ongoing operations. These segments can be used to relocate service safely during service disruptions.

In evaluating the representative infrastructure elements that would require environmental permitting, Alternative 1 presented the least impact to resources, while Alternative 2 would result in substantial impacts to ecological resources and historic resources. Alternative 3 presented significant impacts to multiple water resources and historic resources, however it offers the greatest improvements in redundancy and resilience and the most opportunity to mitigate disruption of existing service during construction.

4.2.3.6 Provide Positive Economic Opportunities for the Northeast Region

This objective is about the extent to which the Action Alternatives support evolution in patterns of urban development and enhance economic opportunity along the corridor. Transportation investments influence economic decisions (i.e., land development and location decisions) and solve transportation challenges. Ridership and capacity metrics define the extent to which each Action Alternative solves the transportation challenge (i.e., how it affects the Intercity and Regional travel markets and how it creates capacity to accommodate future demand).

Under this objective, the FRA evaluated economic opportunities through-service improvements, access to jobs, reduced travel time, and capacity for future growth. The FRA also considered each Action Alternative's ability to promote economic opportunity for communities along the corridor and enhance passenger experience to support economic activity in the region.

Alternative 1 offers a modest improvement over the No Action Alternative and has limited potential to open new economic opportunities. Alternatives 2 and 3 fully address the capacity constraints present in the No Action Alternative, offering significant opportunities for frequent convenient services to more locations that will provide positive economic opportunities. Alternatives 2 and 3 provide service levels and capacity to accommodate demand beyond that forecast for 2040.

The Action Alternatives result in a significant change in the value of travel-time and travel cost savings by diverting travelers from automobiles and planes onto trains. This diversion is scaled by investment, with the greatest benefits realized in Alternative 3.

4.3 NO ACTION ALTERNATIVE

As a baseline for comparison, consistent with National Environmental Policy Act (NEPA) requirements, the FRA defined and evaluated a No Action Alternative that included planned and programmed improvements to the NEC. The FRA also included improvements to the total transportation system in the No Action Alternative. Similar to the differentiation between NEC projects and off-corridor projects, the FRA incorporated other transportation modes into the overall analysis of the No Action Alternative. Their associated capital costs, however, were not included.

The No Action Alternative evaluated in the Tier 1 Draft EIS included planned and programmed improvements to the NEC (see Volume 2, Appendix B). The FRA organized No Action Alternative projects into three categories (costs in $2014 billions):

- Category 1: Funded projects or projects with approved funding plans – approximately $8 billion
- Category 2: Funded or unfunded mandates – approximately $1 billion
- Category 3: Unfunded projects necessary to keep the railroad running – approximately $11 billion

An Update on the No Action Alternative and Related Projects

The FRA defined a No Action Alternative for evaluation in the Tier 1 Draft EIS. The No Action Alternative includes projects that are funded, programmed, or necessary to keep the NEC operating and is the baseline for comparison for the Action Alternatives and Preferred Alternative. This Tier 1 Final EIS incorporates the No Action Alternative developed for the Tier 1 Draft EIS. Although projects have advanced and conditions have changed along the NEC since the release of the Tier 1 Draft EIS in November 2015, the assumptions about overall performance or capacity of the NEC in 2040 did not change. For that reason, and to maintain consistency throughout this evaluation, the No Action Alternative was not updated.

Since the release of the Tier 1 Draft EIS, progress has been made in advancing critical infrastructure projects on the NEC as well as connecting corridors. Some of these were identified as Related Projects to the No Action Alternative—projects with independent utility that are undergoing their own project development or NEPA processes or ones that are necessary to address some of the NEC's most pressing reliability, safety, and capacity needs, such as Boston South Station expansion, Portal Bridge replacement, and the B&P Tunnel replacement. An example of recent progress is the initiation of the NEPA process for the Hudson Tunnel Project to preserve the current functionality of the NEC's Hudson River rail crossing between New Jersey and New York and strengthen the resilience of the NEC. The FRA and NJ TRANSIT are currently leading the NEPA process for the Hudson Tunnel Project. The Hudson Tunnel Project will create new track capacity so that the existing tracks in tunnel (referred to as the North River Tunnel) can be repaired. It is an urgently needed project that is necessary to bring the NEC to a state of good repair. The FRA will continue to work with project sponsors to ensure that those projects remain compatible with and do not preclude the future design and construction of the alternative selected in the Record of Decision.

In addition, several ongoing independent rail projects located within the Study Area that were not included in the No Action Alternative were included as Related Projects. Related Projects are fully or partially funded projects on a connecting corridor but not on the NEC; unfunded projects on the NEC with ongoing or completed NEPA/PE; and fully or partially funded transit or freight projects located off of but connecting to the NEC.[7]

Although the infrastructure improvements on the NEC were categorized differently than those on connecting corridors, the service improvements for both the NEC and connecting corridors were incorporated into the No Action Alternative representative service plans to ensure compatibility with related future plans. Examples include services proposed south of Washington D.C., between Philadelphia and Harrisburg on the Keystone Corridor, and on the Hartford/Springfield Line. Planned Regional services are also reflected in the No Action Alternative representative Service Plan for Related Projects, such as Metro-North Railroad's Penn Station Access Project.

Connecticut's CTrail Hartford Line program would add a second track between New Haven and Hartford and increase Intercity and Regional service frequency on the Hartford/Springfield Line between New Haven and Hartford, CT, and Springfield, MA. These improvements to the Hartford/Springfield Line were included in the No Action Alternative as a Related Project. Therefore, no change in the No Action Alternative is required with the incorporation of the Hartford/Springfield Line into the Preferred Alternative.

The FRA assumes that the No Action Alternative continues current service levels provided on the NEC, and—because the implications of continuing current funding levels on service are hard to predict—that sufficient funding will be made available. However, even with sufficient funding available to continue service levels, the No Action Alternative will not achieve a corridor-wide state of good repair, meet the mobility needs of the Study Area, or FRA policy objectives (as described in Section 4.2.3).

4.3.1 Disinvestment Scenario

The FRA also considered defining a disinvestment scenario in which the current funding levels are maintained, but not increased to allow for the maintenance of current service levels as described in Section 4.2. Forecasting the implications of insufficient funding on the performance of the eight commuter railroads and Amtrak is difficult because of the uncertainty of what improvements would be funded and the related performance implications. It remains uncertain if sufficient funding will be provided to sustain the increasing level of investment necessary to support the No Action Alternative. If sufficient funding is not made available, the NEC's reliability, capacity, and service levels will continue to degrade with the possible following repercussions:

- Reliability will decline, resulting in more-frequent and longer delays, and reduced on-time performance of train service. This reduction in reliability will result from unscheduled delays, as well as scheduled delays required periodically (and randomly) to allow engineering crews to access the railroad to make remedial repairs.

[7] Refer to Section 4.6 for more information.

- Scheduled travel times will increase as the deteriorating condition of NEC infrastructure—particularly rail, bridge, and the underlying foundation supporting the tracks—will require trains to operate more slowly on some portions of the railroad to ensure safety.
- Operating costs for infrastructure maintenance will rise in response to the need for more-frequent maintenance and unscheduled and sometimes substantial repairs.
- Costs for train operations will increase as longer cycle times for equipment will require greater fleet sizes and more crew time and overtime.
- Ridership will decline in response to the reduced level and performance of passenger rail service, leading to declines in revenue and greater operating losses.

However, as mentioned earlier, the FRA has decided that, for the purposes of providing a baseline for comparison, the No Action Alternative assumes sufficient funding to maintain current service levels. In this way, the FRA can separate the discussion of historical or future funding trends from the assessment of positive and negative impacts of the Action Alternatives.

4.4 DEVELOPMENT OF THE PREFERRED ALTERNATIVE

The Preferred Alternative builds on the range of visions defined for the Action Alternatives and the individual components evaluated to support those visions.

The Tier 1 Draft EIS findings, public and stakeholder comments and FRA policy objectives together confirmed that the No Action Alternative did not meet the Purpose and Need and is not a viable option. With the decision not to advance the No Action Alternative, the FRA deliberated on Action Alternatives. As described in Section 4.2, each of the Action Alternatives had pros and cons in how they would meet NEC FUTURE Needs and the FRA policy objectives, and how they were received by the public and stakeholders.

Alternative 1 offers improvements over today's service levels and would bring the NEC to a state of good repair; however, it does not increase capacity enough to allow for substantial growth beyond 2040 or maximize the opportunities to implement operating efficiencies, including new service delivery approaches. Alternatives 2 and 3 provide the desired service volumes to grow beyond 2040, but each requires significant investments with related environmental effects. Alternative 2 does more to improve Regional rail connectivity than Alternative 3, whereas Alternative 3 improves Intercity rail connectivity more than Alternative 2. After considering the pros and cons of each Action Alternative, the FRA then arrayed the Action Alternatives to see how well they aligned with the FRA policy objectives. The FRA determined that addressing the complexity of needs along the diverse NEC would require combining elements of the Action Alternatives. Furthermore, the long-term nature of the alternatives and the necessity of incremental implementation would require flexibility to respond to the range of characteristics or opportunities that could emerge over time.

As part of this process, the FRA coordinated development of the Preferred Alternative with the Federal Transit Administration (FTA) in order that transit program implementation issues and the role of transit operations could be integrated into the FRA's decision on the Preferred Alternative. The FRA also continued close coordination with the Northeast Corridor Commission as well as

operators and those who will be implementers of NEC FUTURE improvements. Additionally, as certain elements from the Action Alternatives were identified as options to carry forward as part of the Preferred Alternative, the FRA met with stakeholders to discuss their comments and address their concerns directly. Outreach efforts included meetings, webinars, and conference calls with affected stakeholders. Additional information on stakeholder coordination is provided in Chapter 11.

The FRA's consideration of Tier 1 Draft EIS findings, public and stakeholder comments, and policy objectives were the basis for decision-making about a Preferred Alternative. Taking these three factors into consideration, the FRA first identified a preferred "vision" for the entire NEC, recognizing that—given the network nature of passenger rail service—that such a vision could only be achieved if it was realized from end-to-end. The FRA preferred vision is the "grow" vision described in Alternative 2, which enables greater use of passenger rail as a safe, environmentally friendly mode of transport. The "grow" vision also resonated with stakeholders and the public, as reflected in comments received, and is consistent with FRA policy objectives.

The FRA defined the Preferred Alternative to a level of detail consistent with a Tier 1 or programmatic EIS and sufficient to evaluate benefits and effects to both the built and natural environments. Characteristics for the Preferred Alternative described in this Tier 1 Final EIS include markets or cities served, proposed infrastructure improvements and routing, service types, and costs. As in the Tier 1 Draft EIS, the FRA identified the markets or city-pairs and representative routings linking those markets, but not specific alignments, allowing the FRA to better understand the regional benefits or impacts resulting from the proposed construction of required infrastructure, as well as implementation of service. The service and infrastructure assumptions outlined in this chapter are not intended to be prescriptive. Other construction types and alignments could be considered in subsequent Tier 2 project studies based on the market and service needs and conditions at that time.

> The assumptions made herein at the Tier 1 level are representative and illustrative to support analysis in both the alternatives development process and the Tier 1 Final EIS. The service and infrastructure assumptions are not intended to be prescriptive.

Foremost in the FRA's deliberations was the importance of defining an end-to-end vision for the entire NEC. Operating efficiencies and new service delivery approaches work best when the entire network is designed for that purpose; otherwise left with choke points in strategic locations, the service objectives could not be achieved.

The following sections describe first how the FRA chose a "vision" and second, how various elements of the Action Alternatives were assembled to achieve that vision. A guiding principle for the FRA in assembling the Preferred Alternative was to incorporate flexibility into the vision. That meant identifying service objectives (i.e., trains per hour, operating practices, and travel times) and places to be served, but not limiting the way in which those services could be provided. A flexible approach allows for railroads and states to craft the final implementation to best meet their specific needs, prioritize the most critical needs, and phase implementation in accordance with the availability of funding.

4.4.1 Selecting a Vision

> Door: "Why it's simply impassible!
> Alice: Why, don't you mean impossible?
> Door: No, I do mean impassible. *(chuckles)*
> Nothing's impossible!"
> — *Lewis Carroll, Alice's Adventures in Wonderland & Through the Looking-Glass*

The FRA determined that achieving a state of good repair on the NEC, a common feature of all three Action Alternatives evaluated in the Tier 1 Draft EIS, should be a priority of the Preferred Alternative, and therefore, the No Action Alternative was dismissed from further consideration. Considering the other Tier 1 Draft EIS evaluation factors and public and stakeholder comments, the FRA next considered the qualities of each of the Action Alternatives that responded to public and stakeholder comments, minimized environmental effect, and aligned with FRA policy objectives. The FRA heard from various agencies and individuals about the importance of preserving and improving the NEC. Furthermore, the importance of providing more service, more frequently and more reliably, also emerged as a shared priority across a diversity of stakeholders. Numerous stakeholders and the public also encouraged the FRA to balance the need for immediate near-term improvements with the needs of future generations. Of the alternatives considered, the FRA concluded that Alternative 2 provided a level-of-service that meets these needs and objectives. However, public concerns, costs and environmental effects associated with off-corridor routing from Hartford to Providence remained a concern. The analysis completed did, however, indicate that the Alternative 2 "grow" vision could provide the desired balance between commitment to the NEC and the FRA policy objectives to meet existing and future market demand with improved services and operating efficiencies. **Based on this information and guidance provided by the stakeholders and the public, the FRA determined that the adoption of the "grow" vision, as represented by Alternative 2 with modifications, best met national and regional goals for passenger rail transportation in the Northeast.**

The "grow" vision prioritizes and embraces an advanced rail service that seamlessly integrates operations and services of Regional and Intercity operators and incorporates a new corridor-wide Metropolitan service to reach and connect local stations with hub and terminal stations. The vision incorporates operational efficiencies, including common ticketing and integrated planning, with the ability to transform the passenger experience by greatly enhancing convenience, reliability, travel-time savings, and travel choices. The seamlessly integrated rail services possible with operational efficiencies will make more effective use of public investments in infrastructure and will create greater transportation and economic benefits than continuing conventional separate operations.

Common ticketing is an essential operational efficiency that would greatly enhance the customer's access to NEC rail services. Building on a vision of seamless integration of rail services, NEC FUTURE's integrated planning of railroad operations and service to guide infrastructure design highlights operational efficiencies that make rail travel easier and more appealing to passengers and also ensure a more-efficient use of railroad infrastructure. Integrated planning recognizes that the capacity of a railroad is a function of both train operations and infrastructure. Coordinating the development of a service plan with infrastructure specifications is an efficient way to avoid the cost of building unnecessary infrastructure. Such an approach can yield operational efficiencies and cost savings, but it also necessitates that train operations occur with a high degree of precision. Therefore, implementation of the Preferred Alternative depends on partnerships between the U.S.

DOT, states, metropolitan planning organizations (MPO), and rail operators to integrate ticketing, operations, service planning, and capital planning for the NEC rail network.

4.4.2 Elements Included in the Preferred Alternative

Once the FRA identified an end-to-end vision, the FRA considered individual segments of the NEC and the best way to implement that vision—drawing from the full range of ideas originally considered for the Action Alternatives evaluated in the Tier 1 Draft EIS. The FRA reviewed these options and re-evaluated opportunities to achieve the "grow" vision. Additionally, the FRA considered refinements to reflect regional or local priorities during the development of the Preferred Alternative. In certain instances, these refinements were incorporated in the Preferred Alternative.

The FRA selected a Preferred Alternative based on the analysis presented in the Tier 1 Draft EIS, and it is reflective of public and stakeholder input. The approach to analysis, evaluation, and presentation of findings in the Tier 1 Draft EIS allowed the FRA to refine the Preferred Alternative using the full range of components for the Action Alternatives considered.

In defining the Preferred Alternative, the FRA evaluated whether or not it was feasible to achieve "grow" objectives—Intercity service volumes of up to 10 tph with a mix of service types plus the full complement of Regional services within each metropolitan area—while staying on the NEC to serve existing markets. The Preferred Alternative includes improved service to all NEC markets, one-seat ride service to and between Major Hub and Hub stations on the Hartford/Springfield Line and NEC markets, and additional service to selected new markets. In this regard, the Preferred Alternative represents a corridor-wide commitment to the NEC and the urban centers it connects today.

Building off a "grow" vision, the Representative Route and infrastructure for the Preferred Alternative are described below. The Preferred Alternative combines, and in some cases refines, elements of the Action Alternatives (see Volume 2, Chapter 4). Elements of the Action Alternatives incorporated in the Preferred Alternative are described below; refinements to the infrastructure elements of the Action Alternatives that are included in the Preferred Alternative are noted in the appropriate bullets. Additional details about the representative infrastructure elements included in the Preferred Alternative are described in Section 4.6 and Section 4.7. The Preferred Alternative incorporates the following:

- **Alternative 2 between Washington, D.C., and Baltimore, MD** – The Preferred Alternative is essentially the same as Alternative 2 in this area. The Preferred Alternative stays on the NEC from Washington, D.C., to Baltimore with expansion from two to four tracks. A new Baltimore tunnel included in the Action Alternatives will likely feature four tracks, consistent with the current B&P Tunnel Replacement Project.[8] The Preferred Alternative does not utilize the

[8] A separate, ongoing evaluation of the 141-year-old Baltimore and Potomac (B&P) Tunnel in Baltimore, Maryland states that the current B&P Tunnel would not be able to accommodate passenger service; and that a new four-track tunnel would be required, which would replace the existing tunnel but would still connect to the existing Baltimore Penn Station. Further details are available at *www.bptunnel.com*.

existing B&P Tunnel but would operate in a new replacement tunnel separate from the Existing NEC. All service will continue to operate through Baltimore Pennsylvania Station.

- **Alternative 3 between Baltimore, MD, and Wilmington, DE** – The Preferred Alternative includes a new segment between eastern Maryland and western Delaware, incorporating the current Susquehanna River Rail Bridge Project consistent with Alternatives 2 and 3 evaluated in the Tier 1 Draft EIS. Costly new routes and stations in downtown Baltimore, proposed in all Alternative 3 options, are not included; instead the Preferred Alternative concentrates service at existing stations and includes new segments between these stations to create a high-performance route enabling highly competitive trip times between major markets of Washington, D.C., Philadelphia, and New York City.
- **Alternative 2 between Wilmington, DE, and New Haven, CT** – The Preferred Alternative is essentially the same as Alternative 2 in this area. The Alternative 2 new segment through Wilmington, DE, would provide necessary capacity, reduce express travel times and avoid impacts to the existing historic station, while minimizing impacts compared to the new segment considered with Alternative 3. New segments that avoid chokepoints and add capacity in New Jersey include two additional tracks from North Brunswick, NJ, through Newark and Secaucus, NJ, continuing under the Hudson River to an expanded Penn Station New York (See call-out box in Section 4.5.5, "Recapping the Station Planning Process in NEC FUTURE"). Continuing through New York, new segments and new track would add capacity and chokepoint relief under the East River, continuing along the Hell Gate Line and ending near Greens Farms, CT. By strengthening the NEC from New York City to New Haven, CT, with new segments separate from but adjacent to the NEC, the Preferred Alternative is preferable to the Alternative 3 option through Central Connecticut, which would divert rail services from existing urban centers, at a much higher cost and with greater environmental impacts.
- **Alternative 1 between New Haven, CT, and east of Providence, RI** – To provide the capacity and travel-time improvements desired, the FRA evaluated the feasibility of achieving Alternative 2 service levels along the NEC with the infrastructure proposed in Alternative 1 in this area of the corridor. As in Alternative 1, the Preferred Alternative includes a new segment on the NEC between Old Saybrook, CT, and Kenyon, RI, which would not only provide a four-track railroad (two tracks on the new segment and two tracks on the NEC) but also provide redundant rail in southeast Connecticut for a portion of the NEC that is most vulnerable to flooding. However, the FRA analysis demonstrated that the Alternative 1 infrastructure would not provide capacity sufficient to deliver the service levels proposed for the "grow" vision.[9] The Hartford/Springfield Line, described below, adds the additional capacity necessary to accommodate desired service levels north of New Haven. In addition to the infrastructure elements incorporated from Alternative 1, the Preferred Alternative includes new track to add capacity between Branford and Guilford stations in New Haven County, CT. In the Preferred Alternative, the NEC is upgraded to four tracks between these two stations.

[9] As noted in Volume 2, Appendix B, the improvements proposed for Alternative 1 (the "maintain" vision) provides capacity for up to 6 trains in the standard peak hour between New Haven, CT and Boston. Therefore, Alternative 1 capacity would be insufficient to support the "grow" vision of 10 trains in the standard peak hour between New Haven and Boston.

- **Alternative 2 between east of Providence, RI and Boston** – The Preferred Alternative is similar to Alternative 2 in this area. A key element is a new segment in the vicinity of Sharon and Hyde Park, MA, that provides additional capacity and operational flexibility near the Route 128 Station. In addition to the infrastructure elements incorporated from Alternative 2, the Preferred Alternative includes new track between Pawtucket, RI, and Sharon, MA. The NEC in this area is upgraded to four tracks.

In addition, based on feedback from stakeholders and the public, the FRA chose to incorporate the Hartford/Springfield Line into the Preferred Alternative, thereby leveraging ongoing improvements associated with Connecticut's CTrail Hartford Line.[10] Including the Hartford/Springfield Line in the Preferred Alternative provides service to underserved markets between New Haven, CT, and Springfield, MA, as well as the additional track and yard capacity necessary to accommodate the "grow" vision in New England with enhanced service to major markets at Hartford, Springfield, Providence, and Boston without construction of new segments through northern Connecticut. Figure 4-2 provides a schematic representation of Action Alternative elements included in the Preferred Alternative. Figure 4-2 shows the type of element (i.e., new track, new segment) and number of tracks.

Some segments included in the Preferred Alternative have been refined from the original configuration or construction type presented in the Tier 1 Draft EIS. These adjustments reflect feedback received from stakeholders and the public as well as comments received from resource and regulatory agencies. In each case, the refinements were made to further avoid or mitigate environmental effects identified through the Tier 1 Draft EIS analysis. The following are segments included in the Preferred Alternative that are refined from the original Action Alternatives evaluated in the Tier 1 Draft EIS:

- Concerns regarding the potential effect of the Alternative 2 Representative Route near the John Heinz National Wildlife Refuge in Pennsylvania resulted in shifting the Preferred Alternative Representative Route so that it would be adjacent to CSX rights-of-way and would minimize new impacts to the John Heinz National Wildlife Refuge.
- As a result of the comments received about the potential effect of an aerial structure proposed as part of Alternative 1 on the Old Lyme, CT, historic district, the FRA used tunnel as the representative construction type for the portion of this new segment included in the Preferred Alternative. This revision avoids the potential effects on cultural, ecological, visual, and other local resources that an aerial structure might cause. In addition, the Tier 1 Final EIS includes a proposed commitment to avoid use of an aerial structure in the historic district of Old Lyme should the FRA include this segment as part of the alternative it selects in the Record of

[10] The FRA approved the New Haven-Hartford-Springfield (NHHS) improvements in a Finding of No Significant Impact (FONSI) issued on August 9, 2012. The FONSI described a series of improvements to be implemented in phases. These improvements included constructing a second track for a portion of the corridor; installing improved train control systems; upgrading at-grade crossings and closing some at-grade crossings; repairing or replacing bridge and culvert structures; constructing a layover and light maintenance facility in the Springfield area; and development of new regional rail stations at Enfield, West Hartford, Newington, and North Haven. The NHHS corridor is referred to as the Hartford/Springfield Line in this Tier 1 Final EIS.

Decision (Selected Alternative). As with all projects, final construction type and alignment would be determined as part of Tier 2 project studies.

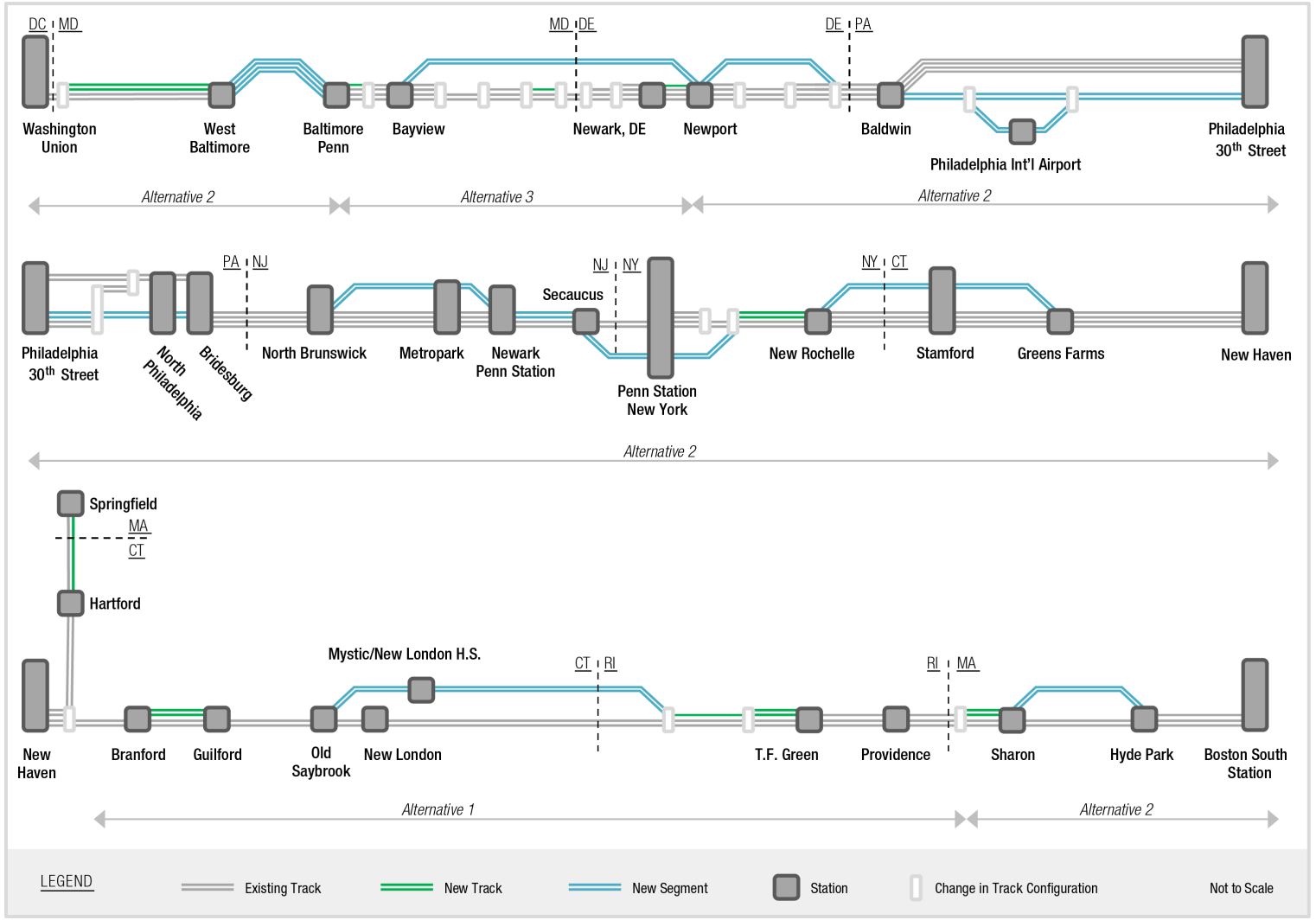
While these specific concerns were addressed with refinements incorporated in the Preferred Alternative, not all concerns could be addressed within the Tier 1 evaluation. Those remaining concerns would be addressed in subsequent Tier 2 project studies that are required before any further design, permitting, or construction could occur. Examples of particular concerns that were evaluated in this Tier 1 Final EIS for the Preferred Alternative include a proposed new segment crossing the Schuylkill River near the Philadelphia Zoo just north of Philadelphia and a proposed new segment in the vicinity of Wilmington, DE. In both cases, concerns about the impacts of these new segments were raised by stakeholders and while the Representative Routes or Service Plans have not been modified, the FRA recognizes the importance of addressing these concerns as an initial step should they be advanced for Tier 2 project study.

The Gateway Program

With the identification of a Preferred Alternative in this Tier 1 Final EIS and the subsequent selection of an alternative in the Record of Decision, the FRA will define a roadmap for future investment on the NEC, helping to ensure that investments made by a variety of stakeholders contribute to progress toward a shared vision. The long-term vision will guide individual project development and evaluation corridor-wide. As the FRA completes the Tier 1 environmental review process for the Preferred Alternative, there are projects that can advance concurrently with that process. These projects include Related Projects such as the Hudson Tunnel Project.

The Gateway program is being advanced by Amtrak in partnership with NJ TRANSIT, the states of New Jersey and New York, the FRA, the FTA, and the Port Authority of New York and New Jersey. The Gateway program includes several investments necessary to address the overall reliability and capacity of the NEC between Newark, NJ, and New York City. Specific improvements identified in the Gateway program are replacement of Portal Bridge over the Hackensack River, added track capacity under the Hudson River, and station capacity to relieve constraints at Penn Station New York. The FRA will work with the various project partners, including the FTA, to ensure that the elements of the Gateway program are consistent with the alternative selected by the FRA in its Record of Decision. In the meantime, the FRA will continue to coordinate closely with Amtrak and its partners on development of the Gateway program.

Figure 4-2: Action Alternative Elements included in the Preferred Alternative



Source: NEC FUTURE team, 2016
Note: Lines depicted in the above figure are illustrative of the number of tracks.
Note: The current B&P tunnel would not accommodate future passenger service and is not included in the Preferred Alternative. A new four-track tunnel, separate from and replacing the existing B&P tunnel would still connect to the existing Baltimore Penn Station, and is included in the Preferred Alternative. Further details are available at *www.bptunnel.com.*

4.4.3 Elements Not Included in the Preferred Alternative

The Preferred Alternative does not include the following specific Representative Route segments:

- New crossings of National Wildlife Refuges (Alternatives 2 and 3)
- A new segment connecting New York City and New Haven via Ronkonkoma (Alternative 3)
- A new segment connecting New York City and Hartford via Danbury, CT (Alternative 3)
- New segments between New Haven and Hartford, CT, and Boston, MA, via Providence, RI (Alternatives 2 and 3) or Worcester, MA (Alternative 3)
- New segments with new stations in downtown Baltimore and Philadelphia (Alternative 3)

4.4.4 Future Opportunities for Expansion

While the Preferred Alternative does not include an end-to-end high-speed second spine as proposed by Alternative 3, it is possible that in future decades there may be a heightened need for additional capacity and performance improvements not specified in the Preferred Alternative that could justify adding new segments of a second spine to the rail network. The FRA did receive numerous comments from the public and stakeholders that favored Alternative 3. However, in addition to the FRA's decision to prioritize the NEC, the cost of a full second spine was high relative to the travel-time savings and other benefits. Much of the benefit of Alternative 3 can be achieved with the new segments and terminal and chokepoint relief projects incorporated into the Preferred Alternative at a lower cost. This includes highly competitive travel times for Intercity-Express service on the NEC. The NEC FUTURE analysis of travel demand and cost does not support a completely separate second spine from Washington, D.C., to New York City and/or Boston, including new routes through major cities. Alternative 3 explored the potential for an optimized end-to-end second spine that is connected and integrated into the existing rail network to take greatest advantage of the new capacity, but even this added utility did not demonstrate benefits that outweigh the costs of a fully separate line. A high-speed second spine incapable of network integration would have even less favorable outcomes.

Additional new segments that might be added to the Preferred Alternative in the future may include new connections, such as a route connecting the NEC to Long Island and/or Connecticut, or additional chokepoint relief such as further expanding capacity at the Hudson River and in New York City. Future commercial opportunities may also arise to use public-private partnerships and other approaches to enhance or leverage specific segments of the NEC and Hartford/Springfield Line with additional new segments.

4.4.5 Evaluation of the Preferred Alternative

The FRA evaluated the Preferred Alternative using the same metrics used to evaluate the Tier 1 Draft EIS Action Alternatives. Volume 1, Chapter 9, provides the full evaluation results for the Preferred Alternative. The evaluation metrics (discussed previously in this chapter and in greater detail in Chapter 9) show how the Preferred Alternative's improvements in mobility, in service frequency and travel times would change travel from a local and end-to-end perspective.

The following sections illustrate the potential for improved mobility and economic growth under the Preferred Alternative. Table 4-2 summarizes the metrics and results used to evaluate the similarities and differences between the No Action Alternative,[11] the Action Alternatives, and the Preferred Alternative.

4.4.5.1 Aging Infrastructure

The Preferred Alternative, consistent with all Action Alternatives, brings the NEC to a state of good repair, eliminating the backlog of infrastructure requiring replacement, and enabling future capital upgrades to be planned and implemented according to a regular replacement cycle.

4.4.5.2 Capacity

Demand for Intercity and Regional rail service exceeds practical capacity under the No Action Alternative across the NEC. The greatest unmet demand is at the Hudson River and into Penn Station New York, where the NEC connects New Jersey to New York City. Although the Preferred Alternative provides capacity to meet growth in demand to 2040, additional capacity needs may be identified in Tier 2 project studies. Also, the Preferred Alternative does not preclude capacity increases beyond those identified for NEC FUTURE. The Preferred Alternative provides excess capacity at other locations along the corridor to accommodate additional off-corridor trips or future growth post 2040, consistent with Alternative 2.

4.4.5.3 Connectivity

Overall, the Preferred Alternative improves connectivity at airport stations more than Alternative 2, but less than Alternative 3. However, the Preferred Alternative proposes service to T.F. Green International Airport (located adjacent to the NEC in Warwick, RI) that is greater than what was proposed in Alternative 3 and provides roughly twice as many daily trains as proposed in Alternative 2. The introduction of Intercity service, mostly Metropolitan service, greatly improves connectivity to interregional markets in the Preferred Alternative. Intercity-Corridor service is possible from Odenton, MD, and Secaucus, NJ.

4.4.5.4 Performance

Passenger rail performance, as measured by travel-time savings between selected station pairs, for the Preferred Alternative are typically greater than Alternative 2 for travel south of New York City, and less than Alternative 2 north of New York City. Travel-time savings are greatest over longer-distance city-pairs and where new rail infrastructure would be built between the pairs.

For the Preferred Alternative, maximum operating speeds of 160 to 220 mph are possible from Washington, D.C., to Boston with new segments and enhancements to the existing NEC. The maximum operating speed on the Hartford/Springfield Line would remain at 110 mph due to the

[11] The No Action Alternative values in Table 4-2 reflect updates made after the Tier 1 Draft EIS to incorporate the Hartford/Springfield Line for comparison with the Preferred Alternative. The metrics for the Action Alternatives were updated where appropriate and as such may be vary from values presented in Volume 2, Chapter 4.

presence of grade crossings.[12] Speeds would also remain limited on the NEC shoreline in southeastern Connecticut due to frequent sharp curves and the presence of grade crossings; however, performance improvements would be possible on the new segment between Old Saybrook, CT, and Kenyon, RI. (See Section 4.6.5 for additional information on grade crossings in the Preferred Alternative.)

4.4.5.5 Resiliency

The Preferred Alternative provides some degree of resiliency over the No Action Alternative by adding new segments separate from the NEC along the corridor. While the Preferred Alternative includes fewer new segments than those included in Alternatives 2 and 3, the Preferred Alternative does include key new segments such as the Old Saybrook-Kenyon new segment and the Bayview to Newport new segment. Both of these new segments would provide supplemental and complimentary rail infrastructure and thereby increase redundancy.

The percentage of at-risk (at-grade and trench) construction types in the Preferred Alternative is less than the No Action Alternative but greater than Alternative 2. The percentage of the Preferred Alternative of at-risk construction types in areas susceptible to flooding is also less than the No Action Alternative but is consistent with Alternatives 1 and 2.

The construction of the new segments, particularly those with at-risk construction types, would entail design elements that include adaptation measures to reduce inundation effects. The Preferred Alternative also affords opportunities to upgrade existing infrastructure in vulnerable areas and to design new infrastructure in subsequent Tier 2 project studies that are resistant to the effects of climate change.

4.4.5.6 Environmental Sustainability

The Preferred Alternative, similar to all Action Alternatives, would reduce net emissions of criteria pollutants and GHGs. Increased emissions of criteria pollutants and GHGs from power plants due to increased electrical requirements of the trains under the Preferred Alternative are offset by a net reduction of roadway emissions due to reduced vehicle-miles-traveled. Overall, the Preferred Alternative would reduce energy use more than the Action Alternatives.

Consistent with the goals and objectives of state and metropolitan planning organizations within the Study Area related to transit-oriented development, the Preferred Alternative has the potential to support development around stations. The Preferred Alternative has greater potential for growth and development around stations than Alternative 2, but less than Alternative 3.

For comparison purposes with the Preferred Alternative, the FRA updated the Action Alternatives emissions analysis based on the updated NEC FUTURE Interregional Ridership Model. These updated values are presented in Table 4-2. As a result, the Action Alternative values presented in

[12] The presence of grade crossings is just one factor in determining maximum operating speeds. Other factors include topography, track geometry of the railroad (i.e., the presence of speed limiting curves), and other safety measures as required by the FRA.

the Tier 1 Final EIS may vary from those presented in the Tier 1 Draft EIS (See Volume 2); however the range of differences between Action Alternatives remains the same.

4.4.5.7 Economic Growth

Construction and rail operation employment effects are derivative of the level of investment. The Preferred Alternative has less rail capital investment, and has less construction related employment than Alternative 2.

The FRA estimated economic effects for the Preferred Alternative based on the updated NEC FUTURE Interregional Model. As with air quality effects (Section 4.4.4.6), the FRA also re-estimated economic effects for the Action Alternatives for comparison purposes. As a result, the values presented in the Tier 1 Final EIS may vary from those presented in the Tier 1 Draft EIS (See Volume 2) although the relative differences between Action Alternatives are similar. The Preferred Alternative would result in rail operations employment effects slightly greater than Alternative 2. Details of other economic effects, including construction employment effects and emissions savings are summarized in Table 4-2.

4.4.5.8 Environmental Impacts

By focusing on the NEC, the Hartford/Springfield Line, and existing markets, the Preferred Alternative has fewer acres of potential acquisition than Alternative 2, but has more acres of potential conversion of land cover to transportation use than Alternative 2 (but still less than Alternative 3).

There are more Section 4(f) Parks, Recreational Areas, and Wildlife and Waterfowl Refuges resources within the Representative Route of the Preferred Alternative than in Alternatives 1 and 2; and one additional Section 6(f) Park in the Preferred Alternative than in Alternative 2.

The total number of National Historic Landmark resources potentially affected by the Preferred Alternative is similar to Alternative 2 and the lower range of Alternative 3. The total number of National Register of Historic Places (NRHP)-listed properties potentially affected is less than all of the Action Alternatives.

4.4.5.9 Capital/O&M Costs

As shown in Table 4-2, the estimated capital cost for the Preferred Alternative is greater than Alternative 1 and less than Alternative 2. The estimated operating cost of the Preferred Alternative is greater than Alternative 2 and less than Alternative 3. Subsequent to the Tier 1 Draft EIS, the FRA recalibrated the O&M cost model to incorporate the Hartford/Springfield Line (see Appendix BB, Technical Analysis on the Preferred Alternative). The recalibration resulted in adjusted unit costs for infrastructure and transportation. The operating costs estimated for the No Action Alternative and Preferred Alternative (Chapters 4, 6 and 9) are based on this updated and recalibrated O&M cost model. For comparison purposes, the FRA also updated the operating cost estimates for the Action Alternatives. These numbers, derived from the updated O&M cost model, are presented in Table 4-2. As a result, the Action Alternative values presented in the Tier 1 Final EIS may vary from

those presented in the Tier 1 Draft EIS (See Volume 2); while the absolute values vary, the relative differences are consistent with the Tier 1 Draft EIS findings.

4.4.5.10 Constructability

The work required for some improvements as part of the Preferred Alternative would be undertaken with sufficient distance from the existing tracks to minimize impacts to ongoing train operations. Implementation of dozens of infrastructure projects along an active rail corridor already operating at capacity will present severe challenges for a region that depends on reliable Intercity and Regional train service. The impacts on train operations expected as part of construction of the Preferred Alternative are comparable to those expected as part of construction of any of the Action Alternatives. New segments would allow more flexibility to maintain service while improvements to the existing NEC are made.

Table 4-2: Summary of NEC FUTURE Alternatives

Project Needs Addressed	Metrics for Evaluating	No Action Alternative	Alternative 1	Alternative 2	Alternative 3 (average)	Preferred Alternative
NEC FUTURE NEEDS						
Aging Infrastructure	■ NEC in a state of good repair	NO	YES	YES	YES	YES
Capacity	■ Peak Rail Capacity utilization (# of trains, peak hour, peak direction)	Wash., D.C.: 6 Hudson River:24 Boston: 11	Wash., D.C.: 12 Hudson River: 37 Boston: 17	Wash., D.C.: 20 Hudson River: 52 Boston: 22	Wash., D.C.: 24 Hudson River: 70 Boston: 24-32	Wash., D.C.: 20 Hudson River: 52 Boston: 18
	■ Peak trains per hour (Intercity trains at Hudson River Screenline)[1]	*	2X the No Action	3X the No Action	5X the No Action	3X the No Action
	■ Annual Passenger Rail Trips[2] (1,000s of Trips)	439,300	509,300	534,300	585,900	542,900
	o Intercity Rail	19,500	34,800	38,900	40,400	40,200
	o Regional Rail	419,800	474,500	495,400	545,500	502,800
	■ Annual Passenger-Miles (in 1,000s)	14,338,900	18,552,300	20,182,400	21,779,500	20,608,700
	o Intercity Rail	3,074,500	6,005,200	6,726,600	7,065,600	6,966,800
	o Regional Rail	11,264,400	12,547,100	13,455,800	14,713,900	13,641,900
	■ Change in Annual Intercity VMT (in millions)	*	-2,300	-2,800	-3,000	-3,000
	■ % Intercity Trips Diverted to Rail (% of trips on the NEC diverted from other modes)	*	47%	44%	49%	49%
	■ % Regional rail Trips Diverted to Rail (% of trips on the NEC diverted from other modes)	*	8%	9%	14%	17%

[1] Screenlines are imaginary lines across which rail and passenger traffic can be counted or measured.

[2] For the Tier 1 Final EIS, the FRA adjusted the NEC FUTURE Interregional Model based on issues identified during the Tier 1 Draft EIS comment period and a reassessment of the overall model outcomes. These adjustments did not affect the relative findings of the Action Alternatives (when compared to the No Action Alternative), but did result in modifications to the total numbers of trips and their distribution by station or metropolitan area. These updated numbers are included in Volume 1, and shown on this table. Appendix BB, Technical Analysis on the Preferred Alternative, contains a detailed description of the reasoning for these adjustments and the process used, and a summary of the changes in the model results, compared to the results presented in the Tier 1 Draft EIS.

* No Action Alternative values are not applicable. The values shown for the Action Alternatives and Preferred Alternative reflect the absolute or percentage change when compared to the No Action Alternative.

Table 4-2: Summary of NEC FUTURE Alternatives (continued)

Project Needs Addressed	Metrics for Evaluating	No Action Alternative	Alternative 1	Alternative 2	Alternative 3 (average)	Preferred Alternative
NEC FUTURE NEEDS (cont'd)						
Connectivity[1]	■ Daily Trains Serving Airport Stations (total number of trains)	BWI: 143 PHL: 72 EWR: 153 T.F. Green: 10	BWI: 252 PHL: 72 EWR: 240 T.F. Green: 81	BWI: 386 PHL: 308 EWR: 364 T.F. Green: 74	BWI: 450 PHL: 374 EWR: 414 T.F. Green: 101	BWI: 350 PHL: 332 EWR: 378 T.F. Green: 154
	■ Air-to-rail diversions (annual one-way trips in 1,000s)	*	WAS–NJ/NY: 110 NJ/NY–BOS: 130 PHL–BOS: 20	WAS–NJ/NY: 120 NJ/NY–BOS: 170 PHL–BOS: 30	WAS–NJ/NY: 150 NJ/NY–BOS: 210 PHL–BOS: 30	WAS–NJ/NY: 160 NJ/NY–BOS: 180 PHL–BOS: 30
	■ Daily Intercity service (one-way) – number of trains for key city-pairs and key stations	WAS–NYC: 38 NYC–BOS: 19	WAS–NYC: 70 NYC–BOS: 47	WAS–NYC: 96 NYC–BOS: 88	WAS–NYC: 150 NYC–BOS: 143	WAS–NYC: 136 NYC–BOS: 94
	■ Daily Intercity service – number of trains to connecting corridors	Richmond–NYC: 9 Harrisburg–NYC: 14 Albany–NYC: 12 Springfield–NYC: 2	Richmond–NYC: 13 Harrisburg–NYC: 13 Albany–NYC: 22 Springfield–NYC: 9	Richmond–NYC: 14 Harrisburg–NYC: 22 Albany–NYC: 22 Springfield–NYC: 27	Richmond–NYC: 14 Harrisburg–NYC: 21 Albany–NYC: 22 Springfield–NYC: 37	Richmond–NYC: 14[2] Harrisburg–NYC: 24 Albany–NYC: 22 Springfield–NYC: 35
	■ Number of Stops by Station (daily)					
	o Total Service (Intercity + Regional rail)	Odenton: 59 PHL Airport: 72 Secaucus: 367 Providence: 74	Odenton: 152 PHL Airport: 72 Secaucus: 522 Providence: 182	Odenton: 256 PHL Airport: 308 Secaucus: 830 Providence: 302	Odenton: 300 PHL Airport: 374 Secaucus: 1144 Providence: 307	Odenton: 238 PHL Airport: 332 Secaucus: 922 Providence: 271

[1] Philadelphia International Airport is served today by Regional rail service located off the existing NEC. T.F. Green Airport is served by Regional rail service today; Intercity Rail service to these airports is included in the Preferred Alternative service plan.

[2] For service planning purposes, three long distance trains continuing south of Washington, D.C., were considered to allow sufficient capacity to accommodate these services. These trains were not explicitly considered in ridership forecasting.

* No Action Alternative values are not applicable. The values shown for the Action Alternatives and Preferred Alternative reflect the net change when compared to the No Action Alternative.

Table 4-2: Summary of NEC FUTURE Alternatives (continued)

Project Needs Addressed	Metrics for Evaluating	No Action Alternative	Alternative 1	Alternative 2	Alternative 3 (average)	Preferred Alternative
NEC FUTURE NEEDS (cont'd)						
Performance	■ Approximate Travel-time savings (minutes) for key city-pairs (Intercity-Express times in min saved relative to No Action Alternative)	*	WAS–NYC: 5 NYC–BOS: 40	WAS–NYC: 20 NYC–BOS: 60	WAS–NYC: 60 NYC–BOS: 90	WAS–NYC: 30 NYC–BOS: 45
	■ Best Station-to-station travel times[1] (h:mm) – Intercity-Corridor[2]	ODN–TRE: N/A[4] WAS–HFD: 6:30 PHL–NHV:2:50	ODN–TRE: 2:10 WAS–HFD: 5:15 PHL–NHV: 2:50	ODN–TRE: 2:05 WAS–HFD: 5:00 PHL–NHV: 2:35	ODN–TRE: 1:50 WAS–HFD: 3:00 PHL–NHV:2:40	ODN–TRE: 1:50 WAS–HFD: 4:25 PHL–NHV:2:35
Resiliency	■ % At-risk construction type (trench and at-grade)					
	o End to end – complete area	62%	52%	48%	43%	53%
	o End to end - within areas susceptible SLR, SS, RF[3]	12%	10%	10%	7%	10%
	■ Number of Stations in areas vulnerable to flooding – Current Climate Conditions, one or more flood hazards	53	61	65	70–71	68

[1] Travel times are rounded to the nearest five minutes.
[2] Stations identified by Amtrak station code except for Odenton, MD (ODN). Table 4-9 for Amtrak station codes.
[3.] Sea Level Rise (SLR), Storm Surge Flooding (SSF), Riverine Flooding (RF)
[4] Intercity-Corridor service between these station pairs not provided in the No Action Alternative.
* No Action Alternative values are not applicable. The values shown for the Action Alternatives and Preferred Alternative reflect the net change when compared to the No Action Alternative.

Table 4-2: Summary of NEC FUTURE Alternatives (continued)

Project Needs Addressed	Metrics for Evaluating	No Action Alternative	Alternative 1	Alternative 2	Alternative 3 (average)	Preferred Alternative
NEC FUTURE NEEDS (cont'd)						
Environmental Sustainability	■ 2040 Changes in Criteria Pollutant Burdens (tons/year)– Existing Energy Profile					
	o CO_2e	*	-612,710	-701,040	-637,530	-713,840
	o CO	*	-4,590	-5,715	-6045	-6,040
	o VOC	*	-60	-75	-75	-75
	o NOx	*	-215	-235	-150	-225
	o PM_{10}	*	-65	-70	-70	-75
	o $PM_{2.5}$	*	-25	-25	-25	-25
	o SO2	*	165	335	510	370
	■ Change in energy use[1] (MMBtu)		-7,849,745	-9,362,435	-9,123,920	-9,375,030
	o Roadways	*	-8,851,035	-10,980,130	-11,705,750	-11,688,940
	o Diesel Trains	*	-1	-128,585	3	28,455
	o Electric Trains	*	1,001,290	1,746,280	2,581,825	2,285,455

[1] For comparison purposes with the Preferred Alternative, the FRA updated the Action Alternatives emissions and energy use analysis based on the updated NEC FUTURE Interregional Ridership Model. As a result, the Action Alternative values presented in the Tier 1 Final EIS may vary from those presented in the Tier 1 Draft EIS (See Volume 2); however the range of differences between Action Alternatives remains the same. Table 4-2 (above) includes the updated numbers.

* No Action Alternative values are not applicable. The values shown for the Action Alternatives and Preferred Alternative reflect the net change when compared to the No Action Alternative.

Table 4-2: Summary of NEC FUTURE Alternatives (continued)

Project Needs Addressed	Metrics for Evaluating	No Action Alternative	Alternative 1	Alternative 2	Alternative 3 (average)	Preferred Alternative
NEC FUTURE NEEDS (cont'd)						
Economic Growth	■ Employment Impacts in the Study Area (# of job-years)	297,950	784,570	1,582,100	3,481,800	1,408,840
	o Construction Employment Effects	295,650	773,670	1,561,100	3,453,200	1,385,340
	o Rail Operations Employment Effects (Intercity)[1]	2,300	10,900	21,000	28,600	23,500
	■ Value of annual travel market savings (millions of $2014)					
	o Total Intercity Travel-Time Savings	*	$625	$892	$1,207	$942
	o Total Emissions Savings	*	$53	$53	$41	$54

[1] For comparison purposes with the Preferred Alternative, the FRA updated the economic effects for the Action Alternatives effects (Rail Operations Employment Effects (Intercity), Total Intercity Travel-Time Savings, and Total Emission Savings) based on the updated NEC FUTURE Interregional Ridership Model. As a result, the Action Alternative values presented in the Tier 1 Final EIS may vary from those presented in the Tier 1 Draft EIS (See Volume 2. Table 4-2 (above) includes the updated numbers.

* No Action Alternative values are not applicable. The values shown for the Action Alternatives and Preferred Alternative reflect the net change when compared to the No Action Alternative.

Table 4-2: Summary of NEC FUTURE Alternatives (continued)

Project Needs Addressed	Metrics for Evaluating	No Action Alternative	Alternative 1	Alternative 2	Alternative 3 (average)	Preferred Alternative
BENEFITS, COSTS, AND OTHER FACTORS						
Environmental Impacts	■ Population: Total population (Affected Environment)[1]	4.9 million	4.5 million	4.9 million	5.9–6.5 million	5.0 million
	■ Land Cover Conversion: Percentage of Representative Route with potential conversion of undeveloped land[2]	20%	19%	21%	16–19%	22%
	■ Hazardous Waste and Contaminated Materials					
	o NPL Superfund (# sites)	0	0	0	1	0
	o Brownfields (# sites)	24	25	35	69	41
	■ Cultural Resources and Section 4(f)/6(f): Total Resources					
	o 4(f) Parks, Recreational Areas, and Wildlife and Waterfowl Refuges: Total resources	111	97	111	116–130	128
	o 6(f) Parks: Total Resources	21	21	23	23–27	24
	o NHL: Total Resources	0	4	5	5–7	5
	o NRHP-Listed: Total Resources[3]	51	142	171	136–150	142

[1] The total population of the No Action Alternative for the Tier 1 Final EIS was updated to include the Affected Environment of the Hartford/Springfield Line. As a result, the population of the No Action Alternative is greater than the population provided in the Tier 1 Draft EIS. The population was 4.4 million in the Tier 1 DEIS. See Chapter 7 for additional information.

[2] The percent potential conversion of undeveloped land is calculated as acres of undeveloped land, divided by total acres. The estimate does not count land cover conversions where the construction type is either tunnel or major bridge (as described in Appendix E.02). The land conversion for the Preferred Alternative, which combines elements from Alternatives 1, 2, and 3, results in slightly higher conversion effects when compared to the No Action Alternative and Action Alternatives, in large part due to the greater percentage of route miles of at-grade construction when compared to Alternatives 2 or 3.

[3] The total number of NRHP sites includes NREs, as shown in Chapter 7.9 to be consistent with the analysis conducted for the Tier 1 Draft EIS. The Tier 1 Draft EIS did not separate these totals for the No Action Alternative and Action Alternatives. For additional clarity, these sites were separated out in the Tier 1 Final EIS.

Table 4-2: Summary of NEC FUTURE Alternatives (continued)

Project Needs Addressed	Metrics for Evaluating	No Action Alternative	Alternative 1	Alternative 2	Alternative 3 (average)	Preferred Alternative
BENEFITS, COSTS, AND OTHER FACTORS (cont'd)						
Cost	■ Total capital costs ($B 2014)	$20	$64–$66	$131–$136	$266–$308	$123–$128
	■ Total Intercity Operating cost ($M 2014)[1]	$890	$1,325	$1,845	$2,250	$1,980
Constructability	■ Percentage of Route Miles by Construction Type					
	o Tunnel	2%	6%	11%	18%	8%
	o Trench	1%	2%	4%	6%	4%
	o At-Grade	61%	50%	44%	37%	49%
	o Embankment	32%	35%	33%	30%	30%
	o Aerial	3%	5%	7%	8%	8%
	o Major bridge	1%	2%	1%	1%	2%

Source: NEC FUTURE team, 2016

[1] The O&M cost model was updated for the Tier 1 Final EIS to incorporate the costs associated with the Hartford/Springfield Line. This update had a dampening effect on the overall unit costs for infrastructure maintenance and transportation as the Hartford/Springfield Line has lower operating costs than the NEC. The updated O&M cost model was applied to the No Action Alternative and Preferred Alternative for the Tier 1 Final EIS analyses. For comparison purposes, the Intercity operating costs for the Action Alternatives were also re-estimated and are presented in this table. Therefore, the Action Alternative values are consistent with the Preferred Alternative but may vary from those values presented in the Tier 1 Draft EIS (see Volume 2, Chapters 4, 6, and 9). Revisions to the O&M cost model are described in Appendix BB, Technical Analysis on the Preferred Alternative.

4.5 DESCRIPTION OF THE PREFERRED ALTERNATIVE

The Preferred Alternative improves the NEC and adds new segments that, together, expand capacity to grow the role of rail. With up to five times more Intercity service, expanded Regional rail service, and the implementation of railroad operating efficiencies, the Preferred Alternative reduces trip times, offers frequent enhanced Intercity-Express service, introduces Metropolitan service, and allows substantial growth for NEC Regional rail markets. The Preferred Alternative brings the NEC to a state of good repair and maximizes its capacity through alleviation of chokepoints and the addition of new tracks to bring the NEC to four tracks at most locations. This not only supports more-efficient and more traveler-friendly service, but helps reduce capital costs by addressing lower cost operational issues such as use of longer, higher capacity trains, reducing dwell time at stations, and offering through-service at major terminals. The markets served by the NEC expand to include more one-seat ride destinations on the NEC, and new or improved intermodal connections, such as rail-airport connections at Philadelphia International Airport, Bradley International Airport (via bus from Windsor Locks), and T.F. Green Airport.

The term **Intercity** is defined as passenger rail service between metropolitan areas. The term **interregional** describes travel flows between different metropolitan areas. **Interregional** and **Intercity** may be used interchangeably when referring to markets, passengers, trips, and passenger rail service.

Regional describes travel within a metropolitan area. **Regional rail** is defined as passenger rail service within the travel shed of a metropolitan area. **Regional rail** provides local and commuter-focused service characterized by a high-percentage of regular travelers. Regional rail is a broad term that reflects the expanded role of commuter railroads to also serve metropolitan travel needs throughout the day and beyond the work week.

The FRA structured the evaluation of the Action Alternatives to facilitate selecting the best elements of each in defining a Preferred Alternative. To that end, the decision to strive for a “grow” vision for the NEC then led the FRA to review geographically distinct sections of the NEC, balance service objectives with various infrastructure options, and select a best fit that minimized environmental effects. Appendix BB, Technical Analysis on the Preferred Alternative, describes this process in further detail.

The Preferred Alternative continues service on the NEC route along the coastline between New York City and Boston, MA. To support additional service and increase performance, the Preferred Alternative includes a new segment between Old Saybrook, CT, and Kenyon, RI, as envisioned in Alternative 1. In addition to improvements to the existing NEC, new segments enable faster Intercity services, provide infrastructure resiliency benefits, and eliminate capacity and operational constraints related to five movable bridges and 11 grade crossings on the NEC in southeastern Connecticut.

The Preferred Alternative incorporates an upgraded Hartford/Springfield Line, extending from the NEC at New Haven Station, to support expanded Intercity and Regional rail service, including more one-seat ride service to points south including New York City and Philadelphia. At Springfield Union Station, passengers can connect north to St. Albans, VT, or east to Boston (see Section 4.5.9.5).

As with the Action Alternatives evaluated in the Tier 1 Draft EIS, the investment program for the Preferred Alternative consists of 1) a set of geographic markets to be served by passenger rail; 2) a Representative Route that connects these markets; 3) assumptions about the level of passenger rail service that will be provided to these markets; and 4) infrastructure improvements that support this level-of-service. These characteristics, which are all representative in nature, are described in the following sections.

To facilitate the environmental assessment of the Preferred Alternative, this chapter provides the physical description of the new segments and upgraded track of the Preferred Alternative from south to north by state and metropolitan area. The Preferred Alternative representative routes and construction characteristics are the basis for the analysis in the NEC FUTURE Tier 1 EIS. They illustrate necessary improvements to achieve the Preferred Alternative service and performance objectives. As part of the Tier 1 process, the FRA has determined the necessity for new segments in particular geographic sections of the NEC in order to meet the Purpose and Need, and has identified a representative route for each potential new segment. The FRA or another federal agency providing funding for a particular project will evaluate specific locations for new segments as part of the Tier 2 project studies, prior to making any decision regarding new segment locations. This chapter also describes service characteristics, capital costs, and operations and maintenance (O&M) costs—corridor-wide rather than by geographic location. Subsequent chapters (see Chapters 5, 6, and 7) provide more detail on the transportation, economic, and environmental benefits and effects of the Preferred Alternative.

4.5.1 Technology Considerations

Emerging and new technologies may be applicable to rail service on the NEC and other transportation needs across the Study Area. These technologies might include new information systems and services, new train propulsion and guideway systems, fare collection innovations, and safety enhancements. The FRA plays an important role in researching new rail transportation approaches and technologies, as well as demonstrating their specific capabilities and role in the broader multimodal transportation system. For example, the FRA sponsored development of next-generation propulsion systems for locomotives and has explored the potential use of magnetic levitation train technology.[13]

Several public comments regarding the Tier 1 Draft EIS focused on magnetic levitation train technology. As noted in Volume 2, Chapter 4, an advanced guideway system, such as magnetic levitation technology, could be used to develop a second spine or portions thereof. This system would require separate stations, and would not support run-through trains from connecting corridors nor offer proven integration efficiencies with today's NEC infrastructure and operators. Furthermore, these technologies remain under development, with few systems in operation internationally. For these reasons, the FRA did not incorporate advanced guideway or similar new technologies in the alternatives development process. However, such technologies could be studied

[13] Magnetic levitation is an advanced transportation technology in which magnetic forces lift, propel, and guide a vehicle over a specially designed guideway. For more information on magnetic levitation technology, see Federal Railroad Administration, Magnetic Levitation Transportation Technology Deployment Program. 49 CFR Part 268. [FRA Docket No. FRA–98–4545; Notice No.3]. RIN 2130–AB29.

separately, and are not precluded as a future transformative investment in the regional transportation system. Other potential applications of new technology transportation systems could support the NEC passenger rail network by connecting off-corridor markets to the NEC, or a major market to the NEC.

4.5.2 Service Planning

The Preferred Alternative provides additional capacity to allow significant increases in peak and off-peak service frequency for all types of service across the entire NEC, as compared to the No Action Alternative. The focus of service improvements and capital investment remains predominately on the NEC Spine, although service improvements are realized on corridors that connect with the Spine.

Representative Service Plans

The FRA developed representative service plans for the No Action Alternative and Preferred Alternative to describe the types and levels of passenger train service operating on the NEC and Hartford/ Springfield Line in 2040. Service plans could provide more limited stop (e.g., skip-stop) or express services. The representative Service Plans are not intended in any way to be prescriptive regarding how service should be operated in the future, nor were they optimized to maximize ridership or net revenues. The NEC FUTURE representative Service Plan demonstrates what is achievable within the proposed capacity configuration, and is not intended to reflect the optimal service that could be operated should travel time be prioritized in the future.

In the Tier 1 Draft EIS, the FRA developed representative service plans for the Action Alternatives. Consistent with this process and for analysis purposes, the FRA developed a representative Service Plan for the Preferred Alternative. Representative service plans define a range of benefits which might occur and whose details could change during subsequent Tier 2 project analysis. The Preferred Alternative representative Service Plan includes both Intercity and Regional services from Washington, D.C., to two northern termini: one in Springfield, MA, and the other in Boston. Connecting services north and east of Springfield Union Station are accounted for in the Preferred Alternative representative Service Plan based on planned services; assumptions about services beyond those already planned are not included in the Preferred Alternative. Representative service is defined by the total number of trains (in the peak hour and throughout the day), travel times, and both passenger-seating and train capacities.

Transit-style Regional rail makes more intensive use of existing track capacity to significantly reduce the need for additional rail infrastructure, offering a simpler array of service patterns, dedicated to and optimized for each main track in the right-of-way.

Consistent with this Tier 1 process, the Preferred Alternative representative Service Plan to meet the "grow" vision provides a basis for the programmatic evaluation of the effects of each Alternative. It is intended to be demonstrative of possible future service and is not fully optimized for ridership or revenue potential. Decisions about operator-specific service plans or schedules are not part of the NEC FUTURE Tier 1 process. Such decisions would be made as part of Tier 2 project studies, which would include local stakeholder and public involvement as appropriate.

The Preferred Alternative representative Service Plan incorporates service and operating enhancements (Section 4.5.2.2). Operating efficiencies in the service plan are representative of what is possible with the infrastructure improvements and are not intended to be prescriptive. For example, for Regional rail, the FRA evaluated an enhanced service concept to maximize benefits to targeted markets and minimize investment in infrastructure, referred to as transit-style service, as an alternative to zone express service in areas of heavy demand. This concept is illustrative of the range of possible service concepts that could be operated with varying benefits to targeted markets. (Refer to Volume 2, Appendix B, *Service Plans and Train Equipment Options Technical Memorandum,* for additional information on transit-style services.) The Preferred Alternative representative Service Plan is operator neutral and provides a technical basis to allow the FRA to estimate future ridership and capital investment needs and costs, as well as assess the environmental benefits and impacts associated with planned construction and future operations of the Preferred Alternative. Operator-specific service plans or schedules are not part of the NEC Future Tier 1 process, and would be developed as part of Tier 2 project studies.

4.5.2.1 Frequency of Service

Like Alternative 2 in the Tier 1 Draft EIS, the Preferred Alternative achieves Intercity service levels of 10 tph, up to five times more service in the peak period over No Action Alternative service levels. Of those 10 tph, 4 tph are Intercity-Express and 6 tph are Intercity-Corridor. Of the Intercity-Corridor, 4 tph are Metropolitans and 2 tph are Intercity-Corridor-Other, which extend service to dozens of other markets beyond the NEC (e.g., long-distance services to Chicago or along the Atlantic coast). Of these 10 tph, service splits at New Haven with 6 tph continuing east and terminating in Boston and up to 4 tph continuing north and terminating in Springfield, MA.

Through capacity and operating improvements, the Preferred Alternative would more than double the Regional rail peak-hour service. At heavily traveled screenlines,[14] such as the Hudson River, Regional rail service would increase from 21 tph to 42 tph in the peak direction. The Preferred Alternative also includes additional service zones to increase peak zone express[15] service and reduce average trip times. The Preferred Alternative allows for increased service to Regional branch lines with sufficient capacity. Note that Regional rail service on the Hartford/Springfield Line in the No Action Alternative includes the CTrail service to be implemented in 2018. Additional service proposed for the full-build of CTrail Regional service is included in the Preferred Alternative.

Table 4-3 depicts train counts, by service type at selected screenlines for the No Action Alternative and Preferred Alternative. Screenlines are used to measure the volume of passenger rail traffic at key locations along the NEC, particularly where capacity or utilization might change. The greater the frequency of Intercity and Regional rail services at a station, the easier it is for travelers to make connections between these services.

[14] Screenlines are imaginary lines across which rail and passenger traffic can be counted or measured.
[15] Weekday peak service that stops at a group of adjacent stations and then operates express to the main terminal.

Table 4-3: Trains per Peak Hour, Existing and 2040 Peak-Hour Peak Direction at Select Screenlines (No Action Alternative and Preferred Alternative)

Screenline	No Action Alternative	Preferred Alternative
Washington, D.C. (*north of Washington, D.C., at Anacostia River)*		
Intercity	2	10
Regional rail	4	10
TOTAL	**6**	**20**
Philadelphia South (*Chester, Pennsylvania)*		
Intercity	2	10
Regional rail	3	8
TOTAL	**5**	**18**
Hudson River *(between New Jersey and New York)*		
Intercity	3	10
Regional rail	21	42
TOTAL	**24**	**52**
East River *(between Manhattan and Queens)**		
Intercity	2	10
Regional rail	36	50
TOTAL	**38**	**60**
New Rochelle (near *New Rochelle Station)*		
Intercity	1	10
Regional rail	21	32
TOTAL	**22**	**42**
New Haven North (*Hartford/Springfield Line)*		
Intercity	1	4
Regional rail	1	2
TOTAL	**2**	**6**
Boston (*south of Back Bay Station)*		
Intercity	2	6
Regional rail	9	12
TOTAL	**11**	**18**

Source: NEC FUTURE, 2015

Note: Peak hour, peak direction service at the Boston South screenline for Existing Conditions and the No Action Alternative was updated for the Tier 1 Final EIS to two trains to capture those peak hours where one Intercity-Express and one Intercity-Corridor train operate in the same hour. This is an update from the Tier 1 Draft EIS.

* Includes service to stations on the NEC; excludes new Long Island Rail Road service to Grand Central Terminal with the East Side Access project.

4.5.2.2 Operational Efficiencies

Onboard amenities such as café car seating would be improved in the Preferred Alternative
Source: Federal Railroad Administration, 2016

The Preferred Alternative incorporates operational efficiencies that exhibit strong service benefits and cost economies. Regular clockface headways and simplified operations are service planning principles used in the Preferred Alternative to reduce variability that can cause delays in day-to-day operations by setting up a repeating schedule of "slots" every hour throughout the day. The clockface headways also make it easier for passengers to use the system because the same train operates repeatedly throughout the day making the same station stops, reduces barriers to use, and improves intermodal connections. Simplified operations with fewer types of trains with simple stopping patterns will offer passengers easy to understand service that matches clockface headway slots with infrastructure capacity. These operational efficiencies can deliver more capacity, more-reliable trains, and an improved passenger experience for all travelers. However, the FRA believes achieving such transformative service quality requires changing the way NEC railroads plan infrastructure and operations.

The Preferred Alternative incorporates the following representative service amenities to enhance the customer experience:

- Integrated ticketing, reservation systems, and fares to improve passenger convenience, reducing boarding times for passengers
- Improved onboard amenities, including higher-quality amenities on Intercity-Express services, such as Wi-Fi, food services, and reserved seating
- Improved access to stations along the Preferred Alternative, including pedestrian, taxi, bicycle, and auto access, car- and bike-sharing, or on-demand services, and by local transit services
- Accommodation of bicycles on trains

4.5.3 Travel Times

The Preferred Alternative improves Intercity travel times between Major Hub and Hubs stations on both the NEC and Hartford/Springfield Line. Average travel times between Major Hub and Hub stations are presented in Table 4-5. Reductions in average travel time between the No Action Alternative and Preferred Alternative for the same Major Hub and Hub stations are presented in Table 4-6.

Travel-time improvements are the result of additional track capacity, specifically new segments permitting trains to operate express at high speed in certain portions of the corridor without conflicting with trains with more-frequent stops. These travel-time improvements are also a result of better, more-frequent, timed transfers between services, which result in shorter travel times for intermediate and smaller markets (Hub or local stations). Chapter 5 includes further discussion of

the combination of improvements to the infrastructure and implementation of operating enhancements to improve travel times.

Average travel times for trip-pairs between the NEC and Hartford and Springfield Stations decrease in the Preferred Alternative, leveraging service and infrastructure improvements on the NEC and Hartford/Springfield Line in the Preferred Alternative. Travel time between Hartford and Providence Stations is 2 hours 50 minutes (3 hours 10 minutes faster than the No Action Alternative). Travel times between Penn Station New York Penn and Springfield is 2 hours 30 minutes (1 hour 5 minutes faster than the No Action Alternative).

The travel times and differences presented in Table 4-5 and Table 4-6 are based on the representative service plans for the No Action Alternative and Preferred Alternative and are not intended to be prescriptive regarding how service should be operated in the future. The FRA did not optimize the representative service plans to maximize ridership or net revenues.

The travel times, and resultant decreases between the No Action Alternative and Preferred Alternative (reflected in Table 4-5 and Table 4-6) are a weighted average of all trains in the Representative Service Plan serving those station pairs. Travel times are based on Intercity-Express travel times; where station pairs are not served by Intercity-Express, the best available Intercity-Corridor times were used. As noted in Appendix BB, Technical Analysis on the Preferred Alternative, the Preferred Alternative includes two Intercity-Express service patterns between Washington, D.C., and Philadelphia. One pattern operates non-stop between Washington Union Station and Philadelphia 30th Street Station; the other pattern makes intermediate stops at BWI Airport, Baltimore Penn Station, Wilmington Station, and Philadelphia 30th Street Station. Travel times for trains operating non-stop between Washington Union Station and Philadelphia 30th Street Station are about 10 minutes less than trains making intermediate stops. For example, travel time between Washington Union Station and Penn Station New York is approximately 2 hours 20 minutes when making stops at Washington Union Station, BWI Airport, Baltimore, Wilmington, and Philadelphia, compared to 2 hours 10 minutes in the non-stop service pattern. The fastest travel times between key city-pairs are achieved with a non-stop service pattern between Philadelphia and Washington, D.C. The fastest travel times, and the difference from the No Action Alternative, are presented in Table 4-4.

Table 4-4: Fastest Intercity-Express Travel Times between Key City-Pairs Rounded to the nearest 5 Minutes (hour:minutes)

From	To	No Action Alternative	Preferred Alternative	Difference
Washington Union	Boston South Station	6:35	5:00	1:35
Washington Union	Penn Station New York	2:45	2:10	0:35
Penn Station New York	Boston South Station	3:30	2:45	0:45

Source: NEC FUTURE: Representative Service Plan, 2016

Fastest travel times between Washington Union Station and Boston South Station includes approximately 10 minutes between arrival and departure at Penn Station New York.

Table 4-5: Average Intercity Travel Times between Selected Major Hub/Hub Stations in the Preferred Alternative Rounded to Nearest Five Minutes (hour:minutes)

	Washington Union	Baltimore Penn Station	Newark, DE	Wilmington Station	Philadelphia 30th Street	Trenton	Newark Penn Station	Penn Station New York	Stamford	New Haven Station	Hartford	Springfield	New London or Mystic/ New London H.S.	Providence Station	Boston South Station
Washington Union		0:30	1:10	1:05	1:20	2:10	2:05	2:15	2:55	3:30	4:25	5:05	4:15	4:35	5:10
Baltimore Penn Station	0:30		0:30	0:35	0:55	1:30	1:40	1:50	2:30	3:05	4:00	4:35	3:45	4:10	4:45
Newark, DE	1:10	0:30		0:10	0:30	1:05	1:40	1:50	2:35	3:15	3:50	4:20	4:05	5:00	5:35
Wilmington Station	1:05	0:35	0:10		0:20	0:50	1:05	1:15	1:55	2:30	3:25	4:00	3:10	3:35	4:10
Philadelphia 30th Street	1:20	0:55	0:30	0:20		0:25	0:45	0:55	1:35	2:10	3:05	3:40	2:50	3:15	3:50
Trenton	2:10	1:30	1:05	0:50	0:25		0:35	0:50	1:35	2:10	2:50	3:25	3:00	3:55	4:35
Newark Penn Station	2:05	1:40	1:40	1:05	0:45	0:35		0:10	0:50	1:25	2:05	2:40	2:05	2:30	3:05
Penn Station New York	2:15	1:50	1:50	1:15	0:55	0:50	0:10		0:35	1:05	1:55	2:30	1:45	2:10	2:45
Stamford	2:55	2:30	2:35	1:55	1:35	1:35	0:50	0:35		0:35	1:20	1:50	1:10	1:40	2:10
New Haven Station	3:30	3:05	3:15	2:30	2:10	2:10	1:25	1:05	0:35		0:35	1:10	0:35	1:05	1:35
Hartford	4:25	4:00	3:50	3:25	3:05	2:50	2:05	1:55	1:20	0:35		0:30	1:30	1:55	2:30
Springfield	5:05	4:35	4:20	4:00	3:40	3:25	2:40	2:30	1:50	1:10	0:30		2:00	2:30	3:00
New London or Mystic/NL H.S.	4:15	3:45	4:05	3:10	2:50	3:00	2:05	1:45	1:10	0:35	1:30	2:00		0:25	1:00
Providence Station	4:35	4:10	5:00	3:35	3:15	3:55	2:30	2:10	1:40	1:05	1:55	2:30	0:25		0:35
Boston South Station	5:10	4:45	5:35	4:10	3:50	4:35	3:05	2:45	2:10	1:35	2:30	3:00	1:00	0:35	

Source: NEC FUTURE: Preferred Alternative Representative Service Plan, 2016

Note: Travel times are based on Intercity-Express travel times; where station pairs are not served by Intercity-Express, the best available Intercity-Corridor times were used. Average Intercity travel times are to/from New London or Mystic/New London H.S. stations. Travel times are calculated using an average of all trains that serve station pairs, which can include multiple stopping patterns.

H.S. = high speed

Table 4-6: Decrease in Intercity Travel Times between Selected Major Hub/Hub Stations in the No Action Alternative and Preferred Alternative Rounded to Nearest Five Minutes (hour:minutes)

	Washington Union	Baltimore Penn Station	Newark, DE	Wilmington Station	Philadelphia 30th Street	Trenton	Newark Penn Station	Penn Station New York	Stamford	New Haven Station	Hartford	Springfield	New London or Mystic/ New London H.S.	Providence Station	Boston South Station
Washington Union		0:05	0:15	0:15	0:20	0:05	0:25	0:30	0:55	1:00	2:05	2:05	1:05	1:20	1:25
Baltimore Penn Station	0:05		0:10	0:10	0:10	0:05	0:15	0:20	0:45	0:50	1:50	1:50	0:55	1:10	1:15
Newark, DE	0:15	0:10		0:05	0:05	0:00	0:05	0:10	1:30	1:45	2:00	2:10	1:55	1:50	2:15
Wilmington Station	0:15	0:10	0:05		0:00	0:05	0:10	0:15	0:35	0:40	1:35	1:35	0:50	1:00	1:05
Philadelphia 30th Street	0:20	0:10	0:05	0:00		0:00	0:10	0:15	0:35	0:40	1:30	1:30	0:50	1:05	1:05
Trenton	0:05	0:05	0:00	0:05	0:00		0:00	0:05	0:40	0:45	1:15	1:20	0:55	1:00	1:00
Newark Penn Station	0:25	0:15	0:05	0:10	0:10	0:00		0:05	0:30	0:35	1:20	1:25	0:45	0:55	1:00
Penn Station New York	0:30	0:20	0:10	0:15	0:15	0:05	0:05		0:15	0:25	1:00	1:05	0:30	0:45	0:45
Stamford	0:55	0:45	1:30	0:35	0:35	0:40	0:30	0:15		0:05	0:45	0:50	0:10	0:30	0:30
New Haven Station	1:00	0:50	1:45	0:40	0:40	0:45	0:35	0:25	0:05		0:15	0:20	0:05	0:25	0:25
Hartford	2:05	1:50	2:00	1:35	1:30	1:15	1:20	1:00	0:45	0:15		0:05	2:40	0:55	0:55
Springfield	2:05	1:50	2:10	1:35	1:30	1:20	1:25	1:05	0:50	0:20	0:05		3:35	0:55	1:00
New London or Mystic NL H.S.	1:05	0:55	1:55	0:50	0:50	0:55	0:45	0:30	0:10	0:05	2:40	3:35		0:15	0:20
Providence Station	1:20	1:10	1:50	1:00	1:05	1:00	0:55	0:45	0:30	0:25	0:55	1:00	0:15		0:05
Boston South Station	1:25	1:15	2:15	1:05	1:05	1:00	1:00	0:45	0:30	0:25	0:55	1:00	0:20	0:05	

Source: NEC FUTURE: Preferred Alternative Representative Service Plan, 2016

Note: Travel times are based on Intercity-Express travel times; where station pairs are not served by Intercity-Express, the best available Intercity-Corridor times were used. Average Intercity travel times are to/from New London or Mystic/New London H.S. stations. Travel times are calculated using an average of all trains that serve station pairs, which can include multiple stopping patterns.

H.S. = high speed

Additional limited-stop, super-express service patterns resulting in shorter travel times between various city-pairs could be run; however, this would require a more complicated service plan and could affect some of the new approaches to delivering services, such as pulse-hub operations at Philadelphia and New Haven. During initial ridership testing, super-express trains did not generate increased Intercity-Express ridership.

4.5.4 Capacity for Existing and New Markets

The Preferred Alternative improves the level-of-service available to NEC markets and as well as new travel markets that are not served currently or are not well served by the NEC. Service to existing markets expands to include more one-seat ride destinations, new and improved rail-airport connections, integrated service on the Hartford/Springfield Line, and increased service to connecting corridors, such as south of Washington, D.C., and the Keystone Corridor. A key service component to serving new markets is the introduction of Metropolitan service, which serves a combination of traditionally Intercity and Regional rail stations, significantly increasing one-seat ride options as well as facilitating easier travel to markets across the NEC. In addition, the Preferred Alternative adds significant capacity to accommodate future growth, improve trip times, and increase reliability. Capacity for growth beyond 2040 is particularly important in the highly congested New Jersey/New York/Connecticut markets.

Between New Haven, CT, and Boston, MA, the Preferred Alternative includes an upgrade of the NEC shoreline route with a supplemental new segment between Old Saybrook, CT, and Kenyon, RI, as envisioned in Alternative 1. It also incorporates an electrified Hartford/Springfield Line connection to the NEC, supporting more-frequent service via New Haven to Hartford, CT, and Springfield, MA.[16] The Preferred Alternative completes the expansion of physical capacity on the Hartford/Springfield Line to a full double-track, electrified rail line supporting up to two Metropolitan, two Intercity-Corridor, and two Regional rail trains per hour in peak hours in each direction.

The Preferred Alternative envisions a primarily four-track railroad for the entire length of the NEC as needed and a two-track railroad the entire length of the Hartford/Springfield Line. These improvements result in significant additional capacity on the NEC between central New Jersey and New Haven, CT—through Penn Station New York—and improved service to NEC markets and service to new markets. Together, these improvements provide additional capacity to allow for through-running and increases in peak and off-peak service across the entire NEC.

Table 4-7 presents measures of peak-hour rail service capacity and practical capacity at five screenline[17] locations for the No Action Alternative and Preferred Alternative. The Preferred Alternative, which adds two additional tracks at the East River screenline, would relieve the East River chokepoint, providing 10 additional slots and excess capacity beyond what will be required in 2040 across the East River.

[16] Passengers can transfer to connecting corridor services north to St. Albans, Vermont and east to Boston at Springfield Union Station. See Section 4.5.9 for additional information on connecting corridors.
[17] Screenlines are imaginary lines across which rail and passenger traffic can be counted or measured.

Table 4-7: Rail Service and Practical Capacity at Select Screenlines (Peak Hour, Peak Direction)

Screenline	No Action Alternative	Preferred Alternative
Washington, D.C. (north of Union Station)		
Total Practical Capacity (Slots/Hour)	**12**	**20**
Total Intercity (EXP+IC)	2	10
Regional Rail	4	10
Total Trains (EXP+IC+REG)	***6***	***20***
Hudson River		
Total Practical Capacity (Slots/Hour)	**24**	**52**
Total Intercity (IC & EXP)	3	10
Regional Rail	21	42
Total Trains (EXP+IC+REG)	***24***	***52***
East River (PSNY --> Queens)		
Total Practical Capacity (Slots/Hour)	**40**	**70**
Total Intercity (IC & EXP)	2	10
Regional Rail	36	50
Total Trains (EXP+IC+REG)	***38***	***60***
New Haven North (Hartford/Springfield Line)		
Total Practical Capacity (Slots/Hour)	**2**	**6**
Total Intercity (IC & EXP)	1	4
Regional Rail	1	2
Total Trains (EXP+IC+REG)	***2***	6
Boston (South of Back Bay Station (NEC))		
Total Practical Capacity (Slots/Hour)	**24**	**24**
Total Intercity (IC & EXP)	2	6
Regional Rail	9	12
Total Trains (EXP+IC+REG)	***11***	***18***

Source: NEC FUTURE: Service Plans, 2016

Note: Peak hour, peak direction service at the Boston South screenline for Existing Conditions and the No Action Alternative was updated for the Tier 1 Final EIS to two trains to capture those peak hours where one Intercity-Express and one Intercity-Corridor train operate in the same hour. This is an update from the Tier 1 Draft EIS.

EXP=Express; IC=Intercity-Corridor; REG=Regional rail; Intercity-Corridor service includes Metropolitan, Off-Corridor and Long-Distance services

4.5.5 Stations/Metropolitan Areas Served

The FRA evaluated services provided at stations and the physical improvements associated with station tracks, platforms, passenger waiting areas and facilities, access and parking, and ancillary buildings. The Preferred Alternative includes service to the 116 stations that exist today—109 of which are on the NEC and 7 of which are on the Hartford/Springfield Line. Table 4-8 lists the quantities of stations, by type, for the NEC + Hartford/Springfield Line and Preferred Alternative. Table 4-9 contains a complete list of stations, their location, and station typology for the Preferred Alternative. The FRA used the station ID (the third column of Table 4-9) to refer to each station in its

assessment of station area Environmental Consequences for applicable resources.[18] The station name and station ID are also references for information displayed in Chapter 7. Volume 2, Chapter 4, contains a complete list of stations analyzed in NEC FUTURE.

Table 4-8: Station Types for Existing NEC + Hartford/Springfield Line and Preferred Alternative

Station Type	Existing NEC + Hartford/Springfield Line	Preferred Alternative
Major Hub	14	17
Hub	23	31
Local	79	90
TOTAL	**116**	**138**

Source: NEC FUTURE team, 2016
Note: Table 4-9 provides a complete list of stations and their locations. Appendix BB, Technical Analysis on the Preferred Alternative, further describes the selection of specific station selection criteria for the Preferred Alternative.

The Preferred Alternative adds 22 new stations for a total of 138 stations. Eight new stations are located in Connecticut, the most of any state within the Study Area. Four new stations are located on the Hartford/Springfield Line, in New Haven and Hartford Counties, followed by two in Fairfield County, one in New Haven County on the NEC, and one in New London County. There are five new stations in New York: four in Bronx County and one in Westchester County. Additional Tier 2 project analyses would address specific issues about new station location, layout, access, amenities, and connecting services. Chapter 5, Transportation, documents the effects to travel conditions related to these new stations.

Penn Station Eagle

Source: NEC FUTURE team, 2016

New stations would serve new or underserved markets and are stations with highway access to the NEC (such as Baldwin Station near Chester, PA, or Mystic/New London H.S. in Groton, CT[19]) or are adjacent to existing stations and designed to accommodate multiple service types with multiple levels of tracks and platforms and convenient passenger connections to the existing station (Metropark in Iselin, NJ, or Stamford in Stamford, CT). New Local stations that would be served on the Hartford/Springfield Line include North Haven in New Haven County, CT, and Enfield in Hartford County, CT.

[18] If Waterbury branch service becomes a shuttle-type operation in the future, a new station would be required to support passenger transfers to NEC trains. Metro-North Railroad is operating such a shuttle service via a temporary Devon Transfer Station during construction along the NEC. The infrastructure or capital costs associated with this type of facility were not evaluated in the Tier 1 Draft EIS or Tier 1 Final EIS and will be considered in a subsequent Tier 2 planning process.

[19] The proposed new Mystic/New London H.S. station would be in addition to and provide service complementary to service to existing stations on the NEC shoreline route.

Major Hub stations in Washington, D.C., Philadelphia, New York City, and Boston are each undergoing their own development and expansion plans. The FRA incorporated the assumptions in these expansion plans as inputs into the Preferred Alternative and is generally consistent with them. In some cases, design-specific solutions might be warranted to accommodate the growth in service proposed for the Preferred Alternative. These refinements will be further investigated in subsequent Tier 2 project studies or other planning processes (Volume 2, Appendix B, *Service Plans and Train Equipment Options Technical Memorandum*, provides further information about the approach and assumptions to including these Major Hub stations).

Five stations would be upgraded to Hub or Major Hub stations to accommodate new service types[20] and improve gaps in connectivity:

- Odenton (Maryland)
- Secaucus (New Jersey)
- Greens Farms (Connecticut)
- Hartford (Connecticut)
- T.F. Green Airport (Rhode Island)

[20] Service type and frequency are the focus of the transportation analysis (see Chapter 5, Transportation), in which the FRA evaluated connectivity, service frequency, travel times, and ridership. (Refer to Volume 2, Chapter 4 for more information on station typology.)

Recapping the Station Planning Process in NEC FUTURE

The FRA developed a hierarchy of station types in order to assess the environmental effects from stations for the Action Alternatives and Preferred Alternative. The representative station area footprint assigned to each station type is intended to capture the necessary physical improvements, taking into consideration the types of service offered as well as adjacent land uses for each station area. The potential physical effects of these station area footprints are documented in Chapter 7 and Appendix EE. Stations are grouped into one of the following types:

- **Major Hub stations** have a station area of 1,500 feet x 600 feet (approximately 20 acres), and offer Intercity-Express, Intercity-Corridor, and Regional services. This station area reflects typical urban settings where land availability is constrained and modal access to the station is more diverse. Major Hub stations at the four primary markets, Washington, D.C., Philadelphia, New York City, and Boston, have unique and larger footprints described below.
- **Hub stations** have a station area of 2,000 feet x 900 feet (approximately 40 acres), and offer more limited Intercity-Express service, when compared to Major Hub Stations; Intercity-Corridor Service, and (in most cases), Regional service. Hub stations are located in existing intermediate markets currently served by Intercity service and new or upgraded stations that would fill connectivity gaps in the existing passenger rail network, serve special trip generators, or provide important intermodal connections. The station area is twice the size of Major Hub stations to reflect the more suburban settings where these stations would likely be located and where land availability is not as constrained as in urban areas.
- **Local stations** have station areas of 1,500 feet x 600 feet (approximately 20 acres) and offer only Regional service. This station area reflects smaller markets typically associated with one service type where parking requirements may be less than Major Hub and Hub Stations.

Major Hub Stations in Primary Markets

Major Hub stations in Washington, D.C., Philadelphia, New York City, and Boston are each undergoing their own expansion plans (see Appendix B, Service Plans and Train Equipment Options Technical Memorandum). The FRA incorporated the assumptions of these expansion plans as inputs into the Representative Service Plan. The approximate dimensions, incorporating the existing stations and their expansion based on available documentation, are detailed below.

- **Washington Union Station** has a station area roughly encompassing D Street NE to K Street NE; and North Capital Street to 2nd Street NE (approximately 100 acres).
- **Philadelphia 30th Street Station** has a station area roughly encompassing Market Street to Spring Garden Street; and 32nd Street and I-76 (approximately 140 acres).
- **Penn Station New York** has a station area roughly encompassing 28th Street to 36th Street; and 9th Avenue to 6th Avenue (approximately 130 acres). The FRA expanded the station area for Penn Station New York in the Tier 1 Final EIS to allow for further expansion to accommodate growth at Penn Station New York, and to accommodate opportunities for future growth beyond the 2040 horizon year. The station area analyzed in the Tier 1 Draft EIS encompassed the area between 30th Street to 34th Street; and 9th Avenue to 6th Avenue.
- **Boston South Station** has a station area roughly encompassing I-93 to the Fort Point Cannel; and I-90 to Summer Street (approximately 25 acres).

Table 4-9: Stations in the No Action Alternative and Preferred Alternative

Geography	County	Station ID	Station Name	Station Typology	No Action Alternative	Preferred Alternative	Station Type
Existing NEC							
D.C.		1	Washington Union (WAS)[1]	Major Hub	X	X	Existing (Expanded)
MD	Prince George's	2	New Carrolton (NCR)#	Hub	X	X	Existing
		3	Seabrook	Local	X	X	Existing
		4	Bowie State	Local	X	X	Existing
	Anne Arundel	5	Odenton	Hub	X	X	Modified
		6	BWI Airport (BWI)[1]	Major Hub	X	X	Existing (Expanded)
	Baltimore County	7	Halethorpe	Local	X	X	Existing
		15	Martin Airport#	Local	X	X	Existing
	Baltimore City	10	Baltimore Penn Station (BAL)#	Major Hub	X	X	Existing
		13	Bayview[2]	Hub	X	X	New
		8	West Baltimore	Local	X	X	Existing
	Harford	16	Edgewood	Local	X	X	Existing
		17	Aberdeen (ABE)#	Hub	X	X	Existing
	Cecil	22	Perryville	Local	X	X	Existing
		23	Elkton	Local		X	New
DE	New Castle	24	Newark, DE (NRK)#	Hub	X	X	Existing
		25	Churchman's Crossing	Local	X	X	Existing
		26	Newport[2]	Local	X	X	New
		27	Wilmington Station (WIL)	Major Hub	X	X	Existing
		28	Edgemoor[2]	Local	X	X	New
		29	Claymont	Local	X	X	Existing

Source: NEC FUTURE team, 2016

Note: Existing Amtrak Station Codes provided in parenthesis where applicable

Stations that would require physical improvements, but would not have a Station Type change. See Appendix BB, Technical Analysis on the Preferred Alternative, for additional information regarding improvements at all stations.

[1] Existing (Expanded) stations would be expanded in conjunction with the Preferred Alternative. The station typology of these stations is unchanged in the Preferred Alternative.

[2] Stations that are included in the No Action Alternative but are not yet operational are considered "new" for the purposes of this analysis. These stations are also included in the Preferred Alternative.

Table 4-9: Stations in the No Action Alternative and Preferred Alternative (continued)

Geography	County	Station ID	Station Name	Station Typology	No Action Alternative	Preferred Alternative	Station Type
Existing NEC (cont'd)							
PA	Delaware	30	Marcus Hook	Local	X	X	Existing
		31	Highland Avenue	Local	X	X	Existing
		32	Chester	Local	X	X	Existing
		33	Eddystone	Local	X	X	Existing
		34	Baldwin[2]	Hub	X	X	New
		35	Crum Lynne	Local	X	X	Existing
		36	Ridley Park	Local	X	X	Existing
		37	Prospect Park	Local	X	X	Existing
		38	Norwood	Local	X	X	Existing
		39	Glenolden	Local	X	X	Existing
		40	Folcroft	Local	X	X	Existing
		41	Sharon Hill	Local	X	X	Existing
		42	Curtis Park	Local	X	X	Existing
		43	Darby	Local	X	X	Existing
	Philadelphia	44	Philadelphia Airport[3]	Hub		X	New
		45	Philadelphia 30th St (PHL)#	Major Hub	X	X	Existing
		47	North Philadelphia (PHN)	Hub	X	X	Existing
		48	Bridesburg	Local	X	X	Existing
		50	Tacony	Local	X	X	Existing
		51	Holmesburg Junction	Local	X	X	Existing
		52	Torresdale	Local	X	X	Existing
	Bucks	53	Cornwells Heights (CWH)#	Hub	X	X	Existing
		54	Eddington	Local	X	X	Existing
		55	Croyton	Local	X	X	Existing
		56	Bristol	Local	X	X	Existing
		57	Levittown	Local	X	X	Existing

Source: NEC FUTURE team, 2016

Note: Existing Amtrak Station Codes provided in parenthesis where applicable

Stations that would require physical improvements, but would not have a Station Type change. See Appendix BB, Technical Analysis on the Preferred Alternative, for additional information regarding improvements at all stations.

[2] Stations that are included in the No Action Alternative but are not yet operational are considered "new" for the purposes of this analysis. These stations are also included in the Preferred Alternative.

[3] The airport is currently served by Regional rail service located off the NEC. The Philadelphia International Airport Station identified in the Preferred Alternative would be built as part of the NEC FUTURE and is a new station separate from the existing Regional rail station. The station area is co-located in Delaware County, PA.

Table 4-9: Stations in the No Action Alternative and Preferred Alternative (continued)

Geography	County	Station ID	Station Name	Station Typology	No Action Alternative	Preferred Alternative	Station Type
Existing NEC (cont'd)							
NJ	Mercer	58	Trenton (TRE)	Hub	X	X	Existing
		60	Hamilton	Local	X	X	Existing
		61	Princeton Junction (PJC)[4]	Local	X	X	Modified
	Middlesex	62	North Brunswick[4]	Hub	X	X	New
		63	Jersey Avenue	Local	X	X	Existing
		64	New Brunswick (NBK)[4]	Local	X	X	Modified
		65	Edison	Local	X	X	Existing
		66	Metuchen	Local	X	X	Existing
		67	Metropark (MET)	Major Hub	X	X	Existing
		68	Metropark H.S.	Major Hub		X	New
	Union	69	Rahway	Local	X	X	Existing
		70	Linden	Local	X	X	Existing
		71	Elizabeth	Local	X	X	Existing
		72	North Elizabeth	Local	X	X	Existing
	Essex	73	Newark Airport (EWR)	Hub	X	X	Existing
		74	Newark Penn Station (NWK)#	Major Hub	X	X	Existing
	Hudson	76	Secaucus	Hub	X	X	Modified
NY	New York	77	Penn Station New York (NYP)[1]	Major Hub	X	X	Existing (Expanded)
	Bronx	78	Hunts Point	Local		X	New
		79	Parkchester/Van Ness	Local		X	New
		80	Morris Park	Hub		X	New
		81	Co-op City	Local		X	New
	Westchester	82	New Rochelle (NRO)#	Hub	X	X	Existing
		83	Larchmont	Local	X	X	Existing
		84	Mamaroneck	Local	X	X	Existing
		85	Harrison	Local	X	X	Existing
		86	Rye	Local	X	X	Existing
		87	Cross-Westchester*	Hub		X	New
		88	Port Chester	Local	X	X	Existing

Source: NEC FUTURE team, 2016

Note: Existing Amtrak Station Codes provided in parenthesis where applicable

Stations that would require physical improvements, but would not have a Station Type change. See Appendix BB, Technical Analysis on the Preferred Alternative, for additional information regarding improvements at all stations.

* Intercity services only

[1] Existing (Expanded) stations would be expanded in conjunction with the Preferred Alternative. The station typology of these stations is unchanged in the Preferred Alternative.

[4] Princeton Junction and New Brunswick stations are reclassified as Local, and a new Hub station is located in North Brunswick, midway between the two, to serve central New Jersey. The location for the Hub station in North Brunswick reflects NJ TRANSIT's plans for a new station (see Appendix B.1, No Action Alternative Report) as well as the existing constraints to expanding Princeton Junction or New Brunswick stations. The North Brunswick station, however, is representative of the improvement that would be needed, and future decisions on a location for a Hub station would be as part of subsequent Tier 2 project-level studies.

H.S. = high speed

Table 4-9: Stations in the No Action Alternative and Preferred Alternative (continued)

Geography	County	Station ID	Station Name	Station Typology	No Action Alternative	Preferred Alternative	Station Type
Existing NEC (cont'd)							
CT	Fairfield	89	Greenwich	Local	X	X	Existing
		90	Cos Cob	Local	X	X	Existing
		91	Riverside	Local	X	X	Existing
		92	Old Greenwich	Local	X	X	Existing
		93	Stamford (STM)	Major Hub	X	X	Existing
		94	Stamford H.S.	Major Hub		X	New
		95	Noroton Heights	Local	X	X	Existing
		96	Darien	Local	X	X	Existing
		97	Rowayton	Local	X	X	Existing
		98	South Norwalk	Local	X	X	Existing
		99	East Norwalk	Local	X	X	Existing
		100	Westport	Local	X	X	Existing
		101	Greens Farms	Hub	X	X	Modified
		102	Southport	Local	X	X	Existing
		103	Fairfield	Local	X	X	Existing
		104	Fairfield Metro	Local	X	X	Existing
		105	Bridgeport (BRP)	Hub	X	X	Existing
		107	Barnum[2]	Local	X	X	New
		108	Stratford	Local	X	X	Existing
	New Haven	109	Milford	Local	X	X	Existing
		189	Orange	Local		X	New
		110	West Haven	Local	X	X	Existing
		111	New Haven Station (NHV)#	Major Hub	X	X	Existing
		113	New Haven State Street	Local	X	X	Existing
		114	Branford	Local	X	X	Existing
		115	Guilford	Local	X	X	Existing
		116	Madison	Local	X	X	Existing
	Middlesex	117	Clinton	Local	X	X	Existing
		118	Westbrook	Local	X	X	Existing
		119	Old Saybrook (OSB)#	Hub	X	X	Existing
	New London	121	New London (NLC)	Hub	X	X	Existing
		124	Mystic/New London H.S.*	Major Hub		X	New
		122	Mystic (MYS)*	Hub	X	X	Existing

Source: NEC FUTURE team, 2016
Note: Existing Amtrak Station Codes provided in parenthesis where applicable
Stations that would require physical improvements, but would not have a Station Type change. See Appendix BB, Technical Analysis on the Preferred Alternative, for additional information regarding improvements at all stations.
* Intercity services only
[2] Stations that are included in the No Action Alternative but are not yet operational are considered "new" for the purposes of this analysis. These stations are also included in the Preferred Alternative.
H.S. = high speed

Table 4-9: Stations in the No Action Alternative and Preferred Alternative (continued)

Geography	County	Station ID	Station Name	Station Typology	No Action Alternative	Preferred Alternative	Station Type
Existing NEC (cont'd)							
RI	Washington	123	Westerly (WLY)*	Hub	X	X	Existing
		125	Kingston (KIN)#	Hub	X	X	Existing
		126	Wickford Junction	Local	X	X	Existing
	Kent	127	T.F. Green	Hub	X	X	Modified
	Providence	128	Providence Station (PVD)	Major Hub	X	X	Existing
		130	Pawtucket	Local		X	New
MA	Bristol	131	South Attleboro	Local	X	X	Existing
		132	Attleboro	Local	X	X	Existing
		133	Mansfield	Local	X	X	Existing
	Norfolk	134	Sharon	Local	X	X	Existing
		135	Canton Junction	Local	X	X	Existing
		136	Route 128 (RTE)#	Major Hub	X	X	Existing
	Suffolk	137	Readville#	Local	X	X	Existing
		138	Hyde Park	Local	X	X	Existing
		139	Forest Hills#	Local	X	X	Existing
		140	Ruggles Street#	Local	X	X	Existing
		141	Back Bay (BBY)	Major Hub	X	X	Existing
		143	Boston South Station (BOS)[1]	Major Hub	X	X	Existing (Expanded)
Existing Hartford/Springfield Line							
CT	New Haven	157	North Haven	Local		X	New
		184	Wallingford (WFD)	Hub	X	X	Existing
		185	Meriden (MDN)	Hub	X	X	Existing
	Hartford	160	Berlin (BER)	Hub	X	X	Existing
		161	Newington	Local		X	New
		186	West Hartford	Local		X	New
		163	Hartford (HFD)	Major Hub	X	X	Modified
		168	Windsor WND)	Hub	X	X	Existing
		169	Windsor Locks (WNL)	Hub	X	X	Existing
		187	Enfield	Local		X	New
MA	Hampden	170	Springfield (SPG)	Hub	X	X	Existing

Source: NEC FUTURE team, 2016

Note: Existing Amtrak Station Codes provided in parenthesis where applicable

Stations that would require physical improvements, but would not have a Station Type change. See Appendix BB, Technical Analysis on the Preferred Alternative, for additional information regarding improvements at all stations.

* Intercity services only

[1] Existing (Expanded) stations would be expanded in conjunction with the Preferred Alternative. The station typology of these stations is unchanged in the Preferred Alternative.

H.S. = high speed

4.5.6 Pricing

Fare policy or pricing is not defined for either Intercity or Regional services. The FRA did make assumptions about overall fare structure to estimate ridership for Intercity services, but did not attempt to optimize fares and ridership nor to be prescriptive about specific fare policy. Those decisions will be the subject of future studies and the decisions of rail operators. The Preferred Alternative has the potential for commercial Intercity services that achieve higher profitability with different pricing and marketing strategies. Similarly, given the local nature of Regional rail operations, the FRA assumed existing individual Regional rail operators fare policies for design of service and estimating ridership. Chapter 5 and Volume 2, Appendix B, provide further discussion of how fares influenced the NEC FUTURE ridership and O&M cost analyses.

4.5.7 Rolling Stock

The service plans for the Preferred Alternative are based on the use of high-performance trainsets, which is consistent with available rolling stock and the projected pace of technology development. High-performance trainsets utilize rail infrastructure more efficiently by minimizing the variations in train performance (e.g., top speed, acceleration and braking rates). Table 4-10 identifies the various types and configurations of rolling stock.

The rolling stock assumptions for the Preferred Alternative represent the best available information about the mix of Intercity equipment based on current technology. In light of the individual fleet standards and requirements for the Regional rail operators, rolling stock assumptions are not prescriptive for Regional rail. To achieve the proposed service objectives of the Preferred Alternative would require restricting operations on the NEC to all electric; today there are some Regional railroads operating diesel-hauled equipment on the NEC. Although the FRA assumed all-electric operations for the Preferred Alternative, it is understood that some Regional rail services may continue to operate diesel-hauled operations as an alternative to converting to all-electric operations. It should be noted that there are consequences associated with decisions to utilize rolling stock with greater variability in performance. Consequences include reduced scheduling flexibility (i.e., the need to schedule around other trains in locations where tracks are shared), reduction in the number of train frequencies, particularly in the standard peak hour, and needs for additional infrastructure for trains with different operating characteristics to pass or overtake one another while in route. (Volume 2, Appendix B, *Service Plans and Train Equipment Options Technical Memorandum*, contains additional information regarding rolling stock assumptions.)

The FRA also assumed the possibility of waivers to operate Tier III equipment at speeds up to 160 mph in a shared environment. Given the comprehensive improvements of infrastructure and systems with implementation of the Preferred Alternative, it is reasonable to assume that sufficient risk reduction would be accomplished to meet regulatory requirements commensurate with future technology and improvements in equipment design. In light of that, the Preferred Alternative's representative Service Plan assumes the possibility of operating Tier III equipment at slower speeds in a shared-use environment. Although not allowable under current regulations, waivers for certain operating conditions or future changes in regulations are possibilities.

Table 4-10: Rolling Stock Assumptions Used for Service Planning Purposes

Rolling Stock	Tier[4]	Locomotive Type/ Traction Power Type	Train Length (Locomotives + Coaches, ft)[1]	Seats/ Car	Off-Corridor Ops	Max. Speed on NEC (mph)
Intercity-Express High-Performance Trainset	III	Concentrated or distributed power w/Catenary	595–1,190	50–60	No	220
Intercity-Corridor Trainset	III	Concentrated or distributed power w/Catenary	595–1,190	60–70	No	220
	III	Dual Power/Cat. + 3rd Rail	1,020	60–70	Yes	160–220[2]
	III	High-Performance Dual Mode	1,020	60–70	Yes	160–220[2]
	III	Dual-Mode/3rd Rail + Diesel	1,020	60–70	Yes	160–220[2]
Intercity-Corridor Train	I	High-Performance Dual Mode	1,000	60–70	Yes	125
	I	Diesel locomotive	1,170	60–70	Yes	110
	I	Electric locomotive/ Catenary	1,170	60–70	Yes	125
Regional rail Electric Multiple-Unit (EMU)[3]	I	EMU/Catenary or 3rd Rail	1,020	105	Yes	100–125
	I	EMU/Catenary or 3rd Rail	1,020	135	Yes	100–125
Regional rail Push-Pull, Single level or Bi-level[3]		Electric, Diesel or Dual-Mode locomotive	1,000	135	Yes	125/100
	I	Electric, Diesel or Dual-Mode locomotive	755	135	Yes	125/100
Intercity Long-Distance Train	I	Same locomotive options as Intercity-Corridor trains	1,170	various	Yes	125

Source: NEC FUTURE team, 2016

[1] Measured in equivalent 85-foot car lengths and 75-foot-long locomotives, or the equivalent length of intact trainset modules. Also can be operated in smaller consists as warranted by demand. High-performance equipment assumed to comprise one or two intact trainset modules.

[2] There is currently no high-performance trainset 220 mph-capable that has both overhead electrification and third-rail or diesel power equipment. The top speed of such dual-mode equipment could be lower than 220 mph. Also of note, this trainset would need to be compatible with the three types of AC power present on the NEC.

[3] Includes through-running services, assuming compatibility with traction power system (if any) on all lines served.

[4] FRA Equipment Tiers are defined in 49 CFR 238. Tier I means operating at speeds not exceeding 125 mph. Tier II means operating at speeds exceeding 125 mph but not exceeding 150 mph. FRA is establishing a Tier III equipment regulation for operating speeds over 125 mph.

4.5.8 Rail-Airport Connections

The Preferred Alternative provides more rail-air connections along the NEC and via the Hartford/Springfield Line. In addition to expanding frequent Intercity and Regional rail service to Baltimore-Washington International (BWI) and Newark Liberty International Airports, the Preferred Alternative includes a new segment that connects to Philadelphia International Airport. This market receives improved rail service, with frequent Intercity-Express, Metropolitan, and Regional rail service up and down the NEC as well as to the Keystone Corridor and the rest of the Southeastern Pennsylvania Transportation Authority (SEPTA) Regional rail network. By incorporating the Hartford/Springfield Line into the Preferred Alternative, there will be a substantial increase in Intercity service to Bradley International Airport via the Windsor Locks train station (with a shuttle bus connection). The Preferred Alternative also provides convenient access to T.F. Green Airport,

with Intercity service at least every 30 minutes at peak periods. Chapter 5, Transportation, discusses the travel benefits associated with this improved rail-airport connectivity.

4.5.9 Connecting Transit and Rail Services

The FRA considered existing transit and passenger rail services at passenger rail stations in defining the Preferred Alternative, particularly since these services contribute to the attractiveness and connectivity of the passenger rail network with the overall transportation system. While the Preferred Alternative does consider the range of available public transit services—local and intercity bus, light rail and urban rail transit, and passenger rail—at individual stations, resulting increases in service demands for these connecting transit services were not evaluated. The FRA generally considered improved connectivity at stations in the assessment of benefits and consequences of the Preferred Alternative. Chapter 5, Transportation, and Chapter 6, Economic Effects and Growth, and Indirect Effects, discuss the range of possible effects on existing transit services as a result of the Preferred Alternative. Of particular note are the indirect effects on Regional rail operator's branch lines and network of services beyond those on the NEC. These and related requirements for additional improvements to existing or planned connecting transit services will be considered in subsequent project-level assessments. Similarly, the improvements proposed with the Preferred Alternative extend to Related Projects (defined in Volume 2, Appendix B.1, *No Action Alternative Report*), which provide connecting transit services and thereby expand the reach of the Preferred Alternative.

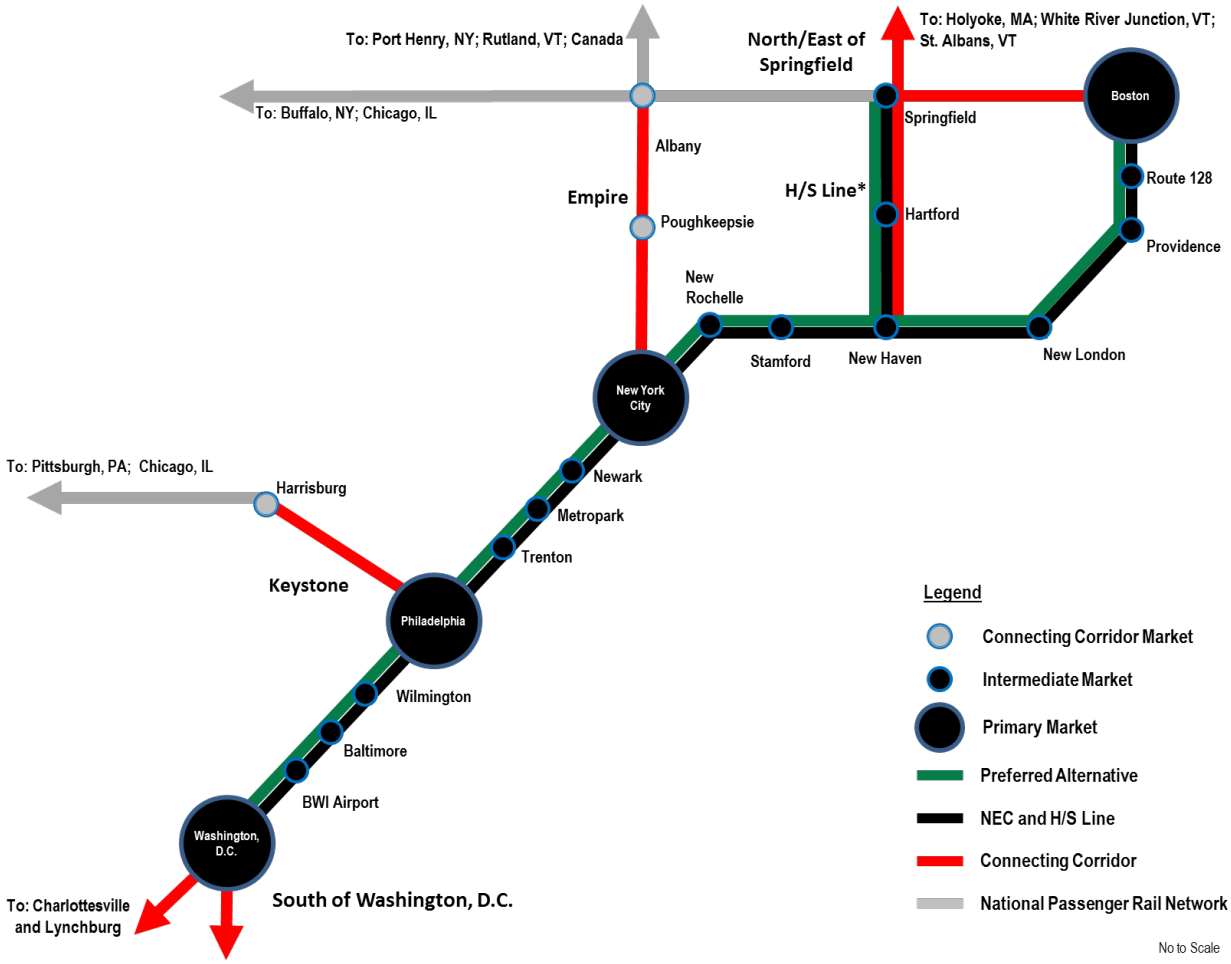
In the Tier 1 Draft EIS, the FRA considered connecting corridors[21] (south of Washington, D.C., the Keystone Corridor, the Empire Corridor, and the New Haven–Hartford–Springfield [NHHS] Corridor) in developing representative service plans and associated infrastructure (Figure 4-3). (The NHHS Corridor describes an ongoing Connecticut and Massachusetts sponsored passenger rail improvement program utilizing the Hartford/Springfield Line, which connects Hartford, CT, and Springfield, MA, to the NEC at New Haven, CT). With the incorporation of the Hartford/Springfield Line into the Preferred Alternative, the FRA considered connections north and east of Springfield in its representative service planning. These connecting corridors today have services that operate onto the NEC. Depending on the characteristics of each connecting corridor—electrified or not, available or planned capacity, frequency of service—improvements proposed with the Preferred Alternative could be leveraged to expand connecting corridor services and expand the benefits of the Preferred Alternative to a larger integrated network.

By way of example, the Preferred Alternative allows for increased service between Philadelphia and Harrisburg, PA, on the existing Keystone Corridor. These service enhancements would further expand the integrated network of passenger rail in the Northeast. Possible service improvements could include introduction of Metropolitan service at 30-minute frequencies in peak periods. Considering recent improvements to the Keystone Line, the enhanced service levels could be accommodated within the line's existing infrastructure footprint. Further exploration of opportunities created by the Preferred Alternative would be the subject of subsequent planning processes. NEC connecting corridors are described below.

[21] In NEC FUTURE, a connecting corridor is defined as a passenger rail corridor that connects directly to another rail corridor (in this instance, the NEC) via a station transfer or through-train service.

Regional rail includes the current services provided by Virginia Railway Express (VRE), Maryland Area Regional Commuter (MARC), Southeastern Pennsylvania Transportation Authority (SEPTA), NJ TRANSIT, Metropolitan Transportation Authority (MTA)-Long Island Rail Road (LIRR), MTA-Metro-North Railroad, Shore Line East, and Massachusetts Bay Transportation Authority (MBTA). None of these railroads, with the exception of Shore Line East, operates exclusively on the NEC. Most include relatively extensive networks of multiple branch lines, which feed one or more major terminal stations. As a result, the NEC does not operate in a vacuum, but rather as a key element within a complex and interconnected rail transportation system.

Figure 4-3: Study Area Connecting Corridors



Source: NEC FUTURE team, 2016
* H/S Line: Hartford/Springfield Line – includes connecting services at Springfield Union Station to points north (to Vermont) and east (to Boston).

4.5.9.1 South of Washington, D.C.

Connecting corridors south of Washington, D.C., provide Intercity service to markets in Virginia (e.g., Lynchburg, Richmond, Newport News, Norfolk), North Carolina (e.g., Raleigh, Charlotte) and points south such as Atlanta, GA, and Jacksonville, FL. Regional rail service operates between

Spotsylvania, VA, and Washington, D.C.; and between Bristow, VA, and Washington, D.C. The connecting corridors south of Washington, D.C., are owned by CSX Transportation or Norfolk Southern.

The Southeast High Speed Rail (SEHSR) program is a series of improvement projects that would improve passenger rail service between Washington, D.C., south through Richmond, VA; Raleigh and Charlotte in North Carolina; and as far south as Florida. The SEHSR network connects to the NEC (and the Preferred Alternative) at Washington Union Station. The representative Service Plan includes up to two slots per hour in each direction for trains that will operate directly to and from south of Washington, D.C.

Multiple segments of the SEHSR network are going through the planning and environmental review process. In 2012, the FRA also signed a Record of Decision on the segment between Richmond and Hampton Roads, VA. The departments of transportation for North Carolina and Virginia prepared a Tier 2 EIS for the segment between Petersburg, VA, and Raleigh, NC. The FRA signed the Final EIS in September 2015. The Virginia Department of Rail and Public Transportation is preparing a Tier 2 Draft EIS for the segment between Richmond, VA, and Washington, D.C., referred to as DC2RVA.[22] A Tier 2 Record of Decision is expected in 2017. The Long Bridge across the Potomac River represents a capacity constraint for freight and passenger rail service between Washington, D.C., and Alexandria, VA. The FRA is working with the District Department of Transportation (DDOT), Virginia Department of Rail and Public Transportation (VDRPT), Amtrak, VRE, and CSX to study capacity expansion options between the two cities and across the Potomac River. DDOT is currently leading a feasibility study and will begin a NEPA evaluation of alternatives in late 2016.

4.5.9.2 Keystone Corridor

Pennsylvania's Keystone Corridor connects Pittsburgh and Harrisburg, PA, to Philadelphia. Amtrak owns the Keystone Corridor between Harrisburg, PA, and Philadelphia. Norfolk Southern owns the corridor between Pittsburgh and Harrisburg, PA. Intercity service operates along the entire length of the corridor—with more-frequent service between Harrisburg, PA, and Philadelphia 30th Station—with continuing service to New York City. Regional rail service operates between Thorndale, PA, and 30th Street Station, through to Center City Philadelphia. The Keystone Corridor Intercity service connects to the NEC at Philadelphia 30th Street Station.

Since 2000, more than $400 million in infrastructure improvements have been made on the segment between Harrisburg, PA, and Philadelphia, resulting in re-electrification of the entire segment, more-frequent service, reduced travel times and higher operating speeds[23] along the corridor. The Pennsylvania Department of Transportation studied options to reduce passenger rail travel times and increase trip frequency—without hindering the important freight service that runs on the same tracks—between Pittsburgh and Harrisburg, PA. The study was completed in 2014.

[22] D.C. to Richmond Southeast High Speed Rail. *http://www.dc2rvarail.com/* (accessed September 28, 2015)
[23] Plan the Keystone. *http://www.planthekeystone.com* (accessed September 28, 2015). Funding for the study was provided by the FRA; however, the FRA did not approve the findings.

Considering recent improvements to the Keystone Corridor between Harrisburg, PA, and Philadelphia, the enhanced service levels could be accommodated within existing capacity. Increased service on the Keystone Corridor is considered in the Tier 1 Final EIS as part of the cumulative impacts assessment. Further exploration of opportunities to take advantage of service enhancements proposed in the Preferred Alternative would be the subject of subsequent planning processes led by Pennsylvania and involving the public and key stakeholders. The representative Service Plan includes up to two slots per hour in each direction for trains that will operate directly to and from connecting corridors such as the Keystone Corridor east of Harrisburg, PA.

4.5.9.3 Empire Corridor

The Empire Corridor connects Niagara Falls and Albany, NY, to New York City. Ownership of the corridor is shared between Amtrak, Metro-North Railroad, and CSX Transportation. Amtrak owns the territory between Penn Station New York and the Bronx, NY. Metro-North Railroad owns the tracks between the Bronx and Poughkeepsie, NY. CSX Transportation owns the territory between Poughkeepsie and Niagara Falls, NY.[24]

Intercity service operates along the entire length of the corridor, providing service from New York City to markets in the Hudson River Valley and western New York. Regional rail service operates from New York City north to Poughkeepsie; however, service terminates at Grand Central Terminal in New York City, not Penn Station New York, which is the terminal for Intercity services. The Empire Corridor Intercity service connects to the NEC at Penn Station New York.

The FRA and the New York State Department of Transportation completed a Tier 1 Draft EIS to evaluate proposed system improvements between Penn Station New York and Niagara Falls Station. A public comment period, which included public hearings, was held in 2014.[25]

4.5.9.4 Hartford/Springfield Line

The Hartford/Springfield Line connects Springfield, MA, and Hartford, CT, to New Haven, CT. Intercity service operates along the entire length of the corridor between Springfield, MA, and New Haven, CT; with some continuing service operating to New York City and Washington, D.C.; and north to St. Albans, VT. Regional rail service currently does not operate on the corridor. The Hartford/Springfield Line connects to the NEC at New Haven Station. **Unlike the other connecting corridors, the Hartford/Springfield Line is incorporated into the Preferred Alternative with expanded Intercity and Regional rail services connecting to the NEC at New Haven, CT.**

The Hartford/Springfield Line was evaluated in 2012 as the *New Haven–Hartford–Springfield Line High Speed Intercity Passenger Rail Project Environmental Assessment/Environmental Impact Evaluation* by the FRA with the FTA and Connecticut Department of Transportation as cooperating agencies (State Project No. 170-2296). A Finding of No Significant Impact was issued on August 9, 2012. The State of Connecticut is currently advancing Phases 1, 2, and 3A of that program. On April 1, 2016, the Connecticut Department of Transportation (CTDOT) issued a Request for

[24] The current lease agreements between CSX and Amtrak allow Amtrak to control dispatching on the CSX-owned portion from Poughkeepsie to Schenectady, NY.
[25] Empire Corridor Tier 1 EIS. *https://www.dot.ny.gov/empire-corridor* (accessed September 28, 2015)

Proposals for a service provider on the Hartford/Springfield Line, now branded as the CTrail[26] Hartford Line. The CTrail Hartford Line would add Regional rail service and improve Regional and Intercity service between Connecticut and western Massachusetts. The new service is expected in be implemented in early 2018. The Preferred Alternative leverages the CTrail Hartford Line improvements already in progress and adds additional track between Hartford, CT, and Springfield, MA; and electrifies the line between New Haven, CT, and Springfield, MA. Section 4.6.1 describes more details on specific improvements.

4.5.9.5 North/East of Springfield, MA

The connecting corridors north and east of Springfield, MA connects Springfield, MA to New England cities north including Holyoke, MA and St Albans, VT and cities east including Worcester, MA and Boston. Heading north, the corridor is owned by Massachusetts from Springfield to East Northfield, MA and the New England Central Railroad (NECR) from East Northfield, MA to St. Albans, VT and the Canadian border. CSX owns the corridor west of Springfield and east to Worcester, MA; Massachusetts owns the corridor from Worcester to Boston. Intercity service operates along both corridors, with north-south through services connecting to the Hartford/Springfield Line (and NEC at New Haven, CT) and east-west through services operating between Boston and Chicago.

The Northern New England Intercity Rail Initiative (NNEIRI)[27] examined opportunities for more-frequent and/or higher-speed intercity passenger rail service on two major rail corridors: 1) the Inland Route corridor between Boston and western Massachusetts via Worcester and Springfield, MA (and a southerly connection from Springfield, MA to New Haven, CT); and 2) from Boston to Montreal via Holyoke, Northampton and Greenfield, MA; and farther to White River Junction, Montpelier and St. Albans, VT; terminating at Montreal Central Station in Quebec, Canada. The northern routing follows the routing of Amtrak's Vermonter service and incorporates recent investments in the Knowledge Corridor[28] from Springfield to East Northfield, MA, as well as improvements throughout Vermont. NNEIRI would further enhance connections in Springfield, MA—south via the Hartford/Springfield Line; north to Vermont and Canada; and east to Boston via the Inland Route.

4.5.10 Ancillary Facilities and Supporting Structures

The FRA did not evaluate the physical footprint or service-related effects associated with ancillary facilities and supporting structures for storage and maintenance facilities, train control systems, and communication and signal systems in this Tier 1 Final EIS. The specific geographic placement of these features would depend on further more-detailed analysis. From a programmatic perspective,

[26] Additional information regarding the NHHS Rail Program can be found in the FRA's *Environmental Assessment/Environmental Impact Evaluation for the New Haven–Hartford–Springfield High-Speed Intercity Rail Program* (2012). *http://www.nhhsrail.com/*

[27] The Northern New England Intercity Rail Initiative (NNEIRI) was conducted by the Massachusetts Department of Transportation and the Vermont Agency of Transportation, in collaboration with the Connecticut Department of Transportation and the FRA. A Finding of No Significant Impact on the NNEIRI was issued in July 2016.

[28] Improvements to the Knowledge Corridor through Massachusetts and Vermont were completed in late 2014, allowing for the operation of the Vermonter service that continues to St. Albans, VT.

the FRA identified the overall requirements, possible features, and potential locations. The assumptions for how the FRA considered each of these facilities or supporting structures are described in the following sections.

4.5.10.1 Storage and Maintenance Facilities

The FRA considered existing storage and maintenance facility locations where capacity could be added to accommodate the rolling stock requirements of the Preferred Alternative. Potential sites could be located within, or could extend beyond, the dimensions of the Representative Route. The potential locations, summarized in Table 4-11, are representative of the types of locations where storage and maintenance facilities would be located, and take into consideration the functional requirements of the Preferred Alternative.

Table 4-11: Potential Intercity Rail Storage and Maintenance Facilities

Intercity Facility Location	Current Principal Functions	NEC FUTURE Assumptions
Washington, D.C.	Ivy City Facility: storage and maintenance of Acela Express, NE Regional, off-corridor and Long-Distance equipment	Yard expansion for growth; shop expansion for longer high-performance trainsets; new site required to accommodate full growth; option for extending Metropolitan service to northern VA with storage and servicing of trainsets
Philadelphia, PA	Philadelphia Coach Yard: storage and maintenance of Keystone Corridor equipment	Expanded storage, servicing and inspection of NEC equipment required for peak service
New York City	Sunnyside Yard: storage and maintenance of Acela Express, NE Regional and Long-Distance equipment	Yard expansion for growth; shop expansion for longer high-performance trainsets; new site in northern NJ may be required for full growth
New Haven, CT	New Haven Yard: storage and maintenance of Hartford Line equipment, including diesel engines	Expanded storage, servicing and inspection of NEC equipment required for peak service
Boston, MA	Southampton Street Yard: storage and maintenance of Acela Express and NE Regional equipment	Yard expansion for growth; shop expansion for longer high-performance trainsets; new site required to accommodate full growth
Harrisburg, PA	Storage, servicing and inspection of Keystone Corridor equipment	Expanded storage, servicing, and inspection as required for increased service
Springfield, MA	Storage, servicing and inspection of Intercity trains on the New Haven–Hartford–Springfield Line	Expanded storage, servicing, and inspection as required for increased service

Source: NEC FUTURE, 2016

The Preferred Alternative would continue to use facilities in or near Washington, D.C., New York City, and Boston, where most trains would start and end service. Additional facilities could be located in Philadelphia and New Haven, CT, which are considered the “quarter points” of the NEC, and would support the beginning and end of the service day and tapering of the peak-period services. For connecting corridors, yard facilities are provided at Harrisburg and Philadelphia, PA, for Keystone Corridor service; at Springfield, MA, and New Haven, CT, for Hartford/Springfield Line service; and Rensselaer, NY (in the Albany area) for Empire Corridor trains. The latter would reduce

reliance on Sunnyside Yard, and free up Sunnyside Yard, and East River Tunnel capacity for expanding NEC service.

The potential sites are representative of future locations. They are included as placeholders and are based on current available information and a scan of potential locations with sufficient size and access to accommodate storage and maintenance requirements. (Volume 2, Appendix B, *Service Plans and Train Equipment Options Technical Memorandum*, provides additional details regarding representative Intercity and Regional rail storage and maintenance facilities.) The FRA did not consider footprint- and service-based environmental effects from storage and maintenance facilities for the Preferred Alternative. Storage and maintenance requirements and their potential effects on the local environment would be considered in subsequent project-level assessments.

The FRA did not identify Regional rail storage and maintenance facilities requirements. Similar to Intercity service, storage and maintenance facilities would be located at the end points of the Regional rail network, where most trains would start and end service. However, the location and requirements for storage and maintenance facilities would depend on the specific operating patterns identified by individual Regional rail operators and how those services were integrated with each Regional rail operator's system, including branch line services not on the NEC. The requirements for additional Regional rail storage and maintenance facilities would be considered in subsequent project-level analyses.

4.5.10.2 Communication and Signal Systems

The NEC signaling system would be upgraded where needed to permit the higher-density operations called for in the service plans. Service planning specifications include a fixed block (cab, no wayside) signal system and an overlay Positive Train Control (PTC) system. Shorter block signal lengths provide for higher-density operation at shorter headways than the existing signal system.[29]

PTC is a control technology used to improve safety conditions on the railroad by preventing or avoiding train collisions and derailments due to excessive speeding. The purpose of PTC is to slow or stop a train that is operating at an excessive speed or operating in a manner inconsistent with the section of track it is traversing. The Rail Safety Improvement Act of 2008, as amended, requires that PTC is implemented over much of the passenger and freight rail network by December 31, 2018.[30]

Advanced Civil Speed Enforcement System is a PTC cab-signaling system designed to prevent train-to-train collisions, protect against over-speed, and protect work crews with temporary speed restrictions. It is installed on Amtrak-owned portions of NEC between Washington, D.C., and Boston and is fully active as of December 2015.[31] Although no specific specifications for PTC are provided in NEC FUTURE, it is assumed that PTC would be implemented in the No Action Alternative and Preferred Alternative and the railroad network would be compliant with all FRA safety regulations.

[29] Moving block technology was not assumed for the NEC or connecting corridors in the NEC FUTURE analysis. (Volume 2, Appendix B, Service Plans and Train Equipment Options Technical Memorandum, provides additional information.)

[30] U.S. Rail Safety Improvement Act of 2008, Pub. L. 110–432, 122 Stat. 4848, 49 U.S.C. § 20101. Approved 2008-10-16. The deadline for implementation of PTC was extended to 2018 in October 2015.

[31] *http://www.railwayage.com/index.php/ptc/acses-fully-operational-on-the-nec.html*

4.5.10.3 Catenary System

The Preferred Alternative modernizes the NEC catenary system in order to support speeds greater than 150 mph. New segments in the Preferred Alternative would also be electrified, allowing for speeds up to 220 mph and seamless operation between the NEC and new segments.

The Preferred Alternative also electrifies the Hartford/Springfield Line although speeds would be limited to 110 mph due to other constraints, such as at-grade crossings. An electrified Hartford/Springfield Line would allow Intercity services to operate between Washington, D.C, and Springfield, MA, without changing locomotives at New Haven Station, which would be required in the No Action Alternative.

4.6 INFRASTRUCTURE ELEMENTS OF THE PREFERRED ALTERNATIVE

The Preferred Alternative includes new track projects on the NEC, adding one to two additional tracks to approximately 100 route miles of the NEC Spine and over 200 miles of new segments, to provide a configuration of at least four tracks at most locations. The Preferred Alternative also includes improvements to the Hartford/Springfield Line between New Haven, CT, and Springfield, MA; completing the double-track configuration on the line between Hartford, CT, and Springfield, MA, and electrifying the line between New Haven and Springfield.

- **Chokepoint** relief projects address constraints near stations, at railroad junctions, and at yard locations
- **New Track** projects are additional track and/or associated systems improvements along the existing NEC, defined as the addition of one or two tracks to the existing NEC, or an upgrade to the catenary or signal systems.
- **Curve Modification** projects straighten or lengthen curves currently limiting operating speed and capacity on the NEC.
- **New Segments** are sections of new track that may be constructed outside the existing NEC right-of-way. New segments diverge from and reconnect to the existing NEC providing additional track capacity to relieve chokepoints.

Key infrastructure elements, taken from the Action Alternatives evaluated in the Tier 1 Draft EIS that comprise the Preferred Alternative include the following:

- The NEC is brought to a predominantly four-track railroad. The NEC will also be brought to a state of good repair which will enhance safety and reduce trip times (all Alternatives).
- New Intercity stations on the NEC to serve intermediate markets and take advantage of improved Intercity services (all Alternatives).
- Leverages ongoing CTrail improvements on the Hartford/Springfield Line – adding new track between Hartford and Springfield, and electrifying the corridor between New Haven, Hartford, and Springfield to provide improved Intercity services to underserved markets between New Haven, CT and Springfield, MA.
- Two-track new segment between Baltimore and Wilmington to provide additional capacity, add resiliency, reduce trip time, and potentially ease construction impacts on the NEC where several major bridge replacement projects are required (Alternative 3).

- Two-track new segment providing access to a new station at Philadelphia International Airport (Alternative 2).
- Two new tracks in tunnel under both the Hudson and East Rivers to accommodate growth in the New York area market (Alternative 2).
- Two-track new segment in southeastern Connecticut to expand capacity, add redundancy and increase resiliency, improve travel times, and avoid five movable bridges and 11 grade crossings (Alternative 1).

Related Projects along the NEC with ongoing or completed NEPA/PE (Preliminary Engineering) are incorporated in the Preferred Alternative. Related Projects are identified with an asterisk in Sections 4.6.1 through 4.6.4.[32] Related Projects that are station and facility improvements, including major stations undergoing their own separate PE/NEPA processes, are not listed by infrastructure element but are discussed more generally in Section 4.5.

The FRA identified infrastructure improvements for the Preferred Alternative based on a representative service plan focused on a "grow" vision, supporting an integrated passenger rail network with service to existing and new markets. In defining the infrastructure elements to support the representative service plan, the FRA considered how each of the proposed improvements complement one another as well as how they might be incrementally implemented to achieve the longer-term vision. Infrastructure elements in the Preferred Alternative, described relative to the No Action Alternative, are listed below.

4.6.1 Chokepoint Relief Projects

The FRA identified chokepoint relief projects at the following locations (projects with an asterisk (*)) incorporate Related Projects as described in Volume 2, Appendix B.1, *No Action Alternative Report)*:

- **Maryland – New Carrollton Station –** 4 platform tracks, to permit express and local trains to operate on separate tracks
- **Maryland – Odenton Station –** island platforms to enable Metropolitan trains to stop at this station on the express tracks
- **Maryland – BWI Station* (Related Project) –** new platform, and improvements to existing platforms, to accommodate four-track upgrades through the station[33]
- **Delaware – Newark, DE station –** relocation of station and track reconfiguration to provide for smoother Intercity, Regional rail and freight train movements
- **Pennsylvania – Philadelphia 30th Street – Penn Interlocking –** four-track approaches to enable the station to operate as a pulse-hub with simultaneous arrivals of trains allowing coordinated transfers between train services at timed intervals
- **New Jersey – Trenton Station and yard access –** improvements to facilitate regional rail terminal operations

[32] Related Projects are further defined in Appendix B.1, *No Action Alternative Report*.
[33] Refer to Section 4.6.2 for corresponding new track project: **Maryland – New Carrollton to Halethorpe** (4 tracks).

- **New Jersey – Metropark Station –** platforms on express tracks to enable Intercity service to make stops on express tracks
- **New Jersey – Hunter Flyover* (Related Project) –** improve access to the NEC from the NJ TRANSIT's Raritan Valley Line
- **New Jersey – Westbound Waterfront Connection –** improve access to the NEC from NJ TRANSIT's Hoboken Terminal
- **New York – New Rochelle (Shell Junction) –** grade separation to provide smoother train movements between the Hell Gate Line and New Haven Line portions of the NEC
- **Connecticut – New Haven Station –** improvements to facilitate smooth Intercity and Regional rail train movements into and out of the station
- **Massachusetts – Canton Junction to Readville track and junction improvements –** to facilitate smoother train movements

4.6.2 New Track

The Preferred Alternative includes 10 new track projects (Figure 4-4) located on the NEC in Maryland, Delaware, New York, Connecticut, Rhode Island, and Massachusetts. Of the four located south of Manhattan, two are in Maryland where most of the NEC is currently a two- or three-track railroad. There are six new track projects north of Manhattan. Three are included on the Hell Gate Line in Queens and the Bronx, NY, and one or two additional tracks are included near Route 128 station in Westwood, MA. New track between Branford and Guilford, CT, is for coordinated overtaking of Intercity-Corridor trains by Intercity-Express trains. New track projects (number of tracks in parentheses is the total, including existing tracks and additional tracks proposed with the Preferred Alternative), identified between known geographic locations are listed below:

- **Maryland** – New Carrollton to Halethorpe (4 tracks)* (Related Project)
- **Maryland** – Union Tunnel (4 Tracks)
- **Maryland** – Aberdeen to Havre de Grace (4 tracks)
- **Delaware** – Newark to Newport (4 tracks)
- **New York** – Hell Gate Line between Queens and Bronx Counties (4 tracks)
- **Connecticut** – Branford to Guilford (4 tracks)
- **Rhode Island** – Kenyon to Davisville (3 tracks/parallel freight track)
- **Rhode Island** – East Greenwich to Warwick (4 tracks)
- **Rhode Island/Massachusetts** – Pawtucket, RI to Sharon, MA (4 tracks)
- ***Hartford/Springfield Line– Connecticut/Massachusetts:***
  - New Haven to Hartford, CT – (2 tracks (existing),[34] electrification)
  - Hartford, CT to Springfield, MA – (2 tracks, electrification, track upgrades)

[34] The Hartford/Springfield Line between New Haven and Hartford is being upgraded to a two track line as part of Connecticut's CTrail project. For this section of the Hartford/Springfield Line, the Preferred Alternative includes electrification and additional upgrades. In addition, the Preferred Alternative includes new track between Hartford, CT, and Springfield, MA.

The **Hartford/Springfield Line track upgrade** and new segments, identified in ***Bold Italics*** and described in Section 4.6.4, are highlighted in the environmental effects assessment presented in Chapter 7.

Preferred Alternative – Fast Facts

- **Total Route Miles (existing):**
  NEC: 457 miles
  Hartford/Springfield Line: 60 miles
- **Approximate Route Miles of New Segments:** 220 miles
- **Approximate Route Miles of New Track:**
  NEC: 100 miles
  Hartford/Springfield Line: 30 miles
- **Total # of Chokepoint Relief Projects:** 12 projects
- **Existing Stations upgraded to Major Hub and Hub Stations:** 5 stations
- **New Major Hub and Hub Stations:** 9 stations
- **New Local Stations:** 13 stations

4.6.3 Curve Modifications

The Preferred Alternative includes six curve modification projects on the NEC. Opportunities to refine the scope of these projects, along with additional curve modification opportunities for speed and performance improvements on the NEC would be addressed in subsequent Tier 2 Studies. A list of specific curve modifications and the proposed shift from its widest point on the NEC is listed below:

- **Maryland –** The NEC shifts a maximum of 300 feet from its current location in the city of Baltimore, MD, east of Baltimore Penn Station, continuing east of I-895.
- **Pennsylvania –** The NEC shifts in North Philadelphia beginning east of the North Philadelphia Rail Station and ending just west of the Bridesburg Rail Station. The segment would be contained in tunnel or trench a maximum of 1,800 feet from its current location.
- **Pennsylvania –** The NEC shifts in the Torresdale section of Philadelphia beginning near Holmesburg Rail Station and Pennypack Creek, ending west of the Bucks County border. The shift is a maximum of 300 feet from its current location.
- **New York –** The NEC shifts a maximum of 500 feet to embankment and aerial structure in Bronx County, near the I-95 and I-895 interchange. The shift places the NEC on the west side of the Bronx River adjacent to I-895.
- **New York –** The NEC shifts a maximum of 300 feet on embankment and major bridge from its current location in Bronx County, near Pelham Bay Park. The improvement includes a new crossing over the Hutchinson River (Pelham Bay).*
- **New York –** The NEC shifts a maximum of 150 feet from its current location near New Rochelle rail station.

4.6.4 New Segment

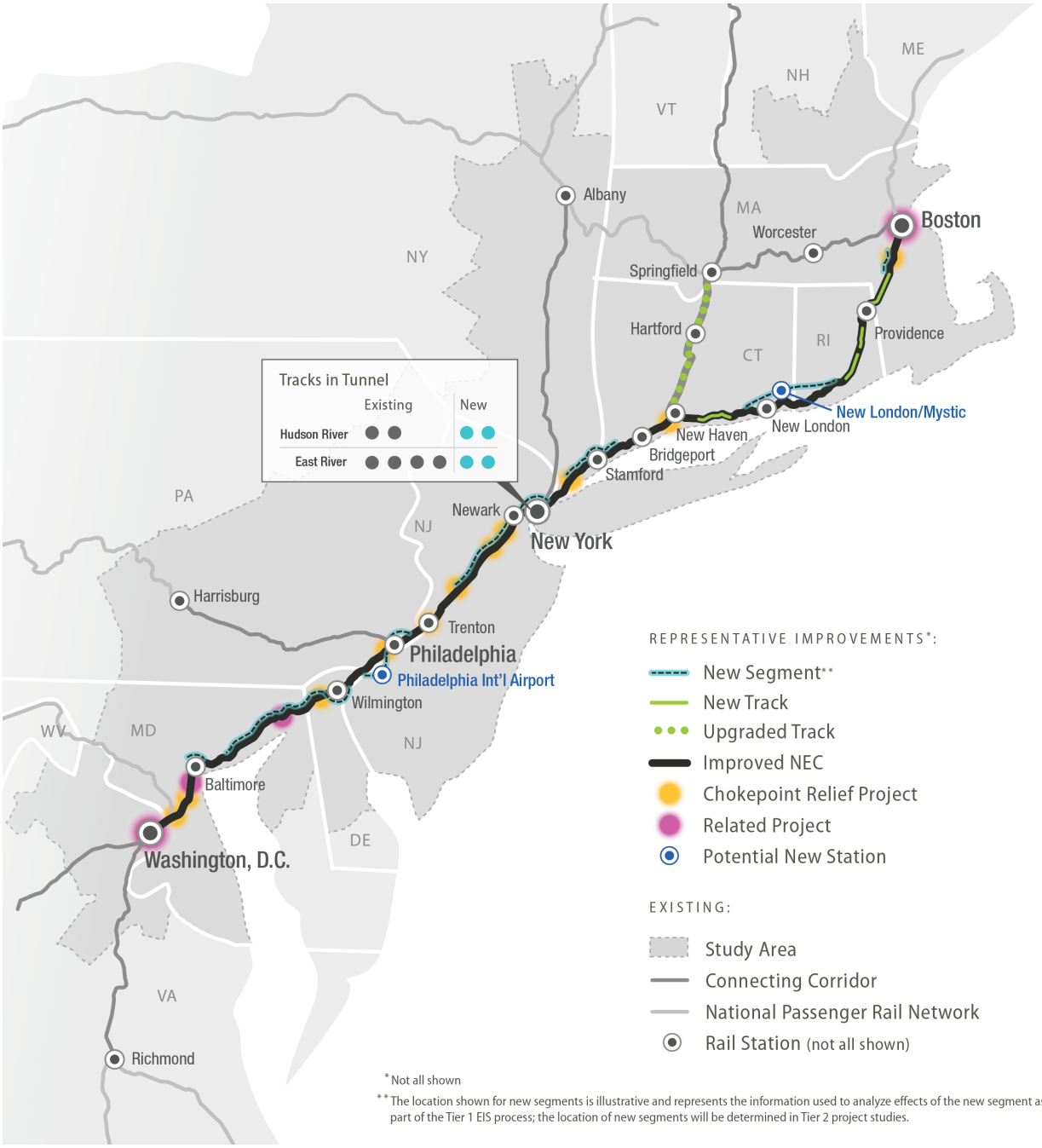
The Preferred Alternative includes 13 new segments parallel to and separate from the NEC. They illustrate necessary improvements to achieve the Preferred Alternative service and performance objectives. As part of the Tier 1 process, the FRA has determined the necessity for new segments in particular geographic sections of the NEC in order to meet the Purpose and Need, and has identified a representative route for each potential new segment. The FRA or another federal agency providing funding for a particular project will evaluate specific locations for new segments as part of the Tier 2 project studies, prior to making any decision regarding new segment locations. Brief

descriptions noting the new segment name and general location are noted below. Detailed geographic descriptions of the new segments are found in Section 4.6.6. In addition to the Hartford/Springfield Line, the environmental effects of new segments in ***Bold Italics*** on environmental resources are assessed in Chapter 7.

- **Maryland – New Baltimore Tunnel* (Related Project) –** Baltimore (approximately 2 miles)
- ***Maryland/Delaware – Bayview to Newport –*** Bayview, MD, to Newport, DE (approximately 60 miles), including a **Susquehanna River crossing* (Related Project)**
- ***Delaware – Wilmington Segment –*** Newport to Edgemoor (approximately 8 miles)
- ***Pennsylvania – Philadelphia Segments –*** Three new segments in Delaware and Philadelphia Counties, PA
  - Baldwin, PA, to Philadelphia 30th Street Station via Philadelphia International Airport (approximately 10 miles)
  - Philadelphia International Airport Station – serves new Philadelphia International Airport Station (approximately 4 miles)
  - Philadelphia 30th Street Station to Bridesburg, PA, through North Philadelphia, PA (approximately 10 miles)
- ***New Jersey – New Brunswick to Secaucus –*** North Brunswick to Secaucus, including Hackensack River crossing (approximately 30 miles)
- ***New Jersey – Secaucus/Bergen Loop –*** near Secaucus rail station, NJ TRANSIT's Main Line, and New Jersey Turnpike (approximately 3 miles)
- **New Jersey/New York – Hudson River Tracks* (Related Project) –** Secaucus, NJ, to expanded Penn Station New York via new tracks under the Hudson River (approximately 4 miles)
- **New York – East River Tracks –** from **expanded Penn Station New York** to Hell Gate viaduct in Queens, NY via new tracks under the East River (approximately 4 miles)
- ***New York/Connecticut – New Rochelle to Greens Farms –*** New Rochelle, NY, to Greens Farms, CT including **New Haven Line bridges* (Related Project)** (approximately 29 miles)
- ***Connecticut/Rhode Island – Old Saybrook-Kenyon –*** Old Saybrook, CT, to Kenyon, RI (approximately 50 miles)
- **Massachusetts – Neponset –** Sharon to Hyde Park (approximately 3 miles)

Figure 4-4 depicts the chokepoint, new track, and new segment locations in the Preferred Alternative. Table 4-12 arrays infrastructure elements by state for the NEC and Hartford/Springfield Line. Additional details about the infrastructure elements are provided in Appendix BB, Technical Analysis on the Preferred Alternative.

Figure 4-4: Preferred Alternative (Chokepoint, New Track, and New Segment Locations)



Source: NEC FUTURE team, 2016

Table 4-12: Preferred Alternative Infrastructure Elements by State

State	Chokepoint Relief	New Track	Curve Modifications	New Segment
NEC				
MD	▪ New Carrollton Station ▪ Odenton Station ▪ BWI Station (Related Project)	▪ New Carrollton to Halethorpe (Related Project) ▪ Union Tunnel ▪ Aberdeen to Havre de Grace	▪ City of Baltimore, MD, east of Baltimore Penn Station, continuing east of I-895	▪ New Baltimore Tunnel (Related Project) ▪ ***Bayview to Newport*** ▪ Susquehanna River crossing (Related Project)
DE	▪ Newark, DE Station	▪ Newark to Newport	▪ None	▪ ***Bayview to Newport*** ▪ ***Wilmington Segment***
PA	▪ Philadelphia 30th Street – Penn Interlocking	▪ None	▪ North Philadelphia Rail Station to Bridesburg Rail Station ▪ Torresdale section of Philadelphia near Holmesburg Rail Station	▪ ***Philadelphia Segments*** - Baldwin, PA, to Philadelphia 30th Street Station - Philadelphia International Airport Station - Philadelphia 30th Street Station to Bridesburg, PA
NJ	▪ Trenton Station and yard access ▪ Metropark Station ▪ Hunter Flyover (Related Project) ▪ Westbound Waterfront Connection	▪ None	▪ None	▪ New Brunswick to Secaucus ▪ Secaucus/Bergen Loop ▪ Hudson River Tracks (Related Project)
NY	▪ New Rochelle (Shell Junction)	▪ Hell Gate Line between Queens and Bronx Counties	▪ Bronx County, near the I-95 and I-895 interchange ▪ Bronx County, near Pelham Bay Park, includes a new crossing over the Hutchinson River (Pelham Bay) ▪ New Rochelle rail station	▪ Hudson River Tracks (Related Project) ▪ East River Tracks (Related Project) ▪ ***New Rochelle to Greens Farms***
CT	▪ New Haven Station	▪ Branford to Guilford	▪ None	▪ ***New Rochelle to Greens Farms*** ▪ ***Old Saybrook-Kenyon***
RI	▪ None	▪ Kenyon to Davisville ▪ East Greenwich to Warwick ▪ Pawtucket, RI to Sharon, MA	▪ None	▪ ***Old Saybrook-Kenyon***

Table 4-12: Preferred Alternative Infrastructure Elements by State (continued)

State	Chokepoint Relief	New Track	Curve Modifications	New Segment
MA	▪ Canton Junction to Readville track and junction improvements	▪ Pawtucket, RI to Sharon, MA	▪ None	▪ Neponset
Hartford/Springfield Line				
CT	▪ None	▪ New Haven to Hartford, CT ▪ Hartford, CT to Springfield, MA	▪ None	▪ None
MA	▪ None	▪ Hartford, CT to Springfield, MA	▪ None	▪ None

Source: NEC FUTURE team, 2016
The Hartford/Springfield Line and new segments highlighted in bold italics are analyzed in Chapter 7.
See Sections 4.6.1 through 4.6.4 for additional information on the description and function of the Elements of the Preferred Alternative.

4.6.5 Highway-Railroad Grade Crossings

Highway-railroad grade crossings (grade crossing) are intersections where a highway crosses a railroad at-grade. Grade crossings may be public or private. Public grade crossings are roadways that are under the jurisdiction of, and maintained by, a public authority. Private grade crossings are on privately owned roadways, such as on a farm or industrial area, and are intended for use by the owner or by the owner's licensees and invitees. A private grade crossing is not intended for public use and is not maintained by a public highway authority.

There are 11 public and private grade crossings on the NEC. All 11 grade crossings exist within an approximately 20-mile span in New London County, CT. There are an additional 42 grade crossings on the Hartford/Springfield Line in New Haven and Hartford Counties, CT, and Hampden County, MA. These 53 grade crossings are present in both the No Action Alternative and the Preferred Alternative. The Preferred Alternative does not add new grade crossings since all new segments are fully grade separated. A list of grade crossings on the NEC and Hartford/Springfield Line is provided in Table 4-13. Additional information on at-grade crossings is provided in Chapter 7.18, Safety.

Table 4-13: Grade Crossings of the NEC and Hartford/Springfield Line

Street	County	Crossing Type	Street	County	Crossing Type
Existing NEC					
Connecticut					
Miner Lane	New London	Public	Latimer Point Road	New London	Public
Bank Street			Wamphassuc Point		Public
State Street			Marina Access		Private
Ferry Street			Elihu Island Access		Private
School Street			Palmer Street		Public
Broadway					
Existing Hartford/Springfield Line					
Connecticut					
Wilson Ave	Hartford	Private	Parker Street	New Haven	Public
Central Street		Public	Hall Avenue		Public
Hamilton Street		Public	Quinnipiac Street		Public
E. Barbar Street		Private	Toelles Road		Public
Island Road		Public	Britania Street		Public
Pierson Lane		Public	Benton Street		Private
Macktown Road		Public	Winchesters		Private
Hayden Station Road		Public	Sackett Point Road		Public
Bridge Street		Public	Stiles Lane		Private
Parsons Road		Public	Devine Street		Private
Bridge Lane		Public	North Colony Street		Public
Meadow Road		Private	Cross Street		Public
Oakwood Avenue		Public	Brooks Street		Public
Flower Street		Public	Perkins Street		Public
Trolley Barn		Private	Ferro Lane		Private
Dexters Crossing		Private	Noroton Lane		Private
Sawmill Road		Private			
Ward Street	New Haven	Public			
East Main Street					
Cooper Street					
Pent Highway					
North Plains					
Massachusetts					
Emerson Road	Hampden	Public			
Binnie Road		Public			
Bark Haul Road		Public			
Meadow Road		Private			

Source: NEC FUTURE team, 2016

4.6.6 Ownership

Ownership of the NEC and Hartford/Springfield Line is divided among Amtrak, MTA-Metro-North Railroad, Connecticut Department of Transportation, and Massachusetts. Amtrak owns the NEC extending from Washington Union Station to New Rochelle, NY; and from Mill River, located east of New Haven, CT, to the Rhode Island/Massachusetts state border. Amtrak owns the Hartford/Springfield Line from the Mill River in New Haven County to Springfield, MA. Metro-North Railroad owns the existing NEC from New Rochelle, NY, to the New York/Connecticut state border. The Connecticut Department of Transportation owns the NEC from the New York/Connecticut state border to the Mill River. Massachusetts owns the NEC from the Rhode Island/Massachusetts state border to Boston South Station. (Appendix AA, Mapping Atlas (Part 2), contains a graphical depiction of ownership of the Existing NEC.[35])

4.7 GEOGRAPHIC DEPICTION AND ORIENTATION OF THE PREFERRED ALTERNATIVE

The term Representative Route is intentionally used to capture the highly conceptual and representative nature of a proposed route for the Preferred Alternative. At this Tier 1 level, the FRA has not defined specific alignments.

This section provides a state-by-state description of the Representative Route of the improvements to the NEC and Hartford/Springfield Line (choke point relief projects, new track, and curve modifications) and new segments in the Preferred Alternative, as presented in Section 4.6.[36] The descriptions highlight key geographic features of the built and natural environments, improvements along the Existing NEC and Hartford/Springfield Line, how the new segments are positioned relative to the Existing NEC, and the typical construction type. Descriptions of the improvements are organized south to north (or west to east) by state, metropolitan area or construction type being assigned—beginning in Washington, D.C., and ending in Boston. The descriptions illustrate necessary improvements to achieve the Preferred Alternative service and performance objectives. As part of the Tier 1 process, the FRA has determined the necessity for new segments in particular geographic sections of the NEC in order to meet the Purpose and Need, and has identified a representative route for each potential new segment. The FRA or another federal agency providing funding for a particular project will evaluate specific locations for new segments as part of the Tier 2 project studies, prior to making any decision regarding new segment locations.

Table 4-14 describes the dimensions of the new segments of the Representative Route for the Preferred Alternative (Refer to Volume 2, Chapter 4 for more information on the development of the Representative Route). The new segments identified in the presentation of environmental effects assessments in Chapter 7 are highlighted on Table 4-14 in ***bold/italics***. Note that new segments without a footprint effect, including tunnel segments in Baltimore and under the Hudson and East Rivers, or those that are adjacent to the NEC, such as the new segment between Neponset and Sharon, MA, are not specifically highlighted in Chapter 7.

[35] Various states, cities, and agencies own stations along the Existing NEC. For example, NJ TRANSIT owns 14 stations along the NEC.
[36] The geographic depiction of the NEC can be found in Volume 2, Chapter 4.

The FRA prepared the environmental effects assessment of the Preferred Alternative, presented in Chapter 7, using the Representative Route, and in some cases, the construction type, of the Preferred Alternative, categorizing potential effects by both geography and construction type. (Appendix AA, Mapping Atlas for the Preferred Alternative, provides a graphical depiction of the Representative Routes of the Preferred Alternative relative to environmental features analyzed in Chapter 7.)

Table 4-14: Preferred Alternative – Footprint Width of New Segments

New Segment	From	To	Width (feet)	Representative Construction Type
Washington, D.C., to New York City				
New Baltimore Tunnel	Baltimore, MD		250	4-track – Tunnel
Bayview to Newport	Bayview, MD	Newport, DE	280	New tracks adjacent to existing 6-track – At-grade
Wilmington Segment	Newport, DE	Edgemoor, DE	150	2-track– At-grade
Philadelphia Segments	Baldwin, PA	Philadelphia 30th Street Station	150	2-track – At-grade
	Philadelphia International Airport Station		150	2-track – Tunnel
	Philadelphia 30th Street Statin	Bridesburg, PA	150	2-track – At-grade and Aerial structure
New Brunswick to Secaucus	North Brunswick, NJ	Secaucus, NJ	150	2-track– At-grade
Secaucus/Bergen Loop	Secaucus, NJ		150	2-track – At-grade
Hudson River Tracks	Secaucus, NJ	New York City	150	2-track – Tunnel
New York City to Boston, MA				
East River Tracks	New York City	Woodside (Queens, NY)	150	2-track – Tunnel
New Rochelle to Greens Farms	New Rochelle, NY	Greens Farms, CT	150	2-track – At-grade
Old Saybrook-Kenyon	Old Saybrook, CT	Kenyon, RI	150	2-track – Tunnel
			150	2-track – At-grade
Neponset	Sharon, MA	Hyde Park, MA	150	2-track – At-grade

Source: NEC FUTURE team, 2016
Note: New segments in ***bold italics*** are analyzed in Chapter 7.

The Representative Route of the Preferred Alternative is illustrative, to support analysis in both the alternatives development process and this Tier 1 Final EIS. These service and infrastructure assumptions are not intended to be prescriptive. Other construction types and alignments could be considered as mitigation in subsequent Tier 2 project-level studies.

Appendix AA, Mapping Atlas for the Preferred Alternative, provides the spatial location of each Representative Route relative to the general location of selected environmental resources. Table 4-15 provides a reference table to the map sheet(s) relative to the following subsection(s).

Table 4-15: Mapping Atlas Reference Guide

Sheet #[1]	Existing NEC + Hartford/Springfield Line	New Segments – Preferred Alternative	Regional Coverage (County and State)
1	X		Washington D.C.; Prince George's County, MD
2	X	X	Anne Arundel, Baltimore County, Baltimore City, MD
3	X	X	Baltimore City, Baltimore County, MD
4	X	X	Harford County, MD
5	X	X	Cecil County, MD
6	X	X	New Castle County, DE
7	X	X	Delaware County, PA
8	X	X	Philadelphia County, PA
9	X		Bucks County, PA
10	X	X	Mercer, Middlesex County, NJ
11	X	X	Middlesex County, NJ
12	X	X	Union, Essex, Hudson County, NJ; New York County, NY
13	X	X	New York, Bronx County, NY
14	X	X	Westchester County, NY; Fairfield County, CT
15	X	X	Fairfield County, CT
16	X		New Haven County, CT
17	X		New Haven County, CT
18	X	X	Middlesex, New London County, CT
19	X	X	New London County, CT
20	X	X	Washington County, RI
21	X		Washington, Kent County, RI
22	X		Providence County, RI; Bristol County, MA
23	X	X	Norfolk County, MA
24	X	X	Norfolk, Suffolk County, MA
25	X		New Haven County, CT
26	X		Hartford County, CT
27	X		Hartford County, CT; Hampden County, MA

Source: NEC FUTURE team, 2016

[1] Sheet # refers to Map Sheet in Appendix AA, Mapping Atlas for the Preferred Alternative.

The Preferred Alternative combines elements of the Action Alternatives to best meet the service needs of specific markets. The bulleted information below describes, in each state, the scope of improvements on the NEC and Hartford/Springfield Line. New segments are described, highlighting adjacent environmental features, metropolitan areas and major passenger rail stations and their location relative to the NEC as previously described. Revisions or derivations to the Representative Route from the Action Alternatives are noted in italics. A summary of new segments utilized in the Preferred Alternative is found in Table 4-16.

Table 4-16: New Segments of the Preferred Alternative

New Segment	State(s)	Approximate Length (Miles)
New Baltimore Tunnel	Maryland	2
Bayview to Newport	Maryland, Delaware	60
Wilmington Segment	Delaware	8
Philadelphia Segments	Pennsylvania	
Baldwin, PA, to Philadelphia 30th Street Station via Philadelphia International Airport		10
Philadelphia International Airport Station		4
Philadelphia 30th Street Station to Bridesburg, PA		10
New Brunswick to Secaucus	New Jersey	30
Secaucus/Bergen Loop		3
Hudson River Tracks	New Jersey, New York	4
East River Tracks	New York	4
New Rochelle to Greens Farms	New York, Connecticut	29
Old Saybrook-Kenyon	Connecticut, Rhode Island	50
Neponset	Massachusetts	3
Approximate Miles of New Segments		**217**

Source: NEC FUTURE Team, 2016

4.7.1 Washington, D.C.

- **Stations –** Washington Union Station would be expanded, consistent with the Washington Union Station Master Plan[37]. The station area considered for analysis roughly encompasses D Street NE to K Street NE and North Capitol Street NW to 2nd Street NE.

4.7.2 Maryland

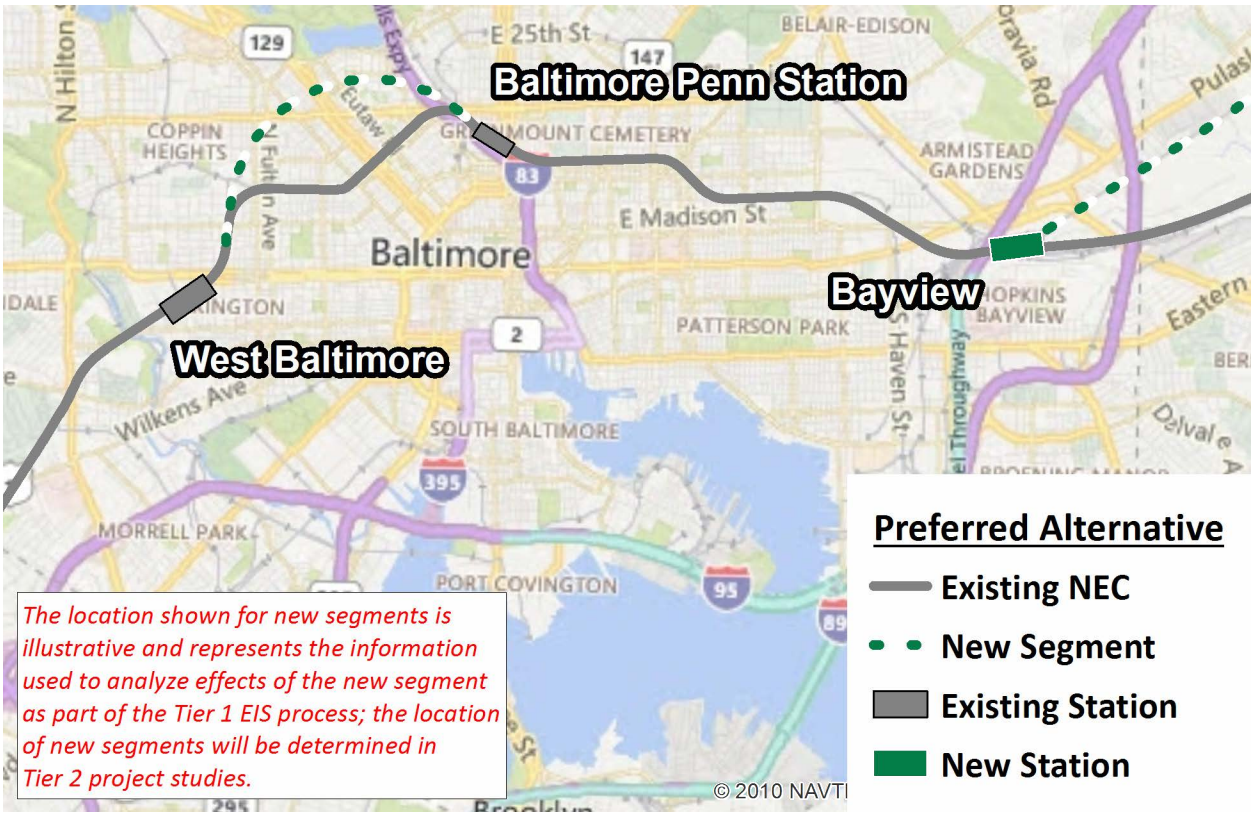
- **NEC –** The NEC would be upgraded to four tracks between New Carrolton and Halethorpe, in the Union Tunnel east of Baltimore Penn Station, and between Aberdeen and Havre de Grace. A curve on the NEC would be modified in Baltimore, east of I-895.
- **New Baltimore Tunnel –** New, four-track segment in tunnel, approaching Baltimore Penn Station from the west. This new segment diverges from the existing NEC in West Baltimore, and continues in an arcing path under U.S. Route 1 (North Avenue), keeping to the south of Druid Hill Park, and crossing under I-83 before reconnecting at-grade to the existing NEC north of Baltimore Penn Station.
- **Bayview to Newport –** New, two-track segment beginning in the Bayview section of Baltimore City, beginning at I-895 and continuing north adjacent to CSX-owned right-of-way at-grade, embankment, or aerial structure to White Marsh Boulevard in Baltimore County. The new segment continues north on aerial structure adjacent to U.S. Route 40, crossing the Gunpowder River on aerial structure into Harford County and continuing north adjacent to U.S. Route 40. The infrastructure continues north adjacent to the CSX-owned right-of-way near Bush River before heading east and continuing north adjacent to the existing NEC near Aberdeen Proving

[37] Washington Union Station Master Plan. *https://www.amtrak.com/ccurl/919/171/Washington-Union-Station-Master-Plan-201207.pdf* (accessed November 1, 2016)

Ground and Aberdeen Station in northern Harford County. The new segment continues north adjacent to the existing NEC, typically at-grade or on embankment then over the Susquehanna River into Cecil County, diverging west in tunnel, before continuing north at-grade, on embankment, or aerial structure near I-95, crossing into New Castle County, DE, near S.R. 2 (Elkton Road).

- **Stations –** New Carrollton Station would be upgraded to four tracks; and Odenton Station would be upgraded with island platforms to support Intercity and Regional service. Improvements at BWI Airport include new and improved platforms to accommodate four-track upgrades through the station. A new Hub station would be located in Bayview and a new Local station would be located in Elkton. Baltimore Penn, Martin Airport, and Aberdeen stations would be improved but would not change station type.

Figure 4-5: New Baltimore Tunnel – Baltimore, MD



Source: NEC FUTURE team, 2016
Note: Approximate station footprints shown
Background Image Source: Microsoft Bing Maps, Accessed June 2016

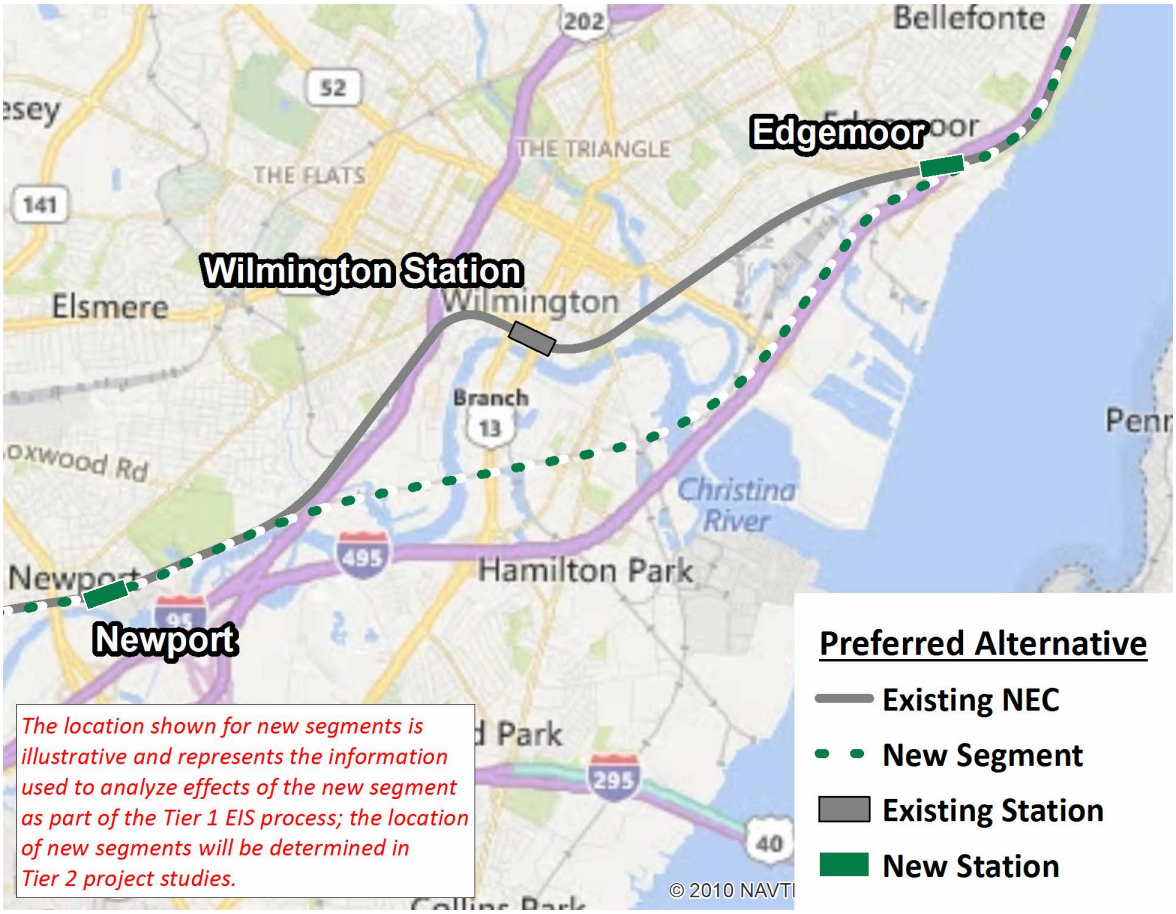
4.7.3 Delaware

- **NEC –**The NEC between Newark and Newport would be upgraded to four tracks.
- **Bayview to Newport –** New, two-track segment continuing from Cecil County, MD, entering Delaware in trench and tunnel under S.R. 2 (Elkton Road), and continuing at-grade near Newark,

DE. The new segment continues north adjacent to the existing NEC at-grade, on embankment or aerial structure, returning back to the NEC in Newport just east of S.R. 141.

- **Wilmington Segment –** New, two-track segment near Wilmington, beginning at the eastern terminus of the new segment listed in the previous bullet, shifting south of the existing NEC and east of I-95, continuing at-grade or on embankment east, crossing the Christina River, U.S. Route 13, and the Christina River again in succession. The segment shifts north, running parallel to I-495, reconnecting with the NEC near Fox Point State Park in Edgemoor. *This new segment is identical to Alternative 2* in the Tier 1 Draft EIS*, following the same routing and depicting the same construction types between Newport and Edgemoor, DE. However in the Preferred Alternative, some Intercity-Express service would utilize this new segment.*[38]
- **Stations –** Newark, DE station would be relocated, and the surrounding tracks reconfigured. New Local stations would be located in Newport and Edgemoor.

Figure 4-6: Wilmington Segment – Wilmington, DE



Source: NEC FUTURE team, 2016
Note: Approximate station footprints shown
Background Image Source: Microsoft Bing Maps, Accessed July 2015

[38] As part of the NEC FUTURE process, the FRA is focusing on corridor-wide solutions and, within the context of the Tier 1 NEPA process, and will not make decisions about final locations of new or expanded infrastructure. Such decisions would be made as part of the Tier 2 project studies, which would include local stakeholder and public involvement as appropriate.

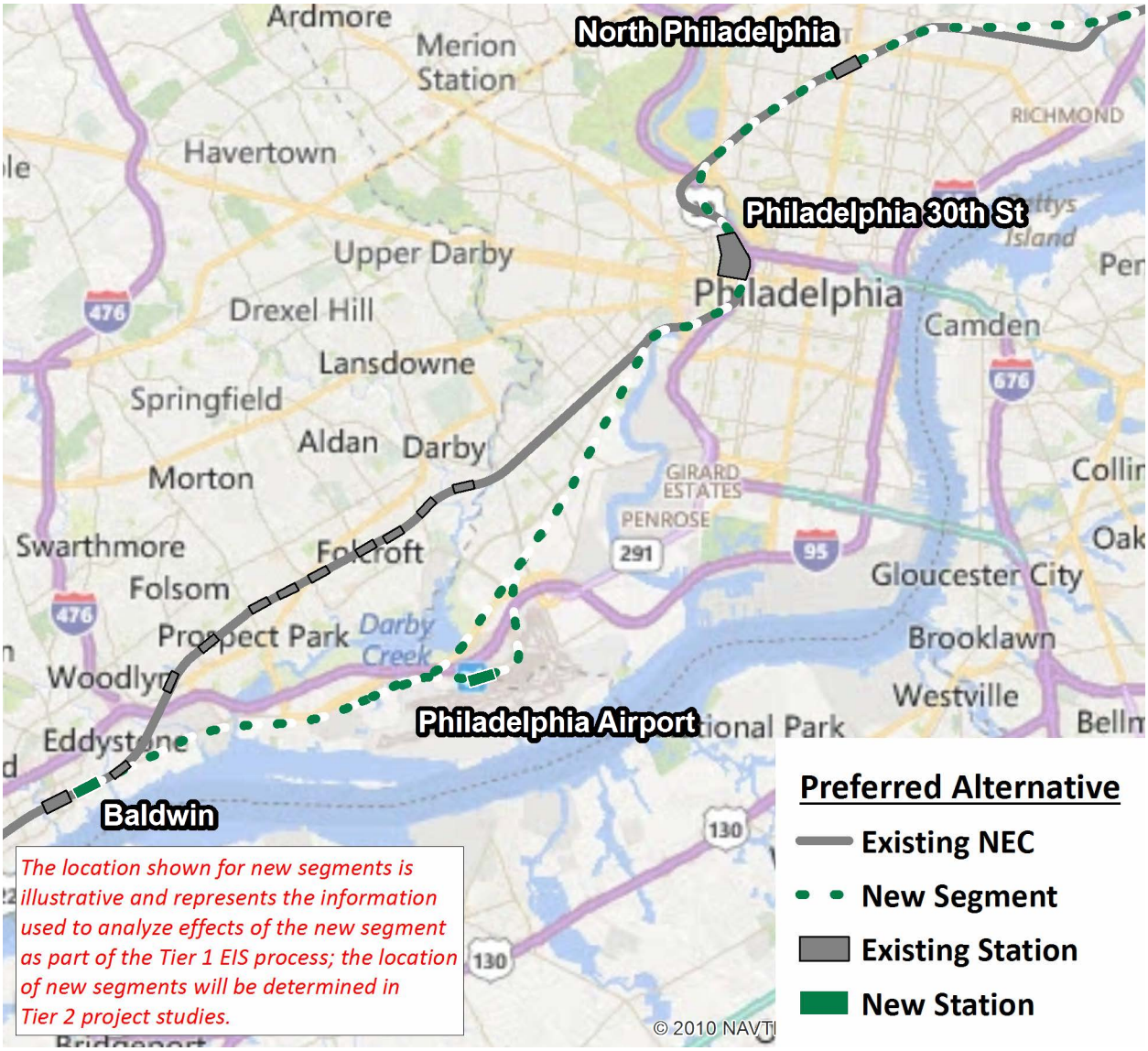
4.7.4 Pennsylvania

- **NEC –** The Penn interlocking system, spanning both the westbound and eastbound approaches to Philadelphia 30th Street Station, would be upgraded to four tracks in both directions. Curves on the NEC would be modified in Philadelphia, near North Philadelphia and Torresdale stations.

There are three new segments in Pennsylvania, collectively referred to as Philadelphia Segments:

- **Baldwin, PA to Philadelphia 30th Street Station –** New, two-track segment, south of Center City, Philadelphia, beginning near Eddystone Rail Station in Delaware County, shifting south of the NEC and running adjacent to S.R. 291 through Essington. The segment shifts north *on aerial structure and embankment*, in close proximity to S.R. 291 and CSX's Chester Secondary Line, *adjacent to the John Heinz National Wildlife Refuge*, continuing at-grade north, adjacent to CSX's Chester Secondary Line. The segment shifts east of the SEPTA Regional Rail "Airport Line," reconnecting with the NEC near the Schuylkill River and the University City section of Philadelphia. *Based on stakeholder feedback of Alternative 2, the FRA shifted the Representative Route and construction type southeast; outside of the John Heinz National Wildlife Refuge.*
- **Philadelphia International Airport Station –** New two-track segment, separate from what is described in the previous bullet, to provide direct service to Philadelphia International Airport. The new infrastructure begins east of I-95, continuing in tunnel under Philadelphia International Airport, reconnecting to the new, two-track segment near Island Avenue in Southwest Philadelphia.
- **Philadelphia 30th Street to Bridesburg –** New two-track segment north of 30th Street Station and continuing to the east of the Schuylkill River. The infrastructure follows I-76 on the east side before traversing the Schuylkill River on an aerial structure. *Note the FRA recognizes the potential effects of this construction type and expects to evaluate alternative construction types to avoid potential effects on parklands and other environmental features in subsequent Tier 2 project studies.*
- **Stations –** New Hub stations would be located in Baldwin, near Chester; and at Philadelphia International Airport. Philadelphia 30th Street and Cornwells Heights Stations would be improved but would not change station type. The Philadelphia 30th Street station area considered for analysis roughly encompasses Market Street to Spring Garden Street; and 32nd Street and I-76.

Figure 4-7: Philadelphia Segments – Delaware and Philadelphia Counties, PA



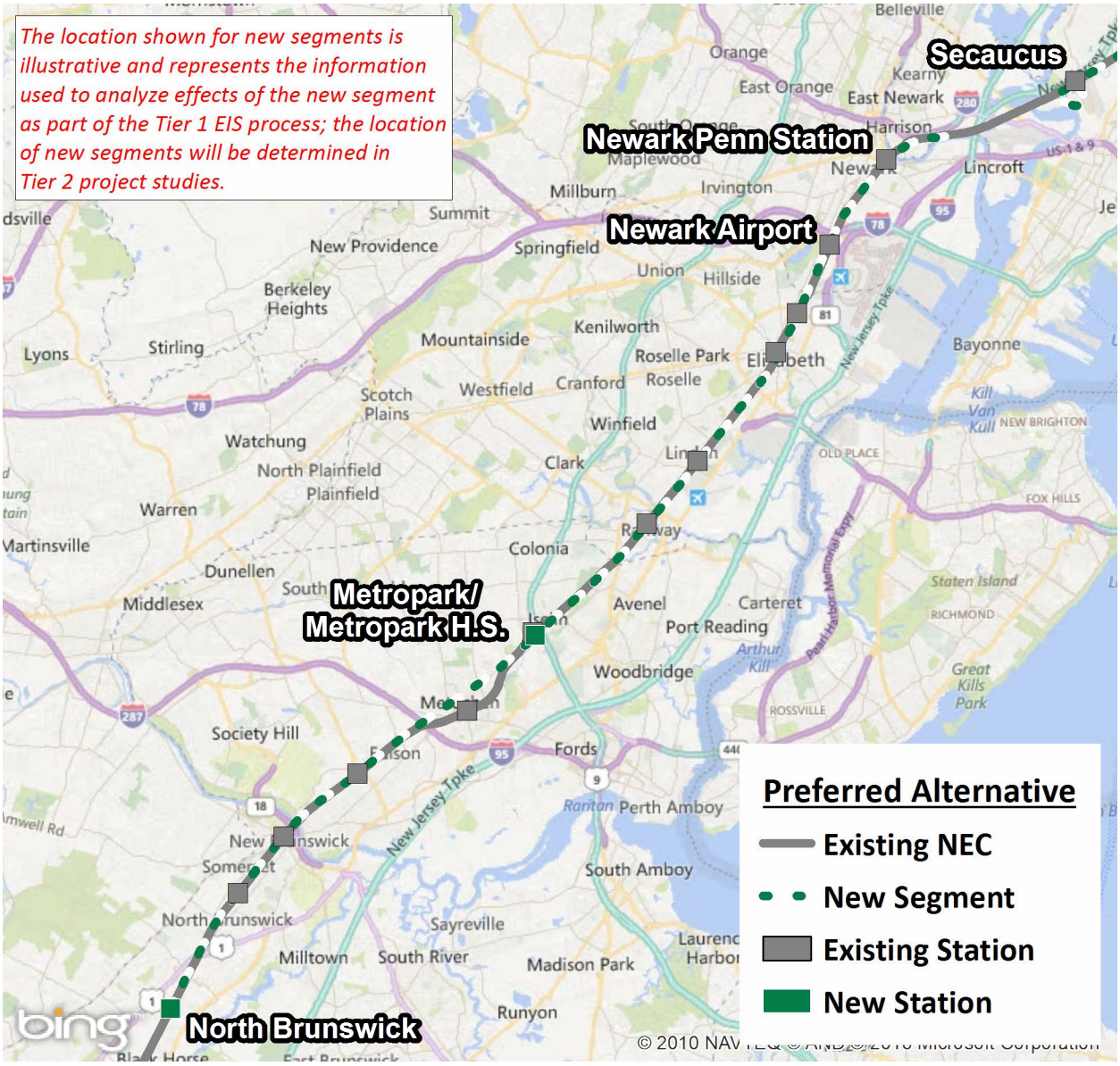
Source: NEC FUTURE team, 2016
Note: Approximate station footprints shown
Background Image Source: Microsoft Bing Maps, Accessed June 2016

4.7.5 New Jersey

- **NEC –** The Hunter Flyover would provide grade separated access to the NEC from NJ TRANSIT's Raritan Valley Line. The Westbound Waterfront Connect east of Newark Penn Station would improve access to NJ TRANSIT's Hoboken Terminal.
- **New Brunswick to Secaucus –** New, two-track segment in central and northern New Jersey, beginning in North Brunswick, Middlesex County, and continuing generally at-grade or on embankment adjacent to the NEC through central Middlesex County. The segment is in tunnel under the Raritan River through New Brunswick and Highland Park, and short tunnel segments near Metuchen in Middlesex County, Elizabeth in Union County, and Newark in Essex County. The new segment reconnects with the NEC in Kearney, Hudson County west of the Passaic River.
- **Bergen/Secaucus Loop –** New, two-track segment beginning perpendicular to and under the NEC at Secaucus rail station, parallel to NJ TRANSIT's Main Line. The segment follows the NJ TRANSIT Main Line at-grade before turning north and shifting to embankment, eventually becoming parallel to the NEC. The new segment continues parallel to the NEC on embankment or aerial structure to just east of Secaucus Road. This is also known as the Bergen Loop or Secaucus Loop.
- **Hudson River Tracks –** Two new tracks in tunnel[39] (tracks three and four) under the Hudson River and associated improvements, beginning on embankment east of Secaucus Rail Station, adjacent to the NEC, continuing east in tunnel west of U.S. Routes 1 & 9, under the New Jersey Palisades and Hudson River, and terminating south of the NEC and Penn Station New York, under West 31st Street (Figure 4-9).
- **Stations –** Trenton Station and the adjacent yard would be improved. A New Hub station would be located in North Brunswick. Platforms would be added to Metropark station to enable Intercity services to make stops on the express tracks. Secaucus Junction would be modified to support Intercity and Regional services, in conjunction with new Hudson River tracks in tunnel (description above). Newark Penn Station would be improved but would not change station type.

[39] The FRA is evaluating the environmental effects of a new Hudson Tunnel. Additional information can be found at: *http://www.hudsontunnelproject.com/*

Figure 4-8: New Brunswick to Secaucus New Segment – Northern New Jersey



Source: NEC FUTURE team, 2016
Note: Approximate station footprints shown.
Background Image Source: Microsoft Bing Maps, Accessed March 2016.

4.7.6 New York

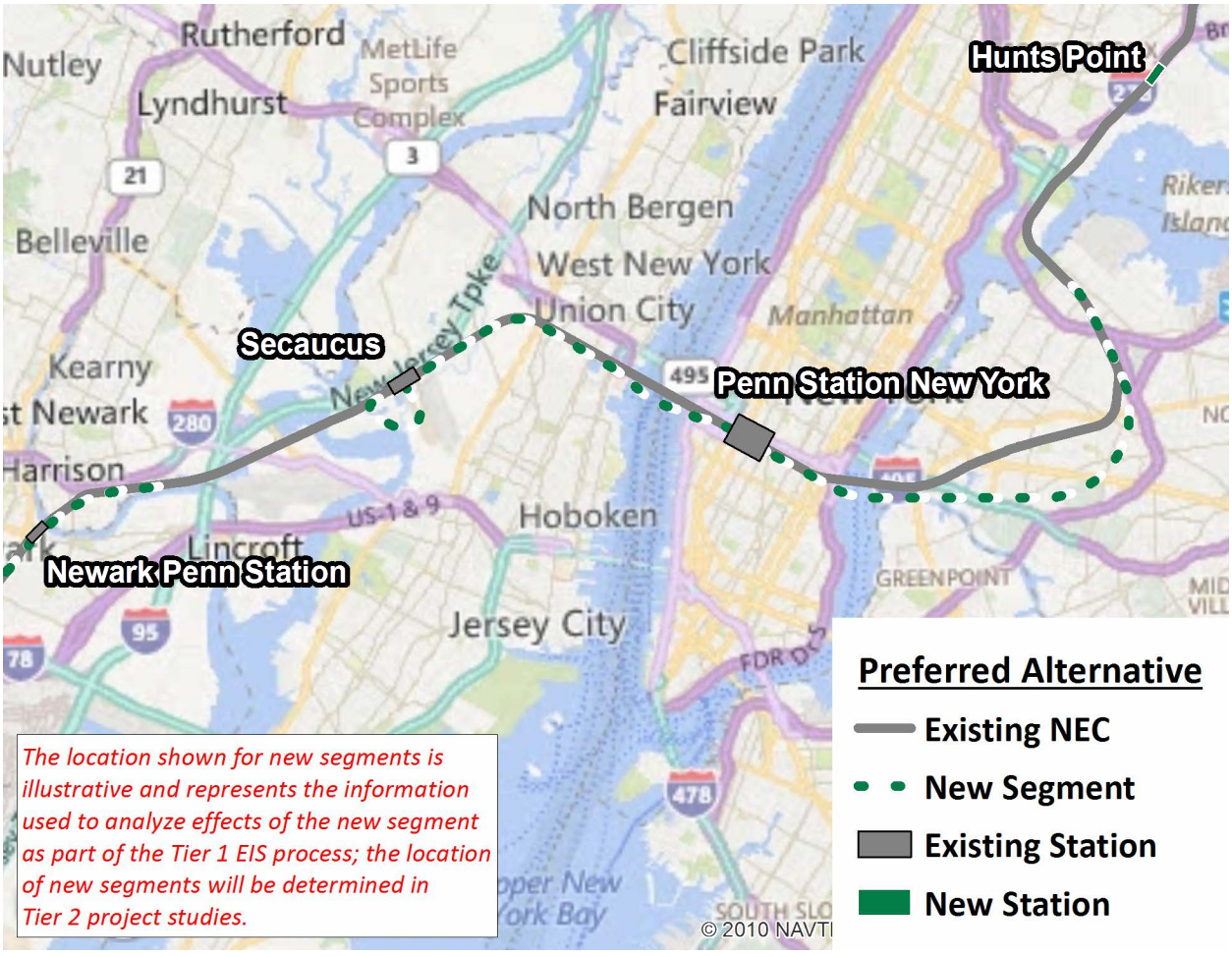
- **NEC –**The NEC would be upgraded to four tracks on the Hell Gate Line between Queens and Bronx Counties. Curves on the NEC would be modified in Bronx County, one near I-895 and Pelham Bay; and in New Rochelle, near New Rochelle Station. Shell Interlocking, west of New Rochelle Station, would be grade separated from the NEC.
- **East River Tracks –** Two new tracks in tunnel, beginning at Penn Station New York in Midtown Manhattan, and continuing east under the East River south of the NEC through Woodside,

Queens. The tunnels rise to an aerial structure, connecting with the Hell Gate Viaduct in Astoria, Queens.

- **New Rochelle to Greens Farms –** New, two-track infrastructure, beginning west of the New Rochelle Station and continuing at-grade or on embankment parallel to the NEC to Rye in eastern Westchester County, into Fairfield County, CT.

- **Stations –** Penn Station New York would be expanded to accommodate future growth. Four new stations would be located in in Bronx County: one Hub station, located in Morris Park; and three Local stations, in Hunts Point, Parkchester/Van Ness, and Co-op City. A new Cross-Westchester Hub station would be located in Westchester County, near the New York/Connecticut border. New Rochelle station would be improved but would not change station type. The Penn Station New York station area considered for this analysis roughly encompasses 28th Street to 36th Street; and 9th Avenue to 6th Avenue.

Figure 4-9: Bergen/Secaucus Loop, Hudson River Tracks, East River Tracks – New York City Area



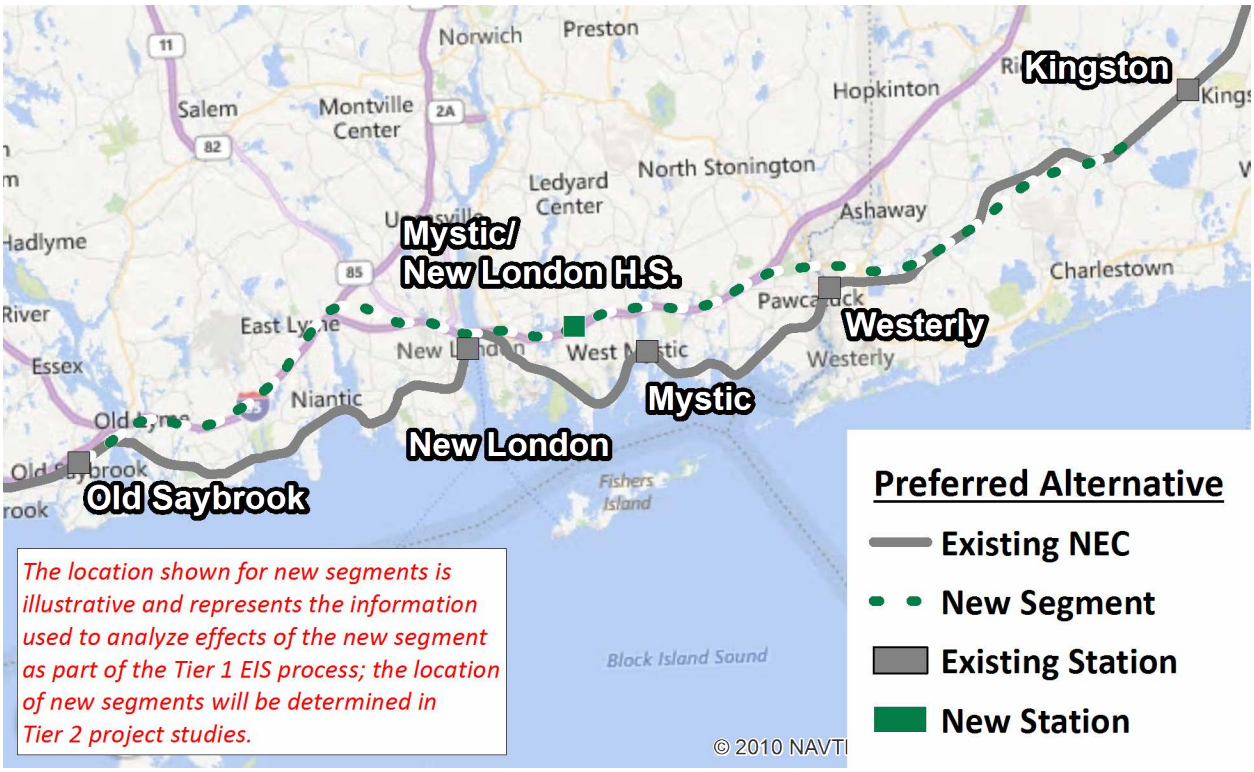
Source: NEC FUTURE team, 2016
Note: Approximate station footprints shown.
Background Image Source: Microsoft Bing Maps, Accessed March 2016.

4.7.7 Connecticut

- **NEC –** The NEC would be upgraded to four tracks between Branford and Guilford.
- **Hartford/Springfield Line –** The Hartford/Springfield Line would be electrified between New Haven and the Connecticut/Massachusetts state line and upgraded to two tracks between Hartford and the Connecticut/Massachusetts state line. Signal systems and grade crossings would be upgraded as appropriate (improvements to the Hartford/Springfield Line in Massachusetts are described in Section 4.7.9). Improvements to the Hartford/Springfield Line also include in-kind replacement of the Hartford Viaduct (through downtown Hartford) and upgrades to the Connecticut River Bridge in Windsor Locks, CT, to accommodate second track service. The Hartford/Springfield Line runs roughly parallel to Interstate 91 (I-91) between New Haven, CT, and Springfield, MA. In Connecticut, beginning at the Mill River, the Hartford/Springfield Line runs north, primarily at-grade and on the west side of the Connecticut River through the municipalities of Hamden, North Haven, Wallingford, and Meriden in New Haven County, CT. The Hartford/Springfield Line crosses into Hartford County, CT, near Silver Lake, and continues north primarily at-grade through the municipalities of Berlin, New Britain, Newington, entering the city of Hartford on an aerial structure near Interstate 84 (I-84). The Hartford/Springfield Line continues north through Hartford County mostly at-grade through Windsor and Windsor Locks on the west side of the Connecticut River, before crossing the Connecticut River on a major bridge into Enfield, CT. The Hartford/Springfield Line continues north on the east side of the Connecticut River, entering Long Meadow in Hamden County, MA, west of I-91.
- **New Rochelle to Greens Farms –** New, two-track infrastructure, continuing from Westchester County, NY, through coastal Fairfield County, parallel to I-95 typically on embankment or aerial structure through Greenwich, Stamford, and Norwalk; terminating in Westport west of Greens Farms rail station.
- **Old Saybrook-Kenyon –** New, two-track segment beginning east of Old Saybrook rail station, shifting north of the NEC, *crossing the Connecticut River in tunnel under Old Saybrook and Old Lyme*, continuing in a series of tunnels, trenches, and aerial structures parallel to I-95 through East Lyme. The new segment shifts northeast and continues a short distance parallel to I-395 in Waterford before crossing to the south of I-395 in tunnel and continuing east adjacent to I-95. The segment crosses the Thames River in New London, between the eastbound and westbound bridge spans of I-95 and continues on embankment or aerial structure parallel to I-95 through Groton and Stonington, crossing the Pawcatuck River north of the NEC into Westerly, Rhode Island (Figure 4-10). *This new segment is a refinement to Alternative 1. Based on comments received on Alternative 1, the FRA changed the construction type to tunnel for the representative route between Old Saybrook and East Lyme, CT, to avoid the use of an aerial structure in the historic district of Old Lyme.*
- **Stations –** New Local stations providing connections to the NEC would be located in Barnum (East Bridgeport) and Orange. Platforms would be added to Stamford station to enable Intercity services to make stops on the express tracks. Greens Farms would be modified to support Intercity and Regional services. Improvements would be made at New Haven Station to facilitate smooth Intercity and Regional rail train movements into and out of the station. A new Mystic/New London Major Hub station would be located on the Old Saybrook-Kenyon New

Segment in New London County. New Local stations providing connections to the Hartford/Springfield Line would be located in North Haven, Newington, West Hartford, and Enfield. Hartford Station would be modified to support both Intercity and Regional services. New Haven and Old Saybrook stations would be improved but would not change station type.

Figure 4-10: Old Saybrook-Kenyon New Segment – Connecticut and Rhode Island



Source: NEC FUTURE team, 2016
Note: Approximate station footprints shown
Background Image Source: Microsoft Bing Maps. Accessed July 2015

Flexibility of a Representative Route

The FRA applied the concept of a "Representative Route" for the NEC FUTURE environmental effects assessments. This concept is useful as a basis for evaluating environmental effects while also providing flexibility to modify a proposed routing during subsequent planning and project development processes. In that way, the Representative Route is representative of the potential effects of an alternative but not limiting in its final design and implementation. The range of potential effects are bounded by an Affected Environment of varying dimensions and a broader Context Area that further allowed the FRA to highlight any environmentally sensitive features that might be within 2-1/2 miles on either side of the Representative Route. (See Chapter 2, Readers' Guide, for additional information.)

The Representative Route does not identify a specific track alignment or line on a map; those specifics will require further analysis in subsequent Tier 2 project studies. The flexibility to consider routing options ensures that specific local concerns that are not addressed in the programmatic scale of this Tier 1 evaluation will be considered in the subsequent Tier 2 project studies. For example, in light of specific concerns with potential impacts to the historic district of Old Lyme, CT, and the Connecticut River estuary, the FRA would require evaluation of alternative routings to identify an alignment that minimizes environmental effects and achieves the desired passenger benefits. As a result of the Tier 2 project study, the alignment between Old Saybrook, CT, and Kenyon, RI, could shift north or south of the Representative Route.

4.7.8 Rhode Island

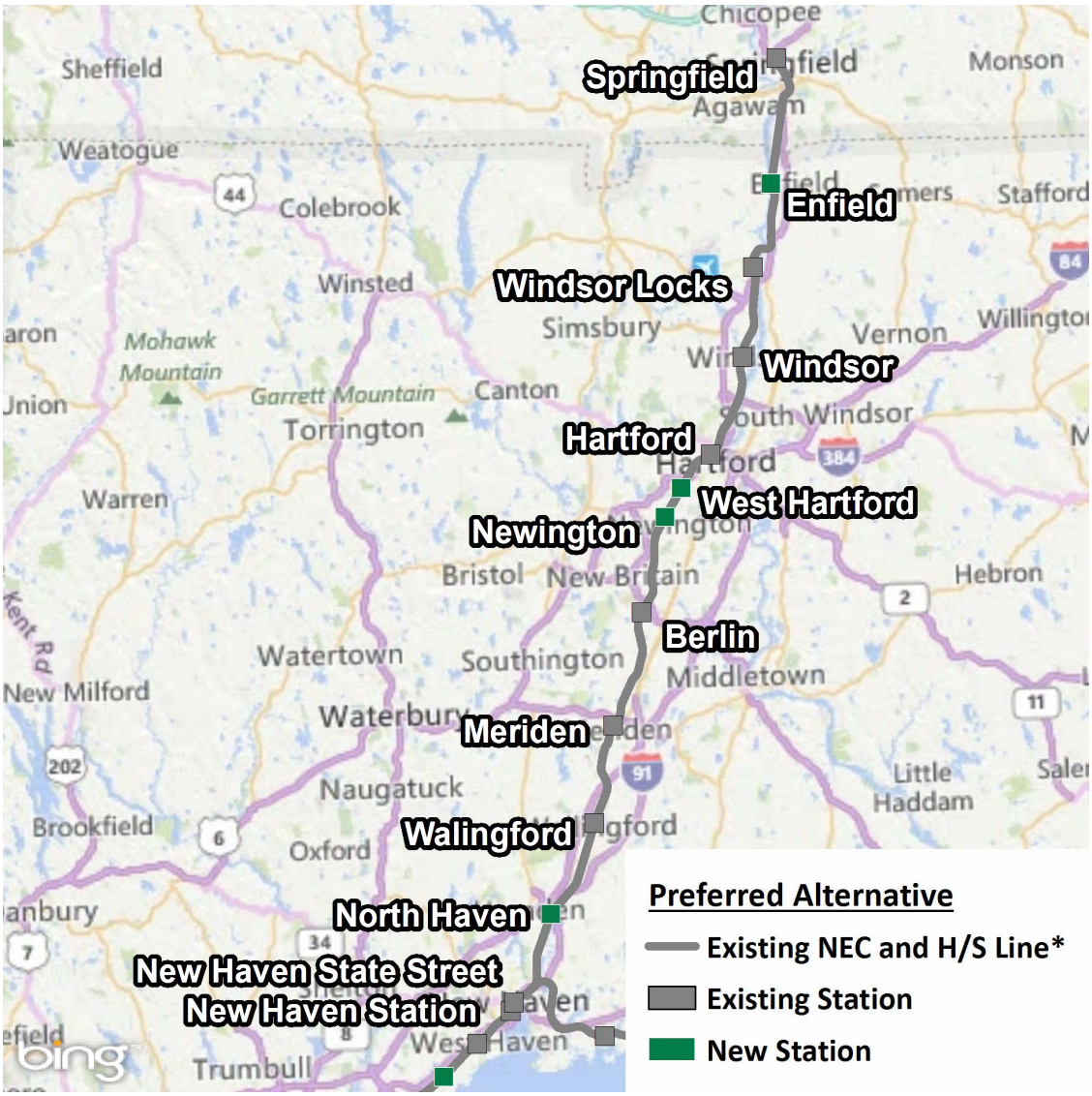
- **NEC** – The NEC would be upgraded to three tracks and a parallel freight track added between Kenyon and Davisville. The NEC would be upgraded to four tracks between Greenwich and Warwick, and between Pawtucket, RI and Sharon, MA.
- **Old Saybrook-Kenyon –** New two-track new segment**,** primarily on embankment or at-grade, continuing from New London County, CT, east through Westerly, RI, adjacent to the NEC, shifting south through Branford and Wood River Junction, reconnecting to the NEC in Kenyon, north of the Pawcatuck River.
- **Stations –** T.F. Green Station would be modified to support Intercity and Regional services. A new Local station would be located in Pawtucket. Kingston station would be improved but would not change station type.

4.7.9 Massachusetts

- **NEC –** Track and junction improvements would be made to the NEC between Canton Junction and Readville to permit smoother trains movements. The NEC would be upgraded to four tracks between Pawtucket, RI and Sharon, MA.
- **Hartford/Springfield Line –** The Hartford/Springfield Line would be upgraded to two tracks and electrified between the Connecticut/Massachusetts State Line and Springfield, MA. Signal systems and grade crossings would be upgraded (i.e., quad-gates) as appropriate. The Hartford/Springfield Line continues at-grade north between the Connecticut River and I-91, entering Springfield, MA, near Forest Park, and continuing north before turning east and crossing under I-91 at-grade, terminating at Springfield Union Terminal.

- **Neponset –** New, two-track infrastructure on embankment and aerial structure, beginning north of Canton Junction Rail Station continuing north and reconnecting with the NEC near Route 128 Rail Station in Dedham.
- **Stations –** Boston South Station would be expanded, consistent with the Boston South Station Expansion and Layover Facility Project.[40] Route 128, Readville, Forest Hills, and Ruggles Street stations would be improved but would not change station type.

Figure 4-11: Hartford/Springfield Line – Connecticut and Massachusetts



Source: NEC FUTURE team, 2016
**H/S Line: Hartford/Springfield Line*
Note: Approximate station footprints shown
Background Image Source: Microsoft Bing Maps. Accessed July 2016

[40] South Station Expansion Project – EEA No. 15028.
http://www.massdot.state.ma.us/southstationexpansion/Home.aspx

4.8 SHARED ACCESS AND CONSIDERATION OF FREIGHT

Shared corridors present challenges to both passenger and freight railroad operations. In light of this, an objective of NEC FUTURE is to consider and coordinate with planned investments throughout the freight rail network and to ensure that passenger rail improvements do not degrade the viability of freight operations in the future. The FRA participated in discussions with the stakeholder freight railroads to understand the needs of the freight rail industry as they relate to the NEC. The FRA is committed to continuing this collaboration moving forward.

The Preferred Alternative preserves freight access to and from the NEC and the Hartford/Springfield Line to seaports, inland ports, and dedicated freight corridors within the Study Area. The Preferred Alternative does not preclude future freight expansion opportunities. The FRA developed specific assumptions for the mixed operations of freight and passenger traffic on the same tracks and in the same right-of-way, consistent with the current FRA regulatory framework. These assumptions can be found in Volume 2, Appendix B.5, *Tier 1 EIS Alternatives Report*, which describes more fully the railroad operating characteristics and limitations on permissible maximum speeds and the mixing of freight and passenger traffic.

The FRA also considered opportunities to accommodate future growth and improvement of freight rail service within the Study Area when defining infrastructure requirements for passenger services. Additional infrastructure associated with the Preferred Alternative would reduce passenger rail-freight rail conflicts while providing additional capacity that could accommodate increases in freight traffic. In addition to preserving freight rail access to industries along the NEC and the Hartford/Springfield Line and not precluding future expansion of freight rail service, the FRA reviewed the Preferred Alternative with respect to potential effects on four specific freight traffic growth opportunities:

- Freight access to the Port of Baltimore, Port of Wilmington, and Delmarva Peninsula
- Freight access along the NEC in southeastern Connecticut and Rhode Island
- Potential high-capacity, high-clearance freight line parallel to the NEC between Washington, D.C., and northern New Jersey
- Freight access to Long Island and New England

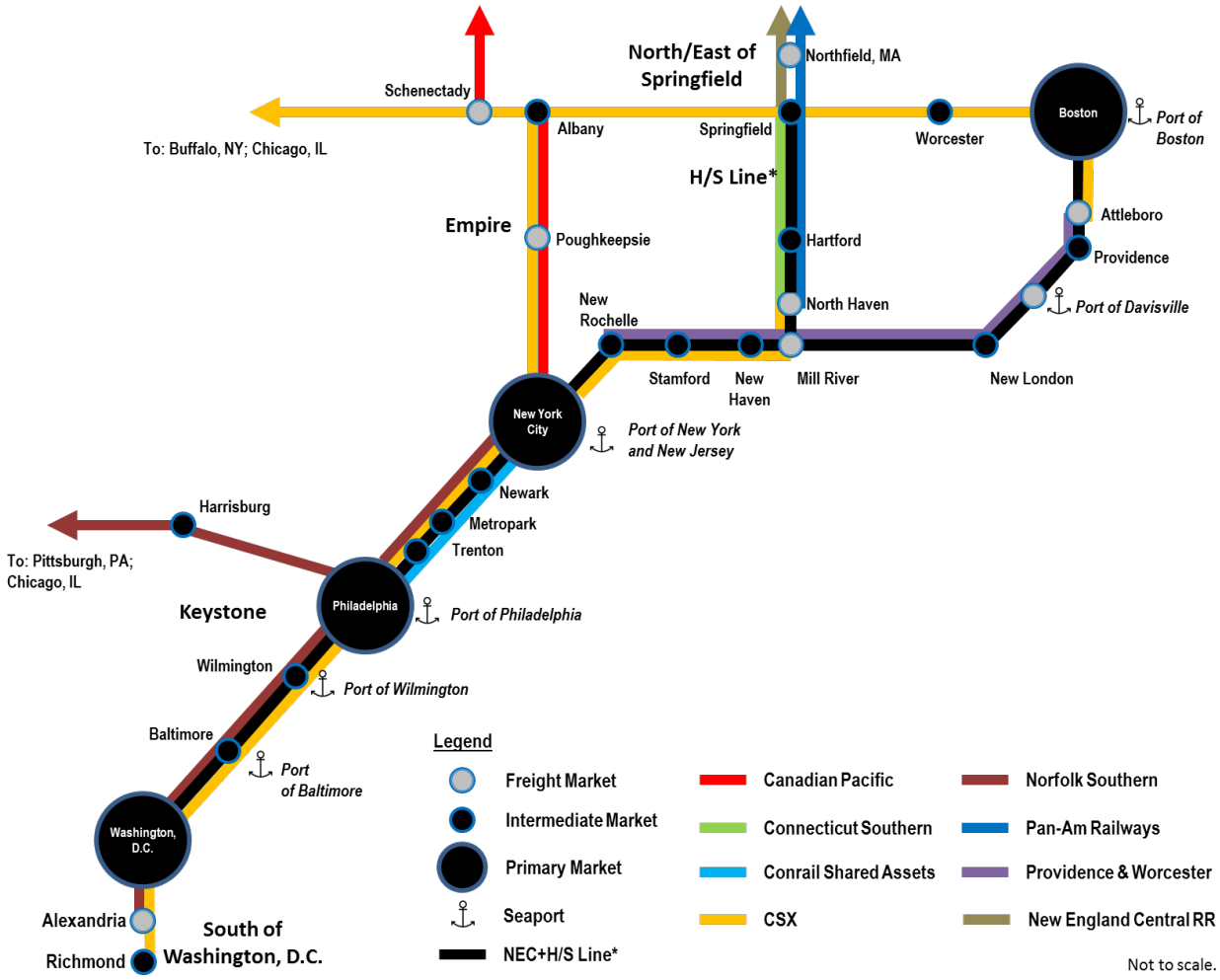
Information on how the Preferred Alternative preserves future freight opportunities is discussed in Chapter 5, Transportation. The role of freight in the Study Area is discussed in Chapter 6, Economic Effects and Growth, and Indirect Impacts.

4.8.1 Existing Freight Access to the NEC and the Hartford/Springfield Line

The Preferred Alternative maintains and provides for growth of freight needs in the Northeast, and reflects the FRA's commitment to expand the passenger rail network, while considering how investments in the Study Area can highlight opportunities to accommodate future growth and improvement of freight service.

Figure 4-12 shows freight railroad access on the NEC and the Hartford/Springfield Line, and connecting corridors in the Study Area. In some cases, the freight railroads own the lines; for example CSX owns the line between Springfield and Worcester, MA. The schematic is intended to illustrate the complexity of the shared operating environment. There may be small gaps where freight railroads are not permitted to operate. These gaps may include extended tunnel segments, such as the existing North River Tunnel under the Hudson River, and underground stations like Penn Station New York.

Figure 4-12: Freight Operations on the Northeast Corridor and Connecting Corridors



Source: NEC FUTURE, 2016

Note: Freight service through Penn Station New York and between Penn Station New York and Spuyten Duyvil is not permitted. CSX operates between Virginia and Maryland via the Long Bridge and Virginia Avenue Tunnel, bypassing Washington Union Station.

* H/S Line: Hartford/Springfield Line

4.8.2 Freight Rail Interface with Preferred Alternative

In defining improvements for the Preferred Alternative, the FRA considered the requirements of freight railroads as users of the NEC. As noted, there will be opportunities as a result of improvements included in the Preferred Alternative to reduce existing constraints or conflicts created with passenger and freight sharing the same tracks. Specifics of how these improvements could have shared benefit, however, will be determined in subsequent Tier 2 project studies or other planning studies involving the relevant stakeholders, freight railroads, and public. This would include any required actions necessary to mitigate safety concerns with passenger trains using Tier III equipment and operating at speeds in excess of 125 mph with freight trains on adjacent tracks. At this point in the process, no decisions specific to alignment or facilities will be made. There are some locations where new segments of the Preferred Alternative is adjacent to rights-of-way owned/operated by the freight railroads. At this point, the expectation is that these new segments could be adjacent or near, but would not use these private rights-of-way. However, specifics have yet to be defined and will be the subject of subsequent Tier 2 project studies or other planning processes, involving early engagement with the appropriate property owners. The Preferred Alternative is adjacent to existing freight railroad rights-of-way in the following locations:

- The Bayview, MD, to Newport, DE, new segment is adjacent to sections of CSX Transportation freight rail right-of-way in Baltimore City, and Baltimore, Harford, and Cecil Counties, MD.
- The Wilmington, DE, new segment is adjacent to sections of Norfolk Southern freight rail right-of-way in New Castle County.
- The new segment between Baldwin, PA, to Philadelphia 30th Street Station via Philadelphia International Airport is adjacent to sections of CSX Transportation freight rail right-of-way in Delaware and Philadelphia Counties.

The Preferred Alternative also includes new track improvements on the NEC and upgrades to the Hartford/Springfield Line that may be in locations either shared by freight railroads (as noted in Figure 4-12), or where freight railroads control access points to freight property adjacent to the NEC and the Hartford/Springfield Line. The FRA would coordinate with freight railroads with regard to these types of improvements as well. Specific examples include but are not limited to:

- Norfolk Southern tracks and yard adjacent to the Newark, DE station
- Delair track through North Philadelphia
- Delco track in North Brunswick, NJ

4.9 COST

The FRA estimated capital and O&M costs for the No Action Alternative and Preferred Alternative to better understand the associated costs of constructing, operating, and maintaining the Preferred Alternative relative to the amount of travel benefits each would provide. Table 4-17 provides the No Action Alternative and Preferred Alternative capital cost estimates. Volume 2, Chapter 4 provides additional detail on the No Action Alternative capital cost estimating methodology and capital cost estimate. The FRA calculated the Preferred Alternative capital cost estimate using the

same methodology used to calculate the No Action Alternative and the Action Alternative capital cost estimates. Cost estimates are high-level, order-of-magnitude estimates, based on a set of reasonable assumptions related to railroad infrastructure, equipment, service plans, and fare policies. The FRA used the capital and O&M cost estimates to evaluate the No Action Alternative and Preferred Alternative (see Chapter 9, Evaluation of Alternatives).

4.9.1 Capital Costs

The FRA based the capital cost estimate for the Preferred Alternative on infrastructure element quantities. Key elements include stations, shops, and lengths of infrastructure by construction type (e.g., tunnel, aerial, embankment), and rail systems. The FRA based vehicle costs on fleet requirements for the representative service plans and assumed vehicle performance specifications (e.g., speed, seating capacity and configuration, amenities). Rolling stock requirements were estimated for Intercity rail service only. Capital cost estimates include storage and maintenance facilities used for Intercity rail operations. Capital costs for these yards are non-site specific, and do not include acquisition costs for yard right-of-way.

Capital cost estimates are summarized for infrastructure, rolling stock and No Action Alternative projects or programs, as described in Section 4.3. Preferred Alternative costs include only No Action Alternative Categories 1 and 2. No Action Alternative Category 3 costs are eliminated in the Preferred Alternative because they include the capital cost to replace or rehabilitate obsolete assets. (Volume 2, Appendix B.6, *Capital Costs Technical Memorandum*, details the methodology used to estimate capital costs. Appendix BB, Technical Analysis on the Preferred Alternative, applies this methodology for the Preferred Alternative.)

Table 4-17 presents the estimated costs of the Preferred Alternative. A range of capital costs are based on low to high allocated contingency rates.[41] An average capital cost estimate for the Preferred Alternative is presented as a range of lowest to highest values.

Table 4-17: Capital Costs – Preferred Alternative ($2014 billions)

Category	Preferred Alternative – Low	Preferred Alternative – High
Infrastructure	$107	$112
Vehicles	$6	$6
Subtotal	*$113*	*$118*
No Action Alternative Projects	$9	$9
Total	**$123**	**$128**

Source: NEC FUTURE team, 2016
Notes: Infrastructure costs include professional services; costs do not include property acquisition costs for yards or stations. Numbers may not add due to rounding.

The development of unit costs that make up the Capital Costs of the Preferred Alternative included both materials and all contractor labor leading up to and including final installation. All unit prices were normalized to an average labor rate. The FRA benchmarked cost estimates of the No Action Alternative and Action Alternatives against cost estimates of the High-Speed 2 (HS2) railway project

[41] The low allocated contingency rate is based on typical historical project values. The high allocated contingency is 50 percent greater than the low allocated contingency rates to reflect unknown risk.

in the United Kingdom. Volume 2, Appendix B.6, *Capital Costs Technical Memorandum,* includes the results of this analysis. Where applicable, the FRA compared specific line-item costs from the HS2 cost estimate to the No Action Alternative and Action Alternatives' costs. For more information on cost validation, see Volume 2, Appendix B.6.

4.9.2 Operations and Maintenance (O&M) Costs

The FRA estimated O&M costs for the Preferred Alternative based on existing Intercity and Regional railroad operating costs for typical cost categories such as labor (e.g., train and maintenance crews), power and fuel, and management and administrative costs. The FRA developed O&M cost estimates through an iterative process, balancing operating costs with ridership and revenue estimates for the Preferred Alternative. The O&M cost model was updated subsequent to the Tier 1 Draft EIS to incorporate the Hartford/Springfield Line costs and also to adjust the average speeds for Regional rail. These model adjustments are described in Appendix BB, Technical Analysis on the Preferred Alternative.

Overall, the incorporation of the Hartford/Springfield Line operating costs had a dampening effect on some of the infrastructure and transportation-related unit costs. As a result, the FRA applied the unit costs from the updated O&M cost model to re-estimate costs for the No Action Alternative and Action Alternatives in order to compare the results with the Preferred Alternative. The service-derived operating statistics and physical characteristics (i.e., passenger-miles, track miles) for the Action Alternatives, however, are the same as those developed for the Tier 1 Draft EIS. The No Action Alternative was updated to include the transportation costs for service to Springfield on the Hartford/Springfield Line.[42]

The cost to operate the Preferred Alternative is approximately $2 billion annually, about twice the cost to operate in the No Action Alternative.[43] The FRA did not attempt to optimize operator revenue in its analysis. Choices about how to optimize revenues would be dependent on future detailed service and operating plans and policies determined by railroad operators (e.g., types and number of classes of service, yield management practices).

4.10 KEY FEATURES AND BENEFITS OF THE PREFERRED ALTERNATIVE

The Preferred Alternative improves the NEC and Hartford/Springfield Line and adds new segments that, together, expand capacity to grow the role of rail. The Preferred Alternative brings the NEC to a state of good repair and maximizes its capacity through alleviation of chokepoints, addition of new tracks at targeted locations, and implementation of service operational efficiencies. Some of these improvements could also reduce conflicts between passenger and freight rail operations where services may coexist. The Preferred Alternative also removes speed restrictions where practical and safe, reduces trip times, offers frequent Metropolitan and enhanced express Intercity services, and allows substantial growth for all Regional rail markets.

[42] The Action Alternatives evaluated in the Tier 1 Draft EIS did not include the transportation costs for service north of Hartford, CT.

[43] Operating costs in $2014. Volume 2, Appendix B, *Operations & Maintenance Cost Technical Memorandum*, details the O&M cost methodology.

The Preferred Alternative achieves sufficient capacity, connectivity, and performance to meet future Northeast mobility needs for 2040 and beyond, and makes it possible to adopt advanced service concepts that will enhance the passenger rail experience. The Preferred Alternative includes over 200 route miles of new segments that expand the capacity to grow the role of rail and improve performance and resiliency of the NEC.

4.10.1 Key Features

Key features of the Preferred Alternative include the following:

- A corridor-wide commitment to the NEC and the urban centers it connects today
- Brings the NEC to a state of good repair and maximizes its capacity through alleviation of chokepoints, addition of new tracks and segments at targeted locations, and implementation of service operational efficiencies.
- Removes speed restrictions with curve and other modifications where practical that enhance safety, reduce trip times, offer frequent Metropolitan and enhanced express Intercity services, and allow for substantial growth for all Regional rail markets.
- Provides a conflict-free pair of express tracks across the entire NEC offering city to city speeds of 160 mph on the NEC and up to 220 mph on new segments that offers opportunities to optimize express services to take commercial advantage of Intercity travel markets.
- Between Washington, D.C., and New York City, expands the NEC with targeted new segments to avoid speed and environmental constraints in northern Maryland and Delaware, near Philadelphia, and in New York City.
- In the New York area, facilitates regional through-service between New Jersey and Long Island/Westchester and preserves the future option of adding Intercity through-service to Long Island. Between New York and New Haven, the Preferred Alternative incorporates the grow vision of strengthening the NEC with new segments close to the NEC that allow for expansion of both Intercity and Regional rail service levels.
- Between New Haven and Providence, upgrades the NEC and adds a supplemental new segment between Old Saybrook, CT, and Kenyon, RI. This new segment will improve performance and enhance system resilience between New Haven and Boston.
- Between New Haven, CT, and Springfield, MA, incorporates enhanced electrified service along the Existing Hartford/Springfield Line responding to comments received to strengthen service to central New England and leverage existing investments and identified market opportunities.

The Preferred Alternative achieves many of the benefits of constructing extensive new segments, conflict-free express tracks, and terminal and chokepoint relief projects at a lower cost than a full second spine. Limited-stop Intercity-Express service envisioned for the Preferred Alternative would offer very competitive trip times at a substantially smaller investment than the capacity necessary to provide for non-stop high-speed rail service on a dedicated second spine. The Preferred Alternative has the potential to accommodate other service plans that feature super-express limited-stop services that can offer market dominant travel times and offer potential for higher margin Intercity rail products that might attract public-private partnerships.

4.10.2 Key Benefits

The FRA has identified a Preferred Alternative that includes improvements to the NEC and Hartford/Springfield Line, implementation of operational efficiencies to effectively improve service options for NEC users, and expansion of the NEC infrastructure to create capacity needed for growing passenger rail service. The FRA's Preferred Alternative defines a path forward to quality passenger rail service for future generations and successfully addresses the following themes:

- Freedom of Mobility – The Preferred Alternative provides more-frequent and reliable service to connect more people and places conveniently by rail and opportunities for public-private partnerships to leverage the substantial market for enhanced rail services.
- Enhancement of Efficiency – The Preferred Alternative encourages opportunities for integrated scheduling and more-efficient railroad operations.
- Strengthening of Communities – The Preferred Alternative expands access to jobs and supports urban centers along the NEC and Hartford/Springfield Line with better connections to foster economic growth; the Preferred Alternative contributes to an improved quality of life by reducing the negative environmental impacts of transportation.
- Flexibility and Phasing of Construction – The Preferred Alternative incorporates flexibility necessary to implement improvements in phases that balance, in response to immediate needs, funding availability, and market conditions.

The following sections describe how the Preferred Alternative achieves these benefits.

4.10.2.1 Freedom of Mobility

The Preferred Alternative provides more-reliable and frequent train travel with easy connections to more places and shorter travel times. An improved passenger experience through common ticketing, and more-convenient schedules and connections will make rail a user-friendly transportation option. The Preferred Alternative:

- Fundamentally changes passenger experience by integrating Regional and Intercity ticketing, operations and services, as well as incorporating a new corridor-wide Metropolitan service to connect local stations with hub and terminal stations; these operational efficiencies lead to treating the NEC rail network as an integrated network of service, and exhibit strong benefits and cost economies for capital investments and operating practices.
- Achieves performance improvement with faster, more-frequent, coordinated services to more places that enhance the role of rail in the Study Area at a lower cost and with less impact than building a complete second spine. Dedicated high-speed tracks, approximately 130 miles of new track added to the NEC and Hartford/Springfield Line, and approximately 220 route miles of new segments designed for very high speeds will offer conflict-free reliable express operations with reduced trip times.
  - Regular limited-stop express service would be possible that will satisfy most time sensitive travel demand for business trips.
  - Super-Express service could be offered making limited intermediate stops.

- Metropolitan service could offer frequent service to other intermediate destinations along with timed transfers at Philadelphia, New York and New Haven.

- Creates intermodal connections by concentrating on urban hub stations well served by transit and by creating convenient airport services with frequent Intercity and Regional service. In addition to BWI and Newark Airports, new connections would be added to reach Philadelphia, T.F. Green, and Bradley International Airports with Intercity service at least every 30 minutes at peak periods.

4.10.2.2 Enhancement of Efficiency

The Preferred Alternative offers better service that comes from operating as a coordinated system, which requires running the railroad differently. Expanded capacity and redundancy along with connected services will also make the NEC rail network more resilient to weather and other catastrophic events. Operating the NEC differently, with coordinated train service schedules, will reduce service disruptions, expand capacity, and will make the system easier for users to understand. The Preferred Alternative:

- Achieves a meaningful improvement in resiliency – to future severe weather events and sea level changes by combining focus on the NEC with new segments that offer substantial performance gains.

- Offers transformed service quality – via adoption of operational efficiencies that require changing the way NEC railroads plan infrastructure and operations. U.S. DOT, Amtrak, regional rail operators and other partners, such as the NEC Commission and the States, will need to work together to realize these potential benefits for the NEC.

4.10.2.3 Strengthening of Communities

Economic development will be spurred with the Preferred Alternative since it offers more-frequent, convenient connections to more places that will be used by more travelers. The existing rail network and transportation system will be strengthened because people will have better access to urban centers, jobs and destinations throughout the Northeast region. The Preferred Alternative:

- Strengthens existing urban centers by concentrating service on the NEC and Hartford/Springfield Line. Major existing terminals would remain as hubs for all services. The NEC rail network would benefit from coordinated schedules to offer timed transfers and function as an integrated network. Costly new routes and stations in downtown Baltimore and Philadelphia are not included in favor of concentrating service at the existing stations.

4.10.2.4 Constructability and Phasing

The Preferred Alternative makes it possible to repair the NEC in phases, with less disruption to passengers and cost savings. Near-term benefits can be achieved while flexibility is maintained by expanding capacity incrementally to adapt to market responses in the future. The Preferred Alternative:

- Creates opportunities for phasing expansion with new segments in Maryland, Delaware, and Connecticut that can be built and placed in service in phases. This creates opportunities for

reducing the impact and cost of achieving a state of good repair by making it possible to temporarily divert train operations to the new segments while reconstructing the NEC.

- Future opportunities for further expansion. While the analysis for NEC FUTURE did not justify advancing a second spine, it is possible that in future decades there may be heightened need for additional capacity and performance improvement that could justify adding additional segments of a second spine to the existing rail network. For example, although not included in the Preferred Alternative, the Alternative 3 link between Long Island and Connecticut would open new travel opportunities and reach a large population on Long Island.

4.11 LOOKING AHEAD

The Preferred Alternative evaluated in this Tier 1 EIS establishes a representative Service Plan and infrastructure improvements to achieve a vision for capacity, connectivity and performance of the NEC for improved mobility into the future. The environmental assessment of the Preferred Alternative, as presented in Chapters 5–9 of this Tier 1 Final EIS, identifies where applicable, potential effects, possible mitigation, and elements for particular consideration in the subsequent Tier 2 project studies. Ultimately, the FRA decisions with regard to a Selected Alternative will be formally adopted in a Record of Decision (ROD). As noted throughout this Tier 1 EIS, the FRA did not decide specific alignments or infrastructure, facilities, or equipment or related design elements of the Preferred Alternative. Project sponsors and approving agencies will make those more-detailed, project-specific decisions in the subsequent Tier 2 project studies, or if outside the federal-funding process, in other planning processes or future studies.

Funding and financing the Tier 2 projects necessary to implement the Preferred Alternative will be an incremental process for the federal government, Amtrak, the NEC states and stakeholders, and the entire region. This process will require the commitment of both the public and private sectors over a long period of time. The FRA and the NEC Commission will take a leading role in working with project sponsors to support the federal financial assistance to advance implementation, including existing and future grant and other financing programs and options. The FRA and other NEC stakeholders may also engage the private sector to explore options for commercial participation to advance Tier 2 projects. Funding and financing options will be further detailed in the Service Development Plan. The FRA will work with the NEC Commission to advance and implement the 5-Year Capital Plan and to ensure its consistency with the Selected Alternative.

Given the multi-jurisdictional scope, complexity, and multi-year timeframe for implementing NEC FUTURE, an incremental approach to implementation is crucial. To that end, the FRA identified an approach to defining an Initial Phase of the Selected Alternative that can be practically implemented in a reasonable timeframe with measurable traveler benefits. Chapter 10, Phasing and Implementation, describes this phase, and consideration of the institutional and governance coordination necessary to advance an Initial Phase. Chapter 10 also clarifies the decisions to be made in this Tier 1 NEPA process, the FRA's ongoing commitment to work with stakeholders to advance the investment program, and equally important, those decisions that are not yet ripe but should not be precluded from future consideration.