SOUTH STATION
EXPANSION

Appendix E - Rail Operations Analysis Technical Report

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massDOT
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1. Introduction

The purpose of this technical report is to summarize the basis of the operations analysis for the South Station Expansion (SSX) project. This includes the methodology and assumptions used in the railroad simulation modeling effort, and the results of the operational evaluation of two potential South Station Terminal configurations. This report follows up on the October 2014 South Station Expansion Project Draft Environmental Impact Report (DEIR) Appendix 2 – *Track Configuration Alternatives Analysis - Tier 1 Screening Technical Report.*

The main findings from the rail operations analysis are as follows:

- Alternative 2 provides seven additional platform tracks and reconfigures Tower 1 Interlocking in its entirety. This alternative maximizes the number of parallel moves through the terminal to increase operational efficiency to the greatest extent possible, and reduces special trackwork in Tower 1 Interlocking. However, it limits the connection between certain platform tracks and the South Side layover facilities.

- Alternative 3 provides seven additional platform tracks and minimizes the amount of new trackwork by connecting to the existing South Station track configuration to the greatest extent possible. Special trackwork added to the existing Tower 1 Interlocking would maximize access to platform tracks from each approach track. Alternative 3 would provide increased flexibility for non-revenue moves between the station platform tracks and the South Side layover facilities. However, it limits access between certain platform tracks and the NEC.

2. Background

The existing South Station Terminal is currently constrained and operating at capacity during the morning and evening peak periods. The configuration of the existing platforms and track infrastructure limits South Station's capacity.

The most critical piece of South Station's track infrastructure is the Tower 1 Interlocking, a major series of signals and switches located immediately outside of the South Station platforms. Tower 1 Interlocking controls train movements between the South Station platforms and the main line tracks of two major rail corridors – one approaching South Station from the south and one from the west. There are nine main line approach tracks, which currently converge through Tower 1 Interlocking and then expand into 13 station tracks and eight platforms in the South Station Terminal area. Of these nine main line tracks, five mainline tracks arrive at South Station from the west, consisting of the NEC Main Line, which operates on Tracks 1, 2, and 3, and the Framingham/Worcester Line, which operates on Tracks 5 and 7. The remaining four main line tracks arrive at South Station from the south, and consist of the Fairmount Line/Dorchester Branch, which operates on Fairmount Line/Dorchester Branch Tracks DB1 and DB2 and the Old Colony Line, which operates on Tracks OC1 and OC2. These four tracks also access the Amtrak and MBTA train maintenance facilities and layover yards.

The existing Tower 1 Interlocking allows a train approaching South Station, on any track, to reach nearly every platform track, effectively limiting the number of trains that can simultaneously move through the interlocking. As shown in the graphic, limiting the number of platforms each train can access increases the parallel moves through the terminal interlocking. In addition, the infrastructure layout forces diverging moves to be made at reduced speeds (10 miles per hour [mph]) in the Tower 1 Interlocking. Cove and Broad Interlockings do not have the capability to allow for the diverging moves needed for efficient operations in and out of the terminal area, forcing many diverging moves to be made at Tower 1

Interlocking (at 10 mph vs. 30 mph at Cove Interlocking), creating more conflicts and resulting in additional delays.

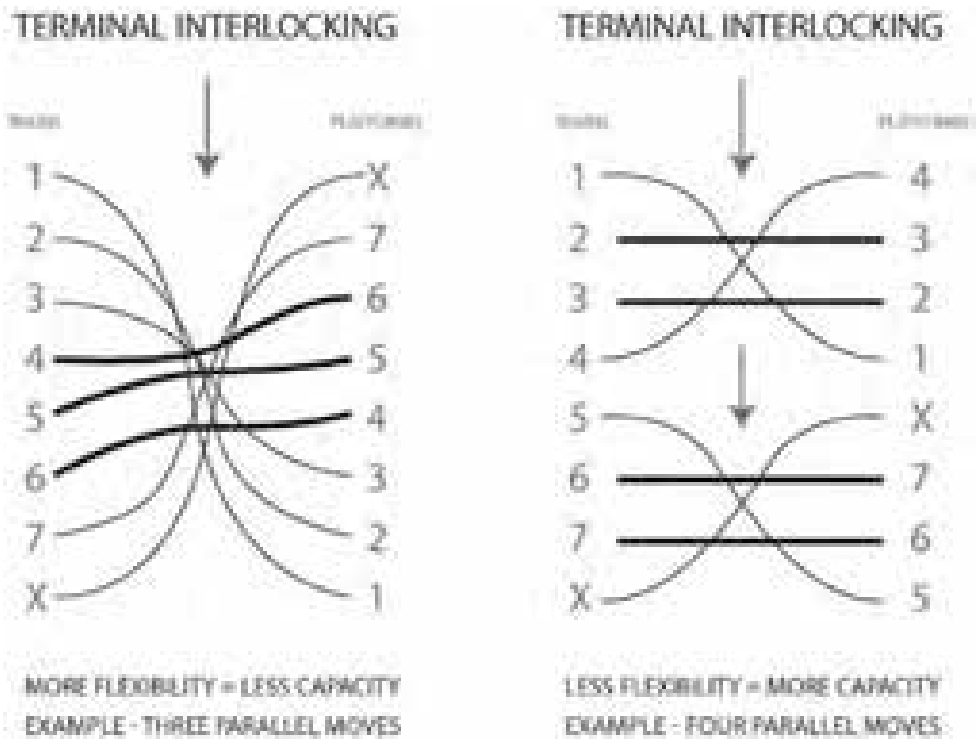

Figure 1 — Capacity versus Operations Example

In addition to the capacity constraints of the Tower 1 Interlocking infrastructure, the lack of adequate layover facilities to the west of South Station creates serious conflicts within the terminal area. Currently, non-revenue yard movements from the stations' lower tracks must cross over to the Dorchester Branch tracks that provide layover access to the Southampton Street Facilities (Front Yard and MBTA's South Side Service and Inspection facility) and Readville (Yard 2). These non-revenue movements restrict access to most of the South Station platforms, obstructing operations on the high-speed NEC into the terminal. As Amtrak and MBTA service volumes increase, these conflicts will be magnified, making it difficult to provide reliable operations. Additional revenue trains associated with the expanded operations will need to compete for limited capacity and terminal track space, which will be further exacerbated by non-revenue trains moving between the terminal and yards.

During the earlier stages of project development, MassDOT identified and evaluated a first set of rail infrastructure alternatives for consideration at the SSX project site. These concepts were developed and evaluated as a part of a first level, or Tier 1, analysis, which are detailed in the October 2014 South Station Expansion Project Draft Environmental Impact Report (DEIR) Appendix 2 – *Track Configuration Alternatives Analysis - Tier 1 Screening Technical Report.*

Based upon evaluation of the various alternatives for platform berthing, infrastructure maintenance, constructability, and order-of-magnitude capital costs, MassDOT determined that Constrained Rail Alternatives 2 and 3 should be advanced into a Tier 2 analysis. To support this effort, operations simulation modeling was conducted for Constrained Rail Alternatives 2 and 3. This work was done to support a portion of the analysis described in FEIR Appendix D - *Track Configuration Alternatives Analysis - Tier 2 Screening Technical Report* and evaluated each alternatives ability to meet future South

Station operational needs, which included measuring the ability to accommodate future service plans and meet on-time performance (OTP) and delay goals, as follows:

- **Accommodate future service plans**. By the year 2035, Amtrak projects 80 weekday revenue trips and 58 weekday non-revenue trips, representing a 100% revenue service increase above current levels. By 2035, the MBTA projects up to 315 weekday revenue trips and 101 weekday non-revenue trips, representing a 13% revenue service increase above current levels. Projections of train movements in and out of South Station are estimated to be a total of 554 daily trains by the year 2035, representing an overall increase of 23% above current revenue service levels.[1]
- **Meet OTP and delay goals**. OTP and delay goals have been established for the South Station complex, which includes the South Station platforms, Tower 1 Interlocking, and the key approach interlockings at Cove on the NEC and Broad in the Southampton Street area. OTP goals for the South Station area are consistent with the current service delivery policy goals of 95% OTP for MBTA[2] commuter rail trains and 95% OTP for Amtrak Acela and Northeast Regional services.[3] The delay percentage represents the percentage of time the trains are operating at less than their maximum or optimal operating speed, and demonstrates the amount of flexibility the given infrastructure has to support the simulated operations. Delay goals are generally to minimize the percentage by which trains are delayed. Delay percentage is a useful statistic to compare infrastructure alternatives and judge their overall operational stability, as it shows the amount of flexibility the infrastructure alternatives have to support a given operating plan.

The following sections provide a detailed discussion of the proposed operations analysis effort, including the methodology and assumptions incorporated into the proposed operations simulation models and future 2035 operating plans. This technical report also summarizes the results of the operational analysis of Alternative 2 and Alternative 3.

3. Methodology

The proposed South Station Terminal track layouts were developed with the goal of increasing the capacity of South Station to meet future operational needs. This is accomplished not only by increasing the number of platform tracks at South Station from 13 to 20 tracks, but by also making improvements to the layouts of Tower 1 and Broad Interlockings to allow for more efficient operations for trains moving in and out of the South Station terminal. Both alternatives were then evaluated by their ability to meet the 2035 South Station operational needs, as measured by their ability to accommodate future service plans and to meet OTP goals, as further described below.

Berkeley's Rail Traffic Controller® (RTC) simulation software was used for the operations analysis of the SSX project. RTC is used to simulate the movement of trains through complex rail networks, such as the South Station terminal area and the Northeast Corridor (NEC). It can be used for a variety of purposes including simulations for operational studies and analyses and simulating real-time train operations. The RTC software simulates trains operating under "deterministic" or "randomized" conditions. Simulating under *deterministic* operations, all train equipment initially enters service on-time and follows fixed departure times and dwell times at stations according to the schedules. Simulating under *randomized*

[1] 2035 revenue service level weekday train movements are based on Massachusetts Department of Transportation. *Basis of Operations Analysis and Assumptions Verification Report*, Version 4. November 2014.

[2] According to the MBTA *Service Delivery Policy* (June 2, 2010), a train is considered on time if it is arriving or departing at a terminal station within 5 minutes of scheduled arrival and departure times. The MBTA Commuter Rail Schedule Adherence Standard for OTP is 95%.

[3] Amtrak Intercity Passenger Rail On-Time Performance: Twentieth Quarterly Report to Congress, February 2013. Viewed June 12, 2013 at www.fra.dot.gov.

conditions allows for the introduction of randomized delays to the simulation in order to observe the effects on the operations. This is important in order to determine the overall stability of an operation. Random delays happen in real day-to-day operations due to signal or track maintenance, malfunctioning equipment or disabled trains, or conflicts with other operations.

The RTC software was used to simulate future South Station rail operations of the two alternatives. To determine whether the infrastructure could support future operations, the heaviest operational period was selected for this analysis: the weekday PM peak period (4:00 PM to 7:30 PM). Existing conditions indicate that this period is the heaviest and most congested period of terminal operations given the large number of revenue and non-revenue Amtrak and MBTA trains.

4. Assumptions

In an effort to accurately reflect actual railroad operations in the model, the following assumptions were used in the operations analysis simulation models. The following list of assumptions was developed in consultation with project stakeholders and railroad operations staff:

- Model Limits
    - NEC Amtrak / MBTA Providence Line – Mansfield
    - MBTA Framingham/Worcester Line – CP-4/Beacon Park Yard
    - MBTA Needham Line – Forest Hills Station
    - MBTA Franklin Line – Readville Station
    - MBTA Fairmount Line – Readville Station
    - MBTA Old Colony Line – JFK Station
    - MBTA South Coast Rail – Future – Canton Junction
    - The analysis does not consider the impacts of proposed future operations beyond the limits of the South Station terminal area.
- Peak Period
    - Weekday afternoon/evening period (4:00 PM to 7:30 PM)
- Operations
    - All Amtrak and MBTA revenue and non-revenue train movements between the South Station terminal, existing layover facilities at Southampton Street and Readville-Yard 2, and assumes proposed layover facilities at Widett Circle and Beacon Park Yard.
    - 2035 Amtrak, MBTA and New England Regional (Inland) operating plans/service levels as provided by or developed with input from stakeholders. (See the following section for additional information on future operating plans.)
- Dwell Times
    - MBTA low-level platform stations: 120 seconds peak, and 45 seconds off-peak at Mansfield, Sharon, Route 128 and Back Bay (Tracks 5 and 7) Stations.
    - MBTA high-level platforms station: 60 seconds peak, and 30 seconds off-peak station dwells.
    - Amtrak stations: 120 seconds peak, and 60 second off-peak and reverse direction peak period dwells.

- Turn Times
    - MBTA turn times are scheduled for 15 minutes, where possible, but will allow for no less than 10 minutes per the MBTA standard operating minimum.
    - All Amtrak Acela and Regional trains return to Southampton Street Facilities between revenue moves, with the exception of four mid-day Acela train turns specified below, for which the trains remain on the platform to turn between the revenue moves:
        - 2190-2165
        - 2150-2167
        - 2154-2173
        - 2158-2175
- Rolling Stock
    - All diesel MBTA trainsets have one F40PH-2C locomotive pulling eight coaches. The future South Coast Rail service to New Bedford and Fall River will have one HHP-8 electric locomotive to pull eight coaches.
    - The 2035 Amtrak Acela trainsets will have two AECP locomotives and eight Acela coaches. The 2035 Amtrak Regional trains will use one HHP-8 electric locomotive to pull ten coaches. The 2035 Amtrak Regional Inland trains will use one F40PH-2C diesel locomotive to pull eight coaches. Amtrak Lake Shore Limited trains will use two F40PH-2C diesel locomotives to pull six coaches.
    - The Future Inland New England Regional trains will use one F40PH-2C diesel locomotive to pull three coaches.

5. Future 2035 Operating Plans

The future simulation models include all planned 2035 MBTA and 2035 Amtrak operations within the study area limits as described below. These service plan assumptions were developed with or provided by MBTA and Amtrak stakeholders as inputs for this operations' analysis.

5.1. Future 2035 MBTA Operations

By 2035, the MBTA's proposed plan will provide 315 weekday revenue trips and 101 weekday non-revenue trips in South Station. For the 2035 MBTA commuter rail service, it was assumed that, with the exception of the Old Colony Lines, each MBTA commuter rail line would gain one additional peak period/peak direction trip. As determined in the *MassDOT Boston South Station HSIPR Expansion Project, Technical Memorandum: Network Simulation Analysis of Proposed 2030 MBTA/Amtrak Operations at South Station Final Report, dated August 1, 2010,* due to capacity constraints, the Old Colony Main Line cannot accommodate additional service without infrastructure improvements.

With the exception of the Fairmount Line, the MBTA Commuter Rail schedules and South Side equipment cycle, effective April 29, 2013, were used as the starting point for these operational inputs. On the Fairmount Line, it was assumed that the four new or planned stations (Newmarket, Four Corners, Talbot Avenue, and Blue Hill Avenue) will be in service by 2035 and that all Fairmount Line trains will stop at all of the existing and new stations. The Fairmount Line service for the future simulation models

is based on service levels specified by CTPS.[4] The 2035 Fairmount Line service, included in the simulation models, will operate with 25-minute headways in the peak periods and at an average of 40-minute headways midday and at nighttime.

The future simulation models also include the proposed 2030 South Coast Rail service to New Bedford and Fall River. This service is based on the proposed South Coast Rail Stoughton Electric Alternative taken from the *Draft Technical Report: Operations Analysis of the Stoughton Electric Alternative*.[5]

These service plan assumptions and service levels for future 2035 MBTA commuter rail service were developed into a future 2035 MBTA South Side operating plan, including full day future schedules for each service and a future South Side equipment cycle. The future full day 2035 MBTA schedules and equipment cycle are attached in Attachments A and B.

5.2. Future 2035 Amtrak Operations

By the year 2035, Amtrak projects 80 weekday revenue trips and 58 weekday non-revenue trips. Future 2035 Amtrak operations are based on the Northeast Corridor Intercity Service Alternative: "B-Low 2020-2040" operating plan provided by Amtrak.[6] The assumed 2035 Amtrak operations will include 14 Acela and nine Regional trains on the NEC in both the northbound and southbound directions. The service plan also includes four projected Inland Regional round trips, and one Inland Lake Shore Limited round trip. It is worthwhile to note that the FRA is currently analyzing the potential future growth along the NEC between Washington, DC and Boston as part of the NEC Future Project, which analyzes alternatives proposing to significantly increase railroad operations along the entire NEC.

The future 2035 operations also includes a proposed Inland New England Regional InterCity service to Springfield. This future service is also based on the Northeast Corridor Intercity Service Alternative: "B-Low 2020-2040" operating plan provided by Amtrak, and includes 12 round trips. The future full day 2035 Amtrak and New England Regional schedule are attached in Attachment B. The future 2035 full day South Station platform Track Occupancy Chart is also attached in Attachment D.

5.3. Future Freight Operations

Future freight operations were assumed to operate as they do today within the project study area. For the purposes of the simulation, existing freight windows were preserved so that no existing freight routes would be adversely impacted.

[4] *Description of Modeling Assumptions and Analysis Methodology for the State Implementation Plan Transit Commitment Projects Current and Proposed Substitutions.* Executive Office of Transportation. March 13, 2007.

[5] *Draft Technical Report, Operations Simulation, Stoughton Electric Alternative.* MassDOT, July 2012.

[6] Northeast Corridor Intercity Service Alternative: "B-Low 2020 – 2040" operating plan provided by Amtrak on November 11, 2013.

5.4. Future Midday Layover Operations

In addition to all revenue train moves, the simulation models also include all MBTA and Amtrak non-revenue train movements between South Station and the layover facilities.

Under existing conditions at South Station, given the configuration of the Tower 1 Interlocking, MBTA trains must cross several main line tracks to access the existing midday layover facilities on the south side of the terminal. When these trains cross through Tower 1, other trains are temporarily restricted from entering or exiting Tower 1 until those trains have cleared. Valuable main line capacity and capacity at South Station are expended by these conflicting train movements.

Having MBTA layover facilities to the west and to the south, along both major rail corridors accessing South Station, would make railroad operations at South Station more efficient and would better accommodate future service growth.

All Amtrak trains enter the South Station Terminal from the west and lay over at existing Southampton Street Yard on the south and will continue to do so in the future. As such, locating MBTA layover facilities to the west and the south would provide many benefits, including: allow Amtrak trains near exclusive use of the central platforms at South Station; allow for a greater number of trains to move in and out of the terminal; and reduce conflicting movements at Tower 1 that consume critical railroad operational capacity. To optimize South Station operations, MBTA revenue trains entering South Station from the south ideally would layover on the south. Likewise, MBTA revenue trains entering from the west ideally would lay over on the west. While there will always be a need for some trains to cross over between the south and west at Tower 1, providing two MBTA separate midday layover facilities would considerably increase South Station's capacity and efficiency of operations.

For the purpose of the 2035 operations analysis, future MBTA proposed midday layover facilities were assumed at Widett Circle and Beacon Park Yard in addition to the existing facilities at the MBTA's South Side Servicing and Inspection (S&I) and Readville - Yard 2 facilities. The proposed future 2035 MBTA equipment cycle developed for the purposes of this operations analysis identified the MBTA equipment trainsets assigned to each midday layover facility. The MBTA equipment would be rotated as necessary on two or three day cycles, as is done today, to balance equipment usage and meet maintenance requirements.

6. Future Infrastructure

During the earlier stages of project development, MassDOT identified and evaluated a first set of rail infrastructure alternatives for consideration at the SSX project site. These concepts were developed and evaluated as a part of a first level, or Tier 1, analysis, which are detailed in the October 2014 South Station Expansion Project Draft Environmental Impact Report (DEIR) Appendix 2 – *Track Configuration Alternatives Analysis - Tier 1 Screening Technical Report.* From this analysis, Alternatives 2 and 3 were identified to be advanced further into a Tier 2 analysis, for which an operations analysis would be performed.

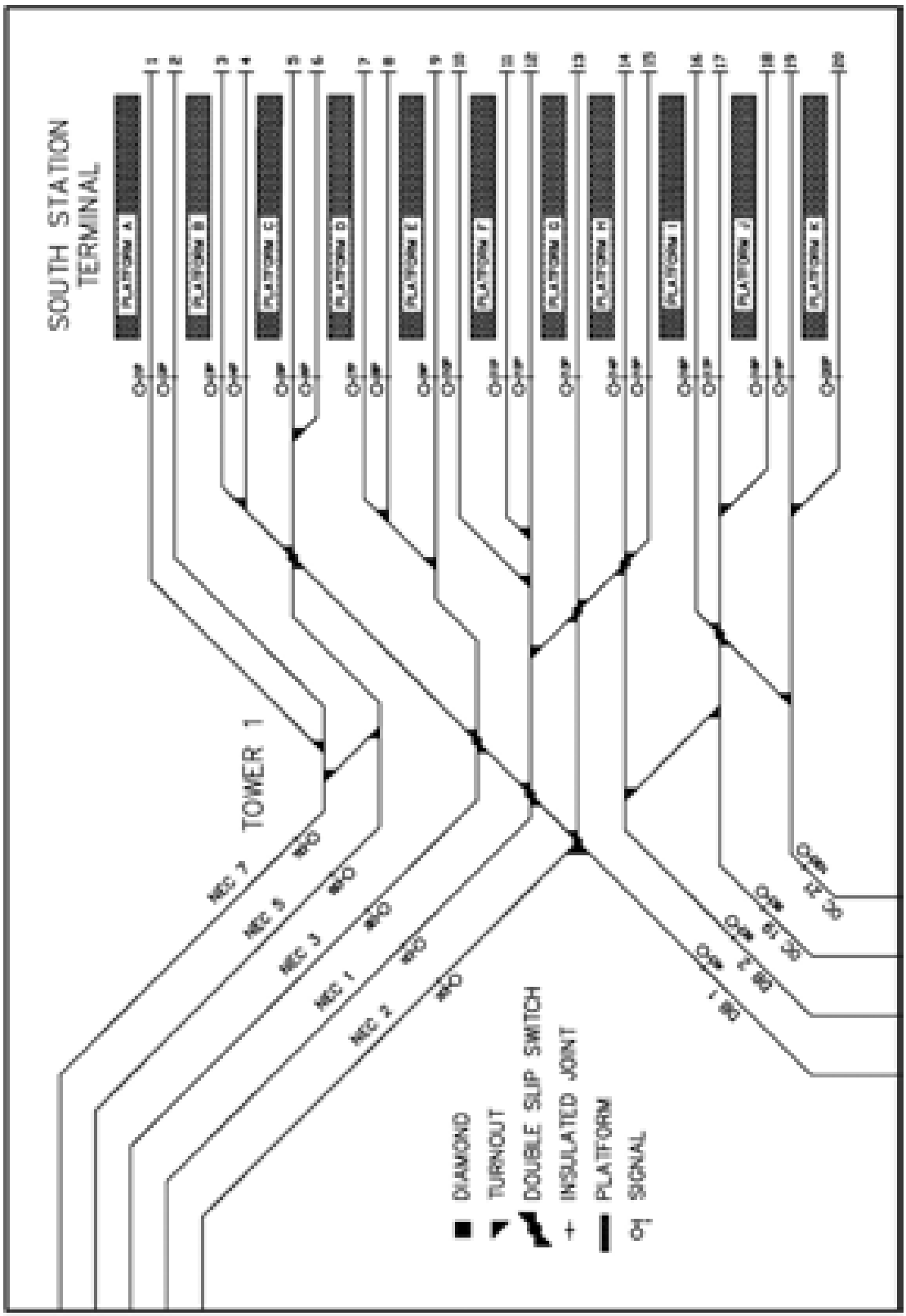

Figure 2 — Alternative 2

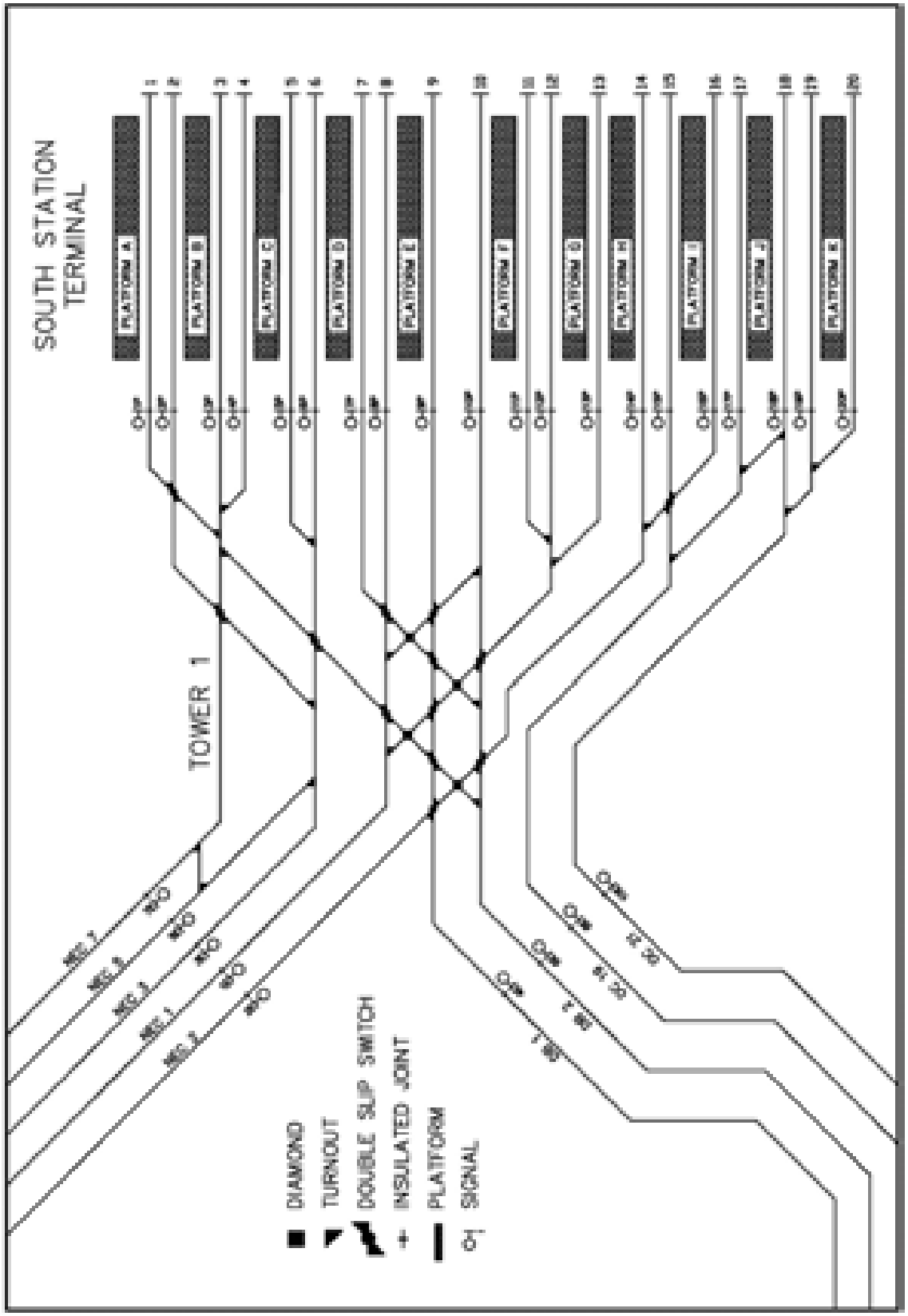

Figure 3 — Alternative 3

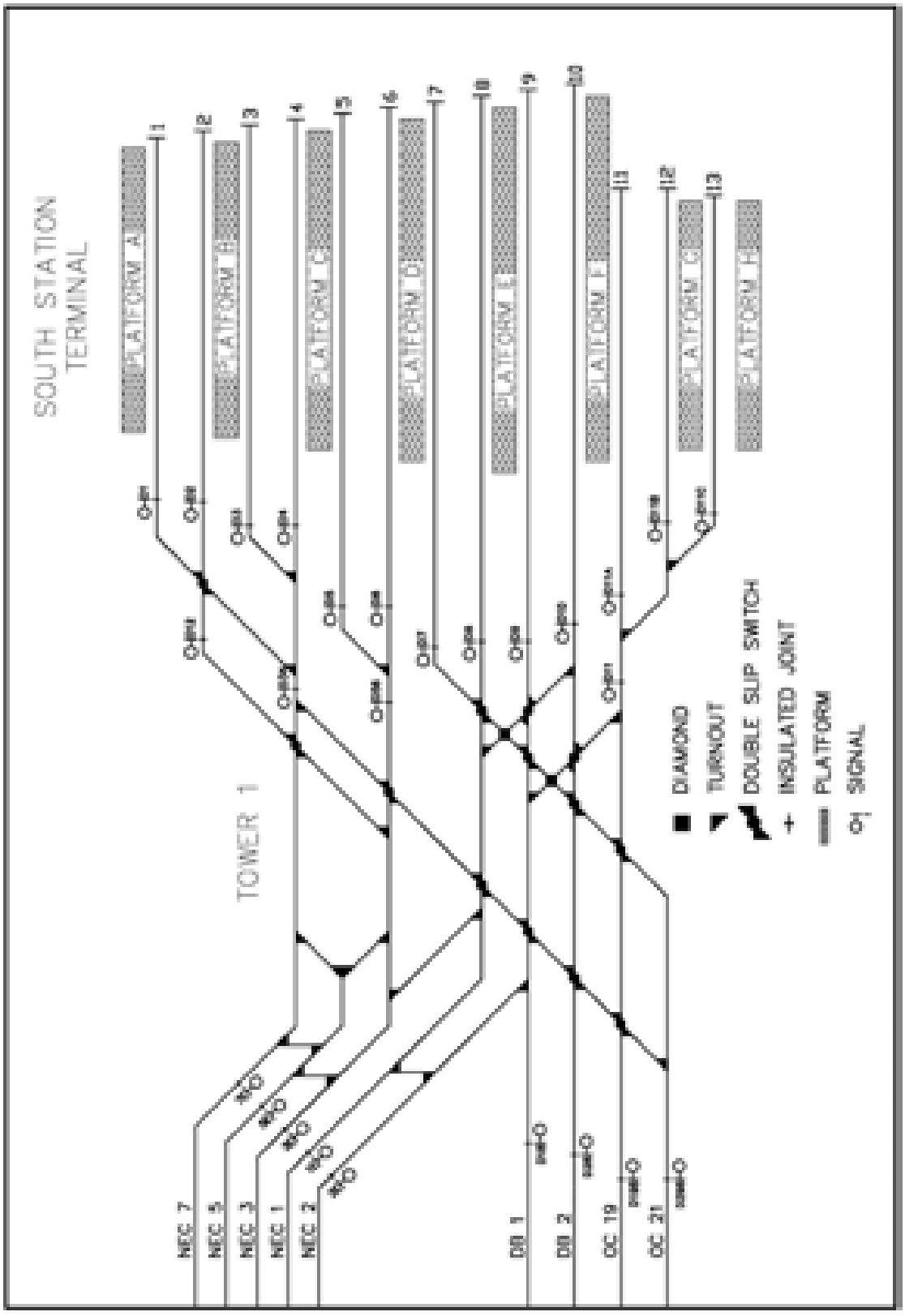

Figure 4 — Existing Conditions

The infrastructure for Alternatives 2 and 3 was developed to support operational efficiencies within the South Station Terminal area, including the ability to provide multiple parallel moves through the Tower 1 Interlocking, and to better access platform berths. The following describes some of the operational benefits of the track configurations developed for Alternatives 2 and 3:

- **Parallel Moves through Tower 1 Interlocking**: The existing South Station layout can support up to six parallel moves through Tower 1 Interlocking. The proposed layout of Tower 1 Interlocking in Alternatives 2 and 3 can support up to eight and seven trains simultaneously moving through the Tower 1 area, respectively.

- **Efficiencies for Platform Berthing:** The proposed alternatives encourage the use of "setup interlockings" at Cove and Broad interlockings to make faster and more efficient crossover moves and to better prepare trains for access to berth at the platforms, while still providing operational flexibility in the event of failures. By using the setup interlockings at Cove and Broad interlockings for crossover movements, South Station could be dissected into "mini terminals" with dedicated platform areas for south and west side services. Because the Tower 1 Interlocking has speed limitations of less than 10 mph, the use of the higher speed (> 30 mph) Cove and Broad interlockings for crossovers would make the necessary crossing movements more efficient, allow for faster movement, and significantly reduce conflicting movements in Tower 1.

Toward these goals, simulation models were developed for each Alternative to test its ability to support the future South Station operations. The following sections summarize each of the infrastructure alternatives simulated, and their operational advantages and disadvantages.

6.1. Alternative 2

The Alternative 2 Tower 1 Interlocking layout is a reconfiguration of the Tower 1 Interlocking connecting the proposed 20 platform tracks with the Northeast Corridor (NEC), the Fairmount Line/Dorchester Branch, and the Old Colony Branch (see Figure 1). The Alternative 2 layout would streamline terminal operations and sectionalize the operations into "mini terminals" to reduce the number of conflicting movements at the critical junction. The Alternative 2 Tower 1 Interlocking layout would support up to eight parallel train movements simultaneously between the nine approach tracks and 20 platform tracks, including five parallel movements to or from the five approach tracks from the NEC and MBTA Worcester Line. For comparison, the existing Tower 1 Interlocking layout can currently support a total of six parallel movements, with the possibility of four parallel movements to or from the NEC and Worcester Line approach tracks.

Alternative 2 makes extensive use of the setup interlockings, such as Cove Interlocking, to allow trains to approach South Station on the appropriate track leads and to quickly move into the desired platform locations while crossing over as few other approach tracks within Tower 1 Interlocking as possible. This operating philosophy would reduce the number of conflicting movements required in the terminal Tower 1 Interlocking, and allow for increased capacity through the terminal area.

In the Alternative 2 layout, a train approaching Tower 1 from NEC Tracks 1-3 would be able to reach only platform Tracks 3-15. Platform Tracks 1 and 2 would not be accessed from these approach tracks, as a result of the lengthening of the platforms and the loss of the connection to these tracks in Alternative 2. Alternative 3 maintains the existing platform length for platform Tracks 1 and 2 and, as such, trains approaching from NEC Tracks 1-3 would be able to access platform Tracks 1-15. The Old Colony and Fairmount Lines would primarily be berthed on Tracks 16-20.

In Alternative 2, there would be operational challenges for non-revenue moves between platform Tracks 3-13 and the South Side layover facilities along the Fairmount Line/Dorchester Branch. In this configuration, platform Tracks 3-13 would only be accessible via Dorchester Branch Track 1 approaching Tower 1 interlocking from the south. In the PM period, non-revenue service coming from the South Side layover facilities would all be routed over this single route of access to reach these platform tracks to prepare for revenue service. These non-revenue moves would be scheduled sequentially and take advantage of gaps between arriving and departing revenue service in Tower 1 in order to reach the appropriate platform track without conflicting with revenue operations and causing delay. As evident in the randomized simulations and described in more detail in the following sections, the Alternative 2 layout and the future operating plan would be robust enough to handle these non-revenue moves with limited delay to revenue service and without significantly impacting on time performance.

6.2. Alternative 3

The Alternative 3 Tower 1 Interlocking layout considers the addition of Tracks 14-20 while maintaining as much of the existing infrastructure as possible (see Figure 2). In this layout, most of the existing special trackwork would remain.[7] Due to the remaining existing infrastructure within Tower 1, arriving and departing trains (specifically those accessing Tracks 7-16 from the NEC) would be forced to make slower single access point maneuvers through the Tower 1 Interlocking, reducing the ability for simultaneous parallel moves.

The Alternative 3 Tower 1 Interlocking layout could support up to seven parallel moves simultaneously between the nine approach tracks and 20 platform tracks, including four parallel movements to or from the five approach tracks from the NEC and Worcester Line. However, if any trains from the NEC tracks were routed to a platform track higher than Track 10, the number of possible simultaneous parallel moves would be reduced to six.

In Alternative 3, a train approaching Tower 1 from NEC Tracks 1 or 2 would be able to reach platform Tracks 1-14 to berth. As in Alternative 2, ideally any crossover moves would be made more efficiently at higher speeds in Cove Interlocking to allow the train to approach South Station on the appropriate track lead and to quickly move into the desired platform location. However, the remaining existing special trackwork in Alternative 3 duplicates many of these crossover moves in Tower 1, forcing moves to be made at slower speeds while crossing over other approach routes through the interlocking.

Alternative 3 was designed to provide the additional seven platform tracks and connect them to the existing South Station layout by adding special trackwork to the existing Tower 1 layout in order to maximize the access to platform tracks from each approach track. When compared to Alternative 2, Alternative 3 would not provide the same operational efficiency or number of parallel moves. However, because it would provide two ladder tracks from the Fairmount Line/Dorchester Branch, Alternative 3 would provide greater flexibility for non-revenue moves between the platform tracks and the South Side layover facilities.

The significant amount of special trackwork throughout the Tower 1 Interlocking layout would pose several challenges for operations in the terminal as described below.

Alternative 3 would allow trains approaching the station from the NEC to access platform Tracks 1-16 from NEC Track 2. However, outbound revenue trains departing from South Station platforms

[7] Special trackwork is a collective railroad term for all components and accessories of turnouts and crossovers or similar track features, including switches, double slip switches, and diamonds.

Tracks 14-16 that must access the NEC could only reach NEC Track 2, which is primarily Amtrak's inbound track. These trains must be routed via NEC Track 2 between Tower 1 and Cove Interlockings, where they could then switch tracks to the primarily outbound NEC Track 1. This operational challenge makes berthing trains on platform Tracks 14-16 less desirable when the trains are turning for outbound NEC revenue service, unless there is no other alternative. If it is necessary to berth trains on these platforms that are turning for outbound NEC service, the operating plan must allow for the outbound move via NEC Track 2 in between any inbound service from the NEC or route the inbound service to avoid creating conflicts and delay on NEC Track 2.

A second operational challenge posed by Alternative 3 concerns the access between NEC Track 3 and the South Station platform tracks. In Alternative 3, only four parallel moves would be possible between the station platform tracks and the five approach tracks from the west (the three NEC tracks and the two Worcester Line tracks). Due to the amount of special trackwork added to the Tower 1 Interlocking, it is not possible to connect NEC Track 3 to the terminal as its own approach track into the station. As a result, NEC Track 3 and NEC Track 5 combine as one approach in Tower 1 Interlocking, and trains approaching South Station on those tracks could only access platform Tracks 1-6. Corridor trains needing to access higher platform tracks must approach the terminal from NEC Tracks 1 or 2, limiting the number of parallel moves that can be made simultaneously. This is compared to Alternative 2, where NEC Track 3 would have a separate approach from NEC Track 5 into the terminal and can access platform Tracks 7-9, allowing for an additional parallel move between the station platform tracks and the NEC.

A third operational challenge posed by the Alternative 3 layout would be track access to platform Tracks 16-20 for Fairmount Line and Old Colony Line service. The primary platform tracks for berthing Fairmount Line trains would be Tracks 16 and 17, and Old Colony Line trains would primarily berth on Tracks 18-20. In Alternative 3, platform Track 17 could only be accessed from Old Colony Track 19, forcing Fairmount service to approach from that track and creating the potential for conflicts with Old Colony Line service. Platform Track 16 could be accessed from both Fairmount Line/Dorchester Branch Tracks 1 and 2 and Old Colony Track 19. This provides flexibility for routing Fairmount Line service as the trains can be routed directly to or from the Dorchester Branch tracks. However, a Fairmount Line train arriving or departing platform Track 16 to Dorchester Branch Track 2 would prevent a parallel move to or from platform Tracks 14 or 15. Similarly, a Fairmount Line train arriving or departing platform Track 16 to Dorchester Branch Track 1 would prevent a parallel move to or from platform Tracks 14 or 15, as well as conflict with any train moving between any platform track and the Dorchester Branch tracks or NEC Track 2. In comparison, Alternative 2 would provide more flexible track access for Fairmount Line and Old Colony Line trains. Trains could move between platform Tracks 16-18 and Fairmount Line/Dorchester Branch Track 2, Old Colony Track 19 and Old Colony Track 20 without conflicting with train movements to or from platform tracks lower than Track 16. With future increased Fairmount Line service frequencies, these challenges for the Alternative 3 layout would increase conflicts and delay for Fairmount Line and Old Colony Line services.

7. Operations Analysis Results

The future 2035 South Station Tower 1 Interlocking layouts, Alternative 2 and Alternative 3, were simulated using Berkeley's RTC simulation software. To determine whether the infrastructure of each alternative could support the future operations, the heaviest operational period was selected for this analysis: the weekday PM peak period (4:00 PM to 7:30 PM). Existing conditions indicate this as the heaviest and most congested period of terminal operations given the large number of revenue and non-revenue Amtrak and MBTA trains. Future 2035 MBTA and Amtrak schedules indicating which trains were included in the simulation models are attached in Attachment B.

The RTC software provided the ability to simulate trains operating under "deterministic" and "randomized" conditions. Simulating under *deterministic* operations, all train equipment initially enters service on-time and follows the fixed departure and dwell times at stations according to the proposed schedules. In this scenario, it is anticipated that the model would determine that all trains would operate at 100% on time, as may occur under ideal conditions. However, in order to evaluate the more realistic occurrences that occur on the railroad on a daily basis, it is necessary to simulate the operations under *randomized* conditions, which would allow for the introduction of randomized delays to the simulation in order to observe the effects on the operations. This is important in order to determine the overall stability of an operation. Random delays happen in real day-to-day operations due to signal or track maintenance, malfunctioning equipment or disabled trains, or conflicts with other operations. After inputting existing operating plans into the RTC model under deterministic conditions, the simulation is run under randomized conditions to determine more realistic effects on existing operations.

The simulation models for the alternatives were run under deterministic and randomized conditions as described below.

7.1. Deterministic Simulation Results

Tables 1 and 2 summarize the delay and OTP statistics of the deterministic (also referred to as "non-randomized") simulation results for the PM peak period (4:00 PM to 7:30 PM) for Alternative 2 and Alternative 3, respectively. The deterministic results for both Alternative 2 and Alternative 3 indicate that the proposed infrastructure would support proposed future operations and meet the MBTA Commuter Rail Schedule Adherence Standard and Amtrak target, exceeding the on-time performance threshold with 100% of all trips departing and arriving at terminals within five minutes of scheduled departure and arrival times. Achieving 100% on-time performance indicates that the model is accurate and that the proposed infrastructure can support the proposed service under deterministic conditions.

While on-time performance under non-randomized conditions is intended be 100% in order to test the stability of the model, delay is defined as the difference between the minimum, or unopposed, run time, and the actual run time required to traverse the route. The percentage of delay represents the extra time it takes a train to travel its route due to conflicts with other trains. As such, a percentage of delay will always be found in a model with mixed traffic, even under deterministic conditions. However, lower delay percentages are preferred and can be utilized to compare infrastructure alternatives to compare the amount of flexibility that the proposed infrastructure has to support the proposed operations. Delays due to each conflict are combined to determine the total percentage of delays for each type of service, as well as for the total operation.

Table 1 — Alternative 2 – Non-Randomized OTP Results

Train Type	Delay Percentage (%)	On-Time Performance (%)
MBTA	2 %	100 %
Amtrak Acela	< 1 %	100 %
Amtrak Regional	5 %	100 %
Amtrak NE Regional	< 1 %	100 %
Total	**2 %**	**100 %**

Table 2 — Alternative 3 – Non-Randomized OTP Results

Train Type	Delay Percentage (%)	On-Time Performance (%)
MBTA	2 %	100 %
Amtrak Acela	< 1 %	100 %
Amtrak Regional	7 %	100 %
Amtrak NE Regional	< 1 %	100 %
Total	**2 %**	**100 %**

The 2035 operations analysis string line diagrams, presented in Attachment C, further demonstrate that the future PM peak period operations, in the idealized conditions, would exceed all MBTA and Amtrak targets. The attached Future Platform Track Occupancy Charts represent the South Station berthing times and platform locations applied in this PM peak period weekday simulation analysis, under deterministic conditions.

7.2. Randomized Simulation Results

As noted previously, simulating under randomized conditions allows for the introduction of randomized delays to the simulation in order to observe the effects on the operations, which helps determine the overall stability of an operation. Random delays happen in real day-to-day operations due to signal or track maintenance, malfunctioning equipment or disabled trains, or conflicts with other operations. For this analysis, the randomization parameters for all inbound Amtrak and MBTA Commuter Rail services were set to randomly delay train station dwell times by up to a maximum of three minutes for Amtrak and up to a maximum of four minutes for the MBTA at Back Bay Station. Train departure times at JFK Station were set to be randomly delayed up to a maximum of four minutes for MBTA Old Colony Line inbound service. Train departure times at Readville Station were set to be randomly delayed up to a maximum of four minutes for MBTA Fairmount Line inbound service. After successfully inputting the proposed future Amtrak and MBTA operations under deterministic conditions, the simulation was dispatched under randomized conditions to determine each alternatives' ability to accommodate future levels of service under realistic settings.

The randomized simulations were run a total of ten times, omitting the two worst and two best simulation results to obtain average results with the remaining simulation runs. Averaged delay[8] and OTP[9] statistics for the simulation runs were then calculated to determine the impact of the Tower 1 Interlocking layout on future South Station operations. The randomized simulations were run to test the overall stability of the operation and compare the results of Alternatives 2 and 3. For the most congested time at South Station, the PM peak period (4:00 PM to 7:30 PM), the results of the OTP and delay analysis are shown in Tables 3 and 4 under randomized conditions. The results for each individual trainset are also provided in Attachment E. As shown below, on-time performance as well as delays due to each conflict were combined to determine the total percentage of OTP and delays for each type of service, as well as for the total operation. The averaged total delay percentage was 7% for all trains, MBTA and Amtrak, in Alternative 2. The average OTP of all trains was approximately 96% for all MBTA and Amtrak trains. These results indicate that the proposed Alternative 2 infrastructure is robust and flexible enough to

[8] The delay percentage represents the percentage of time trains are operating at less than their maximum or optimal operating speed, and demonstrates the amount of flexibility the given infrastructure has to support the simulated operations.

[9] According to the MBTA Service Delivery Policy (June 2, 2010), a train is considered on time if it is arriving or departing at a terminal station within 5 minutes of scheduled arrival and departure times. The MBTA Commuter Rail Schedule Adherence Standard for OTP is 95%. Amtrak's target is 95% OTP for Acela and Regional services, according to the Amtrak Intercity Passenger Rail On-Time Performance: Twentieth Quarterly Report to Congress (February 2013, viewed June 12, 2013 at www.fra.dot.gov).

provide reliable service given the proposed track configuration layout and increase in future 2035 trip volumes.

Table 3 — Alternative 2 – Randomized OTP Results

Train Type	Delay Percentage (%)	On-Time Performance (%)
MBTA	7 %	96 %
Amtrak Acela	7 %	100 %
Amtrak Regional	7 %	100 %
Amtrak NE Regional	6 %	100 %
Total	**7 %**	**96 %**

As shown in Table 4, the averaged total delay percentage for Alternative 3 was determined to be 13% for all MBTA and Amtrak trains. The averaged total OTP was determined to be approximately 94%, with 100% of Amtrak trains arriving at 100% OTP and MBTA slightly less at 93%. These results indicate the proposed Alternative 3 infrastructure is robust and flexible enough to provide reliable service given the proposed track configuration layout and increase in future 2035 trip volumes.

Table 4 — Alternative 3 – Randomized OTP Results

Train Type	Delay Percentage (%)	On-Time Performance (%)
MBTA	13 %	93 %
Amtrak Acela	13 %	100 %
Amtrak Regional	13 %	100 %
Amtrak NE Regional	15 %	100 %
Total	**13%**	**94 %**

8. Findings

As described previously, the purpose of this analysis was to evaluate operationally Constrained Rail Alternatives 2 and 3. Operations simulation modeling was conducted for these alternatives and the findings of this analysis was included as a one criterion, of several, in the FEIR Appendix D - *Track Configuration Alternatives Analysis - Tier 2 Screening Technical Report,* which was used to identify a preferred track configuration for South Station. The main findings from the rail operations analysis are as follows:

- Alternative 2 provides seven additional platform tracks and reconfigures Tower 1 Interlocking in its entirety. This alternative maximizes the number of parallel moves through the terminal to increase operational efficiency to the greatest extent possible, and reduces special trackwork in Tower 1 Interlocking.

- Alternative 3 provides seven additional platform tracks and minimizes the amount of new trackwork by connecting to the existing South Station track configuration to the greatest extent possible. Special trackwork was provided to the existing Tower 1 Interlocking to maximize access to platform tracks from each approach track.

Operations simulation modeling was conducted for the alternatives and evaluated for their capacity to meet future South Station operational needs, as measured by their ability to accommodate future service plans and meet OTP and delay goals, described as follows:

- **Accommodate Future Service Plans**. By the year 2035, Amtrak projects 80 weekday revenue trips and 58 weekday non-revenue trips, representing a 100% revenue service increase above current levels. By 2035, the MBTA projects up to 315 weekday revenue trips and 101 weekday non-revenue trips, representing a 13% revenue service increase above current levels. Projections of train movements in and out of South Station are estimated to be a total of 554 daily trains by the year 2035, representing an overall increase of 23% above current revenue service levels.[10]
- **Meet OTP and Delay Goals**. OTP and delay goals have been established for the South Station complex, which includes the South Station platforms, Tower 1 Interlocking, and the key approach interlockings at Cove on the NEC and Broad in the Southampton Street area. OTP goals for the South Station area are consistent with the current service delivery policy goals of 95% OTP for MBTA[11] commuter rail trains and 95% OTP for Amtrak Acela and Northeast Regional services.[12] The delay percentage represents the percentage of time the trains are operating at less than their maximum or optimal operating speed, and demonstrates the amount of flexibility the given infrastructure has to support the simulated operations. Delay goals are generally to minimize the percentage by which trains are delayed. Delay percentage is a useful statistic to compare infrastructure alternatives and judge their overall operational stability, as it shows the amount of flexibility the infrastructure alternatives have to support a given operating plan.

The operations simulation models were developed for each alternative and were evaluated for how each would support future 2035 service levels, as well as on their OTP and delay performance. Additionally, operational efficiencies and limitations of each alternative were identified and are summarized below.

- **Ability to Meet Future Service Goals.** Both Alternative 2 and Alternative 3 would meet the 2035 future service plans for the MBTA and Amtrak.

- **Ability to Meet OTP and Delay Goals**. The average OTP during the PM peak period was simulated to be 96% for Alternative 2 and 94% for Alternative 3. Average delay in this condition was found to be 7% for Alternative 2 and 13% for Alternative 3. While the results show that trains in Alternative 2 experience less delay and greater OTP than in Alternative 3, these results indicate that both alternatives are robust and flexible enough to provide reliable service given the increase in future 2035 trip volumes.

- **Operational Efficiencies/Limitations.** Operational efficiencies related to parallel moves through the Tower 1 interlocking and access to tracks and platforms were evaluated for each alternative.

[10] 2035 revenue service level weekday train movements are based on Massachusetts Department of Transportation. *Basis of Operations Analysis and Assumptions Verification Report*, Version 4. November 2014.

[11] According to the MBTA *Service Delivery Policy* (June 2, 2010), a train is considered 100% on time if it is arriving or departing at a terminal station within 5 minutes of scheduled arrival and departure times. The MBTA Commuter Rail Schedule Adherence Standard for OTP is 95%.

[12] Amtrak Intercity Passenger Rail On-Time Performance: Twentieth Quarterly Report to Congress, February 2013. Viewed June 12, 2013 at www.fra.dot.gov.

Alternative 2 would require substantially less special trackwork through the Tower 1 Interlocking, providing for more efficient access between the approach tracks and the platform tracks, and allowing up to eight simultaneous parallel moves through the terminal.

Alternative 3 would not provide the same level of operational efficiency or number of parallel moves as Alternative 2; but it would provide increased flexibility for non-revenue moves between the station platform tracks and the South Side layover facilities with two ladders to access the Dorchester Branch tracks. However, the extent of special trackwork throughout the Alternative 3 Tower 1 Interlocking layout poses several challenges for operations in the terminal:

- It is not possible to connect NEC Track 3 as its own approach track into the terminal, requiring the track to combine with NEC Track 5 approach track. Trains approaching on this track would only be able to access platform Tracks 1-6, forcing NEC trains needing to reach higher platform tracks to approach the terminal on NEC Tracks 1 or 2.
- Trains moving between the NEC and platform Tracks 14-16 could only do so via NEC Track 2. This operational challenge makes berthing trains on platform Tracks 14-16 less preferable if the trains are turning for outbound NEC revenue service, unless there is no other alternative. If it is necessary to berth trains on these platforms that are turning for outbound NEC service, the operating plan must allow for the outbound move via NEC Track 2 in between any inbound service from the NEC or route the inbound service to avoid creating conflicts and delay on NEC Track 2.
- The Alternative 3 layout would limit the ability for Fairmount Line trains to access the station without conflicting with other services. Access to Platform Track 17 can only be reached from Old Colony Track 19. Any train moving between the Fairmount Line/Dorchester Branch tracks and platform Track 16 would conflict with trains moving to or from platform Tracks 14 or 15, and if the train is moving to or from Dorchester Branch Track 1 it would prevent other trains from making simultaneous moves between NEC Track 2 and any platform track.

Attachment A – Future 2035 Operating Plans

Future 2035 MBTA Equipment Cycle
Future 2035 South Station Platform Track Occupancy Chart

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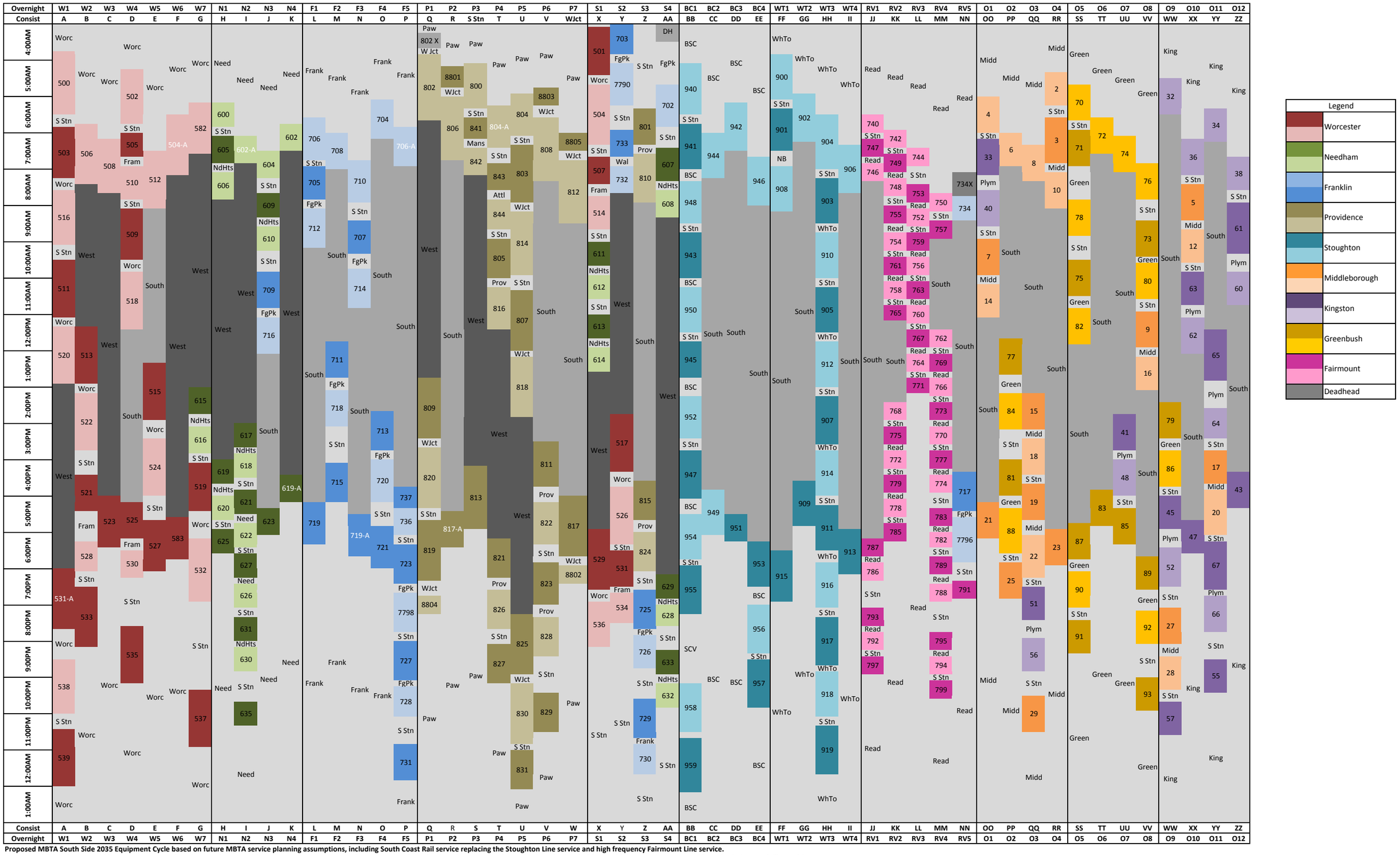


Proposed MBTA South Side 2035 Equipment Cycle based on future MBTA service planning assumptions, including South Coast Rail service replacing the Stoughton Line service and high frequency Fairmount Line service.
Assumes additional MBTA midday layover space at locations on the West side at the proposed Beacon Park Yard (BPY) and another location yet to be determined on the South side, in addition to existing MBTA S&I and Existing Readville Yard 2.
Assumes expanded MBTA overnight layover at terminal yards for each line.
Current configuration represents 52 active consists with 14 spares.

South Station Expansion Project - Operations Analysis
Proposed Future 2035 Track Occupancy Chart

December, 2015

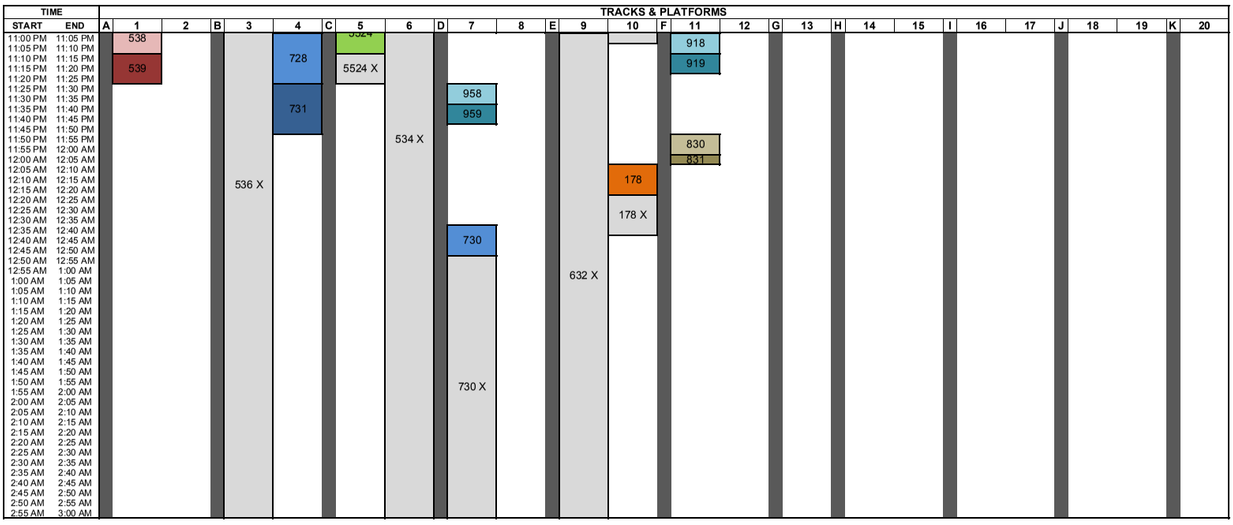
Project #12076.00

Legend

- Worcester
- Needham
- Franklin
- Providence
- Stoughton
- Middleborough
- Kingston
- Greenbush
- Fairmount
- Deadhead & Non-Revenue
- Acela
- Regional
- New England Regional
- Lake Shore Limited

TRACKS & PLATFORMS

TIME


TIME
START
END
TRACKS & PLATFORMS
A
1
2
B
3
4
C
5
6
D
7
8
E
9
10
F
11
12
G
13
H
14
15
I
16
17
J
18
19
K
20
538
539
728
731
5524 X
534 X
536 X
958
959
730
730 X
632 X
178
178 X
918
919
830
831

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Attachment B – Future 2035 Schedules

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Turn From	*Yard*	*Yard*	*501*	*Yard*	*Yard*	*Yard*	*Yard*	*505*	*Yard*	*507*	*503*	*509*	*511*	*513*	*515*	*517*	*521*	*525*	*519*	*531*	*529*	*531-A*
Northbound	**500**	**502**	**504**	**582**	**504-A**	**506**	**508**	**510**	**512**	**514**	**516**	**518**	**520**	**522**	**524**	**526**	**528**	**530**	**532**	**534**	**536**	**538**
Worcester	4:45	5:15	5:40	6:10	6:30	6:45	7:10		7:30		8:35	10:50	12:20	14:10	15:25	16:45			18:12		19:55	21:30
Grafton	5:00	5:29	5:54		6:44	6:59	7:24		7:44		8:48	11:03	12:33	14:23	15:38	16:58			18:25		20:08	21:42
Westborough	5:06	5:34	5:59		6:49	7:04	7:29		7:49		8:52	11:07	12:37	14:27	15:42	17:02			18:29		20:12	21:46
Southborough	5:16	5:43	6:08		6:58	7:13	7:38		7:58		9:01	11:16	12:46	14:36	15:51	17:11			18:38		20:21	21:54
Ashland	5:23	5:48	6:13		7:03	7:18	7:43		8:03		9:05	11:20	12:50	14:40	15:55	17:15			18:42		20:25	21:58
Framingham	5:35	6:00	6:25	6:50	7:15	7:30	7:55	7:55	8:14	8:45	9:16	11:31	13:01	14:51	16:06	17:26	18:15	18:28	18:53	19:42	20:36	22:08
W Natick	5:40	6:06	6:30		7:20	7:35	8:01	8:00	8:19	8:50	9:21	11:36	13:06	14:56	16:11	17:31	18:20	18:33	18:58	19:47		22:13
Natick	5:45	6:11	6:35		7:25	7:40	8:06	8:05	8:24	8:55	9:26	11:41	13:11	15:01	16:16	17:36	18:25	18:38	19:03	19:52		22:17
Wellesley Sq	5:51		6:41		7:31	7:46		8:11	8:30	9:01	9:32	11:47	13:16	15:06	16:22	17:42	18:31	18:44	19:09	19:58		22:22
Wellesley Hls	5:55		6:45		7:35	7:50		8:15	8:34	9:05	9:36	11:51	13:20	15:10	16:26	17:46	18:35	18:48	19:13	20:02		22:25
Wellesley Fms	5:58		6:48		7:38	7:53		8:18	8:37	9:08	9:39	11:54	13:23	15:13	16:29	17:49	18:38	18:51	19:16	20:05		22:28
Auburndale	6:03		6:53		7:43	7:58		8:23		9:13		11:59		15:18								
W Newton	6:06		6:56		7:46	8:01		8:26		9:16		12:02		15:21								
Newtonville	6:10		7:00		7:50	8:05		8:30		9:20		12:05		15:24								
New Balance	6:14	6:30	7:04	7:18	7:54	8:09	8:23	8:34	8:48	9:25	9:50	12:10	13:38	15:28	16:45	18:04	18:50	19:02	19:36	20:16	20:56	22:45
Yawkey	6:20	6:36	7:10		8:00	8:15		8:40					13:44	15:34		18:10			19:42			
Back Bay	6:25	6:41	7:15	7:27	8:05	8:20	8:32	8:45	8:57	9:34	9:59	12:19	13:49	15:39	16:54	18:15	18:59	19:11	19:47	20:25	21:05	22:54
S Stn	6:31	6:47	7:21	7:33	8:11	8:26	8:38	8:51	9:03	9:40	10:05	12:25	13:55	15:45	17:00	18:21	19:05	19:17	19:53	20:31	21:11	23:00
Turn To	*503*	*505*	*507*	*Yard*	*Yard*	*Yard*	*Yard*	*509*	*Yard*	*611*	*511*	*Yard*	*Yard*	*521*	*527*	*531*	*533*	*535*	*537*	*Yard*	*Yard*	*539*

Turn From	*Yard*	*500*	*502*	*504*	*510*	*516*	*Yard*	*Yard*	*Yard*	*616*	*522*	*Yard*	*Yard*	*Yard*	*524*	*Yard*	*526*	*Yard*	*528*	*530*	*532*	*538*
Southbound	**501**	**503**	**505**	**507**	**509**	**511**	**513**	**515**	**517**	**519**	**521**	**523**	**525**	**583**	**527**	**529**	**531**	**531-A**	**533**	**535**	**537**	**539**
S Stn	4:05	6:50	7:00	7:38	9:05	10:30	12:22	13:20	14:45	16:05	16:25	17:00	17:15	17:33	17:45	18:00	18:32	19:01	19:30	20:30	22:20	23:25
Back Bay	4:11	6:56	7:06	7:44	9:11	10:36	12:28	13:26	14:51	16:11	16:31	17:06	17:21	17:40	17:51	18:06	18:38	19:07	19:36	20:36	22:26	23:31
Yawkey						10:41					16:36		17:26		17:56		18:43	19:12	19:41	20:41	22:31	23:36
New Balance	4:20	7:05	7:15	7:53	9:20	10:47	12:37	13:35	15:00	16:20	16:42	17:15	17:32	17:48	18:02	18:15	18:49	19:18	19:47	20:47	22:37	23:42
Newtonville						10:50		13:38	15:03		16:46		17:36			18:21	18:52	19:21	19:50	20:50	22:40	23:45
W Newton						10:54		13:41	15:06		16:50		17:40			18:25	18:56	19:25	19:54	20:54	22:44	23:49
Auburndale						10:57		13:44	15:09		16:53		17:43			18:28	18:59	19:28	19:57	20:57	22:47	23:52
Wellesley Fms					9:27	11:02	12:52	13:49	15:14		16:58		17:48			18:33	19:04	19:33	20:02	21:02	22:52	23:57
Wellesley Hls		7:14		8:04	9:30	11:05	12:55	13:52	15:17		17:01		17:51		18:10	18:36	19:07	19:36	20:05	21:05	22:55	0:00
Wellesley Sq		7:18		8:08	9:34	11:09	12:59	13:56	15:21		17:05		17:55			18:40	19:11	19:40	20:09	21:09	22:59	0:04
Natick		7:22		8:14	9:40	11:15	13:05	14:02	15:27		17:11		18:01		18:14	18:46	19:17	19:46	20:15	21:15	23:05	0:10
W Natick		7:27		8:19	9:45	11:21	13:10	14:07	15:32	16:36	17:17	17:32	18:07		18:20	18:52	19:24	19:52	20:21	21:21	23:11	0:16
Framingham	4:45	7:32	7:39	8:25	9:50	11:27	13:15	14:13	15:38	16:42	17:23	17:40	18:13	18:12	18:27	18:58	19:30	19:57	20:26	21:26	23:16	0:21
Ashland		7:39			9:56	11:33	13:21	14:19	15:44	16:48		17:46			18:34	19:05		20:04	20:33	21:32	23:22	0:27
Southborough		7:44			10:01	11:38	13:26	14:24	15:49	16:53		17:51			18:39	19:10		20:09	20:38	21:37	23:27	0:32
Westborough		7:53			10:10	11:46	13:34	14:33	15:58	17:03		18:01			18:48	19:20		20:18	20:47	21:46	23:36	0:41
Grafton	5:05	8:01			10:17	11:51	13:39	14:39	16:04	17:09		18:08			18:54	19:26		20:24	20:53	21:52	23:42	0:47
Worcester	5:24	8:16			10:31	12:05	13:53	14:53	16:18	17:24		18:23		18:42	19:09	19:41		20:38	21:07	22:06	23:56	1:01
Turn To	*504*	*516*	*510*	*514*	*518*	*520*	*522*	*524*	*526*	*532*	*528*	*Yard*	*530*	*Yard*	*Yard*	*536*	*534*	*538*	*Yard*	*Yard*	*Yard*	*Yard*

Blue	Indicates L stop (regular stop, but train may leave ahead of schedule)
Red	Indicates f stop (train will not stop unless passengers notify conductor they wish to get off or passengers are visible waiting on the platform)
	Indicates peak hour trains
	Indicates trains not simulated as part of the PM Period Alternative 2 and Alternative 3 simulations

Based on MBTA Framingham/Worcester Line Schedule Effective April 29, 2013
Proposed Future 2035 Schedule includes one additional peak period, peak direction trip in each of the peak periods, identified with '-A' at the end of the train number.
Equipment Turns Based on Proposed Future 2035 Eq Cycle

Turn From	*Yard*	*Yard*	*Yard*	*Yard*	*605*	*607*	*609*	*611*	*613*	*615*	*617*	*619*	*621*	*627*	*629*	*631*	*633*
Northbound	600	602	602-A	604	606	608	610	612	614	616	618	620	622	626	628	630	632
Needham Hts	6:10	6:47	7:06	7:30	8:00	8:35	9:36	10:55	12:55	15:05	15:48	17:07	17:44	19:26	20:14	21:15	22:10
Neeham Ctr	6:14	6:51	7:10	7:34	8:04	8:39	9:39	10:59	12:59	15:09	15:52	17:11	17:48	19:30	20:18	21:19	22:14
Needham Jct	6:18	6:55	7:14	7:38	8:08	8:43	9:43	11:03	13:03	15:13	15:56	17:15	17:52	19:34	20:22	21:23	22:18
Hersey	6:21	6:58	7:18	7:42	8:12	8:46	9:46	11:06	13:06	15:16	15:59	17:22	17:55	19:37	20:25	21:26	22:21
W Roxbury	6:25	7:03	7:23	7:47	8:17	8:51	9:51	11:11	13:11	15:28	16:04	17:27	18:02	19:47	20:30	21:31	22:26
Highland	6:28	7:07	7:26	7:50	8:20	8:54	9:53	11:13	13:13	15:30	16:06	17:29		19:49		21:33	22:28
Bellevue	6:31	7:10	7:29	7:53	8:23	8:57	9:56	11:15	13:15	15:32	16:08	17:31		19:51		21:35	22:30
Roslindale	6:34	7:14	7:33	7:57	8:27	9:00	9:59	11:17	13:17	15:34	16:11	17:33		19:53		21:37	22:32
Forest Hills	6:37	7:17	7:36	8:00	8:30	9:03	10:03	11:20	13:20	15:37	16:13	17:36	18:13	19:56	20:37	21:40	22:35
Ruggles	6:42	7:22	7:41	8:05	8:35	9:09	10:08	11:24	13:24					20:00	20:41	21:44	22:39
Back Bay	6:46	7:26	7:45	8:09	8:39	9:13	10:12	11:28	13:28	15:45	16:20	17:44	18:21	20:04	20:45	21:48	22:42
S Stn	6:51	7:31	7:50	8:14	8:44	9:18	10:17	11:33	13:33	15:50	16:25	17:51	18:26	20:09	20:50	21:53	22:47
Turn To	*605*	*Yard*	*Yard*	*609*	*Yard*	*Yard*	*709*	*613*	*Yard*	*519*	*621*	*625*	*627*	*631*	*633*	*635*	*Yard*

Turn From	*600*	*702*	*604*	*514*	*612*	*Yard*	*Yard*	*Yard*	*Yard*	*618*	*Yard*	*620*	*622*	*Yard*	*626*	*628*	*630*
Southbound	605	607	609	611	613	615	617	619	619-A	621	623	625	627	629	631	633	635
S Stn	7:05	7:25	8:45	10:05	11:49	14:00	15:00	15:59	16:30	16:42	17:20	18:01	18:36	19:12	20:20	21:15	22:30
Back Bay	7:10	7:30	8:50	10:10	11:54	14:05	15:05	16:05	16:35	16:47	17:25	18:06	18:41	19:17	20:25	21:20	22:35
Ruggles					11:57	14:08	15:08	16:09	16:39	16:51		18:10	18:45	19:21	20:28	21:23	22:38
Forest Hills	7:16			10:17	12:02	14:14	15:13	16:15	16:44	16:56	17:34	18:15	18:50	19:26	20:33	21:28	22:43
Roslindale	7:20		9:04	10:20	12:05	14:18	15:16	16:18	16:47	16:59	17:37	18:18	18:53	19:29	20:36	21:31	22:46
Bellevue	7:22		9:06	10:22	12:07	14:21	15:18	16:21	16:50	17:02	17:40	18:21	18:56	19:32	20:39	21:34	22:49
Highland	7:24		9:08	10:24	12:09	14:23	15:20	16:23	16:53	17:05	17:43	18:24	18:58	19:34	17:45	21:36	22:51
W Roxbury	7:26	7:42	9:10	10:26	12:11	14:27	15:22	16:25	16:56	17:08	17:49	18:27	19:00	19:41	17:47	21:38	22:53
Hersey	7:32	7:54	9:15	10:32	12:16	14:32	15:27	16:30	17:01	17:15	17:54	18:32	19:05	19:46	17:52	21:43	22:58
Needham Jct	7:42	8:12	9:18	10:35	12:19	14:35	15:30	16:33	17:04	17:18	17:58	18:35	19:08	19:49	17:55	21:46	23:01
Needham Ctr	7:46	8:16	9:22	10:39	12:23	14:39	15:34	16:37	17:08	17:22	18:02	18:39	19:12	19:53	17:59	21:50	23:05
Needham Hts	7:50	8:20	9:26	10:43	12:27	14:43	15:38	16:42	17:12	17:26	18:06	18:43	19:16	19:57	18:03	21:54	23:09
Turn To	*606*	*608*	*610*	*612*	*614*	*616*	*618*	*620*	*Yard*	*622*	*Yard*	*Yard*	*626*	*628*	*630*	*632*	*Yard*

Blue	Indicates L stop (regular stop, but train may leave ahead of schedule)
	Indicates peak hour trains
	Indicates trains not simulated as part of the PM Period Alternative 2 and Alternative 3 simulations

Based on MBTA Needham Line Schedule Effective July 1, 2012
Proposed Future 2035 Schedule includes one additional peak period, peak direction trip in each of the peak periods, identified with '-A' at the end of the train number.
Equipment Turns Based on Proposed Future 2035 Eq Cycle

Turn From	*703*	*Yard*	*Yard*	*Yard*	*Yard*	*Yard*	*733*	*Yard*	*Yard*	*705*	*707*	*709*	*711*	*713*	*737*	*717*	*723*	*725*	*727*	*729*
Northbound	**7790**	**702**	**704**	**706**	**706-A**	**708**	**732**	**710**	**734**	**712**	**714**	**716**	**718**	**720**	**736**	**7796**	**7798**	**726**	**728**	**730**
Forge Park/495	5:05	5:40	6:04	6:35	6:52	7:02		7:48		9:03	10:45	12:05	14:05	16:01		17:36	19:40	20:50	22:15	23:50
Franklin	5:10	5:47	6:11	6:42	6:59	7:09		7:55		9:10	10:52	12:12	14:12	16:08		17:43	19:47	20:57	22:22	23:57
Norfolk	5:19	5:54	6:18	6:49	7:06	7:16		8:02		9:17	10:59	12:19	14:19	16:15		17:49	19:53	21:03		
Walpole	5:25	6:00	6:24	6:55	7:12	7:23	7:55	8:08		9:24	11:06	12:26	14:26	16:21		17:56	20:00	21:09	22:33	0:08
Plimptonville				6:58																
Windsor Gdns	5:29	6:07	6:28	7:01	7:16	7:27	7:59	8:12		9:29	11:11	12:31	14:31	16:25		18:01				
Norwood Ctrl	5:33	6:12	6:32	7:06	7:20	7:32	8:03	8:17	8:51	9:33	11:15	12:35	14:35	16:29	17:23	18:05	20:07	21:16	22:39	0:14
Norwood Dpt	5:36	6:15	6:36	7:09	7:24		8:06	8:20	8:53	9:35	11:17	12:37	14:37	16:32		18:07		21:18		
Islington	5:39	6:18	6:39	7:12	7:27		8:09	8:23	8:56	9:39	11:21	12:41	14:41	16:37		18:11		21:22		
Dedham Corp	5:42	6:21	6:42	7:16	7:30	7:37		8:26	8:58	9:42	11:24	12:44	14:44	16:41	17:41	18:14	20:16	21:25	22:44	0:19
Endicott	5:45	6:24	6:45	7:20	7:33		8:13	8:30	9:00	9:44	11:26	12:46	14:46	16:45		18:17		21:27		
Readville	5:48	6:28	6:48	7:23	7:36		8:19	8:34	9:05	9:47	11:29	12:49	14:49	16:49		18:25				
Hyde Park	VIA	6:32			VIA										VIA	VIA				
Ruggles	FAIR	6:41	6:59	7:34	FAIR	7:52	8:32	8:47	9:19	9:59	11:39	12:57	15:00		FAIR	FAIR				
Back Bay	LINE	6:45	7:03	7:38	LINE	7:56	8:36	8:52	9:24	10:03	11:43	13:01	15:04	17:04	LINE	LINE		21:40	23:01	0:36
S Stn	6:15	6:50	7:08	7:43	8:00	8:01	8:41	8:57	9:29	10:08	11:48	13:06	15:09	17:09	18:05	18:55	20:45	21:45	23:06	0:41
Turn To	*733*	*607*	*Yard*	*705*	*Yard*	*Yard*	*Yard*	*707*	*Yard*	*Yard*	*Yard*	*Yard*	*715*	*721*	*723*	*791*	*727*	*729*	*731*	*Yard*

Turn From	*Yard*	*7790*	*706*	*710*	*610*	*Yard*	*Yard*	*718*	*Yard*	*Yard*	*Yard*	*Yard*	*720*	*736*	*824*	*798*	*726*	*728*
Southbound	**703**	**733**	**705**	**707**	**709**	**711**	**713**	**715**	**717**	**737**	**719**	**719-A**	**721**	**723**	**725**	**727**	**729**	**731**
S Stn	4:00	6:55	7:57	9:24	10:50	12:45	14:40	16:06	16:21	16:39	17:10	17:40	17:52	18:25	19:35	21:00	22:37	23:50
Back Bay			8:02	9:29	10:55	12:50	14:45	16:11	16:26	VIA	17:15	VIA	17:57	18:30	19:40	21:05	22:42	23:55
Ruggles						12:53	14:48	16:15	16:30	FAIR	17:19	FAIR	18:01	18:34	19:43	21:08	22:45	23:58
Hyde Park								16:24	16:39	LINE		LINE	18:11				22:54	
Readville		7:12		9:40	11:05	13:03	14:58	16:28	16:43	17:07		18:03	18:14	18:42	19:53	21:18	22:57	0:08
Endicott		7:16		9:43	11:08	13:06	15:01	16:32		17:12		18:07	18:18	18:46	19:56	21:22	23:02	0:11
Dedham Corp		7:19	8:17	9:45	11:10	13:08	15:04	16:35	16:48	17:14	17:33	18:10	18:22	18:49	19:59	21:24	23:04	0:13
Islington		7:22	8:19		11:13	13:11	15:06	16:38		17:17		18:13	18:24	18:52	20:02	21:27	23:07	0:16
Norwood Dpt		7:25		9:50	11:16	13:14	15:10	16:41	16:53	17:20	17:38	18:16	18:27	18:55	20:05	21:30	23:10	0:19
Norwood Ctrl	4:22	7:32	8:24	9:53	11:19	13:17	15:13	16:45	16:57	17:23	17:41	18:20	18:30	18:58	20:08	21:33	23:12	0:21
Windsor Gdns			8:28	9:57	11:23	13:21	15:17	16:49	17:01		17:44	18:24	18:34	19:02	20:12	21:37	23:16	0:25
Plimptonville											17:48							
Walpole	4:28	7:42	8:32	10:01	11:28	13:26	15:21	16:54	17:06		17:52	18:29	18:42	19:07	20:17	21:41	23:20	0:29
Norfolk			8:38	10:07	11:34	13:32	15:28	17:01	17:13		18:04	18:36	18:50	19:15	20:25	21:48	23:27	0:36
Franklin	4:40		8:45	10:14	11:42	13:40	15:36	17:09	17:21		18:12	18:44	18:56	19:23	20:33	21:56	23:35	0:44
Forge Park/495	4:50		8:52	10:21	11:49	13:47	15:46	17:16	17:28		18:19	18:51	19:03	19:30	20:40	22:03	23:42	0:51
Turn To	*7790*	*732*	*712*	*714*	*716*	*718*	*720*	*Yard*	*7796*	*736*	*Yard*	*Yard*	*Yard*	*7798*	*726*	*728*	*730*	*Yard*

Blue	Indicates L stop (regular stop, but train may leave ahead of schedule)
Red	Indicates f stop (train will not stop unless passengers notify conductor they wish to get off or passengers are visible waiting on the platform)
	Indicates peak hour trains
	Indicates trains not simulated as part of the PM Period Alternative 2 and Alternative 3 simulations

Based on MBTA Franklin Line Schedule Effective July 1, 2012
Proposed Future 2035 Schedule includes one additional peak period, peak direction trip in each of the peak periods, identified with '-A' at the end of the train number.
Equipment Turns Based on Proposed Future 2035 Eq Cycle

Turn From	*703*	*Yard*	*Yard*	*Yard*	*Yard*	*747*	*749*	*Yard*	*753*	*755*	*759*	*761*	*763*	*Yard*	*767*	*769*	*Yard*	*773*	*775*	*777*	*779*	*737*	*783*	*717*	*787*	*789*	*793*	*795*
Northbound	**7790**	**740**	**742**	**744**	**706-A**	**746**	**748**	**750**	**752**	**754**	**756**	**758**	**760**	**762**	**764**	**766**	**768**	**770**	**772**	**774**	**778**	**736**	**782**	**7796**	**786**	**788**	**792**	**794**
Readville	5:48	6:30	6:55	7:24	7:36	7:50	8:15	8:40	9:07	9:45	10:25	11:05	11:45	12:25	13:05	13:45	14:25	15:05	15:45	16:25	17:05	17:41	17:58	18:25	18:50	19:25	20:45	21:25
Fairmount	5:53	6:34	6:59	7:28	7:41	7:54	8:19	8:44	9:10	9:48	10:28	11:08	11:48	12:28	13:08	13:48	14:28	15:08	15:48	16:28	17:08	17:46	18:01	18:32	18:53	19:28	20:48	21:28
Blue Hill Av		6:38	7:03	7:32		7:58	8:23	8:48	9:14	9:52	10:32	11:12	11:52	12:32	13:12	13:52	14:32	15:12	15:52	16:32	17:12		18:05		18:57	19:32	20:52	21:32
Morton St	5:58	6:41	7:06	7:35	7:46	8:01	8:26	8:51	9:17	9:55	10:35	11:15	11:55	12:35	13:15	13:55	14:35	15:15	15:55	16:35	17:15	17:51	18:08	18:36	19:00	19:35	20:55	21:35
Talbot Av		6:45	7:10	7:39		8:05	8:29	8:55	9:20	9:58	10:38	11:18	11:58	12:38	13:18	13:58	14:38	15:18	15:58	16:38	17:18		18:11		19:03	19:38	20:58	21:38
Four Cnrs		6:48	7:13	7:42		8:08	8:33	8:58	9:23	10:01	10:41	11:21	12:01	12:41	13:21	14:01	14:41	15:21	16:01	16:41	17:21		18:14		19:06	19:41	21:01	21:41
Uphams Cnr	6:03	6:51	7:16	7:45	7:51	8:11	8:36	9:01	9:26	10:04	10:44	11:24	12:04	12:44	13:24	14:04	14:44	15:24	16:04	16:44	17:24	17:57	18:17	18:45	19:09	19:44	21:04	21:44
Newmarket		6:54	7:19	7:48		8:14	8:39	9:04	9:28	10:06	10:46	11:26	12:06	12:46	13:26	14:06	14:46	15:26	16:06	16:46	17:26		18:19		19:11	19:46	21:06	21:46
S Stn	6:15	7:02	7:27	7:56	8:00	8:22	8:47	9:12	9:36	10:14	10:54	11:34	12:14	12:54	13:34	14:14	14:54	15:34	16:14	16:54	17:34	18:05	18:27	18:55	19:19	19:54	21:14	21:54
Turn To	*733*	*747*	*749*	*753*	*Yard*	*Yard*	*755*	*757*	*759*	*761*	*763*	*765*	*767*	*769*	*771*	*773*	*775*	*777*	*779*	*783*	*785*	*723*	*789*	*791*	*793*	*795*	*797*	*799*

Turn From	*740*	*742*	*744*	*748*	*750*	*752*	*754*	*756*	*758*	*760*	*762*	*764*	*766*	*768*	*770*	*772*	*Yard*	*774*	*Yard*	*778*	*Yard*	*782*	*7796*	*786*	*788*	*792*	*794*
Southbound	**747**	**749**	**753**	**755**	**757**	**759**	**761**	**763**	**765**	**767**	**769**	**771**	**773**	**775**	**777**	**779**	**737**	**783**	**719-A**	**785**	**787**	**789**	**791**	**793**	**795**	**797**	**799**
S Stn	7:12	7:37	8:25	9:02	9:26	9:47	10:27	11:07	11:44	12:27	13:07	13:44	14:27	15:07	15:47	16:27	16:39	17:20	17:40	17:45	18:12	18:40	19:20	20:07	20:47	21:27	22:07
Newmarket	7:19	7:44	8:32	9:09	9:33	9:54	10:34	11:14	11:51	12:34	13:14	13:51	14:34	15:14	15:54	16:34	16:46	17:27		17:52	18:19	18:47	19:27	20:14	20:54	21:34	22:14
Uphams Cnr	7:21	7:46	8:34	9:11	9:35	9:56	10:36	11:16	11:53	12:36	13:16	13:53	14:36	15:16	15:56	16:36	16:48	17:29	17:48	17:54	18:21	18:49	19:29	20:16	20:56	21:36	22:16
Four Cnrs	7:24	7:49	8:37	9:14	9:38	9:59	10:39	11:19	11:56	12:39	13:19	13:56	14:39	15:19	15:59	16:39	16:51	17:32		17:57	18:24	18:52	19:32	20:19	20:59	21:39	22:19
Talbot Av	7:27	7:52	8:40	9:17	9:41	10:02	10:42	11:22	11:59	12:42	13:22	13:59	14:42	15:22	16:02	16:42	16:54	17:35		18:00	18:27	18:55	19:35	20:22	21:02	21:42	22:22
Morton St	7:30	7:55	8:43	9:20	9:44	10:05	10:45	11:25	12:02	12:45	13:25	14:02	14:45	15:25	16:05	16:45	16:57	17:38	17:54	18:03	18:30	18:58	19:38	20:25	21:05	21:45	22:25
Blue Hill Av	7:33	7:58	8:46	9:23	9:47	10:08	10:48	11:28	12:05	12:48	13:28	14:05	14:48	15:28	16:08	16:48	17:00	17:41		18:06	18:33	19:01	19:41	20:28	21:08	21:48	22:28
Fairmount	7:36	8:01	8:49	9:26	9:50	10:11	10:51	11:31	12:08	12:51	13:31	14:08	14:51	15:31	16:11	16:51	17:03	17:44	17:59	18:09	18:36	19:04	19:44	20:31	21:11	21:51	22:31
Readville	7:40	8:05	8:53	9:30	9:54	10:15	10:55	11:35	12:12	12:55	13:35	14:12	14:55	15:35	16:15	16:55	17:07	17:48	18:03	18:13	18:40	19:08	19:48	20:35	21:15	21:55	22:35
Turn To	*746*	*748*	*752*	*754*	*Yard*	*756*	*758*	*760*	*Yard*	*764*	*766*	*Yard*	*770*	*772*	*774*	*778*	*736*	*782*	*Yard*	*Yard*	*786*	*788*	*Yard*	*792*	*794*	*Yard*	*Yard*

Red	Indicates f stop (train will not stop unless passengers notify conductor they wish to get off or passengers are visible waiting on the platform)
Blue	Indicates L stop (regular stop, but train may leave ahead of schedule)
	Indicates Franklin train sent via Fairmount
	Indicates peak hour trains
	Indicates trains not simulated as part of the PM Period Alternative 2 and Alternative 3 simulations

Based on MBTA Fairmount Line Service Levels specified by CTPS in the "Description of Modeling Assumptions and Analysis Methodology for the State Implementation Plan Transit Commitment Projects Current and Proposed Substitutions" report prepared for the Executive Office of Transportation on March 13, 2007.
Equipment Turns Based on Proposed Future 2035 Eq Cycle

Turn From	*Yard*	*Yard*	*Yard*	*Yard*	*8801*	*841*	*8803*	*801*	*8805*	*843*	*803*	*805*	*807*	*809*	*811*	*815*	*817*	*821*	*819*	*823*	*825*
Northbound	**800**	**802**	**804**	**804-A**	**806**	**842**	**808**	**810**	**812**	**844**	**814**	**816**	**818**	**820**	**822**	**824**	**8802**	**826**	**8804**	**828**	**830**
Wickford Jct		4:52			5:57		6:43		7:34		9:10		13:10	15:40			18:55		19:45		22:10
TF Green		5:07			6:12		6:58		7:51		9:26		13:25	15:54			19:09		19:59		22:24
Providence	5:07	5:27	5:53	6:13	6:32		7:18	7:35	8:07		9:45	11:15	13:41	16:10	17:08	18:00	19:25	19:37	20:15	20:24	22:40
S Attleboro	5:17	5:37	6:02	6:22	6:41		7:28	7:45	8:16		9:54	11:25	13:52	16:20	17:18	18:10		19:47		20:34	22:50
Attleboro	5:27	5:47	6:14	6:34	6:51		7:38	7:55	8:26	8:54	10:04	11:34	14:02	16:30	17:27	18:18		19:56		20:43	22:59
Mansfield	5:36	5:54	6:24	6:44	7:03	7:26	7:50	8:05	8:36	9:03	10:12	11:42	14:12	16:38	17:36	18:26		20:04		20:51	23:08
Sharon	5:44	6:04	6:34	6:54	7:13	7:35		8:15	8:47	9:11	10:21	11:51	14:21	16:47	17:44	18:34		20:12		20:59	23:18
Canton Jct	5:51	6:09				7:41		8:23	8:55	9:18	10:28	11:58			17:51						23:26
Route 128	5:56	6:16	6:44	7:03	7:22	7:47		8:30	9:00	9:20	10:33	12:03	14:30	16:58	17:56	18:47		20:25		21:12	23:31
Hyde Park	6:01	6:21				7:52		8:35	9:05		10:38	12:08			18:02						23:36
Ruggles	6:10	6:30	6:55	7:15	7:34	8:01	8:16	8:43	9:15	9:33	10:45	12:15	14:42	17:11							
Back Bay	6:14	6:34	6:59	7:19	7:38	8:05	8:20	8:47	9:19	9:37	10:49	12:20	14:45	17:15	18:13	18:58		20:36		21:23	23:45
S Stn	6:19	6:39	7:04	7:25	7:44	8:10	8:25	8:53	9:24	9:42	10:54	12:25	14:50	17:20	18:18	19:03		20:41		21:28	23:50
Turn To	*841*	*Yard*	*803*	*843*	*Yard*	*Yard*	*Yard*	*Yard*	*Yard*	*805*	*807*	*Yard*	*Yard*	*819*	*823*	*725*	*Yard*	*827*	*Yard*	*829*	*831*

Turn From	*Yard*	*Yard*	*Yard*	*800*	*Yard*	*804*	*804-A*	*844*	*814*	*Yard*	*Yard*	*Yard*	*Yard*	*Yard*	*Yard*	*820*	*Yard*	*822*	*Yard*	*826*	*828*	*830*
Southbound	**8801**	**8803**	**801**	**841**	**8805**	**803**	**843**	**805**	**807**	**809**	**811**	**813**	**815**	**817**	**817-A**	**819**	**821**	**823**	**825**	**827**	**829**	**831**
S Stn			6:20	6:35		7:20	7:51	10:00	11:20	13:45	15:35	16:10	16:37	17:00	17:28	17:45	18:14	18:50	20:12	21:07	22:24	23:59
Back Bay			6:25	6:40		7:25	7:56	10:05	11:25	13:50	15:40	16:15	16:42	17:05	17:33	17:50	18:19	18:55	20:17	21:12	22:29	0:04
Ruggles			6:28			7:28	7:59		11:28	13:53	15:43	16:18	16:45	17:09	17:37	17:54	18:23	18:58	20:20	21:15	22:32	0:07
Hyde Park								10:16	11:38	14:02	15:51	16:31						19:08	20:30	21:25	22:42	0:16
Route 128			6:40			7:40	8:11	10:21	11:43	14:08	15:57		16:56				18:33	19:13	20:35	21:30	22:47	0:21
Canton Jct						7:46	8:16	10:27	11:49	14:13	16:03		17:15		17:45			19:18	20:40	21:35	22:52	0:26
Sharon			6:49			7:52		10:33	11:55	14:19	16:11	16:46	17:07	17:27	17:55	18:12	18:41	19:24	20:46	21:41	22:58	0:31
Mansfield			6:56	7:08		7:59	8:29	10:40	12:02	14:27	16:20	16:55	17:16	17:36	18:05	18:24	18:51	19:33	20:54	21:49	23:06	0:39
Attleboro			7:05			8:07	8:38	10:48	12:10	14:35	16:30	17:05	17:26	17:50	18:18	18:32	19:00	19:42	21:02	21:57	23:14	0:48
S Attleboro			7:11			8:13		10:55	12:16	14:45	16:40	17:15	17:35	17:59	18:27	18:40	19:08	19:49	21:09	22:04	23:21	0:56
Providence	5:11	5:45	7:20		7:00	8:22		11:05	12:27	14:54	16:50	17:25	17:44	18:10		18:51	19:17	19:59	21:20	22:13	23:31	1:06
TF Green	5:27	6:01			7:16	8:38			12:43	15:10		17:40		18:26		19:07			21:36			
Wickford Jct	5:43	6:17			7:32	8:54			12:59	15:26		17:56		18:42		19:23			21:52			
Turn To	*806*	*808*	*810*	*842*	*812*	*814*	*844*	*816*	*818*	*820*	*822*	*Yard*	*824*	*8802*	*Yard*	*8804*	*826*	*828*	*830*	*Yard*	*Yard*	*Yard*

Blue	Indicates L stop (regular stop, but train may leave ahead of schedule)
	Indicates peak hour trains
	Indicates trains not simulated as part of the PM Period Alternative 2 and Alternative 3 simulations

Based on MBTA Providence Line Schedule Effective July 1, 2012
Proposed Future 2035 Schedule includes one additional peak period, peak direction trip in each of the peak periods, identified with '-A' at the end of the train number.
Equipment Turns Based on Proposed Future 2035 Eq Cycle

Turn From	*Yard*	*Yard*	*Yard*	*Yard*	*Yard*	*Yard*	*Yard*	*Yard*	*901*	*941*	*903*	*943*	*905*	*945*	*907*	*947*	*911*	*953*	*917*	*955*
Northbound	**900**	**940**	**902**	**942**	**904**	**944**	**906**	**946**	**908**	**948**	**910**	**950**	**912**	**952**	**914**	**954**	**916**	**956**	**918**	**958**
Battleship Cv		5:08		6:16		7:02		7:46		8:17		11:07		14:10		17:30		20:01		22:10
Fall River		5:11		6:19		7:05		7:49		8:20		11:10		14:13		17:33		20:04		22:13
Freetown		5:17		6:26		7:12		7:56		8:27		11:16		14:19		17:39		20:12		22:20
Whale's Tooth	4:50		5:55		6:38		7:23		7:56		9:46		12:46		15:47		18:50		21:51	
King's Hwy	4:55		6:00		6:43		7:28		8:01		9:51		12:51		15:52		18:55		21:56	
Taunton Dep	5:07	5:28	6:13		6:57		7:41		8:15		10:03	11:27	13:03	14:30	16:04	17:50	19:10	20:24	22:08	22:31
Taunton	5:12	5:33	6:18		7:02		7:46		8:20		10:08	11:32	13:08	14:35	16:09	17:55	19:15	20:29	22:13	22:36
Raynham	5:18	5:39	6:25		7:09		7:53		8:27		10:14	11:38	13:14	14:41	16:15	18:01	19:26	20:35	22:19	22:42
Easton Vil	5:24	5:45	6:32		7:16		8:00		8:34		10:20	11:44	13:20	14:47	16:21	18:08		20:41	22:25	22:48
N Easton	5:28	5:49	6:36	6:50	7:20	7:36	8:04	8:20	8:38	8:51	10:24	11:48	13:24	14:51	16:25	18:12	19:34	20:45	22:29	22:52
Stoughton	5:32	5:53		6:54		7:40		8:24		8:55	10:28	11:52	13:28	14:55	16:29	18:16	19:38	20:49	22:33	22:56
Canton Ctr	5:38	5:59		7:01		7:47		8:31		9:02	10:34	11:58	13:34	15:01	16:35	18:22	19:44	20:55	22:39	23:02
Canton Jct	5:41	6:02		7:05		7:51		8:35		9:06	10:37	12:01	13:37	15:04	16:38	18:25	19:47	20:58	22:42	23:05
Route 128	5:46	6:07	6:51	7:10	7:35		8:19	8:40	8:53	9:11	10:42	12:06	13:42	15:09				21:03	22:47	23:10
Hyde Park		6:12	6:57	7:16	7:42	7:59	8:25	8:45			10:47	12:11	13:47	15:16	16:45		19:54		22:52	23:15
Ruggles	5:56		7:05		7:50					9:22										
Back Bay	6:00	6:21	7:09	7:25	7:55	8:10	8:36	8:55	9:05	9:27	10:56	12:20	13:56	15:26	16:55	18:38	20:03	21:14	23:01	23:24
S Stn	6:05	6:26	7:14	7:30	8:00	8:15	8:41	9:00	9:10	9:32	11:01	12:25	14:01	15:31	17:00	18:43	20:08	21:19	23:06	23:29
Turn To	*901*	*941*	*Yard*	*Yard*	*903*	*Yard*	*Yard*	*Yard*	*Yard*	*943*	*905*	*945*	*907*	*947*	*911*	*955*	*917*	*957*	*919*	*959*

Turn From	*900*	*940*	*904*	*948*	*910*	*950*	*912*	*952*	*Yard*	*Yard*	*914*	*Yard*	*Yard*	*Yard*	*Yard*	*954*	*916*	*956*	*918*	*958*
Southbound	**901**	**941**	**903**	**943**	**905**	**945**	**907**	**947**	**909**	**949**	**911**	**951**	**913**	**953**	**915**	**955**	**917**	**957**	**919**	**959**
S Stn	6:20	6:46	8:15	9:45	11:16	12:45	14:14	15:45	16:31	16:47	17:21	17:40	17:57	18:23	18:35	19:05	20:25	21:32	23:20	23:42
Back Bay	6:25	6:51	8:20	9:50	11:21	12:50	14:19	15:50	16:36	16:52	17:26	17:45	18:02	18:28	18:40	19:10	20:30	21:37	23:25	23:47
Ruggles						12:54	14:23		16:41	16:57		17:50			18:45	19:15	20:34		23:29	23:51
Hyde Park							14:30	16:00							18:54	19:23	20:43	21:48	23:36	23:59
Route 128	6:37	7:03	8:32	10:02	11:33	13:03	14:36				17:39		18:16	18:41	19:01	19:30			23:42	0:05
Canton Jct	6:43	7:09	8:39	10:08	11:39	13:09	14:42	16:09		17:10		18:05		18:47		19:37	20:52	21:57	23:48	0:11
Canton Ctr			8:43	10:12	11:43	13:13	14:46	16:13		17:14		18:09		18:51		19:41	20:56	22:01	23:52	0:15
Stoughton	6:52	7:17	8:49	10:18	11:49	13:19	14:52	16:19		17:21		18:16		18:58		19:48	21:02	22:07	23:58	0:21
N Easton	6:56	7:21	8:53	10:22	11:53	13:23	14:56	16:23	17:03	17:26	17:54	18:21	18:31	19:03	19:16	19:53	21:06	22:11	0:02	0:25
Easton Vil	6:59		8:57	10:26	11:57	13:27	15:00	16:27	17:07		17:58		18:35		19:20		21:09	22:14	0:06	0:28
Raynham	7:05	7:28	9:03	10:32	12:03	13:33	15:06	16:33	17:14		18:05		18:42		19:27		21:16	22:21	0:12	0:35
Taunton		7:34	9:09		12:09	13:39	15:12	16:39	17:21		18:12		18:49		19:34		21:22	22:27	0:18	0:41
Taunton Dep	7:14	7:39	9:14	10:41	12:14	13:44	15:17	16:44	17:26		18:17		18:54		19:39		21:27	22:32	0:23	0:46
King's Hwy			9:27		12:27		15:30		17:39		18:30		19:07		19:52		21:40		0:36	
Whale's Tooth	7:30		9:31		12:31		15:34		17:44		18:35		19:12		19:57		21:44		0:40	
Freetown		7:50		10:52		13:55		16:55		17:49		18:44		19:26		20:17		22:43		0:57
Fall River		7:58		10:59		14:02		17:02		17:56		18:51		19:33		20:24		22:50		1:04
Battleship Cv		8:01		11:01		14:04		17:04		17:59		18:54		19:36		20:27		22:52		1:06
Turn To	*908*	*948*	*910*	*950*	*912*	*952*	*914*	*954*	*Yard*	*Yard*	*916*	*Yard*	*Yard*	*956*	*Yard*	*958*	*918*	*Yard*	*Yard*	*Yard*

900-919	**New Bedford Service**
940-959	**Fall River Service**
Blue	Indicates L stop (regular stop, but train may leave ahead of schedule)
	Peak Period Trains
	Indicates trains not simulated as part of the PM Period Alternative 2 and Alternative 3 simulations

Schedule Taken From South Coast Rail FEIR Operations Analysis 2030 Proposed Weekday Operating Plan - Electric Service

Project # 12076.00

South Station Expansion Project - Operations Analysis
Middleborough Line - Proposed Future 2035 PM Schedule

December, 2015

Turn From	*Yard*	*Yard*	*Yard*	*Yard*	*003*	*005*	*007*	*009*	*015*	*017*	*019*	*027*
Northbound	002	004	006	008	010	012	014	016	018	020	022	028
Middleborough	5:20	6:00	6:58	7:20	8:07	9:38	11:10	13:08	15:25	16:54	18:05	21:25
Bridgewater	5:30	6:10	7:08	7:30	8:17	9:48	11:20	13:18	15:35	17:04	18:20	21:35
Campello	5:37	6:18	7:16	7:38	8:25	9:56	11:28	13:26	15:43	17:11	18:28	21:42
Brockton	5:41	6:22	7:20	7:42	8:29	10:00	11:32	13:30	15:47	17:15	18:33	21:46
Montello	5:44	6:25	7:23	7:45	8:32	10:03	11:35	13:33	15:50	17:18	18:37	21:49
Holbrook/Randolph	5:49	6:30	7:28	7:50	8:37	10:08	11:40	13:38	15:55	17:23	18:42	21:54
Braintree	5:56				8:44			13:44	16:03	17:31	20:48	22:00
Quincy Ctr		6:42	7:39	8:01		10:20	11:51	13:49				22:05
JFK/UMass	6:10		7:48	8:11	8:58							
S Stn	6:17	6:58	7:56	8:18	9:05	10:36	12:07	14:06	16:24	18:06	19:15	22:22
Turn To	*003*	*033*	*Yard*	*Yard*	*Yard*	*063*	*Yard*	*Yard*	*019*	*067*	*051*	*057*

Turn From	*002*	*036*	*040*	*080*	*Yard*	*064*	*018*	*Yard*	*Yard*	*088*	*052*	*056*
Southbound	003	005	007	009	015	017	019	021	023	025	027	029
S Stn	6:35	8:24	9:57	11:57	14:10	15:43	16:40	17:12	17:57	18:52	20:07	22:30
JFK/UMass						15:49			18:03		20:13	
Quincy Ctr	6:49		10:10	12:10	14:23	15:57	16:53	17:25	18:11	19:05	20:21	22:43
Braintree	6:55	8:43										
Holbrook/Randolph	7:03	8:51	10:22	12:23	14:36	16:10	17:06	17:37	18:23	19:17	20:34	22:56
Montello	7:08	8:56	10:27	12:28	14:41	16:15	17:11	17:42	18:28	19:22	20:39	23:01
Brockton	7:12	8:59	10:30	12:31	14:44	16:18	17:14	17:45	18:31	19:25	20:42	23:04
Campello	7:29	9:03	10:34	12:35	14:48	16:22	17:18	17:49	18:35	19:29	20:46	23:08
Bridgewater	7:38	9:11	10:42	12:43	14:56	16:30	17:26	17:57	18:43	19:37	20:54	23:16
Middleborough	7:50	9:23	10:53	12:55	15:10	16:41	17:38	18:10	18:55	19:50	21:05	23:27
Turn To	*010*	*012*	*014*	*016*	*018*	*020*	*022*	*Yard*	*Yard*	*Yard*	*028*	*Yard*

Blue	Indicates L stop (regular stop, but train may leave ahead of schedule)
Red	Indicates f stop (train will not stop unless passengers notify conductor they wish to get off or passengers are visible waiting on the platform)
	Indicates peak hour trains
	Indicates trains not simulated as part of the PM Period Alternative 2 and Alternative 3 simulations

Based on MBTA Middleborough Line Schedule Effective July 1, 2012
Equipment Turns Based on Proposed Future 2035 Eq Cycle

Turn From	*Yard*	*Yard*	*Yard*	*Yard*	*033*	*061*	*063*	*065*	*041*	*045*	*067*	*051*
Northbound	032	034	036	038	040	060	062	064	048	052	066	056
Kingston	5:32	6:19	7:11	7:37	8:37	10:05		13:35	16:02	18:27	19:23	20:53
Plymouth						10:48	12:06	14:28			19:45	
Halifax	5:42	6:29	7:21	7:47	8:47	10:58	12:16	14:38	16:12	18:40	19:55	21:03
Hanson	5:47	6:34	7:26	7:52	8:52	11:03	12:21	14:43	16:17	18:45	20:00	21:08
Whitman	5:52	6:39	7:31	7:57	8:57	11:08	12:26	14:48	16:22	18:55	20:08	21:13
Abington	5:56	6:43	7:35	8:01	9:01	11:12	12:30	14:52	16:26	18:58	20:12	21:17
S Weymouth	6:01	6:49	7:42	8:06	9:06	11:20	12:37	14:57	16:31	19:03	20:17	21:22
Braintree		6:57	7:50	8:14	9:14	11:27	12:45	15:05	16:38	19:11	20:25	21:29
Quincy Ctr												
JFK/UMass	6:21		8:03	8:28	9:27		12:58					
S Stn	6:29	7:17	8:10	8:35	9:34	11:46	13:05	15:26	16:59	19:28	20:45	21:49
Turn To	*Yard*	*Yard*	*005*	*061*	*007*	*Yard*	*Yard*	*017*	*085*	*027*	*055*	*029*

Turn From	*004*	*038*	*012*	*Yard*	*Yard*	*Yard*	*086*	*Yard*	*020*	*022*	*066*	*028*
Southbound	033	061	063	065	041	043	045	047	067	051	055	057
S Stn	7:11	8:56	10:50	12:25	14:47	16:20	17:00	17:38	18:15	19:29	21:30	22:40
JFK/UMass					14:53	16:26	17:06				21:36	22:46
Quincy Ctr		9:09						17:51				
Braintree	7:32	9:15	11:08	12:44	15:07	16:40	17:19	17:57	18:33	19:47	21:48	22:59
S Weymouth	7:39	9:22	11:15	12:51	15:14	16:47	17:26	18:04	18:40	19:54	21:55	23:06
Abington	7:44	9:27	11:20	12:57	15:19	16:52	17:31	18:09	18:45	19:59	22:00	23:11
Whitman	7:47	9:31	11:24	13:01	15:23	16:56	17:35	18:13	18:48	20:03	22:03	23:15
Hanson	7:57	9:36	11:29	13:06	15:28	17:01	17:40	18:18	18:53	20:08	22:08	23:20
Halifax	8:02	9:41	11:34	13:11	15:33	17:06	17:45	18:23	18:58	20:13	22:13	23:25
Kingston	8:12	9:53		13:23	15:45	17:18	17:57	18:35	19:11	20:26	22:26	23:36
Plymouth		10:23	11:47	13:52	0:00				19:37			
Turn To	*040*	*060*	*062*	*064*	*048*	*Yard*	*052*	*Yard*	*066*	*056*	*Yard*	*Yard*

Blue	Indicates L stop (regular stop, but train may leave ahead of schedule)
	Indicates peak hour trains
	Indicates trains not simulated as part of the PM Period Alternative 2 and Alternative 3 simulations

Based on MBTA Kingston Line Schedule Effective July 1, 2012
Equipment Turns Based on Proposed Future 2035 Eq Cycle

Turn From	*Yard*	*Yard*	*Yard*	*Yard*	*071*	*073*	*075*	*077*	*079*	*081*	*087*	*089*
Northbound	**70**	**72**	**74**	**76**	**78**	**80**	**82**	**84**	**86**	**88**	**90**	**92**
Greenbush	5:40	6:37	7:03	7:50	8:50	10:35	11:50	14:11	15:47	17:20	19:05	20:10
N Scituate	5:47	6:44	7:10	7:57	8:57	10:42	11:57	14:18	15:54	17:27	19:12	20:17
Cohasset	5:54	6:51	7:17	8:04	9:04	10:48	12:04	14:25	16:01	17:38	19:22	20:23
Nantasket Jct	5:58	6:55	7:21	8:08	9:08	10:51	12:08	14:28	16:04	17:42	19:26	20:26
W Hingham	6:03	7:00	7:26	8:13	9:13	10:56	12:13	14:33	16:09	17:47	19:31	20:31
E Weymouth	6:07	7:04	7:30	8:17	9:17	11:03	12:17	14:37	16:12	17:53	19:35	20:34
E Braintree	6:13	7:10	7:36	8:23	9:23	11:09	12:23	14:43	16:18	17:59	19:41	20:40
Quincy Ctr	6:22		7:46	8:32	9:32	11:18	12:32	14:52	16:28		19:53	20:49
JFK/UMass	6:30	7:28										
S Stn	6:38	7:36	8:03	8:49	9:49	11:34	12:48	15:09	16:46	18:34	20:07	21:07
Turn To	*071*	*Yard*	*Yard*	*073*	*075*	*009*	*Yard*	*081*	*045*	*025*	*091*	*093*

Turn From	*070*	*076*	*078*	*Yard*	*Yard*	*084*	*Yard*	*048*	*Yard*	*Yard*	*090*	*092*
Southbound	**71**	**73**	**75**	**77**	**79**	**81**	**83**	**85**	**87**	**89**	**91**	**93**
S Stn	6:54	9:25	10:30	12:41	14:27	16:02	16:52	17:20	17:45	18:38	20:25	22:00
JFK/UMass						16:08		17:26				
Quincy Ctr		8:38	10:43	12:54	14:40		17:05		17:58	18:51	20:38	22:13
E Braintree	7:17	9:47	10:52	13:03	14:49	16:24	17:14	17:42	18:07	19:00	20:47	22:22
E Weymouth	7:23	9:53	10:58	13:08	14:55	16:30	17:20	17:48	18:13	19:06	20:53	22:28
W Hingham	7:30	9:57	11:03	13:12	14:59	16:34	17:24	17:52	18:17	19:10	20:56	22:32
Nantasket Jct	7:34	10:02	11:07	13:17	14:04	16:39	17:29	17:57	18:22	19:15	21:00	22:37
Cohasset	7:37	10:05	11:10	13:20	15:08	16:43	17:33	18:00	18:25	19:19	21:03	22:40
N Scituate	7:45	10:13	11:18	13:28	15:16	16:51	17:41	18:08	18:33	19:27	21:12	22:48
Greenbush	7:55	10:23	11:28	13:39	15:25	16:59	17:51	18:18	18:43	19:36	21:22	22:57
Turn To	*078*	*080*	*082*	*084*	*086*	*088*	*Yard*	*Yard*	*090*	*092*	*Yard*	*Yard*

Blue	Indicates L stop (regular stop, but train may leave ahead of schedule)
	Indicates peak hour trains
	Indicates trains not simulated as part of the PM Period Alternative 2 and Alternative 3 simulations

Based on MBTA Greenbush Line Schedule Effective July 1, 2012
Equipment Turns Based on Proposed Future 2035 Eq Cycle

Inbound	5500	66	5502	5504	3190	3192	140	190	3150	5506	3152	170	5508	3154	142	3156	172	3158	5512	3160	86	5514	3162	174	5516	3164	5518	144	3166	176	5520	3168	448	5522	3170	94	146	3172	5524	178
Lv Springfield	5:59		6:53	8:00			9:05			10:10			11:10		12:30				14:10			15:30			16:36		17:10	17:34			18:10		17:53	19:25				19:53		21:00	
Lv Worcester	6:57		7:51	8:58			10:03			11:08			12:08		13:28				15:08			16:28			17:34		18:08	18:32			19:08		18:57	20:23				20:51		21:58	
Ar Providence		6:32			9:02	9:43		10:27	10:43		11:43	12:02		12:43		13:43	14:02	14:43		15:43	15:52		16:47	17:12		17:43			18:43	19:02		19:38			20:43	20:42		21:43		23:17
Lv Providence		6:53			9:03	9:45		10:29	10:45		11:45	12:04		12:45		13:45	14:04	14:45		15:45	15:54		16:49	17:14		17:45			18:45	19:04		19:40			20:45	20:51		21:45		23:19
Lv Route 128		7:31			9:37	10:19		11:00	11:19		12:19	12:35		13:19		14:19	14:35	15:19		16:19	16:25		17:23	17:45		18:19			19:19	19:35		20:14			21:19	21:25		22:19		23:49
Lv Back Bay	7:47	7:50	8:41	9:48	9:51	10:29	10:53	11:11	11:29	11:58	12:29	12:46	12:58	13:29	14:18	14:29	14:46	15:29	15:58	16:29	16:36	17:18	17:33	17:56	18:24	18:29	18:58	19:22	19:29	19:46	19:58	20:24	21:04	21:13	21:29	21:36	21:41	22:29	22:48	23:58
Ar South Station	7:52	7:55	8:46	9:53	9:56	10:35	10:58	11:16	11:35	12:03	12:35	12:51	13:03	13:35	14:23	14:35	14:51	15:35	16:03	16:35	16:41	17:23	17:39	18:01	18:29	18:35	19:03	19:27	19:35	19:51	20:03	20:30	21:10	21:18	21:35	21:44	21:46	22:35	22:53	0:03
Turn To	*5507*	*Yard*	*5513*	*5517*	*3165*	*Yard*	*Yard*	*Yard*	*Yard*	*5519*	*Yard*	*Yard*	*Yard*	*3173*	*Yard*	*Yard*	*Yard*	*3197*	*5525*	*Yard*	*Yard*	*5527*	*Yard*	*Yard*	*Yard*	*Yard*	*5531*	*Yard*	*Yard*	*Yard*	*5533*	*Yard*	*Yard*	*Yard*	*Yard*	*Yard*	*Yard*	*Yard*	*Yard*	*Yard*	*Yard*
Next Trip	*5507*	*67*	*5513*	*5517*	*3165*	*3167*	*147*	*175*	*3169*	*5519*	*3171*	*177*	*5521*	*3173*	*149*	*3175*	*179*	*3197*	*5525*	*3159*	*95*	*5527*	*3161*	*171*	*5501*	*3163*	*5531*	*143*	*3151*	*173*	*5533*	*3153*	*449*	*5503*	*3155*	*93*	*145*	*3157*	*5505*	*137*

Previous Trip	*3166*	*5516*	*3168*	*86*	*144*	*5522*	*3170*	*3172*	*174*	*5524*	*5500*	*3160*	*94*	*3162*	*146*	*3164*	*5502*	*448*	*176*	*3190*	*3192*	*5504*	*178*	*3150*	*5506*	*5508*	*3152*	*190*	*140*	*3154*	*5512*	*3156*	*170*	*5514*	*3158*	*142*	*172*	*5518*	*5520*	*66*
Turns From	*Yard*	*Yard*	*Yard*	*Yard*	*Yard*	*Yard*	*Yard*	*Yard*	*Yard*	*Yard*	*5500*	*Yard*	*Yard*	*Yard*	*Yard*	*Yard*	*5502*	*Yard*	*Yard*	*3190*	*Yard*	*5504*	*Yard*	*Yard*	*5506*	*Yard*	*Yard*	*Yard*	*Yard*	*3154*	*5512*	*Yard*	*Yard*	*5514*	*3158*	*Yard*	*Yard*	*5518*	*5520*	*Yard*
Outbound	3151	5501	3153	95	143	5503	3155	3157	171	5505	5507	3159	93	3161	145	3163	5513	449	173	3165	3167	5517	137	3169	5519	5521	3171	175	147	3173	5525	3175	177	5527	3197	149	179	5531	5533	67
Lv South Station	5:10	5:30	6:05	6:10	6:10	7:10	7:15	8:05	8:10	8:15	9:10	9:15	9:30	9:56	10:15	11:10	11:10	11:55	12:00	12:10	13:10	13:10	13:30	14:10	14:10	15:10	15:10	15:35	15:50	16:00	17:10	17:15	17:37	18:10	18:10	19:10	19:11	20:10	21:10	21:28
Lv Back Bay	5:15	5:35	6:10	6:15	6:15	7:15	7:20	8:10	8:15	8:20	9:15	9:20	9:35	10:01	10:20	11:15	11:15	12:00	12:05	12:15	13:15	13:15	13:35	14:15	14:15	15:15	15:15	15:40	15:55	16:05	17:15	17:20	17:42	18:15	18:15	19:15	19:16	20:15	21:15	21:34
Lv Route 128	5:24		6:19	6:25			7:29	8:19	8:25			9:29	9:45	10:10		11:24			12:15	12:24	13:24		13:45	14:24			15:24	15:50		16:14		17:29	17:52		18:24		19:26			21:48
Ar Providence	5:44		6:39	6:48			7:49	8:39	8:48			9:49	10:08	10:30		11:44			12:38	12:44	13:44		14:08	14:44			15:44	16:13		16:34		17:49	18:15		18:44		19:51			22:13
Lv Providence	5:45		6:40	6:59			7:50	8:40	8:50			9:50	10:10	10:31		11:45			12:48	12:45	13:45		14:10	14:45			15:45	16:16		16:35		17:50	18:17		18:45		19:53			22:20
Lv Worcester		6:25			7:05	8:05				9:10	10:05				11:10		12:05	12:50					14:05			15:05	16:05			16:45		18:05			19:05		20:05		21:05	22:05	
Lv Springfield		7:23			8:03	9:03				10:08	11:03				12:08		13:03	13:48					15:03			16:03	17:03			17:43		19:03			20:03		21:03		22:03	23:03	

Blue	Blue times indicate stops only to receive passengers and may leave early. (Float in RTC)
	Indicates Peak Period Trains
XXX	Indicates Amtrak High Speed Train
XXX	Indicates Amtrak Regional Train
XX	Indicates Amtrak Long Distance Train
XX	Indicates New England Regional Train (Inland Route)
	Indicates trains not simulated as part of the PM Period Alternative 2 and Alternative 3 simulations

Notes

Amtrak and New England Regional Intercity Service Weekday Schedules taken from the Amtrak Northeast Corridor Intercity Service Alternative: "B-Low 2020 - 2040" Operating Plan

Train Turn Parameters from the Amtrak Operating Plan include notes that 90 minute train turns in Boston are to occur at the platform and 120 minute turns will include a trip to Southampton Yard.

Worcester

NB	Previous Arrival Time	New Arrival Time	Δ Time	Earlier / Later	Notes:	SB	Previous Departure Time	New Departure Time	Δ Time	Earlier / Later	Notes:
504	7:36	7:21	0:15	Earlier		507	7:45	7:38	0:07	Earlier	
582	7:43	7:33	0:10	Earlier		515	13:15	13:20	0:05	Later	
506	8:16	8:26	0:10	Later		525	17:10	17:15	0:05	Later	
508	8:28	8:38	0:10	Later		583	17:35	17:33	0:02	Earlier	
516	10:00	10:05	0:05	Later		527	17:40	17:45	0:05	Later	
526	18:31	18:21	0:10	Earlier		529	17:55	18:00	0:05	Later	
						533	19:18	19:30	0:12	Later	
						535	20:35	20:30	0:05	Earlier	

Needham

NB	Previous Arrival Time	New Arrival Time	Δ Time	Earlier / Later	Notes:	SB	Previous Departure Time	New Departure Time	Δ Time	Earlier / Later	Notes:
600	6:50	6:51	0:01	Later	Travel Time Adjusted	609	8:40	8:45	0:05	Later	
602	7:29	7:31	0:02	Later		611	10:00	10:05	0:05	Later	
606	8:42	8:44	0:02	Later		613	12:00	11:49	0:11	Earlier	
608	9:13	9:18	0:05	Later		619	16:00	15:59	0:01	Earlier	Travel Time Adjusted
610	10:16	10:17	0:01	Later	Travel Time Adjusted	621	16:40	16:42	0:02	Later	
618	16:27	16:25	0:02	Earlier		623	-	-	-	-	Ruggles stop removed
620	17:42	17:51	0:09	Later	Travel Time Adjusted	625	17:55	18:01	0:06	Later	
622	18:17	18:26	0:09	Later		627	18:25	18:36	0:11	Later	Travel Time Adjusted
626	20:01	20:09	0:08	Later		629	19:10	19:12	0:02	Later	Travel Time Adjusted
628	20:36	20:50	0:14	Later		631	20:10	20:20	0:10	Later	Travel Time Adjusted
630	21:38	21:53	0:15	Later							

Franklin

NB	Previous Arrival Time	New Arrival Time	Δ Time	Earlier / Later	Notes:	SB	Previous Departure Time	New Departure Time	Δ Time	Earlier / Later	Notes:
702	-	-	-	-	Ruggles stop added	705	7:55	7:57	0:02	Later	
704	7:09	7:08	0:01	Earlier		793	-	-	-	-	Trip removed, supplemented by Fairmount Service
708	7:59	8:01	0:02	Later		707	9:25	9:24	0:01	Earlier	
732	8:40	8:41	0:01	Later	Ruggles stop added	715	15:55	16:06	0:11	Later	
710	8:54	8:57	0:03	Later		717	16:20	16:21	0:01	Later	
734	9:25	9:29	0:04	Later	Ruggles stop added, Travel Time Adjusted	737	16:45	16:39	0:06	Earlier	Franklin via Fairmount
718	15:05	15:09	0:04	Later	Ruggles stop added, Travel Time Adjusted	721	17:40	17:52	0:12	Later	
720	17:08	17:09	0:01	Later		723	18:15	18:25	0:10	Later	
736	-	-	-	-	Franklin via Fairmount	727	20:50	21:00	0:10	Later	
7796	18:50	18:55	0:05	Later	Travel Time Adjusted	729	22:35	22:37	0:02	Later	

Providence

NB	Previous Arrival Time	New Arrival Time	Δ Time	Earlier / Later		SB	Previous Departure Time	New Departure Time	Δ Time	Earlier / Later	
800	6:20	6:19	0:01	Earlier		843	7:50	7:51	0:01	Later	
802	6:40	6:39	0:01	Earlier		805	9:55	10:00	0:05	Later	
804	7:19	7:04	0:15	Earlier		811	15:30	15:35	0:05	Later	
806	7:45	7:44	0:01	Earlier	Ruggles stop added	813	16:00	16:10	0:10	Later	
842	8:07	8:10	0:03	Later	Ruggles stop added, Travel Time Adjusted	815	16:35	16:37	0:02	Later	
808	8:16	8:25	0:09	Later	Ruggles stop added, Travel Time Adjusted	819	17:40	17:45	0:05	Later	
810	8:51	8:53	0:02	Later	Ruggles stop added, Travel Time Adjusted	821	18:10	18:14	0:04	Later	
812	9:32	9:24	0:08	Earlier		825	20:15	20:12	0:03	Earlier	
844	9:49	9:42	0:07	Earlier		829	22:25	22:24	0:01	Earlier	
814	10:57	10:54	0:03	Earlier	Travel Time Adjusted						
820	-	-	-	-	Ruggles Stop Added						
822	18:22	18:18	0:04	Earlier							
826	20:34	20:41	0:07	Later							
828	21:25	21:28	0:03	Later							

Amtrak Acela

NB	Previous Arrival Time	New Arrival Time	Δ Time	Earlier / Later		SB	Previous Departure Time	New Departure Time	Δ Time	Earlier / Later	
3190	9:51	9:56	0:05	Later		3153	6:10	6:05	0:05	Earlier	
3162	17:35	17:39	0:04	Later		3155	7:10	7:15	0:05	Later	
3168	20:35	20:30	0:05	Earlier		3157	8:10	8:05	0:05	Earlier	
						3159	9:10	9:15	0:05	Later	
						3161	10:10	9:56	0:14	Earlier	
						3173	16:10	16:00	0:10	Earlier	
						3175	17:20	17:15	0:05	Earlier	
						3197	18:20	18:10	0:10	Earlier	

Amtrak Regional

NB	Previous Arrival Time	New Arrival Time	Δ Time	Earlier / Later		SB	Previous Departure Time	New Departure Time	Δ Time	Earlier / Later	
66	8:00	7:55	0:05	Earlier		95	6:05	6:10	0:05	Later	
174	17:51	18:01	0:10	Later		145	10:10	10:15	0:05	Later	
176	19:49	19:51	0:02	Later		147	15:55	15:50	0:05	Earlier	
94	21:43	21:44	0:01	Later		177	17:40	17:37	0:03	Earlier	
						179	19:15	19:11	0:04	Earlier	
						67	21:30	21:28	0:02	Earlier	

MassDOT New England Regional

NB	Previous Arrival Time	New Arrival Time	Δ Time	Earlier / Later		SB	Previous Departure Time	New Departure Time	Δ Time	Earlier / Later	
5500	7:53	7:52	0:01	Earlier		5505	8:10	8:15	0:05	Later	
5502	8:53	8:46	0:07	Earlier							
5516	18:23	18:29	0:06	Later							

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Attachment C – Future 2035 PM Peak Period Stringline Charts

Alternative 2 PM Peak Period Stringline Charts
Alternative 3 PM Peak Period Stringline Charts

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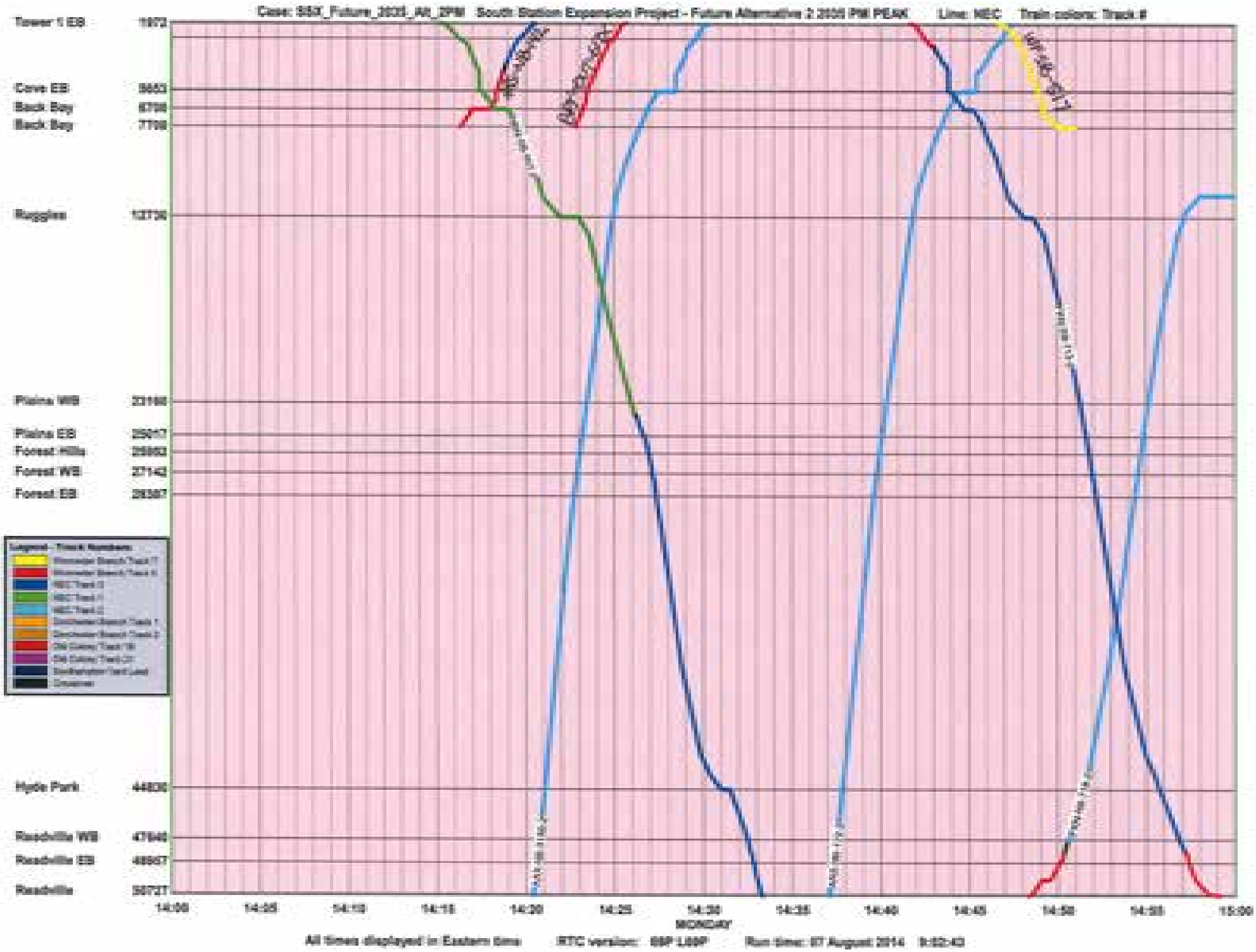
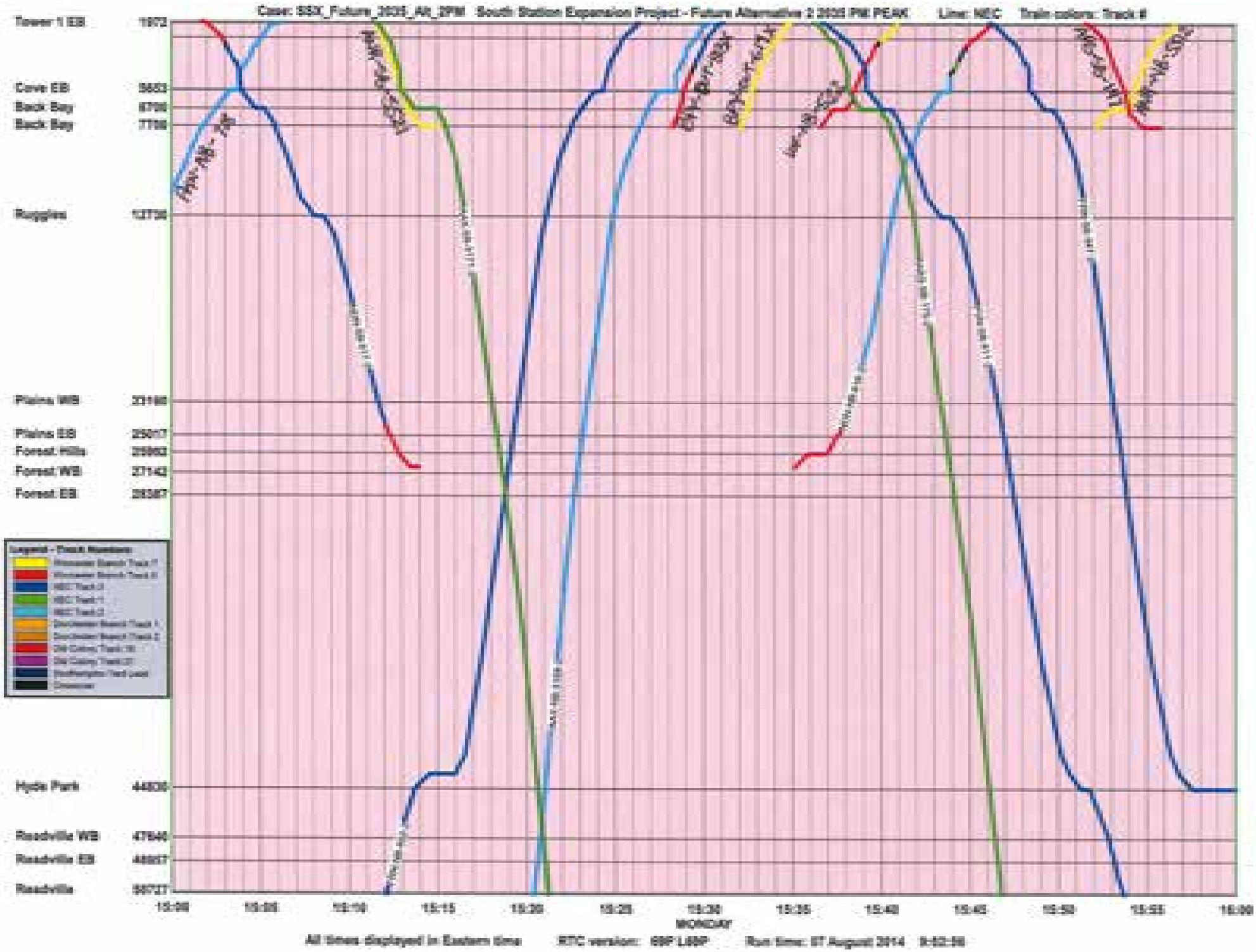
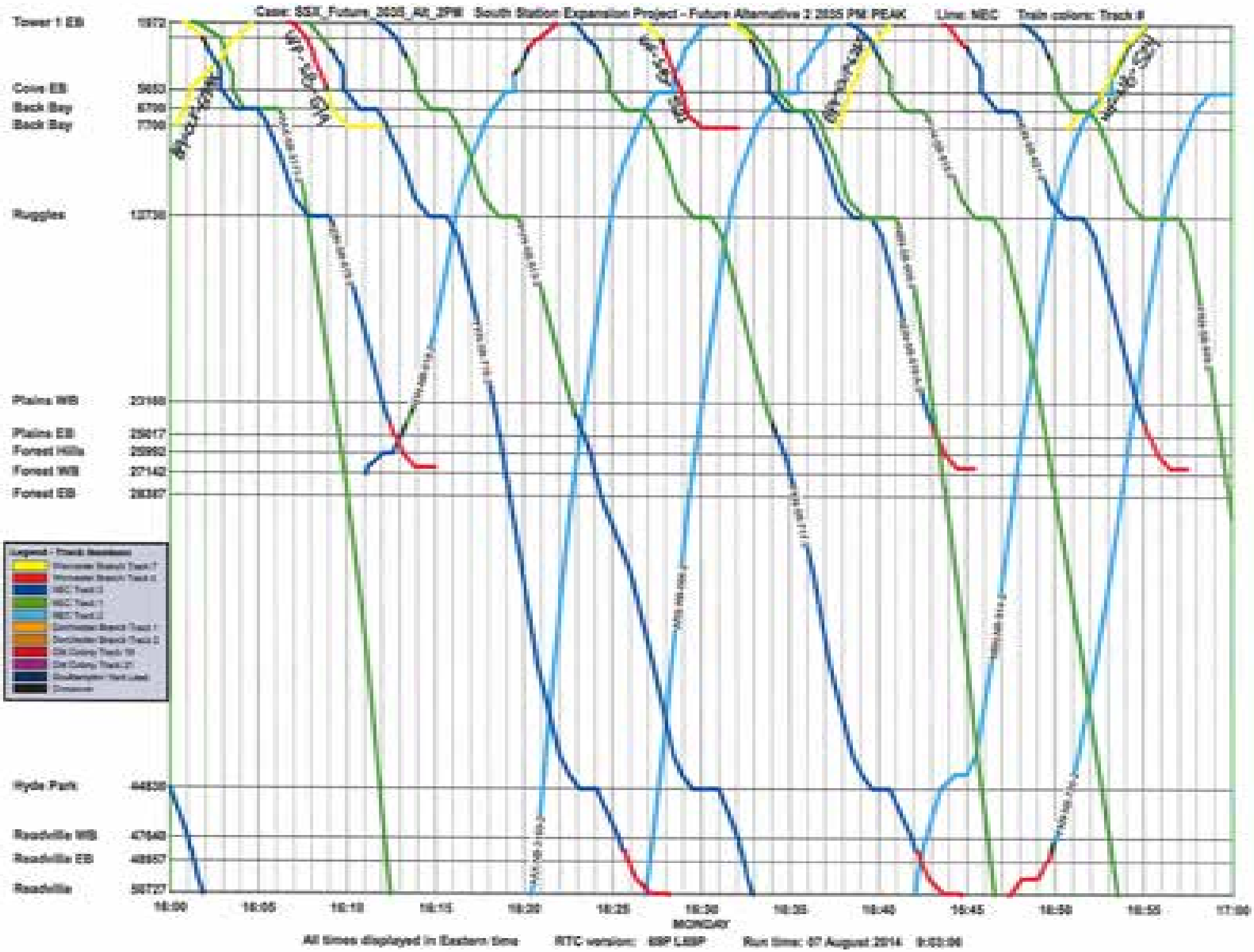
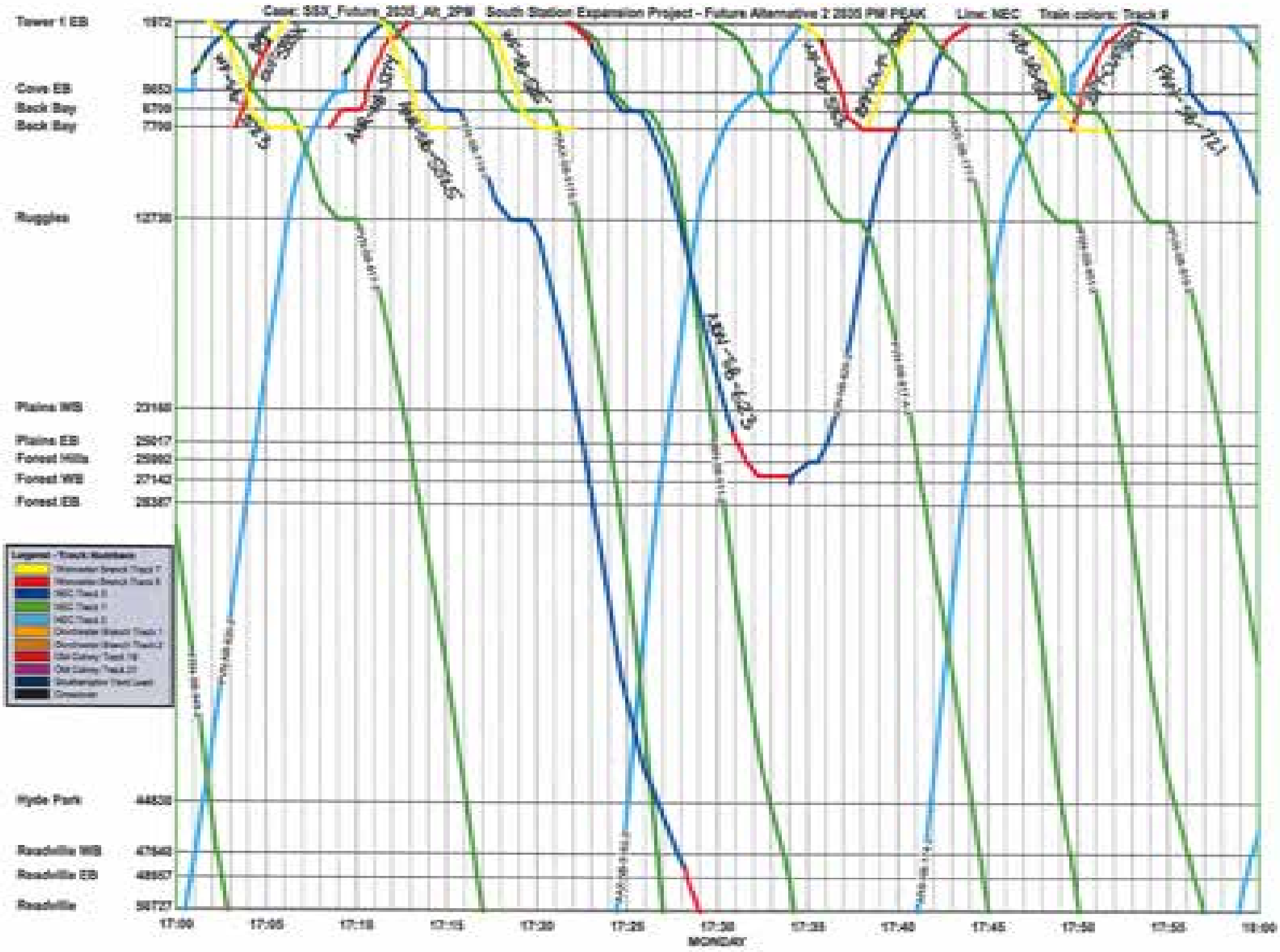
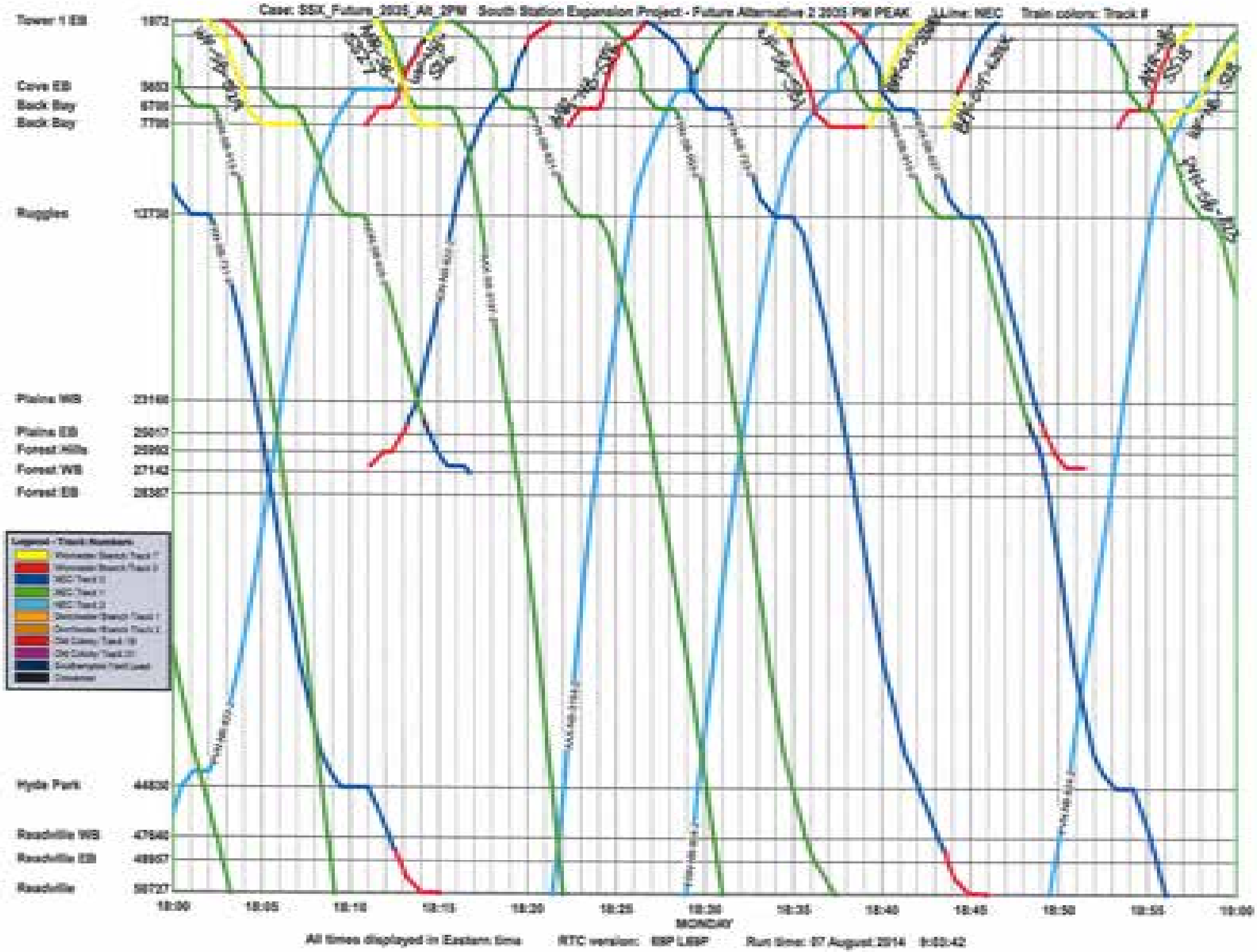
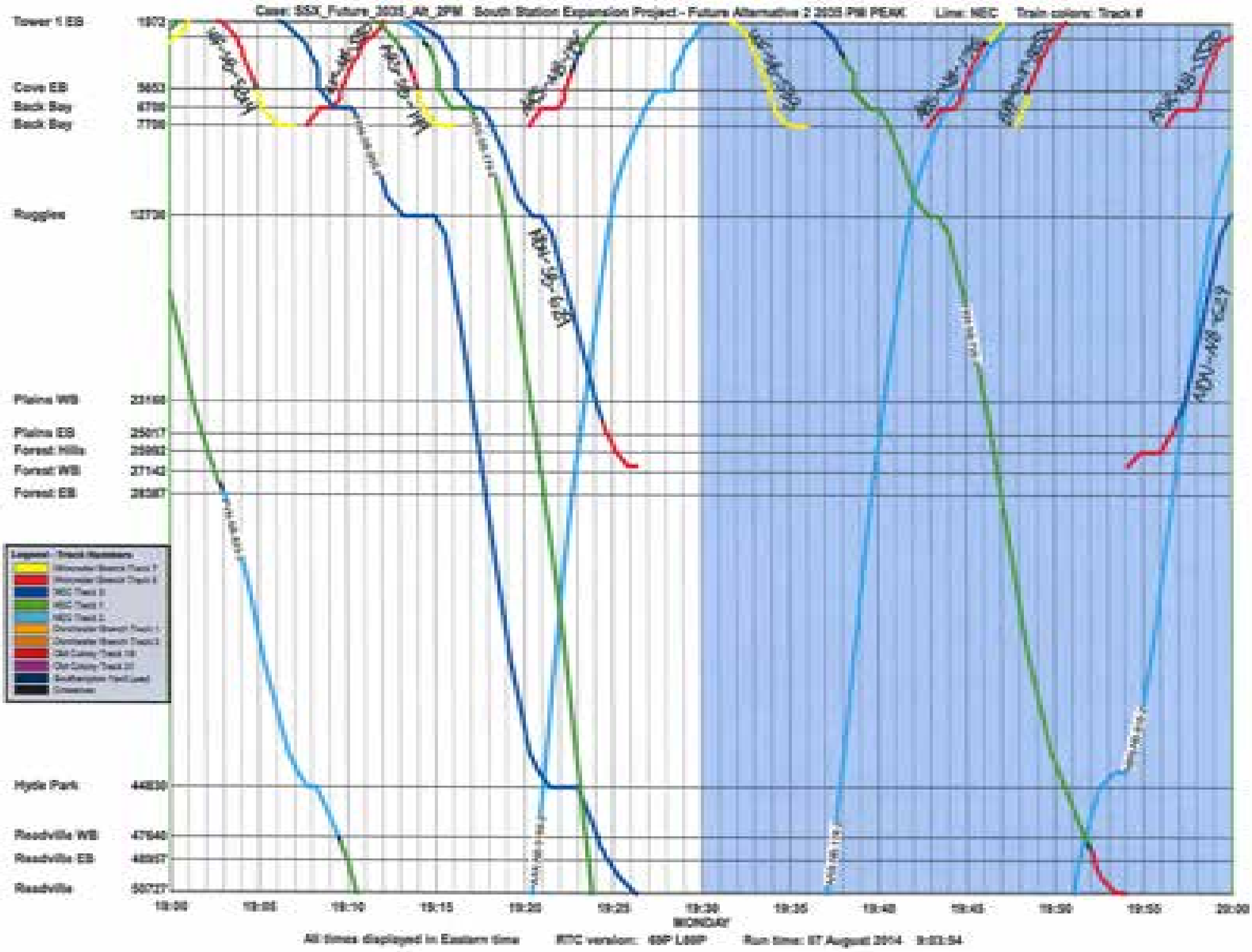

Case: SSX_Future_2035_Alt_2PM South Station Expansion Project - Future Alternative 2 2035 PM PEAK
Line: NEC
Train colors: Track #
Tower 1 EB
Cove EB
Back Bay
Back Bay
Ruggles
Platna WB
Platna EB
Forest Hills
Forest WB
Forest EB
Hyde Park
Readville WB
Readville EB
Readville
14:00
14:05
14:10
14:15
14:20
14:25
14:30
14:35
14:40
14:45
14:50
14:55
15:00
MONDAY
All times displayed in Eastern time
RTC version: 6SP LSSP
Run time: 07 August 2014 9:52:43

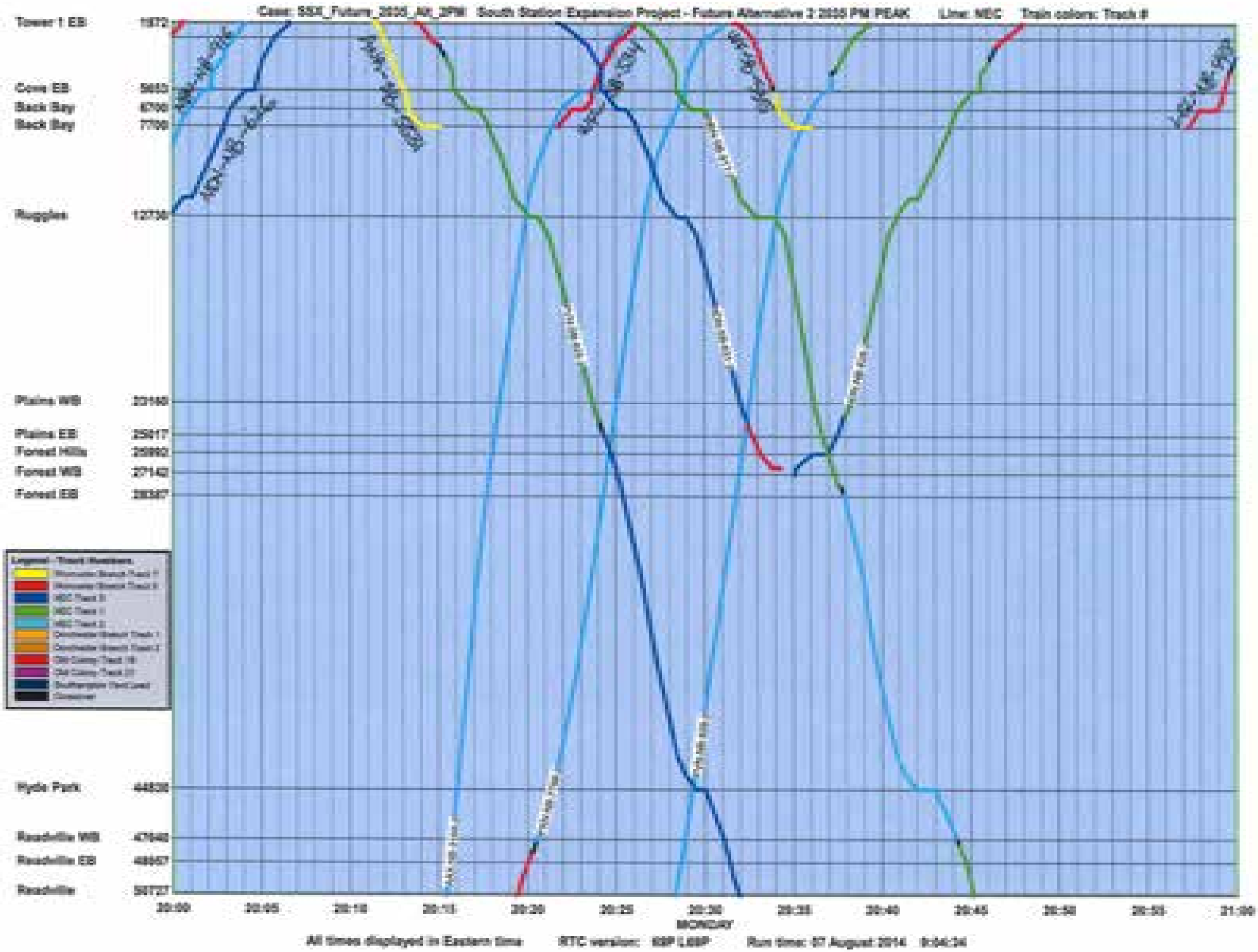

Case: SSX_Future_2035_Alt_2PM South Station Expansion Project - Future Alternative 2 2035 PM PEAK
Line: NEC
Train colors: Track #
Tower 1 EB
Cove EB
Back Bay
Back Bay
Ruggles
Plains WB
Plains EB
Forest Hills
Forest WB
Forest EB
Hyde Park
Readville WB
Readville EB
Readville
15:00
15:05
15:10
15:15
15:20
15:25
15:30
MONDAY
15:35
15:40
15:45
15:50
15:55
16:00
All times displayed in Eastern time
RTC version: 69P L69P
Run time: 07 August 2014

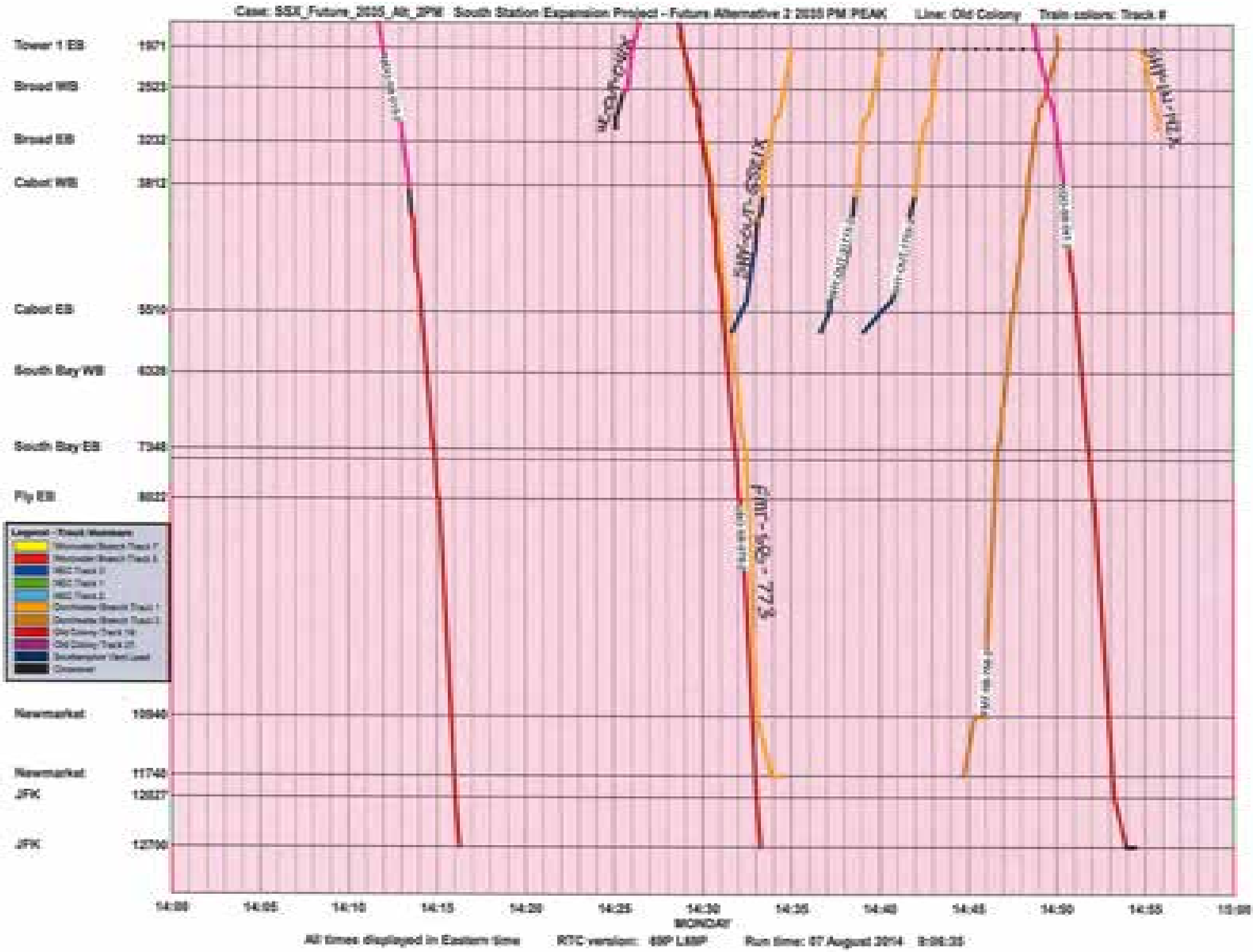

Case: SSX_Future_2035_Alt_2PM South Station Expansion Project - Future Alternative 2 2035 PM PEAK Line: NEC Train colors: Track #
Tower 1 EB
Cove EB
Back Bay
Back Bay
Ruggles
Plains WB
Plains EB
Forest Hills
Forest WB
Forest EB
Hyde Park
Readville WB
Readville EB
Readville
16:00
16:05
16:10
16:15
16:20
16:25
16:30
16:35
16:40
16:45
16:50
16:55
17:00
MONDAY
All times displayed in Eastern time
RTC version: 6SP LSSP
Run time: 07 August 2014

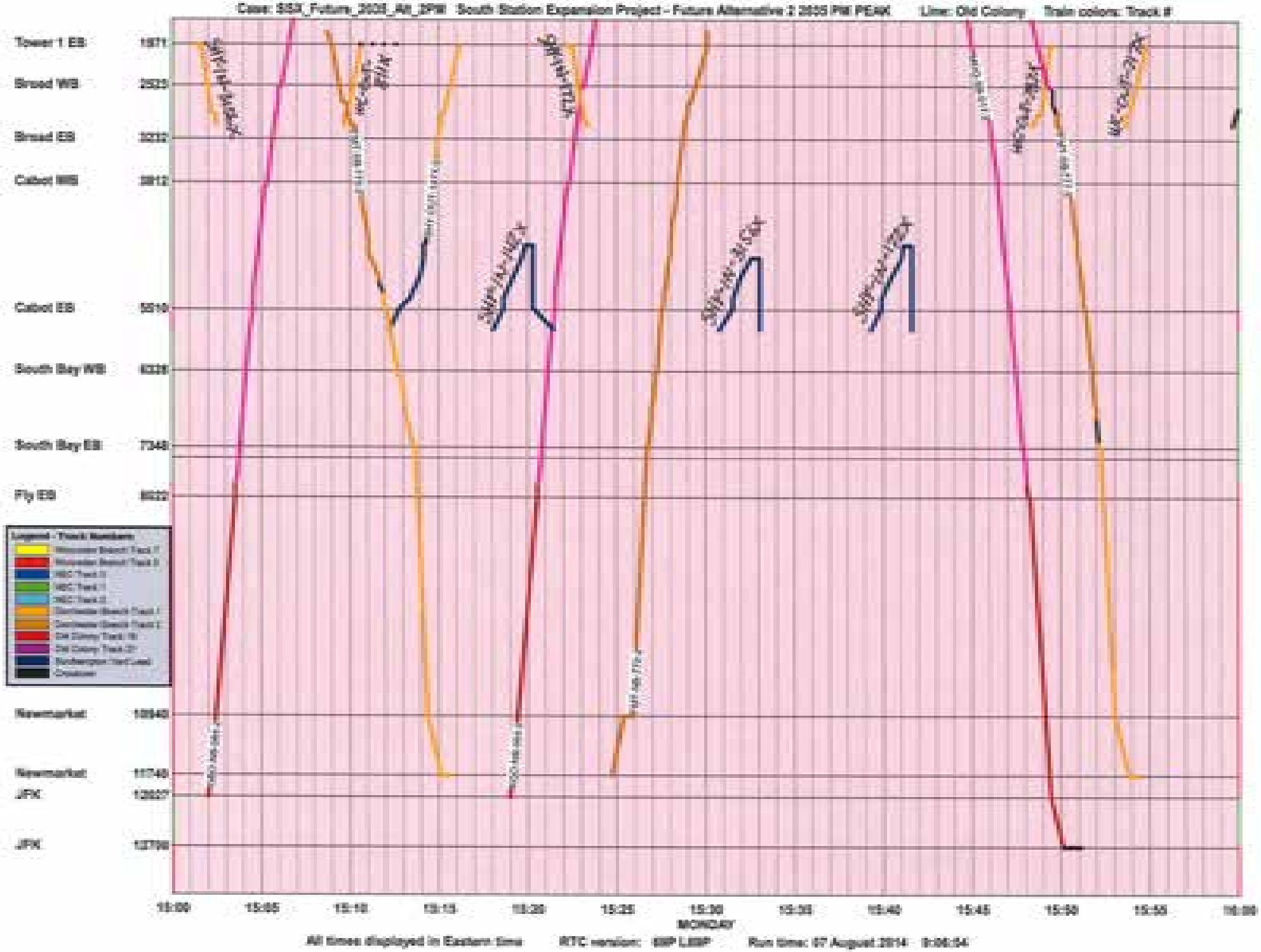

Case: SSX_Future_2035_Alt_2PM South Station Expansion Project - Future Alternative 2 2035 PM PEAK Line: NEC Train colors: Track #
Tower 1 EB
Cove EB
Back Bay
Back Bay
Ruggles
Plains WB
Plains EB
Forest Hills
Forest WB
Forest EB
Hyde Park
Readville WB
Readville EB
Readville
17:00
17:05
17:10
17:15
17:20
17:25
17:30
17:35
17:40
17:45
17:50
17:55
18:00
MONDAY
All times displayed in Eastern time
RTC version: 6SP LSSP
Run time: 07 August 2014

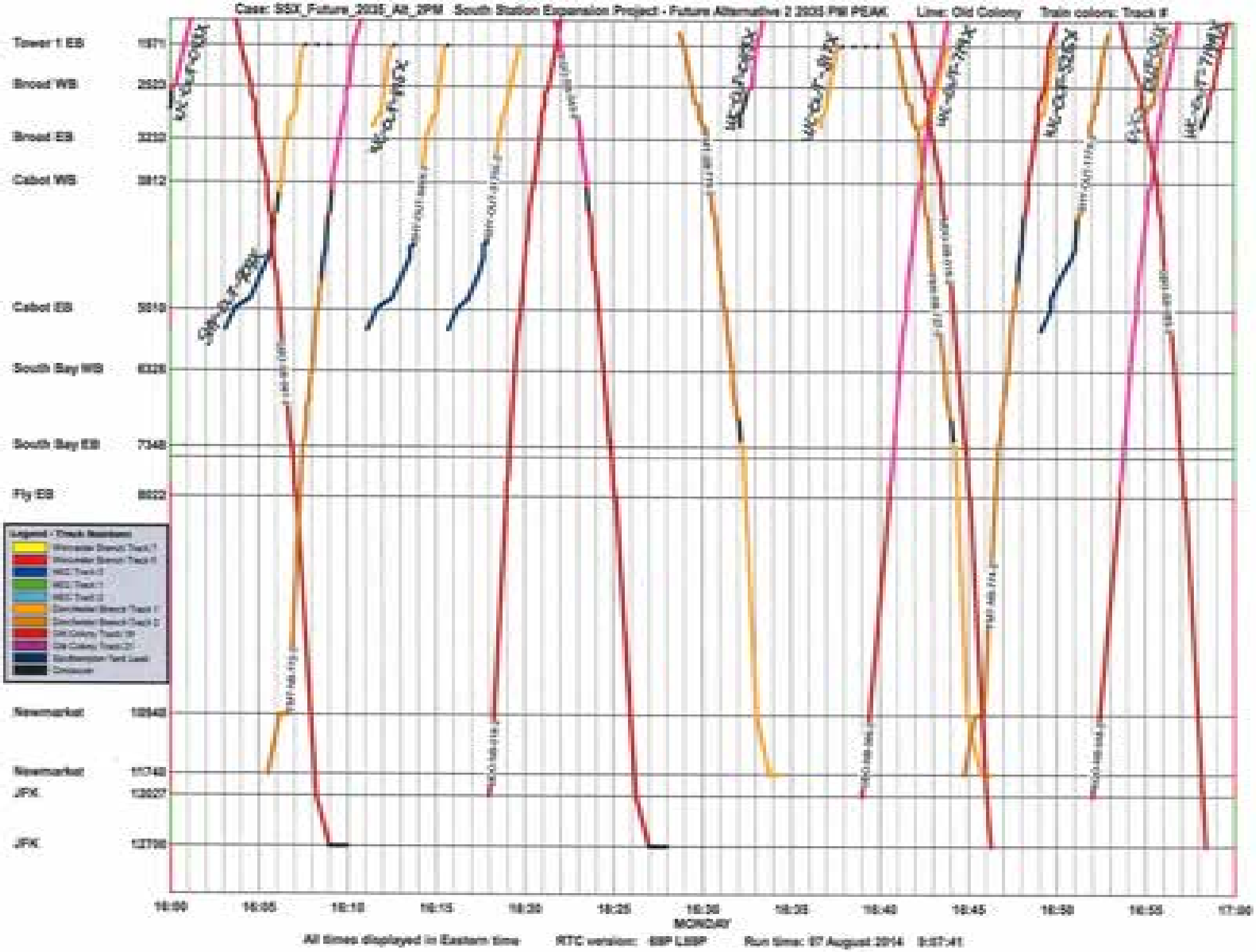

Case: SSX_Future_2035_Alt_2PM South Station Expansion Project - Future Alternative 2 2035 PM PEAK 1 Line: NEC Train colors: Track #
Tower 1 EB
Cove EB
Back Bay
Back Bay
Ruggles
Plains WB
Plains EB
Forest Hills
Forest WB
Forest EB
Hyde Park
Readville WB
Readville EB
Readville
18:00
18:05
18:10
18:15
18:20
18:25
18:30
18:35
18:40
18:45
18:50
18:55
19:00
MONDAY
All times displayed in Eastern time
RTC version: ESP LSSP
Run time: 07 August 2014 9:03:42

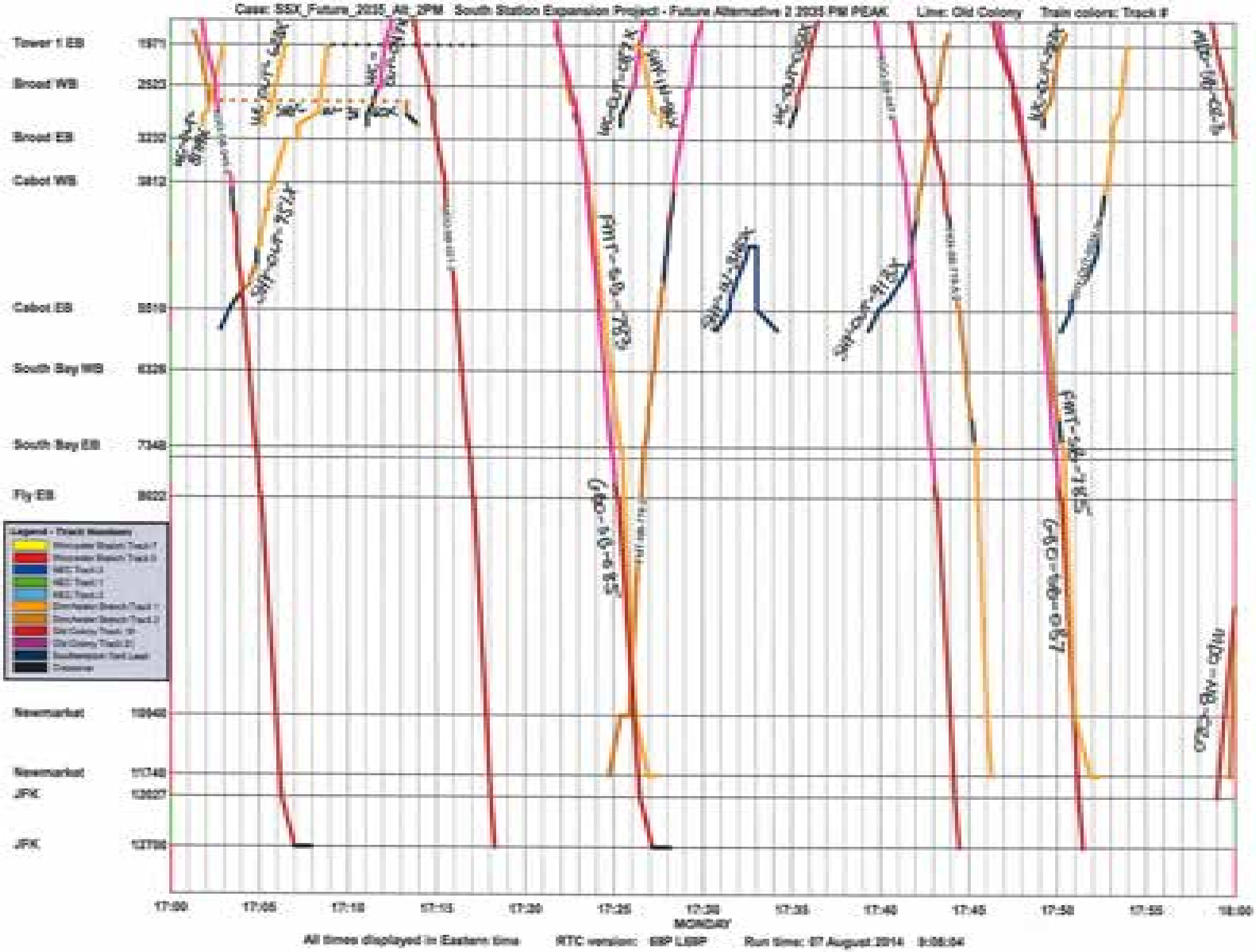

Case: SSX_Future_2035_A6_2PM South Station Expansion Project - Future Alternative 2 2035 PM PEAK Line: NEC Train colors: Track #
Tower 1 EB
Cove EB
Back Bay
Back Bay
Ruggles
Plaina WB
Plaina EB
Forest Hills
Forest WB
Forest EB
Hyde Park
Readville WB
Readville EB
Readville
19:00
19:05
19:10
19:15
19:20
19:25
19:30
MONDAY
19:35
19:40
19:45
19:50
19:55
20:00
All times displayed in Eastern time
RTC version: 49P L69P
Run time: 07 August 2014 9:03:54

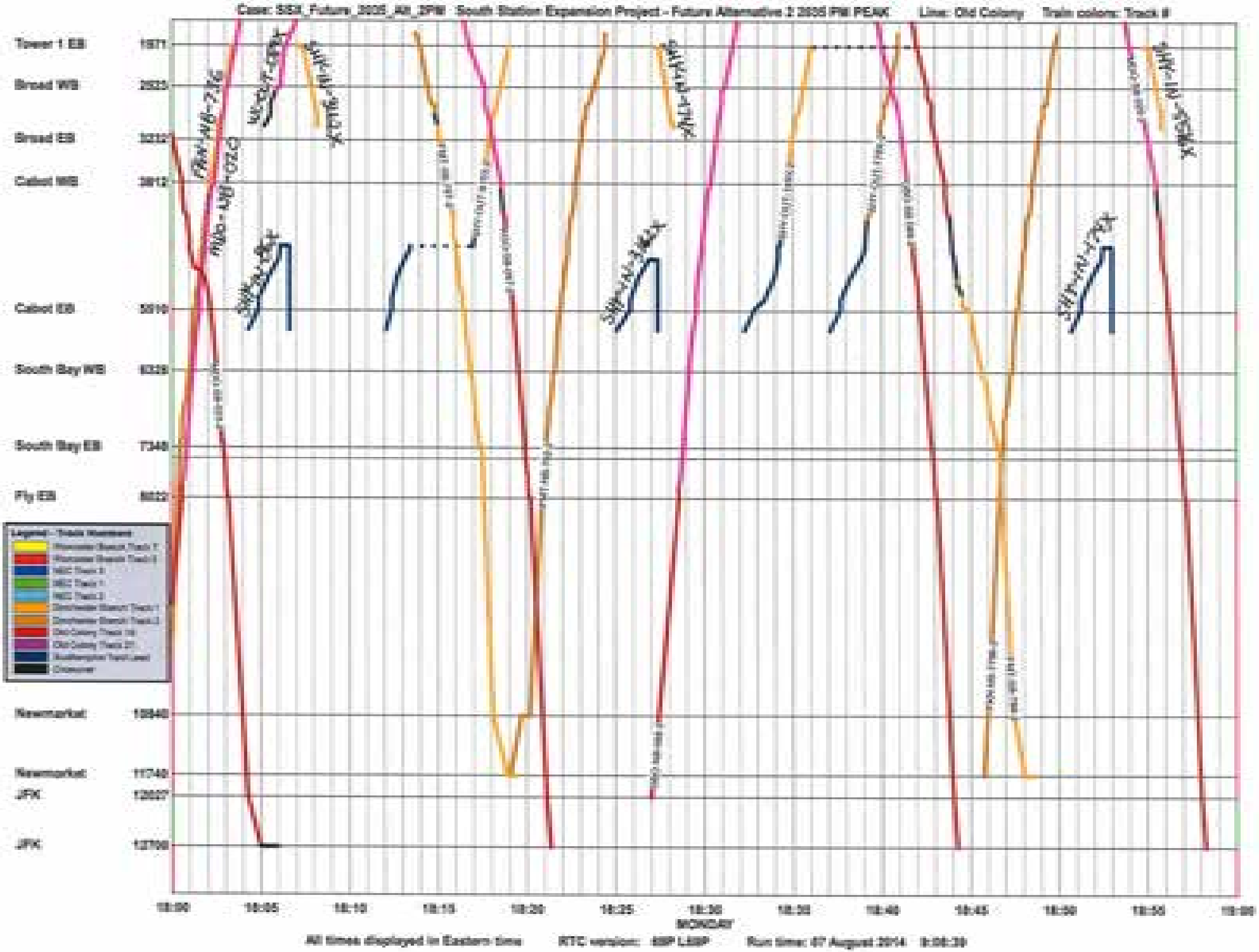

Case: SSX_Future_2035_Alt_3PM South Station Expansion Project - Future Alternative 3 2035 PM PEAK
Line: NEC
Train colors: Track #
Tower 1 EB
1872
Cove EB
Back Bay
Back Bay
Ruggles
12730
Plains WB
Plains EB
25817
Forest Hills
Forest WB
27142
Forest EB
Hyde Park
44838
Readville WB
47640
Readville EB
48557
Readville
50727
MONDAY
All times displayed in Eastern time
RTC version: 63P L63P
Run time: 07 August 2014 9:04:24

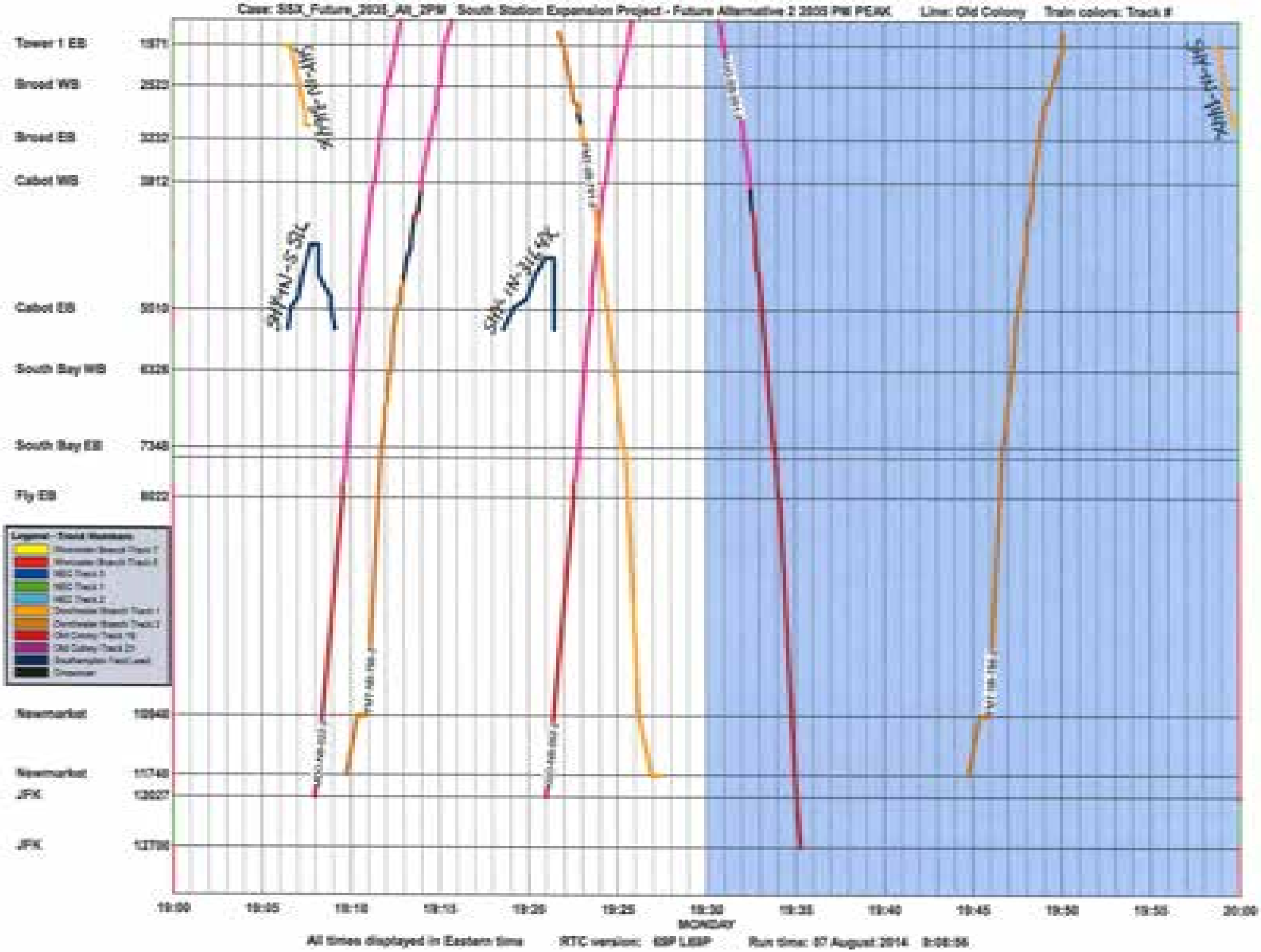

Case: SSX_Future_2035_Alt_2PM South Station Expansion Project - Future Alternative 2 2035 PM PEAK
Line: Old Colony
Trains colors: Track #
Tower 1 EB
Broad WB
Broad EB
Cabot WB
Cabot EB
South Bay WB
South Bay EB
Fly EB
Newmarket
Newmarket
JFK
JFK
14:00
14:05
14:10
14:15
14:20
14:25
14:30
MONDAY
14:35
14:40
14:45
14:50
14:55
15:00
All times displayed in Eastern time
RTC version: 69P L69P
Run time: 07 August 2014

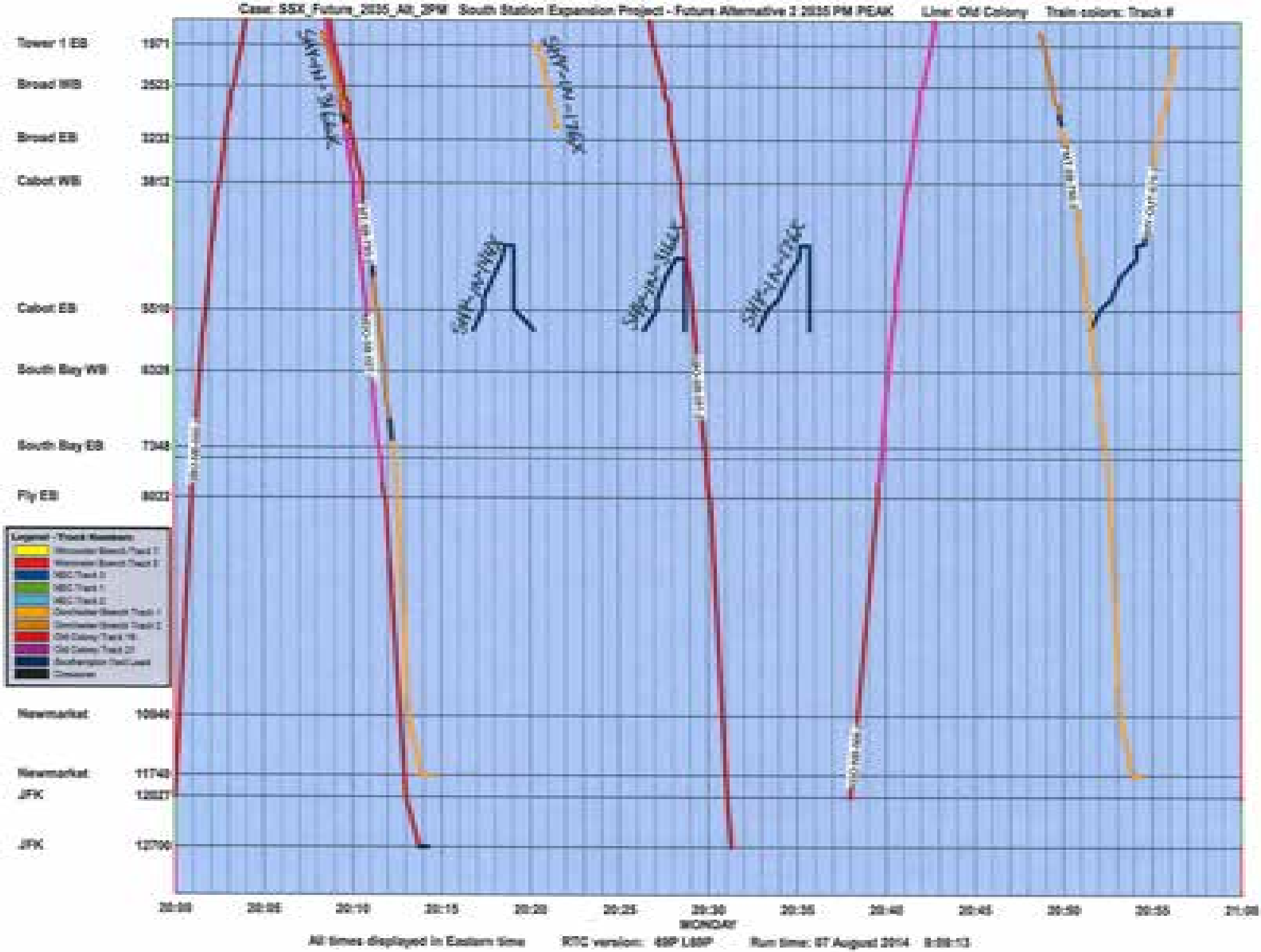

Case: SSX_Future_2035_All_2PM South Station Expansion Project - Future Alternative 2 2035 PM PEAK
Line: Old Colony
Train colors: Track #
Tower 1 EB
1971
Broad WB
2323
Broad EB
3232
Cabot WB
3812
Cabot EB
5510
South Bay WB
6338
South Bay EB
7348
Fly EB
8622
Legend - Track Numbers
Newmarket
10940
Newmarket
11748
JFK
12627
JFK
13700
15:00
15:05
15:10
15:15
15:20
15:25
15:30
15:35
15:40
15:45
15:50
15:55
16:00
MONDAY
All times displayed in Eastern time
RTC version: SSP LSSP
Run time: 07 August 2014 9:06:54


Case: SSX_Future_2035_Alt_2PM South Station Expansion Project - Future Alternative 2 2035 PM PEAK Line: Old Colony Train colors: Track #
Tower 1 EB
Broad WB
Broad EB
Cabot WB
Cabot EB
South Bay WB
South Bay EB
Fly EB
Newmarket
Newmarket
JFK
JFK
16:00
16:05
16:10
16:15
16:20
16:25
16:30
MONDAY
16:35
16:40
16:45
16:50
16:55
17:00
All times displayed in Eastern time
RTC version: SSP LSSP
Run time: 07 August 2014

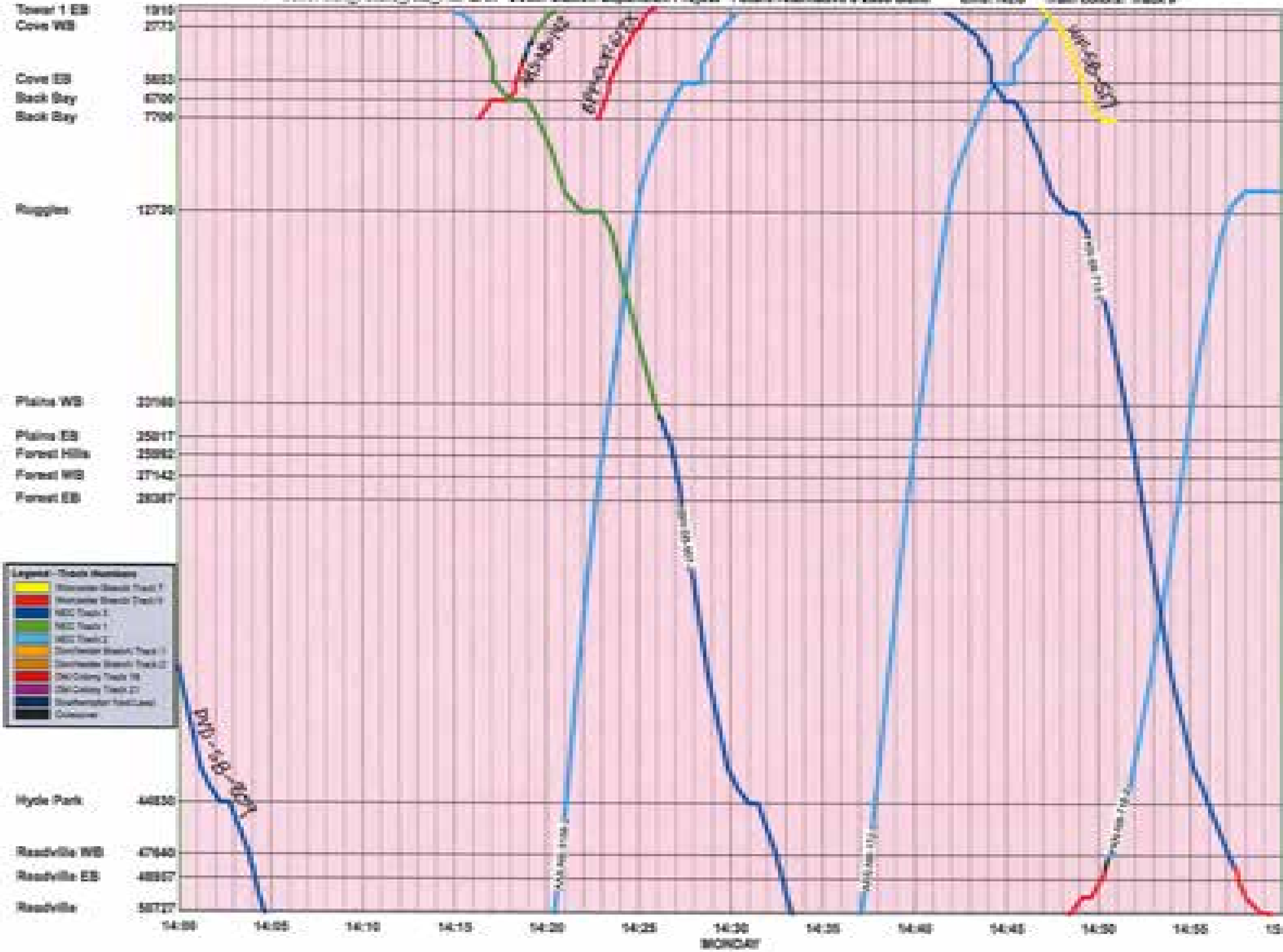

Case: SSX_Future_2035_Alt_2PM South Station Expansion Project - Future Alternative 2 2035 PM PEAK Line: Old Colony Train colors: Track #
Tower 1 EB
Broad WB
Broad EB
Cabot WB
Cabot EB
South Bay WB
South Bay EB
Fly EB
Newmarket
Newmarket
JFK
JFK
17:00
17:05
17:10
17:15
17:20
17:25
17:30
17:35
17:40
17:45
17:50
17:55
18:00
MONDAY
All times displayed in Eastern time
RTC version: ESP LSSP
Run time: 07 August 2014


Case: SSX_Future_2035_All_2PM South Station Expansion Project - Future Alternative 2 2035 PM PEAK
Line: Old Colony
Train colors: Track #
Tower 1 EB
Broad WB
Broad EB
Cabot WB
Cabot EB
South Bay WB
South Bay EB
Fly EB
Newmarket
Newmarket
JFK
JFK
18:00
18:05
18:10
18:15
18:20
18:25
18:30
18:35
18:40
18:45
18:50
18:55
19:00
MONDAY
All times displayed in Eastern time
RTC version: 6SP LSSP
Run time: 07 August 2014

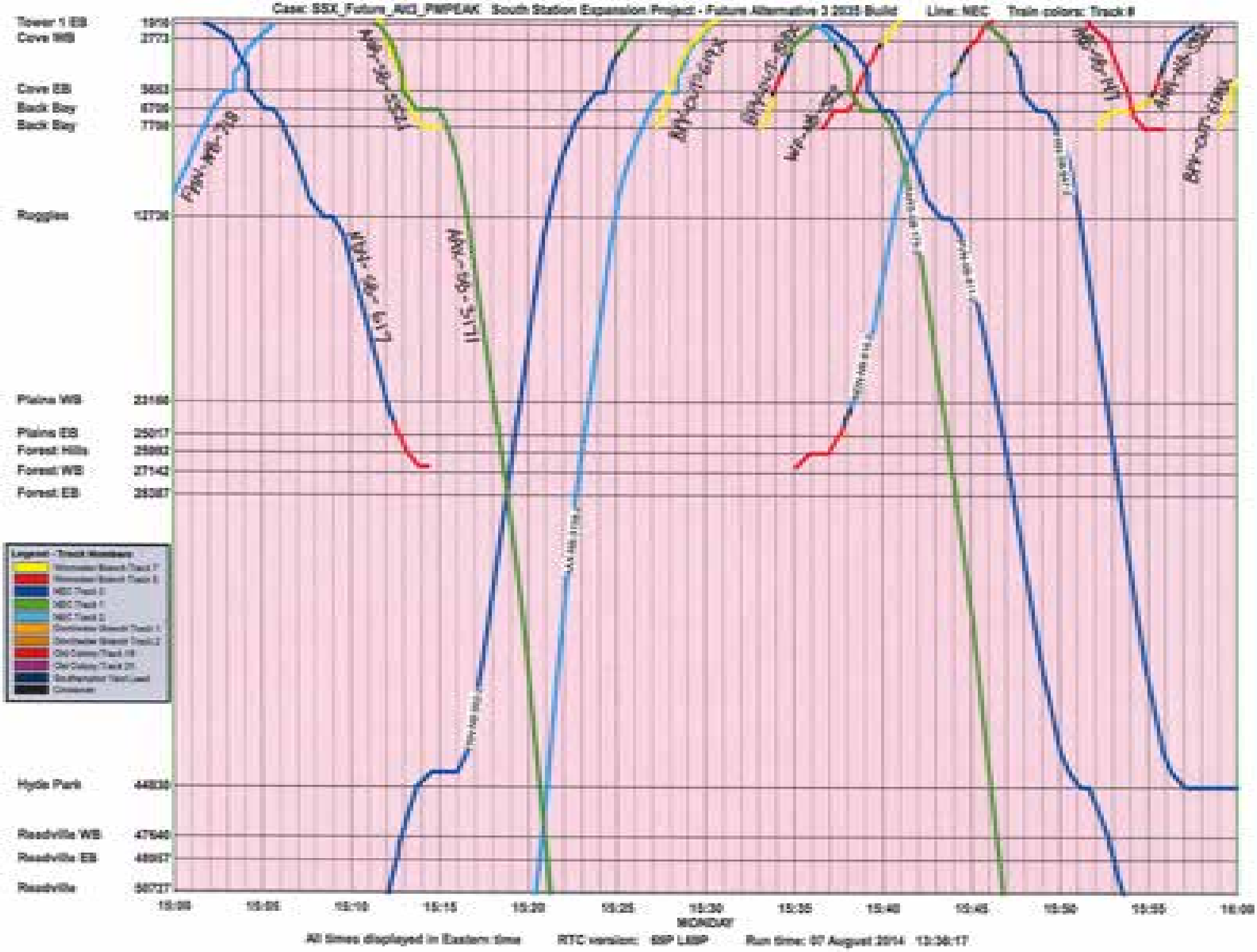

Case: SSX_Future_2035_All_2PM South Station Expansion Project - Future Alternative 2 2035 PM PEAK Line: Old Colony Train colors: Track #
Tower 1 EB
Broad WB
Broad EB
Cabot WB
Cabot EB
South Bay WB
South Bay EB
Fly EB
Newmarket
Newmarket
JFK
JFK
MONDAY
All times displayed in Eastern time
RTC version: 63P LEIP
Run time: 07 August 2014

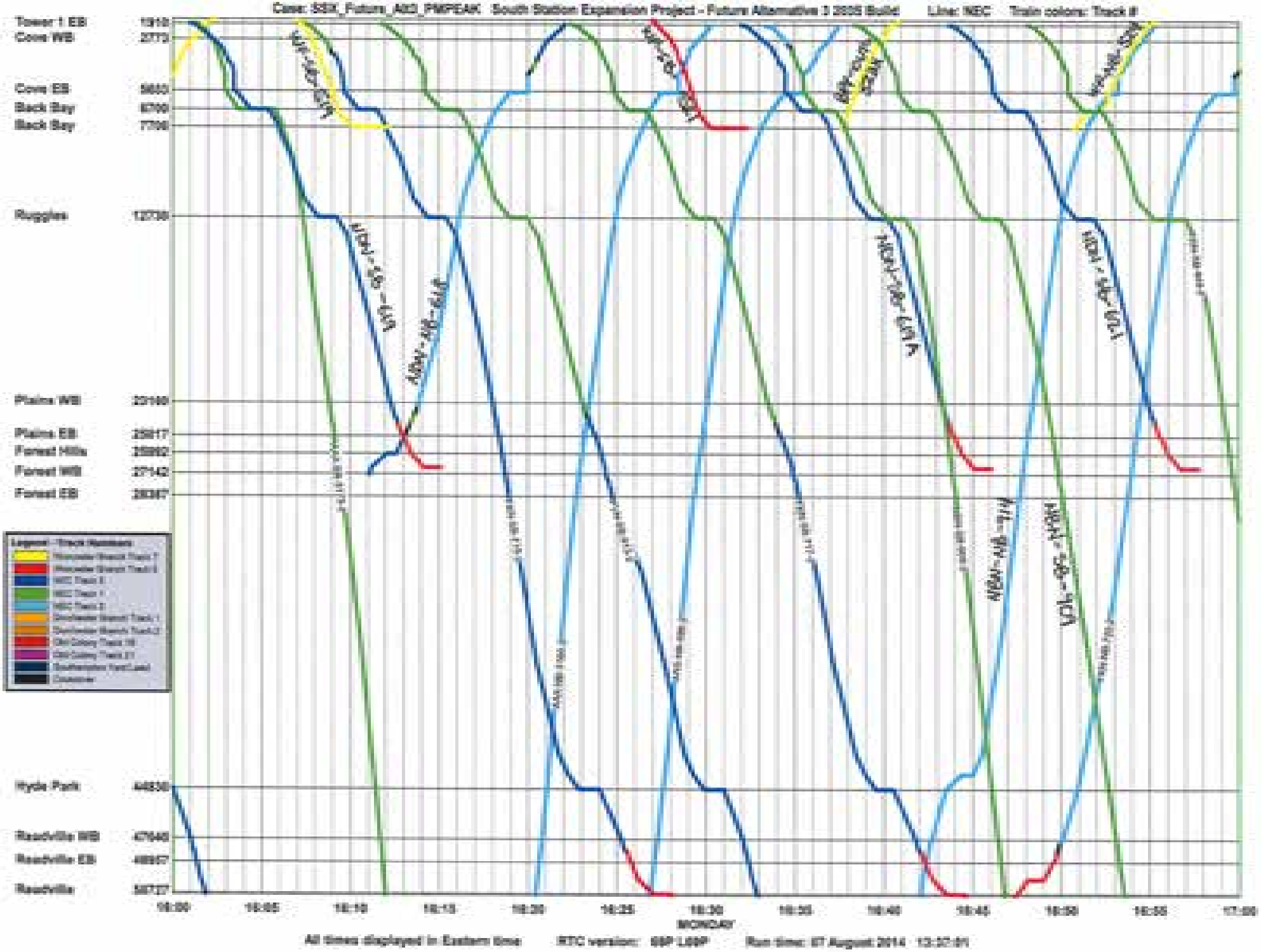

Case: SSX_Future_2035_All_2PM South Station Expansion Project - Future Alternative 2 2035 PM PEAK
Line: Old Colony
Train colors: Track #
Tower 1 EB
Broad WB
Broad EB
Cabot WB
Cabot EB
South Bay WB
South Bay EB
Fly EB
Newmarket
Newmarket
JFK
JFK
MONDAY
All times displayed in Eastern time
RTC version: 69P L69P
Run time: 07 August 2014

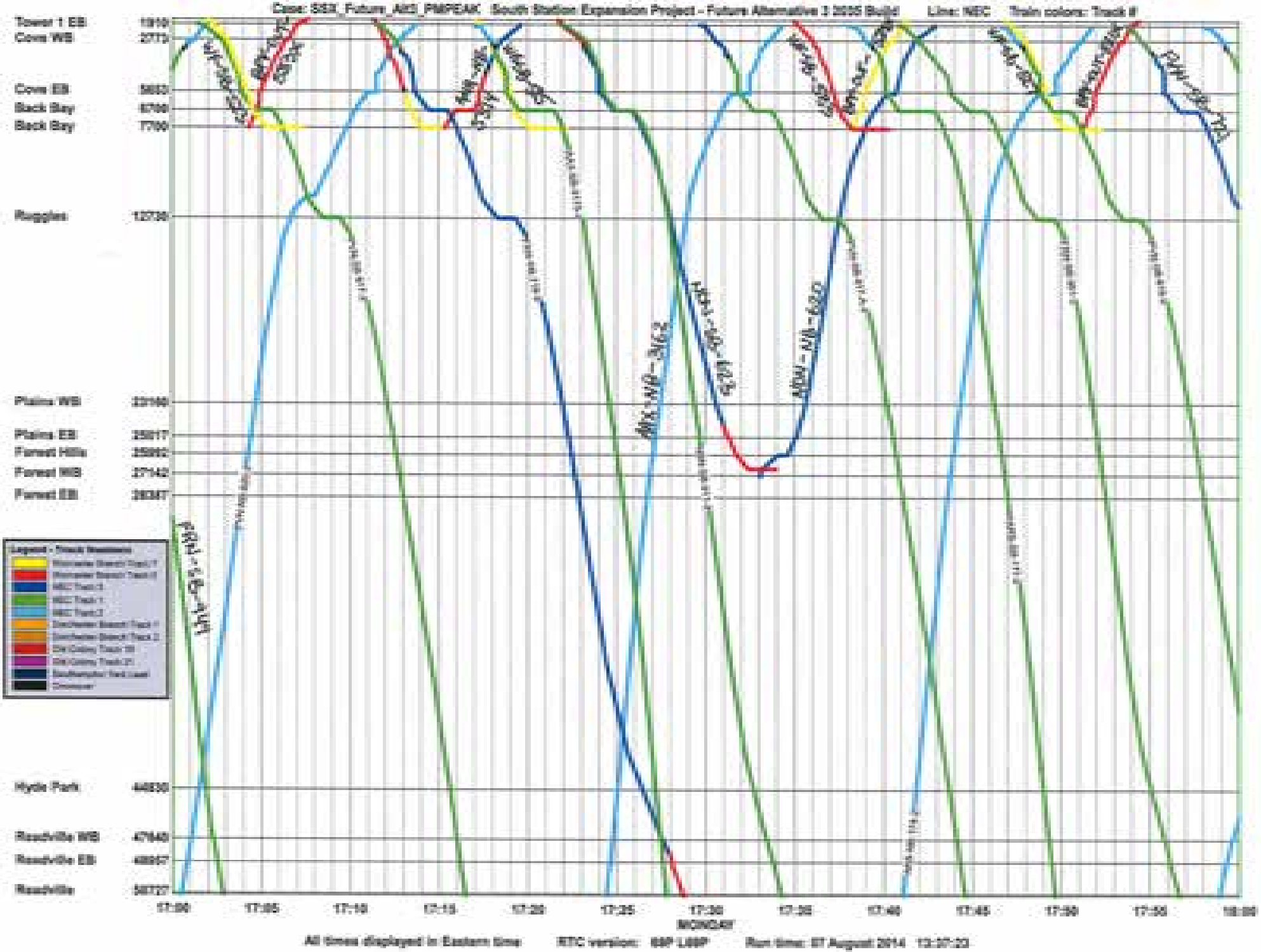
Case: SSX_Future_Alt3_PMPEAK South Station Expansion Project - Future Alternative 3 2035 Build Line: NEC Train colors: Track #

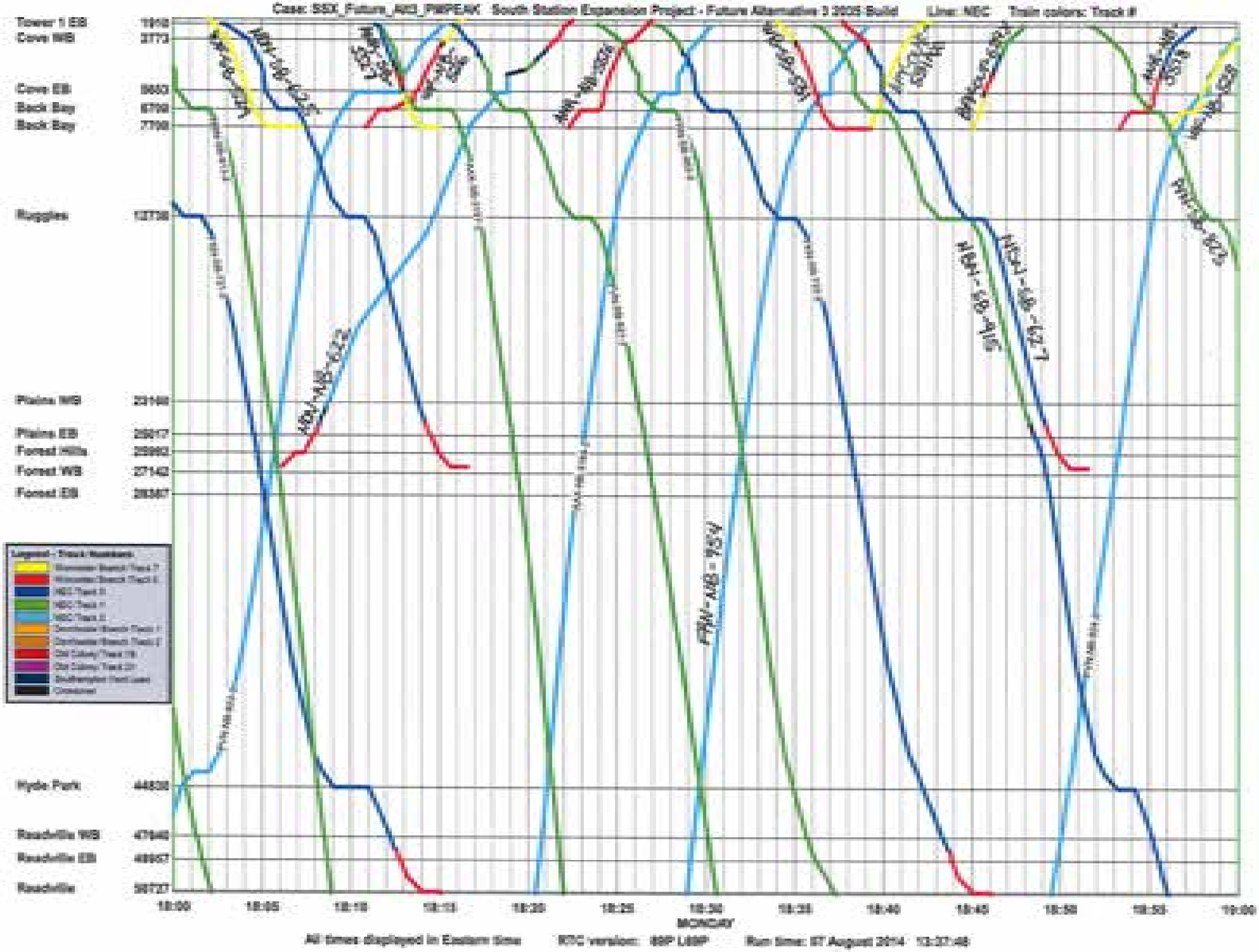


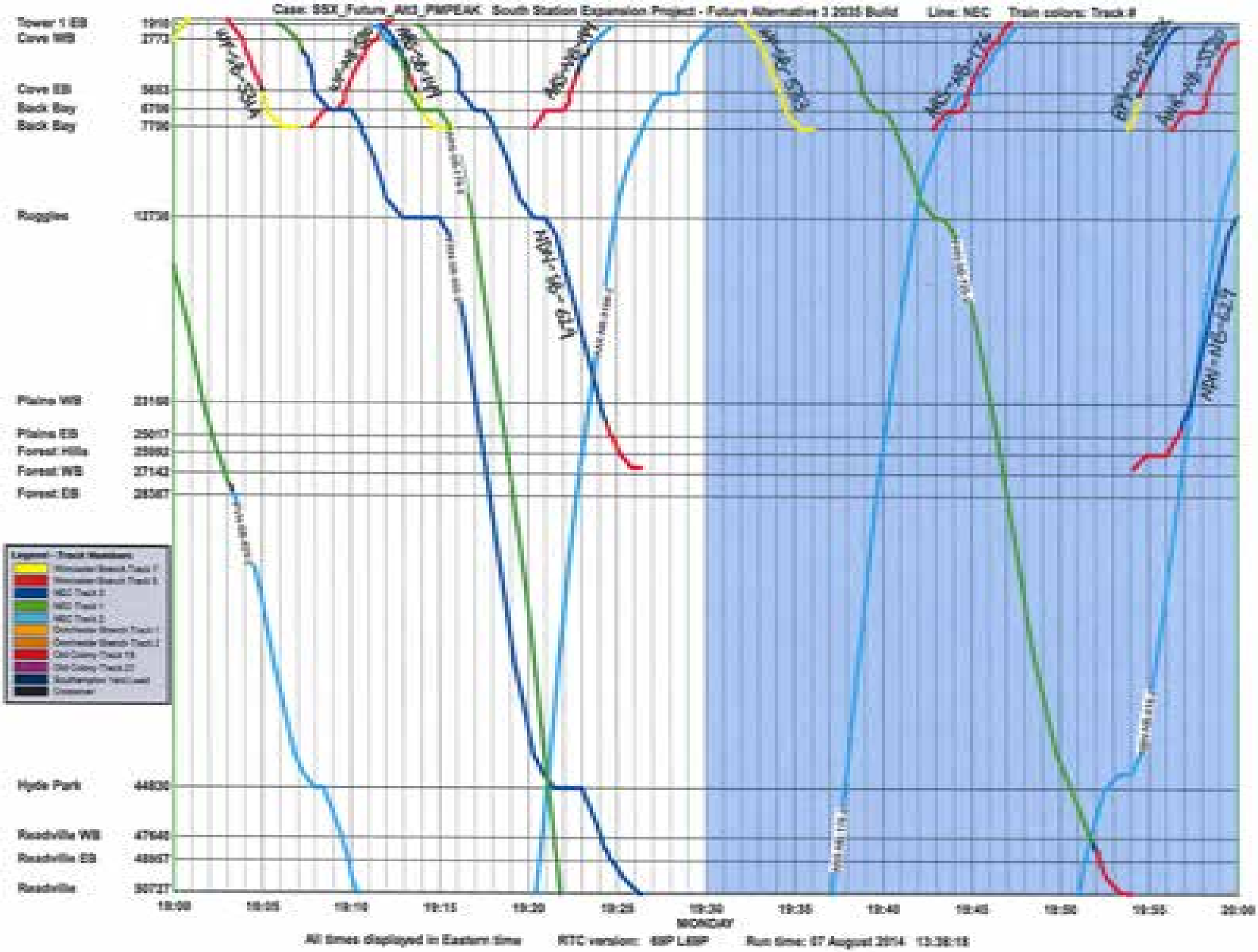
All times displayed in Eastern time RTC version: 69P L69P Run time: 07 August 2014 13:31:48

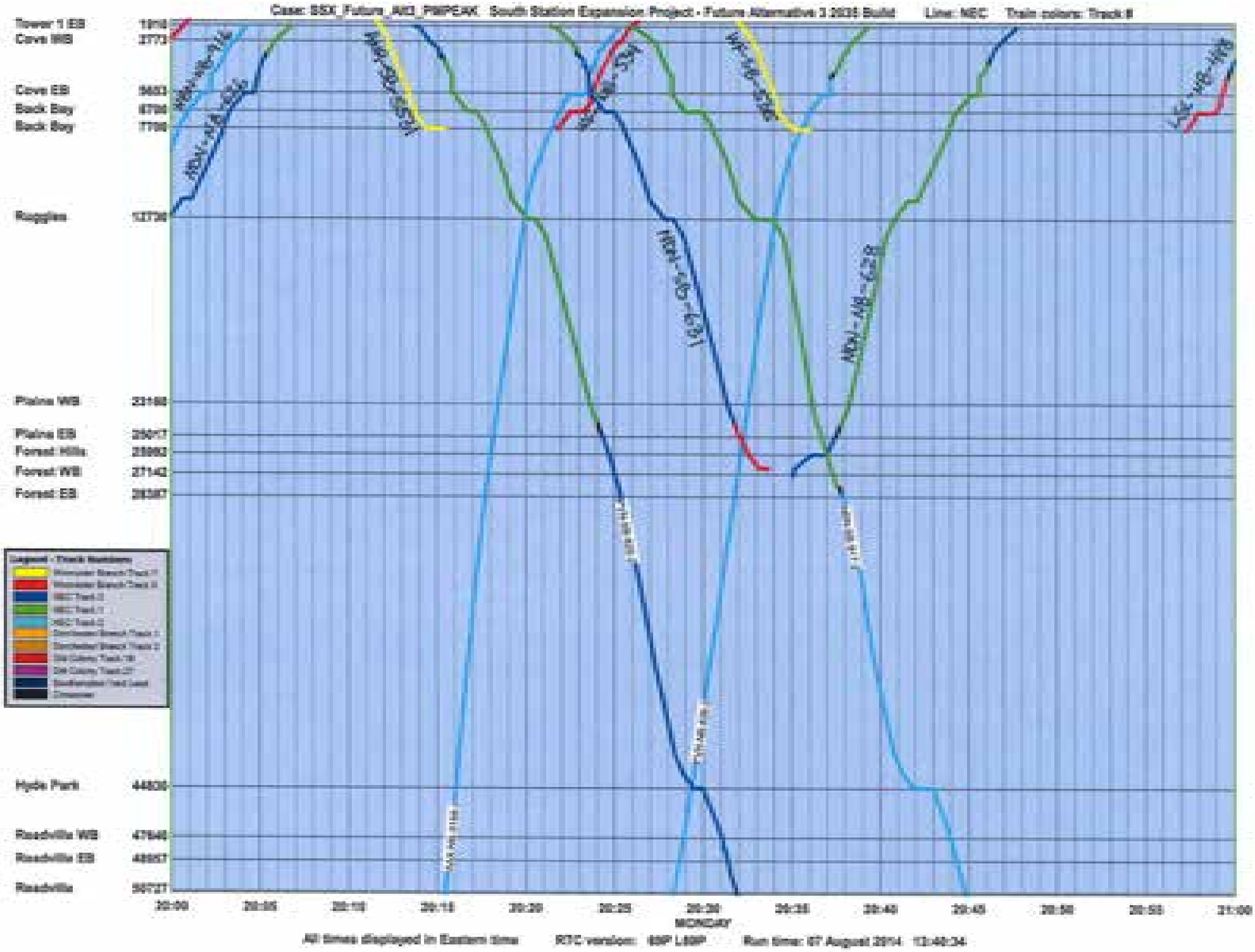

Case: SSX_Future_Alt3_PMPEAK South Station Expansion Project - Future Alternative 3 2035 Build
Line: NEC
Train colors: Track #
Tower 1 EB
Cove WB
Cove EB
Back Bay
Back Bay
Roggles
Plains WB
Plains EB
Forest Hills
Forest WB
Forest EB
Hyde Park
Readville WB
Readville EB
Readville
15:00
15:05
15:10
15:15
15:20
15:25
15:30
15:35
15:40
15:45
15:50
15:55
16:00
MONDAY
All times displayed in Eastern time
RTC version: SSP LSSP
Run time: 07 August 2014 13:36:17

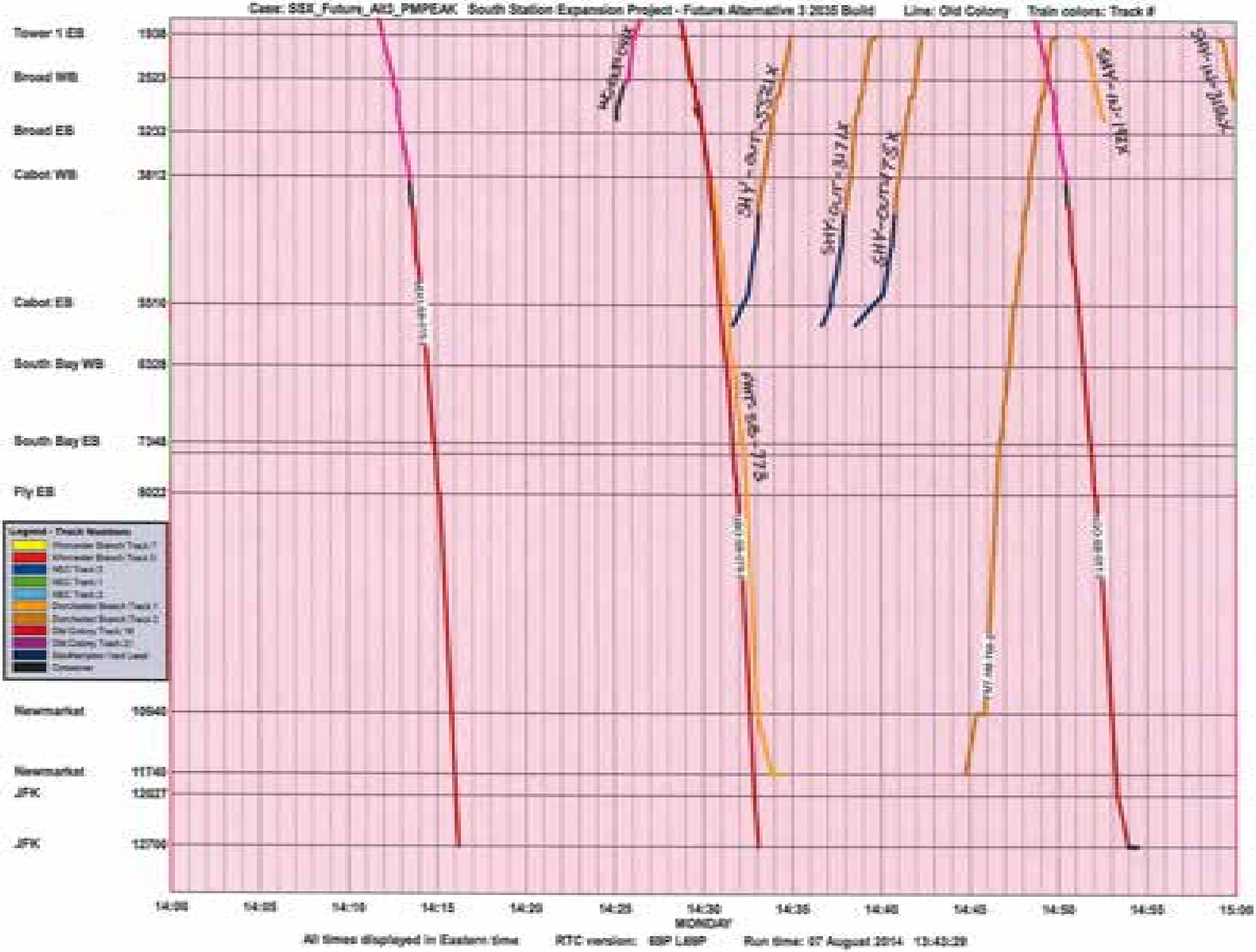

Case: SSX_Future_AlO_PMPEAK South Station Expansion Project - Future Alternative 3 2035 Build
Line: NEC
Train colors: Track #
Tower 1 EB
Cove WB
Cove EB
Back Bay
Back Bay
Ruggles
Plains WB
Plains EB
Forest Hills
Forest WB
Forest EB
Hyde Park
Readville WB
Readville EB
Readville
MONDAY
All times displayed in Eastern time
RTC version: 69P L69P
Run time: 07 August 2014

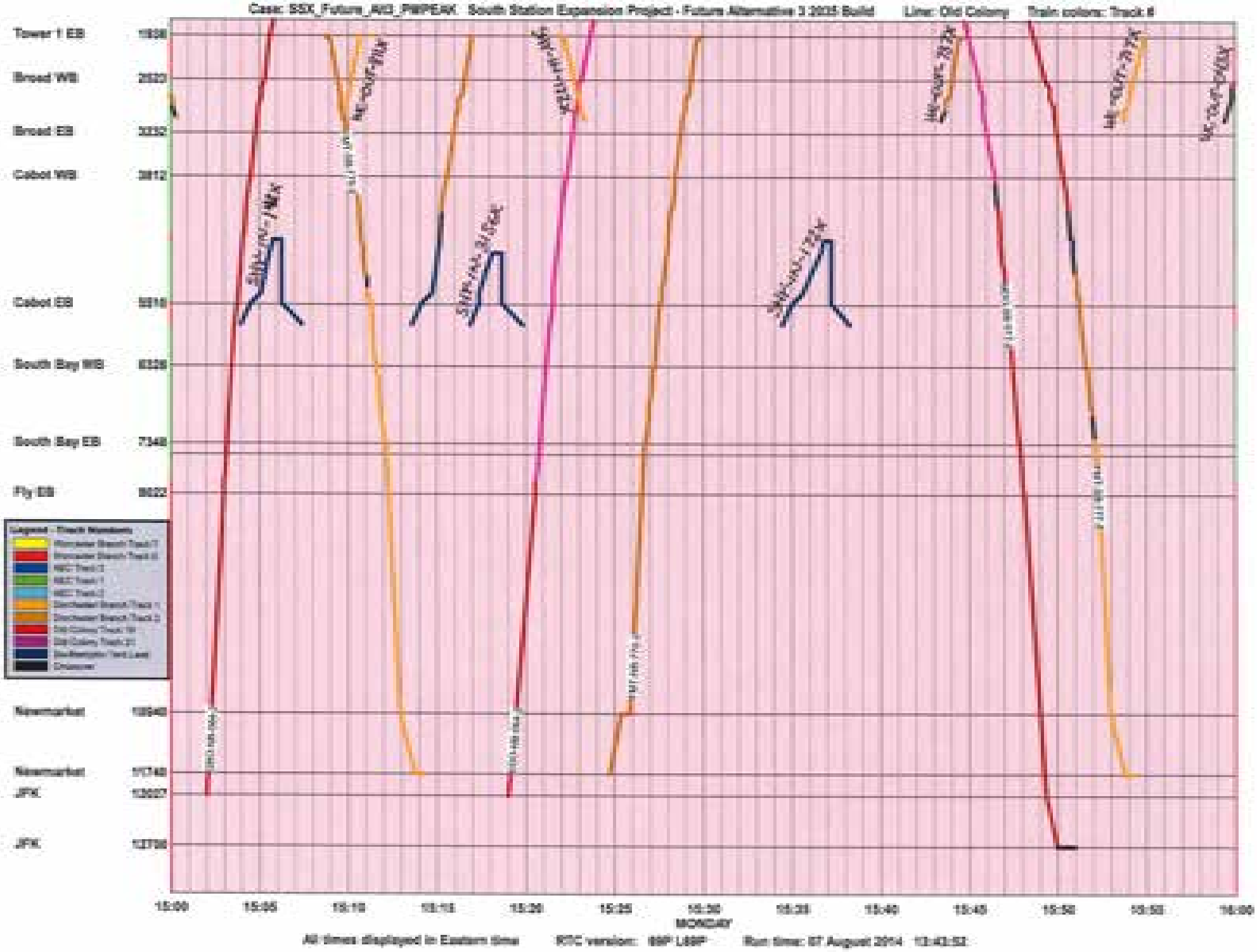

Case: SSX_Future_Alt3_PMPEAK South Station Expansion Project - Future Alternative 3 2035 Build
Line: NEC
Train colors: Track #
Tower 1 EB
Cove WB
Cove EB
Back Bay
Back Bay
Ruggles
Plains WB
Plains EB
Forest Hills
Forest WB
Forest EB
Hyde Park
Readville WB
Readville EB
Readville
17:00
17:05
17:10
17:15
17:20
17:25
17:30
17:35
17:40
17:45
17:50
17:55
18:00
MONDAY
All times displayed in Eastern time
RTC version: 69P L69P
Run time: 07 August 2014 13:27:23

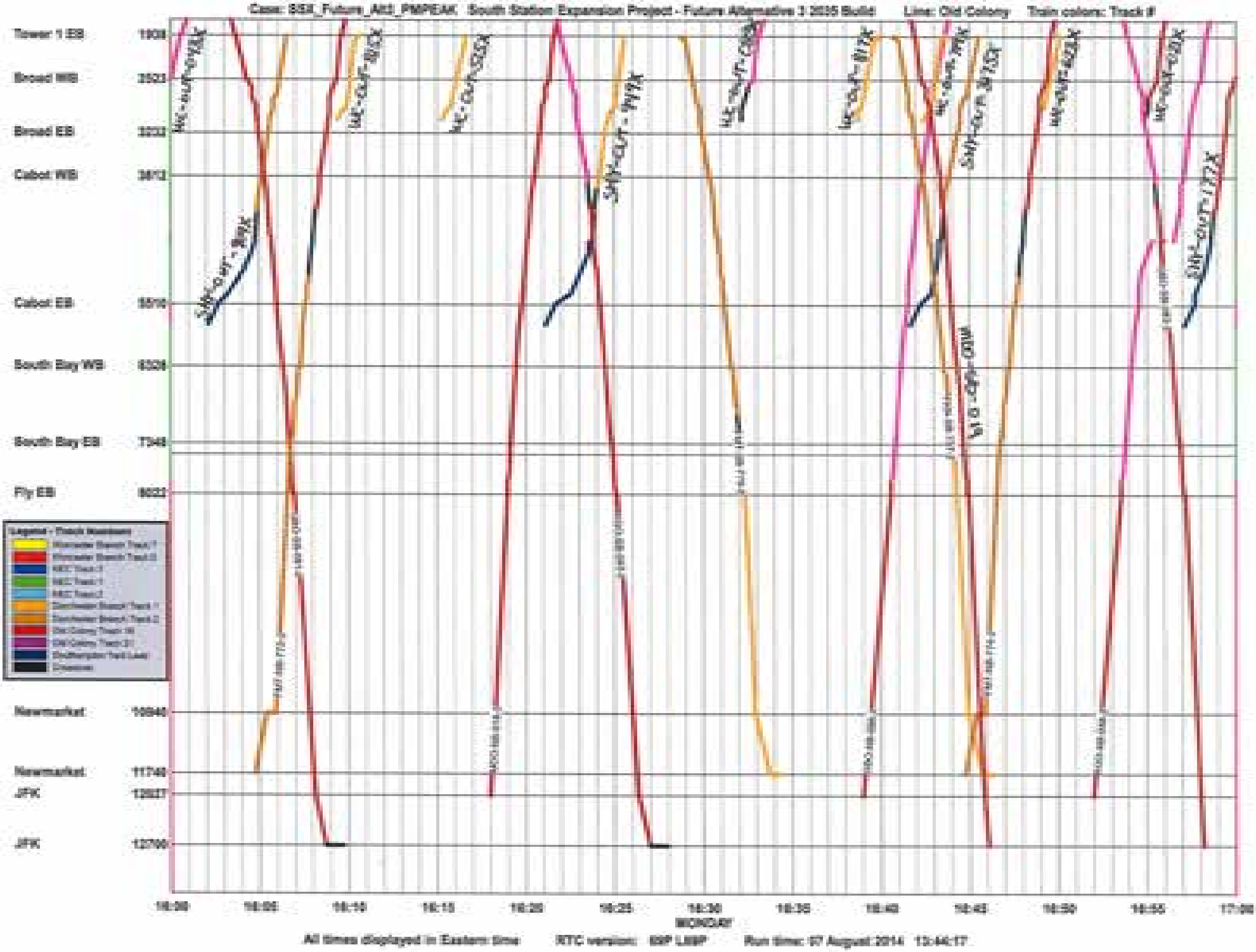

Case: SSX_Future_Alt3_PMPEAK South Station Expansion Project - Future Alternative 3 2035 Build
Line: NEC
Train colors: Track #
Tower 1 EB
Cove WB
Cove EB
Back Bay
Back Bay
Ruggles
Plains WB
Plains EB
Forest Hills
Forest WB
Forest EB
Hyde Park
Readville WB
Readville EB
Readville
18:00
18:05
18:10
18:15
18:20
18:25
18:30
18:35
18:40
18:45
18:50
18:55
19:00
MONDAY
All times displayed in Eastern time
RTC version: 6SP U6SP
Run time: 07 August 2014 13:37:48

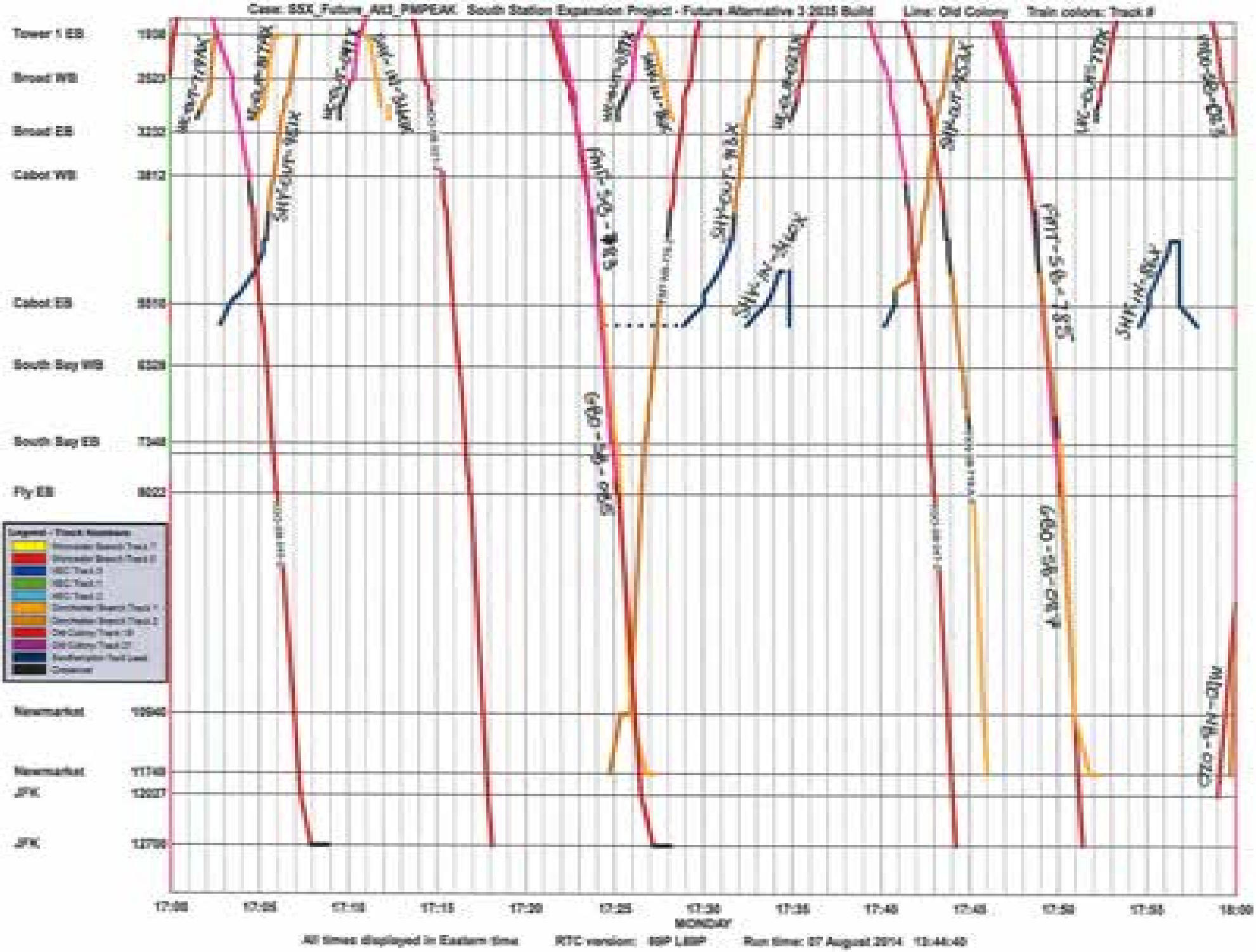

Case: SSX_Future_Alt3_PMPEAK South Station Expansion Project - Future Alternative 3 2035 Build
Line: NEC
Train colors: Track #
Tower 1 EB
Cove WB
Cove EB
Back Bay
Back Bay
Ruggles
Plaine WB
Plaine EB
Forest Hills
Forest WB
Forest EB
Hyde Park
Readville WB
Readville EB
Readville
MONDAY
All times displayed in Eastern time
RTC version: 6IP L6IP
Run time: 07 August 2014 13:38:18


Case: SSX_Future_A03_PMPEAK South Station Expansion Project - Future Alternative 3 2035 Build
Line: NEC
Train colors: Track #
Tower 1 EB
Cove WB
Cove EB
Back Bay
Back Bay
Ruggles
Prairie WB
Prairie EB
Forest Hills
Forest WB
Forest EB
Hyde Park
Readville WB
Readville EB
Readville
20:00
20:05
20:10
20:15
20:20
20:25
20:30
MONDAY
20:35
20:40
20:45
20:50
20:55
21:00
All times displayed in Eastern time
RTC version: 69P L69P
Run time: 07 August 2014 13:46:34

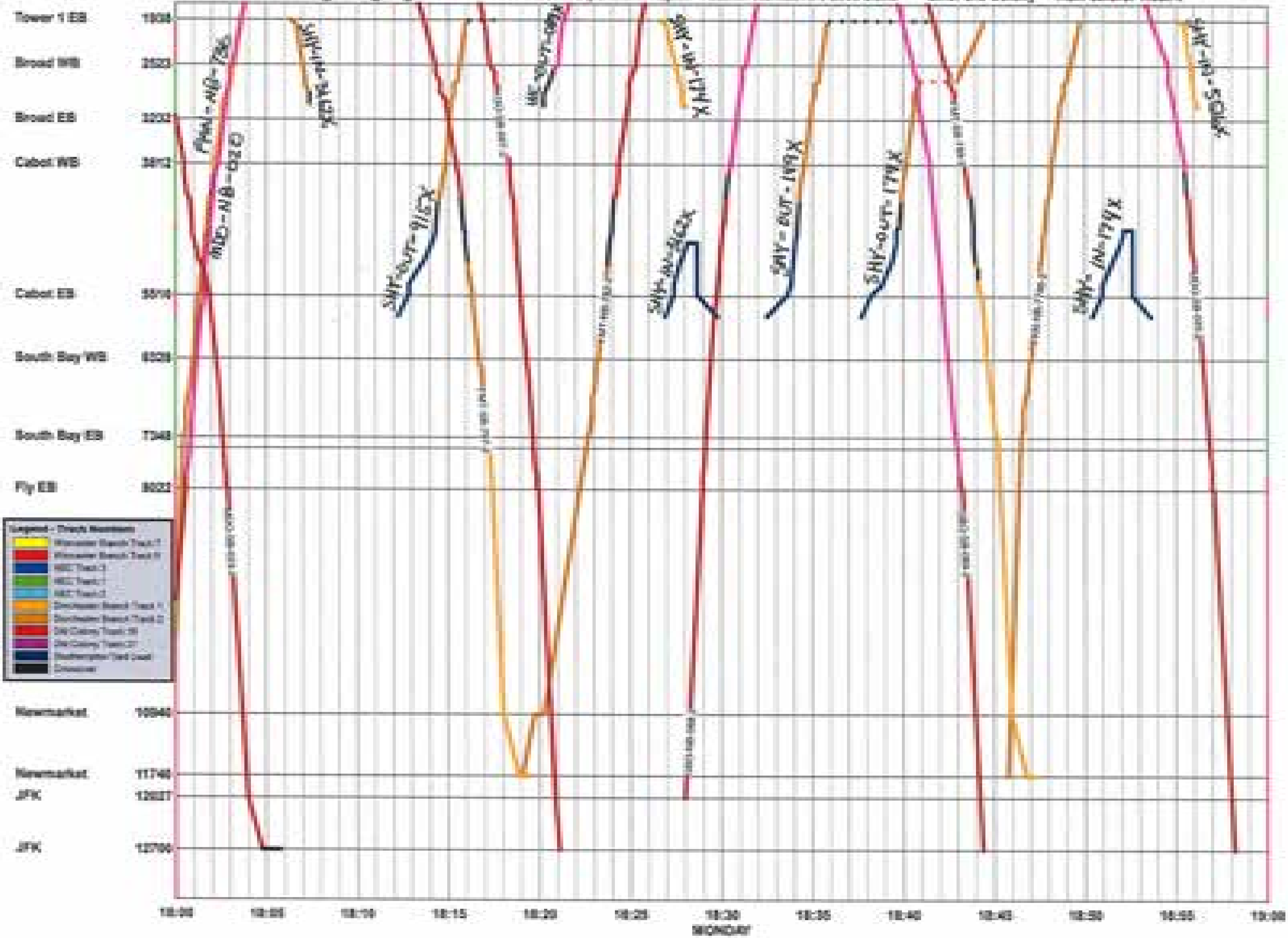

Case: SSS_Future_Alt3_PMPEAK South Station Expansion Project - Future Alternative 3 2035 Build
Line: Old Colony
Train colors: Track #
Tower 1 EB
Broad WB
Broad EB
Cabot WB
Cabot EB
South Bay WB
South Bay EB
Fly EB
Newmarket
Newmarket
JFK
JFK
14:00
14:05
14:10
14:15
14:20
14:25
14:30
MONDAY
14:35
14:40
14:45
14:50
14:55
15:00
All times displayed in Eastern time
RTC version: 69P L69P
Run time: 07 August 2014 13:43:39


Case: SSX_Future_A03_PMPEAK South Station Expansion Project - Future Alternative 3 2035 Build
Line: Old Colony
Train colors: Track #
Tower 1 EB
Broad WB
Broad EB
Cabot WB
Cabot EB
South Bay WB
South Bay EB
Fly EB
Newmarket
Newmarket
JFK
JFK
15:00
15:05
15:10
15:15
15:20
15:25
15:30
15:35
15:40
15:45
15:50
15:55
16:00
MONDAY
All times displayed in Eastern time
RTC version: 69P L69P
Run time: 07 August 2014 13:43:53

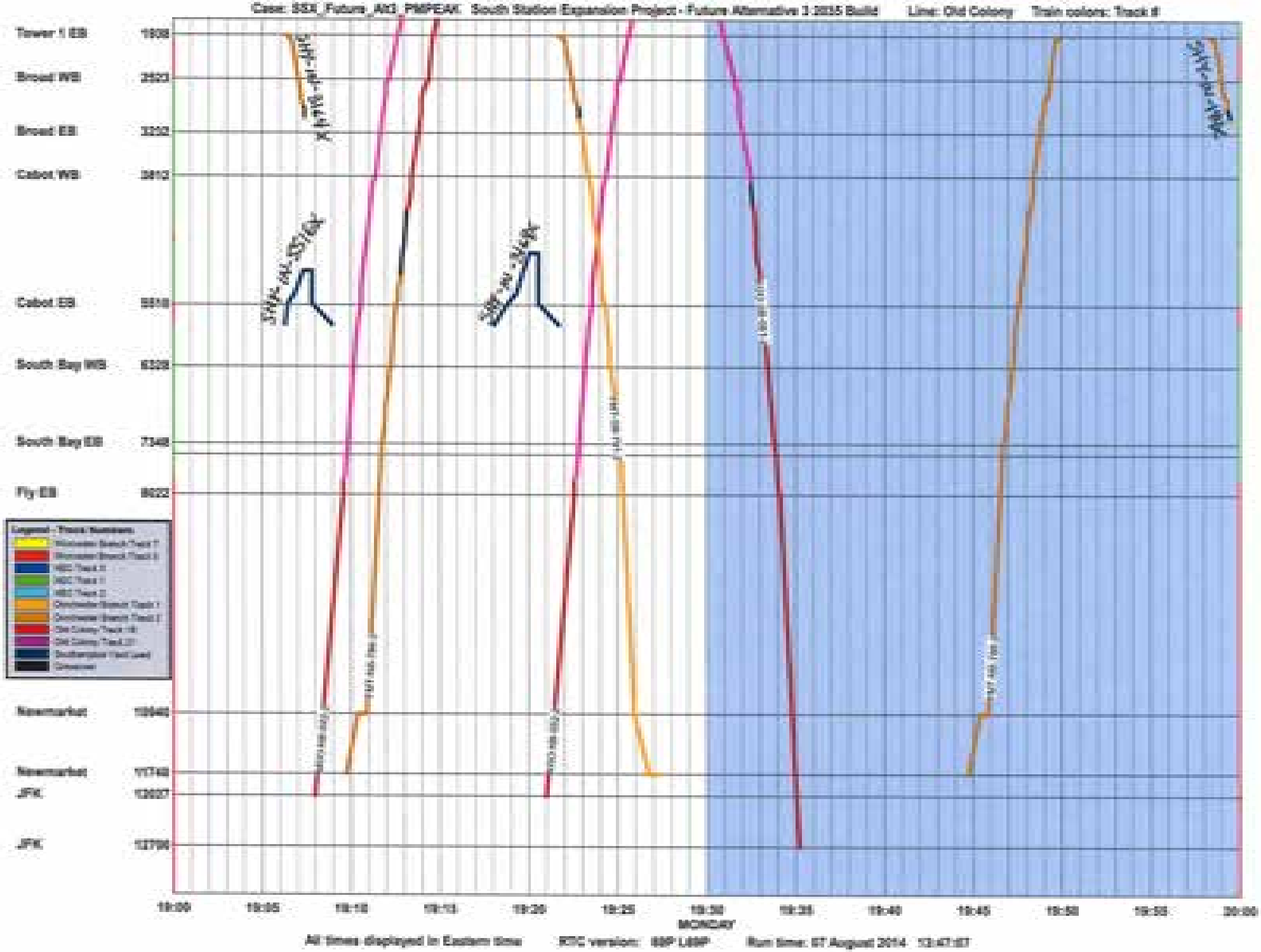

Case: SSX_Future_Alt3_PMPEAK South Station Expansion Project - Future Alternative 3 2035 Build
Line: Old Colony
Train colors: Track #
Tower 1 EB
Broad WB
Broad EB
Cabot WB
Cabot EB
South Bay WB
South Bay EB
Fly EB
Newmarket
Newmarket
JFK
JFK
Legend - Track Numbers
16:00
16:05
16:10
16:15
16:20
16:25
16:30
16:35
16:40
16:45
16:50
16:55
17:00
MONDAY
All times displayed in Eastern time
RTC version: 69P L69P
Run time: 07 August 2014 13:44:17

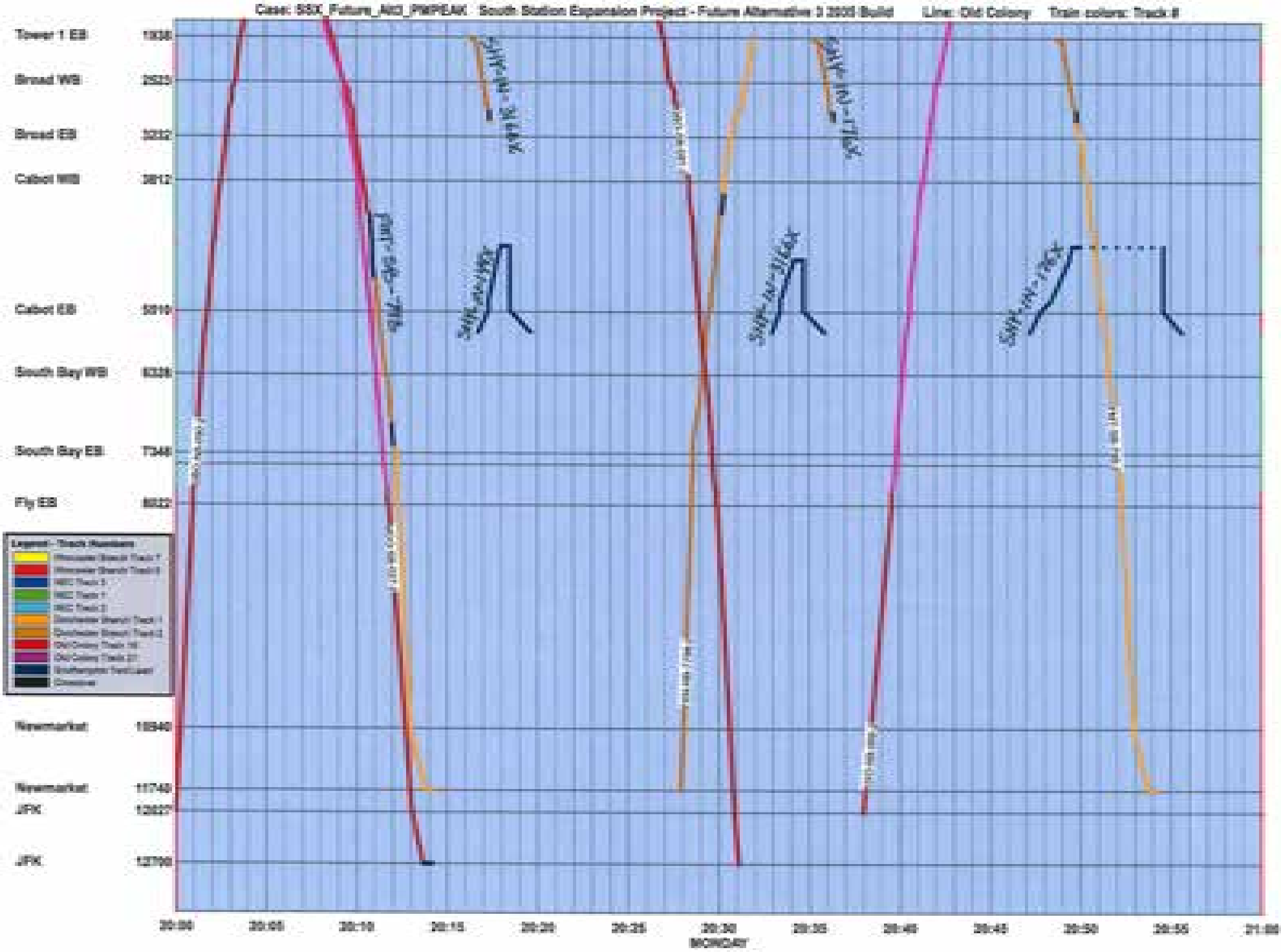

Case: SSX_Future_Alt3_PMPEAK South Station Expansion Project - Future Alternative 3 2035 Build
Line: Old Colony
Train colors: Track #
Tower 1 EB
Broad WB
Broad EB
Cabot WB
Cabot EB
South Bay WB
South Bay EB
Fly EB
Newmarket
Newmarket
JFK
JFK
MONDAY
All times displayed in Eastern time
RTC version: 69P LBIP
Run time: 07 August 2014 13:44:40

Case: SSX_Future_Alt3_PMPEAK   South Station Expansion Project - Future Alternative 3 2035 Build   Line: Old Colony   Train colors: Track #



All times displayed in Eastern time   RTC version: 69P L69P   Run time: 07 August 2014 13:45:07


Case: SSX_Future_Alt3_PMPEAK South Station Expansion Project - Future Alternative 3 2035 Build
Line: Old Colony
Train colors: Track #
Tower 1 EB
Broad WB
Broad EB
Cabot WB
Cabot EB
South Bay WB
South Bay EB
Fly EB
Newmarket
Newmarket
JFK
JFK
MONDAY
All times displayed in Eastern time
RTC version: SSP LSSP
Run time: 07 August 2014 13:47:07


Case: SSX_Future_AltO_PMPEAK South Station Expansion Project - Future Alternative 3 2035 Build
Line: Old Colony
Train colors: Track #
Tower 1 EB
Broad WB
Broad EB
Cabot WB
Cabot EB
South Bay WB
South Bay EB
Fly EB
Newmarket
Newmarket
JFK
JFK
Legend - Track Numbers
20:00
20:05
20:10
20:15
20:20
20:25
20:30
MONDAY
20:35
20:40
20:45
20:50
20:55
21:00
All times displayed in Eastern time
RTC version: 6SP LSSP
Run time: 07 August 2014 13:48:47

Attachment D –
Future 2035 PM Peak Period South Station Track Occupancy Charts

Alternative 2 PM Peak Period South Station Platform Track Occupancy Chart
Alternative 3 PM Peak Period South Station Platform Track Occupancy Chart

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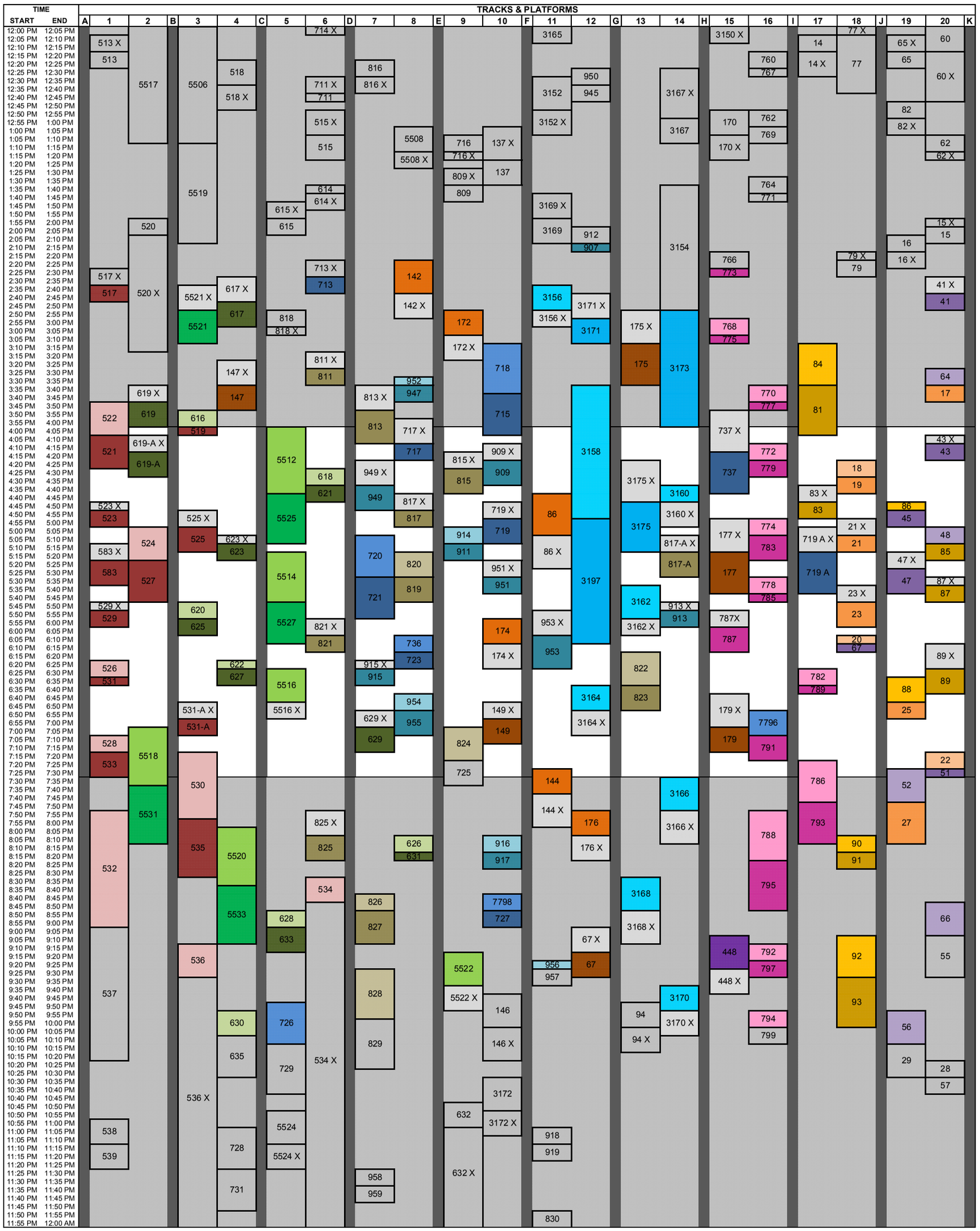
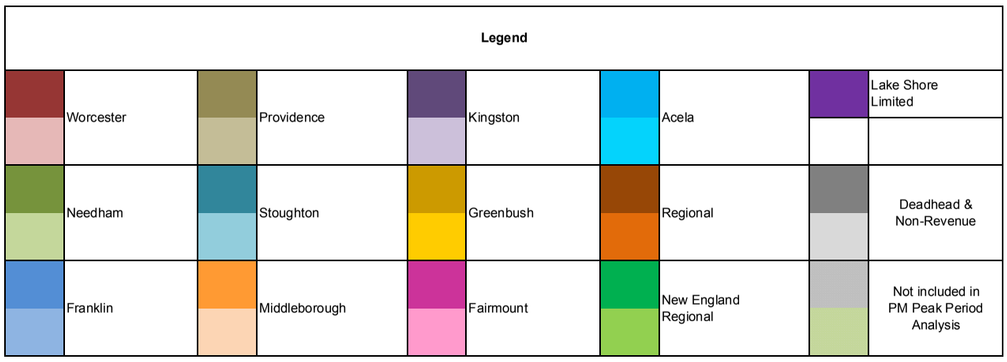
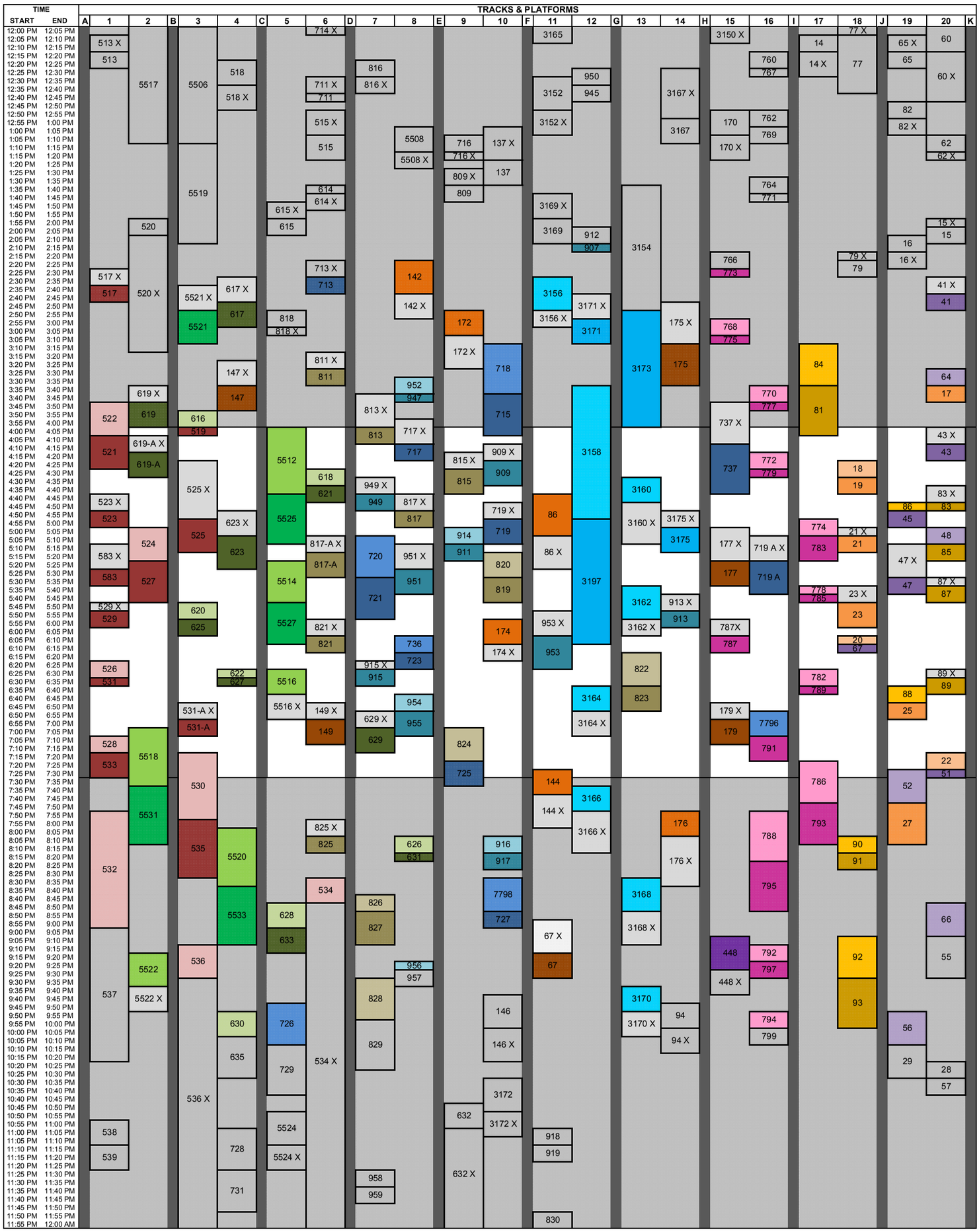


Colored trains shown on the Track Occupancy Chart are represented in the RTC model.
PM Period Analysis On-time Performance and Delay Results only include trains arriving at or departing from South Station between 4:00 PM and 7:30 PM.





Colored trains shown on the Track Occupancy Chart are represented in the RTC model.
PM Period Analysis On-time Performance and Delay Results only include trains arriving at or departing from South Station between 4:00 PM and 7:30 PM.

Legend

	Worcester		Providence		Kingston		Lake Shore Limited
	Needham		Stoughton		Greenbush		Deadhead & Non-Revenue
	Franklin		Middleborough		Fairmount		Not included in PM Peak Period Analysis

Attachment E – Future 2035 PM Peak Period Simulation Results

Alternative 2 PM Peak Period Simulation Results
Alternative 3 PM Peak Period Simulation Results

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South Station Expansion Project Operations Analysis
PM Period Simulation Alternatives
Delay & On-Time Performance Results

		Alternative 2		Alternative 3	
Deterministic Results	**Train Group**	**Delay %**	**OTP %**	**Delay %**	**OTP %**
	Acela	0.37%	100.00%	0.51%	100.00%
	Regional	5.14%	100.00%	7.43%	100.00%
	NE Regional	0.00%	100.00%	0.00%	100.00%
	MBTA	1.53%	100.00%	2.18%	100.00%
	Total	1.59%	100.00%	2.28%	100.00%

		Alternative 2		Alternative 3	
Randomized Results	**Train Group**	**Delay %**	**OTP %**	**Delay %**	**OTP %**
	Acela	6.74%	100.00%	12.98%	100.00%
	Regional	7.49%	100.00%	13.02%	100.00%
	NE Regional	6.28%	100.00%	14.65%	100.00%
	MBTA	6.71%	95.50%	12.99%	92.55%
	Total	6.74%	96.32%	13.06%	93.92%

SSX Project Alternative 2 - PM Period - Randomized Runs - Delay and On-Time Performance Results

	Randomized 1		Randomized 2		Randomized 3		Randomized 4		Randomized 5		Randomized 6		Randomized 7		Randomized 8		Randomized 9		Randomized 10	
Train Group	Delay (%)	OTP (%)	Delay (%)	OTP (%)	Delay (%)	OTP (%)	Delay (%)	OTP (%)	Delay (%)	OTP (%)	Delay (%)	OTP (%)	Delay (%)	OTP (%)	Delay (%)	OTP (%)	Delay (%)	OTP (%)	Delay (%)	OTP (%)
Acela	6.71%	100.00%	3.16%	100.00%	2.74%	100.00%	7.06%	100.00%	3.94%	100.00%	5.39%	100.00%	7.74%	100.00%	5.52%	100.00%	9.00%	100.00%	7.17%	100.00%
Regional	11.01%	100.00%	10.60%	100.00%	7.17%	100.00%	7.16%	100.00%	6.51%	100.00%	8.27%	100.00%	6.66%	100.00%	7.75%	100.00%	9.87%	100.00%	7.01%	100.00%
NE Regional	7.54%	100.00%	5.09%	100.00%	5.91%	100.00%	3.45%	100.00%	9.81%	100.00%	9.38%	100.00%	4.24%	100.00%	7.69%	100.00%	5.69%	100.00%	6.79%	100.00%
MBTA	8.36%	92.90%	8.69%	94.10%	3.17%	100.00%	7.35%	94.10%	7.93%	95.30%	3.33%	100.00%	6.11%	96.50%	6.14%	96.50%	6.73%	94.10%	5.99%	96.50%
Total	8.35%	94.20%	8.22%	95.20%	3.49%	100.00%	7.15%	95.20%	7.61%	96.20%	4.04%	100.00%	6.20%	97.10%	6.25%	97.10%	7.06%	95.20%	6.18%	97.10%

SSX Project Alternative 3 - PM Period - Randomized Runs - Delay and On-Time Performance Results

	Randomized 1		Randomized 2		Randomized 3		Randomized 4		Randomized 5		Randomized 6		Randomized 7		Randomized 8		Randomized 9		Randomized 10	
Train Group	Delay (%)	OTP (%)	Delay (%)	OTP (%)	Delay (%)	OTP (%)	Delay (%)	OTP (%)	Delay (%)	OTP (%)	Delay (%)	OTP (%)	Delay (%)	OTP (%)	Delay (%)	OTP (%)	Delay (%)	OTP (%)	Delay (%)	OTP (%)
Acela	14.29%	100.00%	9.90%	100.00%	7.36%	100.00%	17.07%	100.00%	13.44%	100.00%	15.80%	100.00%	9.28%	100.00%	12.52%	100.00%	10.19%	100.00%	14.83%	100.00%
Regional	15.39%	100.00%	12.59%	100.00%	13.41%	100.00%	11.92%	100.00%	9.27%	100.00%	15.52%	100.00%	11.26%	100.00%	11.09%	100.00%	13.26%	100.00%	11.00%	100.00%
NE Regional	17.26%	100.00%	13.78%	100.00%	11.93%	100.00%	21.50%	100.00%	12.50%	100.00%	10.94%	100.00%	15.36%	100.00%	10.46%	100.00%	20.66%	100.00%	20.10%	100.00%
MBTA	11.83%	92.90%	12.73%	91.80%	11.73%	94.10%	13.01%	94.10%	13.00%	90.60%	15.62%	91.80%	18.05%	90.60%	14.03%	95.30%	5.81%	98.80%	16.38%	90.60%
Total	12.46%	94.20%	12.54%	93.30%	11.49%	95.20%	13.61%	95.20%	12.79%	92.30%	15.44%	93.30%	16.83%	92.30%	13.59%	96.20%	7.22%	99.00%	16.08%	92.30%

Indicates two best simulation runs
Indicates two worst simulation runs

Notes & Assumptions

The simulations were run under randomization a total of ten times, omitting the two worst and two best simulation results and averaging the remaining six runs.
This analysis was modeled for the PM period only to test the operations during the most congested period of operations at South Station.

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