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The Northeast Corridor Transportation Plan

New York City to Boston

Report to Congress

Volume 2
Appendices B Through O

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The Northeast Corridor Transportation Plan
New York City to Boston

Report to Congress

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Appendix B
LONG-TERM SAFETY NEEDS AND RELATED PROJECTS

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Appendix B
LONG-TERM SAFETY NEEDS AND OPERATIONAL SAFETY PROJECTS

INTRODUCTION

Safety is integral to all planning for Northeast Corridor (NEC) Improvements. In mandating the development of a master plan for a coordinated program of improvements, the Amtrak Authorization and Development Act of 1992, Section 708(7) required "an assessment of long-term operational safety needs and a list of specific projects designed to maximize operational safety."

This Plan, covering improvements in the territory from Boston to New York City, is oriented around the need to provide for the anticipated rail traffic in the year 2010. Projections for 2010 show significant increases in intercity and commuter traffic, as well as higher maximum speeds and higher speeds through curves. Train density will peak approaching Penn Station, New York City, where each track will carry an average of one train every 4 minutes between 6 a.m. and 9 p.m. More typical sections of the corridor would carry and average of one train every 20 minutes for each track. Clearly, operational safety is paramount under these conditions.

PREVIOUS SAFETY HISTORY

Because of its basic function of accommodating frequent trains of various types with wide performance variations, the NEC is closely monitored by safety enforcement agencies. Every incident or accident is reviewed to determine the cause and to see if something could be changed or improved in order to prevent a future similar occurrence. Periodic comprehensive assessments of overall safety have been undertaken by both FRA and FTA. For example, extensive safety investigations of both MNCR and LIRR were published in October 1992. Any major incident is usually investigated by both the FRA and the National Transportation Safety Board.

FRA statistics of reportable accidents (an accident involving movement of on-track equipment and incurring at least $6,300 in damage) for the last 10 years show that an average of 42 accidents occurred each year over the whole Boston-Washington NEC. Causes were predominately attributed to track, roadbed, and structures or electrical/mechanical; averaging 13.4 and 12.0 accidents per year respectively for the 1983-1992 timeframe. Signal and communications systems had the lowest rate with only 0.2 accidents per year. Analysis of these data showed most accidents involved yard derailments, pantograph damage, work trains or empty passenger equipment moves; accidents involving revenue passenger trains were very infrequent.

OPERATING CONDITIONS

The NEC main line from Boston to New York City is predominantly double track with about 60 miles (25 percent) being 4 track. There are 238 curves in this territory, approximately 1 per mile, which significantly limit maximum attainable speeds over most of the route. The route is predominately level, with more than 60 percent of the route adjacent to the Long Island Sound or the Atlantic Ocean. Virtually all climatic conditions are encountered over the route: snow, ice, fog, high and low temperature extremes, hurricanes, etc.

Trains operating over this route in the future will have widely varying performance capability. After electrification is completed to Boston, Amtrak Metroliners are projected to have a top speed of 150 miles per hour and an overall average speed of 80 miles per hour for a 3-hour trip time. Sharing the same tracks will be: conventional Amtrak trains averaging 65 miles per hour, commuter trains averaging 30-35 miles per hour, and local freight trains averaging less than 15 miles per hour with stops for servicing industries. This very wide variation in operating performance complicates the requirements for safety features.

The options for removing some highway at-grade crossings and enhancing the safety of others that remain along the route are covered in detail in Appendix A. It should be noted that there is a high probability that some of these crossings will remain in use due to their proximity to wetlands, which severely limits new construction opportunities, and that their closing would eliminate access to coastal areas in violation of state law. Many citizens and their elected officials have also objected to grade separations (bridges) on aesthetic grounds.

OPERATIONAL SAFETY NEEDS AND RELATED PROJECTS

Amtrak intends to procure a new generation of high performance, high-speed passenger cars and locomotives. This equipment will have to operate safely on the same tracks with slower freight and commuter trains. A number of safety issues and interrelationships are addressed in the following sections. Each section refers to specific related projects that are described in greater detail in Appendix C.

Track and Roadbed Structure

The operation of high speed/high curve unbalance vehicles will require a track structure and maintenance of that structure commensurate with the loads imposed by the vehicles. Experience in the U.S. and other parts of the world has shown that heavy concrete ties sitting in deep, high quality ballast with wide shoulder ballast sections will be required. The rail fastening devices should restrain movement in both horizontal and vertical directions to handle the forces caused by trains operating through curves at higher than normal unbalance speeds. Similarly, the rail needs to be of relatively heavy section, 132 pounds per yard or heavier, to sustain the imposed stress.

After initial installation, relatively frequent track geometry inspections must be made and surfacing/alignment maintenance carried out to ensure that the total track structure geometry stays within prescribed safety limits. More than half of the Boston-New York main line has already had this type of track structure installed, and it has been shown to be very stable and easy to maintain over the past 13 years.

Project Reference: Track Program-complete concrete tie and welded rail installation.

Intercity Trains

Amtrak has estimated that it will require 26 trainsets of locomotives and cars to operate reliable hourly 3-hour service in each direction along the NEC and to provide spare sets for maintenance. In order to meet the 3-hour trip time goals, these trains will need to be designed to traverse curves at 8 inches or greater unbalance and will need a maximum speed in the range of 150 miles per hour. The proposed train will have to meet rigorous stability standards when operating at high speeds, especially if the use of push-pull trainsets is adopted.

Since these trainsets will be operating on the same tracks with freight and conventional commuter trains, they will be required to meet North American crashworthiness standards for existing passenger equipment. This would include various buff load requirements, end post shear strength, seat and luggage restraint devices, glazing material, etc. A strict maintenance program will be needed to ensure that routine operating wear and tear does not allow various components to degrade beyond acceptable conditions.

Project References:

Procure Amtrak high-speed trainsets
Construct Amtrak Boston service facility, and
Amtrak medium/heavy overhaul facility.

Commuter Trains

Train simulations have demonstrated the desirability of operating commuter trains at higher speeds in order for them to fit more easily between intercity trains on a two-track rail line. Top speed is proposed to be increased to 100 miles per hour. This has raised questions about train stability, especially in the push mode, and the ability of the braking system to handle the higher speeds. Extensive testing will be performed to determine what, if anything, needs to be modified to adapt commuter train equipment.

Project Reference:

Commuter equipment testing.

Passenger and Station Safety

The research conducted for the development of the NECTP revealed situations at several stations that were less than desirable from the viewpoint of passenger safety. Some stations, both Amtrak and commuter, have only one side platform for both tracks. For example, passengers at Old Saybrook wishing to board a westbound train must stand in the middle of the eastbound track while boarding, because the only platform is adjacent to the eastbound track. This, in effect, blocks use of the eastbound tracks while a trains is in or near the station. This is clearly unacceptable with increased speeds and more frequent service. The Plan includes projects to install new platforms (preferably high-level platforms, to reduce passenger or trespasser access to the tracks), grade-separated handicapped access to the tracks, and audio/visual warning devices to alert people on the platform of an approaching train. The warning system has been tested and proven at some NEC stations in the past.

Project References:
- Construct high-level platforms
- Route 128 improvements
- Construct pedestrian bridges
- Kingston Station intermodal transportation facility
- Reconfigure Old Saybrook Station
- Provide key station ADA access
- Shore Line East south side station relocations
- Shore Line East both sides fully accessible stations, and
- Install approach warning signs and bells.

Right-of-Way Security

Presently, most of the NEC right-of-way is readily accessible to trespassers and vandals at a number of sites. As train speeds and frequencies increase, the potential dangers to both trespassers and to the trains from vandalism increase. Casual pedestrian access to the tracks should be reduced in heavily populated or sensitive areas (parks, beaches, etc.). The Plan includes projects to address this problem.

Project Reference:
- Fence selected sensitive areas
- Grade Crossing Elimination Program, and
- Construct high-level platforms.

Signal and Train Control Systems

As train speeds and frequencies increase, it is imperative that safety systems be in place to ensure that safe separation of trains is maintained and that excessive speed cannot be achieved. All trains currently operating on the NEC are required to have a functioning continuous cab signal/automatic train control (ATC) system. The ATC system takes over and automatically applies the brakes if the train engineer fails to comply with a signal-imposed speed reduction. This basic ATC system is fully capable of providing for the safe operation of trains at higher speeds and frequencies. However, two features are missing from the existing system: it does not generally enforce civil speed restrictions (curves, bridges, stations, temporary maintenance slow orders, etc.) and a "stop" signal is not enforced.

Stopping distances increase dramatically at higher speeds; it takes more than 3 miles to stop from 150 miles per hour with normal service braking under less than optimum conditions. As unbalance speeds through curves increase, the margin for error decreases significantly. Each train engineer is presently responsible for knowing the speed limit for every speed restriction along the NEC, as defined in several pages of the employees timetable special instructions. As speeds increase and braking distances get longer, a minor distraction or the late application of brakes could result in an accident. To preclude this possibility, Amtrak will install a system along the NEC that will result in an automatic brake application if the engineer does not apply the brakes for either a civil speed restriction, or a location at which a positive stop is required.

Currently, when a "stop" is displayed on a wayside signal, the ATC system will enforce a maximum speed of 20 miles per hour. It is thus possible for an engineer to slow a train to 20 miles per hour in preparation for a stop, then become incapacitated or have his attention diverted, allowing the train would roll past the "stop" signal at an interlocking and potentially into the path of a high-speed train, with disastrous results. The FRA also has directed that the "stop" signal be enforced by an automatic brake application in the cab.

Project References:
- Signals compatible with electrification
- Canton Jct. to Boston signal modifications
- Modify on-board cab signal equipment, and
- Install positive stop/civil speed enforcement system.

Electrification Systems

Overhead high voltage railway electrification systems were first used in this country nearly 90 years ago and are common throughout the world. A number of routine design features are employed to ensure that no safety hazards are presented to the general public or railroad employees. These features will be incorporated into the upgraded system. Substations will be fenced and properly grounded. High-speed circuit breakers will quickly de-energize any portion of the system that has experienced a fault and notify the power dispatcher at the CETC control center of the event. All overhead bridges will be fitted with barriers to prevent any contact with the wires. Any adjacent structures will be connected to the electric grounding system so that no high voltages can be induced by the electrification system. Warning signs will be provided as required by various codes.

Amtrak will be working closely with local emergency crews (fire department, emergency medical services, power companies, etc.) to train them in the proper procedures to follow when an incident occurs near the railroad. The CETC control center in Boston, which will have remote control over the whole new electrification system, has immediate communications access to all trains, maintenance forces and police units along the NEC. Amtrak will train their new electrification maintenance forces in all the well-established procedures for working on the system. Fundamental to all electrification maintenance is the practice that the catenary or other circuits are de-energized and temporary grounds are applied on both sides of the work area.

Project References:
- Install 25kV, 60Hz center-fed system
- Step and touch traction return mitigation, and
- New Haven to Providence CETC.

Tunnels

The railway tunnels around Penn Station, New York City were built to codes and design practices that existed about 1908. Since then, a number of advancements have resulted in significant changes to codes for modern construction. The point has been reached where safety system deterioration, and existing codes are necessitating major safety investigations in and around the Penn Station complex. A comprehensive analysis done by the Schirmer Engineering Corp. recommended a large number of changes/investments concerning improved fire fighting capability, improved ventilation, emergency lighting, emergency signage, communications systems, emergency exits, evacuation systems, and the like. A team consisting of Amtrak, Long Island Rail Road, and New Jersey Transit officials has been established to review options and establish a program to rectify the situation.

Project Reference:
Penn Station Fire, Life Safety Improvements.

Deteriorated Structures

Many structures along the NEC continue to deteriorate due to age, lack of adequate maintenance, and environmental conditions. In order to preserve operational safety, slow orders are issued as conditions warrant. Many structures have reached the point where long-term safety needs can only be met by replacing them (recapitalization), not by repairs. Many of these potential safety problems are addressed in the Plan.

Typical Project References:
Peck Bridge Replacement
Walk/Saga Bridge Replacement, and
Replace Deteriorated Bridges and Culverts.

NORTHEAST CORRIDOR SAFETY COMMITTEE

The Rail Safety Improvement Act of 1988 as amended by the Rail Safety Enforcement and Review Act of 1992 established a Northeast Corridor Safety Committee (Safety Committee), which is required to meet periodically and issue a report to Congress every 2 years on "Recommendations to Improve Rail Safety on the NEC." These reports must include the Secretary's comments on the recommendations.

The Safety Committee has met on several occasions, reviewed relevant issues, and developed proposed recommendations. The results of this activity will be transmitted in a separate Congressional report.

ISSUES NOT DIRECTLY ADDRESSED IN THE TRANSPORTATION PLAN

Operating Rules and Staff Training

The Plan discusses the capital projects required to meet program goals, but, obviously, safe operation depends equally on developing and implementing adequate rules and procedures, as well as improving employee training and qualification. To operate safely in a high-speed environment, it will be incumbent upon the employing carriers to ensure that the proper operating rules are promulgated and enforced, that their crews are properly trained to handle both normal and emergency situations, and that sufficient on-board and trackside communications equipment is available and operable.

Passenger Safety Within Trains

As pointed out in previous safety reviews, there is need for additional study of passenger safety within the trains. The issues of passenger comfort and ride stability are, in part, safety issues. Specifically, areas of concern needing further attention are:

- the effects of increased unbalanced superelevation on curves, and higher speeds on standing or walking passengers;
- technologies to cope with those effects; and
- construction standards for the interiors of passenger cars to minimize accident-related injury caused by loose objects in the passenger compartment.

These topics will be addressed in Amtrak's specifications for high-speed trains.

HIGH-SPEED RAIL SAFETY RESEARCH

There are numerous proposals to develop high-speed rail or other advanced technology (e.g., magnetically levitated, or maglev) passenger trains in corridors throughout the United States. Examples of such service have already been developed and are operating in other locations around the world. To respond to these proposals proactively, the FRA has been sponsoring extensive studies of the safety aspects of and issues raised by such high-speed services.

Capable of sustaining speeds of 150 miles per hour, the upgraded Northeast Corridor that will result from implementing the projects of the Plan will clearly fit the definition of a high-speed guided ground transportation system. The findings of the FRA studies need to be taken into account when examining the safety aspects of an NEC high-speed operation.

A four-volume study entitled "Safety of High-Speed Guided Ground Transportation Systems, Collision Avoidance and Accident Survivability," published in March 1993, is directly relevant. In that report, the FRA outlines the safety threats posed by a high-speed operation, and then discusses at length how best to avoid collisions and assure accident survivability. The report concludes with a series of proposed specifications for tracks, vehicles, signals, and the like.

FRA also recently published "High-Speed Rail Tilt Train Technology, A State of the Art Survey," which contains safety issues germane to improvements along the NEC. The report concentrates on high-speed vehicles, discussing passenger comfort and safety and the reliability and maintainability of the rolling stock. Also included is a discussion about track geometry requirements.

The safety factors related to high-speed rail passenger systems are also of interest to organizations other than the FRA. In both 1989 and 1992, the Transportation Research Board (TRB) of the National Research Council published papers on the subject. In the first publication, the TRB outlined safety concerns and suggested remedies in the areas of operations, vehicles, infrastructure, signal systems, communications and electric traction. In the 1993 paper, research problem statements were formulated to encourage further study.

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Appendix C
DESCRIPTION OF INDIVIDUAL PROJECTS

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Appendix C
DESCRIPTION OF INDIVIDUAL PROJECTS

In response to the growth and expansion expected along the Northeast Corridor (NEC), many projects affecting the NEC are being planned by governmental agencies and rail line operators. Development of the PMP requires the identification and coordination of all individual NEC projects. To support the preparation of this report, governmental agencies and operators having a direct interest in the NEC were requested to submit information regarding their planned projects.

This appendix presents descriptions of the various governmental and operator projects and NEC program improvements identified by research conducted to date. These projects have been initially evaluated and found to be necessary and sufficient to support safe and dependable rail passenger service between New York City and Boston in 3 hours, while accommodating the projected level of intercity passenger, commuter and freight service in the year 2010. Proposed projects are listed according to the categories and subsystems outlined in the body of the report. Each category is identified by a heading that appears at the beginning of a sub-section. Categories are further divided into subsystems, identified by italicized headings.

Each proposed project is described under the following headings:

- needs Assessment;
- project Description;
- project Location;
- design and Construction Schedules;
- construction Impact on Operations; and
- anticipated benefits.

Required and Existing Project Funding are contained in Section V.

The geographic locations of the projects and their interrelationships are shown in Appendix E, Geographic Summary of Proposed Improvements, and further illustrated in Appendix F, Track Configuration Charts.

HIGH-SPEED REQUIREMENTS

TRIP TIME

Route Realignments

REALIGN CURVES

Needs Assessment - Train speed is fundamentally limited by the horizontal curvature present in the alignment, regardless of the power rating, method of propulsion, and speed capability of the trains on the line. The Northeast Corridor between New York City and Boston includes in excess of 220 curves. Many of these curves exceed 2 degrees of curvature, which at 3 inches of unbalanced superelevation are presently restricted to a maximum speed of 80 miles per hour. It is track curvature that imposes the most severe constraint on trip time.

Project Description - There are several types of fixed-plant improvements that can be considered to reduce the speed constraints associated with curves:

- increasing superelevation to the maximum allowable for a particular track alignment;
- changing horizontal and vertical alignment, either within the existing right-of-way, or by acquiring land outside the existing right-of-way;
- increasing the amount of unbalanced superelevation used to calculate speeds through curves to minimize track shifts; and
- modifying spirals (the length of track that provides a smooth transition from level, tangent track to curved, superelevated track) by eliminating superelevation runoff onto the adjacent tangent sections.

An analysis has been undertaken to examine the feasibility and resultant speed improvements of implementing maximum superelevation and curve unbalance to meet the speed goals before reducing curvature wherever practical in the New York City-Boston portion of the NEC. Though listed here as a single project, the improvements would actually consist of a large number of separate "sub-projects" at individual curves or groups of curves. The initial analysis represents a "best case"; it is likely that detailed study would reveal local constraints that would limit the feasibility or practicality of implementing some specific sub-projects.

The sub-projects identified in the analysis increase track superelevation on existing alignment, and shift track alignment horizontally within the right-of-way for a number of curves. These alignment changes would allow higher speeds that can be sustained for meaningful periods.

Preliminary curve analysis between New York City and New Haven utilized the latest track geometry car data, Metro-North stringline data, and NECIP 1"=40′ scale plans. The maximum lateral acceleration allowed in the body of the curve was kept below 0.15 g and maximum jerk rate was limited to 0.04 g per sec. Spirals for increased speed were calculated in accordance with criteria previously utilized on the NECIP. In conformance with criteria (which was based on ride comfort, maintenance, and spiral length concerns) established by MNCR maximum, unbalanced superelevation was limited to 5 inches between New Rochelle and New Haven (on the New Haven Line). Amtrak also applied the criteria on the Hellgate Line between New York City and New Haven. Based on the assumption that advanced technology rolling stock would improve ride comfort, and the understanding that significant time savings would be required between New Haven and Boston (on the Shore Line), unbalanced superelevation was limited to 8 inches.

For the purposes of the analyses it was assumed that superelevation would be increased (or similarly decreased) at linear rates specified in Amtrak's MW-1000, *Specifications for Inspection, Construction and Maintenance of Track* (which presently allows ½-inch only up to 50 miles per hour; between 50 and 70 miles per hour a rate of ⅜-inch is allowed and above 71 miles per hour a ¼-inch rate is allowed), and Metro-North's MW-4 (which presently allows ⅜-inch between 60 and 90 miles per hour, and ¼-inch above 90 miles per hour). Additional curve documentation is provided in Appendix I.

Curve analysis between New Haven and Boston included refinement of the curve modification results of the feasibility study of March 1993, prepared by Gannett Fleming/LSTS.

The results of the analyses performed for this study and those prepared for Amtrak was the identification of 129 curves that should be realigned to satisfy goal speeds and enable the trip time goal to be attained. Fifteen of the curves will require superelevation adjustments, but not track shifting. Preliminary analysis has identified the following range of shifts:

Segment	Number of Curves Analyzed	Estimated Shifts 0-.5′	.5′-3.0′	>3.0′
Hellgate (MP E5-E18.7)	12	0	8	4
Metro-North (MP 16.3-72.8)	31	12	16	3
New Haven-Boston (MP 72.8-229)	86	29	50	7

The curve realignments on the NHL will require the realignment of 23 open deck bridges, which will be converted to ballasted deck bridges. These bridges are included in the project to convert open deck bridges and are in addition to the 51 bridges that are to be converted based solely on an analysis of existing structural condition(s).

A preliminary examination of safe braking distances at the increased speeds projected for the NHL to determine the modifications in signal spacing required to ensure safe train separation at the increased train speeds was recently completed. Two scenarios were tested. The first evaluated the impact of only increasing the speed of Amtrak intercity trains by approving their operation at 5 inches of unbalanced superelevation. The evaluation utilized Amtrak's standard braking curve, which because of the improved braking characteristics of the AEM-7 locomotive is different than the standard braking curve used by MNCR. The study indicated that the impact of increased Amtrak speeds would be minimal. Five master signal locations would have to be relocated or added at a cost approximating $0.5 million.

The second scenario was based on the assumption that MNCR rolling stock would be tested, modified if necessary, and approved for operating at increased levels of unbalanced superelevation and higher speeds. It concluded that a slightly higher level of improvements, at a cost approximating $0.7 million, would be required.

The benefits of curve realignment come in small increments. Many small "sub-projects" would be undertaken. Even within the right-of-way, implementation implies significant disruption and expense, with only small benefits for each curve treated. Making improvements of this nature may only be warranted in the context of an overall program directed toward significant trip time reduction.

As part of the project, the Hellgate and New Haven Line segments (Harold to New Haven) need to be surveyed to reflect current conditions and enable final design to be completed. The most recent surveys were performed in the mid-1970s or early-1980s, depending upon location.

Project Location - Throughout the New York City to Boston route (MP E0 to MP 229).

Design and Construction Schedules - The recommended schedule anticipates that certain trip time sensitive realignments will be completed by the end of 2000. The remainder will be completed by the end of 2006. Final design of curves to be realigned on Metro-North has not begun. Design of curves to be realigned between New York City and New Rochelle, and New Haven and Boston, is presently underway. Only a preliminary construction schedule has been identified. Work should be coordinated with other planned improvements to make best use of track outages. Track realignments should be coordinated with the placement of catenary between New Haven and Boston to ensure satisfactory electrified operation and to minimize realignment of catenary after initial installation.

Construction Impact on Operations - The impact will vary by amount and type of work needed in various locations. Shifting and/or replacing four-track undergrade bridges between New Rochelle and New Haven may require that more than one track be out of service at a time during peak periods.

Anticipated Benefits - The curve realignment program will contribute to the attainment of the 3-hour trip time goal. Realignments between New York and New Haven, and New Haven and Boston are projected to save approximately 2.5 and 1.9 minutes respectively.

RECONFIGURE SHELL INTERLOCKING

Needs Assessment - There is an increasing likelihood of Amtrak delays due to conflicts with New Haven Line (NHL) traffic, both westbound as the result of at-grade crossover moves where the Hellgate Line of the Amtrak New York Division diverges from the NHL, and eastbound as Amtrak merges with outbound NHL traffic. The present interchange speed is 15 miles per hour, requiring excessive travel time through Shell Interlocking.

The right-of-way is constrained by retaining walls on each side, complicating the nature and implementation of any solution. Environmental and other considerations, including an adjacent cemetery, limit the feasibility of changes in alignment involving additional right-of-way.

Amtrak currently stops 13 trains per day at New Rochelle. All stops are made in off-commuter peak hours. Amtrak envisions stopping more trains in this potentially lucrative New York City market, however, the approved Flyover track configuration precludes trains from stopping at the present outside platforms at New Rochelle. A revised station configuration will be required to enable intercity trains to stop at New Rochelle.

Project Description - The project would entail the construction of a flyover, i.e., depression of the two eastbound NHL tracks and elevation of the Hellgate Line tracks on an overpass; the construction of a center island platform at New Rochelle; the construction of a siding track at CP 223 (Pike); and additional interlocking construction/modifications to facilitate operations.

Due to the potential for queuing and cascading of delays, improvements at Shell are operationally linked with island platforms at Stamford. The combined benefits from projects at Shell and Stamford, including a reduction of train conflicts and improved reliability of service, would be substantially greater than the individual benefits derived from each.

The double track flyover would begin just west of the New Rochelle station. High-speed turnouts, increased superelevation, and reconfiguration of the curve at the beginning of the Hellgate Line would allow maximum speed limits of 45 miles per hour on clear signal.

Amtrak grades would be approximately 2.5 percent, with Hellgate tracks raised 15 feet; NHL grades would be about 2 percent, with tracks depressed 5 feet. Substantial portions of the civil/structural work would be done by contract, as opposed to Metro-North force account, thereby complicating issues of control and access during construction.

The anticipated environmental impacts are moderate. The Center Street overhead bridge would be rebuilt and elevated to provide adequate horizontal and vertical clearance to the flyover structure. A new Webster Avenue undergrade bridge would be built on the Hellgate Line. New retaining walls would support the track structure in the approaches to the flyover. The noise impact associated with the elevated tracks on the flyover will have to be considered.

The track configuration at New Rochelle station will be modified to enable a center island platform to be constructed between Tracks 1 and 2. A new high level side platform would be constructed adjacent to relocated Track 4. The reconfigured station would be fully handicapped accessible. A new pedestrian overpass will be constructed to access the center island platform. Parking for 300 cars will be provided by the "Provide Improve Intercity and Commuter Parking" project described in subsection C. Because of its deteriorated condition the North Avenue overpass (located at the east end of the Station) needs to replaced. A project managed by Westchester County will construct a single span bridge that will replace the existing double span bridge. The removal of the existing center pier will facilitate construction of the center island platform.

New universal interlockings will be installed at CP 215 on the NHL, and South Shell on the Hellgate Line. Additionally, CP 217 (E. Shell) will be reconfigured to conform to the new center island platform alignment.

Project Location - Immediately west of New Rochelle station (MP 15-MP 17, CP 216).

Design and Construction Schedules - The initial preliminary design performed by De Leuw, Cather in 1990 projected a construction completion date of April 1997. Subsequently, protracted negotiations to authorize MNCR to manage design and construction of the improvements have delayed the beginning of design approximately 2½ years. It is estimated that the pre-construction phase, including an Environmental Assessment, and a formal Environmental Impact Statement, if necessary, will take approximately 32 months, and that construction will take 51 months. A final design agreement was reached in November 1993. If a construction agreement is reached during 1994, construction could be completed by early

2001. The North Avenue bridge should be replaced, the center island platform constructed, and CP 215 (Pelham) constructed during initial stages in the construction program.

Construction Impact on Operations - The phasing of work has to be coordinated with the planned concurrent construction work at Stamford, Peck Moveable Bridge, and New Haven so that train delays can be minimized. Also to be considered in scheduling work between New Rochelle and New Haven between 1994 and 2001 are programs that would: replace existing circuit breakers located on anchor bridges; install constant tension catenary; install concrete ties and rails; realign curves; and replace/upgrade undergrade bridges.

During weekends, when one or more tracks may be taken out of service, operating flexibility would be inhibited; delays to Amtrak and NHL trains may occur. A universal interlocking at Pelham (CP 215) to provide operating flexibility during construction, as well as further reconfiguration of East Shell Interlocking have been recommended by MNCR.

Anticipated Benefits - The flyover will reduce the likelihood of delays to Amtrak trains due to at-grade conflicts with NHL traffic. The increase in maximum allowable speed from 15 to 45 miles per hour at the junction is projected to save approximately 2 minutes and 45 seconds.

STAMFORD STATION CENTER ISLAND PLATFORMS

Needs Assessment - Stamford Station is the highest-volume outlying station on the NHL, with more than 11,000 riders boarding or detraining on a normal weekday. More than 235 NHL revenue and non-revenue trains per day pass the station, with 185 having scheduled stops. It serves as an interchange point for NHL local and express services as well as for the New Canaan Branch connection. It is also seen as an increasingly important station for Amtrak. The several NHL markets it serves (including intrastate and reverse commuting) are anticipated to experience substantial future growth.

Approximately one-half of all New Haven Line commuter trains originate or terminate their runs at Stamford. A large NHL yard just east of the station is reached through restricted speed signal aspects (15 miles per hour maximum); a relatively lengthy time is required for a train to clear the interlocking. Since Stamford serves as a major commuter transfer point between lines and between express and local trains, the sequencing of trains at each side platform is critical. (The existing platforms are outside of the outer-most of four through-tracks, and thus available to only two tracks, two trains at a time.) This imposes a constraint, which causes delay to a single train to cascade to other trains, both NHL and Amtrak.

Any delay to a westbound Amtrak train in the morning peak period can cause it to miss its "slot" at Shell Interlocking, greatly increasing the overall delay. During the evening peak, delays at Stamford for eastbound trains can create congested flow as far back as New Rochelle, thereby exacerbating the potential for delay at Shell Interlocking.

Thus, the key problems at Stamford are inadequate platform access and capacity, restrictive speeds for all trains, and a conflict-generating track configuration. This location currently experiences substantial congestion with delays and problems in sequencing of trains, a situation that can be expected to degenerate over time with more trains operating.

Project Description - Construct two additional center island platforms, permitting simultaneous station stops by express trains as well as local trains, thereby increasing train capacity.

Changes in track configuration and signaling, including the use of high-speed crossovers to minimize delays associated with yard and other moves will be required to implement the revised platform concept.

CP 234 (Stam) and CP 233 (West Stam) Interlockings will be reconfigured and a new interlocking (Selleck Street) constructed to facilitate access to/from the platforms. Recent analyses of operations at Stamford (see Appendix M) have identified two additional crossovers that should be added at CP 232 and CP 234. Amtrak speed through the station will be 80 miles per hour. Washington Boulevard undergrade bridge will be replaced as a highway improvement project. The roadway will be widened to six lanes and overhead clearances improved.

Project Location - Stamford Transportation Center (MP 33).

Design and Construction Schedules - Design is underway and is expected to be completed in August 1994. Construction is projected to begin in April 1995 and be completed in 3 years.

Construction Impact on Operations - Substantial delays to commuter and intercity service may occur at peak hours during construction. The construction of the new Selleck Interlocking at the initiation of construction should help minimize these delays by providing increased operational flexibility.

Anticipated Benefits - The platforms will minimize the present constraints at Stamford and facilitate projected 2010 levels of commuter and intercity trains. Increased operating speeds will result in a savings of approximately 33 seconds and the revised configuration will reduce potential operating congestion and train delays.

RECONFIGURE NEW HAVEN TERMINAL AREA

Needs Assessment - New Haven is the terminus of NHL service eastbound and CDOT commuter service, operated by Amtrak westbound; it is the present eastern end of electrified territory. The yard area includes a major NHL/CDOT maintenance facility. The yard itself and the interlocking control machine have deteriorated, and now generate substantial maintenance expenses.

All Amtrak trains stop at New Haven, not only as a station stop but also to switch motive power (exchanging electric traction for diesel or vice versa) and train crews; electric propulsion is used from New Haven westward. Most of the Amtrak service operates eastward over the Shore Line, but some trains go north to Springfield. The existing track configuration at New Haven is based upon its use in the early part of the century as the junction between steam and electric service. It is not possible to traverse the station area without slow crossover moves. Sharp curvature east of the yard, low-speed turnouts, and signal restrictions typically hold speed to 10 miles per hour or less.

Project Description - The project includes major changes in track configuration to eliminate diverging (crossover) moves for intercity express trains so that speeds up to 50 miles per hour can be used. Pocket tracks to facilitate motive power changes for Springfield trains are to be included in the design. Universal crossover capability would be provided at both ends of the station. Parallel move capability to enable intercity and commuter trains to make simultaneous moves and reduce delays will be provided. The project would provide major improvements to the interlockings, as well as the yard area used to store NHL and CDOT SLE trains through renewal of track, turnouts, and drainage facilities. New track, turnouts, drainage, and interlockings also would reduce maintenance expenses.

Additional speed improvements will be achieved east of Fair Street (between Grand Avenue and Mill River Junction) by eliminating excess trackage, realigning remaining tracks to reduce curvature and adding superelevation to permit higher track speeds. However, curve realignments are limited due to constraints of overhead structures. Speeds of 50 miles per hour for intercity trains (30 miles per hour for commuter trains) will be achieved in this segment through realignments.

Cab signals will be installed on both approaches and through the terminal area. Currently, entering locomotives lose cab signal and receive a restricting indication. Moves in and out of the station are then made at 15 miles per hour or less.

Additional projects that will be implemented in the New Haven Terminal area are subsequently described. They include: relocation of the Amtrak New Haven Service Facility; construction of a 100 car NHL and SLE car storage yard, modification of the existing New Haven Yard and recovery of an estimated 800,000 gallons of free phase diesel oil in the old (pre-NECIP) fueling facility (Parcel G) ("Construct NHL and SLE New Haven Car Storage Yard/New Haven Yard Modifications"); and construction of a SLE fleet maintenance shop and a NHL fleet overhaul shop ("Construct CDOT New Haven Shop").

Project Location - New Haven station area (MP 71.2-MP 74.0).

Design and Construction Schedules - An agreed-upon configuration was established on February 21, 1994. Final design of the revised track configuration is expected to be completed in the fall of 1994. Advertisement for construction bids should take place in January 1995. As of the end of 1993 construction was presently to be completed by the autumn of 1999. MNCR plans to begin installing the new universal "New Haven" interlocking as a first stage in the construction process.

A phasing plan for the terminal area has yet to be established. Initial analysis performed by MNCR indicates that the Amtrak fueling facility should be relocated before reconfiguring the south side of the Terminal.

Construction Impact on Operations - Outages of tracks and interlockings are expected to have a significant impact on normal operations. A significant amount of reconfiguration, car shop and layover facility work in the New Haven terminal is planned for the next 7 years. Work to be managed by Amtrak and CDOT will require close coordination to ensure that train operations and maintenance operations are not adversely affected. The work also should be coordinated with the improvements planned between New Rochelle and New Haven, and between New Haven and New London.

Anticipated Benefits - The significant changes in track configuration at New Haven are projected to reduce intercity trip times by almost 4.5 minutes. The configuration modifications also will enable intercity and commuter trains to make simultaneous moves to and from platforms.

RECONFIGURE OLD SAYBROOK STATION

Needs Assessment - The current configuration of the tracks and station lead to congestion and delays for all the carriers operating through Old Saybrook-Amtrak, SLE, and the P&W. Introduction of high-speed intercity service will heighten the delay problem, as well as require changes in curve alignment. The existing station does not have a westbound platform, resulting in the unsafe practice of passengers crossing the main tracks to board westbound trains.

Project Description - Realignment will include reconfiguration of Brook and Old Saybrook Interlockings, rebuilding Tracks 3 and 4 as passing sidings, and adding a gauntlet track to Track 3. High level platforms will be installed at the station to improve safety as well as train operations.

Project Location - Old Saybrook (MP 105).

Design and Construction Schedules - Work should be completed by the middle of 1999. The platform construction work would be coordinated with the construction of the passing tracks, the reconfiguration of Brook and Old Saybrook interlockings, and construction of the gauntlet track.

Construction Impact on Operations - Construction of the high level platforms will have minimal impact on normal operations.

Anticipated Benefits - The revitalized and reconfigured station will minimize congestion and delays and meet the operating requirements of projected intercity, commuter, and freight operations. The westbound platform will enhance passenger safety.

Track Structures

TRACK PROGRAM

Needs Assessment - High-speed operation requires improved track structures for increased passenger safety and comfort, and greater maintainability. Track should be relined and resurfaced to achieve greater superelevation and appropriate spiral transitions in accordance with Amtrak, MNCR, and MBTA criteria. Spiral transition criteria were previously discussed for the Realign Curve project.

Project Description - A long term, phased track program to be carried out in conjunction with other NEC improvements is needed to achieve desired levels of train performance, system capacity, ride comfort, improved safety and operational flexibility.

Harold to New Rochelle and New Haven to Boston:

The project involves installation of concrete ties (approximately 153 track miles) and 165 miles of continuous welded rail (CWR); track undercutting (approximately 64 track miles); 89 miles of shoulder ballast cleaning; track surfacing; increase of superelevation in curves and/or lengthening spirals wherever possible for higher speed; replacement of wayside and interlocking turnouts; and elimination of track joints.

New Rochelle to New Haven (MP 16.3-MP 71):

Increased operating speeds at a higher rate of unbalanced superelevation on the two inside tracks will require improvements in the maintainability of the track to provide improved ride stability, passenger comfort, and safety. As initially evaluated, approximately 110 miles of concrete ties would be installed on the two inside tracks. In addition, approximately 220 rail miles of 132-pound CWR would be installed to replace 119-pound, 131-pound, and 140-pound rail that was installed before 1970. Some of the 131-pound rail was initially installed by the New Haven in the 1940s and had subsequently been removed from track, welded into CWR, and reinstalled. Three tracks will be undercut and/or undergo ballast cleaning to encourage drainage of the two inside tracks. A track resurfacing program to improve ride comfort also will be required.

Project Location - Track improvements would be undertaken throughout the corridor.

Design and Construction Schedules - Amtrak, as presently scheduled, is planning to complete the work in 1998. CDOT has previously funded, and plans to continue to fund, improvements. The proposed schedule anticipates that an annual track program would be developed for yearly work through the end of 2002. This program would coordinate track undercutting, ballast cleaning, installation of concrete ties, and laying rail with the other numerous planned improvements between New Rochelle and New Haven. The installation of concrete ties and rail on Tracks 1 and 2 would be scheduled for completion prior to the initiation of 3-hour intercity service, and therefore would be completed by the end of 2000. Ties and rail removed during this program, intended for reuse, should be classified and utilized during future maintenance programs. This would maximize the benefit obtained from previous MTA and CDOT track programs.

Construction Impact on Operations - Because of careful coordination with other projects (catenary installation, interlocking reconfigurations, etc.), it is anticipated that delays will be minimized; however, impacts of short duration may occur.

Anticipated Benefits - The recommended program will provide the track structure needed to support high-speed train operations and will result in increased passenger safety and comfort. In particular, the NHL program will be essential to support the increased operating speeds and significant increases in traffic levels projected for 2010. Maintainability to support operation at increased levels of unbalanced superelevation will be enhanced.

Bridges

REPLACE MITER RAILS

Needs Assessment - Miter rails (special trackwork installed at moveable bridges to provide for the smooth passage of trains over the location where the fixed and moveable sections of bridges meet) presently installed on moveable bridges are not designed for, or easily maintained to permit operation at the speeds desired for the proposed high-speed operation. Existing speed restrictions over miter rails are in the range of 40- to 45 miles per hour. Installing new high-speed miter rails would lead to significant time savings, resulting from increased operating speeds.

Project Description - Replace current miter rails (and machinery as required) with high-speed miter rails to provide satisfactory ride quality at the desired speeds. These miters will be attached directly to the structure. Appropriate changes will be made to signals and traction power.

Project Location - Pelham (MP E15.73), Cos Cob (MP 29.90), Walk (MP 41.51), Saga (MP 44.32), Devon (MP 60.42), Connecticut River (MP 106.89), Niantic (MP 116.74) Shaw's Cove (MP 122.65), Groton (MP 124.09) and Mystic (MP 132.16). Prior to placing Peck into service, an upgraded set of miter rails also should be installed.

Design and Construction Schedules - High-speed miter rails should be installed before initiation of 3-hour high-speed service. It is expected that the actual installation of the miter rails, ties (steel or wood), and any support machinery or equipment would take 3 months per bridge. Once suitable designs have been developed installation on all moveable bridges could be completed by mid-1998.

Construction Impact on Operations - Single track outages would be required and should be staged in each operating segment to minimize train delays, and coordinated with other ongoing construction.

Anticipated Benefits - Upgraded miter rails will enable trains speeds to be increased, resulting in time savings and will provide satisfactory ride quality at the desired speeds.

CANTON VIADUCT CLEARANCE IMPROVEMENTS

Needs Assessment - The Canton Viaduct is a multiple-arch granite masonry structure approximately 615 feet long and 22 feet in width. It was built in 1835 and is listed on the National Register of Historic Places. At its highest point, it stands about 50 feet above the level of the East Branch of the Neponset River. It carries both intercity and commuter rail traffic on two tracks. However, there are currently speed restrictions for trains on the Viaduct for two reasons: (1) substandard track centers (11'-8 ¾" near the center of the viaduct) prevent trains operating at high-speed in opposing directions from passing each other safely; and (2) inadequate side clearance from the handrails for southbound Bombardier and Pullman coaches with failed airbag suspension systems. As a result, train speeds are generally limited to 80 miles per hour, with 20 miles per hour limit on westbound Track 1 for MBTA Pullman and Bombardier cars.

Project Description - The project includes removal of the railings and the top layer of capstones, constructing concrete arch supports, and construction of a cantilevered concrete deck, 8 feet wider than present. The waterproofed concrete deck will act as a ballast retainer, providing 4-foot walkways on each side of the structure. Portions of existing concrete arches will be replaced with steel reinforced concrete, matching the historic nature of this structure. Double track railroad will be installed with the necessary clearance (13 feet) for service at speeds greater than 100 miles per hour. To retain the existing features and character of the viaduct, identical wrought-iron railings will be used on the superstructure. Granite coping stone facing will be used in areas where new concrete slab will replace existing granite stone construction.

Project Location - Canton, MA (MP 213.6).

Design and Construction Schedules - Placement of catenary support structures on the viaduct requires that construction work be staged so that the initiation of electrified operation is not delayed. The start of design is dependent upon Amtrak and MBTA negotiating an agreement. Amtrak's current schedule shows construction being completed by August 1997.

Construction Impact on Operations - Construction of a new cantilevered deck would require single track occupancy during an extended period. Major impacts would result for Amtrak and MBTA. A temporary interlocking west of the viaduct will be required during construction to minimize impacts on commuter and intercity train operations. (See Appendix M for a detailed discussion.) The work would have to be staged with the installation of catenary and the reconfiguration of interlockings to minimize these delays.

Anticipated Benefits - Widening of the bridge deck will enable train speeds to be increased, expand track capacity and improve operating safety.

Electrification

INSTALL 25kV 60Hz CENTER-FED SYSTEM

Needs Assessment - The NEC is electrified from New Haven to Washington, and all trains utilize AEM-7 or other electric locomotives for that portion of the route. Conventional diesel-electric power is used on the non-electrified portion between New Haven and Boston. Diesels accelerate at a lower rate than electric locomotives, and this results in longer trip times than would be possible if electric locomotives were utilized. Acceleration is particularly significant when the number of restricted-speed curves between New Haven and Boston is considered. The need to exchange engines at New Haven consumes additional valuable time. With higher speed needed, the lower power of the diesels would be even more of a restriction.

Project Description - The current plan developed by Amtrak calls for 25 kV-60 Hz center-fed electrification of the entire route, for a total of 360 track miles. This includes 322 miles of main track, 12 miles of secondary track or sidings, and 26 miles of yard track.) Constant tension catenary will be used. The design will be compatible with a maximum speed of 150 miles per hour. A single contract has been awarded for design and construction of the catenary and power supply system, which will include substations and switching stations.

The project elements include installation of:

- catenary;
- a 2 X 25 kV autotransformer traction power supply system;
- four substations and utility supply system;
- three switching stations;
- 18 paralleling stations; and
- a supervisory control and data acquisition (SCADA) system, which will be incorporated into the existing CETC facility.

Project Location - Between New Haven and Boston South Station (MP 72.8 to MP 229), and at the existing Boston CETC facility.

Design and Construction Schedules - A design/build contract, awarded by Amtrak in May 1992, calls for a 390-day design phase and a 1,000-day construction phase. Construction is scheduled to begin in fall 1994, and is dependent upon the completion of the Environmental Impact Statement process. The present schedule, calling for the completion of electrified construction by fall 1997, is achievable; however, this will require that the concerns, previously discussed, are promptly and satisfactorily addressed.

Construction Impact on Operations - Impact on normal operations will be minimized by restricting contractor access, performing much work at night, and by the presence of reverse signaling.

Anticipated Benefits - Completes electrification of the NEC between Washington and Boston. Electrification reduces trip time between New York City and Boston by approximately 16 minutes for goal trains to 27 minutes for conventional trains.

PROVIDE CLEARANCE FOR ELECTRIFICATION

Needs Assessment - Current clearances between the rail and overhead bridges are not sufficient to allow the installation of catenary for electrified train operations while preserving existing freight clearances.

Project Description - A significant part of the project involves providing adequate catenary clearance at the 225 overhead bridges along the route. As many as one-third of the bridges appear to provide insufficient clearance.

Specific work may include replacing, raising, or eliminating bridges, undercutting the track at a variety of locations, and possibly combinations of undercutting and replacing/raising to provide the required clearances. Amtrak is performing design studies to identify the improvements required, and will coordinate the work with state and local agencies and be responsible for ensuring that adequate clearances are provided. Amtrak has specified clearances that are intended to enable current freight operations to be maintained. Proposed future operations, such as P&W's Providence to Davisville automobile traffic, have not been taken into account.

Amtrak-specified desirable clearances, measured to bottom of bridge, are listed below. They do not necessarily conform to the current requisite freight clearances, but are in accordance with clearances agreed as part of the original NECIP:

Segment	Clearance
MP 72.5-186.5	19' 2-½"
MP 186.5-189.3	19' 6-½"
MP 189.3-197.0	19' 2-½"
MP 197.0-204.0	19' 6-½"
MP 204.0-226.8	19' 2-½"
MP 226.8-229.0	18' 4-½"

Amtrak's clearance program is based on three special considerations:

- if the existing overhead bridge condition is fair to good and the clearance provided is 30-½" more than the anticipated maximum vehicle height, no modification is proposed;
- if the bridge condition is fair to good and the clearance provided is between 22-½" and 30-½" more than maximum vehicle height, no action is required for the bridge. Catenary installation will be adjusted; and
- if the bridge condition is fair to good and clearance provided is less than 22-½" but greater than 18", no bridge modification is proposed. A special catenary design for this application is being investigated.

Additional factors that may affect the clearance program are speed, bridge width, and type of bridge deck.

Project Location - Between New Haven and Boston South Station (MP 72 to MP 229).

Design and Construction Schedules - Amtrak continues to evaluate options that would result in a cost efficient program to provide the vertical clearances required for the initiation of electrified operation. The clearance improvements ultimately identified by Amtrak are presently scheduled to be completed by the end of 1996.

Construction Impact on Operations - Impact on normal operations would be minimized by: restricting contractor access; performing work at night; coordinating track outages with other construction activities; and by the presence of reverse signaling. If more than one undercutting pass is required at a location, slow orders may be required for limited periods of time.

Anticipated Benefits - Project results in the elimination of vertical clearance constraints, which presently prevent installation of catenary and thus the initiation of electrified train operations, while maintaining existing freight clearances.

NOISE AND VIBRATION MITIGATION PROGRAM

Needs Assessment - Noise and Vibration evaluations performed for the DEIS have identified numerous locations where the impacts of frequent high-speed electrified operation could exceed the evaluation criteria thresholds. Train noise was projected to have the greatest potential affect, while noise from construction and electrification facilities is expected to have substantially less effect along the corridor between New Haven and Boston. The evaluations also determined that the no-build option (retention of current non-electrified operation) also would have noise impacts. The increased train speeds and increased frequency of operation were identified as factors that "could result in a greater total dose of noise energy at a given location over a 24-hour period."

Project Description - Mitigation of train noise impacts through a variety of measures designed to control noise at its source, transmission path or at the noise sensitive receiver. Source mitigation measures would include rolling stock and track-related measures. Path control could consist of the installation of 8- to 16-foot tall, solid, wayside noise barriers along the right-of-way. Each barrier would be at least 200 feet long. Receiver noise control measures could include sound insulation treatment of buildings.

Mitigation of vibration impacts through a variety of measure to minimize the ground-borne transmission of vibration from trains. Enhanced rolling stock and track maintenance programs would potentially reduce the vibration at the source, while a variety of construction techniques could be utilized to further reduce vibration levels.

A definitive program has not been identified. Further study will be required to establish the specific actions to be taken.

Project Location - Various locations between New Haven and Boston.

Design and Construction Schedule - Once a program has been established, a design and construction schedule can be established. Initially it is anticipated that the most sensitive locations should be mitigated prior to the initiation of electrified operation and the remainder should be mitigated prior to the start-up of 3-hour service.

Construction Impact on Operations - Work adjacent to the right-of-way should have a minimal impact on train operations, while work required to install noise and vibration path control measures under the track structure would require track outages.

Anticipated Benefits - Project results in the mitigation of noise and vibration impacts at locations between Hew Haven and Boston where evaluations performed for the DEIS have predicted that more frequent and higher speed train operations would result in certain threshold criteria being exceeded.

Signaling and Train Control

INSTALL SIGNAL SYSTEM COMPATIBLE WITH ELECTRIFICATION

Needs Assessment - Present signal systems east of New Haven will be replaced or modified to accommodate significantly higher speeds. The Shore Line system will be made compatible with planned electrification and speeds up to 150 miles per hour. It will also be necessary operate trains at speed in either direction on either track under contingency conditions.

Project Description - Amtrak's planned New York City-Boston electrification requires the signal system to be compatible with 25kV, 60Hz catenary. This will be accomplished by replacing the existing track circuitry with new 100Hz phase-selective track circuits. Impedance bonds also must be added to allow the flow of negative return current around the insulated joints without inhibiting the signal track circuits. Traffic and block information will be transmitted between locations via line circuits. Cab codes and block criteria are also proposed to be modified to permit higher speeds and the installation of high-speed (80 miles per hour) crossovers. Sixty, 80, 100, 125, and 150 miles per hour signal aspects will be installed at appropriate locations (passing tracks, junctions, high-speed Crossovers, etc.) to provide for high-speed operation, efficiently handle increased train traffic on the corridor, and permit 3-hour intercity passenger service, as well as commuter and freight service, to successfully operate on the same tracks. (The modification of on-board cab signal equipment to enable vehicles to utilize the new codes is described in the "Modify On-Board Cab Signal Equipment" project.) New block layout and signal aspects will accommodate speeds up to 150 miles per hour. The signal system will utilize microprocessor-based track circuits and control/indication equipment. Block spacing will anticipate increased train speeds. Reverse signaling is being installed universally. Interlockings will all be remotely controlled via the Centralized Electrification and Traffic Control (CETC) Center in South Station, Boston.

Project Location - Shore Line (MP 72.8 to MP 229).

Design and Construction Schedules - Work is underway. The installation of reverse signaling is scheduled to be completed before the start of the installation of the catenary system. The remainder of the presently programmed work is scheduled to be completed by the fall of 1996, before the initiation of electrified operation. Additional signal work, not presently funded, will be required to complete the reconfiguration of the additional interlockings and capacity improvement projects.

Construction Impact on Operations - Impact will be minimal. Installation of the signal system will assist in minimizing delays during installation of catenary system.

Anticipated Benefits - Modified signal system will support higher speed train operations, permit utilization of 60, 80, 100, 125, and 150 miles per hour speed indications, facilitate operation of a mix of high-speed trains, commuter trains, and freight trains on the same tracks, and be compatible with electrified train operations

EXTEND CETC FROM NEW HAVEN TO PROVIDENCE

Needs Assessment - The upgrading of the NEC main line east of New Haven (electrification, track improvements, and other work that increase speeds and capacity) will require the utmost in operating flexibility and centralized dispatching. Efficient and reliable dispatching of the many rail services operating the NEC requires a centralized control point. The MBTA has previously agreed that all branch lines feeding the NEC, as well as any new or reactivated lines feeding South Station, will be controlled from the CETC system provided by NECIP.

Project Description - To maximize traffic control over the upgraded railroad, the Centralized Electrification and Traffic Control (CETC) dispatching and traffic management system will be expanded to include the territory between New Haven and Providence.

Project Location - New Haven (MP 72.8) and Providence (MP 185).

Design and Construction Schedules - According to Amtrak's March 1993 schedule the extension of the train control portion of CETC to New Haven is underway and is scheduled to be completed by mid-1994. The SCADA portion will be completed by early 1997.

Construction Impact on Operations - Impact on normal operations should be minimal; small delays may occur as the system is implemented. Installation of CETC, centralizing dispatching capabilities, will help minimize subsequent construction-related delays.

Anticipated Benefits - Installation eliminates the localized control of train operations between New Haven and Boston from individual towers by centralizing the train dispatching function in Boston South Station. Centralized control also will increase operating flexibility, and on-time performance.

INSTALL POSITIVE STOP/CIVIL SPEED ENFORCEMENT SYSTEM

Needs Assessment - Several recent incidents have raised serious doubts about the advisability of operating high-speed passenger trains along the NEC between Washington and Boston without some means to ensure that the various civil speed restrictions (resulting from curves, bridges, tunnels, etc.) are automatically enforced in the locomotive cab by fail-safe devices in a manner similar to the existing Automatic Train Control system. Presently the engineer is responsible for knowing the location and speed associated with each civil speed restriction, and operating the train in accordance with them. This does not always occur and could result in potentially catastrophic results. The need to positively enforce a positive stop at locations where conflicting routes can be established also has been identified. Therefore, the FRA and Amtrak are evaluating alternatives for implementing a positive stop/civil speed enforcement system.

Project Description - A speed enforcement system would be installed in the cab of all trains to enforce positive stop/civil speed restrictions. This system would enforce both permanent and temporary speed restrictions and enforce a positive stop at interlocking home signals. Currently under consideration is a wayside transponder system, which would place transponders in approach to speed restriction locations. The transponders would contain information about the limits of the speed restriction, the maximum allowable speed through the area and the distance to the next transponder location. A reader on the locomotive would decode this information and an on-board computer would calculate the braking curve necessary to achieve the reduction in speed. If the engineer does not comply, a forced reduction would be imposed. It has not been decided whether the transponder system ultimately will be selected as the technology to implement the positive stop/civil speed enforcement system. Regardless of the technology adopted, it must be implemented incrementally, both on the wayside and in the vehicles, without detriment to other users on the Corridor whose vehicles as yet are not equipped. The system to be used is still under review.

Project Location - Various locations between New York City and Boston.

Design and Construction Schedules - Conceptual definition of the system is underway. Implementation will require wayside and on-board modifications. Modification of equipment could begin in 1996 and be incrementally phased so that all modifications to Amtrak locomotives would be completed by the beginning of 2001. Modification of commuter and freight locomotives, and cab cars could be a 10- to 20-year process. A definitive schedule cannot be established until the modification requirements are more clearly identified.

Construction Impact on Operations - Vehicles will have to be removed from service to enable cab signal equipment/systems to be modified. The modification program(s) should be coordinated so that daily intercity, commuter and freight operating requirements are met and simultaneous out-of-service sets of equipment are minimized.

Anticipated Benefits - System will enhance safety of trains operating at higher speeds by ensuring that various civil speed restrictions resulting from curves, bridges, etc., and positive stops at locations where conflicting routes can be established are automatically enforced by fail safe devices.

Stations

ROUTE 128 IMPROVEMENTS

Needs Assessment - To handle increased intercity ridership, the Route 128 station needs rehabilitation and upgrading. Some of the needs--high level platforms and expanded parking--are discussed in other projects. To date only the high level platforms have been planned. This project covers additional items required to support projected service levels.

Project Description - Construct a waiting room and ticket sales counter over the tracks, provide elevators and new stairs, and upgrade the elevated pedestrian overpass to ADA standards. To date only the elevated overpass has been planned.

Project Location - Route 128 station.

Design and Construction Schedule - Amtrak and MBTA have been negotiating a design and construction agreement for this project for 3 years. The proposed schedule assumes that construction would be completed by mid-1998.

Construction Impact on Operations - Construction activities of the over-track facilities could have minimal effect on main line operations. Staging of the platforms would be required to maintain present intercity and commuter operations.

Anticipated Benefits - Project will result in the upgrading of station facilities, which in conjunction with improvements funded in other projects will reduce dwell time for commuter and Amtrak trains, and support increased high-speed and conventional intercity service levels.

KINGSTON STATION INTERMODAL TRANSPORTATION FACILITY

Needs Assessment - Kingston Station was heavily damaged by fire in 1988. RIDOT acquired the station on August 2, 1993. To continue intercity rail service, the station requires extensive repairs. Proposed commuter service also would require various station upgrades. There is no westbound platform. The existing platform serves one track only; westbound riders must stand in the middle of the eastbound track to board the trains. This is considered an unsafe practice, which will be made more untenable as the volume and speed of trains is increased.

Project Description - Restore station damaged by fire; enlarge and improve parking facilities; design high level platform; construct pedestrian crossover and handicap ramp system; do landscaping; improve traffic circulation pattern; provide bicycle path terminus; and implement sewer and drainage improvements. The construction of high level platforms is included in the "Construct High Level Platforms" project.

Project Location - Town of South Kingston (MP 158.1).

Design and Construction Schedules - Design of the restoration is underway. RIDOT and Amtrak are coordinating the configuration of the platforms, siding track, and cross track access. Emergency structural repairs started in September 1993. Final restoration, including relocating station and site work is scheduled to start in mid-1994. Construction of the initial restoration and site work is projected to be completed by the beginning of 1996. The platforms and pedestrian bridge should be completed by the beginning of 1999.

Construction Impact on Operations - Construction of the pedestrian overpass should have minimal affect on main line operations.

Anticipated Benefits - Project will restore the fire-damaged station. The repairs in conjunction with improvements funded in other projects will result in a facility that will support increased high-speed and conventional intercity, as well as projected commuter service levels.

Service Facilities

CONSTRUCT AMTRAK NEW HAVEN SERVICE FACILITY

Needs Assessment - As outlined earlier in the description of the New Haven Terminal Area reconfiguration project, there is need to reconfigure the entire New Haven Terminal and Yard to reduce congestion, improve operating flexibility, and increase speeds through the terminal. As part of that reconfiguration, it is necessary to relocate Amtrak's service facility.

Project Description - Relocate Amtrak's diesel service facility by building a new facility on the north side of the main line tracks; provide layover capacity for two intercity trainsets. This will eliminate conflicting moves between intercity and commuter trains.

Project Location - New Haven (MP 72.5).

Design and Construction Schedules - The construction of the new service facility should be closely coordinated with the other proposed Amtrak and CDOT improvements in the New Haven Terminal area. Initial phasing analysis suggests that relocation to the new facility has to occur before the reconfiguration of the western portion of the terminal. Consequentially, the proposed NECTP schedule calls for construction to start in mid-1995 and be completed by the fall of 1996.

Construction Impact on Operations - The proposed project would require staging of construction to support the continuation of existing operations.

Anticipated Benefits - Relocation of the existing service facility will reduce congestion at the existing New Haven Station by eliminating conflicting moves between intercity and commuter trains. Project is an integral part of a coordinated set of projects required to upgrade the New Haven Terminal Area.

Car Equipment

PROCURE AMTRAK HIGH-SPEED TRAINSETS

Needs Assessment - As a result of the various projects to improve the NEC, high-speed service will be implemented. New train equipment is needed to maximize the effect of the NEC program improvements and to provide state-of-the-art rail transportation to the traveling public.

Project Description - Specify, design, test, and deliver twenty-six Amtrak high-speed intercity trainsets.

Project Location - Entire Northeast Corridor between Washington and Boston.

Design and Construction Schedules - Procurement activities are ongoing and it is assumed that all 26 trainsets will be delivered by the beginning of 2002. The trainsets need to be tested and delivered before the initiation of high-speed 3-hour service, but are not required for the initiation of electrified train operations.

Construction Impact on Operations - None.

Anticipated Benefits - Delivery of high-speed trainsets capable of operating at up to 8 inches of unbalanced superelevation will result in a trip time reduction of approximately 12 minutes when compared to that achievable by existing Amtrak intercity electric high-speed trainsets. The new trainsets will provide the seating capacity to support the projected 2010 demand and service levels, and will provide upgraded levels of service to passengers.

Grade Crossings

GRADE CROSSING ELIMINATION PROGRAM

Needs Assessment - In the New Haven to Boston corridor, there remain 15 public and private crossings that pose a safety threat to highway vehicles and pedestrians as well as train operations.

Project Description - Eliminate at-grade crossings where feasible and practical in accordance with recent federal legislation. Details by specific crossing are contained in the *Plan For Elimination of Highway At-Grade Crossings* as Appendix A in this report.

Project Location - Along the NEC between New Haven (MP 72.8) and Boston (MP 229).

Design and Construction Schedules - The initial draft *Grade Crossing Elimination Plan* indicated that it would be feasible to complete the elimination of the recommended crossings by January 1998. Reaction to the plan varied widely. Although safety officials and agency personnel reacted favorably, citizen groups, and local and state political leaders raised a significant number of objections to both grade separations and eliminations. These concerns were taken into consideration in the preparation of the Final Plan, which placed each of the 15 existing at-grade crossings in one of three groups, according to the degree of consensus expressed subsequent to the publication of the draft Plan:

Group 1. Crossings for which there was a consensus and for which the recommendation contained in the Final Plan is essentially the same as that contained in the draft Plan.

Group 2. Crossings for which there was a general consensus, but for which further technical investigation will be needed to confirm the practicability of certain features of the Final Plan recommendation.

Group 3. Crossings for which there was strong opposition to the recommendations in the draft Plan, and for which development of a Final Plan is subject to demonstration and testing of crossing enhancement systems.

For further detail see Appendix A.

Construction Impact on Operations - Impact on normal operations should be minimal because construction is adjacent to tracks. Occasional short-term track outages may be required, but these can occur during low use periods or in conjunction with other proposed work.

Anticipated Benefits - Safety at the 15 remaining rail-highway crossings will be enhanced as the result of the elimination of certain crossings, and the installation of enhanced crossing protection systems at those that remain.

Safety Enhancements

INSTALL APPROACH WARNING SIGNS AND BELLS

Needs Assessment - High-speed trains will pass commuter station platforms at speeds up to 150 miles per hour. Passengers on the platforms need to be made aware of the approach of the high-speed trains.

Project Description - Work includes: (1) installing train approach warning signs and bells to alert passengers on platforms of approaching high-speed trains, and installing a flashing "stand back" surface stripe immediately behind the tactile platform edge, or other visual warning, to provide additional warning; (2) conducting a study to determine necessary precautions to protect passengers on platforms during passage of high-speed trains.

Project Location - All stations.

Design and Construction Schedules - A schedule has yet to be finalized for this project. The schedule anticipates that the design will accommodate the commencement of construction at the beginning of 1996, with completion by the end of 1997.

Construction Impact on Operations - No impact to operations is expected.

Anticipated Benefits - Passenger safety at stations will be enhanced by the implementation of improvements to alert passengers to the approach of trains.

CAPACITY

Route Realignments

PENN STATION - EXTEND PLATFORM 11 (TRACKS 20 AND 21) AND 5X SWITCH CONNECTION

Needs Assessment - The inability of Platform 11 at Penn Station to accommodate trains longer than eight cars limits operations. All platforms used by the LIRR-with the exception of Platform 11-can handle 12 cars. Increasing ridership has dictated the use of more 12-car trainsets. During the morning peak, more than 70 percent of arriving trains are 10 or 12 cars. Theoretically these longer trains should not be directed into Platform 11, limiting the options available to Terminal Supervisors.

In practice, however, the present plan does assign 6 10-car trains to Track 21 during the morning peak. To clear KN Interlocking, these trains extend east beyond 24L Signal, fouling 29 and 31 Switches within C Interlocking. Thus, the constraint imposed by the limitation of Platform 11 has a subtle but real impact on operations. Passengers in the two east cars must walk single file to leave the train, increasing platform dwell time. Trains in Line 4 that are scheduled to proceed to Track 20 are limited by the single remaining route through C Interlocking.

Another constraint at Penn Station is the lack of direct access from Tracks 13 and 14 to West Yard that limits capacity and operating flexibility. LIRR trains assigned to Platform 7 must operate in the reverse peak direction, using Lines 1 and 2 that are normally used by Amtrak and NJT trains, to permit arrival of following trains, increasing platform dwell time and occupying valuable tunnel slots in Lines 1 and 2. In periods of disruption, when maximum operating flexibility is essential, LIRR trains are deprived of full use of Tracks 13 and 14. Operating plans being formulated to cope with future increased capacity needs at Penn Station are dependant upon this project.

Project Description - The project includes increasing Platform 11 from 8- to 12-car lengths. This would be accomplished by a 280-foot westerly extension of the platform and a new ladder track connecting Tracks 20 and 21 to West Side Yard Lead Track 4W. Also there would be construction of a direct westerly connection of Penn Station Tracks 13 and 14 to West Side Yard lead Tracks 1 and 2 via the 5X Switch.

Project Location - Penn Station (MP E0)

Design and Construction Schedules - Design of the improvements, managed by the LIRR, is presently underway. The proposed schedule envisions that work on Platform 11 will be completed by the end of 1995 and that the 5X ladder will be completed by mid-1997. Construction phasing should be coordinated with ongoing maintenance activities and improvements to the 1 through 4X tracks that may be initiated by New Jersey Transit.

Construction Impact on Operations - The planned work will be performed mainly at night and over weekends. There would be partial or total service disruptions, to both commuter and intercity trains, during construction and cutover. Modifications to 5X may result in temporary loss of operating flexibility.

Anticipated Benefits - The project will result in the elimination of several constraints that limit operating capacity and flexibility at this terminal serving intercity as well as LIRR and NJT commuter trains.

RECONFIGURE HAROLD INTERLOCKING

Needs Assessment - Harold Interlocking, 4 miles east of Penn Station, is the junction where the two-track Amtrak main line from New Rochelle joins six Long Island Rail Road (LIRR) tracks, before they ultimately merge into the four East River tunnels. All traffic to and from Penn Station passes through "F" interlocking, which also controls Amtrak, LIRR and NJ Transit access to the adjacent Sunnyside Yard. Two of the East River tunnels are for exclusive use by LIRR; the other two are shared by Amtrak, LIRR, and the NJ Transit trains en route to Sunnyside for storage. The convergence of this level of traffic in the vicinity of Harold Interlocking has a high potential for congestion and delay, much of which (for westbound moves) is related to tunnel and station capacity.

For eastbound Amtrak trains, the need to cross the LIRR tracks can create delays, a situation that should be alleviated by the cutover to Penn Station central control.

Westbound (Penn Station-bound) Amtrak trains do not enter the interlocking until a route is available and so do not reduce throughput for the LIRR. Eastbound Amtrak trains must traverse three crossovers to reach the Amtrak Hellgate lead track, which then flies over three westbound LIRR main line and Port Washington tracks. The eastward Amtrak move blocks any eastward move of LIRR from either Penn Station or Long Island City.

These situations are conducive to delays, particularly during peak periods. As traffic growth continues, the peak periods are lengthening.

The Penn Station-Harold area has long been a significant NEC bottleneck. A major reconfiguration of the Harold Interlocking has recently been completed. This has reduced delays at Harold to a tolerable level, but delays are still common and the LIRR, Amtrak, and NJT all anticipate substantial future increases in service.

Project Description - Recent evaluations have concluded that **construction of eastbound and westbound grade separations (duckunders)** at Harold Interlocking between Amtrak and LIRR tracks would reduce conflicting moves between the two and permit higher speeds. Eastbound intercity trip time would be reduced by .35 minutes. Westbound conflicting moves would be reduced by construction of a duckunder and a bypass track, saving slightly less time. This work would require the reconfiguration of both F Tower and Harold. The present planning is being coordinated with the ongoing LIRR study of connecting main line tracks to the existing 63rd Street tunnel for access to the east side of Manhattan.

Project Location - Harold Interlocking, New York City (MP E3-MP E4).

Design and Construction Schedules - Preliminary engineering studies are underway. A recommended configuration has recently been established. Final design has been scheduled to begin in mid-2000 and construction could be completed by the end of 2005.

Construction Impact on Operations - Construction could impose delays on LIRR commuter operations, Amtrak intercity operations and Amtrak and NJT access to and from Sunnyside Yard.

Anticipated Benefits - The grade separations will significantly reduce conflicting moves between Amtrak and LIRR trains thereby reducing congestion and delays presently experienced or projected. By increasing operating speeds the improvements will save approximately 22 seconds.

SOUTH STATION CAPACITY IMPROVEMENTS

Needs Assessment - Boston's South Station has certain capacity constraints that will become even worse as planned service increases take effect. These problems will be exacerbated by delays during the electrification project and by nearby highway construction.

Project Description - Modifications will include: adding Tracks 12 and 13; adding and electrifying a fourth track over Fort Point Channel; adding a fifth track in the approach to South Station from the B and A tracks; adding crossovers to Cove Interlocking; and adding an inside ladder in the interlocking for parallel moves.

Project Location - Boston, MA (MP 229).

Design and Construction Schedules - Construction of Tracks 12 and 13 is underway. Other tasks are in various stages of design. Construction should be coordinated with the installation of catenary, and be completed by early 2001. The phasing of the work has to be coordinated with the planned configuration improvements between Readville and Cove Interlockings so that delays can be minimized. The improvements associated with access to the Dorchester Branch can be completed after 3-hour service is initiated.

Construction Impact on Operations - There will be occasional short term track outages as signals, new tracks and crossovers are cut in. Staging of the improvements should be planned to maintain ongoing operations during construction.

Anticipated Benefits - The recommended improvements will increase flexibility and provide a terminal area with increased capacity to handle projected growth in intercity and commuter rail service.

REINSTALL DEVON TO NEW HAVEN FOURTH TRACK

Needs Assessment - Between Devon and New Haven, the fourth track (designated Track 3) deteriorated to the point that it would have required a $10 million investment for restoration to passenger service standards. Consequently, part of that track has been removed. The track is out of service west of MP 65 and several undergrade bridge spans have been removed. The railroad system between Devon and New Haven presently functions as a three-track operation. Portions of Track 3 are being used to provide local freight service.

Lack of the fourth track would have an adverse impact on combined Amtrak and commuter operations. Therefore, it has been concluded that the three remaining tracks will not be sufficient for the level of commuter traffic and intercity speeds anticipated early in the next decade. Initial examination indicates that retention/replacement of the track will be needed by early in the next decade.

Project Description - Future capacity needs justify re-installation of the fourth track. (The Pequonnock River bridge replacement project at Bridgeport will provide four tracks.) The track will be electrified and constructed to standards supporting intercity and local commuter services.

Work is proposed to include: reconfiguration of Devon Interlocking; removal of CP-266 (Woodmont Interlocking); upgrading of track structure and catenary from Devon to New

Haven Interlocking; rehabilitation of bridge structures; reinstallation of Wepawaug and Gulf Street bridges; reinstallation of signals; and relocation of the Milford station platform.

Prior to the initiation of 3-hour intercity service, Devon Interlocking will have to be modified to provide an improved route for intercity trains. Presently, Track 1 does not extend through the interlocking, westbound intercity trains have to divert at 45 miles per hour to access Track 1 west of Devon (see Exhibit F-4). Since the fourth track is not scheduled for reinstallation until 2004, prior to the initiation of 3-hour service, a high-speed (80 miles per hour) crossover will have to be installed connecting Tracks 1 and 3. The turnout will enable westbound intercity trains to utilize the inside track, Track 1 at 80 miles per hour, while avoiding negatively impacting local commuter trains having to access Track 3.

Project Location - Devon to New Haven (MP 61 to MP 72).

Design and Construction Schedules - Design is expected to take a year. Construction would begin early in 2003 and be completed by the middle of 2004. Once the previously discussed universal New Haven interlocking is installed, the addition of the fourth track should facilitate track program and catenary replacement work by providing increased capacity and operating flexibility. Woodmont interlocking would be removed after New Haven is operational.

Construction Impact on Operations - Except for work at Devon and Woodmont interlockings, and Milford Station, minimal impact on normal operations is expected. Staging of the Milford platform relocation will be required to maintain operations.

Anticipated Benefits - In addition to providing increased capacity to handle the projected levels of intercity, commuter, and freight trains the reinstallation of the fourth track will reduce travel time by approximately one-minute by eliminating existing diverging moves for high-speed trains.

CONSTRUCT SHORE LINE EAST (SLE) PASSING SIDINGS

Needs Assessment - Currently there are occasional operating conflicts between SLE commuter trains, Amtrak intercity trains, and freight trains between Old Saybrook and New Haven. When high-speed intercity service is implemented, and as commuter service increases, these conflicts will occur more frequently.

Project Description - Construction of 7 miles of passing sidings to allow increased operating flexibility and facilitate freight operations.

Project Location - Between New London (MP 122.8) and New Haven (MP 72.8), specifically at Branford (westbound), Guilford (two sidings), Clinton (Eastbound), Old Saybrook (two sidings), and Waterford (two sidings).

Design and Construction Schedules - Long lead items, such as turnouts and signals, will control construction start dates. Construction is expected to be completed by the middle of 2002.

Construction Impact on Operations - Installation of turnouts and construction of sidings would be staged to minimize the impact on normal intercity and commuter operations.

Anticipated Benefits - The passing sidings will facilitate the operation of intercity, commuter, and freight trains at different speeds and stopping patterns on this essentially double-track railroad. The sidings will minimize operating conflicts between trains and provide facilities to enable freight trains to efficiently service customers.

CONSTRUCT NEW LONDON TO PROVIDENCE PASSING SIDINGS

Needs Assessment - Passing and/or service sidings will be needed at Westerly, Kingston, Hills Grove, and Cranston to avoid conflicts between local freight trains and Amtrak intercity trains. Analysis of the level of freight service projected by the P&W and the results of recent operations simulations have indicated the need for additional sidings to deal with passenger train overtakes and enable freight movements to be made and local industries to be served.

Project Description - The sidings will be constructed at locations where sidings previously have been removed. At Westerly, a 1-mile westbound siding (Track 3) will be installed. At Kingston, it is initially anticipated that the proposed commuter rail side track will be extended west to provide the westbound siding required by the P&W. At Hills Grove, a westbound passing siding will be constructed to enable local industries to be serviced and to minimize conflicts with projected intercity and commuter rail services. At Cranston, a RH No. 20 turnout will be installed at the west end of Track 6 to provide direct access eastbound from Track 2. At the present time, access to the industrial siding at MP 179 requires a time-consuming back-up move on the main line. The siding is located in a segment bounded by 125-80-65 miles per hour passenger operating speeds, thus freight occupancy of main line tracks needs to be minimized. Implementation of this project will eliminate the back-up move.

Project Location - Westerly (MP 145), Kingston (MP 158), Hills Grove (MP 176), and Cranston (MP 179).

Design and Construction Schedules - Ongoing design at Kingston should accommodate the proposed commuter rail siding and passing track. Kingston to Providence Commuter rail service would be initiated by the beginning of 1999 and the siding would be completed before that date. The upgrading of industrial track 6 at Cranston would be progressed simultaneously. The Westerly and Hills Grove sidings would be completed prior to the initiation of 3-hour intercity service.

Construction Impact on Operations - Impact on normal operations will be minimal.

Anticipated Benefits - The passing sidings will facilitate the operation of intercity, commuter, and freight trains at different speeds and stopping patterns on this essentially double-track railroad. The sidings will minimize operating conflicts between trains and provide facilities to enable freight trains to efficiently service customers.

CONSTRUCT PROVIDENCE TO BOSTON PASSING SIDINGS

Needs Assessment - The introduction of high performance, electrified intercity service will require locations where intercity trains can pass local MBTA commuter trains between Providence and Boston.

Project Description - To provide adequate passing tracks, the project entails: reinstallation of Track 3 at Attleboro (MP 197); rehabilitation of Track 4 from Attleboro to Hebronville (MP 193.7); and construction of Track 5 from Forest Hills (MP 224) to Readville (MP 219).

After 3-hour intercity service is initiated it is proposed that additional sidings be constructed at: Sharon (Track 4), and between Rte. 128 and Read (Track 3).

Project Location - Locations are listed under Project Description.

Design and Construction Schedules - Work at Attleboro, and Readville to Forest Hills (Track 5) should be completed before the initiation of 3-hour intercity service. Work should be staged with installation of catenary. Long lead items (turnouts and signals) will likely control construction start dates. Construction should be completed by the spring of 1997.

Construction of Track 4 at Sharon and Track 3 improvements between Rte. 128 and Readville are expected to be completed by the middle of 2008. The catenary foundations and poles should be situated to provide for the future installation of these sidings.

Construction Impact on Operations - Installation of turnouts and construction of sidings would be staged, location by location, with the installation of high platforms, cross track access structures, and gauntlet tracks. This would minimize the impact on normal intercity and commuter operations.

Anticipated Benefits - The passing sidings will provide locations where intercity trains can overtake local commuter trains, and ultimately add additional capacity to handle projected levels of 2010 train service.

SHORE LINE EAST (SLE) BOTH SIDES FULLY ACCESSIBLE STATIONS

Needs Assessment - The relocation of Branford and Westbrook Stations (see previous SLE South Side Station Relocations) will allow for integrated SLE and Amtrak operations until the year 2000. Subsequently, SLE stations, with high level platforms, will be located on both tracks, providing the greatest flexibility for both operations.

Project Description - Construct fully accessible, grade separated SLE stations on both tracks. Manually operated gauntlet tracks will be required at each station (and are included in a subsequent project) to accommodate high and wide freight movements.

Project Location - Branford (MP 81.3), Guilford (MP 88.8), Madison (MP 93.1), Clinton (MP 96.8), and Westbrook (MP 101.2).

Design and Construction Schedules - These improvements have been initially identified as being required after 2000. Design would not begin until the beginning of 1997 and construction would take 2½ years. The stations would be completed by the end of 2000. The construction at each station would be phased to maintain existing service while constructing the high level platforms, cross track access structures, and gauntlet tracks. Work at each of the five stations would be staged to optimize construction activities.

Construction Impact on Operations - Most of the work will be accomplished adjacent to the main operating tracks. The impact should be minimal. Commuter operations would be maintained by keeping at least part of each existing platform open.

Anticipated Benefits - The grade separated stations at five locations, in conjunction with other improvements at each location, will decrease dwell times for commuter trains thereby reducing the impact of commuter rail operations on high-speed intercity service.

PROVIDE THIRD TRACK FOR P&W FREIGHT SERVICE

Needs Assessment - Projected freight and intercity traffic increases may require the construction of a third track dedicated to freight use. Alternatives evaluated have included that a third track between Boston Switch and Davisville and a shorter stretch of third track between Boston Switch and Cranston. Analyses undertaken as part of the development of this Plan recommended that third track be constructed between Boston Switch and Cranston. The track will be constructed to maintain existing freight clearances between these two locations, unless new overhead bridges have to be constructed. New overhead bridges in the section would be constructed to provide the requisite 20' 7" clearance for non-electrified operation of double stack container cars.

Project Description - Rehabilitate and construct a non-electrified third track between Boston Switch and MP 179 (Cranston). Upgrade existing tracks and construct connecting track, as required. Install No. 20 crossover and turnout at Cranston to provide access to/from main track. Increase freight operating speeds to a minimum of 50 miles per hour, where track geometry permits. An additional project to provide clearances in excess of those presently required is subsequently described. The additional improvements would allow the movement of high cube double stack container cars, or auto racks, to and from the Port of Davisville.

Project Location - NEC (MP 179 and MP 190).

Design and Construction Schedules - Coordination with clearance improvements in this segment would minimize having to perform work twice at the same location. It is envisioned that design will be initiated in 1994 and progressed to enable construction to begin in mid-1996. It is conservatively estimated that construction could be completed by the beginning of 2001.

Construction Impact on Operations - The proposed project would relate directly to Amtrak's schedule and track outages with minimal impact on normal operations.

Anticipated Benefits - The dedicated freight route will eliminate conflicts between relatively slow freight trains, intercity service, and commuter rail operations. The additional capacity provided by the third track and the previously described passing sidings are intended to provide the operating flexibility on this essentially double-track railroad to handle the projected 2010 operating requirements of all parties.

Track Structures

RECONFIGURE EXISTING INTERLOCKINGS

Needs Assessment - Recent simulations and analyses of future intercity, commuter, and freight operating requirements have concluded that significant track changes are required. Additional tracks and passing sidings will require revised interlocking layouts to optimize train operations. Numerous interlockings, presently constructed with low speed turnouts and crossovers, will be reconfigured by the installation of higher speed turnouts and crossovers to increase capacity and operating flexibility. Significant changes are required between New Haven and New London, and between Providence and Boston.

Project Description - Remove existing crossovers and turnouts, and install new (mostly higher speed) turnouts and crossovers to implement desired alignment and configuration changes. This project includes reconfiguration of the following Interlockings: Walk, Central, Branford, Brook, Shaw's Cove, Lawn, Hebronville, Attleboro, Holden, Mansfield, Canton Jct., Readville Transfer, Read, Forest, and Plains.

Project Location - Specific locations are shown in the Geographical Summary of Proposed Improvements tables in Appendix E and on the Track Configuration Charts in Appendix F.

Design and Construction Schedules - Design is complete for some interlockings, but has yet to be scheduled for others. Certain improvements are not required until after 1998. The Sharon passing siding and Track 3 between Route 128 and Readville are anticipated to be the last interlocking reconfigurations completed. Schedules proposed in this report anticipate that they would be completed by the beginning of 2008. The proposed four-track universal interlocking that would be constructed to facilitate replacement of Walk and Saga moveable bridges would be the last reconfiguration completed (by the beginning of 2006) between New Rochelle and New Haven. Brook and Old Saybrook would be the last reconfigurations completed (in mid-1999) between New Haven and New London.

Construction Impact on Operations - Track outages will be required for installation of turnouts and crossovers and realignment of track configurations. Once completed, the reconfigured interlockings will help minimize other construction-related delays.

Anticipated Benefits - The revised interlocking configurations will increase operating speeds through turnouts and crossovers, expedite the use of new passing sidings, increase operating capacity and flexibility, and assist in the minimizing the impact of track outages during maintenance.

INSTALL HIGH-SPEED UNIVERSAL INTERLOCKINGS

Needs Assessment - Electrification of the railroad east of New Haven and the upgrading of other facilities will require a significant number of planned diversions. Number 30 crossovers will enable Amtrak trains to operate at 80 miles per hour, thereby minimizing delays. Once high-speed operations are initiated, the Number 30 crossovers will reduce delays as the result of reduction in MAS to diverge to an adjacent track.

Project Description - Install sets of 2 new universal Number 30 turnouts at 5 locations.

Project Location - Guilford (MP 88.43), Old Saybrook (MP 105), High Street (MP 142.9), Kingston (MP 158), and Davisville (MP 168).

Design and Construction Schedules -Initially, Amtrak has scheduled the No. 30 crossovers to be installed in 1993. The signal work at Old Saybrook is presently scheduled to be completed by the end of February 1994.

Construction Impact on Operations - The installation of turnouts will necessitate track outages. However, installation of these interlockings will help minimize other construction-related delays.

Anticipated Benefits - By increasing the maximum speed of diverging moves from 45 to 80 miles per hour at selected locations the crossovers will increase track capacity by reducing the time high-speed trains spend operating at reduced speeds. By increasing diverging speeds they also will serve to minimize the impact of track outages during construction.

INSTALL GAUNTLET TRACKS

Needs Assessment - As high level passenger platforms are introduced to reduce commuter train dwell times, the movement of high and wide freight shipments through certain stations will become impossible due to restricted clearances. Present high and wide clearance routes have to be maintained, especially Department of Defense access routes to Groton.

Project Description - Install manually operated (or power operated, if required) gauntlet tracks at Corridor locations where infrequent, abnormally wide freight movements are restricted by high level platforms.

Project Location - Branford (MP 81), Madison (MP 93), Clinton (MP 97), Westbrook (MP 102), Old Saybrook (MP 105), Mystic (MP 132.5), Westerly (MP 142), Kingston (MP 158), South Attleboro (MP 192), Attleboro Track 4 (MP 197), Mansfield Track 1 (MP 204), Canton Jct. (on the branch), and Rte. 128 (MP 218). When SLE service is extended west from Old Saybrook to New London, two additional gauntlets will be needed, one at Old Lyme (MP 112) and the other at Niantic (MP 116.5). When RIDOT Kingston-Providence service is initiated, two more gauntlet tracks will be needed, one at Wickford Jct. (MP 165), and the other at Apponaug (MP 175).

Design and Construction Schedules - Construction of the gauntlet tracks would be coordinated with the high-level platform, cross track access structure, and other improvements planned for the various stations. The same designer should be responsible for integrating these elements. Work on the existing SLE stations would be completed by the beginning of 2001. The proposed SLE extension stations would be completed by the beginning of 2005. The South Attleboro, Attleboro, Mansfield, and Rte. 128 gauntlet tracks would be completed by the spring of 1997. The phasing of the siding and high level platforms at Sharon will determine whether a temporary gauntlet would be needed at this location.

Construction Impact on Operations - The installation of the turnouts and gauntlet tracks will necessitate track outages of short duration. Construction can occur at off-peak times, if required.

Anticipated Benefits - The gauntlet tracks will provide clearance for existing high and wide traffic through stations with high-level platforms, and ensure that P&W and Conrail freight routes are maintained.

INSTALL NEW INTERLOCKINGS

Needs Assessment - The year 2010 operating plan calls for a number of trains to run non-stop to Fairfield in the evening. For access to Fairfield these trains must divert from Track 2 to Track 4 at South Norwalk. Many of these trains, run around local trains on Track 4 between Stamford and South Norwalk and merge between the locals at south Norwalk within a narrow time frame. If the opening is missed, the non-stop trains will either be behind a local train between South Norwalk and Fairfield or the local will have to be held west of South Norwalk to allow the non-stop train to go ahead. This problem exists today but the added trains in year 2010 by both Metro-North and Amtrak make holding local trains west of South Norwalk on Track 4 an unacceptable option because usually there is a Danbury train immediately behind the local.

The same situation exists westbound in the morning but the problem of keeping trains in order is lessened because all trains are closer to their origin (either New Haven or Bridgeport).

Analysis of operations during construction once high performance intercity service has begun indicates that three double-track universal crossovers should be installed to minimize delays and provide necessary operating flexibility.

Project Description - Construct interlocked crossovers just west of Fairfield from Track 2 to Track 4 (eastward) and from Track 3 to Track 1 (westward). With these crossovers, the order of trains would not be important. Construct universal interlocked interlockings at Market (MP E10), Point (MP 115), and Lord (MP 135) to facilitate operations during both construction and maintenance operations.

Project Location - Various locations New York City to Providence.

Design and Construction Schedules - The proposed interlockings should be completed by the spring of 2004.

Construction Impact on Operations - Track outages will be required to install crossovers.

Anticipated Benefits - Recent operations simulations and analyses have shown that the installation of new interlockings on the Hellgate Line, New Haven Line, and Shore Line will provide needed additional operating flexibility during projected normal operations as well as when construction and maintenance operations are scheduled.

Signaling and Train Control

CANTON JUNCTION TO BOSTON SIGNAL MODIFICATIONS

Needs Assessment - The signal system between Cove Interlocking and Canton Junction Interlocking as presently configured cannot provide the train handling capacity required by proposed future train operations. Relief would be provided by adding master signal locations at all signal sites.

Project Description - Upgrade all signal sites between Canton Junction and Cove, and at approaches to sidings, terminals, and major junctions to full master locations with 60, 80, and 100 miles per hour aspects.

Project Location - Between Canton Junction (MP 214) and Boston (MP 229), and other sites.

Design and Construction Schedules - Amtrak is presently reviewing the design requirements and has yet to finalize a schedule. For this report, it is projected that the specified modifications should be completed by the end of 1996, before the initiation of electrified service.

Construction Impact on Operations - Impact on normal operations would be minimal.

Anticipated Benefits - Signal modifications will increase operating speeds under various conditions to more efficiently handle increased intercity and commuter train traffic levels.

Stations

CONSTRUCT HIGH LEVEL PLATFORMS

Needs Assessment - A major factor that lengthens intercity and commuter train schedules is station dwell time. Dwell times are longer at stations that have low level platforms, which require passengers to go up or down several steps as they enter or exit a train, especially in inclement weather. These delays have a negative impact on both commuter service and intercity trains. On double-track segments with joint commuter and intercity traffic, commuter trains stopping at low-level platforms will serve to reduce the capacity of the railroad and potentially result in delays to intercity trains.

Project Description - Construct high level platforms at those commuter rail and Amtrak stations that currently do not have them. The locations are listed in Appendix E. Platforms will be of sufficient length to accommodate projected traffic.

Project Location - Between New Haven (MP 72.6) and Boston (MP 229).

Design and Construction Schedules - Construction of the platforms should be phased with other proposed improvements at each station. The high level platforms at the existing SLE stations, other than Old Saybrook, have been identified as required after 2000. The proposed schedule requires that design would not begin until early 1997, and that after 2½ years construction would be completed by the end of 2000. When SLE service is extended to New London, high level stations would be constructed at the two intermediate stops before initiation of the service, i.e., before the service start date, the beginning of 2005.

Amtrak presently plans to have the high level platforms at Mystic, Westerly, and Kingston completed by mid-1999, before the initiation of high-speed operations. High-level platforms for the two proposed intermediate stops between Kingston and Providence would be completed before initiation of the proposed new RIDOT commuter service early in 1999.

The platforms between Providence and Boston are expected to be completed by 2000. Their construction would be staged with other planned improvements at each location. For example, the high level platforms at Hyde Park would be phased with the upgrading of Track 5.

Construction Impact on Operations - Impact on train operations would be minimal because construction is next to the tracks. Pedestrian traffic flow will be altered during construction. Careful staging of the construction of the platforms should enable commuters to continue to use the stations.

Anticipated Benefits - The high-level platforms will reduce the dwell time - and thereby increase track capacity - for intercity and commuter trains at stations that presently have low-level platforms. Passenger safety at several locations will be enhanced by the elimination of the practice of having to stand in the middle of the track to board trains on the adjacent track.

Service Facilities

CONSTRUCT AMTRAK BOSTON SERVICE FACILITY

Needs Assessment - As service levels are increased, there will be a need to expand maintenance facilities in Boston to service the new trainsets. Further, facilities will be needed to service electric locomotives (to be used by conventional trains) once the electrification project is complete.

Project Description - Expand repair space and provide facilities for electric locomotives.

Project Location - Boston Southhampton Yard.

Design and Construction Schedules - A scope has yet to be defined. The work should be coordinated with the electrification of the existing storage yard and maintenance facility. Modifications to the existing facility, to enable the additional maintenance functions associated with an electric locomotive and a new fleet of cars, should be completed before the initiation of high-speed operations between New York City and Boston. These requirements mean that construction would commence in mid-1995 and be completed by mid-1997. As a minimum, design should progress sufficiently to make track layout data available to the electrification contractor.

Construction Impact on Operations - The proposed project would require staging of construction to support the continuation of existing operations.

Anticipated Benefits - Expansion of the facilities at Boston will provide the capability of maintaining electric trainsets and locomotives as well as the additional capacity necessary to inspect and maintain the increased number of intercity trains.

AMTRAK MEDIUM AND HEAVY OVERHAUL FACILITY

Needs Assessment - The operation of the new Amtrak trainsets at higher speeds-maximum 150 miles per hour, will require levels of maintenance that exceed present requirements. Additional facilities to perform medium and heavy repairs will be required. Existing Amtrak shops may not accommodate fixed trainsets (locomotives and coaches operated as a unit that is not taken apart to add or remove equipment for maintenance operations or meet service requirements). Therefore, Amtrak is presently evaluating the required modifications to enable existing maintenance facilities to perform these additional functions.

Project Description - Although improvements at existing facilities in Washington, Wilmington, Sunnyside Yard (New York City), and Boston have been made to maintain existing intercity equipment, major modifications, at an unidentified cost, would be required at these locations. An analysis to evaluate the options of purchasing, or not purchasing, fixed trainsets and the costs of making major or minor revisions to maintenance facilities has to be performed to ascertain the most appropriate expenditure of funds.

Project Location - Not yet determined.

Design and Construction Schedules - A scope has yet to be defined. The work should be coordinated with the electrification of the existing storage yard and maintenance facility. Modifications to the existing facility, to enable the additional maintenance functions associated with an electric locomotive and a new fleet of cars, should be expeditiously completed once location and scope of the work has been identified. As a minimum, design should progress sufficiently to make track layout data available to the electrification contractor. Construction is assumed to be completed by the beginning of 2002.

Construction Impact on Operations - The proposed project would require staging of construction to support the continuation of existing operations.

Anticipated Benefits - The capacity of existing facilities will be increased to accommodate the new trainsets and provide the additional repair and maintenance levels that they will require. The increased levels of maintenance will be essential if projected trip-time reliability goals are to be satisfied.

Car Equipment

MODIFY ON-BOARD CAB SIGNAL EQUIPMENT

Needs Assessment - Plans are being formulated to install a system to enforce civil speed restrictions, and positive stops at locations where conflicting routes can be established, and provide 60, 80, 100, 125, and 150 mile per hour cab signal indications. Current locomotive, MUs and cab car signal capabilities will have to be modified.

Project Description - All cab signal-equipped vehicles operating on the NEC need to have cab signal capabilities modified to enable the positive stop/civil speed enforcement system to be implemented. Cab signal-equipped vehicles may require decoding equipment and on-board computers to calculate the braking curve necessary to achieve the desired speed. The initial summary listing of the vehicles to be modified to operate between New York City and Boston is provided below:

Railroad/Agency	MU Equipment/Cab Cars	Locomotives
Amtrak	0	126
LIRR	0	0
MNCR	165	45
CDOT	11	10
MBTA	111	52
Conrail	0	20
P&W	0	13
Summary	**287**	**266**

Because of the short distance and low speeds at which they operate on the NEC, it is anticipated that LIRR equipment will not have to be modified to operate into Penn Station.

Project Location - Gate (MP E5) to Boston (MP 229).

Design and Construction Schedules - Conceptual definition of the system is underway. Intercity, commuter and freight locomotive, and cab-car on-board cab signal equipment would have to be modified to provide additional cab signal indications and implement positive stop/civil speed enforcement requirements specified by the FRA. Modification of equipment could begin in 1996 and be incrementally phased-in so that all modifications to Amtrak locomotives would be completed by the beginning of 2001. Modification of commuter and freight locomotive, and cab-cars could be a 10- to 20-year process. A definitive schedule cannot be established until the modification requirements are more definitively identified.

Construction Impact on Operations - Modifications of existing cab signal equipment/systems should be coordinated so that daily intercity, commuter, and freight operating requirements are met and simultaneous out-of-service sets of equipment are minimized.

Anticipated Benefits - Modification of on-board intercity, commuter, and freight cab signal equipment (including provision of additional signal indications) will enable the positive stop/civil speed enforcement system to be implemented on commuter, intercity, and freight trains operating on the NEC.

RECAPITALIZATION

Bridges

PELHAM BAY BRIDGE REPLACEMENT

Needs Assessment - Age, traffic, the harsh salt-water environment, and maintenance deferrals over many years have resulted in a steady deterioration of this structure. The bridge was rehabilitated as part of the original NECIP and additional repairs have been made from time to time to keep the bridge functioning. However, major replacement is required to restore the proper structural integrity, mechanical and electrical reliability, and to provide a satisfactory ride quality at the desired speed.

Project Description - Replace existing bridge on a new alignment with a longer span to widen the shipping channel.

Project Location - Pelham Bay (MP E15.73) on Hellgate line.

Design and Construction Schedules - An initial analysis suggests that replacement would take approximately 3 years and that a pre-construction period of 2 years, to include obtaining the necessary permits, should be expected. If design is initiated at the beginning of 2000, construction could be completed by the beginning of 2005.

Construction Impact on Operations - Replacement of the span will require cooperation with the Coast Guard and Corps of Engineers, and careful staging to minimize delays to trains.

Anticipated Benefits - Replacement of the bridge on a new alignment will provide structural integrity, and mechanical/electrical reliability and facilitate increase operating speeds.

WALK BRIDGE/SAGA BRIDGE REPLACEMENT

Needs Assessment - Age, traffic, the harsh salt-water environment, and maintenance deferrals over many years have resulted in a steady deterioration of the structures. Projects to rehabilitate each bridge have just been completed; however, replacement is recommended by MNCR to restore the proper structural integrity, mechanical and electrical reliability, and to provide a satisfactory ride quality at the desired speed.

Project Description - The work at Saga would be generally confined to the river crossing while the work at Walk would extend from the crossovers on the east side to the crossovers at West Walk. It would involve removal/renewal/reconfiguration/upgrading of all special trackwork and replacement of the bridge over Washington and Main, and the bridge at Monroe Street and Spring Street. It is envisioned that Walk-Saga can be replaced in two phases, two tracks at a time, without a need for temporary runarounds. To facilitate this concept, a universal interlocking would be constructed east of the Sagatuck River at MP 45. All interlocking work at both Walk and Saga would lead to permanent improvements for use by NHL trains and Amtrak following project completion.

Project Location - Walk Bridge (MP 41.51) over the Norwalk River; Saga Bridge (MP 44.32) over the Sagatuck River.

Design and Construction Schedules - Design and construction of these two bridges should be done concurrently. Design could begin in 2000. After a 3-year pre-construction period, 7 years would be required to complete the replacement. If subsequent train operations analyses show that a new universal interlocking should be constructed east of Saga, it would be installed and operational before beginning the bridge replacements.

Construction Impact on Operations - Renewal of two tracks at a time will require close coordination of train operations over the remaining two tracks, particularly after high-speed operations have been initiated. Delays to all services can be expected for extended periods of time. The universal interlocking east of Saga would assist in maintaining intercity and commuter service levels during construction.

Anticipated Benefits - Replacement of the bridge will provide structural integrity, and mechanical/electrical reliability and restore it to a state of good repair.

PECK BRIDGE REPLACEMENT

Needs Assessment - The 87-year old Peck Bridge and Bridgeport Viaduct structure has experienced substantial steel corrosion throughout its entire 2,500-foot length. In addition, inherent deficiencies in the bridge foundation have resulted in movement requiring a major pier stabilization project to maintain safe use. The drawbridge is inoperable, and deterioration continues. CDOT pays demurrage to upstream users of the Pequonnock River to compensate for restricted river access.

Project Description - A recent CDOT study concluded that a new structure is required. The lowest cost solution was identified as replacement of the bridge on the current alignment, with improvements to horizontal curvature.

Replacement of the existing rolling lift structure with a trunnion bridge and new viaduct structure that will maintain the current alignment, and four-track configuration, while permitting higher marine and highway clearances, has begun. Temporary detour trackage is being constructed to maintain rail operations during the construction; speeds will be limited to 15 miles per hour during the 3 years of its operation.

Project Location - The bridge is located immediately east of the Bridgeport, Connecticut station (MP 55-MP 56).

Design and Construction Schedules - Design is complete and construction has begun. The project is expected to continue through 1999.

Construction Impact on Operations - A temporary track around the bridge location will be required for up to 3 years, imposing a speed limit of 15 miles per hour on all trains and reducing the current track configuration from four tracks to two. Significant delays are expected.

Anticipated Benefits - Replacement of the bridge will provide structural integrity, mechanical/electrical reliability and by eliminating foundation deficiencies restore it to a state of good repair and eliminate the payment of demurrage by CDOT to marine shippers.

NIANTIC BRIDGE REPLACEMENT

Needs Assessment - Age, traffic, the harsh salt-water environment, and maintenance deferrals over many years have resulted in a steady deterioration of the structure. The bridge was rehabilitated as part of the initial NECIP and repairs have been made from time to time to keep the bridge functioning. However, major rehabilitation or replacement is required to restore the proper structural integrity, mechanical and electrical reliability, and to provide a satisfactory ride quality at the desired speed.

Project Description - Replace the Niantic River Bridge with a new structure on a new alignment that would bypass the existing structure.

Project Location - Niantic River (MP 116.74).

Design and Construction Schedules - An initial analysis suggests that replacement would take approximately 3 years and that a pre-construction period of 2 years, to include obtaining the necessary permits, should be expected. Commencement of design in 2003 would result in completion of construction by 2008.

Construction Impact on Operations - Impact of construction on a new alignment should be minimal.

Anticipated Benefits - Replacement of the bridge will provide structural integrity, and mechanical/electrical reliability and restore it to a state of good repair.

GROTON BRIDGE REPLACEMENT

Needs Assessment - Age, traffic, the harsh salt-water environment, and maintenance deferrals over many years have resulted in steady deterioration of the structure. Repairs have been made from time to time to keep the bridge functioning. However, major rehabilitation or replacement of the moveable span is required to restore the proper structural integrity, mechanical and electrical reliability, and to provide a satisfactory ride quality at the desired speed.

Project Description - Emergency repairs to the trunnion pin have recently been performed. Replacement of the moveable bascule span with a new structure on the existing alignment is required.

Project Location - Groton (MP 124.09) over the Thames River.

Design and Construction Schedules - An initial analysis suggests that replacement would take approximately 3 years and that a pre-construction period would take 2 years, including obtaining the necessary permits. Commencement of design in 2005 would result in completion of construction by 2010.

Construction Impact on Operations - Replacement of the moveable span could require a service shutdown of several weeks. During this time diesel operation utilizing the inland route would be required.

Anticipated Benefits - Replacement of the moveable span will provide structural integrity, and mechanical/electrical reliability and return it to a state of good repair.

CONVERT OPEN DECK BRIDGES

Needs Assessment - Age and deferred maintenance have caused deterioration of undergrade fixed bridges. As a matter of basic infrastructure renewal, repairs, or replacement are required at many locations to restore proper operation and extend the useful life of these fixed bridge structures. In addition, conversion of the open deck bridges to ballasted deck will improve ride comfort, facilitate attainment of higher superelevation and/or higher speed, and have lower maintenance cost.

Project Description - On the NHL, conversion to ballast decks will involve more than just bridge and track work, since many of the existing open deck bridges are adjacent to passenger stations and are in electrified territory. Conversion involves raising the track top of rail up to 18 inches to accommodate ballast, deck, and through structures. In electrified territory, adjustments may have to be made to wire height. If track rise is close to a station, platform heights may also have to be adjusted.

Recent investigations have identified 48 open deck bridges that are to be converted to ballasted deck structures in Connecticut and New York (44 and 4 respectively). Many of these bridges are more than 90 years old and will need continued repairs and/or replacement. An additional 21 open deck bridges will be converted as part of curve realignments on the NHL.

Amtrak has identified 77 open deck bridges that it plans to convert to ballast deck bridges, 60 of them before the year 2000.

On the Wepawaug River Bridge (MP 63.55), the open deck steel truss will be replaced with three steel arched girder and ballast deck structures. The substructure will accommodate the reinstallation of a fourth track between Devon and New Haven.

CDOT planning calls for the funding of annual bridge replacement and rehabilitation programs. The work is coordinated with MNCR.

Project Location - Work over entire New York City-Boston route.

Design and Construction Schedules - Design for Wepawaug River bridge (NHL MP 63.55) is nearly complete. Construction is scheduled to be complete in December 1995. A program to replace the remaining bridges, once they have been identified, will be coordinated with other planned improvements. Recommended conversions of New Haven Line bridges would be completed by 2010. Undergrade bridges that should be shifted or rebuilt to implement curve realignments should be staged to simplify the realignment process.

Amtrak has listed the bridges it proposes to convert each year and developed a preliminary schedule for each year. The presently funded 60 open deck bridges will be replaced by the fall of 1999. The remaining bridges (17 identified to date) would be completed at the rate of 5 per year.

Construction Impact on Operations - Construction activity will be coordinated with other projects, and track outages of varying durations will be likely. It is probable that slower train transit times will result during construction activity.

Anticipated Benefits - Renewal, replacement, or repair of the bridges will extend the useful life of the structures, while conversion to ballasted deck bridges will improve ride comfort and permit higher operating speeds. Replacement of numerous bridges located on curves on a revised alignment will support attainment of trip time goals by enabling speeds to be increased.

REPLACE DETERIORATED BRIDGES AND CULVERTS

Needs Assessment - Age and past deferred maintenance have caused deterioration of undergrade bridges and culverts. Many of these are more than 90 years old and will need continued attention. Replacement is required at many locations to restore their proper functionality. Speed and ride comfort have been compromised on many of the open deck structures.

Project Description - Twenty-five bridge superstructures (3 in New York State and 22 in Connecticut) needing immediate attention will be replaced. Substructures will be rehabilitated as required.

Project Location - Between New Rochelle and New Haven.

Design and Construction Schedules - A program to replace the bridges that subsequently are identified should be coordinated with other planned improvements and be completed by 2010 for the New Haven Line. Detailed schedules have not been developed, but current forecasts call for replacement of approximately three structures per year.

Construction Impact on Operations - Track outages will be necessary to replace the bridges; they should be coordinated with other planned improvements. Taking two tracks out-of-service for extended periods of time would have major impacts on all train services. A replacement methodology that only requires one track at a time to be out-of-service should be evaluated and implemented if it proves feasible.

Anticipated Benefits - Replacement of the bridges and culverts will eliminate the effects of deferred maintenance and return them to a state of good repair.

REPLACE/UPGRADE OVERHEAD BRIDGES IN RHODE ISLAND

Needs Assessment - A number of highway bridges over the NEC tracks need replacement, rehabilitation and/or upgrading. Further, their current profiles provide inadequate clearances for electrification and movement of over dimensional shipments.

Project Description - Replace or upgrade 18 bridges over the NEC main line in the State of Rhode Island. The bridges should provide clearances required by Amtrak. The P&W's plan to run tri-level auto racks and/or double stack containers to Davisville would require significantly greater clearances at many locations and may, if implemented, will require re-evaluation of the design programs.

Project Location - Between West Street in Westerly (MP 141.67) and Cole Street in Pawtucket (MP 190.65).

Design and Construction Schedules - The 18 bridge replacements/upgrades are in varying stages of design. Funding has yet to be obtained. Nine of the bridges would have to be completed to provide clearances required for the start of electrified operation. The remainder would be completed by 2010.

Construction Impact on Operations - Track outages of short duration may be required during construction.

Anticipated Benefits - The project will restore the bridges to a state of good repair, and in numerous cases provide the improved clearances required by Amtrak's electrification program.

Electrification

HELLGATE LINE HANGING BEAM REMOVAL

Needs Assessment - During conversion to 60Hz, the Hellgate catenary wires were replaced, but the steel supporting structures and steel cables were not rehabilitated. Presently the new wires are supported by hanging beams that, in turn, are supported by steel carrying cables. Steel bridle cable is also used for pull-off. All these cables and beams are more than 70 years old and overdue for replacement. Maintenance costs are rising sharply and operating reliability is declining.

Project Description - Amtrak has proposed a project that would include removal of hanging beams, carrying cables, bridle cables, and out-of-service catenary and feeder wires. Catenary would be supported from existing structures that currently support the hanging beams through the steel carrying cables. Design will investigate options to attach the messenger to the existing catenary structures. Rehabilitation of existing catenary structures, guy anchors, guy assemblies, and foundations also is recommended by Amtrak.

Project Location - Between Gate (MP E5) and New Rochelle Interlocking (MP E19).

Design and Construction Schedules - These improvements have initially been identified as required after 2000. Design, including analysis of alternatives, should be completed to enable construction to begin in mid-2004 and be completed in 2½ years.

Construction Impact on Operations - Work will need to be coordinated with bridge work on the Hellgate Line and with work at Shell and Harold. Due to the impact of single track operation on high-speed intercity operations between Gate and Pelham Bay, and then Pelham Bay and Shell, it would be advantageous if work could be scheduled to be accomplished off-peak, at night. However, initial analyses suggest that this approach may increase the construction duration. The full impact on operations will not be known until detailed analyses of the construction requirements and techniques are performed.

Anticipated Benefits - Replacement of the hanging beams will reduce maintenance costs and improve operating reliability on the Hellgate Line.

NEW HAVEN LINE SUBSTATION REPLACEMENT

Needs Assessment - Electrical substations in Connecticut and New York are currently located on anchor bridges above the tracks. Circuit breakers are 75 to 80 years old, and in need of replacement. Replacement parts are difficult to obtain. At some locations loads on the breakers have reached the upper limit of the established rating. Further, short circuit fault clearing times need to be significantly improved. The adequacy of an upgraded power system to accommodate the proposed 2010 service levels was recently evaluated. The results of the preliminary simulations and analyses indicated that, in general, the existing utility supply substations, and the existing autotransformer substations appear to be adequate, based on 2-hour ratings. However, the existing autotransformer feeder system will require strengthening to accommodate the proposed train services under maintenance outage conditions (two feeders, on one side of the right-of-way being out of service). Further detailed study should be undertaken to investigate the impacts on the power supply system. Further details of the preliminary study are contained in Appendix K.

Project Description - Replace all remaining oil-filled circuit breakers at NHL's anchor bridge substations with a state-of-the-art ground mounted system. The replacement breakers would be specified as the indoor draw-out-type and would be enclosed in a prepackaged modular enclosure. It is anticipated that the breakers would be of the same voltage and current rating as the vacuum circuit breakers already in service at the Portchester and Sasco Creek substations.

Project Location - New Rochelle (MP 16.3) to New Haven (MP 72.5)

Design and Construction Schedules - Design for Cos Cob, Stamford, and Darien was 60 percent complete in April 1993. It is expected to take 6 years to complete work at all 13 locations, and that four substations (the final five would be done at the same time) could be progressed simultaneously and would take 2 years for each quartet. If construction were to begin in mid-1994, the project could be completed by mid-2000.

Construction Impact on Operations - Minimal impact on normal operations is expected.

Anticipated Benefits - Replacement of the substations (mounted on catenary bridges) will eliminate identified deficiencies, reduce maintenance costs, and, if properly sized, provide adequate power to meet 2010 operating requirements.

NEW HAVEN LINE CATENARY REPLACEMENT

Needs Assessment - The catenary between New Haven and the Connecticut-New York state line is 75 to 80 years in age and overdue for replacement. Maintenance costs are rising sharply and reliability is becoming questionable. Speeds are reduced by timetable special instruction at certain curves in particularly cold or hot weather. Catenary replacement on the New York portions of the New Haven Line is underway. At present, CDOT will be able to fund replacement very gradually based on current budgets. The ability of the existing catenary to accommodate the proposed 2010 service levels was recently evaluated. It was concluded that the existing catenaries are marginal in their ability to accommodate the proposed service levels. Further, it was recommended that further evaluation of the wires' thermal capacities to accommodate the expanded services and the anticipated higher powered Amtrak locomotives be undertaken.

Project Description - The project includes the replacement of the catenary and designing the system for the maximum speed that geometry and other constraints allow. The final configuration of the system should be established during final design.

Project Location - New Haven to Connecticut/New York line (MP 26.1-MP 72.8).

Design and Construction Schedules - CDOT planning calls for an annual replacement program that would be completed by 2010. A conceptual schedule for replacement as part of a sequential contractual effort, similar to the one presently being completed by the MTA, has been defined. It assumes that 7 to 8 route miles (30 track miles) per year could be renewed and scheduled in conjunction with other planned construction activities. Therefore, if design proceeds to completion so that construction could begin in spring 1995, the program could be completed by spring 2001. The triangular catenary between the state line and Stamford should be replaced before the initiation of 3-hour high-speed intercity service.

Construction Impact on Operations - The logistics of catenary replacement on an operating four-track railroad are always difficult. An additional complication is that approximately 70 percent of the Connecticut portion of the New Haven Line currently uses a "floating beam" suspension. Replacement is likely to require careful staging of multi-track outages and the development of replacement techniques that would enable work to be accomplished during the day. An extensive beam replacement has not been previously undertaken. This effort will require detailed staging during construction to minimize operational impacts.

Anticipated Benefits - Replacement of the catenary will reduce maintenance costs and improve operating reliability on the NHL.

Car Equipment

COMMUTER EQUIPMENT TESTING

Needs Assessment - To date, no testing has been done on the impact of increased operating speeds on the fleet of cars currently in use by NHL, SLE, and MBTA. The equipment should be tested for adequacy of braking systems and stability of equipment in the push mode. It also needs to be determined whether customers will be subjected to a lesser quality ride on curves that allow Amtrak to increase its speed.

Project Description - Ride quality tests would be conducted on NHL, SLE, and MBTA equipment to determine compatibility with higher unbalanced superelevation and high-speed curves.

Project Location - New Rochelle (MP E16.3 to New Haven (MP 72.8); New Haven (MP 72.8) to New London (MP 123); and Providence (MP 185.1) to Boston (MP 229).

Design and Construction Schedules - The test program(s) should be completed by mid-1996. These tests will determine the modifications necessary for each agency's train equipment to enable them to operate at increased speeds and levels of unbalanced superelevation. Depending on the results of the tests, estimates and schedules will be developed at a later date. The program(s) would need to be completed, and any modifications to correct problems identified by the program(s) implemented, before increasing the present maximum operating speed of existing commuter rail equipment.

Construction Impact on Operations - Tests would be done at off-peak times to avoid conflicts.

Anticipated Benefits - The study will determine the compatibility of NHL, SLE, and MBTA commuter equipment with operation at higher-speeds, and higher levels of unbalanced superelevation on curves. If determined to be feasible, programs to modify equipment to increase maximum operating speeds will be defined. Operation of commuter trains, safely and comfortably, at high speeds will facilitate the integration of high-speed trains and commuter trains.

Fencing

FENCE SELECTED SENSITIVE AREAS

Needs Assessment - At a number of locations along the North East Corridor, trespasser access to the tracks and other facilities poses serious threats to safety and security.

Project Description - Determine and catalogue locations to be protected, and erect appropriate fencing.

Project Location - Between New York City (MP 0) and Boston (MP 229).

Design and Construction Schedules - Although the requirements have not yet been identified, previous experience suggests that the work can be designed with construction beginning in 1997. Completion would be by the beginning of 1999, before the start of 3-hour high-speed intercity service.

Construction Impact on Operations - The installation of fencing should not have an impact on normal operations.

Anticipated Benefits - Security and safety of the right-of-way adjacent to residential and park areas will be enhanced by the installation of fencing.

Safety Enhancements

PENN STATION FIRE, LIFE SAFETY IMPROVEMENTS

Needs Assessment - The four East River Tunnels, built in 1906, and the Pennsylvania Station, do not comply with numerous current regulations and safety standards applicable in New York City, or provisions of the National Fire Codes. An operational Emergency Response Plan has been developed highlighting the need for substantial infrastructure modifications.

Project Description

Tunnels - Installation of improved emergency signage, walkways, and lighting is underway. Additional needs include construction of improved ventilation, electrical power systems, and other safety enhancements dictated by the Code and recommended in the report "Application of the Emergency Response Plan Study" (Schirmer Engineering Corp., 1990).

Penn Station - Improvements--particularly those affecting overall capacity and commuter service--are being addressed under an MTA study effort. There are also substantial required safety enhancements.

Project Location - Penn Station and East River Tunnels (MP 0-MP E2).

Design and Construction Schedules - Design should be completed to enable construction to begin in early 1996 and be completed by the beginning of 2007.

Construction Impact on Operations - Work in the East River Tunnels will be scheduled at night and weekends and work in the station should have minimal impact on normal railroad operations.

Anticipated Benefits - The program will eliminate known deficiencies in the station and adjacent East River Tunnels and ensure compliance with current applicable regulations, safety standards, and codes.

STEP AND TOUCH TRACTION RETURN MITIGATION

Needs Assessment - Unless properly grounded, there are potential voltage differences between passenger stations, maintenance facilities, railroad equipment, and structures. This creates a possibility of electric shock to passengers and employees.

Project Description - To eliminate the possibility of electric shock at stations between the New York/Connecticut state line and New Haven on the NHL, the following modifications are presently underway: install new and relocate existing impedance bonds; install new, larger side leads and larger main rail return cables for traction power; ground/splice all aerial cable; ground all structures, catenary equipment and station platforms; and install a positive ground from the static wire to the earth ground. Additional study will be required to determine whether the rail return bonding system must be upgraded to accommodate the larger loads that will be generated by the increased levels of commuter rail service, and the increased speed and frequency of intercity service.

Project Location - State line to New Haven (MP 26.1 to MP 72.8).

Design and Construction Schedules - Recommended improvements have been identified and construction is proceeding; station locations are being done first. CDOT assumes that construction will be completed by the end of 1994.

Construction Impact on Operations - Any impact on normal operations is expected to be minimal.

Anticipated Benefits - The potentially unsafe condition resulting from the electric shock hazard on the NHL will be mitigated by implementation of this program.

OTHER

Route Realignments

RECONFIGURE KINGSTON STATION

Needs Assessment - A siding (Track 3) is needed for future RIDOT commuter service west of Providence to enable RIDOT trains to turn on a track other than the main, thereby reducing conflicts with Amtrak intercity operations. The need for a siding west of the station to accommodate P&W freight operations was previously discussed in the *Construct New London to Providence Passing Sidings* project.

Project Description - Construct a side track off the main line to accommodate RIDOT commuter trains, and P&W freight operations. The siding also should accommodate the new high level platform that will be constructed adjacent to Track 1 (which, in combination with the Track 2 platform, will enhance safety).

Project Location - Town of South Kingston (MP 158.1).

Design and Construction Schedules - Ongoing design should accommodate the proposed commuter rail siding track. The schedule is based on initiating Kingston to Providence Commuter rail service by the beginning of 1999 and completing construction of the siding before that date.

Construction Impact on Operations - Impact on normal operations should be minimal. Outages to install the turnout will be required.

Anticipated Benefits - The siding will by accommodating the proposed commuter rail operation and providing a siding to be used by P&W local freight operations increase operating capacity through the station.

CONSTRUCT DIRECT CONNECTION TO MIDDLEBORO SECONDARY

Needs Assessment - Location of electric cogeneration plants in southeastern Massachusetts would require freight service by 100 car unit coal trains. Frequency is estimated at two to four trains per week. Plant construction may also require high/wide dimensional inbound shipments.

Project Description - Create a direct progressive move to satisfy Conrail's operating needs. Three alternatives have been evaluated: building a connecting track in the northeast quadrant between NEC Track 4 and the Middleboro Secondary; a loop track in the vicinity of the East Junction Secondary; and a 1-mile siding on the East Junction industrial track. The third alternative, intended to enable locomotives to be cut-off and run-around the coal train to provide direct access to the Middleboro Secondary, has the lowest cost and least impact on the surrounding area.

Project Location - Attleboro (MP 197).

Design and Construction Schedules - Design and construction dates are dependent upon when Conrail plans to initiate the planned unit coal train operation. It is expected that the siding would be completed by the middle of 1998.

Construction Impact on Operations - Since construction is likely to be on the East Junction Industrial Track, there should be no impact on normal operations.

Anticipated Benefits - The project will improve Conrail freight operations and minimize the time that the unit coal trains occupy track 4 between Hebronville and Thatcher.

Track Structures

MAINTENANCE AND OPERATING COSTS ALLOCATION STUDY

Needs Assessment - Maintenance standards for high-speed vehicles require frequent inspections to ensure the safety and the integrity of the system. Increased operating speeds for intercity and commuter trains, the operation of trains at levels of unbalanced superelevation in excess of 3 inches, the initiation of electrified operations between New Haven and Boston, the introduction of a new generation of Amtrak high-speed intercity trainsets, and the projected increased commuter rail and intercity traffic densities will require a far more reliable physical plant and rolling stock fleet than is available today. Achieving and maintaining the necessary levels of ride comfort, reliability and availability will require increased levels of maintenance and the initiation of improved maintenance practices. Proactive steps must be taken to improve current maintenance practices in an effort to reduce on-line delay and improve equipment reliability.

Once maintenance requirements and practices are established, the cost of maintenance programs has to be determined. A final step in the analysis process is the allocation of costs between the multiple users (commuter, intercity, and freight) of a segment of the railroad. Numerous methodologies have been proposed to accomplish this, however, there as been little agreement between owner/operators and users as to the appropriate methodology to be used in a situation that intermixes high-speed, freight, and commuter rail operations.

Visual inspections may not be sufficient to detect defects in many components. Periodic inspection by fixed test facilities and automated geometry test vehicles may have to be supplanted by on-board monitoring equipment, or fixed monitoring devices, to monitor operation/integrity of active track components, such as turnouts.

Further, inspection and maintenance cycles also are related to safety. Derailments and collisions at speeds over 125 miles per hour result in greater loss of life and injury to passengers and employees, and damage to equipment and property than accidents at slower speeds.

Project Description - The exact level of maintenance, the specific maintenance practices, and the cost associated with them have not been defined. Existing maintenance practices must be evaluated in light of the projected changes over the next two decades and preventative maintenance programs initiated. Cycles for proper inspection and maintenance of rolling stock, control systems, and facilities such as track and stations must be determined. Furthermore, the study should distinguish between cycles for inspection and maintenance and the additional requirements necessary to ensure comfort and/or high-quality service.

Methodologies for the allocation of operating and maintenance costs between owners and users will have to be evaluated and recommendations made as to the methodology to be used to allocate these costs.

Foreign inspection and maintenance standards should be evaluated for the appropriateness of their transfer to the United States. The study team will have to work closely with Amtrak and the commuter rail and freight operators to ensure that present practices are adequately identified and that future needs are properly evaluated.

Project Location - New York City, NY (E0) to Boston, MA (MP 229).

Design and Construction Schedules - The project should be initiated within the next fiscal year and be progressed jointly with all corridor operators.

Construction Impact on Operations - Short-term there will be no impact on operations. Long term implementation of the studies recommendations should result in increased reliability of operations and maximization of the efficiency of the maintenance and capital construction programs of the various operators.

Anticipated Benefits - By identifying the level of maintenance required to support higher speed operations, recommending specific maintenance practices, calculating the costs associated with the practices, and suggesting a methodology to allocate the costs the study will provide data that will enable NEC owners and operators to upgrade the quality of current maintenance practices and thereby improve the reliability and overall comfort of rail service.

Electrification

P&W FREIGHT CLEARANCE IMPROVEMENTS

Needs Assessment - Clearances presently proposed to be provided by Amtrak will not allow the movement of high cube double stack container cars, or auto racks, to and from the Port of Davisville.

Project Description - Increase clearances on the non-electrified third track between Boston Switch and MP 179 (Cranston) to 20'7" from top of rail to bottom of structure. Increase Amtrak corridor clearances between MP 179 and Davisville to 22'6" from top of rail to bottom of structure. Facilitate freight operating speeds to a minimum of 50 miles per hour, where track geometry permits. In Providence, evaluate connecting the commuter tracks (3 and 5) from their present connection on Track 7 to Track 1 to allow for freight-only track turnouts or crossovers with clearance.

Project Location - NEC (MP 167 and MP 190).

Design and Construction Schedules - A study is underway to coordinate this project with the Rhode Island highway bridge project and Amtrak's clearance improvement requirements. Coordination with other clearance improvements would minimize having to perform work twice at the same location. It is envisioned that design would be progressed to enable construction to begin in mid-1996. It is conservatively estimated that construction could be completed by the beginning of 2001.

Construction Impact on Operations - The proposed project would relate directly to Amtrak's schedule and track outages with minimal impact on normal operations, except for locations requiring undercutting of main tracks. If more than one undercutting pass is required at a location, slow orders may be required for limited periods of time.

Anticipated Benefits - The improvements will upgrade the freight route clearance envelope between Boston Switch and Davisville to enable high cube double stack container cars, or auto racks, to use the route. Between Boston Switch and Cranston the improvements enhance the route provided by the provided by the "Third Track for P&W Freight Service" project.

Signaling and Train Control

NEW HAVEN LINE GO/NO-GO SIGNAL IMPROVEMENTS

Needs Assessment - The present colored light signal system has a variety of aspects, resulting in confusion regarding operating rules and procedures.

Project Description - To simplify operating signal rules and reduce confusion, the current colored light H-5 signals will be configured to a Go/No-Go system. Any unused signals (e.g., approach signals) will be covered and abandoned in place. At a later date, these covered signals will be removed. For a discussion of the impact of proposed increased operating speeds on the NHL signal system see the "Realign Curves" project.

Project Location - State Line to New Haven Interlocking (MP 26.1 to MP 72.8).

Design and Construction Schedules - Design has been completed; construction is expected to be completed by the end of 1994.

Construction Impact on Operations - Impact on normal operations will be minimal.

Anticipated Benefits - The project will result in a simplification of operating signal rules on the NHL, thereby contributing to improved operating efficiency.

Communications

INSTALL NEW HAVEN LINE FIBER OPTICS SYSTEM

Needs Assessment - The existing communications system is a combination of unreliable hard wire railroad communication line and leased telephone lines. The latter, costing in excess of $1.5 million a year, are not considered priority lines by the telephone company and therefore do not receive priority service when problems arise. Interference and noise on the railroad hard wire lines make the system difficult to use.

Project Description - Install a multi-fiber optic cable system within the right-of-way to provide railroad-only communications. By including line drops to hard wire hookups, the system will support the CTC/RRS system, the SCADA system, remote energy meters, public address systems, security systems, telephone lines and computer lines. The requirements imposed by 2010 service levels and equipment should be addressed during final design.

Project Location - State Line to New Haven (MP 26.1 to MP 72.8).

Design and Construction Schedules - CDOT proposes to fund the installation of the fiber optics network in 1995. Therefore design is anticipated to be initiated in 1995 and construction completed by the fall of 1998. For the preliminary duration the cable would be strung on the catenary poles, and drops and connections would be made to wayside facilities.

Construction Impact on Operations - The stringing of the cable will require minimal track time and should have an insignificant impact on normal operations. The work could be easily staged with other planned work.

Anticipated Benefits - The project will reduce operating costs and improve the quality of railroad communications on the NHL.

INSTALL PUBLIC ADDRESS SYSTEMS

Needs Assessment - SLE and MBTA stations lack necessary communication to notify waiting passengers if a train should change tracks and arrive at a different platform. Further, MBTA commuter trains are presently scheduled to operate on specific tracks only.

Project Description - Install public address system at all stations to allow more flexibility in train dispatching.

Project Location - Between New Haven (MP 72.8) and Boston (MP 229).

Design and Construction Schedules - It has been initially proposed that the public address system should be implemented before the initiation of electrified operations. To accomplish this, design would be initiated in 1994 and construction completed by the beginning of 1997.

Construction Impact on Operations - There should be no impact on normal operations.

Anticipated Benefits - The systems will improve the quality of information provided to passengers at MBTA and SLE stations and will contribute to an improvement in the flexibility available to train dispatchers to alter train routes.

Stations

CONSTRUCT PEDESTRIAN BRIDGES

Needs Assessment - There are stations along the NEC where passengers are able to cross the tracks at grade. This poses an obvious safety hazard.

Project Description - Construct bridges to provide safe cross track access for pedestrians, and provide access for the disabled.

Project Location - SLE stations between New Haven and Old Saybrook (and possibly two others if SLE service is extended to New London); stations between Kingston and Providence, if commuter service is extended west from Providence; and four MBTA stations-Attleboro, Mansfield, Sharon and Canton Junction.

Design and Construction Schedules - Schedules have yet to be firmly established. However, the bridges should be completed, concurrent with high level platforms, before initiation of high-speed service. This would prevent passengers from crossing the tracks at grade. The schedules are the same as those previously described for high level platforms.

Construction Impact on Operations - Impact on operations should be minimal.

Anticipated Benefits - The bridges will provide safe passenger access to platforms and provide access for the disabled.

SHORE LINE EAST (SLE) SOUTH SIDE STATION RELOCATIONS

Needs Assessment - Shore Line East stations are located on the north and south sides of the tracks. Depending upon where SLE trains stop, passengers may be required to cross tracks, which is an unsafe practice. This prevents Amtrak trains from passing SLE trains while the latter are at stations.

Project Description - As an interim solution in both directions, relocate Branford and Westbrook stations to the south side of the tracks. This will allow SLE to operate on one track until the 2000, eliminating the need for passengers to cross tracks and allowing Amtrak to operate through the stations at speed. When relocated, Branford will have approximately 250 parking spaces (an increase of 180) and Westbrook will have 150 spaces.

Project Location - Branford (MP 81.3) and Westbrook (MP 101.2).

Design and Construction Schedules - Design for Branford is underway, with construction scheduled for fall 1993 or spring 1994. Schedules for Westbrook are yet to be formulated. Pre-construction activities are expected to be completed by April 1994 and construction completed by January 1996.

Construction Impact on Operations - Since all work is completed next to the operating railroad, the impact on normal operations should be minimal.

Anticipated Benefits - As an interim measure the relocation of the two stations will simplify SLE round trip train operations and improve passenger safety prior to 2000.

PROVIDE IMPROVED INTERCITY AND COMMUTER PARKING

Needs Assessment - As commuter service levels are increased, and as intercity train schedule times are reduced, attracting more business, there will be need for expanded parking facilities at various stations along the NEC. The parking requirement at New Rochelle has been agreed as part of the decision to construct a center island platform to accommodate the proposed level of intercity service at this station (see *Reconfigure Shell Interlocking*).

Project Description - Provide expanding parking at the cited stations.

Joint Amtrak/Commuter Facilities:

New Rochelle	300 spaces
Stamford	garage with 800 spaces
Bridgeport	garage with more than 800 spaces
New Haven	800 spaces
Old Saybrook	200 spaces
Route 128	700 spaces

Commuter-Only Facility:

Canton Junction	700 spaces.

Project Location - Locations are listed under Project Description.

Design and Construction Schedules - Schedules have yet to be established. Design for the New Rochelle, Stamford, Bridgeport, and New Haven improvements could begin in 1998 and be completed by the beginning of 2004. Construction of the improved parking at Old Saybrook should be designed and constructed with the other improvements planned for that station (construction to be completed by the fall of 1998). Similarly, the parking improvements at Rte. 128 also should be progressed concurrently with the other planned improvements, with completion expected in the fall of 1997.

Construction Impact on Operations - Construction of the parking improvements should not affect rail operations. However, construction staging should be planned to minimize the impact on passengers using the stations.

Anticipated Benefits - Expanded parking facilities will provided needed capacity to handle projected increases in intercity and commuter passenger levels.

PROVIDE KEY STATION ADA ACCESS

Needs Assessment - The Americans with Disabilities Act was enacted to prohibit discrimination of the disabled. USDOT issued rules implementing the transportation provisions of ADA. Among other things, these rules require rail transportation providers to identify key stations and submit plans to make them fully ADA accessible.

Project Description - Implement various improvements at designated key stations: update existing signage to include Braille in conformance with ADA standards; provide access to both east- and westbound platforms by tunnel or elevator; install new pavement and striping, sidewalks and handicapped parking stalls; provide accessible routes; update station interiors with new doors; modify ticket counters; update public address and telephone systems; and modify rest rooms.

Project Location - Stamford (MP 33), Bridgeport (MP 55.5), New Haven (MP 72.8), and Old Saybrook (MP 105).

Design and Construction Schedules - In March 1993, a consultant was hired by CDOT to design the required changes at Stamford, Bridgeport, and New Haven. Design would have to be completed to enable construction to begin in mid-1995 and be completed by early 1998. Improvements at Old Saybrook should be completed by the fall of 1998.

Construction Impact on Operations - Construction of these improvements should not affect train operations.

Anticipated Benefits - The project will result in five key stations being made fully ADA accessible.

CONSTRUCT AMTRAK STATION IMPROVEMENTS

Needs Assessment - Intercity ridership at many stations is expected to more than double with the attractive trip times and increased levels of service that will be offered once electrification and other improvements are completed. In many cases, intercity stations are near to capacity with existing ridership. The rehabilitation of stations, previously to have been funded under the NECIP, has been severely curtailed due to a shortage of funds. The need for such rehabilitation has increased with the passage of time.

Project Description - Expansion and renovation of other Amtrak stations north of New York City is proposed to efficiently handle the more than doubled passenger volumes anticipated to result from the improvements made to the north end of the Corridor. Improvements initially evaluated by Amtrak include: improved/additional ticketing facilities; expansion of station facilities and construction of additional seating; renovation of existing facilities; improved signage/graphics; and improvements to commissary facilities.

Project Location - Intercity passenger stations located between New York City and Boston.

Design and Construction Schedules - Because the improvements have yet to be fully defined, schedules have not yet been established.

Construction Impact on Operations - Impact is expected to be minimal

Anticipated Benefits - The planned improvements will enable stations to efficiently handle the increased levels of passenger service.

Service Facilities

CONSTRUCT DAVISVILLE LAYOVER FACILITY

Needs Assessment - When commuter service is extended west from Providence to Kingston, a facility will be needed to prevent costly and time-consuming deadheading of empty trains.

Project Description - Design and construction of a three- or four-track layover yard to store two to three trainsets.

Project Location - Quonset Point/Davisville Industrial Track yard area, Town of North Kingston (MP 168).

Design and Construction Schedules - Schedules will depend upon extension of commuter rail service west of Providence to Kingston. Construction would be completed before the initiation of commuter rail service in 1999.

Construction Impact on Operations - Impact on operations will be minimal.

Anticipated Benefits - The commuter rail yard will reduce congestion and operating costs, and increase capacity by eliminating the deadheading of trains to Providence.

CONSTRUCT READVILLE LAYOVER FACILITY

Needs Assessment - Presently MBTA commuter trains are stored mid-day at a variety of yards in the Boston area. Expanding commuter service will require a new layover yard for storage of 15 trainsets.

Project Description - Construct a 10 track layover facility at the Readville Five Yard site purchased from Amtrak. (Ideally the facility should be located at Readville One Yard to eliminate deadheading MBTA trains on the NEC main line, but the acquisition and development of that site will be a lengthy and complicated process.)

Project Location - Readville (MP 219).

Design and Construction Schedules - Design for Five Yard modifications is nearly complete. MBTA plans to construct the facility within a "few years," therefore the schedule anticipates that the facility will take 14 months to construct and be completed by the beginning of 1998.

Construction Impact on Operations - Track outages of short duration may be required for installation of turnouts.

Anticipated Benefits - The commuter rail yard will provide additional capacity to satisfy the storage requirements of expanded MBTA service.

CONSTRUCT NHL AND SLE NEW HAVEN CAR STORAGE YARD/NEW HAVEN YARD MODIFICATIONS

Needs Assessment - New Haven is the eastern terminus of NHL commuter service and the western terminus of CDOT's SLE service. Due to limited storage capacity at New Haven Yard, both NHL and SLE trains must be stored overnight at station platforms, causing congestion and limiting platform use for revenue service.

Project Description - Construct storage tracks for approximately 100 cars, including water supply and toilet servicing manifolds. Reconfigure yard layout to improve efficiency of current operations. The cost of recovering an 800,000 gallons of free phase diesel oil in the old (pre-NECIP) fueling facility using multiple well methods has been included in this project. This is one of several projects ("Reconfigure New Haven Terminal Area," "Construct Amtrak New Haven Service Facility," and "Construct CDOT New Haven Shop") that will be constructed in the New Haven Terminal Area.

Project Location - New Haven Yard (MP 71.8 to MP 72.8).

Design and Construction Schedules - Final design is scheduled for completion in autumn 1994. Construction advertisement is planned for January 1995. Construction is expected to be completed by the beginning of 1997. The work will need to be coordinated with other New Haven improvements.

Construction Impact on Operations - The project would require coordination with operations and other construction activities. Some track outages of short duration may occur during track and signal system cutovers.

Anticipated Benefits - The yard improvements will provide the capacity to meet planned NHL, Hartford, Waterbury, and SLE service storage requirements at New Haven. Project is an integral part of a coordinated set of projects required to upgrade the New Haven Terminal Area.

CONSTRUCT PROVIDENCE LAYOVER FACILITY

Needs Assessment - Trains used in Boston-Providence commuter service lay over at MBTA's East Junction Yard, causing time-consuming and costly deadheading to and from Providence.

Project Description - Construction of a six track layover yard to serve Providence MBTA trainsets and RIDOT daytime storage. The tracks would be electrified to accommodate the projected acquisition of electric locomotives to operate the Boston-Providence commuter service.

Project Location - Providence/Pawtucket city line (MP 187-MP 188).

Design and Construction Schedule - Design and construction could be completed in 28 months and that construction will be completed by the fall of 1998.

Construction Impact on Operations - Most of the work will be accomplished adjacent to the main operating tracks. The impact should be minimal.

Anticipated Benefits - The commuter rail yard will reduce congestion and operating costs, and increase capacity by eliminating the deadheading of trains to East Junction from Providence.

CONSTRUCT CDOT NEW HAVEN SHOP

Needs Assessment - CDOT does not have a rail car maintenance facility in New Haven that is adequate for the proper maintenance of SLE rolling stock. The existing facility is outdated and does not meet current building codes.

Project Description - Reconstruct the existing Car and Diesel Shop into two separate shops that will provide maintenance of the Shore Line East (SLE) fleet and overhaul of the New Haven Line (NHL) fleet. Shops will include cranes, drop tables, storage, truck washer, machine equipment, and offices to provide enhanced maintenance capabilities. This is one of several projects that will be constructed in the New Haven Terminal Area.

Project Location - New Haven (MP 72.8).

Design and Construction Schedules - Design is complete and construction is scheduled to be completed in the fall of 1995.

Construction Impact on Operations - The proposed project would require staging of construction to support the continuation of existing operations.

Anticipated Benefits - The shop will provide a facility to perform maintenance of NHL and SLE rolling stock. Project is an integral part of a coordinated set of projects required to upgrade the New Haven Terminal Area for all users.

Initiate New Services

EXTEND SLE FROM OLD SAYBROOK TO NEW LONDON

Needs Assessment - Highway congestion continues to increase in the New Haven to New London corridor. An alternative means of commuting is required.

Project Description - Extend existing SLE commuter service eastward beyond its current terminus of Old Saybrook to New London. The existing schedule would be maintained with 25 percent additional capacity. Short, high-level platforms would be provided at each suburban station for handicapped accessibility. CDOT assumes six electric locomotives, if acquired, together with the existing fleet of coaches, would be sufficient to run the service.

Project Location - Old Saybrook (MP 105) to New London (MP 124).

Design and Construction Schedules - SLE service to New London would be initiated at the beginning of 2005. The stations at the two intermediate stops between Old Saybrook and New London should be completed before initiation of new service.

Construction Impact on Operations - None.

Anticipated Benefits - Extension of commuter rail service to New London will provide an alternative means of commuters in this increasingly congested commuter corridor.

ADD RIDOT KINGSTON TO PROVIDENCE SERVICE

Needs Assessment - Highway congestion in the Providence metropolitan area is projected to increase 75 percent by the year 2010. Further, Rhode Island is classified as a serious non-attainment area for air quality. There needs to be an alternative to highway travel for people commuting from southern Rhode Island in the I-95 corridor.

Project Description - Expansion of Boston to Providence service west of Providence to Kingston. Project includes the construction of stations and other necessary right-of-way improvements.

Project Location - Kingston to Providence (MP 158.1 to MP 185.1).

Design and Construction Schedules - Planning, including station locations and operational options, is underway. Before initiation of new service in 1999, the following conditions should be met: construction of two intermediate stations between Kingston and Providence; construction of layover tracks for the equipment (presently expected to be at Davisville) should be complete; and equipment to operate the service should be procured.

Construction Impact on Operations - Short-term impacts may occur due to construction of right-of-way improvements and track and interlocking modifications.

Anticipated Benefits - Extension of commuter rail service to Kingston will provide an alternative means of commuters in this increasingly congested I-95 corridor, and contribute to improved air quality levels.

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New York City to Boston
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Appendix D
OWNERSHIP AND OPERATING RIGHTS

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OWNERSHIP AND OPERATING RIGHTS

INTRODUCTION

The following summary is for information purposes only. It is not intended to establish the legal effects of the various agreements or the rights of the parties thereto. The summaries of the agreements do not necessarily include all of the points covered by the agreements.

SUMMARY OF OWNERSHIP AND OPERATING RIGHTS

Ownership

The portion of the Northeast Corridor between New York City and Boston is divided by ownership into a number of segments, of which Amtrak owns and operates two:

- Penn Station to Shell.
- New Haven to the Rhode Island/Massachusetts State line.

The Segment between Shell and New Haven is operated by the Metro-North Commuter Railroad, a subsidiary of the Metropolitan Transportation Authority (MTA). MTA is the owner of the New York State portion. The Connecticut Department of Transportation (CDOT) owns the Connecticut portion.

The Massachusetts Bay Transportation Authority (MBTA) owns the rail line within Massachusetts and contracts with Amtrak to operate it.

Operating Rights

New Jersey Transit has operating rights between Penn Station and Sunnyside Yard. The Long Island Rail Road has rights between Penn Station and Harold, just east of the Sunnyside Yard.

Amtrak operates its trains over Metro-North and MBTA under trackage rights agreements. Amtrak operates commuter rail trains between Providence and Boston as a "Contract Service" for MBTA and RIDOT.

The Shore Line East Commuter Rail Service, another Contract Service, is operated by Amtrak for CDOT.

Conrail has rights to operate over Amtrak portions of the Corridor under the 1986 amendment agreement, which implements the Freight Service Agreement of April 1, 1976. This includes most of the territory not given over to other freight operators and/or owned by New York/

Connecticut and Massachusetts. The territory includes the Hellgate Line between Webster Avenue ("Shell") and Sunnyside Junction, which Conrail uses to interchange with the LIRR at Fresh Pond Jct. on the CR/LIRR Bay Ridge Branch. In addition, Conrail leases Track 5 from "Pelham" to Oak Point (and Track 6 for a portion of the distance). Conrail Has trackage rights agreements with Metro-North and MBTA.

Providence & Worcester (P&W) operates between the Rhode Island/Massachusetts state line and Westbrook, Connecticut pursuant to several agreements with Amtrak. Conrail has attempted to assign to the P&W its freight service easement between MP 72.83 and MP 101.0. P&W has overhead rights from the state line to Attleboro.

PENN STATION TO SHELL INTERLOCKING

Ownership

Owned, maintained and operated by Amtrak since the sale of the NEC on April 1, 1976. The LIRR operates and maintains Harold Interlocking.

Operating Rights

New Jersey Transit

04-01-76 Sale of NEC to Amtrak

Conrail retained access to Penn Station and Sunnyside Yard; NJT claims to have succeeded to Conrail access rights in 1983.

12-13-82 Settlement Agreement - 900 day option properties - Granted continued access to Sunnyside Yard and required assumption of related costs.

01-01-89 NEC Services Agreement

- Amtrak is responsible for management of the NEC and train operations.
- Established performance payments.
- Term: 2 years.

10-15-92 Letter Agreement

- Extended 1-01-89 Agreement to 6-30-93.
- Modified performance payments to reflect significant improvement.

Long Island Rail Road

01-20-66 Joint Facilities Agreement (with PRR)

- Defines rights to Penn Station, trackage and tunnels.
- Shows Amtrak as successor to PRR.

08-05-88 Joint Facilities Agreement
Restatement of 1966 agreement.

- Codifies existing practices and defines "Zones of Priority."
- Amtrak controls movements, but LIRR has equal rights.
- The Joint Venture Agreement will apply upon completion of Joint Venture improvements.
- Term: 99 years, unless superseded by the Joint Venture Agreement.

08-05-88 Joint Venture Agreement

- Covers design, construction management, operation and maintenance of a CTC system controlling the territory within Hudson, Spuyten Duyvil, and Shell, plus the West Side Yard.

- All parties have equal rights in the "Joint Control Territory" between "A" and Harold, and in the management and conduct of the agreement. Terminal Superintendent's position alternates between Amtrak and LIRR every 6 months; equal numbers of Supervisors of Train Movement; an integrated force of Console Operators from Amtrak and LIRR; one Operating Representative from each for oversight.

- Term: 99 years; may be extended.

Conrail

10-1-86 Second Amended and Restated Freight Operating Agreement

- Replaces previous agreement; applies the Freight Service Easement from 4/1/76.

- Allows Conrail use of Track 5 (known as the Fremont Industrial Track) over the Hell Gate Bridge, from Oak Point Yard to Sunnyside Junction, for interchange with LIRR at Fresh Pond Junction (Queens); known to Conrail as Fremont. (Amtrak is unaware of this provision.)

- Term - As long as CR maintains its easement.

12-22-87 Lease Agreement
Conrail leases Track 5 (known as "5 Main") between Pelham and Oak Point Yard from Amtrak. Term: 20 years.

SHELL INTERLOCKING TO NEW HAVEN

Ownership

Operated and maintained by Metro-North Commuter Railroad, a public benefit corporation and subsidiary of the MTA.

- MTA owns New York State segment.
- CDOT (CTA) owns Connecticut segment.

10-27-70 The New Haven Suburban Passenger Service Agreement

- Three agreements governing purchase or lease of trackage and power transmission facilities between GCT and New Haven (MP 72.83).
- The third agreement governing GCT Joint Facilities is not discussed here.
- Referred to as "The New Haven Leases."

MTA Purchase and Lease Agreement

- Purchase of right-of-way and improvements, except power transmission system, from Woodlawn Junction (Harlem Line) through Shell to the New York/Connecticut State line near Port Chester (MP 26.1).

- Lease of power transmission system over same.

CTA Lease Agreement

- Lease by CTA for CDOT of the balance of the New Haven Line from the state line through the New Haven Station area (MP 72.83).

- Option to purchase for Appraisal Value.

06-21-85 Amended and Restated Service Agreement
Metro-North is the commuter rail operator and the service operator.

Operating Rights

Amtrak

12-30-82 Liability (Letter) Agreement

11-01-91 Agreement for Operation

- Metro-North is the service operator.

- Agrees to provide Amtrak with facilities and services.

- Dispatcher has "sole control over the operation of [Amtrak's] . . . trains".

- Provides for performance payments.

- Term: 20 years, thereafter termination by 12 months written notice.

Conrail

01-01-83 Trackage Rights Agreement (Entered 8-6-91)

- Retention of trackage rights following conveyance of commuter rail properties pursuant to NERSA (1981) - Section 1137.

- Same rights as granted to PC in The New Haven Leases.

- Term: 15 years, thereafter - one year notice to terminate.

Connecticut Rail Systems (P&W)

03-02-93 Purchase and Sale Agreement (with Conrail)

03-12-93 Grant, Assignment and Assumption Agreement (with Conrail)
Transferred non-exclusive overhead (through) freight rights from East Haven (MP 77.0) to South Norwalk (MP 41.3) in connection with the purchase of Conrail's rights on the Danbury and Waterbury Branches.

Note: Pursuant to the Amtrak/Conrail freight operating agreement, Amtrak has not agreed to that transaction.

NEW HAVEN TO RHODE ISLAND/MASSACHUSETTS STATE LINE

Ownership

Owned, maintained and operated by Amtrak since sale of NEC on April 1, 1976.

Exception to Ownership

Central Vermont

10-04-01 Segment of right-of-way at New London Station leased to NYNH&H

- CV retains ownership.
- Term: forever.

Operating Rights

Conrail

10-01-86 Second Amended and Restated Freight Operating Agreement

- Replaces previous agreement; applies the Freight Service Easement from 4-1-76.

- Term: as long as CR maintains its easement.

Note: Conrail has relinquished all rights east of East Haven (MP 77) to the Rhode Island/Massachusetts state line, and granted non-exclusive easements for through freight east to Attleboro, Massachusetts and west to South Norwalk, Connecticut.

RIDOT

04-01-76 RIDOT exercised right as a public interest to claim an operating right for commuter service in the State of Rhode Island, essentially Westerly to Boston Switch.

Providence & Worcester

P&W Groton, Connecticut Agreements

07-09-79 P&W/Amtrak

- Through and local freight operating rights from east end of Thames River Bridge (MP 124) to the east end of Midway Yard (MP 128.4).
- Agreement made in connection with P&W's planned purchase of Norwich Sec. Track and Groton Old Main Branch from Conrail.
- Contingent upon agreement with Conrail (never reached).
- Term: permanent and perpetual easement.

05-28-80 Conveyance Order

05-23-80 Agreement (Amtrak/P&W)

05-31-80 Assignment and Relinquishment of Rights (CR/P&W)

Under these three agreements, P&W received rights for through freight only between Groton and the Groton Old Main Branch.

04-13-82 Order of the Special Court
The basis for the following agreements.

05-01-82 Three Agreements (P&W/CR)
P&W is granted:

- Overhead rights from the Rhode Island/Massachusetts State line (MP 190.8) to Attleboro, Massachusetts (MP 197.5).
- The entire easement from the Rhode Island/Massachusetts State line to Westbrook, Connecticut (MP 101.2).
- Overhead rights from MP 101.2 to MP 100.9.

08-30-82 Letter Agreement (P&W/Amtrak)

- Same territory as above except Rhode Island/Massachusetts State line to Attleboro, Massachusetts not included (owned by MBTA).

- 7-9-79 P&W/Amtrak agreement amended to include the same territory.

- Provided that the 1/3/78 agreement for the Providence "Operating Area" remains in effect.

Note: MBTA grants overhead rights, Rhode Island/Massachusetts State line to Attleboro, Massachusetts, in concurrence with the above.

P&W Providence, Rhode Island Agreements

01-03-78 Agreement (Amtrak/P&W)

- Exchange of various properties in Central Falls; Pawtucket and Providence.

- Trackage between Boston Switch (P&W main line to Worcester) and DePasquale Ave (P&W Washington Sec. Track) designated the Providence "Operating Area."

- Operating Procedures defined for "Operating Area."

- No car mile charges for the first 50,000 cars or the equal of the number of Amtrak passenger cars.

06-30-88 Trackage Rights Agreement (Amtrak/P&W)

- Modified 01-03-89
- Amtrak grants P&W trackage rights agreement over the "Operating Area."
- Term - until abandonment of freight operations.

Additional P&W Rights

06-20-91 Letter to Amtrak from Conrail (not an agreement) indicates that effective 7-1-91 Conrail will transfer to P&W:

- The entire freight service easement between MP 101.0 and East Haven (MP 77.0).

- The overhead easement between East Haven and Amtrak/CDOT property line (MP 72.83).

08-09-91 Purchase and Sale Agreement (P&W/Conrail)
Conrail sells to P&W:

- Two industrial tracks near New Haven.
- The freight service easements listed above (6-20-91).

Note: Amtrak has not approved of these transactions pursuant to Amtrak/Conrail freight operating agreements.

03-02-93 Purchase and Sale Agreement (P&W/CR)

03-12-93 Grant, Assignment and Assumption Agreement (P&W/CR)
These two agreements provide for the sale of rights on several branch lines plus overhead freight trackage rights:

- East Haven (MP 77.0) to New Haven (MP 72.83).

- New Haven to South Norwalk (MP 41.3).

Note: Connecticut Rail System, Inc. is listed as purchaser and assignee. Amtrak has not approved of these transactions pursuant to Amtrak/Conrail freight operating agreements.

Springfield Terminal

12-09-88 Freight operating agreement between Springfield, MA and New Haven, CT

- Does not specify through or local freight.
- Does not define New Haven as to a location on or off the Shore Line.
- Term: 30 years.

RIDOT

Has easement and operating rights for commuter service from Rhode Island/Massachusetts state line to Rhode Island/Connecticut state line. RIDOT sponsors service between Providence and Boston through MBTA.

Contract Services

01-01-88 RIDOT - Agreement with MBTA to provide service between Providence and Attleboro as an extension of the existing MBTA service.

- Operated by Amtrak
- Term: 7 years, extension being negotiated.
- RIDOT claims operating rights for commuter services as entitled under the USRA transfer through Conrail.

11-01-89 CDOT

- Agreement with Amtrak to provide Shore Line East Commuter Rail Service.

- Term: 5 years, automatic renewal.

03-27-90 CDOT Shore Line East Agreement Amendment
No changes affecting operating rights.

RHODE ISLAND/MASSACHUSETTS STATE LINE TO BOSTON

Ownership

Owned by Massachusetts Bay Transportation Authority. Operated and maintained by Amtrak. Four agreements govern the operation of various trains in Massachusetts:

1. September 13, 1972 - MBTA agrees that Amtrak has the right to operate Amtrak trains.

2. July 1, 1984 - MBTA agrees that Amtrak is the operator of the rail line and sets compensation.

3. July 1, 1985 - MBTA grants to Conrail the "non-exclusive" right to perform freight service.

4. November 1, 1986 - MBTA retains Amtrak to operate the commuter rail service.

   Note: The first two agreements are referred to collectively in the January 13, 1993 MBTA/Amtrak Electrification Agreement as "the Operating Agreement".

Sale and Related Agreements

02-03-72 Sale Agreement (PCTC to MBTA) referred to as "the February Agreement". (Revised 4-27-72)

- The Boston & Providence main line, along with several branches and land parcels, sold for $19,500,000.
- PCTC reserves the "Transportation" easement (including intercity passenger service).

09-13-72 Amtrak/PCTC

- PC "shall perform all of its obligations [to Amtrak]...as if...still (the) owner."

09-13-72 Amtrak/MBTA

- Agrees that Amtrak has the right to operate Amtrak trains in Massachusetts.
- Sets limits of four Amtrak trains per hour in each direction.
- Term: until 1996 or abandonment by Amtrak.

This and the 7/1/84 agreement constitute the "Operating Agreement".

09-14-72 PCTC/MBTA

- Assigns a portion of the proceeds from Amtrak to MBTA as a return on investment.
- PCTC will give up freight easement east of Readville if programs necessitate the elimination of freight service.

07-01-84 Operating Agreement (MBTA/Amtrak)

- Amtrak will operate and maintain the rail lines.
- Amtrak will provide efficient and equitable treatment in the dispatching of MBTA trains.
- Term: In effect unless terminated; 18 month notice to terminate.

This and the 9/13/72 Amtrak MBTA agreement constitute "the Operating Agreement".

11-01-86 Commuter Rail Service Agreement (MBTA/Amtrak)

- Amtrak agrees to perform "Contract Service".
- MBTA provides access to property, service equipment, maintenance machines and equipment.
- Performance payments for operation of MBTA trains.
- Term: 3 years through 12-31-89; then until terminated on 12 months notice.

04-01-87 Amendment Agreement
Revisions dealing with non-operating issues.

01-13-93 Electrification in Massachusetts

- MBTA approves of project.
- MBTA will own improvements.
- Term: generally until final inspection.

Operating Rights

Conrail/P&W

7-01-85 Trackage Rights Agreement

- MBTA grants Conrail non-exclusive right to perform freight service.
- Term: 20 years, 6 months (12-31-15), renewable for one 30-year term.

5-1-82 CR/P&W

- Overhead rights - State line to Attleboro
- In connection with agreements of same date for rights from state line to Westbrook, Connecticut.

Unknown MBTA/P&W concurring Agreement

The Northeast Corridor Transportation Plan
New York City to Boston
Volume 2

Appendix E
GEOGRAPHIC SUMMARY OF PROPOSED IMPROVEMENTS

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GEOGRAPHICAL SUMMARY OF PROPOSED
HIGH SPEED REQUIREMENTS
TRIP TIME IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
ROUTE REALIGNMENTS					
Realign Curves	Modify selected curves to achieve speeds proposed to satisfy trip time goals and provide comfortable ride. See following sheets for listing of the curves to be realigned.				
Reconfigure Shell Interlocking	New Interlocking: South Shell. Bridges: Reconstruct Webster Ave. and Beechwood Ave. at new grade.	New Interlocking: CP 215 Reconfigure Interlockings: CP 216 (Shell) and CP 217 (E Shell). New Bridge: Flyover MNCR Tracks 2 and 4. Lower Tracks 2 and 4. Construct required retaining walls. Additional Track: At grade connector. Layover Track: Install layover track off trk 3 at CP 223 (Pike), includes span over Locust Ave and signal/ET support work. Overhead Bridge: Replace Center St. Station Platform: Construct center island platform at New Rochelle			

NEC CURVE IMPROVEMENTS TO MEET THE SPEED GOALS

NEC Segments	E_a Adjustments	Shifts Between 0" - 6"	Shifts More Than 6"
Hellgate	223 217		216 218 219 220 221 224 225 226 227 228 229
Metro North	212/18 208/23 204/26B 199/29B 198/30 197/31 182/44 181/45 178/49 174/53 165/60 B&C 161/63 160/64 156/69	211/21A 206/25 201/28B 202/28A 184/82 183/43 179/47 175/51 169/59A 164/61B 163/62A 159/65 157/68 155/70	213/17 210/21B 209/22 207/24 203/27 196/32 195/33 194/34A 193/34B 192/37A 190/37B 189/38 180/46 177/50 171/55B 170/57 168/59B
New Haven to Boston		16A 16B 31 35 37 42 44A 52 54 55 56 57 59 60 62 69B 70 73 83 92 93 97 99 118 107 117 119 121 125 131 132 135 141 150	16C 17 18 19 20 21 22 23 25/26 32 38 43 50 51 53 58 65 68 69A 74 80 87 91 96 98 101 105 114 115 116 117A 117B 118 120 122 123 124 126 127 128 129 130 149 133 134 136 137 138 139 140 142 143 145 147 148

LEGEND

223 - Amtrak Curve Number
212/18 - Amtrak/MNCR Curve Number
E_a - Actual Superelevation

CONVERT OPEN DECK BRIDGES DUE TO CURVE REALIGNMENT

Milepost	State	Crossing	Curve No.
18.07	NY	Black's Crossing	216
24.02	NY	Purchase Street	208
25.69	NY	King Street	206
25.75	NY	Willet Avenue	206
25.85	NY	Highland Avenue	206
25.94	NY	North Main Street	206
26.12	CT	North Water	205
28.22	CT	Steamboat Road	202
28.68	CT	Davis Mill	201
32.80	CT	Greenwich Avenue	196
32.85	CT	Rippowam River	196
33.76	CT	Elm Street	195
34.16	CT	East Main Street	194
37.57	CT	Leroy Avenue	191
43.97	CT	Saugatuck Avenue	183
49.65	CT	Mill River	178
56.09	CT	Kossuth Street	171
56.19	CT	East Main Street	171
56.33	CT	Pembroke Street	171
56.46	CT	Hallet Street	171
59.99	CT	East Main Street	168

21 Structures 1,444 LF

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GEOGRAPHICAL SUMMARY OF PROPOSED HIGH SPEED REQUIREMENTS TRIP TIME IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
ROUTE REALIGNMENTS (Cont'd)					
Stamford Station Center Island Platforms		New Interlocking: Selleck St. Reconfigure Interlocking: CP 233 (West Stam) and CP 234 (Stam). Install No. 30 cross-overs to facilitate westbound platform access. Includes signal, communication, power and catenary changes required to implement changes. Construct Station Platforms: Construct two 1020' center island platforms, and two 850' side platforms. Replace Bridge: Washington Ave (32.97)roadway widened and overhead clearance improved; replace superstructure and substructure.			

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
ROUTE REALIGNMENTS (Cont'd)					
Reconfigure New Haven Terminal Area		Reconfigure Interlocking: New Haven and Fair Street. Includes signal and catenary changes required to implement changes. Signalling: install cab signals on approaches and through the terminal area. Curve Realignment: Increase MAS to 50 mph and eliminate crossover moves for Express Trains. (Service Facilities: Construct new diesel and MU car facilities.) (Layover Yard Facility: 100 car yard.). (Station: New stations at Chapel/State Street and possibly West Haven.)	Reconfigure Interlocking: Mill River. Upgrade Track: Grand Ave to Mill River.		

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GEOGRAPHICAL SUMMARY OF PROPOSED
HIGH SPEED REQUIREMENTS
TRIP TIME IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
ROUTE REALIGNMENTS (Cont'd)					
Reconfigure Old Saybrook Station			Reconfigure alignment. Required to eliminate passengers crossing tracks to reach platform. (Includes reconfiguration of Brook and Old Saybrook Interlockings, installation of gauntlet track and rebuilding trk 3 and 4 passing sidings.) Provide 2 1050' high level platforms		
TRACK STRUCTURES					
Track Program					
Install Concrete Ties	18.0 TM	Approx. 110 TM	134.6 TM		
Install CWR		Approx. 220 RM	165.4 RM		
Track Undercutting		Approx. 50 TM	63.5 TM		
Ballast Cleaning	18.0 TM	Approx. 115 TM	71.1 TM		
Turnout Replacement			5 ea.	6 ea.	8 ea.
Track Surfacing,	(includes surfacing required to add full superelevation and rework spirals to achieve improved curve speeds) Locations not yet defined.				
Rail Grinding	18.0 TM		380.0 TM		

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GEOGRAPHICAL SUMMARY OF PROPOSED HIGH SPEED REQUIREMENTS TRIP TIME IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
BRIDGES					
Replace Miter Rails Provide ride quality. Required to achieve trip time goal.	Pelham Bay (E15.73)	Cos Cob ((29.90) Walk (41.51) Saga (44.32) Devon (60.42)	Conn River (106.89) Niantic (116.74) Shaw's Cove (122.65)	Groton (124.09) Mystic (132.16)	
Canton Viaduct Clearance Improvements (213.74)					Improve horizontal clearance, operational speed, and capacity by replacing existing deck with a wider ballasted deck.
ELECTRIFICATION					
Install 25 kV 60 Hz Center-Fed System Catenary - Install an auto-tensioned simple catenary			approx. 102 TM	approx. 123 TM	approx. 100 TM
Power Supply - Install a 2 x 25 kV (autotransformer) traction power supply system. Sub-Stations (4) and Utility Supply System Northeast Utilities (NU) New England Electric System (NEES) Boston Edison Company (BECo)			Branford (79.32) - 1,500' transmission line supply (NU) New London (123.59) - underground service from Williams St. (NU)	Warwick (176.64) - adjacent transmission lines (NEES)	Roxbury (226.02) - underground service from Tremont St. (BECo)

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GEOGRAPHICAL SUMMARY OF PROPOSED HIGH SPEED REQUIREMENTS TRIP TIME IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
ELECTRIFICATION (Cont'd)					
Switching Stations (3)			Westbrook (103.53)	Richmond (150.36)	Norton (198.99)
Install 25 kV 60 Hz Center Fed System (Cont'd) Paralleling Stations (18)			Leetes Island (85.99) Madison (92.41) Grove Beach (99.1) Old Lyme (109.50) Millstone (117.54)	Noank (129.45) Stonington (134.65) State Line (139.93) Bradford (145.19) Kingston (157.11) Exeter (161.73) East Greenwich (169.79) Elmwood (181.69)	Providence (187.55) Attleboro (193.40) East Foxboro (205.70) Canton (212.46) Readville ((219.10)
Supervisory Control and Data Acquisition System (SCADA)			Install RTU's	Install RTU's	Install RTU's Upgrade CETC to provide supervisory control.
Install OH Bridge Barriers			All OH Bridges	All OH Bridges	All OH Bridges

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GEOGRAPHICAL SUMMARY OF PROPOSED HIGH SPEED REQUIREMENTS TRIP TIME IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
ELECTRIFICATION (Cont'd)					
Provide Clearance for Electrification					
Replace OH Bridges			Old Clinton Rd. (100.54) Johnnycake Hill Rd. (108.51)	Masons Island Rd. (133.06) Burdickville Rd. (148.41)	Thatcher St. (196.36) Depot St. (211.04) (Possibly undercut)
Raise OH Bridges			Millstone Pt. Rd. (117.31)	Main St. (158.32) Park Ave. (180.29)	
Eliminate Bridge				Reservoir Pedestrian Footbridge (181.72)	[Conant St. (189.24) RIDOT plans replacement]
Undercut Track At OH Bridges			Harbor St. (80.95) Kirkham St. (81.25) Vedders Pt. Rd. (84.29) Moose Hill Rd. (86.54) Fort Path Rd. (91.82)	Palmer Neck Rd. (137.81) Exeter Rd. (163.21) Col. Rodman Hwy. (165.46)	Mineral Spring Ave. (189.00) Washington St. (191.13) County St. (192.47) Holden St. (198.01)

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GEOGRAPHICAL SUMMARY OF PROPOSED HIGH SPEED REQUIREMENTS TRIP TIME IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
ELECTRIFICATION (Cont'd)					
Provide Clearance for Electrification (Cont'd)					
Undercut Track At OH Bridges			Horse Pond Rd. (93.68) Grove Beach Rd. (99.16) Essex Rd. (101.36) School House Rd. (103.62) Ingram Hill Rd. (104.15) Buttonball Rd. (109.43) Columbus Ave (115.62)	Hunts River Rd. (169.79)	Elm St. (201.67) School St. (202.51) River St. (220.74) Blakemore St. (222.82) Tremont/Arlington (228.13) Albany/Broadway (228.51) Broadway (Dorchester BR.) (227.76)
Undercut Track and Re-place/Raise OH Bridges			none identified	none identified	none identified
Noise and Vibration Mitigation Program			Mitigate train noise and vibration impacts resulting from frequent high-speed electrified operation. Various methodologies will be reviewed and a definitive program subsequently established.		
SIGNALING AND TRAIN CONTROL					
Install Signal System Compatible with Electrification			Replace existing track circuitry with new microprocessor controlled ABS track circuits. Replace existing DC track circuits in Interlockings with steady energy 100 Hz track circuits. Provide Reverse Signaling on all main tracks. Install impedance bonds. Modify cab codes, block criteria and block spacing to permit higher speeds (up to 150 MPH) and the installation of high speed crossovers.		
Extend CETC from New Haven to Providence			Extend CETC remote control of interlockings from Providence to New Haven.		

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GEOGRAPHICAL SUMMARY OF PROPOSED HIGH SPEED REQUIREMENTS TRIP TIME IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
SIGNALING AND TRAIN CONTROL (Cont'd)					
Install Positive Stop/Civil Speed Enforcement System (Development of concept underway.)	Design and install a speed enforcement system that will enforce permanent and temporary speed restrictions and enforce a positive stop at interlocking home signals. (Locomotives and MUs to be modified also.) System may be incrementally installed.				
STATIONS					
Route 128 Improvements					Waiting room and ticket sales located over tracks, (other improvements previously listed).
Kingston Station Intermodal Transportation Facility				Restore the historic station that was previously damaged by fire. Provide commuter side track 3. Provide high level platforms, pedestrian cross track access, and ADA improvements. Provide improved and enlarged parking facilities.	
SERVICE FACILITIES					
Construct Amtrak New Haven Service Facility		Relocate Amtrak's New Haven Service Facilities north of the tracks.			

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GEOGRAPHICAL SUMMARY OF PROPOSED HIGH SPEED REQUIREMENTS TRIP TIME IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
CAR EQUIPMENT					
Procure 26 Amtrak High Speed Trainsets	Specify, design, test and deliver next generation of High Speed Equipment to be used on NEC between Washington and Boston.				
GRADE CROSSINGS					
Grade Crossing Elimination Program Group 1 - Construct Grade Separation Structure			Chapman's 112.19)	Wolf's Rock Rd. (160.30)	
Enhance Grade Crossing Protection				Broadway Extension (132.32)	
Acquire Rights, Close and Eliminate Crossing				Caro's (143.70)	Lazy Lady Chicken Farm (198.96)
Group 2 - Further Technical Investigation to Confirm Practicability of Recommendations to Construct Separation Structures			Miner Lane (120.20)	Latimer Pt. Rd. (133,40) Wamphassuck Rd. (134.90) Palmer St. (140.55)	
Group 3 - Development of Final Plan Subject to Demonstration and Testing of Crossing Enhancement Systems			Bank Street Connector (122.50) State Street (122.76) Gov. Winthrop Blvd. (123.01)	School Street (131.50) (location of test and demonstration program) Walker's Dock (136.65) Freeman's (136.70)	
Eliminate Previously Closed Crossings				Cheseborough (136.50)	
SAFETY ENHANCEMENTS					
Install Train Approach Warning Signs and Bells		(Requirements to be evaluated.)	(Requirements to be evaluated.)	(Requirements to be evaluated.)	(Requirements to be evaluated.)

Appendix E
GEOGRAPHICAL SUMMARY OF PROPOSED HIGH SPEED REQUIREMENTS
CAPACITY IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
ROUTE REALIGNMENTS					
Penn Station					
Extend Platform 11 Tracks (20 & 21).	Lengthen Platform to enable 12 car trains to use platform. Includes necessary track, electrification and signal changes.				
5X Switch Connection - (Tracks 13 and 14 to West Side Yard).	Revise A Tower configuration to enable Station Tracks 13 and 14 to be connected to West Side Yard lead tracks 1 and 2 via the 5X switch.				
Reconfigure Harold Interlocking	Reconfigure Interlockings: F Tower and Harold. Construct Tunnel: Eastbound & Westbound Duck unders. Additional Tracks: Eastbound & Westbound.				

Appendix E
GEOGRAPHICAL SUMMARY OF PROPOSED HIGH SPEED REQUIREMENTS CAPACITY IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
ROUTE REALIGNMENTS (Cont'd)					
South Station Capacity Improvements					Construct tracks 12 and 13. Construct 4th track over Fort Point Channel (also electrify). Install fifth track approach from B and A. Modify Cove I/L Install inside ladder in yard.
Reinstall Devon to New Haven Fourth Track (Temporary reconfiguration of CP 261 will be required to facilitate intercity 3-hour service)		Reconfigure Interlocking: CP 261 (Devon) Remove Interlocking: CP 266 (Woodmont). Upgrade Track Structure: CP 261 (Devon) to Fair Street. Inspect and upgrade Catenary: CP 261 (Devon) to Fair Street.			

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GEOGRAPHICAL SUMMARY OF PROPOSED
HIGH SPEED REQUIREMENTS
CAPACITY IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
ROUTE REALIGNMENTS (Cont'd)					
Reinstall Devon to New Haven Fourth Track (Cont'd)		Signalling: Reinstall Signalling System. Rehabilitate Bridges: Beardsley Ave (62.94), High St. (63.27), River St. (63.44), Rock Lane (66.35), Depot Rd. (66.66), Morgan Lane (68.11), Campbell Ave. (70.19), Washington Ave. (70.36) Reinstall Bridge Superstructure: Wepawaug River (63.53). Gulf St. (63.83). Relocate Station Platform: Milford.			
Construct Shore Line East Passing Sidings (length of Branford siding subject to final design)			Branford, Trk. 3, for approx. 60 car rock trains (0.5 mi.) Guilford, Trks 3 and 4 (2.0 mi.), Clinton, Trk 4 (1.0 mi.) Old Saybrook, Trks 3 and 4 (2.5 mi.). Waterford, Trks 3 and 4 (1.5 mi)		

Appendix E
GEOGRAPHICAL SUMMARY OF PROPOSED HIGH SPEED REQUIREMENTS CAPACITY IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
ROUTE REALIGNMENTS (Cont'd)					
Construct New London to Providence Passing Sidings				Westerly, Trk. 3. Kingston, Trk. 3, coordinate with commuter rail siding. Hillsgrove, Trk. 3. Cranston, Trk. 4.	
Construct Providence to Boston Passing Sidings					Attleboro, Reinstall Trk. 3. (No. 20 T.O. W End, No. 30 E End) Attleboro to Hebronville, Rehab Trk 4 (No. 30's W and E End) Sharon, Trk 4. Read-Rte 128, Trk. 3. Forest Hills to Readville, Construct Trk 5 (No. 20's W and E End), upgrade Mother Brook Bridge (220.42)

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GEOGRAPHICAL SUMMARY OF PROPOSED
HIGH SPEED REQUIREMENTS
CAPACITY IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
ROUTE REALIGNMENTS (Cont'd)					
SLE Both Sides Fully Accessible Stations (Manually operated gauntlet tracks will be required at Branford, Clinton and Westbrook on Trk 1 to accommodate high and wide freight movements)			Post 2000, construct fully accessible high level platforms, with cross track access: Branford (81.3) Guilford (88.8) Madison (93.1) Clinton (96.8) Westbrook (101.2)		
TRACK STRUCTURES					
Reconfigure Existing Interlockings	(KN, A Tower, F and Harold previously listed.)	(CP 216 (Shell), CP 217 (E. Shell), CP 232 (W. Stam), CP 233 (Stam), CP 261 (Devon), CP 266 (Woodmont), New Haven, and Fair St. previously listed) CP 241 (Walk) CP 257 (Central)	(Mill River previously listed with New Haven Terminal) Branford (Clinton) Brook Shaw's Cove Groton	(Kingston previously listed with side track) Cranston (for passing siding)	Orms Lawn Hebronville Thatcher Attleboro Holden Mansfield Canton Jct. Transfer, (double track to Dana not precluded) Read Forest Plains (No. 30 E End Trk 5) (Cove (Accom-modates So. Sta./No. Sta. Tunnels) (Tower 1)

Appendix E
GEOGRAPHICAL SUMMARY OF PROPOSED HIGH SPEED REQUIREMENTS CAPACITY IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
TRACK STRUCTURES (Cont'd)					
Install High Speed Universal Interlockings			Guilford, to include passing sidings Old Saybrook, to include passing sidings	High St., Kingston, Davisville, to include converting T.O. to Quonset Pt. to No. 15	
Install Gauntlet Tracks			(Manually operated gauntlet tracks will be required at each SLE station: Branford, Madison, Clinton and Westbrook.) (Old Saybrook) (If service extended to New London, two additional gauntlet tracks (Old Lyme, Niantic) will be re-quired.)	Mystic, Trk. 2 Westerly, Trk. 2 Kingston, Trk. 2 (Wickford Jct. and Apponaug when Kingston - Providence service initiated)	So. Attleboro, Trk. 4 Attleboro, Trk. 4 Mansfield, Trk. 1 Rte. 128, Trk. 2. Canton Jct. (on branch).
Install New Interlockings	Market	(CP 215, as part of Shell Flyover) "CP 250" (Fairfield) (center island platforms are an alternative] (Selleck St. (CP 232) previously listed with Stamford.) ("CP 245," part of replacement of Saga and Walk.)	Point	Lord	

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GEOGRAPHICAL SUMMARY OF PROPOSED
HIGH SPEED REQUIREMENTS
CAPACITY IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
ELECTRIFICATION					
Provide Third Track for P&W Freight Service					
Track Improvements				Additional Track: Provide non-electrified track for freight operations between MP 179 and Boston Switch. Upgrade existing tracks and construct connecting track, as required. Install No.20 crossover and turnout to provide access to/from track.	
Replace OH Bridges				Huntington Expwy. (182.64)	
SIGNALING AND TRAIN CONTROL					
Canton Jct. to Boston Signal Modifications					Convert all signal sites to full master locations with 60, 80 and 100 mph aspects.

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GEOGRAPHICAL SUMMARY OF PROPOSED
HIGH SPEED REQUIREMENTS
CAPACITY IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
STATIONS					
Construct High Level Platforms			New London (SLE Stations included in Terminal/Station Reconfigurations.) (Branford) (Guilford) (Madison) (Clinton) (Westbrook) (Old Saybrook) (South Lyme and Niantic if service extended to New London)	Mystic Westerly Kingston (design in Station Rehabilitation.) (Wickford Jct and Apponaug if RIDOT Kingston to Providence Service initiated).	So. Attleboro Attleboro Mansfield Sharon Canton Jct. (on branch). Route 128 Hyde Park Ruggles St. (Trk 2)
SERVICE FACILITIES					
Amtrak Boston Service Facility					Expand repair space and accommodate electric locomotives. (Requirements not yet defined)
Amtrak Medium and Heavy Overhaul Facility	Construction of additional facilities at existing service facilities to perform medium and heavy repairs of the new Amtrak Trainsets. Amtrak is reviewing the required modifications.				
CAR EQUIPMENT					
Modify On-board Cab Signal Equipment	Modify Amtrak, MNCR, CDOT, RIDOT, MBTA, NJTransit, Conrail and P&W locomotives and MU's as necessary to install the on-board modifications determined necessary to implement the enforced Civil Speed Restriction Requirement on equipment operated on NEC.				

Appendix E
GEOGRAPHICAL SUMMARY OF PROPOSED RECAPITALIZATION IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
BRIDGES					
Pelham Bay (E15.73) Bridge Replacement	Replace existing moveable span with longer bridge on new alignment to widen channel.				
Walk (41.51)/Saga (44.32) Bridge Replacement					
Walk, (Recently rehabilitated, except for painting, to restore structural integrity)		By year 2010, replace existing swing bridge with a pair of double track bascule spans. Replace approach fixed spans with new ballasted deck.			
Saga, (Recently rehabilitated to restore structural integrity)		By year 2010, replace existing pair of bascule spans with new bascule spans with the top of the new substructures above flood stage. New Interlocking: May require new universal interlocking to facilitate double track outages.			

Appendix E
GEOGRAPHICAL SUMMARY OF PROPOSED
RECAPITALIZATION IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
BRIDGES (Cont'd)					
Peck (55.90) Bridge Replacement		Replace lift structure on same alignment at a higher profile. Replace Bridgeport Viaduct.			
Niantic (116.74) Bridge Replacement			Replace existing moveable bridge.		
Groton (124.09) Bridge Replacement			Replace existing moveable span.		
Convert Open Deck Bridges		Selected open deck bridge superstructures, rated as requiring immediate attention, will be replaced with ballast deck bridges, see attached sheet for listing. Raise track, adjust wire height and modify platforms, as necessary, to accommodate ballast decks. Wepawaug River (63.55). (Re-installation of track 3 required for 4th track CP 261 (Devon) to New Haven.)	75.05, 75.77 complete (c), 75.92 (c), 83.58, 83.91, 84.41, 84.76, 85.41, 85.58, 86.17, 96.60, 96.89, 104.48, 104.56, 107.94, 108.11, 108.76, 110.74, 110.95, 112.06, (raise as part of elimination of Chapman's Grade Crossing),	124.35, 126.45, 130.63, 132.75, 135.51, 137.52, 135.67, 141.35, 141.44, 146.39, 147.45, 149.47, 150.59, 152.71, 155.85 (c), 156.03 (c), 167.66 (c), 170.10, 171.84 (c), 174.06 (c), 174.54 (c), 174.76 (c), 177.81 (c), 179.16.	190.55, 193.75 (c), 193.69 (c), 214.75, 216.32, 220.42 (c).

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GEOGRAPHICAL SUMMARY OF PROPOSED RECAPITALIZATION IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
BRIDGES (Cont'd)					
Convert Open Deck Bridges			112.58 (c) 113.20, 114.30, 115.13, 118.92, 122.11, 122.20.		
Replace Deteriorated Bridges and Culverts		Selected bridge Superstructures rated as requiring immediate attention to be replaced. Substructures to be rehabilitate as required. See attached sheet for listing.			

CONVERT OPEN DECK BRIDGES DUE TO RIDE QUALITY IMPROVEMENT

Milepost	State	Crossing	Curve No.
20.12	NY	Fenimore Road	--
20.39	NY	Mamaroneck Avenue	--
23.73	NY	Locust Avenue	--
25.55	NY	Westchester Avenue	--
26.80	CT	Hamilton Avenue	--
28.07	CT	Arch Street	--
29.50	CT	Sachems Road	200
31.62	CT	Tomac Road	--
32.97	CT	Washington Boulevard	--
33.18	CT	Atlantic Street	--
33.40	CT	Canal Street	--
34.71	CT	Hamilton Avenue	193
37.80	CT	Boston Post Road	--
40.93	CT	Spring Street	--
41.10	CT	Monroe Street	--
41.28	CT	Washington and Main	186
41.99	CT	Osborn Street	--
42.14	CT	East Avenue	--
47.16	CT	New Creek Road	--
53.43	CT	Fairfield Avenue	--
54.06	CT	Wordin Avenue	--
54.22	CT	Iranistan Avenue	--
54.44	CT	South Avenue	--
54.55	CT	Park Avenue	--
54.70	CT	Myrtle Avenue	173
54.78	CT	Warren Street	173
54.84	CT	Lafayette Street	173
54.92	CT	Broad Street	173
54.98	CT	Main Street	173
55.36	CT	Union Street	--
56.75	CT	Seaview Avenue	--
57.44	CT	Bishop Avenue	--
57.60	CT	Bruce Avenue	--
58.75	CT	West Broad Street	--
59.04	CT	Main Street	--
62.98	CT	Beardsley Avenue	162
63.31	CT	High Street	161
63.45	CT	River Street	161
63.55	CT	Wepawaug River	161
63.85	CT	Gulf Street	--
64.59	CT	Indian River	160
64.74	CT	Old Gate Lane	160
66.56	CT	Rock Lane	--
66.68	CT	Depot Road	158
68.10	CT	Morgan Lane	--
70.25	CT	Campbell Avenue	--
70.37	CT	Washington Avenue	--

48 Structures 2,821 LF

REPAIR/REPLACE DETERIORATED BRIDGES AND CULVERTS

Milepost	State	Crossing	Curve No.
13.26	NY	Bronxdale	221
22.38	NY	Macy	209
23.90	NY	Blind Brook	208
27.78	CT	Field Point Road	203
29.69	CT	Luke's Crossing	--
31.29	CT	Sound Beach	--
35.38	CT	Noroton Road	193
39.06	CT	Five Mile Run	189
39.11	CT	Rowayton Avenue	--
41.82	CT	Fort Point	185
48.64	CT	Westway Road	--
48.83	CT	Center Street	--
48.89	CT	Spruce Street	--
49.08	CT	Old Post Road	--
49.65	CT	Mill River	--
50.01	CT	North Pine Cr	--
50.30	CT	Mill Plain Road	177
50.88	CT	Roundhill Road	177
51.09	CT	Benson Road	177
53.03	CT	Ash Creek	174
53.59	CT	Bostwick Avenue	--
53.70	CT	Hancock Avenue	--
53.83	CT	Howard Avenue	--
58.92	CT	King Street	--
71.28	CT	West River	--

25 Structures 1,176 LF

Appendix E
GEOGRAPHICAL SUMMARY OF PROPOSED RECAPITALIZATION IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
BRIDGES (Cont'd)					
Replace/Upgrade Overhead Bridges in Rhode Island (Related to Clearance Improvement projects)				West St. (141.67), Main St. (146.25), Carolina Rd. , (Pawatuck Rd.) (152.3), Route 112 (153.54), Burdickville Rd. (Beaver River Rd.) (154.04), RI Rt. 2 (Miantonomi Hwy. (154.33) Dry Bridge Rd. (163.5) Stony Lane (166.87) Main St. (Pontiac Rd.) (175.61) Pettaconsett Ave. (178.46) Park Avenue (180.29) Roger Williams Ave. (181.99) Rt. 6 (183.33, 183.36, & 183.39) Westminster St. (183.51) Harris Ave. (183.87)	Conant St. (189.24) Cole St. (190.65)
Repair				Ramp Repair: (RI Rt. 10 180.68), I-95 (180.71)	
New				Quonset Pt. Access (168.90)	

Appendix E
GEOGRAPHICAL SUMMARY OF PROPOSED RECAPITALIZATION IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
ELECTRIFICATION					
Hellgate Line Hanging Beam Removal	Remove hanging beams, steel carrier cables and rehabilitate supporting structures, Gate to Shell. May require reconfiguration of catenary that was installed as part of initial NECIP and additional pulloffs and poles.				
New Haven Line Substation Replacement (An initial computer simulation of the proposed 2010 service levels is presently being undertaken to evaluate the impacts on the existing catenary and power supply systems. It has not been completed as of this submittal.)		Install ground mounted circuit breakers to replace existing oil-filled circuit breakers located on anchor bridges. New Rochelle (16.3), Pike (23.5), Cos Cob (29.7), Stamford (33.3), Darien (37.8), S. Norwalk (41.2), E. Norwalk (41.9), Burr Road (53.3), Central (56.8), Bridgeport (57.5), Devon (60.8), Woodmont (66.6), New Haven (72.3).			

Appendix E
GEOGRAPHICAL SUMMARY OF PROPOSED
RECAPITALIZATION IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
ELECTRIFICATION (Cont'd)					
New Haven Line Catenary Replacement		Install Constant Tension Catenary designed for 110 mph operation for six raised pantographs: MP 26.1 to MP 72.0.			
Car Equipment					
Commuter Equipment Testing		Test existing CDOT/MNCR equipment to determine ride quality if operated at higher speeds and/or unbalanced superelevation.	Test existing CDOT equipment to determine ride quality if operated at higher speeds and/or unbalanced superelevation.		Test existing MBTA/RIDOT equipment to determine ride quality if operated at higher speeds and/or unbalanced superelevation.
FENCING					
Fence Selected Sensitive Areas			Locations not yet defined.	Locations not yet defined.	Locations not yet defined.
SAFETY ENHANCEMENTS					
Penn Station Fire, Life Safety Improvements	Penn Station Improvements: Not presently defined, requirements to be further refined in conjunction with Amtrak and LIRR.				

Appendix E
GEOGRAPHICAL SUMMARY OF PROPOSED RECAPITALIZATION IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
SAFETY ENHANCEMENTS (Cont'd)					
Step and Touch Traction Return Mitigation		MP 26.1 to MP 72.8 Minimize danger of electric shock to passengers and employees, and overload of electrical equipment through installation of new equipment and modification of existing facilities.			

Appendix E
GEOGRAPHICAL SUMMARY OF PROPOSED OTHER IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
ROUTE REALIGNMENTS					
Reconfigure Kingston Station				Reconfigure alignment to Provide commuter rail side track (trk 3), and freight passing siding.	
Direct Connection to Middleboro Secondary					Additional Track: Construct passing track on East Jct Secondary.
TRACK STRUCTURES					
Maintenance and Operating Costs Allocation Study	Undertake a study to define the costs associated with achieving and maintaining the levels of ride comfort, reliability and availability that will be necessitated by the introduction of high performance trains and increased operating speeds for intercity and commuter trains. Methodologies for the allocation of operating and maintenance costs between owners and users should be evaluated and a preferred methodology recommended.				
ELECTRIFICATION					
P&W Freight Service Clearance Improve-ments Raise OH Bridges					 Mineral Spring Ave (189.00) Central St. Footbridge (190.07)

Appendix E
GEOGRAPHICAL SUMMARY OF PROPOSED OTHER IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
ELECTRIFICATION (Cont'd)					
P&W Freight Clearance Improvements (Cont'd)					
Undercut Track at OH Bridges - (Tracks 1 and 2 Davisville to MP 179)				Davisville Rd. (168.53) Garnet St. Footbridge (172.91) U.S. Rte. 1 (175.00) Gorton Pond Rd. (175.01) Airport Connector (176.23) Coronado Rd. (176.65) Rte 37 East (178.09) Rte 37 West (178.13)	
Undercut Track at OH Bridges - Freight Siding Track MP 179 to Boston Switch (at certain locations main tracks also may be undercut)				I-95 Ramp (180.68) RI Rte 10 (180.69) I-95 Ramp (180.71) Reservoir Ave. (181.66) Union Ave. (182.99) Westminster St. (183.51) Broadway (183.66) Atwells Ave. (184.29)	Smith St. (185.78) I-95 (NB/SB) (186.12) Charles St. (186.44) Lonsdale Ave. (188.91) Dexter St. (189.61) Broad St. (189.81) Barton St. (189.94) Cross St. (190.03) Sacred Heart Ave. (190.23)

Appendix E
GEOGRAPHICAL SUMMARY OF PROPOSED OTHER IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
ELECTRIFICATION (Cont'd)					
P&W Freight Clearance Improvements (Cont'd)					
Undercut Track				Providence Station - Track 7	
Undercut Track and Replace/Raise OH Bridges				Rocky Hollow Rd. (171.5) Magnon Rd. (182.45) Cranston St. (182.60)	
Remove Structure					Pawtucket Station (189.88)
Rehabilitate Bridges					Orms St. (186.07)
SIGNALING AND TRAIN CONTROL					
New Haven Line Go, No-Go Signal Improvements (Recommendation to reduce the number of signal aspects to three and simplify signal operating rules will ultimately need to be coordinated with FRA Safety's requirements relative to enforcement of civil speed restrictions.)		Configure the colored light H-5 signals to the Go No-Go position. Unused signals (approach signals, for example) subsequently will be removed.			

Appendix E
GEOGRAPHICAL SUMMARY OF PROPOSED OTHER IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
COMMUNICATIONS					
Install New Haven Line Fiber Optics		Install fiber optic system with line drops to hard wire hookups to provide railroad only communication needs.			
Install Public Address Systems			Install public address system at all stations.	Install public address system at all stations.	Install public address system at all stations.
STATIONS					
Construct Pedestrian Bridges Provide Cross Track Access			Branford, Guilford, Madison, Clinton, Westbrook.) (Possibly two additional stations between Old Saybrook and New London.	Kingston, Davisville or Wickford Jct., and Hillsgrove.	Sharon Canton Jct. (Attleboro and Mansfield use existing underpasses).
STATIONS					
Shore Line East (SLE), South Side Station Relocations			Branford: Relocate existing north side station to the west and on the south side of the tracks. Provide approximately 250 parking spaces, and make fully accessible.		

Appendix E
GEOGRAPHICAL SUMMARY OF PROPOSED
OTHER IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
STATIONS (Cont'd)					
Shore Line East (SLE), South Side Station Relocations (Cont'd)			Westbrook: Relocate existing north side station to the south side of the tracks. Provide approximately 150 parking spaces, and make fully accessible.		
Provide Improved Parking - Intercity and Commuter Parking		New Rochelle: provide 300 spaces (coordinated with center island platform requirements). Stamford: provide 800 additional parking spaces. Bridgeport: Study required to assess feasibility of constructing garage with capacity in excess of 800 spaces. New Haven: provide 800 additional parking spaces.	Old Saybrook: provide 200 additional parking spaces.		Route 128 (700 cars Intercity plus commuter).
Provide Improved Parking - Commuter					Canton Jct.

Appendix E
GEOGRAPHICAL SUMMARY OF PROPOSED OTHER IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
STATIONS (Cont'd)					
Provide Key Station ADA Access Implement various improvements to make key stations accessible: Update existing signage, provide access to east- and westbound platforms, provide accessible routes, update misc. platform and station interior facilities.		Stamford Bridgeport New Haven	Old Saybrook		
Amtrak Station Improvements	Not yet identified.		Not yet identified.	Not yet identified.	Not yet identified.
SERVICE FACILITIES					
Construct Davisville Layover Facility				Construct 3 to 4 Track facility to store 2 to 3 train sets. (Requirement for and feasibility still under review.)	
Construct Readville Layover Facility					Construct mid-day layover facility at "five yard." ("One yard facility not included.) Construct Layover Track at Hill.

Appendix E
GEOGRAPHICAL SUMMARY OF PROPOSED OTHER IMPROVEMENTS

Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
SERVICE FACILITIES (Cont'd)					
Construct NHL and SLE New Haven Car Storage Yard (Related to New Haven Terminal Reconfiguration)		Construct storage tracks for approximately 100 NHL and SLE cars. Includes water supplies and toilet servicing manifolds.			
Construct Providence Layover Facility				Construct 6 Track facility to serve the Providence MBTA commuter rail service. Electrify tracks to accommodate electric locomotives.	
CDOT New Haven Commuter Rail Shop and NHL Overhaul Shop		Reconstruct existing facility and provide modern facilities. (Previously described in New Haven Terminal Reconfiguration.)			

Appendix E
GEOGRAPHICAL SUMMARY OF PROPOSED OTHER IMPROVEMENTS

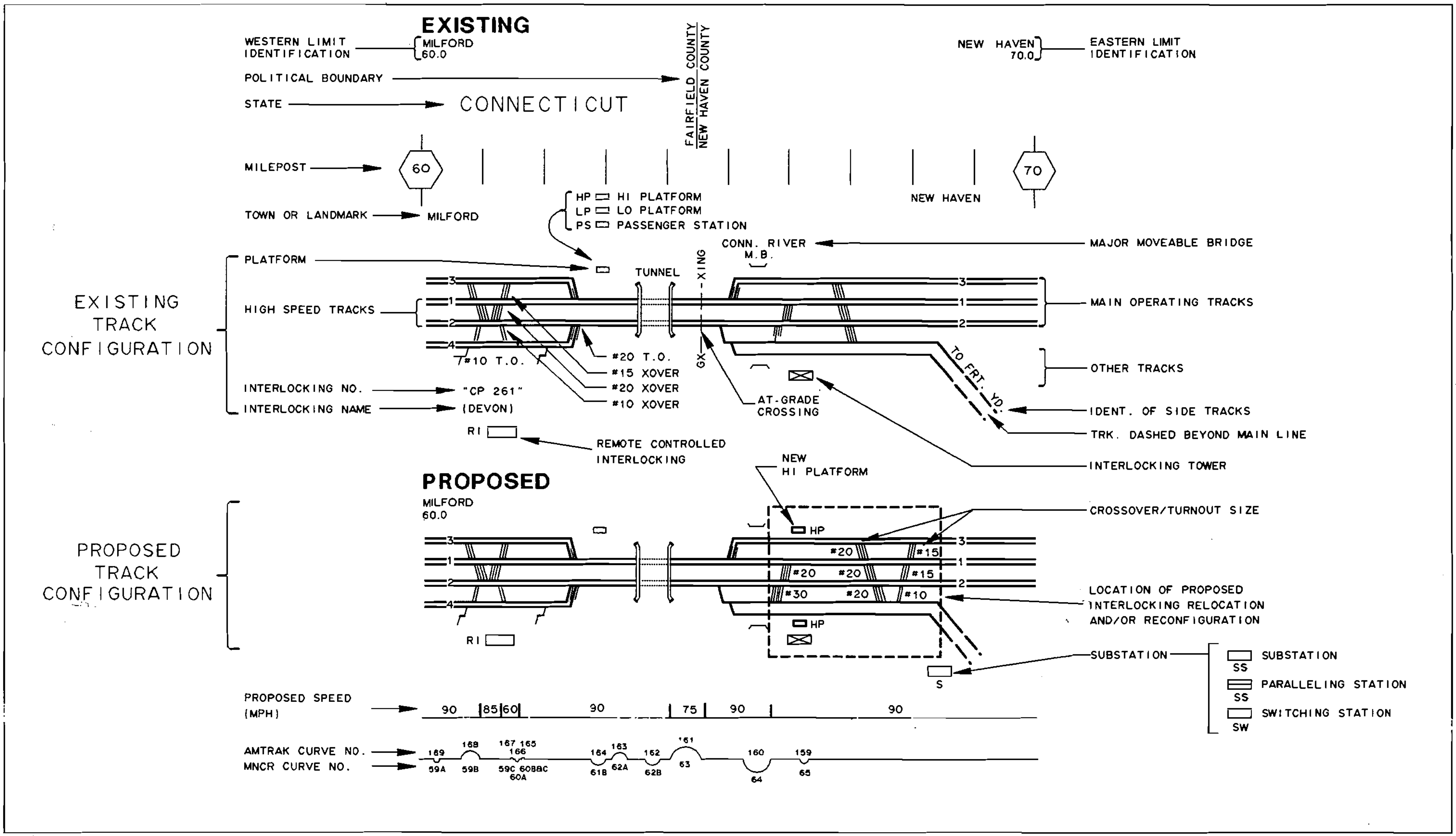
Project Name	New York to New Rochelle	New Rochelle to New Haven	New Haven to New London	New London to Providence	Providence to South Station
INITIATE NEW SERVICES					
Extend SLE from Old Saybrook to New London			Feasibility of extending service under review. If extended the following will be required as a minimum. (Construct two stations (possibly at Niantic and South Lyme). Include high level platforms, manually operated gantlet track, cross track pedestrian access and ADA access.)		
Add RIDOT Kingston to Providence				Feasibility of re-initiating commuter rail service is being evaluated. Locate two Intermediate Stations: either Wickford Jct (165), Davisville (168) or Hillsgrove (176-177). Interlock switches to w. end trks 3 & 5, Prov. Sta. (Procure Trainsets.)	

The Northeast Corridor Transportation Plan

New York City to Boston

Volume 2

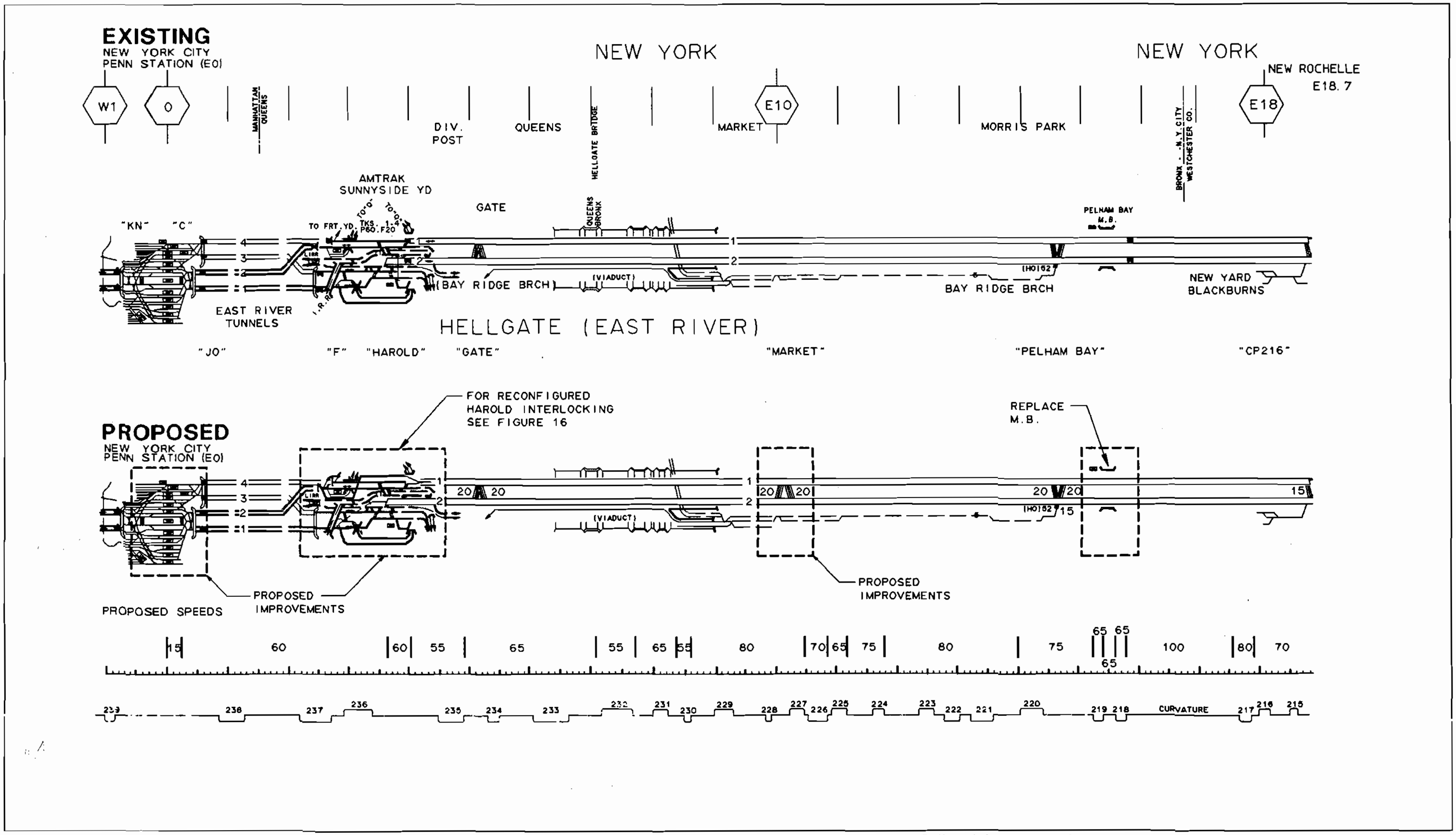
Appendix F
TRACK CONFIGURATION CHARTS



SCALE IN MILES
0 1 2 3

De LEUW, CATHER

EXHIBIT F-1
TRACK CONFIGURATION LEGEND
Existing And Proposed 2010 Track Configurations



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SCALE IN MILES

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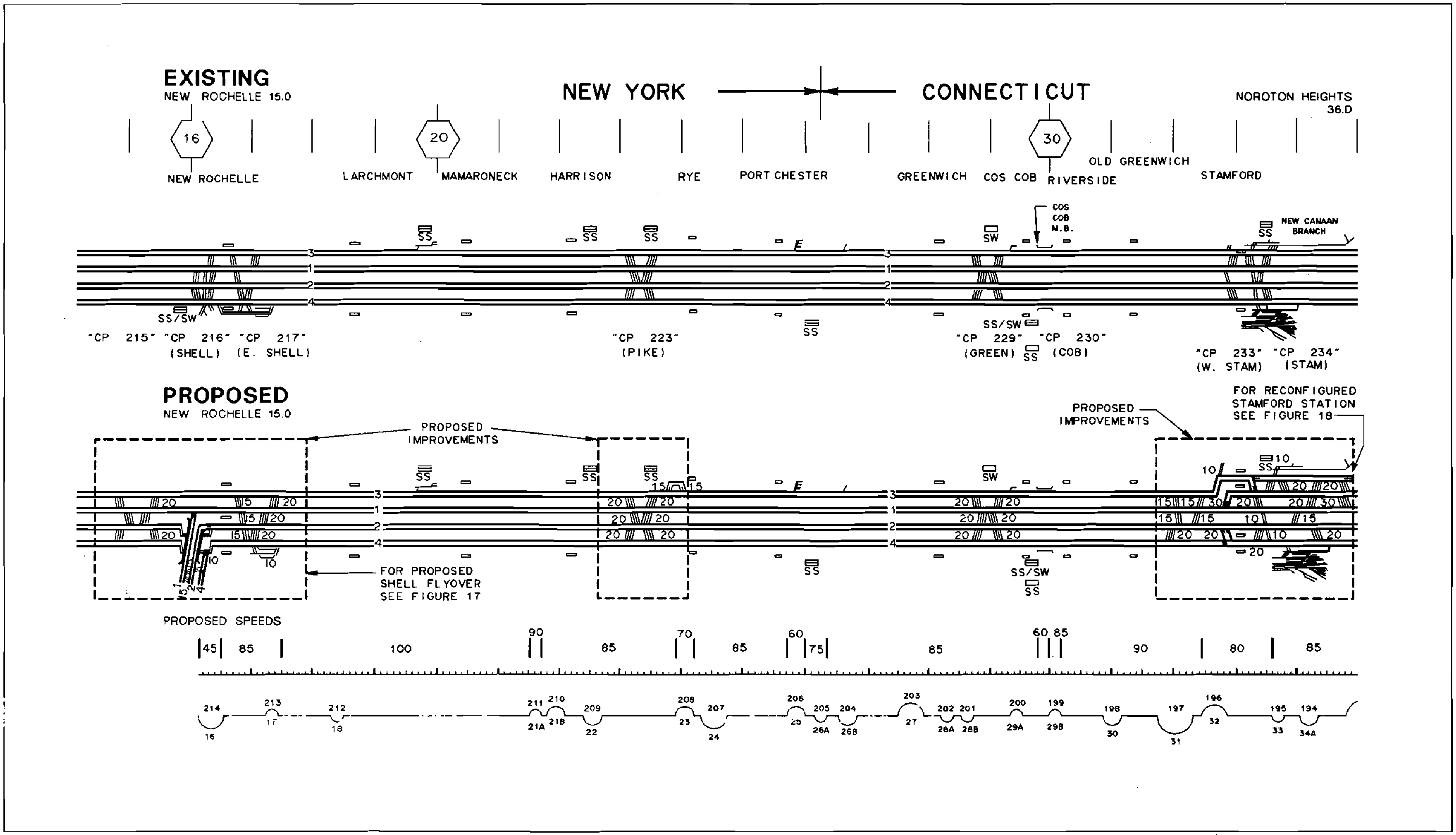
EXHIBIT F-2

PENN STATION (E0) TO NEW ROCHELLE (E18.7)

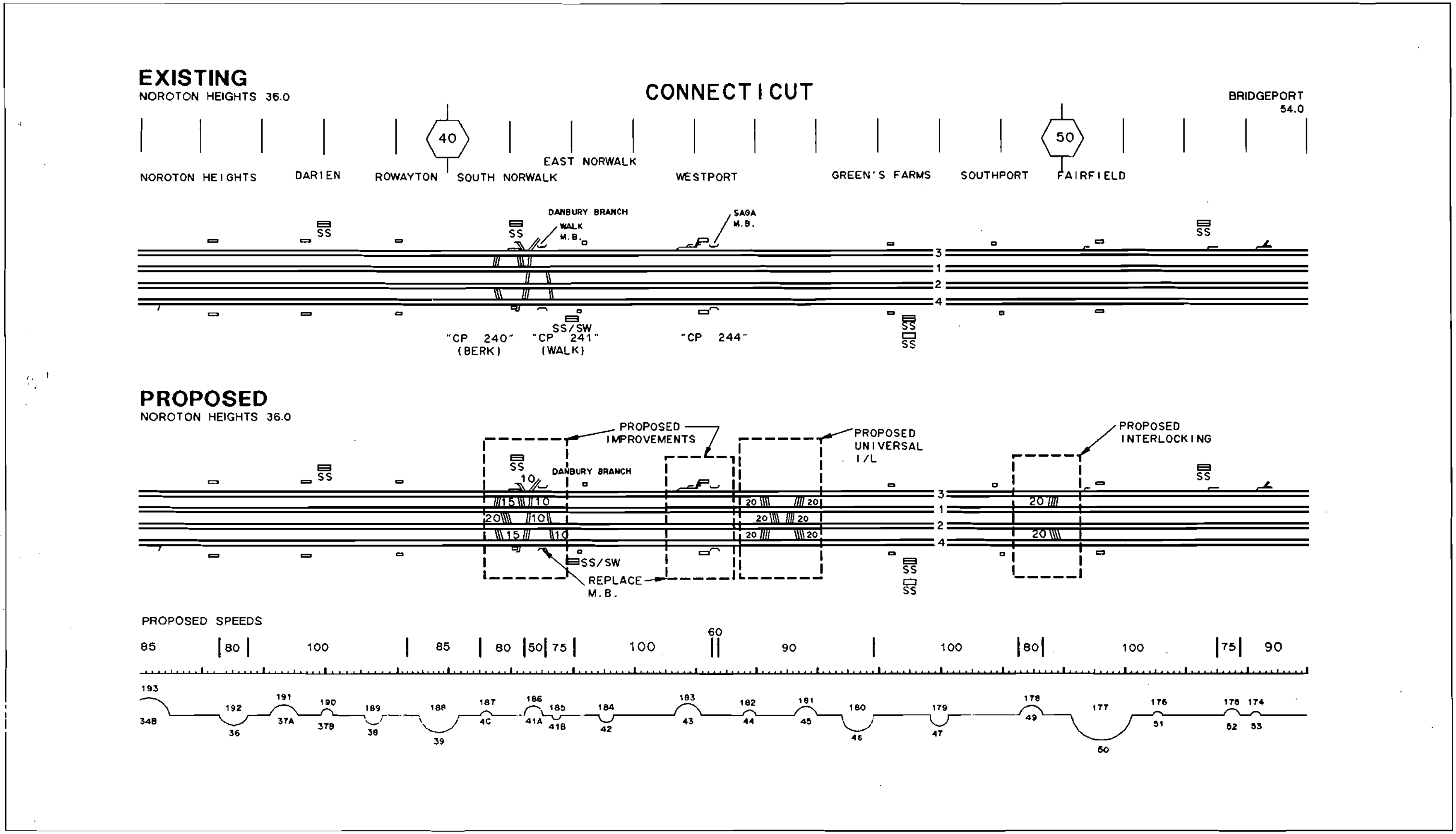
Existing And Proposed 2010 Track Configurations



SCALE IN MILES 0 1 2 3

De LEUW, CATHER

EXHIBIT F-3
NEW ROCHELLE (15.0) TO NOROTON HEIGHTS (36.0)
Existing And Proposed 2010 Track Configurations



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Task Order No. T00001
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SCALE IN MILES 0 1 2 3

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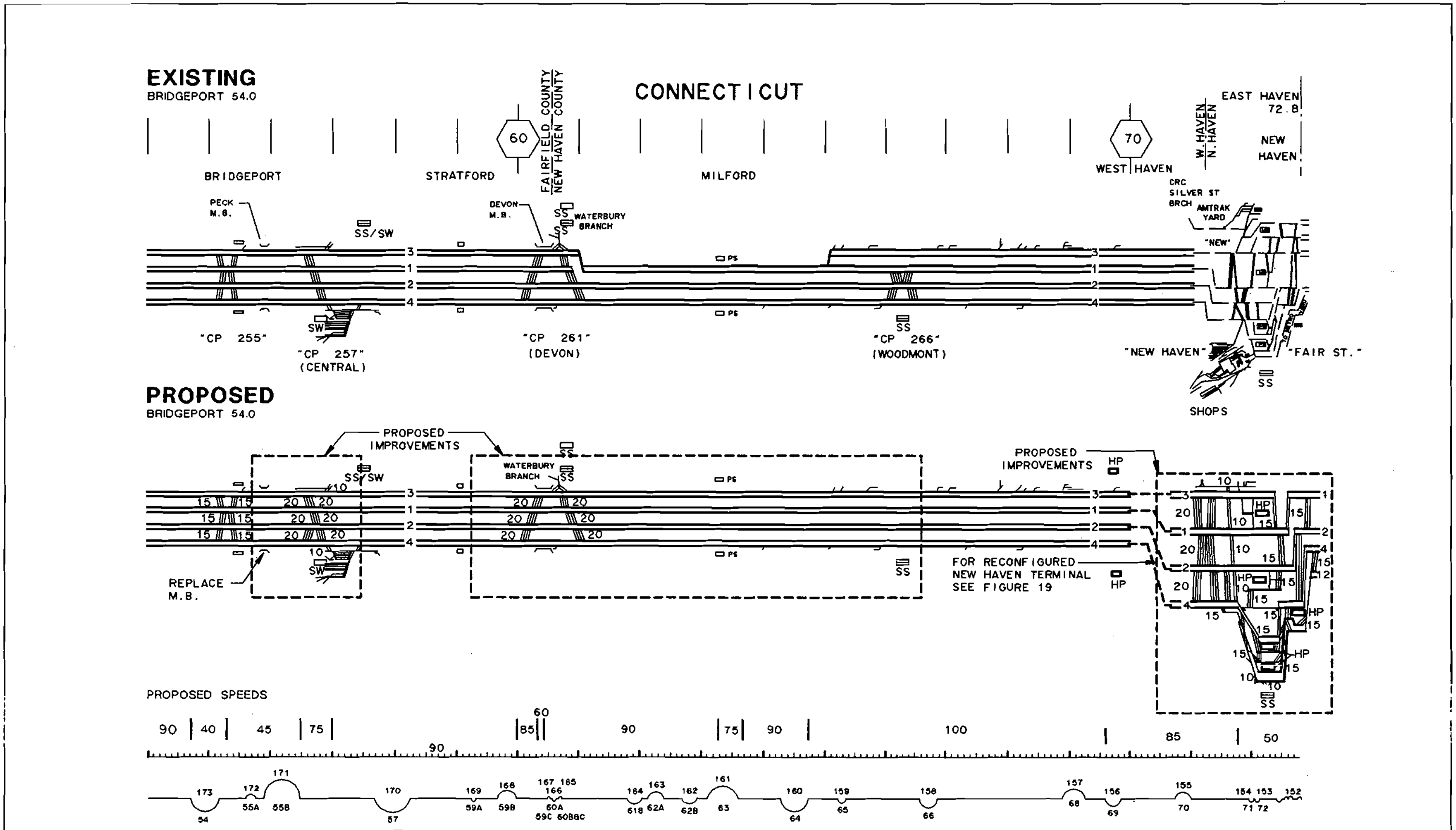
EXHIBIT F-4

NOROTON HEIGHTS (36.0) TO BRIDGEPORT (54.0)

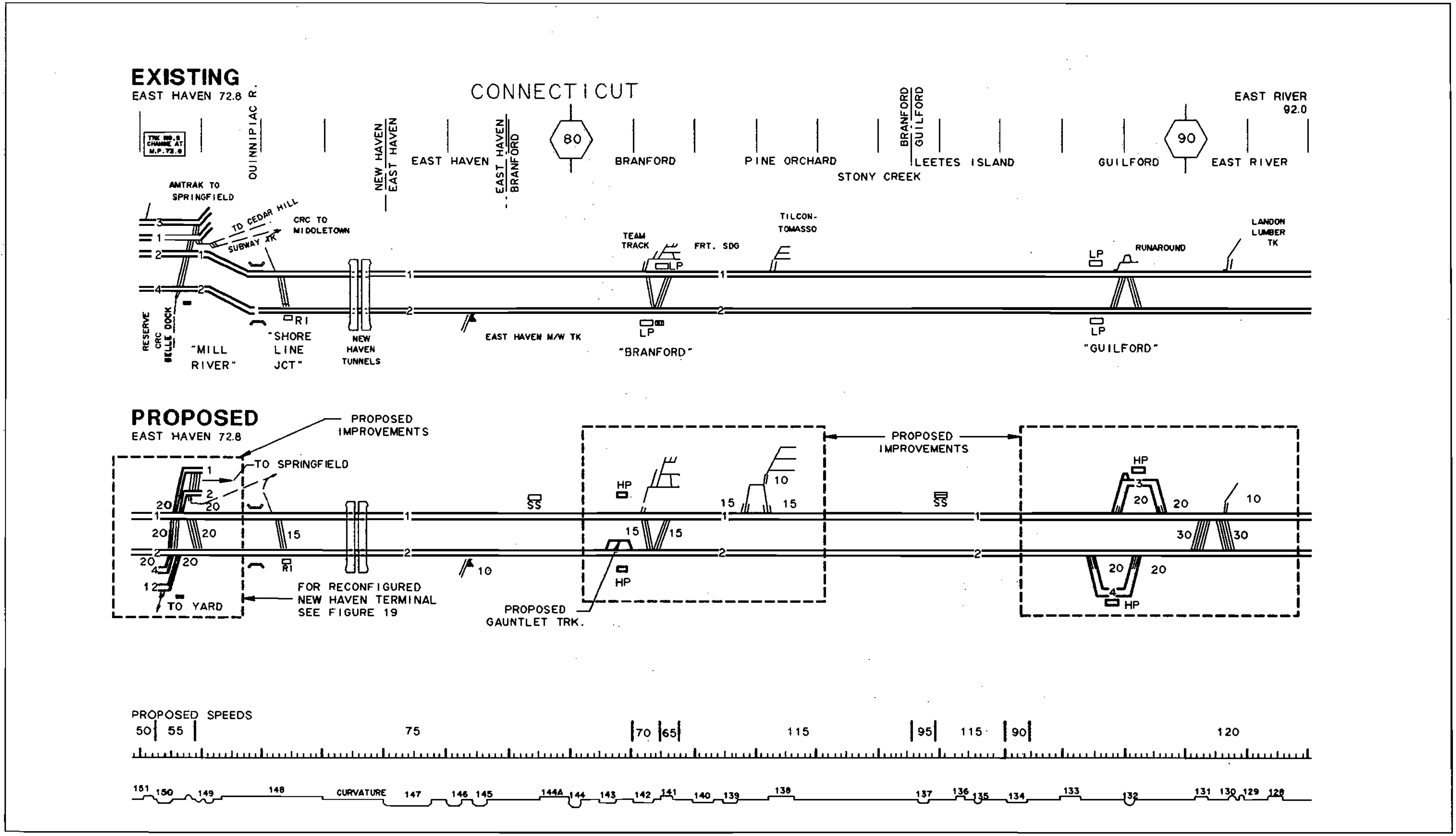
Existing And Proposed 2010 Track Configurations



SCALE IN MILES
0 1 2 3

De LEUW, CATHER

EXHIBIT F-5
BRIDGEPORT (54.0) TO EAST HAVEN (72.8)
Existing And Proposed 2010 Track Configurations



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SCALE IN MILES
0 1 2 3

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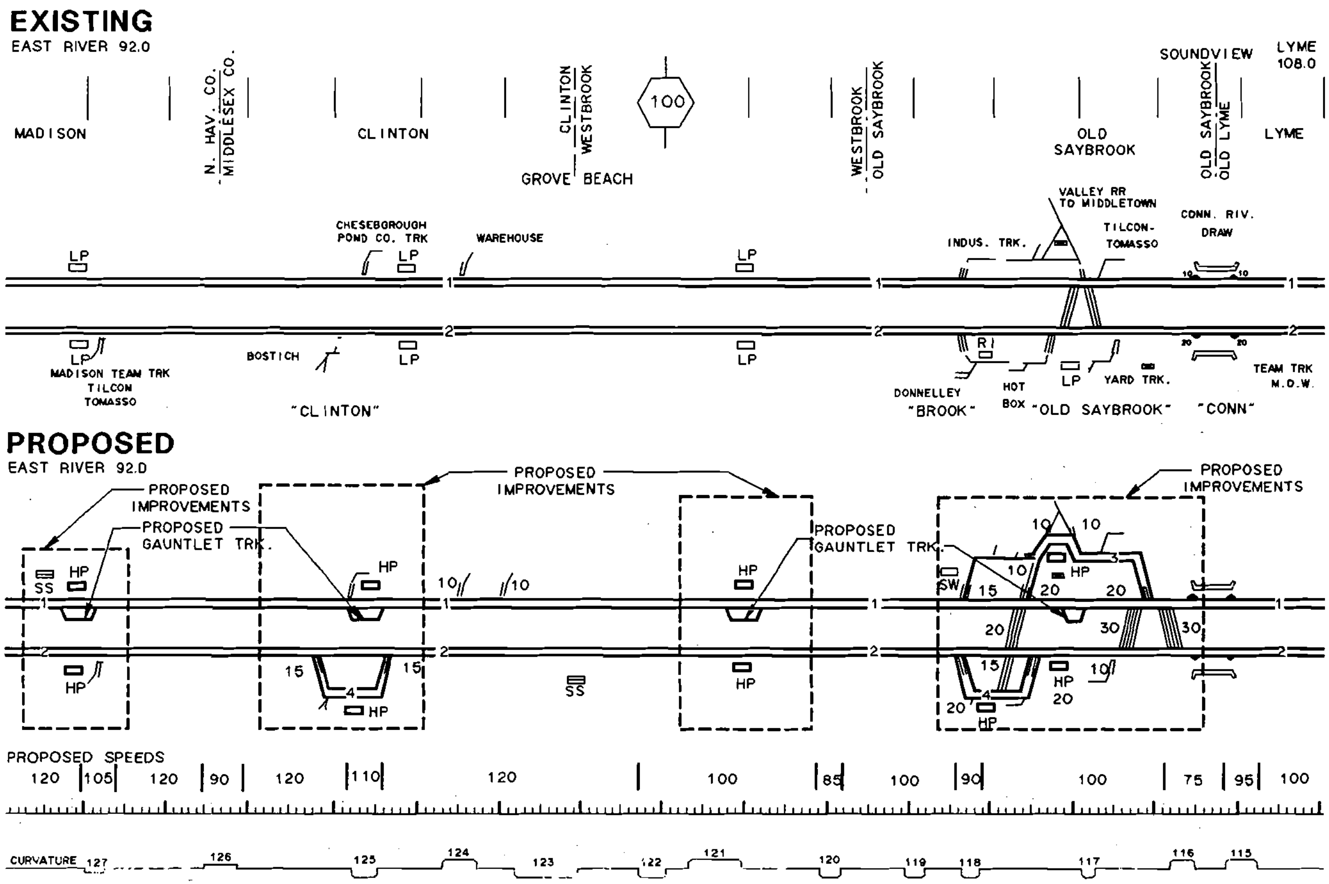
EXHIBIT F-6
EAST HAVEN (72.8) TO EAST RIVER (92.0)
Existing And Proposed 2010 Track Configurations



SCALE IN MILES 0 1 2 3

De LEUW, CATHER

EXHIBIT F-7
EAST RIVER (92.0) TO LYME (108.0)
Existing And Proposed 2010 Track Configurations

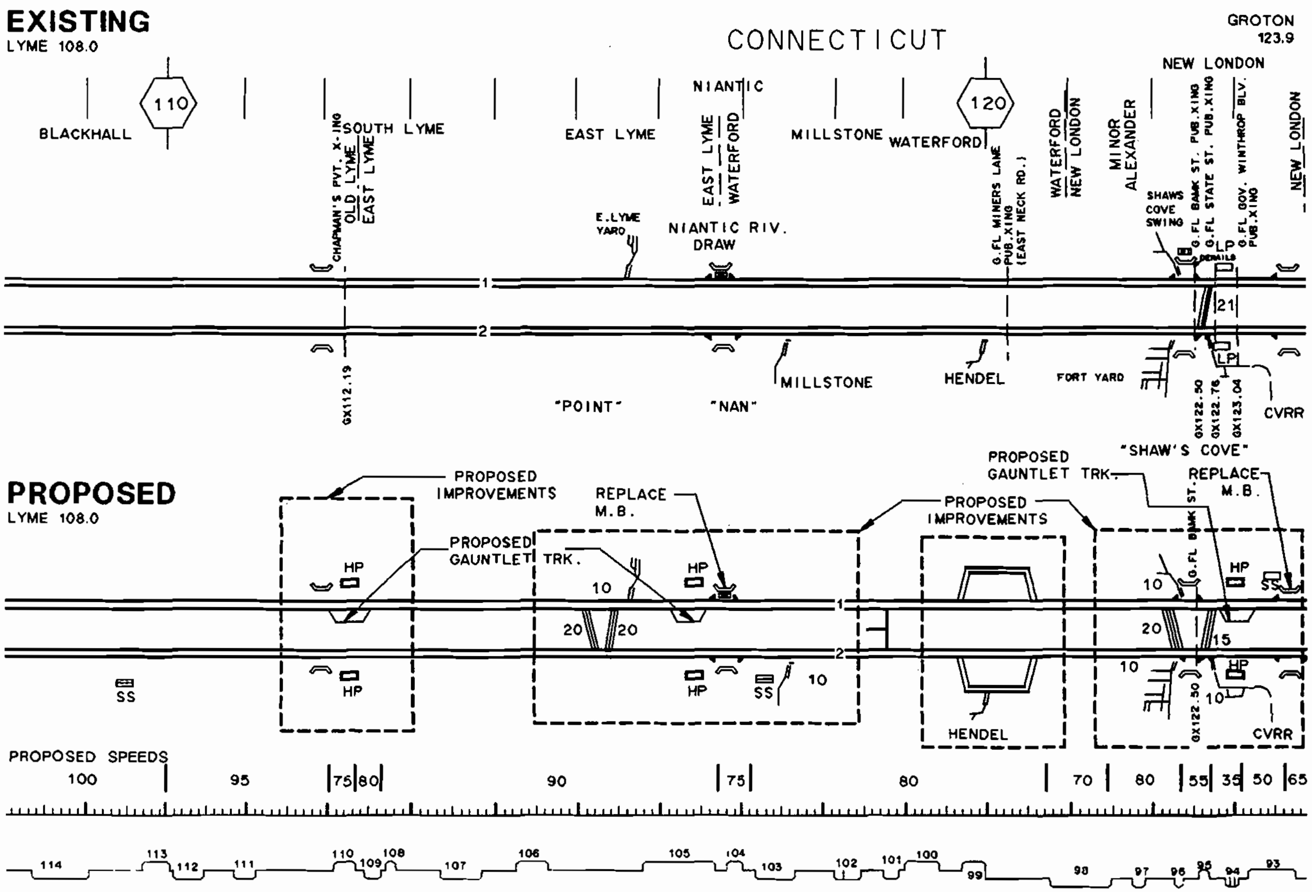


EXHIBIT F-8
LYME (108.0) TO GROTON (123.9)
Existing And Proposed 2010 Track Configurations

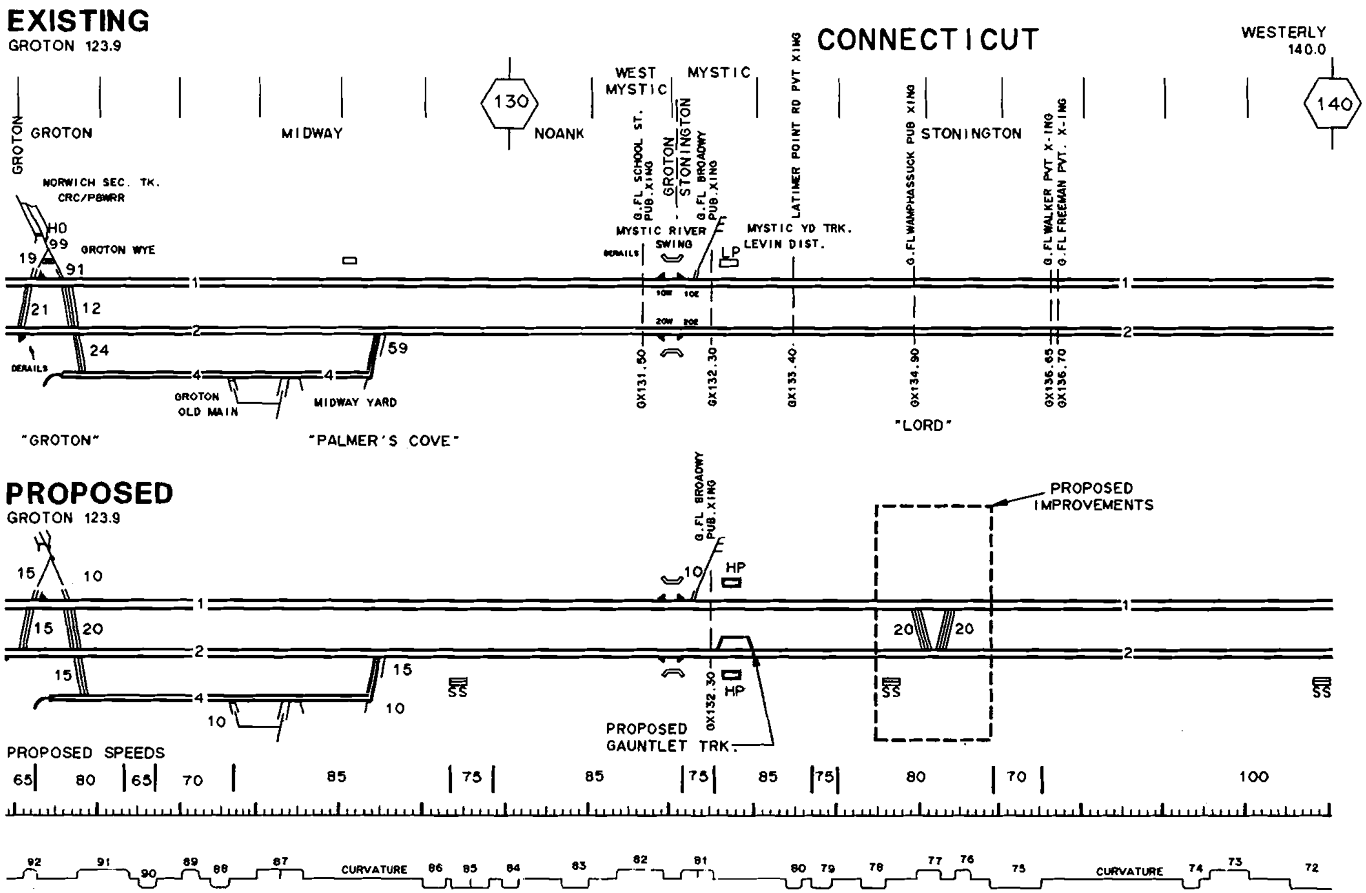
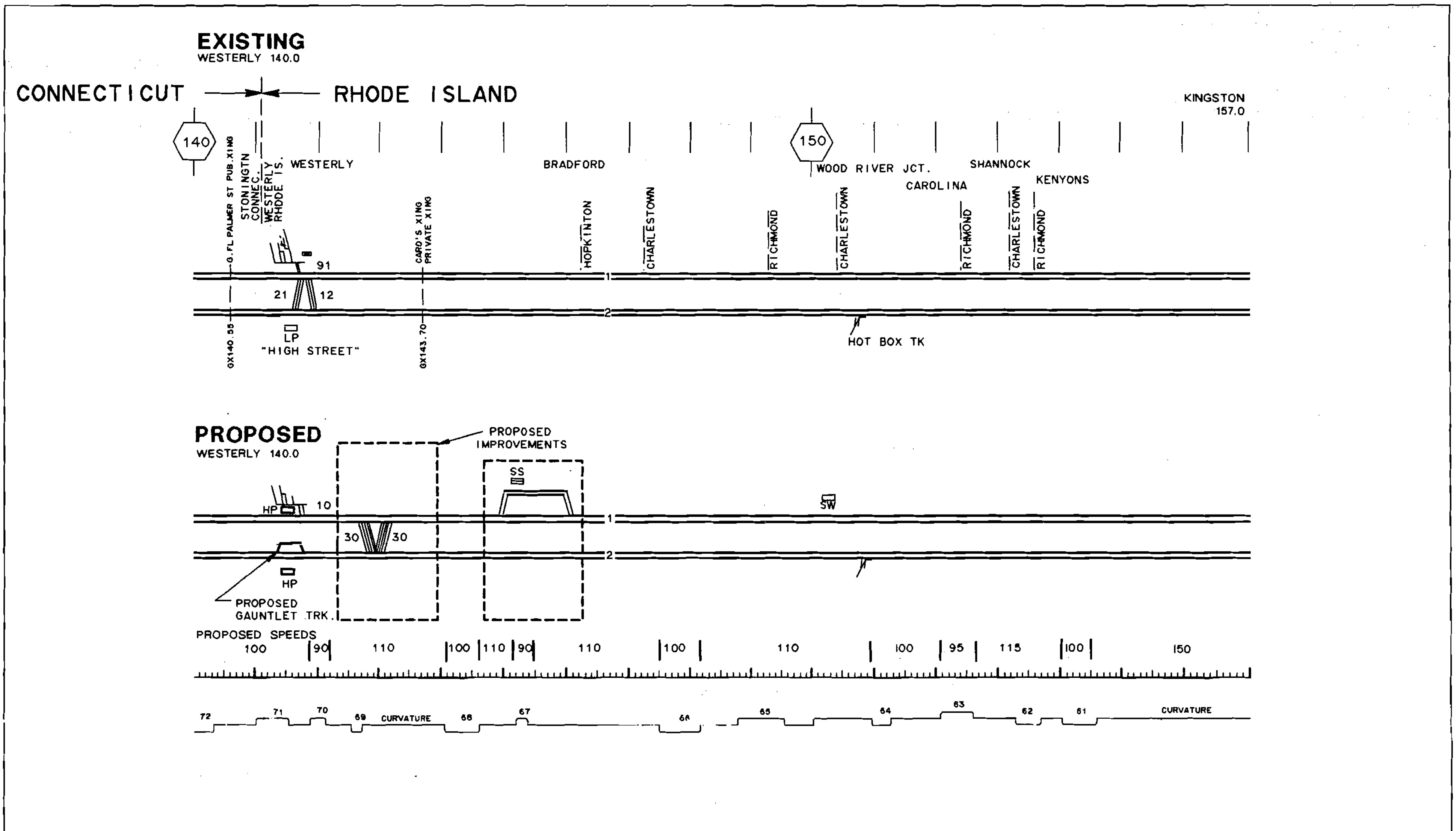


EXHIBIT F-9

GROTON (123.9) TO WESTERLY (140.0)

Existing And Proposed 2010 Track Configurations



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SCALE IN MILES
0 1 2 3

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EXHIBIT F-10
WESTERLY (140.0) TO KINGSTON (157.0)
Existing And Proposed 2010 Track Configurations

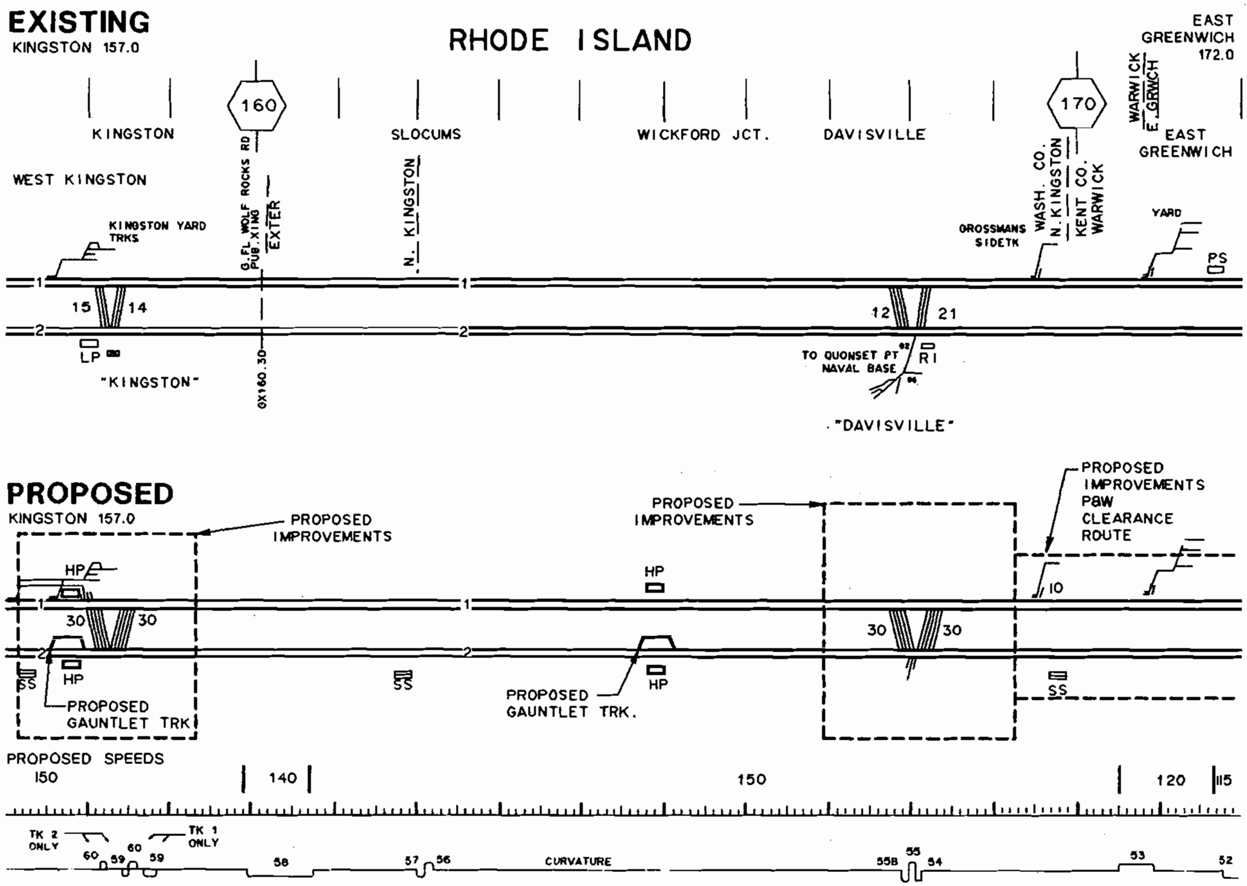

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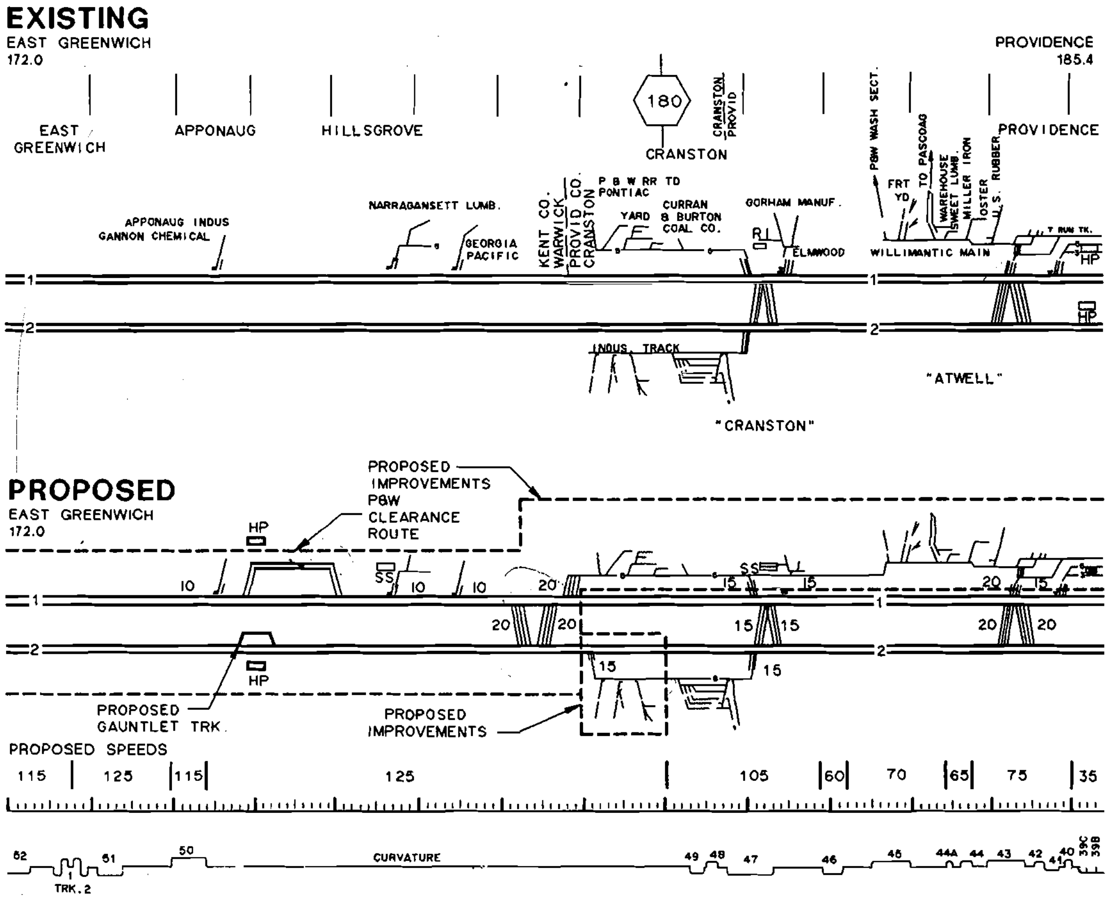
EXHIBIT F-11

KINGSTON (157.0) TO EAST GREENWICH (172.0)

Existing And Proposed 2010 Track Configurations



Task No. 3 - Preliminary Program of Projects

SCALE IN MILES 0 1 2 3

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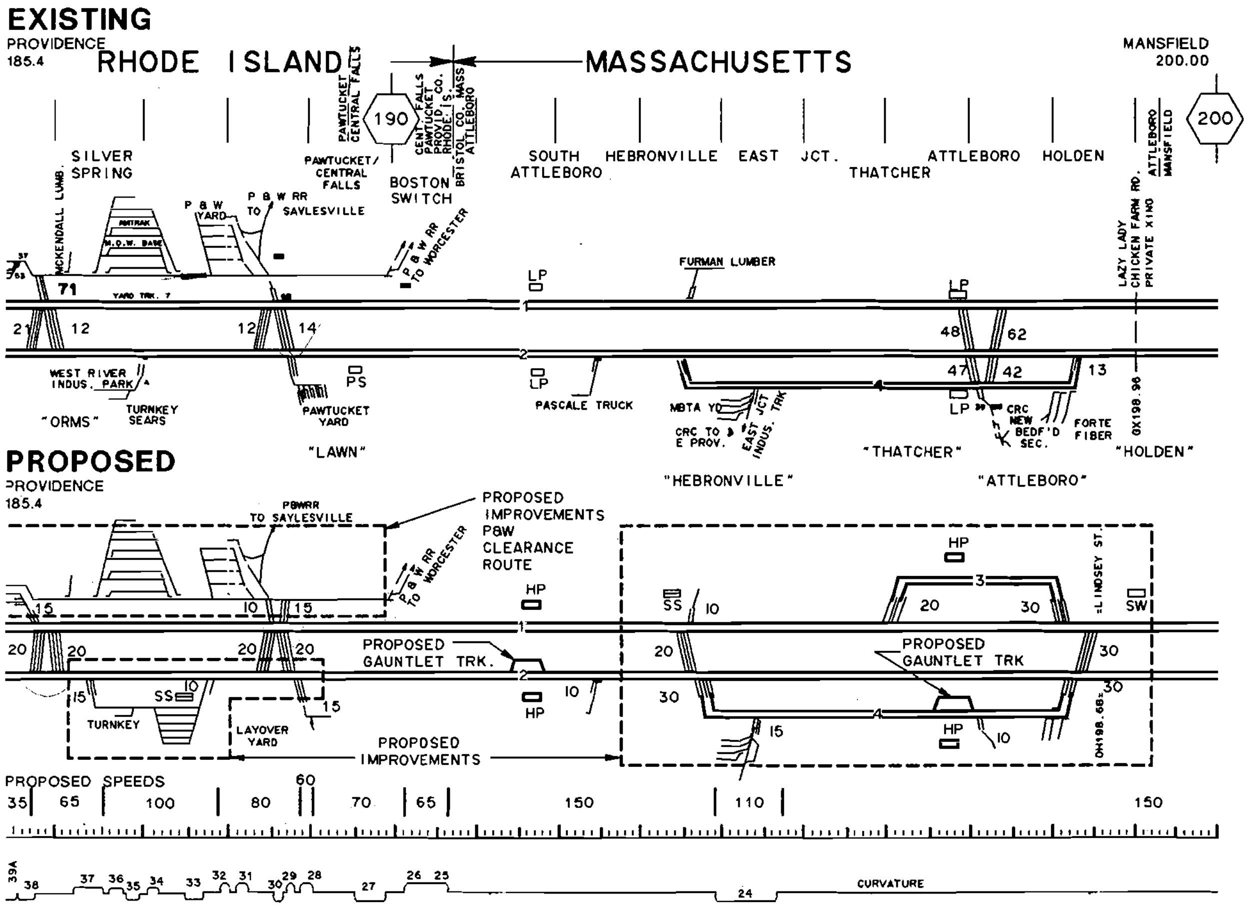
EXHIBIT F-12

EAST GREENWICH (172.0) TO PROVIDENCE (185.4)

Existing And Proposed 2010 Track Configurations



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0 1 2 3

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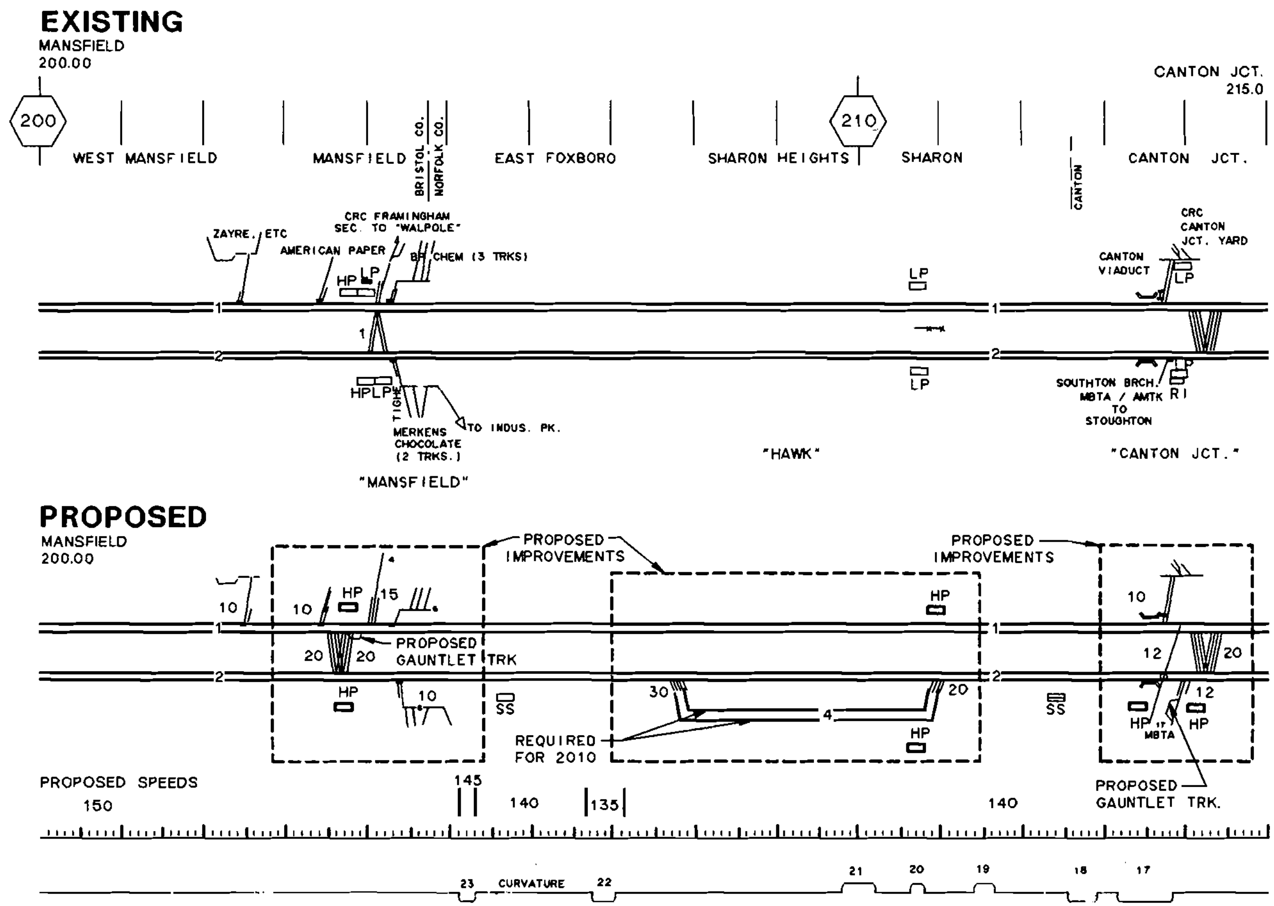
EXHIBIT F-13

PROVIDENCE (185.4) TO MANSFIELD (200.0)

Existing And Proposed 2010 Track Configurations



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SCALE IN MILES 0 1 2 3

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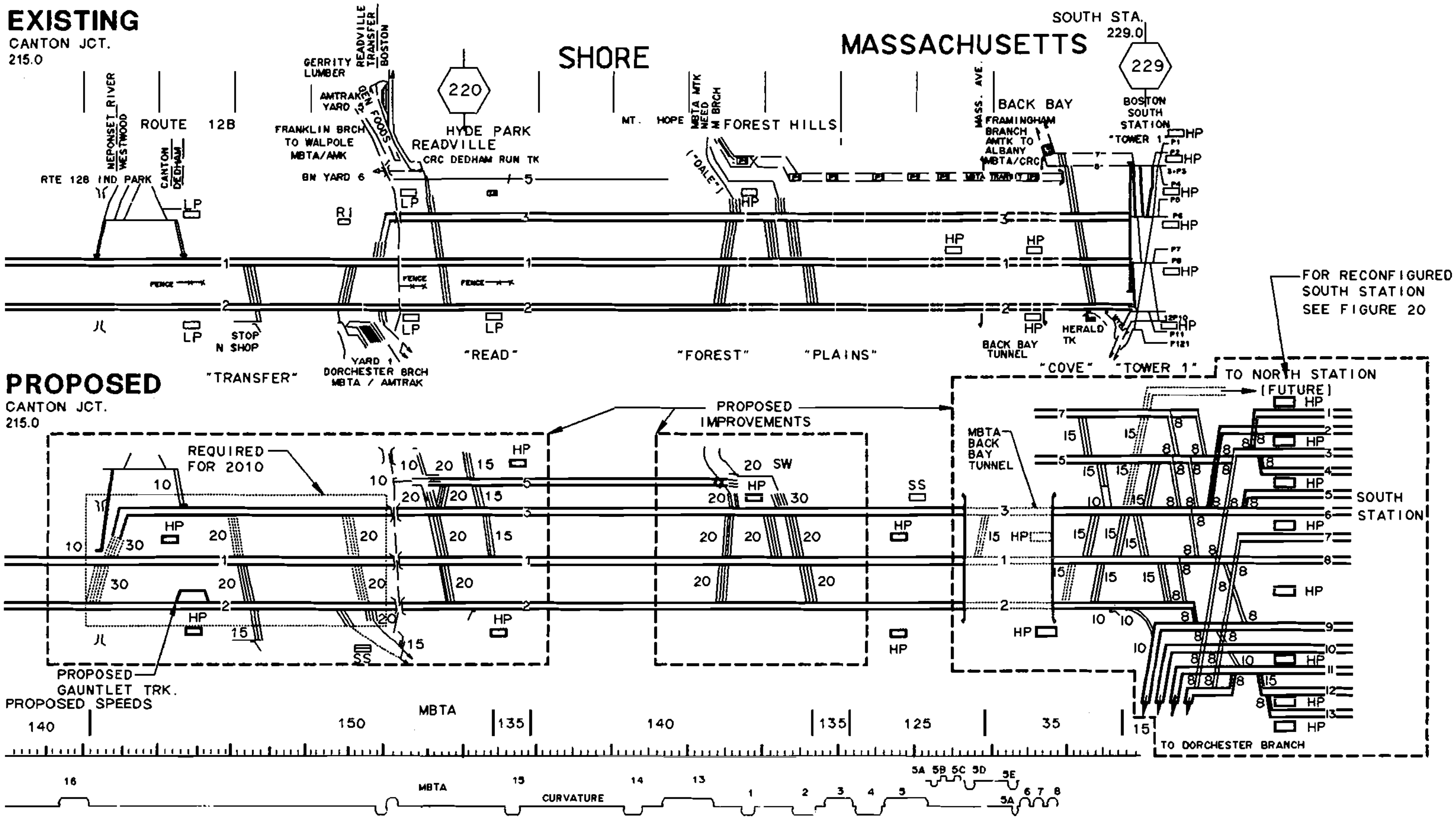
EXHIBIT F-14

MANSFIELD (200.0) TO CANTON JCT (215.0)

Existing And Proposed 2010 Track Configurations



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SCALE IN MILES 0 1 2 3

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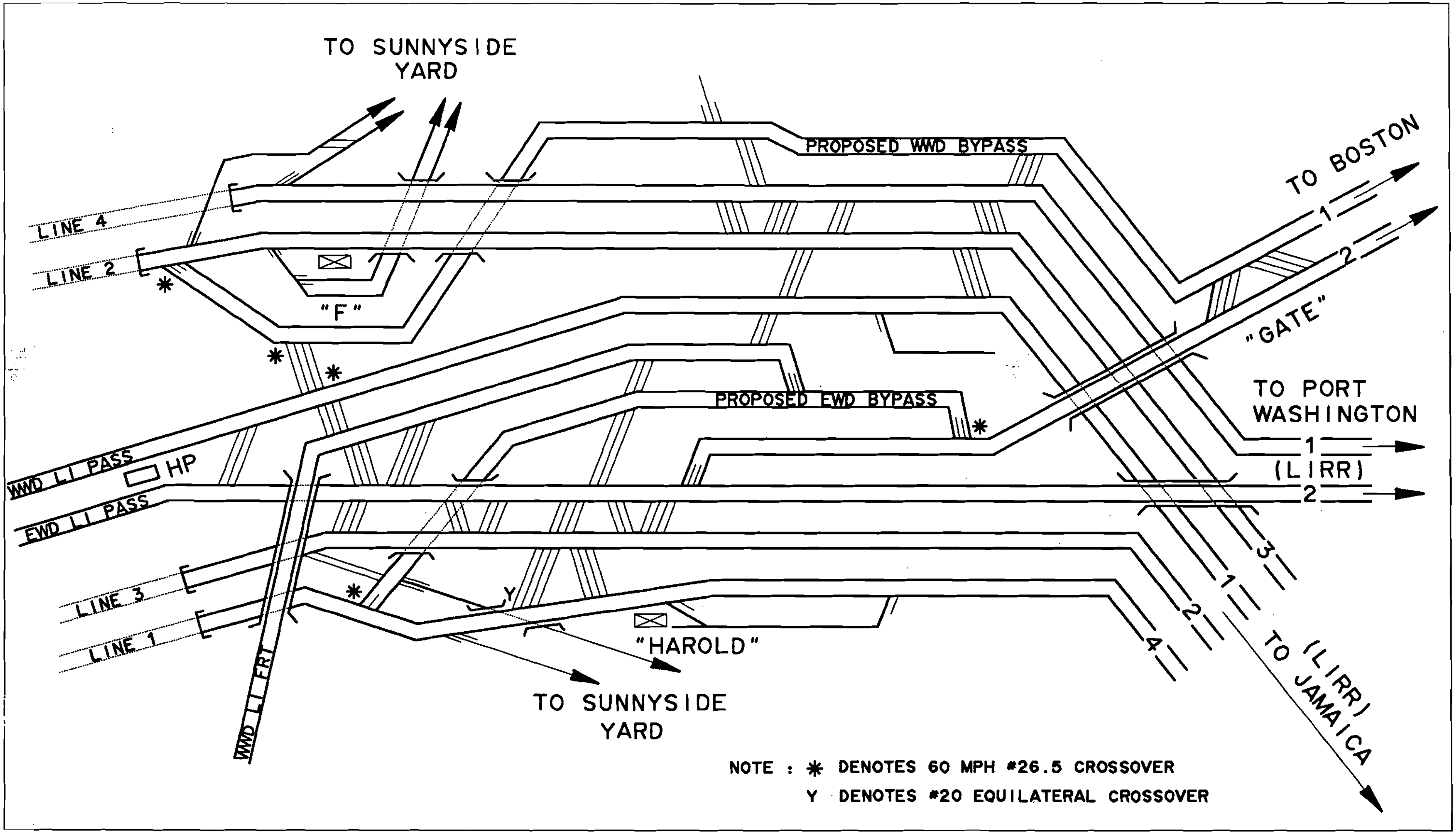
EXHIBIT F-15

CANTON JCT (215.0) TO SOUTH STA (229.0)

Existing And Proposed 2010 Track Configurations



NOT TO SCALE

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EXHIBIT F-16

RECONFIGURED HAROLD INTERLOCKING (E03)

Existing And Proposed 2010 Track Configurations

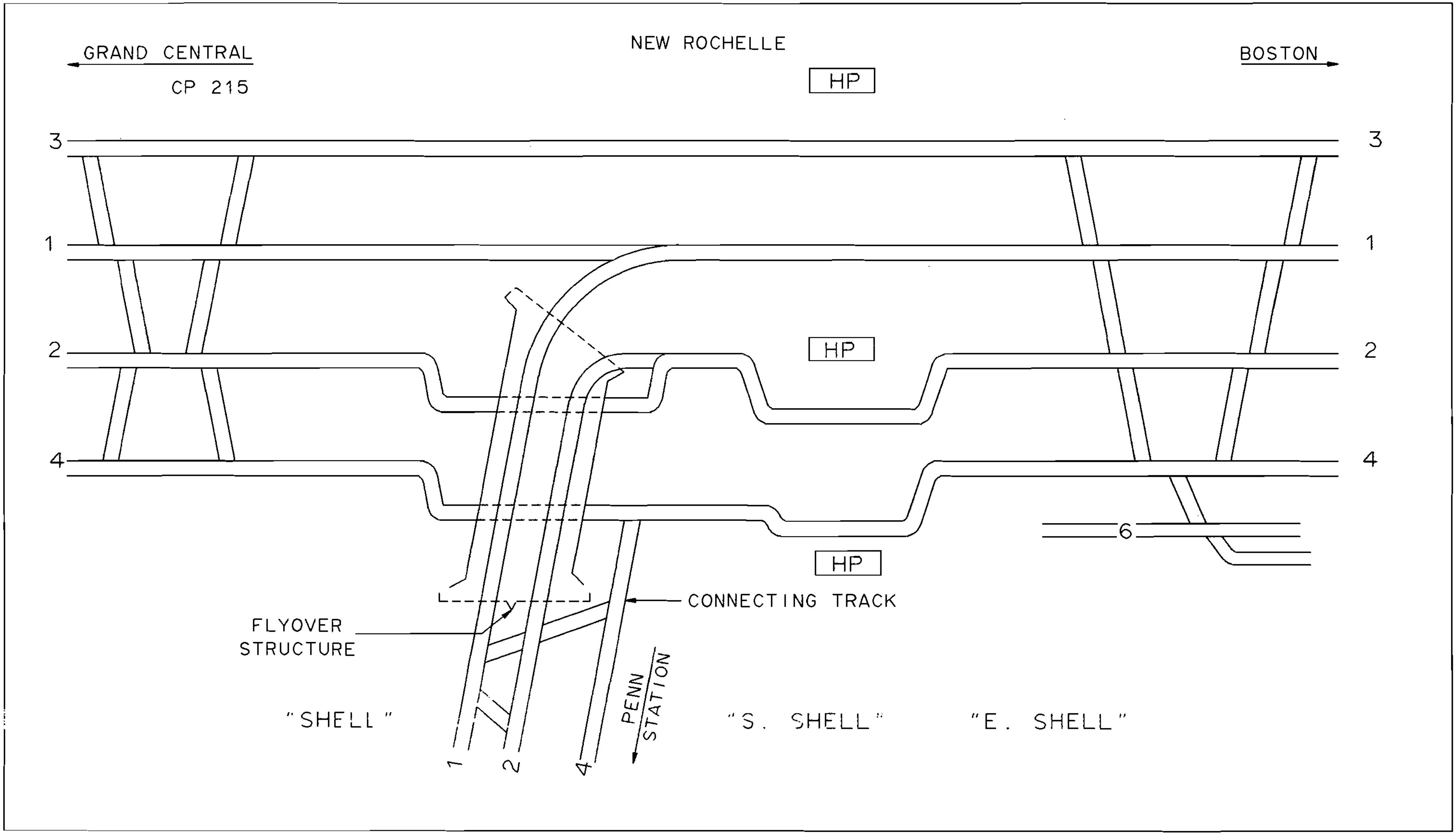

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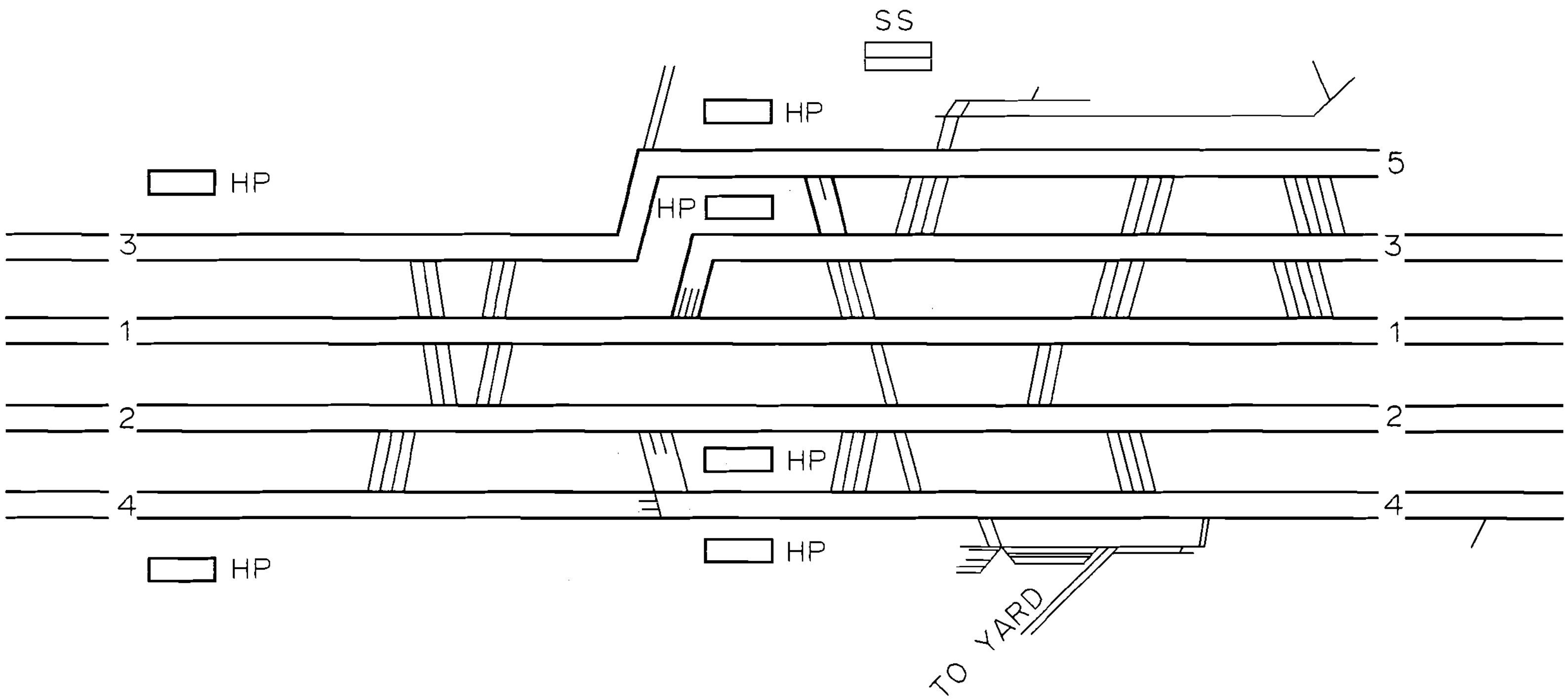
EXHIBIT F-17

PROPOSED SHELL FLYOVER (15.0)

Existing And Proposed 2010 Track Configurations



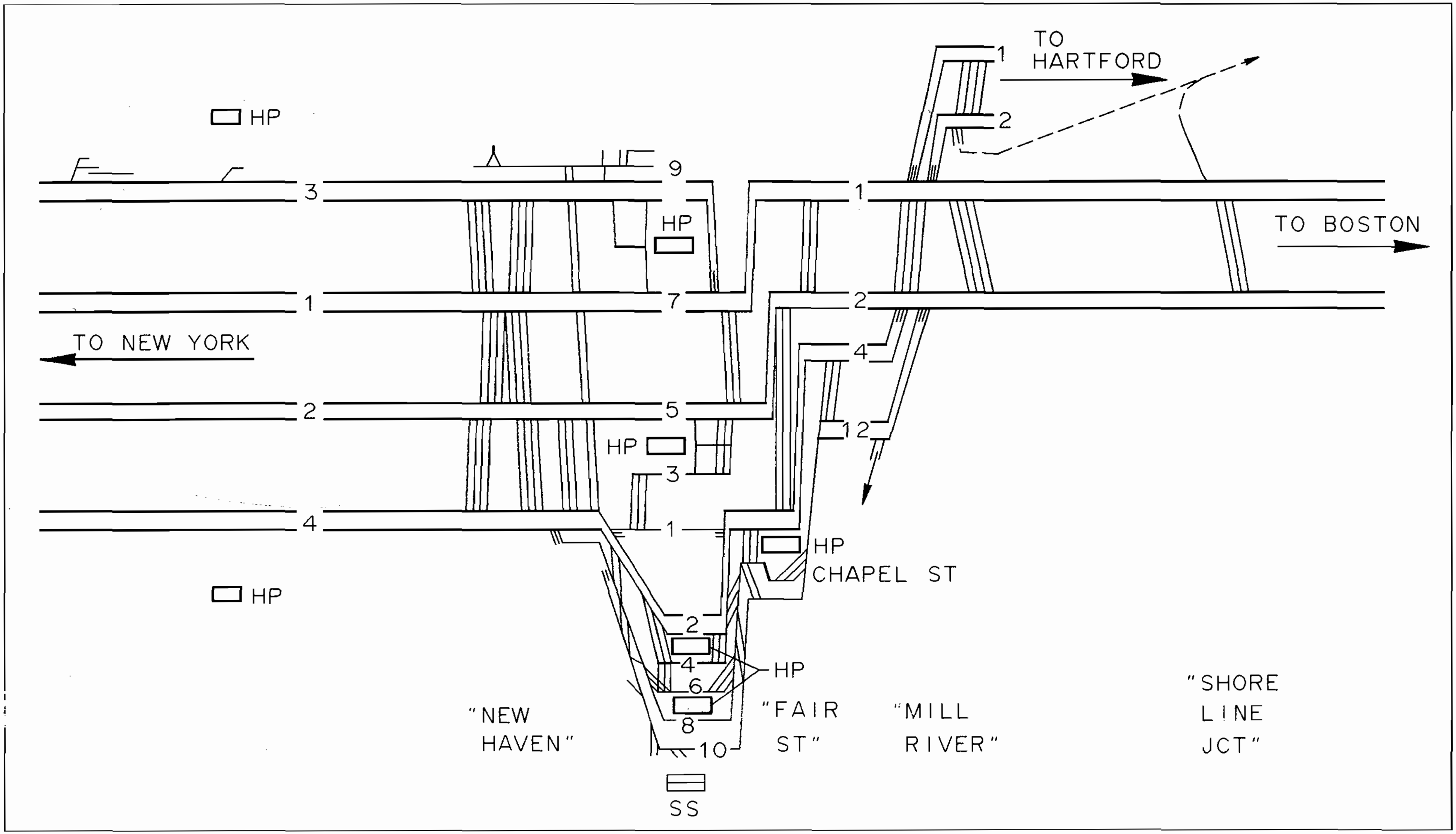
NOT TO SCALE

De LEUW, CATHER

EXHIBIT F-18

PROPOSED STAMFORD STATION (36.0)

Existing And Proposed 2010 Track Configurations



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Task Order No. T00001

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Task No. 3 - Preliminary Program of Projects

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EXHIBIT F-19

RECONFIGURED NEW HAVEN TERMINAL (72.8)

Existing And Proposed 2010 Track Configurations

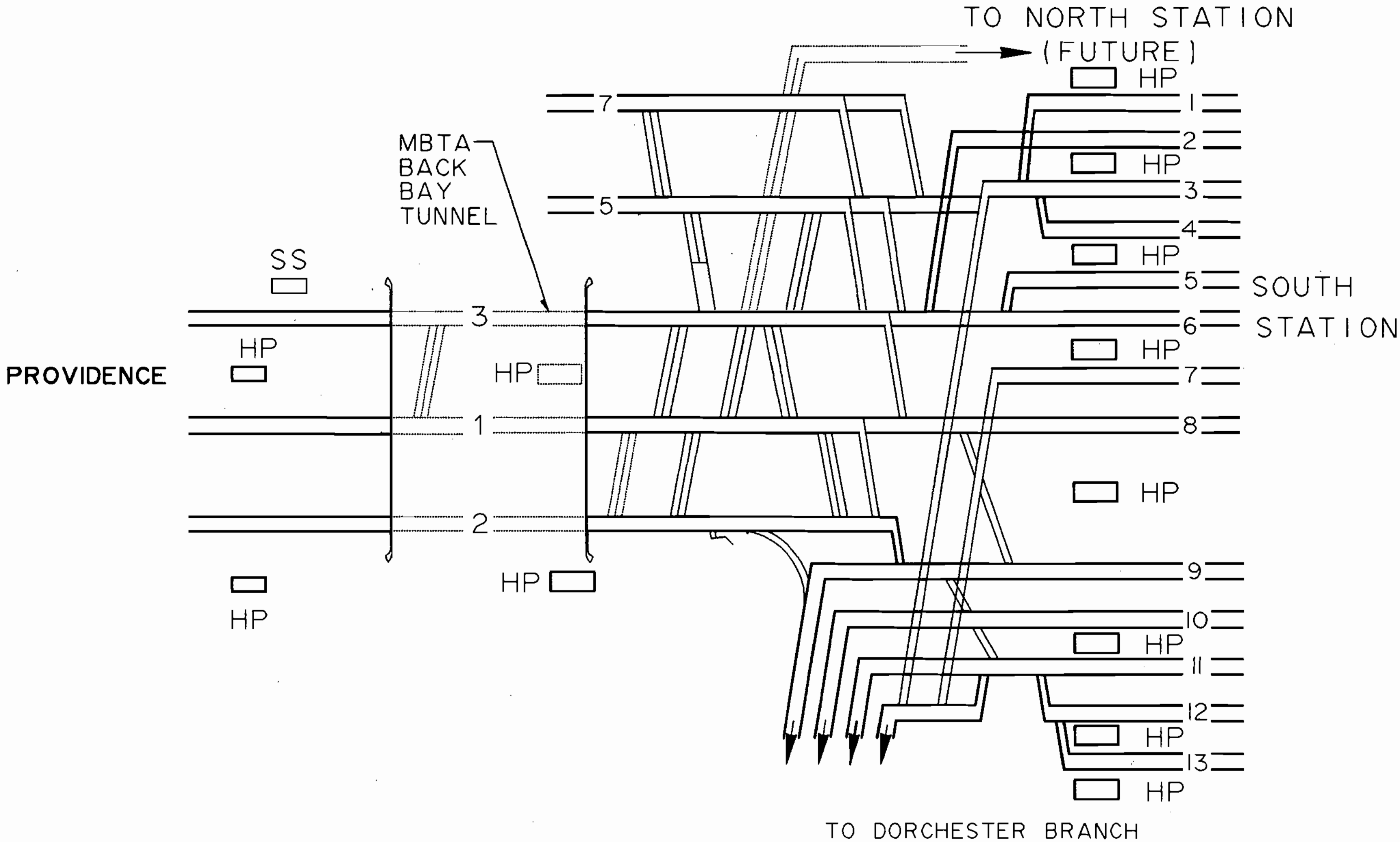

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EXHIBIT F-20

PROPOSED SOUTH STATION (229.0)

Existing And Proposed 2010 Track Configurations

The Northeast Corridor Transportation Plan

New York City to Boston

Volume 2

Appendix G
SCHEDULE OF PROPOSED PROJECTS

APPENDIX G
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Tables

Appendix G
IMPLEMENTATION ISSUES AND CONSTRUCTION SCHEDULES

INTRODUCTION

A schedule for expeditiously implementing the recommended improvement projects is presented in this Appendix. The construction completion requirements that should be satisfied to achieve three significant events, referred to as *milestones*, also are defined. The operational impacts of the schedule also are discussed. Strategies for developing and revising construction plans and schedules are presented in Appendix M. A suggested operating plan during construction also is provided in Appendix M.

The schedule concludes that Amtrak could initiate limited 3-hour New York City to Boston intercity service, to comply with the Congressional mandate, by early to mid-2001. However, an additional eight years would be required to complete the improvements necessary to rehabilitate the railroad infrastructure and optimize the capacity of the railroad to facilitate reliable intercity, commuter and freight service. The schedule provides for expeditious construction of the entire program of projects, while still accommodating a reasonable level of train service--in terms of trip times and frequencies--during the 1993 to 2010 construction period.

As discussed in Appendix M maintaining reasonable service levels, (i.e., no less than existing levels) during construction will require careful joint staging of track outages by the managers of interrelated construction projects (such as reconfiguring New Haven Terminal and relocating the Amtrak New Haven Service Facility). Preliminary operational analyses indicate that a coordinated approach to scheduling intercity, commuter, and freight trains during construction will be required if delays to intercity passengers and commuters are to be minimized. Operations simulations have demonstrated that the schedule is feasible.

METHODOLOGY

Amtrak's "Northeast High Speed Rail Improvement Project Master Schedule" served as a valuable source of schedule data for the presently funded projects being managed by Amtrak. Initial schedule information for several projects also was provided by the LIRR, MNCR, CDOT, RIDOT, and MBTA. The rationales for the schedules were discussed with railroad and agency officials, and revised, if necessary, to reflect current status and to interrelate them with other projects.

Schedules for projects for which only a minimum of conceptual design has been performed were developed based on previous experience with planning, staging and estimating the duration of railroad engineering projects.

Schedules were developed for each of the five geographic operating segments of the Corridor:

- New York Penn Station to New Rochelle, MP E-0 to MP E-18.7
- New Rochelle to New Haven, MP 16.3 to MP 72.8
- New Haven to New London, MP 72.8 to MP 123.9
- New London to Providence, MP 123.9 to MP 185.4
- Providence to Boston South Station, MP 185.4 to MP 229.

Because the level of commuter rail operations varies significantly (Amtrak's schedule is more uniform) along the Corridor, the geographic separation of the project schedules was essential for developing construction durations and analyzing the impact of construction on train operations.

Although some of the recommended projects began prior to January 1, 1993, that date was selected as the first date of the recommended schedule. To conform with the goal of scheduling improvements to facilitate operations in 2010, December 31, 2009 was selected as the closing date of the scheduling window.

Durations

For all but a few projects (those for which construction has already begun or for which design may not be required), two durations for each project were defined: pre-construction and construction. The pre-construction duration includes all design and subsequent procurement activities (including long-lead items such as turnouts and signaling equipment) leading to the initiation of construction. The construction duration consists of all activities, including testing and acceptance, required to place the improvements into service. Schedules at a more detailed level (i.e., long-lead items, testing, etc.) were not developed.

Constraints to Scheduling

Because an adequate level of detail on project-specific resource requirements is not currently available for all of the projects, the schedule are not resource-constrained. That is, it is estimated that sufficient railroad labor, contractor personnel, material and construction equipment will be available to support the construction schedules. The availability of resources should enable construction to be expeditiously and efficiently progressed. One potential labor resource constraint may be the availability of both Amtrak and MNCR personnel to support the proposed level of construction between now and 2002. This factor should be reviewed on an ongoing basis.

The level of funding presently available for NECIP and commuter rail improvements was not considered to be a constraint when establishing project start dates. Instead, design and construction dates were established to ensure that improvements were accomplished in time to meet anticipated needs.

The lack of detailed staging information for numerous projects, such as the reconfiguration of New Haven Terminal and the installation of the 25kV 60Hz center-fed electrification system, prevented the development of detailed, integrated staging plans.

The scheduled running times of intercity and commuter trains need to be adjusted as work proceeds, to reflect either long-term improvements in running times that completion of certain projects will provide, or delays that could occur in the short term as the result of scheduled construction activities.

Milestones

Three milestones, representing significant accomplishments, were identified and attainment established by the completion of critical projects:

- initiate electrified service;
- implement 3-hour New York City to Boston service; and
- complete 2010 requirements.

The schedule estimates when these events would be achieved.

The first milestone, initiation of electrified service, represents the completion of electrifying the Northeast Corridor by constructing an overhead electric wire catenary system between New Haven and Boston. It is presently estimated that electrification could be completed by the fall of 1997. Activities critical to achieving this milestone are subsequently discussed.

When this milestone is achieved, certain improvements necessary to establish reliable three-hour trip time will not have been completed. Therefore, electrification is considered as an interim step toward meeting the second milestone, initiation of three-hour New York City to Boston service. It is anticipated that three-hour service could be initiated as early as 2001.

Finishing all work by 2010 depends on completing certain capacity-related improvements and numerous bridge replacements and other projects categorized as recapitalization projects, i.e., required to revitalize or extend the life of the physical assets of the corridor.

Trip time, capacity, recapitalization, and safety objectives can be satisfied by 2010.

Impact of Construction on Train Operations

The impact of the schedules on train operations was assessed to determine whether reasonable service levels can be maintained during construction. The Monte Carlo™ model was used to develop stringlines of the proposed 2010 operating schedules. Manual analysis, based on extensive personal train operating and dispatching experience, was then applied to re-draw the stringlines for a variety of track outage scenarios. The results of the analyses performed are presented in Appendix M.

CONSTRUCTION SCHEDULE

A construction schedule based on estimated financial and construction scheduling constraints, as well as commuter and intercity train operating considerations is presented in this subsection. The operational impacts and financial implications of the schedule also are presented.

SCHEDULE OF PROJECTS

MILESTONE REQUIREMENTS

Construction projects required to achieve the three milestones (electrified service, three-hour intercity service, and 2010 completion) are discussed below, along with those projects identified as critical to achieving them.

Initiate Electrified Service

Various recommended improvements should be completed before beginning an electrified operation that will supersede diesel intercity operation between New Haven and Boston. These projects have been funded and are being progressed by Amtrak (and in one instance by CDOT). Numerous projects to reduce operating time and improve the reliability of service will not be completed by the fall of 1997. Therefore, initial electrified service between New York City and Boston will be greater than three hours, typically 3½ hours. Capacity on some segments may be slightly less than current levels due to on-going track outages for construction associated with projects necessary to achieve the next milestone.

Based on data available as of February 1994, it is anticipated that electrified operation between New Haven and Boston could begin by the fall of 1997.

Projects Expected to be Completed. The initiation of electrified service anticipates that the following improvements will have been completed.

The installation of a state-of-the art **25kV 60Hz center-fed electrification system** between New Haven and Boston will complete the electrification of the NEC. The work is being progressed as part of a design/build contract, awarded by Amtrak in May 1992, that specifies a 390-day design phase and a 1,000-day construction phase. As presently scheduled by Amtrak, construction is to begin in the fall of 1994 and be completed by the fall of 1997. Construction cannot begin until the Environmental Impact Statement process is completed. Although design delays have occurred and the Draft Environmental Impact Statement has been delayed, construction still could begin in the fall of 1994 as presently planned.

Initiation of electrified service between New Haven and Boston requires that several improvements presently being implemented by Amtrak are completed. They are:

- installation of a **signal system compatible with electrification**, and completion of **Canton Junction to Boston South Station signal modifications**; and
- extension of **CETC from New Haven to Providence**

Electrified operation also requires that several infrastructure improvements be completed. To ensure the continued operation of existing diesel hauled freight services, and to adequately isolate the electrified overhead catenary system (OCS) from the overhead structures, Amtrak should **increase vertical clearance** to numerous structures built over the railroad. Quite often providing the clearances will require taking an operating track out of service. These outages should be coordinated, not only with the electrification work but also with:

- the **realignment of curves** between New Haven and Boston that have been determined necessary to facilitate three-hour service;
- the **track program** to upgrade track structures for operations at increased levels of unbalanced superelevation and higher speeds; and
- **improving horizontal clearances on the Canton Viaduct.**

Placement of catenary support structures on the viaduct requires that construction work be staged so that the electrification is not delayed. Also, it is recommended that an ongoing program to **mitigate certain hazardous step and touch traction return problems** between New Rochelle and New Haven be completed.

The curve realignments should be coordinated with catenary placement between New Haven and Boston to ensure satisfactory electrified operation and to minimize realignment of catenary after initial installation. The OCS should be installed in its final configuration in as many locations as practicable. Curves requiring the shifting and/or rebuilding of undergrade bridges or that have an impact on adjacent facilities, such as high level platforms, will receive priority consideration since design lead times and construction durations will be longer and have more complex staging requirements.

These are the minimum requirements that should be satisfied before diesel operation of intercity trains between New Haven and Boston ceases and electrified service begins.

It is envisioned that initiation of electrified service between New Haven and Boston would not require delivery of all **26 high speed Amtrak intercity passenger trainsets.** Amtrak could begin the service using its existing Intercity fleet to operate high speed service each business day between Boston, New York City and Washington. As high speed passenger trainsets are delivered, the frequency of service could be increased until the planned 16 per day are operating. The existing Intercity fleet cannot attain the planned 150 miles per hour maximum speed, so a maximum authorized speed of 125 miles per hour would be in force initially.

As presently scheduled, neither the grade crossing elimination program nor the fencing of all sensitive areas will be completed prior to beginning electrified service and therefore were not considered a constraint to the initiation of electrified service. As a minimum, however, priority sensitive areas should be fenced, and crossings where speeds are expected to exceed 80 miles per hour should be eliminated and/or upgraded prior to starting electrified service.

Train Service Times When First Milestone is Achieved. TPC simulations have estimated the level of improvement in running times for both goal and conventional trains, i.e., what will the trip times be in the fall of 1997 when electrified operations are initiated. Since the major improvements at Harold, Shell, Stamford and New Haven will not have been completed by then, the improvements are basically the result of improvements between New Haven and Boston, as previously discussed. As summarized below intercity trains save 32 minutes, while conventional trains save approximately 40 minutes. The amount of reduction in trip time for conventional trains is greater for two primary reasons: Amtrak presently schedules a longer New Haven stop for conventional trains than intercity trains (for this comparison Train 193 does not merge with a Springfield Train) and the improved operating characteristics of the AEM-7 reduce the delays making station stops.

IMPROVEMENT	TIME SAVED GOAL TRAIN (minutes:seconds)	 CONVENTIONAL TRAIN (minutes:seconds)
Electrify (New Haven-Boston)	6:23	11:05
Eliminate Engine Change	9:00	14:00
Adjust Train Consist (to 6 Amfleet Coaches to reflect increased demand)	1:10	N/A
Increase Curve Speeds (New Haven-Boston) E_u=5"	17:42	14:57
Total Time Saved	31:55	40:02

The results of the simulations are contained in Tables G-1 through G-3. Since the majority of the new trainsets would not yet be delivered, the goal train runs in Table G-1 were based on speeds calculated at only 5 inches of unbalanced superelevation (the limit of the current AEM-7s). Only when new trainsets are used by all goal trains would 150 miles per hour maximum speed and speeds calculated at 8 inches of unbalanced superelevation be allowed.

The bases for these simulations were consistent with those described in Section VI. Essentially, the runs combined the results from the upgraded facility scenario between Boston and New Haven (excluding the reconfigured New Haven terminal) with the results of the Baseline scenario between New Haven and New York City. The trip time reductions from the overall Baseline and from the Baseline (All-Electric) TPC times are discussed below.

The interim improvement in goal train times from the Baseline (Table G-1) is about 33 minutes (for an AEM-7 engine plus 5 amfleet cars) or about 32 minutes for a 6-car train; the improvement from the Baseline (All-Electric) case is about 18 minutes for a 5-car train or 17 minutes for a 6-car train. Amtrak could possibly establish selected four-stop trains with scheduled trip times of three hours 40 minutes to three hours 50 minutes, depending upon the pad established for that time frame in the construction program.

The improvement in the running time of an eight-stop conventional train (Table G-2) would be about 40 minutes compared with the Baseline run and about 15 minutes compared with the Baseline (All-Electric) run. Amtrak could possibly establish four-stop eight-stop conventional trains with scheduled trip times of 4 hours to 4 hours 10 minutes, depending upon the pad established for that time frame in the construction program.

The running time savings for a 12-stop conventional train (Table G-3) would be about 41 minutes compared with the Baseline run and about 14.5 minutes when compared to the Baseline (All-Electric) run. Amtrak could possibly establish 12-stop conventional trains with scheduled trip times of 4 hours 10 minutes to 4 hours 20 minutes, depending upon the pad established for that time frame in the construction program.

Trip Times After Delivery of New Trainsets. After delivery of the new trainsets, an additional improvement in goal train times between New Haven and Boston from the interim improvements of about 12 minutes could be attained. Amtrak could possibly establish four-stop goal trains with scheduled trip times of three hours 30 minutes to three hours 40 minutes, depending upon the pad established for that time frame in the construction program.

Areas of Concern. The electrification design and build contractor has not completed the 60 percent design submittal as of the end of January 1994. However, it is apparent that the track configuration provided to the contractor does not conform to what has been agreed to by all parties. Amtrak should expeditiously provide 40-scale drawings to enable the contractor to proceed in accordance with the agreed configuration. A final design should be submitted by the middle of 1994 if the fall 1994 construction start date is to be met.

Agreements to authorize the design of many improvements by commuter agencies have yet to be consummated. Unless these are expeditiously completed, delays to construction may occur. Of particular concern is the lack of agreement regarding the Canton Viaduct. Recent analysis indicates that catenary poles cannot be installed along the length of the viaduct until at least half of the widened deck is installed.

NEW HAVEN TO NEW LONDON

By the spring of 1994, to facilitate operations during construction of the electrification system and minimize construction-related delays, Amtrak will install **high speed universal interlockings with No. 30 crossovers** at two locations in this segment and two between New London and Providence. As an interim solution to the problems associated with operating SLE commuter trains and intercity trains in this double track segment, **existing stations at Branford and Westbrook will be relocated to the south side** of the right-of-way.

NEW LONDON TO PROVIDENCE

Restoration of **Kingston Station and construction of an intermodal transportation facility** is being progressed by RIDOT. Construction of the initial restoration and site work is estimated to be completed by the beginning of 1996.

PROVIDENCE TO BOSTON

Construction of **passing sidings at Attleboro and from Readville to Forest Hills (Track 5)** should be staged with installation of catenary and should be completed by the spring of 1997. Installation of turnouts and construction of sidings is planned to be staged, location by location, with the installation of high platforms, cross track access structures, and gauntlet tracks to minimize impacts on normal intercity and commuter operations.

NEW YORK CITY TO BOSTON CORRIDOR WIDE-IMPROVEMENTS

A program to **test MNCR, SLE and MBTA commuter equipment** and evaluate the impact of operating at increased speeds should be initiated by mid-1994 and be completed by mid-1996. These testing program(s) need to be completed, and any corrections implemented before increasing the present maximum operating speed of existing commuter rail equipment. A study to analyze the operating and maintenance costs associated with the initiation of high performance intercity service also should be undertaken. The study also will address methodologies to allocate these costs amongst owners and users. Improvements to enhance communication with commuters include installing **public address systems at commuter and intercity stations**. Improvements to enhance communication with commuters also includes **installing approach warning signs and bells**.

The construction of several other improvements will be progressed during this period but will not be completed prior to the start of electrified operation. They are summarized in a subsequent subsection.

Initiation of Three-Hour New York City to Boston Service

Once electrified service begins, a significant number of projects that reduce trip time and/or provide additional capacity to various segments of the NEC north of New York City will still be uncompleted. The rationale for the scheduling of these improvements is presented below.

Significant terminal and interlocking reconfigurations and other time-saving improvements, as well as improvements anticipated to increase capacity, should be completed before the initiation of three-hour New York City to Boston service. These improvements have been identified as necessary to enable a TPC trip time with sufficient pad (seven to eight percent) to be achieved. With this amount of pad, Amtrak should be able to schedule and operate the mandated service. The improvements also will accommodate future levels of commuter service and should enable reasonable on-time objectives to be attained.

The initiation of 150 miles per hour, high performance, intercity service also would depend upon implementing a positive stop/civil speed enforcement system between Boston and New York City, which will enforce positive stops at junction points, and civil speed restrictions caused by stations, bridges, or curves. Successful implementation includes completing wayside modifications and equipping all intercity locomotives and trainsets used in the territory. Modification of commuter and freight locomotives, cab cars and multiple unit commuter equipment would be required as part of this project.

Estimated Start of Three-Hour Service. Based on the latest data available as of December 1993, it is estimated that three-hour service between New Haven and Boston could be initiated by early 2001. The controlling projects are the reconfiguration of Shell Interlocking, the realignment of selected curves between New Rochelle and New Haven, the installation of concrete ties on the two inside tracks between New Rochelle and New Haven, and the implementation of the wayside positive stop/civil speed enforcement improvements. Numerous projects to increase capacity in the NHL, SLE and MBTA commuter segments will have been completed prior to achievement of this milestone.

Table G-1

COMPARATIVE SIMULATED RUNNING TIMES FOR GOAL TRAINS

With Various Train Consists and Facility Configurations

Showing Effect of Improving Boston-New Haven Section Only

Four Intermediate Stops[1]

Train Consist	Baseline: Existing TT Speeds	6"E_a+5"E_u (BO-NH)/ Existing TT (NH-NY)	Difference From Baseline[2]
F40PH+5 Amfl. (BO-NH)/ 1-AEM-7 + 5 Amfl. (NH-NY)	3-50.6[3]	N/A	N/A
1-AEM-7 + 5 Amfleet	N/A	3-17.5[4]	33.1 (17.7)
1-AEM-7 + 6 Amfleet	N/A	3-18.7	31.9 (16.5)

[1]Intermediate stops (one-minute dwell) at Back Bay, Route 128, Providence, and New Haven (included in the engine-change allowance for the Baseline run only; see footnote 3).

[2]Figures in parentheses indicate difference compared to Table M-1.

[3]Includes a 10-minute engine change allowance at New Haven.

[4]The Boston-New Haven time was estimated from the TPC results for the Baseline (All-Electric) case.

Table G-2

COMPARATIVE SIMULATED RUNNING TIMES AND TIME SAVINGS FOR CONVENTIONAL TRAINS

Based upon Present Stop Pattern of #1711[5]
(Typical Stop Pattern)

Showing Effect of Improving Boston-New Haven Section Only

Train Consist	Baseline: Existing TT Speeds	6"E_a+5"E_u (BO-NH)/ Existing TT (NH-NY)	Difference From Baseline[6]
F40PH+8 Amfl. (BO-NH)/ AEM-7 + 8 Amfl. (NH-NY)	4-13.3[7]	N/A	N/A
AEM-7 + 8 Amfleet	N/A	3-33.3	40.0 (15.0)

[5]Includes stops (one-minute dwell) at Back Bay, Route 128, Providence, New London, Old Saybrook, New Haven (included in the engine-change allowance for the Baseline run only; see footnote 3), Stamford, and New Rochelle.

[6]Figures in parentheses indicate difference compared to Table M-9.

[7]Includes a 15-minute engine change allowance at New Haven.

Table G-3

COMPARATIVE SIMULATED RUNNING TIMES
AND TIME SAVINGS FOR CONVENTIONAL TRAINS

Based upon Present Stop Pattern of #193[8]
(All Stop Pattern)

Showing Effect of Improving Boston-New Haven Section Only

Train Consist	Baseline: Existing TT Speeds	6"E_a+5"E_u (BO-NH)/ Existing TT (NH-NY)	Difference From Baseline[9]
F40PH+8 Amfl. (BO-NH)/ AEM-7 + 8 Amfl. (NH-NY)	4-23.3[10]	N/A	N/A
AEM-7 + 8 Amfleet	N/A	3-42.0	41.3 (14.5)

[8]Includes stops (one-minute dwell) at Back Bay, Route 128, Providence, Kingston, Westerly, Mystic, New London, Old Saybrook, New Haven (included in the engine-change allowance for the Baseline run only; see footnote 3), Stamford, and New Rochelle.

[9]Figures in parentheses indicate difference compared to Table M-11.

[10]Includes a 15-minute engine change allowance at New Haven.

Furthermore, even if the above mentioned are completed on schedule, construction activities in the 2001-2010 period may preclude reliable three-hour trip time during this time frame. The most significant impacts are expected to come from the replacement of moveable and fixed undergrade bridges on the NHL.

Projects Expected to be Completed. The initiation of three-hour New York City to Boston service requires the prior completion of the following improvements.

The existing electric equipment cannot attain the speeds necessary to meet the trip time goal, therefore **partial procurement (at least 8) of the 26 high speed trainsets** should be completed prior to initiation of three-hour service. The trainsets are not required for the initiation of electrified train operations.

Maximum operating speeds requiring levels of unbalanced superelevation greater than 3 inches are essential achieving the three-hour trip time. These speeds will not be allowed until the wayside portion of the **positive stop/civil speed enforcement system** has been installed and on-board modifications to existing Amtrak locomotives completed. This is anticipated by the beginning of 2001. The new trainsets are to incorporate the necessary on-board systems. The modification of commuter equipment will be incrementally phased and is estimated to be completed by 2010.

On-board cab signal equipment on intercity, commuter and freight rolling stock also would have to be modified to provide the additional cab signal indications proposed by Amtrak. Modifications to existing cab signal equipment/systems should be coordinated so that daily intercity, commuter and freight operating requirements are met.

The recommended schedule anticipates that numerous **trip time-sensitive realignments** will be completed before initiating three-hour service. Although curves in each of the geographic segments north of New York City should be realigned, it is anticipated that only curve realignments between New Rochelle and New Haven will remain to be completed after three-hour service is initiated.

Those curves requiring the shifting and/or rebuilding of undergrade bridges or that have an impact on adjacent facilities, such as high level platforms, should receive priority consideration since their lead times and construction durations will be longer and have more complex staging requirements. This work should be coordinated with other planned improvements to make best use of track outages.

The **reconfiguration of several major interlockings and terminal complexes** results in significant time savings and contributes to improvements to the reliability of operations. All but one of the major reconfigurations is located between New York City and New Haven. Implementation of the interlockings/terminals also has a negative impact in that delays during construction prevent attainment of a three-hour service until all but one of these improvements are completed. The improvement to be completed after 2001 is the **Harold Reconfiguration** project. Funding considerations have resulted in implementation being delayed post-2001,

Of the other terminal reconfigurations the **Shell Flyover** is the last planned to be completed. The initial 1990 preliminary design estimated a construction completion date of April 1997. Subsequently, protracted negotiations to authorize MNCR to manage design and construction of the improvements have delayed the beginning of design approximately two and one-half years.

It is estimated that the pre-construction phase, including a formal EIS, will take approximately 32 months and that construction will take 51 months. A design agreement was signed in November 1993; based on the stated durations, construction could be completed by early 2001.

The phasing of work at New Rochelle has to be coordinated with the planned concurrent construction work at Stamford, Peck moveable bridge, and New Haven so that delays can be minimized. Also to be considered in scheduling work between New Rochelle and New Haven between 1994 and 2001 are programs that would replace existing circuit breakers located on anchor bridges, install constant tension catenary, install concrete ties and running rail, realign curves, and replace/upgrade undergrade bridges.

Reconfiguration of the **Stamford** Interlocking complex will result in the construction of **center island station platforms** at this busy commuter and intercity terminal. Construction is estimated to begin in April 1995 and be completed in three years.

A significant amount of **reconfiguration, car shop and layover facility work in the New Haven terminal** is planned for the next seven years. Work to be managed by Amtrak and CDOT will require close coordination with MNCR to ensure that train operations and maintenance operations are not adversely affected. The work also should be coordinated with the improvements planned between New Rochelle and New Haven, as well as those planned between New Haven and New London. All construction at New Haven is presently estimated to be completed by the autumn of 1999. A phasing plan for the terminal area has yet to be established. Initial analysis performed by MNCR indicates that the **Amtrak Service Facility** should be relocated before reconfiguring the south side of the Terminal.

The **South Station capacity improvements** are the only major terminal improvements being implemented north of New Haven. Construction of Tracks 12 and 13 is underway. Construction of the additional track, platform and interlocking improvements should be coordinated with the installation of catenary, and should be completed before the initiation of three-hour intercity service.

In addition to these terminal and major interlocking improvements, the following improvements should be completed prior to the initiation of three-hour intercity service.

Miter Rails on ten existing moveable bridges should be replaced to enable maximum authorized speeds to be achieved the trip time goals. The recommended schedule completes this program by mid-1998.

To prevent undesirable crossings of the railroad right-of-way, **selected sensitive areas** between New Haven and Boston will be fenced before the start of three-hour intercity service. As presently programmed, the fencing program would be completed by the beginning of 1999. A program to mitigate train noise and vibration impacts at selected locations also will be completed prior to the start-up of three-hour service.

The **Grade Crossing Elimination Plan** (Appendix A) indicates that it would be feasible to complete the elimination of selected grade crossing hazards between New Haven and Boston by January 1998.

Replacement of Peck Moveable Bridge, presently being progressed by CDOT, is expected to continue through 1999. A temporary track around the bridge will be required for up to three years, imposing a 15 miles per hour speed restriction on all trains and reducing the current track configuration from four to two tracks.

The **replacement of 13 existing substations on the New Haven Line** is expected to take 6 years and could be completed by mid-2000.

The construction of **fully accessible existing stations** on both sides of the railroad for the Shore Line East commuter service would be completed by the end of 2000. The construction at each station would be phased to maintain existing service while constructing the **high level platforms, cross track access structures and gauntlet tracks** (the latter to ensure that high and wide load freight trains clear the high platforms). Work at each of the five stations would be staged to optimize construction activities. Commuter operations would be maintained by keeping at least part of each existing platform open.

Amtrak presently plans to **construct high level platforms** at Old Saybrook, Mystic, Westerly and Kingston by mid-1999, before the initiation of high speed operations. High level platforms for the two proposed intermediate stops between Kingston and Providence would be completed before initiation of the proposed new RIDOT commuter service early in 1999. The platforms between Providence and Boston are expected to be completed by 2000. Their construction would be staged with other planned improvements at each location (the construction of the passing tracks, the reconfiguration of Brook and Old Saybrook interlockings, and construction of the gauntlet track). For example, the high level platforms at Hyde Park would be phased with the upgrading of Track 5.

The **reconstruction of the Amtrak Boston Service Facility** to provide a service and inspection (S&I) facility for the new trainsets should be coordinated with the electrification of the existing storage yard and maintenance facility. It should be completed before the initiation of high speed operations between New York City and Boston.

Train Service Times When Milestone is Achieved. TPC simulations have shown that, depending upon the train consist, that total savings from Baseline conditions can range from about 58 minutes to almost 65 minutes. As summarized below, intercity trains save an additional 30 minutes 48 seconds when, while conventional trains save an additional 19 minutes 7 seconds.

The total time saved, including the reductions as the result of electrification, are approximately 63 minutes for intercity goal trains and 59 minutes for conventional trains.

IMPROVEMENT	TIME SAVED	
	GOAL TRAIN (minutes:seconds)	CONVENTIONAL TRAIN (minutes:seconds)
Shell Flyover	2:45	2:44
Stamford Center Isl. Platforms	0:33	1:06
Restore Fourth Track	0:57	1:01
New Haven Terminal	4:26	4:37
Increase Curve Speeds (New Rochelle-New Haven) E_u=5"	9:35	9:38
New Trainsets	12:32	0:00
Total Time Saved	30:48	19:07

If there were no further major construction projects requiring major track outages and consequently train diversions to be completed, Amtrak could implement a reliable three-hour intercity service when this milestone is achieved. However, as will be subsequently discussed only selected, four-stop trains will be able to operate with 3-hour schedules. The remainder of the intercity trains, would require additional pad to account for construction delays, and would have schedules exceeding 3 hours.

Areas of Concern. Until the Amtrak operation through both New Rochelle station and New Haven Terminal is optimized, it is not reasonable to assume that the mandated trip time can be achieved and Amtrak will be unable to operate selected trains on a three-hour schedule. Final design of Shell Interlocking was delayed two and one-half years awaiting a design agreement between Amtrak and MNCR. Consequently, the end of 2000 is the earliest possible completion date. Final design of the track alignment through New Haven is underway, however, design of additional improvements, such as drainage, has not begun. Unless design of the numerous improvements is simultaneously progressed construction staging and thus the projected completion date may be impacted.

The finalization of FRA Office of Safety's requirements and the ultimate definition of a program to implement the positive stop/civil speed enforcement system also are critical. The wayside and on-board equipment requirements cannot be identified nor can the final design process begin until this process is completed. Detailed installation and staging programs cannot be established by Amtrak, commuter operators and freight carriers until the implementation requirements are established.

A third area of concern is the level of construction that should be completed in the New Rochelle to New Haven segment. Significant amounts of work requiring track outages should be completed prior to the initiation of 3-hour intercity service. The majority of agreements authorizing design and construction for those projects to be managed by commuter agencies using funds being passed through by Amtrak have not been consummated. This should be given priority and accelerated.

Close coordination of operating and construction schedules will be required to ensure that the recommended construction program does not severely inconvenience commuter and intercity passengers. Unless design and/or construction agreements for the Shell, Stamford, and New Haven projects are expeditiously completed, the schedules planned in this report will slip and attainment of project goals may be delayed. The Providence-to-Boston segment also is a concern, particularly because of the need to coordinate all the other track-related improvements with the installation of the overhead catenary system.

Projects Completed by Start of Three-Hour Service. Numerous additional improvements, either presently under construction or scheduled to be built within the next three years, will be completed before the initiation of three-hour service. They are briefly summarized by geographical segment in this subsection.

NEW YORK CITY TO NEW ROCHELLE

The proposed schedule envisions that work on **Platform 11 and the 5X ladder In Penn Station** will be completed by mid-1997. Construction phasing should be coordinated with ongoing maintenance activities and other proposed improvements.

A plan to integrate construction of the center island platform at New Rochelle Station with the proposed Shell Flyover will have to be developed. The schedule expects that design and construction can be completed by the beginning of 2000.

NEW ROCHELLE TO NEW HAVEN

CDOT proposes to fund the installation of a **Fiber Optics Network** in 1995. Therefore, it is anticipated that construction could be completed by the fall of 1998. The work should be easily staged with, and not delay, other planned work in this segment.

NEW HAVEN TO NEW LONDON

Work to **reconfigure Old Saybrook Station** should be completed by the middle of 1999, before the initiation of three-hour intercity service. To further facilitate intercity, commuter, and freight train operations, **seven passing sidings** will be constructed at five locations during this period.

NEW LONDON TO PROVIDENCE

Providing the **clearance improvements** required for the P&W to operate double stack trains from Providence to Davisville should be coordinated with other proposed clearance improvement and overhead bridge projects to avoid duplication of effort. It is envisioned that design will be progressed to enable construction to begin in mid-1996. It is conservatively estimated that construction could be completed by the beginning of 2001. **Three passing sidings** to facilitate freight operations also would be constructed at Westerly, Hills Grove, and Cranston, Rhode Island.

RIDOT's Kingston to Providence commuter service requires an integrated set of improvements to enable service to begin in 1999. As a minimum, the following should be completed: **reconfiguration of Kingston Station**; **construction of two intermediate stations** between Kingston and Providence; and **construction of layover tracks** for the equipment (presently expected to be at Davisville); At Kingston, **high level platforms**, a **siding track** to store trains, and a **pedestrian bridge** to provide cross track access should be provided.

PROVIDENCE TO BOSTON

At **Providence, a layover facility** for MBTA/RIDOT Boston service trains is anticipated to be completed by the fall of 1998.

Amtrak and MBTA have been negotiating a design and construction agreement for **improvements to the Route 128 Station.** The proposed schedule assumes, if a satisfactory agreement can be reached, that construction would begin in mid-1996 and be completed by mid-1998. Staging of construction would be required to maintain present intercity and commuter operations.

Design for a **layover facility for MBTA trains at Readville** is nearly complete. The schedule anticipates that modifications to Five Yard could be completed by the fall of 1996.

Completion of a **direct connection to the Middleboro Secondary** at Attleboro to facilitate a forecasted Conrail unit coal train operation depends on the timing of Conrail's decision. It is expected that the siding could be completed by the beginning of 1998, if required.

NEW YORK CITY TO BOSTON CORRIDOR WIDE IMPROVEMENTS

To satisfy recent legislation, **ADA access should be provided at key stations. Stamford, Bridgeport, New Haven and Old Saybrook** have been designated by CDOT. Construction should be completed by the fall of 1997.

Completion of 2010 Requirements

Once three-hour New York City to Boston intercity service has been initiated, numerous recommended projects will still be uncompleted. Maintaining reliable commuter service, freight operations and three-hour intercity service while completing the remaining projects is a key factor in controlling the scheduling and staging of these projects. The remaining work also will have to coordinated with the increased level of maintenance required to maintain the comfort and quality of ride at the increased speeds and level of unbalanced superelevation.

Estimated Completion. Staging numerous moveable bridge replacements will enable all projects to be completed by the beginning of 2010 while minimizing delays to train operations.

Projects Expected to be Completed. The additional improvements to be completed are briefly summarized for the entire corridor and by geographical segment in this subsection.

NEW YORK CITY TO BOSTON CORRIDOR WIDE IMPROVEMENTS

Modify commuter and freight rolling stock's **on-board cab signal equipment so that the positive stop/civil speed enforcement system** can be implemented could be a 10- to 20-year process. Modifications of existing cab signal equipment/systems should be coordinated so that daily intercity, commuter and freight operating requirements are met.

Ongoing programs to **realign curves, reconfigure existing interlockings, upgrade track structure on the NHL, procure High Speed Trainsets** and construct **Amtrak medium and heavy repair facilities** will be completed after the initiation of three-hour service.

Replacement of moveable bridges at Pelham, Walk, Saga, Niantic and Groton should be phased, although located in different corridor segments should be phased to minimize delays to intercity trains once three-hour service has been initiated. Furthermore, these projects will require coordination with the Coast Guard and Corps of Engineers.

The **reconfiguration of several existing interlockings** is not required until after 1998. The **Sharon passing siding** and **Track 3 between Route 128 and Readville** are anticipated to be the last interlocking reconfigurations completed. Proposed schedules anticipate that they would be completed by the beginning of 2008.

Several **new interlockings** are also proposed. An interlocking at **Market,** between New York City and New Rochelle, will be required to minimize delays while the replacements of the hanging beam catenary and Pelham moveable bridge are progressed. The proposed **Fairfield Interlocking** should be completed in the spring of 2004, and the proposed four-track universal interlocking, **CP 245**, that would be constructed to facilitate replacement of Walk and Saga moveable bridges would be the last reconfiguration completed between New Rochelle and New Haven.

The proposed increases in the levels of commuter and intercity rail traffic will require that improved intercity and commuter parking facilities be provided at several stations. Design for proposed improvements at **New Rochelle, Stamford, Bridgeport and New Haven** could begin in 1998 and be completed by the beginning of 2008. Construction of improved parking at **Old Saybrook** should be designed and constructed with the other improvements planned for that station. Similarly, the parking improvements at **Route 128** should be progressed concurrently with the other planned efforts.

NEW YORK CITY TO NEW ROCHELLE

Implementation of the **Penn Station Fire, Life Safety Improvements** depends on defining the definition of a coordinated plan of improvements for the terminal and the East River Tunnels. Construction is estimated to begin in early 1996 and be completed by the beginning of 2007.

The **reconfiguration of Harold Interlocking**, located about 15 miles west of New Rochelle and three miles east of New York Penn Station, will be progressed after completion of the Shell Flyover. The planning and coordination of the work program at Harold presents a different set of operating constraints (than Shell) if delays to LIRR commuter operations, Amtrak intercity operations, and Amtrak and NJT access to and from Sunnyside Yard are to be minimized. Initial analyses indicate that final design could begin in mid-2000 and construction could be completed by the end of 2005.

Replacement of the **Pelham Bay moveable bridge** is not essential to the initiation of three-hour intercity service, but due to its age and condition the bridge should be renewed as part of this program. If design is initiated at the beginning of 2000, construction could be completed by the beginning of 2005.

Removal of the Hellgate line hanging beam also has been identified as required after 2000. It is estimated that construction could begin in mid-2004 and be completed in two and one-half years. Due to the impact of single track operation on high speed intercity operations between Gate and Pelham Bay and then Pelham Bay and Shell, it would be advantageous if work could be scheduled for nighttime off-peak hours. However, this approach may increase the construction duration. The full impact on operations will not be known until detailed analyses of the construction requirements and techniques are performed.

NEW ROCHELLE TO NEW HAVEN

Reinstallation of the fourth main track between Devon and New Haven should be completed by the middle of 2004. In conjunction with the new universal New Haven interlocking installed as an initial stage of **reconfiguring the New Haven Terminal area**, the addition of the fourth track should facilitate catenary replacement work by providing increased capacity and operating flexibility. Woodmont Interlocking would be removed after New Haven Interlocking is operational.

Replacement of the New Haven line catenary in Connecticut is one of several programs being undertaken to eliminate years of deferred maintenance and upgrade the line. As initially planned, construction could be completed by spring 2009. Replacement is likely to require careful staging of multi-track outages to minimize operational impacts.

A program to **convert open deck bridges** to ballast deck bridges should be coordinated with other planned improvements. Recommended conversions of New Haven Line bridges would be completed by 2010. Shifting or rebuilding undergrade bridges to implement curve realignments should be staged to simplify the realignment process.

A program to **replace deteriorated bridges and culverts** also is anticipated to be completed by 2010 for the New Haven Line.

Replacement of Walk and Saga moveable bridges will be a complex undertaking that after a three-year pre-construction period, should take seven years to complete. The renewal of two tracks at a time will require close coordination of train operations over the remaining two tracks, particularly after high speed operations have been initiated. Significant delays are expected.

NEW HAVEN TO NEW LONDON

The extensions of **SLE commuter service from Old Saybrook to New London** should be completed by the middle of 2004. **Stations at two intermediate stops** between Old Saybrook and New London (Niantic and South Lyme) should be constructed before initiation of new service. The stations would have **high level platforms, gauntlet tracks** (to facilitate freight operations), and **pedestrian bridges**. The six electric locomotives to be acquired, together with the existing fleet of coaches, should be sufficient to run the service.

The **conversion of open deck bridges** in this segment should be completed by 2002.

Replacement of Niantic Bridge is estimated to take approximately three years and require a pre-construction period of two years, to include obtaining the necessary permits. Completion of construction is anticipated to be in 2008.

NEW LONDON TO PROVIDENCE

Replacement of Groton Bridge has been initially phased with the planned replacement of Walk, Saga and Niantic in an attempt to minimize delays. Replacement of the moveable span, which would occur between 2007 and 2010, could require a service shutdown of several weeks. During this time diesel operation utilizing the inland route would be required. Completion of construction is anticipated to be in 2010.

A program to **Replace and/or upgrade overhead bridges in Rhode Island**, although not yet finalized, is anticipated to be completed by 2010.

PROVIDENCE TO BOSTON

Passing sidings at **Sharon (Track 4)** and **between Rte. 128 and Readville (Track 3)** are expected to be completed by the beginning of 2008. The catenary foundations and poles should be constructed by Amtrak's electrification contractor to provide for the future installation of these sidings.

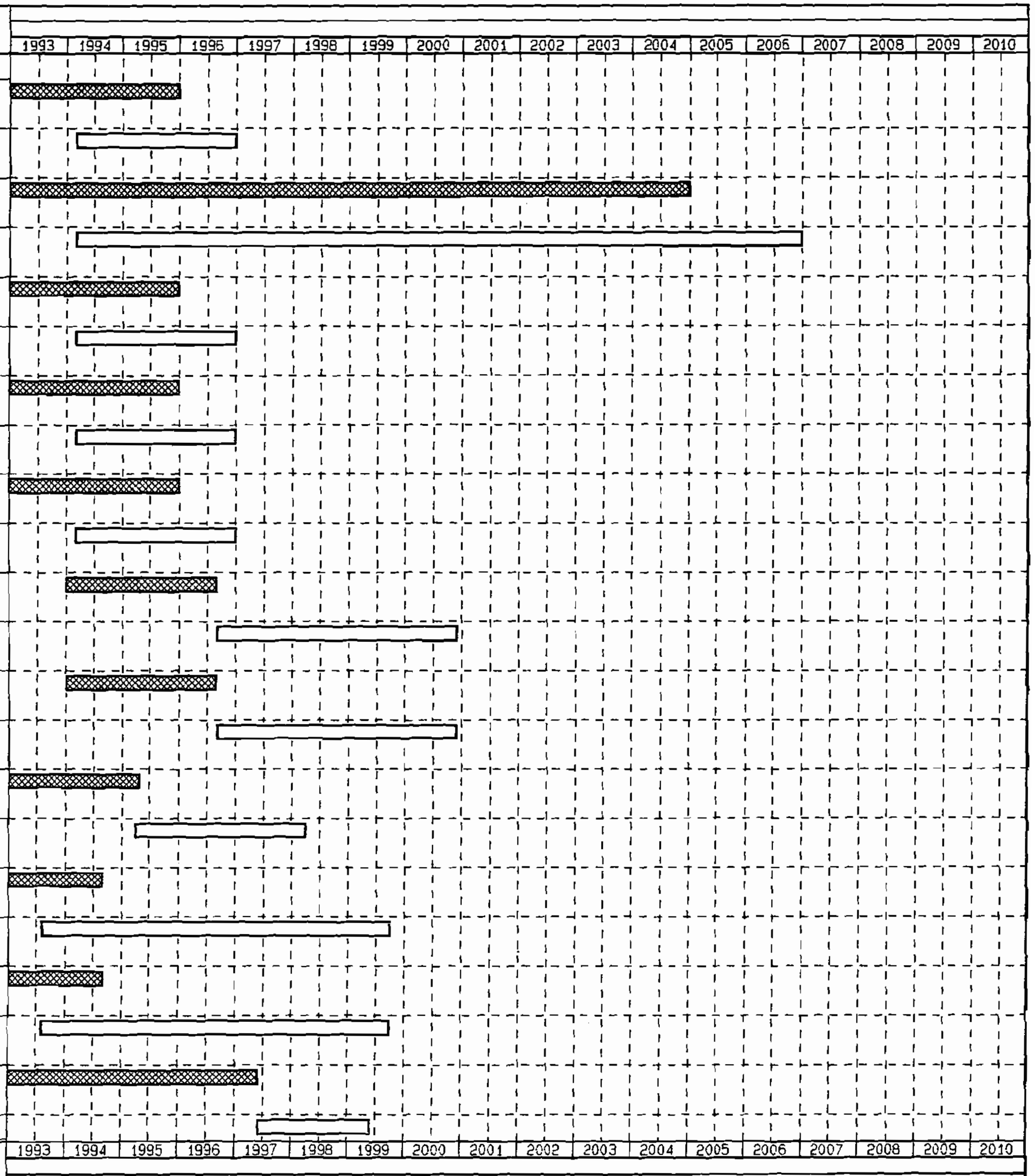
PROGRAMS NOT YET DEFINED AND ESTIMATED

Programs to **construct new stations** and **improvements** at existing Amtrak stations have not been identified; therefore schedules were not established. As they are subsequently defined, such programs should be incorporated into planning for the New York City to Boston improvements.

Areas of Concern. Minimizing operating delays while replacing the fixed and moveable bridges is the primary concern in the 2001 to 2010 time frame.

Appendix G
SCHEDULE OF PROPOSED PROJECTS
Sorted by Category

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
HIGH SPEED REQUIREMENTS: TRIP TIME		
REALIGN CURVES	1JAN93	31DEC95
NEW YORK-NEW ROCHELLE CURVES	1MAR94	31DEC96
REALIGN CURVES	1JAN93	31DEC04
NEW ROCHELLE-NEW HAVEN CURVES	1MAR94	31DEC06
REALIGN CURVES	1JAN93	31DEC95
NEW HAVEN-NEW LONDON CURVES	1MAR94	31DEC96
REALIGN CURVES	1JAN93	31DEC95
NEW LONDON-PROVIDENCE: CURVES	1MAR94	31DEC96
REALIGN CURVES	1JAN93	31DEC95
PROVIDENCE-SOUTH STATION: CURVES	1MAR94	31DEC96
SHELL FLYOVER	1JAN94	31AUG96
SHELL FLYOVER: NEW YORK-NEW ROCHELLE	1SEP96	30NOV00
SHELL FLYOVER	1JAN94	31AUG96
SHELL FLYOVER: NEW ROCHELLE-NEW HAVEN	1SEP96	30NOV00
STAMFORD STATION CENTER ISLAND PLATFORM	1JAN93	30APR95
STAMFORD STATION	1APR95	31MAR98
NEW HAVEN TERMINAL	1JAN93	31AUG94
NEW HAVEN TERMINAL: NEW ROCHELLE-NEW HAVEN	1AUG93	30SEP99
NEW HAVEN TERMINAL	1JAN93	31AUG94
NEW HAVEN TERMINAL: NEW HAVEN-NEW LONDON	1AUG93	30SEP99
RECONFIGUE OLD SAYBROOK STATION	1JAN93	31MAY97
OLD SAYBROOK STATION	1JUN97	31MAY99



Plot Date 30APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

RJ63

TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY IMPROVEMENT CATEGORY

Sheet 1 of 14

PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

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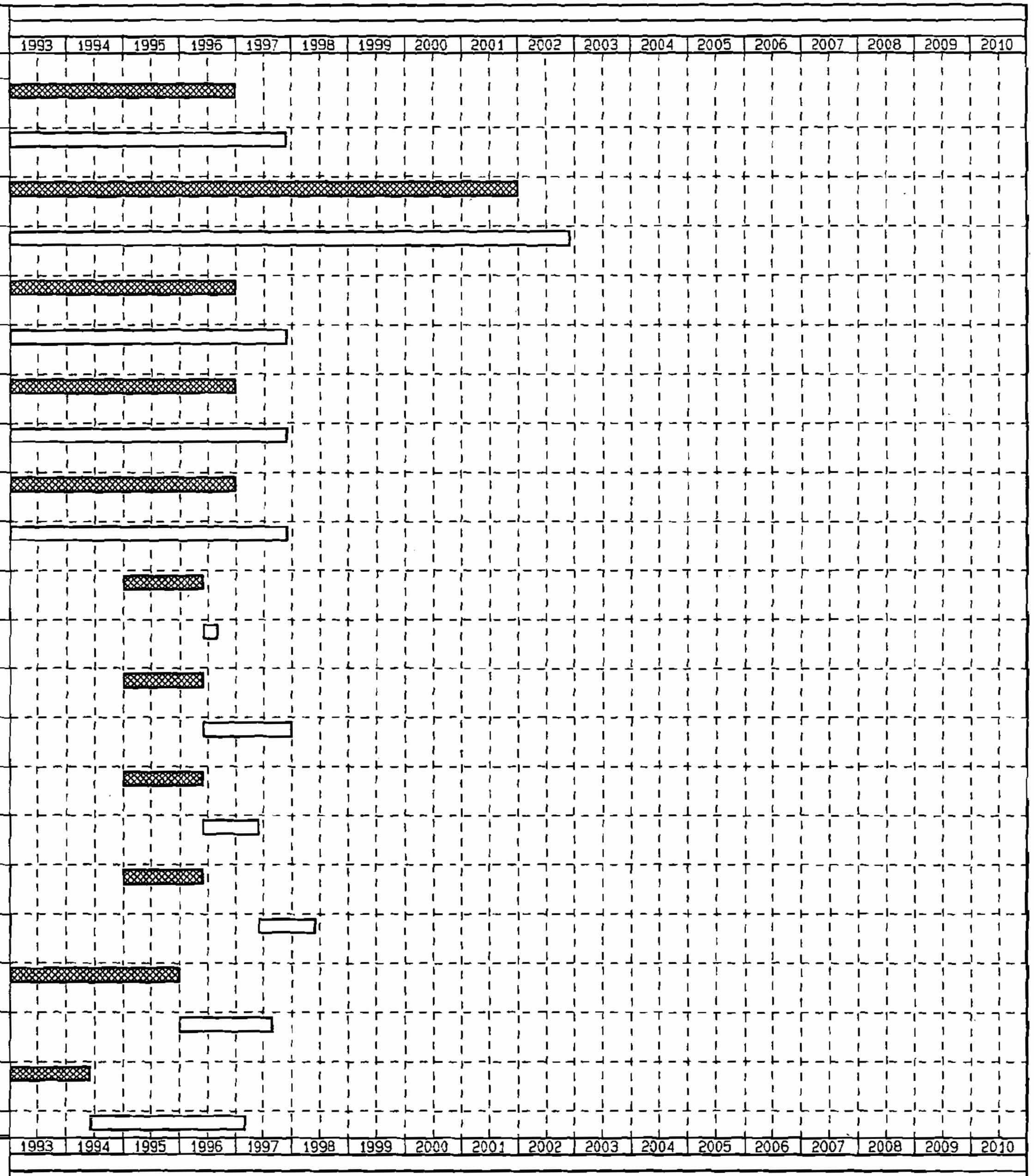
ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
HIGH SPEED REQUIREMENTS: TRIP TIME		
TRACK PROGRAM	1JAN93	31DEC96
NEW YORK-NEW ROCHELLE TRACKWORK	1JAN93	30NOV97
TRACK PROGRAM	1JAN93	31DEC01
NEW ROCHELLE-NEW NEW HAVEN TRACKWORK	1JAN93	30NOV02
TRACK PROGRAM	1JAN93	31DEC96
NEW HAVEN-NEW LONDON TRACKWORK	1JAN93	30NOV97
TRACK PROGRAM	1JAN93	31DEC96
NEW LONDON-PROVIDENCE: TRACKWORK	1JAN93	30NOV97
TRACK PROGRAM	1JAN93	31DEC96
PROVIDENCE-SOUTH STATION: TRACKWORK	1JAN93	30NOV97
REPLACE MITER RAILS	1JAN95	31MAY96
NEW YORK-NEW ROCHELLE MITER RAILS	1JUN96	31AUG96
REPLACE MITER RAILS	1JAN95	31MAY96
NEW ROCHELLE-NEW HAVEN MITER RAILS	1JUN96	31DEC97
REPLACE MITER RAILS	1JAN95	31MAY96
NEW HAVEN-NEW LONDON MITER RAILS	1JUN96	31MAY97
REPLACE MITER RAILS	1JAN95	31MAY96
NEW LONDON-PROVIDENCE: MITER RAILS	1JUN97	31MAY98
CANTON VIADUCT CLEARANCE IMPROVEMENTS	1JAN93	31DEC95
CANTON VIADUCT	1JAN96	31AUG97
INSTALL 25KV 60 hZ CENTER FED SYSTEM	1JAN93	31MAY94
NEW HAVEN-NEW LONDON: 25 KV SYSTEM	1JUN94	28FEB97



Plot Date 30APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

RJ63

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TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY IMPROVEMENT CATEGORY

PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

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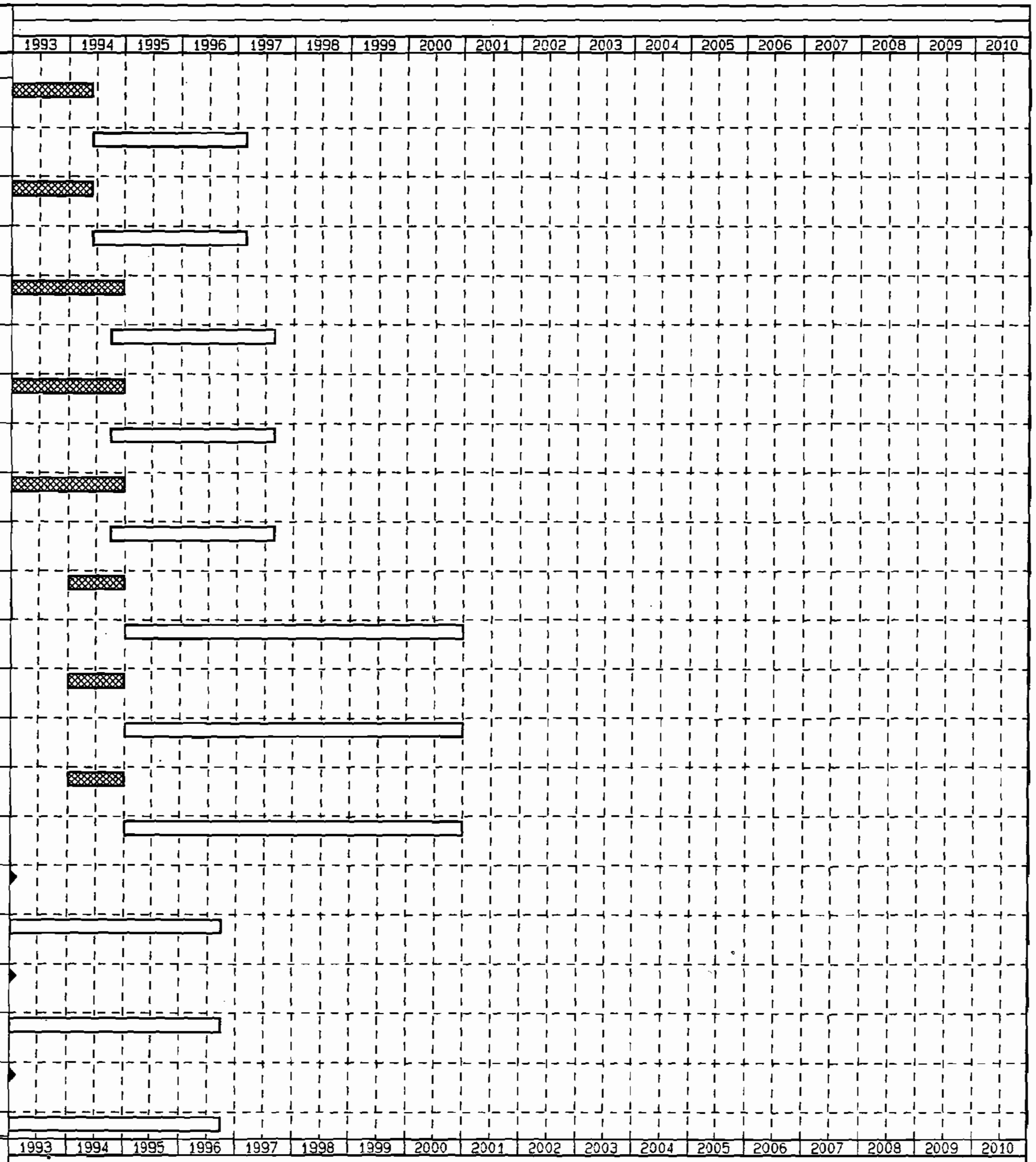
ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
HIGH SPEED REQUIREMENTS: TRIP TIME		
INSTALL 25KV 60 hZ CENTER FED SYSTEM	1JAN93	31MAY94
NEW LONDON-PROVIDENCE: 25 KV SYSTEM	1JUN94	28FEB97
INSTALL 25KV 60 hZ CENTER FED SYSTEM	1JAN93	31MAY94
PROVIDENCE-SOUTH STATION: 25 KV SYSTEM	1JUN94	28FEB97
PROVIDE CLEARANCE FOR ELECTRIFICATION	1JAN93	31DEC94
NEW HAVEN-NEW LONDON CLEARANCE FOR ELECT.	1OCT94	31AUG97
PROVIDE CLEARANCE FOR ELECTRIFICATION	1JAN93	31DEC94
NEW LONDON-PROVIDENCE: CLEARANCE	1OCT94	31AUG97
PROVIDE CLEARANCE FOR ELECTRIFICATION	1JAN93	31DEC94
PROVIDENCE-SOUTH STATION: CLEARANCE	1OCT94	31AUG97
DEVELOP NOISE & VIBRATION MITIGATION PROGRAM	1JAN94	31DEC94
IMPLEMENT NOISE & VIBRATION MITIGATION PROG	1JAN95	31DEC00
DEVELOP NOISE & VIBRATION MITIGATION PROGRAM	1JAN94	31DEC94
IMPLEMENT NOISE & VIBRATION MITIGATION PROG	1JAN95	31DEC00
DEVELOP NOISE & VIBRATION MITIGATION PROGRAM	1JAN94	31DEC94
IMPLEMENT NOISE & VIBRATION MITIGATION PROG	1JAN95	31DEC00
SIGNAL COMPATIBLE W/ELECTRIFICATION		31JAN93A
NEW HAVEN-NEW LONDON SIGNALING	1JAN93	30SEP96
SIGNAL COMPATIBLE W/ELECTRIFICATION		31JAN93A
NEW LONDON-PROVIDENCE: SIGNALING	1JAN93	30SEP96
SIGNAL COMPATIBLE W/ELECTRIFICATION		31JAN93A
PROVIDENCE-SOUTH STATION: SIGNALING	1JAN93	30SEP96



Plot Date 30APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
◇/P Milestone/Flag Activity

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TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY IMPROVEMENT CATEGORY

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PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

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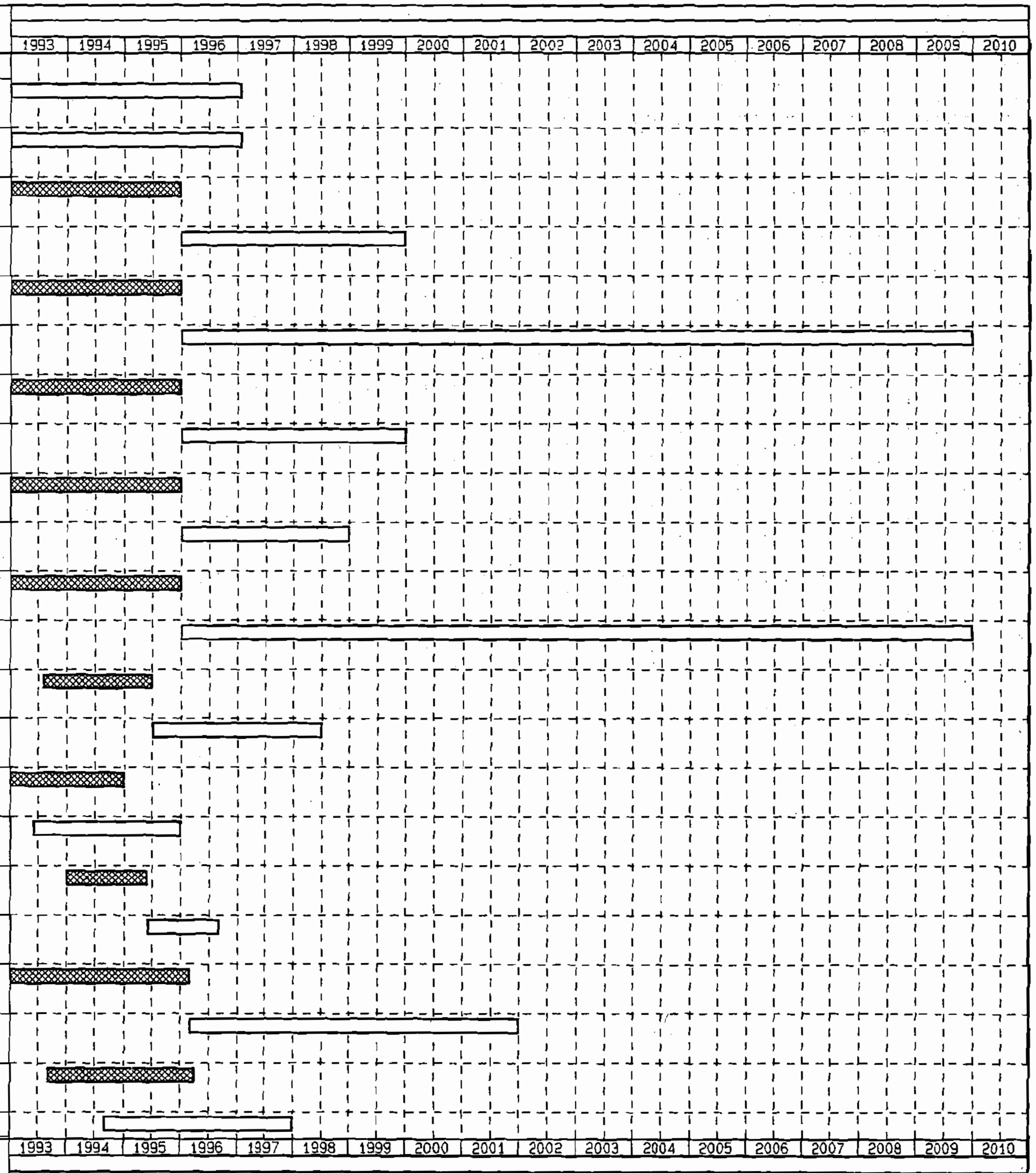
ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
HIGH SPEED REQUIREMENTS: TRIP TIME		
NEW HAVEN-NEW LONDON CETC	1JAN93	31JAN97
NEW LONDON-PROVIDENCE CETC	1JAN93	31JAN97
INSTALL CIVIL SPEED ENFORCEMENT SYSTEM	1JAN93	31DEC95
NEW YORK-NEW ROCHELLE SPEED ENFORCEMENT	1JAN96	31DEC99
INSTALL CIVIL SPEED ENFORCEMENT SYSTEM	1JAN93	31DEC95
NEW ROCHELLE-NEW HAVEN SPEED ENFORCEMENT	1JAN96	31DEC09
INSTALL CIVIL SPEED ENFORCEMENT SYSTEM	1JAN93	31DEC95
NEW HAVEN-NEW LONDON SPEED ENFORCEMENT	1JAN96	31DEC99
INSTALL CIVIL SPEED ENFORCEMENT SYSTEM	1JAN93	31DEC95
NEW LONDON-PROVIDENCE: SPEED ENFORCEMENT	1JAN96	31DEC98
INSTALL CIVIL SPEED ENFORCEMENT SYSTEM	1JAN93	31DEC95
PROVIDENCE-SOUTH STATION: SPEED ENFORCEMENT	1JAN96	31DEC09
ROUTE 128 IMPROVEMENTS	1AUG93	30JUN95
ROUTE 128	1JUL95	30JUN98
KINGSTON STA. INTERMODAL TRANSPORTATION FACILITY	1JAN93	31DEC94
KINGSTON INTERMODAL	1JUN93	31DEC95
CONSTRUCT AMTRAK NEW HAVEN SERVICE FACILITY	1JAN94	31MAY95
AMTRAK NEW HAVEN SERVICE FACILITY	1JUN95	31AUG96
PROCURE AMTRAK HIGH SPEED TRAINSETS	1JAN93	29FEB96
TRAINSETS PRODUCTION/DELIVERY	1MAR96	31DEC01
GRADE CROSSINGS: ELIMINATION PROGRAM	1SEP93	31MAR96
NEW HAVEN-NEW LONDON GRADE CROSSINGS	1SEP94	31DEC97



Plot Date 30APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

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Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

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TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY IMPROVEMENT CATEGORY

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PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

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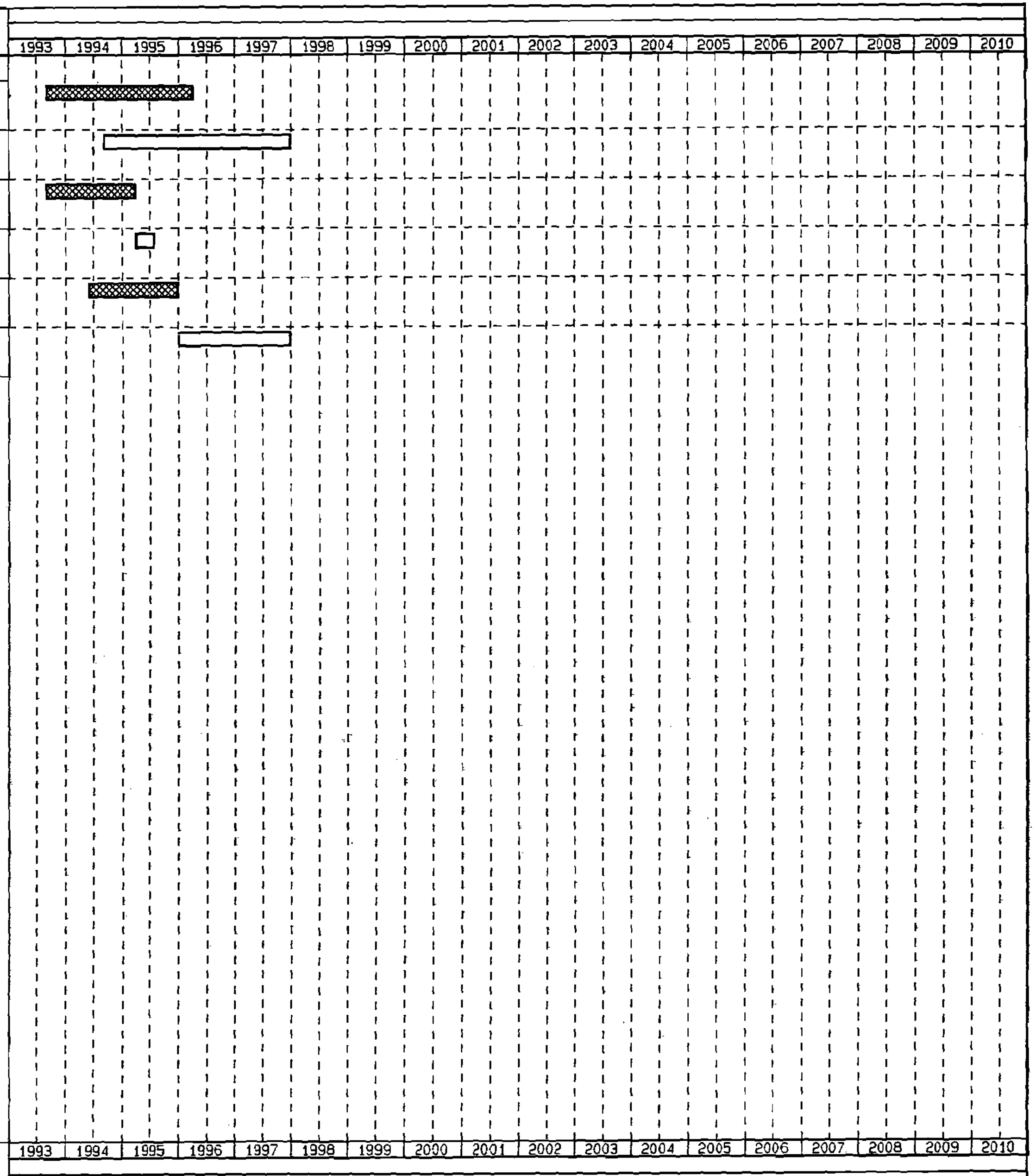
ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
HIGH SPEED REQUIREMENTS: TRIP TIME		
GRADE CROSSINGS: ELIMINATION PROGRAM	1SEP93	31MAR96
NEW LONDON-PROVIDENCE: GRADE CROSSINGS	1SEP94	31DEC97
GRADE CROSSINGS: ELIMINATION PROGRAM	1SEP93	31MAR95
PROVIDENCE-SOUTH STATION: CROSSINGS	1APR95	31JUL95
INSTALL APPROACH WARNING SIGNS & BELLS	1JUN94	31DEC95
APPROACH WARNING SIGNS	1JAN96	31DEC97



Plot Date 30APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

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TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY IMPROVEMENT CATEGORY

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PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

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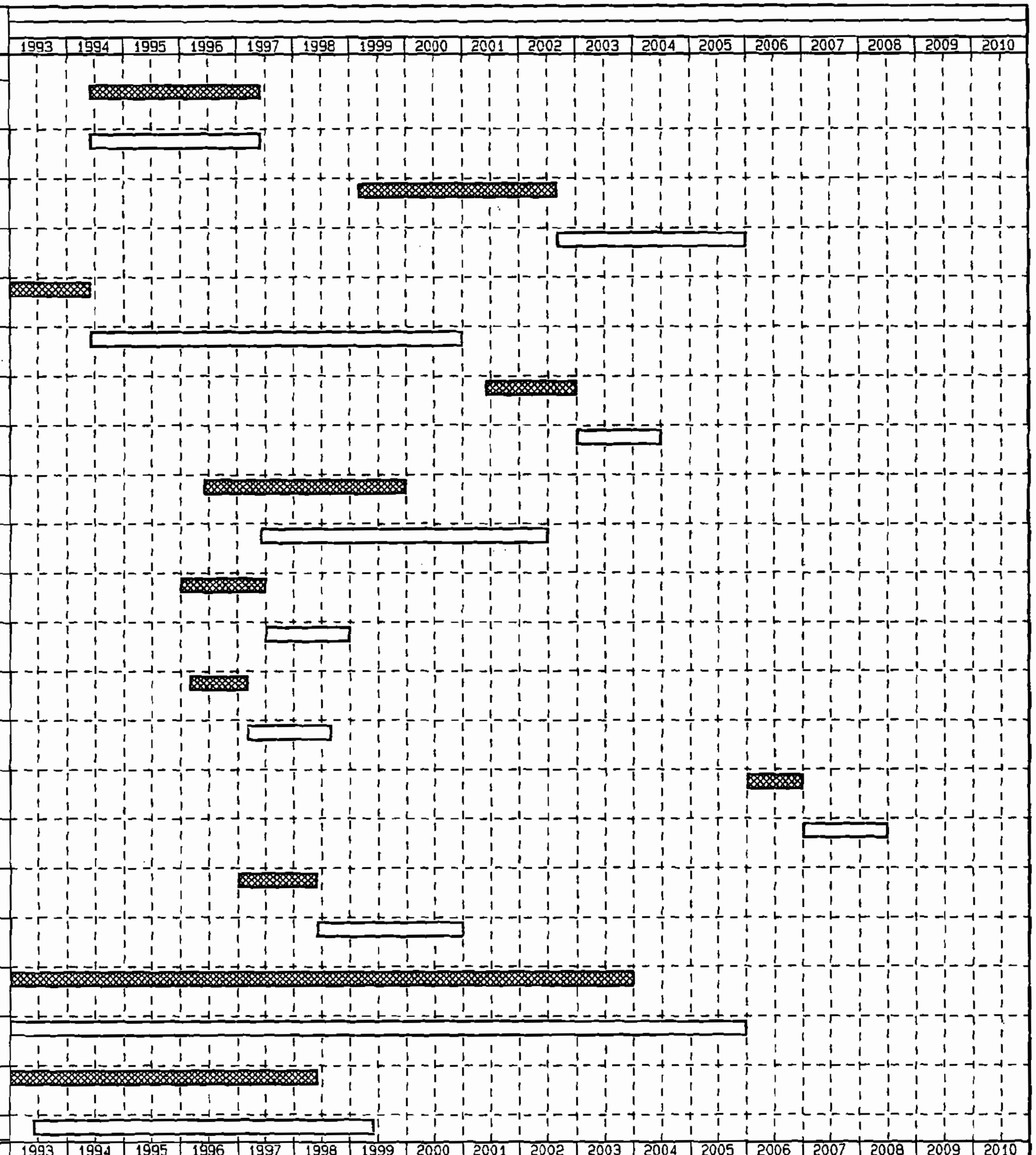
ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
HIGH SPEED REQUIREMENTS: CAPACITY		
PENN STATION-EXTEND PLATFORM 11 & 5X CONNECTION	1JUN94	31MAY97
N.Y. PENN STATION	1JUN94	31MAY97
HAROLD INTERLOCKING	1MAR99	31AUG02
HAROLD INTERLOCKING	1SEP02	31DEC05
SOUTH STATION CAPACITY IMPROVEMENTS	1JAN93	31MAY94
BOSTON SOUTH STATION	1JUN94	31DEC00
REINSTALL DEVON TO NEW HAVEN FOURTH TRACK	1JUN01	31DEC02
FOURTH TRACK	1JAN03	30JUN04
CONSTRUCT SHORE LINE EAST (SLE) PASSING SIDINGS	1JUN96	31DEC99
SLE PASSING SIDINGS	1JUN97	30JUN02
CONSTRUCT KINGSTON TO PROVIDENCE PASSING SIDINGS	1JAN96	30JUN97
KINGSTON/CRANSTON SIDINGS	1JUL97	31DEC98
PROVIDENCE-SOUTH STATION PASSING SIDINGS	1MAR96	28FEB97
ATTLEBORO: FOREST HILLS-READVILLE (TRACK 5)	1MAR97	31AUG98
PROVIDENCE-SOUTH STATION PASSING SIDINGS	1JAN06	31DEC06
SHARON (TRACK 4), RTE 128-READVILLE	1JAN07	30JUN08
SHORE LINE EAST SLE BOTH SIDES FULLY ACCESSIBLE	1JAN97	31MAY98
SLE FULLY ACCESSIBLE STATIONS	1JUN98	31DEC00
RECONFIGURE EXISTING INTERLOCKINGS	1JAN93	31DEC03
NEW ROCHELLE-NEW HAVEN INTERLOCKINGS	1JAN93	31DEC05
RECONFIGURE EXISTING INTERLOCKINGS	1JAN93	31MAY98
NEW HAVEN-NEW LONDON INTERLOCKINGS	1JUN93	31MAY99



Plot Date 30APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

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Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

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PRELIMINARY SCHEDULE OF PROJECTS
BY IMPROVEMENT CATEGORY

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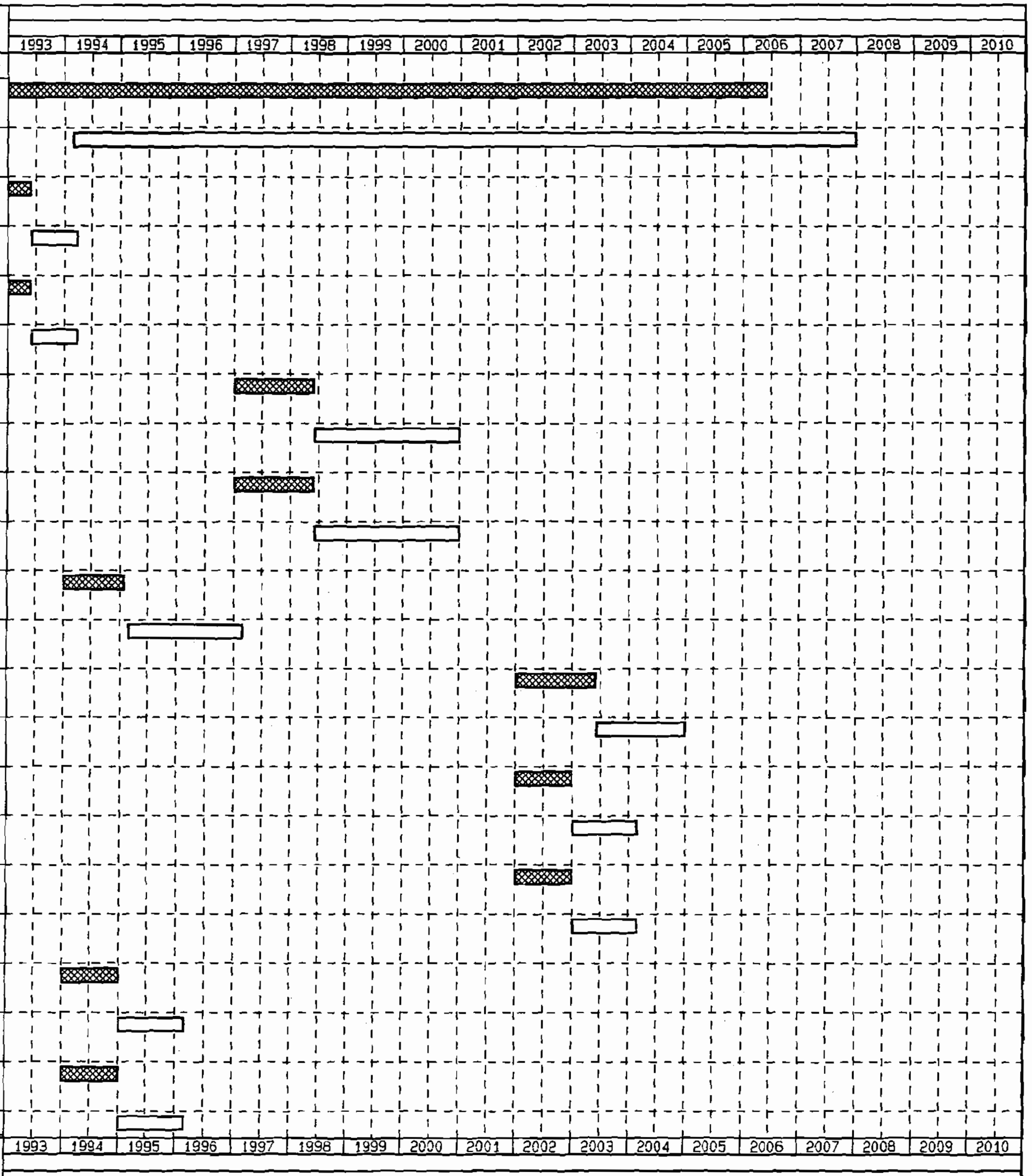
PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
HIGH SPEED REQUIREMENTS: CAPACITY		
RECONFIGURE EXISTING INTERLOCKINGS	1JAN93	31MAY06
PROVIDENCE-SOUTH STATION: INTERLOCKINGS	1MAR94	31DEC07
INSTALL HIGH SPEED UNIVERSAL INTERLOCKINGS	1JAN93	31MAY93
NEW HAVEN-NEW LONDON HIGH SPEED I/L	1JUN93	31MAR94
INSTALL HIGH SPEED UNIVERSAL INTERLOCKINGS	1JAN93	31MAY93
NEW LONDON-PROVIDENCE: HIGH SPEED I/L	1JUN93	31MAR94
INSTALL GAUNTLET TRACKS: SLE	1JAN97	31MAY98
EXISTING STATIONS: GAUNTLET TRACKS	1JUN98	31DEC00
INSTALL NEW LONDON - PROVIDENCE GAUNTLET TRACK	1JAN97	31MAY98
NEW LONDON - PROVIDENCE GAUNTLET TRACK	1JUN98	31DEC00
INSTALL GAUNTLET TRACKS	1JAN94	31JAN95
PROVIDENCE-SOUTH STATION: GAUNTLET TRACKS	1MAR95	28FEB97
INSTALL GAUNTLET TRACKS: SLE	1JAN02	31MAY03
PROPOSED STATIONS-SLE	1JUN03	31DEC04
INSTALL NEW INTERLOCKINGS	1JAN02	31DEC02
NEW YORK-NEW ROCHELLE INTERLOCKINGS	1JAN03	29FEB04
INSTALL NEW INTERLOCKINGS	1JAN02	31DEC02
NEW ROCHELLE-NEW HAVEN NEW INTERLOCKINGS	1JAN03	29FEB04
INSTALL NEW INTERLOCKINGS	1JAN94	31DEC94
NEW HAVEN-NEW LONDON INTERLOCKINGS	1JAN95	29FEB96
INSTALL NEW INTERLOCKINGS	1JAN94	31DEC94
NEW LONDON-PROVIDENCE INTERLOCKINGS	1JAN95	29FEB96



Plot Date 30APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

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PRECONSTRUCTION
PRECONSTRUCTION PHASE

TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY IMPROVEMENT CATEGORY

Date	Revision	Checked	Approved

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
HIGH SPEED REQUIREMENTS: CAPACITY		
THIRD TRACK FOR P & W FREIGHT SERVICE NL-PROV	1JUN94	30JUN96
THIRD RAIL P & W FREIGHT SERVICE NL-PROV	1JUL96	31DEC00
THIRD TRACK FOR P&W FREIGHT SERVICE PROV-SO. STA	1JUN94	30JUN96
THIRD TRACK P & W FREIGHT SERVICE PROV-S ST	1JUL96	31DEC00
CANTON JCT TO BOSTON SIGNAL MODIFICATIONS	1JAN94	31MAY95
SIGNAL MODIFICATIONS	1JUN95	31DEC96
HIGH LEVEL PLATFORMS: SLE	1JAN97	30JUN98
EXISTING STATIONS: SLE	1JUL98	31DEC00
HIGH LEVEL PLATFORMS: SLE	1JAN02	30JUN03
PROPOSED STATIONS: SLE	1JUL03	31DEC04
HIGH LEVEL PLATFORMS	1JAN95	30JUN96
NEW LONDON-PROVIDENCE: PLATFORMS	1JUN95	31MAY99
HIGH LEVEL PLATFORMS	1AUG94	30JUN96
PROVIDENCE-SOUTH STATION: PLATFORMS	1JUL95	31DEC99
CONSTRUCT AMTRAK BOSTON SERVICE FACILITY	1JAN94	31MAY96
AMTRAK BOSTON SERVICE FACILITY	1JUN96	31MAY99
CONSTRUCT MEDIUM & HEAVY OVERHAUL FACILITY NY-NR	1JAN96	31DEC97
CONSTR. MEDIUM & HEAVY OVERHAUL FAC. NY-NR	1JAN98	31JAN02
CONSTRUCT MEDIUM & HEAVY OVERHAUL FACILITY PV-BO	1JAN96	31DEC97
CONSTR. MEDIUM & HEAVY OVERHAUL FAC. PV-BOS	1JAN98	31JAN02
MODIFY ON-BOARD CAB SIGNAL EQUIPMENT	1JAN93	31DEC95
NEW YORK-NEW ROCHELLE CAB SIGNAL	1JAN96	31DEC99

1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010

Plot Date 30APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

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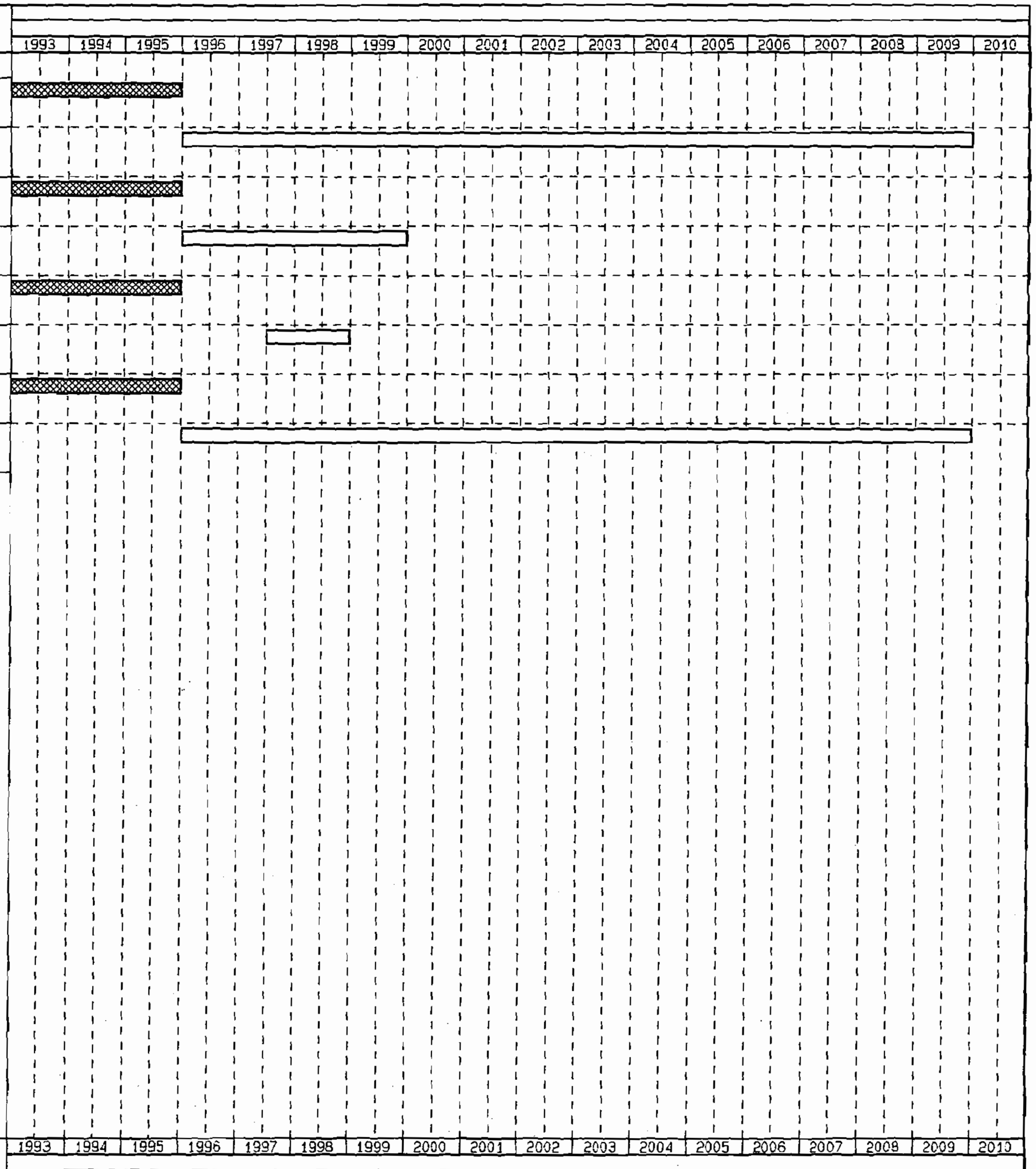
PRECONSTRUCTION
PRECONSTRUCTION PHASE

TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY IMPROVEMENT CATEGORY

Date	Revision	Checked	Approved

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
HIGH SPEED REQUIREMENTS: CAPACITY		
MODIFY ON-BOARD CAB SIGNAL EQUIPMENT	1JAN93	31DEC95
NEW ROCHELLE-NEW HAVEN CAB SIGNAL	1JAN96	31DEC09
MODIFY ON-BOARD CAB SIGNAL EQUIPMENT	1JAN93	31DEC95
NEW HAVEN-NEW LONDON: CAB SIGNAL	1JAN96	31DEC99
MODIFY ON-BOARD CAB SIGNAL EQUIPMENT	1JAN93	31DEC95
NEW LONDON-PROVIDENCE: CAB SIGNAL	1JUL97	31DEC98
MODIFY ON-BOARD CAB SIGNAL EQUIPMENT	1JAN93	31DEC95
PROVIDENCE-SOUTH STATION: CAB SIGNALS	1JAN96	31DEC09



Plot Date 30APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

RJ93

TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY IMPROVEMENT CATEGORY

PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

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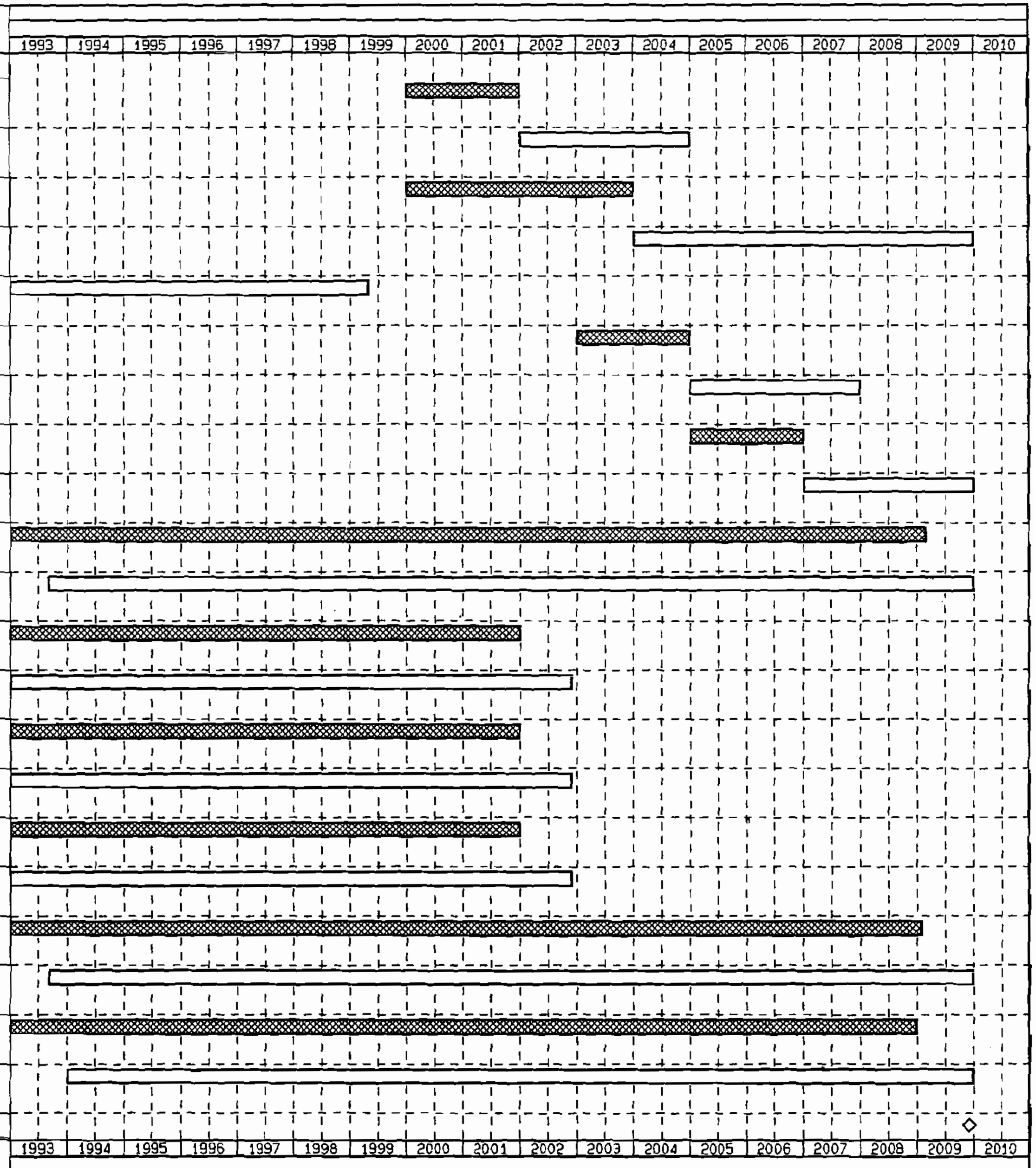
ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
RECAPITALIZATION		
PELHAM BAY BRIDGE REPLACEMENT	1JAN00	31DEC01
PELHAM BAY	1JAN02	31DEC04
WALK BRIDGE/SAGA BRIDGE REPLACEMENT	1JAN00	31DEC03
WALK/SAGA BRIDGES	1JAN04	31DEC09
PECK BRIDGE REPLACEMENT	1JAN93	30APR99
NIANTIC BRIDGE REPLACEMENT	1JAN03	31DEC04
NIANTIC BRIDGE	1JAN05	31DEC07
GROTON BRIDGE REPLACEMENT	1JAN05	31DEC06
GROTON BRIDGE	1JAN07	31DEC09
CONVERT OPEN DECK BRIDGES	1JAN93	28FEB09
NEW ROCHELLE-NEW HAVEN CONVERT BRIDGES	1SEP93	31DEC09
CONVERT OPEN DECK BRIDGES	1JAN93	31DEC01
NEW HAVEN-NEW LONDON CONVERT BRIDGES	1JAN93	30NOV02
CONVERT OPEN DECK BRIDGES	1JAN93	31DEC01
NEW LONDON-PROVIDENCE: CONVERT BRIDGES	1JAN93	30NOV02
CONVERT OPEN DECK BRIDGES	1JAN93	31DEC01
PROVIDENCE-SOUTH STATION: CONVERT BRIDGES	1JAN93	30NOV02
REPLACE DETERIORATED BRIDGES & CULVERTS	1JAN93	31JAN09
NEW ROCHELLE-NEW HAVEN BRIDGES	1SEP93	31DEC09
REPLACE/UPGRADE OVERHEAD BRIDGES IN RHODE ISLAND	1JAN93	31DEC08
NEW LONDON-PROVIDENCE: OVERHEAD BRIDGES	1JAN94	31DEC09
	1DEC09	30NOV09



Plot Date 30APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

RJ83

TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY IMPROVEMENT CATEGORY

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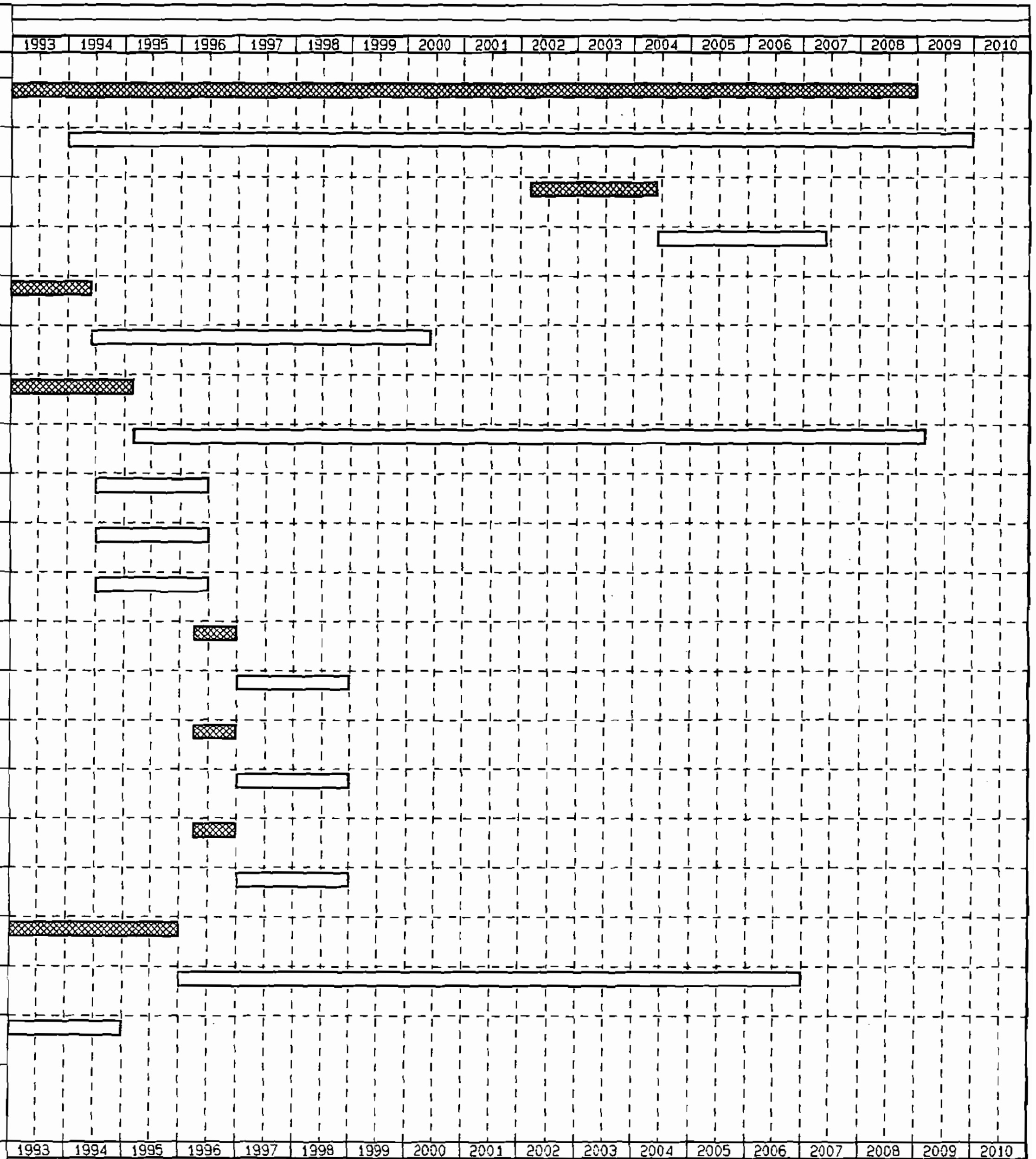
PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
RECAPITALIZATION		
REPLACE/UPGRADE OVERHEAD BRIDGES IN RHODE ISLAND	1JAN93	31DEC08
PROVIDENCE-SOUTH STATION: OVERHEAD BRIDGES	1JAN94	31DEC09
HELLGATE LINE HANGING BEAM REMOVAL	1MAR02	31MAY04
HELLGATE HANGING BEAM	1JUN04	31MAY07
NEW HAVEN LINE SUBSTATION REPLACEMENT	1JAN93	31MAY94
NHL SUBSTATION	1JUN94	31MAY00
NEW HAVEN LINE CATENARY REPLACEMENT	1JAN93	28FEB95
NHL CATENARY	1MAR95	28FEB09
EQUIPMENT TESTING: NHL	1JUL94	30JUN96
EQUIPMENT TESTING: SLE	1JUL94	30JUN96
EQUIPMENT TESTING: MBTA	1JUL94	30JUN96
FENCE SELECTED SENSITIVE AREAS	1APR96	31DEC96
NEW HAVEN-NEW LONDON FENCING	1JAN97	31DEC98
FENCE SELECTED SENSITIVE AREAS	1APR96	31DEC96
NEW LONDON-PROVIDENCE: FENCING	1JAN97	31DEC98
FENCE SELECTED SENSITIVE AREAS	1APR96	31DEC96
PROVIDENCE-SOUTH STATION: FENCING	1JAN97	31DEC98
PENN STATION: FIRE LIFE SAFETY IMPROVEMENTS	1JAN93	31DEC95
FIRE LIFE SAFETY	1JAN95	31DEC06
STEP & TOUCH TRACTION RETURN MITIGATION: NHL	1JAN93	31DEC94



Plot Date 30APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

RJ63

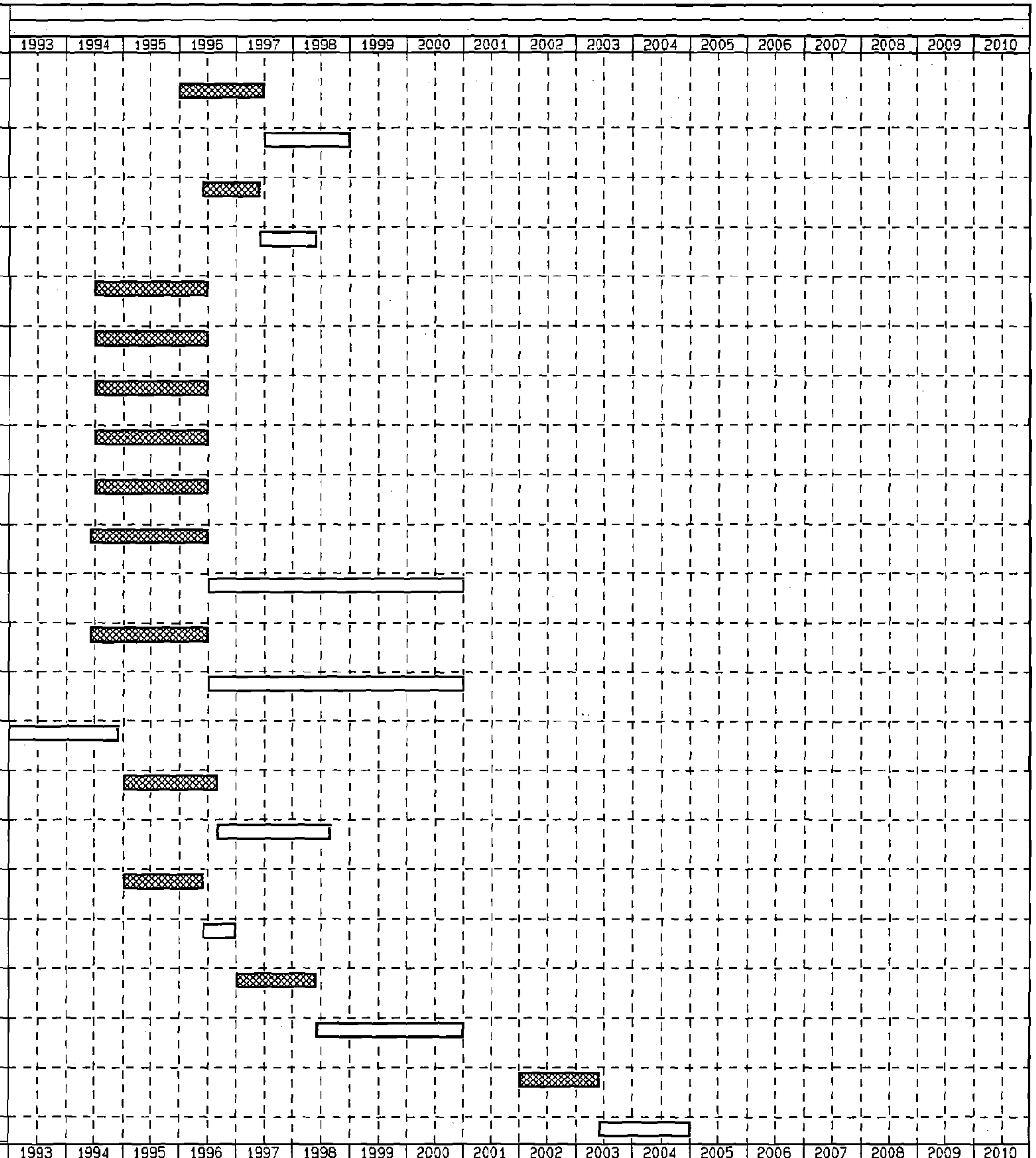
Sheet 11 of 14

TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY IMPROVEMENT CATEGORY

PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
OTHER		
RECONFIGURE KINGSTON STATION	1JAN96	30JUN97
KINGSTON STATION	1JUL97	31DEC98
DIRECT CONNECTION TO MIDDLEBORO SECONDARY	1JUN96	31MAY97
DIRECT CONNECTION-MIDDLEBORO SECONDARY	1JUN97	31MAY98
MAINT. & OPERATING COST ALLOCATION STUDY NY-NR	1JUL94	30JUN96
MAINT. & OPERATING COST ALLOCATION STUDY NR-NH	1JUL94	30JUN96
MAINT. & OPERATING COST ALLOCATION STUDY NH-NL	1JUL94	30JUN96
MAINT. & OPERATING COST ALLOCATION STUDY NL-PR	1JUL94	30JUN96
MAINT. & OPERATING COST ALLOCATION STUDY PR-BO	1JUL94	30JUN96
P&W FEIGHT SERVICE CLEARANCE IMPROVEMENTS	1JUN94	30JUN96
NEW LONDON-PROVIDENCE: P & W FREIGHT SERVICE	1JUL96	31DEC00
P&W FEIGHT SERVICE CLEARANCE IMPROVEMENTS	1JUN94	30JUN96
PROVIDENCE-SOUTH STATION: P & W SERVICE	1JUL96	31DEC00
NEW HAVEN LINE GO/NO-GO SIGNAL IMPROVEMENTS	1JAN93	30NOV94
INSTALL NEW HAVEN LINE FIBER OPTIC SYSTEM	1JAN95	31AUG96
NHL FIBER OPTICS	1SEP96	31AUG98
INSTALL PUBLIC ADDRESS SYSTEM	1JAN95	31MAY96
PUBLIC ADDRESS SYSTEM	1JUN96	31DEC96
CONSTRUCT PEDESTRIAN BRIDGES: EXISTING STATIONS	1JAN97	31MAY98
NEW HAVEN-NEW LONDON PEDESTRIAN BRIDGES	1JUN98	31DEC00
CONSTRUCT PEDESTRIAN BRIDGES: PROPOSED STATIONS	1JAN02	31MAY03
NEW HAVEN-NEW LONDON PEDESTRIAN BRIDGES	1JUN03	31DEC04



Plot Date 30APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY IMPROVEMENT CATEGORY

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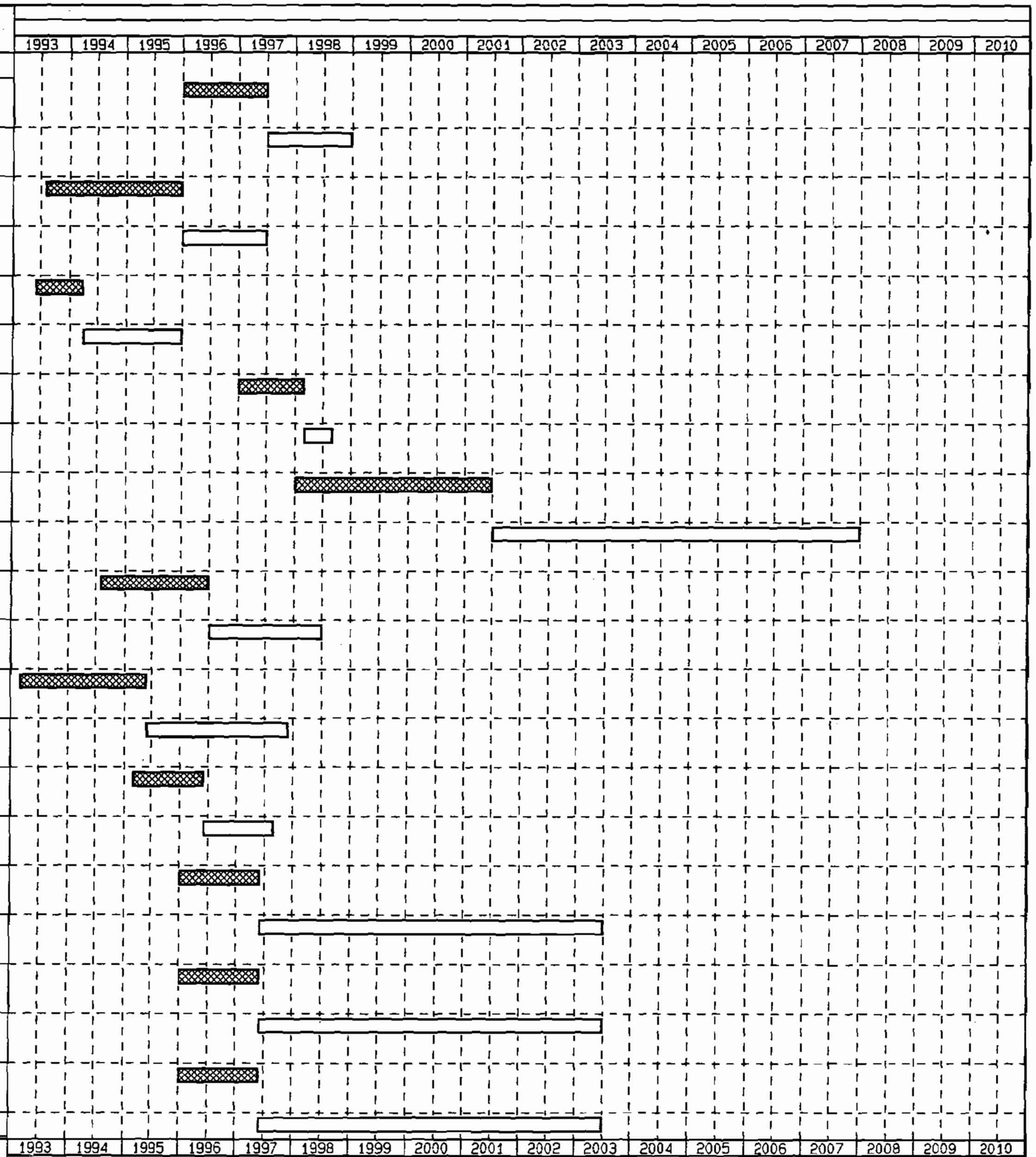
PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
OTHER		
CONSTRUCT PEDESTRIAN BRIDGES	1JAN96	30JUN97
NEW LONDON-PROVIDENCE: PEDESTRIAN BRIDGES	1JUL97	31DEC98
CONSTRUCT PEDESTRIAN BRIDGES	1AUG93	31DEC95
PROVIDENCE-SOUTH STATION: ROUTE 128	1JAN96	30JUN97
SHORE LINE EAST SLE SOUTH SIDE STA. RELOCATIONS	1JUN93	31MAR94
SLE STATION RELOCATIONS	1APR94	31DEC95
IMPROVED PARKING: NEW HAVEN-NEW LONDON	1JAN97	28FEB98
OLD SAYBROOK PARKING	1MAR98	31AUG98
IMPROVED PARKING: NEW ROCHELLE-NEW HAVEN	1JAN98	30JUN01
NEW ROCHELLE-NEW HAVEN PARKING	1JUL01	31DEC07
IMPROVED PARKING: PROVIDENCE-SOUTH STATION	1AUG94	30JUN96
ROUTE 128 PARKING	1JUL96	30JUN98
KEY STATION ADA ACCESS	1MAR93	31MAY95
NEW ROCHELLE-NEW HAVEN	1JUN95	30NOV97
KEY STATION ADA ACCESS	1MAR95	31MAY96
NEW HAVEN-NEW LONDON: ADA ACCESS	1JUN96	31AUG97
AMTRAK STATION IMPROVEMENTS NY-NR	1JAN96	31MAY97
AMTRAK STATION IMPROVEMENTS NY-NR	1JUN97	30JUN03
AMTRAK STATION IMPROVEMENTS NH-NL	1JAN96	31MAY97
AMTRAK STATION IMPROVEMENTS NH-NL	1JUN97	30JUN03
AMTRAK STATION IMPROVEMENTS NL-PR	1JAN96	31MAY97
AMTRAK STATION IMPROVEMENTS NL-PR	1JUN97	30JUN03



Plot Date 30APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

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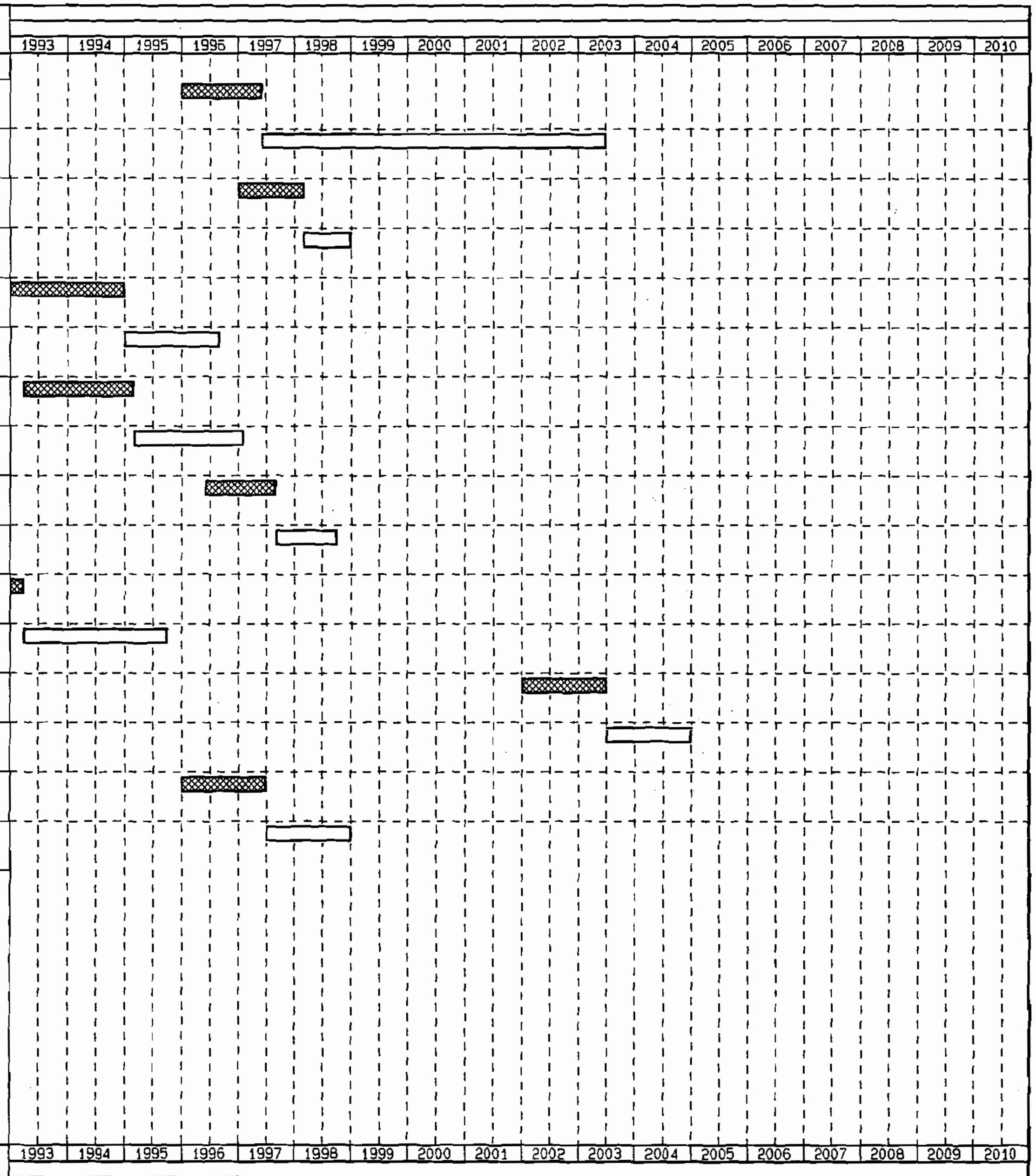
PRECONSTRUCTION
PRECONSTRUCTION PHASE

TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY IMPROVEMENT CATEGORY

Date	Revision	Checked	Approved

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
OTHER		
AMTRAK STATION IMPROVEMENTS PR-80	1JAN96	31MAY97
AMTRAK STATION IMPROVEMENTS PR-80	1JUN97	30JUN03
CONSTRUCT DAVISVILLE LAYOVER FACILITY	1JAN97	28FEB98
DAVISVILLE LAYOVER FACILITY	1MAR98	31DEC98
CONSTRUCT READVILLE LAYOVER FACILITY	1JAN93	31DEC94
READVILLE LAYOVER FACILITY	1JAN95	31AUG96
NHL & SLE NEW HAVEN CAR STORAGE YARD	1APR93	28FEB95
NHL & SLE CAR STORAGE YARD	1MAR95	31JAN97
CONSTRUCT PROVIDENCE LAYOVER FACILITY	1JUN96	31AUG97
PROVIDENCE LAYOVER FACILITY	1SEP97	30SEP98
CDOT NEW HAVEN SHOP	1JAN93	31MAR93
CONSTRUCT CDOT NEW HAVEN SHOP	1APR93	30SEP95
EXTEND SLE OLD SAYBROOK TO NEW LONDON	1JAN02	30JUN03
SLE TO NEW LONDON	1JUL03	31DEC04
ADD RIDOT KINGSTON-PROVIDENCE SERVICE	1JAN96	30JUN97
RIDOT NEW SERVICE	1JUL97	31DEC98



Plot Date 30APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
◇/F Milestone/Flag Activity

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TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY IMPROVEMENT CATEGORY

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PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

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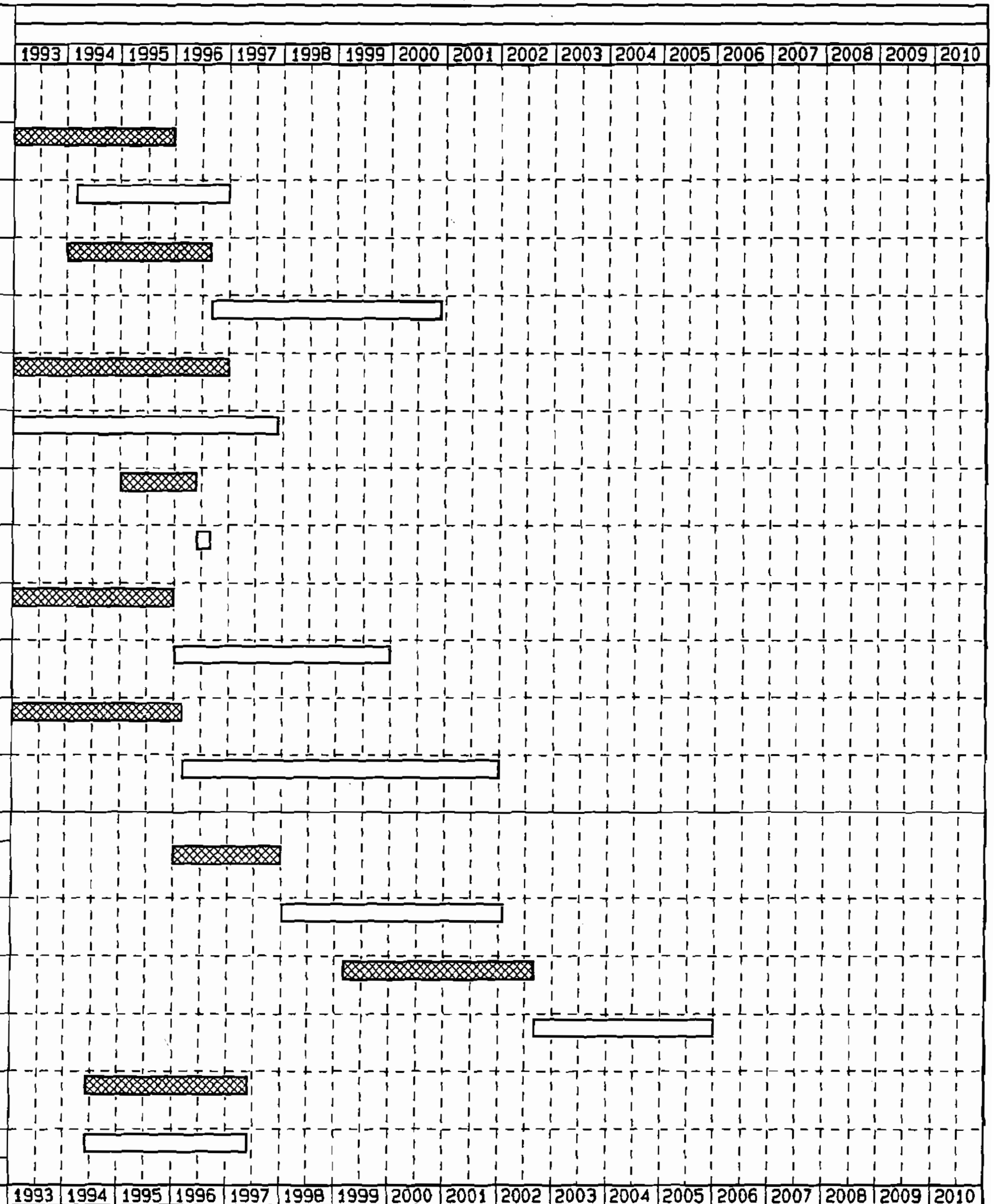
Appendix G
SCHEDULE OF PROPOSED PROJECTS
Sorted by Geographic Segment

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
NEW YORK-NEW ROCHELLE MPEO-E18.7 HIGH SPEED REQUIREMENTS: TRIP TIME		
REALIGN CURVES	1JAN93	31DEC95
NEW YORK-NEW ROCHELLE CURVES	1MAR94	31DEC96
SHELL FLYOVER	1JAN94	31AUG96
SHELL FLYOVER: NEW YORK-NEW ROCHELLE	1SEP96	30NOV00
TRACK PROGRAM	1JAN93	31DEC96
NEW YORK-NEW ROCHELLE TRACKWORK	1JAN93	30NOV97
REPLACE MITER RAILS	1JAN95	31MAY96
NEW YORK-NEW ROCHELLE MITER RAILS	1JUN96	31AUG96
INSTALL CIVIL SPEED ENFORCEMENT SYSTEM	1JAN93	31DEC95
NEW YORK-NEW ROCHELLE SPEED ENFORCEMENT	1JAN96	31DEC99
PROCURE AMTRAK HIGH SPEED TRAINSETS	1JAN93	29FEB96
TRAINSETS PRODUCTION/DELIVERY	1MAR96	31DEC01
HIGH SPEED REQUIREMENTS: CAPACITY		
CONSTRUCT MEDIUM & HEAVY OVERHAUL FACILITY NY-NR	1JAN96	31DEC97
CONSTR. MEDIUM & HEAVY OVERHAUL FAC. NY-NR	1JAN98	31JAN02
HAROLD INTERLOCKING	1MAR99	31AUG02
HAROLD INTERLOCKING	1SEP02	31DEC05
PENN STATION-EXTEND PLATFORM 11 & 5X CONNECTION	1JUN94	31MAY97
N.Y. PENN STATION	1JUN94	31MAY97



Plot Date 28APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

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TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY RAILROAD DEVELOPMENT PROJECT

Sheet 1 of 17

PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

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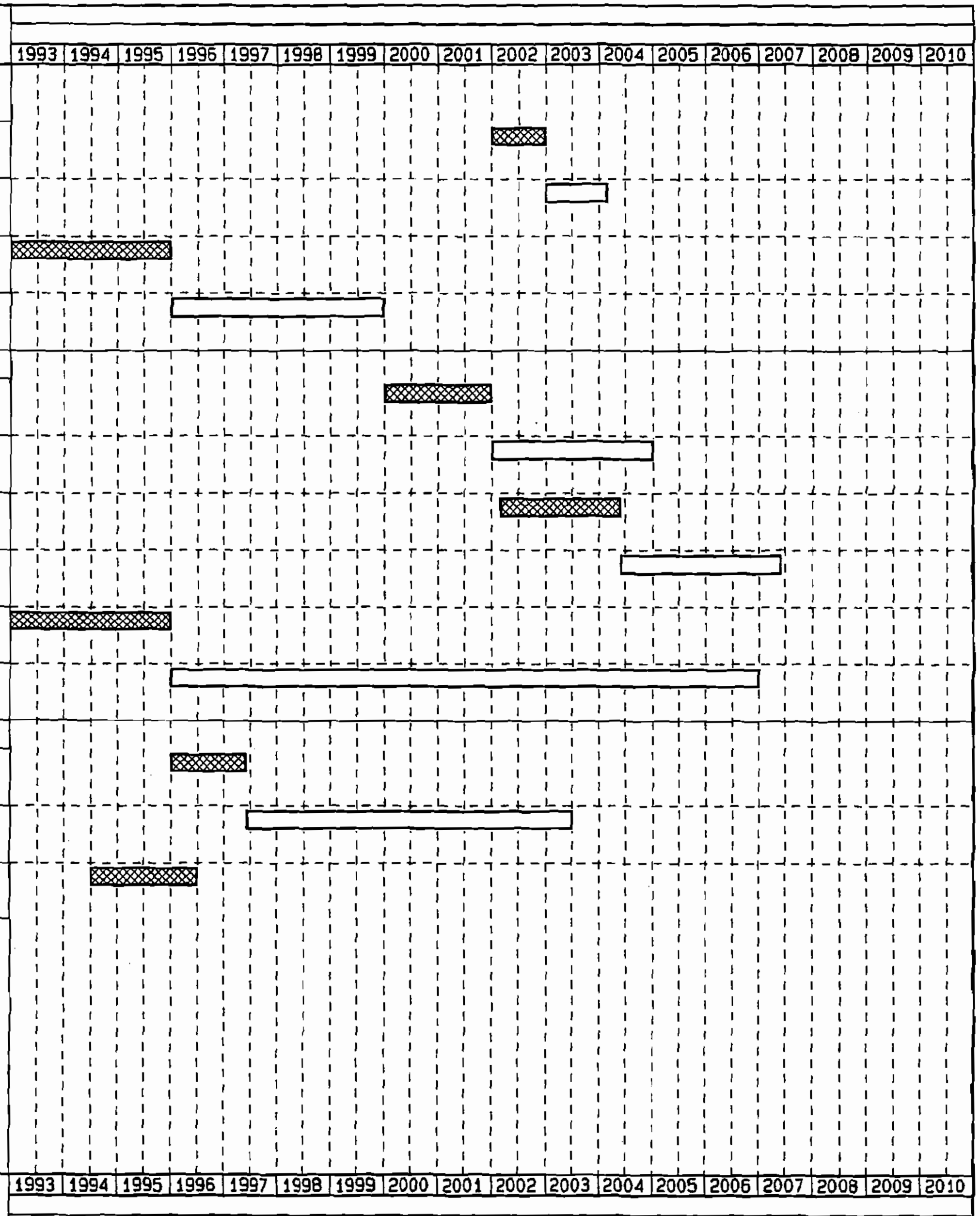
ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
NEW YORK-NEW ROCHELLE MPEO-E18.7 HIGH SPEED REQUIREMENTS: CAPACITY		
INSTALL NEW INTERLOCKINGS	1JAN02	31DEC02
NEW YORK-NEW ROCHELLE INTERLOCKINGS	1JAN03	29FEB04
MODIFY ON-BOARD CAB SIGNAL EQUIPMENT	1JAN93	31DEC95
NEW YORK-NEW ROCHELLE CAB SIGNAL	1JAN96	31DEC99
RECAPITALIZATION		
PELHAM BAY BRIDGE REPLACEMENT	1JAN00	31DEC01
PELHAM BAY	1JAN02	31DEC04
HELLGATE LINE HANGING BEAM REMOVAL	1MAR02	31MAY04
HELLGATE HANGING BEAM	1JUN04	31MAY07
PENN STATION: FIRE LIFE SAFETY IMPROVEMENTS	1JAN93	31DEC95
FIRE LIFE SAFETY	1JAN96	31DEC06
OTHER		
AMTRAK STATION IMPROVEMENTS NY-NR	1JAN96	31MAY97
AMTRAK STATION IMPROVEMENTS NY-NR	1JUN97	30JUN03
MAINT. & OPERATING COST ALLOCATION STUDY NY-NR	1JUL94	30JUN96



Plot Date 28APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

RJ83

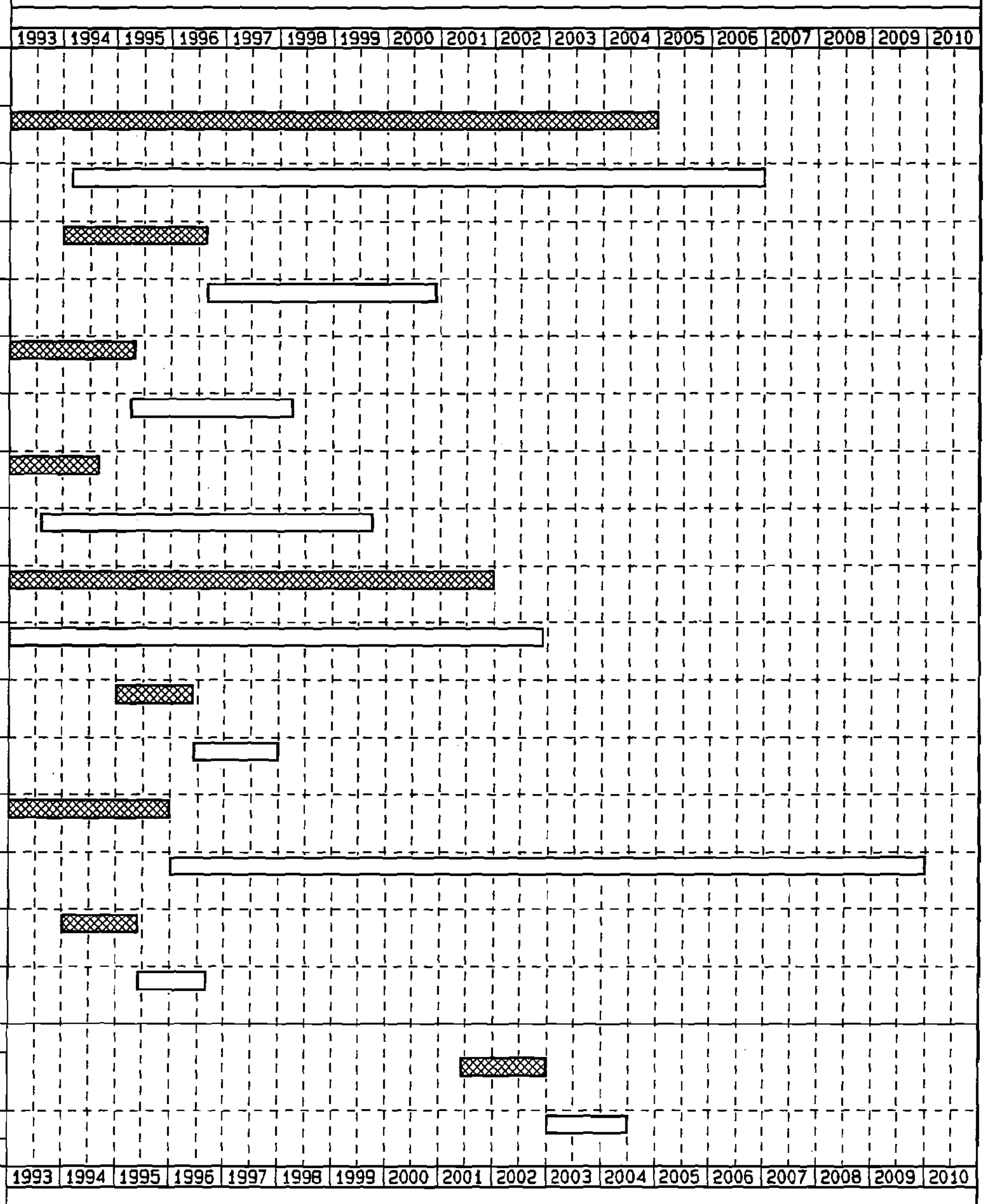
TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY RAILROAD DEVELOPMENT PROJECT

Sheet 2 of 17

PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
NEW ROCHELLE-NEW HAVEN MP15-MP72.8 HIGH SPEED REQUIREMENTS: TRIP TIME		
REALIGN CURVES	1JAN93	31DEC04
NEW ROCHELLE-NEW HAVEN CURVES	1MAR94	31DEC06
SHELL FLYOVER	1JAN94	31AUG96
SHELL FLYOVER: NEW ROCHELLE-NEW HAVEN	1SEP96	30NOV00
STAMFORD STATION CENTER ISLAND PLATFORM	1JAN93	30APR95
STAMFORD STATION	1APR95	31MAR98
NEW HAVEN TERMINAL	1JAN93	31AUG94
NEW HAVEN TERMINAL: NEW ROCHELLE-NEW HAVEN	1AUG93	30SEP99
TRACK PROGRAM	1JAN93	31DEC01
NEW ROCHELLE-NEW NEW HAVEN TRACKWORK	1JAN93	30NOV02
REPLACE MITER RAILS	1JAN95	31MAY96
NEW ROCHELLE-NEW HAVEN MITER RAILS	1JUN96	31DEC97
INSTALL CIVIL SPEED ENFORCEMENT SYSTEM	1JAN93	31DEC95
NEW ROCHELLE-NEW HAVEN SPEED ENFORCEMENT	1JAN96	31DEC09
CONSTRUCT AMTRAK NEW HAVEN SERVICE FACILITY	1JAN94	31MAY95
AMTRAK NEW HAVEN SERVICE FACILITY	1JUN95	31AUG96
HIGH SPEED REQUIREMENTS: CAPACITY		
REINSTALL DEVON TO NEW HAVEN FOURTH TRACK	1JUN01	31DEC02
FOURTH TRACK	1JAN03	30JUN04



Plot Date 28APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

RJ63

TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY RAILROAD DEVELOPMENT PROJECT

PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

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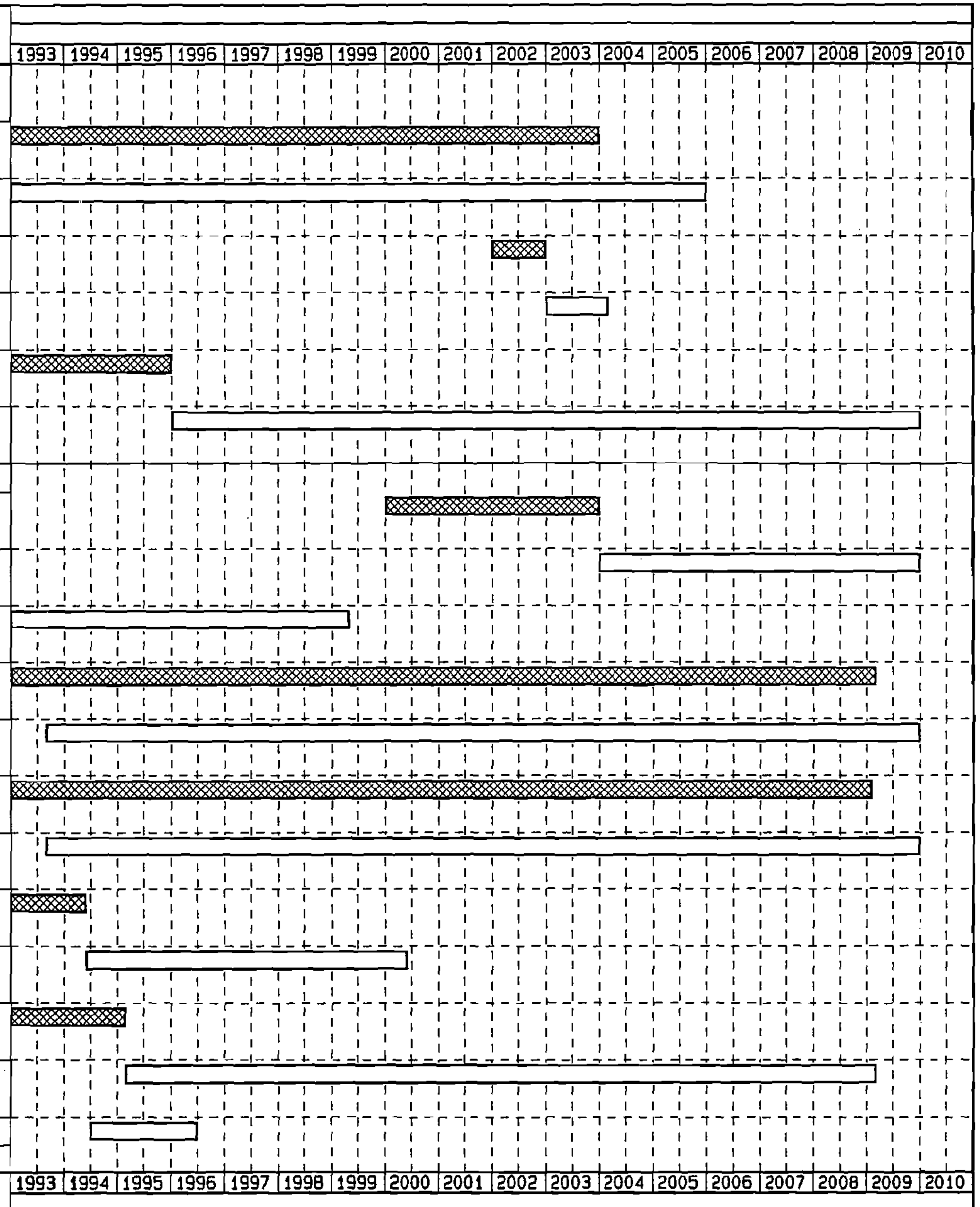
ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
NEW ROCHELLE-NEW HAVEN MP15-MP72.8 HIGH SPEED REQUIREMENTS: CAPACITY		
RECONFIGURE EXISTING INTERLOCKINGS	1JAN93	31DEC03
NEW ROCHELLE-NEW HAVEN INTERLOCKINGS	1JAN93	31DEC05
INSTALL NEW INTERLOCKINGS	1JAN02	31DEC02
NEW ROCHELLE-NEW HAVEN NEW INTERLOCKINGS	1JAN03	29FEB04
MODIFY ON-BOARD CAB SIGNAL EQUIPMENT	1JAN93	31DEC95
NEW ROCHELLE-NEW HAVEN CAB SIGNAL	1JAN96	31DEC09
RECAPITALIZATION		
WALK BRIDGE/SAGA BRIDGE REPLACEMENT	1JAN00	31DEC03
WALK/SAGA BRIDGES	1JAN04	31DEC09
PECK BRIDGE REPLACEMENT	1JAN93	30APR99
CONVERT OPEN DECK BRIDGES	1JAN93	28FEB09
NEW ROCHELLE-NEW HAVEN CONVERT BRIDGES	1SEP93	31DEC09
REPLACE DETERIORATED BRIDGES & CULVERTS	1JAN93	31JAN09
NEW ROCHELLE-NEW HAVEN BRIDGES	1SEP93	31DEC09
NEW HAVEN LINE SUBSTATION REPLACEMENT	1JAN93	31MAY94
NHL SUBSTATION	1JUN94	31MAY00
NEW HAVEN LINE CATENARY REPLACEMENT	1JAN93	28FEB95
NHL CATENARY	1MAR95	28FEB09
EQUIPMENT TESTING: NHL	1JUL94	30JUN96



Plot Date 28APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

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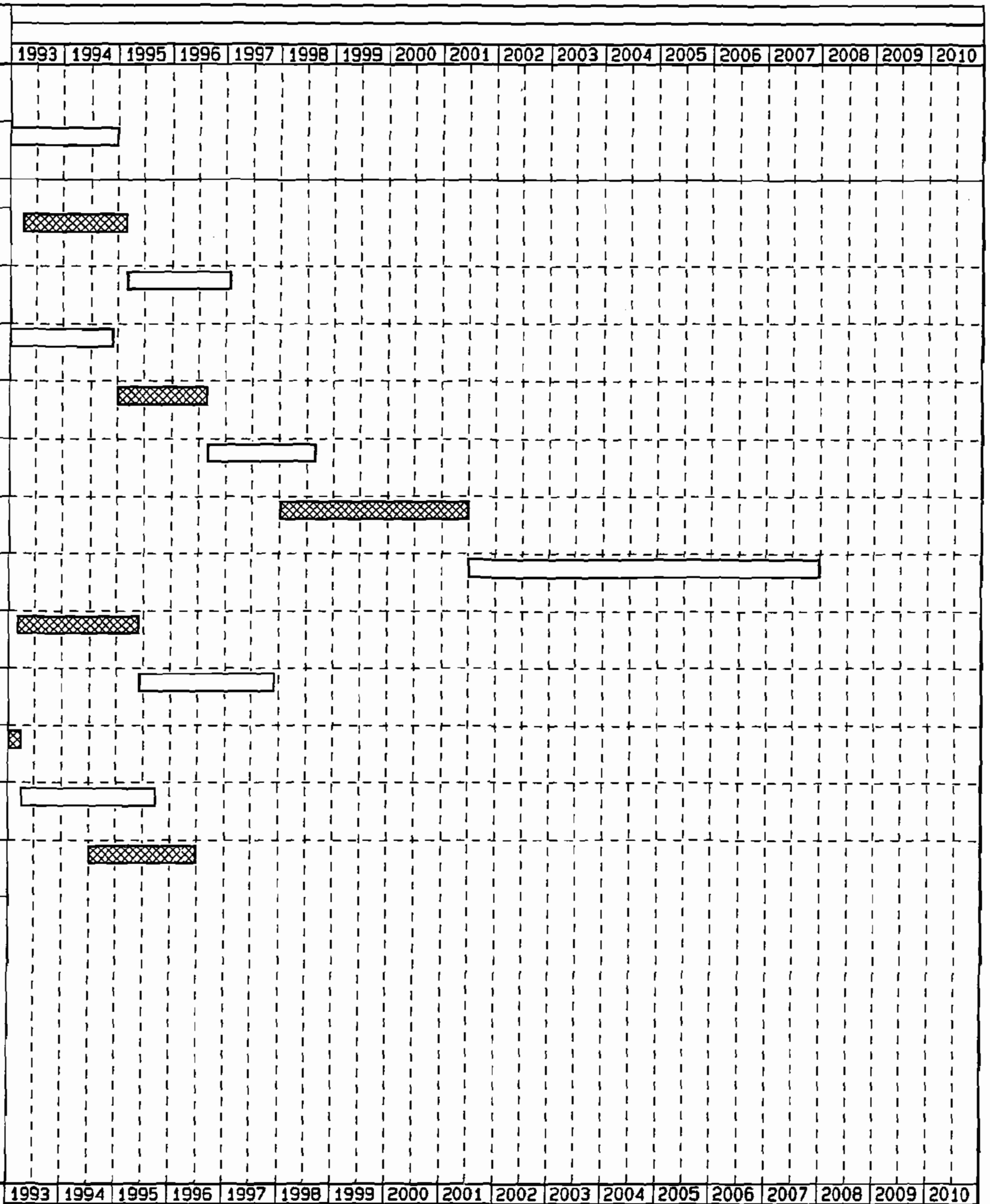
PRECONSTRUCTION
PRECONSTRUCTION PHASE

TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY RAILROAD DEVELOPMENT PROJECT

Date	Revision	Checked	Approved

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
NEW ROCHELLE-NEW HAVEN MP15-MP72.8 RECAPITALIZATION		
STEP & TOUCH TRACTION RETURN MITIGATION: NHL	1JAN93	31DEC94
OTHER		
NHL & SLE NEW HAVEN CAR STORAGE YARD	1APR93	28FEB95
NHL & SLE CAR STORAGE YARD	1MAR95	31JAN97
NEW HAVEN LINE GO/NO-GO SIGNAL IMPROVEMENTS	1JAN93	30NOV94
INSTALL NEW HAVEN LINE FIBER OPTIC SYSTEM	1JAN95	31AUG96
NHL FIBER OPTICS	1SEP96	31AUG98
IMPROVED PARKING: NEW ROCHELLE-NEW HAVEN	1JAN98	30JUN01
NEW ROCHELLE-NEW HAVEN PARKING	1JUL01	31DEC07
KEY STATION ADA ACCESS	1MAR93	31MAY95
NEW ROCHELLE-NEW HAVEN	1JUN95	30NOV97
CDOT NEW HAVEN SHOP	1JAN93	31MAR93
CONSTRUCT CDOT NEW HAVEN SHOP	1APR93	30SEP95
MAINT. & OPERATING COST ALLOCATION STUDY NR-NH	1JUL94	30JUN96



Plot Date 28APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

RJG5

TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY RAILROAD DEVELOPMENT PROJECT

PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

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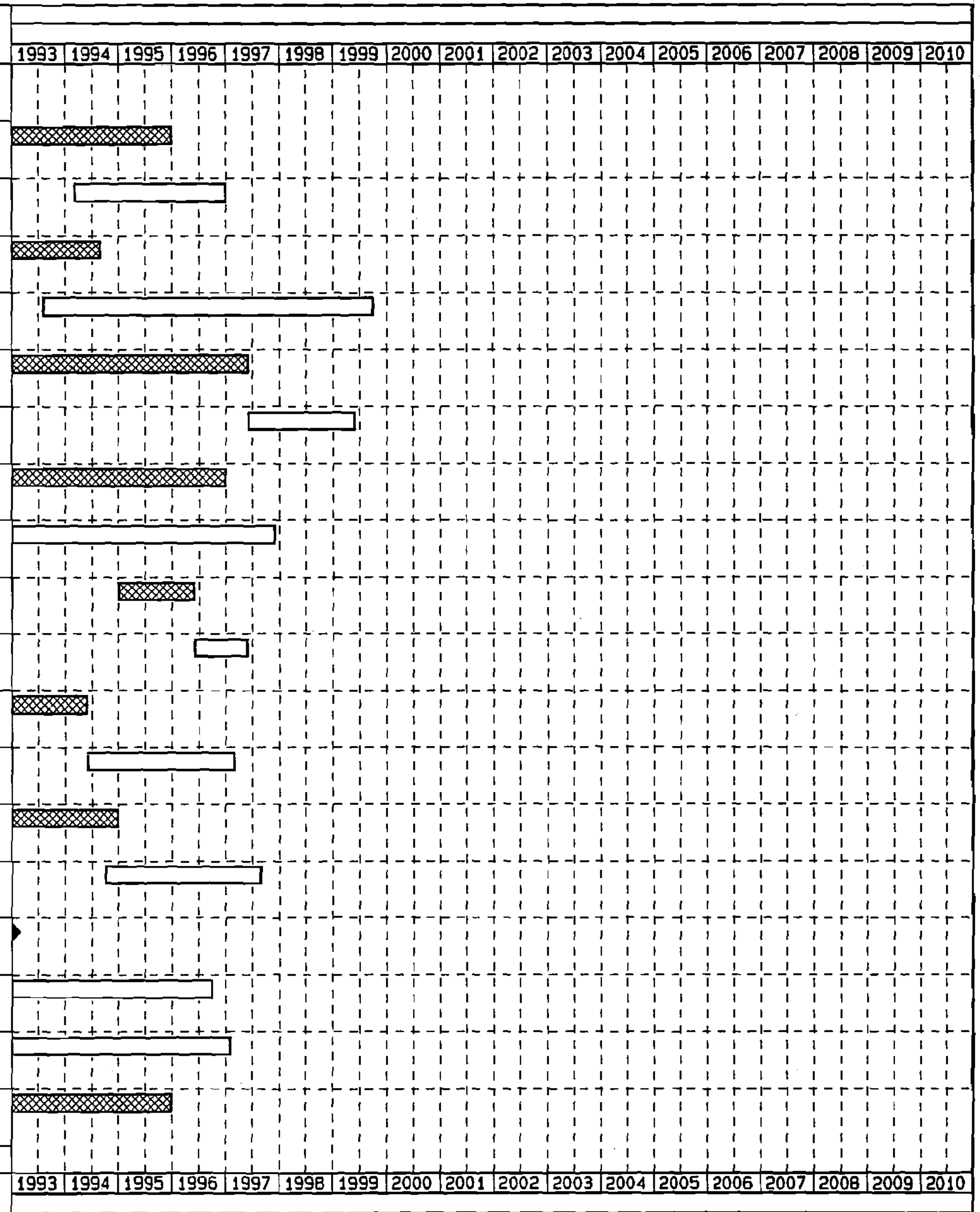
ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
NEW HAVEN-NEW LONDON MP72.8-MP123.9 HIGH SPEED REQUIREMENTS: TRIP TIME		
REALIGN CURVES	1JAN93	31DEC95
NEW HAVEN-NEW LONDON CURVES	1MAR94	31DEC96
NEW HAVEN TERMINAL	1JAN93	31AUG94
NEW HAVEN TERMINAL: NEW HAVEN-NEW LONDON	1AUG93	30SEP99
RECONFIGUE OLD SAYBROOK STATION	1JAN93	31MAY97
OLD SAYBROOK STATION	1JUN97	31MAY99
TRACK PROGRAM	1JAN93	31DEC96
NEW HAVEN-NEW LONDON TRACKWORK	1JAN93	30NOV97
REPLACE MITER RAILS	1JAN95	31MAY96
NEW HAVEN-NEW LONDON MITER RAILS	1JUN96	31MAY97
INSTALL 25KV 60 hZ CENTER FED SYSTEM	1JAN93	31MAY94
NEW HAVEN-NEW LONDON: 25 KV SYSTEM	1JUN94	28FEB97
PROVIDE CLEARANCE FOR ELECTRIFICATION	1JAN93	31DEC94
NEW HAVEN-NEW LONDON CLEARANCE FOR ELECT.	1OCT94	31AUG97
SIGNAL COMPATIBLE W/ELECTRIFICATION		31JAN93A
NEW HAVEN-NEW LONDON SIGNALING	1JAN93	30SEP96
NEW HAVEN-NEW LONDON CETC	1JAN93	31JAN97
INSTALL CIVIL SPEED ENFORCEMENT SYSTEM	1JAN93	31DEC95



Plot Date 28APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

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Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

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TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY RAILROAD DEVELOPMENT PROJECT

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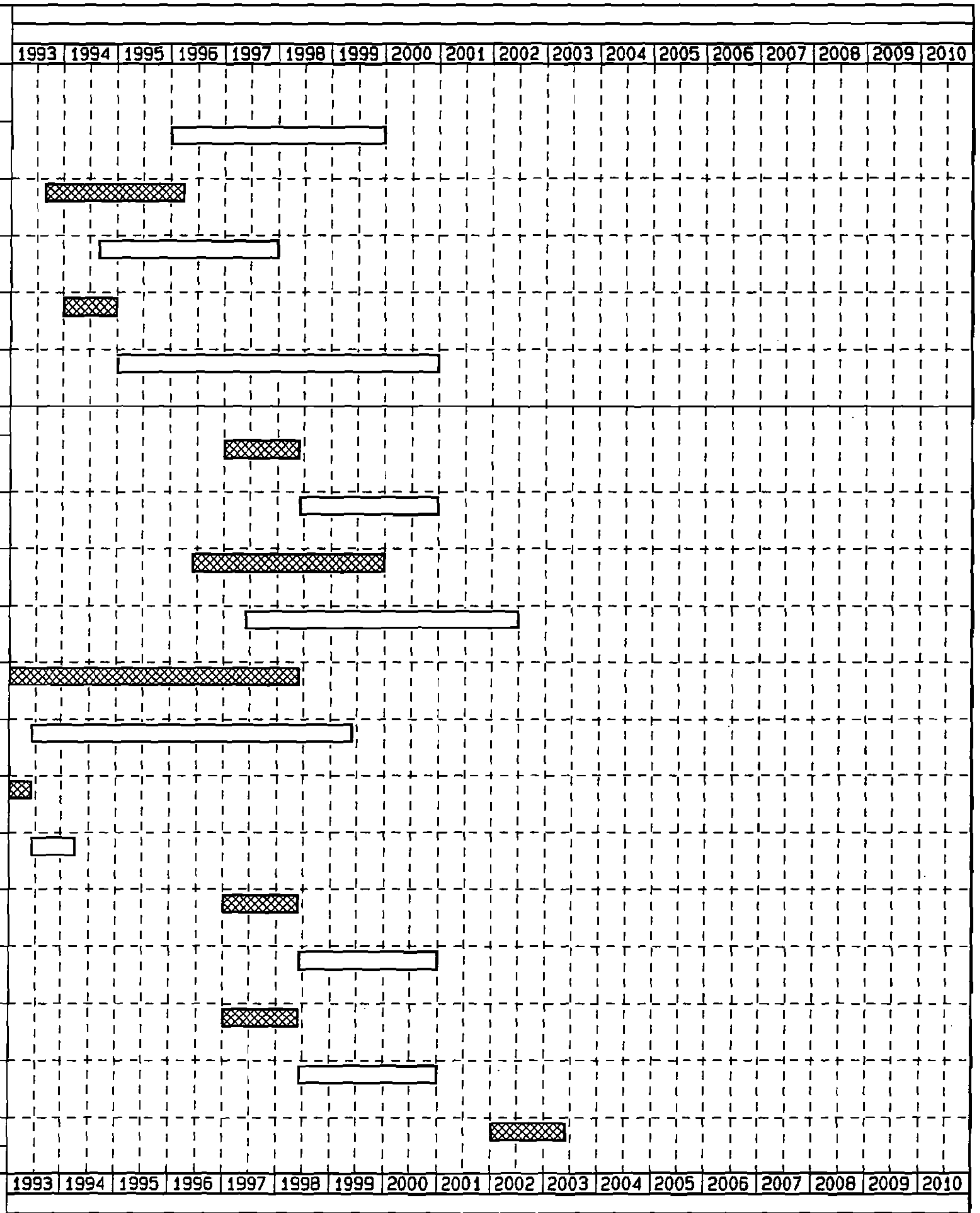
PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
NEW HAVEN-NEW LONDON MP72.8-MP123.9		
HIGH SPEED REQUIREMENTS: TRIP TIME		
NEW HAVEN-NEW LONDON SPEED ENFORCEMENT	1JAN96	31DEC99
GRADE CROSSINGS: ELIMINATION PROGRAM	1SEP93	31MAR96
NEW HAVEN-NEW LONDON GRADE CROSSINGS	1SEP94	31DEC97
DEVELOP NOISE & VIBRATION MITIGATION PROGRAM	1JAN94	31DEC94
IMPLEMENT NOISE & VIBRATION MITIGATION PROG	1JAN95	31DEC00
HIGH SPEED REQUIREMENTS: CAPACITY		
SHORE LINE EAST SLE BOTH SIDES FULLY ACCESSIBLE	1JAN97	31MAY98
SLE FULLY ACCESSIBLE STATIONS	1JUN98	31DEC00
CONSTRUCT SHORE LINE EAST (SLE) PASSING SIDINGS	1JUN96	31DEC99
SLE PASSING SIDINGS	1JUN97	30JUN02
RECONFIGURE EXISTING INTERLOCKINGS	1JAN93	31MAY98
NEW HAVEN-NEW LONDON INTERLOCKINGS	1JUN93	31MAY99
INSTALL HIGH SPEED UNIVERSAL INTERLOCKINGS	1JAN93	31MAY93
NEW HAVEN-NEW LONDON HIGH SPEED I/L	1JUN93	31MAR94
INSTALL GAUNTLET TRACKS: SLE	1JAN97	31MAY98
EXISTING STATIONS: GAUNTLET TRACKS	1JUN98	31DEC00
INSTALL NEW LONDON - PROVIDENCE GAUNTLET TRACK	1JAN97	31MAY98
NEW LONDON - PROVIDENCE GAUNTLET TRACK	1JUN98	31DEC00
INSTALL GAUNTLET TRACKS: SLE	1JAN02	31MAY03



Plot Date 28APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

RJG3

TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS BY RAILROAD DEVELOPMENT PROJECT

PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

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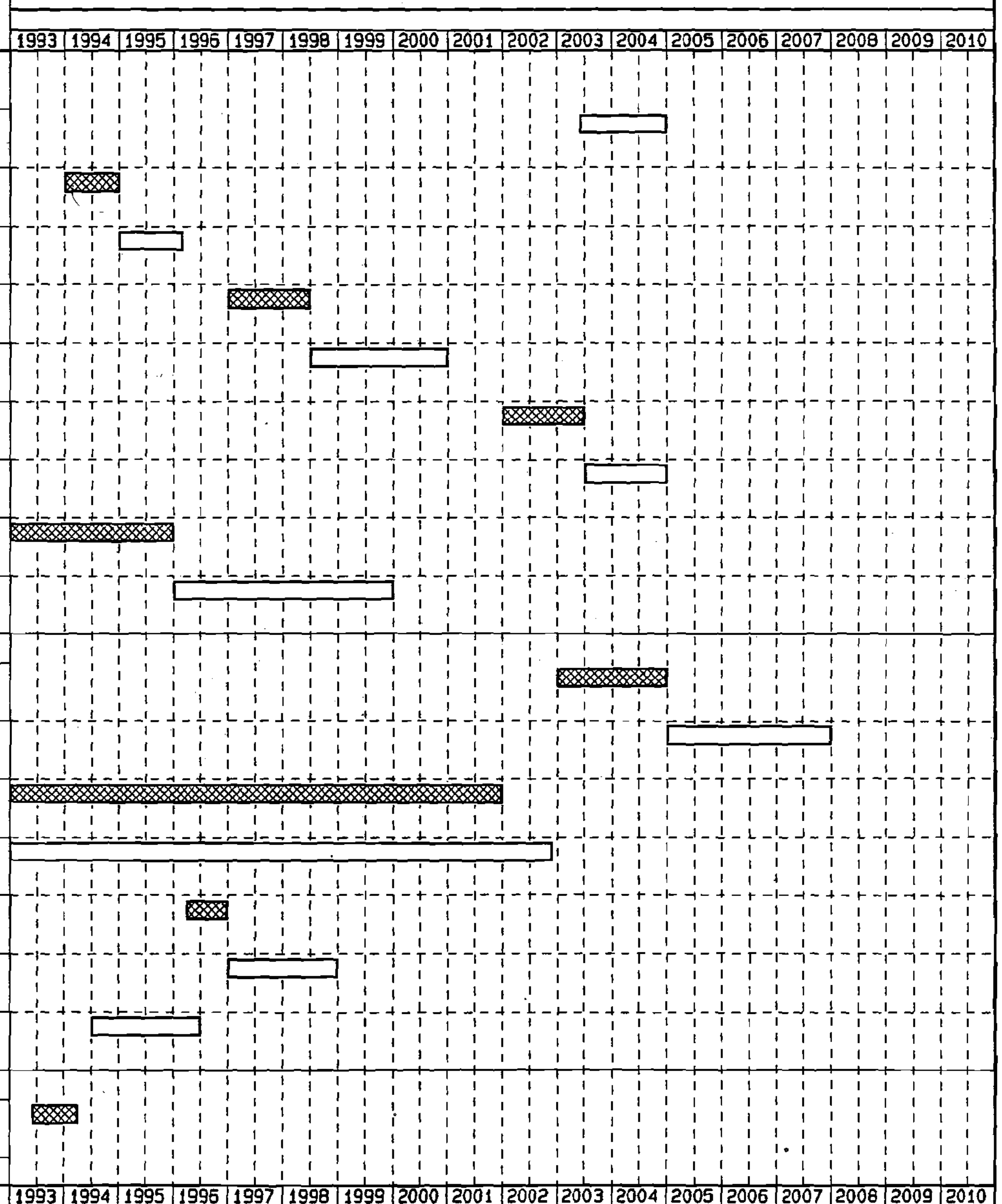
ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
NEW HAVEN-NEW LONDON MP72.8-MP123.9 HIGH SPEED REQUIREMENTS: CAPACITY		
PROPOSED STATIONS-SLE	1JUN03	31DEC04
INSTALL NEW INTERLOCKINGS	1JAN94	31DEC94
NEW HAVEN-NEW LONDON INTERLOCKINGS	1JAN95	29FEB96
HIGH LEVEL PLATFORMS: SLE	1JAN97	30JUN98
EXISTING STATIONS: SLE	1JUL98	31DEC00
HIGH LEVEL PLATFORMS: SLE	1JAN02	30JUN03
PROPOSED STATIONS: SLE	1JUL03	31DEC04
MODIFY ON-BOARD CAB SIGNAL EQUIPMENT	1JAN93	31DEC95
NEW HAVEN-NEW LONDON: CAB SIGNAL	1JAN96	31DEC99
RECAPITALIZATION		
NIANTIC BRIDGE REPLACEMENT	1JAN03	31DEC04
NIANTIC BRIDGE	1JAN05	31DEC07
CONVERT OPEN DECK BRIDGES	1JAN93	31DEC01
NEW HAVEN-NEW LONDON CONVERT BRIDGES	1JAN93	30NOV02
FENCE SELECTED SENSITIVE AREAS	1APR96	31DEC96
NEW HAVEN-NEW LONDON FENCING	1JAN97	31DEC98
EQUIPMENT TESTING: SLE	1JUL94	30JUN96
OTHER		
SHORE LINE EAST SLE SOUTH SIDE STA. RELOCATIONS	1JUN93	31MAR94



Plot Date 28APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

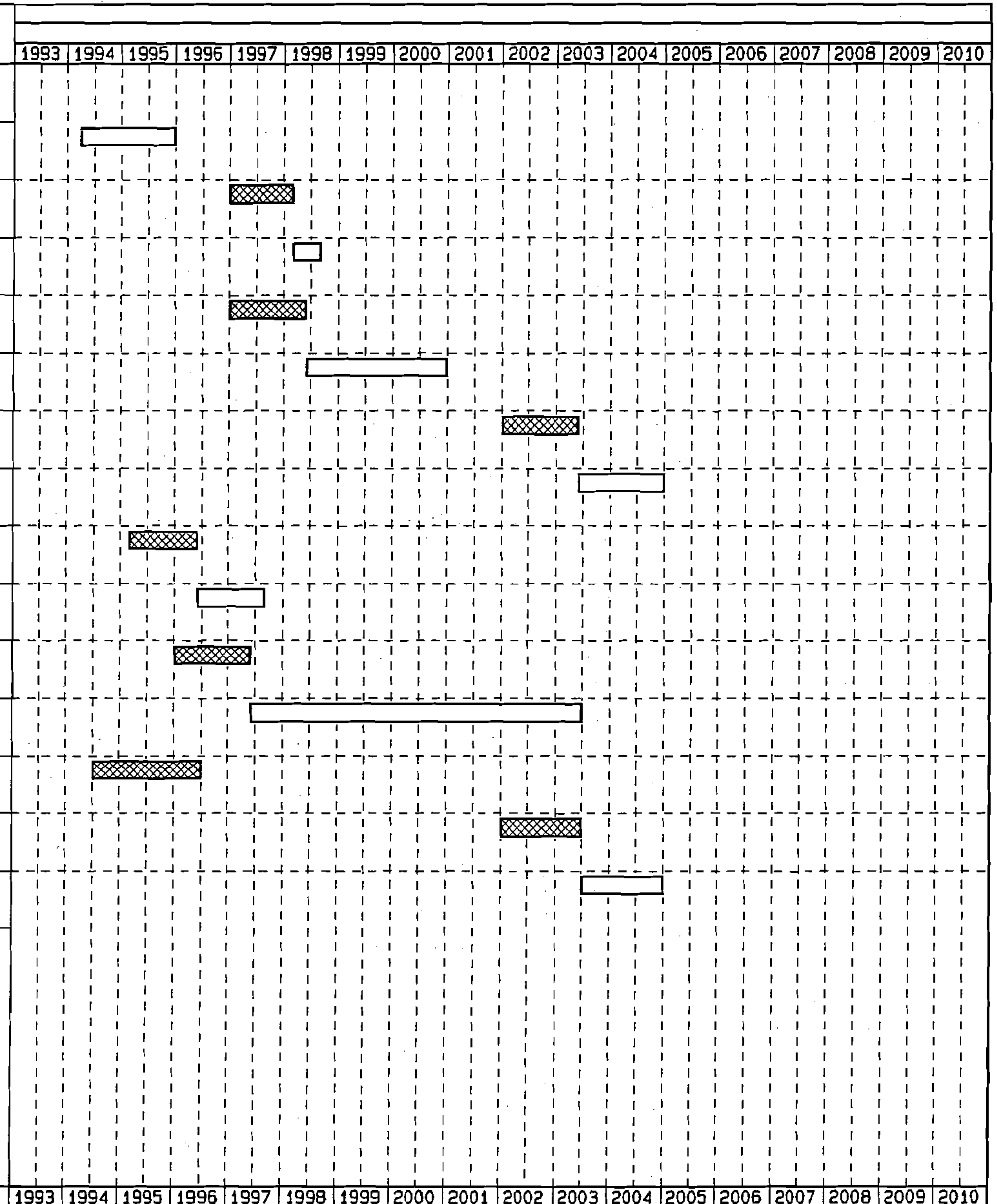
TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY RAILROAD DEVELOPMENT PROJECT

Sheet 8 of 17

PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
NEW HAVEN-NEW LONDON MP72.8-MP123.9 OTHER		
SLE STATION RELOCATIONS	1APR94	31DEC95
IMPROVED PARKING: NEW HAVEN-NEW LONDON	1JAN97	28FEB98
OLD SAYBROOK PARKING	1MAR98	31AUG98
CONSTRUCT PEDESTRIAN BRIDGES: EXISTING STATIONS	1JAN97	31MAY98
NEW HAVEN-NEW LONDON PEDESTRIAN BRIDGES	1JUN98	31DEC00
CONSTRUCT PEDESTRIAN BRIDGES: PROPOSED STATIONS	1JAN02	31MAY03
NEW HAVEN-NEW LONDON PEDESTRIAN BRIDGES	1JUN03	31DEC04
KEY STATION ADA ACCESS	1MAR95	31MAY96
NEW HAVEN-NEW LONDON: ADA ACCESS	1JUN96	31AUG97
AMTRAK STATION IMPROVEMENTS NH-NL	1JAN96	31MAY97
AMTRAK STATION IMPROVEMENTS NH-NL	1JUN97	30JUN03
MAINT. & OPERATING COST ALLOCATION STUDY NH-NL	1JUL94	30JUN96
EXTEND SLE OLD SAYBROOK TO NEW LONDON	1JAN02	30JUN03
SLE TO NEW LONDON	1JUL03	31DEC04



Plot Date 28APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

RJG3

TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY RAILROAD DEVELOPMENT PROJECT

Sheet 9 of 17

PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

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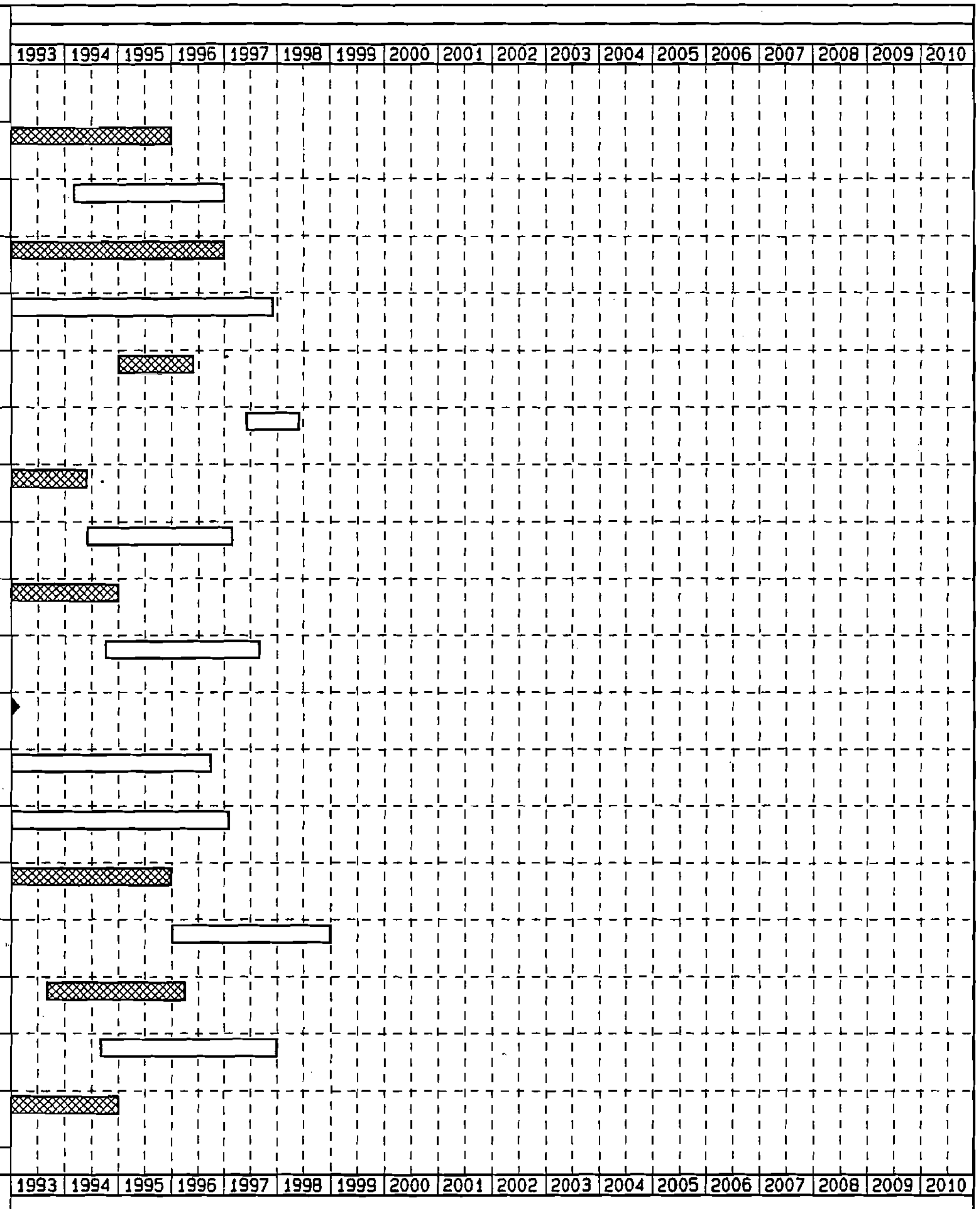
ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
NEW LONDON-PROVIDENCE MP123.9-MP185.4 HIGH SPEED REQUIREMENTS: TRIP TIME		
REALIGN CURVES	1JAN93	31DEC95
NEW LONDON-PROVIDENCE: CURVES	1MAR94	31DEC96
TRACK PROGRAM	1JAN93	31DEC96
NEW LONDON-PROVIDENCE: TRACKWORK	1JAN93	30NOV97
REPLACE MITER RAILS	1JAN95	31MAY96
NEW LONDON-PROVIDENCE: MITER RAILS	1JUN97	31MAY98
INSTALL 25KV 60 hZ CENTER FED SYSTEM	1JAN93	31MAY94
NEW LONDON-PROVIDENCE: 25 KV SYSTEM	1JUN94	28FEB97
PROVIDE CLEARANCE FOR ELECTRIFICATION	1JAN93	31DEC94
NEW LONDON-PROVIDENCE: CLEARANCE	1OCT94	31AUG97
SIGNAL COMPATIBLE W/ELECTRIFICATION		31JAN93A
NEW LONDON-PROVIDENCE: SIGNALING	1JAN93	30SEP96
NEW LONDON-PROVIDENCE CETC	1JAN93	31JAN97
INSTALL CIVIL SPEED ENFORCEMENT SYSTEM	1JAN93	31DEC95
NEW LONDON-PROVIDENCE: SPEED ENFORCEMENT	1JAN96	31DEC98
GRADE CROSSINGS: ELIMINATION PROGRAM	1SEP93	31MAR96
NEW LONDON-PROVIDENCE: GRADE CROSSINGS	1SEP94	31DEC97
KINGSTON STA. INTERMODAL TRANSPORTATION FACILITY	1JAN93	31DEC94



Plot Date 28APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

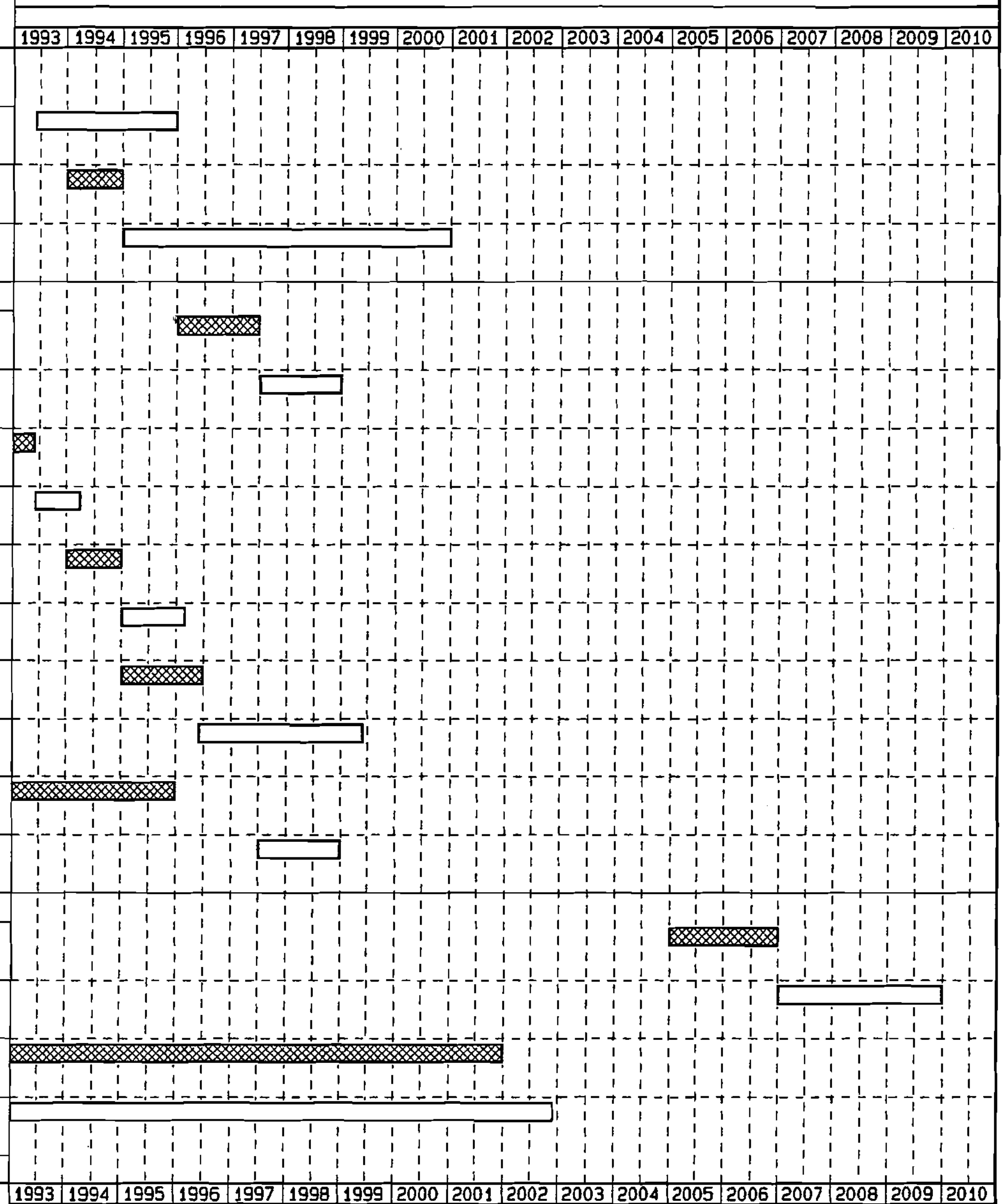
Sheet 10 of 17

PRECONSTRUCTION
PRECONSTRUCTION PHASE

TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY RAILROAD DEVELOPMENT PROJECT

Date	Revision	Checked	Approved

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
NEW LONDON-PROVIDENCE MP123.9-MP185.4 HIGH SPEED REQUIREMENTS: TRIP TIME		
KINGSTON INTERMODAL	1JUN93	31DEC95
DEVELOP NOISE & VIBRATION MITIGATION PROGRAM	1JAN94	31DEC94
IMPLEMENT NOISE & VIBRATION MITIGATION PROG	1JAN95	31DEC00
HIGH SPEED REQUIREMENTS: CAPACITY		
CONSTRUCT KINGSTON TO PROVIDENCE PASSING SIDINGS	1JAN96	30JUN97
KINGSTON/CRANSTON SIDINGS	1JUL97	31DEC98
INSTALL HIGH SPEED UNIVERSAL INTERLOCKINGS	1JAN93	31MAY93
NEW LONDON-PROVIDENCE: HIGH SPEED I/L	1JUN93	31MAR94
INSTALL NEW INTERLOCKINGS	1JAN94	31DEC94
NEW LONDON-PROVIDENCE INTERLOCKINGS	1JAN95	29FEB96
HIGH LEVEL PLATFORMS	1JAN95	30JUN96
NEW LONDON-PROVIDENCE: PLATFORMS	1JUN96	31MAY99
MODIFY ON-BOARD CAB SIGNAL EQUIPMENT	1JAN93	31DEC95
NEW LONDON-PROVIDENCE: CAB SIGNAL	1JUL97	31DEC98
RECAPITALIZATION		
GROTON BRIDGE REPLACEMENT	1JAN05	31DEC06
GROTON BRIDGE	1JAN07	31DEC09
CONVERT OPEN DECK BRIDGES	1JAN93	31DEC01
NEW LONDON-PROVIDENCE: CONVERT BRIDGES	1JAN93	30NOV02



Plot Date 28APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

RJ63

TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY RAILROAD DEVELOPMENT PROJECT

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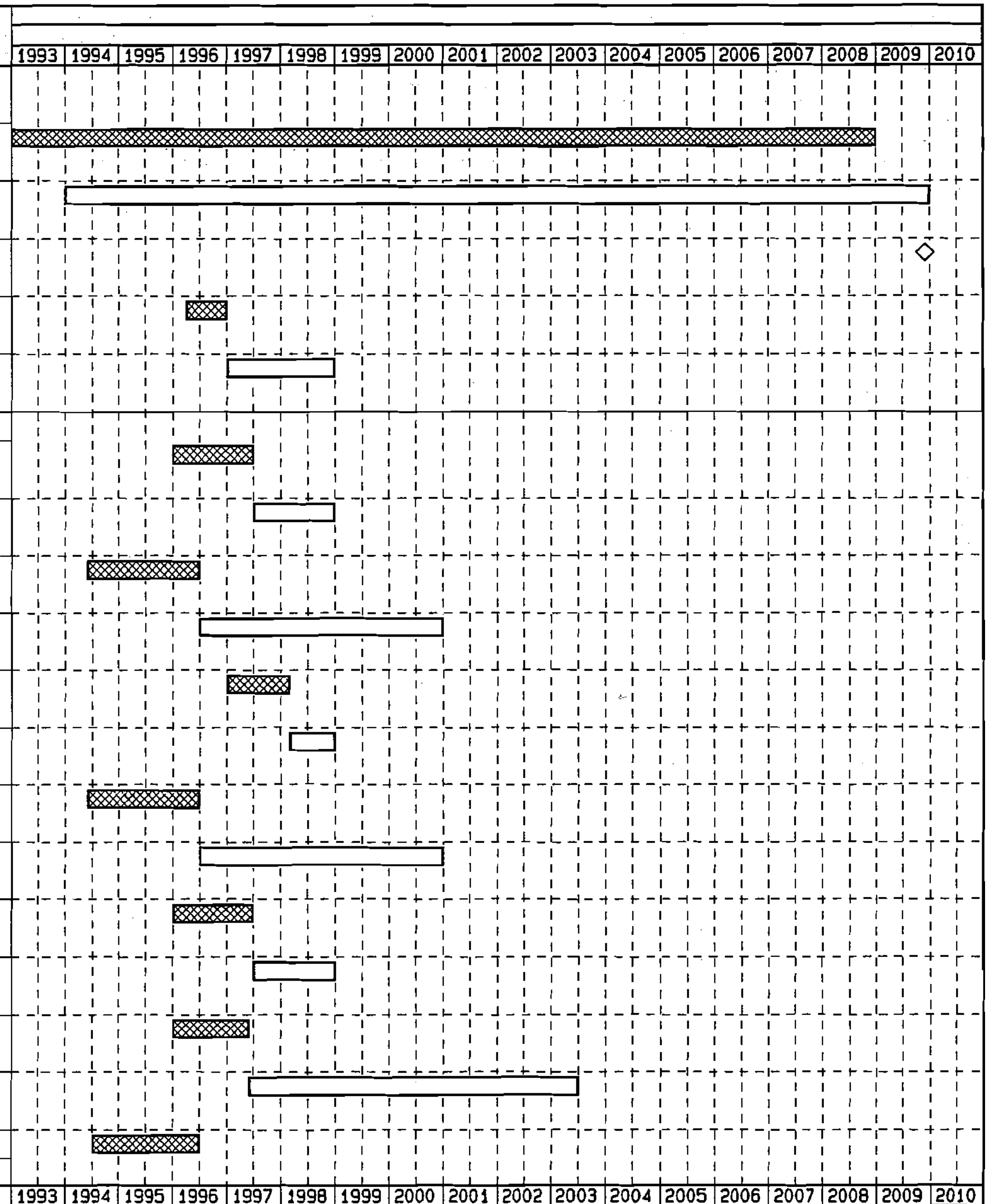
PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
NEW LONDON-PROVIDENCE MP123.9-MP185.4 RECAPITALIZATION		
REPLACE/UPGRADE OVERHEAD BRIDGES IN RHODE ISLAND	1JAN93	31DEC08
NEW LONDON-PROVIDENCE: OVERHEAD BRIDGES	1JAN94	31DEC09
	1DEC09	30NOV09
FENCE SELECTED SENSITIVE AREAS	1APR96	31DEC96
NEW LONDON-PROVIDENCE: FENCING	1JAN97	31DEC98
OTHER		
RECONFIGURE KINGSTON STATION	1JAN96	30JUN97
KINGSTON STATION	1JUL97	31DEC98
THIRD TRACK FOR P & W FREIGHT SERVICE NL-PROV	1JUN94	30JUN96
THIRD RAIL P & W FREIGHT SERVICE NL-PROV	1JUL96	31DEC00
CONSTRUCT DAVISVILLE LAYOVER FACILITY	1JAN97	28FEB98
DAVISVILLE LAYOVER FACILITY	1MAR98	31DEC98
P&W FEIGHT SERVICE CLEARANCE IMPROVEMENTS	1JUN94	30JUN96
NEW LONDON-PROVIDENCE: P & W FREIGHT SERVICE	1JUL96	31DEC00
CONSTRUCT PEDESTRIAN BRIDGES	1JAN96	30JUN97
NEW LONDON-PROVIDENCE: PEDESTRIAN BRIDGES	1JUL97	31DEC98
AMTRAK STATION IMPROVEMENTS NL-PR	1JAN96	31MAY97
AMTRAK STATION IMPROVEMENTS NL-PR	1JUN97	30JUN03
MAINT. & OPERATING COST ALLOCATION STUDY NL-PR	1JUL94	30JUN96



Plot Date 28APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

RJ63

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PRECONSTRUCTION
PRECONSTRUCTION PHASE

TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS BY RAILROAD DEVELOPMENT PROJECT

Date	Revision	Checked	Approved

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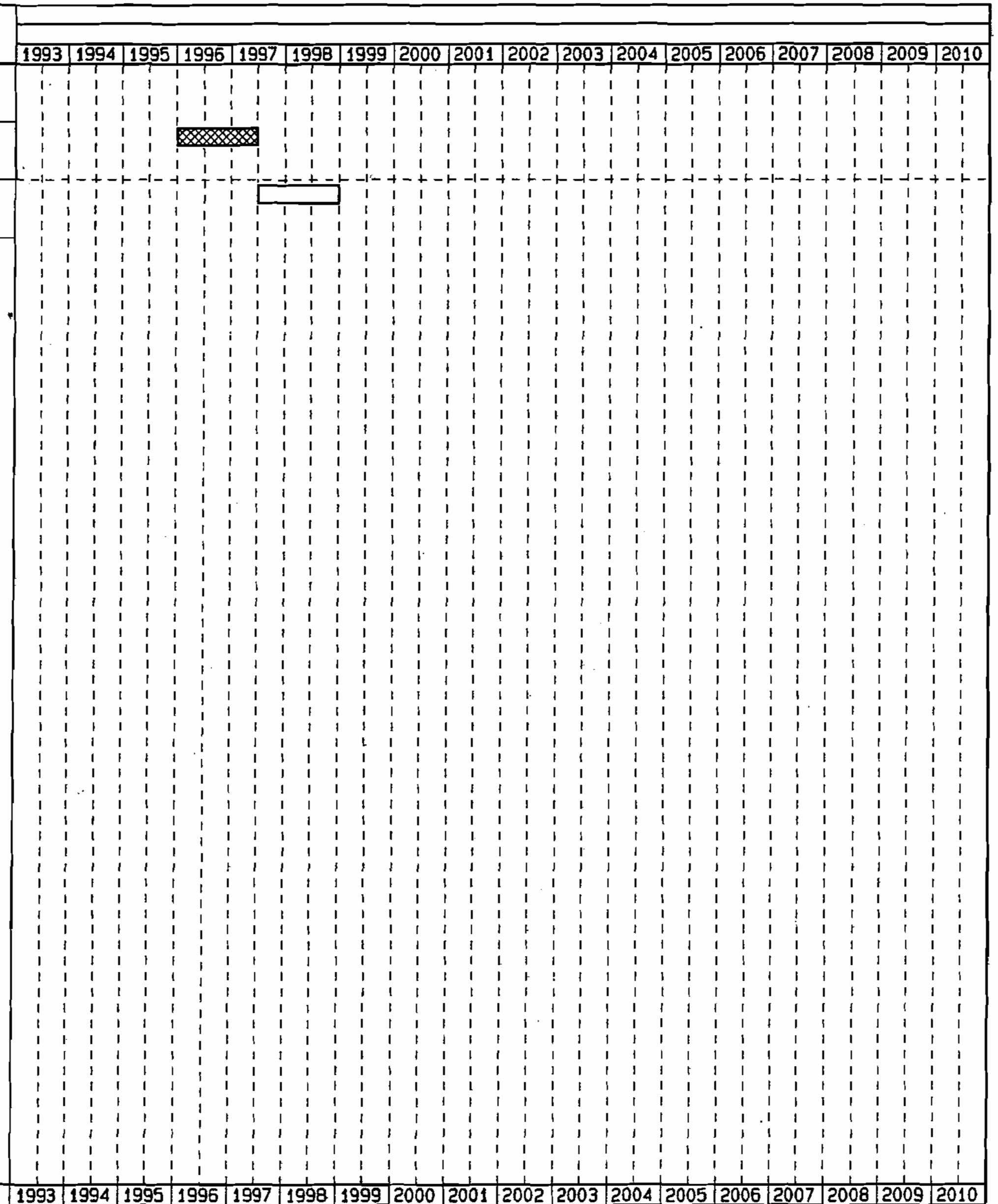
ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
NEW LONDON-PROVIDENCE MP123.9-MP185.4 OTHER		
ADD RIDOT KINGSTON-PROVIDENCE SERVICE	1JAN96	30JUN97
RIDOT NEW SERVICE	1JUL97	31DEC98



Plot Date 28APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

AJ03

Sheet 13 of 17

PRECONSTRUCTION
PRECONSTRUCTION PHASE

TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS BY RAILROAD DEVELOPMENT PROJECT

Date	Revision	Checked	Approved

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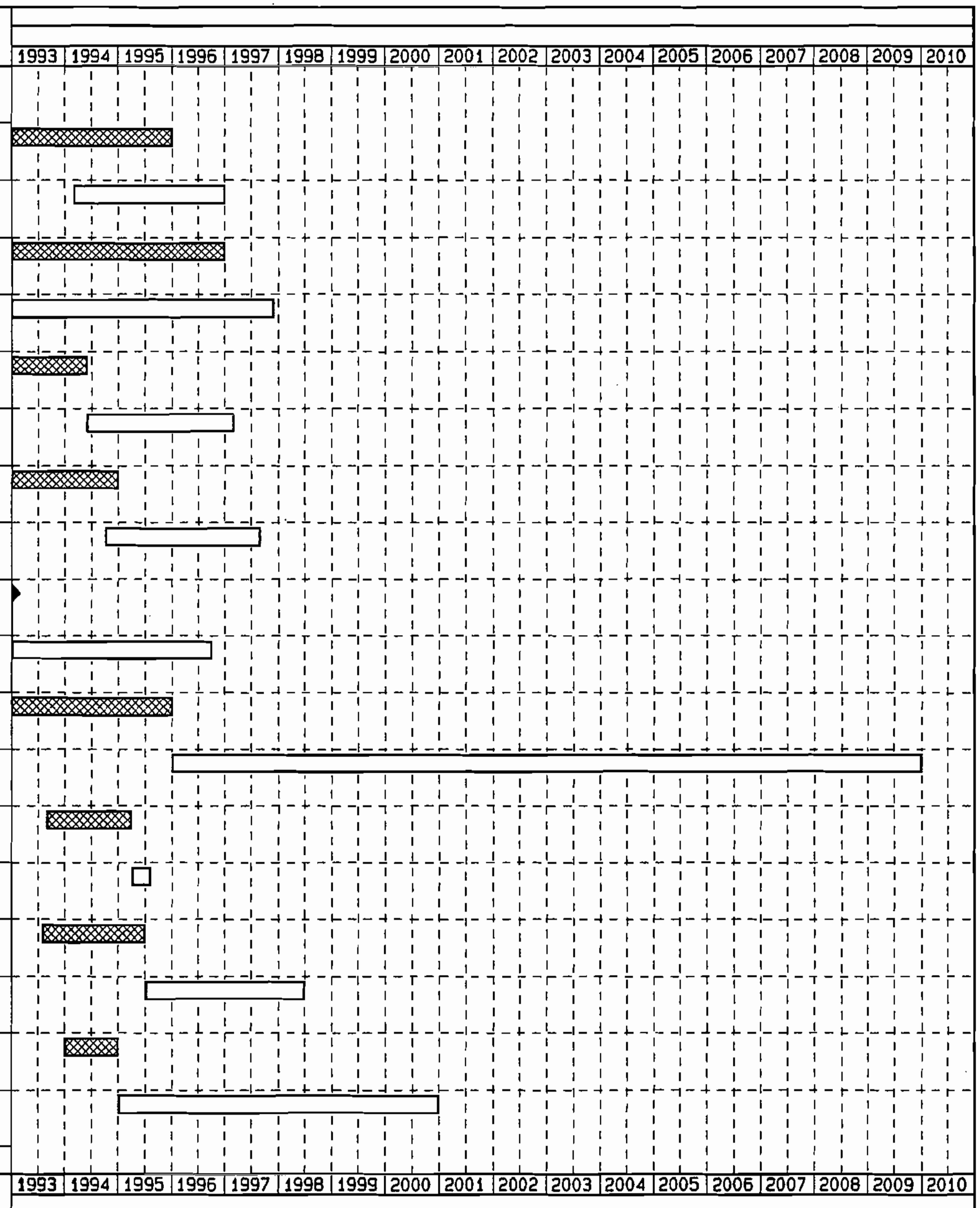
ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
PROVIDENCE-SOUTH STATION MP185.4-MP229 HIGH SPEED REQUIREMENTS: TRIP TIME		
REALIGN CURVES	1JAN93	31DEC95
PROVIDENCE-SOUTH STATION: CURVES	1MAR94	31DEC96
TRACK PROGRAM	1JAN93	31DEC96
PROVIDENCE-SOUTH STATION: TRACKWORK	1JAN93	30NOV97
INSTALL 25KV 60 hZ CENTER FED SYSTEM	1JAN93	31MAY94
PROVIDENCE-SOUTH STATION: 25 KV SYSTEM	1JUN94	28FEB97
PROVIOE CLEARANCE FOR ELECTRIFICATION	1JAN93	31DEC94
PROVIDENCE-SOUTH STATION: CLEARANCE	1OCT94	31AUG97
SIGNAL COMPATIBLE W/ELECTRIFICATION		31JAN93A
PROVIDENCE-SOUTH STATION: SIGNALING	1JAN93	30SEP96
INSTALL CIVIL SPEEO ENFORCEMENT SYSTEM	1JAN93	31DEC95
PROVIDENCE-SOUTH STATION: SPEED ENFORCEMENT	1JAN96	31DEC09
GRADE CROSSINGS: ELIMINATION PROGRAM	1SEP93	31MAR95
PROVIDENCE-SOUTH STATION: CROSSINGS	1APR95	31JUL95
ROUTE 128 IMPROVEMENTS	1AUG93	30JUN95
ROUTE 128	1JUL95	30JUN98
DEVELOP NOISE & VIBRATION MITIGATION PROGRAM	1JAN94	31DEC94
IMPLEMENT NOISE & VIBRATION MITIGATION PROG	1JAN95	31DEC00



Plot Date 28APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

RJ63

TASK NO. 5
PRELIMINARY SCHEOULE OF PROJECTS
BY RAILROAD DEVELOPMENT PROJECT

Sheet 14 of 17

PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

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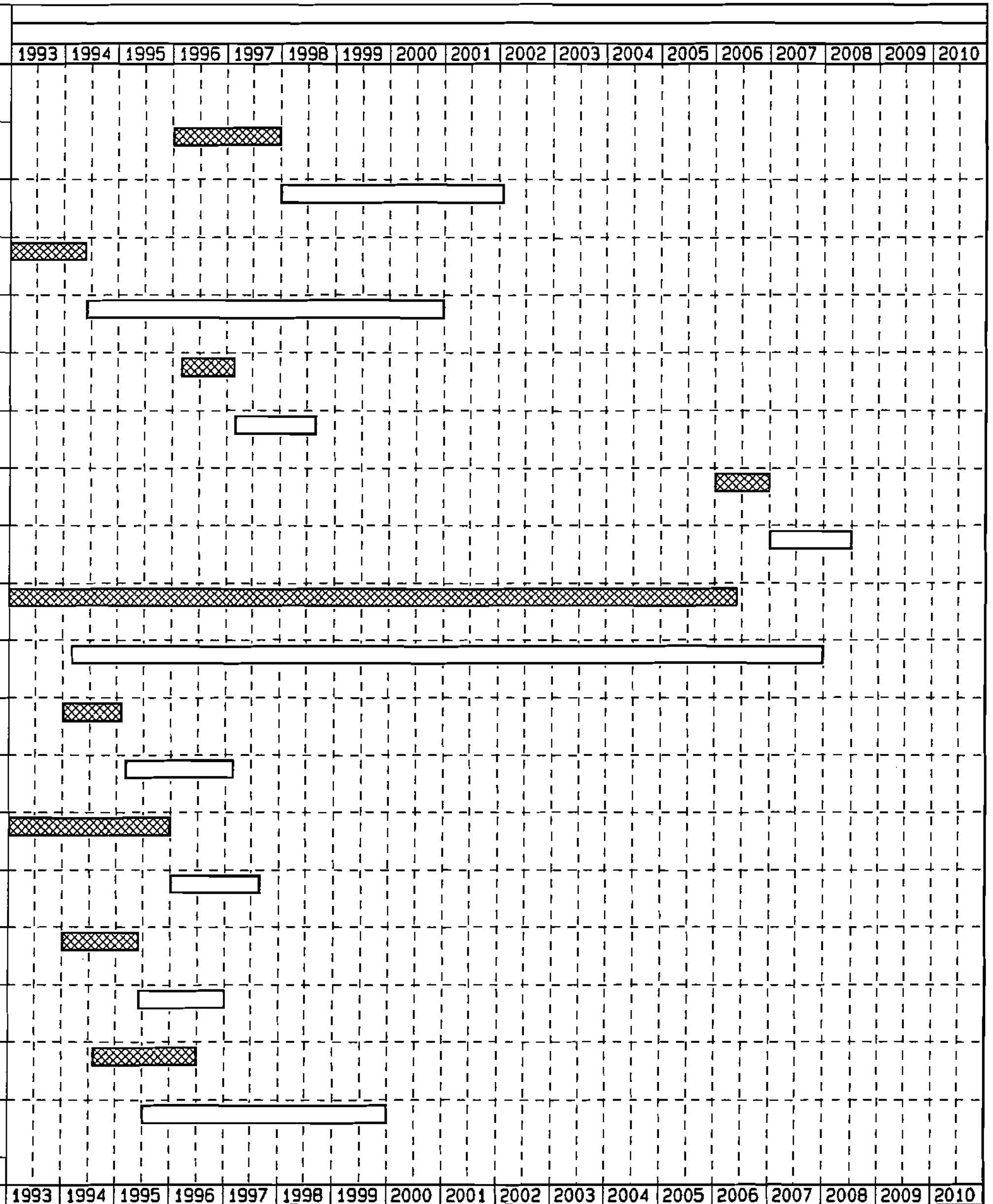
ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
PROVIDENCE-SOUTH STATION MP185.4-MP229 HIGH SPEED REQUIREMENTS: CAPACITY		
CONSTRUCT MEDIUM & HEAVY OVERHAUL FACILITY PV-BO	1JAN96	31DEC97
CONSTR. MEDIUM & HEAVY OVERHAUL FAC. PV-BOS	1JAN98	31JAN02
SOUTH STATION CAPACITY IMPROVEMENTS	1JAN93	31MAY94
BOSTON SOUTH STATION	1JUN94	31DEC00
PROVIDENCE-SOUTH STATION PASSING SIDINGS	1MAR96	28FEB97
ATTLEBORO: FOREST HILLS-READVILLE (TRACK 5)	1MAR97	31AUG98
PROVIDENCE-SOUTH STATION PASSING SIDINGS	1JAN06	31DEC06
SHARON (TRACK 4), RTE 128-READVILLE	1JAN07	30JUN08
RECONFIGURE EXISTING INTERLOCKINGS	1JAN93	31MAY06
PROVIDENCE-SOUTH STATION: INTERLOCKINGS	1MAR94	31DEC07
INSTALL GAUNTLET TRACKS	1JAN94	31JAN95
PROVIDENCE-SOUTH STATION: GAUNTLET TRACKS	1MAR95	28FEB97
CANTON VIADUCT CLEARANCE IMPROVEMENTS	1JAN93	31DEC95
CANTON VIADUCT	1JAN96	31AUG97
CANTON JCT TO BOSTON SIGNAL MODIFICATIONS	1JAN94	31MAY95
SIGNAL MODIFICATIONS	1JUN95	31DEC96
HIGH LEVEL PLATFORMS	1AUG94	30JUN96
PROVIDENCE-SOUTH STATION: PLATFORMS	1JUL95	31DEC99



Plot Date 28APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

RJ63

TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY RAILROAD DEVELOPMENT PROJECT

Sheet 15 of 17

PRECONSTRUCTION
PRECONSTRUCTION PHASE

Date	Revision	Checked	Approved

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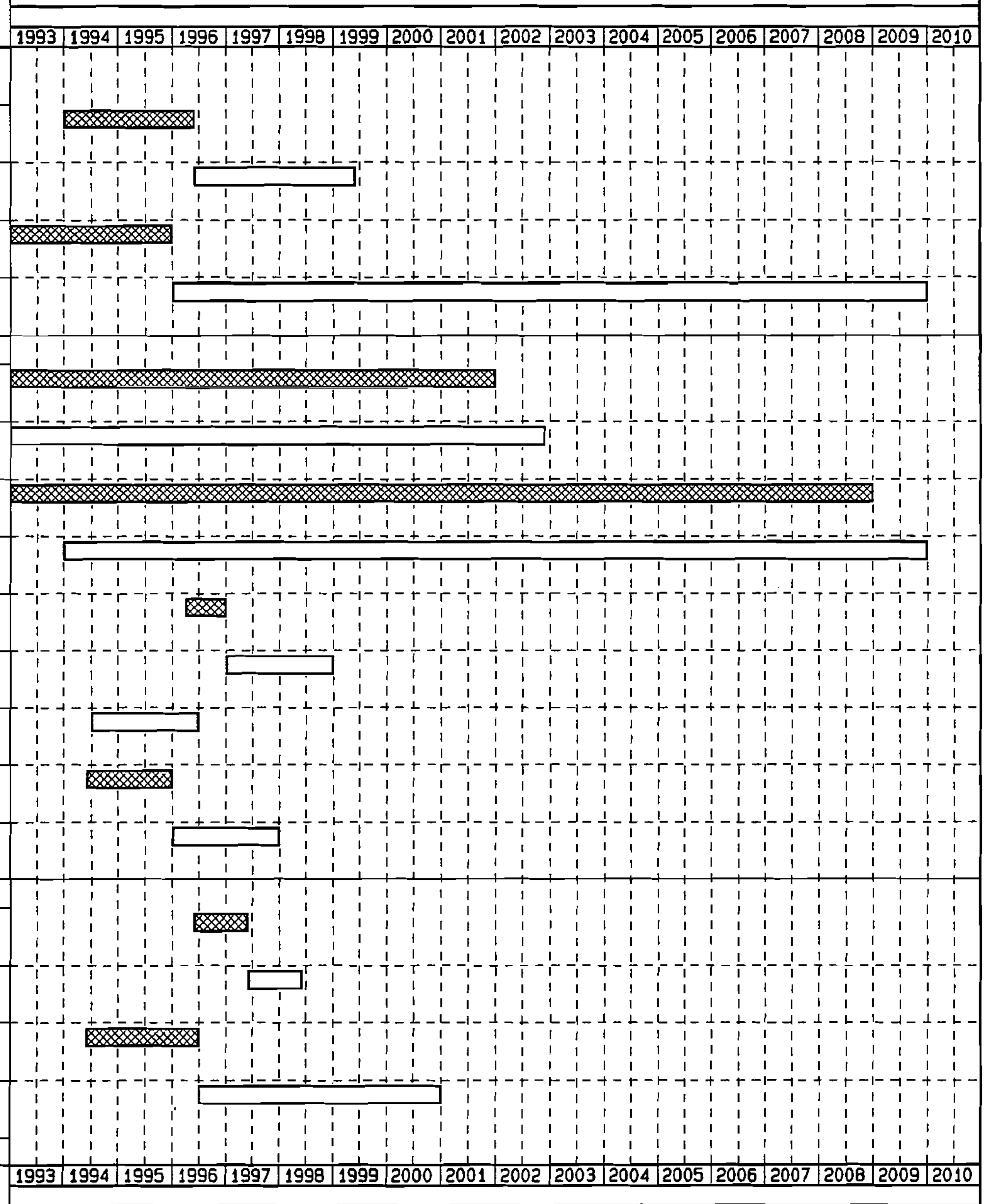
ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
PROVIDENCE-SOUTH STATION MP185.4-MP229 HIGH SPEED REQUIREMENTS: CAPACITY		
CONSTRUCT AMTRAK BOSTON SERVICE FACILITY	1JAN94	31MAY96
AMTRAK BOSTON SERVICE FACILITY	1JUN96	31MAY99
MODIFY ON-BOARD CAB SIGNAL EQUIPMENT	1JAN93	31DEC95
PROVIDENCE-SOUTH STATION: CAB SIGNALS	1JAN96	31DEC09
RECAPITALIZATION		
CONVERT OPEN DECK BRIDGES	1JAN93	31DEC01
PROVIDENCE-SOUTH STATION: CONVERT BRIDGES	1JAN93	30NOV02
REPLACE/UPGRADE OVERHEAD BRIDGES IN RHODE ISLAND	1JAN93	31DEC08
PROVIDENCE-SOUTH STATION: OVERHEAD BRIDGES	1JAN94	31DEC09
FENCE SELECTED SENSITIVE AREAS	1APR96	31DEC96
PROVIDENCE-SOUTH STATION: FENCING	1JAN97	31DEC98
EQUIPMENT TESTING: MBTA	1JUL94	30JUN96
INSTALL APPROACH WARNING SIGNS & BELLS	1JUN94	31DEC95
APPROACH WARNING SIGNS	1JAN96	31DEC97
OTHER		
DIRECT CONNECTION TO MIDDLEBORO SECONDARY	1JUN96	31MAY97
DIRECT CONNECTION-MIDDLEBORO SECONDARY	1JUN97	31MAY98
THIRD TRACK FOR P&W FREIGHT SERVICE PROV-SD. STA	1JUN94	30JUN96
THIRD TRACK P & W FREIGHT SERVICE PROV-S ST	1JUL96	31DEC00



Plot Date 28APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

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Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

RJ03

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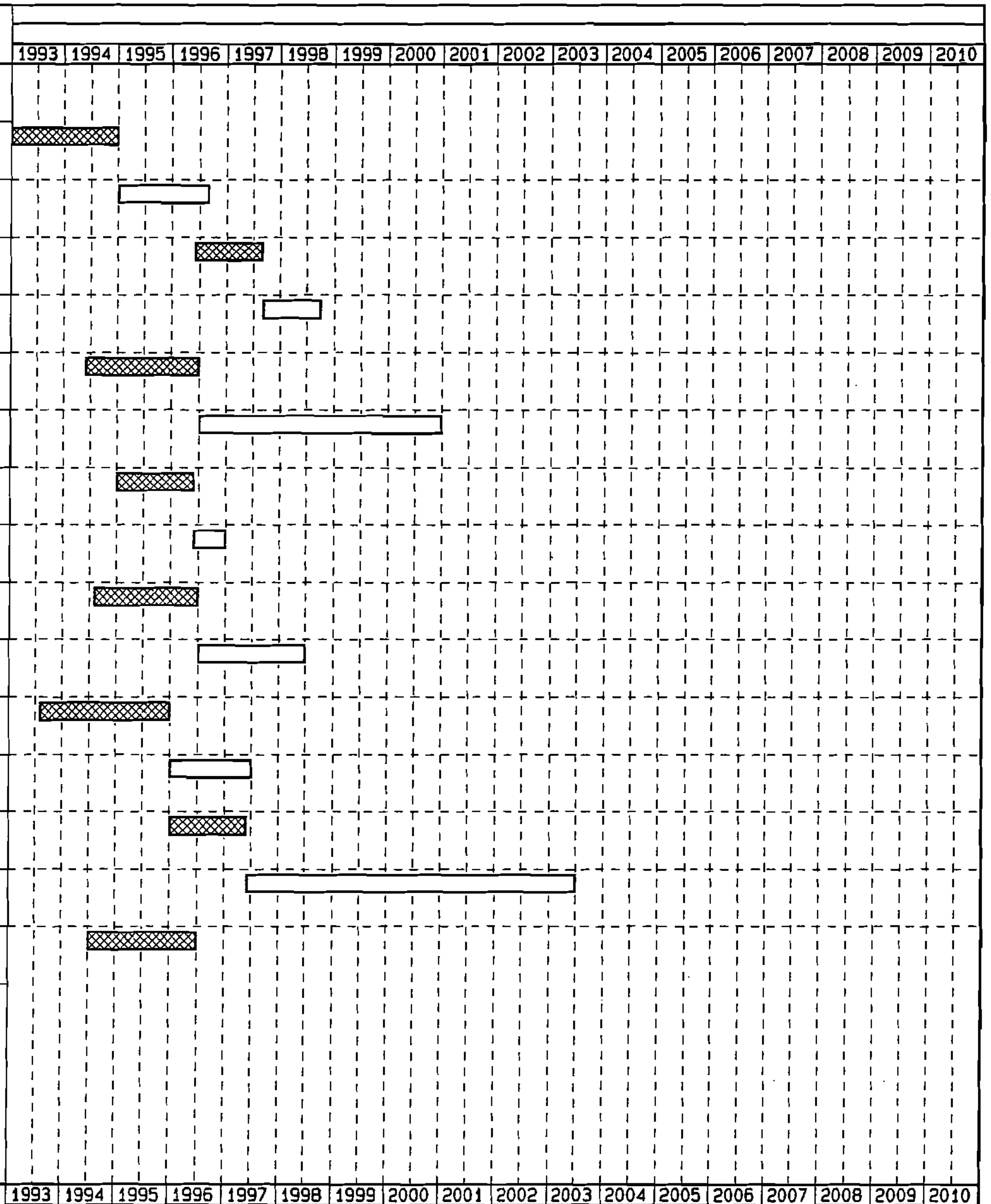
PRECONSTRUCTION
PRECONSTRUCTION PHASE

TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS BY RAILROAD DEVELOPMENT PROJECT

Date	Revision	Checked	Approved

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
PROVIDENCE-SOUTH STATION MP185.4-MP229 OTHER		
CONSTRUCT READVILLE LAYOVER FACILITY	1JAN93	31DEC94
READVILLE LAYOVER FACILITY	1JAN95	31AUG96
CONSTRUCT PROVIDENCE LAYOVER FACILITY	1JUN96	31AUG97
PROVIDENCE LAYOVER FACILITY	1SEP97	30SEP98
P&W FEIGHT SERVICE CLEARANCE IMPROVEMENTS	1JUN94	30JUN96
PROVIDENCE-SOUTH STATION: P & W SERVICE	1JUL96	31DEC00
INSTALL PUBLIC ADDRESS SYSTEM	1JAN95	31MAY96
PUBLIC ADDRESS SYSTEM	1JUN96	31DEC96
IMPROVED PARKING: PROVIDENCE-SOUTH STATION	1AUG94	30JUN96
ROUTE 128 PARKING	1JUL96	30JUN98
CONSTRUCT PEDESTRIAN BRIDGES	1AUG93	31DEC95
PROVIDENCE-SOUTH STATION: ROUTE 128	1JAN96	30JUN97
AMTRAK STATION IMPROVEMENTS PR-80	1JAN96	31MAY97
AMTRAK STATION IMPROVEMENTS PR-80	1JUN97	30JUN03
MAINT. & OPERATING COST ALLOCATION STUDY PR-80	1JUL94	30JUN96



Plot Date 28APR94
Data Date 1JAN93
Project Start 1JAN93
Project Finish 31DEC09

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

RJ63

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PRECONSTRUCTION
PRECONSTRUCTION PHASE

TASK NO. 5
PRELIMINARY SCHEDULE OF PROJECTS
BY RAILROAD DEVELOPMENT PROJECT

Date	Revision	Checked	Approved

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The Northeast Corridor Transportation Plan
New York City to Boston
Volume 2

Appendix H
TIMETABLES OF NEC CARRIERS

2010 Amtrak Schedule

National Railroad Passenger Corporation, 30th and Market Streets, Philadelphia, PA. 19104

Amtrak

December 20, 1993

Mr. Michael C. Holowaty
Parsons De Leuw, Inc.
1133 15th St., N.W.
Washington, DC 20005-2701

Mike
Dear Mr. Holowaty:

Enclosed, for your inclusion in the Program Master Plan, is a clean copy of our latest revision for 2010 Amtrak operations. This draft includes all assumptions used for New Haven to Boston simulations. Also, we made one or to adjustments to reflect Ernie Clausing's modifications to the simulations from New Haven to New York. However, Ernie may have made slot adjustments we did not include.

If you have any questions, please don't hesitate to call. Best wishes for a happy holiday season.

Sincerely,

Tom Morgan

Thomas W. Morgan
Sr. Scheduling Planner

cc: H. G. Ramp

PROPOSED FREQUENCY OF SERVICE FOR YEAR 2010
DRAFT FOR PLANNING PURPOSES ONLY
BASED ON 2'40" NYP-WAS AND 3'00" BBY-NYP RUNNING TIMES

ORIGIN CITY	DEST. CITY	TYPE TRAIN	FREQUENCY	FAS TRAIN #	BBY	RTE	PVD	KIN	WLY	MYS	NLC	OSB	SPG	NHV	BRP	STM	NRO	ARR NYP	DEP NYP	PHL	ARR WAS	DEP WAS	ARR HAR
NYP	WAS	M	M-F	301															05:30 AM	S	08:10 AM		
NYP	WAS	C	M-F	303															05:45 AM	S	09:00 AM		
NYP	WAS	XM	M-F	305															06:15 AM	S	08:45 AM		
NYP	CLT	C	D	79															06:20 AM	S	09:35 AM	10:05 AM	
PHL	HAR	C	M-F																	05:30 AM			07:30 AM
NYP	WAS	M	M-F	319															06:50 AM		09:30 AM		
NYP	WAS	XM	M-F	307															07:15 AM	S	09:45 AM		
NYP	ATL	C	D	17															06:45 AM	S	10:00 AM	10:30 AM	
PHL	HAR	C	M-F																	06:45 AM			08:45 AM
NYP	JAX	C	D	89															07:20 AM	S	10:35 AM	11:05 AM	
MTR	WAS	C	D	601										05:45 AM		S		07:15 AM	07:35 AM	S	10:50 AM		
NYP	PGH	C	D	603															07:45 AM	09:15 AM			11:30 AM
BOS	WAS	M	M-SA	201	04:30 AM	S	S				S	S		S	S	S	S	07:40 AM	08:00 AM	S	10:40 AM		
NYP	WAS	XM	M-F	309															08:15 AM	S	10:45 AM		
SPG	WAS	C	D	401									05:40 AM	06:55 AM	S	S	S	08:25 AM	08:45 AM	S	12:00 PM		
BOS	WAS	M	D	101	05:35 AM	S	S				S			S				08:40 AM	09:00 AM	S	11:40 AM		
NYP	FLA	L	D	81															09:25 AM	S	01:10 PM	01:40 PM	
SPG	ACY	C	D	503									06:30 AM	07:45 AM	S	S	S	09:15 AM	09:35 AM				
BOS	WAS	C	D	103	05:55 AM	S	S	S	S	S	S	S		S	S	S	S	09:25 AM	09:45 AM	S	01:00 PM		
PHL	HAR	C	M-F	603																11:15 AM			01:15 PM
BOS	WAS	M.	D	105	06:40 AM	S	S							S				09:40 AM	10:00 AM	S	12:40 PM		
NYP	CVS/CHI	L	D	51															10:05 AM	S	01:20 PM	01:55 PM	
BOS	NYP	C	M-F	107	06:55 AM	S	S	S			S			S		S	S	10:25 AM					
SPG	WAS	C	D	405									07:40 AM	08:55 AM	S	S		10:30 AM	10:45 AM	S	02:00 PM		
BOS	WAS	M	M-F	109	07:40 AM	S	S									S		10:40 AM	11:00 AM	S	01:40 PM		
PHL	HAR	C	S-S	603																12:45 PM			02:45 PM
BOS	WAS	C	D	111	07:55 AM	S	S	S			S	S		S		S		11:25 AM	11:45 AM	S	03:00 PM		
BOS	WAS	M	D	113	08:40 AM	S	S							S				11:40 AM	12:00 PM	S	02:40 PM		
NYP	NPN	C	D	605															12:05 PM	S	03:20 PM	03:50 PM	
NYP	PGH	C	D	607															12:20 PM	01:50 PM			
BOS/SPG	RVR	C	D	153	07:10 AM								09:40 AM	10:55 AM	S	S	S	12:25 PM	12:45 PM	S	04:00 PM	04:40 PM	
WAS	CHI	C	D																			04:45 PM	
PHL	HAR	C	SU-F	603																02:15 PM			04:15 PM
NYP	CHI	L	D	41															12:55 PM	02:25 PM			04:55 PM
BOS	WAS	M	M-F	115	09:40 AM	S	S									S		12:40 PM	01:00 PM	S	03:40 PM		
BOS	WAS	C	D	117	09:55 AM	S	S	S		S	S	S		S		S		01:25 PM	01:45 PM	S	05:00 PM		
NYP	NOL	L	D	19															01:50 PM	S	05:30 PM	06:05 PM	
BOS	WAS	M	D	119	10:40 AM	S	S							S				01:40 PM	02:00 PM	S	04:40 PM		
ACY	WAS	C	SU-F	501																03:10 PM	05:15 PM		
NYP	NPN	C	D	609															02:05 PM	S	05:20 PM	05:50 PM	
NYP	HAR	C	SU-F	607															02:35 PM	04:35 PM			06:35 PM
PHL	HAR	C	SA																	04:35 PM			06:35 PM
SPG	WAS	C	D	407									11:40 AM	12:55 PM	S	S	S	02:25 PM	02:45 PM	S	06:00 PM		
BOS	WAS	M	M-F	121	11:40 AM	S	S									S		02:40 PM	03:00 PM	S	05:40 PM		
NYP	RVR	C	D	611															03:05 PM	S	06:20 PM	06:50 PM	
NYP	WAS	XM	SU-F	313															03:30 PM	S	06:00 PM		
PHL	HAR	C	M-F																	05:35 PM			07:35 PM
NYP	FLA	L	D	83															03:25 PM	S	07:10 PM	07:40 PM	
BOS	WAS	C	D	123	11:55 AM	S	S	S			S			S		S	S	03:25 PM	03:45 PM	S	07:00 PM		
BOS	CHI	C	D		12:00 PM																		
BOS	WAS	M	D	125	12:40 PM	S	S							S				03:40 PM	04:00 PM	S	06:40 PM		
NYP	WAS	XM	M-F	315															04:30 PM	S	07:00 PM		
SPG	WAS	C	D	409									01:40 PM	02:55 PM	S	S	S	04:25 PM	04:45 PM	S	08:00 PM		
NYP	PHL	C	M-F																04:47 PM	06:27 PM			
BOS	WAS	M	D	127	01:40 PM	S	S									S		04:40 PM	05:00 PM	S	07:40 PM		
NYP	HAR	C	M-F																05:08 PM				08:23 PM
NYP	PHL	C	M-F																05:13 PM	06:53 PM			
NYP	WAS	XM	M-F	317															05:30 PM	S	08:00 PM		
NYP	PHL	C	M-F																05:38 PM	07:18 PM			
NYP	HAR	C	SA-SU	607															05:38 PM	07:38 PM			09:38 PM
BOS	WAS	C	D	129	01:55 PM	S	S				S			S		S	S	05:25 PM	05:45 PM	S	09:00 PM		
BOS	WAS	M	D	131	02:40 PM	S	S							S				05:40 PM	06:00 PM	S	08:40 PM		
NYP	PHL	C	M-F																06:03 PM	07:43 PM			
NYP	FLA	L	D	85															06:05 PM	S	09:45 PM	10:15 PM	
NYP	HAR	C	M-F	607															06:29 PM	08:19 PM			10:19 PM
NYP	PHL	C	M-F																06:38 PM	08:18 PM			
ACY	HAR	C	SA-SU																	08:45 PM			10:45 PM
BOS/SPG	WAS	C	D	151	01:10 PM								03:40 PM	04:55 PM	S	S	S	06:25 PM	06:45 PM	S	10:00 PM		
BOS	WAS	M	M-F	133	03:35 PM	S	S							S		S		06:40 PM	07:00 PM	S	09:40 PM		
BOS	WAS	C	D	135	03:55 PM	S	S	S		S	S	S		S		S	S	07:25 PM	07:45 PM	S	11:00 PM		
ACY	RVR	C	D	611																08:30 PM	10:35 PM	11:05 PM	
BOS	WAS	M	D	137	04:35 PM	S	S							S		S		07:40 PM	08:00 PM	S	10:40 PM		
PHL	HAR	C	FR,SU																	10:45 PM			12:45 AM
SPG	WAS	C	D	413									05:40 PM	06:55 PM	S	S	S	08:25 PM	08:45 PM	S	12:00 AM		
BOS	WAS	M	D	139	05:40 PM	S	S							S				08:40 PM	09:00 PM	S	11:40 PM		
HYA	NYP	C	SU	157			05:55 PM							07:50 PM		S		09:20 PM					
BOS	WAS	C	D	141	05:55 PM	S	S		S		S			S	S	S	S	09:25 PM	09:45 PM	S	01:00 AM		
BOS	NYP	M	SU-F	143	06:40 PM	S	S									S		09:40 PM					
ACY	WAS	C	SA	505																11:30 PM	01:30 AM		
SPG	PHL	C	D	417									07:40 PM	08:55 PM	S	S	S	10:25 PM	10:45 PM	11:45 PM			
BOS	NYP	M	M-F	145	07:35 PM	S	S							S		S		10:40 PM					
BOS	NYP	C	SU-F	147	07:55 PM	S	S	S			S	S		S	S	S	S	11:25 PM					

RHS
TOTNECSB
Last
Refined
06-Dec-93
10:04 AM

PROPOSED FREQUENCY OF SERVICE FOR YEAR 2010
DRAFT FOR PLANNING PURPOSES ONLY
BASED ON 2'40" NYP-WAS AND 3'00" BBY-NYP RUNNING TIMES

ORIGIN CITY	DEST CITY	TYPE TRAIN	FREQUENCY	FAS TRAIN #	BBY	RTE	PVD	KIN	WLY	MYS	NLC	OSB	SPG	NHV	BRP	STM	NRO	ARR NYP	DEP NYP	PHL	ARR WAS	DEP WAS	ARR HAR
SPG	NYP	C	D	415									09:40 PM	10:55 PM	S	S	S	12:25 AM					
BOS	NPN	C	D	613	10:30 PM	S	S	S	S	S	S	S		S		S		03:10 AM	03:30 AM	S	07:45 AM	08:15 AM	

PROPOSED FREQUENCY OF SERVICE FOR YEAR 2010
DRAFT FOR PLANNING PURPOSES ONLY
BASED ON 2'40" NYP-WAS AND 3'00" BBY-NYP RUNNING TIMES

ORIGIN CITY	DEST. CITY	TYPE TRAIN	FREQUENCY	FAS TRAIN #	DEP WAS	DEP HAR	PHL	ARR NYP	DEP NYP	NRO	STM	BRP	NHV	SPG	OSB	NLC	MYS	WLY	KIN	PVD	RTE	BBY
NYP	BOS	M	M-F	100					06:00 AM	S	S		S							S	S	09:10 AM
NYP	BOS	C	M-F	102					06:15 AM	S	S	S	S		S	S		S		S	S	09:45 AM
NYP	BOS	M	SU-F	104					07:00 AM	S	S									S	S	10:00 AM
NYP	SPG	C	M-F	400					07:15 AM	S	S	S	08:45 AM	10:00 AM								
PHL	NYP	C	M-F				05:52 AM	07:07 AM														
PHL	NYP	C	M-F				05:57 AM	07:27 AM														
WAS	BOS	M	M-SA	106	05:00 AM		S	07:40 AM	08:00 AM		S									S	S	11:00 AM
WAS	BOS	C/MAIL	D	108	04:45 AM		S	07:55 AM	08:15 AM		S		S		S	S	S	S	S	S	S	11:45 AM
PHL	NYP	C	M-F				06:37 AM	08:07 AM														
PHL	NYP	C	M-F				07:10 AM	08:25 AM														
WAS	BOS	M	D	110	06:00 AM		S	08:40 AM	09:00 AM		S		S							S	S	12:05 PM
WAS	NYP	XM	M-F	300	06:10 AM		S	08:45 AM														
PHL	NYP	C	M-F				07:38 AM	08:53 AM														
HAR	PHL	C	M-F			05:35 AM	07:40 AM															
WAS	SPG	C	D	402	05:45 AM		S	08:55 AM	09:15 AM	S	S	S	10:45 AM	12:00 PM								
WAS	NYP	XM	M-F	302	06:50 AM			09:20 AM														
HAR	NYP	C	M-F			06:15 AM		09:30 AM														
WAS	BOS	M	M-F	112	07:00 AM		S	09:40 AM	10:00 AM				S							S	S	01:00 PM
HAR	PHL	C	M-F			06:35 AM	08:40 AM															
FLA	NYP	L	D	82	06:11 AM		S	09:51 AM														
WAS	BOS	C	D	114	06:45 AM		S	09:55 AM	10:15 AM	S	S		S		S	S			S	S	S	01:45 PM
WAS	NYP	XM	M-F	304	07:30 AM		S	10:00 AM														
WAS	BOS	M	D	116	08:00 AM		S	10:40 AM	11:00 AM		S									S	S	02:00 PM
WAS	SPG	C	D	404	07:45 AM		S	10:55 AM	11:15 AM	S	.S	S	12:45 PM	02:00 PM								
HAR	NYP	C	S-S			07:20 AM	S	11:20 AM														
HAR	NYP	C	M-F			08:00 AM	S	11:30 AM														
HAR	ACY	C	S-S			08:00 AM	S															
WAS	BOS	M	M-F	118	09:00 AM		S	11:40 AM	12:00 PM				S							S	S	03:00 PM
FLA	NYP	L	D	84	08:10 AM		S	11:50 AM														
WAS	ACY	C	SA	500	08:30 AM		10:35 AM															
WAS	BOS	C	D	120	08:45 AM		S	11:55 AM	12:15 PM	S	S		S		S	S		S	S	S	S	03:45 PM
RVR	ACY	C	D	600	09:05 AM		11:10 AM															
WAS	BOS	M	D	122	10:00 AM		S	12:40 PM	01:00 PM		S									S	S	04:00 PM
WAS	SPG/BOS	C	D	124	09:45 AM		S	12:55 PM	01:15 PM	S	S	S	02:45 PM	04:00 PM								06:30 PM
RVR	NYP	C	M-S	602	10:05 AM		S	01:15 PM														
CHI	BOS	L	O																			04:55 PM
WAS	BOS	M	M-F	126	11:00 AM		S	01:40 PM	02:00 PM				S							S	S	05:00 PM
NOL	NYP	L	D	20	10:05 AM		S	01:45 PM														
WAS	BOS	C	D	128	10:45 AM		S	01:55 PM	02:15 PM		S		S		S	S	S		S	S	S	05:45 PM
CHI	WAS	C	D																			
HAR	NYP	C	D			11:00 AM	S	02:30 PM														
WAS	BOS	M	D	130	12:00 PM		S	02:40 PM	03:00 PM		S									S	S	06:00 PM
NPN	NYP	C	D	604	12:05 PM		S	03:15 PM														
WAS	SPG	C	D	406	11:45 AM		S	02:55 PM	03:15 PM	S	S	S	04:45 PM	06:00 PM								
NYP	HYA	C	FR	690					03:45 PM	S	S		05:15 PM									
WAS	BOS	M	M-F	132	01:00 PM		S	03:40 PM	04:00 PM				S							S	S	07:00 PM
WAS	BOS	C	D	134	12:45 PM		S	03:55 PM	04:15 PM	S	S	S	S		S	S			S	S	S	07:45 PM
NYP	SPG	C	D	408					04:30 PM				06:00 PM	07:15 PM								
WAS	BOS	M	D	136	02:00 PM		S	04:40 PM	05:00 PM		S		S							S	S	08:05 PM
PHL	BOS	C	SU-F	138			03:45 PM	04:55 PM	05:15 PM				S							S	S	08:45 PM
RVR	SPG/BOS	C	D	156	01:45 PM		S	04:55 PM	05:20 PM	S	S	S	06:50 PM	08:05 PM								10:35 PM
CHI	NYP	L	D	40		12:50 PM	03:50 PM	05:20 PM														
HAR	PHL	C	M-F			01:55 PM	03:55 PM															
WAS	BOS	M	D	140	03:00 PM		S	05:40 PM	06:00 PM	S						S				S	S	09:00 PM
WAS	BOS	C	D	142	02:45 PM		S	05:55 PM	06:15 PM		S		S			S	S	S		S	S	09:45 PM
WAS	NYP	XM	M-F	200	03:30 PM		S	06:00 PM														
WAS	ACY	C	SU-F	502	03:35 PM		05:40 PM															
WAS	BOS	M	D	144	04:00 PM		S	06:40 PM	07:00 PM	S	S		S							S	S	10:10 PM
FLA	NYP	L	D	86	03:05 PM		S	06:45 PM														
WAS	SPG	C	D	410	03:45 PM		S	06:55 PM	07:15 PM		S	S	08:45 PM	10:00 PM								
PGH	NYP	C	D	608		03:05 PM	05:30 PM	07:10 PM														
WAS	MTR	C	D	610	04:20 PM		S	07:30 PM	07:50 PM		S		09:20 PM									
WAS	NYP	XM	M-F	314	04:30 PM		S	07:00 PM														
WAS	BOS	M	D	146	05:00 PM		S	07:40 PM	08:00 PM				S							S	S'	11:00 PM
HAR	PHL	C	D			04:30 PM	06:30 PM															
WAS	BOS	C	D	148	04:45 PM		S	07:55 PM	08:15 PM	S	S				S	S			S	S	S	11:45 PM
NPN	NYP	C	D	612	05:15 PM		S	08:25 PM														
WAS	BOS	M	D	150	06:00 PM		S	08:40 PM	09:00 PM		S		S							S	S	12:05 AM
WAS	SPG	C	D	412	05:45 PM		S	08:55 PM	09:15 PM	S	S	S	10:45 PM	12:00 AM								
CLT	NYP	C	D	80	06:15 PM		S	09:25 PM														
PGH	NYP	C	D	614		05:30 PM	07:55 PM	09:35 PM														
WAS	NYP	M	SU-F	308	07:00 PM		S	09:40 PM														
ACY	SPG	C	D	504				09:45 PM	10:05 PM	S	S	S	11:35 PM	12:50 AM								
WAS	NYP	C	D	310	06:45 PM		S	09:55 PM														
WAS	NYP	M	M-F	202	08:00 PM		S	10:40 PM														
CHI/CVS	NYP	L	D	50	07:30 PM		S	10:45 PM														
JAX	NYP	C	D	90	07:45 PM		S	10:55 PM														
ATL	NYP	C	D	18	08:45 PM		S	11:55 PM														
HAR	PHL	C	D			07.30 PM	09.30 PM															
WAS	NYP	M	M-F	312	09 00 PM		S	11:40 PM														
NPN	BOS	C	D	616	10:30 PM		S	02:50 AM	03:20 AM		S		S		S	S	S	S	S	S	S	08:00 AM

RHS
TOTNECN8
Latest
Refinement:
06-Dec-93
10:01 AM

2010 MBTA OPERATIONS PHILOSOPHY

INITIAL TRAIN OPERATIONS PHILOSOPHY FOR BOSTON TRAIN MOVEMENT MODELING (TO BE ALTERED AS REQUIRED BY MODELING RESULTS)

Framingham Service:

South Station tracks 1 and 2
Outbound track 7, inbound track 5
All trains stop at Back Bay

Needham Service:

South Station Tracks 3 and 4
All services in both directions to use track 3
Off peak service stops: Back Bay, Ruggles, Forest Hills
Peak Flow stops: Back Bay, Ruggles, Forest Hills
Counter Flow Stops: Forest Hills, Ruggles, Back Bay

Franklin Service:

South Station track 3, 4 and 5
All services in both directions to use track 3 except counter flow moves use Dorchester line
Off peak service stops in both directions: Readville, Hyde Park, Ruggles, Back Bay
Peak Flow far zone stops: Ruggles, Back Bay
Peak flow near zone stops: Readville, Hyde Park, Ruggles, Back Bay

Stoughton Service

South Station tracks 6 and 7
Outbound track 1 or 3 (off peak only), inbound track 2
Off peak service stops in both directions: Canton Jct., Route 128, Readville, Hyde Park, Ruggles, Back Bay
Peak flow far zone stops: Canton Jct., Ruggles, Back Bay
Peak flow near zone stops: Canton Jct., Route 128, Ruggles, Back Bay
Counter flow stops:
- Far zone: Back Bay, Ruggles
- Near zone: Back Bay, Route 128, Canton Jct.

Providence Service:

South Station tracks 6, 7 and 8
Outbound track 1, inbound track 2
Off peak and peak service stops in both directions: Providence, South Attleboro, Attleboro, Mansfield, Sharon, Ruggles, Back Bay
Counter flow stops: Providence, South Attleboro, Attleboro, Mansfield, Ruggles, Back Bay

Readville Service:

INITIAL TRAIN OPERATIONS PHILOSOPHY FOR BOSTON TRAIN MOVEMENT MODELING (TO BE ALTERED AS REQUIRED BY MODELING RESULTS)

South Station tracks 11 and 12

Old Colony Service:

South Station tracks 10, 11, 12

Amtrak Service:

South Station tracks 8, 9, 10
Outbound track 1, inbound track 2
Stops: Providence, Route 128, Back Bay

Train Sequence:

Tracks 2 and 1: Amtrak, Providence, Stoughton far zone, Stoughton near zone
Track 3: Franklin far zone, Franklin near zone, Needham, Needham counter flow

Yard Moves:

Use Dorchester tracks 1 and 2 or yard lead 17
Access to future Readville Yard to be determined later.
Freight moves use available windows in passenger operations.

Train Numbering System for MBTA 2010 Service

Providence Service	0800's 9800's
Stoughton Service	0900's Far zone 9900's Near zone 8900's Off peak and Counter flow
Franklin Branch Service	0700's Far zone 9700's Near zone 8700's Off peak and Counter flow
Needham Service	0600's All stop 9600's All stop
Deadhead to Readville Yard	7000's

INITIAL TRAIN OPERATIONS PHILOSOPHY FOR BOSTON TRAIN MOVEMENT MODELING (TO BE ALTERED AS REQUIRED BY MODELING RESULTS)

South Station tracks 11 and 12

Old Colony Service:

South Station tracks 10, 11, 12

Amtrak Service:

South Station tracks 8, 9, 10
Outbound track 1, inbound track 2
Stops: Providence, Route 128, Back Bay

Train Sequence:

Tracks 2 and 1: Amtrak, Providence, Stoughton far zone, Stoughton near zone
Track 3: Franklin far zone, Franklin near zone, Needham, Needham counter flow

Yard Moves:

Use Dorchester tracks 1 and 2 or yard lead 17
Access to future Readville Yard to be determined later.
Freight moves use available windows in passenger operations.

Train Numbering System for MBTA 2010 Service

Providence Service	0800's 9800's
Stoughton Service	0900's Far zone 9900's Near zone 8900's Off peak and Counter flow
Franklin Branch Service	0700's Far zone 9700's Near zone 8700's Off peak and Counter flow
Needham Service	0600's All stop 9600's All stop

Deadhead to Readville Yard 7000's

INITIAL TRAIN OPERATIONS PHILOSOPHY FOR BOSTON TRAIN MOVEMENT MODELING (TO BE ALTERED AS REQUIRED BY MODELING RESULTS)

MBTA Services Simulated

2010 Schedules

From Boston - PM Peak

Metroliner	35 minutes after the hour
Conventional	50 minutes after the hour
Providence	15 and 45 minutes after the hour
Stoughton Far Zone	20 and 50 minutes after the hour
Stoughton Near Zone	25 and 55 minutes after the hour
Franklin Far Zone	15 and 45 minutes after the hour
Franklin Near Zone	20 and 50 minutes after the hour
Needham	25 and 55 minutes after the hour

From Boston - Off Peak

Metroliner	35 minutes after the hour
Conventional	50 minutes after the hour
Providence	05 and 35 minutes after the hour
Stoughton	10 and 40 minutes after the hour
Franklin	30 minutes after the hour
Needham	15 minutes after the hour

To Boston - PM Peak

Metroliner and Conventional	Hourly
Providence	05 and 35 minutes after Metroliner
Stoughton Far Zone	05 minutes after the Providence trains at Canton Jct.
Stoughton Near Zone	15 minutes later at Canton Jct.
Franklin Far Zone	05 and 35 minutes after the hour at Readville
Franklin Near Zone	15 and 45 minutes after the hour at Readville
Needham	05 and 35 minutes after the hour at Forest Hills

From Boston - Off Peak

Metroliner and Conventional	Hourly
Providence	05 and 35 minutes after Metroliner
Stoughton	05 minutes after the Providence trains at Canton Jct.
Franklin	05 minutes after the hour at Readville
Needham	05 minutes after the hour at Forest Hills

2010 RIDOT Kingston - Providence Service

Amtrak

February 10,1993

Mr. Stephen A. Devine
Project Manager - Planning Division
Rhode Island Department of Transportation
Two Capital Hill
Rm 372 State Office Building
Providence, RI 02903

Dear Mr. Devine:

We have reviewed your proposed Year 2010 Kingston to Providence commuter service and have prepared a revised operating pattern (please see attachment). This operating pattern is based on trip times from our Train Performance Calculator (TPC); equipment turn times based our experience with the MBTA equipment; and available operating slots for the 2010 service plan.

At this stage of planning, the only additional facility that this pattern requires is a separate commuter station track at Kingston. Changes from this pattern may require additional facilities.

The total trip time used for this exercise is 32 to 33 minutes. This trip time is adequate for 2 intermediate stops and possibly 3 stops (depending on ridership and dwell time). The addition of a third stop may make some of the slots tight and may require additional investment in facilities in order to allow for overtakes of the commuter trains by high speed trains.

The service may be run with dedicated equipment, thru MBTA Providence equipment or a combination of dedicated and thru-equipment. The use of thru equipment may simplify the operation of Providence station. But, the planned consist for the MBTA's Providence service is 2 locomotives and 9 cars (mostly BI-levels) which probably provides far more seating capacity than is required.

This pattern would require 3 sets of equipment if dedicated sets are used. The use of 2 dedicated sets plus one morning and one evening thru-set may be the most efficient use of equipment.

Sincerely,

Tom Morgan

Thomas W Morgan
Sr. Scheduling Planner

cc: H. G. Ramp
R. U. Cogswell

RIDOT 2010 Proposed Commuter Service

Westbound

Train #	Providence	Kingston
5101	6:08a	6:40a
5103	6:42	7:13
5105	7:12	7:45
5107	7:40	8:12
5109	will not operate if P&W operates daylight	
5111	11:42	12:15p
5113	4:10p	4:42
5115	4:43	5:15
5117	5:25	6:00
5119	6:12	6:44
5121	7:19	7:51
5123	8:42	9:15
5125	10:00	10:33

Eastbound

Train #	Kingston	Providence
5100	5:57a	6:30a
5102	6:52	7:24
5104	7:24	7:55
5106	8:00	8:32
5108	8:25	8:57
5110	will not operate if P&W operates daylight	
5112	1:15p	1:47p
5114	5:02	5:35
5116	5:25	5:57
5118	6:13	6:48
5120	7:05	7:37
5122	8:17	8:50
5124	9:28	10:01

2010 CDOT SLE SERVICE

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

24 WOLCOTT HILL ROAD, P.O. BOX A
WETHERSFIELD, CONNECTICUT 06129-0801

Phone: 203-667-7364

August 31, 1992

Mr. Richard E. Johnson
Chief Engineer NECIP &
Major Capital Projects
National Railroad Passenger Corporation
30th Street Station
30th & Market Streets
Philadelphia, PA 19104

Dear Mr. Johnson:

This is to provide you with a conceptual year 2010 NEC schedule for the Shore Line East commuter rail service and including the assumption of a pattern New Haven-Hartford commuter service as well, per your request.

These schedules are conservative in that a modest unidirectional traffic growth is reflected by year 2010 on the Shore Line East, with only minimal peak direction New London - New Haven service. Hartford service is shown for year 2010 as a peak bidirectional half-hourly pattern service, with hourly off peak service. Passenger equipment is envisioned for morning dispatch, mid-day (limited) and evening layover at the New Haven maintenance facilities. Equipment cycling is shown for revenue runs; deadhead train movements and marshalling locations are left to your discretion for the best fit. All schedules can carry two to three times the present passenger volume with consist adjustments.

The Department would have preferred to reserve capacity for the possibility of higher desired traffic levels, yet we have attempted to reflect a reasonable expected demand in traffic growth.

Very truly yours,

Richard P. Rathbun

Richard P. Rathbun
Director of Rail Operations
Bureau of Public Transportation

cc: Mr. Richard Cogswell
Mr. Anthony Carr
Mr. Horace G. Ramp

CONCEPTUAL 2010 COMMUTER RAIL SCHEDULE
NEW HAVEN - NEW LONDON

E A S T B O U N D

New Haven	Fair Street	Mill River	Old Saybrook	New London	Cycle #
3.45 am	3.47 am	3.51 am	4.20 am		A2 dh
3.50 am	3.52 am	3.56 am	4.25 am		B2 dh
4.55 am	4.57 am	5.01 am	5.30 am		C2 dh
5.15 am	5.17 am	5.21 am	5.50 am	6.10 am	D2 dh
5.50 am	5.52 am	5.56 am	6.25 am	6.45 am	A4 dh
7.00 am	7.02 am	7.06 am	7.35 am		B4 dh
8.05 am	8.07 am	8.11 am	8.40 am		C4 dh
12.15 pm	12.17 pm	12.21 pm	1.05 pm	1.30 pm	D4
3.23 pm	3.25 pm	3.29 pm	4.13 pm		A6
4.15 pm	4.17 pm	4.21 pm	5.05 pm		B6
5.05 pm	5.07 pm	5.11 pm	5.55 pm	6.20 pm	C6
5.30 pm	5.32 pm	5.36 pm	6.20 pm		D6
6.11 pm	6.13 pm	6.17 pm	7.01 pm	7.26 pm	A8
7.18 pm	7.20 pm	7.24 pm	8.08 pm		B8
8.30 pm	8.32 pm	8.36 pm	9.20 pm		C8
9.10 pm	9.12 pm	9.16 pm	10.00 pm		D8

W E S T B O U N D

New London	Old Saybrook	Mill River	Fair Street	New Haven	Cycle #
	4.50 am	5.34 am	5.38 am	5.40 am	A3
	5.30 am	6.14 am	6.18 am	6.20 am	B3
	5.50 am	6.34 am	6.38 am	6.40 am	C3
6.25 am	6.50 am	7.34 am	7.38 am	7.40 am	D3
7.00 am	7.25 am	8.09 am	8.13 am	8.15 am	A5
	7.55 am	8.39 am	8.43 am	8.45 am	B5
	8.55 am	9.39 am	9.43 am	9.45 am	C5
1.50 pm	2.15 pm	2.59 pm	3.03 pm	3.05 pm	D5
	4.30 pm	4.39 pm	5.03 pm	5.05 pm	A7 dh
	5.20 pm	5.49 pm	5.53 pm	5.55 pm	B7 dh
6.35 pm	7.00 pm	7.44 pm	7.48 pm	7.50 pm	C7 dh
	6.35 pm	7.04 pm	7.08 pm	7.10 pm	D7 dh
7.40 pm	8.00 pm	8.29 pm	8.33 pm	8.35 pm	A9 dh
	8.23 pm	8.52 pm	8.56 pm	8.58 pm	B9 dh
	9.35 pm	10.04 pm	10.08 pm	10.10 pm	C9 dh
	10.15 pm	10.44 pm	10.48 pm	10.50 pm	D9 dh

CONCEPTUAL 2010 COMMUTER RAIL SCHEDULE
NEW HAVEN - HARTFORD

N O R T H B O U N D - NEC TIMES
(to Hartford)

New Haven	Fair Street	Mill River	Cycle #
4.30 am	4.32 am	4.36 am	A2+B2 dh
4.40 am	4.42 am	4.46 am	C2 dh
5.45 am	5.47 am	5.51 am	D2
6.15 am	6.17 am	6.21 am	E2
6.50 am	6.52 am	6.56 am	A4
7.20 am	7.22 am	7.26 am	B4
7.50 am	7.52 am	7.56 am	C4
8.45 am	8.47 am	8.51 am	D4
10.05 am	10.07 am	10.11 am	A6
11.05 am	11.07 am	11.11 am	B6
12.10 pm	12.12 pm	12.16 pm	C6
1.05 pm	1.07 pm	1.11 pm	A8
2.05 pm	2.07 pm	2.11 pm	B8
3.25 pm	3.27 pm	3.31 pm	C8
4.20 pm	4.22 pm	4.26 pm	E4
5.10 pm	5.12 pm	5.16 pm	A10
5.35 pm	5.37 pm	5.41 pm	B10
6.10 pm	6.12 pm	6.16 pm	D6
6.45 pm	6.47 pm	6.51 pm	C10
7.20 pm	7.22 pm	7.26 pm	E6
7.55 pm	7.57 pm	8.01 pm	A12
9.00 pm	9.02 pm	9.06 pm	B12

S O U T H B O U N D - NEC TIMES
(from Hartford)

Mill River	Fair Street	New Haven	Cycle #
6.29 am	6.33 am	6.35 am	A3
7.04 am	7.08 am	7.10 am	B3
7.29 am	7.33 am	7.35 am	C3
8.04 am	8.08 am	8.10 am	D3
8.34 am	8.38 am	8.40 am	E3
9.34 am	9.38 am	9.40 am	A5
10.39 am	10.43 am	10.45 am	B5
11.39 am	11.43 am	11.45 am	C5
12.44 am	12.48 am	12.50 am	A7
1.39 pm	1.43 pm	1.45 pm	B7
2.39 am	2.43 am	2.45 am	C7
3.39 pm	3.43 pm	3.45 pm	A9
4.39 pm	4.43 pm	4.45 pm	B9
5.04 pm	5.08 pm	5.10 pm	D5
5.54 pm	5.58 pm	6.00 pm	C9
6.24 pm	6.28 pm	6.30 pm	E5
7.04 pm	7.08 pm	7.10 pm	A11
7.34 pm	7.38 pm	7.40 pm	B11
8.19 pm	8.23 pm	8.25 pm	D7
9.19 pm	9.23 pm	9.25 pm	C11
10.19 pm	10.23 pm	10.25 pm	E7+A13
11.39 pm	11.43 pm	11.45 pm	B13

2010 NHL SERVICE

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TRAIN	1026 DN	1028 DH	1030 DH	94NH6	1136 DH	1310	154 AMTRAK	94ST6	1510	1036 DH	12 AMTRAK	1080 DH	1038 DH
				1/2 HR EXP REV PK		2"E	WAS-BOS METRO	20" FREQ	STOPS		WAS-BOS MAIL		
FREQUENCY													
FREQUENCY NOTES													
LEAVE	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM
Grand Central Terminal	7.23	7.28	7.34	G 7.38	7.39	G 7.41		G 7.55	G 8.08	8.10		8.15	8.17
125th Street (R)				C 7.48		C 7.51		C 8.05	C 8.18				
Mott Haven Jct.	7.36	7.41	7.47	7.51	7.52	7.54		8.08	8.21	8.23		8.28	8.30
Fordham (E.190th St.)(R)						C 7.58		C 8.12					
CP112	7.44	7.49	7.55	7.59	8.00	8.02		8.16	8.29	8.31		8.36	8.38
CP212	7.46	7.51	7.57	8.01	8.02	8.04		8.18	8.31	8.33		8.38	8.40
Mount Vernon						S 8.06		S 8.20					
Pelham						S 8.09	-------	S 8.23			-------		
CP216	7.50	7.55	8.01	8.05	8.07	8.11	8.20	8.25	8.35	8.37	8.38	8.42	8.44
New Rochelle		------	------			S 8.12		S 8.26			S 8.40		
Larchmont						S 8.16		S 8.30					
Mamaroneck						S 8.19		S 8.33					
Harrison						S 8.22		S 8.36					
CP223	7.57			8.12	8.15	8.24		8.38	8.42	8.45		8.49	8.53
Rye	------					S 8.25		S 8.39		------			------
Port Chester						S 8.28		S 8.42					
Greenwich, Conn.				S 8.18		S 8.32		S 8.46	S 8.48				
CP229				8.20	8.25	8.34		8.48	8.50			8.55	
Cos Cob					------	S 8.35			S 8.51				
Riverside						S 8.37			S 8.53				
Old Greenwich						S 8.39			S 8.55				
Stamford				S 8.25		S 8.42	S	S 8.54	S 8.59		S		
CP234				8.27		-------		-------	9.00			9.00	
Noroton Heights				S 8.29					S 9.03			------	
Darien				S 8.32					S 9.06				
Rowayton				S 8.35									
South Norwalk				S 8.38					S 9.12				
CP241				8.39					9.13				
East Norwalk				S 8.41					S 9.15				
Westport				S 8.44					S 9.18				
Green's Farms				S 8.48									
Southport				S 8.51									
Fairfield				S 8.54					S 9.26				
CP255				9.00					9.32				
Bridgeport				S 9.01					S 9.33				
CP257				9.03					E 9.35				
Stratford				S 9.07					S 9.39				
CP261				9.10					9.42				
Milford				S 9.13					S 9.45				
New Haven, Conn.				S 9.24					S 9.56		S		
Fair Street				-------					-------				
ARRIVE	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM
Turn To													
Turn From													
Connecting Trains													

TRAIN	990B DANBY	1412	1082 DH	97NH8	1314	156 AMTRAK	1514	464 AMTRAK	1316	1084 DH	1086 DH	1046 DH
	EXT (1810)	10"L 20" FREQ		1/2 HR EXP REV PK		WAS-BOS METRO		WAS-SPG				
FREQUENCY												
FREQUENCY NOTES												
LEAVE	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM
Grand Central Terminal	G 8.19	G 8.21	8.38	G 8.38	G 8.41		G 9.08		G 9.11	9.18	9.23	9.28
125th Street (R)	S 8.29	C 8.31		C 8.48	C 8.51		C 9.18		C 9.21			
Mott Haven Jct.	8.32	8.34	8.51	8.51	8.54		9.21		9.24	9.31	9.36	9.41
Fordham (E.190th St.)(R)		C 8.38			C 8.58				C 9.28			
CP112	8.40	8.42	8.59	8.59	9.02		9.29		9.32	9.39	9.44	9.49
CP212	8.42	8.44	9.01	9.01	9.04		9.30		9.34	9.41	9.46	9.51
Mount Vernon		S 8.46			S 9.06				S 9.36			
Pelham		S 8.49			S 9.09	-------		-------	S 9.39			
CP216	8.46	8.51	9.05	9.05	9.11	9.20	9.34	9.38	9.41	9.45	9.51	9.55
New Rochelle		S 8.52			S 9.12			S 9.40	S 9.42			
Larchmont		S 8.56			S 9.16				S 9.46			
Mamaroneck		S 8.59			S 9.19				S 9.49			
Harrison		S 9.02			S 9.22				S 9.52			
CP223	8.53	9.04	9.12	9.12	9.24		9.40		9.54	9.53	10.00	10.03
Rye		S 9.05			S 9.25				S 9.55			------
Port Chester		S 9.08			S 9.28				S 9.58			
Greenwich, Conn.		S 9.12		S 9.18	S 9.32				S10.02			
CP229	8.59	9.14	9.18	9.20	9.34		9.46		10.04	9.59	10.06	
Cos Cob					S 9.35				S10.05			
Riverside					S 9.37				S10.07			
Old Greenwich					S 9.39				S10.09			
Stamford	9.06	S 9.22		S 9.25	S 9.42	S	S 9.51	S	S10.12			
CP234	S 9.07	9.23	9.23	9.27	-------		E 9.52		-------	10.05	10.18	
Noroton Heights			------	S 9.29			S 9.55				------	
Darien				S 9.32			S 9.58					
Rowayton				S 9.35								
South Norwalk	S 9.17			S 9.38			S10.04					
CP241	9.18	9.30		9.39			10.05			10.15		
East Norwalk	-------	-------		S 9.41								
Westport				S 9.44			S10.10					
Green's Farms				S 9.48			S10.13					
Southport				S 9.51								
Fairfield				S 9.54			S10.17					
CP255				10.00			10.23			10.30		
Bridgeport				S10.01			S10.24	S				
CP257				10.03			E10.26			10.34		
Stratford				S10.07								
CP261				10.10			10.30			10.39		
Milford				S10.13			S10.34					
New Haven, Conn.				S10.24		S	S10.45	S		11.00		
Fair Street				-------			-------			------		
ARRIVE	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM
Turn To												
Turn From												
Connecting Trains												

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	OFF-PK THRU		WAS-BOS METRO		WAS-BOS			WAS-BOS METRO		WAS-SPG			WAS-BOS METRO			WAS-BOS		1/2 HR EXP OFF PK		WAS-BOS METRO		RVR-BOS	NHV-SPG
TRAIN	9408 DANBY	1318	158 AMTRAK	1518	166 AMTRAK	1320	1322	180 AMTRAK	1522	480 AMTRAK	1324	1326	182 AMTRAK	1526	1826 DANBY	168 AMTRAK	1328	04NN10	1330	184 AMTRAK	1530	86 AMTRAK	486 AMTRAK
FREQUENCY																							
FREQUENCY NOTES																							
LEAVE	AM	AM		AM	AM	AM	AM	AM	AM	AM	AM	AM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Grand Central Terminal	G 9.32	G 9.41		G10.08		G10.11	G10.41		G11.08		G11.11	G11.41		G12.08			G12.11	G12.38	G12.41		G 1.08		
125th Street (R)	S 9.42	C 9.51		C10.18		C10.21	C10.51		C11.18		C11.21	C11.51		C12.18			C12.21	C12.48	C12.51		C 1.18		
Mott Haven Jct.	9.45	9.54		10.21		10.24	10.54		11.21		11.24	11.54		12.21			12.24	12.51	12.54		1.21		
Fordham (E.190th St.)(R)		C 9.58					C10.58					C11.58							C12.58				
CP112	9.53	10.02		10.29		10.32	11.02		11.29		11.32	12.02		12.29			12.32	12.59	1.02		1.29		
CP212	9.55	10.04		10.30		10.34	11.04		11.30		11.34	12.04		12.30			12.34	1.00	1.04		1.30		
Mount Vernon		S10.06				S10.36	S11.06				S11.36	S12.06					S12.36		S 1.06				
Pelham		S10.09	-------		-------	S10.39	S11.09	-------			S11.39	S12.09	-------			-------	S12.39		S 1.09	-------		-------	
CP216	9.59	10.11	10.20	10.34	10.38	10.41	11.11	11.20	11.34	11.38	11.41	12.11	12.20	12.34		12.38	12.41	1.04	1.11	1.20	1.34	1.38	
New Rochelle		S10.12			S10.40	S10.42	S11.12			S11.40	S11.42	S12.12				S12.40	S12.42		S 1.12			S 1.40	
Larchmont		S10.16				S10.46	S11.16				S11.46	S12.16					S12.46		S 1.16				
Mamaroneck		S10.19				S10.49	S11.19				S11.49	S12.19					S12.49		S 1.19				
Harrison		S10.22				S10.52	S11.22				S11.52	S12.22					S12.52		S 1.22				
CP223	10.06	10.24		10.40		10.54	11.24		11.40		11.54	12.24		12.40			12.54	1.10	1.24		1.40		
Rye		S10.25				S10.55	S11.25				S11.55	S12.25					S12.55		S 1.25				
Port Chester		S10.28				S10.58	S11.28				S11.58	S12.28					S12.58		S 1.28				
Greenwich, Conn.		S10.32				S11.02	S11.32				S12.02	S12.32					S 1.02		S 1.32				
CP229	10.12	10.34		10.46		11.04	11.34		10.46		12.04	12.34		12.46			1.04	1.16	1.34		1.46		
Cos Cob		S10.35				S11.05	S11.35				S12.05	S12.35					S 1.05		S 1.35				
Riverside		S10.37				S11.07	S11.37				S12.07	S12.37					S 1.07		S 1.37				
Old Greenwich		S10.39				S11.09	S11.39				S12.09	S12.39					S 1.09		S 1.39				
Stamford	10.19	S10.42		S10.51	S	S11.12	S11.42		S11.51	S	S12.12	S12.42		S12.51		S	S 1.12	S 1.21	S 1.42		S 1.51	S	
CP234	S10.20	-------		10.52		-------	-------		E11.52		-------	-------		E12.52	12.58		-------	1.22	-------		E 1.52		
Noroton Heights	10.24			S10.55					S11.55					S12.55				S 1.25			S 1.55		
Darien	10.28			S10.58					S11.58					S12.58				S 1.28			S 1.58		
Rowayton	10.32								S12.01									S 1.31					
South Norwalk	S10.35			S11.04					S12.04					S 1.04	S 1.09			S 1.34			S 2.04		
CP241	10.36			11.05					12.05					1.05	1.10			1.35			2.05		
East Norwalk	-------													S 1.07	-------			S 1.37					
Westport				S11.10					S12.10					S 1.10				S 1.40			S 2.10		
Green's Farms																		S 1.43			S 2.13		
Southport				S11.14														S 1.46					
Fairfield				S11.17					S12.17					S 1.17				S 1.49			S 2.17		
CP255				11.23					12.23					1.23				1.55			2.23		
Bridgeport				S11.24					S12.24	S				S 1.24				S 1.56			S 2.24	S	
CP257				E11.26					E12.26					1.26				1.58			2.26		
Stratford				S11.30										S 1.30				S 2.02			S 2.30		
CP261				11.31					12.31					1.32				2.04			2.32		
Milford				S11.34					S12.34					S 1.34				S 2.06			S 2.34		-------
New Haven, Conn.			S	S11.45	S				S11.45	S			S	S 1.45		S		S 2.17			S 2.45	S	S
Fair Street				-------					-------					-------				-------			-------		
ARRIVE	AM	AM	AM	AM	AM	AM	AM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Turn To																							
Turn From																							
Connecting Trains																							

EFF. Rev. 8-12-93 EASTWARD	G	1/2 HR EXP OFF PK		WAS-BOS METRO		WAS-BOS		1/2 HR EXP OFF PK		WAS-BOS METRO
TRAIN	1332	04NH12	1334	186 AMTRAK	1534	170 AMTRAK	1336	94NH14	1338	188 AMTRAK
FREQUENCY										
FREQUENCY NOTES										
LEAVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Grand Central Terminal	G 1.11	G 1.38	G 1.41		G 2.08		G 2.11	G 2.38	G 2.41	
125th Street (R)	C 1.21	C 1.48	C 1.51		C 2.18		C 2.21	C 2.48	C 2.51	
Mott Haven Jct.	1.24	1.51	1.54		2.21		2.24	2.51	2.54	
Fordham (E.190th St.)(R)			C 1.58						C 2.58	
CP112	1.32	1.59	2.02		2.29		2.32	2.59	3.02	
CP212	1.34	2.00	2.04		2.30		2.34	3.00	3.04	
Mount Vernon	S 1.36		S 2.06				S 2.36		S 3.06	
Pelham	S 1.39		S 2.09	-------		-------	S 2.39		S 3.09	-------
CP216	1.41	2.04	2.11	2.20	2.34	2.40	2.41	3.04	3.11	3.20
New Rochelle	S 1.42		S 2.12				S 2.42		S 3.12	
Larchmont	S 1.46		S 2.16				S 2.46		S 3.16	
Mamaroneck	S 1.49		S 2.19				S 2.49		S 3.19	
Harrison	S 1.52		S 2.22				S 2.52		S 3.22	
CP223	1.54	2.10	2.24		2.40		2.54	3.10	3.24	
Rye	S 1.55		S 2.25				S 2.55		S 3.25	
Port Chester	S 1.58		S 2.28				S 2.58		S 3.28	
Greenwich, Conn.	S 2.02		S 2.32				S 3.02		S 3.32	
CP229	2.04	2.16	2.34		2.46		3.04	3.16	3.34	
Cos Cob	S 2.05		S 2.35				S 3.05		S 3.35	
Riverside	S 2.07		S 2.37				S 3.07		S 3.37	
Old Greenwich	S 2.09		S 2.39				S 3.09		S 3.39	
Stamford	S 2.12	S 2.21	S 2.42		S 2.51	S	S 3.12	S 3.21	S 3.42	S
CP234	-------	2.22	-------		2.52		-------	3.22	-------	
Noroton Heights		S 2.25			S 2.55			S 3.25		
Darien		S 2.28			S 2.58			S 3.28		
Rowayton		S 2.31			S 3.01			S 3.31		
South Norwalk		S 2.34			S 3.04			S 3.34		
CP241		2.35			3.05			3.35		
East Norwalk		S 2.37			S 3.07			S 3.37		
Westport		S 2.40			S 3.10			S 3.40		
Green's Farms		S 2.43			S 3.13			S 3.43		
Southport		S 2.46			S 3.16			S 3.46		
Fairfield		S 2.49			S 3.19			S 3.49		
CP255		2.55			3.25			3.55		
Bridgeport		S 2.56			S 3.26			S 3.56		
CP257		2.58			3.28			3.58		
Stratford		S 3.02			S 3.32			S 4.02		
CP261		3.04			3.34			4.04		
Milford		S 3.06			S 3.36			S 4.06		
New Haven, Conn.		S 3.17		S	S 3.47	S		S 4.17		
Fair Street		-------			-------			-------		
ARRIVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Turn To										
Turn From										
Connecting Trains										

EFF. Rev. 8-12-93 EASTWARD				WAS-SPG		2ND E	OFF-PK EXP		NYP-NYA	WAS-BOS METRO			
TRAIN	1536	1538	1838 DANBY	472 AMTRAK	1340	1540	99ST8	1342	234 AMTRAK FR	190 AMTRAK	1544	1442	1642
FREQUENCY	FR ON												
FREQUENCY NOTES													
LEAVE	PM	PM	PM	PM	PM	PM	PM	PM			PM	PM	PM
Grand Central Terminal	G 3.03	G 3.08			G 3.11	G 3.36	G 3.38	G 3.41			G 4.03	G 4.06	G 4.08
125th Street (R)		C 3.18			C 3.21	C 3.46	C 3.48	C 3.51			C 4.13	C 4.16	C 4.18
Mott Haven Jct.	3.16	3.21			3.24	3.49	3.51	3.54			4.16	4.19	4.21
Fordham (E.190th St.)(R)								C 3.58					
CP112	3.24	3.29			3.32	3.57	3.59	4.02			4.24	4.27	4.29
CP212	3.25	3.30			3.34	3.58	4.00	4.04			4.25	4.28	4.30
Mount Vernon					S 3.36			S 4.06					
Pelham				-------	S 3.39			S 4.09	-------	-------			
CP216	3.29	3.34		3.38	3.41	4.02	4.04	4.11	4.08	4.20 1	4.29 1	4.32 2	4.34 4
New Rochelle				S 3.40	S 3.42			S 4.12	S 4.10				
Larchmont					S 3.46			S 4.16					
Mamaroneck					S 3.49			S 4.19					
Harrison					S 3.52			S 4.22					
CP223	3.35	3.40			3.54	4.09	4.11	4.24			4.36 1	4.39 2	4.41 4
Rye					S 3.55		S 4.12	S 4.25					S 4.42
Port Chester					S 3.58		S 4.15	S 4.28					S 4.45
Greenwich, Conn.					S 4.02	S 4.16	S 4.19	S 4.32					S 4.49
CP229	3.41	3.46			4.04	4.18	4.21	4.34			4.42 1	4.45 2	4.51 4
Cos Cob					S 4.05		S 4.22	S 4.35					
Riverside					S 4.07		S 4.24	S 4.37					
Old Greenwich					S 4.09		S 4.26	S 4.39					
Stamford		S 3.51		S	S 4.12	S 4.23	S 4.29	S 4.42	S			S 4.50 4	S 4.56
CP234	3.46	3.52			-------	4.24	-------	-------			4.47 1	4.51	4.57 4
Noroton Heights		S 3.55										S 4.54	
Darien		S 3.58										S 4.57	S 5.02
Rowayton		S 4.01										S 5.00	
South Norwalk		S 4.04	S 4.10									S 5.05	S 5.09
CP241	3.54	4.05	4.11			4.32					4.56 4	5.07 4	5.10 4
East Norwalk		S 4.07	-------								S 4.58	-------	S 5.12
Westport	S 3.58	S 4.10				S 4.35					S 5.01		S 5.15
Green's Farms		S 4.13									S 5.05		S 5.19
Southport		S 4.16									S 5.08		S 5.22
Fairfield	S 4.06	S 4.19				S 4.43					S 5.12		S 5.26
CP255	4.12	4.25				4.49					5.18 4		5.32 4
Bridgeport	S 4.13	S 4.26		S		S 4.50			S		S 5.19		S 5.33
CP257	4.15	E 4.28				4.52					5.21 4		5.35 4
Stratford	S 4.19	S 4.32				S 4.56					S 5.25		S 5.39
CP261	4.22	4.34				4.59					5.28 4		5.42 4
Milford	S 4.23	S 4.36				S 5.02					S 5.31		S 5.45
New Haven, Conn.	S 4.34	S 4.47		S		S 5.13			S	S 5.05	S 5.42		S 5.56
Fair Street	-------	-------				-------					-------		-------
ARRIVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Turn To													
Turn From													
Connecting Trains													

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NEW HAVEN LINE

		WAS-BOS			NYP-SPG					WAS-BOS METRO
TRAIN	1244	174 AMTRAK	1944	1644	474 AMTRAK	1246	1546	1846 DANBY	1646	192 AMTRAK
FREQUENCY										
FREQUENCY NOTES										
LEAVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Grand Central Terminal	G 4.10		G 4.24	G 4.26		G 4.30	G 4.36	G 4.42	G 4.46	
125th Street (R)	C 4.20		C 4.34	C 4.36		C 4.40	C 4.46	C 4.52	C 4.56	
Mott Haven Jct.	4.23		4.37	4.39		4.43	4.49	4.55	4.59	
Fordham (E.190th St.)(R)						C 4.47				
CP112	4.31		4.45	4.47		4.51	4.57	5.03	5.07	
CP212	4.33		4.46	4.50		4.53	4.59	5.05	5.09	
Mount Vernon	S 4.35					S 4.55				
Pelham	S 4.38	-------			-------	S 4.58				-------
CP216	4.40 4	4.38 2	4.51 2	4.53 4	4.55 1	5.00 4	5.03 1	5.09 2	5.13 4	5.20 2
New Rochelle	S 4.41	S 4.40		C 4.55		S 5.02				
Larchmont	S 4.45					S 5.06				
Mamaroneck	S 4.48					S 5.09				
Harrison	S 4.51					S 5.13			S 5.19	
CP223	4.54 4	2	4.57 2	5.00 4	1	5.18 4	5.10 1	5.15 2	5.21 4	2
Rye	------			S 5.01		-------			S 5.22	
Port Chester				S 5.05					S 5.25	
Greenwich, Conn.				S 5.09					S 5.29	
CP229		2	5.03 2	5.11 4	1		5.16 1	5.21 2	5.31 4	2
Cos Cob				S 5.12					S 5.32	
Riverside				S 5.14					S 5.34	
Old Greenwich				S 5.16					S 5.36	
Stamford		S 2	S 5.08	S 5.19				S 5.26 2	S 5.40 4	S 5.34
CP234			5.09 2	5.20 4	1		5.21 1	5.28 4	5.41	2
Noroton Heights								S 5.32	S 5.44	
Darien								S 5.36	S 5.47	
Rowayton								S 5.40	S 5.50	
South Norwalk							5.29 1/2	S 5.44	S 5.56	
CP241		2	5.17 2	5.28 4	513 1/2		5.30 4	5.46 4	6.01 4	2
East Norwalk							S 5.32	-------	S 6.03	
Westport							S 5.35		S 6.07	
Green's Farms							S 5.39		S 6.11	
Southport							S 5.42		S 6.15	
Fairfield			2	S 5.37			S 5.45		S 6.19	
CP255		2	5.31 5	5.43 4	2		5.51 4		6.25 4	2
Bridgeport		S [illegible]	S 5.33	S 5.44			S 5.52		S 6.26	
CP257		[illegible]	5.35 3	5.46 4	2		5.54 4		6.28 4	2
Stratford				S 5.50			S 5.58		S 6.32	
CP261			5.51 3	5.53 4	2		6.01 4		6.35 4	2
Milford			-------	S 5.56			S 6.04		S 6.38	
New Haven, Conn.		S 551		S 6.07	S 539		S 6.15		S 6.49	S 6.06
Fair Street				-------			-------		-------	
ARRIVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Turn To										
Turn From										
Connecting Trains										

							PHL-BOS 5ME	NHV-SPG				WAS-BOS 10ML	
TRAIN	1248	1550	1552	1852 DANBY	1752 NEWCAN	1352	178 AMTRAK	476 AMTRAK	1452	1652	1254	176 AMTRAK	1256
FREQUENCY													
FREQUENCY NOTES													
LEAVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Grand Central Terminal	G 4.55	G 5.01	G 5.03	G 5.06	G 5.06	G 5.11			G 5.13	G 5.15	G 5.17		G 5.19
125th Street (R)	C 5.05			C 5.16		C 5.21				C 5.25			
Mott Haven Jct.	5.08	5.14	5.16	5.19	5.18	5.24			5.26	5.28	5.30		5.32
Fordham (E.190th St.)(R)	C 5.12												
CP112	5.16	5.22	5.24	5.27	5.29	5.32			5.34	5.36	5.38		5.40
CP212	5.18	5.24	5.26	5.29	5.31	5.34			5.36	5.38	5.40		5.42
Mount Vernon	S 5.20												S 5.44
Pelham	S 5.23						-------					-------	S 5.47 4
CP216	5.25 4	5.28 2	5.31 2	5.33 2	5.36 2	5.38 4	5.40 2		5.41 2	5.42 4	5.44 4	5.46 2	5.49
New Rochelle	S 5.27										S 5.45	S 5.48	S 5.51
Larchmont	S 5.31										S 5.49		-------
Mamaroneck	S 5.34										S 5.52		
Harrison	S 5.38									S 5.48	S 5.56		
CP223	5.41 4	5.35 2	5.38 2	5.49 4	5.48 2	5.45 4	2		5.48 2	5.50 4	5.59 4	2	
Rye	-------									S 5.51	-------		
Port Chester										S 5.55			
Greenwich, Conn.						S 5.51				S 5.59			
CP229		5.41 2	5.44 2	5.46 4	5.49 2	5.52 4	2		5.54 2	6.00 4		2	
Cos Cob						S 5.55				S 6.03			
Riverside						S 5.58				S 6.06			
Old Greenwich						S 6.01			3	S 6.09			
Stamford				S 5.51					S 5.59 4	S 6.15			
CP234		5.45 2	5.48 2	5.52 4	5.58 2	6.10 4	2		6.01	6.16 4		2	
Noroton Heights					-------	-------			S 6.05	S 6.20			
Darien									S 6.08	S 6.24			
Rowayton									S 6.11	S 6.28			
South Norwalk				S 6.01					S 6.15	S 6.32			
CP241		5.52 4	5.55 4	6.03 4			2		6.17 4	6.34 4		2	
East Norwalk			S 5.57	-------					-------	S 6.39			
Westport			S 6.01							S 6.42			
Green's Farms			S 6.05							S 6.46			
Southport			S 6.08							S 6.49			
Fairfield		S 6.02	S 6.12							S 6.53			
CP255		6.08 4	6.18 4				2			7.00 4		2	
Bridgeport		S 6.09								S 7.01			
CP257		6.11 4	6.21 4				2			7.03 4		2	
Stratford		S 6.15	-------							S 7.07			
CP261		6.18 4					2			7.10 4		2	
Milford		S 6.21								S 7.13			
New Haven, Conn.		S 6.32					S 6.24	S		S 7.24		S 6.39	
Fair Street		-------								-------			
ARRIVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Turn To													
Turn From													
Connecting Trains													

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TRAIN	1556	1558	1458	1758	1360	1260	1262	1860 DANBY	1562	1662
FREQUENCY										
FREQUENCY NOTES										
LEAVE	PM	PM	PM	PM	PM	PM		PM	PM	PM
Grand Central Terminal	G 5.21	G 5.23	G 5.25	G 5.28	G 5.30	G 5.33	G 5.35	G 5.36	G 5.38	G 5.40
125th Street (R)										C 5.50.
Mott Haven Jct.	5.34	5.36	5.38	5.41	5.43	5.46	5.48	5.49	5.51	5.53
Fordham (E.190th St.)(R)										C 5.57
CP112	5.42	5.44	5.46	5.49	5.51	5.54	5.56	5.57	5.59	6.01
CP212	5.44	5.46	5.48	5.51	5.53	5.56	5.58	5.59	6.01	6.03
Mount Vernon										S 6.05
Pelham										S 6.08
CP216	5.48 2	5.50 4	5.52 2	5.55 2	5.57 4	6.00 4	6.02 4	6.03 2	6.05 2	6.11 4
New Rochelle							S 6.04			S 6.12
Larchmont							S 6.08			S 6.16
Mamaroneck							S 6.11			S 6.19
Harrison						S 6.07	S 6.14			S 6.22
CP223	5.55 2	5.57 4	5.59 2	6.02 2	6.04 4	6.09 4	6.17 4	6.10 2	6.12 2	6.24 4
Rye						S 6.10	-------			S 6.25
Port Chester						S 6.13				S 6.28
Greenwich, Conn.					S 6.10	S 6.18				S 6.32
CP229	6.01 2	6.03 4	6.05 2	6.08 2	6.11 4	-------		6.16 2	6.18 2	6.34 4
Cos Cob					S 6.14					S 6.35
Riverside					S 6.17					S 6.37
Old Greenwich					S 6.20					S 6.39
Stamford			S 6.10 3/4		S 6.23			S 6.22 3/4		S 6.44
CP234	6.06 2	6.08 4	6.12	6.12 2	-------			6.24 4	6.23 2	6.45 4
Noroton Heights			S 6.15	-------						S 6.50
Darien			S 6.18							S 6.55
Rowayton			S 6.21							S 6.58
South Norwalk		S 6.17	S 6.26					S 6.35		S 7.02
CP241	6.14 2/4	6.18 4	6.28 4					6.37 4	6.31 3/4	7.03 4
East Norwalk		S 6.20	-------					-------		S 7.06
Westport		S 6.23								S 7.10
Green's Farms		S 6.27								S 7.15
Southport		S 6.30								S 7.18
Fairfield	S 6.24	S 6.34							S 6.41	S 7.23
CP255	6.30 4	6.40 4							6.47 4	7.29 4
Bridgeport	S 6.31								S 6.48	S 7.30
CP257	6.33 4	6.45 4							6.49 4	7.32 4
Stratford	S 6.36	-------							S 6.53	S 7.36
CP261	6.39 4								6.56 4	7.39 4
Milford	S 6.42								S 6.59	S 7.42
New Haven, Conn.	S 6.53								S 7.10	S 7.53
Fair Street	-------								-------	-------
ARRIVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Turns from										
Turns to										
Connecting Trains										

TRAIN	1962	1462	1464	194 AMTRAK (WAS-BOS METRO)	1364	1266	1268	1566	1568	1868 DANBY	1770 NEWCAN	260 AMTRAK (WAS-BOS)	1670
FREQUENCY													
FREQUENCY NOTES													
LEAVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM		PM
Grand Central Terminal	G 5.42	G 5.45	G 5.48		G 5.53	G 5.56	G 5.59	G 6.02	G 6.05	G 6.08	G 6.17		G 6.16
125th Street (R)			C 5.58		C 6.03								
Mott Haven Jct.	5.55	5.58	6.01		6.06	6.09	6.12	6.15	6.18	6.21	6.30		6.29
Fordham (E.190th St.)(R)													
CP112	6.03	6.06	6.09		6.14	6.17	6.20	6.23	6.26	6.29	6.38		6.37
CP212	6.05	6.08	6.11		6.16	6.19	6.22	6.25	6.28	6.31	6.40		6.39
Mount Vernon							S 6.24						
Pelham				-------			S 6.27					-------	
CP216	6.09 2	6.12 2	6.15 2	6.20 1	6.20 4	6.23 4	6.32 4	6.29 2	6.32 2	6.35 2	6.44 2	6.38 2	6.43 4
New Rochelle							S 6.32					S 6.40	
Larchmont						S 6.26	-------						
Mamaroneck						S 6.30							
Harrison						S 6.34							
CP223	6.16 2	6.19 2	6.22 2	1	6.27 4	6.37 4		6.36 2	6.39 2	6.42 2	6.51 2	2	6.50 4
Rye					S 6.29	-------							S 6.51
Port Chester					S 6.33								S 6.55
Greenwich, Conn.					S 6.37								S 6.59
CP229	6.22 2	6.25 2	6.28 2	1	6.39 4			6.42 2	6.45 2	6.48 2	6.56 2	2	7.01 4
Cos Cob					S 6.40								S 7.02
Riverside					S 6.42								S 7.04
Old Greenwich					S 6.44								S 7.06
Stamford	S 6.28 2	H 6.31 2			S 6.47						S 7.03 2	S 6.55 2	S 7.11
CP234	6.29 1	6.32	6.33 2/4	633 1/2	-------			6.47 2	6.50 2	6.53 2/4	7.05		7.12 4
Noroton Heights			H 6.37							S 6.56	-------		S 7.17
Darien			H 6.41							S 7.01			S 7.22
Rowayton			H 6.45							S 7.05			S 7.25
South Norwalk		H 6.41 3/4	S 6.49							S 7.09			S 7.29
CP241	6.37 1	6.42 4	6.52 4	2				6.55 3/4	6.58 3/4	7.11 4		2	7.30 4
East Norwalk		H 6.44	-------						S 7.00	-------			S 7.33
Westport		H 6.47							S 7.03				S 7.37
Green's Farms		H 6.51							S 7.07				S 7.42
Southport		H 6.54							S 7.10				S 7.45
Fairfield		D 6.58						S 7.05	S 7.14				S 7.50
CP255	6.51 1/3	7.05 4		2				7.11 4	7.20 4			2	7.56 4
Bridgeport	S 6.53 3							S 7.12					S 7.57
CP257	6.55	7.14 4		2				7.14 4	7.23 4			2	7.59 4
Stratford		-------						S 7.18	-------				S 8.03
CP261	7.02 3/4			2				7.21 4				2	8.06 4
Milford	-------							S 7.24					S 8.09
New Haven, Conn.				7.04				S 7.35				S 7.26	S 8.18
Fair Street								-------					-------
ARRIVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Turns from													
Turns to													
Connecting Trains													

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TRAIN	1272	1574	1472	1374	1676	WAS-BOS METRO 196 AMTRAK	1576	1876	1776	WAS-SPG 478 AMTRAK	1278
FREQUENCY											
FREQUENCY NOTES											
LEAVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Grand Central Terminal	G 6.20	G 6.31	G 6.35	G 6.38	G 6.41		G 7.04	G 7.07	G 7.10		G 7.13
125th Street (R)	C 6.30	C 6.41	C 6.45		C 6.51		C 7.14	C 7.17	C 7.20		
Mott Haven Jct.	6.33	6.44	6.48	6.51	6.54		7.17	7.20	7.23		7.26
Fordham (E.190th St.)(R)					6.58						
CP112	6.41	6.52	6.56	6.59	7.02		7.25	7.28	7.31		7.34
CP212	6.43	6.54	6.58	7.01	7.04		7.27	7.30	7.33		7.36
Mount Vernon	S 6.45				S 7.06						
Pelham	S 6.48				S 7.09	-------				-------	
CP216	6.51 4	6.58 2	7.02 2	7.05 4	7.11 4	7.18 2	7.31 2	7.34 2	7.37 2	7.40 2	7.40 4
New Rochelle	S 6.52				S 7.12	S 7.20				S 7.42	
Larchmont	S 6.56				S 7.16						S 7.43
Mamaroneck	S 6.59				S 7.19						S 7.46
Harrison	S 7.03			S 7.12	S 7.22						S 7.50
CP223	7.05 4	7.05 2	7.09 2	7.14 4	7.24 4	2	7.38 2	7.41 2	7.44 2	2	7.53 4
Rye	-------			S 7.15	S 7.25						-------
Port Chester				S 7.19	S 7.28						
Greenwich, Conn.				S 7.23	S 7.32						
CP229		7.11 2	7.15 2	7.25 4	7.34 4	2	7.44 2	7.47 4	7.50 2	2	
Cos Cob				S 7.26	S 7.35						
Riverside				S 7.28	S 7.37						
Old Greenwich				S 7.30	S 7.39						
Stamford			S 7.20 4	S 7.33	S 7.45	S	S 7.49 2	S 7.53 4	S 7.55	S 7.56	
CP234		7.16 2	7.21	-------	7.46 4	2	7.50	7.54 4	7.56 2	7.57 2	
Noroton Heights			S 7.25		S 7.51			S 7.58	-------		
Darien			S 7.29		S 7.56			S 8.02			
Rowayton			S 7.33		S 7.59			S 8.06			
South Norwalk			S 7.37		S 8.03		S 7.58	S 8.11			
CP241		7.25 4	7.40 4		8.07 4	2	7.59 4	8.13 4		2	
East Norwalk		S 7.28			S 8.10		S 8.01	-------			
Westport		S 7.32			S 8.14		S 8.04				
Green's Farms		S 7.36			S 8.19		S 8.07				
Southport		S 7.39			S 8.22		S 8.10				
Fairfield		S 7.43			S 8.27		S 8.14				
CP255		7.50 4	7.55 4		8.33 4	2	8.21 4			2	
Bridgeport		S 7.51			S 8.34		S 8.22			S 8.18 4	
CP257		E 7.53 4	8.00 4		8.36 4	2	E 8.24 4			4	
Stratford		S 7.57	-------		S 8.40		S 8.28				
CP261		8.00 4			8.43 4	2	8.31 4			4	
Milford		S 8.03			S 8.46		S 8.34				
New Haven, Conn.		S 8.14			S 8.57	S 8.06	S 8.45			S 8.33	
Fair Street		-------			-------		-------				
ARRIVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Turns from											
Turns to											
Connecting Trains											

TRAIN	1378	1578	1480	1380	WAS-MTR 60 AMTRAK	WAS-BOS METRO 198 AMTRAK	1580	1880 DANBY	OFF-PK EXP 04ST10	WAS-BOS 262 AMTRAK	1382	1/2 HR OFF-PK EXP 95NH16
FREQUENCY												
FREQUENCY NOTES												
LEAVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Grand Central Terminal	G 7.16	G 7.38	G 7.40	G 7.42			G 8.08		G 8.10		G 8.11	G 8.38
125th Street (R)	C 7.26	C 7.48		C 7.52			C 8.18		C 8.20		C 8.21	C 8.48
Mott Haven Jct.	7.29	7.51	7.53	7.55			8.21		8.23		8.24	8.51
Fordham (E.190th St.)(R)				C 7.59								
CP112	7.37	7.59	8.01	8.03			8.29		8.31		8.32	8.59
CP212	7.39	8.01	8.03	8.05			8.30		8.32		8.34	9.00
Mount Vernon	S 7.41			S 8.07							S 8.36	
Pelham	S 7.44			S 8.10	-------	-------				-------	S 8.39	
CP216	7.46 4	8.05	8.07	8.12	8.15	8.20	8.34		8.36	8.40	8.41	9.04
New Rochelle	S 7.47			S 8.13							S 8.42	
Larchmont	S 7.51			S 8.17							S 8.46	
Mamaroneck	S 7.54			S 8.20							S 8.49	
Harrison	S 7.57			S 8.23							S 8.52	
CP223	7.59 4	8.12	8.14	8.25			8.40		8.42		8.54	9.10
Rye	S 8.00		S 8.16	S 8.26					S 8.43		S 8.55	
Port Chester	S 8.03		S 8.20	S 8.29					S 8.46		S 8.58	
Greenwich, Conn.	S 8.07		S 8.25	S 8.33					S 8.50		S 9.02	
CP229	8.09 4	8.18	8.27	8.35			8.46		8.52		9.04	9.16
Cos Cob	S 8.10		S 8.29						S 8.53		S 9.05	
Riverside	S 8.12		S 8.32						S 8.55		S 9.07	
Old Greenwich	S 8.14		S 8.35						S 8.57		S 9.09	
Stamford	S 8.17	S 8.24		S 8.41	S		S 8.51		S 9.00	S	S 9.12	S 9.21
CP234	-------	8.25	8.39	-------			8.52		-------		-------	9.22
Noroton Heights		S 8.28					S 8.55					S 9.25
Darien		S 8.32					S 8.58					S 9.28
Rowayton		S 8.35					S 9.01					S 9.31
South Norwalk		S 8.38	8.44				S 9.04	S 9.15				S 9.34
CP241		8.39	S 8.46				9.05	9.16				9.35
East Norwalk		S 8.41	-------				S 9.07	-------				S 9.37
Westport		S 8.43					S 9.10					S 9.40
Green's Farms		S 8.47					S 9.13					S 9.43
Southport		S 8.50					S 9.16					S 9.46
Fairfield		S 8.54					S 9.19					S 9.49
CP255		9.01					9.25					9.55
Bridgeport		S 9.02					S 9.26					S 9.56
CP257		9.04					E 9.28					9.58
Stratford		S 9.08					S 9.32					S10.02
CP261		9.11					9.34					10.04
Milford		S 9.14					S 9.36					S10.06
New Haven, Conn.		S 9.25			S	S	S 9.47					S10.17
Fair Street		-------					-------					-------
ARRIVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Turns from												
Turns to												
Connecting Trains												

EFF. Rev. 8-12-93 EASTWARD	OFF-PK EXP		WAS-BOS METRO		WAS-SPG		1/2 HR OFF-PK EXP			ACY-SPG				1/2 HR OFF-PK EXP			13"E		1/2 HR OFF-PK EXP	
TRAIN	04ST12	1384	200 AMTRAK	1584	480 AMTRAK	1386	95NH18	1088 DN	1388	654 AMTRAK	1588	1888	1390	95NH18	1392	1195	1592 1792	1394	04NH20	1396
FREQUENCY																FR ON				
FREQUENCY NOTES																				
LEAVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	AM	PM	PM	PM	PM
Grand Central Terminal	G 8.40	G 8.41		G 9.08		G 9.11	G 9.38		G 9.41		G10.08		G10.11	G10.38	G10.41		G11.08	G11.11	G11.38	G11.41
125th Street (R)	C 8.50	C 8.51		C 9.18		C 9.21	C 9.48		C 9.51		C10.18		C10.21	C10.48	C10.51		C11.18	C11.21	C11.48	C11.51
Mott Haven Jct.	8.53	8.54		9.21		9.24	9.51		9.54		10.21		10.24	10.51	10.54		11.21	11.24	11.51	11.54
Fordham (E.190th St.)(R)		C 8.58							C 9.58						C10.58					C11.58
CP112	9.01	9.02		9.29		9.32	9.59		10.02		10.29		10.32	10.59	10.02		11.29	11.32	11.59	12.02
CP212	9.02	9.04		9.30		9.34	10.00		10.04		10.30		10.34	11.00	10.04		11.30	11.34	12.00	12.04
Mount Vernon		S 9.06				S 9.36			S10.06				S10.36		S11.06			S11.36		S12.06
Pelham		S 9.09				S 9.39			S10.09				S10.39		S11.09			S11.39		S12.09
CP216	9.06	9.11	9.20	9.34	9.38	9.41	10.04		10.11	10.28	10.34		10.41	11.04	11.11		11.34	11.41	12.04	12.11
New Rochelle		S 9.12			S 9.40	S 9.42			S10.12	S10.30			S10.42		S11.12			S11.42		S12.12
Larchmont		S 9.16				S 9.46			S10.16				S10.46		S11.16			S11.46		S12.16
Mamaroneck		S 9.19				S 9.49			S10.19				S10.49		S11.19			S11.49		S12.19
Harrison		S 9.22				S 9.52			S10.22				S10.52		S11.22			S11.52		S12.22
CP223	9.12	9.24		9.40		9.54	10.10		10.24		10.40		10.54	11.10	11.24		11.40	11.54	12.10	12.24
Rye	S 9.13	S 9.25				S 9.55			S10.25				S10.55		S11.25			S11.55		S12.25
Port Chester	S 9.16	S 9.28				S 9.58			S10.28				S10.58		S11.28			S11.58		S12.28
Greenwich, Conn.	S 9.20	S 9.32				S10.02			S10.32				S11.02		S11.32			S12.02		S12.32
CP229	9.22	9.34		9.46		10.04	10.16		10.34		10.46		11.04	11.16	11.34		11.46	12.04	12.16	12.34
Cos Cob	S 9.23	S 9.35				S10.05			S10.35				S11.05		S11.35			S12.05		S12.35
Riverside	S 9.25	S 9.37				S10.07			S10.37				S11.07		S11.37			S12.07		S12.37
Old Greenwich	S 9.27	S 9.39				S10.09			S10.39				S11.09		S11.39			S12.09		S12.39
Stamford	S 9.30	S 9.42	S	S 9.51	S	S10.12	S10.21		S10.42	S	S10.51		S11.12	S11.21	S11.42		S11.51	S12.12	S12.21	S12.42
CP234				9.52			10.22	10.35			10.52			11.22			11.52		12.22	
Noroton Heights				S 9.55			S10.25				S10.55			S11.25			S11.55		S12.25	
Darien				S 9.58			S10.28				S10.58			S11.28			S11.58		S12.28	
Rowayton				S10.01			S10.31				S11.01			S11.31			S12.01		S12.31	
South Norwalk				S10.04			S10.34				S11.04	S11.10		S11.34			S12.04		S12.34	
CP241				10.05			10.35	10.45			11.05	11.11		11.35			12.05		12.35	
East Norwalk				S10.07			S10.37				S11.07			S11.37			S12.07		S12.37	
Westport				S10.10			S10.40				S11.10			S11.40			S12.10		S12.40	
Green's Farms				S10.13			S10.43				S11.13			S11.43			S12.13		S12.43	
Southport				S10.16			S10.46				S11.16			S11.46			S12.16		S12.46	
Fairfield				S10.19			S10.49				S11.19			S11.49			S12.19		S12.49	
CP255				10.25			10.55				11.25			11.55			12.25		12.55	
Bridgeport				S10.26	S		S10.56			S	S11.26			S11.56			S12.26		S12.56	
CP257				10.28			10.58				E11.28			11.58			12.28		12.58	
Stratford				S10.32			S11.02				S11.32			S12.02			S12.32		S 1.02	
CP261				10.34			11.04				11.34			12.04		12.29	12.34		1.04	
Milford				S10.36			S11.06				S11.36			S12.06			S12.36		S 1.06	
New Haven, Conn.			S	S10.47	S		S11.17			S	S11.47			S12.17		12.45	S12.47		S 1.17	
Fair Street																				
ARRIVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	AM	PM	AM	AM	AM	AM	AM
Turns from																				
Turns to																				
Connecting Trains																				

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		BOS-WAS							MTR-WAS										BOS-WAS METRO				
TRAIN	1301	67 AMTRAK	5507	1303	1305	1507	1307	1509	61 AMTRAK	1511	1309	1711	1311	1811	1513	1211	1313	1315	151 AMTRAK	1417	1419	1521	1217
Frequency																							
Frequency Notes																							
LEAVE																							
Fair Street																							
New Haven, Conn.																							
		S				S 453		S 525	S 545	S 543					S 558				S 628			S 624	
Milford						S 504		S 536		S 554					S 609							S 635	
CP261						507		539	559	557					612				638			638	
Stratford						S 510		S 542		S 600					S 616							S 641	
CP257						E 514		E 546	603	E 604					E 619				641	624	632	645	
Bridgeport						S 516		S 548		S 606					S 621				S 644			S 647	
CP255						517		549	606	607					622				645	630	638	648	
Fairfield						S 523		S 555		S 613					S 628						S 646	S 654	
Southport						S 526		S 558							S 631						S 649		
Green's Farms						S 529		S 601							S 634						S 652		
Westport						S 533		S 605		S 621					S 639						S 656		
East Norwalk						S 536		S 608							S 642						S 700		
CP241						538		610	620	625				629	644				659	647	702	705	
South Norwalk						S 539		S 611						S 631	S 645					S 653		S 706	
Rowayton						S 542		S 614						S 635						S 656			
Darien						S 545		S 617						S 640						S 700			
Noroton Heights						S 548		S 620						S 645						S 704			
CP234						E 552		623	629	634		641		649	653		649	645	705	707	711	715	
Stamford	S 1225	S		S 500	S 530	S 553	S 558	S 625	S 630		S 619	S 643	S 638	S 651	S 655				S 706	S 709			
Old Greenwich	S 1227			S 502	S 532		S 600				S 621		S 640					S 658					
Riverside	S 1229			S 504	S 534		S 602				S 623		S 642					S 701					
Cos Cob	S 1231			S 506	S 536		S 604				S 625		S 644					S 703					
CP229	1232			507	537	558	605	630	635	638	626	648	645	655	659		653	704	710	714	717	720	
Greenwich, Conn.	S 1234			S 509	S 539		S 607				S 628		S 647					S 706					
Port Chester	S 1238			S 513	S 543		S 611				S 632		S 652					S 710					
Rye	S 1241			S 516	S 546		S 614				S 635		S 655					S 713					
CP223	1242			517	547	604	615	636	642	644	636	654	656	701	705		659	714	715	720	723	726	
Harrison	S 1244			S 519	S 549		S 617				S 638						S 708						
Mamaroneck	S 1247			S 522	S 552		S 620				S 641						S 711						
Larchmont	S 1250			S 525	S 555		S 623				S 644						S 715						
New Rochelle	S 1254			S 529	S 559		S 627				S 648					S 711			S 720				S 726
CP216	1255			530	600	611	628	643	655	651	649	701	703	708	712	712	718	721	721	727	730	733	727
Pelham																							
Mount Vernon																							
CP212																							
CP112																							
Fordham (E.190th St.)(D)																							
Mott Haven Jct.																							
125th Street (D)																							
Grand Central Terminal	123			600	630	638	658	710		718	721	729	732	737	741	744	747	750		753	756	759	801
ARRIVE	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM
Turns from																							
Turns to																							
Connecting Trains																							

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TRAIN	1919	1319	1819	1723	1321	1525	1323	1325
Frequency								
Frequency Notes								
LEAVE								
Fair Street								
New Haven, Conn.								
						S 640 3		
Milford						S 651		
CP261	640 3					654 3		
Stratford						S 657		
CP257	647 3					701 3		
Bridgeport	S 649					S 703		
CP255	650 3					704 3		
Fairfield								
Southport								
Green's Farms								
Westport								
East Norwalk								
CP241	707 3		705			719 3 1		
South Norwalk			S 711 3 1					
Rowayton								
Darien								
Noroton Heights								
CP234	714 3	700 3	720 1	720 1		728 1	714 3	5
Stamford	S 716 1				S 701 5	S 730 3 1		S 725 3
Old Greenwich					S 707			S 729
Riverside					S 710			S 732
Cos Cob					S 713			S 735
CP229	722 1	705 3	730 1	727 1	714 3	734 1	719 3	737 3
Greenwich, Conn.					S 717			S 739
Port Chester					S 721		S 738	
Rye					S 725		S 742	
CP223	728 1	717 3	739 1	733 1	727 3	740 1	743 3	745 3
Harrison		S 724			S 730			
Mamaroneck		S 727			S 733			
Larchmont		S 731			S 737			
New Rochelle					S 741			
CP216	736 1	734 3	744 1	740 1	742 3	745 1	750 3	752 3
Pelham								
Mount Vernon								
CP212								
CP112								
Fordham (E.190th St.)(D)								
Mott Haven Jct.								
125th Street (D)								
Grand Central Terminal	803	804	806	809	816	817	820	822
ARRIVE	AM	AM	AM	AM	AM	AM	AM	AM
Turns from								
Turns to								
Connecting Trains								

TRAIN	1427	1429	1825	1225	1327	1529	1329	1331	1731	1431
Frequency										
Frequency Notes										
LEAVE										
Fair Street										
New Haven, Conn.										
						S 657 3				
Milford						S 708				
CP261						711 3				
Stratford						S 714				
CP257	650 1	655 3				717 3				
Bridgeport						S 720				
CP255	657 1	702 3				721 3				
Fairfield		S 710				S 727				
Southport		S 713								
Green's Farms		S 716								
Westport		S 721				S 735				
East Norwalk		S 724	44							
CP241	714 1/3	726 3 1	729 3			739 3 1				735 3
South Norwalk	S 717		S 731							S 737
Rowayton	S 720									S 740
Darien	S 724									S 743
Noroton Heights	S 728								5	S 746
CP234	731 1	735 1	739 3		733 3	747 1	736 1		753 1	750 3
Stamford	S 733		S 740 1					S 742 5 3		S 752 1
Old Greenwich										
Riverside										
Cos Cob										
CP229	738 1	741 1	744 1		739 3	752 1	743 1	749 3	759 1	756 1
Greenwich, Conn.								S 751		
Port Chester								S 755		
Rye								S 759		
CP223	744 1	749 1	751 1		747 3	758 1	750 5 3	801 3	805 1	802 1
Harrison							S 754			
Mamaroneck							S 758			
Larchmont					S 758					
New Rochelle				S 759 3						
CP216	751 1	756 1	758 1	800	802 3	805 1	805 5	807 3	812 1	809 1
Pelham										
Mount Vernon										
CP212										
CP112										
Fordham (E.190th St.)(D)										
Mott Haven Jct.										
125th Street (D)										
Grand Central Terminal	823	826	828	830	832	834	835	837	839	0841
ARRIVE	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM
Turns from										
Turns to										
Connecting Trains										

TRAIN	SPG-WAS 141	1629	1229	BOS-WAS METRO 153 AMTRAK	1533
Frequency					
Frequency Notes					
LEAVE					
Fair Street					
New Haven, Conn.					
	S 655 1	S 645 3		S 735 1	S 706 3
Milford		S 656			S 717
CP261	709 1	659 3		745 1	720 3
Stratford		S 702			S 723
CP257	713 1	E 706 3		748 1	727 5
Bridgeport	S 715	S 710			S 729
CP255	716 1	714 3		750 1	730 3
Fairfield		S 717			S 735
Southport		S 721			S 738
Green's Farms		S 724			S 741
Westport		S 728			S 744
East Norwalk		S 732			S 748
CP241	733 1	736 3		801 1	752 3
South Norwalk		S 737			S 753
Rowayton					S 756
Darien					S 759
Noroton Heights					S 802
CP234	742 1	745 3		806 1	806 3 1
Stamford	S 743	S 746			S 808
Old Greenwich		S 749			
Riverside		S 752			
Cos Cob		S 755			
CP229	748 1	756 3		810 1	813 1
Greenwich, Conn.		S 759			
Port Chester					
Rye					
CP223	752 1	806 3		815 1	818 1
Harrison					
Mamaroneck					
Larchmont					
New Rochelle			S 817 3	S 820	
CP216	805 1	813 3	818	821 1	824 1
Pelham					
Mount Vernon					
CP212					
CP112					
Fordham (E.190th St.)(D)					
Mott Haven Jct.					
125th Street (D)					
Grand Central Terminal		844	850		853
ARRIVE	AM	AM	AM	AM	AM
Turns from					
Turns to					
Connecting Trains					

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TRAIN	1833	1231	1535	1333	1935	1635	1433	1735	1235	1437	1539	1839	1337
Frequency													
Frequency Notes													
LEAVE													
Fair Street													
New Haven, Conn.			s 725			s 715					s 745		
Milford			s 736			s 726					s 756		
CP261			739		742	729					759		
Stratford			s 742			s 732					s 802		
CP257			745		748	735				749	806		
Bridgeport			s 747		s 751	s 737				s 756	s 808		
CP255			748		752	738				757	809		
Fairfield						s 744				s 803	s 815		
Southport													
Green's Farms													
Westport						s 752				s 811	s 823		
East Norwalk										s 814			
CP241	759		805		807	756	802			816	827	823	
South Norwalk	s 801						s 804			s 817		s 824	
Rowayton							s 807					s 827	
Darien							s 810					s 830	
Noroton Heights							s 814					s 834	
CP234	808		811	802	815	806	818	820		823	836	838	
Stamford					s 817	s 808	s 819	s 822		s 824		s 840	
Old Greenwich						s 810				s 826			
Riverside						s 812				s 828			
Cos Cob						s 814				s 831			
CP229	814		817	807	821	817	824	827		834	840	845	833
Greenwich, Conn.				s 813		s 820				s 835			s 835
Port Chester				s 817									s 840
Rye				s 820									s 843
CP223	820	810	823	822	826	825	830	833	835	843	846	851	845
Harrison		s 817		s 823					s 837				
Mamaroneck		s 820							s 840				
Larchmont		s 823							s 843				
New Rochelle									s 847				s 853
CP216	826	827	829	830	833	833	837	840	849	850	853	858	855
Pelham													
Mount Vernon													
CP212													
CP112													
Fordham (E.190th St.)(D)													
Mott Haven Jct.													
125th Street (D)													
Grand Central Terminal ARRIVE	856 AM	857 AM	859 AM	901 AM	901 AM	903 AM	906 AM	910 AM	919 AM	920 AM	922 AM	925 AM	0927 AM
Turns from													
Turns to													
Connecting Trains													

TRAIN	SPG-ACY 655 AMTRAK	1237	BOS-WAS MAIL 13 AMTRAK	1639	1541	BOS-WAS METRO 155 AMTRAK	1239	1341	1441	1545	1241	1345
Frequency												
Frequency Notes												
LEAVE												
Fair Street												
New Haven, Conn.	s 745		s 800	s 756	s 804	s 836				s 835		
Milford				s 807	s 815					s 846		
CP261				810	818					849		
Stratford				s 813	s 821					s 852		
CP257				817	E 825				842	856		
Bridgeport	s		s	s 819	s 827					s 858		
CP255				820	828				846	859		
Fairfield				s 826	s 834				s 852	s 905		
Southport					s 837				s 855			
Green's Farms					s 840				s 858			
Westport					s 845				s 903			
East Norwalk					s 848				s 906			
CP241				836	850				908	913		
South Norwalk					s 851				s 909			
Rowayton					s 854				s 912			
Darien					s 857				s 915			
Noroton Heights					s 900				s 918			
CP234				842	904				922	923		
Stamford	s		s	s 843	s 906			s 912	s 923	s 925		s 933
Old Greenwich				s 845				s 914				s 935
Riverside				s 847				s 916				s 937
Cos Cob				s 850				s 918				s 939
CP229				852	911			919	928	930		940
Greenwich, Conn.				s 854				s 921				s 942
Port Chester				s 858				s 925				s 946
Rye				s 901				s 928				s 949
CP223		852		903	917		908	929	934	937	927	950
Harrison		s 855		s 904			s 914				s 933	s 952
Mamaroneck		s 858					s 917				s 937	s 955
Larchmont		s 901					s 920				s 940	s 958
New Rochelle	s 839	s 904	s 900				s 924				s 944	s 1002
CP216	840	906	901	908	924	920	925	936	940	943	945	1004
Pelham												
Mount Vernon												
CP212												
CP112												
Fordham (E.190th St.)(D)												
Mott Haven Jct.												
125th Street (D)												
Grand Central Terminal ARRIVE	AM	0936 AM	AM	938 AM	0952 AM	AM	0955 AM	1004 AM	1010 AM	1013 AM	1015 AM	1035 AM
Turns from												
Turns to												
Connecting Trains												

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	BOS-NYP		SPG-WAS	BOS-WAS METRO			1/2 HR EXP	OP EXP SPLIT 1349	SPLIT 1349	BOS-WAS		BOS-WAS METRO			
TRAIN	161 AMTRAK	1445	143 AMTRAK	157 AMTRAK	1447	1247	94NH3	99ST3	1249	163 AMTRAK	1551	159 AMTRAK	1351	97NH5	1353
FREQUENCY															
FREQUENCY NOTES															
LEAVE	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM
Fair Street															
New Haven, Conn.															
	S		S				S 9.28			S 9.34	S 9.58	S		S10.28	
Milford							S 9.39				S10.09			S10.39	
CP261							9.42				10.12			10.42	
Stratford		-------					S 9.44				S10.14			S10.44	
CP257		9.13					9.47				10.17			10.47	
Bridgeport			S				S 9.49				S10.19			S10.49	
CP255		9.19					9.50				10.20			10.50	
Fairfield		S 9.25					S 9.56				S10.26			S10.56	
Southport		S 9.28					S 9.59				S10.29			S10.59	
Green's Farms		S 9.31					S10.01				S10.31			S11.01	
Westport		S 9.35					S10.04				S10.34			S11.04	
East Norwalk		S 9.38													
CP241		9.39			9.45		10.09				10.39			11.09	
South Norwalk		S 9.41			S 9.46		S10.10				S10.40			S11.10	
Rowayton					S 9.49										
Darien					S 9.52		S10.15				S10.45			S11.15	
Noroton Heights					S 9.55		S10.18				S10.48			S11.18	
CP234		9.48			9.58		10.21				10.51			11.21	
Stamford	S	S 9.50	S	S	S10.00		S10.23	S10.26		S	S10.53		S11.00	S11:23	S11.30
Old Greenwich					S10.02			S10.28					S11.02		S11.32
Riverside					S10.04			S10.30					S11.04		S11.34
Cos Cob					S10.06			S10.32					S11.06		S11.36
CP229		9.55			10.07		10.28	10.33			10.58		11.07	11.28	11.37
Greenwich, Conn.					S10.09			S10.35					S11.09		S11.39
Port Chester					S10.13			S10.39					S11.13		S11.43
Rye					S10.16			S10.42					S11.16		S11.46
CP223		10.01			10.17	10.20	10.34	10.43	10.47		11.04		11.17	11.34	11.47
Harrison					S10.19	S10.24		S10.45	S10.49				S11.19		S11.49
Mamaroneck						S10.27			S10.52				S11.22		S11.52
Larchmont						S10.30			S10.55				S11.25		S11.55
New Rochelle	S10.00					S10.34			S10.59				S11.29		S11.59
CP216	10.01	10.08	10.10	10.20	10.25	10.35	10.40	10.51	11.00	11.04	11.10	11.20	11.30	11.40	12.00
Pelham	-------		-------	-------		S10.38			S11.03	-------		-------	S11.33		S12.03
Mount Vernon						S10.41			S11.06				S11.36		S12.06
CP212		10.13			10.29	10.43	10.44	10.55	11.09		11.14		11.39	11.44	12.09
CP112		10.15			10.31	10.45	10.46	10.57	11.11		11.16		11.41	11.46	12.11
Fordham (E.190th St.)(D)						D10.50			D11.16				D11.45		
Mott Haven Jct.		10.24			10.40	10.55	10.54	11.06	11.21		11.24		11.50	11.54	12.19
125th Street (D)		D10.27			D10.44	D10.58	D10.57	D11.10	D11.24		D11.27		D11.53	D11.57	D12.22
Grand Central Terminal		S10.39			S10.55	S11.09	S11.08	S11.21	S11.35		S11.38		S12.04	S12.08	S12.33
ARRIVE		AM	AM	AM	AM	AM	AM	AM	AM		AM		PM	PM	PM
Turns from															
Turns to															
Connecting Trains		1545 1747 1447			1445 1247	1447					1751 1351 1951 3651		1551		

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		SPG-NHV	BOS-WAS		BOS-WAS METRO				BOS-WAS		BOS-WAS METRO
TRAIN	1855	465 AMTRAK	165 AMTRAK	1555	181 AMTRAK	1355	95NH7	1357	167 AMTRAK	1559 a	183 AMTRAK
FREQUENCY											
FREQUENCY NOTES											
LEAVE	AM	AM	AM	AM	AM	NOON	AM	PM	AM	AM	AM
Fair Street											
New Haven, Conn.		S -------	S	S10.58	S		S11.28		S	S11.58	S
Milford				S11.09			S11.39			S12.09	
CP261				11.12			11.42			12.12	
Stratford							S11.44			S12.14	
CP257				11.17			11.47			E12.17	
Bridgeport			S	S11.19			S11.49			S12.19	
CP255				11.20			11.50			12.20	
Fairfield				S11.26			S11.56			S12.26	
Southport							S11.59				
Green's Farms							S12.01				
Westport				S11.34			S12.04			S12.34	
East Norwalk										S12.37	
CP241	11.29			11.39			12.09			12.39	
South Norwalk	S11.30			S11.40			S12.10			S12.40	
Rowayton				S11.42							
Darien				S11.45			S12.15			S12.45	
Noroton Heights				S11.48			S12.18			S12.48	
CP234	11.40			11.51			12.21			E12.51	
Stamford	-------		S	S11.53	S	S12.00	S12.23	S12.30	S	S12.53	
Old Greenwich						S12.02		S12.32			
Riverside						S12.04		S12.34			
Cos Cob						S12.06		S12.36			
CP229				11.58		12.07	12.28	12.37		12.58	
Greenwich, Conn.						S12.09		S12.39			
Port Chester						S12.13		S12.43			
Rye						S12.16		S12.46			
CP223				12.04		12.17	12.34	12.47		1.04	
Harrison						S12.19		S12.49			
Mamaroneck						S12.22		S12.52			
Larchmont						S12.25		S12.55			
New Rochelle			S12.00			S12.29		S12.59			
CP216			12.01	12.10	12.20	12.30	12.40	1.00	1.00	1.10	1.20
Pelham			-------		-------	S12.33		S 1.03	-------		-------
Mount Vernon						S12.36		S 1.06			
CP212				12.14		12.39	12.44	1.09		1.14	
CP112				12.16		12.41	12.46	1.11		1.16	
Fordham (E.190th St.)(D)						D12.45					
Mott Haven Jct.				12.24		12.50	12.54	1.19		1.24	
125th Street (D)				D12.27		D12.53	D12.57	D 1.22		D 1.27	
Grand Central Terminal				S12.38		S 1.04	S 1.08	S 1.33		S 1.38	
ARRIVE	AM	AM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Turns from											
Turns to	1826										
Connecting Trains	1555			1755 1355		1555					

		DBURY THRU	1/2 HR EXP		SPG-WAS		BOS-WAS METRO		1/2 HR EXP		BOS-WAS	
TRAIN	1359	94081	04NH9	1361	467 AMTRAK	1563	185 AMTRAK	1363	04NH11	1365	169 AMTRAK	1567
FREQUENCY												
FREQUENCY NOTES												
LEAVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Fair Street												
New Haven, Conn.			S12.28		S	S12.58			S 1.28		S	S 1.58
Milford			S12.39			S 1.09			S 1.39			S 2.09
CP261			12.42			1.12			1.42			2.12
Stratford			S12.44						S 1.44			S 2.14
CP257			E12.47			E 1.17			E 1.47			E 2.17
Bridgeport			S12.49		S	S 1.19			S 1.49			S 2.19
CP255			12.50			1.20			1.50			2.20
Fairfield			S12.56			S 1.26			S 1.56			S 2.26
Southport												S 2.29
Green's Farms						S 1.31						
Westport			S 1.04			S 1.34			S 2.04			S 2.34
East Norwalk		-------	S 1.07						S 2.07			
CP241		1.00	1.09			1.39			2.09			2.39
South Norwalk		S 1.01	S 1.10			S 1.40			S 2.10			S 2.40
Rowayton												
Darien			S 1.15			S 1.45			S 2.15			S 2.45
Noroton Heights			S 1.18			S 1.48			S 2.18			S 2.48
CP234		1.10	1.21			E 1.51			2.21			E 2.51
Stamford	S 1.00	S 1.12	S 1.23	S 1.30	S	S 1.53	S	S 2.00	S 2.23	S 2.30	S	S 2.53
Old Greenwich	S 1.02			S 1.32				S 2.02		S 2.32		
Riverside	S 1.04			S 1.34				S 2.04		S 2.34		
Cos Cob	S 1.06			S 1.36				S 2.06		S 2.36		
CP229	1.07	1.16	1.28	1.37		1.58		2.07	2.28	2.37		2.58
Greenwich, Conn.	S 1.09			S 1.39				S 2.09		S 2.39		
Port Chester	S 1.13			S 1.43				S 2.13		S 2.43		
Rye	S 1.16			S 1.46				S 2.16		S 2.46		
CP223	1.17	1.22	1.34	1.47		2.04		2.17	2.34	2.47		3.04
Harrison	S 1.19			S 1.49				S 2.19		S 2.49		
Mamaroneck	S 1.22			S 1.52				S 2.22		S 2.52		
Larchmont	S 1.25			S 1.55				S 2.25		S 2.55		
New Rochelle	S 1.29			S 1.59	S 2.00			S 2.29		S 2.59	S 3.00	
CP216	1.30	1.29	1.40	2.00	2.01	2.10	2.20	2.30	2.40	3.00	3.01	3.10
Pelham	S 1.33			S 2.03	-------		-------	S 2.33		S 3.03	-------	
Mount Vernon	S 1.36			S 2.06				S 2.36		S 3.06		
CP212	1.39	1.33	1.44	2.09		2.14		2.39	2.44	3.09		3.14
CP112	1.41	1.35	1.46	2.11		2.16		2.41	2.46	3.11		3.16
Fordham (E.190th St.)(D)	D 1.45							D 2.45				
Mott Haven Jct.	1.50	1.43	1.54	2.19		2.24		2.50	2.54	3.19		3.24
125th Street (D)	D 1.53	D 1.46	D 1.57	D 2.22		D 2.27		D 2.53	D 2.57	D 3.22		0 3.27
Grand Central Terminal	S 2.04	1.57	S 2.08	S 2.33		S 2.38		S 3.04	S 3.08	S 3.33		S 3.38
ARRIVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Turns from												
Turns to												
Connecting Trains												

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	BOS-WAS METRO		1/2 HR EXP	20" FREQ.		SPG-WAS	10"L 20" FREQ.			BOS-WAS METRO	ST-HA EXP		2"L 20" FREQ. (1273)	1/2 HR EXP	BOS-WAS	10"L 20"FRQ EXT TO NC
TRAIN	187 AMTRAK	1367	99NH13	04ST5	1081 DH	471 AMTRAK	1369	1083 DH	1571	189 AMTRAK	04ST7	1271	94ST9	99NH15	171 AMTRAK	1773
FREQUENCY																
FREQUENCY NOTES																
LEAVE	PM	PM	PM	PM	PM		PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Fair Street																
New Haven, Conn.			S 2.28		2.50	S			S 2.58					S 3.28	S	
Milford			S 2.39						S 3.09					S 3.39		
CP261			2.42		3.05				3.12					3.42		
Stratford			S 2.44						S 3.14					S 3.44		
CP257			E 2.47		3.10				3.17					E 3.47		
Bridgeport			S 2.49			S			S 3.19					S 3.49		
CP255			2.50		3.14				3.20					3.50		
Fairfield			S 2.56						S 3.26					S 3.56		
Southport																
Green's Farms																
Westport			S 3.04						S 3.34					S 4.04		
East Norwalk			S 3.07						S 3.37					S 4.07		
CP241			3.09		3.28				3.39					4.09		
South Norwalk			S 3.10						S 3.40					S 4.10		
Rowayton									S 3.42							
Darien			S 3.15						S 3.45					S 4.15		
Noroton Heights			S 3.18						S 3.48					S 4.18		
CP234			3.21		3.36			3.55	3.51					4.21		
Stamford		S 3.00	S 3.23	S 3.20		S	S 3.40		S 3.53	S	S 4.00		S 4.20	S 4.23	S	S 4.40
Old Greenwich		S 3.02		S 3.22			S 3.42				S 4.02		S 4.22			S 4.42
Riverside		S 3.04		S 3.24			S 3.44				S 4.04		S 4.24			S 4.44
Cos Cob		S 3.06		S 3.26			S 3.46				S 4.06		S 4.26			S 4.46
CP229		3.07	3.28	3.27	3.40		3.47	4.01	3.58		4.07		4.27	4.28		4.47
Greenwich, Conn.		S 3.09		S 3.29			S 3.49				S 4.09		S 4.29			S 4.49
Port Chester		S 3.13		S 3.33			S 3.53				S 4.13		S 4.33			S 4.53
Rye		S 3.16		S 3.36			S 3.56				S 4.16		S 4.36			S 4.56
CP223		3.17	3.34	3.37	3.46		3.57	4.07	4.04		4.17		4.37	4.34		4.57
Harrison		S 3.19		S 3.39			S 3.59				S 4.19	S 4.24	S 4.39			S 4.59
Mamaroneck		S 3.22		S 3.42			S 4.02					S 4.27	S 4.42			S 5.02
Larchmont		S 3.25		S 3.45			S 4.05					S 4.30	S 4.45			S 5.05
New Rochelle	S 3.15	S 3.29		S 3.49		S 4.00	S 4.09					S 4.34	S 4.49		S 5.00	S 5.09
CP216	3.16	3.30	3.40	3.50	3.53	4.01	4.10	4.14	4.10	4.20	4.25	4.35	4.50	4.40	5.01	5.10
Pelham	-------	S 3.33		S 3.53		------	S 4.13			-------		S 4.38	S 4.53		-------	S 5.13
Mount Vernon		S 3.36		S 3.56			S 4.16					S 4.41	S 4.56			S 5.16
CP212		3.39	3.44	3.59	3.57		4.19	4.18	4.14		4.29	4.44	4.59	4.44		5.19
CP112		3.41	3.46	4.01	3.59		4.21	4.20	4.16		4.31	4.46	5.01	4.46		5.21
Fordham (E.190th St.)(D)		D 3.45										D 4.50	D 5.05			D 5.25
Mott Haven Jct.		3.50	3.54	4.09	4.07		4.29	4.28	4.24		4.40	4.55	5.09	4.54		5.29
125th Street (D)		D 3.53	D 3.57	D 4.12			D 4.32		D 4.27		D 4.43	D 4.58	D 5.12	D 4.57		D 5.32
Grand Central Terminal		S 4.04	S 4.08	S 4.23	4.25		S 4.33	4.44	S 4.38		S 4.54	S 5.11	S 5.25	S 5.08		S 5.45
ARRIVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Turns from																
Turns to																
Connecting Trains																

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TRAIN	1575	BOS-WAS METRO 191 AMTRAK	1275	5"E 1375	1/2 HR EXP 94NH17	1047 DN	1043 DN EX FR	1143 DN FR ON	1049 DN	20"FRQ 98ST11	99DB1
FREQUENCY											
FREQUENCY NOTES											
LEAVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Fair Street											
New Haven, Conn.	s3.55	s 4.36 1			s 4.28 3						
Milford	S4.06				s 4.39						
CP261	4.09	1			4.42 3						
Stratford	S4.11				s 4.44						
CP257	4.14	1			E 4.47 3						
Bridgeport	S4.16				s 4.49						
CP255	4.17	1			4.50 3						
Fairfield	S4.23				s 4.56						
Southport	S4.26										
Green's Farms	S4.28										
Westport	S4.32				s 5.04						
East Norwalk	S4.35				s 5.07						
CP241	4.37	1/3			5.09 3		5.12 3	5.12 3			5.13 3
South Norwalk	S4.39				s 5.10						s 5.15
Rowayton	S4.42										s 5.19
Darien	S4.46										s 5.24
Noroton Heights	S4.49										s 5.29
CP234	E4.53	3			5.17 3		5.20 3	5.20 3			5.33 3
Stamford	S4.55			s 5.00 3	s 5.19		------			s 5.20 3	s 5.35
Old Greenwich				s 5.02						s 5.22	
Riverside				s 5.04						s 5.24	
Cos Cob				s 5.06						s 5.26	
CP229	5.00	3		5.07 3	5.24 3			5.28 3		5.27 3	5.39 3
Greenwich, Conn.	s5.02			s 5.09						s 5.29	
Port Chester				s 5.13						s 5.33	
Rye				s 5.16						s 5.36	
CP223	5.09	3/1	5.12 3	5.17 3	5.30 3	5.28 3		5.34 3	5.50 3	5.37 3	5.45 3
Harrison			s 5.15	s 5.19						s 5.39	
Mamaroneck			s 5.18	s 5.22						s 5.42	
Larchmont			s 5.21	s 5.25						s 5.45	
New Rochelle			s 5.25	s 5.29						s 5.49	
CP216	5.15	5.20 1	5.26 3	5.30 3	5.36 3	5.37 3		5.45 3/1	5.57 3	5.50 3	5.52 3
Pelham		--------	s 5.29	s 5.33						s 5.53	
Mount Vernon			s 5.32	s 5.36						s 5.56	
CP212	5.19		5.35	5.39	5.40	5.47		5.49	6.01	5.59	5.56
CP112	5.21		5.37	5.41	5.42	5.49		5.51	6.03	6.01	5.58
Fordham (E.190th St.)(D)			D 5.41	D 5.45						D 6.05	
Mott Haven Jct.	5.29		5.46	5.49	5.50	5.57		5.59	6.12	6.09	6.06
125th Street (D)	D5.32		D 5.49	D 5.52	D 5.53					D 6.12	D 6.09
Grand Central Terminal	S5.46		S 6.02	S 6.03	S 6.04	6.13		6.15	6.27	S 6.23	S 6.20
ARRIVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Turns from											
Turns to											
Connecting Trains											

TRAIN	SPG-NHV 473 AMTRAK	2"E BOS-WAS 173 AMTRAK	5"L EXT TO NC 1377	1057 DN	1055 DN	1579	BOS-WAS METRO 193 AMTRAK	1179 DN FRI	1/2 HR EXP 97NH19	1379	1061 DN	1069 DN
FREQUENCY												
FREQUENCY NOTES												
LEAVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Fair Street												
New Haven, Conn.	S -------	s 5.06 1				s 4.58 3	s 5.34 1	5.10 3	s 5.28 3			
Milford						s 5.09			s 5.39			
CP261		1				5.12 3		5.25 3	5.42 3			
Stratford						s 5.14			s 5.44			
CP257		1/3				5.17 3		5.30 3	E 5.47 3			
Bridgeport		s 5.24 3				s 5.19			s 5.49			
CP255		3/1				5.20 3		5.36 3	5.50 3			
Fairfield						s 5.26			s 5.56			
Southport												
Green's Farms						s 5.31						
Westport						s 5.35			s 6.04			
East Norwalk						s 5.38			s 6.07			
CP241		1				5.40 3		5.47 3	6.09 3			
South Norwalk						s 5.42			s 6.10			
Rowayton												
Darien						s 5.49			s 6.15			
Noroton Heights						s 5.52			s 6.18			
CP234		1/3				5.56	1/3	5.57 3	6.21 3			
Stamford		s 5.44 3/1	S5.40 3			s 5.58 3	s 6.07 3/1	6.00	s 6.23	s 6.05 3		
Old Greenwich			S5.42					------		s 6.07		
Riverside			S5.44							s 6.09		
Cos Cob			S5.46							s 6.11		
CP229		1	5.47 3			6.03 3			6.28 3	6.12 3		
Greenwich, Conn.			S5.49			s 6.05				s 6.14		
Port Chester			S5.53							s 6.18		
Rye			S5.56							s 6.21 3		
CP223		1	5.57 3		6.08 3	6.11 3			6.34 3	6.22 3	6.27 1	
Harrison			S5.59							s 6.24		
Mamaroneck			S6.02							s 6.27		
Larchmont			S6.05							s 6.30		
New Rochelle		s 5.58	S6.09							s 6.34		
CP216		5.59 1	6.10 3	6.13 3	6.15 3	6.18 3	6.20 1		6.40 3	6.35 3	6.34 1	6.48 1
Pelham		-------	S6.13				-------			s 6.38		
Mount Vernon			S6.16							s 6.41		
CP212			6.19 3	6.17	6.19	6.22			6.44	6.44	6.38	6.52
CP112			6.21	6.19	6.21	6.24			6.46	6.46	6.40	6.53
Fordham (E.190th St.)(D)			D6.25							D 6.50		
Mott Haven Jct.			6.29	6.27	6.29	6.32			6.54	6.55	6.48	7.01
125th Street (D)			D6.32			D 6.35			D 6.57	D 6.58		
Grand Central Terminal			S6.43	6.41	6.43	S 6.46			S 7.08	S 7.09	7.02	7.15
ARRIVE			PM	PM	PM	PM		PM	PM	PM	PM	PM
Turns from												
Turns to												
Connecting Trains												

EFF. Rev. 8-12-93 WESTWARD	4"L		5"L BOS-WAS			BOS-WAS METRO	4"L			2"E REV PK 1/2 HR EXP		SPG-WAS			BOS-WAS METRO		1/2 HR LOCAL LATE NIGHT	BOS-WAS		BOS-WAS METRO		
TRAIN	1087 DH	1067 DH	175 AMTRAK	1381	1583	195 AMTRAK	1073 DH	1383	1065 DH	04NH21	1385	475 AMTRAK	1587	1079 DH	197 AMTRAK	1387	04ST13	177 AMTRAK	1591	199 AMTRAK	1391	1181 DH
FREQUENCY																						
FREQUENCY NOTES																						
LEAVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Fair Street																				8.34 1		
New Haven, Conn.	5.39 3		S 6.18 1		S 5.58 3	S 6.34 1				S 6.26 3		S 7.09 3	S6.58 3		S 7.35 1			S 8.09 3	S7.58 3	1		
Milford					S 6.09					S 6.37			S7.09						S8.09			
CP261	5.54 3		1		6.12 3	1				6.40 3		3	7.12 3		1			3	8.12 3	1		
Stratford					S 6.14					S 6.42									S8.14			
CP257	6.04 3		1		6.17 3	1				E 6.45 3		3	7.17 3		1			3	8.17 3	1		
Bridgeport	------				S 6.19					S 6.47		S 7.28 3	S7.19					S 8.28	S8.19			
CP255			1		6.20 3	1				6.48 3		3/1	7.20 3		1			3/1	8.20 3	1		
Fairfield					S 6.26					S 6.54			S7.26						S8.26			
Southport					S 6.29																	
Green's Farms																						
Westport					S 6.35					S 7.02			S7.34						S8.34			
East Norwalk										S 7.05									S8.37			------
CP241			1		6.40 3	1			7.05 1	7.07 3		1	7.39 3		1			1	8.39 3	1		9.00
South Norwalk					S 6.42					S 7.08			S7.40						S8.40			
Rowayton													S7.42									
Darien					S 6.49					S 7.13			S7.45						S8.45			
Noroton Heights					S 6.52					S 7.16			S7.48						S8.48			
CP234			1/3		6.56 3	1/3			7.15 1	7.19 3		1/3	7.51 3		1			1/3	E8.51 3	1/3		9.10
Stamford			S 6.51 3/1	S 6.35 3	S 6.58	S 7.08 3/1		S 7.05 3	------	S 7.21 3/1	S 7.30 3	S 7.47 3/1	S7.53			S 8.00 3	S 8.30 3	S 8.47 3/1	S8.53 3/1	S 9.07 3/1	S 9.00 3	------
Old Greenwich				S 6.37				S 7.07			S 7.32					S 8.02	S 8.32				S 9.02	
Riverside				S 6.39				S 7.09			S 7.34					S 8.04	S 8.34				S 9.04	
Cos Cob				S 6.41				S 7.11			S 7.36					S 8.06	S 8.36				S 9.06	
CP229			1	6.42 3	7.03 3	1		7.12 3		7.26 1	7.37 3	1	7.58 3		1	8.07 3	8.37 3	1	8.58 1	1	9.07 3	
Greenwich, Conn.				S 6.44				S 7.14			S 7.39					S 8.09	S 8.39				S 9.09	
Port Chester				S 6.48				S 7.18			S 7.43					S 8.13	S 8.43				S 9.13	
Rye				S 6.51				S 7.21			S 7.46					S 8.16	S 8.46				S 9.16	
CP223		6.50 3	1	6.52 1	7.09 3	1	7.18 1	7.22 3		7.32 1	7.47 3	1	8.04 3	8.06 1	1	8.17 3	8.47 3	1	9.04 1	1	9.17 3	
Harrison				S 6.54				S 7.24			S 7.49					S 8.19	S 8.49				S 9.19	
Mamaroneck				S 6.57				S 7.27			S 7.52					S 8.22	S 8.52				S 9.22	
Larchmont				S 7.00				S 7.30			S 7.55					S 8.25	S 8.55				S 9.25	
New Rochelle			S 7.05	S 7.04				S 7.34			S 7.59	S 8.00				S 8.29	S 8.59	S 9.00			S 9.29	
CP216		6.57 3	7.06 1	7.05 3	7.16 3	7.20 1	7.25 1	7.35 3		7.38 1	8.00 3	8.01 1	8.10 3	8.13 1	8.20 1	8.30 3	9.00 3	9.01 1	9.10 1	9.20 1	9.30 3	
Pelham			-------	S 7.08		-------		S 7.38			S 8.03	-------			-------	S 8.33	S 9.03	-------		-------	S 9.33	
Mount Vernon				S 7.11				S 7.41			S 8.06					S 8.36	S 9.06				S 9.36	
CP212		7.01		7.14	7.20		7.29	7.44		7.42	8.09		8.14	8.17		8.39	9.09		9.14		9.39	
CP112		7.03		7.16	7.22		7.31	7.46		7.44	8.11		8.16	8.19		8.41	9.11		9.16		9.41	
Fordham (E.190th St.)(D)								D 7.50								D 8.45					D 9.45	
Mott Haven Jct.		7.12		7.24	7.30		7.39	7.55		7.52	8.19		8.24	8.27		8.50	9.19		9.24		9.50	
125th Street (D)				D 7.27	D 7.33			D 7.58		D 7.55	D 8.22		D8.27			D 8.53	D 9.22		D9.27		D 9.53	
Grand Central Terminal		7.26		S 7.38	S 7.44		7.52	S 8.09		S 8.06	S 8.33		S8.38	8.44		S 9.04	S 9.33		S9.38		S10.04	
ARRIVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Turns from																						
Turns to																						
Connecting Trains																						

EFF.
Rev. 8-12-93
WESTWARD

TRAIN	1593	477 AMTRAK	201 AMTRAK	1089 DH	1393	179 AMTRAK	1595	1495	479 AMTRAK	1597
		SPG-PHL	BOS-NYP METRO			BOS-NYP			SPG-NYP	
FREQUENCY										
FREQUENCY NOTES										
LEAVE	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Fair Street										
New Haven, Conn.	S 8.58	S 9.09	S 9.34	9.05		S10.09	S 9.58		S11.09	S11.23
Milford	S 9.09						S10.09			S11.34
CP261	9.12			9.19			10.12			11.37
Stratford							S10.14			S11.39
CP257	E 9.17			9.25			10.17			11.42
Bridgeport	S 9.19	S 9.28		------		S10.28	S10.19		S11.28	S11.44
CP255	9.20						10.20			11.45
Fairfield	S 9.26						S10.26			S11.51
Southport							S10.29			
Green's Farms	S 9.31									S11.56
Westport	S 9.34						S10.34			S11.59
East Norwalk										
CP241	9.39						10.39	10.58		12.04
South Norwalk	S 9.40						S10.40	S11.01		S12.05
Rowayton										S12.07
Darien	S 9.45						S10.45			S12.10
Noroton Heights	S 9.48						S10.48			S12.13
CP234	E 9.51						E10.51	11.08		12.16
Stamford	S 9.53	S 9.47	S10.07		S10.00	S10.47	S10.53	S11.10	S11.47	S12.18
Old Greenwich					S10.02			S11.12		
Riverside					S10.04			S11.14		
Cos Cob					S10.06			S11.16		
CP229	9.58				10.07		10.58	11.17		12.23
Greenwich, Conn.					S10.09			S11.19		
Port Chester					S10.13			S11.23		
Rye					S10.16			S11.26		
CP223	10.04				10.17		11.04	11.27		12.29
Harrison					S10.19			S11.29		
Mamaroneck					S10.22			S11.32		
Larchmont					S10.25			S11.35		
New Rochelle		S10.00			S10.29	S11.00		S11.39	S12.00	
CP216	10.10	10.01	10.20		10.30	11.01	11.10	11.40	12.01	12.35
Pelham		-------	-------		S10.33	-------		S11.43	-------	
Mount Vernon					S10.36			S11.46		
CP212	10.14				10.39		11.14	11.49		12.39
CP112	10.16				10.41		11.16	11.51		12.41
Fordham (E.190th St.)(O)					D10.45			D11.55		
Mott Haven Jct.	10.24				10.50		11.24	12.00		12.49
125th Street (O)	D10.27				D10.53		D11.27	D12.03		D12.52
Grand Central Terminal	S10.38				S11.04		S11.38	S12.14		S 1.03
ARRIVE	PM	PM	PM	PM	PM	PM	PM	AM	AM	AM
Turns from										
Turns to										
Connecting Trains										

The Northeast Corridor Transportation Plan
New York City to Boston
Volume 2

Appendix I
INTERLOCKING AND CURVE DOCUMENTATION

Appendix I
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Tables

Appendix I
INTERLOCKING AND CURVE DOCUMENTATION

INTRODUCTION

Recent simulations and analyses of future intercity, commuter, and freight operating requirements have concluded that significant track changes are required to achieve trip time goals, improve the reliability of intercity and commuter operations, increase capacity, and provide improved operating flexibility. These needs would be satisfied by reconfiguring major terminals and interlockings, removing existing crossovers and turnouts, and installing new (mostly higher speed) turnouts and crossovers to implement desired alignment and configuration changes. Revised interlocking layouts also will be required to optimize train operations entering and leaving the additional tracks, and passing sidings that also have been recommended. The number of interlockings that will be modified and the new interlockings that are recommended are significant. Details of recommended programs are contained in Appendix C. A geographical summary of the improvements is contained in Appendix E, and the proposed track configurations are illustrated in Appendix F. The interlocking changes that have been recommended are summarized in subsection B.

Track curvature imposes the most severe constraint on trip time. Consequently, realigning or changing the physical characteristics of existing curves is the third primary means of reducing trip times included in this program. Several types of fixed-plant improvements can minimize the constraints to speed associated with curves:

- increasing superelevation to the maximum allowable for a particular track alignment;
- changing horizontal and vertical alignment, either within the existing right-of-way, or by acquiring land outside the existing right-of-way;
- increasing the amount of unbalanced superelevation used to calculate speeds through curves to minimize track shifts; and
- modifying spirals (the length of track that provides a smooth transition from level, tangent track to curved, superelevated track) by eliminating superelevation runoff onto the adjacent tangent sections.

The rationale for the realignments recommended in this program is summarized in subsection C. Details of the recommended curve realignment program are contained in Appendix C. A geographical summary of the improvements is contained in Appendix E.

INTERLOCKINGS

In addition to the *Reconfigure Existing Interlockings* project, existing interlockings will be reconfigured as the result of numerous other projects. The existing interlockings to be reconfigured and the project in which each interlocking is included are listed in Table I-1. Recommended new interlockings also are listed. The table is organized geographically from New York City to Boston.

The cost estimates for the reconfigured and new interlockings are summarized in Table I-2. Certain interlockings, which are included in Terminal reconfiguration projects are not listed, primarily because it is not practical to breakout the cost from the data available.

Table I-1

LISTING OF RECONFIGURED INTERLOCKINGS BY PROJECT

Interlocking	Project	Additional Requirement
KN	Platform 11 and 5X Switch	
A Tower	Platform 11 and 5X Switch	
F Tower	Reconfigure Harold Interlocking	
Harold	Reconfigure Harold Interlocking	
Market	Install New Interlocking	
South Shell	Reconfigure Shell Interlocking	
CP 216 (Shell)	Reconfigure Shell Interlocking	
CP 217 (E. Shell)	Reconfigure Shell Interlocking	
CP 223 (Pike)	Reconfigure Shell Interlocking	
Selleck Street	Stamford Station Center Island Platforms	
CP 233 (W. Stam)	Stamford Station Center Island Platforms	
CP 234 (Stam)	Stamford Station Center Island Platforms	
CP 241 (Walk)	Reconfigure Existing Interlocking	
CP 246 (Saga)	Walk Bridge/Saga Bridge Replacement	New Interlocking
CP 250 (Fairfield)	Install New Interlocking	Operating Flexibility
CP 257 (Central)	Reconfigure Existing Interlocking	Operating Flexibility
CP 261 (Devon)	Reinstall Devon to New Haven Fourth Track	
CP 266 (Woodmont)	Reinstall Devon to New Haven Fourth Track	Remove
New Haven	Reconfigure New Haven Terminal Area	
Fair Street	Reconfigure New Haven Terminal Area	
Mill River	Reconfigure New Haven Terminal Area	
Branford	Reconfigure Existing Interlocking	
Guilford	Install High Speed Universal Interlockings	Sidings also
Clinton	Construct SLE Passing Sidings	Siding Track
Brook	Reconfigure Existing Interlocking	Sidings also
Old Saybrook	Install High Speed Universal Interlockings	Sidings also
Point	Install New Interlocking	
Shaw's Cove	Reconfigure Existing Interlocking	

Table I-1

LISTING OF RECONFIGURED INTERLOCKINGS BY PROJECT

Interlocking	Project	Additional Requirement
Groton	Reconfigure Existing Interlocking	
Lord	Install New Interlocking	
High Street	Install High Speed Universal Interlockings	
Kingston	Reconfigure Kingston Station	
Davisville	Install High Speed Universal Interlockings	
Cranston	Construct Kingston to Providence Passing Siding	P&W Clearance Improvements
Orms	Reconfigure Existing Interlocking	Providence Layover Facility
Lawn	Reconfigure Existing Interlocking	
Hebronville	Reconfigure Existing Interlocking	Siding also
Thatcher	Reconfigure Existing Interlocking	
Attleboro	Reconfigure Existing Interlocking	
Holden	Reconfigure Existing Interlocking	Siding also
Mansfield	Reconfigure Existing Interlocking	
Sharon	Construct Providence to Boston Passing Sidings	
Canton Jct.	Reconfigure Existing Interlocking	
Transfer	Reconfigure Existing Interlocking	Siding also
Read/Hyde	Reconfigure Existing Interlocking	Siding also
Forest	Reconfigure Existing Interlocking	Siding also
Plains	Reconfigure Existing Interlocking	Siding also
Back Bay	South Station Capacity Improvements	
Cove	South Station Capacity Improvements	
Tower 1	South Station Capacity Improvements	

Table I-2

MILE POST	LOCATION	ELECTRIFICATION COST	SIGNAL COST	MISC. COST	TRACK WORK COST	LOCATION TOTAL
RECONFIGURE PROJECTS						
MBTA: ST LINE - BOSTON						
224.5	PLAINS, MASS	$0	$0	$84,088	$840,877	$924,965
223.4	FOREST, MASS	$310,000	$827,000	$65,858	$658,581	$1,861,439
220.0	READ/HYDE, MASS	$0	$0	$346,752	$3,467,519	$3,814,271
217 - 220	READVILLE TRANSFER, MASS	$0	$0	$13,163	$131,630	$144,793
214.2	CANTON JUNCTION, MASS	$645,200	$1,301,600	$91,523	$915,233	$2,953,556
204.0	MANSFIELD, MASS	$0	$0	$105,907	$1,059,066	$1,164,973
198.6	HOLDEN, MASS	$340,000	$659,000	$84,221	$842,206	$1,925,427
195.4	ATTLEBORO, MASS	$201,800	$605,000	$41,328	$413,276	$1,261,404
196.0	THATCHER, MASS	$0	$0	$0	$0	$0
193.6	HEBRONVILLE, MASS	$516,000	$717,000	$78,883	$788,825	$2,100,708
MBTA: ST LINE - BOSTON SUBTOTAL		***$2,013,000***	***$4,109,600***	***$911,721***	***$9,117,213***	***$16,151,535***
189.0	LAWN, RHODE ISLAND	$0	$0	$28,031	$280,306	$308,337
185.0	ATWELLS, RHODE ISLAND	$0	$0	$0	$0	$0
181.0	CRANSTON, R I - IN SIDING	$0	$0	$0	$0	$0
158.2	KINGSTON , RI. - IN HIGH SPEED I/L	$0	$0	$0	$0	$0
132.0	MYSTIC RIVER, CONN	$0	$0	$0	$0	$0
129.2	PALMERS COVE, CONN	$0	$0	$0	$0	$0
124.6	GROTON, CONN	$0	$0	$15,826	$158,255	$174,081
123.8	SHAWS COVE, CONN	$0	$0	$35,956	$359,563	$395,519
103.0	BROOK, CONN	$0	$0	$29,856	$298,560	$328,416
81 - 82	BRANFORD, CONN	$0	$0	$33,415	$334,154	$367,569
75.3	SHORE LINE JUNCTION, CONN	$0	$0	$0	$0	$0
SHL NH-PROV SUBTOTAL		$0	$0	$143,084	$1,430,838	$1,573,922
NHL CONNECTICUT						
57.0	CP 257 - CENTRAL, CONN	$276,000	$1,047,000	$35,956	$359,563	$1,718,519
42.0	CP 241 - WALK, CONN	$276,000	$1,047,000	$35,956	$359,563	$1,718,519
NHL CONNECTICUT SUBTOTAL		***$552,000***	***$2,094,000***	***$71,913***	***$719,126***	***$3,437,039***
	TOTAL ELECTRIFICATION COST	$2,565,000				
	TOTAL SIGNAL COST		$6,203,600			
	TOTAL MISC. COST			$1,126,718		
	TOTAL TRACK WORK COST				$11,267,177	
	GRAND TOTAL					***$21,162,495***

NOTES

1 Unit costs include material, labor, and equipment (fully loaded and marked up).
2 Unit costs do not include flagging protection or overtime costs.
3 Unit costs do not include markups for design, design management, or construction management.
4 Unit costs are stated in second quarter 1993 dollars.

Table I-2 (Continued)

NORTHEAST CORRIDOR HIGH SPEED RAIL PASSENGER SERVICE IMPROVEMENT PROGRAM
UNIT COST LIBRARY FOR TRACKWORK, CATENARY, COMMUNICATIONS, AND SIGNAL WORK (MID 1993 DOLLARS)

MILE POST	LOCATION	ELECTRIFICATION COST	SIGNAL COST	MISC. COST	TRACK WORK COST	LOCATION TOTAL
NEW PROJECTS						
50.0	**CP 250 FAIRFIELD, CONN**	$552,000	$1,169,000	$244,013	$719,126	$2,684,139
135.0	**LORD, RHODE ISLAND**	$520,000	$769,000	$200,813	$719,126	$2,208,939
115.0	**POINT, CONN**	$520,000	$769,000	$200,813	$719,126	$2,208,939
10.0	**MARKET, NY**	$520,000	$769,000	$200,813	$719,126	$2,208,939
	TOTAL ELECTRIFICATION COST	**$2,112,000**				
	TOTAL SIGNAL COST		**$3,476,000**			
	TOTAL MISC. COST			**$846,450**		
	TOTAL TRACK WORK COST				**$2,876,504**	
	GRAND TOTAL					***$9,310,954***

NOTES

1 **Unit costs include material, labor, and equipment (fully loaded and marked up).**
2 **Unit costs do not include flagging protection or overtime costs.**
3 Unit costs do not include markups for design, design management, or construction management.
4 **Unit costs are stated in second quarter 1993 dollars.**

CURVES

The results of a speed analysis of curves, and the civil impacts associated with realigning them for the Hellgate and New Haven Line (NHL) segments of the Northeast Corridor (between Harold and New Haven) was performed by De Leuw, Cather & Co. The results of those analyses are summarized in the following subsection. Amtrak continues to analyze the curve realignment requirements between New Haven and Boston. The initial results of their work are summarized at the end of this subsection.

CURVE ANALYSIS NEW YORK CITY TO NEW HAVEN

EXECUTIVE SUMMARY

The speed analysis assessed the extent of realignments to existing curves and the associated civil impacts required to meet the proposed speed goals. Eighty-one curves in the Hellgate and NHL segments were studied.

The speed analysis considered two types of realignments:

a. Soft Realignments.

Soft realignments are realignments that will not have any cost impacts, and are achieved by either increasing the unbalanced superelevation up to a maximum of 5 inches to meet the desired speeds, or by increasing the actual superelevation, and maintaining the ratio of existing spiral length to the actual super elevation greater than or equal to 62 for speeds up to 90 miles per hour, and greater than or equal to 83 for speeds above 90 miles per hour.

b. Hard Realignments.

Hard realignments are realignments that will have cost impacts and are achieved by introducing changes to actual superelevation, degree of curvature, and spiral lengths. Existing curves for which soft realignments will not enable desired goal speeds to be achieved were analyzed to determine the hard realignment that would be required. Changes to the actual superelevation were made in accordance with the Amtrak MW-1000 or Metro-North MW-4 for minimum required spirals, as applicable. Unbalanced superelevation was limited to 5 inches and was computed using the following equation:

$$E_u = 0.0007 \times D_c \times V^2 - Ea$$

Where, E_u = Unbalance superelevation in inches
Ea = Actual superelevation in inches
D_c = Degree of Curve

V = Speed in Miles per hour

Also, lateral acceleration parallel to the floor board was limited to 0.15 g in the body of the curve and the maximum jerk rate through spirals was limited to 0.04 g per second, in accordance with assumed comfort criteria.

Three sources of data were used in the speed analysis of curves:

- system curve data (stringline data)-NHL segment;
- track geometry car charts-all tracks; and
- comprehensive curve analysis.

To facilitate the analysis a spread sheet was used to estimate the amount of shifts required. Certain compound curves were tested by running a COGO analysis. Existing and proposed curve data was used to compute shifts. Eighty-one curves were analyzed in the Hellgate and NHL segments. Based upon the results of this analysis 16 existing curves will meet the proposed speeds, within the 5-inch unbalanced limits. Fifteen existing curves will require adjustments to the actual superelevation to meet the proposed speeds. Curves meeting the speed goals and those requiring adjustments of actual super elevations are listed below:

A. Sixteen (16) curves that will meet the speed goals and require no adjustments.

Curve No.		Maximum*	Proposed Speed
Amtrak	MN	Speed (MPH)	(MPH)
238		58	60
237	-	60	60
236	-	68	60
233	-	73	65
231	-	68	60
205	26A	77	75
200	29A	84	85
192	36	82	80
188	39	90	85
187	40	83	80
186	41A	54	55
185	41B	77	75
175	52	80	75
166	60A	89	90
162	62B	89	90
158	66	105	100

* Calculated using the previously listed formula.

B. Sixteen curves will meet the speed goals by adjusting E_a without changing spirals.

Curve No. Amtrak	MN	Maximum Speed (MPH)	Proposed Speed (MPH)	E_a Exist (inches)	E_a Proposed (inches)
223	-	79	80	3-3/8	4-0
217	-	93	80	1-2/8	1-6/8
212	18	105	100	0-6/8	1-6/8
208	23	70	70	4-1/8 / 2-9/8	5-2/8 / tree-0
204	26B	84	85	4-1/8	4-7/8
199	29B	84	85	4-0	4-7/8
198	30	90	90	2-0	2-5/8
197	31	88	90	3-0	4-4/8
182	44	90	90	1-6/8	2-5/8
181	45	90	90	2-6/8	4-4/8
178	49	79	80	5-2/8	4-7/8
174	53	90	90	1-1/8	3-0
165	60B&C	90	90	0-4/8	1-4/8
161	63	75	75	Ea adjusted to MW-4 criteria	
160	64	88	90	3-1/8	3-6/8
156	69	83	85	5-0	5-2/8

C. Thirteen curves will require shifts of about 6 inches to meet the proposed speed goals.

Curve No. Amtrak	MN	Maximum Speed (MPH)	Proposed Speed (MPH)	Shifts West	Shifts Middle	Shifts East
211	21A	90	90	0.314	0.382	0.445
206	25	60	60	-0.044	0.292	0.610
201	28B	85	85	0.393	0.442	0.489
184	42	100	100	0.522	0.573	0.620
183	43	100	100	0.664	0.620	0.559
179	47	100	100	0.440	0.444	0.440
176	51	100	100	0.440	0.553	0.664
169	59A	90	90	0.038	0.030	0.022
164	61B	90	90	-0.405	-0.038	0.331
163	62A	90	90	0.183	0.092	0.00
159	65	100	100	0.345	0.346	0.345
157	68	100	100	0.664	0.493	0.307
155	70	85	85	0.232	0.232	0.232

D. Twenty-four curves have to be realigned between 6 inches and 3 feet to meet the proposed speed goals.

Curve No. Amtrak	MN	Maximum Speed (MPH)	Proposed Speed (MPH)	Shifts West	Middle	East
229	NA	80	80	0.022	0.482	0.851
228	NA	80	80	2.787	2.712	2.609
227	NA	80	80	0.017	0.717	1.307
226	NA	70	70	0.049	1.210	2.267
225	NA	65	65	2.520	1.380	0.011
222	NA	80	80	2.008	1.154	0.208
218	NA	65	65	1.829	1.590	1.321
216	NA	70	70	-0.621	-0.060	0.521
213	17	85	85	0.950	0.858	0.748
210	21B	85	85	1.369	1.017	0.626
209	22	85	85	1.189	1.219	1.189
207	24	85	85	1.048	1.438	1.607
203	27	85	85	1.382	1.226	0.908
202	28A	85	85	0.770	0.660	0.538
196	32	80	80	0.635	1.231	1.718
195	33	85	85	0.978	0.988	0.978
194	34A	85	85	1.148	0.568	-0.055
193	34B	85	85	0.932	0.344	-0.401
190	37B	100	100	0.951	0.877	0.794
189	38	100	100	1.092	1.099	1.092
180	46	90	90	0.994	1.069	0.994
177	50	100	100	0.656	0.791	0.751
171	55B	45	45	1.046	0.421	-0.271
170	57	90	90	2.053	1.925	1.474

Six curves will require shifts in excess of 3 feet to achieve speed goals.

Curve No. Amtrak	MN	Maximum Speed (MPH)	Proposed Speed (MPH)	West	Shifts (Ft.) Middle	East
224	NA	44	75	10.343	8.075	0.471
221	NA	68	80	4.694	5.072	4.694
220	NA	61	75	-0.018	6.805	9.987
219	NA	54	65	2.927	3.398	3.716
191	37A	90	100	3.804	3.822	3.563
168	59B	82	90	1.390	5.869	1.723

SPEED ANALYSIS OF CURVES AND CIVIL IMPACTS

OBJECTIVE

The goal of the Plan is to reduce the trip time between New York City and Boston to less than 3 hours. There are several changes to the methods of operation, to the facilities, and to the equipment that can contribute to the overall goal.

One of these changes is to increase the speed of the trains. Increasing the speed may require one or all of the following:

- more powerful locomotives;
- coaches that can provide comfort at greater unbalanced speeds;
- tracks and track beds that can withstand the energies transferred at higher speed (including greater imbalance); and
- alignments that can accommodate the greater speeds without exceeding acceptable limits for:
  - actual superelevation,
  - unbalanced superelevation,
  - lateral acceleration to the passenger
  - spiral lengths limited by:
    - rate of change of change of actual superelevation or twist,
    - rate of change of change of lateral acceleration to the passenger or jerk.

The objective of this analysis was to propose realignments to the existing curves so that proposed speeds can be reached and to identify civil impacts caused by the proposed realignments. The results of the analysis were used to develop a project estimate for realigning curves. Since Amtrak was performing detailed analyses of the curves between New Haven and Boston, De Leuw, Cather & Co. concentrated on the curves located between New York City and New Haven. The methodology employed to perform the analysis and the results of the analysis are presented in this subsection.

CRITERIA AND SCOPE

Criteria

The criteria utilized in the performance of this analyses were as follows.

Maximum actual superelevation should not exceed 6 inches. Actual superelevation was chosen in increments commensurate with the runoff rate in MW-1000 and MW-4 for the Hellgate Line and the NHL, respectively, and speed.

Maximum unbalanced superelevation should not exceed 5 inches.

Maximum lateral acceleration parallel to the floorboards should not exceed 0.15 g.

For conventional coach equipment at 6 inches of unbalanced superelevation the roll angle should be 2.87 degrees and lateral acceleration parallel to floorboards should be 0.15 g.

All actual superelevation should be introduced and removed over the entire length of the spiral; actual superelevation should not be introduced and removed on the adjacent tangents.

Maximum jerk rate through the spiral should be 0.04 g per sec.

Maximum track twist rate (introduction and removal rate of actual superelevation) through existing spirals, both the Hellgate Line and the NHL-for speeds less than, and equal to 90 miles per hour, should be 1/2-inch in 31 feet; for speeds greater than 90 miles per hour, maximum track twist rate should be 3/8-inch per 31 feet.

Track twist rates for alignments at proposed speeds specified by Amtrak and MNCR:

Hellgate Line-

speeds from 0 to 50 miles per hour, 1/2-inch per 31 feet;
speeds from 51 to 70 miles per hour, 3/8-inch per 31 feet; and
speeds from 71 to 125 miles per hour, 1/4-inch per 31 feet.

New Haven Line-

speeds from 0 to 60 miles per hour, 1/2-inch per 31 feet;
speeds from 61 to 90 miles per hour, 3/8-inch per 31 feet; and
speeds from 91 to 100 miles per hour, 1/4-inch per 31 feet.

Scope

The curves to be considered in the analysis were those on the Hellgate Line from Harold to New Rochelle and those on the NHL between New Rochelle and New Haven.

One product of the analysis was a list of the highest speeds that can be reached without realignment or adjustment to the actual superelevation on each of the existing curves, while satisfying safety and comfort criteria. Those curves whose highest speed meets or exceeds currently proposed speed are shown in Table L-3. The worksheets for each curve are available but have not been included in this Appendix. For those curves there will be no civil impacts or associated costs. Since this may be an iterative process, the highest speed will be useful for other trip scenarios.

A second product was a list of the highest speeds that can be reached without realignment and with adjustment to the actual superelevation, while satisfying safety and comfort criteria. Those curves whose highest speeds meet or exceed currently proposed speeds are highlighted in Table L-4. The costs associated with a change in actual superelevation includes changing bridge timbers on open deck bridges and adjusting the catenary wire.

A third product was a list of proposed realignments for the remaining curves to reach the proposed speeds. In addition to safety and comfort criteria the proposed realignments will comply with standard AMTRAK and MNCR field maintenance practices. Shifts are shown on Table L-4. The impacted bridges are shown on the worksheets in Appendix E. Actual bridge impacts will need to be confirmed on a bridge-by-bridge basis. Where there are no undergrade bridges and the shifts are less than 6 inches, the realignments can be performed with regular maintenance procedures, and will not result in significant additional civil costs. Curves that have turnouts within their length have not been identified, but need to be since turnouts will limit the actual superelevation and the speed in the curve. In these cases the realignment will be more significant resulting in greater shifts and greater costs.

The analysis technique (a spreadsheet) made it easier to answer "what-if?" questions, such as, how much will the proposed speed be reduced if the realignment shift was reduced so as not to impact bridge B? Or, how much additional shift would be required to increase the proposed speed on curve A?

The analysis technique resulted in an estimate that is considered accurate to plus and minus 0.1-foot for simple spiraled curves, provided that the radius (degree of curvature) was not changed or the spirals were not changed by a significantly unequal amount. For compound curves the analysis technique is not reliable. For these more challenging realignments dummy cogos should be run to determine the shifts. A dummy cogo is a cogo that properly uses all of the geometric elements (degree of curvature, spiral length, and intersection angle) of the alignment but the coordinates are not associated to any specific location. A dummy cogo was performed on a two centered compound curve which was judged to be an extreme case. From this cogo it is judged that the maximum predicted shift will not be exceeded throughout the curve. However, the general characteristics of the shifting shown for compound curves should not be relied upon.

One item not considered in this analysis was track centers. In general track centers are accounted for in the program because if one track requires realignment, all adjacent tracks to the inside of the curve must be aligned accordingly. However, if existing track centers are not adequate for high speed operations, further shifting would be required to provide proper high speed track centers. These shifts are not accounted for in this analysis.

METHODOLOGY

Soft Realignments

There are two types of alignment changes: soft and hard. Soft alignment changes are changes in unbalanced superelevation, lateral acceleration to the passenger and jerk that do not require physical changes. Therefore, there is no cost associated with obtaining desired the speeds. These realignments assume that the existing track twist (rate of introduction of superelevation) is acceptable.

Table I-3
SIXTEEN CURVES THAT WILL MEET THE SPEED GOALS AND REQUIRE NO ADJUSTMENTS

Curve No.		Maximum*	Proposed Speed
Amtrak	MN	Speed (MPH)	(MPH)
238		58	60
237	-	60	60
236	-	68	60
233	-	73	65
231	-	68	60
205	26A	77	75
200	29A	84	85
192	36	82	80
188	39	90	85
187	40	83	80
186	41A	54	55
185	41B	77	75
175	52	80	75
166	60A	89	90
162	62B	89	90
158	66	105	100

* Calculated using the previously listed formula.

Table I-4
SIXTEEN CURVES WILL MEET THE SPEED GOALS BY ADJUSTING E_A WITHOUT CHANGING SPIRALS

Curve No.		Maximum	Proposed Speed	E_a	
Amtrak	MN	Speed (MPH)	(MPH)	Exist (inches)	Proposed (inches)
223	-	79	80	3-3/8	4-0
217	-	93	80	1-2/8	1-6/8
212	18	105	100	0-6/8	1-6/8
208	23	70	70	4-1/8 / 2-9/8	5-2/8 / 3-0
204	26B	84	85	4-1/8	4-7/8
199	29B	84	85	4-0	4-7/8
198	30	90	90	2-0	2-5/8
197	31	88	90	3-0	4-4/8
182	44	90	90	1-6/8	2-5/8
181	45	90	90	2-6/8	4-4/8
178	49	79	80	5-2/8	4-7/8
174	53	90	90	1-1/8	3-0
165	60B&C	90	90	0-4/8	1-4/8
161	63	75	75	Ea adjusted to MW-4 criteria	
160	64	88	90	3-1/8	3-6/8
156	69	83	85	5-0	5-2/8

Table I-5
THIRTEEN CURVES REQUIRING SHIFTS OF ABOUT 6 INCHES TO MEET THE PROPOSED SPEED GOALS

Curve No. Amtrak	MN	Maximum Speed (MPH)	Proposed Speed (MPH)	Shifts West	Middle	East
211	21A	90	90	0.314	0.382	0.445
206	25	60	60	-0.044	0.292	0.610
201	28B	85	85	0.393	0.442	0.489
184	42	100	100	0.522	0.573	0.620
183	43	100	100	0.664	0.620	0.559
179	47	100	100	0.440	0.444	0.440
176	51	100	100	0.440	0.553	0.664
169	59A	90	90	0.038	0.030	0.022
164	61B	90	90	-0.405	-0.038	0.331
163	62A	90	90	0.183	0.092	0.00
159	65	100	100	0.345	0.346	0.345
157	68	100	100	0.664	0.493	0.307
155	70	85	85	0.232	0.232	0.232

Table I-6
TWENTY-FOUR CURVES REALIGNED BETWEEN 6 INCHES AND 3 FEET

Curve No. Amtrak	MN	Maximum Speed (MPH)	Proposed Speed (MPH)	Shifts West	Middle	East
229	NA	80	80	0.022	0.482	0.851
228	NA	80	80	2.787	2.712	2.609
227	NA	80	80	0.017	0.717	1.307
226	NA	70	70	0.049	1.210	2.267
225	NA	65	65	2.520	1.380	0.011
222	NA	80	80	2.008	1.154	0.208
218	NA	65	65	1.829	1.590	1.321
216	NA	70	70	-0.621	-0.060	0.521
213	17	85	85	0.950	0.858	0.748
210	21B	85	85	1.369	1.017	0.626
209	22	85	85	1.189	1.219	1.189
207	24	85	85	1.048	1.438	1.607
203	27	85	85	1.382	1.226	0.908
202	28A	85	85	0.770	0.660	0.538
196	32	80	80	0.635	1.231	1.718
195	33	85	85	0.978	0.988	0.978
194	34A	85	85	1.148	0.568	-0.055
193	34B	85	85	0.932	0.344	-0.401
190	37B	100	100	0.951	0.877	0.794
189	38	100	100	1.092	1.099	1.092
180	46	90	90	0.994	1.069	0.994
177	50	100	100	0.656	0.791	0.751
171	55B	45	45	1.046	0.421	-0.271
170	57	90	90	2.053	1.925	1.474

Table I-7
SIX CURVES REQUIRING SHIFTS IN EXCESS OF 3 FEET TO ACHIEVE SPEED GOALS.

Curve No.		Maximum	Proposed Speed	Shifts (Ft.)		
Amtrak	MN	Speed (MPH)	(MPH)	West	Middle	East
224	NA	44	75	10.343	8.075	0.471
221	NA	68	80	4.694	5.072	4.694
220	NA	61	75	-0.018	6.805	9.987
219	NA	54	65	2.927	3.398	3.716
191	37A	90	100	3.804	3.822	3.563
168	59B	82	90	1.390	5.869	1.723

Actual Superelevation on Tangent, Maximum Twist, etc. To meet comfort standards it was not considered acceptable to extend actual superelevation or track twist on to the tangents. Introduction and removal of actual superelevation should be linear, and should occur over the length of the spiral. Also, track twist should be limited for safety reasons. For both the Hellgate and NHL segments, if the existing superelevation extends onto the tangent or the circular curve, the ratio of existing spiral length to existing actual superelevation must be greater than or equal to 62 for speeds equal to or less than 90 miles per hour, and greater than or equal to 83 for speeds greater than 90 miles per hour. If not, a soft change was not considered acceptable, and the spiral had to be lengthened in accordance with Amtrak's MW-1000 criteria for the Hellgate Line, and MNCR's MW-4 criteria for the NHL. If the existing superelevation extended on to the tangent or curve body and a soft change was acceptable, the only work required would be surfacing the track so that the twist would only be on the spiral.

When the proposed speed can be reached with only a soft change, the existing curve was determined to be satisfactory, no realignment is required and there are no associated impacts to other facilities.

Hard Realignments

Hard alignment changes are changes to actual superelevation, degree of curvature, and/or spiral lengths. Hard changes result in a physical change to the track, and when certain thresholds are reached, hard changes will impact adjacent or supporting facilities, such as, overhead bridges, undergrade bridges, signal towers, catenary towers, station platforms, etc.

Shifts and Impacts

In the context of the overall NECTP, the signaling and catenary costs are accounted for regardless of track shift. Also, right of way is generally not considered a factor unless the shift is very large and in those cases right of way will be considered separately. In general, the impacts of track shifts on overhead and undergrade bridges are of greatest concern, as is a determination whether the change can be made as part of a routine track maintenance surfacing operation.

Although each bridge located on the body of a curve ultimately will have to be individually evaluated to determine the impact of the assumed track shift, for these analyses it was generally assumed that if a specific shift exceeded the followings limits, the bridge would be impacted:

- open deck bridges with no additional improvement work proposed--any shift or change in superelevation;
- open deck bridges with through girders, or through deck girders scheduled for tie replacement--6 inches;
- open deck bridges with deck girders scheduled for tie replacement--1-foot;
- open deck bridges scheduled for conversion to ballasted deck--2 feet;
- ballasted bridges--2 feet; and
- overhead bridges--3 feet.

It has been assumed that bridges listed for replacement would be designed to accommodate the proposed alignment changes.

It also has been assumed that realignments that require shifts of 6 inches, and less, would be accomplished through regular maintenance practices and procedures. If the shift exceeds 6 inches, the track shifting cannot be done as part of maintenance and will require an independently scheduled effort.

Analysis Guidelines, Assumptions and Techniques

The analysis process utilized to analyze speeds and curves, and evaluate impacts on structures is included as Attachment A. The following are the guidelines, assumptions, and techniques for doing the analysis.

Degree of Curvature, Radius

The proposed radius and degree of curvature were not bound by any convention, i.e., there was no requirement that degree of curvature must be in 15 minute increments or that radii have to be in multiples of 100 feet.

Actual Superelevation

For curves whose superelevation is proposed to be changed, superelevation has been assumed to be implemented in increments in accordance with the way superelevation is introduced in the spiral by railroad maintenance personnel. The Hellgate and NHL segments will have their own schemes as Amtrak and MNCR have separate and distinct criteria. For curves whose existing actual superelevation is not a proper multiple and no change is required to the alignment, i.e., no change to degree of curvature and spiral lengths, the existing actual superelevation (E_a) was not changed to make it a proper multiple. The present Amtrak and MNCR superelevation criteria are as follows:

Hellgate Line

Speed Range, New York City	E_a introduced in multiples of
0 to 50	1/2"
51 to 70	3/8"
71 to 125	1/4"

New Haven Line

Speed Range, New York City	E_a introduced in multiples of
0 to 60	1/2"
61 to 90	3/8"
91 to 100	1/4"

Unbalanced Superelevation

Unbalanced superelevation was computed from the following equation.

$$E_u = 0.0007 * D_c * V^2 - E_a$$

where E_u is unbalanced superelevation in inches
E_a is actual superelevation in inches
D_c is degree of curvature in decimal degrees
V is speed in miles per hour.

In accordance with previous agreed assumptions, unbalanced superelevation was limited to a maximum of 5 inches on the Hellgate and NHL.

Lateral Acceleration Parallel to the Vehicle's Floor boards

When unbalanced superelevation occurs, passengers are subjected to a steady state lateral acceleration. This acceleration is the component of centripetal acceleration that is parallel to the floor boards of the vehicle. The calculation for this component takes into account the floor board rotation due to actual superelevation and the roll of the car body as it's suspension responds to the centripetal lateral acceleration. The lateral acceleration is computed from the following equation.

$$A_L = \{[(E_a + E_u) / G * \mathrm{COS}(\mathrm{THETA} - \mathrm{PHI} * E_u / 6)] - \mathrm{SIN}(\mathrm{THETA} - \mathrm{PHI} * E_u / 6)\} * g$$

where, A_L is lateral acceleration parallel to floor boards in g
THETA is the angle due to the actual superelevation = ARCSIN(E_a /G)
G = distance between rail head centers = 60 inches
PHI is the vehicle roll angle per 6 inches of unbalanced superelevation = 2.87 degrees per 6 inches of E_u.

The PHI value of 2.87 was derived from conventional coach data provided on page 21 of the report for the FRA entitled *Railroad Passenger Ride Safety*, revised April 1989. Conventional non-tilting equipment has to be considered since either tilting or non-tilting equipment ultimately may be used. The tests reported indicated that both the LRC Coach (non-banking) and the Amfleet Coach reached 0.15 g of steady state lateral acceleration at 6 inches of unbalanced superelevation. By substituting these values into the above equation a PHI value of 2.87 is found calculated all values of actual superelevation up to 6 inches.

For this project, review of previous research and consultation with the FRA have led to the recommendation that 0.15 g should be the lateral acceleration limit. This analyses performed assumed that 0.15 g to be the lateral acceleration limit. Vehicle test data indicates that 0.15 g will be reached at 6 inches of unbalanced superelevation, therefore as long as unbalanced superelevation is limited to 5 inches, the lateral acceleration limit of 0.15 g will not be exceeded.

The PHI value is based upon available data for conventional non-tilting equipment. It is unlikely that new, non-tilting equipment will have a larger PHI coefficient, however, it might have a smaller value. A smaller PHI value would result in smaller lateral accelerations (good for passenger comfort) and in shorter comfort spiral lengths that would be based on a maximum jerk rate (jerk rate and comfort spiral are discussed in the following subsection). Consequently, spirals established based on the PHI value of 2.87 will be longer than necessary if the new non-tilting equipment has a smaller PHI. Therefore, the construction impacts resulting from shifts determined by the PHI value established for this report will be conservative.

The Comfort Spiral, Jerk, and Jolt

The comfort spiral transitions the passenger through a change in lateral acceleration (unbalanced superelevation) at a comfortable rate. Assuming that a vehicle's speed is constant while traversing a spiral, unbalanced superelevation (lateral acceleration) changes linearly as the passenger travels along the spiral. This is because: degree of curvature changes linearly along a spiral; actual superelevation is introduced linearly along the spiral; and vehicle roll is linearly related to lateral acceleration. The change in lateral acceleration is referred to as jerk, with units of g per sec.

The jerk is computed by dividing the change in lateral acceleration (which is found by using the above equation and the change in unbalanced superelevation) by the time it takes for the passenger to travel over the spiral. The time is found by dividing the spiral length by the vehicle speed, with appropriate adjustments for units.

After a jerk rate has been established for a project, the minimum comfort spiral length can be computed by dividing the change in lateral acceleration by the jerk rate, and multiplying the quotient by the vehicle speed:

$$L_s = A_L / J * V = A_L / 0.04 * 88 / 60 * V = 36.67 * A_L * V$$

where, L_s is minimum comfort spiral length in feet
J is maximum jerk rate in g per sec
A_L is found from the earlier equation as a function of unbalanced superelevation.

AREA recommends 0.03 g per sec as a maximum jerk rate, when conditions permit. But where the cost of the realignment of existing tracks will be excessive the AREA recommends that the jerk rate should not exceed 0.04 g per sec. For this analysis a jerk rate of 0.04 g per sec was assumed.

The *Railroad Passenger Ride Safety* report, cited above, lists the lateral acceleration and jerk limits for several railroads. Jerk limits range from 0.03 to 0.1 g per sec. It is generally true that when a railroad accepts a higher jerk rate, it accepts a lower lateral acceleration. This is consistent with the observation reported in the same report that people are able to tolerate larger jolts when they are in a lower steady state lateral acceleration environment.

A jolt is also a rate of change of lateral acceleration per second, but it is considered as an occurrence that occurs in 1 second. A jolt is usually a response to a track irregularity. When jolts exceed 0.25 g per sec it is usually a sign that, for that speed, the track needs adjustment. The jerk through a spiral usually occurs over several seconds and, therefore, is not considered a jolt.

Usually back and forth car body rolling occurs when a track irregularity is encountered. The more violent the rolling the greater the jolt. When the jolt is measured as a lateral acceleration parallel to the floor boards, the position of the accelerometer affects the magnitude of the reading. In a double deck car, for the same track irregularity, a passenger on the lower level near the roll center of the car body will feel a smaller jolt than a passenger on the upper level.

The *Railroad Passenger Ride Safety* report also indicates that the researchers did not find any evidence that jerk is a comfort concern. This suggests that the comfort spiral could be shortened until the jerk is 0.25 g per sec. The problem with this approach is that the track has to be maintained in perfect condition. Any track irregularity would result in a total change in lateral acceleration that exceeds 0.25 g per sec.

The SNCF was found to have the highest limits, 0.15 g and 0.10 g per sec. Since comfort is a subjective feeling of the passenger, the SNCF may be recognizing that the French have a higher threshold to discomfort, or that they may be willing to tolerate a higher percentage of the passengers to be uncomfortable. Or, and perhaps more likely, SNCF has made a commitment to high quality track with tight maintenance tolerances for their high speed lines. (The British and American comfort criteria were established at comfort limits where 50 percent of the passengers will be satisfied. The Japanese desire to have 90 percent of the passengers satisfied.)

Track Twist

If the track twist, the rate of introduction or removal of superelevation, is too large safety is impaired. When computing the maximum allowable speed for the existing alignment, the analysis performed verified that the ratio of the existing spiral length to actual superelevation was equal to, or greater than, 83 for speeds above 90 miles per hour, and equal to, or greater than, 62 for speeds below, and including, 90 miles per hour.

When the maximum allowable speed did not reach the proposed speed, either the spirals were lengthened, or both the degree of curvature was decreased and spiral lengths were adjusted. Where these alignment changes were required the spiral lengths were changed to satisfy the appropriate actual superelevation runoff rate assumed for the Hellgate and NHL segments. The new spirals also were checked for jerk. The actual superelevation was adjusted until the jerk criteria was satisfied. The following are the separate and distinct runoff rate criteria specified for the Hellgate Line (by Amtrak) and the NHL (by MNCR) and used in the analysis.

Hellgate Line

Speed Range, miles per hour	Runoff per 31'
0 to 50	1/2"
51 to 70	3/8"
71 to 125	1/4"

New Haven Line

Speed Range, miles per hour	Runoff per 31'
0 to 60	1/2"
61 to 90	3/8"
91 to 100	1/4"

Track Shifts

For this analysis, shifts between the existing and the proposed alignments were computed at 3 points: near each of the curve spiral points and near the mid-point of the curve. The shifts near the curve spiral points were estimated as the difference between the spiral offsets, the "p" distance, for the proposed and existing spirals. At the curve's mid-point the difference in the external distances for the proposed and existing alignment was estimated to be the amount of shift required.

These estimated shifts were checked by running a series of dummy COGO analyses. A dummy COGO is a coordinated smooth alignment that uses the prescribed spiral lengths, curve radii, and deflection angles but whose coordinates are not intended to relate to any specific location on the ground. The coordinates are therefore "dummies," assumed for the calculations performed. A dummy COGO of the existing alignment cannot be set to the existing location of a track unless it can be matched against coordinates measured along the existing track. Similarly a proposed dummy COGO cannot be used to determine offsets to an existing track or to wayside obstructions. However, the offsets between dummy COGOs of existing and proposed alignments can be used to find the shifts that would occur if the dummy COGO of the existing alignment is accurate.

The estimated shifts were checked by running several dummy cogos using typical alignment curve data, and calculating offsets. A range of intersection angles, radii, spiral lengths, and differential spiral lengths, when the existing spirals are unequal, were tested. For simple, spiral curves it was found that the estimated shifts were within 0.1 feet and that they were usually on the conservative side, i.e., 0.1-foot larger than actual. If the proposed alignment has a different intersection angle or a significantly different radius, the estimated shifts become less accurate.

Compound Curves

Compound curves (a combination of two or more curves connected by transition spirals) added another level of complexity to the analysis. Except for the following modifications, the method used to estimate the amount of shift was basically the same as for simple curves. The following labeling was used:

Existing Compound Curve
- A-spiral length between tangent and longer radius curve
- B-longer radius curve

C-combining spiral length
D-shorter radius curve
E-spiral length between tangent and shorter radius curve

Proposed Compound Curve
PA-spiral length between tangent and longer radius curve
PB-longer radius curve
PC-combining spiral length
PD-shorter radius curve
PE-spiral length between tangent and shorter radius curve.

Each curve in the compound curve was analyzed separately. For the first curve the following curve elements were used:

Existing
A-spiral length
B-curve radius
E-C-spiral length
Proposed
PA-spiral length
PB-curve radius
PE-PC-spiral length.

For the second curve the following curve elements were used:

Existing
A+C-spiral length
D-curve radius
E-spiral length

Proposed
PA+PC-spiral length
PD-curve radius
PE-spiral length.

From initial checks it was found that the external distance is very dependent upon the intersection angle, but that the difference in external distances is not very sensitive to the intersection angle. Therefore, using data from track geometry car graphs provided by MNCR and Amtrak, it was assumed to be sufficient to divide the total intersection angle in the same proportion as the curve lengths.

Dummy COGO checks indicated that the largest shift found using the estimating method is similar to the largest found with the dummy COGO but the location of the peak shift may not be correctly represented. To check for impacts at specific locations dummy COGO should be used.

Basis for Existing Curve Data

As with any analysis, the results of the curve analyses performed were only as good as the quality of the available existing data. The best source of data is good mapping or surveyed data points of the existing tracks. Description of an alignment by degree of curvature is incomplete, it is similar to describing a line by its slope. The description of a curve is not complete until the Y intercept is known. Stringline data and track geometry car data also are not ideal sources of data. The degree of curvature is never uniform, always varying. The result is that data elements assumed to describe the alignment may vary greatly from the actual configuration. The variation cannot be determined without mapping or surveyed data points.

The existing data sources used to develop information for the analyses performed were as follows, surveyed data points are not included:

- system curve data (stringline data)-NHL only;
- track geometry car charts;
- comprehensive curve analysis;
- track charts;
- "A Working Paper" for the Hellgate Line;
- "A Working Paper" for the NHL;
- AMTRAK comments on "A Working Paper" for the NHL; and
- aerial Mapping.

The track charts were used for general orientation but not to define spiral lengths, curvature, etc. The "A Working Paper" report relied upon stringline techniques, which is a good smoothing procedure but not an effective design tool, and was therefore used for background information only.

The aerial mapping for these segments is 15 years old, the tracks may have been shifted, and other conditions changed. To have used the maps effectively would have required extensive effort to update and verify information. This was not felt to be necessary for this planning study; however, the existing maps were used to verify the longitudinal location of bridges and develop basic information in support of the cost estimates that were developed.

Various data sources provided information relative to the existing superelevation, spiral lengths, curve lengths, and degree of curvature: NHL System Curve Data (stringline data), Track Geometry Car Charts, and the Comprehensive Curve Analysis. The NHL System Curve Data (stringline data) for all tracks, and the Track Geometry Car Charts provide insight as to the existing spiral and curve lengths; while the Comprehensive Curve Analysis provided no spiral or curve length data. Quite often the data provided by one source conflicted with information from one of the other sources.

The Comprehensive Curve Analysis appears to be an interpretation of the Track Geometry Car Charts. Most of the data is for track 4, not for the proposed high speed tracks, which are tracks 1 and 2. Therefore, this document was used in a limited manner.

Although there were possible errors in the track geometry car data, it was necessary to use them in some instances. The System Curve Data (stringline data) became the primary source of data, however, the System Curve Data was provided by Metro-North and, therefore, is only available for the NHL between New Rochelle and New Haven. Also for compound curves the

System Curve Data did not provide compound spiral lengths nor lengths of the individual simple curves. Therefore, the track geometry car charts had to be used for the Hellgate Line and to supplement spiral, and curve lengths in compound curves on the NHL.

For the Hellgate Line track 2 track geometry car chart data was used for the existing data. For a few curves track 1 data was used when it was judged from the existing degree of curvature, actual superelevation, and spiral lengths that track 1 would require greater adjustments and shifts than track 2.

Track 1 System Curve Data was used for the NHL except when there was only track 2 data available or when there was a compound curve. Since it was necessary to supplement the System Curve Data with track geometry car chart data in compound curves, it was decided not to mix data sources for a curve. Therefore, for the compound curves all of the data was derived from the track geometry car charts.

The track geometry car chart data was reduced as follows. The track geometry produces strip charts with fluttering lines. A visual average was made for the degree of curvature and actual superelevation. If the data was not uniform, the curve was subdivided into a compound curve. The distance between uniform curvature data points was assumed to be spiral lengths. The distance between uniform actual superelevation data was <u>not</u> assumed to have any relationship to spiral length because MNCR has been running actual superelevation off onto the tangents and into circular curves.

It was assumed that tracks 3 and 4 also will be shifted, as necessary, when either would be the inside track on a curve, and thus need to be shifted to maintain adequate clearance to the shifted inner tracks. The costs for this effort were included in the project estimate, but it was assumed that the magnitude of shifts and, therefore, impacts on adjacent right-of-way structures would be driven by the changes required to the high speed tracks, tracks 1 and 2.

For each curve, the existing data from each source was tabulated. The source data was compared, curve by curve, and data type by data type. Finally, one set of existing data for each curve was selected and compiled. The compiled data is the most conservative.

Speeds

The existing speeds were taken from the existing MNCR Employees Timetable. The proposed speeds were taken from the "Existing and Proposed 2010 Track Configurations" charts prepared for Task No. 3-Preliminary Program of Projects. These proposed speeds do not consider signal speed restrictions. Proposed speeds have been established in multiples of 5 miles per hour.

When determining the maximum allowable speed within the criteria the speed is shown to the nearest mile per hour.

The Spreadsheet

To facilitate the analysis a spreadsheet was developed that allows for the existing speed, degree of curvature, spiral and curve lengths, and superelevation to be input. The input was utilized to perform a variety of calculations. The spreadsheet determined the maximum speed obtainable given the existing alignment and actual superelevation, by only making soft changes, i.e., only changes to speed, unbalanced superelevation, and jerk. No change to curvature, spiral lengths, and actual superelevation were made. In general it was assumed that the proposed curvature will remain unchanged.

For those instances when curvature changes were analyzed, the spreadsheet was used to determine the shifts associated with changes in degree of curvature, actual superelevation, and spiral lengths that would satisfy Amtrak MW-1000 and MNCR MW-4 criteria, and attain the proposed speeds. For the proposed alignment only the proposed speed and actual superelevation had to be input. Unbalanced superelevation, spiral lengths, and shifts were computed. "What if" questions about shifts and speeds were asked, and answered, by using different proposed speeds for input. Limitations concerning the shift calculations were discussed earlier.

ANALYSIS PROCESS

The following questions for each curve were answered and the analysis proceeded as indicated.

1. What is the existing?:

   a. AMTRAK curve number
   b. Metro North curve number
   c. speed
   d. degree of curvature or radius
   e. actual superelevation
   f. spiral length(s)
   g. does superelevation run onto either the tangent or circular curve?

   The following were computed:
   h. unbalanced superelevation;
   i. steady state lateral acceleration to the passenger; and
   j. spiral offset(s) and external.

2. If 1.g. was yes, it was assumed that the superelevation does not run onto the tangent and circular curve when the following were computed/developed:

   a. steady state jerk(s).
   b. track twist(s), rate of change of change in actual superelevation, i.e., ratio of existing spiral length to existing actual superelevation.
   c. list of open deck bridges with no planned work.
   d. list of open deck bridges with through girder or through deck girders scheduled for tie replacement.
   e. list of open deck bridges with deck girders scheduled for tie replacement.
   f. list of open deck bridges scheduled for change to ballast.
   g. list of ballasted bridges.
   h. list of overhead bridges.
   i. list of bridges to be replaced.
   j. list of turnouts located in the curve.

3. If 1.g. was no, the highest speed that does not exceed 5 inches of unbalanced superelevation nor exceed 0.15 g lateral acceleration nor exceed 0.04 g per sec jerk was determined. This assumed that the existing radius, superelevation, and spiral length(s) would remain unchanged. This speed was assumed to be the highest speed with no impacts, no shift requirements, and that did not require an alignment change. Note: when the existing spirals were of unequal length, the shorter spiral was used to compute jerk. The analysis would proceed to 5, skipping 4.

4. If 1.g. is yes, and

   a. if 2.b. was greater than 83, the highest speed that does not exceed 5 inches of unbalanced superelevation, nor exceed 0.15 g lateral acceleration, nor exceed 0.04 g per sec jerk was determined. The existing radius, superelevation, and spiral length(s) were to remain unchanged. This speed was considered as the highest speed attainable with no impacts, no shift, and not requiring an alignment change. Note: when the existing spirals were of unequal length, the shorter spiral was used to compute jerk. The analysis proceeded to 5.

   b. if 2.b. was greater than 62, the highest speed less than or equal to 90 miles per hour that does not exceed 5 inches of unbalanced superelevation, nor exceed 0.15 g lateral acceleration, nor exceed 0.04 g per sec jerk was determined. The existing radius, superelevation, and spiral length(s) were assumed to remain unchanged. This speed was assumed to be the highest speed with no impacts, no shift, and that did not require an alignment change. Note: when the existing spirals were of unequal length, the shorter spiral was used to compute jerk. The analysis proceeded to 5.

   c. if 2.b was less than 62 a spiral length change was required. The spreadsheet would report that an alignment change was required. The analysis would proceeded to 5.

5. Steps 1-4 were performed for all the curves, a curve list showing the highest speed determined in 3, 4.a. and 4.b was developed. The proposed speed for each of these curves was listed. The curves whose highest speed met or exceeded their proposed speed were highlighted. The list was entitled *Highest Speeds for All Curves without Alignment Changes*. Proceed to 6.

6. For all curves that were not highlighted in 5 (i.e., those curves that will need alignment changes, and/or changes in superelevation, radius or spiral length-to achieve the proposed speed, without changing radius) increase actual superelevation in increments specified for the segment and speed, without exceeding 6 inches, until the proposed speed was reached without exceeding 5 inches of unbalanced superelevation or exceeding 0.15 g lateral acceleration. If there was a turnout in the circular curve or spiral, it was assumed that the actual superelevation may be decreased but not increased from the existing. If the proposed speed could not be achieved without exceeding the above limitations, the radius was increased until the proposed speed was reached, without exceeding the above limitations. Using the radius and superelevation that were determined to be necessary to achieve the proposed speed, the shortest spiral length that satisfied the MW-1000 in the Hellgate segment and MW-4 in the NHL segment, and did not exceed the 0.04 g per sec jerk, was calculated. Spiral lengths were established as an integer multiple of 31 feet.

Shifts to achieve the proposed alignment were calculated. The impact of the proposed shifts on each bridge were evaluated. If the shifts exceeded the followings limits the bridge was considered to be impacted:

- open deck bridges with no planned work-any shift or change in superelevation;
- open deck bridges with through girders or through deck girders scheduled for tie replacement--6 inches;
- open deck bridges with deck girders scheduled for tie replacement--1-foot;
- open deck bridges scheduled for change to ballast--2 feet;
- ballasted bridges--2 feet; and
- overhead bridges--3 feet.

Bridges listed for replacement were assumed to not be impacted by alignment changes.

A list all of the curves that required alignment changes to achieve the proposed speed was developed. It included: proposed speeds, bridges impacted by alignment changes, curves requiring 6 inches or less of shift, and curves limited by the presence of turnouts. The list was entitled *All Curves Requiring Alignment Change to Meet Proposed Speeds and Impacted Bridges.*

CURVE ANALYSIS NEW HAVEN TO BOSTON

EXECUTIVE SUMMARY

A report entitled *Amtrak Shore Line, Curve Modification Study, P.I. No. 3, Phase !!* was prepared for Amtrak by Gannett Fleming/LSTS. The report presented the results of an analysis of the feasibility of redesigning existing NEC curves between New Haven and Boston to maximize the civil design speeds within the constraints of both Amtrak's MW-1000 and Swederail's guidelines for the X2000 equipment. The report provided the preliminary curve geometry, required track shifts, impact on fixed facilities, and conceptual level cost estimates to achieve the required track realignments.

The analyses sought to achieve target speeds supplied by Amtrak. The preliminary designs indicated that the target speeds could be met (or even exceeded) on over 80 percent of the study curves. Failure to achieve target speed was generally due to limitations on available tangent track lengths between reverse curves, or limitations in available right of way. Of the 80 percent of curves where target speeds were achieved, almost 50 percent of the curves required no realignment. For those curves requiring realignment, over 90 percent required maximum track shifts of less than 3 feet.

The report noted that the analysis was based upon track geometry presented on the original NECIP drawings. The results could vary when final design was performed utilizing updated mapping that was being prepared when the report was written.

The proposed track realignments would have optimized civil design speeds for the X2000 equipment that Amtrak is currently testing.

CURVE ANALYSES PERFORMED

Earlier studies conducted for Amtrak had identified the "theoretical" maximum speed achievable for each curve between New Haven and Boston. These speeds had utilized existing curve radii, a maximum actual superelevation of 6 inches, and unbalanced superelevation of 8 inches. The earlier studies had not addressed the sufficiency of the existing spirals to accommodate the increase in superelevation, and/or the impact of redesigning the curves to increase existing spiral lengths.

The study (performed by Amtrak's General Engineering Consultant (GEC)) was performed in two phases. The Phase I report was submitted in August 1992 and the Phase II report submitted in March 1993. Amtrak identified two categories of realignments:

- category A, curves that require track realignment, and/or resurfacing to achieve X2000 target speeds (similar to the hard realignments in the De Leuw, Cather report); and

- category B, curves where no track modifications are required to achieve target X2000 speeds.

Existing MW-1000 speeds also were calculated. These speeds were not compromised in order to achieve X2000 target speeds. Also, where existing curves are not being altered, and present MW-1000 criteria is no achieved, existing MW-1000 speeds were not reduced.

Criteria

MW-1000. MW-1000 criteria specified superelevation runoff rates based upon maximum authorized speeds. The maximum rate of change per 31 feet of track is set at 1/4" for speeds of 71 to 125 miles per hour. A maximum rate for speeds of 125 to 150 miles per hour is not specified. The Amtrak study assumed that the maximum rate of change would be 1/4" per 31 feet for speeds of 71 to 150 miles per hour. Minimum spiral lengths were set using the less restrictive formula $L = 1.22\ E_uV$ and a maximum E_u of 5 inches (assuming FRA approval).

X2000. Minimum spiral lengths were verified using a maximum E_u of 9.65 inches (245 mm). The X2000 criteria allows significantly higher rates of change for superelevation runoff at all speeds, however, since the actual superelevation must be set to accommodate both X2000 and existing equipment, the lower rates of change specified in MW-1000 were utilized in every analysis. In some instances where existing runoff rates did not meet current MW-1000 criteria but exceeded the X2000 requirements, spiral lengths were not adjusted. In no case were existing substandard spiral lengths reduced or runoff rates increased. Furthermore, this approach was employed only where satisfying current MW-1000 criteria would result in significant track shifts, relocation of major fixed facilities or modifications to curves that otherwise achieved X2000 target speed with no realignment.

RESULTS

A spreadsheet summarizing the work was developed. It presented a variety of preliminary data that will be refined during final design. A listing of curves initially proposed to be realigned follows. The amount of shift required is based on the maximum shift that was preliminarily calculated by the GEC.

SIGNAL SYSTEM IMPACT, INCREASED MAXIMUM AUTHORIZED SPEEDS-NEW ROCHELLE TO NEW HAVEN

INTRODUCTION

A requirement of the upgrades being considered for the Amtrak New York to Boston route is a trip time of 3 hours or less. Train simulations indicate that upgrades to the New York to New Haven portion of the route are required. Amtrak uses the New Haven Line from New York to New Haven. These upgrades include increasing train speed in some areas. Wayside and cab signal boundaries are placed to ensure safe train separation at a given maximum track speed. An examination of safe braking distances at the increased trains speeds was performed to determine the modifications in signal spacing required to ensure safe train separation at the increased train speeds.

This report documents the safe braking calculations used to assess the adequacy of the signal spacing as well as the train braking characteristics, track profile information, and train speed information used in performing the safe braking calculations. The methods employed in performing the safe braking calculations are described, and the safe braking calculations and results are presented. The existing signal spacing information used to determine areas that require modification is likewise included. The modifications to support the increased train speeds are presented along with cost estimates to implement the modifications.

SUMMARY

The increase in train speed on the New Haven Line segment makes necessary the following modifications to the NHL's existing signal system:

- Add Master Location at MP 30.33; revision made necessary by raising MAS from 75 miles per hour to 85 miles per hour;

- Relocate ML 506/507 from MP 51.24 to MP 51.09; revision made necessary by raising MAS from 75 miles per hour to 90 miles per hour;

- Relocate ML 544/545 from MP 54.41 to MP 54.46; revision made necessary by raising MAS from 75 miles per hour to 90 miles per hour;

- Relocate ML 637/638 from MP 63.81 to MP 63.84; revision made necessary by raising MAS from 85 miles per hour to 90 miles per hour; and

- Relocate ML 649/650 from MP 64.95 to MP 64.86; revision made necessary by raising MAS from 85 miles per hour to 100 miles per hour.

It is recommended that new master locations should be purchased and installed for each relocation. A unit cost for purchase and installation of a master location is estimated to be $90,268.50. The total cost for purchase and installation of five master locations is therefore $451,342.50.

DESCRIPTION OF INFORMATION USED IN EXAMINATION

The information used in conducting the examination documented in this report is described in this section. Each of the five sources of information is described. The source of the information, the use made of the information and a brief description of the way that the information was interpreted is included.

Item 1: BLOCK PLAN NEW HAVEN LINE
Source: Metro-North
Dwg. Number: BP-NHL Sheets 1 through 14
Date: 7/11/86, Revised 2/20/91 - 10/8/91
Use: Grade information for safe braking calculations
Method of Use: Grade was approximated over the entire length of the braking run for each signal boundary. The approximate average grade from the signal boundary to the safe braking point was determined from these block plans. This average grade value was then used to recalculate the safe braking point. The average grade was then approximated again and the braking point was recalculated. This iterative process was repeated for each signal boundary until the calculated braking point and the estimated braking point used to estimate grade converged.
Reproduced: Appendix A

Item 2: AMTRAK STANDARD BRAKING DISTANCE CALCULATIONS
Source: AMTRAK
Dwg. Number: S-603 Sheets 1 through 7
Date: 10/3/89-11/6/91 Revised 11/6/91
Use: Braking characteristics and formulae for safe braking calculations
Method of Use: Formulae are given for safe braking calculations and equated distances for both ascending and descending grades. Tables for various speeds and grades are also given. The formulae were reproduced in a spreadsheet for performing the safe braking calculations. The spreadsheet calculations were verified with a selection of the calculations given in the tables.
Reproduced: Appendix B

Item 3: TPC Output Listings
Source: TAD
Dwg. Number: 55GEE and 55GEW
Date: 4/6/92
Use: These simulation listings show the speeds required to meet the three hour New York to Boston runtime goal. The speeds shown in the "LIMIT" column, along with the information described in Item 4, were used to revise MAS. The boundaries for changes in MAS were taken from Item 4 and the magnitude of MAS within these boundaries was taken from the highest speed shown on the TPC listings. The revised MAS values were used as the initial speed in the safe braking calculations. In a number of instances, documented elsewhere herein, MAS boundaries were shifted slightly to avoid otherwise unnecessary modifications to the existing signal boundaries. Likewise, in a number of instances documented elsewhere herein, the "LIMIT" column indicated a speed significantly higher than the "ACTUAL" column and use of the lower of the two avoided modifications which were otherwise unnecessary.
Reproduced: Appendix C

Item 4: NEW HAVEN LINE MAXIMUM ALLOWABLE SIGNAL SPEED 100 miles per hour STUDY
Source: Metro-North
Dwg. Number: TKSPEED
Date: 3/15/91
Use: This plan shows where the track is divided into MAS (maximum allowable speed) zones. These MAS zone boundaries were used throughout this examination. The magnitude of speed allowed within the zone was modified according to the highest "LIMIT" speed found in the TPC (train simulator) listing. Recommendation was made to shift slightly the zone boundaries (see REVISION DESCRIPTION) in order to avoid otherwise unnecessary modifications to the existing signal system in some instances.
Reproduced: Appendix D

Item 5: NEW HAVEN LINE ROUTINGS
Source: Metro-North
Dwg. Number: RTG-NHL1 & RTG-NHL2
Date: RTG-NHL1 6/7/89 REVISED 4/13/92, RTG-NHL2 1/14/91 REVISED 1/14/91
Use: The existing limits of control for each signal location are shown on these plans. The limits of control are intimately tied to and are determined by safe braking distance. The increase in track speed alters safe braking distance, thus making this examination necessary. These plans were used to identify areas where the higher speeds force modification to the existing signal system. Method of Use: The existing limits of control and the implicit location of the existing safe braking points were compared with the newly calculated safe braking points. Where the existing limits of control do not allow use of the new safe braking point, the situation was noted and solutions devised.
Reproduced: Appendix E.

SAFE BRAKING CALCULATION DESCRIPTION

Two computer spreadsheets were created to perform safe braking calculations. One spreadsheet was created for eastbound moves and the other spreadsheet was created for westbound moves. A description of the relevant spreadsheet data, which is not self-evident, follows:

- The column headed "Zone" refers to the MAS zone within which the existing signal boundary falls. The zone numbers were assigned arbitrarily. The zone boundaries coincide with the boundaries as defined in "NEW HAVEN LINE MAXIMUM ALLOWABLE SIGNAL SPEED 100 miles per hour STUDY" reproduced in Appendix D.

- The column headed "Grade" refers to the estimated average grade from the existing signal boundary to the safe braking point. The grade was estimated using the "BLOCK PLAN NEW HAVEN LINE" reproduced in Appendix A.

- The column headed "Prop.[osed] MAS" is the highest speed found in the "LIMIT" column of the TPC printout (reproduced in Appendix C) within the MAS zone.

- The column headed "Safe Brake Dist" is the safe braking distance from the existing signal boundary. The formulae used to calculate the safe braking distance were taken from "AMTRAK STANDARD BRAKING DISTANCE CALCULATIONS" reproduced in Appendix B. Values in the "Existing Signal Sta.", "Prop. MAS", and "Grade" columns are used for these calculations.

- The column headed "Safe Braking Point" is the sum (for eastbound) or difference (westbound) of the "Existing Signal Sta." column and the "Safe Braking Pt." column. This point is used to decide whether the existing signal control limits are valid at the new train speeds.

An excerpt of one of the spreadsheets is reproduced below. The spreadsheets are reproduced in their entirety in Appendix F.

CONTROL LINE DIAGRAM DESCRIPTION

A series of control line diagrams were produced. These diagrams show each existing signal boundary. These diagrams were produced by reproducing the track plan portion of the "BLOCK PLAN NEW HAVEN LINE" drawings (reproduced in their entirety in Appendix A) onto larger sheets. Control lines were then drawn from each signal boundary to the newly calculated safe braking points. An "X" is shown on each of these control lines at the new safe braking point. The control lines were then extended and terminated with an arrow at the existing control limit as found on the "NEW HAVEN LINE ROUTINGS" drawings (reproduced in Appendix E). These control line diagrams are designated SKRAK051493 sheets 1 through 7 and are reproduced in Appendix G.

Where the existing control limits are adequate for the new braking points, the control lines are noted "OK". Where the existing control limits are not adequate for the new braking points, the control lines are noted "NOT OK". Control lines are judged adequate when the next signal boundary's safe braking point is located at or before the end of the existing control limit. Where the existing control limits are found not adequate for the new braking points, a solution has been formulated and may be found in this report under the heading "REVISION DESCRIPTION".

ANALYSIS OF IMPACT AND FORMULATION OF MODIFICATIONS

Each existing signal boundary control limit which was found inadequate for the new safe braking points is listed in the "REVISION DESCRIPTION" reproduced in Appendix H. An excerpt from the "REVISION DESCRIPTION" is reproduced below.

Item 1 MP 28.77, CB 292, CP 229, Eastbound Home, Eastbound move
See SK-RAK-051493 sheets 2&3
Revision made necessary by raising MAS from 75 miles per hour to 85 miles per hour.
Solution: add master location at MP 30.33.

Item 2 MP 40.75, CB 515, CP 240, Eastbound Home, Westbound move
See SK-RAK-051493 sheets 3&4

Revision made necessary by raising MAS from 85 miles per hour to 100 miles per hour.
Solution: Proposed MAS shown as 100 miles per hour-change to 85 miles per hour-MAS change overlimits must change, but no impact on TPC runs.

An item number has been assigned to each revision. The number immediately following the item number (example: 28.77) is the milepost of the signal boundary where the existing control limit was found to be inadequate. Where the signal boundary is located at a catenary bridge, the catenary bridge number is then given (example: CB 292). Following the catenary bridge number is a description of the signal boundary, then the direction of travel for which the control limit is inadequate.

The next line identifies the sheet or sheets of the control line diagram (reproduced in Appendix G) where the signal boundary and the control limits are shown.

The third line describes the cause of the inadequacy in the existing control limits.

Beginning on the fourth line is the solution proposed to restore adequate control limits. Six of the items listed do not require modifications to the existing signal system. Five of the items do require modifications to the existing signal system, either moving or adding master or automatic signal locations. One item notes that the higher speeds must be considered in redesigning New Haven interlocking.

COST ESTIMATE

The examination of braking distance increases due to increased MAS on the New York to New Haven portion of Amtrak's route over the New Haven Line indicates that one master location must be added and four master locations must be relocated. It is recommended that new master locations should be purchased and installed to replace the existing master locations identified as requiring relocation. Therefore, this estimate assumes the purchase and installation of five master locations.

Description	Material	Labor Hours		
Instrument House	$ 37,000.00	40		
Foundation	400.00	16		
	28,000.00	128		
Impedance Bond (8)	500.00	8		
Cable (MCM)	1,600.00	128		
Insulated Joint (8)		32		
Trenching	370.00	10		
Aerial Cable	$ 67,870.00			
Total Material		362	@ $ 50.00	/ Hour =
Labor Hours		$ 18,100.00		
Labor Cost				

Material & Labor	$85,970.00
W/Testing	X 1.05
Each Master	$ 90,268.50
	X 5
Total for Five Master Locations	$451,342.50

REVISION DESCRIPTION

Item 1 MP 28.77, CB 292, CP 229, Eastbound Home, Eastbound move
See SK-RAK-051493 sheets 2&3.
Revision made necessary by raising MAS from 75 miles per hour to 85 miles per hour.
Solution: Add master location at MP 30.33.

Item 2 MP 40.75, CB 515, CP 240, Eastbound Home, Westbound move
See SK-RAK-051493 sheets 3&4.
Revision made necessary by raising MAS from 85 miles per hour to 100 miles per hour.
Solution: Proposed MAS shown as 100 miles per hour-change to 85 miles per hour-MAS change over limits must change, but no impact on TPC runs.

Item 3 MP 41.13, CB 522, CP 240, Eastbound Home, Eastbound move
See SK-RAK-051493 sheet 4.
Revision made necessary by raising MAS from 85 miles per hour to 100 miles per hour.
Solution: MAS must not change to 100 miles per hour as originally proposed--use 90 miles per hour instead-MAS therefore changes to 90 miles per hour from MP 42.12 to MP 44.06 rather than 100 miles per hour-TPC shows actual simulator speed at 91.47 miles per hour; therefore there is minimal TPC impact-Revision to the wayside is quite difficult in this area-TPC change is more attractive.

Item 4 MP 41.64, CB 532, CP 241, Westbound Home, Westbound move
See SK-RAK-051493 sheet 4.
Revision made necessary by raising MAS from 85 miles per hour to 100 miles per hour.
Solution: MAS must not change to 100 miles per hour as originally proposed--use 90 miles per hour instead-MAS therefore changes to 90 miles per hour from MP 42.12 to MP 44.06 rather than 100 miles per hour-TPC shows actual simulator speed at 91.47 miles per hour thus there is minimal TPC impact-Revision to the wayside is quite difficult in this area-TPC change is more attractive.

Item 5 MP 44.06, CB 574, CP 244, Eastbound Home, Westbound move
See SK-RAK-051493 sheet 4.
Revision made necessary by raising MAS from 85 miles per hour to 100 miles per hour.
Solution: Use 70 miles per hour MAS rather than 100 miles per hour-TPC actual speed is 61.13 miles per hour; therefore no TPC impact.

Item 6 MP 42.49, CB 547, ML 424, Westbound move
See SK-RAK-051493 sheet 4.
Revision made necessary by raising MAS from 75 miles per hour to 100 miles per hour-note that current MAS of 75 miles per hour does not provide safe braking distance.
Solution: Use MAS of 70 miles per hour-TPC actual speed is 61.13 miles per hour; therefore no impact.

Item 7 MP 38.05, CB 468, ML 380/381, Eastbound move
See SK-RAK-051493 sheets 3 & 4.
Revision made necessary by raising MAS from 75 miles per hour to 100 miles per hour.
Solution: change MAS limits-use 85 miles per hour at CB 494-TPC actual speed is 85 miles per hour.

Item 8 MP 53.21, CB 734, ML 531/532, Westbound move
See SK-RAK-051493 sheet 5.
Revision made necessary by raising MAS from 75 miles per hour to 90 miles per hour.
Solution: Move ML 506/507 from MP 51.24 to MP 51.09.

Item 9 MP 55.16, CB 771, CP 255, Eastbound home, Westbound move
See SK-RAK-051493 sheet 5.
Revision made necessary by raising MAS from 75 miles per hour to 90 miles per hour.
Solution: Move ML 544/545 from MP 54.41 to MP 54.46.

Item 10 MP 61.06, CB 871, CP 261, 2W Signal, Eastbound move
See SK-RAK-051493 sheet 6.
Revision made necessary by raising MAS from 85 miles per hour to 90 miles per hour.
Solution: Move ML 637/638 from MP 63.81 to MP 63.84.

Item 11 MP 67.58, CB 986, Automatic 675/ML 676, Westbound move
See SK-RAK-051493 sheets 6 & 7.
Revision made necessary by raising MAS from 85 miles per hour to 100 miles per hour.
Solution: Move ML 649/Automatic 650 from MP 64.95 to MP 64.86.

Item 12 Eastbound moves into New Haven beginning at MP 70.01, CB 1028
Assume New Haven Interlocking will be re-designed to allow proposed TPC speeds.

INTRODUCTION

Addendum 1

This is the first addendum to the document entitled "STUDY INCREASED MAS NEW ROCHELLE TO NEW HAVEN WITH AEM7 SIGNAL SYSTEM IMPACT". A maximum trip time from New York to Boston of three hours has been mandated for Amtrak trains. This mandate necessitated increased speed for Amtrak trains over the New Haven Line from New Rochelle to New Haven. The original study was prepared to assess the ability of the New Haven Line's existing signaling system to accommodate the higher speeds contemplated for Amtrak trains. Areas where the existing signaling system was found to be inadequate were identified in the original report. Solutions to overcome these inadequacies were proposed and cost estimates for implementing these solutions were prepared and presented.

New Haven Line trains share the track with Amtrak trains from New Rochelle to New Haven on the New Haven Line. The original report addressed increasing speed for Amtrak trains only. It was determined after the original report was prepared that increasing speed for Amtrak trains only was of little benefit since the higher speed Amtrak trains would likely be restricted in, many instances, when following slower New Haven Line trains. This addendum was prepared to make an assessment similar to the original report, but considers New Haven Line trains as well as Amtrak trains, as opposed to the original report's consideration of Amtrak trains only.

The distinction between Amtrak and New Haven Line trains arises from the braking characteristics of Amtrak's AEM-7/Amfleet being somewhat better (shorter braking distances) than the New Haven Line trains. The original report showed that the longer braking distances generated by running at higher speeds was partially offset by the better braking characteristics of the Amtrak trains.

This addendum assumes New Haven Line trains running at the same higher speeds as the Amtrak trains used in the original report. The number and nature of modifications to the existing signaling system identified in this addendum are therefore different from those identified in the original report. The modifications identified within this addendum allow for operation of either Amtrak or NHL trains from New Rochelle to New Haven on the New Haven Line at the speeds required to meet the mandated three hour runtime from New York to Boston.

SUMMARY

Addendum 1

The increase in train speed on the New York to New Haven (New Haven Line) portion of Amtrak's route makes necessary the following modifications to the New Haven Line's existing signal system. This document differs from the original release because braking characteristics of New Haven Line equipment were used in place of Amtrak's AEM-7/Amfleet braking characteristics.

- Add Master Location at CB 945, MP 68.10, revision made necessary by raising MAS from 85 miles per hour to 90 miles per hour;

- Change existing Code Change Point at CB 888, MP 61.98 to a Master Location, revision made necessary by raising MAS from 80 miles per hour to 90 miles per hour;

- Change existing Code Change Point at MP 42.12 to a Master Location, revision made necessary by raising MAS from 75 miles per hour to 100 miles per hour;

- Add a Master Location at CB 486, MP 39.08, revision made necessary by raising MAS from 75 miles per hour to 100 miles per hour;

- Extend control line for Automatic Signal 278/Master Location 277 at CB 270, MP 27.55 from MP 30.17 to MP 31.19, revision made necessary by raising MAS from 85 miles per hour to 95 miles per hour;

- Extend control line for Eastbound Home Signal at CP 229, CB 292, MP 28.77 from MP 30.17 to MP 31.19, revision made necessary by raising MAS from 75 miles per hour to 85 miles per hour;

- Change existing Code Change Point at MP 31.76 to a Master Location, revision made necessary by raising MAS from 75 miles per hour to 90 miles per hour;

- Add a Master Location at MP 43.68, revision made necessary by raising MAS from 85 miles per hour to 100 miles per hour;

- Extend control line for Master Location 531/532 at CB 734, MP 53.21 from MP 51.24 to MP 48.76, revision made necessary by raising MAS from 75 miles per hour to 90 miles per hour; and

- Extend control line for Automatic Signal 675/Master Location 676 at CB 986, MP 67.58 from MP 64.95 to MP 63.81, revision made necessary by raising MAS from 85 miles per hour to 100 miles per hour.

It is recommended that new Master Locations should be purchased and installed for each relocation of master locations. Changing a Code Change Point to a Master Location is estimated as a new Master Location.

One Master Location, furnish and install	$ 90,268.50
Quantity of new Master Locations	X 6
Cost for 6 new Master Locations	$ 541,611.00
Extension of control lines at one location,	$ 24,500.00
Quantity of control line extensions	X 4
Cost for control line extension at 4 locations	$ 98,000.00

Total cost for 6 new Master Locations and 4 control line extensions $639,611.00.

DESCRIPTION OF INFORMATION SUPPLIED WITH ADDENDUM 1

Appendix A

Metro-North Braking Chart--contains the braking formula for New Haven Line trains, which was used in the preparation of this addendum.

Appendix B

Safe Braking Calculations--These calculations are similar to those included in the original report but use the Metro-North braking formulas.

Appendix C

Control Line Diagrams--The diagrams prepared for, and included in the original report, were modified to show the braking points resulting from the safe braking calculations using Metro-North braking characteristics. The New Haven Line safe braking points are identified with an "O" whereas the Amtrak safe braking points are identified with an "X". Ignore points denoted by an "X" encircled with an "O".

Appendix D

Revision Description--A short description of the strategies used to overcome inadequacies in the existing signaling system.

REVISION DESCRIPTION FOR NEW HAVEN LINE BRAKING CHARACTERISTICS

Item 1 MP 64.95, CB 940, ML 649/Automatic 650, Eastbound Move
See SK-RAK-051493 sheet 6.
Revision made necessary by increasing MAS from 85 miles per hour to 90 miles per hour.
Solution: Add master location at CB 995 MP 68.10 and terminate MP 64.95 control line at this new master location, versus existing termination at MP 67.58. Clearing time impact: 19 seconds.

Item 2 MP 59.98, CB 857, CP 261, Eastbound Home/ML 601, Eastbound Move
See SK-RAK-051493 sheet 6.
Revision made necessary by increasing MAS from 80 miles per hour to 90 miles per hour.
Solution: Change MAS at MP 61.06 from 90 miles per hour to 85 miles per hour. No other impact.

Item 3 MP 61.06, CB 871, CP 261, Westbound Home/ML 610, Eastbound Move
See SK-RAK-051493 sheet 6.
Revision made necessary by increasing MAS from 80 miles per hour to 90 miles per hour.
Solution: Change CCP at CB 888, MP 61.98 to a master location. No other impact.

Item 4 MP 54.41, CB 775, ML 544/545, Eastbound Move
See SK-RAK-051493 sheet 5.
Revision made necessary by increasing MAS from 75 miles per hour to 100 miles per hour.
Solution: Change MAS at MP 55.16 from 100 miles per hour to 75 miles per hour. No other impact.

Item 5 MP 41.64, CB 532, CP 241, Westbound Home, Eastbound Move
See SK-RAK-051493 sheet 4.
Revision made necessary by increasing MAS from 75 miles per hour to 100 miles per hour.
Solution: Change CCP at MP 42.12 to a master location. No other impact.

Item 6 MP 38.05, CB 468, ML 380/381, Eastbound Move
See SK-RAK-051493 sheet 4.
Revision made necessary by increasing MAS from 75 miles per hour to 100 miles per hour.
Solution: Add a master location at MP 39.08 CB 486. No other impact.

Item 7 MP 40.87, CB 517, CP 240, Westbound Home, Eastbound Move
See SK-RAK-051493 sheet 4.
Revision made necessary by increasing MAS from 75 miles per hour to 85 miles per hour.
Solution: Change MAS at MP 41.13 from 85 miles per hour to 75 miles per hour. No other impact.

Item 8 MP 27.55, CB 270, Auto 278/ML 277, Eastbound Move
See SK-RAK-051493 sheet 2.
Revision made necessary by increasing MAS from 85 miles per hour to 95 miles per hour.
Solution: Extend control line from MP 30.17 to MP 31.19. Clearing time impact: 41 seconds.

Item 9 MP 28.77, CB 292, CP 229, Eastbound Home, Eastbound Move
See SK-RAK-051493 sheet 2.

Revision made necessary by increasing MAS from 75 miles per hour to 85 miles per hour.
Solution: Extend control line from MP 30.17 to MP 31.19. Clearing time impact: 41 seconds.

Item 10 MP 31.19, CB 335, Auto 311/ML 312, Eastbound Move
See SK-RAK-051493 sheet 3.
Revision made necessary by increasing MAS from 75 miles per hour to 90 miles per hour.
Solution: Change CCP at MP 31.76 to a master location. No other impact.

Item 11 MP 21.26, CB 156, ML 212/213, Eastbound Move
See SK-RAK-051493 sheet 2.
Revision made necessary by increasing MAS from 75 miles per hour to 100 miles per hour.
Solution: Change MAS at MP 22.32 from 100 miles per hour to 85 miles per hour. No other impact.

Item 12 MP 18.13, CB 98, ML 181/182, Westbound Move
See SK-RAK-051493 sheet 1.
Revision made necessary by increasing MAS from 90 miles per hour to 100 miles per hour.
Solution: Change MAS at MP 16.95 from 100 miles per hour to 85 miles per hour. No other impact.

Item 13 MP 36.04, CB 432, ML 360/361, Westbound Move
See SK-RAK-051493 sheet 3.
Revision made necessary by increasing MAS from 75 miles per hour to 100 miles per hour.
Solution: Change MAS at MP 34.69 from 100 miles per hour to 85 miles per hour. No other impact.

Item 14 MP 40.75, CB 515, CP 240, Eastbound Home, Westbound Move
See SK-RAK-051493 sheet 4.
Revision made necessary by increasing MAS from 75 miles per hour to 100 miles per hour.
Solution: Change MAS at MP 39.53 from 100 miles per hour to 85 miles per hour. No other impact.

Item 15 MP 44.06, CB 574, CP 244, Eastbound Home, Westbound Move
See SK-RAK-051493 sheet 4.
Revision made necessary by increasing MAS from 85 miles per hour to 100 miles per hour.
Solution: Add master location at MP 43.68. No other impact.

Item 16 MP 42.49, CB 547, Auto 424, Westbound Move
See SK-RAK-051493 sheet 4.
Revision made necessary by increasing MAS from 75 miles per hour to 100 miles per hour.

Solution: Change MAS at MP 41.64 from 100 miles per hour to 60 miles per hour. Negligible runtime impact.

Item 17 MP 43.13, CB 558, Auto 431, Westbound Move
See SK-RAK-051493 sheet 4.
Revision made necessary by increasing MAS from 85 miles per hour to 100 miles per hour.
Solution: Change MAS at MP 42.49 from 100 miles per hour to 85 miles per hour. Negligible runtime impact.

Item 18 MP 53.21, CB 734, ML 531/532, Westbound Move
See SK-RAK-051493 sheet 5.
Revision made necessary by increasing MAS from 75 miles per hour to 100 miles per hour.
Solution: Extend control line from existing termination at MP 51.24 to MP 48.76. Clearing time impact 90 seconds.

Item 19 MP 55.16, CB 771, CP 255, Eastbound Home, Westbound Move
See SK-RAK-051493 sheet 5.
Revision made necessary by increasing MAS from 75 miles per hour to 90 miles per hour.
Solution: Change MAS at MP 54.41 from 90 miles per hour to 75 miles per hour. No other impact.

Item 20 MP 67.58, CB 986, Auto 675/ML 676, Westbound Move
See SK-RAK-051493 sheet 7.
Revision made necessary by increasing MAS from 85 miles per hour to 100 miles per hour.
Solution: Extend control line from existing termination at MP 64.95 to MP 63.81. Clearing time impact 40 seconds.

ADDENDUM 1 SIGNAL SYSTEM IMPACT USING METRO-NORTH BRAKING CHARACTERISTICS

The Northeast Corridor Transportation Plan
New York City to Boston
Volume 2

Appendix J
AMTRAK COMMENTS ON THE PLAN

National Railroad Passenger Corporation, 60 Massachusetts Avenue, N.E., Washington, D.C. 20002 Telephone (202) 906-3000

Amtrak

January 11, 1994

Honorable Jolene Molitoris
Administrator
Federal Railroad Administration
400 Seventh Street, S.W.
Washington, D.C. 20590

Dear Jolene:

As directed by section 4 of the Amtrak Authorization and Development Act of 1992, I am enclosing Amtrak's comments on the Northeast Corridor Improvement Project Boston-New York Program Master Plan. We will provide by separate letter more detailed comments on various, specific aspects of the most recent draft of the Master Plan.

Amtrak applauds the Federal Railroad Administration's effort to establish a blueprint for improvements and upgrades to the nation's most important and heavily traveled rail line. We have enjoyed working with you and your staff on developing the Master Plan and appreciate the efforts you have made to address and accommodate Amtrak's concerns.

Please let me know if you have any questions regarding our comments.

Sincerely,

Thomas M. Downs
President

Enclosure

COMMENTS OF THE
NATIONAL RAILROAD PASSENGER CORPORATION
ON THE
NORTHEAST CORRIDOR IMPROVEMENT PROJECT
BOSTON-NEW YORK
PROGRAM MASTER PLAN

Congress directed that the National Railroad Passenger Corporation, better known as Amtrak, submit formal comments on the Northeast Corridor Improvement Project Boston-New York Program Master Plan (Master Plan). This plan, a blue print for bringing the Northeast Corridor into the next century, has been developed by the Federal Railroad Administration (FRA) pursuant to the Amtrak Authorization and Development Act of 1992.

Amtrak applauds the FRA's work to prepare this comprehensive plan for the systematic improvement of the Northeast Corridor. The improvements identified by FRA would enable the Northeast Corridor to absorb the projected rapid growth in demand for increased, faster and more reliable intercity and commuter rail service, thereby even further enhancing its role as a critical element of the region's -- and the nation's -- transportation system.

As part of the Northeast Corridor Improvement Project, Amtrak has been directed by Congress to implement an ambitious program of improvements that would reduce travel time between New York and Boston to under three hours. The scope of the project -- called the Northeast High-Speed Rail Improvement Project (NHRIP) -- was developed in 1988 by Amtrak and the Coalition of Northeastern Governors as a means of alleviating the growing congestion that is choking the economic health of the Northeast. Both the scope of work for NHRIP and its projected cost remain essentially the same today as when originally developed.

NHRIP involves upgrading the signal system, bridges, and track structure between New Haven and Boston to permit up to 150 mph train operations, electrification of the line between New Haven and Boston, elimination of a number of bottlenecks along segments of track used for both intercity passenger and commuter rail service, and acquisition of a new generation of built-in-America high-speed trainsets capable of higher speeds and attracting the large travel market in the Northeast.

The projected cost for these improvements has changed little since the NHRIP program first was presented to Congress -- approximately $900 million for infrastructure improvements and $450 million for high-speed trainsets. Amtrak has always emphasized that this cost projection for implementation of three-hour New York-Boston service was and continues to be based on a number of assumptions. First, we have assumed that recapitalization of the rail line would continue to be funded in much the same manner as it has been since the transfer of property from the Penn Central to Amtrak and state agencies in 1976: by the owner of the specific section of the railroad. Thus, for example, NHRIP includes various improvements on Amtrak-owned right-of-way needed primarily to address deferred maintenance and ensure reliable train operations. Second, it has been Amtrak's expectation that improvements to expand track capacity (e.g., additional tracks and center island platforms) or speeds on the rail line (e.g., increased track elevation) would be funded by the railroad or agency that primarily benefits from the improvements even if not the owner of the track. Third, Amtrak has had to use budgetary estimates for a number of project components -- primarily maintenance facilities and the high-speed trainsets -- since it still is too early to more accurately project actual costs. Lastly, it is not currently possible to estimate the cost of environmental mitigation or of at-grade crossing elimination, because the FRA has not completed its studies in these areas, or of the cost for implementing a civil speed/positive stop system of high-speed trains, as this system is still under development by Amtrak.

Amtrak is pleased to see that FRA acknowledges on Page I-8 of its Master Plan Executive Summary that, with certain adjustments, the "cost of the trip time projects is roughly equivalent to the NEHRIP estimate". We do not agree with the decision by the FRA to include a number of additional specific recapitalization (e.g., concrete ties in commuter territory) and capacity expansion projects in the cost of completing NHRIP. Nonetheless, we recognize that recapitalization and capacity expansion projects ultimately are essential over the next 20 years if the rail line is to reliably and cost effectively support projected increases in all types of rail service, including intercity passenger, commuter, and freight. Amtrak is confident that the responsibility for funding these projects can be resolved as the need for them becomes more critical.

Amtrak has provided detailed comments to the FRA throughout the drafting of the Master Plan and the FRA has been able to address many of these comments and concerns. The manner in which the FRA has sought input from impacted railroads and agencies has been a model for reaching consensus on an issue as important and comprehensive as this. Amtrak looks forward to working with the FRA and all the users of the rail line to implement this program of improvements that is so essential to the continues economic vitality of the entire Northeast.

Importance Of The Northeast Corridor

The Northeast Corridor rail line is a resource of invaluable importance to transportation, the economy and environment of the entire northeastern quadrant of our nation. Amtrak owns and operates much of the Northeast Corridor and has succeeded over the years in coordinating train schedules and construction work with state agencies and railroads that operate over or own portions of the rail line. Well over 100 million commuter and 11 million intercity passengers use the rail line annually to travel in the region, providing an environmentally sound and energy efficient alternative to the congestion that is choking the region's highway and air transportation systems. Without efficient, reliable rail passenger service on the Northeast Corridor, the region's -- and the nation's -- economy would falter.

Unfortunately, while there are relatively abundant federal, state and local resources for billion dollar upgrades to area roads and highways and for investment in airports and air traffic control systems, funding for maintenance and upgrade of the nation's busiest and most important rail corridor is paltry compared to its needs. Deterioration of the rail line would directly lead to the need for massive investments in increased highway and airport expansion; yet, historically, the federal government and states have had to scrape together funding merely to keep the rail line in operation. This makes no sense from a transportation, environmental or economic perspective and has severely complicated the Congressionally-mandated goal of upgrading the rail line to permit three-hour New York-Boston rail passenger service.

The Master Plan underscores two very important points:

- A significant investment is required simply to address four decades of deferred maintenance in the railroad. Capital investment by predecessor railroads and federal and state governments over the last 40 years in the New York-Boston segment of the Northeast Corridor rail line has totaled only a small fraction of the investment that should have been made to protect the rail line and address the depreciating plant. As a result, we are faced with the need for a major and costly rebuilding of the rail line in a short period of time, resulting in delays to passengers, longer train schedules, and disruption to the region's economy.

- Despite the need for upgrading, the Northeast corridor rail line offers an enormous opportunity to expand transportation in the region without the need for property acquisition and with significant positive environmental benefits. Amtrak's project to reduce New York-Boston travel time to under three hours will result in an substantial transfer of travelers from automobiles and airplanes to the train and permit Amtrak to become the mode of choice for intercity transportation along the entire Northeast Corridor. MBTA, RIDOT, ConnDOT, MTA, LIRR and Metro North all project significant increases in passenger volumes over the next two decades. While it will be a challenge to adapt the rail line to handle this projected increase in service, the improvements identified by FRA will permit an enormous increase in rail passenger service with minimal changes to the physical layout of the rail line. Given the public outcry against new highways and airports, the ability of the rail line to handle significantly increased traffic is a major and irreplaceable benefit.

These two points are important when considering the 15-year total cost of over $3 billion projected by FRA to complete the master plan of improvements. While this is a large sum of money, it represents only a tiny fraction of the cost of constructing a new lane on Interstate 95 or adding capacity at regional airports. Nonetheless, funding for improvement of rail infrastructure has never been easy to allocate through the general revenues portion of the federal budget and, absent a dedicated rail capital investment trust fund, will become more and more difficult to find.

In this regard, Amtrak, and all travelers in the Northeast, have benefitted enormously from the leadership and vision of Senator Frank R. Lautenberg, who chairs the Senate Subcommittee on Transportation and Related Agencies Appropriations. His interest in improved rail passenger service has made possible critical funding to maintain the Northeast Corridor as well as Amtrak's current high-speed rail project between New York and Boston. Fortunately, there is now strong support for the upgrade of the corridor from the Secretary of Transportation Federico Pena and FRA Administrator Jolene Molitoris, and from Representative Bob Carr, Chairman of the House Transportation Appropriations Committee. Despite the tough federal budget environment, this support augers well for implementing the program of improvements that FRA has identified as essential to ensure that the Northeast Corridor rail line can handle the growing demand for reliable high-speed and commuter passenger service.

Specific Comments On The Master Plan

Amtrak wishes to address several general issues in these comments, which are discussed below.

1. Timing For And Ability To Achieve Three Hour Service. Amtrak is extremely pleased that the Master Plan confirms that reliable three-hour New York-Boston service is readily achievable on the Northeast Corridor even though all users of the rail line intend to significantly increase service over the next 15 years. Indeed, electrification of the railroad and elimination of various bottlenecks in New York, Connecticut and Massachusetts, will ultimately permit faster, electrified MBTA and Shore Line East commuter service and improved reliability of all passenger service.

As part of NHRIP, Amtrak has developed an extremely powerful and sophisticated computer modeling capability -- called Monte Carlo -- that can actually "run" a railroad using various operating scenarios. The program, originally written by Transportation and Distribution Associates (TAD) and modified by Amtrak, can vary the number and speed of trains, take tracks out of service, change track configurations, and alter station facilities (e.g., assume use of high-level platforms to reduce dwell time). Monte Carlo permits a modeling of the railroad that reflects the vagaries of the daily operations -- trains running late, track outages, etc. The FRA used Amtrak's model for a number of its own analyses included in the Master Plan.

It is on the basis of this modeling that Amtrak identified the program of improvements necessary to achieve a reliable three-hour or better New York-Boston service. After reviewing the Master Plan in detail, Amtrak remains as confident as ever that reliable three-hour service will be achieved upon completion of the NHRIP program and that implementation of faster and more frequent Amtrak service will not adversely impact the reliability of commuter service. In this regard, it is important to note that three-hour service requires no changes to Metro North's New Haven-New Rochelle segment of track except the ability to operate at five inches of cant deficiency. Thus, while other improvements in commuter territory would permit even further reductions in travel time, Amtrak is not depending on them to achieve a reliable three-hour schedule.

Amtrak's high-speed rail improvement program contemplates the completion of electrification during 1997. Amtrak plans incremental reductions in scheduled travel time following completion of the electrification system and other improvement projects. Three hour service depends on the use of new high-speed trainsets and will then be phased in as they are delivered.

With good management of the rail line by its respective owners and tight coordination of work activities, Amtrak believes reliable three hour service -- including the customary "pad time" (extra time built into the schedule) of five percent -- can be initiated by summer of 1999 (assuming timely delivery of the high-speed trainsets). This is about two years earlier than projected in the Master Plan, which assumes a more rapid and greater level of non-NHRIP construction work on the rail line by the end of the decade than Amtrak believes is realistic.

Clearly, the ultimate timing for completion of the New York-Boston high-speed rail improvements, as well as for other projects undertaken by the states to address deferred maintenance, will depend greatly on when funding is appropriated by Congress and state legislatures and how projects are prioritized. Amtrak remains fully committed to implementing its three hour Metroliner Service program in 1999 and intends to work very closely with Congress, the FRA and state agencies to ensure that all improvements progress in an orderly, efficient manner with the least adverse impact to rail travelers.

2. Control Of Train Operations. The Master Plan suggests that service over the New York-Boston corridor could be better coordinated and made more reliable if a single entity controlled all train operations, much as Amtrak does south of New York. Currently, Metro North controls the New Rochelle-to-New Haven segment of the rail line, with Amtrak controlling the remainder. Amtrak and Long Island Railroad jointly dispatch trains through the tunnels between Harold Interlocking in Queens and Penn Station.

It is important to emphasize that the current coordination between Amtrak and Metro North and Amtrak and Long Island Railroad has worked well. Amtrak and Metro North have established strong working relations over the past decade that has made decisions affecting the scheduling of trains through commuter territory more equitable and responsive to each railroad's needs. Amtrak and Long Island Railroad shared train dispatching responsibilities has been extremely successful in coordinating the hundreds of trains traveling between Penn Station and Queens.

While a single operator would present many benefits, Amtrak believes that the current coordination between the railroads has worked and can work well. Amtrak intends to work as closely as possible to ensure that improvements made between New York and Boston are implemented in a manner that maximizes the reliability of service and meets the specific needs of each of the railroads.

3. Freight Service. Much concern has been raised by officials and shippers in Connecticut and Rhode Island regarding the impact of increased passenger service on freight service

along the Northeast Corridor. The Providence and Worcester Railroad (P&W) provides freight service in Rhode Island under an agreement and perpetual easement with Amtrak. It also operates in Connecticut as the assignee of Conrail, with which Amtrak has an agreement. Amtrak recognizes the importance of maintaining existing and providing for future freight service on the Corridor. In this regard, Amtrak has committed to the following:

- electrification of the rail line between New Haven and Boston will be designed so that it does not physically interfere with the freight railroads' ability to provide existing freight service. Thus, where necessary, clearances under overhead bridges and width clearances will be increased to eliminate any impediment to existing freight service. Amtrak has not been provided funding to increase clearances under overhead bridges in order to permit the use of double stack or tri-level automobile carriers by the freight railroads. However, these modern freight cars cannot be used today due to inadequate clearances.

- the electrification system will not impair the ability to construct a third track for freight use between Davisville and Pawtucket, Rhode Island, a distance of 22 miles. To this end, Amtrak is progressing the design of portal structures that can be constructed along the railroad to span the property where a third track would be built. This will help minimize the property acquisition cost and environmental impact of constructing the third track. It should be noted that the issue of financial responsibility for the incremental cost of the portal structures has not been resolved.

- the electrification system will be designed to accommodate the need for the accepted additional commuter and freight sidings. Over the past two years, all users of the rail line -- commuter railroads, state agencies and freight carriers -- have been requested to identify projected growth on the rail line for the year 2010. All improvements necessary to accommodate this growth have been included in the Master Plan. In the case of local freight service (as well as commuter service), a number of passing sidings ultimately will be required in order for the railroad to reasonably accommodate projected service levels. Portal structures will be installed to span future side tracks where necessary to increase the capacity of the railroad. It is unclear precisely when these additional sidings will be needed, but use of the portal structures will minimize the cost of constructing them when appropriate.

It is important to note that section 703 of the Railroad Revitalization and Regulatory Reform Act of 1976, in which Congress set forth the specific goals of the Northeast Corridor Improvement Project, establishes a priority for the scheduling of intercity passenger trains over freight trains. While the law also recognizes the importance of maintaining and improving commuter and freight service, this goal is to be achieved only to the extent such improvement is compatible with the goal of regularly scheduled and dependable intercity passenger service (with commuter service taking precedence over freight service).

Amtrak recognizes that both the reliability and cost of freight service are critical factors in the decision by shippers to use rail freight service and, in some cases, to remain in business at their current locations. Nonetheless, with the constraints posed by a congested two track railroad, Amtrak cannot promise that there will be no impact on either reliability or cost as traffic by all users of the rail line increases in the coming decades. There will always be a balancing of interests -- intercity passenger versus commuter; commuter versus freight; freight versus intercity passenger -- at the base of all decisions regarding schedules, levels of service and the funding of improvements. For its part, Amtrak intends to work closely with the P&W and its shippers to minimize any adverse impacts to freight service.

4. Air Quality Improvement. The Master Plan downplays the important improvements that upgrade of the rail line -- both to provide high-speed passenger service and increased commuter service -- will have for the region's air quality. Indeed, the Draft Environmental Impact Statement on electrification of the New Haven-Boston rail line found that elimination of diesel passenger rail service, as well as reduction in automobile and airline traffic, will result in a significant reduction in air pollution along the rail line. This is particularly important for a region that currently fail to comply to federal Clean Air Act mandates. The DEIS projected the following annual net decrease in pollutants:

- Volatile Organic Compounds (VOC):
  reduction of 174 kg/day (63,510 kg/year) -- 7%
- Nitrous Oxides:
  reduction of 1658 kg/day (605,170 kg/year) -- 13%
- Carbon Monoxide:
  reduction of 946 kg/day (378,870 kg/year) -- 4%

The DEIS also found that electrification of passenger service will result in a net annual decrease of 10 million gallons of transportation fuel and a net reduction in the amount of petroleum imported by the nation of over 4 million gallons.

Moreover, these improvements are based solely on improved Amtrak service and do not take into account the impact of the increased level of service planned by commuter authorities along the rail line for the year 2010.

Given that the alternative to improved rail service is increased highway or airport usage, these reductions in pollution represent an important means for improving the quality of the air in the Northeast.

CONCLUSION

The Northeast Corridor has been extremely fortunate that key members of Congress, the Administration, and state government have supported the funding necessary for its upgrade despite the constraints imposed by the federal deficit. Strong leadership and vision will continue to be required if the improvements identified in the Master Plan are to be implemented over the next two decades. The result, however, will be a heavily utilized, energy efficient and environmentally superior alternative to the congestion that is clogging the region's highways and airports. Moreover, the cost of these improvements pale in comparison with the cost of highway and airport capacity expansion projects that otherwise would be required.

The FRA has done an excellent job in developing a Master Plan of improvements that will permit the Northeast Corridor to achieve its full transportation potential. Amtrak looks forward to working with the FRA, the Congress and state officials in the coming years to ensure that this potential is fully achieved.

The Northeast Corridor Transportation Plan

New York City to Boston

Volume 2

Appendix K
EVALUATION OF NEW HAVEN LINE'S POWER SYSTEM

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Appendix K
EVALUATION OF THE NEW HAVEN LINE'S POWER SYSTEM

INTRODUCTION

De Leuw, Cather & Co. performed a preliminary analysis of the ability of the New Haven Line's existing power supply system to accommodate the increased electrical loadings that would result from the year 2010 rail traffic between New Rochelle, NY and New Haven, Ct. The purpose of the study was to perform a first order of magnitude approximation of the existing power supply system to determine if there were any areas of potential concern that would require a more detailed investigations. This summary report discusses the methodology and findings of the initial analysis, and presents recommendations for additional, more detailed study and analysis.

METHODOLOGY

The existing New Haven Line power supply system is an autotransformer system operating at 12.5,0,12.5 kV, 60 Hz. Originally constructed in 1908-1913 as a 25 Hz system, it was upgraded to 60 Hz in the late 1970's. The catenary system between New Rochelle, N.Y. and the New York-Connecticut State Line has been replaced with a modern auto-tensioned simple system. Between the New York-Connecticut State Line and Stamford, CT. the original triangular catenary configuration is used. Between Stamford and New Haven, CT., the original Hanging Beam configuration is still in service. CDOT plans to replace these two original styles of catenary with a configuration similar to that recently installed in New York State.

Four key components of the power supply system were examined to obtain an initial assessment of the system's ability to accommodate the increase in traffic levels and Amtrak's next generation of high performance rolling stock. The four components were:

- the supply substations,
- the autotransformer substations,
- the along-track autotransformer feeders, and
- the overhead catenary system.

These are the major components of the power supply system, each one being critical to the adequate supply of reliable power to the rolling stock.

To model the power system to assess its ability to accommodate year 2010 traffic levels several simplifying assumptions were made:

- All Phase Breaks were considered as open. This presents a worst case scenario for the supply substations, which are normally fed from the same utility phase relationships on the northern end of the line, and operate with the phase breaks closed;
- Line impedances and losses were neglected. The catenaries and feeders represent an infinite bus as far as the trains are concerned;
- Autotransformer substations were treated as center fed substations. Contributions from adjacent substations were not calculated. The feeding zone approximated for the autotransformer substations was the zone defined as half the distance from its adjacent substations. While this does not agree with the actual feeding system employed on the New Haven Line, it does provide a reasonable first order approximation of the loadings;
- Contingency operations were not analyzed;
- The rail return system was not evaluated. It was assumed that return currents and voltage rise would remain within acceptable limits;
- Utility and transformer impedances were neglected;
- Two-hour ratings were used to assess substation thermal capacity; and
- Evaluations were performed for both standard rolling stock and future high-performance Amtrak rolling stock.

A power demand simulation was performed using an energy analysis program. This program uses the electrical and mechanical characteristics of the rolling stock, timetables and alignment data to calculate the energy demand of the various trains. The consist and schedule data is then used to simulate all the trains running on the route, and the energy demands on the various substations is calculated. It is noted that the maximum demands occurred during morning and evening rush periods, with the exception of the yards, which exhibited the greatest demands during night layovers and early morning dispatching.

FINDINGS

The existing utility supply substations appear to have adequate capacity to accommodate the presently perceived future load growth when evaluated on a two-hour basis. The evaluation of the supply substations was performed on their base transformer ratings as supplied by Metro-North. Increases in rating due to forced air and oil cooling were not considered. This allowed a more conservative approach to the evaluation. The 30 minute (both low and high power load) demands are summarized in Table K-1. The two-hour (both low and high power load) demands are summarized in Table K-2. The one minute (both low and high power load) demands are summarized in Table K-3.

The existing Autotransformer substations appear to be the greatest cause for concern. When examining both low and high power scenarios, some autotransformer substations demonstrated loadings in excess of their two-hour thermal rating. This will require the addition of autotransformer capacity at selected autotransformer stations to mitigate the overload conditions. The 30 minute (both low and high power load) demands are summarized in Table K-4. The two-hour (both low and high power load) demands are summarized in Table K-5. The one minute (both low and high power load) demands are summarized in Table K-6.

The existing autotransformer feeder system appears to have adequate capacity when all feeders are in service. When two feeders are removed from service (i.e., routine maintenance outage), there are several sections of the feeder system that appear to be marginal in their ability to accommodate the loadings. It may be possible to limit train performance during outages to mitigate the effects of the thermal loading on the feeders. Another option would be to limit outages to off peak periods, which would avoid the high loadings occurring during critical times. The worst one minute, 15 minute, and 30 minute loads (both low and high power) are presented in Table K-7.

The present and proposed replacement catenaries appear to have marginal thermal capacity to support the proposed high performance consists. The results of the ampacity calculations performed are presented in Table K-8. This analysis supports Metro-North's and CDOT's decision to replace the existing catenaries. The data indicates that the replacement catenaries may have an adequate time constant to support the high performance train if the system is idle and at ambient temperature before the train enters a feeding section. A characteristic of the Overhead catenary system is that it will heat every time a train enters the section. It will then cool before the next load is applied. The next train in the section will again heat the wire, starting from the temperature it has cooled to. Therefore, frequent trains may not provide sufficient cooling time, which eventually may overheat the wire. This can be critical in several sections of the route where the autotransformer station spacings and schedule headways may allow a following train into a feeding section of catenary before, or immediately after, the leading train has cleared out. The consequences of overheating are accelerated annealing of the conductors, which causes a detrimental reduction in mechanical properties.

Recognizing that the New York State replacement has been accomplished, the need for parallel feeders to augment the catenary conductors should be assessed.

Demand Percentage Analyses

The low and high power load demand data for the 10 highest two demand periods was evaluated to determine the percentage of the load that would be allocable to the three electrified operations-Amtrak, New Haven Line and Shore Line East-modelled in 2010. Shore Line East operations only affected Fair St. Autotransformer Substation and Devon Feeder Substation. The percentage breakdowns are summarized in: Table K-9 for Autotransformer Substations (high power), Table K-10 for Autotransformer Substations (low power), and Table K-11 for Feeder Substations. The percentage breakdown by service varies by location. With the exception of New Haven Autotransformer Substation, the peak power demand of New Haven Line trains is responsible for the largest percent of the demand. Furthermore, the New Haven Line peak period demand percentage increases as the substation locations near New York City, as would be expected by the increased volume of commuter rail operations.

RECOMMENDATIONS

The study undertaken for this report only represents a first order of magnitude evaluation of the existing power supply system. Its purpose was to use initial approximations to identify areas where there is a reasonable comfort level that the system has adequate capacity, and, conversely, those areas where there may be reason for concern.

This initial study has indicated that there are several areas of concern for the capability of the existing New Haven Line power supply system to support future high speed trains along with an increase in commuter traffic. These concerns are in the area of autotransformer capacity, feeder capacity, and Overhead catenary system thermal characteristics. There are also several areas that were beyond the scope of this initial study, which will warrant further investigation as part of a comprehensive system study and evaluation.

It is therefore recommended that a further, more detailed study be undertaken to address these concerns. The detailed study should include, but not be limited to:

A. A complete computer simulation and analysis of the traction power system. The computer model to be used should be capable of modeling the complete electrical network and various train schedules. Schedule deviations and the mix of rolling stock should be accommodated, as well as contingency operations. A complete electrical simulation program, similar to PDI's TRAKPAC or Electrack's RAILPOWER, will be required to fully simulate the system.

B. Overhead catenary system thermal characteristics warrant further investigation in detail. This is normally a function included in the analysis noted above. The analysis must include the effects of the cyclic loading due to train schedules and consists.

C. Utility coordination should be undertaken to determine the utility feed characteristics and limitations with respect to the unique demand requirements of the traction power system.

D. The study should include an analysis of circuit breaker sizing and protection. CDOT currently is undertaking a circuit breaker replacement program. The impacts of the future operations and high performance rolling stock should be considered in this design and protection coordination.

E. The rail return system should be investigated from both a capacity and voltage rise standpoint. Higher performance trains and more frequent schedules can lead to increased return currents and rail potential rise.

F. Signalling and communications equipment should be checked for adequacy to accommodate increased rail return and fault currents as well as EMI levels.

G. The proposed replacement Overhead catenary system should be checked for dynamic compliance with the higher speed trains and pantographs. Although currently accepted practices would indicate that the proposed replacement system should exhibit satisfactory performance with a single high speed pantograph, further examination may be prudent due to the long stretches of equal span lengths, and the potential to use high speed consists with multiple pantographs.

Table K-1
30 MINUTE DEMANDS FOR FEEDER SUBSTATIONS

LOW POWER LOADS						
FEEDING SS NAME & NUMBER	OVERALL CONT. RATING (KVA)	30min. RATING @250%(KVA)	LOAD DEMAND			COMMENT
			(KW)	(KVAR)	(KVA)	
Mt. Vernon (23W)	10000	25000	DOES NOT SUPPLY NEC			N/A
Mt. Vernon (23E)	10000	25000	12107	7810	14407	OK
Cos Cob (310W)	10000	25000	10565	7115	12737	OK
Cos Cob (310E)	15000	37500	17128	11315	20528	OK
Sasco Creek (51R)	15000	37500	14153	9380	16979	OK
Devon (26M)	15000	37500	11354	7202	13446	OK

HIGH POWER LOADS						
FEEDING SS NAME & NUMBER	OVERALL CONT. RATING (KVA)	30min. RATING @250%(KVA)	LOAD DEMAND			COMMENT
			(KW)	(KVAR)	(KVA)	
Mt. Vernon (23W)	10000	25000	DOES NOT SUPPLY NEC			N/A
Mt. Vernon (23E)	10000	25000	12182	7846	14490	OK
Cos Cob (310W)	10000	25000	10618	7082	12763	OK
Cos Cob (310E)	15000	37500	17456	11474	20889	OK
Sasco Creek (51R)	15000	37500	14714	9648	17595	OK
Devon (26M)	15000	37500	11561	7278	13661	OK

Table K-2
TWO HOUR DEMANDS FOR FEEDER SUBSTATIONS

LOW POWER LOADS

FEEDING SS NAME & NUMBER	OVERALL CONT. RATING (KVA)	2 HR RATING @ 150% (KVA)	LOAD DEMAND (KW)	LOAD DEMAND (KVAR)	LOAD DEMAND (KVA)	COMMENT
Mt. Vernon (23W)	10000	15000	DOES NOT SUPPLY NEC			N/A
Mt. Vernon (23E)	10000	15000	11006	7020	13054	OK
Cos Cob (310W)	10000	15000	10809	7469	13139	OK
Cos Cob (310E)	15000	22500	15637	10575	18877	OK
Sasco Creek (51R)	15000	22500	13101	8989	15888	OK
Devon (26M)	15000	22500	10903	6776	12837	OK

HIGH POWER LOADS

FEEDING SS NAME & NUMBER	OVERALL CONT. RATING (KVA)	2 HR RATING @ 150% (KVA)	LOAD DEMAND (KW)	LOAD DEMAND (KVAR)	LOAD DEMAND (KVA)	COMMENT
Mt. Vernon (23W)	10000	15000	DOES NOT SUPPLY NEC			N/A
Mt. Vernon (23E)	10000	15000	11154	7238	13297	OK
Cos Cob (310W)	10000	15000	10927	7501	13254	OK
Cos Cob (310E)	15000	22500	15885	10682	19143	OK
Sasco Creek (51R)	15000	22500	13537	9158	16344	OK
Devon (26M)	15000	22500	11217	6940	13190	OK

Table K-3
ONE MINUTE DEMANDS FOR FEEDER SUBSTATIONS

LOW POWER LOADS						
FEEDING SS NAME & NUMBER	OVERALL CONT. RATING (KVA)	1 MIN RATING @ 400% (KVA)	LOAD DEMAND (KW)	(KVAR)	(KVA)	COMMENT
Mt. Vernon (23W)	10000	40000	DOES NOT SUPPLY NEC			N/A
Mt. Vernon (23E)	10000	40000	22837	14255	26921	OK
Cos Cob (310W)	10000	40000	21668	15776	26803	OK
Cos Cob (310E)	15000	60000	27895	18564	33508	OK
Sasco Creek (51R)	15000	60000	25403	17190	30673	OK
Devon (26M)	15000	60000	21161	14327	25555	OK

HIGH POWER LOADS						
FEEDING SS NAME & NUMBER	OVERALL CONT. RATING (KVA)	1 MIN RATING @ 400% (KVA)	LOAD DEMAND (KW)	(KVAR)	(KVA)	COMMENT
Mt. Vernon (23W)	10000	40000	DOES NOT SUPPLY NEC			N/A
Mt. Vernon (23E)	10000	40000	23235	14447	27360	OK
Cos Cob (310W)	10000	40000	21541	15814	26723	OK
Cos Cob (310E)	15000	60000	28319	18769	33974	OK
Sasco Creek (51R)	15000	60000	26263	17235	31413	OK
Devon (26M)	15000	60000	23527	15412	28126	OK

Table K-4

THIRTY MINUTE DEMANDS FOR AUTOTRANSFORMER SUBSTATIONS

ATSS NAME & NUMBER		CONT. RAT(KVA)	30 MIN RTG @ 250%(KVA)	LOW POWER OPERATIONS LOAD DEMAND (KW)	LOW POWER OPERATIONS LOAD DEMAND (KVAR)	LOW POWER OPERATIONS LOAD DEMAND (KVA)	LOW POWER OPERATIONS COMMENT	HIGH POWER OPERATIONS LOAD DEMAND (KW)	HIGH POWER OPERATIONS LOAD DEMAND (KVAR)	HIGH POWER OPERATIONS LOAD DEMAND (KVA)	HIGH POWER OPERATIONS COMMENT
Vern	0	6000	15000				NOT				NOT
Mount Vernon	23	4000	10000				IN				IN
New Rochelle W.	61W	8000	20000				STUDY				STUDY
New Rochelle E.	61E	8000	20000	3437	2151	4055	OK	3442	2147	4057	OK
Mamaroneck	128	6000	15000	6942	4444	8243	OK	6971	4427	8258	OK
Harrison	178	6000	15000	3843	2395	4528	OK	3775	2315	4428	OK
Pike	93	12000	30000	2515	1573	2966	OK	2555	1592	3010	OK
E. Port Chester	245	4000	10000	3888	2779	4779	OK	4006	2837	4909	OK
Cos Cob W.	310W	4000	10000	4013	2631	4799	OK	4065	2772	4920	OK
Cos Cob E.	310E	4000	10000	1444	992	1752	OK	1560	1072	1893	OK
Stamford	374	12000	30000	8486	5507	10116	OK	8649	5586	10296	OK
Darien	465	4000	10000	4291	3025	5250	OK	4304	3032	5265	OK
South Norwalk	524	4000	10000	3973	2610	4754	OK	3908	2557	4670	OK
East Norwalk	537	4000	10000	731	527	901	OK	753	520	915	OK
Sasco Creek	634	8000	20000	6192	4307	7543	OK	6385	4171	7627	OK
Burr Road	736	4000	10000	5525	3626	6609	OK	5763	3741	6871	OK
E. Bridgeport	814	4000	10000	5410	3437	6409	OK	5520	3491	6531	OK
Devon	867	8000	20000	2524	1690	3038	OK	2444	1622	2933	OK
Woodmont	962	8000	20000	3322	2279	4029	OK	3523	2251	4181	OK
New Haven	1060	12000	30000	3523	2218	4163	OK	3675	2290	4330	OK
Fair Street	1081			5025	2542	5631	FEED FROM NEW HAVEN	5025	2542	5631	FEED FROM NEW HAVEN

Table K-5
TWO HOUR DEMANDS FOR AUTOTRANSFORMER SUBSTATIONS

ATSS NAME & NUMBER		CONT. RAT(KVA)	2Hr.RATING @175%(KVA)	LOW POWER OPERATIONS LOAD DEMAND (KW)	(KVAR)	(KVA)	COMMENT	HIGH POWER OPERATIONS LOAD DEMAND (KW)	(KVAR)	(KVA)	COMMENT
Vern	0	6000	10500				NOT				NOT
Mount Vernon	23	4000	7000				IN				IN
New Rochelle W.	61W	8000	14000				STUDY				STUDY
New Rochelle E.	61E	8000	14000	4036	2851	4941	OK	4100	2879	5010	OK
Mamaroneck	128	6000	10500	7270	4746	8682	OK	7534	4847	8958	OK
Harrison	178	6000	10500	5158	3336	6143	OK	5271	3393	6269	OK
Pike	93	12000	21000	3797	2504	4548	OK	3939	2585	4711	OK
E. Port Chester	245	4000	7000	4607	3364	5704	OK	4646	3368	5738	OK
Cos Cob W.	310W	4000	7000	5761	3992	7009	MARGINAL	5899	4054	7158	MARGINAL
Cos Cob E.	310E	4000	7000	2357	1659	2882	OK	2491	1766	3053	OK
Stamford	374	12000	21000	8851	6024	10706	OK	8993	6093	10863	OK
Darien	465	4000	7000	5227	3857	6496	MARGINAL	5394	3798	6597	MARGINAL
South Norwalk	524	4000	7000	5193	3523	6275	OK	5152	3458	6205	OK
East Norwalk	537	4000	7000	1650	1212	2047	OK	1714	1239	2115	OK
Sasco Creek	634	8000	14000	6820	4703	8284	OK	7158	4844	8643	OK
Burr Road	736	4000	7000	6267	4269	7583	MARGINAL	6439	4334	7762	MARGINAL
E. Bridgeport	814	4000	7000	3623	2150	4213	OK	3703	2179	4297	OK
Devon	867	8000	14000	4382	3006	5314	OK	4454	3034	5389	OK
Woodmont	962	8000	14000	4788	3257	5791	OK	5014	3342	6026	OK
New Haven	1060	12000	21000	4345	2866	5205	OK	4411	2862	5258	OK
Fair Street	1081			4829	2577	5474	FEED FROM NEW HAVEN	4829	2577	5474	FEED FROM NEW HAVEN

Table K-6
ONE MINUTE DEMANDS FOR AUTOTRANSFORMER SUBSTATIONS

ATSS NAME & NUMBER		CONT. RAT(KVA)	ONE MIN RTG @ 300%(KVA)	LOW POWER OPERATIONS LOAD DEMAND (KW)	(KVAR)	(KVA)	COMMENT	HIGH POWER OPERATIONS LOAD DEMAND (KW)	(KVAR)	(KVA)	COMMENT
Vern	0	6000	18000				NOT				NOT
Mount Vernon	23	4000	12000				IN				IN
New Rochelle W.	61W	8000	24000				STUDY				STUDY
New Rochelle E.	61E	8000	24000	10910	7917	13480	OK	10910	7917	13480	OK
Mamaroneck	128	6000	18000	16770	12465	20895	FAIL	16770	20895	26792	FAIL
Harrison	178	6000	18000	15973	10992	19390	FAIL	16309	1154	16350	OK
Pike	93	12000	36000	11313	7733	13703	OK	12264	8193	14749	OK
E. Port Chester	245	4000	12000	15538	11385	19263	FAIL	15538	11385	19263	FAIL
Cos Cob W.	310W	4000	12000	6009	4690	7623	OK	17627	13115	21971	FAIL
Cos Cob E.	310E	4000	12000	16481	12293	20561	FAIL	6009	4690	7623	OK
Stamford	374	12000	36000	20988	14894	25736	OK	20986	14894	25734	OK
Darien	465	4000	12000	18595	15725	24353	FAIL	18595	15725	24353	FAIL
South Norwalk	524	4000	12000	12361	8695	15113	FAIL	12485	8855	15306	FAIL
East Norwalk	537	4000	12000	5225	4146	6670	OK	5689	3849	6869	OK
Sasco Creek	634	8000	24000	17293	12005	21052	OK	19853	12201	23302	MARGINAL
Burr Road	736	4000	12000	17565	12653	21648	FAIL	17565	12653	21648	FAIL
E. Bridgeport	814	4000	12000	10252	6737	12267	MARGINAL	23913	16347	28966	FAIL
Devon	867	8000	24000	11908	7690	14175	OK	12043	8442	14707	OK
Woodmont	962	8000	24000	12782	8530	15367	OK	12361	7394	14404	OK
New Haven	1060	12000	36000	15148	11597	19078	OK	15148	11597	19078	OK
Fair Street	1081			9363	7538	12020	FEED FROM NEW HAVEN	9681	8011	12566	FEED FROM NEW HAVEN

Table K-7
AUTOTRANSFORMER SYSTEM FEEDER EVALUATION

SUBSTATION	FEEDER RATINGS		LOW POWER LOADS			HIGH POWER LOADS		
	FULL CAP	OUTAGE	WORST 1 Min	WORST 15 Min	WORST 30 Min	WORST 1 Min	WORST 15 Min	WORST 30 Min
DEVON	1920	960	1217	837	640	1339	875	651
SASCO CREEK	1920	960	1416	1006	809	1495	1035	838
COS COB EAST	1920	960	1596	1157	978	1618	1167	995
COS COB WEST	1920	960	1276	724	607	1273	729	608
MT VERNON	1920	960	1281	769	686	1303	769	690

Denotes feeder does not support loads during outage
All feeders are adequate for normal conditions

NOTE: Evaluation based on 4 No. 4/0 Feeders in Full Capacity Operation
2 No. 4/0 Feeders in Outage Condition
4/0 Feeders are rated at 480 Amps RMS @ 75 Deg C.

Table K-8
OCS AMPACITY CHECK

OCS STYLE	RMS RATING	SINGLE AEM-7	TIME TO HEAT	DOUBLE AEM-7	TIME TO HEAT
Existing OCS	575 Amperes	764 Amperes	9.6 Minutes	1528 Amperes	2.3 Minutes
Proposed OCS	915 Amperes	764 Amperes	N/A	1528 Amperes	3.8 Minutes

NOTES:

1. Neglects Steel Messengers in Existing Catenaries
2. AEM-7 Currents based on TPC runs by D&Z (1 minute)
3. OCS Ratings are for worn wire
4. OCS ratings and times calculated for 75 Deg. C
5. Loads do not include the use of catenaries for autotransformer feeders, which can add an additional 400 Amperes per catenary

Table K-9
TWO HOUR DEMAND SHARING
AUTOTRANSFORMER SUBSTATIONS

ATSS NAME & NUMBER		HIGH POWER OPERATIONS DEMAND (KW)	PERCENTAGE AMTRAK	PERCENTAGE NHL/SLE
Vern	0	A	0.00%	100.00%
Mount Vernon	23	A	0.00%	100.00%
New Rochelle W.	61W	A	0.00%	100.00%
New Rochelle E.	61E	4100	16.94%	83.06%
Mamaroneck	128	7534	26.87%	73.13%
Harrison	178	5271	26.26%	73.74%
Pike	93	3939	25.56%	74.44%
E. Port Chester	245	4646	28.58%	71.42%
Cos Cob W.	310W	5899	31.39%	68.61%
Cos Cob E.	310E	2491	32.57%	67.43%
Stamford	374	8993	24.36%	75.64%
Darien	465	5394	36.61%	63.39%
South Norwalk	524	5152	35.82%	64.18%
East Norwalk	537	1714	37.33%	62.67%
Sasco Creek	634	7158	36.95%	63.05%
Burr Road	736	6439	34.93%	65.07%
E. Bridgeport	814	3703	39.94%	60.06%
Devon	867	4454	48.02%	51.98%
Woodmont	962	5014	49.35%	50.65%
New Haven	1060	4411	53.39%	46.61%
Fair Street	1081	4829	14.22%	85.79%

NOTES: A - Not in Study
Demand percentages are based on the average of the top 10 tow hour demand periods
Demands are RMS Kilowatts
Fair St - NHL 81.33%, SLE 4.46%

Table K-10
TWO HOUR DEMAND SHARING
AUTOTRANSFORMER SUBSTATIONS

ATSS NAME & NUMBER		LOW POWER OPERATIONS DEMAND (KW)	PERCENTAGE AMTRAK	NHL/SLE
Vern	0	A	0.00%	100.00%
Mount Vernon	23	A	0.00%	100.00%
New Rochelle W.	61W	A	0.00%	100.00%
New Rochelle E.	61E	4036	15.62%	84.38%
Mamaroneck	128	7270	24.21%	75.79%
Harrison	178	5158	24.37%	75.63%
Pike	93	3797	22.56%	77.44%
E. Port Chester	245	4607	27.98%	72.02%
Cos Cob W.	310W	5761	29.73%	70.27%
Cos Cob E.	310E	2357	28.70%	71.30%
Stamford	374	8851	23.12%	76.88%
Darien	465	5227	37.98%	62.02%
South Norwalk	524	5193	36.75%	63.25%
East Norwalk	537	1650	34.88%	65.12%
Sasco Creek	634	6820	33.82%	66.18%
Burr Road	736	6267	33.14%	66.86%
E. Bridgeport	814	3623	38.15%	61.85%
Devon	867	4382	47.12%	52.88%
Woodmont	962	4788	46.87%	53.13%
New Haven	1060	4345	52.76%	47.24%
Fair Street	1081	4829	14.22%	85.78%

NOTES: A - Not in Study
Demand percentages are based on the average of the top 10 tow hour demand periods
Demands are RMS Kilowatts
Fair St - NHL 81.33% SLE 4.46%

Table K-11

TWO HOUR DEMAND SHARING FOR FEEDER SUBSTATIONS

LOW POWER LOADS			
FEEDING SS NAME & NUMBER	DEMAND (KW)	DEMAND PERCENTAGE	
		AMTRAK	NHL/SLE
Mt. Vernon (23W)	DOES NOT SUPPLY NEC	0.00%	100.00%
Mt. Vernon (23E)	11006	20.03%	79.97%
Cos Cob (310W)	10809	22.00%	78.00%
Cos Cob (310E)	15637	22.87%	77.13%
Sasco Creek (51R)	13101	28.69%	71.31%
Devon (26M)	10903	39.01%	60.99%

NOTE: DEVON - NHL 56.57%, SLE 4.42%

HIGH POWER LOADS			
FEEDING SS NAME & NUMBER	LOAD DEMAND		
	(KW)	(KVAR)	(KVA)
Mt. Vernon (23W)	DOES NOT SUPPLY NEC	0.00%	100.00%
Mt. Vernon (23E)	11154	21.24%	78.76%
Cos Cob (310W)	10927	22.67%	77.33%
Cos Cob (310E)	15885	24.08%	75.92%
Sasco Creek (51R)	13537	30.98%	69.02%
Devon (26M)	11217	40.14%	59.86%

NOTE:

A - Not in Study

Demand percentages are based on the average of the top 10 tow hour demand periods

Demands are RMS Kilowatts

DEVON (LOW) - NHL 56.57%, SLE 4.42%

DEVON (HIGH) - NHL 55.02%, SLE 4.84%

The Northeast Corridor Transportation Plan

New York City to Boston

Volume 2

Appendix L
OPERATIONS ANALYSIS TO SUPPORT PROJECT GOALS

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Appendix L
OPERATIONS ANALYSIS TO SUPPORT PROJECT GOALS

INTRODUCTION

The results of the Train Performance Calculator simulations that were performed in support of this Plan are discussed in detail in this Appendix. Results for Goal Trains and Conventional Trains are presented. The ability of the recommended improvements to support reliable 3-hour intercity trip times also is evaluated. The results of the Monte Carlo™ simulations also are analyzed. Operational impacts during construction also are presented. Finally, regulations relative to the use and operation of moveable bridges are summarized.

ABILITY TO MEET PROJECT GOALS

As agreed upon at meetings involving all the railroads, and pertinent federal and state agencies operations analyses were performed to assess the impact of the proposed projects on rail operations and to help identify other additional improvements that will benefit future operations. The models that were used are:

- the Train Performance Calculator, which assesses the performance of a single train over the route to measure trip time differences between the existing track configuration and the proposed configuration for a variety of train consists; and

- the Monte Carlo™ model, which simulates the entire schedule of high speed intercity trains, coexisting with commuter service, over the route at year 2010 service levels to determine areas of operating conflicts and delays.

Train Performance Calculator Runs

A program of Train Performance Calculator (TPC) analyses was undertaken to support concurrent work by Amtrak and the FRA to develop a recommended track configuration and alignment that satisfies the legislated goal of "...regularly scheduled, safe, and dependable rail passenger service between Boston, Massachusetts, and New York City, New York, in 3 hours or less." The results of the analyses to date are summarized as follows.

Conditions for Simulations of "Goal Trains"

TPC simulations of goal trains (i.e., those scheduled to meet the mandated 3-hour trip time between Boston and New York City, analogous to the present Metroliner service) on the existing and the upgraded facility configurations were based upon the conditions described in the following subsections.

"Baseline" TPC Runs. Baseline TPC runs were performed upon the existing facility configurations, i.e., prior to any improvements being made under the present project. The Baseline considered diesel power between Boston and New Haven and electric power between New Haven and New York City:

- Existing Maximum Authorized Speeds (MASs) were used; diesel trains were limited to 100 miles per hour (the maximum speed permitted for F40PH diesel locomotives); and electric trains also were limited to 100 miles per hour (the highest speed presently permitted at any point between New Haven and New York City).

- Speed restrictions were as shown on Amtrak's and Metro-North Commuter Railroad's (MNCR) employee timetables that were in effect in October 1991[1]; in the case of the speeds on Amtrak from Boston to New Haven, Special Instruction 1037-A4b "Speed Restrictions for Amtrak Passenger Trains Handled by F40PH Engine(s) and Consisting Exclusively of Amfleet Cars" was used.

- Positive stops and Civil speed restrictions were not enforced by the signal system in these simulations.

- Train consist was five Amfleet cars powered by one F40PH diesel locomotive between Boston and New Haven, and by one AEM-7 electric locomotive between New Haven and New York City.

- Four intermediate station stops of 1-minute duration were used at Back Bay, Route 128, Providence, and New Haven; the engine-change at New Haven was expected to take 10 minutes (the total dwell time at New Haven would be 10 minutes since passenger unloading and loading can be accomplished during the engine-change).

TPC Runs Post-Electrification (Boston-New Haven). To determine the amount of time savings to be experienced after electrification of the Boston-New Haven section, before other improvements were implemented, another set of TPC runs was performed. The following conditions were used:

- Existing MASs were used; trains were limited to 110 miles per hour between Boston and New Haven (the highest MAS presently permitted at any point on that section of the railroad), and 100 miles per hour between New Haven and New York City.

- Speed restrictions were the same as for the Baseline case; as in the Baseline case, positive stops and curve speeds were not enforced.

- Intermediate station stops of 1-minute duration were used at Back Bay, Route 128, Providence, and New Haven.

- Four train consists were tested:

  - one and two AEM-7 locomotives and six Amfleet cars;

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[1]Only minor changes have occurred between October 1991 and today.

- one Krauss-Maffei Class 127 electric locomotive[2] and six Amfleet cars; and

- one Amtrak Generic (i. e., next generation high-speed) locomotive[3] and six tilt-body cars.

TPC Simulations of Future Facility Improvements. TPC simulations of the future facility improvements (i.e., curve speed increases and grade separations) were made using the following conditions:

- An MAS of 150 miles per hour was used, where possible, between Boston and New Haven; 100 miles per hour was used between New Haven and New York City.

- For the initial set of alternatives, four intermediate station stops of 1-minute duration were assumed at Back Bay, Route 128, Providence, and New Haven.

- Four train consists were tested:

  - one and two AEM-7 locomotives and six Amfleet cars;

  - one Krauss-Maffei Class 127 electric locomotive and six Amfleet cars; and

  - one Amtrak Generic (i. e., next generation high-speed) locomotive and six tilt-body cars.

- Between Boston and New Haven three sets of speed limits were used, speeds with 6 inches of unbalanced superelevation (identified as E_u on the accompanying tables)[4], with 8 inches of unbalanced superelevation, and with 9 inches of unbalanced superelevation; these all assume that selected curves would be upgraded to 6 inches of actual superelevation (identified as E_a on the tables).

- Between New Haven and New York City speed limits were based upon selected improvements in curve geometry and 5 inches of unbalanced superelevation.

- All civil speed limits and positive stops were considered to be enforced by the signal system or some other means of enforcement in accordance with the anticipated FRA requirement of a positive stop/civil speed enforcement system.

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[2]A demonstration locomotive recently placed in revenue service in Germany that has characteristics (power-to-weight ratio, acceleration, adhesion, etc.) suiting it to NEC high-speed operations.

[3]Consistent with performance specifications being developed by Amtrak.

[4]To offset the thrust of a train against the outer rail of a curve, the outer rail is raised in comparison to the inner rail. The amount that the outer rail (the "high rail") is raised above the inner rail (the "low rail") is called actual superelevation. If the train is operated around a curve at a speed requiring 9 inches of superelevation, and the curve has only 6 inches (the maximum allowed by Federal Track Standards) in track, the 3-inch differential is the amount of "unbalanced superelevation."

The runs with AEM-7 and Krauss-Maffei engines and Amfleet cars were made for comparison purposes, although it is recognized that they are not equipped to operate at speeds computed for more than approximately 5 inches of unbalanced superelevation. The TPC runs, however, illustrate the running times that could be expected given the relevant performance and physical characteristics of these types of rolling stock.

Conditions used in the TPC simulations, including MASs, speeds through curves, and unbalanced superelevation, are all a function of track structures, equipment structural capacity, and crashworthiness and represent the collective best judgment of experienced rail operators. Before high-speed operations are introduced, however, many of these conditions will have to be analyzed in greater detail, and tested to ensure the safety of the total system.

TPC Running Times and Schedule Times

It must be noted that the TPC simulated running time is the optimum time that may be expected of a given train operated over a railroad line with given physical characteristics. The TPC times reported in Tables L-1 through L-11 are therefore the most optimistic running times for each given train consist.

When train schedules are prepared using TPC simulated times as a basis for the train running times, it is necessary to add an allowance for minor operating irregularities, which may be expected to occur on a daily basis. Several terms are used for this allowance, the most common of which are "pad", "cushion time", or "slop". A discussion of the issue of the amount of pad that should be added to the TPC times is found in a later subsection. Unless this allowance is added to the TPC running time, trains will not be able to perform reliably on a day-to-day basis; they also will not be able to regain any lost time resulting from minor delays (i.e., temporary speed restrictions, diversions around maintenance work, etc.).

Description of the Goal Train Output Tables

The results of the TPC simulations are contained in Tables L-1 through L-6. The tables are organized to present the overall running times and time savings (compared with the Baseline TPC run) from Boston to New York City for the different train consists and facility configuration assumptions. Table L-1 illustrates the running times and time savings to be achieved after electrifying the Boston-New Haven section but before any further facility improvements such as curve realignments, increases in superelevation, construction of flyovers, etc., are made. It can be considered the Baseline (All-Electric) scenario and is identified in the tables as the scenario with "Existing TT [Timetable] Speeds (All-Electric)".

A speed profile graph also is provided (Figures L-1-A and L-1-B) showing the performance of the conventionally powered New England Express (Train 151) of today.

Tables L-2, L-3, and L-4 illustrate the running times and time savings (also compared with the Baseline TPC run) resulting from improvements to curve geometry on the Boston-New Haven section to permit operation at speeds computed for 6 inches of unbalanced superelevation, 8 inches of unbalanced superelevation, and 9 inches of unbalanced superelevation, respectively. In all cases, selected curves would have upgraded actual superelevation of 6 inches, and curve speeds between New Haven and New York City would be computed for 5 inches of unbalanced superelevation. These tables also illustrate the trip time savings in comparison with the Baseline (All-Electric) scenario.

Figures L-2-A and L-2-B present the speed profile of an all electric HSR train, traveling over an improved corridor, and operating at 8 inches unbalanced superelevation (Boston-New Haven), and 5 inches unbalanced superelevation (New Haven-New York City).

Table L-6 illustrates the impact of adding two station stops (specifically those at New London and Stamford) to the running time of a goal train. These runs were performed for the 6-inch unbalanced superelevation case only.

TPC Results for the Goal Trains

Tables L-1 through L-4 show the running times and time savings resulting from the facility configuration improvements:

- Table L-1-Electrification between Boston and New Haven with no changes in track configuration. The impact of this improvement can be gauged by comparing the Baseline (combined diesel/electric) running time with the Baseline (All-Electric) times. The impact varies from about 14 minutes (the single AEM-7 consist with 6 Amfleet cars) to slightly more than 16 minutes (for the other consists). Of that savings, 9 minutes results from the elimination of the engine-change at New Haven.

- Table L-2 provides an estimate of the time savings that may be achieved by selectively increasing actual curve superelevation to 6 inches between Boston and New Haven, selectively increasing actual superelevation on curves between New Haven and New York City, and computing curve speeds for 6 inches of unbalanced superelevation between Boston and New Haven and 5 inches of unbalanced superelevation between New Haven and New York City. Also included are: a flyover at New Rochelle to improve speeds entering and leaving Amtrak's Hellgate Line; improvement in the facility configuration at New Haven; a duckunder at Harold; and restoration of the fourth track between New Haven and Devon. These improvements provide total savings ranging from about 54.2 minutes (with a single AEM-7 engine) to 59.2 minutes (for the three other consists) compared with the Baseline. Compared with the Baseline (All-Electric) scenario, savings are from 40 minutes (single AEM-7) to 42.9 minutes.

- Tables L-3 and L-4 illustrate the effect of increasing the unbalanced superelevation to 8 and 9 inches, respectively. Assuming that all of the train consists could operate at the higher unbalance speeds, total savings (compared with the Baseline times in the first column in each table) of about 58.4 to 63.7 minutes can be achieved with 8 inches of unbalanced superelevation, and from 59.8 to almost 65.2 minutes with 9 inches of unbalanced superelevation.

- Table L-5 illustrates the incremental effect of increasing unbalanced superelevation from 6 inches to 8 and 9 inches. The increase from 6 to 8 inches produces time savings of from 4.2 to 4.5 minutes, while a further increase from 8 to 9 inches gives incremental savings of 1.4 to 1.6 minutes.

Adding Intermediate Stops

Another goal-train TPC run was made with 6 inches of unbalanced superelevation between Boston and New Haven, and two additional stops of 1-minute duration at Stamford and New

London. This run (Table L-6) simulates operations in the event Amtrak decides to add two stops to goal-train schedules.

As Table L-6 indicates, increases in running time for two additional stops range from 3.9 to 4.3 minutes. Simulations with 8 inches and 9 inches of unbalanced superelevation (on the Boston to New Haven segment only) have not been made. However, because only the curve speeds at New London would be affected by the change in unbalance, and by only 5 miles per hour, the increased running time for these cases would be only slightly greater than that shown for 6 inches of unbalanced superelevation.

Performance of Conventional Trains

Amtrak intends to supplement goal-train service between New York City and Boston with conventional train service between New York City and Boston (as well as between New York City and Springfield) every other hour. Conventional trains typically run at somewhat lower speeds (an MAS of 110 miles per hour, for instance) and make more station stops than the goal trains; these trains have more seating capacity than the goal trains and, hence, may serve a larger segment of the travelling public than do the goal trains. To determine the time savings to be achieved in the operation of conventional trains on the Northeast Corridor after completion of electrification and other improvements between Boston and New York City, TPC simulations of two conventional train stopping patterns were performed. The two patterns were as follows:

- A pattern with an average number of stops for a conventional train; this was based upon present[5] train #171, the "Minute Man", with intermediate stops at Back Bay, Route 128, Providence, New London, Old Saybrook, New Haven, Stamford, and New Rochelle.

- A pattern making all conventional train stops; this was based upon present train #193, the "Benjamin Franklin", with intermediate stops at Back Bay, Route 128, Providence, Kingston, Westerly, Mystic, New London, Old Saybrook, New Haven, Bridgeport, Stamford, and New Rochelle.

In each case, a train consist of one AEM-7 locomotive and eight Amfleet cars was used. Since non-tilt body rolling stock was used the maximum unbalanced superelevation used was 5 inches.

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[5]"Present" in this context refers to train schedules in effect on January 1, 1993. The latest timetable has changed some of the conventional train stopping patterns.

Table L-1
COMPARATIVE SIMULATED RUNNING TIMES FOR GOAL TRAINS
With Various Train Consists and Facility Configurations
Showing Effect of Electrifying Boston-New Haven Section

Four Intermediate Stops[6]

Train Consist	**Baseline: Existing** TT Speeds	**Existing TT Speeds** (All-Electric)	**Difference** From Baseline
F40PH+5 Amfl. (BO-NH)/ 1-AEM-7 + 5 Amfl. (NH-NY)	3-50.6[7]	N/A	N/A
1-AEM-7 + 5 Amfleet	N/A	3-35.2	15.4[8]
1-AEM-7 + 6 Amfleet	N/A	3-36.4	14.2
2-AEM-7 + 6 Amfleet	N/A	3-34.4	16.2
1-GEN + 6 Tilt Cars	N/A	3-34.6	16.0
1-K-M Class 127 + 6 Amfl.	N/A	3-34.3	16.3

[6]Intermediate stops (1-minute dwell) at Back Bay, Route 128, Providence, and New Haven (included in the engine-change allowance for the Baseline run only; see next footnote).

[7]Includes a 10-minute engine-change allowance at New Haven.

[8]Time savings before increase in train consist to six cars.

BOSTON-NEW HAVEN, BASELINE SPEED

Train 151, Conv.-Powered "NE Express"

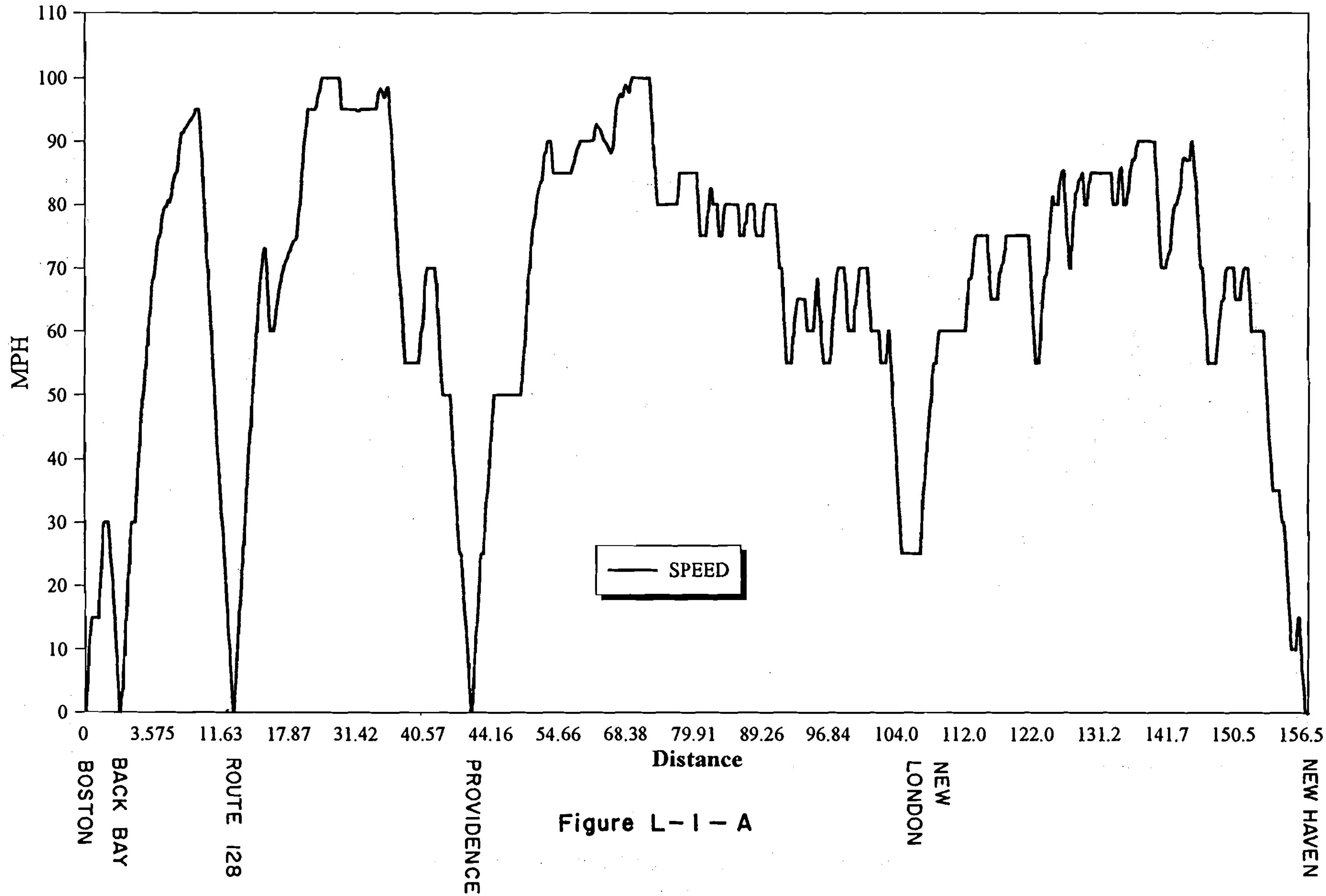

Figure L – I – A

Figure L — I — B
NEW HAVEN-NEW YORK, BASELINE SPEED

Train 151, Conv.-Powered "NE Express"

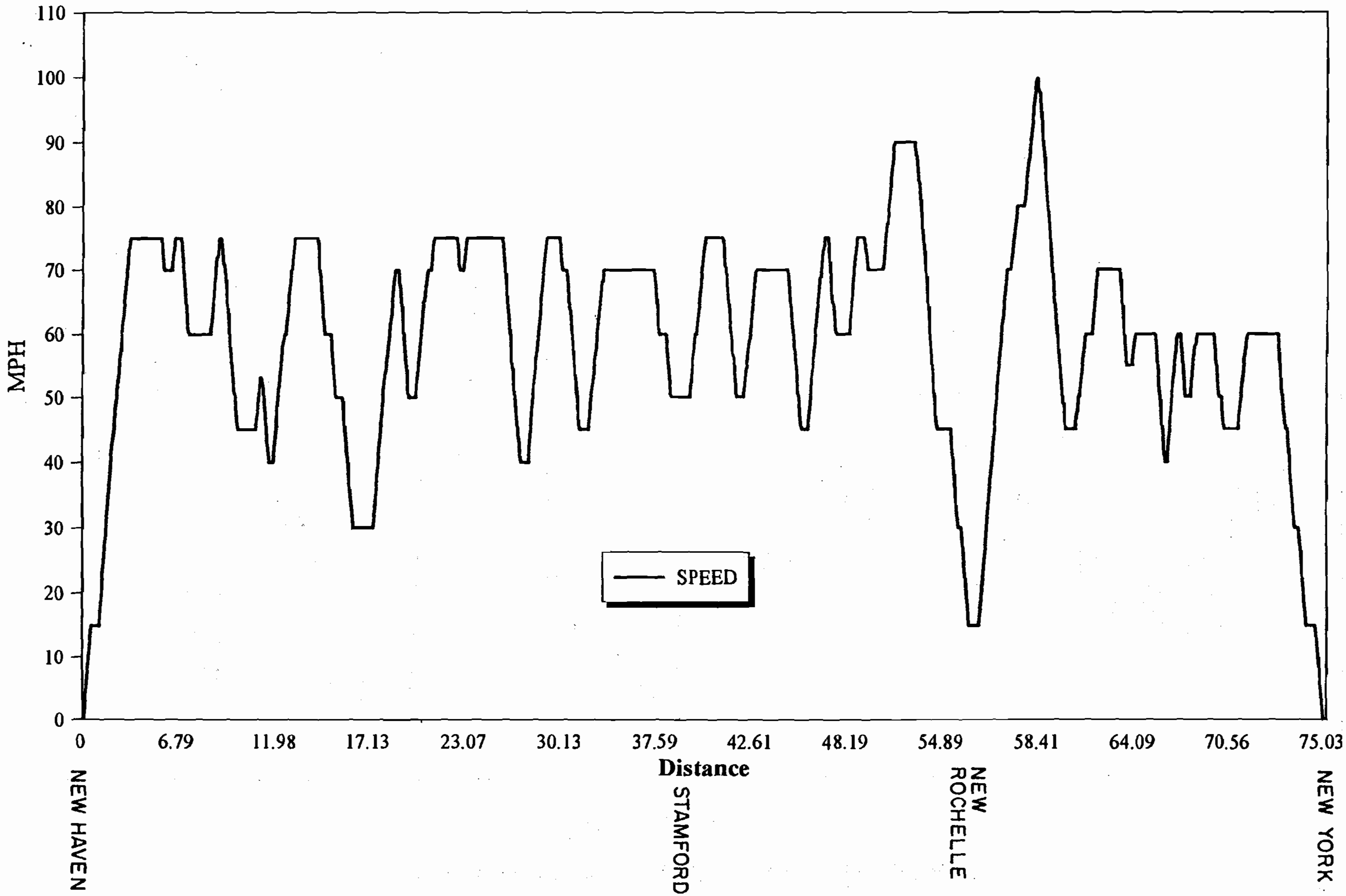

Table L-2
COMPARATIVE SIMULATED RUNNING TIMES FOR GOAL TRAINS
With Various Train Consists and Facility Configurations
Showing Effects of Electrifying Boston-New Haven Section
Plus Increasing Curve Superelevation to 6 Inches
and Using a Curve Unbalance of 6 Inches

Four Intermediate Stops[9]

Train Consist	Baseline: Existing TT Speeds	6"E_a+6"E_u (BO-NH)/ 5" E_u (NH-NY)	Difference From Baseline[10]
F40PH+5 Amfl. (BO-NH)/ 1-AEM-7 + 5 Amfl. (NH-NY)	3-50.6[11]	N/A	N/A
1-AEM-7 + 6 Amfleet	N/A	2-56.4[12]	54.2 (40.0)
2-AEM-7 + 6 Amfleet	N/A	2-51.9[12]	58.7 (42.5)
1-GEN + 6 Tilt Cars	N/A	2-52.0	58.6 (42.6)
1-K-M Class 127 + 6 Amfl.	N/A	2-51.4[12]	59.2 (42.9)

[9]Intermediate stops (1-minute dwell) at Back Bay, Route 128, Providence, and New Haven (included in the engine-change allowance for the Baseline run only; see footnote 11).

[10]Figures in parentheses indicate difference compared to Table L-1.

[11]Includes a 10-minute engine-change allowance at New Haven.

[12]Shown for comparison purposes only; these types of rolling stock do not operate at curve speeds computed for more than 5" E_u.

Table L-3
COMPARATIVE SIMULATED RUNNING TIMES FOR GOAL TRAINS
With Various Train Consists and Facility Configurations
Showing Effects of Electrifying Boston-New Haven Section
Plus Increasing Curve Superelevation to 6 Inches
and Using a Curve Unbalance of 8 Inches

Four Intermediate Stops[13]

Train Consist	Baseline: Existing TT Speeds	6"E_a+8"E_u (BO-NH)/ 5" E_u (NH-NY)	Difference From Baseline[14]
F40PH+5 Amfl. (BO-NH)/ 1-AEM-7 + 5 Amfl. (NH-NY)	3-50.6[15]	N/A	N/A
1-AEM-7 + 6 Amfleet	N/A	2-52.2[16]	58.4 (44.2)
2-AEM-7 + 6 Amfleet	N/A	2-47.5[16]	63.1 (46.9)
1-GEN + 6 Tilt Cars	N/A	2-47.5	63.1 (47.1)
1-K-M Class 127 + 6 Amfl.	N/A	2-46.9[16]	63.7 (47.4)

[13]Intermediate stops (1-minute dwell) at Back Bay, Route 128, Providence, and New Haven (included in the engine-change allowance for the Baseline run only; see footnote 15).

[14]Figures in parentheses indicate difference compared to Table L-1.

[15]Includes a 10-minute engine-change allowance at New Haven.

[16]Shown for comparison purposes only; these types of rolling stock do not operate at curve speeds computed for more than 5" E_u.

BOSTON-NEW HAVEN, 3-HOUR TRIP TIME

Goal Train @ 6" Ea and 8" Eu.

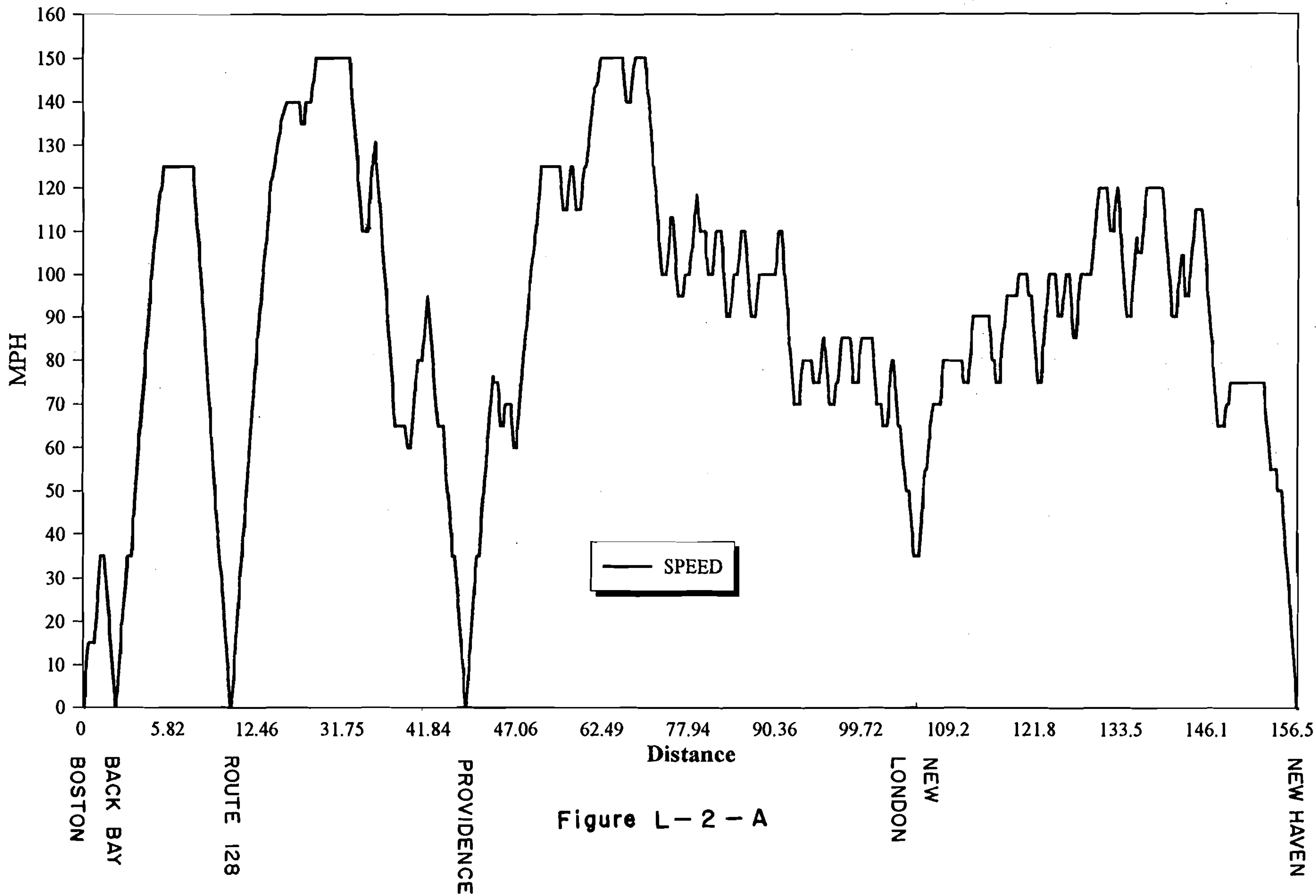

Figure L-2-A

Figure L - 2 - B

NEW HAVEN-NEW YORK, 3-HOUR TRIP TIME

Goal Train @ 5" Eu. Throughout

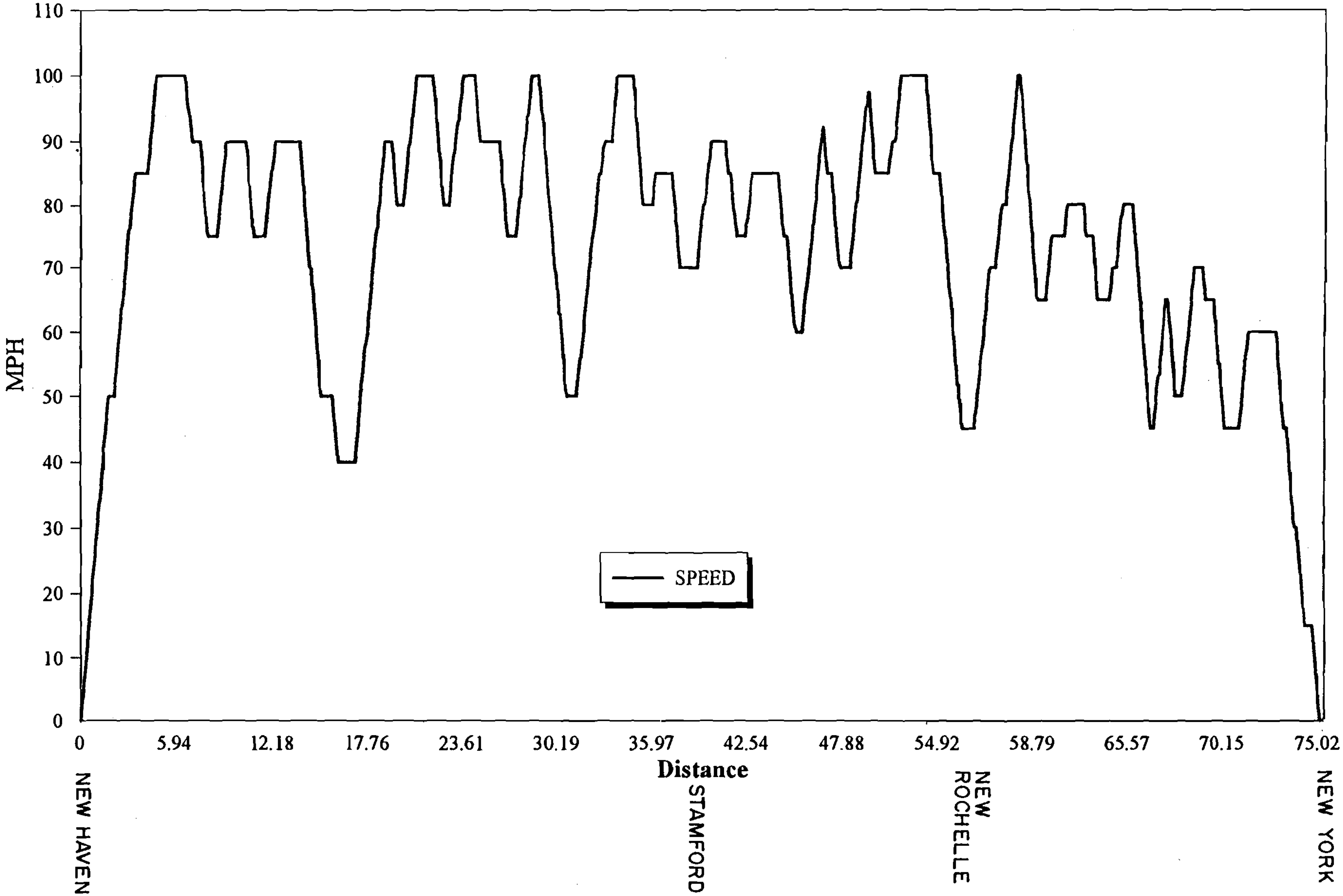

Table L-4
COMPARATIVE SIMULATED RUNNING TIMES FOR GOAL TRAINS
With Various Train Consists and Facility Configurations
Showing Effects of Electrifying Boston-New Haven Section
Plus Increasing Curve Superelevation to 6 Inches
and Using a Curve Unbalance of 9 Inches

Four Intermediate Stops[17]

Train Consist	Baseline: Existing TT Speeds	6"E_a+9"E_u (BO-NH)/ 5" E_u (NH-NY)	Difference From Baseline[18]
F40PH+5 Amfl. (BO-NH)/ 1-AEM-7 + 5 Amfl. (NH-NY)	3-50.6[19]	N/A	N/A
1-AEM-7 + 6 Amfleet	N/A	2-50.7[20]	59.9 (45.6)
2-AEM-7 + 6 Amfleet	N/A	2-45.9[20]	64.7 (48.5)
1-GEN + 6 Tilt Cars	N/A	2-46.0	64.6 (48.6)
1-K-M Class 127 + 6 Amfl.	N/A	2-45.4[20]	65.2 (49.0)

[17]Intermediate stops (1-minute dwell) at Back Bay, Route 128, Providence, and New Haven (included in the engine-change allowance for the Baseline run only; see footnote 19).

[18]Figures in parentheses indicate difference compared to Table L-3.

[19]Includes a 10-minute engine-change allowance at New Haven.

[20]Shown for comparison purposes only; these types of rolling stock do not operate at curve speeds computed for more than 5" E_u.

Table L-5
INCREMENTAL TIME SAVINGS ACHIEVED BY INCREASING UNBALANCED SUPERELEVATION (E_u) FROM 6" TO 8" AND 9"

Incremental Trip Time Savings

Train Consist	6"E_a+8"E_u (BO-NH)/ 5" E_u (NH-NY)[21]	6"E_a+9"E_u (BO-NH)/ 5" E_u (NH-NY)[22]
1-AEM-7 + 6 Amfleet	4.2	1.4
2-AEM-7 + 6 Amfleet	4.4	1.6
1-GEN + 6 Tilt Cars	4.5	1.5
1-K-M Class 127 + 6 Amfl.	4.5	1.5

[21]Compares the running times shown in Table L-3 with those shown in Table L-4.

[22]Compares the running times shown in Table L-4 with those shown in Table L-3.

Table L-6
COMPARATIVE SIMULATED RUNNING TIMES FOR GOAL TRAINS
With Various Train Consists and Facility Configurations
Showing Effects of Electrifying Boston-New Haven Section
Plus Increasing Curve Superelevation to 6 Inches,
Using a Curve Unbalance of 6 Inches,
And Increasing the Number of Stops to Six

Train Consist	Four Stops[23] Baseline: Existing TT Speeds	Six Stops[24] 6"E_a+6"E_u (BO-NH)/ 5" E_u (NH-NY)	Difference From Baseline[25]
F40PH+5 Amfl. (BO-NH)/ 1-AEM-7 + 5 Amfl. (NH-NY)	3-50.6[26]	N/A	N/A
1-AEM-7 + 6 Amfleet	N/A	3- 00.6[27]	49.9 (4.3)
2-AEM-7 + 6 Amfleet	N/A	2-55.8[27]	54.8 (3.9)
1-GEN + 6 Tilt Cars	N/A	2-55.9	54.6 (3.9)
1-K-M Class 127 + 6 Amfl	.N/A	2-55.3[27]	55.2 (3.9)

[23]Intermediate stops (1-minute dwell) at Back Bay, Route 128, Providence, and New Haven (included in the engine-change allowance for the Baseline run only; see footnote 26).

[24]Intermediate stops (1-minute dwell) at Back Bay, Route 128, Providence, New London, New Haven, and Stamford.

[25]Figures in parentheses show increase in running time compared to Table L-4.

[26]Includes a 10-minute engine-change allowance at New Haven.

[27]Shown for comparison purposes only; these types of vehicles do not operate at curve speeds computed for more than 5" E_u.

Results of Conventional Train TPC Runs

Tables L-7 and L-8 illustrate the effect of the proposed facility improvements upon the running time of Train #171. The specific time savings are as follows:

- Table L-7 shows that a savings of about 25 minutes may be expected from electrification of the Boston-New Haven segment of the NEC. Of that savings, elimination of the engine-change contributes 14 minutes; and

- Table L-8 shows that the expected savings from various curve and other facility improvements, in addition to electrification, will be about 59.5 minutes (approximately 34.4 minutes more than what is achieved from electrification alone).

Tables L-9 and L-10 illustrate the effect of the proposed facility improvements upon the running time of Train #193. The specific time savings are as follows:

- Table L-9 shows that a savings of almost 27 minutes may be expected from electrification of the Boston-New Haven segment of the NEC. Of that savings, elimination of the engine-change contributes 14 minutes; and

- Table L-10 shows that the expected savings from various curve and other facility improvements, in addition to electrification, will be about 58.5 minutes (approximately 31.7 minutes more than that achieved from electrification alone).

It is interesting to note that the overall time savings for the 12-stop train (#193) is less than that for the eight-stop train (#171). Intuitively, one would expect the opposite. However, on further analysis it was found that restoration of Track 3 from New Haven to Devon produced an anomaly in the operation of Train #193 when stopping at Bridgeport. In short, an additional diverging movement is required to reach the platform at Bridgeport after restoring Track 3 west of New Haven; the penalty caused by this diverge more than outweighs the time savings resulting from the other facility improvements. To test whether operation of Train #193 on a similar routing to that used today would reduce its service time, a further TPC simulation was performed; the results are illustrated in Table L-11. The result was a further degradation in the time savings by about two full minutes.

Table L-7
COMPARATIVE SIMULATED RUNNING TIMES AND TIME SAVINGS FOR CONVENTIONAL TRAINS
Based upon Present Stop Pattern of #171[28]
(Typical Stop Pattern)
Showing Effect of Electrifying Boston-New Haven Section

Train Consist	Baseline: Existing TT Speeds	Existing TT Speeds (All-Electric)	Difference From Baseline
F40PH+8 Amfl. (BO-NH)/ AEM-7 + 8 Amfl. (NH-NY)	4-13.3[29]	N/A	N/A
AEM-7 + 8 Amfleet	N/A	3-48.3	25.1

[28]Includes stops (1-minute dwell) at Back Bay, Route 128, Providence, New London, Old Saybrook, New Haven (included in the engine-change allowance for the Baseline run only; see next footnote 29), Stamford, and New Rochelle.

[29]Includes a 15-minute engine-change allowance at New Haven.

Table L-8
COMPARATIVE SIMULATED RUNNING TIMES
AND TIME SAVINGS FOR CONVENTIONAL TRAINS
Based upon Present Stop Pattern of #171[30]
(Typical Stop Pattern)
Showing Effect of Electrifying Boston-New Haven Section
Plus Increasing Curve Superelevation to 6 Inches
and Using a Curve Unbalance of 5 Inches

Train Consist	Baseline: Existing TT Speeds	6"E_a+5"E_u (BO-NH)/ 5" E_u (NH-NY)	Difference From Baseline[31]
F40PH+8 Amfl. (BO-NH)/ AEM-7 + 8 Amfl. (NH-NY)	4-13.4[32]	N/A	N/A
AEM-7 + 8 Amfleet	N/A	3-13.8	59.5 (34.4)

[30]Includes stops (1-minute dwell) at Back Bay, Route 128, Providence, New London, Old Saybrook, New Haven (included in the engine-change allowance for the Baseline run only; see footnote 3), Stamford, and New Rochelle.

[31]Figures in parentheses indicate difference compared to Table L-7.

[32]Includes a 15-minute engine-change allowance at New Haven.

Table L-9
COMPARATIVE SIMULATED RUNNING TIMES AND TIME SAVINGS FOR CONVENTIONAL TRAINS
Based upon Present Stop Pattern of #193[33]
(All-Stop Pattern)
Showing Effect of Electrifying Boston-New Haven Section

Train Consist	Baseline: Existing TT Speeds	Existing TT Speeds (All-Electric)	Difference From Baseline
F40PH+8 Amfl. (BO-NH)/ AEM-7 + 8 Amfl. (NH-NY)	4-23.3[34]	N/A	N/A
AEM-7 + 8 Amfleet	N/A	3-56.5	26.8

[33]Includes stops at Back Bay, Route 128, Providence, Kingston, Westerly, Mystic, New London, Old Saybrook, New Haven (included in the engine-change allowance for the Baseline run only; see footnote 32), Bridgeport, Stamford, and New Rochelle.

[34]Includes a 15-minute engine-change allowance at New Haven.

Table L-10
COMPARATIVE SIMULATED RUNNING TIMES AND TIME SAVINGS FOR CONVENTIONAL TRAINS
Based upon Present Stop Pattern of #193[35,36]
(All-Stop Pattern)
Showing Effect of Electrifying Boston-New Haven Section Plus Increasing Curve Superelevation to 6 Inches and Using a Curve Unbalance of 5 Inches

Train Consist	Baseline: Existing TT Speeds	6"E_a+5"E_u (BO-NH)/ 5" E_u (NH-NY)	Difference From Baseline[37]
F40PH+8 Amfl. (BO-NH)/ AEM-7 + 8 Amfl. (NH-NY)	4-23.3[38]	N/A	N/A
AEM-7 + 8 Amfleet	N/A	3-24.7	58.5 (31.7)

[35]Includes stops (1-minute dwell) at Back Bay, Route 128, Providence, Kingston, Westerly, Mystic, New London, Old Saybrook, New Haven (included in the engine-change allowance for the Baseline run only; see footnote 38), Bridgeport, Stamford, and New Rochelle.

[36]Operates via Track 1, New Haven to Central.

[37]Figures in parentheses indicate difference compared to Table L-9.

[38]Includes a 15-minute engine-change allowance at New Haven.

Table L-11
COMPARATIVE SIMULATED RUNNING TIMES
AND TIME SAVINGS FOR CONVENTIONAL TRAINS
Based upon Present Stop Pattern of #193[39,40]
(All-Stop Pattern)
Showing Effect of Electrifying Boston-New Haven Section
Plus Increasing Curve Superelevation to 6 Inches
and Using a Curve Unbalance of 5 Inches

Train Consist	Baseline: Existing TT Speeds	6"E_a+5"E_u (BO-NH)/ 5" E_u (NH-NY)	Difference From Baseline[41]
F40PH+8 Amfl. (BO-NH)/ AEM-7 + 8 Amfl. (NH-NY)	4-23.3[42]	N/A	N/A
AEM-7 + 8 Amfleet (29.8)	N/A	3-26.7	56.6

[39]Includes stops (1-minute dwell) at Back Bay, Route 128, Providence, Kingston, Westerly, Mystic, New London, Old Saybrook, New Haven (included in the engine-change allowance for the Baseline run only; see footnote 42), Bridgeport, Stamford, and New Rochelle.

[40]Operates via Track 3, New Haven to Central.

[41]Figures in parentheses indicate difference compared to Table L-9.

[42]Includes a 15-minute engine-change allowance at New Haven.

2010 TRAFFIC LEVEL OPERATIONS

Monte Carlo™ Simulations

When several services coexist on the same trackage, conflicts are likely. Delays from these conflicts can jeopardize the reliability of all services; therefore a methodology is required that can measure the impact of these conflicts. With services as interrelated as those on the NEC, simulation of the entire interrelated system is the only valid methodology.

Therefore, in addition to the TPC model, a model using the Monte Carlo™ simulation package was developed by Amtrak and modified to include the projects initially considered necessary to achieve the trip time and reliability goals.

The purpose of the Monte Carlo™ simulations was to provide information as to:

- where delays occur;
- where schedule changes can eliminate conflicts; and
- where facility changes can eliminate conflicts.

Simulation Methodology

The starting point for the simulation was to encode the planned year 2010 facility into the Monte Carlo™ format. Year 2010 schedules were obtained from each entity (Amtrak and commuter agencies, except for Metro-North) and encoded into the model. Metro-North provided a proposed year 2013 schedule. For the purposes of this report it was assumed to closely approximate a 2010 schedule, and also was encoded into the Monte Carlo™ model.

Amtrak trains were entered into the models at New York, New Haven, or Boston on their scheduled departure times. When each train entered the system, the model determined whether it would depart the terminal on time or late. If late, the model determined how late by sampling historical departure statistics. Before leaving the terminal, each train's road performance factor was determined, varying from the minimum running time to about 3 percent greater than the minimum. This technique accounted for minor differences in locomotive performances and train handling. Thus the operation of the same train on successive days probably varied, as they do in actual operations.

Using the dispatching rules encoded in the model for that train or a group of trains (having the same stopping pattern, for example) simulated, the actual dispatcher controlled operation. The train could be routed on regularly assigned tracks or other tracks if the former are not available. If no track was available, or if an interlocking was blocked, the train would wait until a route was available. Trains were kept from following each other too closely just as they actually would be by the signaling system.

Every main track crossover and turnout was represented in the model. When a train used a crossover, either to reach an assigned track or because of contingencies, the additional time, if any, to use the crossover was accounted for by the model. Each interlocking route was blocked for a designated amount of time to preclude conflicting trains from using it simultaneously. Time consumed making station stops also was simulated.

Commuter trains also entered the model on their scheduled times. For example, in MBTA territory, Franklin Branch trains were entered while still on the Branch to correctly simulate interlocking occupancy at Read. In New Haven Line (NHL) territory, trains were entered while still in Stamford Yard or Bridgeport Yard, or on the Waterbury, or Danbury Branches. Trains from Grand Central Terminal were entered prior to arriving at Shell. These trains were sampled for lateness and performance, and were routed in a manner similar to that previously described for intercity trains.

The Monte Carlo™ simulator provides a large number of tabular reports to assist in analysis of the simulation. In addition, stringlines of the simulation can be plotted for each simulation run using Amtrak's plotting program. The stringlines visually depict the performance and delays for each train.

Terminal operations in New York City (Penn Station), New Haven, and Boston (South Station) were not simulated. It was expected that the terminals could accommodate the traffic being simulated. While the capacities of the terminals cannot be ignored, this study considered the line capacity and terminal capacity as separate problems.

2010 Operations Between New York City and New Haven

Achieving the running time goals under theoretical circumstances does not ensure meeting them in actual operations. The numerous interfaces with commuter trains at New Rochelle and at Harold affect trip times.

The simulation results indicated that it is virtually impossible for trains to receive a clear-signal route during peak hours (7 a.m. to 9 a.m. and 5 p.m. to 7 p.m.) between New Rochelle and South Norwalk on the NHL. Delays of 5 minutes are commonly incurred during these periods. Many of these delays occur because of the inability of Amtrak trains to overtake and pass slower New Haven Line trains. These delays are exacerbated when New Haven Line trains are delayed by Pike turns passing through the peak direction flow. During the off-peak, Amtrak trains should be able to operate on clear signals nearly all the time.

New Haven Line trains also receive increased delay during the peak periods because slots that are now used exclusively by Metro-North trains are occupied by the added Amtrak trains. Also, the ability to operate three tracks inward during the morning and three tracks outward in the evening is made more difficult by the increase in opposing direction Amtrak trains, which cannot be diverted onto another track without losing time. In spite of the difficulty, it was found necessary to divert selected Amtrak trains onto the local tracks to create a window for a few trains to operate in the three and one fashion. The construction of a recommended layover track east of Pike will eliminate the current practice of using the main track as a holding track to turn trains, but the new track does not eliminate delays to through trains caused by the Pike turns accessing the new track. Each Pike Turn can delay two to three trains in the peak hour.

Between New Rochelle and Stamford, the running times for Amtrak trains are about 3 minutes faster than the current New Haven Line expresses. In the evening period, eastbound New Haven Line trains operate on Track 2 at about 3-minute headways (nearly the minimum signal headway). Therefore, Track 2 is nearly at capacity during that period before three faster Amtrak trains are inserted into the flow. Some trains will be delayed three or more minutes unless they can be operated on another track.

Giving Amtrak priority between New Rochelle and Stamford would require at least a 10-minute window between New Haven Line trains at New Rochelle or Stamford. Even if this window could be scheduled, Amtrak trains would have to hit the gap precisely on schedule every time to prevent delays. This gap does not exist. Therefore, to create a slot, selected trains are encoded to operate on another track whenever possible.

Several operating options have been simulated, and none are feasible with the existing (1993) track configuration. It was concluded that some of the delays could be prevented with the inclusion of a suitable eastbound crossover to get from Track 1 to Track 2 at South Norwalk without conflicting with a New Haven Line train diverging from Track 2 to Track 4. This new crossover was used three times during the evening peak to reduce congestion at Stamford Station on Track 2. South Norwalk should be reconfigured in conjunction with the rehabilitation of Saga and Walk bridges.

The simulations also have analyzed the impact of stopping Amtrak trains on Track 4 at New Rochelle versus stopping at an exclusive Amtrak station on the Hellgate Line. The diversion and traffic delays incurred by stopping on Track 4 suggest that this option is not feasible when stopping more than a handful of Amtrak trains. Subsequent simulations have tested the feasibility of having an island platform between Tracks 1 and 2 at New Rochelle. Stopping at an island platform is viable except between 7 a.m. and 9 a.m. westbound and between 5 p.m. and 7 p.m. eastbound. By operating selected Amtrak trains that stop at New Rochelle on the third track to remove them from the peak direction flow, and by fine-tuning the New Haven Line schedule, it may also be viable to use an island platform during those hours, but only when trains are operated according to schedule.

The simulations also suggest that minor alignment changes (an additional crossover from Track 3 to Track 1 at West Stam and a 53A and 53B crossover at CP 234) are desirable, since they would allow westbound New Haven Line and Amtrak trains to move through Stamford without conflict. This would create a parallel situation to the eastbound flow. This crossover also was used twice during the simulation to allow New Canaan trains, which were operating in a three and one fashion, to access the branch through Station Track 5, without using Stamford interlocking.

An additional crossover at Bridgeport (Central) also would help reduce delays. Simulations suggest that a 30-second saving and reduced congestion would result from the use of a crossover from Track 4 to Track 2.

Finally, it was concluded from the simulations that during off-peak and reverse-peak periods, schedules for both intercity and commuter services can be formulated that would allow Amtrak to traverse the NHL on the best signal aspects. However, major changes in train patterns would be required to allow this during peak traffic periods.

2010 Operations and Facilities East of New Haven

The proposed 2010 Amtrak schedule calls for a Metroliner to leave New York City and Boston on the hour, followed by a conventional train leaving 15 minutes after the hour. This train arrives at Boston or New York City immediately ahead (5 minutes) of the next Metroliner. Scheduling Amtrak trains in this manner is necessary to prevent an Amtrak train from overtaking another Amtrak train on the double-track Shore Line. This scheduling technique also determines the windows that are available for commuter trains. In SLE territory, there are few such windows available for peak service operation. However, the proposed 2010 SLE service level is very close to the present level. Any substantial increase would require additional track capacity.

In addition to such facility changes, there are other possible changes that would probably improve SLE performance. Electrified equipment with acceleration rates closer to Amtrak's performance (as opposed to currently used diesel locomotives) could enlarge the existing available slots, improve recovery from overtakes, and shorten trip time.

In MBTA territory, an eastbound commuter train scheduled to leave Providence a few minutes after a Metroliner can arrive in Boston before the following Amtrak conventional train. In other words, it is not overtaken. Since MBTA's 2010 service plan calls for half-hourly service from Providence, the next MBTA train will be overtaken by Amtrak at Attleboro. Therefore, facilities have been provided at Attleboro to allow the run-around to take place without undue delay to either Amtrak or MBTA. Once the overtaking has been accomplished, the MBTA train can proceed to Boston without further delay.

Analyses have shown that if an Amtrak train is only a few minutes late, delays to MBTA trains would occur. Therefore, fall-back run-around facilities also should be installed at Sharon and Route 128 to provide added flexibility in scheduling and in handling operational requirements. These additional facilities are required to prevent a degradation of MBTA service caused by increased Amtrak service.

In the westward direction, the westbound Metroliner and the MBTA Providence train leave Boston simultaneously on parallel tracks, 15 minutes before the Amtrak conventional train. The MBTA train can arrive at Attleboro before the Amtrak conventional train overtakes it. Therefore, facilities must be provided to accommodate this movement. Such facilities were removed a few years ago.

A Stoughton train leaves Boston 5 minutes after the Providence train and Metroliner, but 10 minutes ahead of the Amtrak conventional train. The Stoughton train is overtaken at Route 128, so facilities have to be built to accommodate this. The next Stoughton train can run to Canton Junction without being overtaken.

Two other improvements were derived from the simulations. First, the use of high-power electric locomotives on the MBTA trains would improve operations. The considerations used for MBTA service included longer bi-level trainsets. This reduces the horsepower to trailing ton ratio significantly; the use of a higher power locomotive or two diesels would allow a speedier operation.

TRIP TIME FINDINGS

The repetitive TPC and dispatching (Monte Carlo™) simulations, under varying train consists and track/right-of-way configurations, have identified a number of important factors that will affect NEC operating strategy. The following section describes these operational and engineering factors, and the subsequent conclusions derived from the simulation activity.

Scheduling Pad

Background. In planning train schedules or analyzing the results of TPC runs, *pad* is defined as the difference between a published schedule time and the best achievable time between two terminals. When planning schedules the amount of pad allows trains to incur small increments of delay en route and still maintain a high probability of on-time performance. When analyzing the results of TPC runs, two additional components of pad are considered: the expectation that not all of the configuration and alignment improvements incorporated into the model will prove physically feasible; and the realization that the model assumes that the train engineer operates the train in a consistent and precise manner in response to speed changes, and therefore may be too optimistic.

Traditionally, the most common way of adding pad to the schedule is to concentrate much of it toward the end of the run. The reason for this technique is that pad, which is distributed throughout a schedule and is consumed by waiting for scheduled departure times at intermediate stations, is unavailable to cover any delays that may occur toward the end of a run. Since, traditionally, the on-time performance of a train is measured by the time at the final terminal, many schedule makers and transportation supervisors prefer to have the pad allocated toward the end of the run.

In scheduling high-performance trains, it may be more appropriate to distribute pad at the location where delay is most likely to occur. The following example is taken from the proposed 2010 schedule.

A review of available statistics has shown that, unless an eastbound grade separation is provided at Harold, the interface with LIRR trains will delay the average Amtrak train about 2 minutes and that 90 percent of the trains will receive some delay. This delay occurs because trains are so tightly scheduled through the interlocking that even a slight delay to one train can cascade and have an impact on many following trains.

In consideration of this fact, some pad should be allowed at Harold. If this pad is not provided, an optimistic eastbound arrival time at New Rochelle would be scheduled and the time span provided in the Metro-North schedule to enter the NHL may not be routinely achieved. Due to the volume of trains, some train, either New Haven Line or Amtrak, will be delayed.

Pad Considerations. The amount of pad to provide depends upon the nature of the railroad being operated. Because of the significant differences in the amount of commuter rail service, the 50 miles of railroad between New London and Providence should require less pad than the 50 miles of railroad between New Rochelle and New Haven. Traditionally, a percentage of the schedule is allotted for pad.

Amtrak, as a policy, uses 5 percent for timetable scheduling purposes. The previous VNTSC simulation work also used 5 percent. Because the amount of pad required for this proposed operation is not really known, 5 percent may be adequate. However, it may not be appropriate to apply one percentage value universally to all trains. For example, an unscheduled diversion in high speed territory may have a greater impact on a high-performance train than on a conventional train.

Realistic estimates of pad cannot be made until a facility and schedules have been defined. Even then, determining the distribution of pad must be based on subjective evaluation.

The Impact of Junctions Upon Pad. A review of the proposed 2010 configuration and operating schedules indicates that there will be at least 23 locations at which commuter rail and intercity operations will directly interface, and possibly conflict, potentially resulting in delays to either or both commuter and intercity trains. These locations, listed in Table L-12, include branch line intersections, yard access locations, stations, and planned passing sidings. Three are located between New York City and New Rochelle; eight between New Rochelle and New Haven, including New Haven; four between New Haven and Providence; and eight between Providence and Boston.

A review of the Monte Carlo™ simulations indicates that the volume of moves per day, particularly during the rush hours, is substantial. For most of these locations, the configuration definition analysis has attempted to maximize operating/diverging speeds, thereby attempting to minimize the impact of conflicts. However, only Harold and Shell are planned to be grade-separated. The remaining locations will remain level junctions, using turnouts and crossovers to divert trains. Thus the potential for conflicts that could delay intercity trains remains significant, suggesting that a pad in the range of 12- to 15 minutes, which represents 7- to 9 percent added to the TPC time for these trains, would be justified.

Commuter trains also will be delayed at these junctions. Generally, the amount of pad used for commuter trains (typically 5 minutes) will be less than for intercity trains because of the shorter duration of commuter train runs.

Achievement of Planned NEC Improvements and Impact upon Pad. The TPCs expected that the presently projected curve speeds and signal improvements will be achieved. Experience has indicated that not all of these planned improvements will prove physically feasible and not all of the anticipated savings will be achieved in the real world. This is another reason why a pad of more than 5 percent is necessary during the planning phase of a project.

Pad Recommendations. Based on the FRA's present analyses, a 12- to 15-minute (7- to 9-percent) pad is being used to determine whether a reliable 3-hour time between New York City and Boston is achievable. For planning purposes it is better to overestimate pad than to underestimate it, unless doing so grossly distorts construction costs.

Tolerance. Amtrak presently considers that a train operating in the New York City to Boston segment is "on-time" at its destination if it arrives within 10 minutes of its scheduled arrival time. This 10-minute variance is considered tolerance and is in addition to the 5 percent pad. Commuter tolerance is 5 minutes. These tolerances were included in computing on-time performance.

Table L-12
COMMUTER JUNCTIONS AND OVERTAKE SITES AFFECTING INTERCITY SERVICE

Location	Enter/Exit	Turning Point	Other
1. Penn Station/JO	NJT/LIRR	-	-
2. Harold/F	Sunnyside Yard	-	Merge and cross LIRR
3. Shell (CP216)	-	MNCR	Merge and cross MNCR
4. Pike (CP223)/E. Shell (C(217)	-	MNCR	-
5. Stamford (CP 234)	MNCR Yard MNCR New Canaan Branch	MNCR	Shared Station Platform
6. Walk (CP241)	Danbury Branch	MNCR	-
7. Port (CP255)	-	MNCR (Waterbury)	Merge for Bridgeport stations stops or shared platform
8. Central (CP257)	MNCR Yard	-	Merge for Bridgeport stations stops or shared platform
9. Devon (CP261)	Waterbury Branch	-	-
10. New Haven Station	MNCR Yard Amtrak Yard CDOT yard Springfield Line	MNCR Amtrak CDOT	-
11. Mill River/Grand Avenue	Springfield Line	-	-
12. Guilford Passing Tracks	-	-	CDOT overtaking point (both directions)
13. Old Saybrook/New London	Amtrak Montrealer	COT	Shared station platforms - both locations
14. Kingston/Davisville	-	RIDOT (future)	
15. Providence/Atwells Station	MBTA yard RIDOT yard (future)	MBTA RIDOT (future)	Shared station platforms

Table L-12
COMMUTER JUNCTIONS AND OVERTAKE SITES AFFECTING INTERCITY SERVICE

Location	Enter/Exit	Turning Point	Other
16. Layover Yard/Orms	MBTA yard RIDOT yard (future)	-	-
17. Attleboro passing tracks	-	-	MBTA overtaking point (both directions)
18. Canton Junction (Station stop moved to branch)	MBTA Stoughton Branch	-	-
19. Sharon	-	-	MBTA overtaking point (eastbound only)
20. Route 128	-	-	MBTA overtaking point (both directions) Shared platforms
21. Readville (Rush hour counter flow moves via Dorchester Branch)	MBTA Franklin Branch MBTA Dorchester Branch MBTA Yard (Future)	-	-
22. Forest Hills/Plains		-	-
23. Cove/South Station	MBTA Framingham Branch MBTA Old Colony Branch MBTA Dorchester Branch MBTA Yard Amtrak Yard	MBTA	Shared platforms at Back Bay and South Station

Trip Time Goal Status

The TPC simulations have clearly indicated that the performance characteristics of the next-generation Amtrak intercity rolling stock will be critical to achieving the 3-hour trip time goal. Amtrak is presently planning to specify a locomotive with a rating of at least 20 horsepower per ton for a six-car trailing consist. For this reason, the following discussion centers on the simulated performance of the next-generation locomotive, presently known as the "Generic" locomotive.

The amount of unbalanced superelevation at which Amtrak ultimately is allowed to operate in each of the operating segments (i.e., New York City to New Rochelle, New Rochelle to New Haven, and New Haven to Boston) also is critical. (Recently Amtrak was permitted by the FRA to operate (under controlled test conditions) at 9 inches of unbalanced superelevation with the X-2000 between Washington and New York City, in revenue service).

To determine whether a reliable 3-hour service can be operated, Table L-13 was prepared to summarize the overall running times for the Generic locomotive and six tilt-body cars. The results are shown for speeds computed for the three different unbalanced superelevation conditions between Boston and New York City that have been simulated. In all cases, positive stop/curve speed enforcement, a 150 mile per hour MAS, and four station stops (Back Bay, Route 128, Providence, and New Haven) were used. The table also shows the amount of pad available for each run.

Using the 7- to 9 percent pad recommendation mentioned in the previous section, it is clear that only the cases in which 8 and 9 inches of unbalanced superelevation were used resulted in a run time that provides the recommended pad. The 8-inch case just barely qualifies.

Table L-13

SIMULATED RUN TIMES AND AVAILABLE PAD

Case	Simulated Run Time	Pad (mins.)	Pad (% of TPC Time)
6"E_a+6"E_u (BO-NH)/ 5" E_u (NH-NY)	2-51.9	8.1	4.7%
6"E_a+8"E_u (BO-NH)/ 5" E_u (NH-NY)	2-47.5	12.5	7.5%
6"E_a+9"E_u (BO-NH)/ 5" E_u (NH-NY)	2-46.0	14.0	8.4%

Considering the above-mentioned uncertainties, it would appear that the case with 9 inches of unbalanced superelevation can achieve the 3-hour trip time goal, but with little time to spare.

The 8-inch unbalance case would probably drop out very quickly if changes in the basic conditions were implemented.

The service goal for acceptable on-time performance has yet to be established.

An article entitled "Passengers Demand Detailed Punctuality Figures" in the July 1993 Railway Gazette International sheds some interesting (even surprising) light upon the on-time performance of several European railways. Table L-14 shows the on-time performance of train services that are similar to those on the Northeast Corridor, although in the cases of the French TGV in particular, a high degree of segregated trackage is used.

It should be noted that a number of potential changes in the conditions upon which the TPC results are based might occur, which would further erode the amount of available pad. For example:

- there may still be some question as to whether all of the curve modifications that are used are feasible from an engineering standpoint;

- if a 150 mile-per-hour MAS cannot be achieved, there would be some increase in TPC running time;

- if an unbalanced superelevation lower than 8 or 9 inches must be used, the trip time would suffer;

- should the hardware/software package that is used for positive stop/curve speed enforcement result in a less optimum impact on train speed than the TPC program presently predicts (e. g., should an underspeed situation occur during speed reductions), trip times will increase; and

- adding station stops at New London and Stamford to the schedules of goal trains would result in an increase in running time of about 4 minutes; these trains could not be reliably operated on 3-hour schedules.

Perhaps the most remarkable thing about the on-time performance figures reported in the article and contained in Table L-14 is that they are so low. European railways are reputed to have very high on-time performance, but that reputation is not borne out by these statistics.

At present, it is not known how much schedule pad is used by these operators. It is quite possible that extremely tight scheduling (in other words, use of a relatively small percentage of pad) contributes to these low on-time performance figures.

It is believed that an on-time performance of at least 90 percent should be established as a goal for NEC train services.

Table L-14
ON-TIME PERFORMANCE OF SEVERAL EUROPEAN RAILWAYS

Country/Service	Allowance (mins.)	On-Time Performance (Percent) 1989	1990	1991	1992
France/TGV	14	81.5	76.4	75.8	74.9
Germany/ Inter-City	5	N/A	67.9	79.9	84.0
Great Britain/ InterCity	10	84.2	85.0	84.1	87.0
Italy/ Long-Distance	15	80.0	80.0	80.0	84.0
Sweden/ Long-Distance	5	78.3	78.7	80.1	81.8

Operations at Key Interlockings

An integral component of railroad operations are junction points--locations where trains enter, leave, or cross a main line track. Junctions are commonly referred to as interlockings because these locations have signals or other hardware "interlocked" to prevent conflicting train movements. Interlockings typically require some reduced speed movements and signal lead times that affect capacity through the interlocking limits, and ultimately the capacity of the entire track route.

Key interlocking locations and their affect on overall corridor operations are discussed below.

Harold. Harold is a major LIRR and Amtrak junction that serves the East River tunnels and the Sunnyside Yard complex. The operation for Amtrak trains through Harold in both directions is analogous to an automobile crossing two lanes of a busy expressway to gain access to the median area and having a traffic signal halt the expressway traffic long enough to let the auto cross. A gap of at least 5 minutes between LIRR trains is needed to allow Amtrak to traverse Harold without delaying or being delayed by LIRR trains. The planned Harold duckunders (underpasses) will eliminate most, if not all, of the delay caused from Amtrak crossing the LIRR at grade.

The need for the duckunders is apparent. Currently the LIRR operates slightly more than 30 eastward trains per hour between 5 p.m. and 6 p.m. It is clear that when LIRR trains are passing Harold at a rate of more than one train every 2 minutes, a 5-minute gap would rarely, if ever, exist. Therefore, Amtrak trains are forced through the LIRR trains on an "as-best-as-can-be" basis, which reduces the needed gap to about 2 minutes. A recent study made for

Amtrak reveals that 94 percent of eastward Amtrak trains receive some delay passing through Harold, and the average delay per train is 2.5 minutes.

The extent of the LIRR delays is not known because the study was made from Amtrak records. It is clear that when the normal flow of LIRR trains is interrupted to let Amtrak through, some bunching of LIRR trains will occur. In most cases, at least one and possibly three or four LIRR trains are slowed (not necessarily stopped) each time an Amtrak train is forced through during this period. Unless the duckunders are constructed to mitigate the impact of the increased number of trains that will be operated in year 2010, increased delays to each road will result.

New Rochelle. New Rochelle is the junction point where Amtrak's Hellgate Line joins New Haven Line tracks. As with Harold, the need for Amtrak trains to cross tracks, at grade, and merge with commuter operations impacts track capacity and operational speed. Simulations indicate that the problem period at New Rochelle occurs between 5:30 p.m. and 6:30 p.m.

The impact at New Rochelle for westward Amtrak trains is nearly identical to that at Harold except the numbers of New Haven Line trains are slightly less. The proposed flyover will eliminate delays for westward Amtrak trains and eastward New Haven Line trains because Amtrak trains will pass over the MNCR tracks. The flyover will also eliminate the delays caused by crossing Track 4 at grade eastbound. However, the flyover will not eliminate the merging delays.

To merge eastward goal trains into the flow of New Haven Line trains without delaying either Amtrak or New Haven Line trains requires a minimum of a 10-minute window, which must consistently be hit with precision. The current timetable has two such windows in the hour and one is used by an Amtrak train. In 2010, three such windows are required; and because there will be more New Haven Line trains[43], the ability to provide an extra window is virtually impossible. Even if these windows could be provided, the normal variance in day-to-day operation would tend to close the windows. The problem is still unresolved and will continue to be evaluated.

Pike. Pike interlocking is located between Harrison and Rye stations on the NHL. During peak hours some trains from New York City (Grand Central Terminal (GCT)) use a main line track at Pike to turn (change directions) and return to New York City (GCT). Doing this requires that the train operator change ends and make a brake test, and this takes approximately 10 minutes. The train then waits for its scheduled window to go west on Track 3. Thus, the process of turning a train at Pike effectively eliminates a track from service during the rush hour. A tail track will be constructed along Track 3 so that these turns can be made without occupying the main track. Still, to reach this track, the turning trains must cross Tracks 2, 1, and 3, effectively blocking them for approximately 2 minutes.

These trains are sandwiched between trains operating on approximately 3-minute headways. A 2-minute window is required to cross, and when the crossing movement is completed, the next non-turning train could be as much as 2 minutes beyond the controlling master location and in a reduced-speed mode. The total delay to this train would be in the range of 1 to 1.5 minutes. This delay would be cascaded back to succeeding trains until a gap between trains is large

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[43]Currently 11 trains, increasing to 13 in 2010.

enough to absorb the delay. Normally, the ripple effect should be dissipated after two or three trains. Since three trains per hour turn, as many as nine trains could be delayed in 2010. The long-term solution to this choke point is the construction of a bridge to carry the returning trains over the main tracks, thereby eliminating conflicting moves

Stamford. Besides handling through Amtrak and commuter trains, Stamford also originates trains. The critical period at Stamford is in the morning, between 6:45 a.m. and 7:54 a.m., when nine westward trains originate in Stamford Yard. The yard is located on the south side of the railroad tracks, and therefore trains must cross and/or occupy one or all of the four main line tracks to reach westbound tracks (inbound) to New York City (GCT).

Not all of these trains that originate at Stamford yard make a passenger stop at Stamford station and therefore do not have to go to Track 3 (the northern most track). If they did, 16 trains would operate through the single platform Track 3 in this hour, exceeding the track's practical capacity.

Some of these trains can operate west on Track 2 (in a three and one fashion) to a point where they must cross Track 1 to access Track 3 for their station stops. Enough pad is provided their schedules so that they can wait on Track 2 for a window to open to cross Track 1, thus trains on Track 1 would not normally be delayed. Trains can wait on Track 2, when necessary, because there are no eastward trains scheduled on Track 2. This will not be true in 2010, when two Amtrak trains will be using Track 2 during this period.

Therefore, some or all of the trains now operating west on Track 2 will go to Track 3 or Track 5 at Stamford or Selleck Street. The additional platform track (Track 5) at Stamford will allow this to occur without overloading the station. Offsetting this advantage, the potential conflicts with other westward trains[44], which are now spread over a number of interlockings, will be concentrated at Stamford. Even with this increase, the additional capacity provided at Stamford will let trains move through Stamford better than they do today.

South Norwalk. Other than for an hour in the morning and an hour in the afternoon, operations at South Norwalk present few problems. The problem during these hours derives from the fact that the interlocking configurations at Walk and West Walk cause more trains to use the single platform tracks than desirable.

Between 6 p.m. and 7 p.m., 10 trains (12 in 2010) use Track 4 at Norwalk Station, but not all trains stop. The nonstopping trains must use the station track because they make stops immediately east of South Norwalk. The proposed interlocking east of the Saga drawbridge will allow these trains to avoid the station and thereby ease the problem.

Crossing the Danbury trains over Tracks 2, 1, and 3 to access the branch is and will remain a continuing potential for some delay. As previously noted this process can block the main line tracks for approximately 2 minutes.

New Haven. The current route through New Haven consists of about 2 miles of slow 10- to 15 miles per hour trackage. In order to attain the 3-hour goal, New Haven will be

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[44]13 trains in 1993, and 17 trains in 2010.

reconstructed using reconfigured interlockings and realigned tracks to achieve at least a 50 miles per hour alignment.

The advantages of the reconfiguration are that New York City-Boston trains will normally have no diversion through New Haven and that New Haven Line trains can cross from their station tracks to the reinstalled Track 3 at 45 miles per hour instead of 15 miles per hour. Transit times for both intercity and commuter trains will be improved, and this in turn will result in less interlocking occupancy.

Canton Junction. MBTA trains to, and from Stoughton, exit/enter the Shore Line at Canton Junction. In the current operation, a train going to Stoughton cannot enter the single-tracked branch if it is occupied by a late train coming from Stoughton. As a result, the train to Stoughton is held on Track 1 east of Canton Junction Interlocking. While this is not a major problem today, it will become unacceptable as more and more trains are added.

Westward trains to Stoughton stopping at Canton Junction, make their stop at the eastward platform and occupy the interlocking until cleared onto the branch. This operation also would become unacceptable as more and more trains are added.

Currently peak service is limited to two trains per hour because of the single-track, but this will increase to four trains per hour in 2010. Therefore, a new double-tracked station for Canton Junction will be constructed on the branch and a parallel-route interlocking installed so that trains can enter/exit the branch simultaneously. Taking the station stop off the main tracks will provide capacity for the projected increase in the number of trains on those tracks.

Readville to Boston. Operations between Readville and Boston involve Amtrak and commuter trains serving the Franklin, Needham, Stoughton, and Providence/Attleboro services. The current operating practice in the morning-peak is to operate inbound (eastward) trains from the Franklin and Needham branches on Track 3. In the afternoon-peak, the direction is reversed and trains to the Franklin and Needham branches operate westward on Track 3. In this way, these trains do not interfere with trains on Tracks 2 and 1. The current volume is five trains per hour (eight in 2010) on Track 3.

Track 2 is normally an eastward track for Amtrak, Stoughton, Providence/Attleboro, and some off-peak Franklin/Needham trains. The current volume is six trains per hour (eight in 2010). Track 1 is normally a westward track for all services, except for the Franklin and Needham trains in the afternoon. The current volume is about six trains per hour (eight in 2010). Some Franklin Branch trains also run via the Dorchester Branch.

The numbers of 2010 trains does not include approximately 30 deadhead trains between South Station and a proposed storage yard at Readville. When these trains are added, a major capacity problem will exist between Forest Hills and Boston for 2010 operations. This problem has not been resolved and will continue to be under study.

Moveable Bridges

Another factor affecting corridor operations is the potential interruption of rail service posed by moveable bridges. There are 11 moveable bridges over navigable waters on the NEC between New York City and Boston. Amtrak operates one bridge on the Hellgate line at Pelham Bay in the vicinity of Morris Park. It also operates five moveable bridges on the Shore Line in Connecticut at:

- CONN (Stratford);
- NAN (Niantic);
- SHAWS COVE (New London);
- GROTON (Groton/New London); and
- MYSTIC RIVER (Mystic).

MNCR operates five moveable bridges on the New Haven Line segment of the NEC; all are located within the State of Connecticut:

- COS COB (Cos Cob);
- WALK (East Norwalk);
- SAGA (Westport);
- PECK (Bridgeport); and
- DEVON (Stratford).

The federal government regulates the use and operation of moveable bridges over navigable waters. Subsection 117.5 of 33CFR gives the basic requirement:

> "Except as otherwise required, ... drawbridges shall open promptly and fully for the passage of vessels when a request to open is given ...."

Individual bridges may have restrictions applied to the general requirement to open "promptly and fully" whenever requested. Exhibit L-3 summarizes opening criteria. The restrictions are discussed below for each body of water. Of the 11 moveable bridges, only Pelham Bay does not have restrictions listed in the CFR. The restrictions for the 10 Shore Line moveable bridges are as follows:

COS COB (§117.209 Mianus River)

[S]hall operate as follows:

(a) From 5 a.m. to 9 p.m.

(1) The draw shall open on signal immediately for the passage of commercial vessels and as soon as practicable but no later than 20 minutes after the signal to open for the passage of all other vessels.

(2) When a train scheduled to cross the bridge without stopping has passed the Greenwich or Riverside stations and is in motion toward the bridge, the draw shall open as soon as the train has crossed the bridge.

(b) From 9 p.m. to 5 a.m., the draw need not be opened for the passage of vessels.

WALK (§117.217 Norwalk River)

[S]hall open on signal as follows:

(1) From 5 a.m. to 9 p.m., except that, from Monday through Friday excluding holidays, the draw need not be opened from 7 a.m. to 8:45 a.m. and 4 p.m. to 6 p.m. unless an emergency exists.

(2) Only once in any 60-minute period from 5:45 a.m. to 7 a.m. and 6 p.m. to 7:45 p.m.

(3) From 9 p.m. and 5 a.m., if at least 4 hours notice is given.

(4) A delay of up to 20 minutes may be expected if a train is approaching so closely that it may not be safely stopped.

Figure L-3
MOVEABLE BRIDGE OPENING CRITERIA

	SOON AS POSSIBLE		DELAY PERMITTED	ADVANCE NOTIFICATION REQUIRED			RUSH HOURS		CLOSED NIGHTS	MINIMUM DELAY
INTER-LOCKING	PUBLIC VESSEL, VESSEL IN TOW, VESSEL IN DISTRESS	COM MERC IAL VESS EL	TO OTHER VESSELS	NIGHT	DAY	NIGHT	PROHIBITED	LIMITED OPENINGS (PRE/POST RUSH)	YEAR ROUND	FOR MOVING TRAINS
Pelham Bay										
Cos Cob		X	X						X	X
Walk				X			X	X		X
Saga	X				X		X		X	X
Peck	X			X			X	X		X
Devon				X			X	X		X
Conn		X	X							X
Nan				X						X
Shaws Cove	X					X				X
Groton	X	X	X							X
Mystic River	X		X			X				X

NOTES:

PECK- Signal to open is 3 blasts.
CONN- Full opening regardless of size of vessel.
SHAWS COVE- Advance notice required on weekend days from 12/1 thru 3/31.

SAGA (§117.221 Saugatuck River)

- [S]hall open at all times as soon as possible for passage of a public vessel of the United States, vessel in tow or for a vessel in distress.

- [S]hall operate as follows:

(1) Year-round need not open:

(i) Weekdays from 7 a.m. to 8:10 a.m. and 5:30 p.m. to 7 p.m. except on Federal holidays; and

(ii) From 9 p.m. to 5 a.m.

(2) From October 1-May 31, open on signal:

(i) Weekdays from 8:10 a.m.-4 p.m.;

(ii) Weekends and Federal holidays 7 a.m.-4 p.m.; and

(iii) If at least 8 hours notice is given: daily, from 5 a.m.-7 a.m., 4 p.m.-5:30 p.m. and 7 p.m.-9 p.m., and weekends and Federal holidays from 5:30 p.m.-7 p.m.

(3) From June 1-September 30, open on signal 5 a.m.-9 p.m. except as provided in paragraph (1) (i) of this section.

(4) A delay in opening the draw not to exceed 10 minutes may occur when a train scheduled to cross the bridge without stopping has entered the drawbridge block.

PECK (§117.219 Pequonnock River)

- Public vessels of the United States and vessels in distress shall be passed through the drawbridge as soon as possible.

- [S]hall open on the signal of three blasts as follows:

(1) From 5:45 a.m. to 9 p.m. except:

(i) From Monday through Friday, excluding holidays or emergencies, the draw need not be opened from 6:45 a.m. to 7:15 a.m., 7:45 a.m. to 8:15 a.m. and 4:30 p.m. to 6:15 p.m.

(ii) From Monday through Friday, excluding holidays or emergencies, the draw need not be opened more than once during the periods of 5:45 a.m. to 6:45 a.m., 7:15 a.m. to 7:45 a.m., 8:15 a.m. to 9 a.m., and 6:10 p.m. to 8:15 p.m.

(2) From 9 p.m. to 5:45 a.m., the draw shall open on signal if at least 8 hours notice is given.

(3) The draw need not open on signal if a train is approaching so closely that it may not be safely stopped; however, the delay in opening the draw shall not exceed 7 minutes from the time of the request.

DEVON (§117.207 Housatonic River)

[S]hall operate as follows:

(1) The draw shall open on signal except as follows:

(i) From 7 a.m. to 9 a.m. and from 4 p.m. to 5:45 p.m. Monday through Friday except Federal holidays or an emergency, the draw need not be opened for the passage of vessels.

(ii) From 5:30 a.m. to 7 a.m. and from 5:45 p.m. to 8:15 p.m. except Saturdays, Sundays and Federal holidays, the draw need not be opened more than once in any 60-minute period.

(iii) From 9 p.m. to 5 a.m., the draw shall open on signal if notice is given to the chief dispatcher of the railroad before 4 p.m. on the day of the intended passage.

(2) A delay in opening the draw shall not exceed 20 minutes for the passage of approaching trains from the time of the request.

CONN (§117.205 Connecticut River)

[S]hall open on signal:

(1) For commercial vessels except .... when a westbound train scheduled to cross the bridge without stopping has passed Old Lyme and Blackhall Station, or an eastbound train has passed Saybrook Junction Station, and is in motion toward the bridge, the draw shall be opened as soon as the train has crossed the bridge.

(2) For all other vessels which cannot pass the closed bridge the draw shall be opened as soon as practicable, but in no case shall the delay be more than 20 minutes from the time of request.

(3) All openings of the draw shall afford full horizontal and vertical clearance, regardless of the size or requirements of the passing vessel.

NAN (§117.215 Niantic River)

[S]hall open on signal except that, from April 1 through October 31 from 8 p.m. to 4 a.m. and from November 1 through March 31 from 6 p.m. to 6 a.m., the draw shall open on signal if at least 1-hour notice is given. When a train scheduled to cross the bridge without stopping has entered the drawbridge block, a delay in opening the draw may occur until the train has cleared the block.

SHAWS COVE (§117.223 Shaws Cove)

[S]hall open on signal from December 1 through March 31 from 6 a.m. to 5 p.m. Monday through Friday. From December 1 through March 31 from 5 p.m. to 8 a.m. and on Saturdays and Sundays, the draw shall open on signal if at least 8 hours notice is given. From April 1 through November 30 from 5 a.m. to 10 p.m. the draw shall open on signal; and from 10 p.m. to 5 a.m., the draw shall open on signal if at least 1-hour notice is given. A delay in opening the bridge of up to 10 minutes may be expected if a train is approaching so closely that it may not be safely stopped. When a vessel is in an emergency that may endanger life or property, the draw shall open as soon as possible.

GROTON (§117.224 Thames River)

[S]hall open:

(a) Immediately on signal for vessels owned or operated by the United States Government, state and local vessels used for public safety, vessels in an emergency, and commercial vessels; except, when a train scheduled to cross the bridge without stopping has passed the Midway, Groton, or New London stations and is in motion toward the bridge, the draw shall not be opened for the passage of any vessel until the train has crossed the bridge; and

(b) As soon as practicable for all other vessels but no later than 20 minutes after the signal to open is given.

MYSTIC RIVER (§117.211 Mystic River)

[S]hall operate as follows:

(1) From April 1 to October 31, the draw shall open on signal.

(2) From November 1 to March 31, the draw shall open on signal from 5 a.m. to 9 p.m. From 8 p.m. to 5 a.m., the draw shall open on signal if at least 8 hours notice is given.

(3) Public vessels of the United States, state and local vessels used for public safety, vessels in emergency, and commercial vessels shall be passed immediately at any time; however, the opening may be delayed up to 8 minutes to allow trains, which have entered the drawbridge block and are scheduled to cross the bridge without stopping, to clear the block.

(4) All other vessels shall be passed as soon as practicable but no later than 20 minutes after the signal to open is given.

CONCLUSIONS

The preceding paragraphs have described the challenges inherent in the physical aspects of the project in meeting the stated goals. The following conclusions are derived from the discussion.

Trip Time Goals

Running a high speed train between New York City and Boston in 3 hours (with sufficient pad) can be accomplished, provided:

- all alignment modifications as described elsewhere in this report are constructed;
- 8 to 9 inches unbalanced superelevation running is permitted; and
- 150 miles per hour running is permitted.

Track Capacity

Goal trains could be assimilated in today's corridor schedule through schedule adjustments and with construction of the planned track and configuration improvements. However, given the 2010 schedules as provided by all corridor users, there is insufficient capacity in some corridor segments to accommodate all users during peak periods without compromise. These segments are (1) New Rochelle-South Norwalk and (2) Canton Junction-Boston. In addition, the 2010 capacity of the four East River tunnels and Penn Station has been questioned by others but has not been studied in this report.

Deficient capacity can be handled in three ways: constructing additional track/facilities; reducing train schedules; and lengthening schedules to accommodate delay. The latter two options are policy decisions and defeat project goals.

Moveable Bridges

Other than regulations in place, NEC operations are subject to interruption by the operation of moveable bridges. Depending upon circumstances, openings can be in the 10- to 20-minute range. Although the openings are relatively infrequent, their occurrence could impose considerable delay upon NEC operations, especially under 2010 traffic volumes. Fortunately, bridge operating restrictions are in place during rush hours on the principal New Haven Line moveable bridges. Similar restrictions could be requested from the Coast Guard for other shoreline bridges as the need is demonstrated.

The Northeast Corridor Transportation Plan

New York City to Boston

Volume 2

Appendix M
OPERATIONS ANALYSIS TO SUPPORT CONSTRUCTION

Appendix M
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Appendix M
OPERATIONS ANALYSIS TO SUPPORT CONSTRUCTION ACTIVITIES

INTRODUCTION

A schedule for expeditiously implementing the recommended improvement projects was presented in Section VI and further defined in Appendix G. The operational impacts of the schedule are discussed in subsection B of this Appendix. Strategies for developing and revising construction plans and schedules, and a suggested operating plan during construction, are provided in subsection C.

The recommended schedule provides for expeditious construction of the entire program of projects, while still accommodating a reasonable level of train service--in terms of trip times and frequencies--during the 1993 to 2010 construction period.

Maintaining reasonable service levels, (i.e., no less than existing levels) during construction will require careful joint staging of track outages by the managers of interrelated construction projects, such as reconfiguring New Haven Terminal and relocating the Amtrak New Haven Service Facility. Preliminary operational analyses indicate that a coordinated approach to scheduling intercity, commuter, and freight trains during construction will be required if delays to intercity passengers and commuters are to be minimized. Operations simulations have demonstrated that the proposed schedule is feasible.

The scheduled running times of intercity and commuter trains need to be adjusted as work proceeds, to reflect either long-term improvements in running times that completion of certain projects will provide, or delays that could occur in the short term as the result of scheduled construction activities. For example, Amtrak has recently increased the scheduled running times of intercity trains between New York City and Boston by approximately 10 minutes to accommodate the number of track outages necessitated by contractor and Amtrak work. As the MTA and CDOT capital programs have been implemented, MNCR has always adjusted its schedules to reflect anticipated arrival times at key stations. The amount of pad added by MNCR depends upon the time of day and can vary train by train and the level of planned work. This practice should continue.

Prior to the May 1993 Amtrak Timetable, Amtrak had approximately 6 minutes of pad between New Haven and New Rochelle for non-stop trains (60-minute trip time compared to 54-minute TPC time). Presently, the trip time is 63 minutes, or approximately a 9-minute (17-percent) pad. A 20-percent pad (11 minutes) would increase the trip time to about 65 minutes, and should be sufficient to allow for two diversions due to construction.

OPERATING IMPACTS DURING CONSTRUCTION

Completion of the improvement projects will require periodic track outages. The impact on operations will vary from segment to segment, according to the number of tracks and the level of intercity, commuter, and freight operations. Recent analyses show the following to be areas of concern:

- operations during construction in multiple track territory;
- single track operations during construction;
- single tracking for widening the Canton Viaduct;
- replacement of hanging beam catenary on the Hellgate Line;
- operations during construction of the Shell Flyover;
- operations during construction of the Stamford center island platforms; and
- operations during replacement of the Walk and Saga Bridges.

These operations analyses suggest the strategies discussed in the following subsections to deal with the staging of projects requiring track outages.

Operations During Construction in Multiple Track Territory

Twenty-four-hour track outages in multiple track territory may cause extensive delays. The areas with the greatest likelihood of delays are those being operated nearest to capacity during the peak periods between New Rochelle and Stamford, and between Forest Hills and Boston.

NHL Four-Track Territory Between New Rochelle and Stamford. Different operating schemes would be necessary for morning and evening commuter peaks. Approximately 29 trains operate during both the morning and evening peak hour. As an example, if Track 4 is out of service:

- in the morning, all eastbound trains would be diverted onto Track 2, with westbound trains operating normally on Tracks 1 and 3; and

- in the evening, eastbound trains that are normally operated on Track 4 would be diverted onto Track 2, eastbound Track 2 trains onto Track 1, and all westbound trains onto Track 3.

Review of the current timetable suggests that this type of scheme would be workable. This is essentially the manner in which trains have been operated when the catenary was replaced and concrete ties installed in New York State. The amount of delay incurred depends upon how close to schedule trains arrive at the boundary of the out-of-service area, especially when all trains in one direction are forced onto one track.

It is known that at least one diversion will be required on the NHL because of bridge work and that a second diversion would also be likely at some other location during the construction period. How much time is lost depends upon where the diversions take place. Two locations were analyzed to represent a worst case: one west of Stamford and another east of Stamford.

The location west of Stamford, between CP 229 (Green) and CP 223 (Pike), was selected because slow downs could be required at both locations. Had CP 217 (East Shell) been used as a diversion location, the time loss would not be representative because a slow down is made at New Rochelle to enter the Hellgate Line in all cases. The location east of Stamford is between CP 255 (Port) and CP 241 (Walk). The diversion time loss at Port is somewhat less than normal because the diversion is made in a reduced-speed location, but the diversion at Walk is greater than normal because a number 10 (15 miles per hour) crossover is involved.

TPC simulations were made with trains making the diversions stated above and the results were compared to TPC simulations in which no diversions were made. The time difference between the two represents the minimum time loss for the two diversions:

	Time in Minutes	
	Today	**Future**
Port-Walk	3.6	6.1
Green-Pike	1.2	2.3
Total for both	4.8	8.4

Delays for future diversions are much greater than current diversions because it is assumed that spirals have not been lengthened on the outer track and that current speeds will apply.

Other factors may increase time losses. Slow orders are usually required adjacent to the work site, and the diverted train may close in behind a local train and follow it, causing further delay. Scheduling and planning can eliminate to a great extent the latter situation, especially for the very long-term projects, such as replacement of fixed and moveable bridges.

Also, in some cases it may be possible to reduce time losses by making diversions where trains will normally be operating more slowly. For example, if no eastbound local train is ahead between Pike and East Shell, much time can be saved by making the diversion at East Shell instead of Pike because a slow down is required at East Shell anyway. A train making a Stamford stop could eliminate most of the Green-Pike diversion delay if it could operate between Stamford and East Shell without overtaking a local. Alternatively, some of the Green-Pike delay could be eliminated if the train could operate between Stamford and Pike without overtaking a local.

The same is also true east of Stamford. Trains making a Stamford stop could eliminate the Walk diversion-delay (and also the Stamford diversion-delay) if they did not overtake a local between Walk and Stamford. A train stopping at Bridgeport would suffer no diversion delay at Port if it operated Track 3 to Track 3.

Therefore, the amount of pad to be added during construction to compensate for diversion delays cannot be established in across-the-board terms. As each operating schedule is constructed, the route each train will normally use must be noted and pad added to each train as appropriate for the route taken. The current pad for an Amtrak train on NHL is about 9 minutes for a 54-minute non-stop TPC run.

MBTA three-track territory between Forest Hills and Boston. The development of workable solutions is more difficult in this segment of the Corridor. Approximately 16 trains operate during both the morning and evening peak hour. Major disruptions are likely if one of the tracks is out of service on a 24-hour basis. An entirely new, temporary train schedule would need to be developed to cope with such outages.

To summarize, the method of coping with track outages during construction in multiple-track territory will depend upon whether three or four tracks are normally in use, and upon the normal density of service. As difficult as implementing the operational adjustments may be, construction-period operations on a single-track will be significantly more complex.

Single-Track Operations During Construction

Double-track segments exist between Harold and New Rochelle and between New Haven and Readville. Various projects will require single-track operation during construction; durations could range from 24 hours to several months. Twenty-four-hour single tracking in double track territory can interfere with train performance. The amount of delay that will occur while operating all trains on one track depends upon three factors:

- the length of time it takes a train to traverse and clear the single-track segment;
- the number of trains being operated; and
- the train schedules.

Clearing a Single-track Segment. When a train arrives at one end of a single-track segment, the track may already be occupied by an opposing train. The probability of that happening depends upon the percentage of time the single-track is occupied by opposing trains. For example, if westbound trains occupy a segment of single-track 25 percent of the time, it is likely that 25 percent of eastbound trains would find the single-track occupied. Operating personnel responsible for train schedules try to lessen that likelihood.

The amount of delay depends upon how long it takes opposing train to use and release the single-track segment. When a train encounters the single-track occupied by a train from the opposite direction, the wait may be brief. However, if the opposing train has just entered the single-track at the far end, the wait will be equal to the time it takes the opposing train to traverse the single segment. This would be the maximum delay under normal conditions.

One way to control delays is to limit the amount of time a train occupies the single-track.This can be achieved by shortening the length of single-track. During the initial NECIP, this was achieved by installing intermediate, manually operated crossovers at several locations. (Remotely controlled, interlocked crossovers have proven more effective in reducing delays.) Recently, manually operated crossovers at Clinton, Point, Lord, and Wood River Junction which shortened long blocks were removed, thereby increasing the level of delays that may be experienced while waiting for opposing trains to clear the longer blocks. Considering that the number of trains in 2010 will more than double, the removal of the intermediate crossovers may have been premature.

While single tracking during construction, the goal is not to create additional capacity, but rather to control the maximum delays at each of the single tracking locations, especially if there is more than one location at any give time. If the maximum delays are not controlled, on-time performance will be poor.

A maximum standing delay of 10 minutes per meet (excluding diversion delay caused by slowing down to switch from track to track) appears to be a reasonable goal. Therefore, any segment of single-track that trains must occupy in excess of 10 minutes at today's speeds (because the track is not yet upgraded) will cause the maximum standing delays to exceed the 10-minute goal.

Table M-1 displays the current running times between selected crossover locations, according to the proposed track configurations (see Appendix F for detailed configuration plans).

Each of the locations listed in Table M-1 will have maximum standing times in excess of 10 minutes. Also, each of the locations, except between Gate and Pelham Bay, have had or will have had intermediate crossovers removed as part of the track configuration that had been agreed prior to the finalization of the NECTP. At a minimum, the pairs of crossovers at Point and Lord should be replaced and interlocked. A new pair of crossovers between Gate and Pelham Bay also should be installed and interlocked. The additional crossovers on the Hellgate Line are required because the volume of trains operated there compared to east of New Haven is larger and 24-hour single tracking to enable the proposed curve realignments and catenary work to be completed is likely.

Number of Trains Operated. Delay magnitude is affected by the number of trains being operated. The number of meets (trains passing one another in opposite directions) between any two points varies with the square of the number of trains operated. Consequently, increasing the number of trains from 10 to 14 per day will double the number of meets and double the amount of the delay. Increasing the number of trains from 10 to 20 per day will quadruple the number of meets and more than quadruple the amount of delay.

Train Schedules. If the construction period covers several months at one location, schedules can be adjusted to minimize delays. However, when work is being performed at several locations on the Corridor and when the location of the work changes frequently, the use of pad in planning schedules is the usual method to allow for the inevitable delays due to single tracking.

Single Tracking After Construction. After construction, the three interlockings added for construction staging should be retained. The objective in the post-construction period changes from controlling maximum delays, to operating as much service as possible during an emergency single tracking situation, and optimizing train operations while maintenance functions are performed.

With the restored or added crossovers in service, and with the upgraded speeds, the maximum capacity of a single-track section would be a total of four to six trains per hour during an emergency situation. To operate a total of four trains per hour during a long-term single-track emergency, without resorting to fleeting (operating several trains in the same direction consecutively, with minimum delays), the traffic direction should be able to be reversed at least every 25 minutes.

This cannot be done at the first two locations listed in Table M-1, even with upgraded speeds. If one track is out of service, there would be insufficient capacity to handle all 2010 Amtrak trains expeditiously. When this situation arises, all trains--both Amtrak and commuter--will receive unacceptable delays. Therefore, the recommended crossovers are essential to future operations as well as necessary during construction.

Single Tracking for Canton Viaduct

Widening the Canton Viaduct is an improvement critical to the installation of the electrified catenary system and increasing operating capacity. The current volume over the viaduct in the peak hour is six trains (three Amtrak and three MBTA) and is expected to increase. Therefore, capacity for at least 10 trains should be provided while single tracking over the bridge during construction to accommodate this growth and provide a small cushion. To achieve this capacity, the length of the single-track segment should necessarily be quite short.

Assuming a worst case situation, in which all 10 trains alternate directions, 5 directional reversals per hour will take place. Each reversal would require time for a train to enter the single-track after an opposing train has passed and time for diverting back to the normal-track necessary. It is anticipated that these two factors could total 5 minutes. The time for each reversal also will require twice the running time between adjacent crossover locations. Because of a probable slow order in the work zone on the bridge and less-than-clear signals, a conservative average speed on the single-track could be as low as 30 miles per hour.

Calculations indicate the length of the single-track for the assumptions made should be 1.75 miles. To locate a new crossover 1.75 miles west of the crossover at Canton Junction would locate the new facility approximately at MP 213. With the crossover placed at this location, about half of the trains would receive some delay (in the 3- to 4-minute range) under a first-come, first-served use of the single-track.

Placing the crossover location at MP 213 would increase capacity, reduce the probability of receiving delay, and reduce the delay if it does occur. Milepost 213 is the preferred location, but MP 212.5 would be acceptable. The location should be determined during the preliminary design process.

Replacement of Hanging Beam Catenary on the Hellgate Line

Each hanging beam on the Hellgate Line supports the catenary system on both tracks. The catenary system rehabilitation work on the Hellgate Line will involve removing the hanging beams and replacing them with independent catenary suspension systems for each track. Replacement of the hanging beams could require electric power to be removed from both tracks. However, the goal of the design phase should be to develop techniques that will enable the remaining catenary work to be accomplished from early morning to late evening while taking only one track at a time out of service at a time. Replacement of the wire will not be required because it is new.

Power can be removed from both tracks between 11:30 p.m. and 6:30 a.m., provided that diesels pull trains 66 and 67 under the dead wire. One track would be in service for operating these trains. Further, power can be removed from both tracks between 9:30 p.m. and 6:30 a.m., if the same diesels also pull trains 193 and 654.

With the recommended added crossover described above, probably located at the former Market Interlocking site, 1 track of the Hellgate Line could be removed from service for 24-hour periods during construction. However, the segment between Pelham Bay and New Rochelle should not be single tracked while the Shell Flyover is under construction at New Rochelle, as discussed below.

Table M-1
CURRENT RUNNING TIMES BETWEEN CROSSOVER LOCATIONS

Segment (Crossover Removed)	Time (Minutes)	
	Amtrak	Commuter
Groton-Westerly (Lord)	19	--
Old Saybrook-Shaw's Cove (Point)	18	25
Westerly-Kingston (Wood River Junction)	14	--
Guilford-Old Saybrook (Clinton)	14	21
Mansfield-Canton Junction (Eastbound)	8	15
Gate-Pelham Bay (Market)	12	--
Davisville-Cranston (Green)	11	17[1]

Operations During New Rochelle Construction

The Shell Flyover/New Rochelle Station reconstruction project is complex, involving the construction of a grade-separated merge of the Hellgate Line service with NHL service and providing a station stop for frequent Amtrak service. Extensive track realignments will occur.

Twenty-four-hour single tracking on the Hellgate Line between Pelham Bay and New Rochelle should not be planned while Amtrak is single tracking at New Rochelle station during the construction of the island platforms and/or the Shell Flyover.

All Amtrak trains will receive some delay traversing the single-track route through New Rochelle, but westbound Amtrak trains can be additionally delayed by:

- eastbound NHL trains stopping on Track 4;
- eastbound NHL express trains operating on Track 2; and
- eastbound Amtrak trains traversing the single-track connector between the Hellgate Line and NHL Track 4.

When any of these conditions occurs, delays of 5 minutes or more will be experienced by westbound Amtrak trains. Eastbound NHL trains and Amtrak trains operating on Track 4 can also delay one another. Simulations indicate that one westbound Amtrak train experienced 11 minutes delay in this situation. If the segment of the Hellgate Line between New Rochelle and Pelham Bay is also out of service, an additional 4 or 5 minutes could be added to the maximum delays experienced. Holding a westbound Amtrak train for 10 to 15 minutes on

[1] Estimated future service times at current speed limits

NHL main tracks could have a significant impact on all trains, unless the westbound train is held on Track 6 in New Rochelle Station. Simulations concluded that construction of a station at Nardozzi Place on the Hellgate Line would not have eliminated these delays. However, constructing an island platform between Tracks 1 and 2 will eliminate Track 6.

It would be advantageous to have the island platform in service before construction of the Shell Flyover. If the platform is constructed after the Flyover is in service, the period of time that Amtrak would use Track 4 would be lengthened as much as a year because construction of the new eastbound platform would force trains that normally do not use Track 4 to use it.

Having the island platform in service before constructing the Flyover would facilitate the realignment of Tracks 4 and 3 in staging the Flyover construction. NHL trains could avoid Tracks 4 and 3 by stopping on Tracks 1 and 2 during the off peak hours and all day on weekends. Amtrak trains could also use the new platform at all times, until forced onto the single-track Hellgate connector while the flyover is being competed. At that time they will scheduled to stop on Track 4.

For NHL trains to access the island platform, a new 42[3] crossover and a new 31[4] crossover would be installed at a new interlocking CP 215 (Pelham), which would be installed west of Interstate 95. This interlocking supplants the initially agreed temporary 42 and 21 crossovers west of New Rochelle station that, if installed, would have added 2.5 minutes (according to the TPC simulations) to Amtrak train trip times with little or no reduction in Track 4 occupancy time. The new Interlocking west of I-95 would be constructed as part of CP 215 and would remain in service after construction of the Flyover.

Operations During Stamford Construction

Except for New Canaan trains, the approved Stamford Station plan (see Appendix F for details) poses no major operational problems during construction.

If the New Canaan shuttle track is taken out of service to construct Track 5, these trains will have no satisfactory place to be platformed. The only option is to use Track 3. However, the New Canaan shuttles cannot occupy Track 3 for 11 minutes awaiting their scheduled return to New Canaan, because other trains are scheduled to use Track 3 during this time.

It is essential that: the interlocking at Selleck be constructed prior to the start of the center island platforms and the renewal of Washington Street Bridge; and that the existing shuttle track (a dead end track that extends into the station) remain in service until all the work on the westward side is finished except for the shuttle track. The existing shuttle track can then be realigned a few feet and coupled to new Track 5, the work being completed overnight or on a weekend. New Canaan trains and others can then begin using the new Track 5 at the completed portions of the westward island and side platforms. Trains using Track 3 will always have the full platform length available. Once operations on Track 5 commence, the remaining portion (the east quarter or less) of the two westward platforms can be finished.

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[3] A 42 crossover goes from Track 4 to Track 2, west to east.

[4] A 31 crossover goes from Track 3 to Track 1, west to east.

While Track 5 and the westward side platform are being constructed and the existing platform widened, trains will continue to use Track 3. Construction may cause some minor inconvenience to riders on the existing platform, but unless the inconvenience results in longer dwell times it will not have an operational impact.

The same is true while the eastward side platform and relocated Track 4 itself are being constructed. The existing platform cannot be widened until trains are operating on the relocated Track 4 and the existing Track 4 is removed. After cutting over to the relocated Track 4, the narrow side platform may cause increased dwell times.

Operations During Reconstruction of Walk and Saga Bridges

Due to their proximity, the Walk and Saga four-track moveable bridges are proposed to be reconstructed at the same time. This project will require a phased effort in which, over a 5-mile segment, two of four tracks will be continuously out of service. This work is presently scheduled to begin after the initiation of 3-hour intercity service. The anticipated construction staging would result in operational delays and thus have an impact on the reliability of intercity and commuter train operations.

A two-track operation would be used while these bridges are being replaced. While the bridge carrying Tracks 1 and 3 is being replaced, all trains would use Tracks 2 and 4, and the opposite would be the case while the other spans are being replaced. A new universal interlocking (with number 20 crossovers) is proposed to be installed east of the Saga Bridge to facilitate this work. It should remain in place after completion of the bridge replacements.

While Tracks 1 and 3 are out of service, all westbound trains would be delayed at the new Saga Interlocking while slowing down to merge from Track 1, or Track 3, onto Track 2. These delays would be in the 1.5- to 2-minute range. The current timetable is designed so that trains in this area could be operated on two tracks, and thus merging conflicts would be minimal. This would not be true as more trains are added to the schedule. Therefore, in 2010, up to one-third of the trains operated would receive 4 to 5 minutes merge-and-follow delay as a result of the proposed double track operation. Since the work is scheduled to be finished in year 2009, many more trains will be operating, so the current schedule cannot be used to evaluate the impacts.

A more significant operating problem will emerge at Walk Interlocking, where only slow speed (15 miles per hour) routes are available to cross trains back to their normal tracks. Therefore, the combined diverging delays could be as much as 5 to 6- minutes per train. If a way can be found to install higher speed routes through Walk, the combined diverging delays might be reduced to 3 to 4- minutes.

These projects are scheduled so that when Tracks 1 and 3 are out of service at the Saga Bridge, they would also be out of service at the Walk Bridge. In that way, work could be done in parallel on both bridges with one track outage. This means that a new westward route from Track 2 to Track 1, and from Track 1 to Track 3 into South Norwalk Station, should be installed west of the Walk Bridge. During preliminary design it should be ascertained whether a temporary right hand Number 15 (30 miles per hour) turnout (or at least a direct track connection) leading from Track 2 to Track 1 can be installed immediately west of the Walk Bridge, and east of the curve.

This configuration may not provide sufficient throughput for westbound trains. The proposed 2010 schedule would have 14 (7 local and 7 express) westbound trains traversing this track between 7:00 a.m. and 8:00 a.m. At 4 minutes' signal separation per train, 56 minutes of the hour would be consumed. Windows available on Track 4 could be used by westbound trains that do not stop at South Norwalk. However, for parallel running to have any real value, a temporary crossover route from Track 4 to Track 2 would be necessary at Saga. However, once at Walk, there is no westbound route to return to Track 1 from Track 4 west of the Walk Bridge. Because of curves, bridges, and the station, installation of such a route may not be feasible.

When Tracks 2 and 4 are out of service and Tracks 1 and 3 are being used as a double-track, the track capacity constraints become even more severe. All eastward trains (Danbury's included) would have to use a Number 10 (15 miles per hour) crossover leading from Track 2 to Track 1 in Walk. There is not enough capacity available.

As currently conceived, the scheduling of the bridge work could create significant operating problems for all types of service, especially since the construction duration is expected to be 6 years. Further analysis is required to assess capacity requirements and resulting operating plans.

Operations During New Haven Terminal Construction

The work at New Haven Station will require extensive track outages. Sufficient platform tracks will need to remain in service to maintain all train schedules during New Haven construction. By properly staging construction, few, if any, delays should be generated by taking some tracks out of service on a 24-hour basis. In some instances, day-to-day operations may have to be altered to cope with the outages. A train-by-train operating plan will be required for each long-term track outage in the construction staging plan.

This is especially true when it is considered that NHL currently stores about 80 cars overnight at New Haven, all in the station. Taking station tracks or approach tracks out of service may reduce storage space, or make storage locations inaccessible, so alternate storage areas may be required. The tracks and platforms that are to be out of service, and when they are to be out of service, should be coordinated with the MNCR operating department so the operating plans can be adjusted.

Two options should be evaluated: deadheading some trains to Bridgeport Yard for storage and/or rescheduling some of its zone trains to reduce the number of cars that need to be stored at New Haven. In either case, changes in operating plans will be required.

Amtrak requires nearly exclusive use of three station tracks for through trains and for combining or detaching the Springfield and Boston sections of certain trains. Any one of Tracks 3, 5, 7, or 9 can be taken out of service, but some operational changes would be necessary to minimize delays. Construction work on interlockings and approach tracks should be scheduled to avoid blocking two station tracks simultaneously for an extended period.

Amtrak trains requiring a locomotive exchange should be directed to a platform that allows access to a locomotive pocket track so that the exchange can be made efficiently. Generally this means that eastbound trains should arrive on Tracks 3 or 5, and westbound trains on Tracks 7 or 9.

However, if Track 2 (easterly extension of Station Track 5) is out of service between Mill River and the station, and the track has been reconfigured according to the preliminary design plans dated March 1, 1993, Station Tracks 3 and 5 also would be out of service for eastbound trains. There is no direct access from these tracks to either Tracks 4 or 1, only to Track 2. In that situation, eastbound Amtrak trains would be forced onto Tracks 7, 9, or 2 in the NHL section of the station. Such an operation, while not impossible, would be inefficient and cause delays.

A locomotive exchange on Tracks 7, 9, or 2 would be difficult because there is no convenient place to stage the outbound unit. Further, combining the Springfield and Boston sections might have to be done on one track when there are eastbound and westbound Amtrak trains in the station at the same time. Combining on one track is possible when a locomotive pocket track is available, but is a time-consuming procedure.

A 57 crossover (between Tracks 5 and 7) just west of the Track 7 and 9 dividing switch would solve the problem by providing the direct access. The crossover also would ease the locomotive staging problem.

Similarly, NHL and SLE trains should be able to operate normally when one of Tracks 2, 4, 6, or 8 is out of service. Because no locomotive exchange is required, there is more flexibility in assigning these trains to station tracks. Further, Track 3 also would be available as an alternative, allowing trains to be turned even if Track 2 is out of service, as previously described.

Impact of Construction

The previous analyses clearly indicate that the magnitude of the work to be completed can have a severe impact on train operations. Since work will be ongoing in each of these segments on almost a weekly basis for the next 17 years, the need for coordinated planning is essential. See the following subsection for recommendations.

PLAN FOR SCHEDULING COORDINATION DURING CONSTRUCTION

Coordinating train schedules with construction activities must be an important objective of all parties responsible for rail service in the New York City-Boston corridor. Without full cooperation between operators, service levels to commuters, intercity travelers, and freight customers could, during periods of heavy construction, deteriorate to an unacceptable level.

The basic operating plan for a railroad consists of the schedules published in the operating timetable or other documents. For a passenger railroad, these schedules are contained in the employee timetable. The schedule is a compromise between diverse interests: the engineering and construction personnel who require track usage to achieve their construction goals and objectives, the operating personnel whose train operations use the same tracks to serve the traveling public, and the marketing department, which gauges consumer demand and develops schedules to satisfy that demand.

For a construction project as large as the this, planning a timetable must be started years, not a few months, in advance. These schedules and construction plans should be reviewed on a regular basis, with 30-day, 90-day, 180-day, and multiyear horizons. The construction group(s) should prepare a schedule of the desired track usage, where it is needed, and when it is needed. The operating group(s), in conjunction with marketing personnel of each railroad, should identify the trains that are to be run and the times that they should operate. These two needs will conflict and differences will have to be resolved.

It is recommended that a technical staff of individuals, with no day-to-day operating responsibilities, be established and empowered to resolve the conflicts and recommend solutions for all rail operating segments between New York City and Boston. Answerable to a higher-level policy board consisting of the NEC operators, they would be responsible for long-term planning as well as recommending solutions to problems that arise daily as construction progresses and operating requirements vary. It is envisioned that the group would be small, possibly not more than three persons: one from construction/engineering, one from transportation, and a scheduler (or possibly a modeling expert). Additional support should be provided by staff from agencies operating in the Corridor. The members should be familiar with the requirements of each group; this will enable them to develop viable solutions in concert.

The group would apply basic techniques to analyze the issues and develop resolutions. Copies of the stringline for the ideal operating schedule (without track outages or other constraints) would be color coded to depict potential track outages by time period. The stringlines would be continually updated as conditions and requirements change. In the long term, this tool would enable each group to plan their operations in advance, and should prevent any of the groups or affected railroads from having to accept an unsatisfactory operating plan.

Changing departure times may resolve the problems easily. However, that may not always be possible. Changing a departure time to solve a conflict at one point may create another conflict elsewhere. Considering that a given Amtrak train may meet as many as five other Amtrak trains (current timetable) between New York City and Boston, changing the location of one meet to resolve a conflict could also change the location of four other meets. The inclusion of commuter trains adds even more meets, which also must be accommodated.

These problems are not new, nor are they unsolvable. One recently publicized attempt to reach a solution was made by the Burlington Northern Railroad. Its problem was that non-coordinated, scheduled track outages on various parts of the system were causing late deliveries of time-sensitive freight. As a countermeasure, the railroad attempted to move freight by using computerized stringlines of track outages on a systemwide basis. By so doing, the interests of neither Operating nor Engineering took automatic precedence.

Coordination of Construction and Operating Schedules

Both Amtrak and MNCR have developed on an on-going basis operating plans based on analyses of the effect of planned construction activities requiring track outages and/or the re-routing of trains. Unfortunately, the planning is done independently; if the program recommended by this Plan is to be successful these practices have to stop. Their most recent operating plan activities are discussed below.

Amtrak, as the operator of MBTA's services, takes the MBTA's needs into consideration. Amtrak, LIRR, and NJT operations will be altered by the Penn Station Central Control project and have recently begun the process of coordinating with each other relative to operations planning.

Coordination of Construction and Operating Schedules by Amtrak. To provide track occupancy time for trackwork and construction work in 1993, Amtrak has rescheduled its trains between New York City and Boston. The basis for the schedules are simulations performed by Amtrak. Figure M-1 is a stringline plotted from those schedules. The schedules have been cleverly crafted so that all scheduled meets occur at interlockings. Since there are no scheduled meets at other than interlockings between Old Saybrook and Providence, any 2 non-adjacent track segments on opposite tracks can be taken from service on a 24-hour basis for the duration of the construction period. There are no built-in schedule delays and work locations can be changed without schedule changes.

If all trains are on time, the network should work well at the current level of traffic, which should continue to 1997. Schedules for an increased level of service have not been developed. Amtrak has added 8 to 10 minutes' pad to the revised schedules to assure reliability.

The key condition is that all trains must be on time. Should trains operate late, the nicely planned operation would begin to fall apart. Table M-2 shows the impact that late trains have on other trains if a track is out of service between Old Saybrook and Groton and a second track is out of service between High Street and Kingston (scenario 1). Some trains can be late 15 to 20- minutes without impacting other trains. Other trains, if late, will delay one or more trains. Train 169 will delay Train 12 at Old Saybrook, and Train 12 in turn will delay Train 171 at Kingston. If Train 169 is 10 minutes late at Old Saybrook, Train 12 will be delayed 10 minutes, but if Train 12 makes it's schedule between Old Saybrook and Kingston, Train 171 will be delayed 10 minutes at Kingston. These delays can be visualized on the stringline in Figure M-1 by the designations A and B.

Between Old Saybrook and Shaw's Cove Interlockings, a significant improvement could be derived from the proposed installation of Point Interlocking, and the crossover at Shaw's Cove Interlocking. Point would reduce the distance between interlocked crossovers from 18 miles to approximately 9 miles in each direction. With these installations the delays to Trains 12 or 171 may be reduced or eliminated. The benefits of these crossovers are shown in Table M-3. Scenario 1 illustrates the delays that would occur without Point Interlocking. Scenarios 1a and 1b illustrate the impact of installing Point. In scenario 1a, the minimum conflict-resolution-delay is obtained by delaying Train 12 at Old Saybrook as long as Train 169 is less than 12 minutes late. If Train 169 is more than 12 minutes late, further delaying Train 169 at Point produces the least delay. In Scenario 1b, neither train is delayed when the crossovers have been installed. This result should be compared to Scenario 1 in which the crossovers have not been installed.

Table M-4 shows the impacts if two other track segments are out of service, this time between Groton and High Street and between Kingston and Davisville (Scenario 2). Table M-5 shows the reduction to delays for Train 153 achieved by the installation of the recommend Lord Interlocking.

Between Providence and Boston, the operating plans have not been finalized. Initially, Amtrak believes that tracks can be taken out of service at night during the week and continuously on weekends, when MBTA service is minimal.

Coordination of Construction and Operating Schedules on the NHL. MNCR currently issues schedule revisions to accommodate programmed construction work to be accomplished on the lines it operates, including the portion of the NHL owned by CDOT. The basic service pattern are identical in each revised schedule, but originating and running time adjustments are made so that windows exist for every train, including Amtrak trains.

Recent analyses have indicated that 10 or more minutes', pad is currently built into Amtrak schedules on the NHL. As a result, Amtrak trains have enough reserve time to have at least one diversion (an unscheduled changing from the normally scheduled operating track). At most locations, a double-diversion should not consume more than 5 minutes of the 10-minute pad. This would leave 5 minutes for some traffic delay in route. This amount of pad should be sufficient for the current schedules.

The goal trains with a 3-hour schedule will not have a 10-minute pad on the NHL, but rather about 5 minutes of pad between New York City and New Haven. If 3-hour schedules are instituted before all construction work requiring significant track outages is completed on the NHL (Saga Bridge is not due to be completed before 2009), there will be insufficient pad to cover the construction delays.

Therefore, reliable 3-hour schedules (except for perhaps a few well chosen off-peak trains) may not be feasible until the major bridge work is completed on the NHL.

All of this points to the need for a formalized NEC scheduling committee. This committee should be functioning now.

Table M-2
SCENARIO 1
IMPACT OF LATE TRAINS ON OTHER TRAINS
DURING SINGLE TRACKING[1]
(Summer 1993 Schedule)

Late Trains	Other Trains Made Late
151	None
169	12 at Old Saybrook (see Train 12)[2]
153	12 at High Street (see Train 12)
171	None
173	190 at High Street
175	170 at High Street
179	172 at High Street; 174 at Old Saybrook[2]
193	None
66	151 at Kingston
12	171 at Kingston
190	None
170	None
154	175 at Groton[3]
172	None
174	None
176	193 at Groton [3]

[1]A track is out of service, Old Saybrook to Groton, and another track is out of service High Street to Kingston

[2]Delay may be reduced or eliminated by installation of the recommended Point Interlocking, if Groton-Point segment were out of service.

[3]Delay may be reduced or eliminated by installation of the recommended Point Interlocking, if Old Saybrook-Point segment were out of service.

Table M-3
COMPARATIVE BENEFITS OF RECOMMENDED POINT[1] INTERLOCKING FOR TRAIN 12

Scenario 1-Without Point Interlocking-Track 05-Old Saybrook to Shaw's Cove

Lateness of Train 169[2] (minutes)	Delay to Train 12 (minutes)	Delay to Train 169 (minutes)
5	5 @ Old Saybrook	0
10	10 @ Old Saybrook	0
15	15 @ Old Saybrook	0
20	0	18 @ Shaw's Cove[3]

Scenario 1a-With Point Interlocking-Track 05-Old Saybrook to Point

5	5 @ Old Saybrook	0
10	10 @ Old Saybrook	0
15	0	8 @ Point
20	0	3 @ Point

Scenario 1b-With Point Interlocking-Track 05-Point to Shaw's Cove

5	0	0
10	0	0
15	0	0
20	0	0

[1]Location assumed near Nan to equalize running times.

[2]Arrival at Shaw's Cove.

[3]An alternative would be to delay Train 12 for 20 minutes at Old Saybrook, in which case Train 169 would have no delay.

Table M-4
SCENARIO 2
IMPACT OF LATE TRAINS ON OTHER TRAINS
DURING SINGLE TRACKING[1]
(Summer 1993 Schedule)

Late Trains	Other Trains Made Late
151	66 at Kingston
169	None
153	None
171	12 at Kingston
173	None
175	154 at Groton[2]
179	None
193	176 at Groton[2]
66	None
12	153 at High Street[3]
190	173 at High Street[3]
170	175 at High Street[3]
154	None
172	179 at High Street[3]
174	None
176	None

[1]A track is out of service, Groton to High Street, a second track is out of service, Kingston to Davisville.

[2]Delay may be reduced or eliminated by use of the recommended Lord Interlocking, if Lord-High Street segment were out of service.

[3]Delay may be reduced or eliminated by use of the recommended Lord Interlocking if Groton-Lord segment were out of service.

Table M-5
COMPARATIVE BENEFITS OF RECOMMENDED LORD INTERLOCKING FOR TRAIN 153

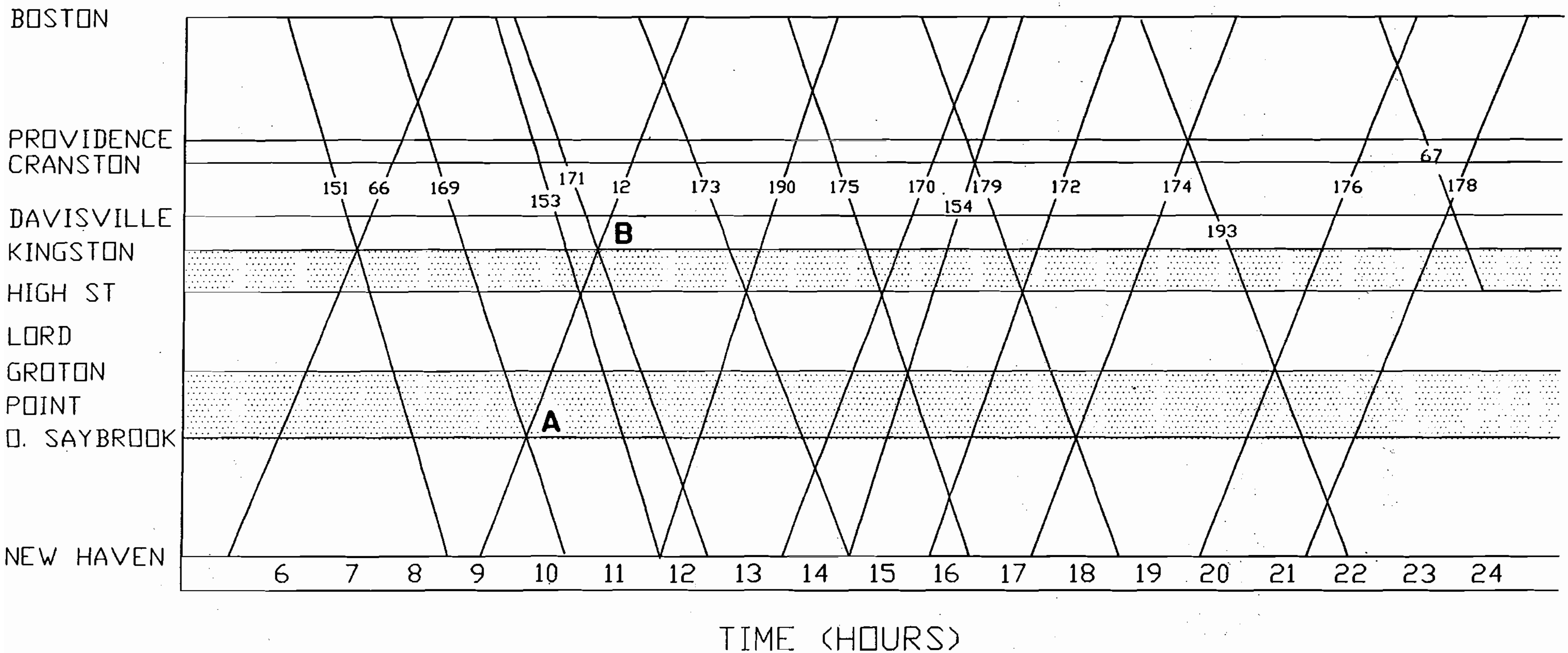
Scenario 2a-Without Lord Interlocking-Track 05-Groton to High Street

Lateness of Train 12 (minutes)	Delay to Train 153 (minutes)	Delay to Train 12 (minutes)
5	5 @ High Street	0
10	10 @ High Street	0
15	15 @ High Street	0
20	0	17 @ Groton[1]
Scenario 2b-With Lord Interlocking-Track 05-Groton to Lord		
5	0	0
10	0	0
15	0	0
20	1 @ Lord	0
Scenario 2c-With Lord Interlocking-Track 05-Lord to High Street		
5	5 @ High Street	0
10	0	9 @ Lord[2]
15	0	4 @ Lord
20	0	0

[1]An alternative would be to delay Train 153 for 20 minutes at High Street, in which case Train 12 would have no delay.

[2]An alternative would be to delay Train 153 for 10 minutes at High Street, in which case Train 12 would have no delay.

Figure M-1
STRINGLINE OF SUMMER 1993 AMTRAK SCHEDULE
(SHADED AREA INDICATES ONE TRACK OUT OF SERVICE)



The Northeast Corridor Transportation Plan

New York City to Boston

Volume 2

Appendix N
INTEGRATED SCHEDULING AND DISPATCHING FOR THE NEC

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Appendix N
INTEGRATED SCHEDULING AND DISPATCHING FOR THE NEC

INTRODUCTION

Other portions of this Plan discuss the unique position of the Boston-New York City Corridor, which has multiple owners/operators, compared to other high performance intercity rail systems in other parts of the world, which have centralized ownership/operation. The Amtrak Authorization and Development Act of 1992 requires the NECTP to provide ". . . for the coordinated scheduling of intercity and commuter trains, including the provision of priority scheduling, dispatching and occupancy of tracks for appropriately frequent, regularly scheduled intercity rail passenger service of 3 hours or less between Boston, Massachusetts and New York City, New York, with appropriate intermediate stops" and "a comprehensive plan to control future congestion on the Northeast Corridor attributable to increases in intercity and commuter rail passenger service."

The program of projects in this Plan includes a number of improvements needed to operate the projected 2010 commuter, freight, and intercity service on the same tracks. The provision of new or expanded physical facilities does not necessarily mean that they will be used as intended in the daily operating world unless the schedules of all services are fully integrated and the minute-to-minute real time dispatching is likewise coordinated. This Appendix addresses the dispatching and schedule planning that ultimately will be required to provide reliable service to all Corridor users as 3-hour service is initiated and the frequency of Amtrak, commuter, and freight trains increases.

CURRENT ARRANGEMENTS

Over the time period covered by this Plan, particularly during the times of intense construction activity, in order to minimize service disruptions to their customers, intercity, commuter, and freight operators will be required to cooperate fully with each other in preparing train schedules and in other facets of rail operations. The allocation of scarce track capacity demands a level of coordination along the entire 231 miles of the Corridor and associated branch lines that has never before been required. This experience, however, should form a foundation upon which to build the very kind of operating environment that will be so important to the success of future operations. The shared experience of scheduling trains under very difficult construction can evolve into an awareness of the need to extend and expand future cooperation and coordination.

It is first useful to review the basic operating differences between the services. A local commuter train making all stops may average about 30 miles per hour from origin to destination. A "zone express" commuter train during the rush hour may average 35-45 miles per hour depending on the number of stops in the "zone," the length of the run, and the propulsion system. A conventional intercity train may average 65 miles per hour, while a Metroliner will have to average nearly 80 miles per hour to make the 3-hour goal. Furthermore, about half of the 3-hour Metroliner trains will operate during a local commuter rush hour. For example, a 2:00 p.m. Boston Metroliner departure will arrive in New York City at 5:00 p.m. and vice versa; while a 6:00 p.m. New York City departure will not get out of rush hour traffic until it leaves New Haven an hour later. The factors of high equipment reliability and discipline in schedule adherence become much more important as rush hour density increases towards theoretical capacity limits at critical choke points. Rapid communication is essential as speeds and speed disparity increase.

The NECIP recognized the basic communications problem when the Centralized Electrification and Traffic Control (CETC) system was specified for the Corridor. Time-consuming verbal exchanges between dispatchers and tower operators were eliminated by having the dispatcher control the interlockings directly, while train identification and location is shown to all dispatchers in the room on an individual track circuit basis so that decisions can be made in real time. Dispatchers controlling adjacent territories can see at a glance which trains are going to movê into their territory next. All previously time-consuming manual record keeping automatically takes place in the computer. The CETC system also remotely controls the electric traction power distribution system, so that the service status of every track segment is shown at all times, again eliminating telephone communications. CETC reliability is obtained through multiple processor fault tolerant computers, back-up power supplies, redundant communication lines, continuous system diagnostics, redundant field units, and related systems. The Boston CETC system will soon control the Shore Line from New Haven to Boston, while the New York City (Penn Station) system will control from New York City to New Rochelle. The high density section from New Rochelle to New Haven (54 miles) is controlled by a Metro-North facility. A brief summary of arrangements currently in force or planned under current agreements follows.

New York City-New Rochelle Train Control

Penn Station Central Control will control operations between New York's Penn Station and New Rochelle; however, the institutional dispatching arrangements are unique. Within this jurisdiction, the segment extending between Penn Station and Harold Interlocking will be dispatched jointly by Amtrak and the LIRR. The pool of dispatchers assigned to the segment will be made up of 50 percent Amtrak and 50 percent LIRR employees. They will be evenly divided throughout dispatching shifts. Supervision will rest with the Amtrak or LIRR terminal superintendent, each given that authority for alternating 6-month periods.

New Rochelle-New Haven Train Control

Metro-North is in the process of modernizing its dispatching capabilities. A new operations center is being constructed (and is partially operational) at Grand Central Terminal. Although design and hardware are different from CETC, the same basic capabilities of real time train status display and remote control of routing are present.

New Haven station is currently operated in a split mode, with Amtrak controlling east side operations at Fair Street interlocking, and Metro-North controlling the rest of the station. The proposed station reconfiguration includes eliminating the split operation by incorporating the function of Fair Street interlocking within a new station control center. Amtrak will control from the vicinity of Mill River eastward from the Boston CETC facility.

New Haven-Boston Train Control

Amtrak controls all NEC train movements between New Haven and Boston. A CETC center is located in Boston South Station. Presently, CETC control extends between Boston and Cranston, Rhode Island; traditional dispatching is in effect between Cranston and New Haven. CETC, per agreements with MBTA, also will control the Franklin, Needham, Dorchester, and Stoughton branches. MBTA contracts with Amtrak to perform train control functions and currently provides incentive payments to Amtrak for on-time performance of MBTA trains.

Through the operating agreement, MBTA has the right to choose dispatching entities or assume control of the NEC tracks within the Massachusetts boundaries. Thus, it is possible that the NEC train control function could be further sectionalized should MBTA choose to control the trackage or choose a dispatching entity other than Amtrak.

MBTA monitors Amtrak train control performance by evaluating daily train performance reports. Also, an MBTA desk is in place at the CETC center, manned on an as-needed basis. It has been requested that a CETC monitor be placed in the MBTA operations center to enable real-time monitoring.

Having described the hardware and software required to control the Corridor, the question of who actually operates the systems and the basic dispatching rules must now be addressed. Each user or tenant of today's railroad feels, with some justification, that the organization dispatching a particular segment of the NEC gives preference to its own trains at the expense of the other users. Accusations abound of tenant trains being delayed, held in terminals, unnecessarily held on passing tracks, etc., to the point that no user seems willing to trust another to dispatch its trains. Amtrak believes that its trains should receive priority, because they must interface with so many commuter operations; yet the commuter operators counter that Amtrak trains are often not on time and therefore cause excessive delays to commuter service by having to be handled out of sequence. The freight operators complain about sitting in passing sidings for hours waiting for passenger trains that never arrive.

In spite of these conflicting priorities, the NEC must still accommodate freight, commuter, and intercity service as expeditiously as feasible.

ALTERNATIVE FUTURE ARRANGEMENTS

Notwithstanding the institutional and ownership issues, efficient management principles would have the NEC, and associated branch lines, controlled/dispatched by one entity. This would promote corridor-wide coordination and control. The single entity could be:

- Amtrak, the only entity whose trains traverse the entire railroad, or another corridor railroad;

- a separate company jointly owned by all users and owners, analogous to "union terminal companies" created by private passenger railroads operating out of a common station;

- an independent organization, similar in function to the Federal Aviation Administration air traffic control organization to control train dispatching; or

- a joint users' entity composed of the corridor operators to address long and short term issues, scheduling and dispatching policies and procedures, and to reach agreement routinely on operating schedules.

Key to the success of any of the proposed options is the degree of scheduling and control that each agency is willing to relinquish. This appears to be limited as the staffs of the corridor's operating agencies report to boards who hold them accountable for performance and reliability of only part of the service.

Under ideal circumstances, the Boston to New York City corridor should be run by one organization. Amtrak, as the national carrier and the only operator with service in the entire corridor, would appear to be the logical choice. In effect, this is the present arrangement for operations south of New York City. Trust must exist between Amtrak and all the corridor operators for this option to be acceptable. However, some railroads feel that Amtrak would not act as an unbiased operator and would show favoritism to the intercity operations at the expense of commuter and freight service.

The single company concept is taken from an approach used in the late 19th- and early 20th century when major stations were constructed for joint use by more than one railroad. Under a Union Station agreement, a separate company would be established to operate the terminal with each railroad holding shares in the Union Station company. Train dispatching on the line would be conducted by the company's employees. Scheduling could be initiated by the individual operating railroads but would have to be reconciled and implemented by the single company. In adapting the single company concept to the NEC, a separate corporation would be set up, with corporate shares being held by the owners and users of the corridor for independent dispatching of trains, according to previously agreed upon guidelines. In the FAA type operation ownership of the corridor segments would not change. Under this option, dispatching and scheduling coordination would be performed by an entity having nothing to gain from this arrangement. Nevertheless, the corridor operators still may be reluctant to give up control of their segments to another group.

Finally, the joint users' entity could be partially modeled after the Penn Station Terminal control group currently being instituted by the LIRR and Amtrak for the operation of the Penn Station to Harold Interlocking segment, and could function as follows.

A hierarchy of working relationships would exist. A policy group consisting of the senior officers from the corridor owners would meet two to three times per year to address major issues. A small technical group, or scheduling committee from the operating agencies would meet regularly. This committee would be responsible for developing the short-term schedule and plan for longer periods. Committee members would come to meetings with viewpoints from their respective organizations reflecting operating, marketing and construction issues. Issues which could not be resolved at the technical level would be elevated to the policy group.

Further discussion is needed among the corridor operators to select an appropriate institutional arrangement. This discussion will require consideration of the technical support, scheduling, dispatching control and train prioritization options described below.

No matter which single entity is chosen or how many control centers are used, a number of basic schedule/operational guidelines/operating rules must be either agreed to by all parties or imposed. Examples might be:

- Amtrak is given two trains per hour per direction to schedule at their convenience, but can change schedules only once a year;
- commuter services schedule the next eight trains in each direction at their convenience;
- Amtrak is given another train to schedule in each direction;
- commuter services schedule the next six trains in each direction, etc.;
- Amtrak trains lose their priority if they are more than 3 minutes late during a local rush hour or 7 minutes late at other times;
- commuter trains lose their priority if they are more than 3 minutes late during a rush hour or 5 minutes late at other times; and
- freight trains have their mileage fee reduced by 50 percent on any train delayed more than 1½ hours by passenger service.

Irrespective of the dispatching/control system installed, the development of train schedules under increasingly dense traffic conditions will require a more formal and disciplined procedure to develop local and corridor-wide schedules.

At present, Amtrak coordinates Corridor scheduling with the seven commuter operators. Generally, Amtrak schedules change twice a year (spring and fall); commuter agencies change schedules also, but these may or may not coincide with Amtrak's changes. Further, Amtrak and the other operating agencies have changed some individual schedules on short notice. Because of the capacity constraints in many corridor locations, future scheduling will be much more sensitive to minor schedule changes. For example, a 10-minute change in the departure time of an Amtrak train in Washington, D.C. could require the rescheduling of other commuter and Amtrak trains throughout the travel time window of the train between Washington, New York City, and Boston.

Scheduling and conflict resolution on the NEC can be improved by implementing the following actions regardless the dispatching arrangements:

Form a NEC Scheduling Committee

This committee could consist of a maximum of two persons from each agency operating over the Corridor. They would meet regularly (monthly/bi-monthly). This committee would be responsible for developing the short-term schedule (i.e., 6-month), and plan for longer periods, (i.e., 1-year or 2). Committee members would come to meetings with the viewpoints of their respective organizations.

Major schedule changes would be enacted through committee actions. The fitting of minor schedule adjustments, extra movements, etc., of a local nature could be handled by the parties involved on a case-by-case basis, and on relatively short notice. The committee would determine uniform dates for major schedule changes.

Simulate New Schedules

Schedule details can be tested through simulation. Enough time should be allowed between the definition of new schedules and their implementation so the capacity simulations may be undertaken to assist in locating potential operating difficulties. Monte Carlo™ type simulations can also assist in developing a recovery strategy before actual schedule changes are implemented.

Establish Basic Scheduling Priorities

The achievement of frequent, regularly scheduled and reliable 3-hour service from Boston to New York City requires that these trains be scheduled first in the process and assigned routes with an absolute minimum of diverging moves at interlockings to minimize trip time. Three-hour trip times would not be possible if intercity trains were scheduled after commuter trains.

One element of NEC dispatching and performance that is frequently overlooked involves the 11 moveable bridges over navigable waterways. Depending on the type of marine vehicle(s) requesting the bridge opening, service may be interrupted for 10-, 20-, or more minutes. Although agreements have been negotiated limiting bridge openings to non-rush hours at four locations (Walk, Saga, Peck and Devon), summertime marine traffic is substantial and likely to cause delays as NEC rail traffic frequencies and speeds increase. Reliable NEC service for anticipated 2010 levels of traffic will require a new set of uniform bridge opening procedures to be negotiated with the Coast Guard.

CONCLUSIONS

1. As 3-hour service is initiated and the frequency of Amtrak commuter, and freight trains increases, basic management principles will require that the daily dispatching and control of the NEC, and its associated branch lines, with its complex mixture of high-speed intercity, commuter and freight trains, be vested in one entity.

2. Effective dispatching and control of the NEC cannot occur unless scheduling of all services is jointly planned and simulated prior to being implemented.

3. Frequent, regularly scheduled and reliable 3-hour Boston-New York City trip time can only be achieved if these trains are given both scheduling and dispatching priority.

The Northeast Corridor Transportation Plan

New York City to Boston

Volume 2

Appendix O
AMTRAK AUTHORIZATION AND DEVELOPMENT ACT
PUBLIC LAW 102-533
OCTOBER 27, 1992

Public Law 102–533
102d Congress

An Act

To authorize appropriations for the National Railroad Passenger Corporation, and for other purposes.

Oct. 27, 1992
[H.R. 4250]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

Amtrak Authorization and Development Act.
45 USC 501 note.

SECTION 1. SHORT TITLE.

This Act may be cited as the "Amtrak Authorization and Development Act".

SEC. 2. SAFETY IMPROVEMENTS.

Title VIII of the Rail Passenger Service Act (45 U.S.C. 642 et seq.) is amended by adding at the end the following new section:

"SEC. 811. RAIL AT-GRADE CROSSINGS. 45 USC 650.

"(a) ELIMINATION.—The Secretary, in consultation with the States along the main line of the Northeast Corridor, shall develop a plan by September 30, 1993, for the elimination of all highway at-grade crossings of such main line by December 31, 1997.

"(b) EXCEPTIONS.—The plan developed under subsection (a) may provide that the elimination of a highway at-grade crossing not be required if eliminating such crossing is impracticable or unnecessary and the use of the crossing will be consistent with such conditions as the Secretary considers appropriate to ensure safety.

"(c) FUNDING.—The Corporation shall pay 20 percent of the cost of the elimination of each highway at-grade crossing pursuant to the plan.".

SEC. 3. EXPERIMENTATION WITH NEW TECHNOLOGIES.

Title VIII of the Rail Passenger Service Act (45 U.S.C. 642 et seq.) (as amended by section 2) is amended by adding at the end the following new section:

"SEC. 812. EXPERIMENTATION WITH NEW TECHNOLOGIES. 45 USC 650b.

"(a) PLAN.—The Corporation shall develop a plan for the demonstration of new technologies in rail passenger equipment. Such plan shall provide that any new equipment procured by the Corporation that may significantly increase train speeds over existing rail facilities shall be demonstrated, to the extent practicable, throughout the national intercity rail passenger system.

"(b) REPORT TO CONGRESS.—The Corporation shall, not later than September 30, 1993, submit to the Committee on Energy and Commerce of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate a report summarizing the plan developed under subsection (a), including its goals, locations for technology demonstration, and a schedule for implementation of the plan.

"(c) COOPERATION.—The Corporation, in order to facilitate efforts to increase train speeds throughout the national intercity rail passenger system, shall, upon request by eligible applicants, consult and cooperate, to the extent feasible, with such applicants proposing technology demonstrations authorized and funded pursuant to Federal law.".

SEC. 4. NORTHEAST CORRIDOR PROGRAM MASTER PLAN.

(a) AMENDMENT.—Title VII of the Railroad Revitalization and Regulatory Reform Act of 1976 (45 U.S.C. 851 et seq.) is amended by adding at the end the following new section:

45 USC 856.

"SEC. 708. PROGRAM MASTER PLAN.

"Within 1 year after the date of enactment of this section, the Secretary, in consultation with the Corporation and the commuter and freight railroads operating over the Northeast Corridor main line between Boston, Massachusetts, and New York, New York, shall develop and submit to the Committee on Energy and Commerce of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate a program master plan for a coordinated program of improvements to such main line that will permit the establishment of regularly scheduled, safe, and dependable rail passenger service between Boston, Massachusetts, and New York, New York, including appropriate intermediate stops, in 3 hours or less. Such plan shall include—

"(1) a description of the implications of such improvements for the regional transportation system, including the probable effects on general travel trends and on travel volumes in other transportation modes, and the implications for State and local governments in attaining compliance with the Clean Air Act;

"(2) an identification of the coordinated program of improvements and the specific projects that comprise that program, including their estimated costs, schedules, timing, and relationship with other projects;

"(3) an identification of the financial responsibility for the specific projects that comprise the program, and the sources of those funds;

"(4) an operating plan for the period of construction of the improvements demonstrating a coordinated approach to scheduling intercity and commuter trains;

"(5) an operating plan, for the period after completion of the program, for the coordinated scheduling of intercity and commuter trains, including the provision of priority scheduling, dispatching, and occupancy of tracks for appropriately frequent, regularly scheduled intercity rail passenger service of 3 hours or less between Boston, Massachusetts, and New York, New York, with appropriate intermediate stops;

"(6) a comprehensive plan to control future congestion on the Northeast Corridor attributable to increases in intercity and commuter rail passenger service;

"(7) an assessment of long-term operational safety needs and a list of specific projects designed to maximize operational safety; and

"(8) any comments the Corporation submits to the Secretary regarding the contents of the plan.

The Secretary shall submit to the Congress any modifications made to the program master plan, along with any comments the Corporation submits to the Secretary regarding such modifications.".

(b) CONFORMING AMENDMENT.—The table of contents for the Railroad Revitalization and Regulatory Reform Act of 1976 is amended by inserting after the item relating to section 707 the following new item:

"Sec. 708. Program master plan.".