Eastern Connecticut Corridor Rail and Transit Feasibility Study (ECRTS)

Appendix E: Corridor Capacity Analysis and Service Framework

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1. Introduction

One of the first steps in determining whether the southeastern Connecticut rail corridors can accommodate the addition of new rail service is to perform a corridor capacity analysis. This analysis assesses the potential impacts new service would have on existing Shore Line East (SLE) and Amtrak rail services within the corridor. Three different service levels were considered based on planning documents prepared by the Connecticut Department of Transportation's Office of Rail and by Amtrak: existing service (2022); planned service levels over the next 5-7 years; and the longer-term plan for service (15 years and beyond).

What Is a Corridor Capacity Analysis?

All railroad lines have a level of capacity, frequently expressed as Trains per Hour (TPH), for a given route. It establishes the volume of trains that can be accommodated over the course of the day and can be a key determinant in establishing a route's ability to serve a given market. Defining line capacity of the Northeast Corridor (NEC) through southeastern Connecticut requires an understanding of the railroad's infrastructure, the condition level it is maintained to, the specific train control systems installed, and the types of services operated over it (Amtrak's Acela and Regional service; CTDOT's Shore Line East commuter rail service). Key factors included in the analysis are:

- Number of main tracks available
- Presence or absence of passing points (two or more tracks, sidings, station tracks, etc.)
- Presence or absence of movable bridges
- Type of train control system (track warrants, wayside/cab signals, available codes, etc.)
- Maximum and average speeds over the section
- Speed differential between types of services
- Number of stations in the section
- Presence of major freight service facilities (depending upon freight operations)

Each of the above factors contributes to determining the line's capacity. Multiple tracks allow train operations in both directions and provide much greater capacity than single-track operations, even with passing sidings present. US Coast Guard regulations limit the amount of time mariners must wait for passage through a bridge (20 minutes). NEC movable bridges in Amtrak-owned territory must normally be kept in the open position until a train approaches.

Maximum operational speeds are regulated by the "FRA Track Class" a track is maintained to, as well as the type of train control system installed. Higher speeds require a complete cab-signal system as well as a Positive Train Control (PTC) application. Average speed is governed by the maximum speed as well as other limitations such as curve speed restrictions or speed limits associated with at-grade crossings that may be present. NEC grade crossings are limited to speeds of 80 miles per hour (mph).

Maximum and average speed is also affected by the type of equipment operated. With only a few exceptions nationwide, commuter train equipment is limited to 80 or 100 mph and operates at slower speeds through curves with lower "unbalance" limits (the centrifugal force felt by passengers through a curve). Intercity trains operate at 110, 125, or 160 mph maximum speeds and most include higher limits of unbalance.

The combination of infrastructure factors, equipment performance, and station stops create a "profile" of the train passing over the section of rail line. As would be expected, faster trains traverse the section in a shorter

period. Slower trains, especially those with station stops, will require longer times to cover the same distance. Intercity trains, in particular, can experience station dwell times of several minutes, substantially lengthening schedules. Commuter trains tend to have shorter dwell times, but often make many more stops and require longer running times. This differential is a critical factor in determining overall line throughput. Rail lines carrying trains with large differences in travel times will carry a reduced number of trains compared to lines with uniform travel times. The mix in train running times will require additional schedule time added between the leading, slower train and following, faster train to maintain a "Clear" signal indication. The added time is no longer available for use by a third (or fourth) train – thus reducing overall throughput (total number of trains passing through the corridor).

2. Northeast Corridor – Westerly to New London

The Northeast Corridor is constructed as a two-track system between New London, Connecticut and Westerly, Rhode Island – the limits of the study area. Tracks are electrified with a 27.5kv AC constant tension catenary system with independent catenary support poles. Each track is equipped with a bidirectional, multi-code cab-signal signal system optimized to support high speed service; not dense commuter operations. All tracks are equipped with the Amtrak's Advanced Civil Speed Enforcement System (ACSES) for complete PTC compliance. Due to many curves present, this section is among the slowest in the entire Boston to Washington corridor, with a maximum speed of 90 mph.

New London has two low-level platforms that contain two very short high-level platforms, one on either track. Sharp curvature through the station precludes full-length ADA-compliant platforms, causing extended dwell times for stopping trains. Also at New London, a third track branches off and connects with Genesee & Wyoming Inc.'s (GWI) Line to Norwich on the west side of the Thames River. A rudimentary station platform allows passenger access to Track 6 and is used by terminating Shore Line East (SLE) trains from Stamford or New Haven. The NEC crosses the Thames River on a movable bridge 1.3 miles east of the New London Station, where the junction to GWI's east side line to Norwich begins in Groton. Additionally, a third running track also begins at this location. While portions of this line are electrified (for training), the track is intended to support freight operations serving a very large stone quarry located in Groton and not used by passenger trains. Three miles eastward is another junction, referred to as "Palmers Cove". There, tracks lead directly to the quarry and to the former original main line looping to the east, leading to the Electric Boat facilities. The junction area has been identified as a potential station location.

Ten miles east of New London, the NEC crosses the Mystic River on a second movable bridge with the Mystic train station located immediately beyond it. This station is also located on a sharp curve, which has precluded construction of ADA-compliant high platforms and triggered extended dwell times. Short of relocating the station, no engineering solution has been developed yet to address it. The Town of Stonington lies four miles to the east and has been identified as a zone for a potential station. It has two of the last remaining grade crossings on the NEC and their presence contributes to restrictive speeds.

Nineteen miles east of New London is Westerly, RI and the proposed terminus of commuter service. Like New London and Mystic stations, Westerly is located on a curve in the alignment, though not as severe as New London or Mystic. Low platforms remain in use. One- and one-half miles to the east of the station is the High Street Interlocking (a facility for switching trains from one track to another). The property would appear to be available to construct a short "Tail Track," which would be able to hold at least one commuter train clear of the main tracks. This is likely to be an operational requirement for any expansion of SLE service.

A small maintenance yard used by Amtrak is situated closer to the station. However, its track configuration is oriented in the wrong direction (towards Boston) and would not be well-suited to support the commuter service

towards New London. With some additional infrastructure improvements, it may be possible to utilize the space for overnight storage of equipment if needed to support a future service plan. Figure 1 is a diagram that shows the Northeast Corridor between New London and Westerly along with relevant features for the potential service concept.

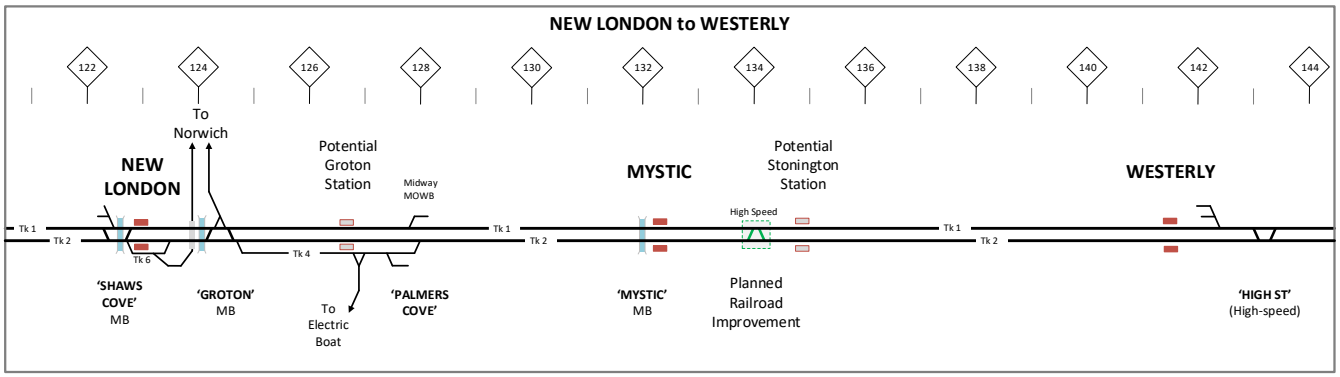

Figure 1: Northeast Corridor Study Territory

2.1. Northeast Corridor Capacity

It is possible to display the interaction of the trains, their time requirements and distances traveled graphically in a space / time format, often referred to as a "String Chart" based on historical railroad practices. The graphic can also accurately represent utilization of the rail line capacity for a given section of the rail line and time interval plotted. Current and future service along the Northeast Corridor through the study territory runs on relatively uniform time intervals. Thus, it is reasonable to assume a graphic representing one hour during normal hours of operation (approximately 16 hours of the day) can be applied for the balance of the day. Two scenarios were evaluated. Both pivot off of the critical effect the presence of movable bridge operations has on service. Each time a bridge is closed to rail traffic, many actions occur; signals are set to "Stop," derails are opened, the movable portion of the bridge is unlocked, the bridge operates (raised or swung), vessels pass through the bridge, and the closing process takes place in the reverse order of opening. These actions all consume time and can create significant impediments to both rail and marine traffic. Historically, the predecessor New Haven Railroad diverted certain freight traffic over inland routes to avoid sending it over the five movable bridges in southeastern Connecticut.

The first scenario, shown in Figure 2, evaluates operating one commuter train per hour along with Amtrak's planned operations. It assumes a 13-minute bridge open time (actually 10 minutes open to allow for the above opening process) plus 5 minutes to close the bridge to marine traffic in advance of an approaching train. The second scenario, shown in Figure 3, evaluates a more aggressive, and more problematic scenario of operating two commuter trains per hour with 10-minute bridge open times and 3-minute train approach times. These timings are likely the minimums required and leave virtually no reserves capable of accommodating off-schedule operations. Figure 2 and Figure 3 graphically show potential use of NEC for a one-hour interval. In these figures, overlap implies infeasibility of operation without substantial policy or infrastructure changes.

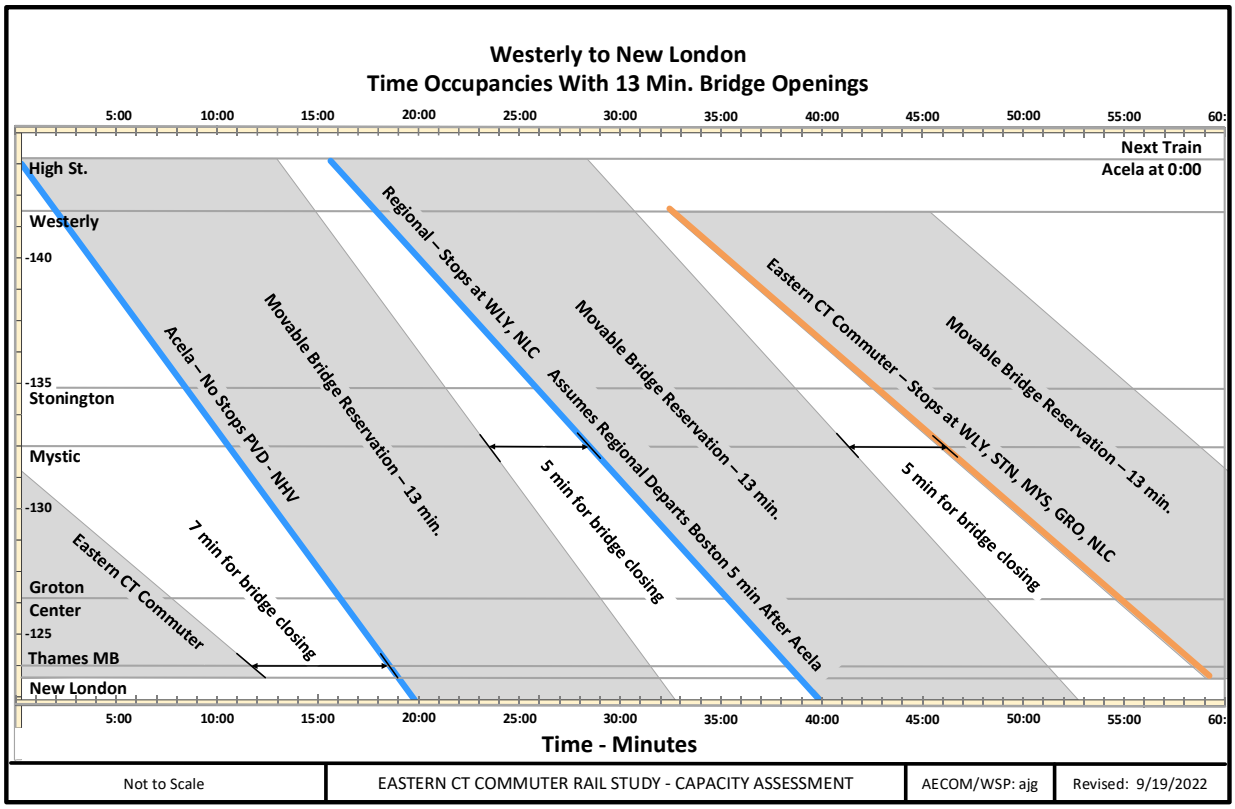

Figure 2: Eastern CT Study Occupancies with 13-minute Bridge Openings

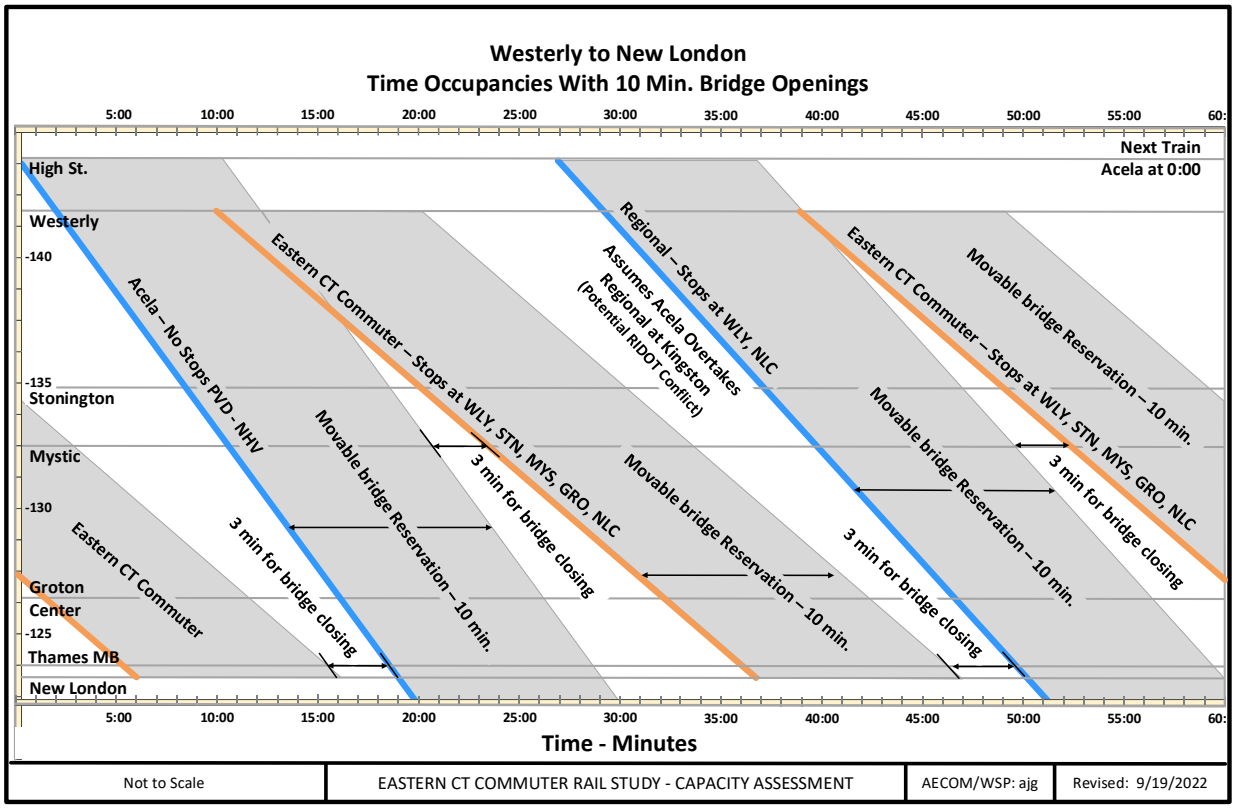

Figure 3: Eastern CT Study Occupancies with 10-minute Bridge Openings

2.2. Northeast Corridor Signal System Capacity

Train control / signal systems provide for the safe passage of trains over a given section of rail line. Their design and function varies based upon the types of trains operated (high-speed, commuter, freight, etc.), maximum and average speeds, and planned volume of train traffic. The NEC train control system in the study territory is considered capable of accepting a following train approximately every 5-6 minutes, providing both trains are of the same type and make the same station stops. However, movable bridge opening requirements exceed and supersede the designed signal headway limits and, as such, are not a primary factor to determining maximum line capacity between Westerly and New London. For the service alternative using the Groton Secondary (Old Road) to the primary Electric Boat facilities in new London, installation of a signal system on Track 4 between the Groton Interlocking and the junction to the Groton Secondary should be considered a requirement.

2.3. Storage of Equipment – New London

Other than potentially very quick turnarounds during the peak periods, commuter trains cannot be stored on either of the two main tracks at New London station between assignments. An alternative location must be identified and improved, if necessary, for this purpose. If possible, the storage location should be configured in such a manner that a commuter train can access it in one continuous operation. Multiple crossover operations and/or reversing direction for back-up movements are much less desirable and may not be feasible given New London's 6-train per hour planned volume. Three strategies have been identified as follows:

1. The first would use a former freight siding track connected to Track 1 adjacent to Crocker's Boat Yard. It currently appears to be used by Amtrak Engineering for work equipment. This track could accept a relatively short commuter train in a continuous operation after discharging its passengers at the station. However, this location would require trains to cross a third movable bridge, "Shaw's Cove," and add to the number of bridge closures that already have greater train volume than the Mystic or Thames River movable bridges. It is also not configured well to access Track 2, the eastbound track to Westerly, and would likely require eastbound trains to operate on Track 1 to the Groton interlocking before crossing over. Such an operation would require longer time occupancies on Track 1 in in the face of on-coming traffic. Of the three options discussed, it is the least desirable concept.
2. A second option would involve improving Track 6 through New London Station to hold both existing SLE and extension trains. Approximately 1,000 feet is available between the State Street and Governor Winthrop Boulevard grade crossings which may be long enough to hold two 4-car trains, each of which is typically 400-450 feet in length. Improvements to install mid-point holding signals would be required. Westbound trains (from Westerly) would cross over to Track 2 over the Thames River and operate on a new powered crossover enabling trains faster access to Track 6. The location of crossover, the clearance points for the grade crossing circuits, as well as the ability to extend the existing platform to serve both trains will need to be determined in more detail. Potential slow-speed operations on Track 2 as well as the time trains would occupy Track 2 between New London and the Groton interlocking are drawbacks that would need to be evaluated in detail.

   A third option would extend SLE trains from New London eastward and return from Westerly to assume the schedule to Old Saybrook and west. This strategy would avoid adding additional trains in a given hour through New London but would likely require more non-revenue trains departing from the SLE storage yard in New Haven, or possibly from a future location in Old Saybrook to support the expanded operation and increase the total number of SLE trains operating over the three movable bridges between New London and Old Saybrook. The Track 6 improvements listed in Option 2 could also provide a benefit for the thru-running strategy by creating a passing siding able to hold an eastbound SLE train to enable a following Amtrak train pass it, as is done at Guilford and Old Saybrook.

Thru-running operations also bring two additional features that the first two options would not have. First, it would bring the equipment to an established, secure location and allow existing staff to service and maintain the trains. This avoids the expense to construct overnight storage service facilities and establish secure premises. Both can result in substantial financial savings. Second, SLE service would effectively be extended, enabling one-seat rides to stations to the west and better serving markets beyond New London. This could have a measurable benefit with forecasted ridership.

Figure 4 provides a closer view of this critical section of the NEC.

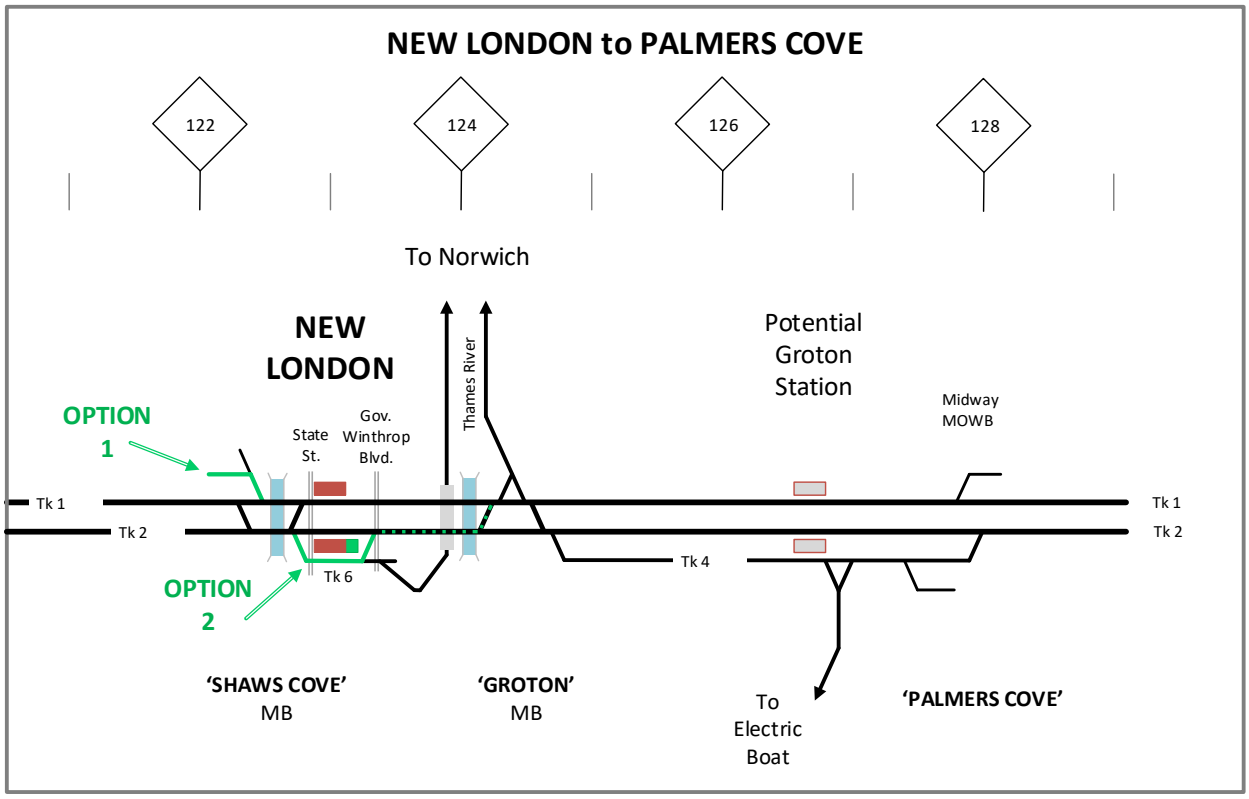

Figure 4: Potential Train Storage Location - New London to Palmers Cove

2.4. Northeast Corridor Capacity Assessment

Assuming sufficient, off-main, turn-around and storage facilities can be provided, operation of one commuter train per hour in each direction between Westerly and New London, either as a stand-alone operation or as an extension of SLE, is considered conceptually feasible. A second commuter train in each hour may be possible but doing so would impinge on movable bridge opening time requirements and would require Amtrak to schedule its trains using a schedule pattern that could conflict with both Rhode Island Department of Transportation (RIDOT) and Metro-North planned operations. On the following page, existing and preliminary future Amtrak NEC running times and frequencies are shown in Table 1 and Table 2, respectively. Given the considerations of the existing and potential future Amtrak service, as well as the conditions provided in Section 2, Table 3 details potential conceptual running time and frequency of commuter service in southeastern Connecticut.

Table 1: Northeast Corridor – Amtrak Current Running Times and Frequencies

	# of Stops	Running Time	Frequency
Acela	Non-Stop	16 – 18 minutes	10 weekday roundtrips
Regional	1 Stop	18 – 20 minutes	9 weekday roundtrips
Regional	2 Stops	20 – 22 minutes	9 weekday roundtrips
Regional	3 Stops	22 – 26 minutes	9 weekday roundtrips

Source: Amtrak

Table 2: Northeast Corridor – Amtrak Future Running Times and Frequencies (PRELIMINARY)

	# of Stops	Running Time	Frequency
Acela	Non-Stop	15 – 17 minutes	14 weekday roundtrips
Regional	1 Stop	16 – 18 minutes	17 weekday roundtrips
Regional	2 Stops	18 – 20 minutes	17 weekday roundtrips
Regional	3 Stops	20 – 24 minutes	17 weekday roundtrips

Source: Amtrak
Note: Travel time reductions for Regional Service assume high-level platforms at Mystic and Westerly

Table 3: Extension Service – Potential Running Times and Frequencies (CONCEPTUAL)

	# of Stops	Running Time	Frequency
Commuter	All Stops	25 – 29 minutes	TBD weekday roundtrips

Note: Travel times assume high-level platforms at Groton, Mystic, Stonington, and Westerly

3. Thames River Corridors and Groton Secondary

Unlike the Northeast Corridor, with its carefully coordinated schedules involving over 2,000 weekday trains, both the West and East Thames River Corridors and the Groton Secondary (Spur) host only limited freight operations (1-2 times per day) that run to meet market demand and do not operate on fixed schedules. As such, line capacity requirements will be different and focused on maintaining good freight service as well as accommodating conceptual passenger services.

3.1. Thames River Corridor West

GWI's former New England Central Route (NECR) and prior to NECR, the Central of Vermont (CV), had provided a main freight route from New London to Canada since the 19th century. As such, it was designed and maintained to accommodate long freight trains and operate at reasonably fast speeds. In the 1980s, it hosted Amtrak's Montrealer to/from Montreal, PQ until discontinued as part of a federal budget reduction. Changing markets and corporate structures within the rail industry brought about reductions in through freight volume, but service to local customers and the Port of New London remains important with expansion of its volume in anticipation of supporting a budding wind-farm industry off of Block Island, Rhode Island.

Opportunities for freight service to operate throughout the day (as opposed to night-only when passenger service would not run), are reliant upon sufficient rail line infrastructure to enable freight operations during passenger service hours. Examples of improvements to facilitate joint operations includes:

- Passing siding for passenger trains at New London off the NEC and clear of all yard operations. Unless the service runs using only a single trainset, it is critical to provide a passing point near New London Station to accept passing trains off of the NEC tracks.
- Long lead track or double track approaching the New London Yard port facilities to enable a freight train to be built off of the main track before departure or hold an arriving freight train clear of the main track.
- Potential mid-point passing track between New London and Norwich able to hold a freight train (also likely needed for passenger service). While the corridor is only 11 miles in length, a mid-point siding may be critical to achieving more precisely timed deliveries and operations.
- Potential lead track extensions of industrial sidings able to hold a local freight train if service is to be provided during passenger service operations.
- Passing siding at Norwich for freight trains, north of the passenger station, or double track approaching the Norwich passenger station.

The above improvements cover a range of needs and, depending on the passenger service plan developed, as well as planned freight operations, it may be possible that not all of these improvements would be required. A more detailed set of potential needs will be considered as the ECRTS progresses.

3.2. Thames River Corridor East

GWI's former Norwich Secondary, originally constructed by regional New York and New England Railroad as an outlet to the Atlantic, remained an important north/south route to Worcester and northern New England after competitor New Haven Railroad acquired it in the 1920s. It hosted passenger service until 1970. Traffic volume declined precipitously under Conrail operations and today just a once-per-day local freight operates on the line. Similar to the western corridor, certain improvements should be evaluated in the context of potential passenger operations, though at a smaller scale considering the shorter trains operated. Examples of improvements to facilitate joint operations includes:

- Passing siding for passenger or freight trains at Groton on the east corridor track clear of the NEC.
- Potential mid-point passing track between New London and Norwich able to hold a local freight train or passenger train. Like the west corridor, the siding may be needed to properly time passenger trains or hold a local freight.
- Potential lead track extensions of industrial sidings able to hold a local freight train if service is to be provided during passenger service operations.
- Ability to hold a freight train north of the passenger station, without interfering with grade crossings, etc.

The above improvements cover a range of needs and, depending on the passenger service plan developed, as well as planned freight operations, not all of the improvements may be required. A more detailed set of potential needs will be considered as the ECRTS progresses.

3.3. Groton Secondary

The Groton Secondary Spur was originally constructed as the New Haven Railroad's Main Line and led to a ferry terminal to carry passengers and cargo to New London. Passenger and ferry service was discontinued after a bridge over the Thames River was constructed in the 1890s, enabling continuous operations. The ferry terminal facilities were repurposed and eventually became the site of today's General Dynamics Electric Boat ship-building operations. As with the Thames River corridors, certain improvements should be evaluated in the context of potential passenger operations. Although its short length and confined ROW cap potential improvements, investments should be considered to help ensure a viable service could be operated:

- Complete upgrade of Track 4 from Groton to Palmers Cove to host competitive passenger service. The improvements should include, but are not limited to, installation of a complete signal system, interlocked switches, and PTC.
- Passing siding for passenger or freight trains, if possible before trains enter/exit the Groton Secondary.
- Ability to hold a freight train at General Dynamics Electric Boat without interfering with passenger operations.

The above improvements cover a range of needs and, depending on the passenger service plan developed, as well as planned freight operations, not all of the improvements may be required. A more detailed set of potential needs will be considered as the ECRTS progresses.

3.4. Thames River Corridors, Groton Secondary Capacity Assessment

Assuming sufficient railroad infrastructure improvements are made, to be determined through the development of ECRTS service plans, it appears feasible that each of the above corridors could host passenger service and do so in a manner that does not provide material harm to on-going freight operations.