FANSITMATTERS Fall 2023

Modernizing the Fitchburg Line

Rapid, Reliable Transit for Waltham, Concord, and Fitchburg

The MBTA's Fitchburg Line extends from Boston, through dense and job-rich areas of Cambridge and Somerville, through low-density suburbs near office parks, to the Gateway Cities of Fitchburg and Leominster. The Fitchburg Line is the MBTA's second-longest line and the longest to run entirely in Massachusetts. While the Fitchburg Line spans three different ridership markets and is poised to be a high-ridership, high-performing economic engine for these markets, the line's current low frequencies and long trip times mean that it falls well short of maximizing its potential as a dependable transit service for all kinds of trips. A shift toward a Regional Rail model would improve service to all three markets, bringing modern intercity service to Fitchburg and Leominster, regional connectivity to key suburban areas and job centers, and subway-like rail service to underserved areas of Somerville and Cambridge.

A Regional Rail model on the Fitchburg Line would involve train frequencies (or headways) of every 30 minutes or better to Wachusett and every 15 minutes or better headways to Waltham; cheaper, rationalized fares with free, coordinated transfers to regional transit authority (RTA) buses and other MBTA services; and infill stations to serve the currently underserved Somerville/ Cambridge urban rail market. To facilitate these service levels and make the most of these investments, the following key infrastructure and operational upgrades are necessary:

- » Electrification of the Fitchburg Line with overhead catenary systems (OCS)
- » Installation of high-level platforms at all stations
- Introduction of fast-accelerating and reliable Electric Multiple Units (EMUs)
- » Grade separation in Waltham Center to enable double track and subway-like frequency on the urban segment
- » Timed transfers to existing and future bus service to provide first-last mile connections

Electrification and high platforms would reduce travel times by 33 minutes to approximately an hour for all-stops trains, a 45% decrease from current travel times.



TransitMatters is a 501(c)(3) nonprofit dedicated to improving transit in and around Boston by offering new perspectives, uniting transit advocates, and informing the public. We utilize a high level of critical analysis to advocate for plans and policies that promote convenient, effective, and equitable transportation for everyone. Learn more & download other Regional Rail reports at: <u>http://regionalrail.net</u>

Current Situation

The Fitchburg Line runs 54 rail miles from North Station to Wachusett and serves three travel markets with distinct needs: the Gateway Cities of Fitchburg and Leominster, with over 40,000 people each; low-density suburban towns with populations ranging from 10,000 to 20,000, some of which have significant commuter activity to Boston; and dense inner core suburbs from Brandeis/Roberts through Belmont and Cambridge. The line also connects to the Red Line at Porter Square in Cambridge.

The intercity market consists of towns past I-495, especially Leominster and Fitchburg. This combined metropolitan region has approximately 33,000 jobs as of late 2017. Only 11% of these jobs are close to the Fitchburg and North Leominster train stations; however, the number of jobs within half a mile of Fitchburg Station increased by 3% every year between 2011 and 2018, and better rail service is likely to increase job concentration further. With more competitive end-to-end travel time brought about by electrification and other improvements, intercity rail will become a more appealing travel option for those in this market.

The Fitchburg Line has been historically oriented around peak commuting, but changing travel patterns related to increased remote work have changed this; off-peak ridership has recovered much more quickly than peak ridership. Reflecting this change, the Fitchburg Line presently operates an hourly clockface schedule all day on weekdays (though only every other train continues past Littleton). The suburban market begins west of Brandeis/Roberts station and primarily serves peak travel between wealthy low-density suburbs and Boston and Cambridge via the Red Line at Porter. Pre-pandemic, the busiest station on the line excluding North Station and Porter is South Acton, with 1,000 inbound boardings; running inbound, most trains would reach their peak load by Belmont or Waltham, with few riders boarding or alighting on the urban end. Regional Rail brings halfhourly all-day service to this market; this would both boost ridership in the current market and open up new reverse-commute opportunities.

Current Wachusett Fitchburg North Leominster Shirley Ayer Littleton/Route 495 South Acton West Concord Concord Lincoln Silver Hill* Hastings* Kendal Green **Brandeis/Roberts** Waltham Center Waverley **Belmont** Porter Red Line Commuter Rail Amtrak North Station Green Line Orange Line Legend Existing Line GD Transit Connection O Existing Station

Fitchburg Line

* Station closed at time of publishing.

The urban market displays the most significant potential for growth. Spanning Brandeis/Roberts and the line's terminus at North Station, there is substantial unmet demand from dense areas along the corridor currently underserved by rapid transit, but current low ridership due to infrequent schedules and high fares.

Waltham Center and Brandeis/Roberts had 770 inbound boardings (and 890 total boardings) in 2018, while the other urban stations each had fewer than 400 inbound boardings. The Red Line has over 8,000 daily boardings at Porter Square, while the Commuter Rail service only attracts 275 inbound boardings. Thanks to a project in the last decade that double-tracked an eight-mile single-track segment through West Acton, the Fitchburg Line is almost entirely double-track. Only a ³/₄-mile portion of the line remains single-track, through and just east of Waltham Center station. Due to weak service, reverse peak ridership is low. Pre-COVID, the outbound train departing North Station at 7:43 am, the busiest reverse-peak train, averaged 216 passengers, and by the time it departed Brandeis, it had 120; only a smattering continued all the way to the Fitchburg area.



* Brickbottom jobs include 2,407 which are also within the area covered by Union Square.

Demographics







Required Infrastructure Investment

To achieve greater mobility, we propose a variety of infrastructure and operational improvements, including electrification, full-length high-level platforms, timed transfers, infill stations, and a rationalized fare structure. Trains would run at least every 15 minutes all day between North Station and Brandeis/Roberts and at least every half-hour to Wachusett.

High platforms allow for faster boarding and alighting, while electric multiple units with overhead catenary electrification have better acceleration over existing diesel locomotives. If these investments are made, overall stop penalties and dwell times can be cut from upwards of 2.5 minutes to 60-75 seconds, with end-toend trip times reduced by 33 minutes, even with up to four additional stops. Service today takes over an hour and a half for all-stops trains and over an hour for express trains; our plan would cut the all-stops time down to about an hour end-to-end.



Costs

The Fitchburg line is among the more difficult of the MBTA commuter rail lines to modernize fully, and our cost estimates reflect that difficulty; at US costs, the cost of these improvements is significant, particularly given the grade separation project in Waltham. Given the line's length, total electrification costs are also higher. However, with adherence to best practices, the electrification cost in particular can be significantly reduced, potentially as much as \$100 million. Construction of shorter platforms will further cut costs. With constrained budgets, we recommend deferring the Warrendale infill station to a later phase or not building it, pursuing a consolidated station to serve both Brickbottom and Union Square, and building single-side platforms from Ayer west.

We present the below cost estimate to give an order-ofmagnitude sense of costs and show what is possible given best practices, including reasonable value engineering (for example, 400-foot platforms instead of 800-foot).

Project Type	Total
Electrification	\$200M
Rolling Stock	\$250M
Waltham Center Elevated Tracks & Station Rebuild	\$100M
Other Platforms and Stations	\$350M
Total	\$850M

Freight Accommodation

CSX Transportation runs about four freight trains per day in each direction on its main line, which shares track with the Fitchburg Line on the segment just east of Ayer and the outer terminus. Freight service presents three fixable issues for modernization.

First, the line is shared with some oversize freight trains. This means platforms may need to be narrower. EMUs with retractable gap fillers, long used on European trains, can be procured and are about to become the standard for American passenger service after successful tests on Brightline service in Florida.

Second, mixing frequent passenger traffic and moderately frequent freight traffic requires some scheduling adjustment. This can also be mitigated: the shared segment is about 18 miles long, about 18 minutes by EMUs, and 40 minutes by slower diesel freight trains. As long as freight trains can go faster than 25 mph, they can fit between half-hourly off-peak passenger trains. Alternatively, if that is not possible, passenger trains can single-track off-peak with a timed meet at any intermediate station when the freight trains are not running.

Third, the presence of double-stacked freight means that overhead electrification wires have to be higher than the usual height to clear taller trains. This is common in China and increasingly in India. In the Northeastern United States, this exists on a handful of segments of track shared with commuter rail, most notably in the Philadelphia suburbs and a segment of the Northeast Corridor in Rhode Island south of T.F. Green Airport. This is not ideal for high-speed trains, but trains on the Fitchburg Line need only run up to 100 mph, so high pantographs will not increase noise or air drag.

Electrification

Electrification is one of the two primary capital investments required to enable Regional Rail; the other, high platforms, is covered later. Based on Amtrak's Northeast Corridor electrification project in the late 1990s (\$5.6 million per mile in 2020 dollars), electrifying the 47-mile-long Fitchburg Line should cost \$267 million, including catenary and supporting infrastructure. This figure is high by international standards and is used as a realistic upper bound; it is possible to achieve a lower cost with disciplined project management and attention to best practices.

By the time the Fitchburg Line will be undergoing electrification, the MBTA will have had experience with electrification on Phase 1 regional rail lines and can realistically attain lower costs by consulting with and employing planners with experience on electrification projects. This means that lower costs should be attainable from learning and economies of scale. Based on examples from countries with a variety of prior electrification experience, including New Zealand, Israel, Germany, Austria, Denmark and Norway, the Fitchburg Line could cost as little as \$100 million to electrify.¹

Electrification permits trains to run without emitting any point-source pollution. Additionally, because EMUs are more popular with international regional railroads than diesel trains or electric locomotives and unpowered cars, the market for EMUs is the most developed, making them especially easy to buy and maintain. 2018 changes to Federal Railroad Administration regulations makes these vehicles largely accessible to the US market.

EMUs also accelerate very quickly: together with high platforms, as detailed below, they reduce the time cost of serving a station from about 3 minutes to 60-75 seconds. This is valuable because, as explained in the infill section below, the inner Fitchburg Line could benefit from adding many more stops, providing frequent urban service through Somerville, Cambridge, Belmont, and Waltham. Without electrification, such infill stops would add 2-3 minutes each, unacceptably increasing total travel times.



Platform gap fillers, like those shown here, allow for stations to be built with high-level platforms that don't interfere with wide freight cars, while also providing safe access for passengers to embark and disembark the train. Credit: <u>Hoff1980, CC BY-SA 3.0</u>, via Wikimedia Commons



Higher-than-normal wires are used for electrified train service on various regional rail lines around Philadelphia, allowing for freight trains to also use the tracks without interference from the wires.

Credit: Derek Yu, CC BY-SA 2.0, via Wikimedia Commons

¹ For further analysis, see the TransitMatters report <u>Regional Rail Electrification: Costs, Challenges, and Benefits</u> (Fall 2021) as well as research by the Transit Costs Project.

High Level Platforms

Good Regional Rail service requires boarding from the platform to the train to be step-free. This is necessary for accessibility, but also dramatically speeds up boarding and alighting for all passengers. It takes about half as long for a passenger to board when there is level boarding, and this difference is especially pronounced at rush hour when there are many passengers lining up to board. With high platforms, the train only needs to open its doors for 30 seconds, except at busy city center stations like North Station; in contrast, today's low platforms slow down boarding to a minute off-peak and as long as 2-3 minutes at busy suburban stations during rush hour.

North Station—Ayer

Only North Station, South Acton, Littleton/495, and Wachusett currently have high-level platforms. Half of inbound peak passengers disembark at Porter Square, and low platforms cause trains to dwell for up to three minutes, making it a top priority for level boarding. Fortunately, conversion of Porter Square to a full highlevel platform stop is feasible, and could be completed in conjunction with other upgrades to station access to amenities. Shifting the platform area to the east allows for construction of full-high-level platforms within the constraints of the trench and opens up new access opportunities from Beacon Street in Somerville. The current elevator at Porter Square would remain connected to the new platform via a short ramp.

The MBTA was able to build bidirectional 800' platforms for around \$21 million in 2020 dollars. However, it is possible to lower this cost by building shorter platforms at lower ridership stations. Particularly with 15-minute peak frequencies, the per-train loads will be manageable at 400' platforms even as overall ridership increases. Doing so requires purchasing EMUs with open gangways between cars so riders can board or alight from any car and reach stations with shorter platforms regardless of mobility constraints. West Concord, Concord, and Lincoln stations also have extant roads that allow riders to reach each side of the station from each platform, meaning that large vertical circulation structures are not necessary at these stations, so long as ADA-compliant ramps are built. In contrast, Waverly station's platform may be more complex to raise given the fact that it is in a trench.

Assuming 800' platforms on the urban segment and 400' platforms northwest of Weston/128, we estimate a cost of around \$257 million in 2020 dollars, potentially less given the lack of vertical circulation needed between West Concord and Lincoln.

Ayer-Wachusett

Stations between Ayer and Wachusett should have highlevel platforms like the rest of the line. The presence of freight traffic between Ayer and Wachusett may require some modification to allow freight trains to pass safely and with adequate clearance. However, some targeted investments can resolve this issue without significant cost. Single-track platforms would allow for the separation of freight and passenger tracks in the station area and avoid potential construction difficulties at Ayer (due to an infrequently used freight spur) and Fitchburg (due to a siding). Nonetheless, single track operations would make scheduling more delicate; gauntlet tracks (which provide two distinct tracks in a compressed rightof-way) would allow both freight trains to clear platforms while allowing passenger trains to serve both platforms safely, at higher capital cost.



High-level platforms, as seen here at South Acton station, allow the use of more doors for faster boarding, and removes stairs that otherwise make boarding difficult or inaccessible. Credit: <u>The Boston Railfan</u>, <u>CC BY-SA 4.0</u>, via Wikimedia Commons

Speed

The top speed should be 100 mph, except where constrained by track geometry and approach restrictions near North Station. Positive Train Control, which prevents overspeed incidents, has been implemented and is already active on the entirety of the commuter rail network. Many segments are too curved and impose speed limits going down to 70 or even 60, but long stretches of 100 are feasible — for example, between Lincoln and just past Littleton/495. Higher track speeds require track renewal and more ongoing maintenance, so permitting sections of track for 100 mph does come with a cost. However, this cost could be minimized with more efficient track-renewal techniques. Should the MBTA adopt such methods, 100 mph track sections would likely be worth the added expense.

One way to speed up trains is through superelevation, that is, banking the outer rail a few inches to mitigate the loss in speed while turning corners. The maximum superelevation is 6 inches, but most curves are flatter, around 2-3 inches, which should be changed during routine track maintenance to make it easier to travel faster. EMUs are especially useful because they are more reliable and less likely to break down and sit still on a superelevated track. However, even diesel trains can run on superelevated tracks — there are 6-inch curves on the Fitchburg Line today, for example, at Belmont station, and federal regulations permit up to 7 inches.



The Issue of Express Service

The Fitchburg Line is 54 miles long, the second-longest in the system.² Because diesel locomotives accelerate slowly and nearly all stations on the line lack full high platforms, the all-stop trip takes 96 minutes today. Prior to the COVID-19 pandemic, a number of rush hour trains ran nonstop from South Acton to Porter and North Station. This raises the question of whether or not express service is desirable with electrification. The question of whether or not to run express service is one of ridership potential and cost. Additional service requires buying additional train sets and introduces scheduling complications: with 15-minute urban end frequency and 30-minute express frequency, overtakes would be required. Express service could also introduce scheduling complications at North Station and around the single track bottleneck in Waltham.

On the other hand, express service makes rail a more appealing option for would-be riders in the intercity market. In the case of the Framingham/Worcester Line, the second longest after Fitchburg, express service is desirable because the line has high ridership west of Framingham and many stations in closer-in suburbs. Conversely, our analysis of the Providence/Stoughton Line caused us to oppose express service to Providence due to the wide stop spacing and consistently high ridership across all suburban stations. The long-term desirability of express service may depend on how the corridor evolves and whether the intercity travel market grows.

Northwest of Brandeis/Roberts, only South Acton has more than 500 riders. While higher frequency service may help, Fitchburg-Leominster (population of 80,000) is simply a smaller travel market than Worcester (with 190,000 people). Conversely, the Waltham-Somerville segment has higher demand than the Worcester Line through Newton: Brandeis/Roberts and Waltham already have about 800 weekday inbound boardings each, and jobs near existing and proposed stops range from 4,000 to 7,500; on the Worcester Line, only Newtonville has more than 2,000. The high job density around the existing and future inner stations means people are likely to want to travel there and not just to North Station, which would increase reverse-peak ridership to fill otherwise-empty trains. Thus, while there is a plausible case for express service on the Fitchburg Line, it is relatively weak in the presence of frequent, higher speed service that Regional Rail operations would provide.

² The longest MBTA line is the Providence/Stoughton Line, due to the extension to Wickford Junction.

Grade Separation

The Fitchburg Line is entirely double track except for the segment through downtown Waltham, including the downtown area and station location. Waltham has a dense downtown and the streets crossed by tracks are reasonably busy. Grade separation in urban areas, including station rebuilding, is expensive; based on grade separation projects on the Caltrain commuter rail line, we estimate a cost of \$170-200 million in 2020 dollars. At 15-minute bidirectional frequency, gates would close every 7.5 minutes, not disruptive enough to justify the expense. Rather, modern gates, called quad gates, should be installed to provide maximum protection. Further, at 15-minute bidirectional frequency, the single track is not a constraint given high EMU reliability.

However, if the North-South Rail Link is built, the oneseat ride to downtown Boston and points south will generate demand for much more frequent service up to Waltham, on the order of a train every 5 minutes at peak. Much more frequent service will increase disruption, not just for car traffic, but for pedestrian, bike, and bus traffic as well, and the single track segment will need to be doubled.

Unlike the noisy steel elevated tracks that used to run in Boston and still run in Chicago and New York, the viaducts would rest on concrete spans. This is standard on most of the elevated metro and regional rail lines in Paris and Berlin, in the San Francisco Bay Area, a short segment of the 7 train along Queens Boulevard in New York City, and the new Green Line Extension viaduct. In Boston, the Lechmere Viaduct, the elevated structure that carries the Green Line across the Charles River, is also fairly quiet. Elevated concrete railroads dampen noise, so trains passing above are quieter than cars at street level. The land use between Carter Street and the tracks today is surface parking, and this project could also transform that into retail under the spans, which could be built as arches for additional aesthetic appeal.



Waltham station is currently fairly minimal and has only a single track, despite room for a more significant structure that could better serve the nearby downtown. Credit: Pi.1415926535, CC BY-SA 3.0, via Wikimedia Commons



A concrete viaduct, such as the one shown here between Lechmere and Science Park, can provide grade separation to downtown Waltham without adding noise to the area like other construction methods would.

Credit: <u>Beantowndude316 from USA</u>, <u>CC BY 2.0</u>, via Wikimedia Commons

Infill Stations and Stop Consolidation

Uniquely on the MBTA Commuter Rail network, the Fitchburg Line could benefit from both inserting some infill stops and removing other stops. The line's inner segment to Brandeis/Roberts passes through dense areas, and thus additional stops make sense at higher frequency. In contrast, the suburban segment past Brandeis/Roberts makes too many closely-spaced, low-ridership stops in Weston.

The line has four strong infill candidates between Brandeis/Roberts and North Station. With EMUs and high platforms, each station adds roughly a minute to the schedule; the number of trainsets required to operate our proposed schedule does not change with or without these infill stations. The utility of urban infill increases in the presence of the North-South Rail Link (NSRL). North Station's current location is just outside walking distance of most downtown jobs, and reaching further destinations requires at least one transfer. Even without NSRL, however, providing new transit connections to several employment centers and an additional Green Line transfer would make the stop useful for potential riders from the rest of the line, as well as workers living along other North Side lines, who can transfer at North Station.



Infill: Somerville

There is a compelling case for infill at two locations in Somerville, where the line's potential catchment experienced 15% job growth between 2011 and 2018, and the tech firms in the area have expanded their office space. Union Square, the terminus of one branch of the Green Line Extension, is bypassed by the Fitchburg Line. In addition to transfers to the Green Line and many bus routes, including Route 86 serving Sullivan Square and Harvard Square and multiple high-frequency routes proposed by the MBTA's bus network redesign, a station stop here would serve an area with 10,000 employed residents and 11,000 jobs within a half-mile radius; even prior to NSRL, this stop would allow faster access to these jobs from the Fitchburg Line, and non-auto reverse commute options for some residents. This stop would also build resilience and allow the Fitchburg Line to serve as an alternative option in case of shuttles or disruptions on the Union Square branch.

Another potential but more complicated location is Brickbottom at Somerville Avenue. Within a quarter mile, there are 5,000 jobs, 66% more than Union Square, and the immediate area has begun to grow beyond its prior industrial primary use with active redevelopment plans. Even more jobs are within a half-mile, but most are in Kendall Square, currently better served by the transfer to the Red Line at Porter Square. Another complication is that a stop would likely block a connection of light rail along the Grand Junction line, currently under study by the City of Cambridge, to the Green Line Extension. However, if Grand Junction service bypasses the Green Line in favor of another routing, such as to Sullivan Square, a Brickbottom station could provide a faster transfer to Kendall jobs than provided by the Red Line.

An alternative is to build one station roughly between the Union Square Green Line station and Medford Street. This would serve the densest part of Brickbottom's catchment and provide a less direct but still feasible transfer to Grand Junction service while avoiding the infrastructural constraints that a Brickbottom station would impose. Nonetheless, we include a Brickbottom station on our schedules and in our cost estimates.



Infill: Porter Square

Additionally, while not an infill stop, Porter Square would see significantly increased service. Although Porter is currently served by the Red Line, the immediate area brings significant further opportunities for transitoriented development. South of the platform area is a large parking lot owned by Lesley University, which has recently sold property for further redevelopment; portions of this lot could be redeveloped, and part of this project could include an upgrade to high-level platforms. Moreover, the modifications needed to install a full-highlevel platform at Porter would also facilitate greater station access from Somerville Ave.

More frequent service at Porter Square would open up reverse-commute opportunities and afford more direct connections to Somerville and the North Station area than is provided by the current Red Line service. Coupled with a potential Union Square infill stop, regional rail service would provide rapid-transit-like connectivity between Cambridge and Somerville for a fraction of the price of extending GLX. Regional rail would also provide a more convenient and viable alternative in case of disruptions on the Red Line. As such, although Porter Station is already served by rapid transit and (infrequent) commuter rail, a regional rail service model would afford significant benefits to this region of Cambridge.

Inifll: Alewife/Fresh Pond

A station in the Fresh Pond area of North Cambridge, southwest of the Red Line terminus at Alewife, would serve 9,000 jobs within half a mile of the likely station site. The area has seen recent development and growth: 1,982 housing units have been built in the last decade alongside several office buildings and two hotels, and another 1,430 units are in preliminary stages. Thus, the purpose of this station is to provide this development, much of which is closer to the Fitchburg Line than Alewife station, with additional transit options for residents and commuters. This station does not aim to provide a connection to the Red Line, which will always be more convenient from Porter Square; however there may be opportunities to extend some bus routes serving Alewife to make the Fitchburg Line connection here as well.



Infill: Clematis Brook/Warrendale

Until 1978, a stop called Clematis Brook existed in the Warrendale neighborhood of Waltham, at Beaver Street. Today, an office park and a University of Massachusetts satellite campus abuts the site; within a half-mile radius there are 4,000 jobs and 1,700 employed residents. For comparison, the existing downtown Waltham station has 5,500 jobs and 5,000 employed residents; Brandeis has 4,500 jobs as well.

No infill stations are immediate priorities west of Route 128, as the line has retained many of its historic towncenter stops. The only location that may be useful is West Acton, but there are only 700 jobs within half a mile, and the trains can run through this area at 100 mph in absence of a stop here, so the time cost is higher and the benefits are lower.



Stop Consolidation: Weston

Weston's three stations — Silver Hill, Hastings, and Kendal Green — have minimal facilities and fewer than 250 riders per day combined. In late 2020, the MBTA closed Hastings and Silver Hill stations in response to the sharp ridership decrease; we recommend they remain closed.

Opportunities for ridership growth in Weston are limited: the town built no multifamily housing in the decade from 2006-2016, and no connecting bus routes exist. Kendal Green has the highest ridership of the three and is accessible via a pedestrian and bike path, but even here, growth opportunities are likely marginal. That said, as municipalities respond to the MBTA communities law, which requires more multifamily housing around commuter rail stops, the opportunities for ridership growth and related service-planning decisions should be reevaluated.

The Town of Weston and the state have expressed interest in a park-and-ride station off Route 20 in the Cedarwood area, where the line intersects Route 128. In addition to stop consolidation and park-and-ride capacity, the stop would be ideal as a transfer point for local buses and shuttle service to the office parks along 128, which has long been a high-growth region. Sprawl repair around these office parks could allow for transitoriented development around the station site as well.



Silver Hill, pictured above, has a small shelter but no signage, platform, or amenities. In addition to its minimal infrastructure, the station also sees very low ridership. Credit: <u>Pi.1415926535</u>, <u>CC BY-SA 3.0</u>, via Wikimedia Commons

Frequency

The urban market needs high all-day frequency, at least a train every 15 minutes, and ideally more. It also needs more closely spaced walk-up stops and fare integration with local buses to attract urban riders from Cambridge, Belmont, and Waltham. The suburban market needs highcapacity rush hour service, which it already receives. Our plan provides the same service but with more reliability.

West of Route 128, demand skews heavily towards suburb-to-downtown commutes. As such, trains should run half-hourly off-peak beyond Route 128. Fitchburg would also fit a half-hourly off-peak frequency since it is far enough from Boston that a 15-minute frequency is not necessary. The intercity market needs consistent all-day frequency, every half hour, and good integration with Fitchburg's bus network.

North-South Rail Link

The Fitchburg Line benefits greatly from the construction of the North-South Rail Link (NSRL). If the NSRL tunnel is built, demand will very likely rise in all segments due to the one seat ride from the suburbs to the job-rich area around South Station (174,738 within half a mile vs. 76,151 within half a mile of North Station), outlying job centers such as Back Bay, and improved connections to rapid transit services and regional rail lines that currently terminate at South Station.

With NSRL, the one-seat ride to Downtown Boston's Financial District and outlying job centers will increase demand and provide an alternative to the Red Line at Porter, warranting higher frequency. Increasing service from every 15 minutes in each direction to a higher frequency, such as every 5 minutes, makes double-tracking the single-track segment in Waltham essential.

Among these segments, the sharpest increase in demand would come from the inner segment due to the tens of thousands of jobs near Brickbottom, Union Square, Porter, and Alewife, and to some extent, the other stations up to Brandeis. Most workers in these areas do not reside along the Fitchburg Line, but instead in dense neighborhoods along other regional rail lines, making NSRL connections especially valuable.

Bus and Subway Connections

Wherever possible, buses should connect to Regional Rail to expand its reach. Timed connections or frequent through running buses and trains will ensure that transfer times will be short. The following reforms are required:

- » Mode-neutral fare integration: buses, subways and trains should charge the same fare within a specified zone, with free transfers and revenue sharing agreements with RTAs.
- » Orienting bus routes and schedules to feed Regional Rail, made easier by clockface scheduling and the reliability improvements from electrification.

The Fitchburg Line provides several opportunities for aligning Regional Rail to connect to buses and subways.



Waltham stations on the Fitchburg line are already wellserved by bus routes that provide connections to the surrounding area, as well as to other rail and rapid transit lines.



Frequent Urban Connections

Today, many bus routes connect with and sometimes run parallel to the Fitchburg Line. Notably, the MBTA's route 73 connects Waverly with the Red Line, while the 70 connects Waltham with the Red Line; both routes are within the top 20 highest-ridership bus routes. The 74 and 75 also connect the Fitchburg Line with the Red Line at Belmont. Although the Fitchburg Line offers a faster ride into Boston, a one-way trip from Waltham costs \$7 plus a \$2.40 transfer to rapid transit, while a local bus and rapid transit transfer only costs \$2.40; as a result, many people take slower but cheaper local buses. Lowering fares to cost the same no matter which mode used would encourage riders to use faster rail service instead, lowering operating costs and allowing some bus resources to be used on other routes instead.

Porter Square is a strong transfer point for local buses, including the 77, a high-ridership route from Arlington Heights to Harvard Station. Free transfers would further enhance the connection to the Red Line, which already exists and is used by many rush-hour commuters. These routes would complement frequent Regional Rail service, connecting to population and job centers such as Harvard Square, Medford Square, and Arlington Center. Belmont Center and Waverley also have connecting local buses to Harvard Station. Multiple routes around Newton and Watertown connect at Waltham, while private shuttle services from Waltham link the line to office parks.

The 500-series bus routes serving Brandeis/Roberts and Waltham Center provide express service to Back Bay and Downtown Boston via the Massachusetts Turnpike. Since these buses must contend with rush hour congestion, fast and frequent Regional Rail would often provide a faster trip. Thus, many or all of these routes could instead terminate at Regional Rail stations, running more frequently in the suburbs.



The current fare system charges considerably more to take a trip by rail versus a slower bus and subway transfer. Under the proposed fare system, traveling the same distance costs the same reasonable price, regardless of mode used.

Timed Suburban Connections

Beyond Weston, buses can easily be timed to connect with half-hourly trains. The best connections are at stations that are served close to the hour. At North Leominster, for example, our schedule has trains in both directions stopping on the hour every half hour. Therefore, a circulating bus can arrive a few minutes before the hour, wait a few minutes for schedule recovery, allow a driver bathroom break, and then return to its outlying destination.

Moreover, since trains run every half hour, it is best if a bus round trip is shorter than half an hour, or an hour if two vehicles are used. This means the one-way trip time should be about 11-12 minutes, which is about 3-4 miles on suburban and small-city streets. South of North Leominster, a bus could serve Downtown Leominster and the apartment buildings on Route 12. To the north, buses could serve Lunenburg Crossing and the historic center of Lunenburg.

MART, the bus system that serves the Fitchburg-Leominster area has its main hub at the Fitchburg station, and new or restructured bus routes should continue to connect at this point. Express bus service from Gardner and Wachusett Mountain to Wachusett will continue to be a valuable option due to the superior connection to Route 2. With trains serving Fitchburg three to four minutes on each side of the hour, bus connection times are looser, since there is a gap between inbound and outbound train arrivals.

There are also potential routes for shuttle connections to office parks, such as at Hanscom Air Force Base, where many biotech and technology jobs exist.



Just like the areas closer to urban Boston, Fitchburg-area stations offer a number of connections to bus routes that enable access to the surrounding area.

Scheduling and Frequency

- » Trains should operate between 5:00 am and 1:00 am, seven days a week.
- » Scheduling should adhere to recurring clockface intervals, multiplied by two at peak hours (e.g., on a 30 minute headway, a train departing at 1:35 should be followed by one departing at 2:05.)
- » Frequency should be the same for both inbound and outbound trains.

Fleet Requirements

During rush hour, 15-minute service with one-way trip times just longer than an hour requires ten trainsets. Offpeak, half-hourly service requires five sets to Wachusett and another two for overlay service to Brandeis/ Roberts, for a total of seven. If overlay service extends to Weston/128, an additional train set is required, for a total of eight.

Clockface Scheduling

Outbound trains should depart North Station at :07, :22, :37, and :52, and arrive at Wachusett at :10, :25, :40, and :55. Symmetrically, inbound trains should depart Wachusett at :05, :20, :35, and :50, and arrive at North Station at :08, :23, :38, and :53; this way they meet on double track just outside Waltham, rather than on the single-track stretch through Waltham.

FITCHBURG LINE Station Proposed Current **NORTH STATION** 0:00 0:00 Brickbottom 0:02 _ 0:04 _ Union Square PORTER SQUARE 0:06 0:10 — Alewife 0:09 **BELMONT CENTER** 0:11 0:15 WAVERLY 0:13 0:17 _ Clematis Brook/Warrendale 0:16 WALTHAM CENTER 0:17 0:22 **BRANDEIS/ROBERTS** 0:20 0:25 0:23 0:29 Weston/128 LINCOLN 0:26 0:34 CONCORD 0:30 0:39 0:32 WEST CONCORD 0:43 SOUTH ACTON 0:36 0:48 LITTLETON/495 0:40 0:55 AYER 0:46 1:03 SHIRLEY 0:49 1:08 NORTH LEOMINSTER 0:55 1:17 1:26 FITCHBURG 0:59

1:03

1:37

Frequency

With electrification and infill stations, the following frequency is warranted:

	Regional Rail		Current	
Stations	Peak	Off-Peak	Weekday	Weekend
North Station—Brandeis	15 min	15 min	60 min	120 min
Brandeis—Wachusett	15 min	30 min	60 min	120 min

WACHUSETT

With NSRL and doubling of the Waltham single track pinch, feasible frequency greatly increases on the urban end.

Stations	Peak	Off-Peak
North Station—Brandeis	5 min	10 min
Brandeis—Wachusett	15 min	30 min

What is Regional Rail?

MBTA Commuter Rail operates as a mid-20th century service with a mid-20th century business model. It reflects out of date biases about where people and jobs are located, and about how people desire to get from one place to another. Many people no longer work on a strictly 9 am to 5 pm weekday schedule, and many more want convenient and frequent train schedules that respond to the needs of their daily lives.

"The current Commuter Rail paradigm costs way too much money for way too little ridership."

- MBTA FMCB Chairman Joe Aiello, 11/20/17

Our current approach to Commuter Rail, as a business model, fails to offer its rider/customers the service they want and need. As a result it contributes to the region's worsening traffic congestion, keeps Gateway Cities isolated during most of the day, and exacerbates income inequality since the inadequate service compels many to drive – for lower income people, the high cost of owning, maintaining and driving an automobile can have a crippling effect on their ability to make ends meet.

Public transit must be frequent all day, not just at rush hour. A Regional Rail system would have trains running at least every half hour all day in the suburbs and at least every fifteen minutes in Boston and other Inner Core communities.

Regional Rail requires both frequent all day service, accessible platforms and smarter equipment to provide the service. That means high-level platforms at stations to simplify and speed up boarding and alighting. It also means electrification of the system, enabling use of Electric Multiple Units to replace the current push/pull diesel fleet. EMUs will be more reliable and less expensive to maintain, will provide riders with speedier trips, and will provide better service without polluting the air around them.

A highly functioning Regional Rail system includes five critical components:

- » Systemwide electrification and the purchase of highperformance electric trains.
- » High platforms, providing universal access and speeding up boarding for everyone.
- » Strategic infrastructure investments to relieve bottlenecks.
- » Frequent service all day: every 30 minutes in the suburbs and every 15 minutes in denser neighborhoods.
- » Free transfers between regional trains, subways, and buses, and fare equalization with the subway in the subway's service area.

And one useful component that will complete cross-region mobility:

» With a modern electric Regional Rail system in place, the North-South Rail Link (NSRL) is the next step to drastically enhance regional mobility. NSRL allows trips between any two stations through a oneseat ride or single, seamless transfer, providing the flexibility and connectivity to which many riders and potential riders would be drawn.

MORE INFORMATION AND REPORTS AVAILABLE AT: <u>HTTP://REGIONALRAIL.NET</u>

REGIONAL RAIL FOR METROPOLITAN BOSTON	WINTER '18
REGIONAL RAIL PROOF OF CONCEPT	FALL '19
REGIONAL RAIL PHASE 1	SUMMER '20
PROVIDENCE/STOUGHTON LINE	SPRING '20
FAIRMOUNT LINE	FALL '20
NEWBURYPORT/ROCKPORT LINE	WINTER '21
OLD COLONY LINES	SPRING '21
REGIONAL RAIL ELECTRIFICATION	FALL '21
HAVERHILL LINE	FALL '21
LOWELL LINE	FALL '22
FITCHBURG LINE	FALL '23

Regional Rail has 5 transformative benefits:



Almost all commuter rail stops have poor accessibility.

32 are entirely inaccessible. High-level platforms provide step free access to all riders, including those with mobility constraints, parents with strollers, and riders with heavy equipment or suitcases.

Regional Rail improvements facilitate economic growth and provide a wider customer base for local businesses.

Frequent, reliable rail can increase development near stations. Regional Rail provides a green, economical way to access our rich cultural resources and recreational amenities.

Modern electric trains create zero local emissions, reduce noise pollution, and increase reliability, making rail more attractive relative to car trips.

Electrification can thus help reduce respiratory ailments in environmental justice communities, and is critical for meeting the Commonwealth's 2050 zero net emissions goals.

Regional Rail opens up new housing markets, and makes transit-oriented development more attractive.

Workers who commute some or all days of the week can use the train for other longer trips, and walk or bike to local destinations. Frequent, reliable, and affordable rail service opens up new employment opportunities, particularly in Gateway Cities, which are well positioned to become employment centers in their own right.

Frequent, reliable, and affordable rail service opens up new employment opportunities.

Regional Rail both reduces the "spatial-skills mismatch" that holds back employment, and provides access to vocational opportunities to boost workers' skills. Regional Rail itself will provide up to 250,000 direct and indirect jobs during construction.





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