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TO:	Northern Middlesex Metropolitan Planning Organization
FROM:	Blake Acton, Transportation Planner II
DATE:	September 30, 2025
RE:	LRTA Jobs Accessibility Analysis

INTRODUCTION

This memorandum evaluates the performance of the Lowell Regional Transit Authority (LRTA) since the onset of the COVID-19 pandemic (the pandemic), focusing on three core dimensions: service levels, ridership, and job accessibility. The study compares LRTA's outcomes to those of three peer agencies: Brockton Area Transit (BAT), Worcester Regional Transit Authority (WRTA), and Merrimack Valley Regional Transit Authority (MeVa). By benchmarking LRTA against these agencies, the analysis provides a clear, data-driven assessment of progress and identifies actionable opportunities for improvement.

The approach combines National Transit Database statistics with advanced schedule-based travel time simulations, using U.S. Census job flow data and annual GTFS feeds to estimate how well transit currently connects workers to jobs across the region. By tracking performance before, during, and after the pandemic, and by comparing LRTA to similar regional agencies, this study delivers insights to support both immediate decision-making and long-term planning.

In addition to agency-level findings, the report highlights job accessibility patterns by individual LRTA routes, offering a detailed view of where future service investments could produce the greatest gains. While the results show that LRTA's service and ridership recovery has lagged behind its peers, recent operational improvements demonstrate both the agency's responsiveness and its potential to accelerate recovery and expand access. The findings and recommendations presented here are intended to inform LRTA leadership, municipal partners, and regional policymakers as they plan for a more connected and sustainable future.

METHODS

This study estimates how well regional transit connects workers to jobs by combining job flows from the U.S. Census Bureau's Longitudinal Employer–Household Dynamics (LEHD) Origin–Destination Employment Statistics (LODES) with schedule-based routing using [r5r: Rapid Realistic Routing with R5 in R]. We compute door-to-door travel times by transit and foot, then ask, for each home–work pair, whether transit is fast enough to beat walking alone. Summarizing those results yields an "alignment score": the share of workers who both live and work within an RTA's fixed-route municipalities and can reach their jobs within a specified time budget. We emphasize 45 minutes (reflecting typical Massachusetts transit commutes) and also report a ratio between 75 and 45 minutes to identify latent opportunities where better connectivity could unlock more trips.

We assembled annual GTFS feeds for 2016–2025 for LRTA and peer RTAs (BAT, WRTA, and MeVa), paired them with a constant pedestrian network (February 2025 OpenStreetMap plus a MassGIS digital elevation model for slope-aware walking speeds), and modeled each agency in isolation to avoid cross-system confounding. For each agency-year we built an r5r network and generated a quarter-mile hexagon grid of candidate origins/destinations, retaining centroids within one mile of a fixed-route stop inside municipalities with service. Using expanded_travel_time_matrix(), we simulated six departure times (6:00 a.m., 9:00 a.m., 12:00 p.m., 3:00 p.m., 6:00 p.m., and 9:00 p.m.) and a 20-minute travel window to capture departures around each time and reduce missed trips on infrequent routes.

We then linked modeled travel times to jobs by assigning each census block's representative point to its nearest hexagon and counting a job as "transit-accessible" only when the fastest walk+transit path is faster than walking alone. This choice intentionally rewards frequency, speed, and coordinated transfers that is able to compete with walking. Results are reported as alignment scores at both time budgets and compared across agencies, years, and routes to reveal patterns rather than to fixate on small annual fluctuations.

Finally, we note key constraints. LODES workplace locations are periodically revised (notably between 2015 and 2016), so we use 2016–2022 jobs data, carrying 2022 forward to 2023–2025. GTFS quality varies by agency and update cadence; LRTA's flag-stop flexibility is not represented; and OpenStreetMap pedestrian coverage can be optimistic, especially in suburban contexts.

Peer Agencies

For this study, Brockton Area Transit Authority (BAT), Merrimack Valley Regional Transit Authority (MeVa), and Worcester Regional Transit Authority (WRTA) were selected as peer agencies for comparison with the LRTA. We selected a maximum of three peer agencies due to practical constraints for running simulations. Figure 1 provides a regional map of all peer agencies and LRTA fixed-route networks as of 2025.

Peer selection was guided by the following criteria:

1) Gateway City Status: Each agency serves a Massachusetts "Gateway City" which are smaller, diverse urban centers with lower average incomes and large immigrant populations. These demographic and economic characteristics strongly influence transit usage patterns.

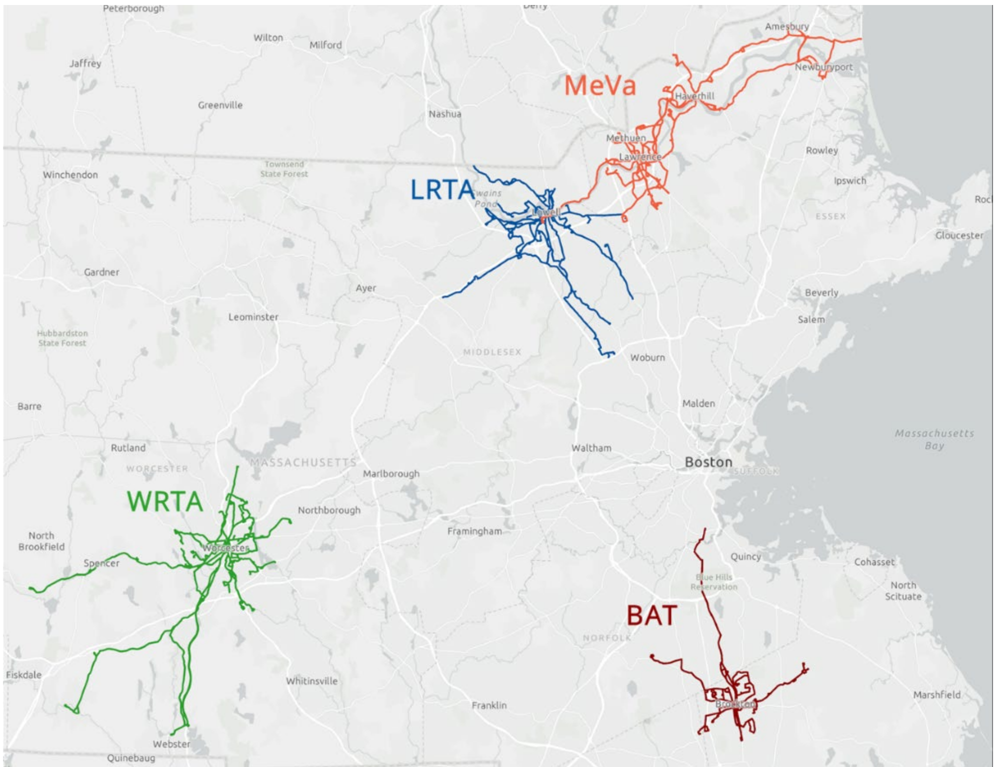
2) Comparable Ridership: All selected agencies exhibit nominal ridership levels that are similar to LRTA, controlling for system size and available resources. This excludes very high-ridership systems such as MBTA and PVTA, as well as smaller agencies like CATA or MWRTA.

3) Regional Urban Identity: Each agency is anchored by one or two historical satellite cities: Lowell, Lawrence/Haverhill, Worcester, or Brockton. Each has a distinct urban identity, dense core, and regional job centers. All have commuter rail service to Boston but remain culturally

and economically distinct from the Boston core, functioning as more than mere suburbs of Boston.

These criteria ensure that results and comparisons throughout this study are relevant for evaluating LRTA's performance and job access outcomes in comparison to its peers.

Figure 1: Fix-Routes of LRTA and Selected Peer Regional Transit Authorities in 2025



Tools Used

We primarily employed free and open-source tools. For travel-time modeling, we used r5r. For geospatial and tabular data processing, we relied on Python packages GeoPandas and pandas. ArcGIS Pro was used for viewing, querying, and quality control of intermediate and final outputs.

Data Preparation

The following data packages were reviewed, cleaned, and analyzed in the development of this project:

1) Transit schedules. The General Transit Feed Specification (GTFS) is the standard format used by mapping and routing software to represent transit services. We assembled annual GTFS snapshots for 2016–2025 for LRTA, BAT, WRTA, and MeVa. Historical feeds were obtained from the publicly available transitfeeds.com archive, which is being superseded by the paid Mobility Database; zero-cost access to the archive may not remain available. We located at least one GTFS file per year for each agency, with two exceptions: BAT (no 2024 feed found) and WRTA (no 2017 feed found). Current public GTFS are publicly available in the following

locations:
LRTA: https://data.trilliumtransit.com/gtfs/lowell-ma-us/
BAT: https://data.trilliumtransit.com/gtfs/brockton-ma-us/
WRTA: https://data.trilliumtransit.com/gtfs/wrta-ma-us/
MeVa: https://data.trilliumtransit.com/gtfs/merrimackvalley-ma-us/

2) Elevation. Because steep grades reduce walking speed, we incorporated a digital elevation model (DEM) from MassGIS (https://www.mass.gov/info-details/massgis-data-layers) into the pedestrian network to apply slope-based impedance. To reduce computational load, the DEM was resampled to a 10-meter cell size.

3) Walking infrastructure. The pedestrian network is based on OpenStreetMap data from Geofabrik (https://www.geofabrik.de/). We used the latest available OSM extract (February 2025) for all simulations, including historical years. Holding the walking network constant isolates transit-service changes over time; we acknowledge that this choice may reduce representational accuracy for earlier years.

4) Jobs. Employment data are from LEHD LODES, Version 8, Origin–Destination (OD), enumerated to 2020 census blocks. We used Massachusetts OD files for years 2016–2022 (latest available at the time of analysis). Each record pairs a home block with a work block, allowing us to count workers who both live and work within each RTA's service region and could, in principle, use local transit to reach their jobs.

Process

After preparing the data, we conducted the analysis following the steps below.

1) Build travel network. For each year and each RTA, we created a distinct travel network by running setup_r5() with the agency–year GTFS, the statewide OSM road network, and the DEM.

2) Simulate travel times. To stay within computational limits, we limited the number of origin–destination (OD) points to fewer than 3,500. Because travel times are computed between every point and every other point, adding points exponentially increases the number of calculations memory requirements as then number of points grows. To achieve the finest feasible spatial resolution, we used the following procedure.

    a. First, we generated a hexagonal grid with a quarter-mile diameter, approximately the distance most riders are willing to walk to reach bus transit.

    b. Next, we calculated the centroid of each hexagon and retained only those centroids that (a) fall within a municipality with fixed-route service and (b) are within one mile of a fixed-route bus stop. We removed commuter-oriented fixed routes from the RTAs to downtown Boston because they are infrequent and carry relatively few passengers; including them would force us to simulate a much larger Boston network for limited analytical benefit. A notable exception is BAT's Route 12, which we retained because it provides a frequent, all-day regional connection between Brockton and Ashmont Station in Boston. Applying this process to LRTA using the 2025 GTFS yielded 2,531 hexagons, producing 2,531 × 2,531 = 6,405,961 OD pairs.

c. We then used the expanded_travel_time_matrix() function to calculate travel times between all OD pairs. We simulated six departure times at three-hour intervals: 6:00 a.m., 9:00 a.m., 12:00 p.m., 3:00 p.m., 6:00 p.m., and 9:00 p.m. In this function, we set the travel-window parameter to 20 minutes, which computes travel times for every minute from 10 minutes before to 10 minutes after the scheduled departure. This choice mitigates a limitation in which infrequent bus service could be missed if only a single timestamp were evaluated (see Rapid Realistic Routing in the Limitations section). Because we compute times for each minute within that 20-minute window, LRTA in 2025 requires 6,405,961 × 20 = 128,119,220 travel-time calculations per departure time. Across six departure times, this totals 128,119,220 × 6 = 768,715,320 simulations for LRTA in 2025 alone.

3) Assign travel times to jobs. We derived representative points for U.S. Census block polygons (i.e., the most central point within each polygon, given that blocks can be irregularly shaped). Each block was assigned to its nearest hexagon centroid, inheriting the corresponding OD travel times from step 2. In some cases, the nearest hexagon centroid to a block's representative point lies in a water body; r5r automatically snaps origins and destinations to the nearest routable road segment, so such cases remain valid for analysis. A job is considered accessible by transit only when a walk+transit trip is faster than walking alone. In the model, simulated riders choose the fastest available option regardless of distance. For hourly services, riders may wait up to 59 minutes for the next bus; in many instances such as these, walking is therefore faster. If walking is always faster than transit, the simulated agent will never select transit, effectively omitting that service from the results. Thus, in this study a job is counted as transit-accessible only when transit is sufficiently frequent and fast to compete with walking.

4) Calculate alignment scores. We then computed "alignment scores," defined as the percentage of jobs for which the existing transit service can connect workers' homes and workplaces within a specified travel-time budget. At the RTA-wide scale, we first counted all workers who both live and work in municipalities with fixed-route service. This represents the theoretical maximum universe of potential transit commuters. We then counted how many of these jobs are reachable within a given time budget. The resulting percentage is typically small in absolute terms because alignment compares actual service to an ideal of perfect connectivity. Alignment scores are not especially informative in isolation; rather, they are useful for identifying patterns when compared across RTAs, years, and routes.

In this study, we emphasized a 45-minute budget, reflecting the average commute time for Massachusetts transit users reported by the U.S. Census. We selected 45 minutes because it better reflects observed rider behavior and rewards frequent, fast, and well-connected service. We also computed alignment using a 75-minute budget. The 75-minute results help identify where improved connectivity could yield the largest gains: when alignment is relatively low at 45 minutes but higher at 75 minutes, this suggests latent or unmet demand and the potential for ridership growth if service is improved.

Limitations

- **Jobs**

  A notable limitation is that the U.S. Census Bureau routinely updates LODES, shifting workers' home and workplace locations. Year-to-year noise is expected as the Bureau updates the data. Because our methods simulate travel to workplace locations, and jobs often cluster (for example, at hospitals, schools, office campuses, and universities), even minor spatial shifts can affect results. We evaluated these shifts by reviewing Workplace Area Characteristics (WAC) year to year to detect changes at major employers known not to have moved. We found evidence of a substantial revision between 2015 and 2016. For example, in the 2015 files, approximately 4,000 UMass Lowell jobs were placed near VFW Highway by the Cushing Field Complex on North Campus; in 2016, those jobs were reassigned to a block near Donahue Hall on East Campus. The 2016 location is closer to multiple LRTA routes and generally more accessible to downtown, producing shorter modeled travel times. Because our model incorporates walking and transfer network effects, any real-world change in job access between 2015 and 2016 would be overwhelmed by the noise introduced by this reassignment. Consequently, the study uses LODES from 2016 through 2022. As of July 2025, the latest available LODES is 2022; we therefore used 2022 LODES for the 2023, 2024, and 2025 simulations. While we reviewed each year from 2016 to 2022 and found no further major workplace-location changes, readers should be cautious when interpreting small year-to-year variations. The value of this study lies in comparing major or long-term differences in relative patterns across regional transit systems and routes.

- **Transit Schedules**

  The simulations rely on the General Transit Feed Specification (GTFS) for transit schedules, routes, and stop locations. Although GTFS is a standard, agencies maintain it with varying frequency and rigor. In Massachusetts, all RTAs (including the LRTA) contract with a single vendor (as of July 2025, Trillium, based in Portland, Oregon, owned by Optibus) to manage their respective GTFS. Each RTA is responsible for communicating updates and correcting discrepancies. Accuracy varies over time as backlogs are addressed. For example, NMCOG's 2024 LRTA stop inventory corrected the digital locations of nearly 18 percent of stops.

  This study assumes GTFS quality is sufficiently consistent across agencies and years to support broad comparisons. The model knows service only through GTFS: if a stop is added in the field but not yet reflected in GTFS, it is absent from the simulation. The model also assumes access and egress can only occur at designated stops. LRTA, however, allows riders to interact with the service as a flag-stop system in which riders may request pickup and drop-off between stops where safe and feasible. Such flexibility is not represented and may understate access in some contexts.

- **Pedestrian Network**
  We use OpenStreetMap (OSM) for the pedestrian network. OSM is volunteer-maintained, so coverage and accuracy vary by location. r5r prioritizes sidewalks and trails when present; if none are mapped, it will route along a road segment unless the road is explicitly tagged as prohibiting pedestrians (for example, Interstate segments). As a result, the modeled sidewalk network is somewhat optimistic relative to on-the-ground conditions, and is likely to produce slightly shorter walk times than real world conditions. This effect is likely more pronounced in suburban areas with sparse pedestrian infrastructure.

- **Routing Simulations**
  We computed travel times with r5r function expanded_travel_time_matrix(). All riders access transit by walking; bicycling is not simulated. The model assumes able-bodied pedestrians walking at 3.6 km/h.

  The most consequential limitation for this study is the travel window. This parameter allows the model to reflect riders' willingness to adjust their departure time to an infrequent schedule rather than depart at a single preferred time. The function computes travel times at one-minute intervals across the window and reports the median value. We used a 20-minute window which is the largest feasible given our computational budget. For example, for a 6:00 a.m. departure the model evaluates 5:50–6:10 a.m.; any service just before that window (for example, 5:49) is omitted. For transit departure times after the window the simulated rider will wait for the next trip for as long as the time budget allows. Larger windows smooth results; with LRTA's roughly hourly service on many routes, narrow windows can yield effective "no service" at locations where trips fall just before the sampled interval. To mitigate this, we ran six time slices at three-hour intervals (6 a.m., 9 a.m., 12 p.m., 3 p.m., 6 p.m., and 9 p.m.).

  It is also important to note that this modeling challenge mirrors riders' actual experience with infrequent service. Fully eliminating it could obscure the real difficulties of using transit with limited frequency.

- **Study-area Isolation**
  Each RTA is simulated in isolation. Riders cannot transfer to MBTA services or neighboring RTAs. We made this choice for two reasons. First, isolating systems avoids attributing changes in one RTA's accessibility to network effects in another. Second, expanding the modeled network increases computational demands nonlinearly, which would have forced additional compromises (for example, smaller travel windows or pruning routes) that we judge more harmful to result quality than constraining riders to a single RTA.

RESULTS

The following section is composed of two parts: part one provides an evaluation of LRTA's performance metrics that include service levels, ridership, and productivity since the COVID-19 pandemic and compares them to peer-agencies. Part two presents the results of the travel time simulations, an evaluation of jobs alignment between LRTA and peer agencies as well as comparison of individual LRTA fixed routes.

Part One: Performance Metrics

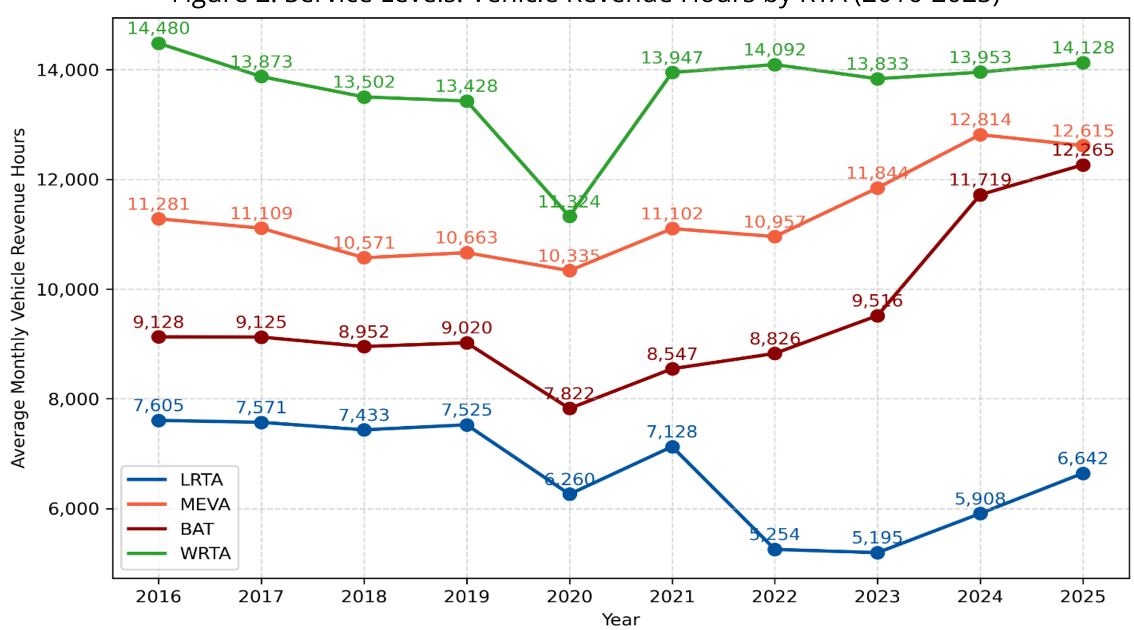
The data presented in the following section is drawn from the National Transit Database (NTD) "Complete Monthly Ridership" tables (with adjustments and estimates) from July 2025. These data are routinely updated and publicly available in the National Transit Database (NTD). In the following sections mentions of "pre-pandemic" metrics refers to those in 2019.

Service Levels

Figure 2 displays the average monthly vehicle revenue hours (VRH) provided by each RTA from 2019 through 2025. VRH is a widely used metric for quantifying the amount of transit service an agency delivers. Simply put, it captures the total hours that buses are actively operating and available to the public. By summing the hours accumulated by every bus in an RTA's fleet while they are in revenue service, we can compare overall service levels between agencies and track how those levels have changed over time.

Reviewing trends in VRH across the four RTAs reveals several important patterns. First, all agencies maintained relatively steady service levels prior to the COVID-19 pandemic, followed by sharp declines in 2020 as agencies responded to public health restrictions and reduced demand. However, the timing and extent of service recovery since then has varied considerably.

Figure 2: Service Levels: Vehicle Revenue Hours by RTA (2016-2025)



Note: 2025 value includes the first seven months of 2025. Absence of a marker indicates missing data.

Table 1 provides a snapshot of the change in VRH by RTA between 2019 and 2025. Both WRTA and MeVa were able to restore and then exceed their pre-pandemic service levels as early as 2021. By 2025, WRTA's average monthly VRH has grown by 5.2% over 2019 levels, while MeVa's recovery has been even more pronounced, with a remarkable 18.3% increase in monthly VRH. BAT experienced a somewhat slower recovery, but eventually surpassed its pre-pandemic service level in 2023. By 2025, BAT is providing 36% more service hours than it did in 2019, representing the largest absolute and relative growth among the peer agencies.

Table 1: Change in Average Monthly Vehicle Revenue Hours by RTA between 2019 and 2025

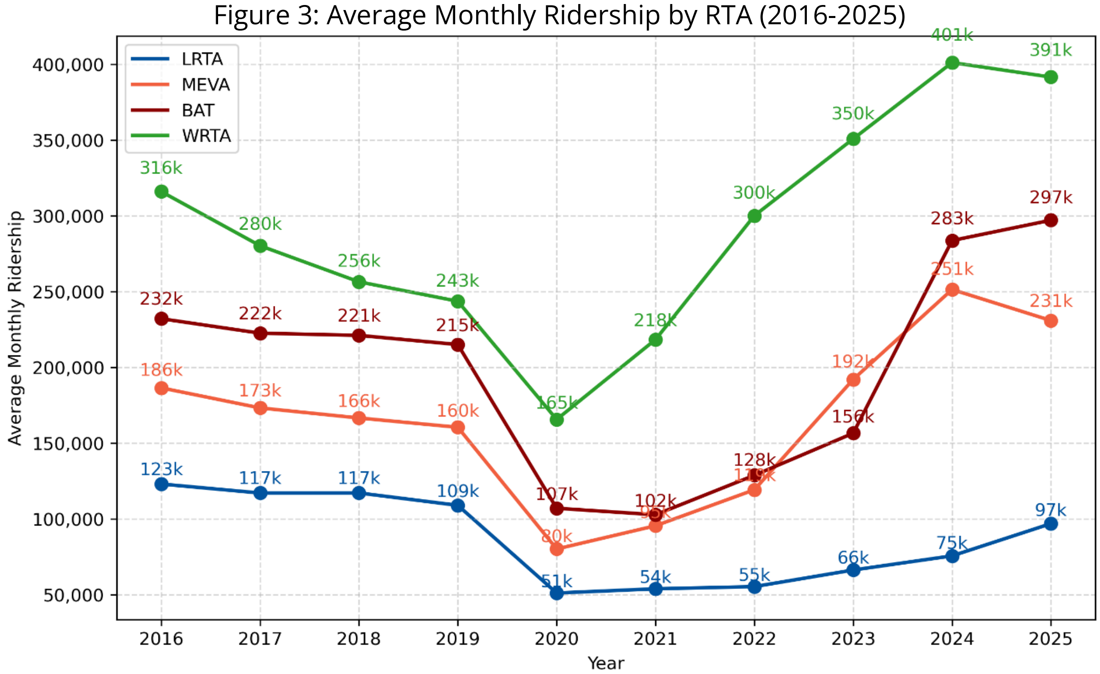
RTA	Year Exceeded 2019 VRH	VRH in 2019	VRH in 2025	VRH Change 2019 to 2025	VRH Percent Change 2019 to 2025
WRTA	2021	13,428	14,128	+ 700	+ 5.2%
MeVa	2021	10,663	12,615	+ 1,952	+ 18.3%
BAT	2023	9,020	12,465	+ 3,445	+ 36%
LRTA	Not yet recovered	7,525	6,642	- 883	- 11.7%

In contrast, LRTA remains an outlier. While the agency has gradually increased service levels since 2023, as of mid-2025 LRTA's average monthly VRH was still 11.7% below its 2019 baseline. With no full recovery yet achieved, LRTA remains the only agency among its peers that provides less service in mid-2025 compared to 2019.

Ridership

Figure 3 presents average monthly ridership from 2016 to 2025 for the four regional transit authorities (RTAs) participating in this analysis. These data are drawn from unlinked passenger trips (UPT) in the National Transit Database (NTD). For the remainder of this section "ridership" will refer to UPT. All four RTAs experienced substantial ridership declines in 2020 due to the pandemic, however, the timing and magnitude of subsequent recovery has varied considerably across agencies.

Figure 3: Average Monthly Ridership by RTA (2016-2025)



Note: 2025 value includes the first seven months of 2025.

Among the four RTAs in this analysis, the WRTA achieved the fastest ridership recovery, surpassing its pre-pandemic (2019) levels in 2022. Table 2 provides a change in ridership between 2019 and 2025 by RTA. As of 2025, WRTA's average monthly ridership is now 60.7% higher than in 2019, reflecting the strongest growth among its peers. The MeVa was the second to recover, exceeding its pre-pandemic ridership in 2023 and currently maintaining a 43.9% increase over 2019 levels. BAT followed, reaching and surpassing its pre-pandemic ridership in 2024; BAT's 2025 ridership is 38.1% above its 2019 figure. In contrast, the LRTA has not yet recovered to pre-pandemic levels and, as of 2025, is operating with average monthly ridership still 11.1% below its 2019 baseline.

Table 2: Change in Average Monthly Ridership by RTA between 2019 and 2025

RTA	Year Exceeded 2019 Ridership	When RTA Eliminated Fares	Ridership in 2019	Ridership in 2025	Ridership change from 2019 to 2025
WRTA	2022	March, 2020	243,752	391,654	+ 60.7%
MeVa	2023	March, 2022	160,599	231,030	+ 43.9%
BAT	2024	December, 2023	215,171	297,222	+ 38.1%
LRTA	Not yet recovered	December, 2024	109,087	97,022	- 11.1%

A pattern emerges when comparing ridership recovery to fare-free implementation. Each RTA's ridership surpassed pre-pandemic levels in the same order in which they adopted fare-free policies, with an average lag of about 16 months between going fare free and achieving full recovery. If LRTA follows a similar trajectory, it could expect to reach or exceed its 2019 ridership by mid-2026.

Despite this, early data suggest that LRTA's ridership growth post-fare free is lagging behind peer agencies. To illustrate:

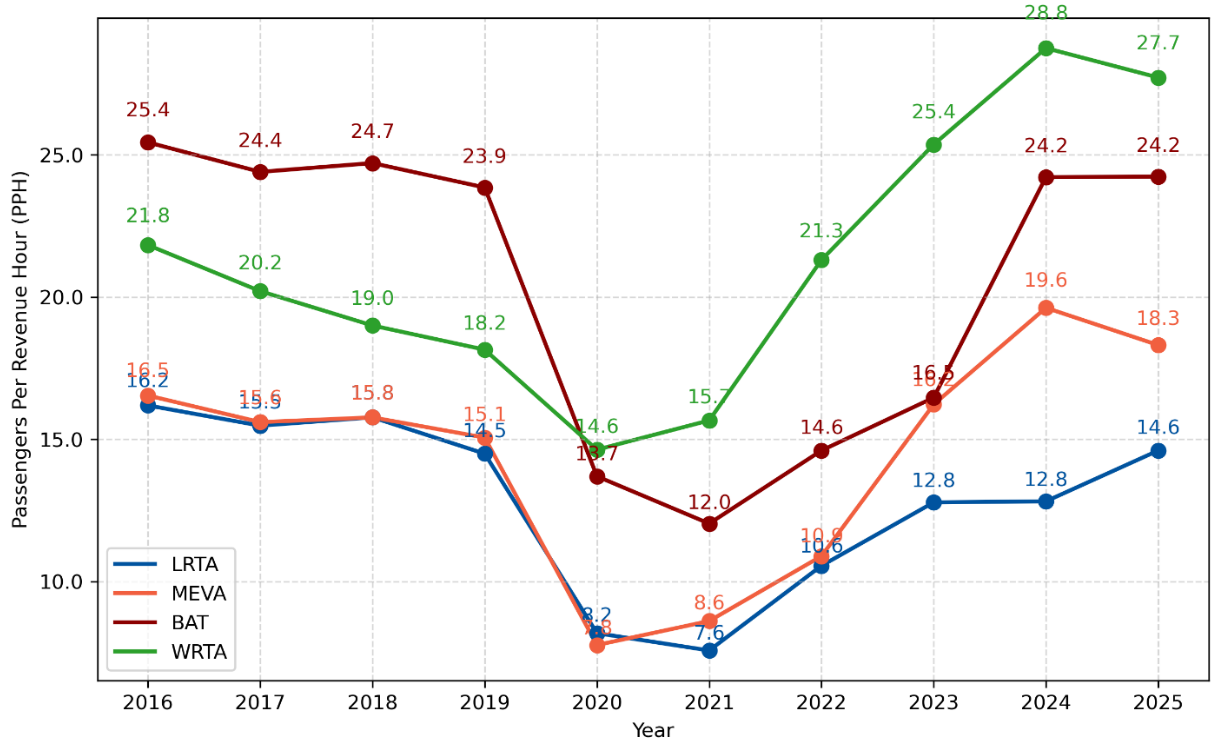
- In MeVa's first full year after going fare free, ridership increased by 61%.
- BAT experienced an even greater 81% increase in its first full fare-free year.
- In contrast, during the first six months following the launch of LRTA's fare-free program, ridership has only increased by 14% compared to 2024.

Notably, WRTA's fare-free transition occurred during the height of the pandemic and is less directly comparable; thus, MeVa and BAT provide the most relevant benchmarks to compare to LRTA. While it is too early to draw firm conclusions, this preliminary pattern suggests that factors beyond fare policy may be suppressing LRTA's ridership growth relative to its peers.

Productivity

Figure 4 presents average monthly productivity, defined as passengers per vehicle revenue hour (VRH), for the four RTAs from 2019 to 2025. Simply put, this metric is the average number of passengers who board a bus in an hour. It helps reveal whether changes in ridership are being driven by service increases alone, or by attracting more passengers per hour of service.

Figure 4: Average Passengers Per Revenue Hour by RTA (2016-2025)



Note: 2025 value includes the first seven months of 2025. Absence of a marker indicates missing data.

Among the four RTAs, WRTA has experienced the most significant gains in productivity, rising 52.2% from 18.2 passengers per VRH in 2019 to 27.7 in 2025. This growth pattern coincides with the agency's surge in ridership following its early adoption of fare-free service and rapid restoration of service hours to pre-pandemic levels. MeVa has also seen notable growth in productivity, increasing from 15.1 to 18.2 passengers per VRH (+20.5%) between 2019 and 2025.

The growth in productivity observed in WRTA and MeVa is a strong indicator that these agencies have successfully induced new demand for transit service. Typically, when agencies expand service, one might expect the average bus to have fewer passengers, or at best maintain the same number of riders as before. However, as shown in Table 3, both WRTA and MeVa saw their average bus carry more passengers even as service expanded. This suggests that both agencies have crossed a threshold where many residents are now able to use transit more frequently for their everyday travel needs, resulting in new and sustained demand for transit.

Table 3: Change in Productivity by RTA between 2019 and 2025.

RTA	Year Exceeded 2019 Value	Passengers per Hour in 2019	Passengers per Hour in 2025	Change from 2019 to 2025	Percent Change from 2019 to 2025
WRTA	2022	18.2	27.7	+ 9.5	52.2%
MeVa	2023	15.1	18.2	+ 3.1	20.5%
BAT	2024	23.9	24.2	+ 0.3	1.3%
LRTA	2025	14.5	14.6	+ 0.1	0.7%

BAT's productivity in 2025 resembles its 2019 value increasing from 23.9 to 24.2 passengers per VRH (+1.3%) over the period. However, this modest increase obscures BAT's remarkable recovery with productivity doubling between 2021 and 2024.

Finally, LRTA's productivity has now fully recovered to its pre-pandemic level, rising from 14.5 to 14.6 passengers per VRH (+0.7%) since 2019. This recovery indicates that demand for transit in the LRTA region remains at least as strong as it was before the pandemic and suggests that if LRTA were to restore service to pre-pandemic levels, ridership is very likely to match or surpass previous highs as well. Notably, LRTA's partial service restoration following the end of the operator shortage in June 2024 (splitting three combined routes into six individual lines) contributed to a 14% increase in productivity, demonstrating the agency's ability to improve service and induce rider demand. While productivity remains lower than its peers, these gains emphasize that LRTA is capable of improving its performance metrics.

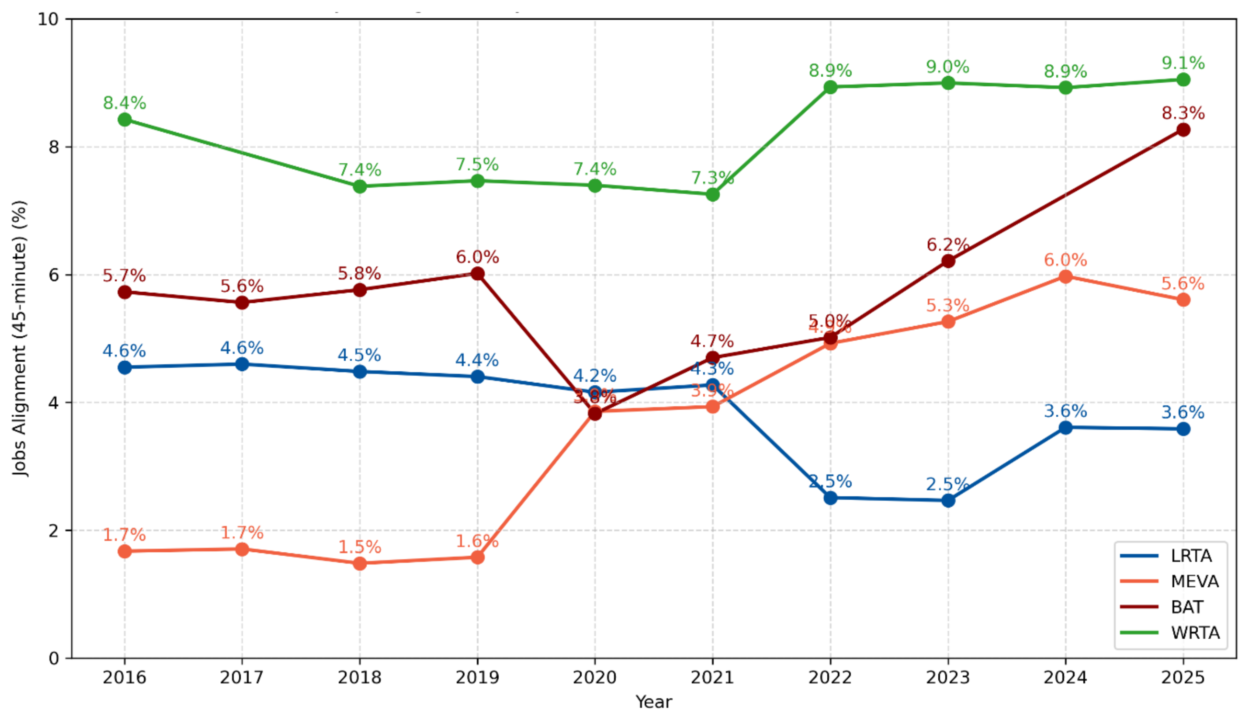
Part Two: Jobs Accessibility

This section compares regional job accessibility by transit for LRTA and three peer RTAs (BAT, WRTA, and MeVa) from 2016 to 2025. In this section we discuss *Jobs Alignment* which is percentage of workers who both live and work in municipalities with fixed-route service who can reach their workplace by a combined walk-and-transit trip within 45 minutes. We also discuss *Alignment Ratio* which is found by dividing the percentage of workers who can reach work in 75 minutes by the ratio of workers who can reach work in 45 minutes. The alignment ratio is a useful measure of potential ridership as agencies with a higher value indicate a relatively large number of workers who can already use transit to reach their workplace and would be more likely to do so if travel times were shortened.

Jobs Alignment

Figure 5 presents the share of regional jobs reachable within forty-five minutes by transit from 2016 through 2025. Table 4 summarizes the change in job alignment for each RTA between 2019 and 2025.

Figure 5: Jobs Alignment by RTA for 45-Minute Commute (2016-2025)



Note: Absence of a marker in a given year indicates missing schedule data for that year.

Table 4: Change in 45-Minute Job Alignment by RTA between 2019 and 2025

RTA	Year Exceeded 2019 Alignment	Alignment in 2019	Alignment in 2025	Percent Change in Alignment
WRTA	2022	7.5%	9.1%	+ 21.3%
MeVa	2020	1.6%	5.6%	+ 250%
BAT	2023	6%	8.3%	+ 38.3%
LRTA	Not yet recovered	4.4%	3.6%	- 18.2%

WRTA consistently leads with the highest worker–job alignment and the smallest variation over time. Between 2019 and 2025, WRTA's 45-minute job alignment rose from 7.5% to 9.1%, a 21.3% increase. This stability reflects WRTA's strong core network and service levels. Notably, between 2021 and 2022, WRTA's 45-minute alignment increased sharply (+1.6 percentage points), coinciding with frequency improvements on key routes and resulting in over 1,600 additional workers gaining access to jobs within 45 minutes.

BAT and LRTA both experienced stable job alignment pre-pandemic, followed by sharp declines and gradual recoveries. BAT's alignment dropped from 6.0% in 2019 to 3.8% in 2020 but rebounded steadily, surpassing pre-pandemic levels by 2023 and reaching 8.3% by 2025 (+38.3% over 2019).

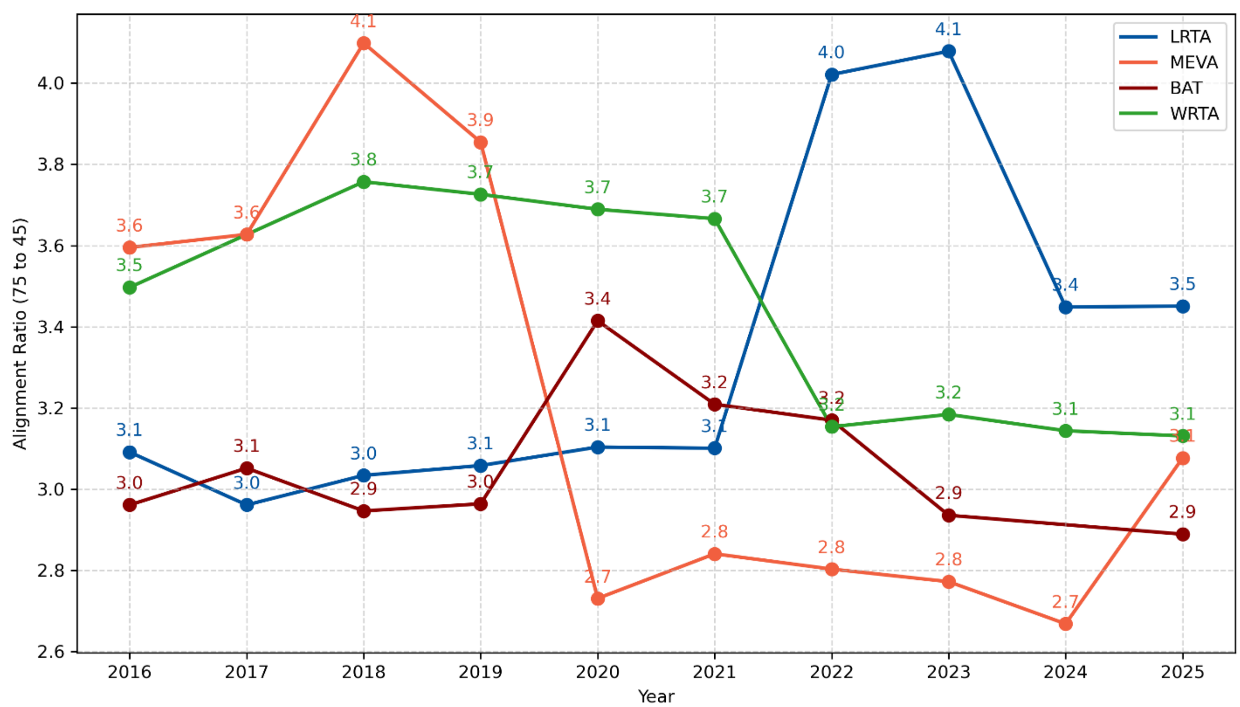
LRTA's downturn was later and deeper, falling from 4.3% in 2021 to 2.5% in 2022 before partially rebounding to 3.6% in 2024, but remaining 18.2% below its 2019 level in 2025.

MeVa stands out for its steady, incremental improvement after 2020. The results highlight MeVa's years of gradual improvements in frequency, span and route alignment have clearly paid off. Though it started with the lowest 45-minute alignment (1.6% in 2019), MeVa's figure increased to 5.6% by 2025, marking a 250% improvement in jobs alignment over 2019.

Job Alignment Ratio

Figure 6 and Table 5 summarize the change in job alignment ratio for each RTA between 2019 and 2025. The alignment ratio measures the relationship between jobs reachable within seventy-five minutes and those reachable within forty-five minutes by transit. Lower ratios indicate that a greater share of near-reachable jobs are already accessible within a rider-reasonable time frame, while higher ratios point to untapped potential: trips that could become viable with even modest reductions in travel time. Over time, decreasing ratios are a sign that agencies are successfully converting "almost in reach" trips into competitive commutes.

Figure 6: Untapped Potential: 75- vs 45-Minute Alignment by RTA (2016-2015)



Note: Higher indicates greater potential. Absence of a marker in a given year indicates missing schedule data for that year.

Across the period, WRTA, MeVa, and BAT all show improvements in their alignment ratios, with WRTA and MeVa each achieving a more than 16% reduction and BAT showing a modest 3% decrease. These trends signal a growing share of jobs being brought within practical reach as agencies improved service and streamlined their networks.

By contrast, LRTA's alignment ratio increased from 3.1 in 2019 to 3.5 in 2025, a 12.9% rise, indicating that a larger share of jobs remains just out of reach for many potential riders. This reflects the challenge faced by LRTA in restoring both service levels and directness of travel. However, there are positive signs: following LRTA's 2024 service improvements, the alignment ratio declined by 17%, demonstrating that targeted enhancements to frequency and connectivity can dramatically reduce travel times and help close the gap for would-be riders.

Overall, these results also highlight a broader pattern: commute times for transit riders have increased since 2019 across the region. While all agencies experienced disruptions due to the pandemic and subsequent operational constraints, those able to restore or expand service have been more successful in bringing jobs back within reasonable reach.

Table 5: Change in 45-Minute Job Alignment Ratio by RTA between 2019 and 2025

RTA	Year Exceeded 2019 Alignment	Alignment Ratio in 2019	Alignment Ratio in 2025	Percent Change in Alignment
WRTA	2022	3.7	3.1	- 16.2%
MeVa	2020	3.9	3.1	- 20.5%
BAT	2023	3.0	2.9	- 3.3%
LRTA	Not yet recovered	3.1	3.5	+ 12.9%

Note: Alignment ratio is calculated by dividing the percent of jobs reachable within 75 minutes by the percent reachable within 45 minutes; lower is better.

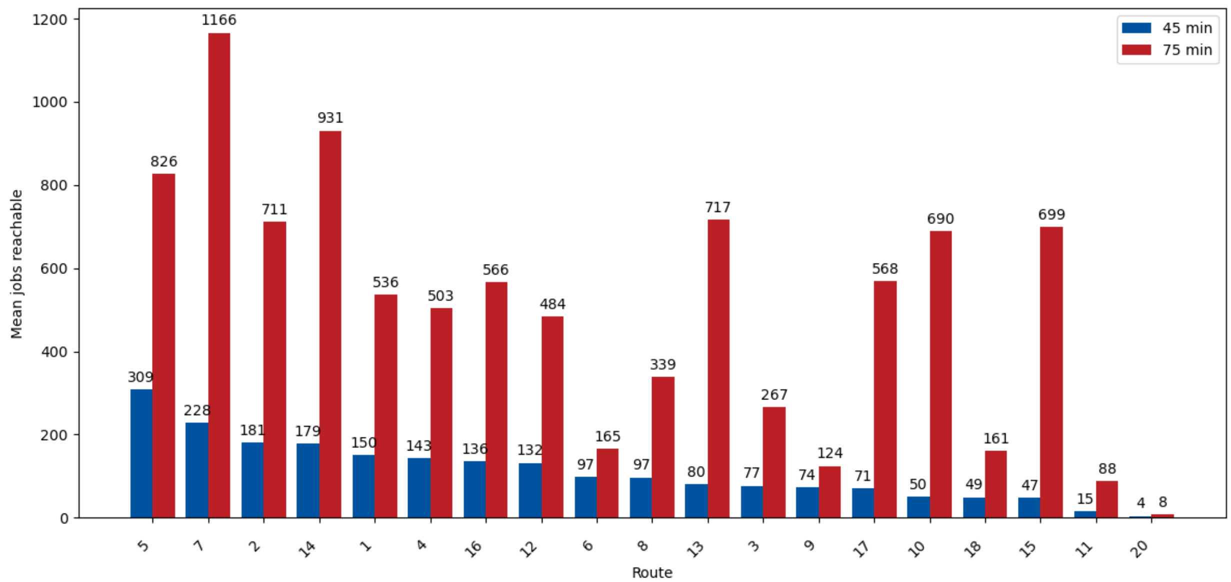
Jobs by LRTA Route

This section presents detailed job accessibility results by individual LRTA route for a typical weekday in 2025. The analysis is based on the LRTA schedule published on January 9, 2025, which was the agency's planned service for July 2, 2025. While actual service on that date may differ, these results reflect the official schedule as of early January and are representative of LRTA's operational intentions for summer 2025.

Table 6 and Figure 7 summarize, for each route, the average number of workers that simulations show could use that LRTA route as part of a trip from home to work. These results represent the average across five weekday departure times; the 9:00 p.m. departure was excluded from this analysis because LRTA does not provide service at that hour. As a reminder, these simulated trips incorporate walking, waiting, and transferring between routes, making the results especially sensitive to both service frequency and the timing of transfer connections.

Finally, a limitation to these results is that routes with long end-to-end travel times will have lower 45-minute job access values, since lengthy in-vehicle times reduce the number of destinations reachable within the simulation window. This primarily affects suburban routes 12, 14, and 15, which have end-to-end travel times of 54, 50, and 45 minutes respectively. All other routes operate with end-to-end travel times of 34 minutes or less and are less impacted by this penalty.

Figure 7: Mean Number of Workers with Workplaces Reachable by Transit in 45 and 75 Minutes by LRTA Route



Route 7

Among all LRTA routes, Route 7 stands out as a clear leader in job accessibility potential. With 30-minute frequencies and a relatively short end-to-end travel time of 32 minutes, Route 7 enables 228 workers to reach their workplace within 45 minutes making it the second-highest value among all routes. This strong performance is largely due to the high concentration of jobs located along the route at short travel times, including major destinations such as UMass Lowell (within 10 minutes) and Lowell General Hospital (within 20 minutes). When the travel time window is extended to 75 minutes, Route 7 emerges as an even greater outlier: 1,166 workers are able to reach their workplace, by far the highest among all routes. These results indicate that Route 7 has the greatest untapped potential for new ridership among LRTA services, with a large pool of workers who could access jobs if modest improvements were made to frequency or connectivity.

Routes 10 and 13

Routes 10 and 13 stand out among LRTA's suburban services for their combination of relatively short end-to-end travel times (32 minutes each) and high untapped potential for job access. Route 10, which operates along the Bridge Street and Lakeview Avenue corridors, connects Centerville, Dracut, and Tyngsborough. With 50 workers able to reach their jobs within 45 minutes and 690 within 75 minutes, Route 10 has second highest alignment ratio systemwide. Similarly, Route 13, connecting Lowell with Westford (which includes areas rezoned under the MBTA Communities Act, within which 500+ new housing units are as of the writing of this report proposed for development), enables 80 workers to reach jobs within 45 minutes, jumping to 717 within 75 minutes with the third highest alignment ratio. Their high alignment ratios, despite their shorter travel times, highlights that these routes' potential are significantly impacted by their low service frequency (approximately one trip per hour) and that substantial gains that could be realized with additional frequency.

Routes 14 and 15

Routes 14 and 15, while characterized by long end-to-end travel times (50 and 45 minutes, respectively), also exhibit pronounced gaps between the number of jobs accessible within 45 and 75 minutes. For Route 14, 179 workers can reach jobs within 45 minutes, rising to 931 at 75 minutes; for Route 15, the corresponding figures are 47 and 699. Although their high alignment ratios are partly a result of the long in-vehicle travel times, these results indicate that improving frequencies and reducing travel times along these corridors would be hugely beneficial for job access. Both routes serve areas with recent and anticipated job growth, as well as communities designated for new housing development under the MBTA Communities Act, suggesting growing potential demand for improved transit connectivity in the future.

Table 6: Jobs Accessibility Metrics by LRTA Route in 2025

LRTA Route	Workers who can access work in 45 minutes	Workers who can access work in 75 minutes	Alignment Ratio (75 min / 45 min)	Difference Between 45 Minute and 75 Minute
7	228	1166	5.1	938
14	179	931	5.2	752
15	47	699	14.9	652
10	50	690	13.9	640
13	80	717	9.0	637
2	181	711	3.9	530
5	309	826	2.7	517
17	71	568	8.0	497
16	136	566	4.2	430
1	150	536	3.6	386
4	143	503	3.5	360
12	132	484	3.7	352
8	97	339	3.5	242
3	77	267	3.5	190
18	49	161	3.3	112
11	15	88	5.8	73
6	97	165	1.7	68
9	74	124	1.7	50
20	4	8	1.9	4

CONCLUSION

This study provides a comprehensive evaluation of LRTA's recent service, ridership, and job accessibility performance, comparing outcomes with three peer agencies (BAT, WRTA, and MeVa). While the results highlight challenges facing LRTA, particularly in the pace of post-pandemic service and ridership recovery, they also reveal promising areas of recent progress and opportunities for future improvement.

While LRTA has not yet matched the speed of recovery observed in its peers, recent improvements have yielded tangible benefits. The 2024 service changes directly improved productivity and access, demonstrating LRTA's capacity to respond to regional needs. These gains show that further progress is not only possible but well within reach.

Key Findings

1) LRTA's overall service levels and ridership in 2025 remain roughly 11–12% below pre-pandemic (2019) benchmarks, placing the agency behind its peers, all of whom have restored or exceeded 2019 service and ridership levels.
2) Data strongly suggest that the pace of ridership recovery closely tracks the pace of service restoration and timing of the adoption of fare-free policies. Peer agencies that restored or expanded service more aggressively experienced stronger, earlier ridership gains.
3) LRTA's service productivity (measured as passengers per service hour) has rebounded to pre-pandemic levels in 2025 largely due to targeted service improvements implemented in mid-2024 when LRTA split three combined routes into individual lines. This also led to measurable gains in ridership and job accessibility.
4) LRTA's job accessibility metrics, both regionally and by individual route, indicate that strategic service expansions and better transfer coordination especially on high-potential routes (7, 10, 13, 14, 15) could unlock additional demand and lead to significant ridership growth.

Recommendations

1) Increase Service Frequency on High-Demand Routes:
    a. Consider increasing Route 7 frequency to every 20 minutes. Simulation results show this corridor has the highest latent demand and could deliver the most immediate impact on ridership and job access.
    b. Incrementally improve service frequencies on the key suburban routes of 10, 13, 14, and 15 to every 30 or 40 minutes, addressing the substantial "almost in reach" job access gap currently limited by hourly headways.
2) Enhance Transfer Coordination:
    a. Prioritize operational strategies that reduce waiting times for transfers between the highest-ridership routes at the Kennedy Center.
3) Consider Revisiting Routes with Low Jobs Accessibility:
    a. Focus future service improvements or route adjustments on routes and corridors with the greatest observed gaps between 45- and 75-minute job access, as these present the clearest opportunity for gains. At the same time consider rebalancing resources from very low accessibility routes (see bottom of Table 6) to ones with more potential.
4) Plan Ahead for Future Growth:
    a. Routes 13, 14, and 15 traverse corridors where new, higher-density housing is anticipated under the MBTA Communities Act. As these routes already have high

jobs accessibility potential LRTA has a unique opportunity to proactively strengthen transit service in these areas ahead of new development, positioning the agency to capture future riders and support regional growth goals.

Further Study

The consistent finding that peer agencies have been able to recover and expand service more rapidly than LRTA despite similar funding mechanisms and operations warrants additional investigation. A better understanding of the strategies employed by peer agencies and the specific barriers facing the LRTA region could be helpful to informing future policy and investment decisions.

Future research could also examine the role of route alignment and network directness in improving regional connectivity, with an emphasis on streamlining routes and reducing overall travel times for transferring passengers. The simulations performed for this study contain detailed data on transfers that could serve as a foundation for further study of specific routes.

A follow-up study could apply the travel time simulations already completed for this study to Replica origin-destination data, which MassDOT currently provides to metropolitan planning organizations. By using Replica data to replace the current jobs dataset, LRTA could evaluate overall travel demand patterns, not just work commutes. In addition, Replica's time-of-day metadata would enable a more nuanced analysis of trip purposes and reveal opportunities for expanding service span which would show routes where there is the most demand for later evening service.