TARC 2025:
Moving Forward Together

Volume I: Existing Conditions Report

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Managed by:

Prepared by:

Table of Contents

Table of Contents

1: Introduction

What is *TARC 2025: Moving Forward Together?*

TARC 2025: Moving Forward Together is a network redesign project that will solicit direct input from the community to create an updated TARC transit network that can better meet the community's goals and priorities—within the reality of the funding that TARC can expect over the next 5 to 10 years.

This effort is one of the core TARC approaches to proactively address its looming fiscal cliff and maintain a reliable and effective regional transit system. It is also an important opportunity to redesign Louisville's transit network to update and innovate service to better match the current and future needs of the Louisville region. The intent is that TARC will implement the new network between August 2025 and January 2026.

Through this process, TARC will deliver two proposals.

- One proposal will assume a significant reduction in fixed-route bus service, based on the projected revenues from TARC's primary funding sources.
- The other proposal will show how TARC could be more reliable and useful for Louisville residents if additional dedicated operating revenue is secured.

Why is TARC 2025 Needed?

TARC is facing serious financial problems. We need to act now if we want to keep TARC service strong for the community for many years to come. TARC 2025 is addressing this situation by working directly with the community to update Louisville's transit network to meet shared priorities within the expected funding in the coming years.

TARC's fiscal challenges are a results of several intersecting factors:

- **A limited local funding mechanism**: the Jefferson County occupational tax hasn't changed its rate in 50 years,and has failed to keep pace with the region's development pattern and the costs of paratransit service.
- **Minimal state support** in comparison to peer agencies**.**
- **An increasingly challenging financial climate nationwide** for transit agencies since the COVID-19 pandemic, due to a decline in ridership and fare revenues plus a substantial upward pressure on wages for employees due to competition from other employers such as delivery services.
- **The expiration of emergency funding** for transit agencies provided by the federal government during the pandemic.

What is a Network Redesign?

A bus network redesign is when the transit agency makes **changes to where** buses go, **how often** they come, **and when** they are available in order to make sure that the transit system better meets current needs.

- TARC 2025 starts with conversations with key stakeholders, transit riders, and the overall community to help to determine what's most important.
- We will then come to the community with alternative Network Concepts that show what a completely different TARC system could look like. Community feedback on those concepts will guide us in creating a Draft Plan of changes to the bus network to better meet those goals.
- Then we will bring that Draft Plan to the community for feedback. After the community gives feedback on the draft plan, the TARC Board will decide on a final plan to implement.

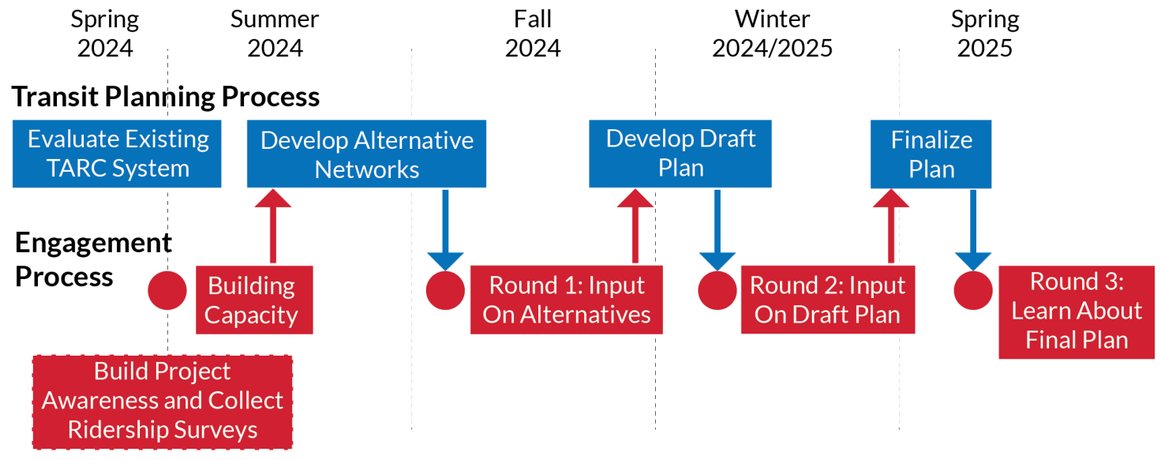


Figure 1: The process of designing, analyzing, and engaging the public on draft plans that will guide TARC 2025.

What is the Timeline?

We are acting fast to minimize as much disruption to our customers as possible, and plan to complete the TARC 2025 project within a one-year timeframe. The graphic above lays out the overall process.

Major phases of the project include:

- **Spring 2024 – Data Analysis and Existing Conditions:** Collection and analysis of data to identify strengths, weaknesses, and key features in the existing network. An on-board survey of riders and poll of non-riders will be completed. We will use the input and analysis to design alternative Network Concepts.
- **Summer 2024 – Concepts Development and Conversation:** Public conversation and input on the three TARC Network Concepts will drive priorities in the final proposal. This will involve extensive public engagement activities and conversations with the region's most important political, business, and community leaders.
- **Fall 2024 – Develop Draft Plan:** With the public input from the summer conversations, we will develop a Draft Plan and recommendations for a new network.
- **Late 2024 – Draft Plan Conversation:** We will reach back out to political, business, community leaders, transit riders, and the overall community for their review and provide feedback on the recommended draft networks.
- **Winter 2025 – Final Plan:** Two final proposals will be delivered – one assuming no additional revenue, and one assuming that additional revenue is secured. Community meetings in every neighborhood in the region will be held to present the Final Plan.
- **Late 2025/Early 2026 – Implementation:** The intent is for TARC to implement a new network somewhere between August 2025 and early 2026.

How Did We Get Here?

The Fiscal Gap

The charts to the right track three major factors: operating expenses, operating revenues, and the gap between the two.

Figure 2 (top left) shows the trends in TARC's Operating Expenses from 1994 to 2023 in constant 2023 dollars. Wages and benefits represent on average 68% of total operating expenses over this period. Transit, like many public services, is a labor intensive business and labor costs tend to rise faster than overall inflation levels. Wages and benefits have increased about 23% in real terms since 1994. Yet this does not paint the full picture of labor costs.

Paratransit expenses, in the blue line, are primarily labor costs for paratransit operators, mechanics, dispatchers, and supervisors. These costs are paid to a contractor, so they are counted differently from an accounting standpoint, but they are still primarily labor costs. Paratransit costs began increasing rapidly in the early 1990s after the unfunded mandate of the Americans with Disability Act expanded the eligibility and requirements to provide paratransit service. Since 1995, paratransit costs have increased 780% after adjusting for inflation.

Figure 3 (top right) shows the trends in TARC's Operating Revenues from 1994 to 2023 in constant 2023 dollars. TARC's primary operating funding source is the Occupational Tax, whereby TARC receives 0.2% of the total payroll of people working within Jefferson County. This tax source was dedicated to TARC through a 1974 referendum and is set by law. The Occupational Tax funds the Mass Transit Trust Fund that TARC oversees and which serves as the critical backup funds for TARC's ability to self-insure and provide capital grant matching funds. The occupational tax revenues have increased by 54% since 1994, after adjusting for inflation.

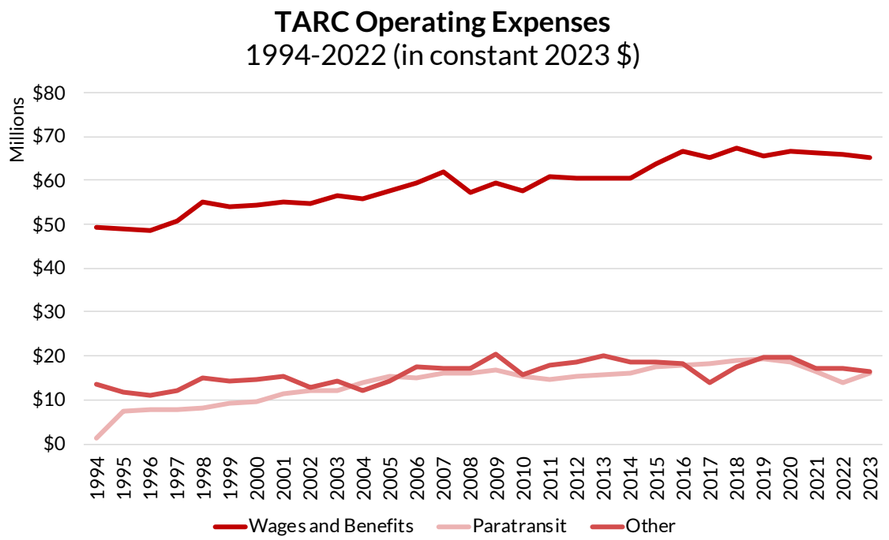


Figure 2: TARC's largest operating expenses are wages and benefits.

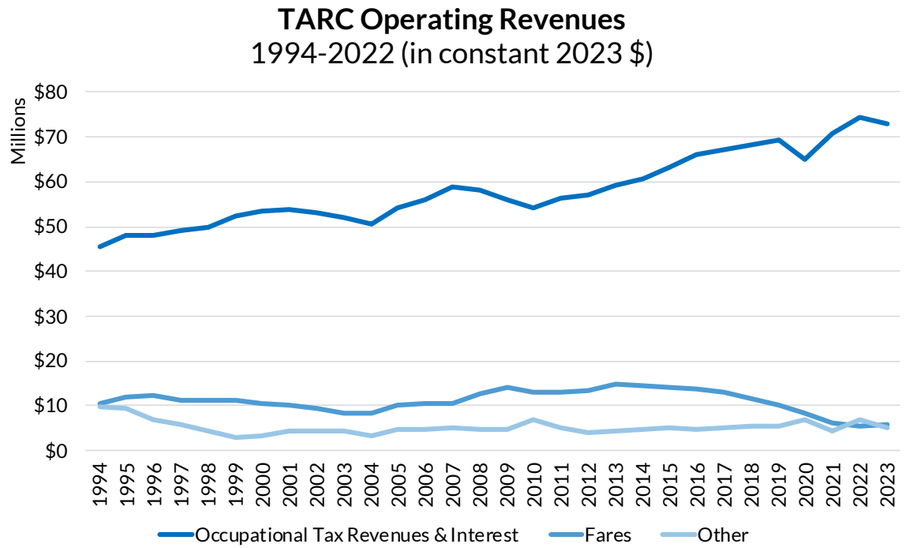


Figure 3: The biggest source of operating revenue for TARC is from the Occupational Tax.

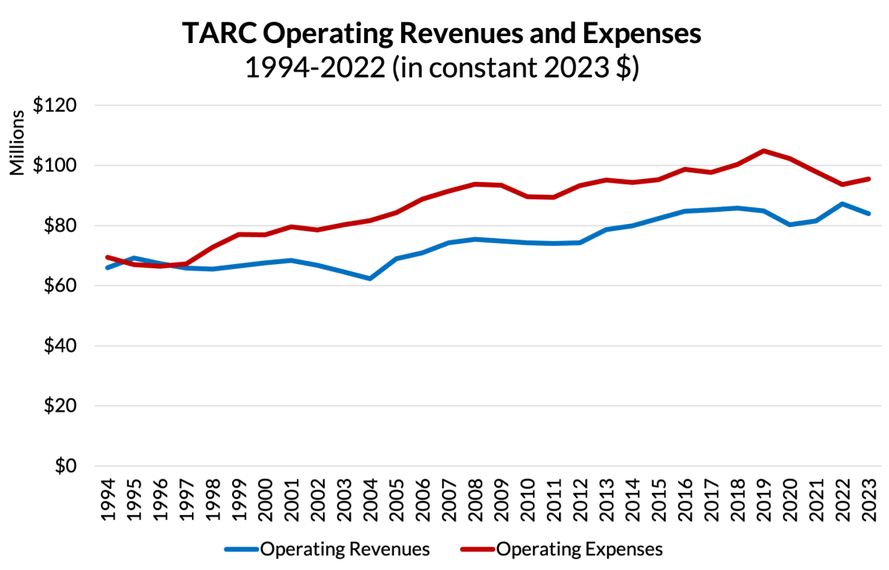


Figure 4: TARC operating revenues have trailed operating expenses since 1995.

Unfortunately, TARC's other major operating funding source, fares, have declined by 44% over the same period. Similarly, other funding sources have declined by 54% over that period.

The challenge this has created is a structural funding gap, shown in Figure 4 on the left. Since 2003, TARC has run a structural deficit of about $12 million per year, on average, in 2023 dollars. This gap has been filled by using larger and larger shares of Federal funding for operating expenses. In early 2024, TARC projected that the operations gap could grow up to $30 million in the next several years.

At most transit agencies, federal funding is prioritized for capital expenses to maximize the funding match. By using larger shares of federal funding on operating expenses, TARC had to delay critical capital projects like maintenance facility rehabilitation, bus purchases, and other long-term investments.

During the COVID-19 pandemic, the federal government provided special grants for operating funding to help agencies weather the unexpected challenges. TARC was able to use the $93 million received to fill this structural gap from 2020 to 2024. **The special federal funding has now been exhausted, and TARC must now find a way to close this fiscal gap.**

TARC cannot raise taxes. TARC cannot substantially increase revenues from other sources. The only short-term solution that is entirely within TARC's control is to reduce service until expenses fit within revenues.

A Changing City Presents Challenges

The Physical Gap

While the gap between TARC's revenues and expenses has grown, TARC has also been under a different kind of pressure: a demand to serve a physically growing urban and suburban territory with lower and lower ridership potential.

Figure 6 shows a population dot density map of Jefferson County in 1970 on the left and 2020 on the right. Two major trends stand out:

- Population has spread dramatically farther out in the eastern and southeastern suburbs.
- Population has declined significantly in the core of older Louisville neighborhoods.

These trends are borne out if we examine the weighted average density of population at each time period. Weighted average density measures the average density at which people live in a given area. Instead of simply dividing the total population of Jefferson County by its area, we calculate the density of each Census Tract, then multiply it by the population of that area, sum that total and divide by the total population in the county. Thus we get a measure of the typical person's experience of density. Figure 7 shows that the weighted average density of population in Jefferson County has declined by 32% since 1970 and it declined every decade through 2010 and increased just slightly from 2010 to 2020.

What does this mean for TARC? We discuss on page 15 how density is a critical factor in the potential for transit to achieve high ridership relative to cost.

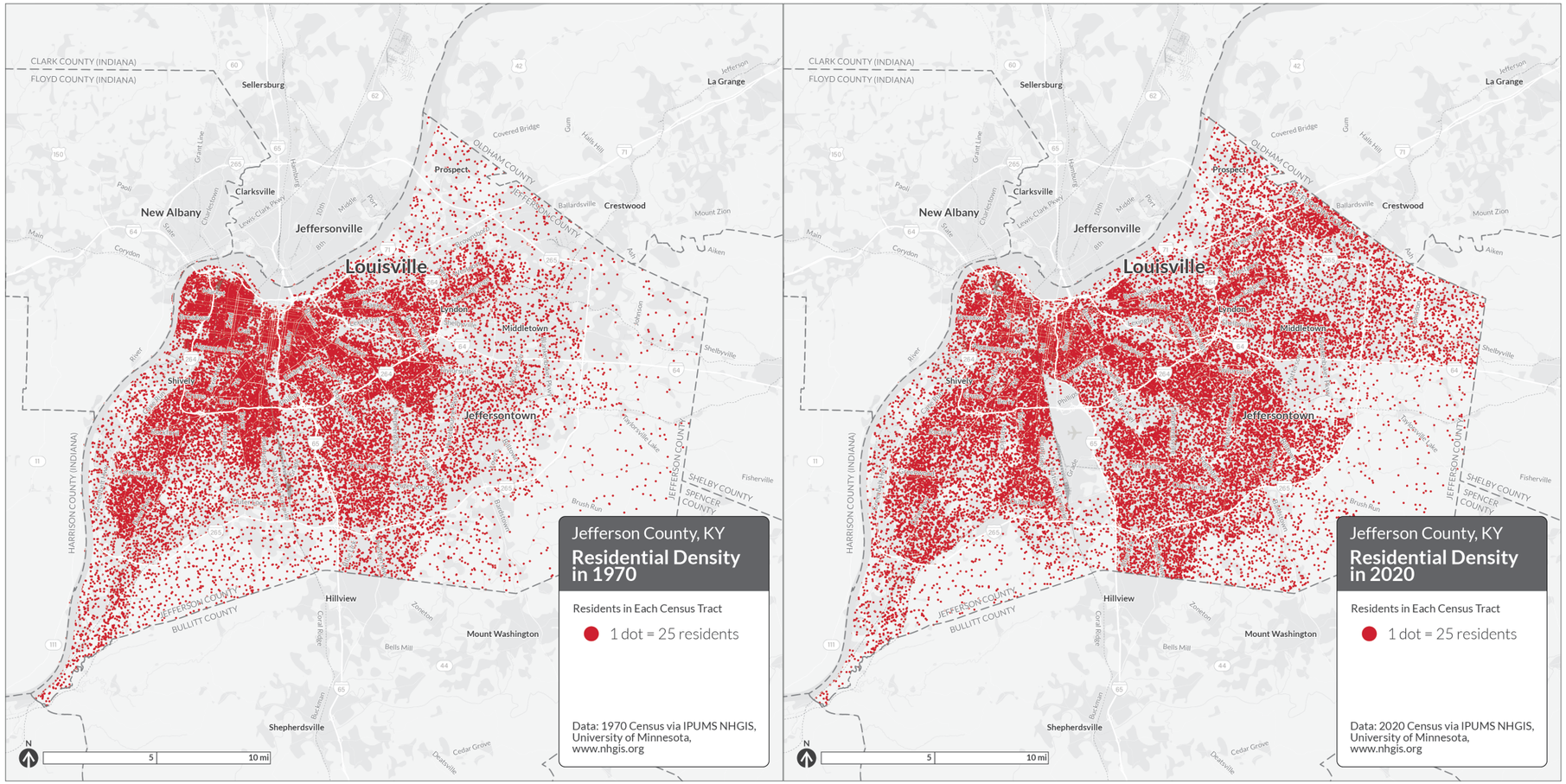


Figure 6: Population density in Jefferson County in the 1970 (left) and 2020 (right) census. The density of population has declined in the historic core, while it has increased substantially in the eastern and southeastern suburbs.

If overall density is falling and the overall service area is expanding, then TARC's thin budget is being pulled across a larger territory that has lower potential ridership.

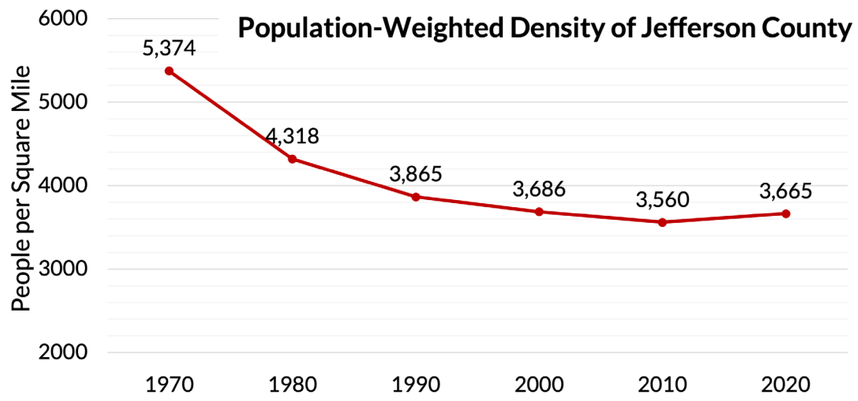


Figure 7: Population-weighted density of Jefferson County has declined significanty since 1970.

Ridership Decline and Projected Service Decline

Ridership Decline

Like many transit agencies, TARC has experienced two major effects from the COVID-19 pandemic.

Ridership has fallen steeply since 2019, as some workers started working from home, and some people started avoiding transit in order to practice social distancing. Additionally, most U.S. cities had a gradual decline in transit ridership from about 2014 to the start of the pandemic, as did TARC. These trends are visible in Figure 8 below.

The trend line shows ridership declining about 34% from 2013 to 2019. Some of this trend is due to the physical gap between TARC's service area trends and its budget. Some of it is explained by changes in other external factors, like gas prices. Ridership then fell another 53% during the pandemic. The ridership decline has hurt TARC's fare revenues, which have declined from about 15% of revenues to about 7% of revenues in this time.

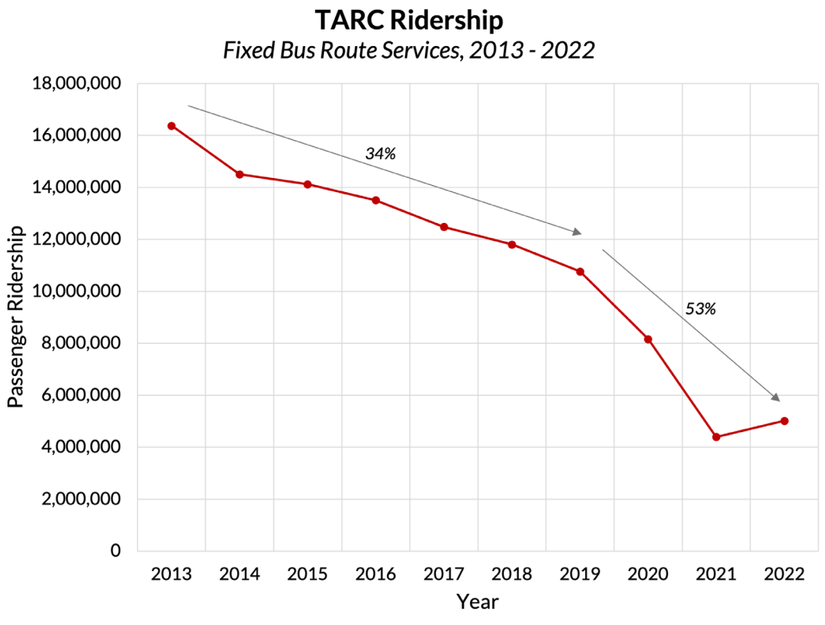


Figure 8: TARC ridership was falling even before the COVID-19 pandemic.

Service Decline

While ridership has declined since 2013, the overall level of service provided has remained relatively flat. The cost of a transit route relates primarily to the time spent by operators running the route, since most of the cost of transit is in the wages paid to everyone running the system day-to-day. In the transit business, the measurement of time spent operating service is called "service hours" or sometimes "revenue hours of service". One bus operating on a route, picking up and dropping of people has spent one "service hour".

The service hours provided on any particular route, and to any particular stop, will depend on a few factors:

- The length of the route.
- The operating speed of the bus (since a slower operating speed means that covering the same distance takes more time).
- The frequency of service along the route or to the stop (since higher frequency is supplied by more buses and operators out driving the route).
- The span of service along the route each day and each week.

Figure 9 shows the total number of service hours operated annually by TARC from 2013 to 2023. The chart continues with the projected number of services hours expected in 2024 to 2026. From 2013 to 2023 TARC operated about 550,000 service hours annually, and that number declined by about 5%. At the depths of the pandemic, when TARC made substantial service changes, the total number of hours operated only declined by 10%.

With the fiscal challenges TARC is facing, it is projected that service hours will need to be reduced by around 40%, to less than 290,000 annual hours by 2026.

This large of a reduction in service will be quite noticeable to the community. While bus riders cannot go until the bus arrives, car drivers and bicyclists do not experience this challenge. One way to think about this situation is that waiting for a bus is like waiting for a gate at the end of your driveway to open, and you cannot leave until it opens. If your gate currently opens every 30 minutes, a 40% cut in service means it would only open once every 50 minutes. If you miss the window in which you can leave, then you have to wait another full 50 minutes to do so.

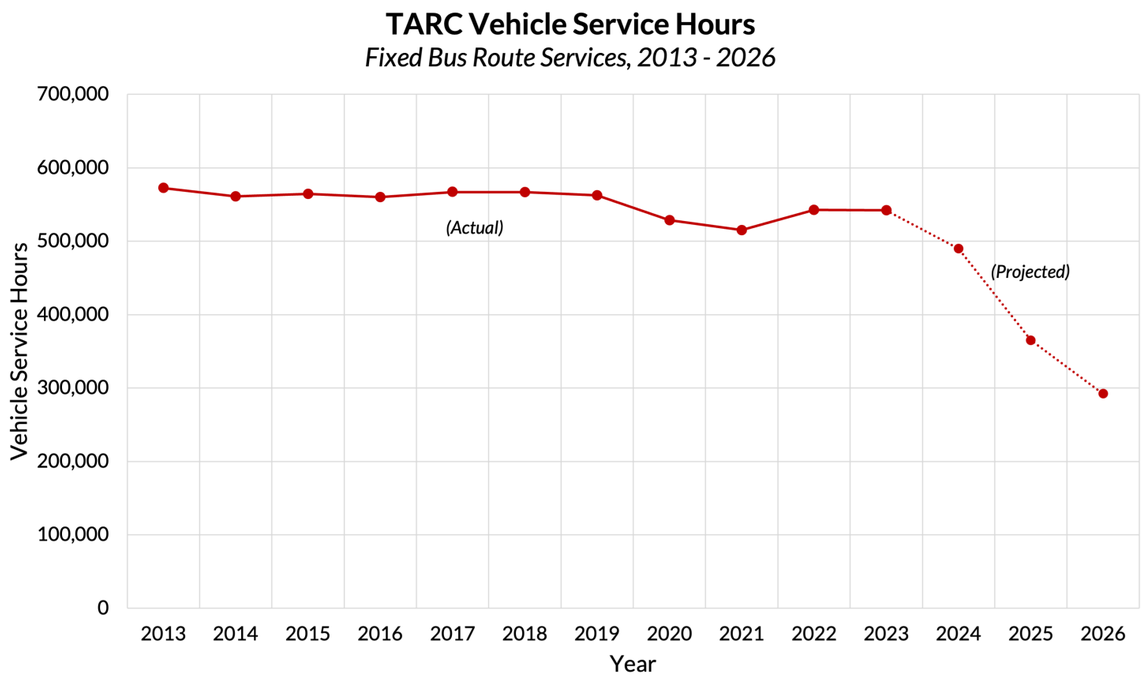


Figure 9: TARC has modestly reduced service in the past decade, but its impending fiscal challenge may require large and painful reductions in service.

Conflicting Goals in Limited Resources

Transit's Many Goals

With this enormous challenge, TARC must start a conversation with the community about what goals it should prioritize. Transit can serve many different goals. It is not possible to excel towards all these goals at the same time. Within a limited budget, communities have to carefully consider what kind of goals they want their transit system to fulfill. Reasonable people will disagree about which of these goals is most important. Examples of transit's goals include:

- **Economic:** Transit can give workers access to more jobs, businesses access to more people, and students access to education and training.

- **Social:** Transit can meet the needs of people who are in situations of disadvantage, providing lifeline access to services and jobs.

- **Congestion Mitigation:** Transit can allow for continued economic growth beyond what congestion would limit.

- **Environment:** High transit use can reduce greenhouse gas emissions, and local impacts of air and noise pollution.

Some of these goals are only served if transit is very useful so that many people choose to use transit. For example, transit can only mitigate congestion and pollution if many people choose to take the bus rather than drive. Transit is successful at economic goals when it can provide the most people access to the most opportunities. We call these **ridership goals** because they are achieved by designing service to obtain high ridership.

Other goals are served by making simply some level of transit available in as many areas as possible. A route may serve a small number of people, but deliver a lot of benefit in their lives by giving them the option to take transit if they have no other way of traveling. In that way, it provides residents some choice, and insurance against isolation. It may also fulfill political or social obligations, for example by getting service close to every taxpayer or into every district. We call these types of goals **coverage goals** because they are achieved by covering geographic areas with service, regardless of ridership.

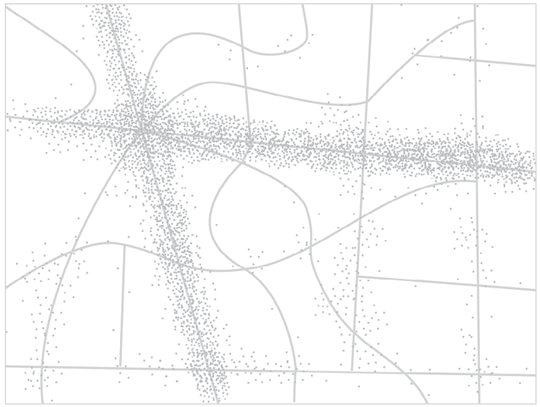
Ridership and Coverage Goals Conflict

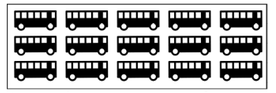
Ridership and coverage goals conflict. Within a limited budget, if a transit agency wants to do more of one, it must do less of the other.

Here is an illustration of how ridership and coverage goals conflict with one another due to geometry and geography. In the fictional town at the top of the image on the right, the little dots indicate homes, commercial buildings and other land uses. The lines indicate roads. Most of the activity in the neighborhood is concentrated around two roads.

A transit agency pursuing only ridership goals would focus service on the streets where there are large numbers of people, where walking to transit stops is easy, and where the straight routes feel direct and fast to customers. Because service is concentrated onto fewer routes frequency is high and a bus is always coming through the neighborhood soon. This results in a network like the one at bottom-left.

If the transit agency were pursuing only coverage goals, on the other hand, it would spread out services so that every street had a bus route, as in the network at bottom-right. As a result, all routes would be infrequent, requiring long waits, even in the busiest places.





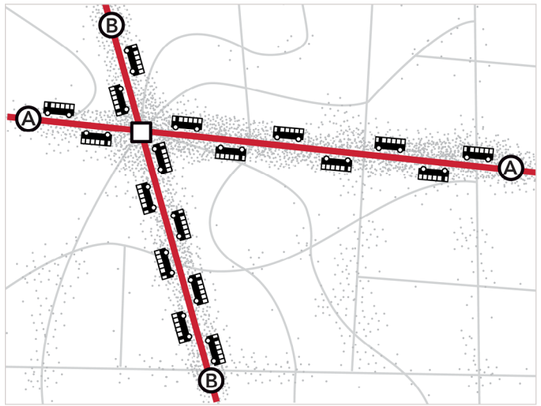
Imagine you are the transit planner for this fictional neighborhood. The dots scattered around the map are people and jobs.

The 18 buses above are the resources the town has to run transit.

Before you can plan transit routes, you must first decide:

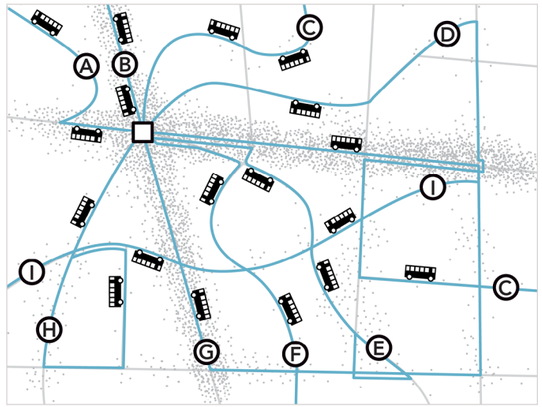
What is the purpose of your transit system?

If you maximize ridership...



...all 18 buses are focused on the busiest streets. Waits for service are short but walks to service are longer for people in less populated areas. Frequency and ridership are high but some places have no service.

If you maximize coverage...



...the 18 buses are spread around so that there is a route on every street. Everyone lives near a stop but every route is infrequent, so waits for service are long. Only a few people can bear to wait so long, so ridership is low.

Figure 10: Comparing an imaginary town, if transit were run with the goal of maximizing frequency and ridership, to the same town if transit is run with the goal of providing a little service near everyone.

An agency can pursue ridership and provide coverage within the same budget, but it can't fully do both with the same dollar. The more it does of one, the less it does of the other.

COVID-19 Changed Travel Habits

Even if TARC was not facing a fiscal crisis, the recent ridership trends and major changes in travel patterns since the pandemic might argue for a major redesign of the bus network. The charts on this page help paint a large-scale picture of changing travel patterns in the region since 2019. These charts use Replica data, a data source that uses cell phone and mobile app data to assess trip activity.

Figure 11 shows the change in trips across the day in 2019 and 2023. The dotted line shows the pattern of trips in 2019 while the solid line shows trips in 2023. In general there was more trip activity in the morning hours in 2019, with a slightly higher peak in the AM time period. Afternoons and evenings have higher trip activity in 2023, with a pronounced level of higher activity in the 6-9 PM time period in 2023, compared to 2019.

Figure 12 shows the change in the pattern of transit trips across the day. In 2019 overall activity was much higher, with a peak at noon of about 6,000 estimated trips. In 2023, overall trip activity is much lower, with a maximum of about 2,500 estimated trips at the peak at midday. Transit trips increase in the morning and roughly plateau around 2,000 to 2,500 estimated trips until 5 PM, when trip activity slowly declines.

Figure 13 shows the change in trips by mode from 2019-2023. Walking and biking trips are up about 13%, likely reflecting more work from home activity leading to more short trips around and within people's own neighborhoods. Car trips are up by 4%. Transit trips are down by 49%, which tracks with TARC's own estimates of about a 54% decline since 2020.

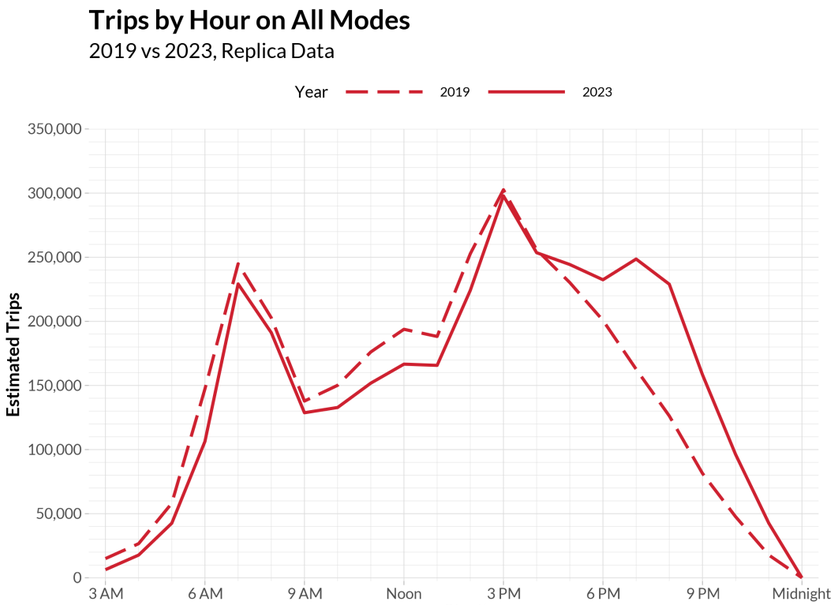


Figure 11: An overall look of all trips in Louisville by the hour, comparing before and after the pandemic.

Even if TARC was not facing a fiscal crisis, the substantial decline in ridership since 2013 combined with significant travel pattern changes since the pandemic suggest that TARC's services should be completely rethought to better meet today's needs.

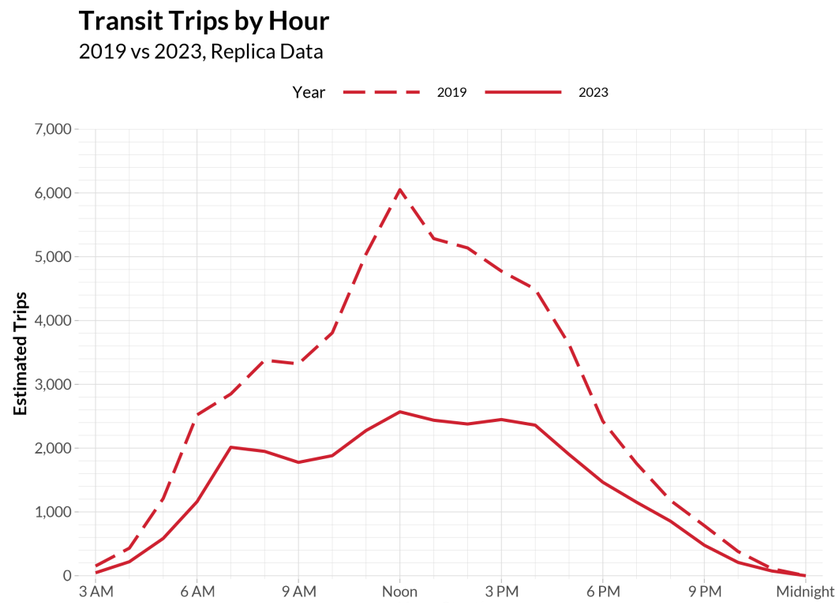


Figure 12: 2019 vs 2023 estimated trips on transit per hour. Transit trips have dropped by about 50%.

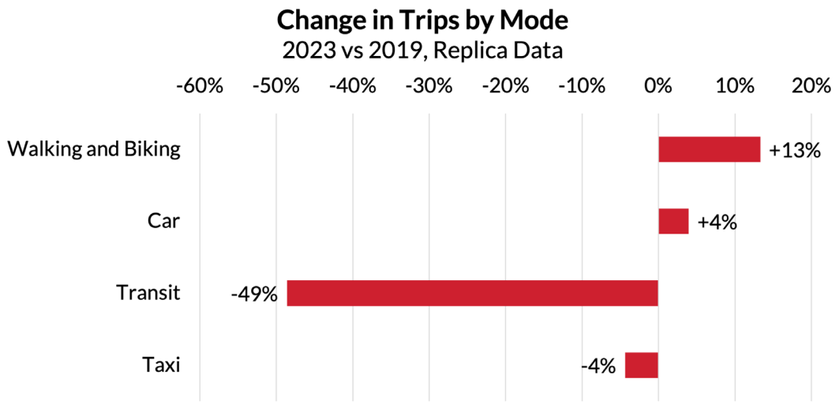


Figure 13: Difference of change between 2019 and 2023 in the amount of trips by mode. Transit trips have fallen dramatically since the pandemic, but other modes have marginally increased.

What Else is in This Report?

The remainder of this report lays out key facts about transit geometry, markets and needs in Louisville, transit performance, and key choices about what TARC should prioritize going forward.

Transit Geometry

In Chapter 2, we summarize the basic principles of transit geometry, how they affect the access and opportunities that transit can provide to residents, workers, and visitors, and how the underlying geometry forces every community to grapple with some key value trade-offs in the design of its transit system.

Markets and Needs

In Chapter 3, we assess the markets for transit in the region, the potential for high ridership, and the areas where the need for transit is high even if the density of demand is not.

By "market" we are referring specifically to the demands for transit that result in high ridership relative to cost. This way of thinking about a transit market is similar to the way a private business thinks about its market for sales—how many potential customers there are, how useful they will find the product, and how well the product competes for their business.

The need for transit can be defined in many ways, but in most communities, people in need of transit usually includes those in poverty, people who are less likely to be able to drive, like seniors and youth, or households without cars.

Existing Network

In Chapter 4, we analyze the fixed route transit network performance including the frequency of service, productivity of service and how the network performs on measures like access to jobs.

Key Choices

In Chapter 5, we summarize key value choices that only the community and its leaders can make about how transit should serve the region. These value choices cannot be answered by technical experts because they are questions about what goals and values the communities prioritizes. There is not a technically correct answer to these value questions.

Balance Between Ridership and Coverage?

What should the balance between ridership goals and coverage goals be? How would you divide 100% between these goals:

- Maximizing ridership by providing high-frequency, useful services to dense places. This will put more people near the most useful services, but the number of people across the region who are near transit may reduce.
- Maximizing coverage by extending lower-frequency services to reach more of the region. This will increase the number of people who have some transit service near them, but reduce the number of people with access to frequent, useful transit services.

Walking or Waiting?

There is a limit to how much a transit agency can increase ridership, within a fixed budget, without increasing walking distances to service and thereby increasing frequencies. This choice, between walking and waiting, relates to a larger choice about how to balance ridership and coverage goals.

Does the Region Have Enough Service?

As TARC is facing a fiscal crisis that could result in dramatic reduction in transit, a key question is "Should the region invest more in transit?" Looking at transit service compared to peers, TARC rates relatively low on a per-capita basis. And other regions that invest more in transit get more ridership, even relative to their population. You can't ride a bus that's not there, and there is a certain truth to the saying that you get what you pay for with transit.

With more service, more people and destinations could have useful transit that would encourage more ridership. IF the region wants transit to be more useful and more relevant to the community's needs, part of the answer may be providing more service overall with additional investment.

Next Steps

This Choices Report represents the first step in a three phase process of thinking about balancing goals and priorities for the region's transit network. This report is the basis for surveys, and outreach for the initial phase of the TARC 2025. The public, stakeholders, and riders will be invited to respond to these key questions and provide other input on their preferences around how transit serves Louisville and the surrounding region. This input will be gathered through online survey and in-person surveying, stakeholder meetings, and other engagement events. Details on the latest event and the online surveys will be available at:

www.ridetarc.org/tarc2025

Future phases of engagement will include a:

- Concepts Phase where we will have three alternative Net,work Concepts for a redesigned transit network to present contrasting options.
- Draft Plan Phase, where we will present recommended scenarios for a new TARC network in a fiscally constrained scenario and in a scenario with additional funding.
- Final Plan Phase, where TARC will present the final plan and explain how we got to the recommendations and details on when new routes and services will be implemented.

We hope you will engage with TARC 2025 so that we can all move forward together.

2: What Makes Transit Useful?

Transit is Useful Because of the Access It Provides

Wherever you are in your city, there are a limited number of places you can reach in a given amount of time. These places can be viewed on a map as a "blob" around your location. Beyond this area are things you can't reach because it simply takes too long to get there.

The technical term for the blob you can reach in a given time is an **isochrone,** and the destinations in that isochrone are the opportunities you can **access:** for work, school, shopping, or any other reason you might want to go somewhere.

It is also fair to think of **access as freedom,** in the physical sense. If you can use transit go to more places, you have the choice to not drive or hire a car, and you have more choice in the places you can go to, the jobs you can hold, the things you can do, and so on. In a sense, you are more free.

How Transit Expands Access

Transit provides value when it increases people's freedom. That happens by increasing the number of useful places people can access in a reasonable amount of time. The extent of your access is determined by:

- **The network,** including transit lines with their frequency, speed, and span. This determines how long it takes to get from any point on the network to any other point. So, if you can get further in the same amount of time, the "blob" around you is bigger, and you can access more opportunities.
- **The layout of the city.** This determines how many useful destinations can be located near transit stops. Where there are more people or useful destinations near a given stop, good access from that point is of value to more people. If there are more opportunities inside your blob, you can access more opportunities.
- Your **location.** This determines which routes are close and frequent enough to be useful to you, and changes how big or small your blob is.

Why Access Matters

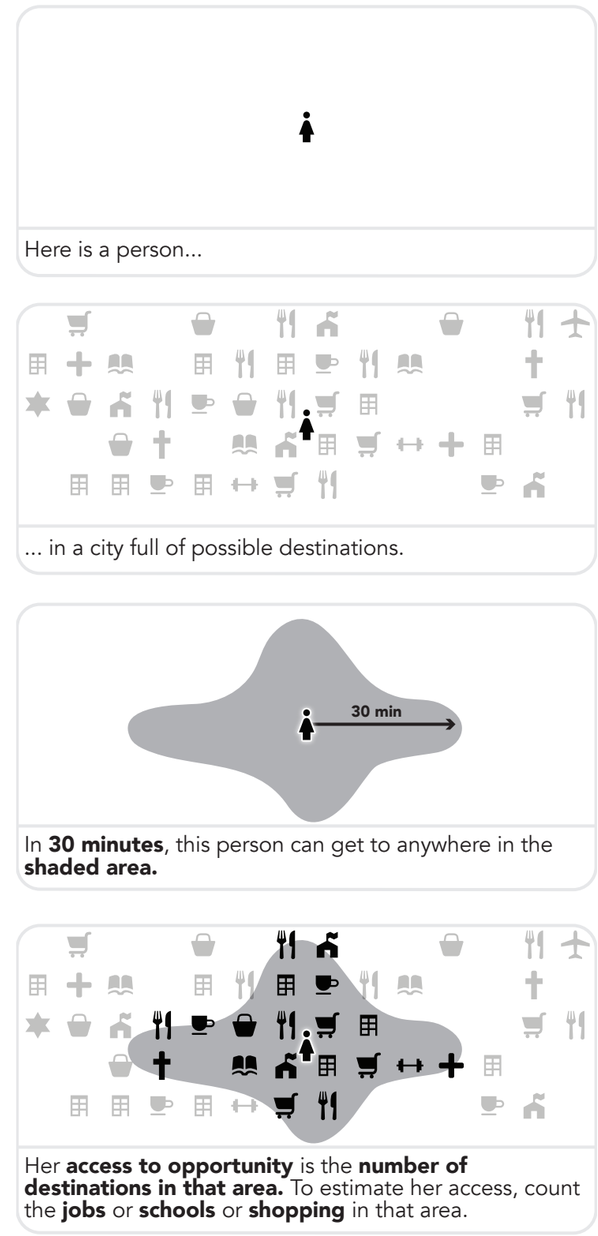
On an individual level, access represents convenience and the ability to do the things you need to do, when you want to. It is not a prediction of what you will do. To that extent, **the level of access transit provides is part of what determines transit ridership.**

If you are deciding where to live based on whether you'll be able to get to your job, school, relatives, or medical care, you are asking a question about access. That access will influence your decision. If you want the **choice of not needing to drive a car,** you'd want to maximize access by walking, biking, and transit from your location.

Access is also something that many people see as **a worthy goal in itself.** For example:

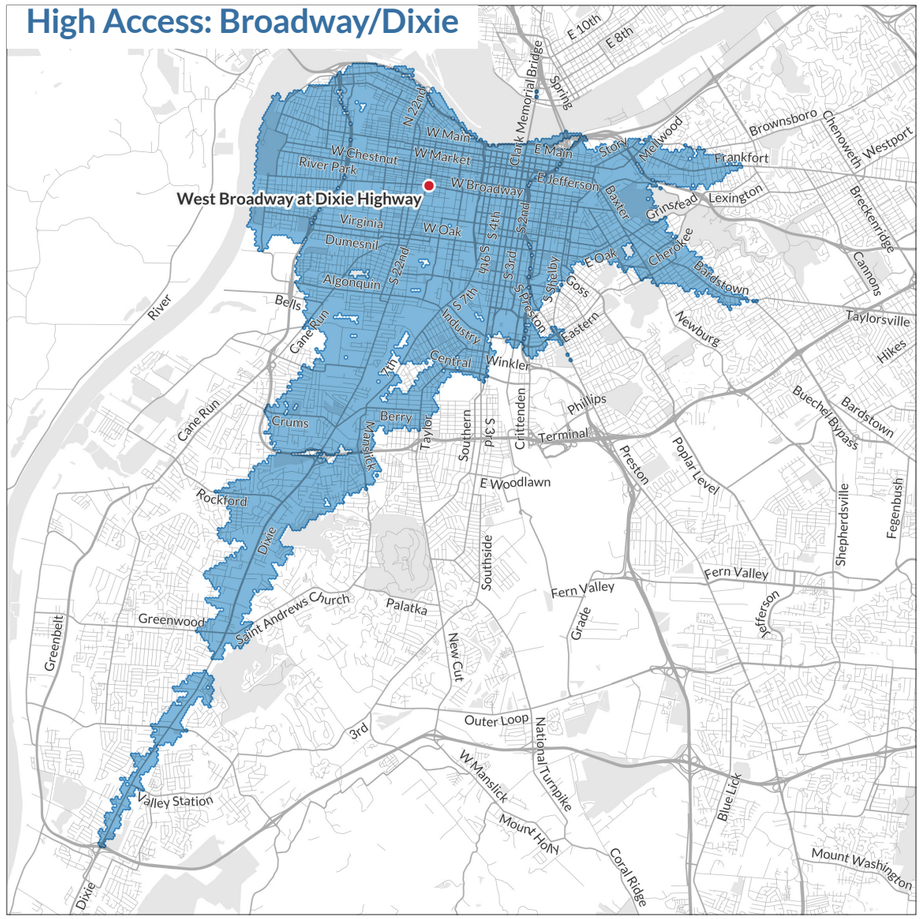
- Access to jobs is a key concern for keeping people employed.
- Access to more people means that a business can have a larger pool of workers as well as customers.
- Access to many amenities from a particular location gives that location value. Real estate firms routinely outline where you can get to by car from a particular development parcel—this is the same analysis for transit.

Figure 14: Visualizing access as what you can reach in a given amount of time.



What Can I Reach in a Reasonable Amount of Time?

High Access: Broadway/Dixie



These maps show how far someone can reach by transit and walking in 45 minutes or less, starting from each of the locations.

The travel time includes:

1. Walking to the bus stop
2. Average waiting time for a bus
3. Time on the bus
4. Average waiting time and time on the bus for any transfers
5. Walking from the bus stop

Low Access: Goldsmith/Peabody

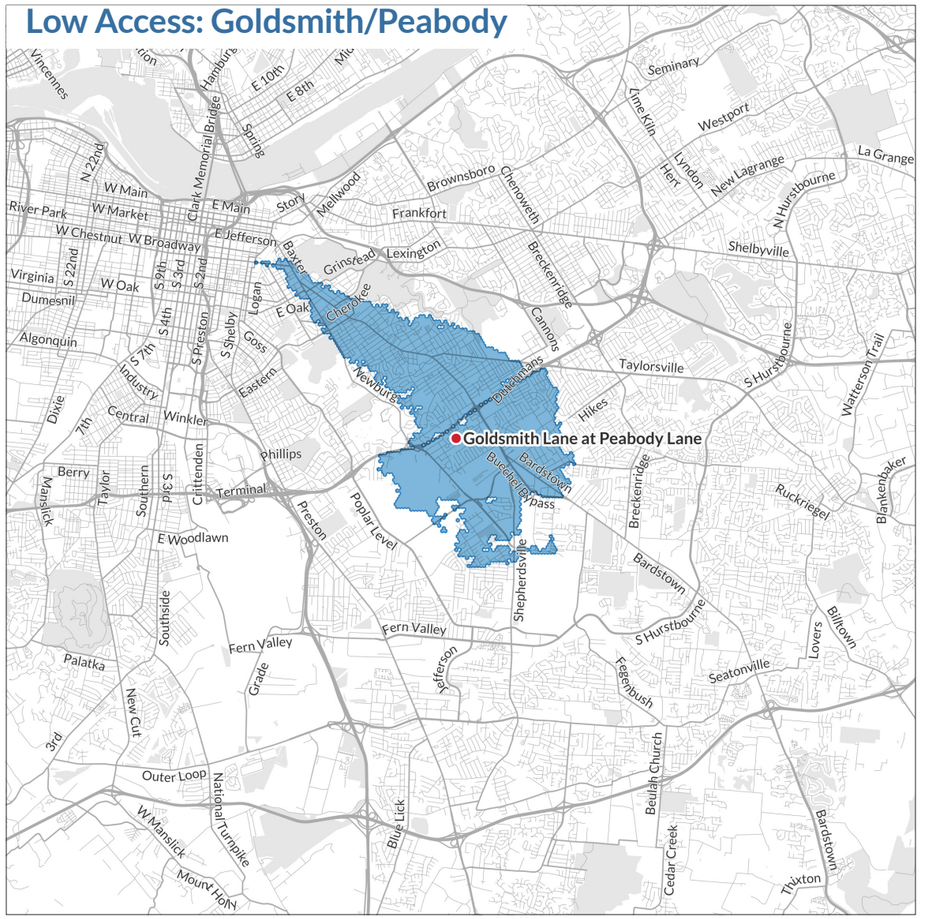


Figure 15: Examples of isochrones from two locations in Louisville: West Broadway at Dixie Highway and Goldsmith Lane at Peabody Lane.

Someone starting at the intersection of West Broadway and Dixie Highway can take two frequent, useful routes: the 10 along Dixie Highway and the 23 along Broadway, with buses every 15 minutes. Downtown is quite close to this location, and they can reach it with a very short wait and a short bus ride on Route 23. In Downtown, they can transfer to many other routes, particularly the frequent Routes 4 and 28. Route 10 also lets them travel very far along Dixie Highway within 45 minutes. All of these factors result in a relatively large isochrone. In total, someone can access **up to 173,000 jobs** within 45 minutes of travel from this location.

Someone who lives in one of the apartment complexes along Goldsmith Lane only has service along Route 21, which is very infrequent, and they have to wait very long on average to use that route. In order to get to Downtown along Route 21, they have to drive through a very long deviation along Gardiner Lane. They could instead walk quite a long distance to Bardstown Road where they could catch two of the three branches of Route 23, with a wait time potentially as long as every 30 minutes. In 45 minutes, they can only barely reach the eastern end of Broadway, and the only major job centers they can reach are Watterson Park and the Bashford Manor Shopping Center. This results in a relatively small isochrone with not much in it. Someone starting from Goldsmith Lane at Peabody Lane can access only **up to 33,000 jobs** in 45 minutes or less.

Frequency Makes Transit Useful

A transit network is a pattern of routes and services, where each line:

- follows a **path,**
- at certain days and times (its **span**),
- at a given average **speed**, and
- has buses coming once every certain number of minutes. This is the headway or **frequency.**

Frequency is invisible and easy to forget. Yet on transit it is one of the most important factors determining where you can get to in a given amount of time. This is because time spent waiting is a major component of travel, and waiting time is directly related to frequency.

Frequency is Freedom

More frequent service dramatically improves access. High frequency reduces travel time by providing several related and compounding benefits:

- **Shorter Waits.** Unless you plan your life around a bus schedule, the average wait for transit is half the frequency. If a bus comes every 30 minutes, your average wait will be 15 minutes. But if it comes every 15 minutes, your average wait will be 7.5 minutes.
- **Faster Transfers.** To go further than the places on the bus route you happen to be on, you'll need to connect to another route. Better frequency makes this kind of connection easy, because the next bus is always coming soon.
- **Easier Recovery from Disruption.** Frequent service is more reliable, because if a bus breaks down you don't have to wait as long until the next one shows up.
- **Spontaneity and Freedom.** When transit comes every few minutes, there's no need to build your day around a bus schedule. You can show up at the stop and go whenever you want.

Frequency and Ridership

One measure that can be used to assess transit routes is **productivity,** or how many riders use a route relative to the cost of operating that route. This measure speaks to what someone has in mind when talking about "efficiency". The total hours of service on a route (that is, the total time each bus and driver spend serving all the trips on a route) directly measure the cost of operating the route. Hence, productivity can be measured as ridership divided by service hours.

The plot at right shows all the routes operated by transit agencies in 42 different U.S. cities, at various points in time within the last ten years. Each route is located on the plot based on its frequency and its productivity (boardings per service hour). More frequent routes are to the left, and more productive routes are higher up. The shade of each hexagon indicates the number of routes in that place on the graph.

The plot shows that higher productivity is correlated with higher frequency, even though higher frequencies require more service hours, and thus cost more. In other words, **ridership *relative to cost* appears to rise rapidly as frequency increases.** This is a two-way street: transit agencies rarely run high frequency service in places where they expect low ridership. But conversely, if frequency isn't very high, the amount of ridership transit can attract is fundamentally limited.

Frequent service is strongly correlated with high ridership per unit cost.

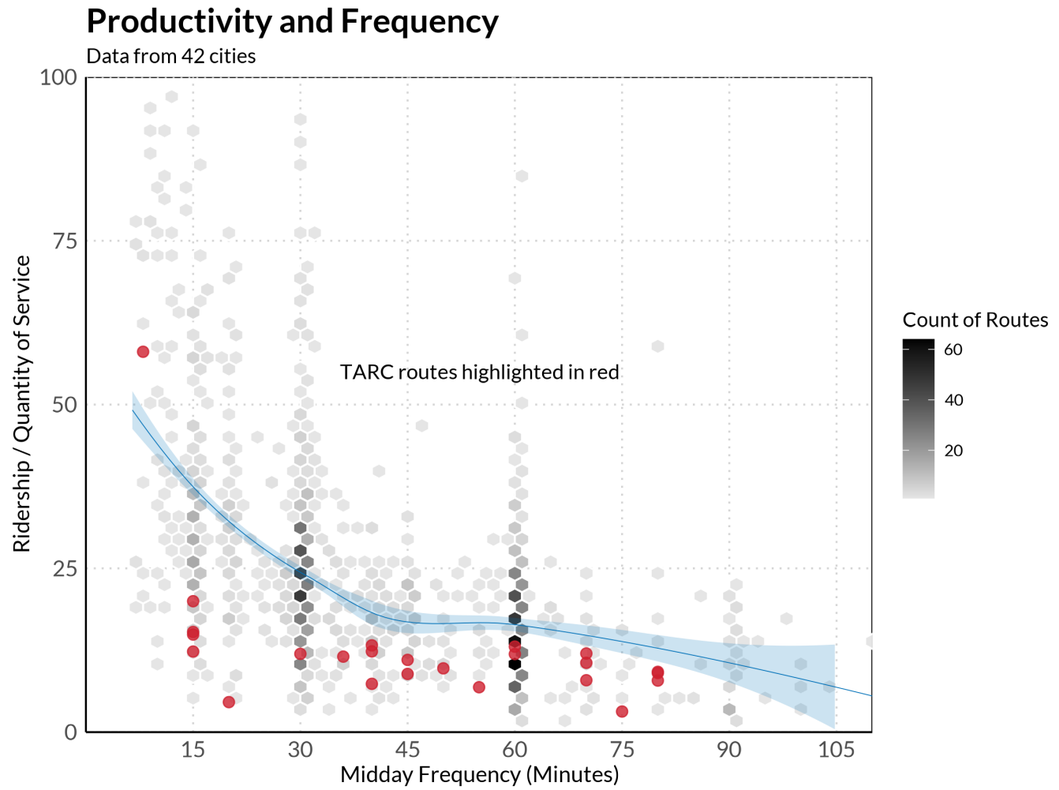


Figure 16: Transit Productivity and Frequency in 42 cities across the USA. More frequent routes tend to attract a higher number of riders per hour of service. TARC routes' data is highlighted in red.

What is Frequent Enough?

Frequency is expensive, so it's important to think about just how frequent service needs to be. **A frequency of 15 minutes or better has a good chance of being useful** to someone whenever they need to travel, especially if that frequency extends over many hours of the day, every day. In the TARC system, the four frequent routes provide a much higher level of freedom than the lower frequency routes in the network.

Adequate frequency depends on trip length, because it doesn't make sense to wait long to go a short distance. Very short downtown or campus circulators, for example, don't generate high ridership unless they can be run with frequencies well under 15 minutes. For many people, it wouldn't make sense to wait more than 10 minutes to go half a mile, because you could probably walk to your destination in that time. But it might make sense to wait that long to go several miles across town.

Radial Networks Allow Many Connections When Frequencies are Low

There are two basic network shapes that can be found in most transit systems, illustrated in Figure 17.

Radial networks have a central point, and nearly all routes go to that point—often downtown. A radial network design ensures that anyone looking to travel downtown can make their trip without the need to transfer. Anyone going to another outlying place can get there with a single transfer at the center. Radial networks arose naturally in pre-car cities because so much commerce and culture was centralized.

Grid networks also offer people a way to travel from anywhere to anywhere with a single transfer. But unlike in a radial network, the transfers in a grid network happen wherever two routes intersect.

Radial vs. Grid Networks

In many cities, there is a large concentration of people, jobs, and activities in the central downtown area. Radial networks make more sense in such contexts, as most people can access the large concentration of opportunities in the center in a reasonable time with a direct ride, or can travel across the city to other destinations with a single transfer in the center.

In large urban areas with radial networks, some journeys from outlying areas near each other require such a long time to get into and out of downtown that they become impractical by transit. This is when agencies might start adding **orbital** or **cross-town** routes for more direct connections outside of downtown. However, if orbital routes are not frequent, the long waiting time can remove any time advantage over traveling to the center to transfer, making them less useful.

In large cities with many centers of activity or expansive areas of activity (such as Los Angeles, Chicago, or Houston) a large frequent grid requires much less out-of-direction travel than a radial network.

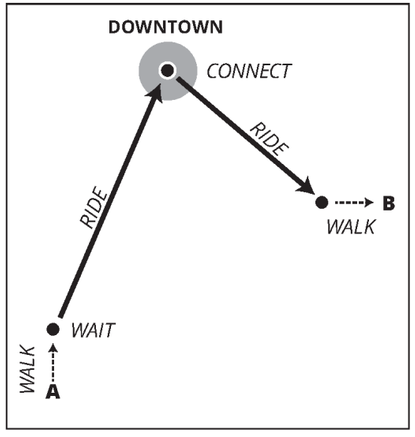
A frequent grid of intersecting routes offers the simplicity and reliability of a street network. The grid can be formed along two parallel sets of intersecting roads (a "lattice"), or a set of radial roads and intersecting orbital roads (like a spider web).

The key to a useful grid network is high frequency. When every route in the grid network is frequent, then it is easy to transfer at any point where two routes cross. When routes are infrequent, grid networks become much less useful, because the waiting time for transfers become intolerable.

In a grid network, it is hard to coordinate route schedules such that transfers in all possible directions can be made with short waits at every possible place where routes cross. In such a case, radial networks can be more useful because many routes converge in one spot. It is then much easier to coordinate schedules such that transfers between many routes require only a small wait in the central location. This is a powerful network design feature, often called **pulsing.**

The existing TARC network is an example of a highly-radial, mostly infrequent network, with a few orbital routes. The limited resources available to serve the relatively large area across the region means that only four routes and the UofL circulator are frequent (every 15 minutes or better). Most of the infrequent routes come Downtown, but they don't all meet in a single location. They have different frequencies ranging between 30 and 70 minutes, which means they also cannot consistently meet a route with a different frequency. Downtown transfers from one infrequent route to another are thus complicated and can be quite long.

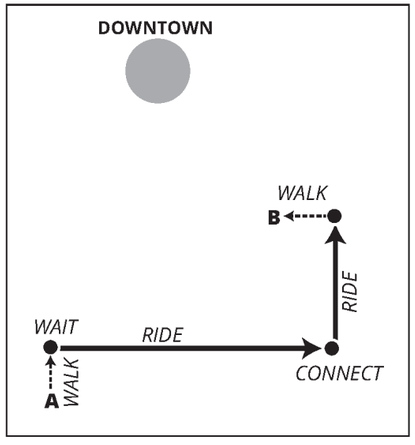
Basic Transit Network Shapes



Radial

Most routes lead to and from the center. Anyone wishing to travel from one non-central location to another must pass through downtown and transfer there.

A radial structure makes sense when one part of a city (typically the downtown) is a dominant destination. In a radial network many routes can be scheduled to converge at a set time (called a "pulse") to reduce the waiting time needed to transfer.



Grid

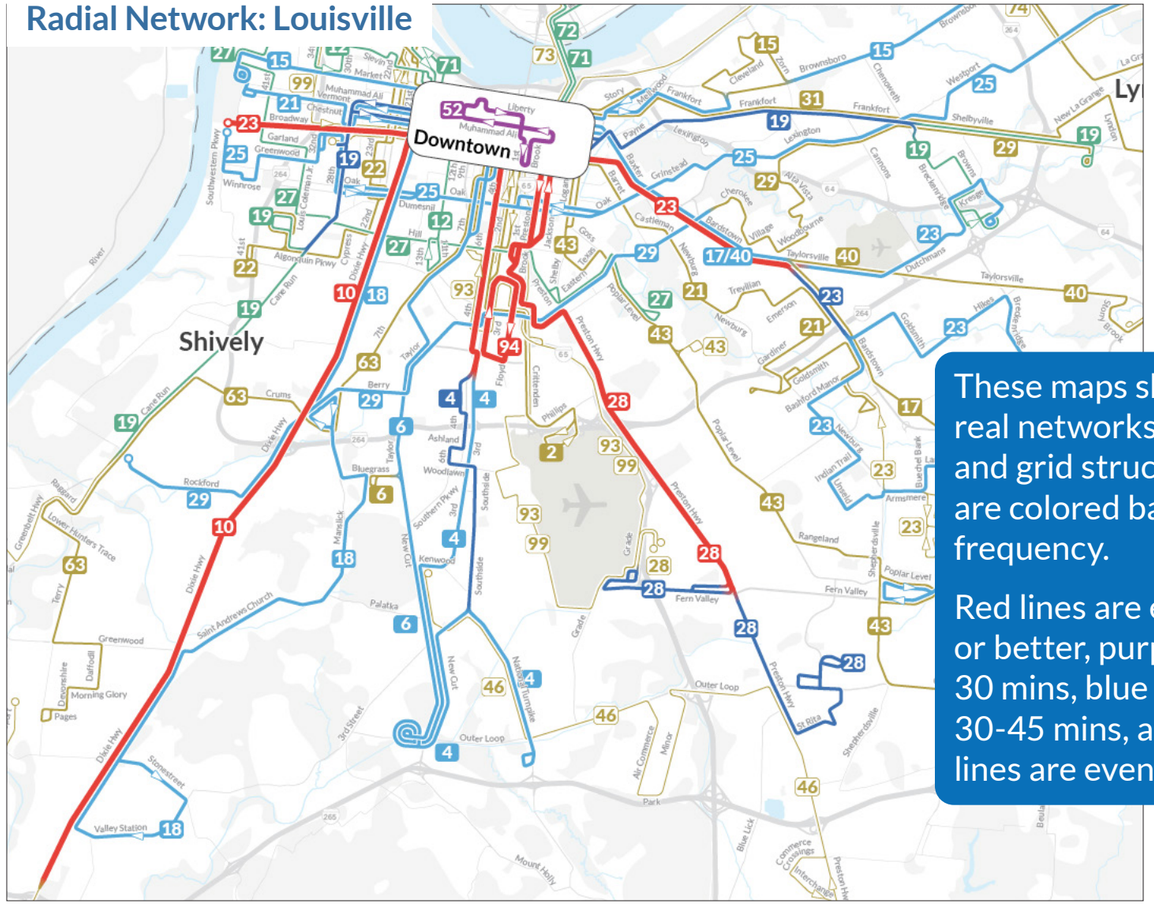
Routes intersect all across the city, not only in a downtown, and people transfer in those places.

Grid networks are only effective when the intersecting routes offer high frequencies so that connections between routes do not require long, discouraging waits. A grid structure is most suited to a city with multiple activity centers and corridors, where people are traveling among many different destinations.

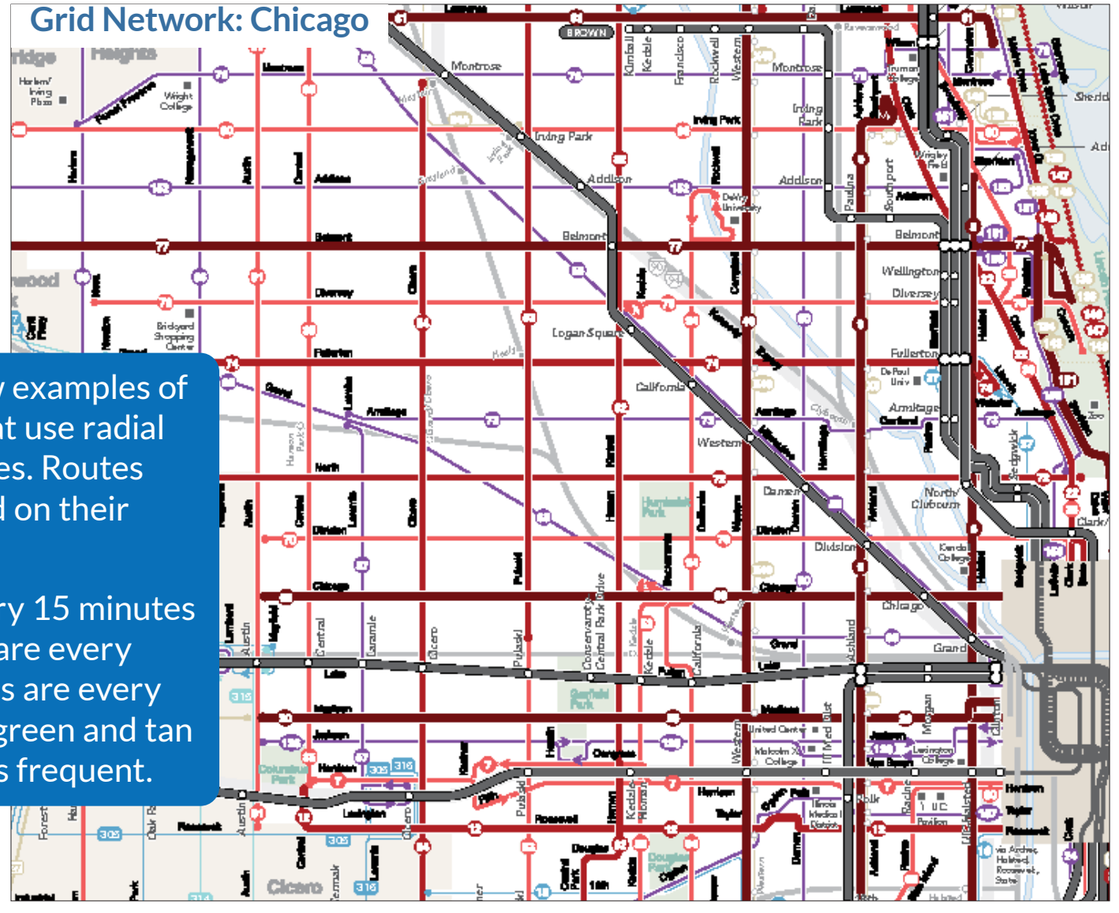
Figure 17: Radial and Grid transit networks.

Examples of Radial and Grid Networks

Radial Network: Louisville



Grid Network: Chicago



These maps show examples of real networks that use radial and grid structures. Routes are colored based on their frequency.

Red lines are every 15 minutes or better, purple are every 30 mins, blue lines are every 30-45 mins, and green and tan lines are even less frequent.

Figure 18: An example of the mostly radial TARC Network at a glance and the grid network in Chicago, Illinois.

Louisville has a high concentration of jobs, activities, and residents in and around Downtown, or located close to one of the many arterial roads that radiate outward from Downtown. Therefore, many TARC routes run radially along these arterials. However, some routes stay entirely out of Downtown, and instead go around it in an “orbital” manner.

Chicago is an example of a grid network. Above is a map of the CTA bus network in the western and northwestern parts of Chicago. Lots of residents are jobs are spread throughout this area, and most streets are arranged in a grid. A clear pattern emerges from the high-frequency North-South and East-West routes in the network. Anybody traveling in this area can transfer from one high-frequency route to another where they intersect, with a short wait, without needing to travel all the way into Downtown Chicago.

Access and Usefulness Also Depend on the Built Environment

Creating a high-access transit network isn't just about faster or more frequent service. Many factors outside the control of TARC —such as land use, development, urban design, and street networks—affect transit's usefulness. This is why **land use and infrastructure decisions made by cities and other agencies are an essential part of transit's success.**

The built environment factors shown in Figure 19 are critical to facilitating a broadly useful transit network:

- **Density.** Where there are many residents, jobs and activities in an area, there are many places people might want to go.
- **Walkability.** An area only becomes accessible by transit if most people can safely and comfortably walk to and from the nearest transit stops.
- **Linearity.** Direct paths between many destinations are faster and cheaper for TARC to operate, relative to the number of places served. Linear routes are also easier to understand and more appealing to most potential riders.
- **Proximity.** The longer the distance between two places that TARC wants to serve, the more expensive it is to connect them. Areas with continuous development are more cost-effective to serve than areas where there are large, undeveloped gaps between destinations.
- **Mix of Uses.** When there is a mix of land-uses along a direct path, transit can provide direct access to a broad range of destinations. Mixed-use transit corridors also tend to be very productive, because people ride in both directions at many times of the day.

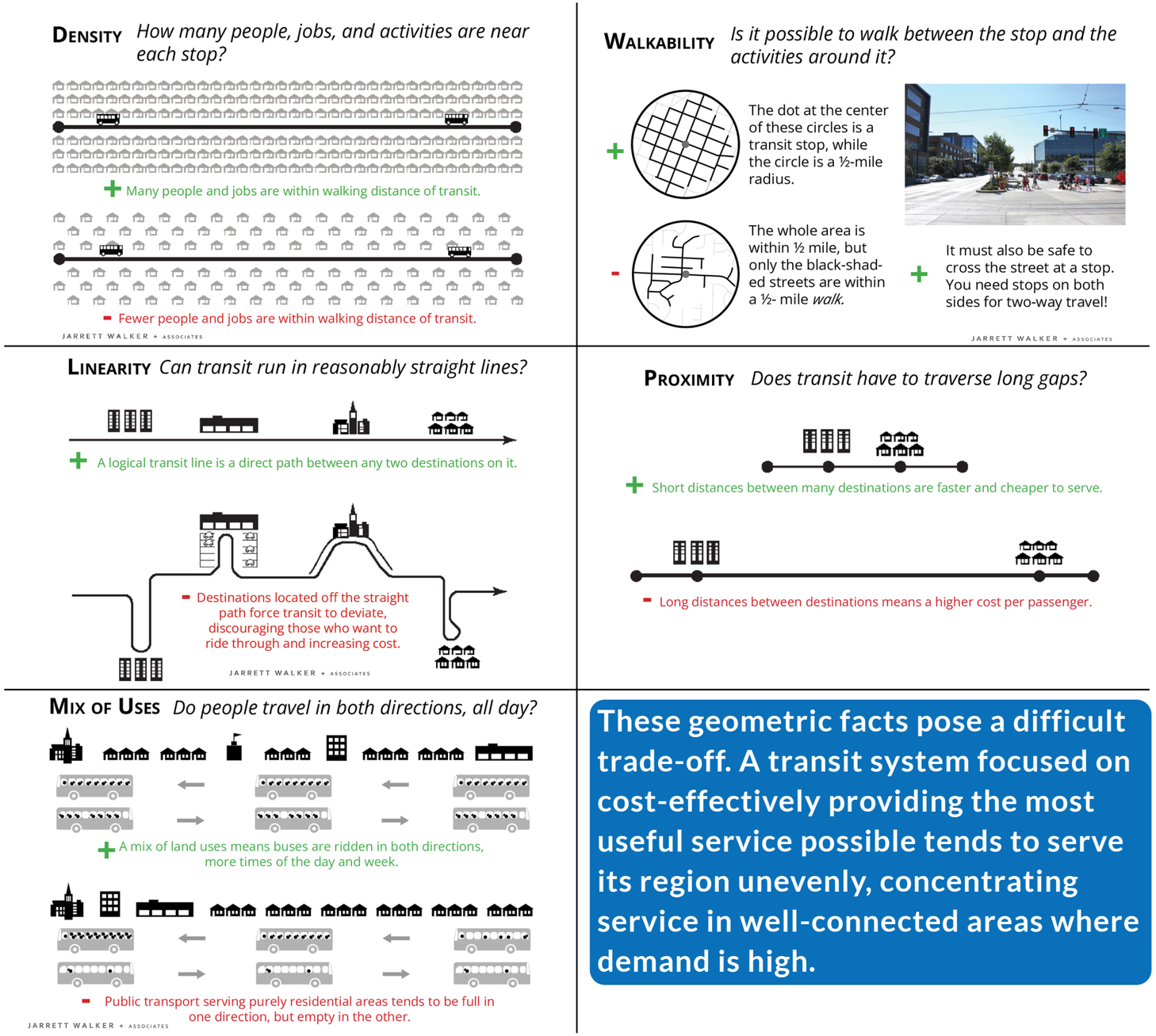


Figure 19: How land use and development patterns affect transit's usefulness.

These geometric facts pose a difficult trade-off. A transit system focused on cost-effectively providing the most useful service possible tends to serve its region unevenly, concentrating service in well-connected areas where demand is high.

3: Transit Market and Needs

The Market and Need for Transit

In this chapter, we present and discuss data that inform two distinct types of considerations in transit planning:

- Where are the **strongest markets** for transit with potential for high ridership and low operating costs per rider because of **demand**?
- Where are there **moderate or severe needs** for transit where coverage services may be important even if they do not attract high ridership relative to cost?

Examining Demand and Need

The maps and diagrams on the following pages help visualize potential transit markets and needs based on the following considerations:

- **Residential** density
- **Job** density
- **Activity** density (combined residential and job density)
- **Street connectivity**
- **Poverty** density
- **Areas of Persistent Poverty**
- **Zero-vehicle household** density
- **Senior** density
- **Youth** density

For each category, this chapter typically includes a map of Louisville and the surrounding areas, explaining the relevance of that category to transit planning, and key observations about the spatial variation in that category in Louisville.

Using These Measures

No one measure tells us that a place has high ridership potential or high needs. Rather, we must consider them in combination.

Designing for Ridership

If you asked a transit planner to draw you a very high-ridership bus route, that planner would mostly look at densities of all residents and jobs, the walkability of streets and neighborhoods, and the cost of running a bus route long enough to reach them.

The potential demand for a strong transit market is mostly defined by *where* people are, and *how many* of them are there, rather than by *who* they are.

Only secondarily would that planner look into the income, age, or other attributes of those residents or workers. The "who" attribute that has the strongest influence on transit ridership potential is income. A lower-income person is often more likely to choose transit than someone with a higher income. This is especially true in outlying areas, where driving and parking cars is easier, so transit tends to often be used by people who don't have the option to drive.

Designing for Coverage

If you asked a transit planner to draw you a route that helped as many people with severe needs as possible, they would look at where low-income people, seniors, and youth live, and where they need to go.

The densities at which these people live matters, because at higher densities a single bus stop can be useful to more people in need. However, the transit planner might also try getting the route closer to small numbers of people. In fact, the more distant and scattered people are, the more isolated they can be, and the more they might need access to transit.

Where there are *moderate or severe needs* for transit, coverage may be important even if it does not serve a large total number of people.

Civil Rights and Equity

Another important map in this chapter is not strictly related to demand or need but rather to civil rights. It shows where **People of Color** live.

Unequal treatment on the basis of race, ethnicity, or national origin is prohibited by the Civil Rights Act of 1964. Regulations by the Federal Transit Administration require that TARC consider the benefits and burdens that People of Color experience from transit service and consider this in the process of planning for transit projects.

While a person's race or ethnicity does not tell us directly if they need transit, or if they have a propensity to use transit, we know that there is a correlation between race/ethnicity and income and wealth.

The historic impacts of segregation and discrimination have had long-lasting effects on the patterns of housing, development, and investment across the region. The ramifications of these policies continues today. If you are a Person of Color in the United States you are more likely to have a lower income and less likely to own a car.

Therefore, knowing where People of Color live helps us see where there are intersections between patterns of historic segregation and concentrations of people in poverty today. Providing affordable transportation options for low-income communities and Communities of Color is an important strategy in addressing economic insecurity, and may be an important goal, more broadly, for addressing the racial and social equity goals of the Community.

It is also important to understand where large numbers of People of Color, people in poverty, and other historically marginalized populations live so that public outreach during this project can maximize opportunities for participation for those historically vulnerable communities that have not traditionally participated in the transportation planning process.

This requires being sensitive to language and cultural barriers to participation and offers an opportunity for historically vulnerable communities to share their perspective and voice in the contemplation of service changes and how those service changes have an impact on their community.

Indicators of Demand: Residential Density

Most people's daily travel begins or ends at home. Places with many households are also destinations for people not living there: be it for visiting friends, caring for family, or home-based work. So, understanding where many people live close together is key to assessing the strength of the market for transit. The map on the right shows the pattern of residential density in and around Louisville.

Key Observations

The Louisville area can be separated into four main "wedges" of residential density radiating out from Downtown: west/southwest, southeast, east/northeast, and the Indiana cities. Major barriers that separate these wedges include freeways like I-64 and I-65, rail lines, large industrial parks and airports, as well as large green areas and natural features including the Ohio River.

The biggest cluster of high residential density lies south of Downtown, in Old Louisville and near UofL. This area has many apartment buildings and small-lot single-family houses. It is surrounded by moderately dense neighborhoods, especially extending east in Germantown and along the Bardstown Road corridor. Parts of West Louisville, particularly areas closer to the Ohio River, also have moderate-to-high residential density. Much of this area bounded by Algonquin Parkway, Eastern Parkway, and I-64 has small-lot development and densely-connected street grids. In Indiana, the cores of Jeffersonville and New Albany have only a moderate density of residents.

Outside of this dense core, **moderate suburban residential density is dispersed within the I-265 belt.** While mostly taking the form of more closely single-family residences, these areas also feature some townhouses. There are also a few scattered pockets of high residential density across the region which correspond to apartment buildings surrounded by lower density single-family houses.

Often, **these pockets of suburban density are far from each other, and are not arranged along linear corridors.** Inside, they have street networks with lots of curved roads, loops, and cul-de-sacs. This means that people have to either walk a long distance to reach transit on a main arterial road, or buses have to deviate into each cul-de-sac to reach them, making transit less useful.

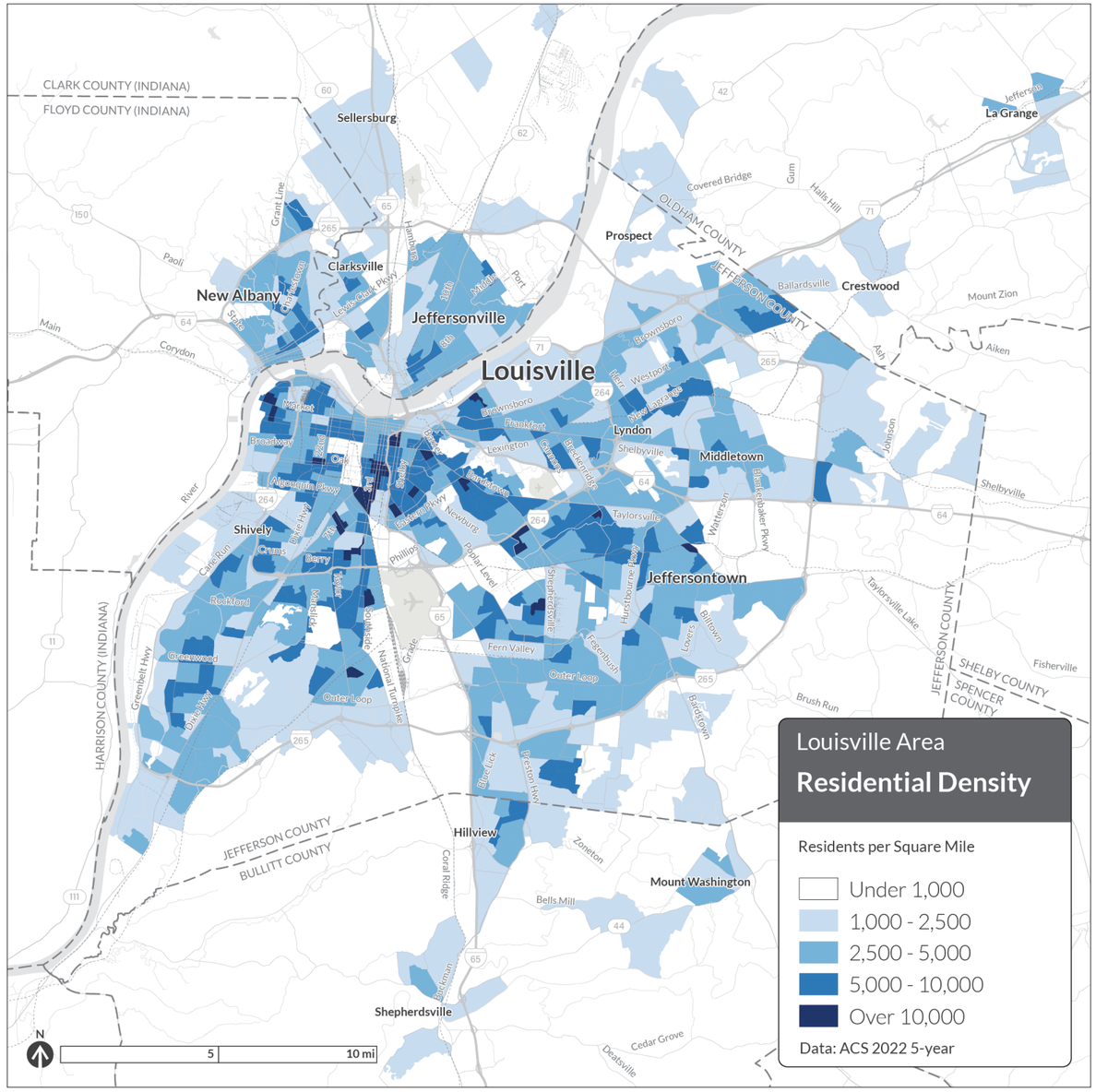


Figure 20: Residential density in the Louisville area.

How Development Patterns Affect Transit's Usefulness

Figure 21 shows an example of two areas with similar residential density at the same scale, but demonstrating very different development patterns.

On the top left, Old Louisville has a dense, well-connected grid of streets. There are some apartment buildings as well as a large number of densely-packed small-lot single family houses. Because of the street grid, the routes serving this area can be direct and linear. For example, Route 4 from UofL to Downtown does not have to make deviations, and can be very useful. The well-connected street grid makes it easy for someone to walk from one street to another in order to catch a bus.

On the top right are the several apartment and condominium complexes in Bashford Manor and Hayfield-Dundee. This area has a lot of residents, but the street network in this area is very disconnected. This makes it hard to efficiently serve this area by transit. Route 21 has to make a big deviation on its way towards and from Downtown to serve housing complexes along both Gardiner Lane to the North of I-264 and Goldsmith Lane to the South of I-264.

The patterns of street connectivity in Louisville and their impact on the usefulness of transit are further examined on page 22.

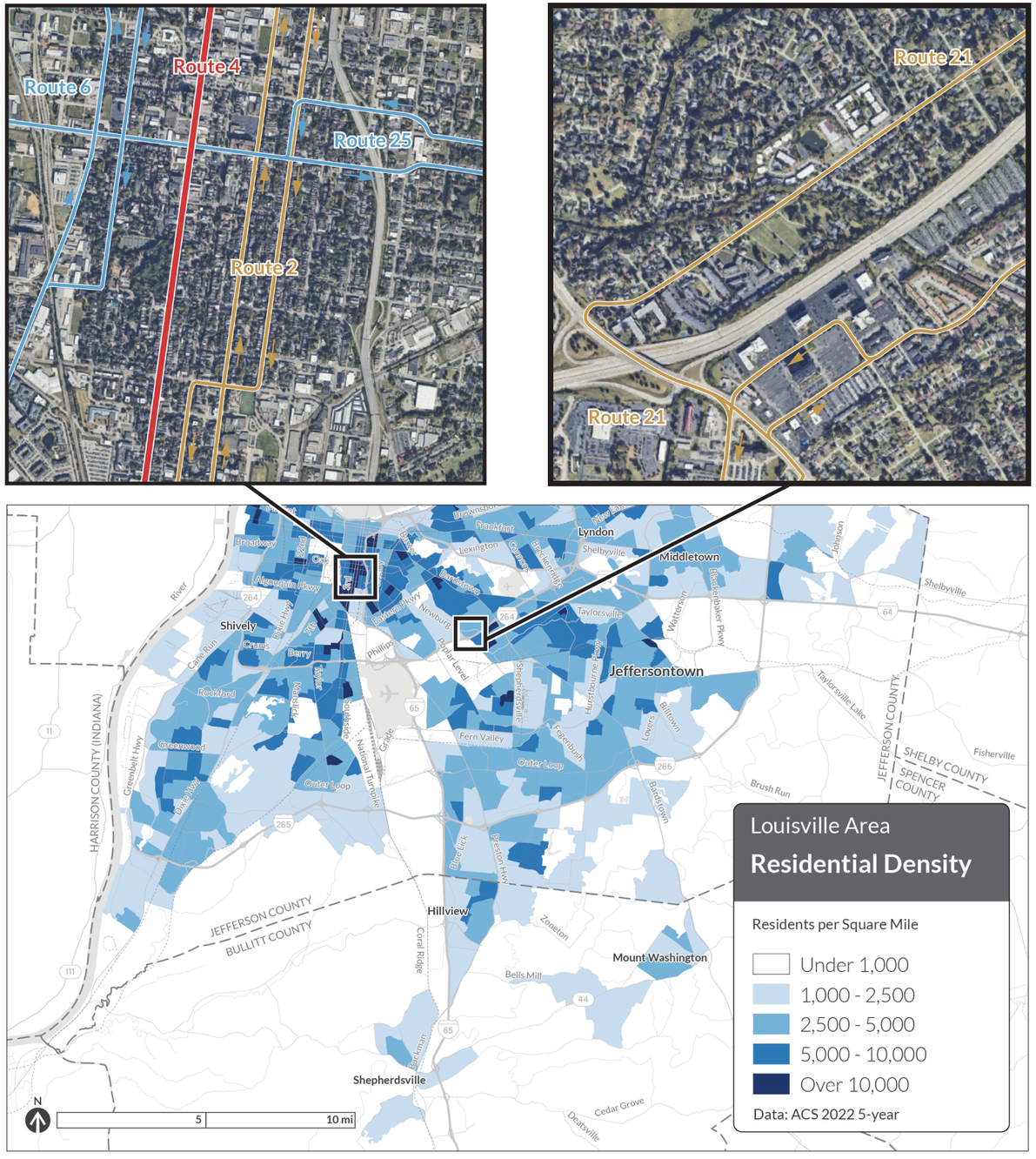


Figure 21: Old Louisville, with its well-connected street grid and small lots (top left) is much easier to serve efficiently by transit than the car-oriented development in Bashford Manor and Hayfield-Dundee (top right).

Indicators of Demand: Job Density

The map on the right shows the pattern of job density in the Louisville area. Job density can tell us not just about where people go for work, but also about important destinations people travel to. **One person's workplace may be a destination for dozens or even hundreds of people throughout the day.**

College, universities, and hospitals have many jobs, and also generate all-day travel demand as students, staff, patients, and visitors arrive and leave at different times throughout the day as classes start and end and medical appointments are scheduled. Retail and service jobs also attract many customers and visitors.

Office jobs can generate demand from workers at peak times, but many office jobs are located in office parks, which are hard to serve with transit in a useful way. Industrial and logistics jobs, in contrast, attract few visitors beyond employees who arrive and leave at specific times of the day based on shifts, or suppliers—who arrive in trucks.

Key Observations

Many jobs are **concentrated in and around Downtown Louisville.** There are a large number of office jobs, and also many service jobs in the many entertainment and tourism destinations. More importantly, Downtown also houses government offices that serve as major destinations, like the Social Security Administration office and multiple courts. Also very close to Downtown are two major destinations on opposite sides of I-65: Jefferson Community & Technical College to the West, and the large medical center to the East. Many jobs are also located further East of Downtown, along East Market Street (NuLu) and near the eastern end of Broadway. **University of Louisville (UofL) campus** is a major center of jobs and destinations. Outside of this dense core of jobs, there are moderate amounts of retail and service jobs concentrated along major radial arterial roads like Dixie Highway, Bardstown Road, and Frankfort Avenue/Shelbyville Road.

Industrial and Logistics Jobs

There are many **large industrial and logistics job centers,** particularly in the southeastern parts of Louisville, like Watterson Park, UPS Worldport, the Ford Assembly Plant, and GE Appliance Park.

There are also many areas with industrial jobs in southern and southwestern parts of Louisville: for example, East of the CSX rail tracks and Louisville International Airport, and in Riverport. The large number of jobs in these areas are spread out across a very large land area, so it is hard to serve every part of a particular employer's facility by transit. Industrial and logistics job centers are also often located in hard-to-walk places.

Suburban Job Centers

There are **significant pockets of job density scattered around the Louisville area, particularly in the eastern parts.** These often correspond to one of:

- Large suburban shopping centers like Mall St. Matthews and Springhurst Towne Center
- Suburban office and industrial parks like Bluegrass Commerce Park
- Hospitals and medical centers, like the several Norton Healthcare and UofL Health facilities

These places are designed to be accessed primarily by cars. The buildings are set far back from the street behind large parking lots and the streets within these areas are spaced far apart. This makes for very long walks to any transit service on the main roads. Many of these areas also have minimal sidewalks and relatively wide roads with few safe crossings. Together, these design features limit the potential transit ridership.

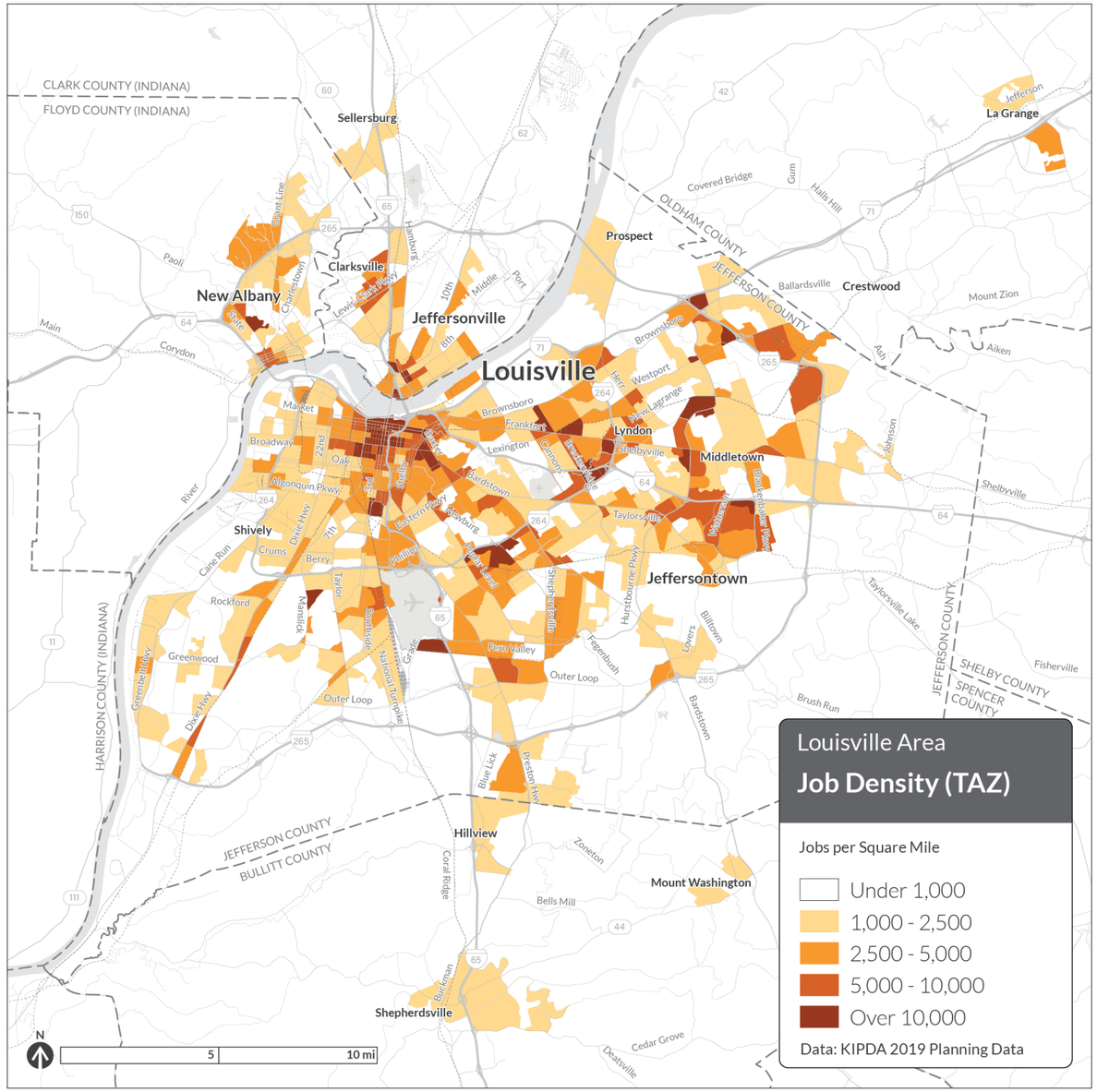


Figure 22: Job density in the Louisville area.

Indicators of Demand: Activity Density

Transit routes serving purely residential neighborhoods tend to be used mostly in only one direction each morning and evening rush hour. Where residential, commercial, and other uses are mixed, people are traveling in both directions so buses can be full in both directions. Corridors which straddle multiple purely residential and purely employment area also see some of the benefits of mixed land-uses.

Activity density maps, like the one to the right, depict not only high density, but also the mix of activities in an area. In this map, places with more residential density are shown in deeper shades of blue, while places with more jobs are shown in increasing shades of yellow. Places with higher density and mix of uses show up as deeper red, purple, and orange shades.

Key Observations

Downtown Louisville and nearby areas have the densest mix of residents and jobs, especially in the southern parts of Downtown towards Old Louisville and UofL as well as east along Broadway and Bardstown Road.

Clusters of moderate to high mix of population and job density appear throughout the more suburban eastern parts of Louisville. These correspond to places where large apartment developments are close to large destinations like shopping centers or medical centers. Bardstown Road and Frankfort Avenue/Shelbyville Road have many more pockets of moderate-to-high density mix of uses than other corridors like Dixie Highway and Preston Highway.

Activity density also offers a better understanding of regional development patterns outside of the dense inner core of Louisville. Although there are some redder and yellower places in the western and southwestern parts of Louisville, these areas are predominantly residential.

In contrast to this, there are many more red-to-yellow places in the eastern and southeastern parts. This means that people living in western and southwestern parts of Louisville do not have a lot of jobs nearby compared to people in the eastern and southeastern areas.

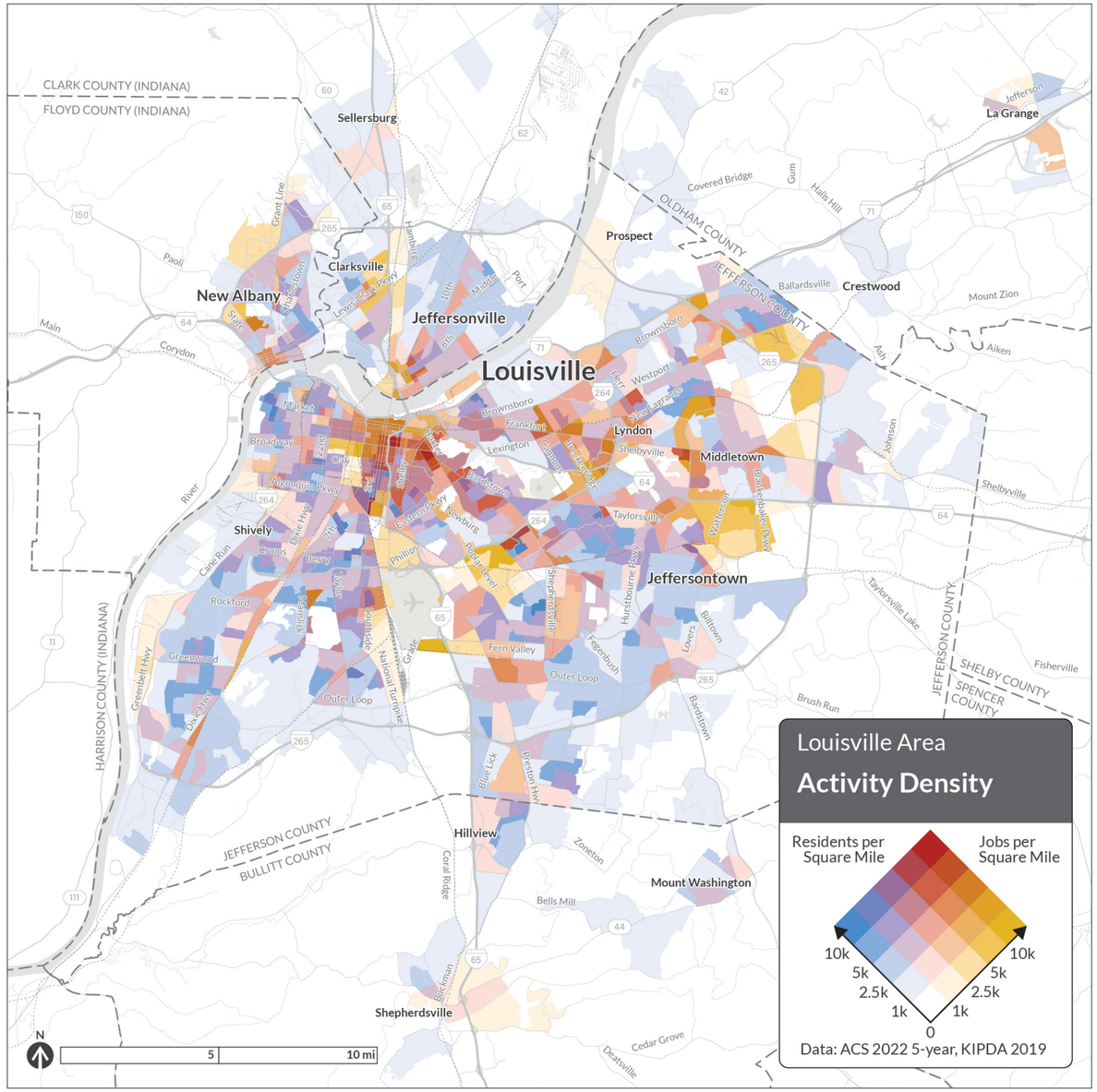


Figure 23: Activity density in the Louisville area. Residential density is shown in shades of blue, job density is shown in shades of yellow, and places where residents and jobs are both present are shown in shades of red. The darker the color, the greater the number of jobs or residents in the area.

Indicators of Demand: Street Connectivity

In almost all cases, transit trips begin or end by walking. Therefore, the ability to walk to and from transit is very important. The more destinations and residents there are near a stop, the stronger the likely transit market. However, the size of the market is also limited by the street pattern, since that determines how much of the area around a stop is truly within a short walking distance.

Actual walking distances to and from bus stops can far exceed the direct, or "crow's fly", distances. Figure 24 shows how the street network's connectivity can be measured by comparing the area that can actually be reached on the street network to the direct distance area.

Areas with highly connected street patterns provide short and direct paths between any two locations. Areas with poorly connected street patterns, along cul-de-sacs, or close to freeways or other barriers, force long and circuitous paths between locations and discourage walking.

This measure does not take into account the presence of sidewalks and crosswalks, or the safety of intersections, all of which majorly affect people's ability and willingness to walk to transit.

Key Observations

Downtown Louisville and the neighborhoods around it have the highest street connectivity in the region. This is the older core of the City with a densely-spaced street grid. Beyond Downtown, high street connectivity extends significantly into most of West Louisville and somewhat east along the Bardstown corridor and south along 3rd Street and Taylor Boulevard. Pockets of high connectivity exist in St. Matthews where Frankfort Avenue/ Shelbyville Road meet Breckenridge Lane, as well as in the cores of Jeffersonville and New Albany.

Neighborhoods built before the 1950s tend to be more walkable, made of dense street grids with many intersections and consistent sidewalk networks that make it easier to walk to bus stops and neighborhood amenities. Many parts outside this core area also have moderately high street connectivity, but are segmented by parkways, freeways, and railway tracks. These obstructions can often be seen surrounded by lighter areas in the map.

Some moderate connectivity is concentrated along major arterial streets in the region, but is surrounded by areas with poor street connectivity. Street connectivity is much lower in suburban-style developments with disconnected street patterns and fragmented sidewalk networks. Many of these developments are designed to minimize car traffic past the most valuable real estate. This is done in part with intentionally poor street connectivity. Due to the cul-de-sacs and lack of connections to the main roads, walking routes to the nearest bus stop are long and circuitous.

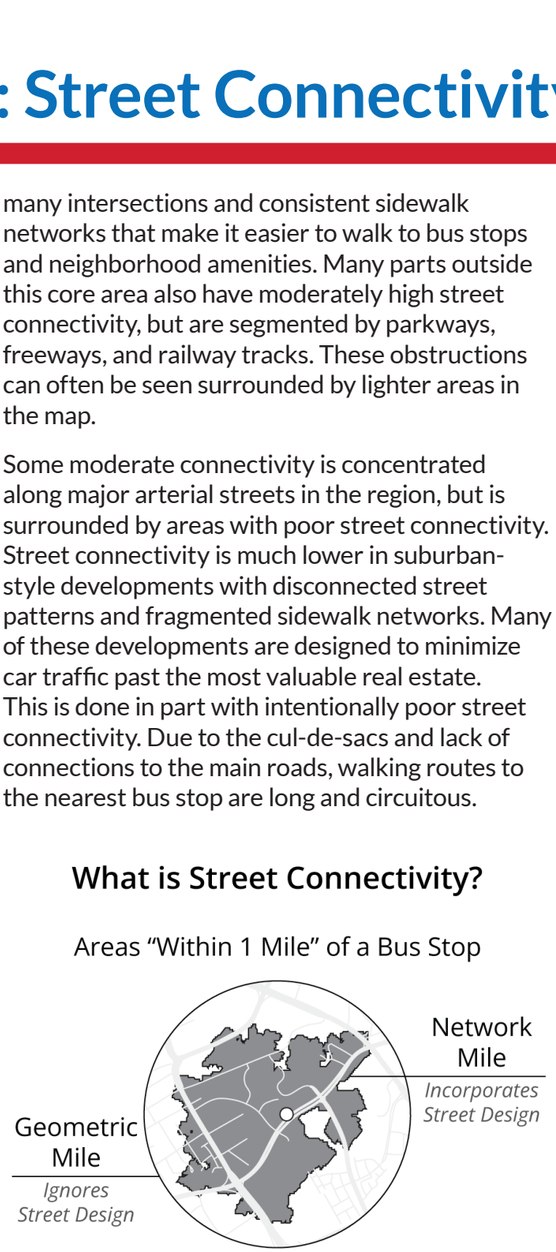


Figure 24: Calculation of street connectivity.

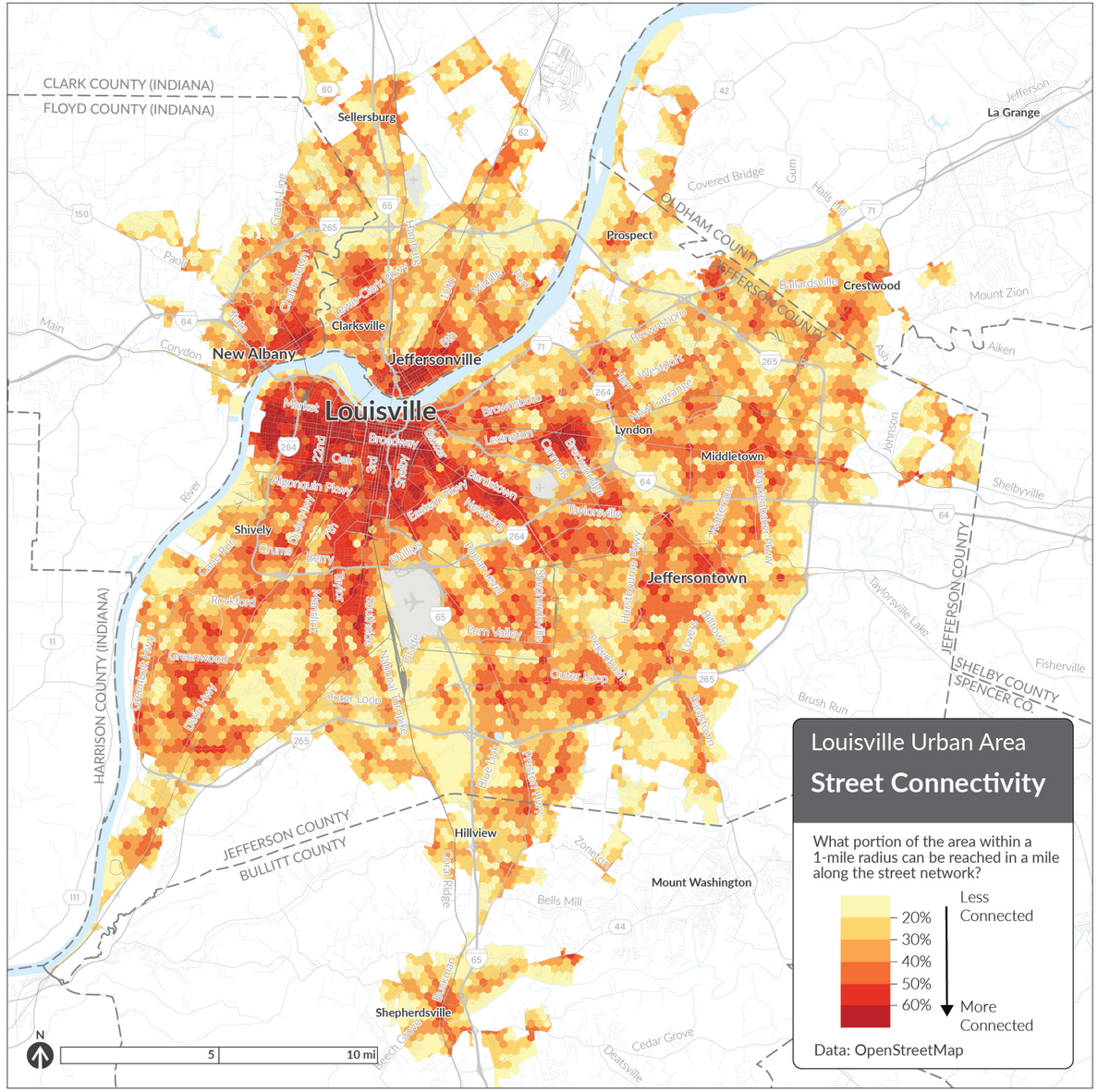


Figure 25: Street connectivity in the Louisville area. The darker the color, the more street and pedestrian path connections are available, and the shorter and more direct walks can be between two points.

Indicators of Demand and Need: Zero-Vehicle Households

Another factor affecting transit's competitiveness and need in an area is the availability of personal cars. Generally, people without vehicles have fewer options than those who do have access to personal cars. However, **people without cars do not necessarily default to using transit.** If transit is useful—reasonably fast, reliable, available when needed—for people to use it to reach the places they need to go, it can be a compelling option.

If transit does not present a realistic travel option, then people without cars will find other ways to reach the places they need to go by getting rides from friends or family members, cycling, using electric scooters, walking, or using taxis or taxi services like Uber or Lyft. Alternatively, some people may not travel, thereby limiting their access to the economic, social, and other opportunities.

Key Observations

The map on the right shows the density of households without cars. The largest concentration of zero-vehicle households is around Downtown Louisville, Phoenix Hill and Old Louisville. There is a moderate-to-high density of zero-vehicle households throughout West Louisville. These patterns shows significant overlap with the low-income density map on page 24.

Outside the historic core of Louisville, there are a few pockets of zero-vehicle households in the eastern suburbs. These generally correspond to clusters of apartment buildings close to retail areas as well as senior living communities. Notably, there are pockets of low-income residents in southeastern Louisville near the area's industrial parks that don't clearly correspond to higher densities of zero-vehicle households. This is not only because the overall density of people in these areas is also lower, but also because the development pattern and lack of useful transit service make it difficult to live without a car.

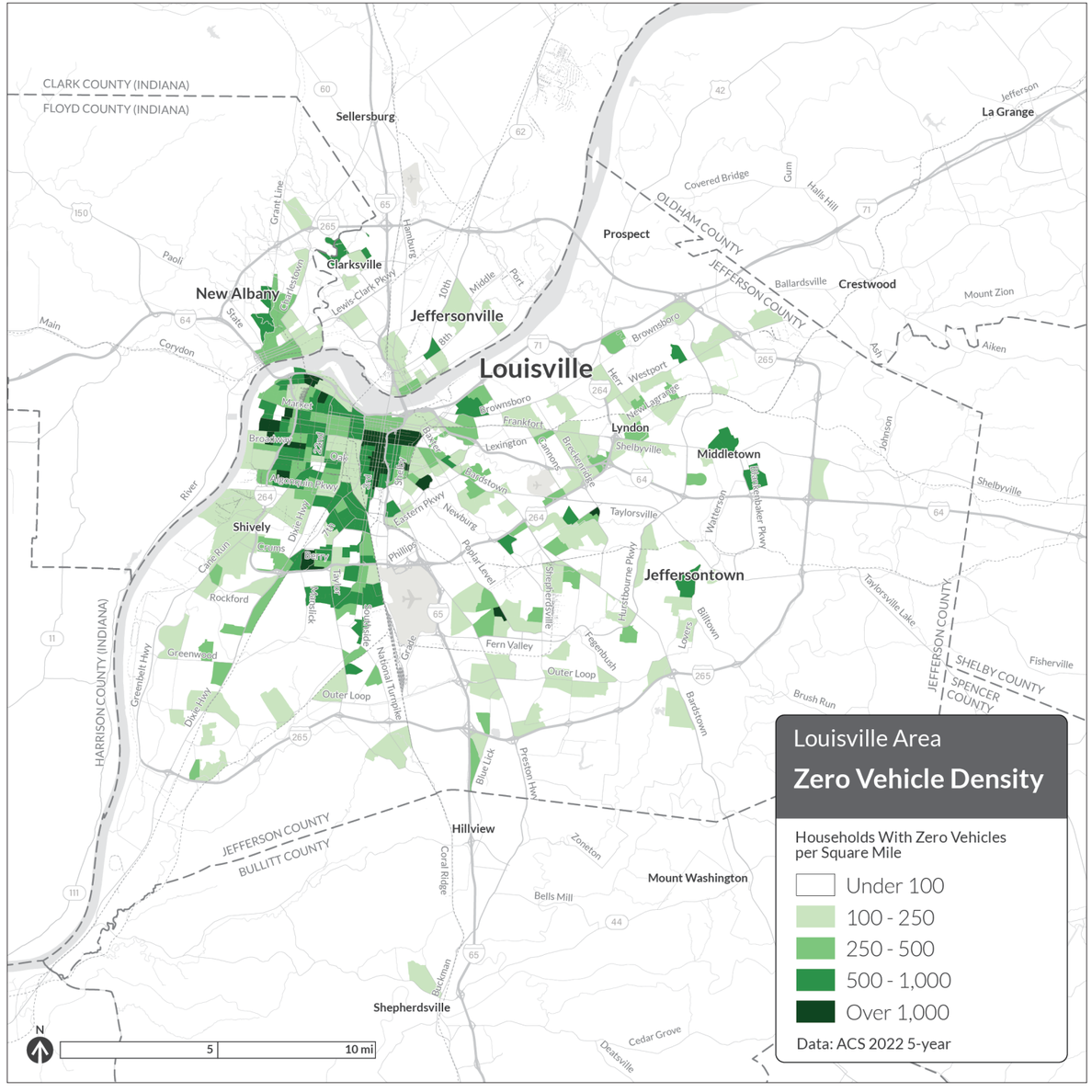


Figure 26: Density of Zero-Vehicle Households in the Louisville area.

Indicators of Demand and Need: Low-Income Residents

A frequently-cited goal for transit service is to provide affordable transportation for lower-income people, who are less likely to own cars. Understanding where low-income populations are located is also a key civil rights requirement.

In some built environments, serving people with low incomes can meet a ridership goal. Transit can be an attractive option due to its low price. In medium to high density areas with walkable street networks, this can produce high ridership.

For a long time the transit industry has described lower income people as "dependent" riders and higher income people as "choice" riders. However, **an area with low-income residents doesn't necessarily generate high transit ridership just because of the residents' incomes.** If transit doesn't actually allow people to make the trips they need in a reasonable amount of time, even people with low incomes will not use it. Most people will seek other options, such as buying a used car or getting a ride from a friend, even if it causes financial or social stress.

Key Observations

The map on the right shows the density of residents whose income is below 150% of the Federal Poverty Line level. Overall, **West Louisville and southern Louisville have a higher density of low-income residents** than the eastern parts of Louisville.

Many of the areas with relatively higher density of low-income residents in the inner core of Louisville are easy to serve by transit because of the good street connectivity. In these places, transit can attract ridership by being useful to lots of people while also providing an affordable option to cars.

Outside of this core, there are many pockets of low-income residents spread across the southwestern parts and outer southeastern parts of Louisville. These pockets often correspond to specific apartment complexes surrounded by single-family housing.

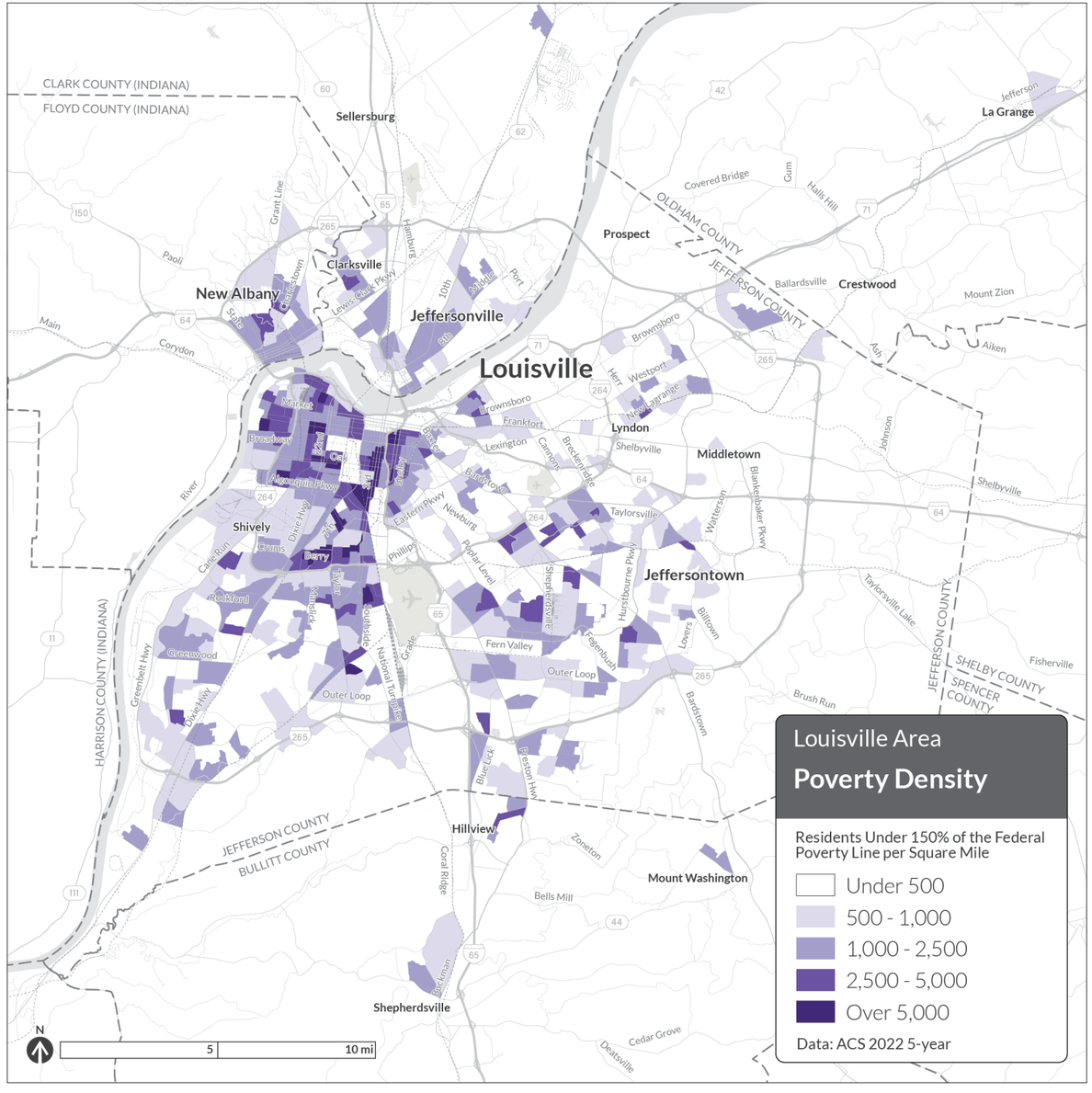


Figure 27: Density of Residents in Poverty in the Louisville area. Poverty is defined as 150% of the Federal poverty level.

Indicators of Need: Areas of Persistent Poverty

We can also look at areas where a large portion of residents have low incomes to understand the distribution of poverty in Louisville.

The 2021 Infrastructure Investment and Jobs Act (also commonly known as the Bipartisan Infrastructure Law) defines Areas of Persistent Poverty (AoPP) at census tract levels as **areas which have had "a poverty rate of 20% as measured in the American Community Survey (ACS) 2014-2018 5-year data series".** This specific definition is relevant because it is used for federal government grants and studies that aim to improve infrastructure, mobility, and access to opportunity for low-income residents.

The map on the right highlights AoPP census tracts in red, overlaid on top of the low-income resident density map from the previous page. The red area is highlighting poverty **rate,** and not poverty **density.** Therefore, this map highlights a transit need, especially when density and land use patterns in an area are not supportive of high transit ridership[1].

Key Observations

Overall, AoPP census tracts are widespread on the western side of Louisville. Downtown and the inner urban core of the City almost completely fall in AoPP tracts. Most areas of the southwestern part of Louisville are also in AoPP tracts. There are some pockets of relatively higher poverty density that are not in AoPP tracts (these often correspond to specific clusters of apartment communities). There are also many areas with a relatively low density of low-income residents that are within Areas of Persistent Poverty.

Another large stretch of AoPP census tracts is in southeastern Louisville: around Watterson Park, Beuchel, Newburg, and near Jefferson Mall. These areas have several block groups with moderate-to-high density of low-income residents.

Within Indiana, large parts of Clarksville, southern Jeffersonville, and southern New Albany are classified as AoPP zones. Within these areas New Albany has the highest density of people in poverty. Of note, the highest density pocket of poverty in Clarksville, the area north of Green Tree Mall, is not within an AoPP, likely because the areas has developed more recently and therefore does not have the history of persistent poverty that other parts of the region have experienced.

Many parts of eastern Louisville are not in AoPP census tracts, but still have scattered pockets of low-income residents.

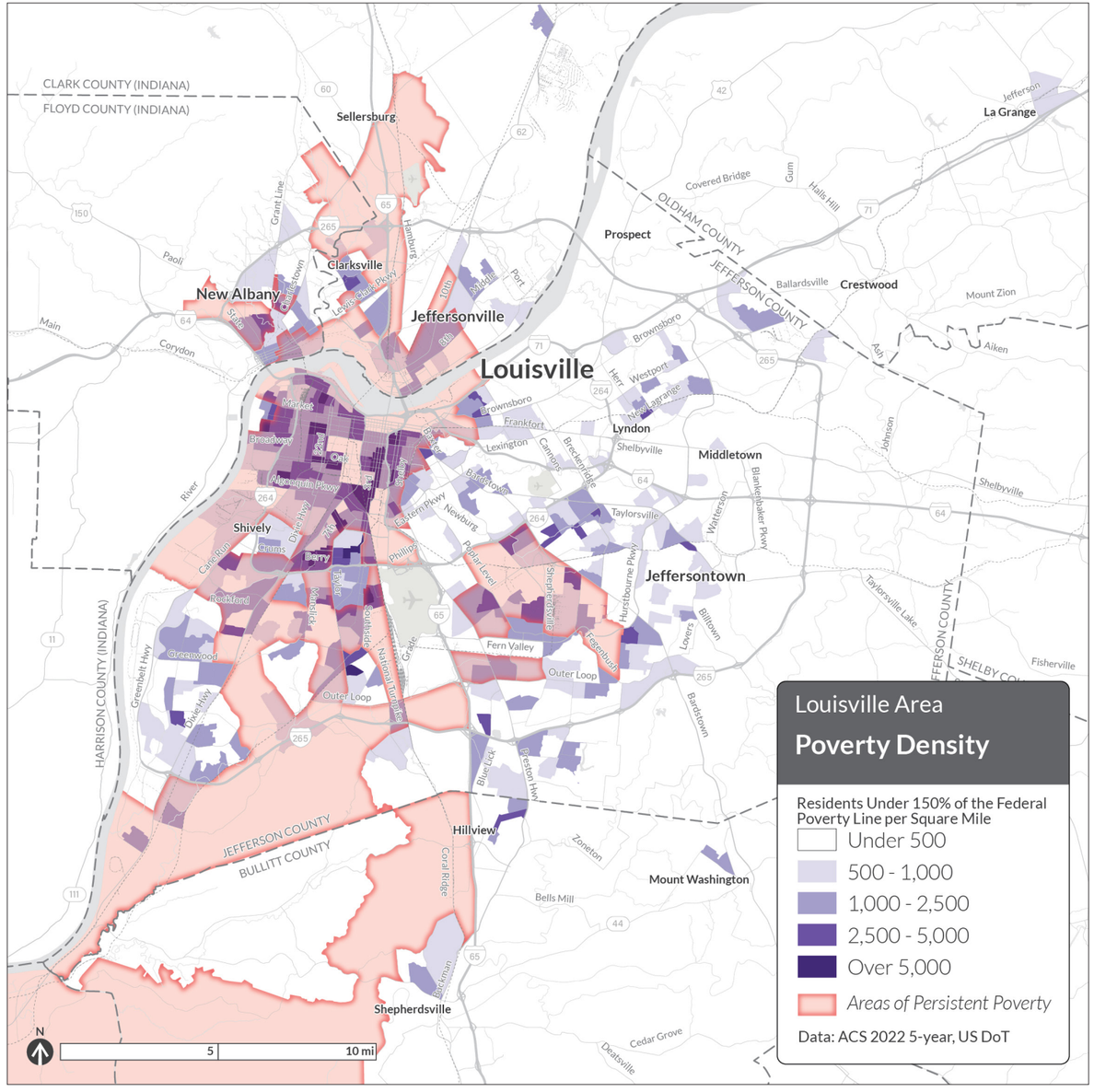


Figure 28: Areas of Persistent Poverty census tracts. These areas are shown in red, overlaid on the density of residents in poverty in the Louisville area.

1 There is also a big difference in the level of geographical data. Areas of Persistent Poverty are defined at a census tract level, while the poverty density data is available at a census block group level. A census tract can include many block groups.
A large concentration of low-income residents in a few block groups may lead to the overall poverty rate in that block group being higher. Or large numbers of higher-income block groups may lead to a tract having a low poverty rate, even if it has pockets of high poverty density.

Indicators of Need: Senior Residents

Some seniors cannot drive and may be more likely to use transit. As a group, senior-headed households are also less likely to own cars than the general population.

Seniors tend to have different preferences for transit than younger people. Seniors are more likely to be sensitive to walking distance. On average, seniors also tend to be less sensitive to long waits and slow or indirect routes, because many are retired and have relatively flexible schedules. In contrast, most riders who are employed, in school, or caring for kids in school will find service with long waits and slow or indirect routes to be not as useful.

Due to these factors, transit service designed primarily to meet the needs of seniors rarely attracts high overall ridership relative to cost. Thus, the amount of focus that transit agencies place on meeting the needs of seniors should be carefully balanced with the needs and desires of the entire community.

Key Observations

The map on the right shows the distribution of density of residents aged 65 or higher in the Louisville area. The distribution of seniors is relatively even across the region as most areas show a uniform light pink color. Much of the variation in density of seniors is closely linked to the overall density of residents in the area. Senior density is not organized into major clusters or corridors which might significantly point to a particular need for transit service.

Some pockets of senior density correspond closely to pockets of zero-vehicle households, particularly where there are specific senior living communities in the eastern parts of Louisville.

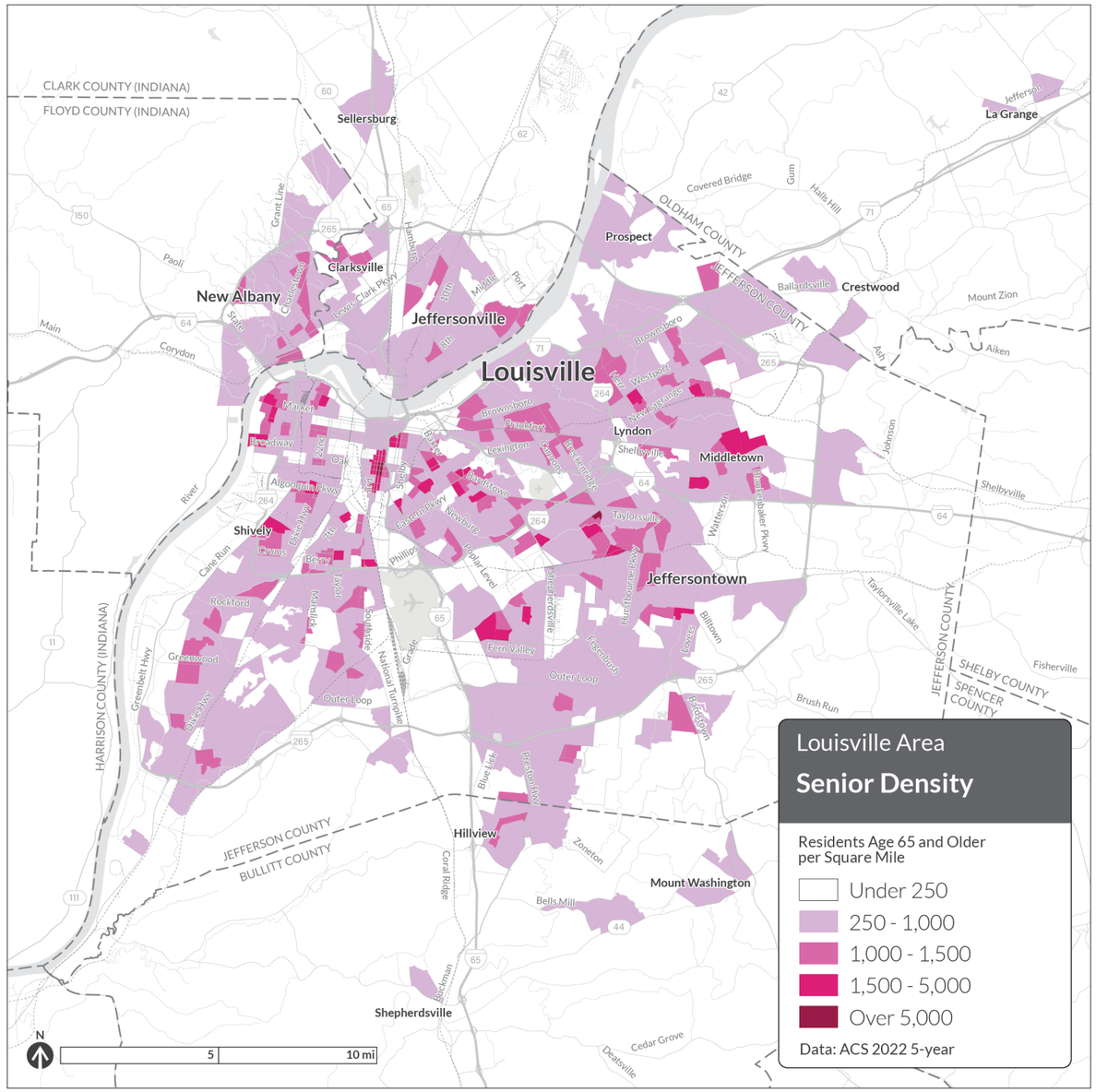


Figure 29: Density of Senior Residents at or over age 65 in the Louisville area.

Indicators of Need: Young Residents

Just as transit coverage can meet the needs of seniors who cannot or choose not to drive, transit coverage can also meet the needs of children and teenagers who are too young to drive. Whatever effect an increase in price has on ridership among working age people, it will have an even stronger effect on ridership among young and old people. This is why most transit agencies, along with movie theaters and other for-profit businesses, offer a discounted price for seniors and children.

However, **young people and seniors are very different in their ability and willingness to walk to transit service**. Most young people can and will walk farther to reach transit service than seniors.

Key Observations

The map on the right shows the distribution of density of residents aged 17 or under in the Louisville area.

Youth density generally tracks with the density of residents across the city, with the denser pockets of residents in multi-family apartment complexes and affordable housing communities also showing high youth density. The only exception is the areas near Downtown and UofL, which have very few youth compared to the population density.

Because we use the same color scale to map senior and youth density, we can see that the density of young residents across Louisville is generally higher than that of seniors.

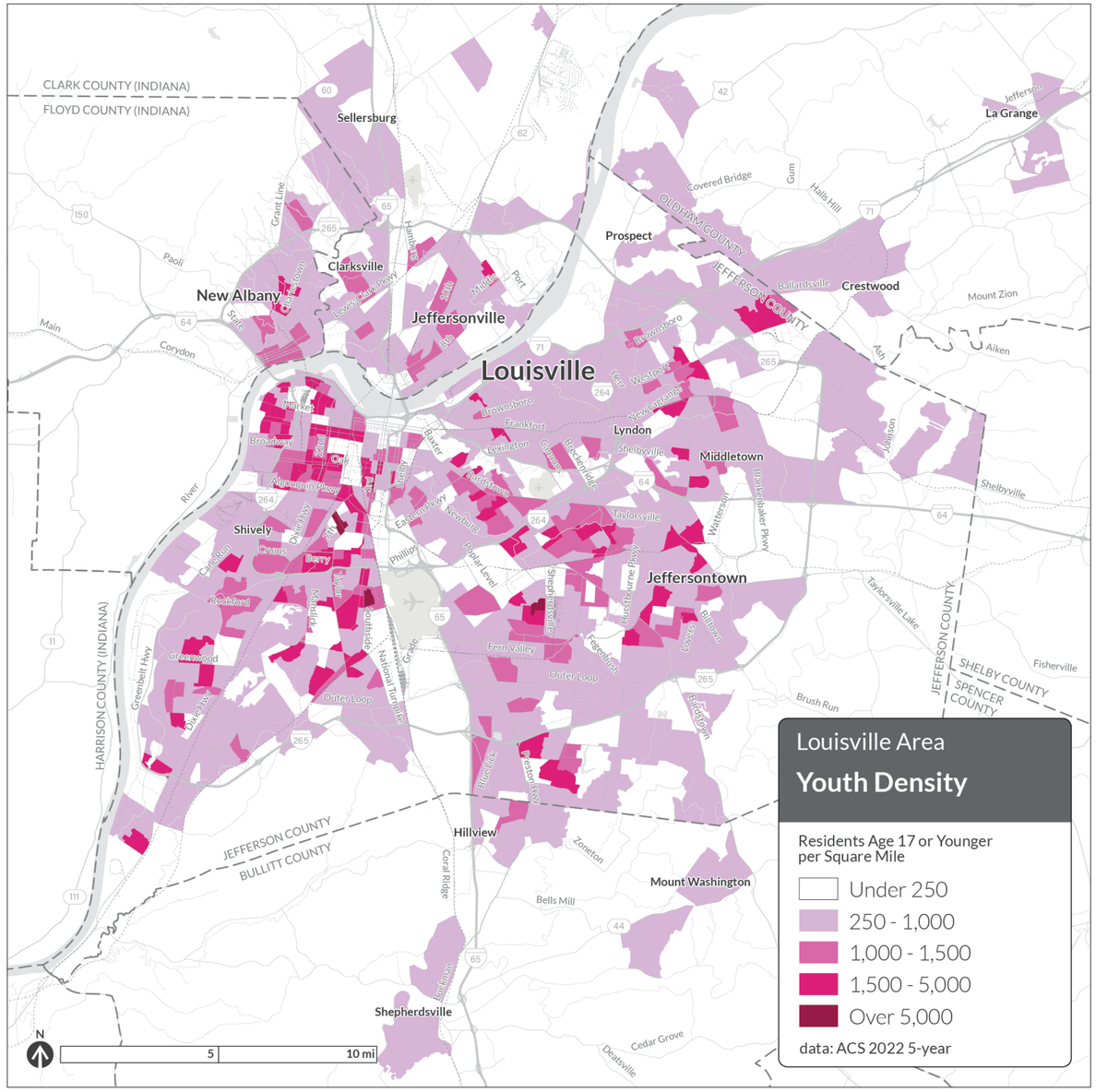


Figure 30: Density of Young Residents at or under age 17 in the Louisville area.

Civil Rights: Race and Ethnicity

Understanding where People of Color live is critical to fulfilling the obligations of Title VI and other federal requirements to consider the benefits and burdens of transit service for historically-marginalized populations.

Louisville, like almost every U.S. city, has a history of discriminatory practices that have led to significant racial segregation to the present day. This means that when TARC makes decisions about where to provide service, down which streets and in which neighborhoods, those choices have a racial dimension.

Equity-based transit goals are often articulated in terms of improving mobility or transit access for people of color, particularly in places where the existing development patterns and transportation networks contribute to disparities in access to jobs and other opportunities. **Intentional planning to address historic inequalities can be an important coverage goal** beyond just meeting federal requirements.

Where People of Color live **in relatively dense, linear, and proximate areas, transit can achieve high ridership relative to cost while also fulfilling coverage goals.** On the other hand, where People of Color live in neighborhoods that are not dense, and not linear, and not proximate, the challenge for transit is weighing the need to serve that neighborhood over others that might achieve higher ridership relative to cost.

Key Observations

The map on the right shows the distribution of people by race and ethnicity in the Louisville area. Each dot corresponds to 25 residents who identify with that particular group. Like many U.S. cities, Louisville is diverse overall, but has neighborhoods that are in effect segregated.

Residents in most areas of West Louisville, south to Shively predominantly identify as Black or African American. Downtown and southern parts of Louisville between I-264 and I-265 have many areas with a mix of people of diverse backgrounds. Residents in other areas, particularly in the eastern part of Louisville, predominantly identify as White or Caucasian, with some Residents of Color spread throughout.

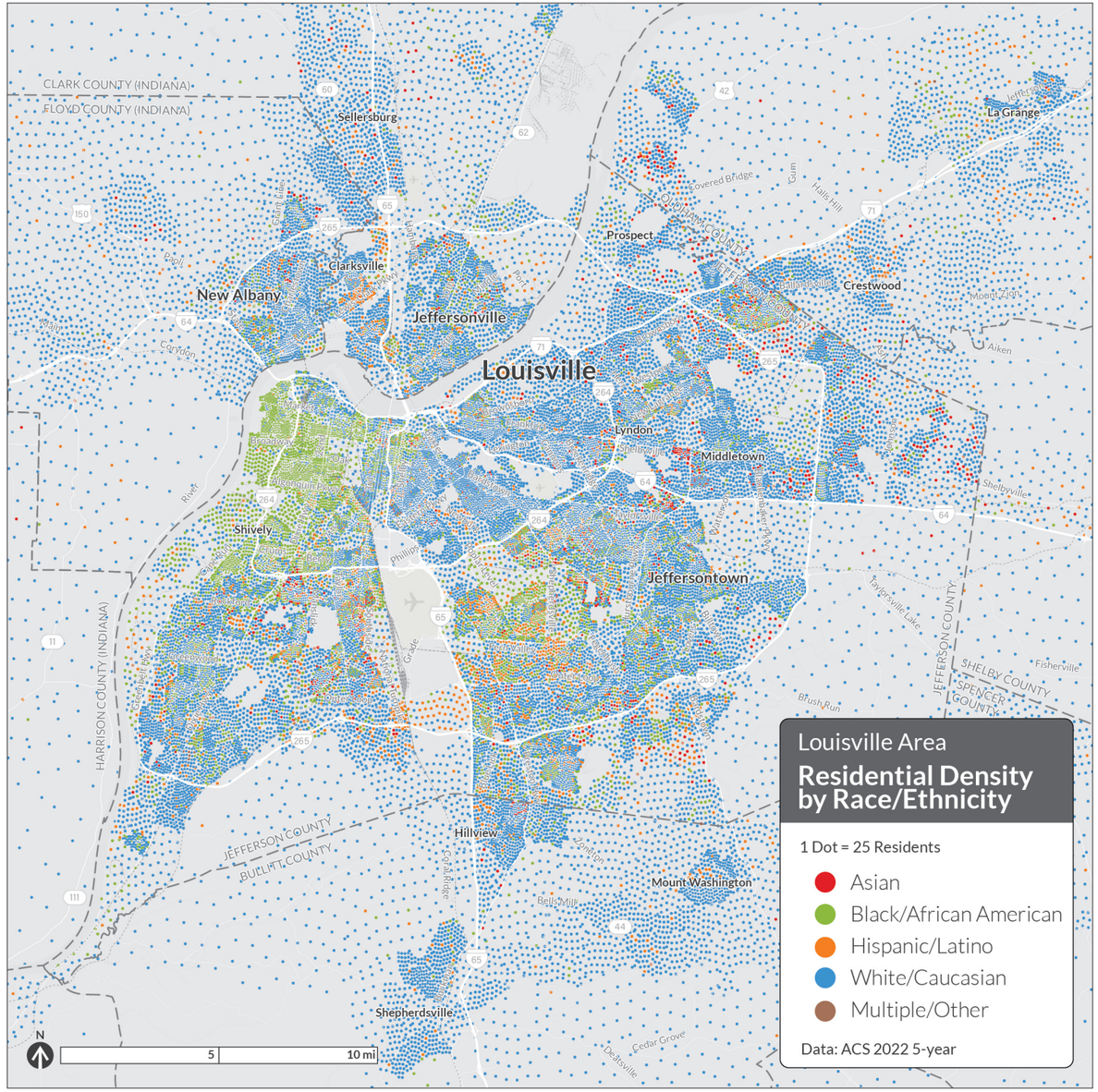


Figure 31: Race and ethnicity of Louisville Area residents. Where many dots are very close together, the overall density of residents is higher. Where dots of a single color predominate, people of a particular race or ethnicity make up most of that area's residents.

Persistent Impacts of Historic Patterns of Segregation

The map on the right shows neighborhoods in Louisville in 1936, color-coded based on assessments of their relative "security" for lending mortgages and home loans, produced by the Home Owners' Loan Corporation (HOLC). In general, neighborhoods with higher populations of People of Color (shown in yellow or red in this map) were rated at lower levels, meaning that it was harder to get loans to buy or renovate property in those neighborhoods. This was called **"redlining".**

Comparing this map to the map on the previous page shows that there is substantial overlap with the areas marked in red and yellow on this map and the areas where People of Color live today. This redlining map is **just one example of a myriad of laws and regulations that encouraged and maintained segregation then, and still impact current patterns** of where people live in and the disparate levels of access to opportunity available to different people.

The implications of historical patterns of segregation on access to opportunity for People of Color are quite stark to the present day. The yellow and red areas on this map mostly correspond to where People of Color live today as well as to where poverty is concentrated. While many jobs are concentrated near these areas in Downtown Louisville and UofL, the many suburban jobs on the east side of Louisville remain difficult to access from these areas.

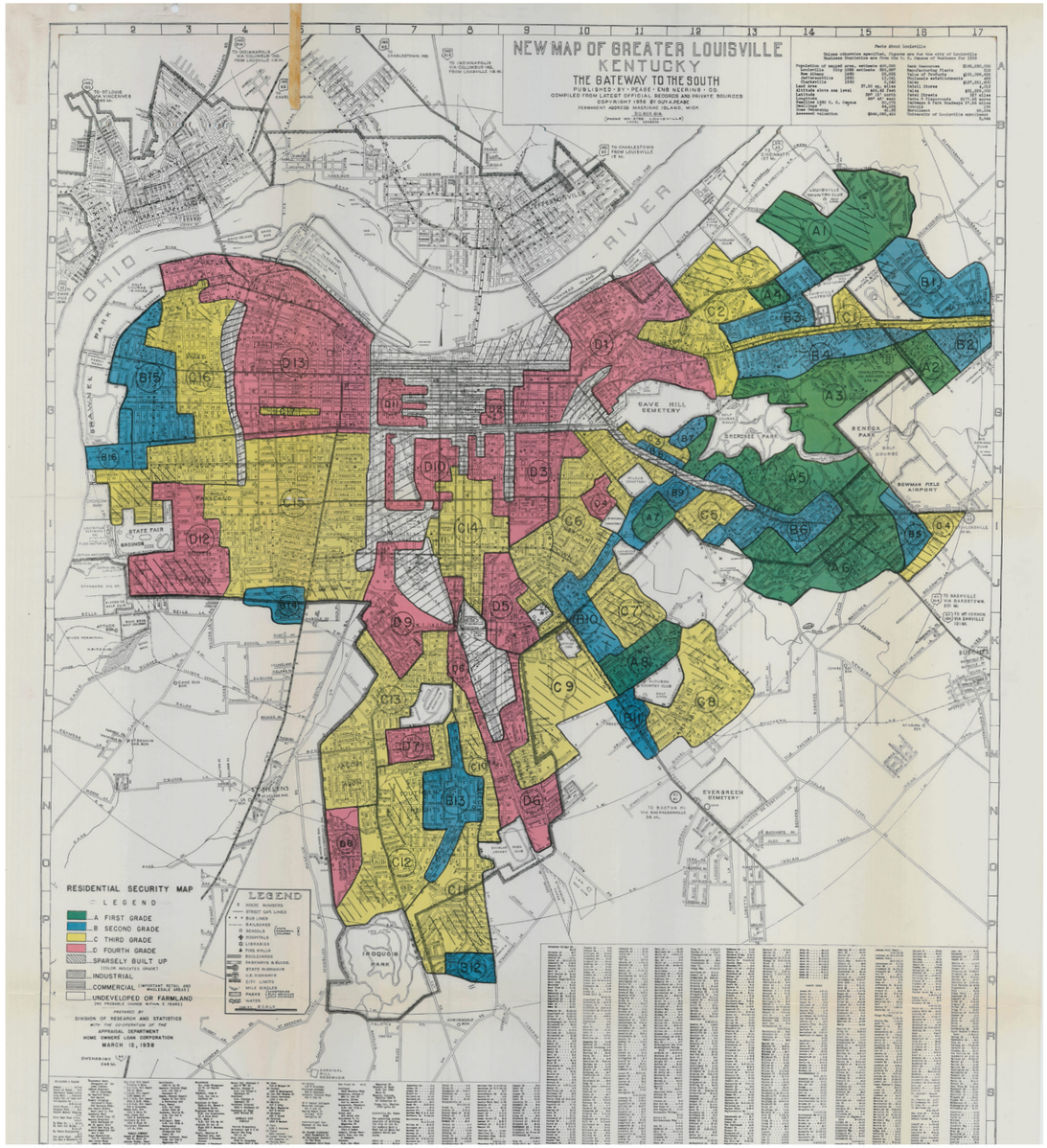


Figure 32: Historic map of "Residential Security" by HOLC that defined the relative "security" of investing in each neighborhood. The neighborhoods with higher rates of People of Color tended to get much lower ratings, which had severe subsequent economic repercussions. Source: University of Richmond Digital Scholarship Lab.

4

4: The Existing TARC Network

The TARC Network

This chapter describes the existing TARC network, its structure, context, limitations, and the available information about its recent performance.

Why Think About Frequency?

On every map of transit routes in this report, the **color on the map shows the frequency of buses** in that segment at midday on weekdays. Frequency can also be referred to as **headway,** or the time gap between each departure.

In conversations about transit, there is always a great focus on **where** transit service is provided in a region. But sometimes not enough attention is paid to when transit service is provided. The **when** of transit service is:

- **Frequency** or headway: How many minutes are between each bus on a route? How long do you need to wait for the next bus?
- **Span** or duration: How many hours of the day does a route run? Does it run on weekends? Is it available early in the morning and late in the night?

Low frequencies and short spans are one of the main reasons people do not find transit useful for their travel. Particularly, **high frequency makes transit useful** in many ways:

- It **reduces waiting** time, and thus the overall travel time.
- It **improves reliability** for passengers. If something happens to your bus, another one is always coming soon.
- It makes the service **more legible.** You don't need to remember a timetable if you know your bus will be there in a short time.
- It makes **transfers** from other routes **fast and reliable,** and makes the network more useful overall.

Map of the Transit Network

The map on the right shows the TARC network in Louisville Metro and surrounding areas, with route patterns and service levels during Spring 2024:

- **Red** means buses every 15 minutes or better.
- **Purple** means buses around every 20 minutes.
- **Deep blue** means buses around every 30 minutes.
- **Light blue** means buses more than every 30 minutes, up to every 45 minutes.
- **Green** means buses more than every 45 minutes, up to every 60 minutes.
- **Thicker tan** lines have more than 60 minutes between buses.
- Thinner tan segments have very limited bus trips, or do not operate during the middle of the day.

A more detailed map of the network focused on areas in the urban core of Louisville is on the next page.

Where is Useful Transit Service Today?

Routes 4, 10, 23, 28 provide 15-minute frequency for some portion of their length along major corridors radiating out of Downtown: 4th Street, Dixie Highway, Broadway–Bardstown Road, and Preston Street/Jackson Street–Preston Highway, respectively.

Route 94 is the University of Louisville Cardinal Shuttle that operates every 7-8 minutes, but only on Weekdays during the academic year.

Route 52 is the Downtown Medical Center Circulator that operates every 20 minutes. Most of

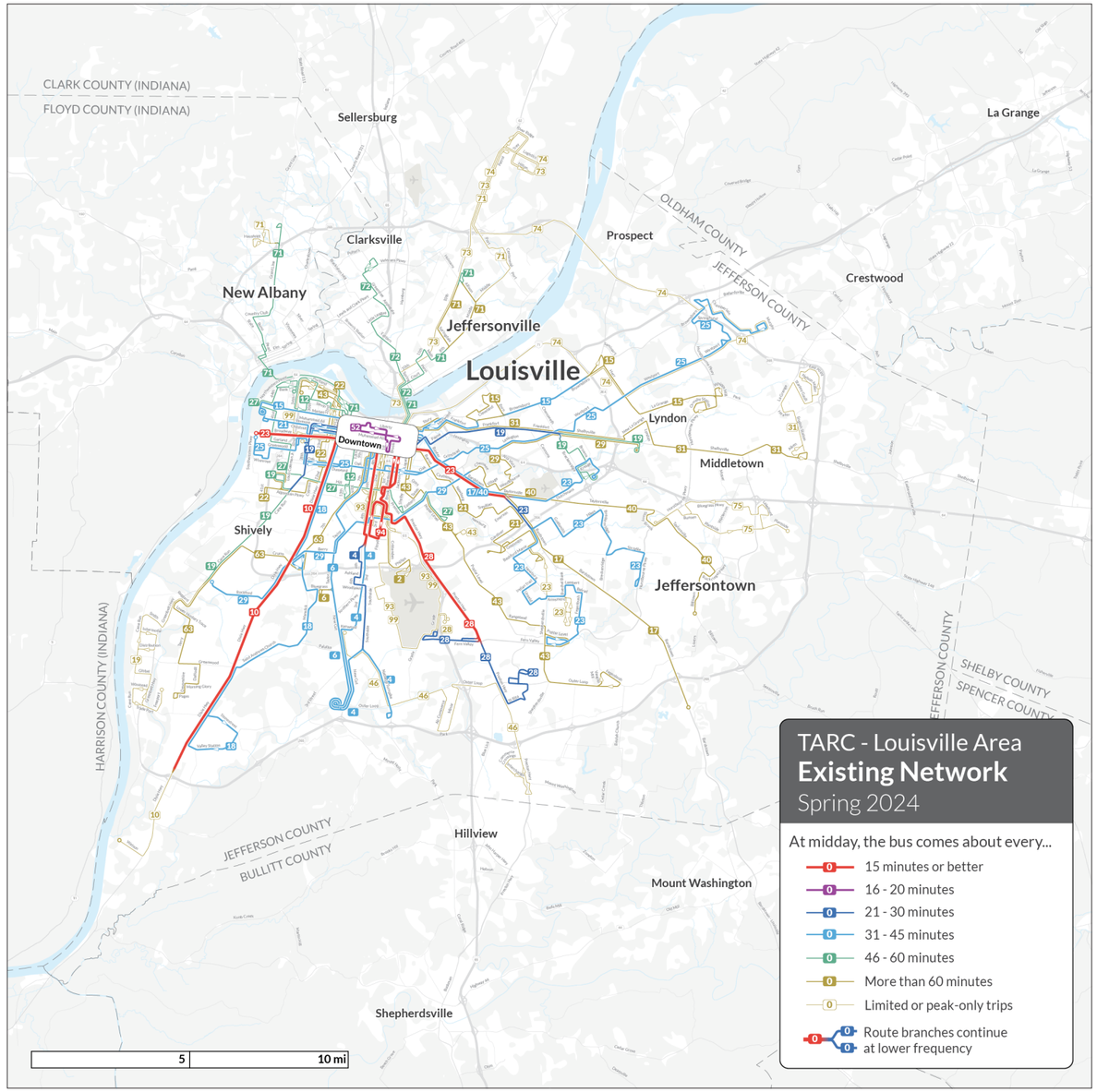


Figure 33: The existing TARC network with routes color-coded by frequency.

Route 19 and the outer segments of Route 28 have a frequency of every 30 minutes. Routes 4 and 23 have segments where the gap between buses is 30 minutes followed by 15 minutes because of the timetable of the "branching" segments (described below). These are shown in deep blue.

A majority of TARC's weekday service consists of routes with frequencies worse than every 30 minutes, going as low as every 75 minutes. These are the light blue, green, and the thicker tan lines on the map. Just because a route has low frequency doesn't mean it isn't important. These routes serve a crucial need: they provide at least some transit service in as many areas as possible with a limited amount of resources.

Route Branching

Many TARC routes have multiple patterns: some trips run on different streets than others, especially outside the core of Louisville. These patterns share a common main segment closer to Downtown. Together, these "branch" patterns can offer a higher frequency on the main "trunk" segment.

Lower-frequency branches are an important tool to provide transit coverage with limited resources. **Consistent patterns and frequencies across the day make transit much more legible,** even with branching. However, some branching patterns in the TARC system are quite complex. For example:

- The start and end points of many trips in the timetable, especially during peak periods, are different.
- Many routes have branches that only operate as specific trips or only during peak periods.
- Routes 4 and 23 have three branches, which significantly adds to their complexity compared to having just two branches.

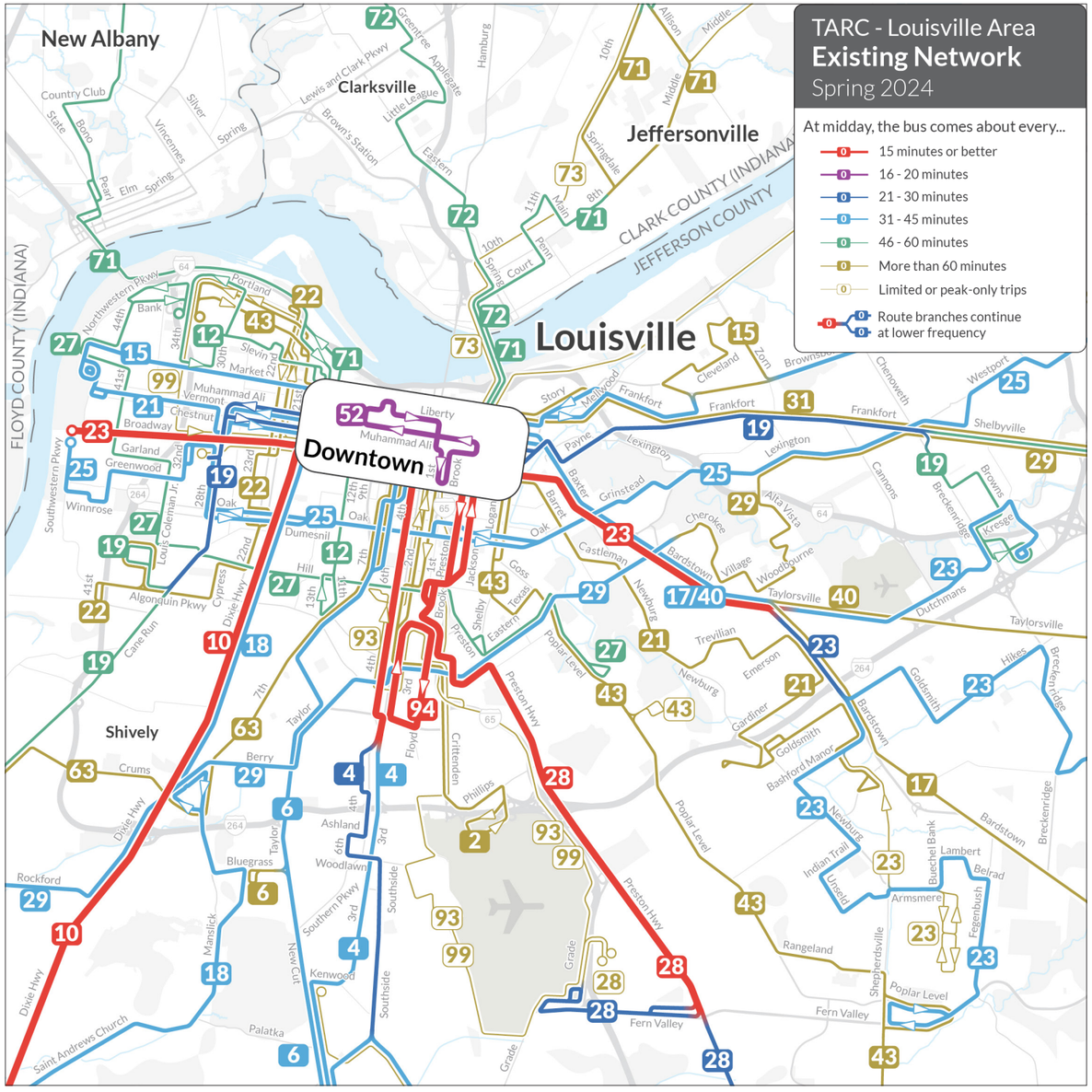


Figure 34: The existing TARC network in the urban core of Louisville.

- Route 15 has a split in the middle of the route, in Clifton Heights, and also branching patterns further East.
- Route 19 has branching on both its eastern and western sides. However, the branches on the eastern side are not consistently served by the same trips as the branches on the western side, especially in the peak periods. This is shown in the image below, where each box is a different combination of branches.

Monday - Friday Eastbound

(A) Freeport Universal	(B) Walmart	(C) Rockford Cane Run	(D) 35th Bohne	(E) Wilson Algonquin	(F) 29th (Nia Center) Broadway	(G) Chestnut 5th	(H) Frankfort Clifton	(I) Breckenridge Shelbyville	(J) Dupont Dutchmans	(K) Oxmoor Center
			4:56	5:00	5:10	5:25	5:40	5:49		6:01
			5:26	5:30	5:40	5:55	6:09	6:17	6:29	
5:27	5:42	C5:46		6:00	6:10	6:25	6:39	6:48	7:00	
			6:15	6:19	6:29	6:45	L6:55			
		6:23		6:38	6:49	7:05	7:20	7:29		7:41
6:30	6:48	C6:53		7:08	7:19	7:35	7:50	7:59	8:11	
			7:18	7:23	7:34	7:50	L8:00			
		7:23		7:38	7:49	8:05	8:20	8:29		8:41
			7:48	7:53	8:04	8:20	8:35	8:46	8:59	
7:30	7:48	C7:53		8:08	8:19	8:35	8:49	9:00		9:12
		8:23		8:38	8:49	9:05	9:19	9:30		9:42
			8:48	8:53	9:04	9:20	9:35	9:46	9:59	

Figure 35: Route 19's timetable has many combinations of trip patterns on the East and West sides.

Predominantly Radial Network

Louisville has a big concentration of jobs, activities, and residents in and around Downtown. Although a large portion of the urban core of Louisville has a gridded street network, many residents and jobs are located close to one of the many arterial roads that radiate outward from Downtown. Therefore, a radial network fits naturally with the overall pattern of development. A majority of TARC's routes run radially along arterial roads and converge Downtown.

As discussed on page 13, for a grid of routes to function well, they need to be highly frequent, every 15 minutes or better, so that wait times to transfer are minimal. However, frequency is expensive. TARC's current level of resources and the decision to spread those resource thinly across most areas of the city means that it can only afford to operate four corridors at every 15 minutes or better, so most other routes operate every 30, 40, 60 minutes or worse.

Potential for Timed Connections

A major limitation of TARC's infrequent network is that it lacks any intentional timed connections. When the frequency of service is low, it is critical to time connections between routes to minimize wait times when transferring. In many communities this will be organized at a central point in or very close to downtown.

Such coordination is not easy to implement in the multiple possible transfer points of a grid network. But in a radial network where service converges at a single point, designing timetables to enable timed transfers at that point is much easier. The biggest positive outcome of timed connections is that riders coming from many routes can transfer with very short waiting time to other routes, even if they had to wait a long time for their first bus.

Orbital Routes in a Radial Network

Routes 22, 25, 27, and 29 all attempt to provide an **orbital** function, and don't go through Downtown. All of these routes have limited frequency: at best every 40 minutes during midday. They are highlighted in the map on the right.

Orbital routes are sometimes provided to enable travel between specific outer areas without having to go to downtown and transfer. This can lead to a **complex network of infrequent routes that each serve specific demands,** and don't collectively form a single useful network.

Particularly where infrequent orbital routes cross other infrequent routes (radial or orbital), the wait time to transfer from one route to another can be really long. In West Louisville, the complex network of the radial Routes 12, 15, 19, and 21 and the orbital Routes 11, 27, and 27 is an example of service spread thin to satisfy very specific trip demands.

When infrequent orbital routes are too close to the downtown core, many trips can be made faster using other frequent routes, even if you need to transfer. For example, someone travelling from Nia Center to Shelby Park Community Center at noon on a weekday has to wait until 12:34 PM to board a Route 25 bus to get there at 12:54 PM. They can instead board a Route 23 bus at 12:11 PM, transfer to a Route 28 bus at 12:40 PM, walk for 5 minutes, and still get to the destination at 12:48 PM.

In radial-orbital networks, orbital routes can provide faster travel for many journeys and provide significant access to opportunities in the outer parts of a city only if they are:

- Sufficiently frequent, or
- So far from the downtown core that it is faster to use the orbital route than it is to travel into downtown and back out.

Figure 36: Orbital routes in the TARC network.

Downtown Louisville

The map on the right shows the TARC network in Downtown Louisville. The key feature of the street network in Downtown is **one-way streets.** These lead to service in opposite directions for routes being on different streets. Another key feature of the Downtown network is that **service is distributed across a large number of nearby parallel streets,** instead of being concentrated into specific corridors or converging at a specific place. Because of both these features, the TARC network in Downtown is very complex.

Many TARC routes from outer areas end in Downtown by looping around various streets. Service is distributed to cover many streets, so **almost every route in Downtown has a different looping pattern,** which adds to the complexity of the Downtown network. The exceptions to this complexity are Routes 15, 19, 21, 23, and 71: East-West routes that run through Downtown, from one side to another, generally following a single street or one-way couplet for most of their lengths.

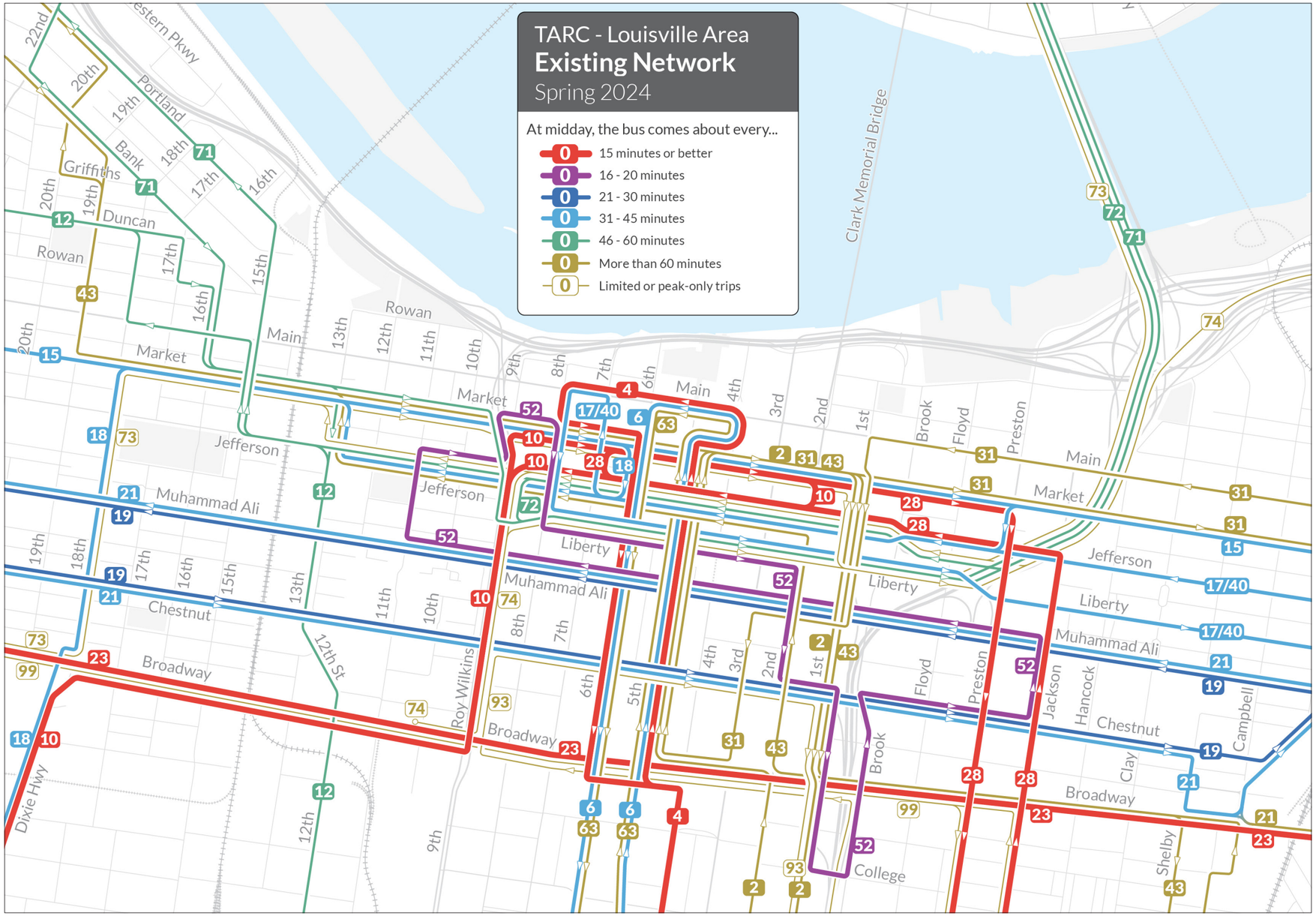


Figure 37: The existing TARC network in Downtown Louisville.

When is Service Available?

The chart on the right summarizes each TARC route's hours and days of service on Weekdays during Spring 2024. Most branch segments that have Weekday service are also shown separately in this chart.

The colors represent the frequency (how often a bus on the route comes) of service during each hour of each day. The chart showing the span of service on weekends is on the next page.

Weekday Service

On weekdays, TARC service typically starts between 4 AM and 5 AM, and ends around midnight. Most routes have lower frequency in the evenings. In particular, the frequent routes 4, 10, 23, and 28 do not maintain their very useful daytime frequencies after 7 PM.

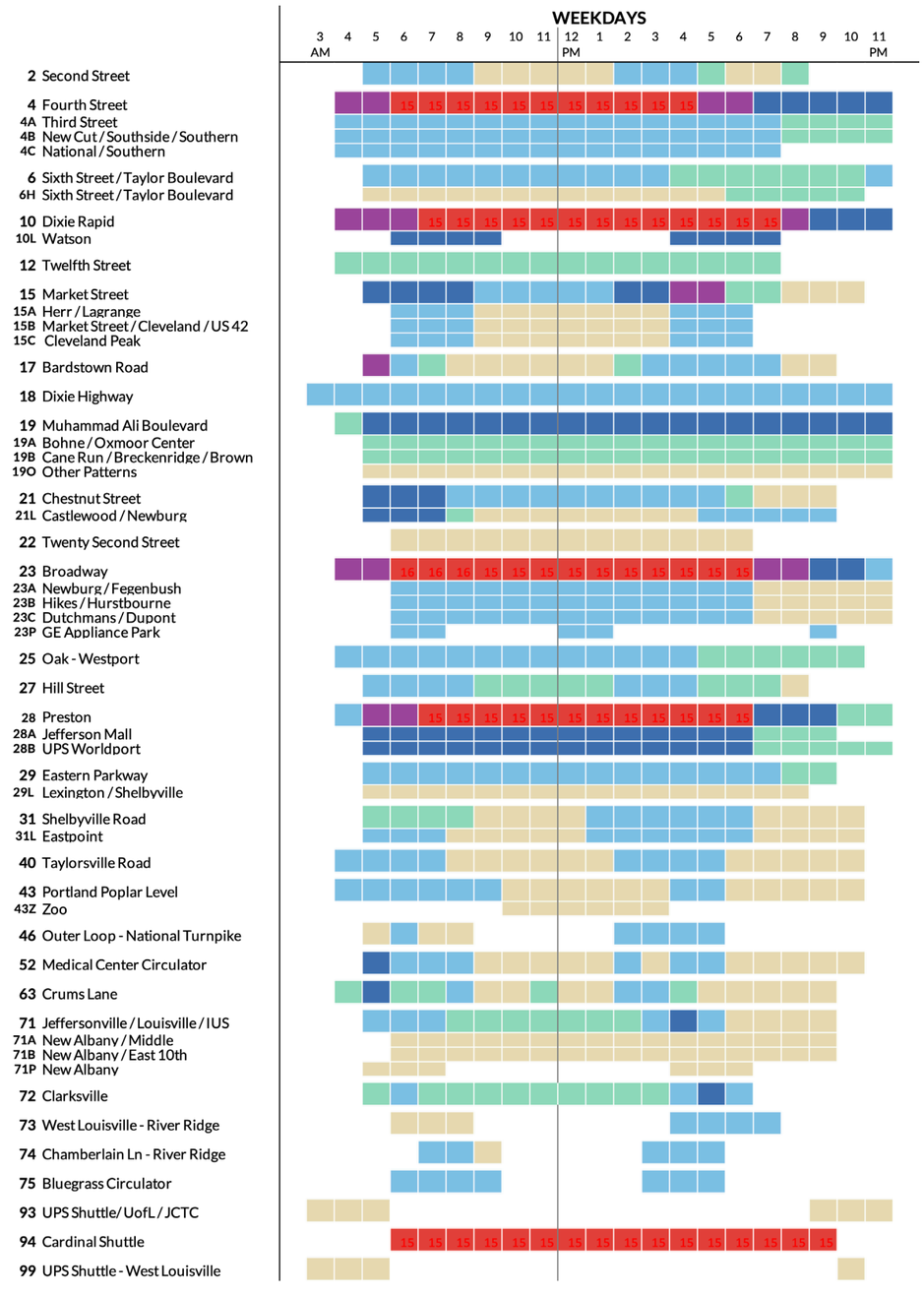
The Cost of Peaking

Before the COVID-19 pandemic, it was quite common for many more people to travel and commute during rush or peak hours, and many agencies offered a great deal of extra service during these times. Many routes in the TARC system are more frequent in the morning and evening "peak" periods.

Peaking has some high costs that are often invisible to the public, and many communities find it hard to account for these costs while thinking about their transit network:

- Peak services have higher labor cost than service at other hours, specifically for split shifts—where operators work in the morning and evening rush hours with a long break in between. Split shifts can be undesirable for operators and they can be expensive for a transit agency.
- The agency must maintain a large fleet of buses for the peaks, and that portion of the fleet sits idle at all other times. For each extra bus that is run during peak times, the agency had to purchase the bus, find land to store it on, pay people to maintain it.
- Short peak runs require drivers to go to and from the operating base with a bus twice a day. This time is called deadhead, and can cost an agency a great deal of time.

Peak services are planned with the intention of providing additional capacity when there are a large number of people. However, the COVID-19 pandemic has brought a large change in people's travel pattern over the day. Many agencies are finding that the peaked patterns of demand have diminished significantly from before the pandemic, while midday, evening, and weekend demand has not dropped as much.



TARC Bus Route Frequencies, Spring 2024

The bus comes about every:

15 minutes | 16 - 20 minutes | 21 - 30 minutes
31 - 45 minutes | 46 - 60 minutes | Over 60 minutes

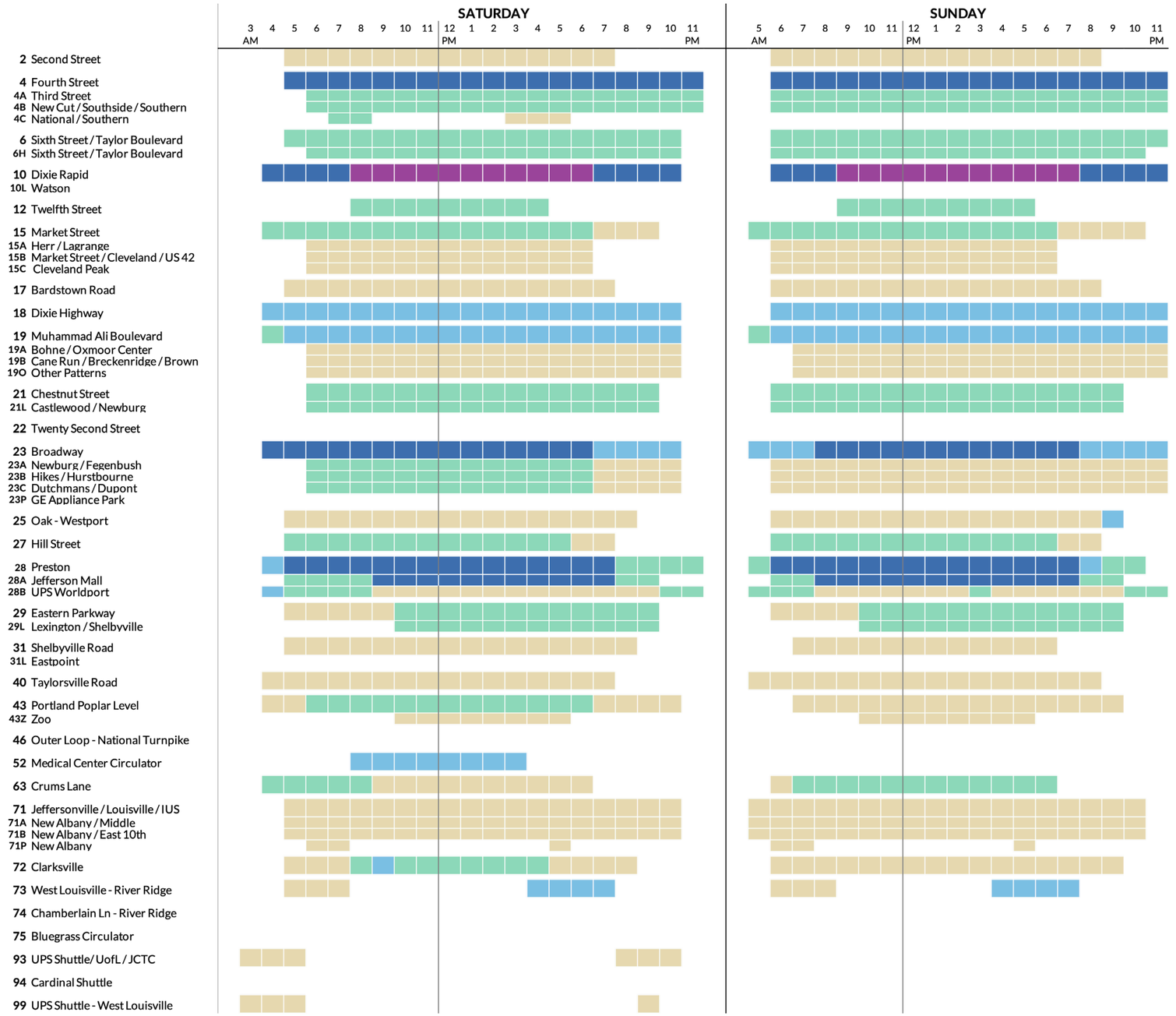
Figure 38: The frequency and span of service on weekdays for each TARC route as of Spring 2024.

Less Weekend Service

Weekend service typically starts around 5 AM and ends around 11 PM. Most frequent trunk routes that operate every 15 minutes drop back to every 30 minutes on weekends. **Reduced weekday evening service and short weekend spans limit the usefulness of the transit network** in several ways:

- Few service workers commute during rush hours. Many service workers change shifts in the early morning or late evening. If transit is less frequent in the evening, it makes trips for these workers much harder.
- People working in retail or restaurant jobs often need to work on weekends. A route that runs infrequently on the weekends is missing the peak time for people in these industries.
- People value flexibility and spontaneity. Having the flexibility to make a trip outside of specific hours is important to all people. Everyone wants the ability to get home outside of the traditional 8-to-5 workday.

Offering **long spans of service throughout the day and week, in places where large numbers of people can use transit, is key to attracting high ridership** over time. Lower frequencies, short hours of service, and weekday-only schedules often help in achieving a coverage goal, as transit can be spread out over many routes, many neighborhoods and long distances, so that a little bit of service is close to many places and people.



TARC Bus Route Frequencies, Spring 2024

The bus comes about every:

15 minutes | 16 - 20 minutes | 21 - 30 minutes
31 - 45 minutes | 46 - 60 minutes | Over 60 minutes

Figure 39: The frequency and span of service on weekends for each TARC route as of Spring 2024.

Where are People Riding Today?

The map on the right shows the average number of daily boardings on Weekdays at each stop in the TARC network during September and October 2023.

High ridership areas and corridors can appear in two different ways on this map: either as individual large dots, or as multiple medium-sized dots that are very close to each other. Looking for those patterns we can observe where the highest boardings occur:

- Ridership is heavily concentrated within inner parts of Louisville, particularly in Downtown and near the UofL Campus (the map on the following page shows more detail for the inner parts of Louisville).
- Dixie Highway and Preston Highway are both frequent corridors with significantly high ridership through most of their length. Similarly, the inner parts of Bardstown Road where Route 23 is frequent also has strong ridership. Other corridors like Cane Run Road, Taylor Road/New Cut Road, Southside Drive, Poplar Level Road, Frankfort Road, and Westport Road have relatively modest ridership.
- The outer ends of routes like 4, 6, 10, 28, and 31 which are major shopping centers (for example, Jefferson Mall or the Walmart on Outer Loop) or employers (like UPS Worldport), have relatively large dots.
- Other suburban corridors such as New Cut Road, Bardstown Road, Shelbyville Road, and Westport Road have a significant drop off in boardings in the lower density suburban fringe.

Looking at this map, we must keep in mind that not every stop is offering the same level of service:

- A small dot on a low-frequency route may simply reflect the low level of service.
- A small dot on a more frequent route would suggest low demand for transit near that stop.
- A large dot where there are multiple infrequent routes could simply reflect the multiple options available, or it could point towards people transferring from one route to another.
- A large dot on an infrequent route means that ridership is high despite a low level of service, which suggests that nearby transit demand may be high, and under-served.

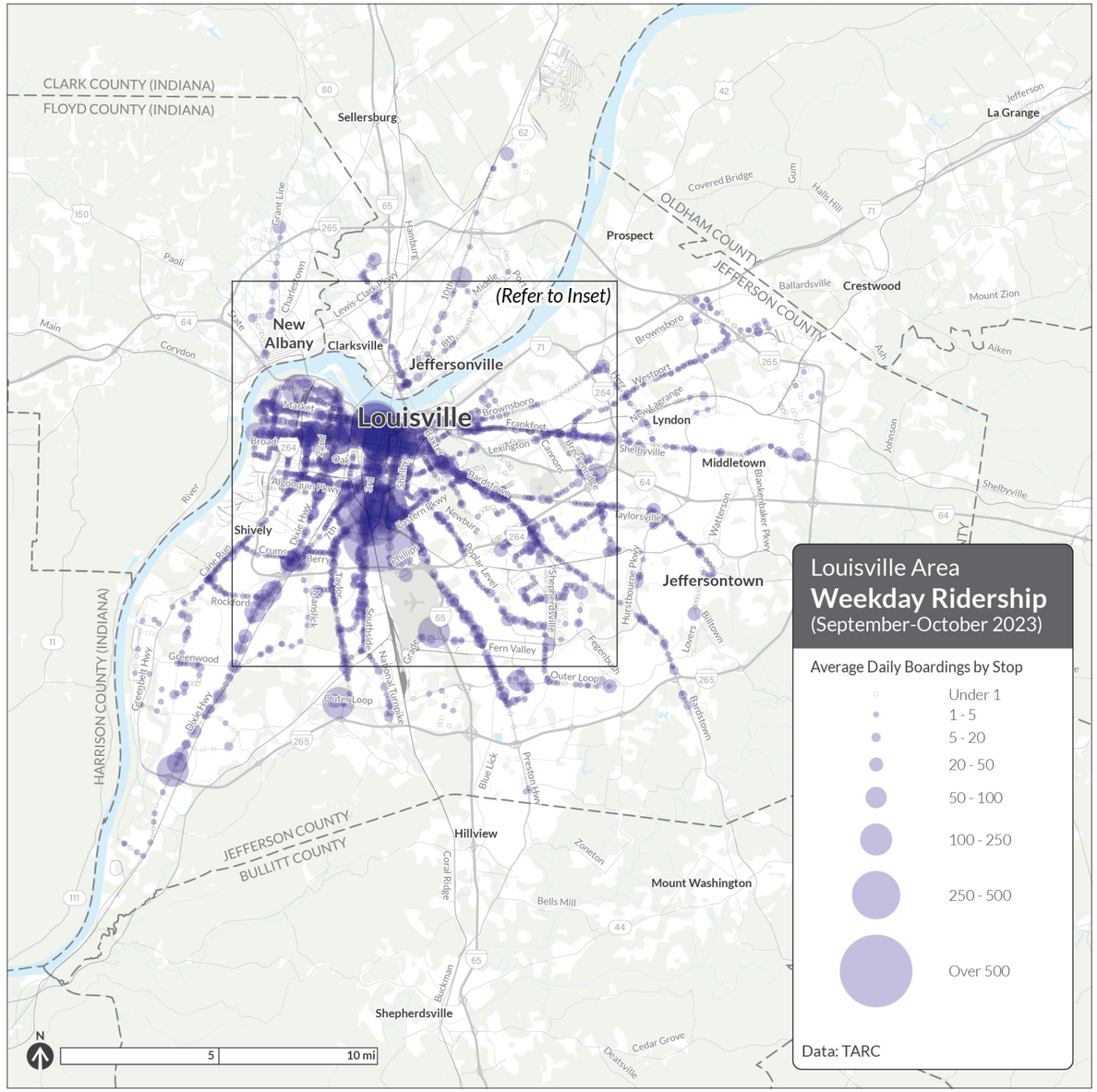


Figure 40: Boardings by stop for all TARC routes across the entire service area. For more detail in the inner parts of Louisville, refer to the map on the next page.

The map on the right shows ridership at each stop in the within the inner parts of Louisville in more detail.

- The University of Louisville stands out as a place with very high number of boardings. Most of the large dots in the area are along Route 94, which circulates as a one-way loop around campus. Buses are often coming every 5-7 minutes, so people have extremely short waits. UofL students can also ride the TARC system for free, which also increases the 94's appeal. All of these factors mean that the shuttle is very useful to get around the UofL campus compared to walking, despite it being a large one-way loop.
- Because the University has such a large concentration of jobs and students, ridership on the frequent Routes 4 and 28 as well as Routes 2 and 29 also contribute to the boardings here.
- Boardings in Downtown are high along Broadway, 3rd/4th Streets, Jefferson/Market Streets, and near the medical center. These point to the usefulness of the frequent Routes 4, 23, and 28. Boardings are also significantly high where these routes cross each other and people transfer. Muhammad Ali Boulevard and Chestnut Street have moderate boarding activity along Route 19.
- Outside of Downtown and UofL, Broadway, Bardstown Road, Dixie Highway, and Preston Highway stand out as corridors with relatively high ridership. Along Dixie Highway, some of the biggest ridership dots are located at stops where Route 10 crosses other routes. This suggests significant numbers of transfers happening there.
- Grocery stores like the two Kroger locations in West Louisville, shopping centers like Bashford Manor Mall, and large employers like the UPS Worldport also show up as places with lots of ridership.

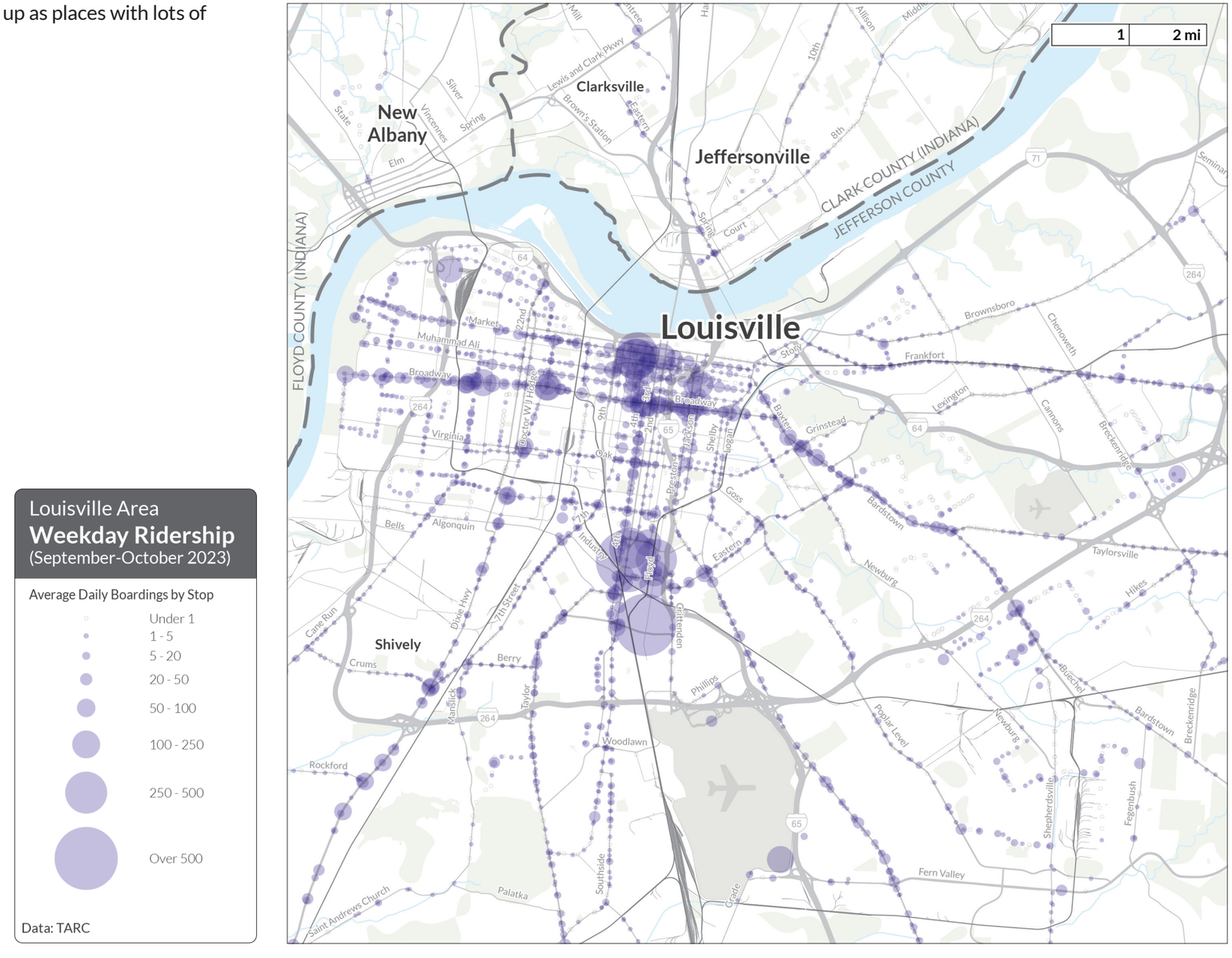


Figure 41: Boardings by stop for all TARC routes in the inner parts of Louisville.

Ridership Relative to Cost

Some communities adopt goals like "increasing transit usage" or "reducing car emissions". These goals depend on making transit useful to lots of people such that they can "maximize ridership". Implicit in this statement, however, is a constraint: there is a limit to how much funding is available to increase ridership. A transit agency cannot spend infinite amounts of money pursuing each additional rider in pursuit of "maximum" ridership.

The more specific way to state this goal, then, is to "maximize ridership within a fixed budget." Even if the budget grows, it is and will always be limited.

People who value the environmental, business, or development benefits of transit will talk about ridership as the key to meeting their goals. Since the transit agency is operating under a fixed budget, the measure they should be tracking is not sheer ridership but **ridership relative to cost.** They would not be satisfied simply by a large dot on the boardings map on the previous page, until they knew what it cost the transit agency to achieve that large dot.

Service is Cost

The cost of a transit route relates primarily to the time spent by operators running the route. It is mostly the wages paid to the people running the system day-to-day. In the transit business, the measurement of time spent operating service is called "service hours" or sometimes "revenue hours".

One bus operating on a route, picking up and dropping of passengers has spent one "service hour". **Service hours are a direct measure of the quantity of service.** The service hours on any particular route will depend on a few factors:

- The **length** of the route,
- The operating **speed** of the route (since a slower operating speed means that covering the same distance takes more time),
- The **frequency** of service along the route or to the stop (since higher frequency is supplied by more buses and operators out driving the route at once), and
- The **span** of service along the route each day and each week.

Ridership relative to cost is called productivity. In this report, productivity is measured as boardings per service hour:

$$Productivity = \frac{Ridership}{Cost} = \frac{Boardings}{Service\ Hours}$$

Productivity is strictly a measure of achievement towards a ridership goal. Services that are designed for coverage goals will likely have low productivity. This does not mean that these services are failing or that the transit agency should cut them. It just means that their funding is not being spent to maximize ridership.

Where is Productive Service Today?

The scatter plot on the right shows the individual routes from TARC, plotted according to their weekday midday frequency (horizontal axis) and their weekday productivity, or ridership per service hour (vertical axis). More frequent services tend to have higher productivity (ridership relative to cost), even though providing high frequency requires more service hours and is more costly.

This happens because frequent service is very useful and convenient for riders. Many transit agencies target this (more expensive) service towards their strongest ridership markets, often in suitably dense and walkable environments. High ridership is a common result of providing frequent service in such places.

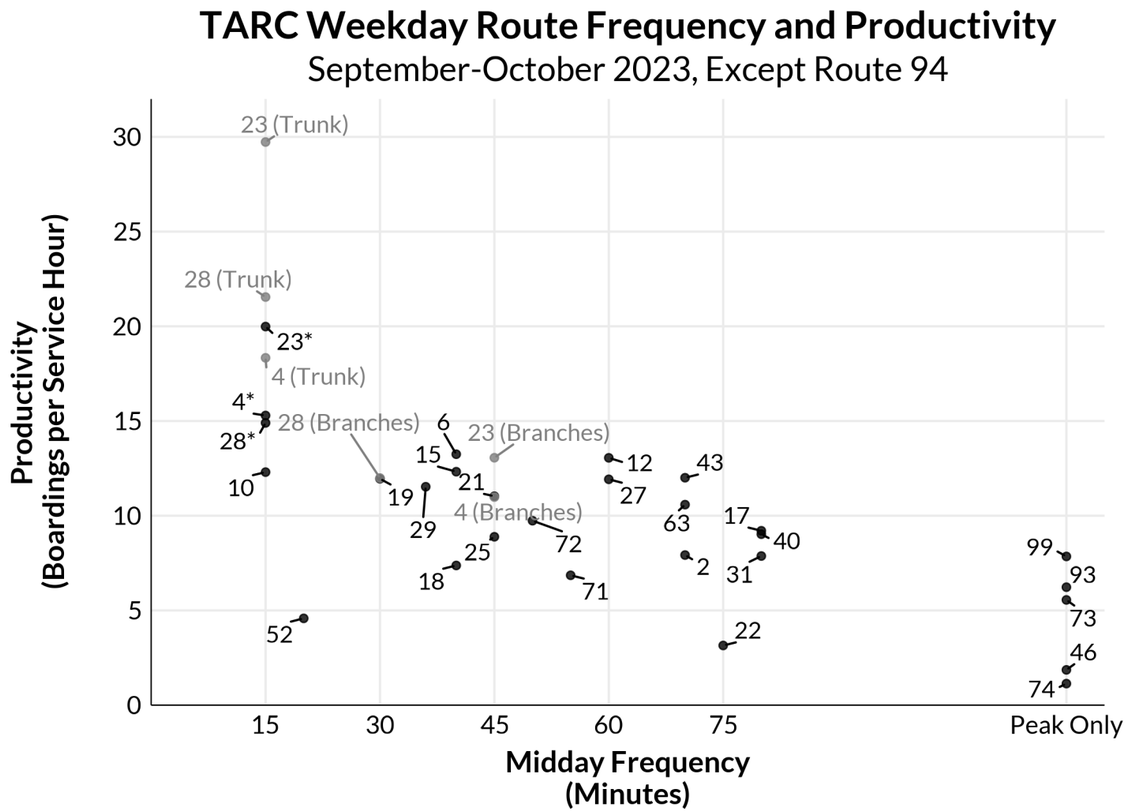


Figure 42: Productivity by frequency of route and route segments for TARC services in Fall 2023.

Not only do frequent routes tend to have higher ridership overall, but they often also have higher ridership *relative to their cost.*

Route 94 is the most productive TARC route, with 58 boardings per service hour on Weekdays. We described the reasons for its usefulness and high ridership on page 38. It is not included in Figure 42.

Many TARC routes have a productivity of around 8 to 12 passengers per service hour. Routes 23, 4, and 28 have the highest productivity at around 15-20 boardings per service hour. This productivity is for their entire weekday service, which also includes the ridership and service hours on their more infrequent branch segments. We can look at just the 15-minute "trunk" segments of these routes separately from the branches. The productivity along those segments is much higher: for example 30 boardings per service hour for Route 23's Broadway-Bardstown Road segment.

The Downtown Medical Circulator Route 52 has very low productivity. Like Route 94, it is a short one-way loop in an area with a lot of activity. However, it has a frequency of only every 20 minutes. In many cases, people can walk to their destination, in the time it takes to wait for a bus they just missed. Route 52 also has a very short span, it only operates between 9:30 AM and 5 PM.

Routes 6, 15, and 43 have relatively high productivity compared to other routes with similar frequency. This is because they can achieve a good mix of two-way demand in relatively direct, linear paths. For example, Route 6 has Downtown and the Outer Loop Walmart at either ends, other major destinations like UofL Mary & Elizabeth Hospital in the middle, as it passes through areas with a good level of residential density.

Routes 27 and 29 are orbital routes that have relatively high productivity with respect to other orbital routes like Routes 22 and 25. They are far enough from Downtown and connect big enough mixes of people and opportunities that they can be useful for many peoples' travel. Route 12 is an exception to this pattern. It is very close to Downtown and is only every 60 minutes. But it has two strong ridership anchors on either end: Parkhill and Kroger. Also, the trip between these two places isn't faster on any journey through Downtown.

Productivity and Peaking

The distribution of TARC riders by time of day is quite common in the wake of COVID-19, which has caused a lasting decline in commuting at the traditional rush hours.

In the chart on the right, the vertical axis shows how three measures change over a weekday, relative to each measure's daily average:

- Ridership is the **red line,** which increases steadily over the morning, and stays high around all the way through 5 PM with some ups and downs. The fluctuations are often related to school and college students leaving from classes, people running errands, and service workers commuting.
- The amount of service (measured as service hours) that TARC runs over the span of the day is the **blue line.** There are distinct "peaks" in the morning and afternoon, which are the increased peak frequency and special trips that many routes have in their timetable. The midday level of service is lower.
- The **black line** is the productivity in each hour: ridership divided by service hours. Notably, productivity dips significantly during the morning and afternoon "peak" periods. These dips highlight the mismatch between TARC's ridership across the day and the service it provides.

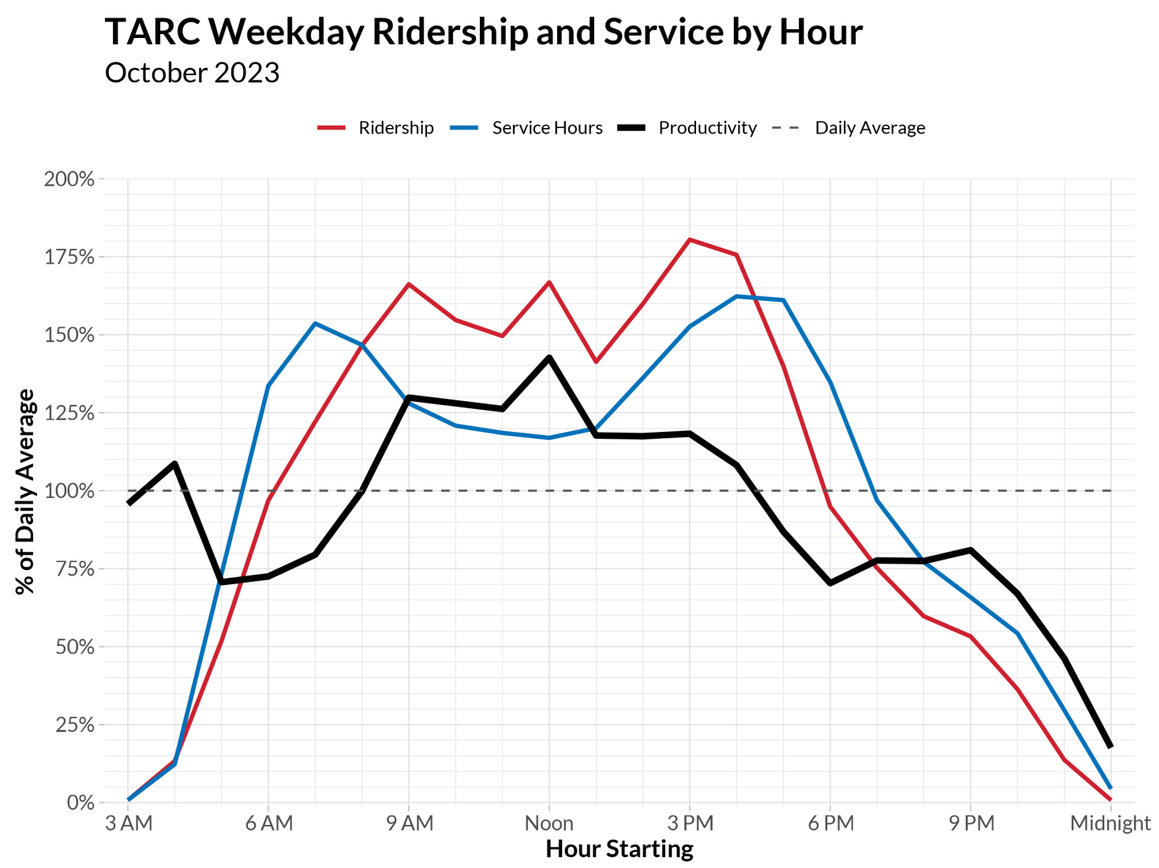


Figure 43: Change in levels of ridership, service, and the productivity of service by hour on weekdays in Fall 2023.

Proximity: How Many People and Jobs are Near Transit?

A commonly held goal for transit is to provide lifeline access for many people, and measuring how many people or jobs are served by transit tells us something about how well the transit network is meeting that coverage goal.

Coverage goals for transit are served when transit is available to people, whether or not they ride it in large numbers. The chart at right shows the coverage provided by the existing TARC services to residents and jobs in Louisville Metro at midday on a weekday in Spring 2024. The overall coverage is divided into coverage by transit of particular frequencies at midday.

Proximity to Transit

Close to 60% of Metro Louisville/Jefferson County residents are within a half mile of some transit service. Only 13% of residents are within a ½-mile distance of high-frequency service every 15 minutes or better. 29% of residents are within half a mile of service that comes at best every 30-60 minutes. 17% of residents are only near service less than every hour, or only at peak periods.

74% of all jobs are within half a mile of some transit service, with 26% of jobs near every 15-minute service. Larger concentrations of jobs tend to often be located in Downtown and close to frequent transit corridors. But many suburban job centers can be very far from transit in hard-to-serve places.

79% of Residents in Areas of Persistent Poverty census tracts and 73% of Low-Income Residents overall are within a half mile of some transit service. 30% of Residents in AoPP are close to frequent transit, while only 22% of Low-Income Residents overall are near frequent transit. This difference is related to the geographic distribution of poverty. AoPP tracts are mostly located around Downtown and in the western and southern parts of Louisville. These areas have many places with high density of Low-Income Residents, but there are also pockets of Low-Income Residents in areas which are in the more suburban areas of Louisville that are hard to serve by transit.

81% of Louisville's Households Without Cars are near transit, and a third are near the 15-minute services. Since households without cars are likelier to depend on and use transit, it makes sense that a larger portion of these households could try to locate close to transit.

69% of Louisville's Residents of Color live near transit, compared to 60% of residents overall. 18% of Residents of Color are within a half mile of frequent transit service, compared to 13% of residents overall. The proportions of young and senior citizens close to transit are similar to residents overall.

These conditions are not static and can change as a result of a changing economy and a changing city. Changes in the pattern of demand for housing or location of jobs can shift the patterns of who has access to what kind of transit, without any changes to the transit network.

Land use planning, growth permitting, and affordable housing policies at local jurisdictions affect the long-term access to useful transit as much as design of the transit network does. Many cities have seen an increase in housing demand near useful transit and in walkable, urban areas. If this increasing demand is not matched by increases in the supply of housing, then people living on low incomes may have to move away from frequent transit (or any transit service) to seek lower housing costs.

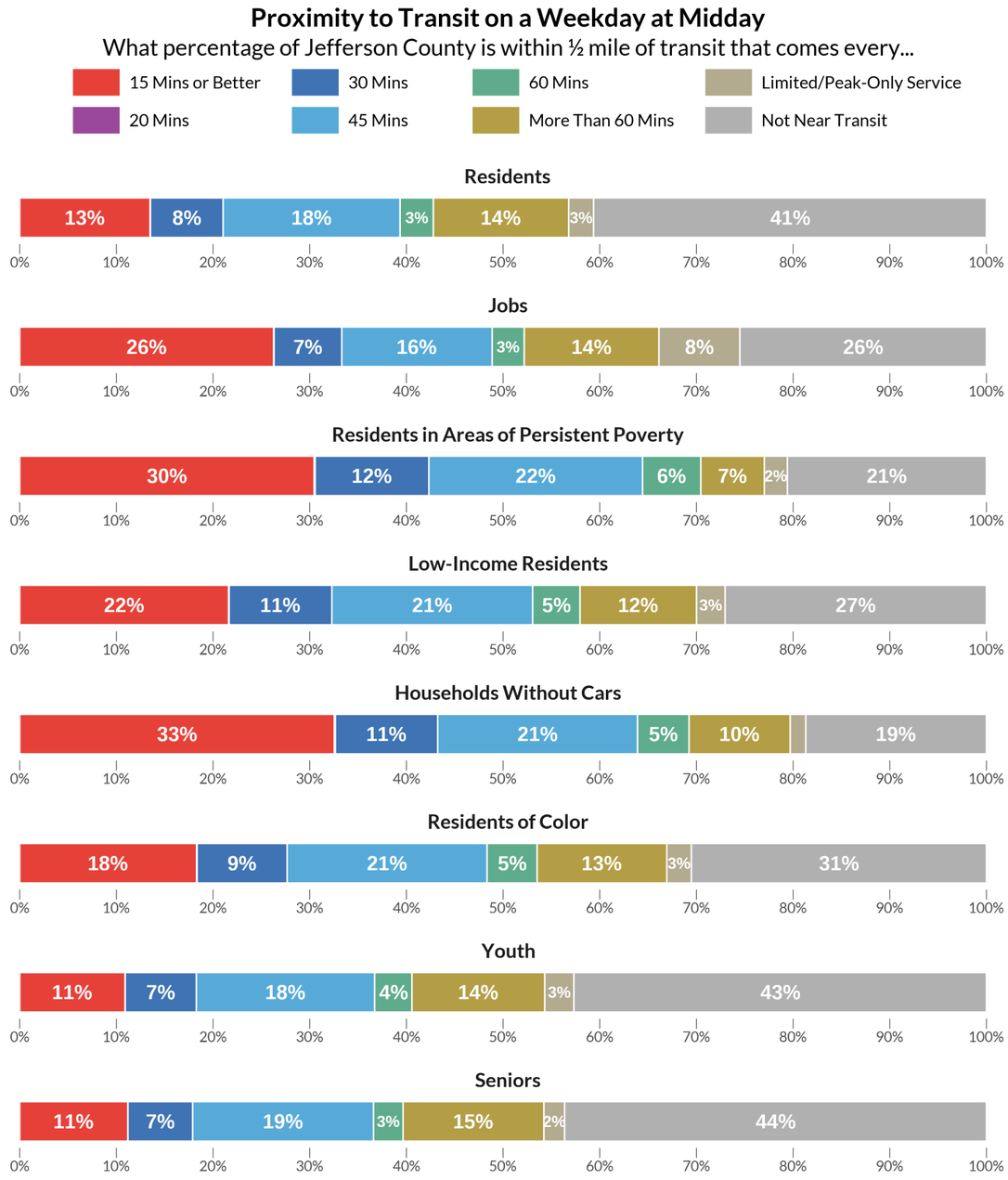


Figure 44: Proximity of people and jobs in Louisville to transit, including key demographic subgroups, by the frequency of service at midday.

Access: What Can You Reach in a Reasonable Amount of Time?

Wherever you are, there is a limited area you could reach within a reasonable amount of time. The extent of this area affects your options in life: for employment, school, shopping, health care or whatever other places you might want to reach.

The number of destinations you can reach within a set amount of time is called **access.** We discuss this concept in more detail in Chapter 2 on page 9.

Transit is useful when it increases the number of useful places people can access in a reasonable amount of time.

We can make isochrones from many places across the Louisville Urban Area, as shown on page 11, and calculate how many jobs and other opportunities are inside each isochrone. The map on the right shows the number of jobs someone traveling from that point can access by transit and walking within 60 minutes. In places that have a deeper color, you can reach more jobs than in places with a lighter color.

Two major factors influence how many jobs you can access from a given location:

- **How many jobs are in and near that location.** This means that places close to lots of jobs have large amounts of job access and appear darker. So areas like Downtown, Old Louisville, UofL campus, West Louisville and the inner parts of Bardstown Road, all appear darker.
- **How much transit expands your job access.** Areas near the frequent segments of Routes 4, 10, 23, and 28 have lots of job access. Many other segments along the relatively less frequent routes 19 and 25, as well as areas near some of the outer branches of Routes 4 and 23 also offer modest job access within 60 minutes of travel.

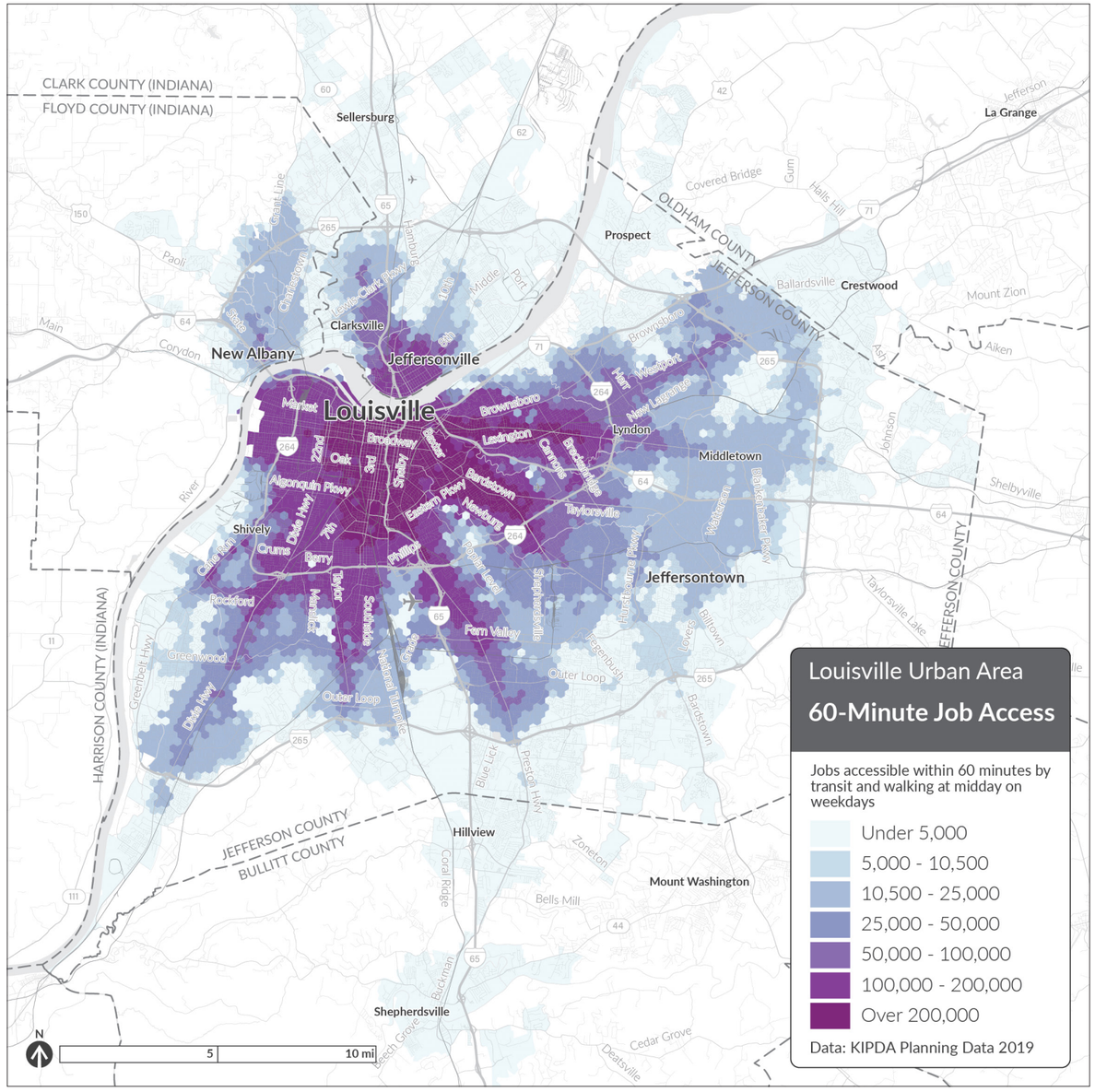


Figure 45: Number of jobs accessible within 60 minutes by walking and transit using the existing TARC network.

Job Access by Demographic Groups

We can summarize the distribution of job access by transit in the map on the previous page based on how many people live across all the different parts of Louisville. The chart on the right shows the number of jobs accessible on average by the residents overall and among key demographic groups.

Residents in Areas of Persistent Poverty and Households without cars can access substantially more jobs than residents overall. This is closely linked to the geography of these groups. AoPP census tracts are mostly located around Downtown and in the western and southern parts of Louisville near lots of industrial and suburban retail job centers. Households without cars tend to be located closer to transit, and particularly closer to useful frequent transit, compared to residents overall. Households without cars are also more likely to be located in denser places with more mix of land uses, like near Downtown, UofL, and in apartments close to large retail centers.

On average, Residents of Color in Louisville only have modestly higher job access in than residents overall. Even though a larger portion of Residents of Color are near transit than residents overall, and often also closer to Downtown and UofL, many of them are very far away from many of the jobs in the eastern and southern parts of Louisville.

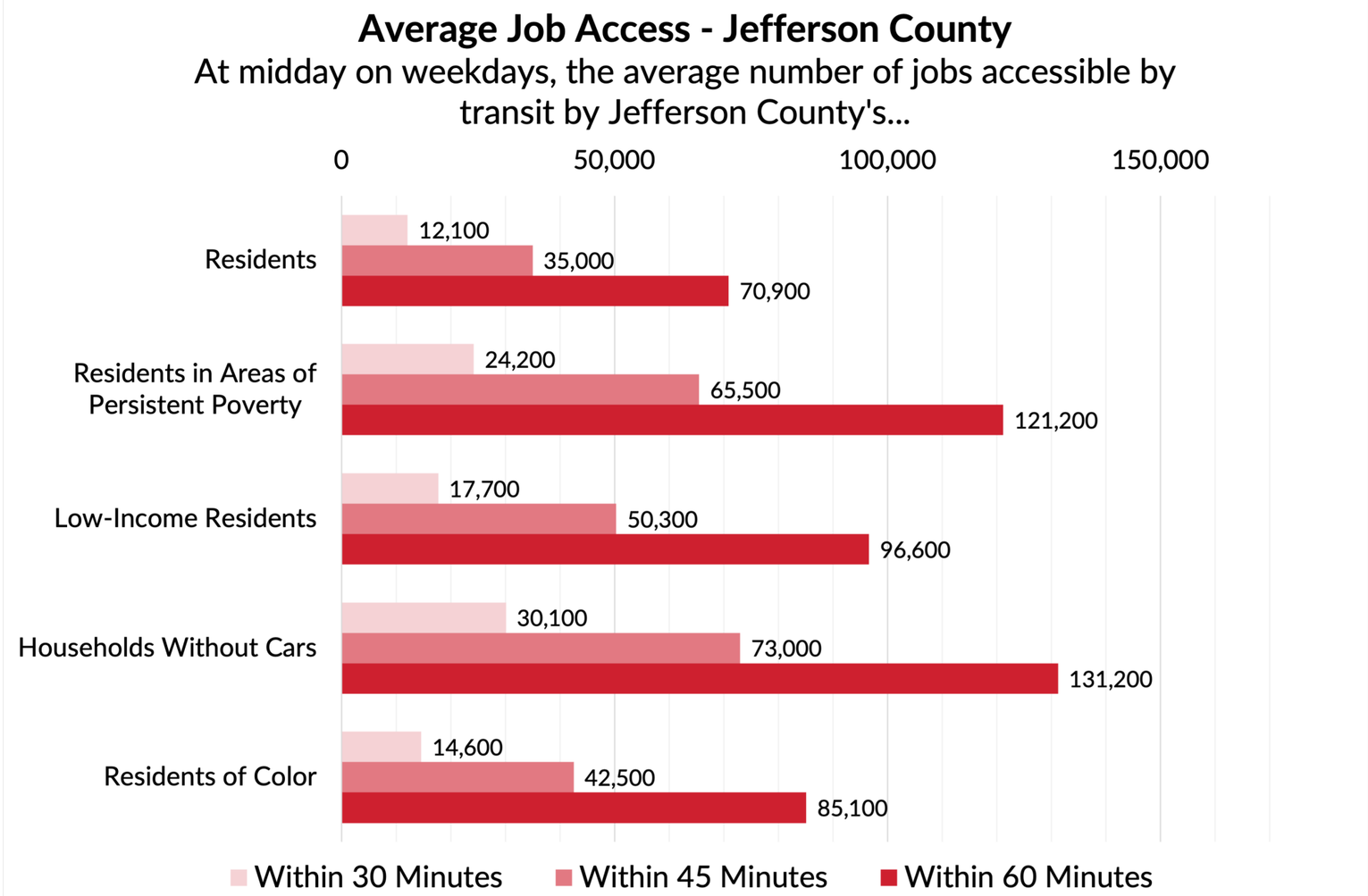


Figure 46: Access to jobs in Louisville by walking and transit, including key demographic subgroups.

How Transit Changes Access

Added Access by Transit

Transit can't provide equal access to everyone, because your access to destinations depends a lot on where you are located and how far you are from useful destinations, as well as the frequency and drive time of routes connecting a particular area. For example, when cities limit how much housing can be built, lower-income people are sometimes forced to live especially far from the things that they need, which can create an unequal access situation that is too big for transit to solve.

The map on the right shows the access provided by transit within 60 minutes **relative to** what can be achieved just by walking up to 30 minutes. This shows where transit at its existing levels is most effectively adding access to what would be possible by only walking.

Close to major centers of job density and a well-connected street grid like in Downtown, the added job access by transit is relatively modest, because there are already a large number of jobs nearby that you could reach by walking.

Many of the darkest-colored areas in the map are places which do not have many jobs nearby, but are within a short enough distance of substantial job density, so that transit can greatly increase the jobs you can access within 60 minutes. These include West and Southwest Louisville as well as areas near Crescent Hill. The areas surrounding the outer parts of Routes 4, 10, and 28 also have high levels of added job access due to the availability of frequent transit.

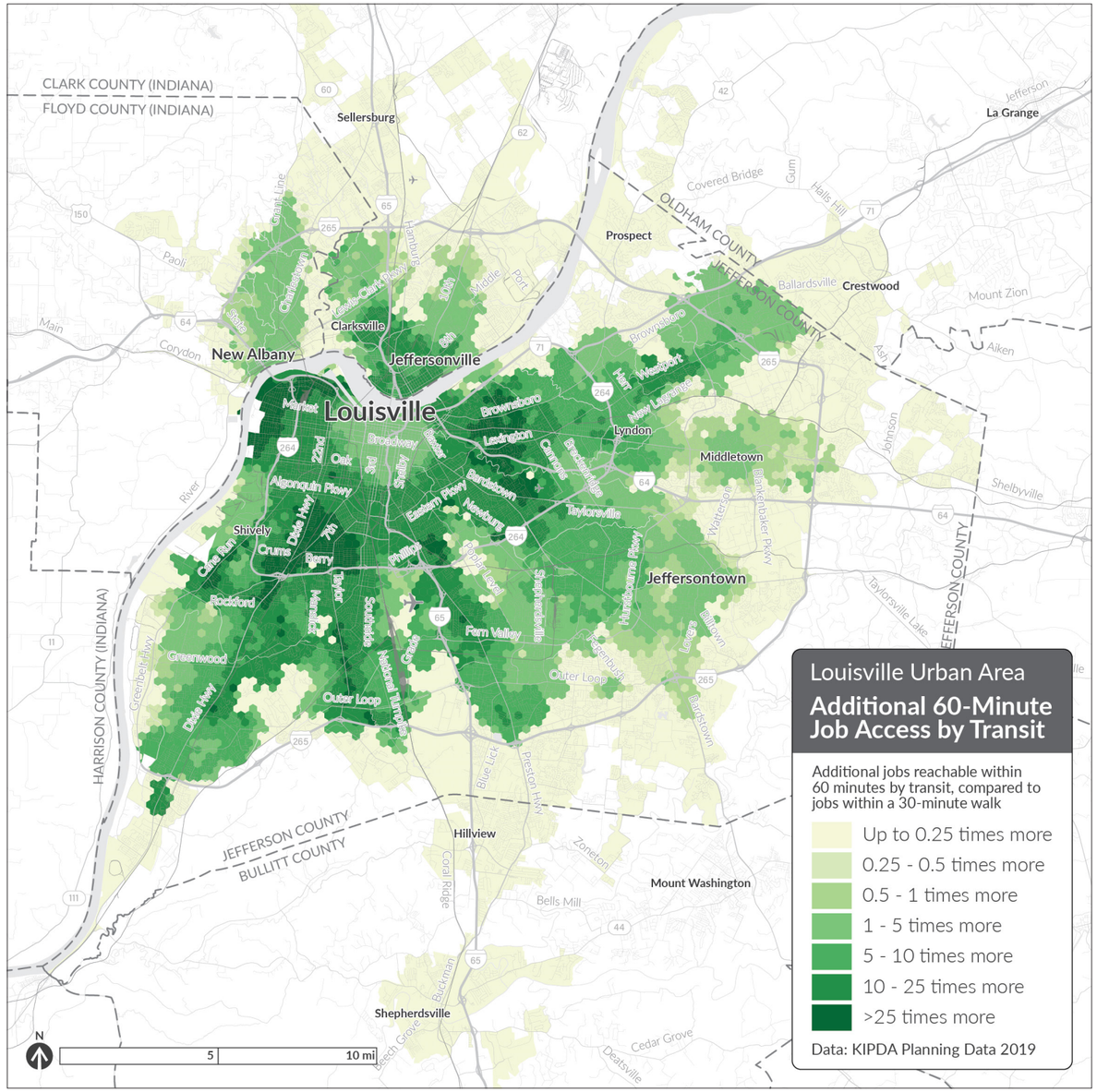


Figure 47: Map showing how many more jobs are accessible within 60 minutes by transit over those that are only reachable by walking up to 30 minutes.

5: Key Choices

How Do We Prioritize Limited Resources?

TARC 2025: Moving Forward Together comes at a very pivotal and challenging moment for TARC. It is a unique opportunity for the Louisville community to think about the purpose of its transit network, so that it can achieve a network that is best suited to its goals, priorities, and values.

As a part of this process, there are many choices that Louisville community will need to make. **These choices are important because they can result in very different transit networks** that can have very different outcomes for the people, businesses, and institutions of Louisville. **These key choices cannot be made by technical experts,** but must be based on the values of the community.

Contrasting Visions

Especially in the context of limited resources, these choices are trade-offs. The various goals that those choices help achieve are in conflict with each other, and there are not enough resources available to fulfill all of those goals simultaneously. Many of these trade-off choices can be related to two contrasting ways of envisioning the network.

Should Louisville have a transit network that:

- Invests its resources in **getting some transit service close to as many people as possible,** so that they have the option to use transit, even if transit is not useful in reaching many places and opportunities in a reasonable amount of time? Or...
- Invests its resources in frequent useful service where the most people and opportunities are, so that it can be **very useful to many people to get to the most possible number of destinations and opportunities,** even if it can't be near some people and opportunities?

These two ways of thinking about the purpose of a transit network lead to two very different, contrasting network designs and outcomes. **However, they are not binary options, and no community focuses solely on one vision or another, but tries to find a balance between these contrasting visions.**

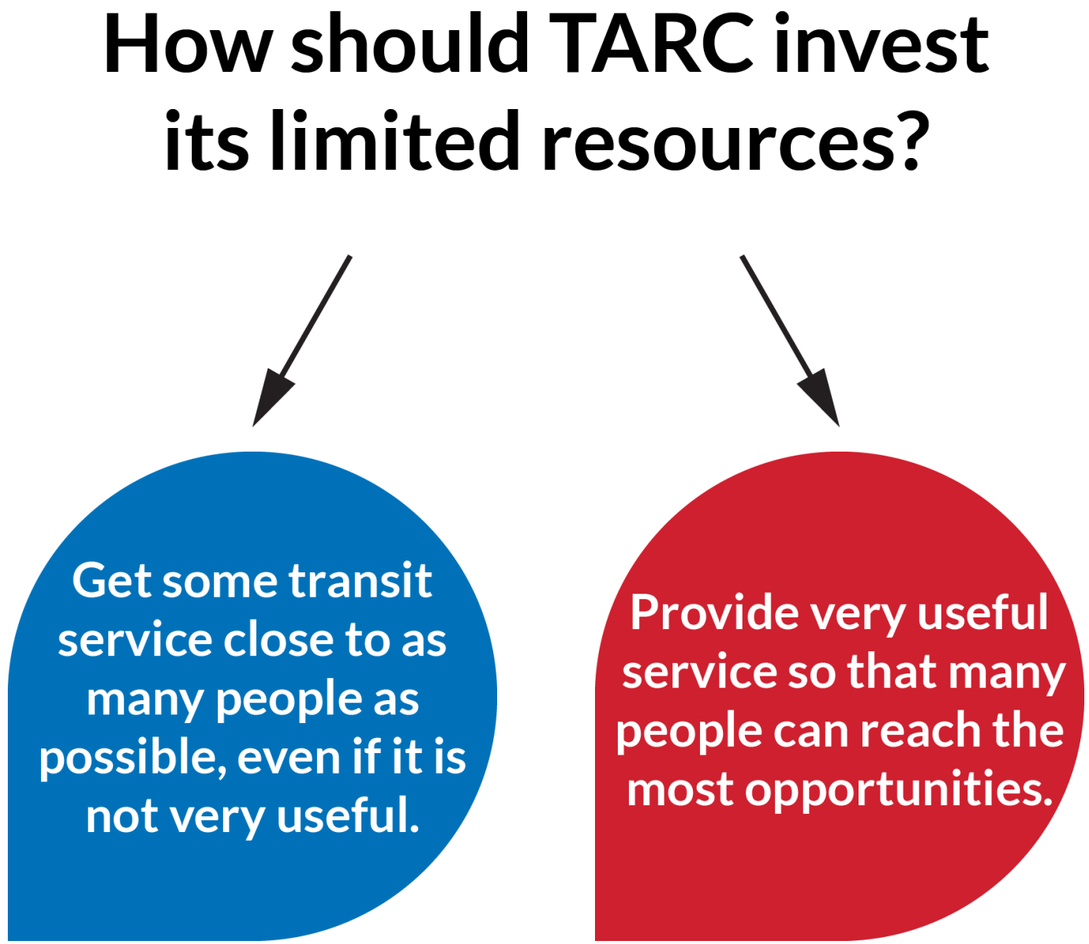


Figure 48: Two different and contrasting ways to think about the purpose of the TARC network.

Key Choice: Ridership or Coverage?

The most important and difficult choice for TARC will be between providing useful service with high frequency that will attract **high ridership,** and providing **wide coverage** in as many parts of Louisville as possible.

A network designed to maximize ridership will be very useful to the most number of people, but not everyone will have service. It will fulfill several expected goals for transit, including:

- Getting more people to ride transit because transit is very useful for most people's journeys.
- Making more "efficient" use of tax dollars by reducing the cost to provide each ride by increasing the number of riders and collecting more fare revenue relative to cost of providing service.
- Improving emissions and air quality by replacing single-occupancy vehicle trips with shared transit trips.
- Supporting dense and walkable development and redevelopment.

On the other hand, a network designed to maximize coverage will have service close to as many people as possible, but there will not be very useful, frequent service close to most people. Many popular transit goals do not require high ridership in order to be achieved, and instead are achieved by providing transit coverage in many places. These include:

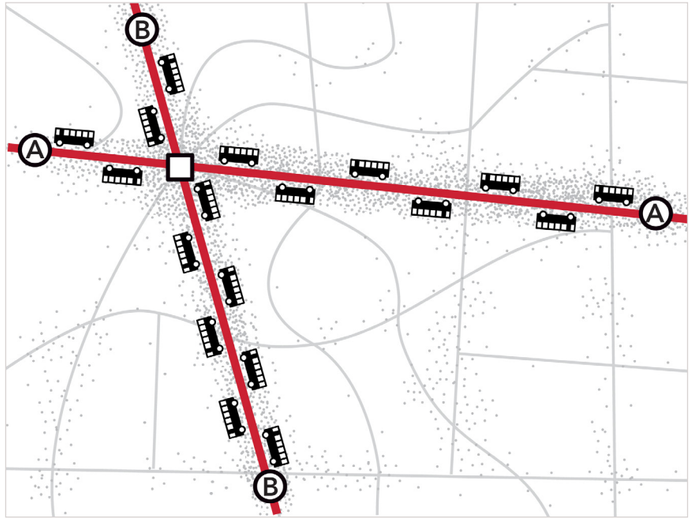
- Ensuring that everyone in the city or service area has access to some transit service, no matter where they live.
- Getting service close to as many neighborhoods within the area.
- Providing "lifeline" transit access as for people who cannot use personal vehicles.
- Serving newly developing places, even if they don't yet have the size or density to constitute a large transit market.

This choice is not binary. A community can pursue high ridership and extensive coverage at the same time, but the more it pursues one, the less it can provide of the other. Most cities (including Louisville currently) have some direct, linear, frequent on which ridership and productivity are high, and other routes for specific coverage purposes, often with loops, deviations, low frequencies, and running during limited times.

Every dollar spent providing very high frequency along a dense mixed use corridor is a dollar that cannot be spent bringing transit closer to each person's home or reaching residential areas in the less dense parts of Louisville, and vice versa. We suggest thinking about this choice not as a binary, "yes-or-no" decision, but as a point on a sliding scale that the community can help to set.

How much of TARC's resources should be spent on useful service in pursuit of high ridership? How much should be spent on providing coverage?

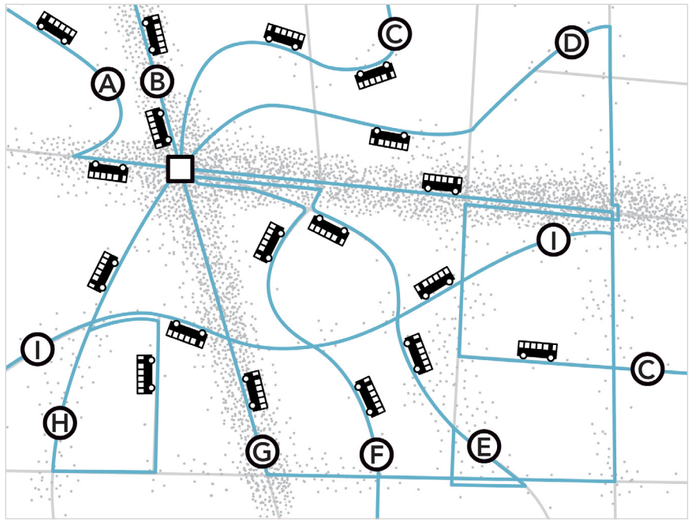
Ridership Network



Maximizing Ridership

A high-ridership network concentrates service where the most people and jobs are in close proximity. It has very frequent, direct, linear routes that operate longer in the day and across the week. Service is very useful for lots of people, so ridership is high.

Coverage Network



Maximizing Coverage

In a high-coverage network, service is spread thin to cover as many people and jobs as possible. Routes are less frequent, operate fewer hours, and have more deviations and large one-way loops and splits. Service is less useful to most people, so ridership is low.

Figure 49: A network designed solely to maximize ridership looks very different from a network designed solely to maximize coverage.

Key Choice: Walking or Waiting?

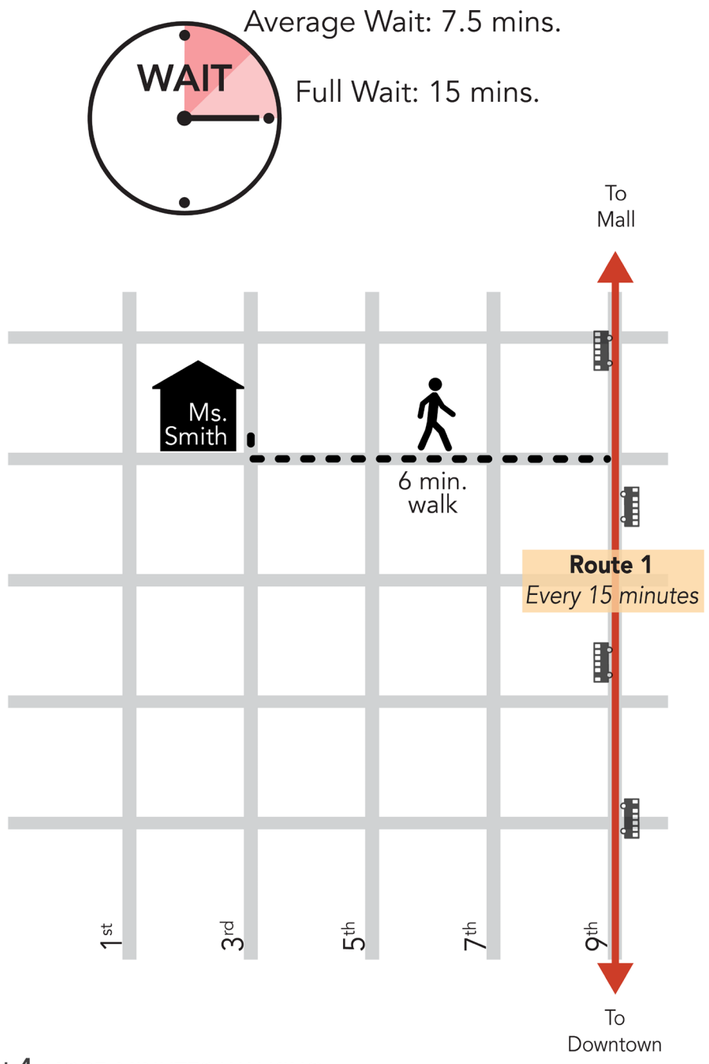
Another way to think about the question of ridership and coverage is to think specifically about how far a person should have to walk or bike to reach a bus stop, and how long they should have to wait, on average, before the next bus comes.

If TARC planned transit service around longer walks to service, more bus routes could operate more frequently on some corridors. Many riders would wait less and would get to their destination sooner, even with a slightly longer walk. Because it is more useful in getting people to their destinations sooner, frequent service tends to generate higher ridership, even when it requires longer walks.

Walking and waiting are important to consider on their own, because both of these activities add time and inconvenience to any transit trip, and different people have a wide variety of preferences regarding each. A young, able-bodied person who is in a hurry might have no problem walking half a mile to a bus stop if the bus is always coming soon. But longer walks can be challenging for many people, including seniors, disabled people, and those traveling with young children, groceries or large items.

Is it more important for service to be frequent with short waits, or for service to be available nearby within a shorter walk?

Minimize Waiting
with routes coming every 15 mins., more widely spaced.



+4 MORE MINUTES WALKING
-7.5 FEWER MINUTES WAITING ON AVERAGE =
3.5 MINUTES FASTER ON AVERAGE

Minimize Walking
with closely-spaced routes coming every 30 mins.

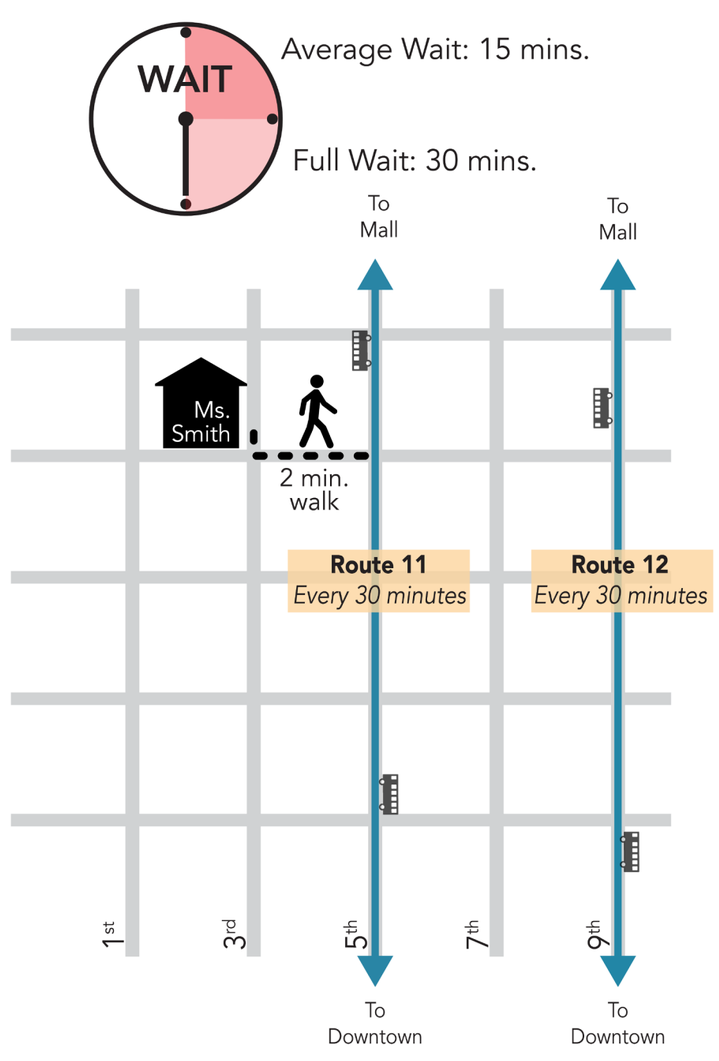


Figure 50: In many situations, consolidating service on many infrequent routes can make the average person's trip faster. However, people may value shorter walks over shorter waits.

Key Choice: What Level of Transit Resources is Enough?

Wrestling with the first choice—how to balance ridership and coverage—and changing the transit network to meet clear goals that match the community values, may improve people's sense that the transit network is delivering on their goals and is worth further investment.

Yet it is also worth considering whether the current investment level is sufficient to meet the community's overall transportation and economic development goals. As noted on page 4, the Louisville region has expanded physically, with people and jobs moving farther out from the core since the dedicated occupational tax for TARC was approved in 1974. With that expanded footprint has come expanded costs to serve the larger range of developed places in the region.

Investment and Relevance

The chart in Figure 51 compares two service statistics for some of Louisville's peer cities. These include similarly sized urban areas like the nearby Cincinnati (OH) and Indianapolis (IN); the more further away Memphis (TN), Richmond (VA), and New Orleans (LA). We also included the slightly smaller Knoxville (TN) and Spokane (WA), and a Canadian city, Hamilton (Ontario) for comparison.

For each of these cities, we calculated how much that community invests in transit service relative to its size (by dividing annual service hours per capita), and compared that to how much ridership these cities see relative to their size (annual boardings per capita).

Generally, places that invest more in transit service relative to their population see a higher level of ridership relative to their population. People can't ride bus routes that don't exist. Figure 51 demonstrates this principle of **"if you invest, people will ride".**

Investment and Transit Goals

Louisville could increase transit frequency and ridership without investing in more service. However, this would require cutting and reallocating low-ridership services. There is no way around this basic geometric fact.

There are only two paths forward, if the region wants to increase transit frequency, transit usefulness, and transit ridership:

- Cut low-ridership coverage services, or
- Supply more transit service.

When there is new revenue available for transit, ridership can be increased without cutting coverage. The growing resource pot protects the community from having to make painful trade-offs between competing, but closely-held, values. **In the difficult fiscal condition that TARC faces, additional funding would protect existing riders and the community from potentially painful service reductions.**

The questions of how to balance frequency with coverage, and how much service to pay for, both relate to public trust in TARC and people's feelings about whether the transit network is valuable and relevant to their lives. **If the goals for transit that the agencies are pursuing are not currently aligned with the goals of the community, or if people do not understand what goals the agencies are trying to achieve, then there will be some natural reluctance to increase investment in the transit system.**

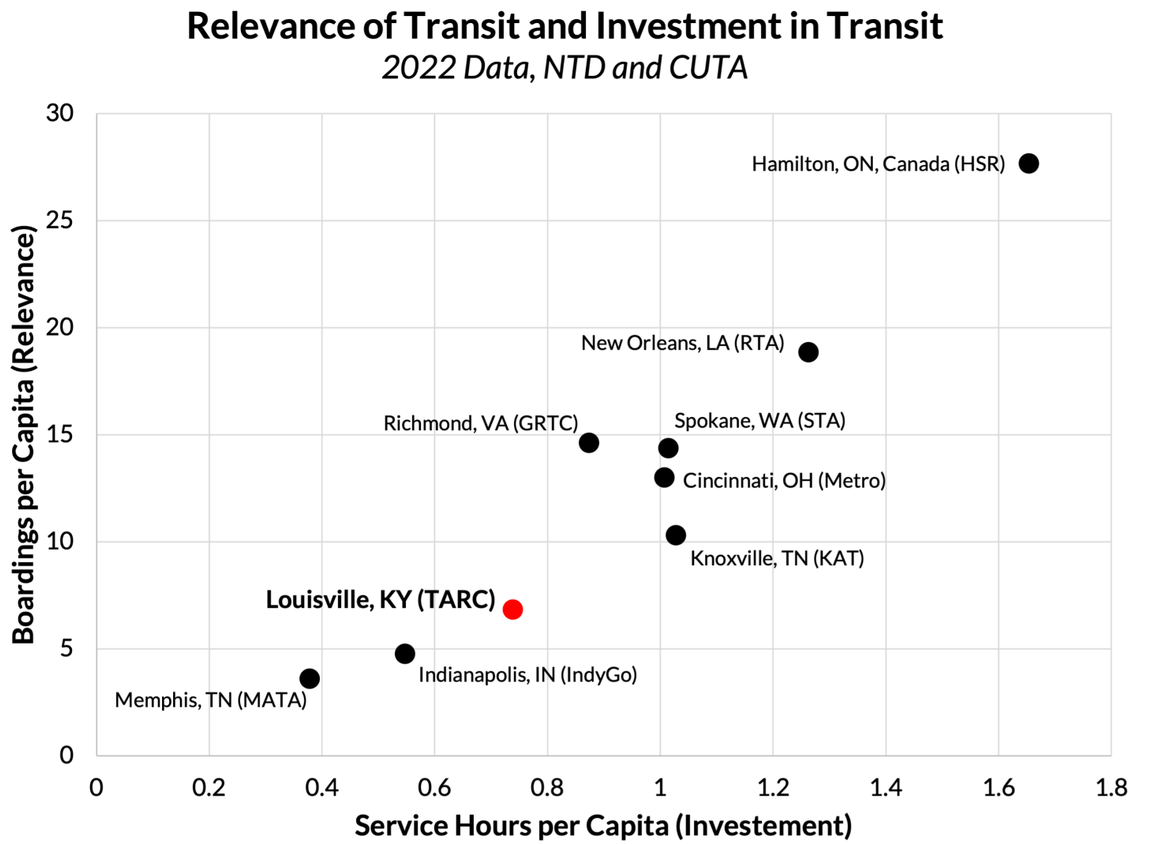


Figure 51: Service Hours per Capita (Investment) and Boardings per Capita (Relevance) for Louisville compared to peers shows the principle of "if you invest, they will ride".

6: Next Steps

Next Steps

This report is the first step working with the Louisville Community for *TARC 2025: Moving Forward Together*. This study of the existing network was launched with a coinciding survey of riders and non-riders in the Louisville area. Equipped with the analysis of the current system and the opinions of the public - the project team, TARC members, and city staff gathered for a week in May 2024 to draw three new concepts for the TARC system. We drew two alternative Concepts to account for the upcoming fiscal gap, and one Concept assuming additional revenue would be procured for increased transit service.

We will take several key actions throughout the summer to develop and present these Concepts. We will hold a workshop with key stakeholders to help educate them on the trade-offs laid out in this report. We are completing maps and analysis of the three Concepts to compare key outcomes relative to the existing TARC Network. These will be critical pieces which will form the first round of public engagement on the Concepts by the end of July.

Throughout this process, we urge you, the community, to think about what priorities you want to emphasize for the TARC network, and to provide your input during public engagement. This is when the concepts will be first shown to the public to illustrate what level of service is possible within the new budget constraints, and the impacts of those constraints on transit outcomes like access to opportunities and proximity to transit. Your feedback from this phase will inform the design of two Draft Recommended Networks: one with the constrained budget and the other with a higher budget assumption than today. We will summarize those Drafts for stakeholders and the public to review in Winter 2024. The second round of public engagement will be used to finalize these two networks. The intent is to implement the new constrained network between August 2025 and early 2026.

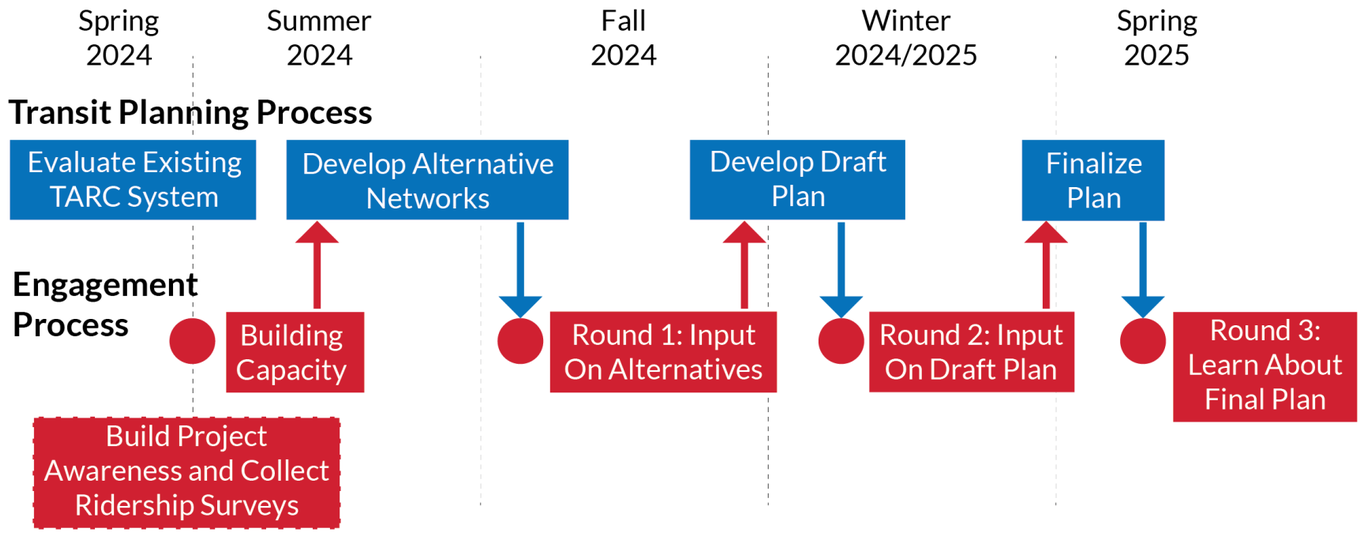


Figure 52: The process of designing, analyzing, and engaging the public on draft plans that will guide TARC 2025.