Metro Transit Network Redesign Choices Report - Executive Summary

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metro transit | Network Redesign

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UrbanAssets

The Metro Transit Network

Madison's Public Transportation System

In Madison, public transportation is provided by Metro Transit, a division of the City of Madison's Department of Transportation. Metro Transit provides two kinds of service:

- **Transit.** This is the service offered by most buses, operating on fixed routes and following published schedules. Anyone in Madison can use transit by boarding a bus at a bus stop and paying the appropriate fare.

- **Paratransit.** This is a specialized door-to-door service for people with disabilities that make it difficult to use transit. Paratransit is part of how Metro Transit fulfills its obligations under the Americans with Disabilities Act (ADA).

When we talk about the "transit network", we mean the network of regular bus routes. This redesign does not envision changes to paratransit. As of early 2021, the transit network includes:

- 23 routes that operate all day, seven days a week. Service typically starts between 5 and 7 AM, and ends around 11 PM.

- 18 routes that operate on weekdays only, including ten routes which operate only during the morning and afternoon peaks (more or less 6 to 9 AM and 3 to 6 PM).

- 4 weekend-only routes. These routes combine one or more weekday routes to expand the area coverable by a single bus on weekends.

The map in Figure 1 shows the routes currently operated by Metro Transit.

Although Metro Transit service is centered around City of Madison, some of its service is funded by neighboring municipalities, and by organizations such as the University of Wisconsin and the Madison Metropolitan School District.
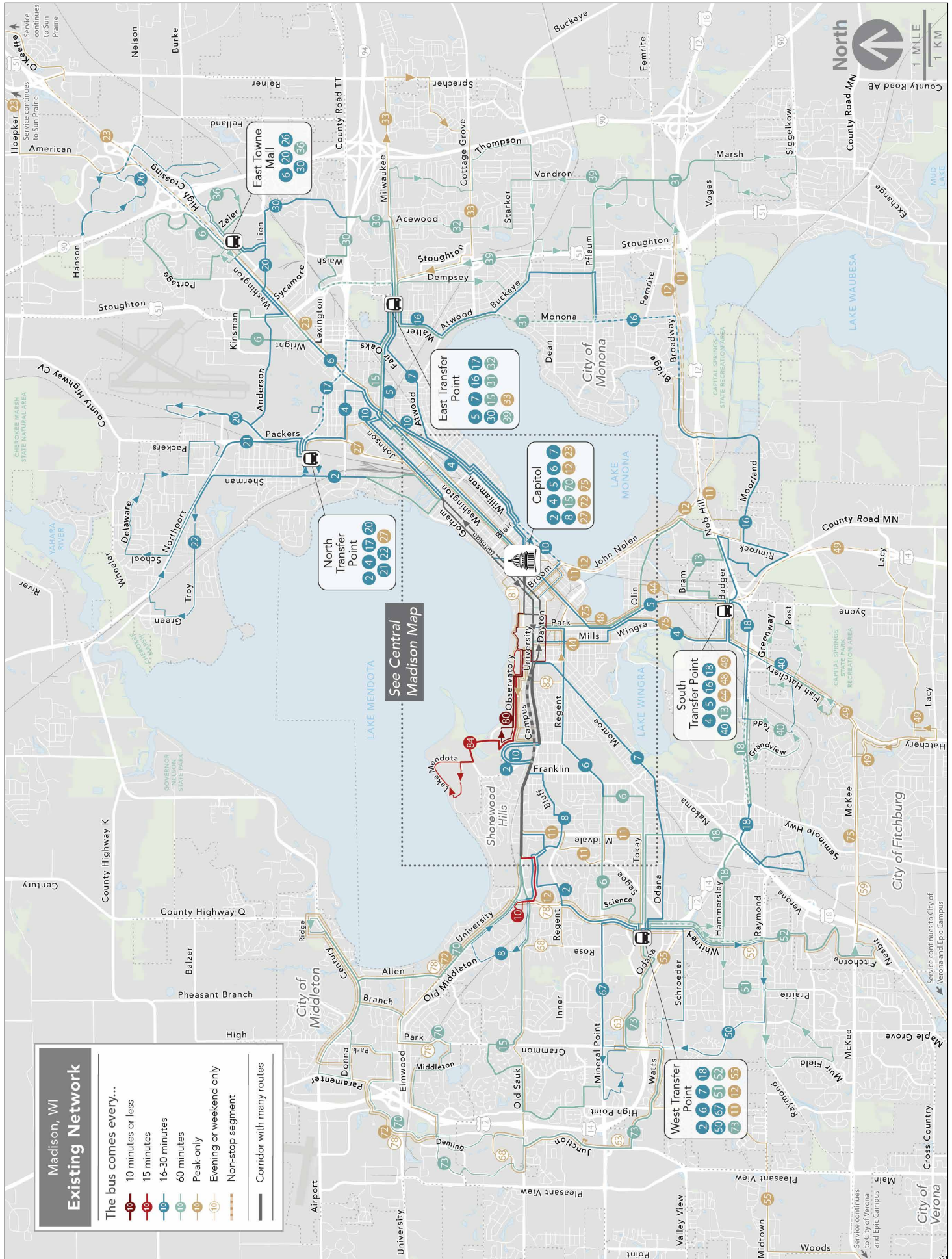
Madison, WI
Existing Network

The bus comes every...

- 10 minutes or less
- 15 minutes
- 16-30 minutes
- 60 minutes
- Peak-only
- Evening or weekend only
- Non-stop segment
- Corridor with many routes

North Transfer Point
2 4 17 20
21 22 27

East Towne Mall
6 20 26
30 36

East Transfer Point
5 7 16 17
5 7 16 31 32
30 39 33

Capitol
2 4 6 7
2 4 5 6 12 23
8 15 70
27 72 75

South Transfer Point
4 5 16 18
4 13 44 48 49
40 18

West Transfer Point
2 6 7 18
50 51 52
50 67 11 55
73 11 12 55

Figure 1: Metro Transit network of bus routes, as of early 2021. The network is centered around Downtown Madison, where many routes converge. Most outlying areas are served by routes that connect to a local transfer point, where passengers can transfer to routes going Downtown or across town.

What makes a Transit Network Useful?

Access and Freedom

Wherever you are, there is a limited number of places you could reach in a given amount of time. These places can be viewed on a map as a blob around your location.

Think of this blob as a "wall around your life." Beyond this area are things you can't do because it simply takes too long to get there. The extent of this area affects your options in life: for employment, school, shopping, or whatever places you want to reach.

The technical term for this is access, but it's also fair to call it freedom, in the physical sense. If you can go to more places, you have more choices, so in an important sense you are more free.

How Transit Expands Access

The basic point of transit is to increase the number of useful places people can access in a reasonable amount of time without driving, beyond the area they could reach on their own.

On transit, the extent of your access is determined by:

- The **network,** including transit lines with their frequency, speed, and duration. These features determine how long it takes to get from any point on the network to any other point.

- The **layout of the city.** This determines how many useful destinations can be located near transit stops. For example, where there are more people or useful destinations near a given stop, good access from that point is of value to more people.

- Your **location.** This determines which routes are close and frequent enough to be useful to you.
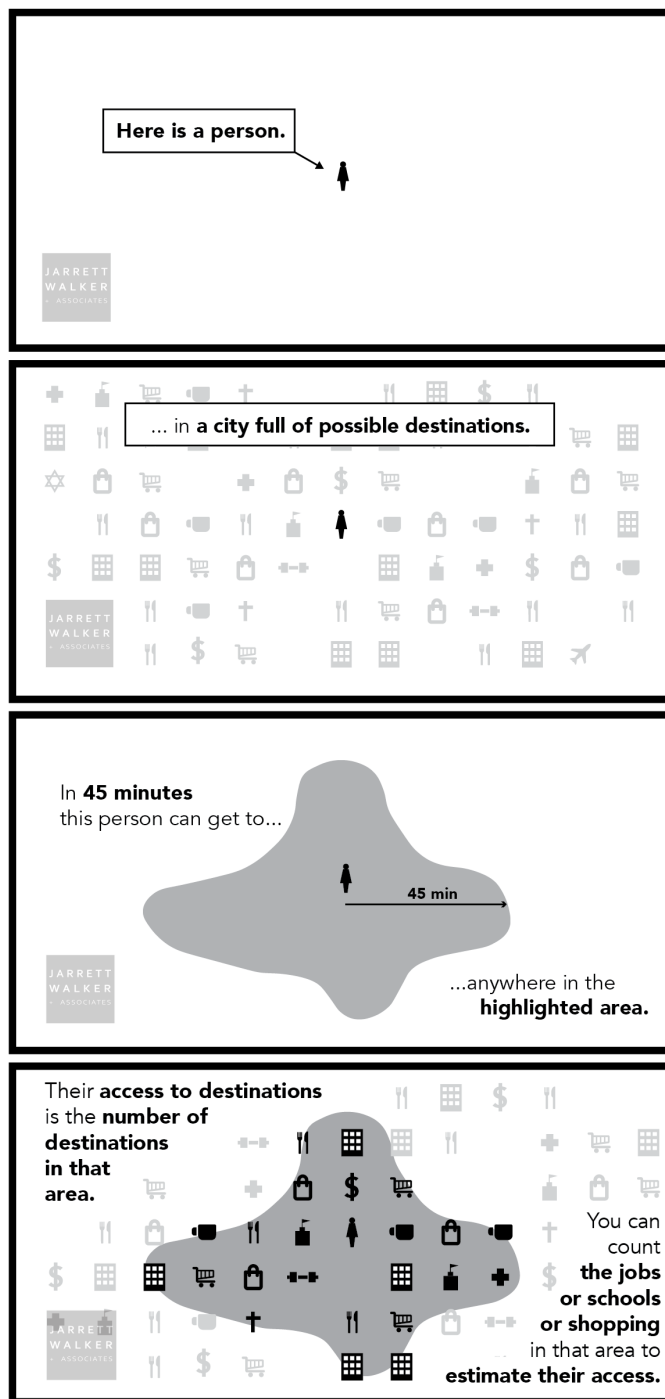
WHAT IS ACCESS?

Figure 2: Access is the ability to get from your current location to places you need to go. The more places you can access in a reasonable amount of time, the more freedom you have to live your life in the way you need. Transit helps increase this freedom by providing access to more places, without needing to drive.

Why does the transit network need a redesign?

A twenty-year old system...

The basic shape of Madison's current transit network was established in 1998. The system revolves around five hubs:

- The **Capitol** in Downtown Madison, where many routes converge on their way to and from different sides of town. Most Downtown routes are in fact connecting two of the:

- **Four Transfer Points** (North; East, South and West). Most outlying parts of Madison are served by bus routes that connect to a Transfer Point. From there, passengers connect to a second route to go Downtown or across town.

...that leaves some people and places behind...

The Transfer Point system has some advantages. By combining people from many routes onto the same bus going into downtown, it uses resources efficiently, which enables Metro Transit to provide more extensive service. Timed connections also make it easier for people to travel within their side of town, or between areas far from downtown.

The disadvantage is that transfers impose delay on the passenger. That time can be worth it in the context of a fairly long trips, but Metro Transit is unusual in requiring transfers for many short trips into downtown, increasing travel times from the affected areas. This problem is largest in the North and South parts of the city, which can have long travel times over short distances.

This is illustrated by Figure 3. This map shows that Metro Transit can connect people to many jobs in 45 minutes or less if they live close-in, but not if they live farther out than the Transfer Points.

This contrast is further illustrated by the examples provided in Figure 5 on page 8 and Figure 6 on page 9.

...and can be confusing even where it works best.

The hourglass shape of central Madison means transit service naturally converges on a small number of streets as buses approach Downtown. This is both necessary and useful, providing the most service in the areas where the most people are nearby to use it.

But **even though bus volumes are high Downtown, the actual frequency of service tends to be fairly low**. This is the result of decisions that favor service in many directions over service that comes often. For example, on Gorham and Johnson streets:

- Routes 2, 5 and 10 each operate every 30 minutes on weekdays, all day. That's six buses per hour per direction.

- Six buses per hour is enough to provide a frequency of every 10 minutes along this segment, which would be useful for local travel, but the routes are not scheduled to do that. Instead, there's a bus every 12 to 18 minutes eastbound, and every 4 to 15 minutes westbound.

There are similar situations on every major east-west street Downtown: East Washington, Jenifer, and University Avenue. And on each of these streets and many others, service is further complicated by routes that change or don't operate on weekends and evenings.

The result is that **there are many buses on many streets, but there are relatively few trips anyone could take where the fastest bus comes more often than every 30 minutes.**
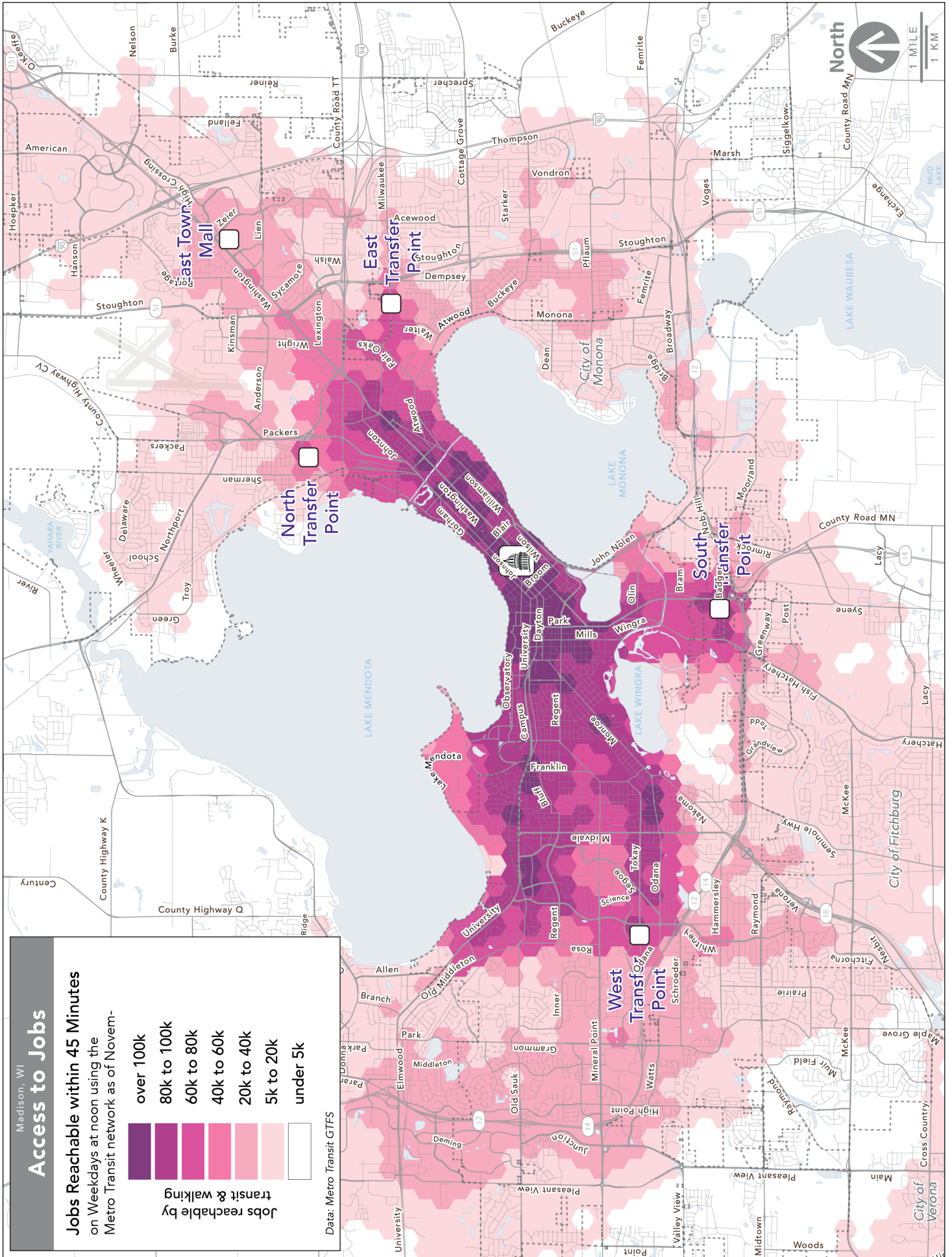
Access to Jobs

Madison, WI

Jobs Reachable within 45 Minutes

on Weekdays at noon using the Metro Transit network as of November—

Jobs reachable by transit & walking

- over 100k
- 80k to 100k
- 60k to 80k
- 40k to 60k
- 20k to 40k
- 5k to 20k
- under 5k

Data: Metro Transit GTFS

North Transfer Point

East Transfer Point

East Towne Mall

West Transfer Point

South Transfer Point

North

1 MILE
1 KM

Figure 3: Metro Transit network of bus routes, as of early 2021. The network is centered around Downtown Madison, where many routes converge. Most outlying areas are served by routes that connect to a local transfer point, where passengers can transfer to routes going Downtown or across town.

Madison, WI
Existing Network

The bus comes every...

10	10 minutes or less
10	15 minutes
10	16-30 minutes
10	60 minutes
10	Peak-only
10	Evening or weekend only
	Non-stop segment
	Corridor with many routes

Capitol

Routes that terminate at the Capitol:

2 4 5 6 7 15 12 27
8 70 23 72 75

Non-stop service on Campus Dr. on dashed segment

8 10 15 70 12 72

North

1/2 MILE
1/2 KM
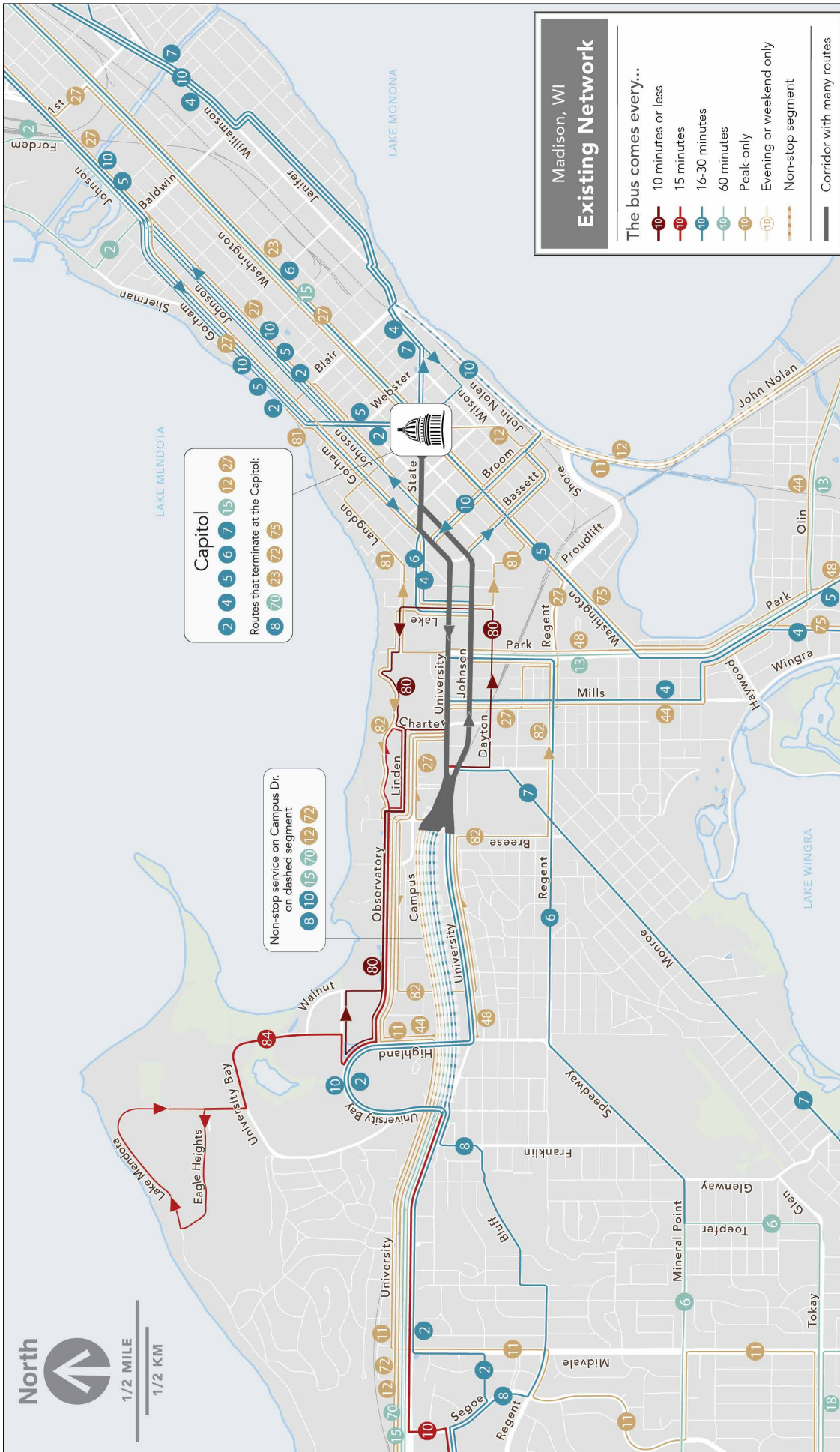
How the Usefulness of Transit Varies by Location

This map shows how far someone can reach by transit and walking in 45 minutes or less, starting from the location shown. Travel times include: walking to the nearest bus stop, the average wait for the next bus, time on the bus, and any transfers.

Example of High Access – Downtown Madison

How far can I travel in **45 minutes** from

Capitol

Jobs reachable	112,500
Residents reachable	128,600

This map shows the areas of Madison you could reach in 45 minutes on average if starting the trip between 12:00pm and 1:00pm using the October 2020 Madison Metro transit network.

0   1   2   3 mi
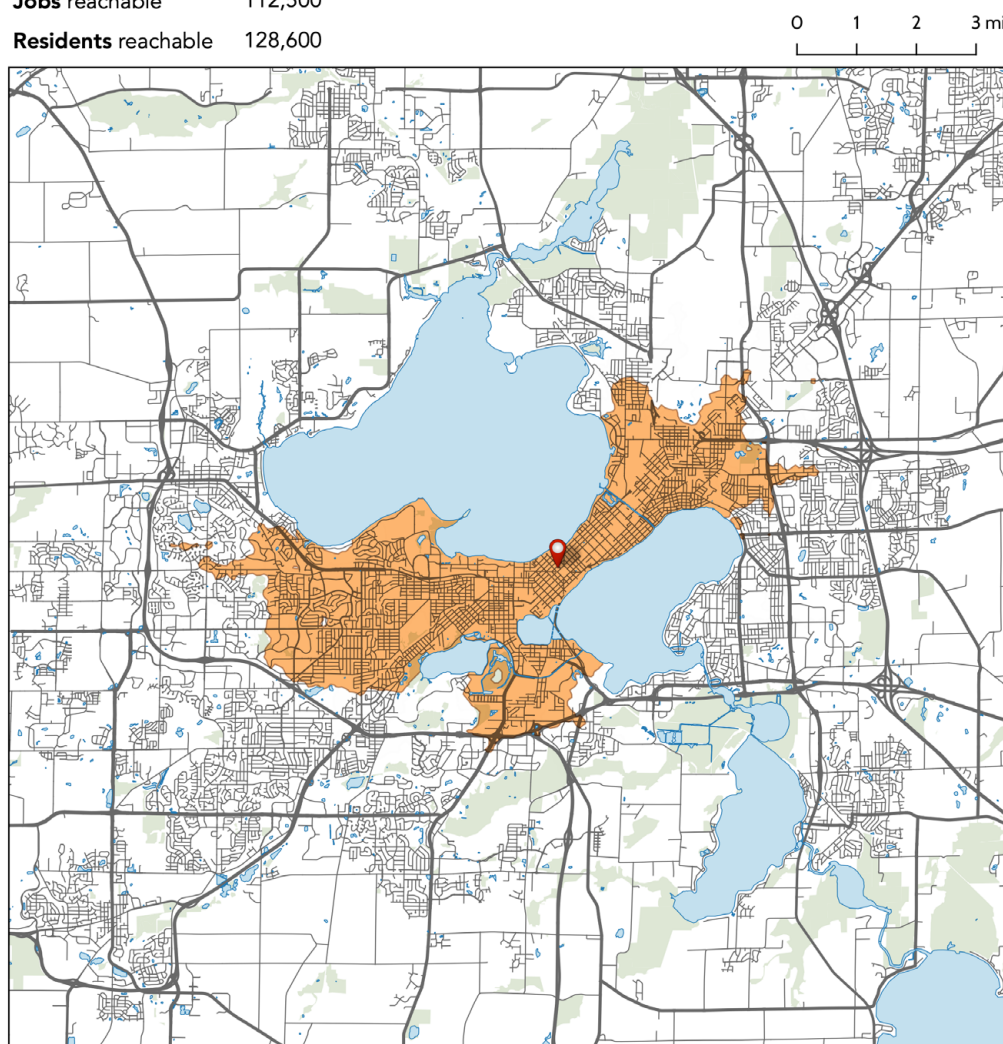
This Downtown location features direct service to all of Madison's inner neighborhoods. Even though most routes are not very frequent, the direct services and central location make it possible to **reach about half of city residents and 60% of jobs in Madison in 45 minutes or less.**

Figure 5: An example of travel-time maps from the Capitol in Madison. Compare this with the example on the next page from Northside Town Center.

How the Usefulness of Transit Varies by Location

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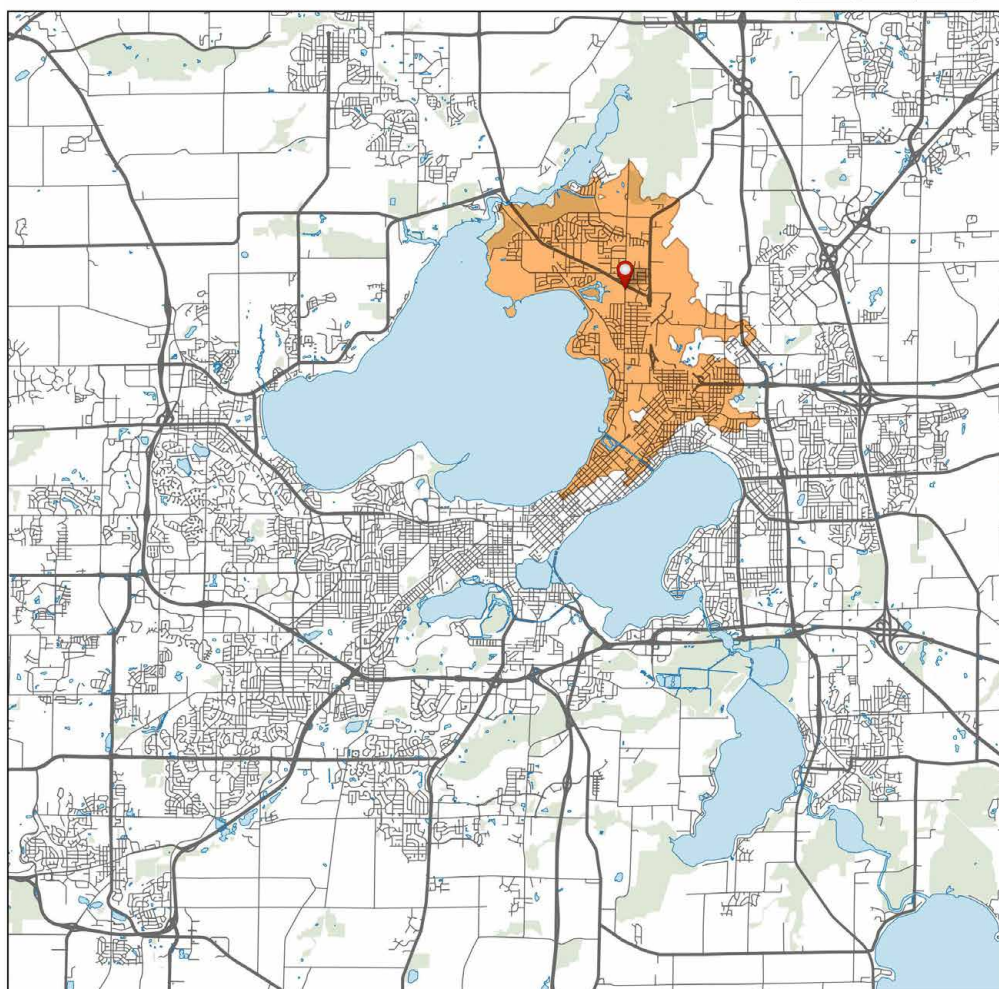
Example of Low Access – North Side

How far can I travel in **45 minutes** from

Northside Town Center

This map shows the areas of Madison you could reach in 45 minutes on average if starting the trip between 12:00pm and 1:00pm using the October 2020 Madison Metro transit network.

Jobs reachable   18,400

Residents reachable   41,100

0   1   2   3 mi

This is 4.5 miles from the Capitol. Routes 21 and 22 go to the North Transfer Point, where passengers can make a timed connection with buses that go to other areas. The combined effects of being a few miles away from downtown, having to wait for buses that come every thirty minutes, and waiting an additional 5 minues at the Transfer Point, mean that it's only possible to **reach about 10% of jobs in Madison and 15% of residents in 45 minutes or less.**

Figure 6: An example of travel-time maps from the Northside Town Center. Compare this with the example on the previous page from the Capitol.

The Challenge of Transit in Madison

Downtown is the largest destination by far

As a state capital with a major university, and being geographically constrained by bodies of water on two sides, Madison has a higher concentration of housing, jobs near Downtown than many cities of similar size. Figure 7 below, shows the number of jobs within 1.5 miles of locations throughout the city. It illustrates the dramatic concentration of destinations in central Madison.

The high density of Central Madison allows buses to serve more trips, at a lower cost per passenger. Radial routes that extend outward also brings an abundance of destinations within reach of people throughout the city.

Nevertheless, most people aren't travelling Downtown

Metro Transit has limited resources and has logically deployed much of those resources towards Central Madison because many people's daily trips start or end there.

That means there isn't much direct service between peripheral areas, even though demand for trips to and from these areas exists, and has been growing. Approximately two-thirds of Madison's jobs are located beyond the isthmus and the university.

Metro has to answer to the travel needs of people traveling throughout the city, but **within a fixed budget, it has to make conscious trade-offs between where to focus the most service.**
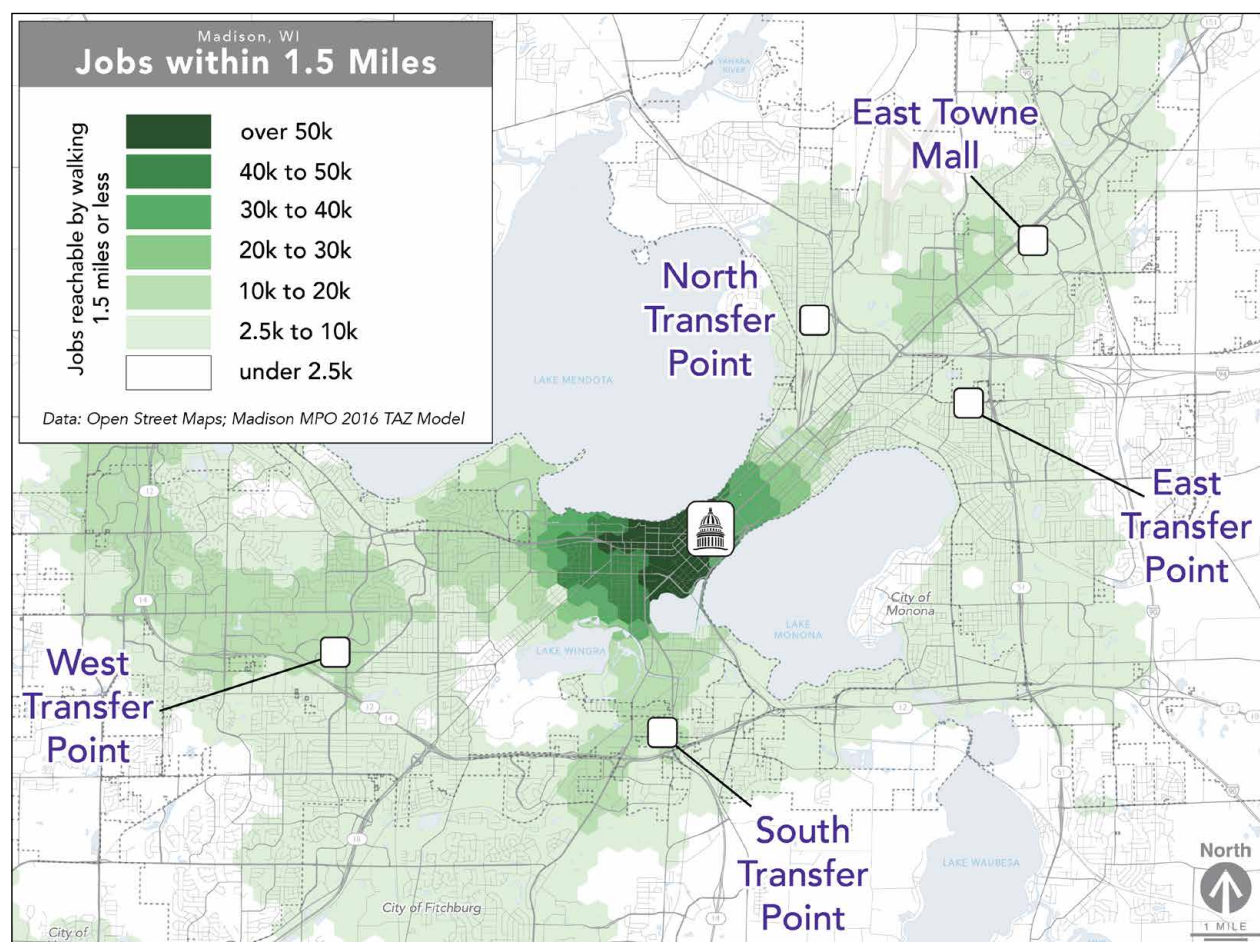

Figure 7: There are many jobs and opportunities within walking distance walking distance from locations along the UW campus, and across the isthmus. Radial transit routes allow people throughout the city to access the dense cluster of opportunities in central Madison with relative ease.

Most outlying areas aren't built for transit

Transit service between peripheral areas is further complicated by a range of transit hostile land-use patterns.

Transit is most effective when it can operate along linear, continuous corridors of high density, where many people are within a short walk of bus stops.

The meandering streets and dead-ends of some outlying areas mean that fewer people can walk to bus stops on main roads, or that buses have to make time-consuming deviations to get close to destinations. Barriers like freeways and railroads prevent people from reaching bus stops on the other side, even if they are close enough to see.

Figure 8 (at right) illustrates this by comparing the development pattern of Central Madison with that of an area around the Beltline freeway and High Point Road.
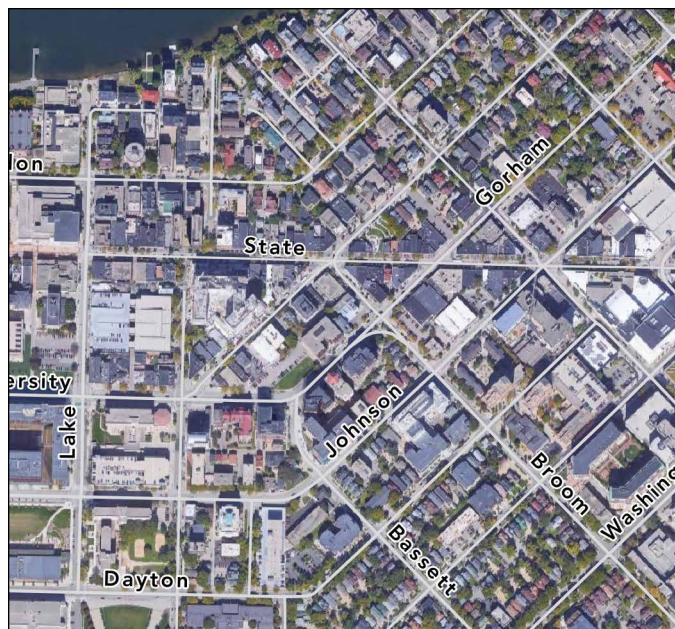
Imagery ©2021 Google, Imagery ©2021 , Maxar Technologies, USDA Farm Service Agency
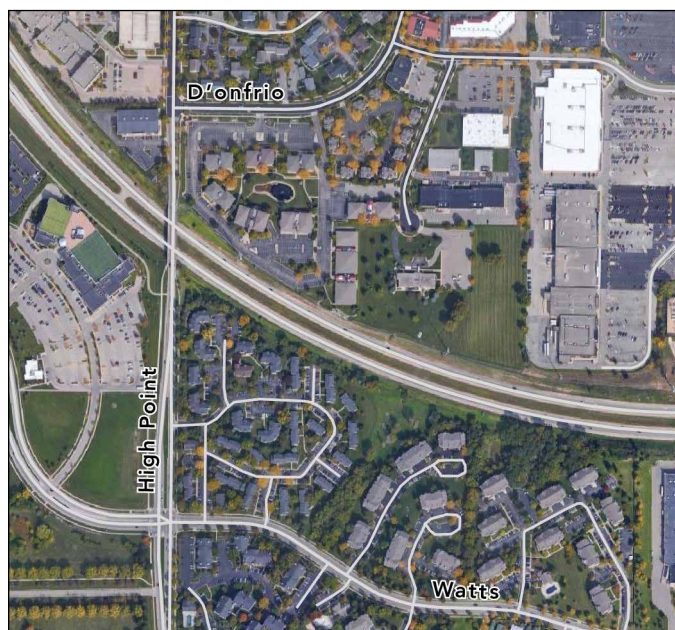
Imagery ©2021 Google, Imagery ©2021 , Maxar Technologies, USDA Farm Service Agency

Figure 8: In central parts of Madison like the upper example from Capitol Square, the connective street grid maximizes the area within short walk of each bus stop. In some peripheral areas like lower example from Watts Road and HIgh Point Road, a combination of landscaping, fences and dead-end roads makes it impractical or impossible to walk in a straight path, except to the main road.

How does the network redesign relate to BRT

Making the Most of BRT

As part of the Metro Forward plan, the City of Madison has been planning the construction and operation of a Bus Rapid Transit (BRT) system.

The Transit Network Redesign offers an opportunity to think about how BRT will work in the context of the whole network, and to extend its benefits beyond the East-West route to the whole city.

BRT will serve Mineral Point Road, University Avenue, Downtown Madison, and East Washington Avenue.". **It will run every 15 minutes or better, all day up to 7 days a week**, reaching many of Madison's busiest destinations.

Maximizing the value of this frequent cross-town service requires re-thinking all of Metro Transit's other routes, considering issues like:

- Should outlying routes still use the Transfer Points, or should they connect to BRT at other locations?

- Once BRT is implemented, what other routes should continue to run all the way Downtown?

The City intends for the East-West BRT to begin operating by 2025. The network redesign could be implemented beforehand, with a "pre-BRT" route that would serve the same areas.

At this time, plans for these two routes (shown as BRT B and BRT C on the map in Figure 9) remain conceptual. Many details remain to be worked out, and will be refined as part of the Transit Network Redesign.
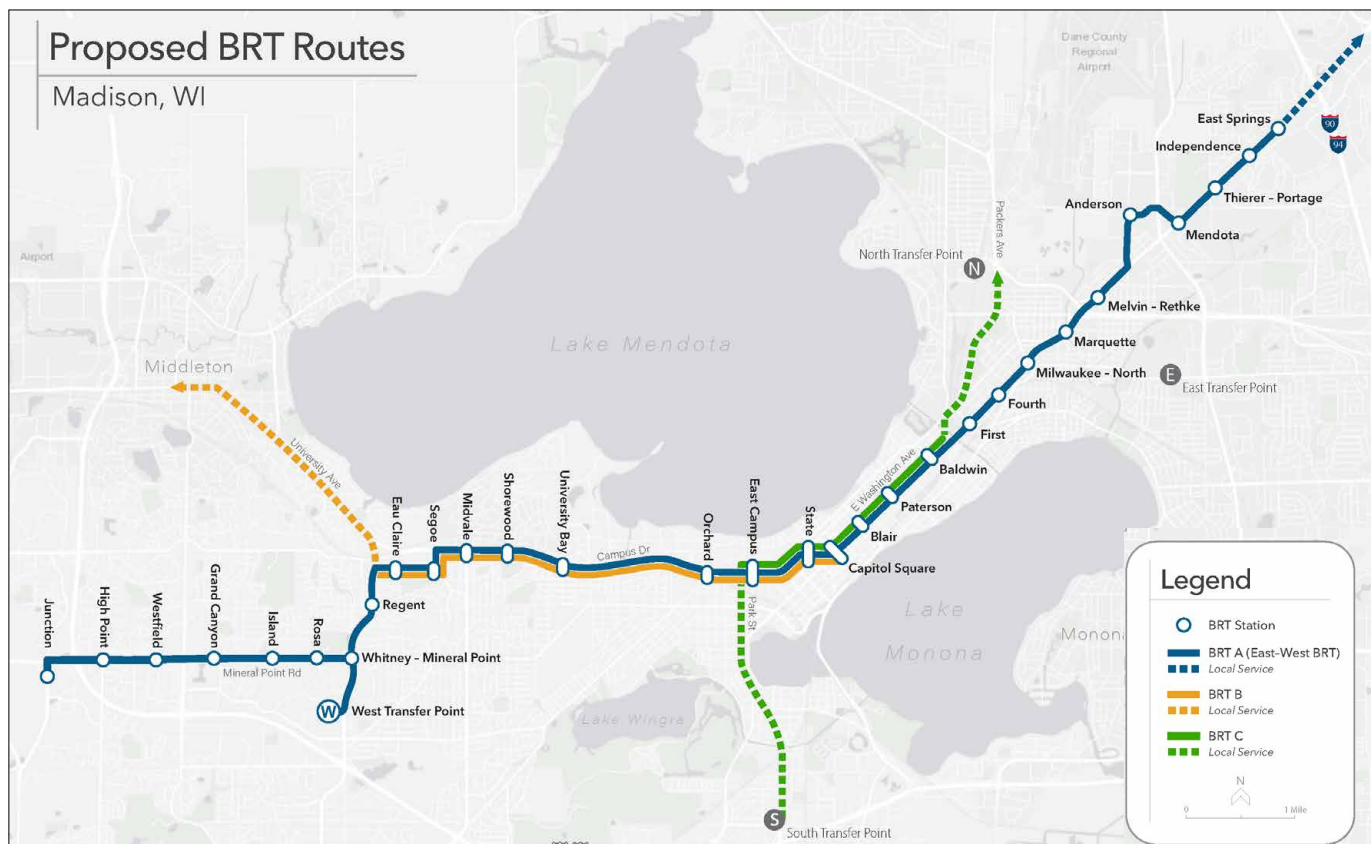

Figure 9: Bus Rapid Transit lines envisioned by the City of Madison, as of early 2021. BRT A is the main East-West Corridor; the City has undertaken significant detailed planning work on this route. BRT B and BRT C remain conceptual routes to serve other areas. BRT B would serve Middleton, while BRT C would be a North-South route. (Source: City of Madison)

How has the pandemic impacted Metro Transit use?

The COVID-19 pandemic has presented Metro Transit with significant short-term challenges. In response to low ridership and public health concerns, **Metro Transit has reduced service by over 20%**. Rush hour service has taken the biggest cut, wth some buses reallocated to peripheral routes to reduce crowding.

The conditions experienced during the pandemic won't last forever. But they do lay bare certain assumptions inherent in pre-pandemic service planning, and the unequal level of need experienced by different types of riders.

Ridership is way down.

Comparing Fall 2019 to Fall 2020:

- **Weekday ridership is over 80% lower**, from 51,000 to less than 10,000 boardings per day.

- **Weekend ridership is about 60% lower**. Saturday boardings went from nearly 16,000

to just over 6,000 per day. Sunday boardings went from nearly 12,000 to less than 5,000 per day.

- Data from spring 2021 shows that **ridership is slowly recovering**, but is still far from pre-pandemic levels.

Rush hour is almost gone.

Figure 10 shows that weekday ridership in pre-pandemic times was heavily concentrated in the morning and afternoon rush. Ridership peaked in the 4 PM hour was about twice as high as in the middle of the day.

Although Metro Transit continues to see more boardings in the mid-afternoon, there is no longer a clear 8-to-5 pattern dominating ridership.

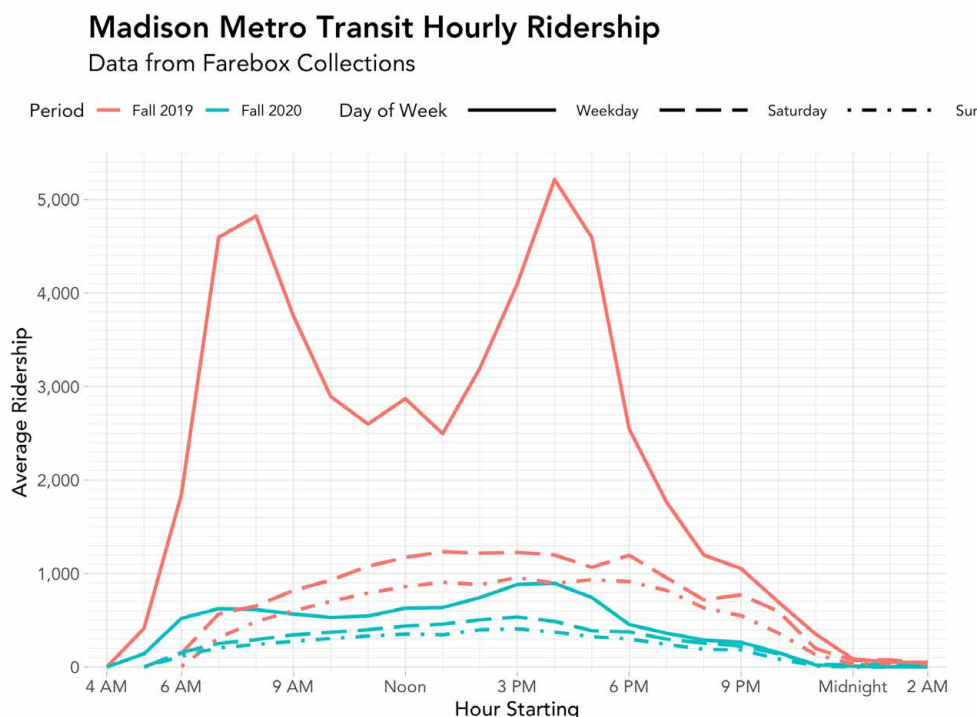This change relates not just to how many people were riding, but who was riding.

Madison Metro Transit Hourly Ridership
Data from Farebox Collections

Period — Fall 2019 — Fall 2020   Day of Week —— Weekday – – – Saturday · – · – · Sun

Figure 10: How ridership varied by hour and by day of the week in Fall 2019 and Fall 2020.

Ridership change has been unequal

The charts in Figure 10 and Figure 11 show how ridership has changed by area and by time of day. The maps in Figure 12 and Figure 13 (see next page) give us further context for what we observe. Specifically:

- Pre-pandemic service and ridership were heavily focused on two groups: the University of Wisconsin and downtown office jobs. This is clear from where bus routes go, where boardings took place, and the dominant 8-to-5 pattern in 2019 weekday ridership.

- During the pandemic, **University-related ridership has dropped the most.** This is explained by the prevalence of remote learning, and perhaps also in part by a greater willingness on the part of students and staff to commute by bicycle or car.

- **Ridership has dropped the least in peripheral low-income areas and communities of color.** This reflects the areas that are most likely to house many essential workers, and where people are likely to lack alternatives to transit for their mobility needs.

- The Fall 2020 patterns of weekday and weekend ridership by hour suggests that **most pandemic-era transit users are likely essential workers with daytime hours, and people on non-work trips.**

Current ridership is not a picture of the future. As the pandemic recedes, transit ridership will likely increase and may return to pre-pandemic levels. We share this snapshot because of what it reveals about the people who rely most on transit, and whose travel purposes are so essential to society that they continue even in a public health emergency.
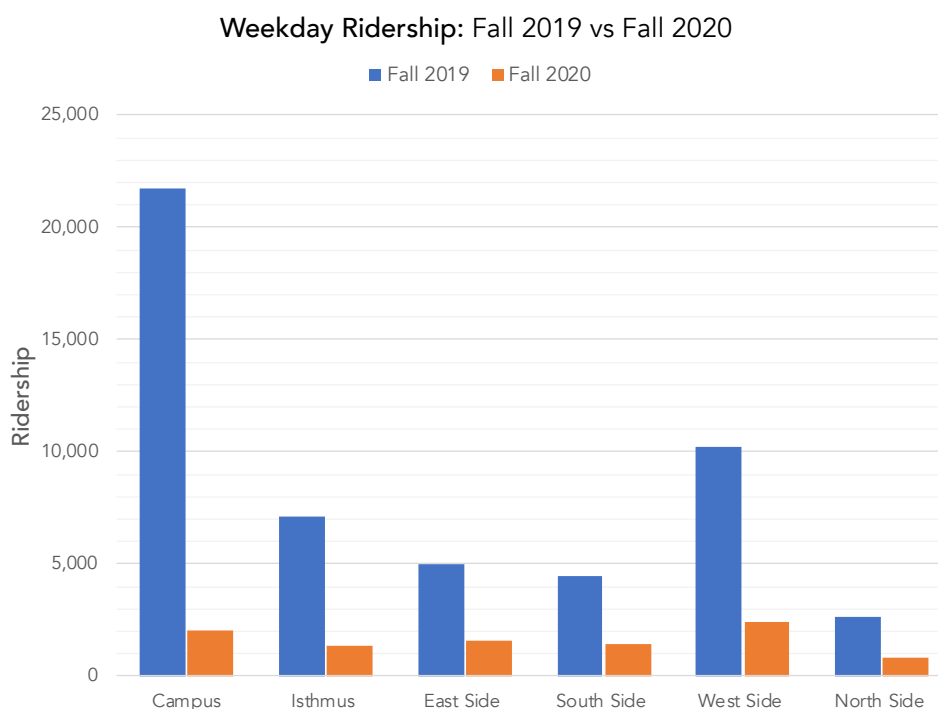

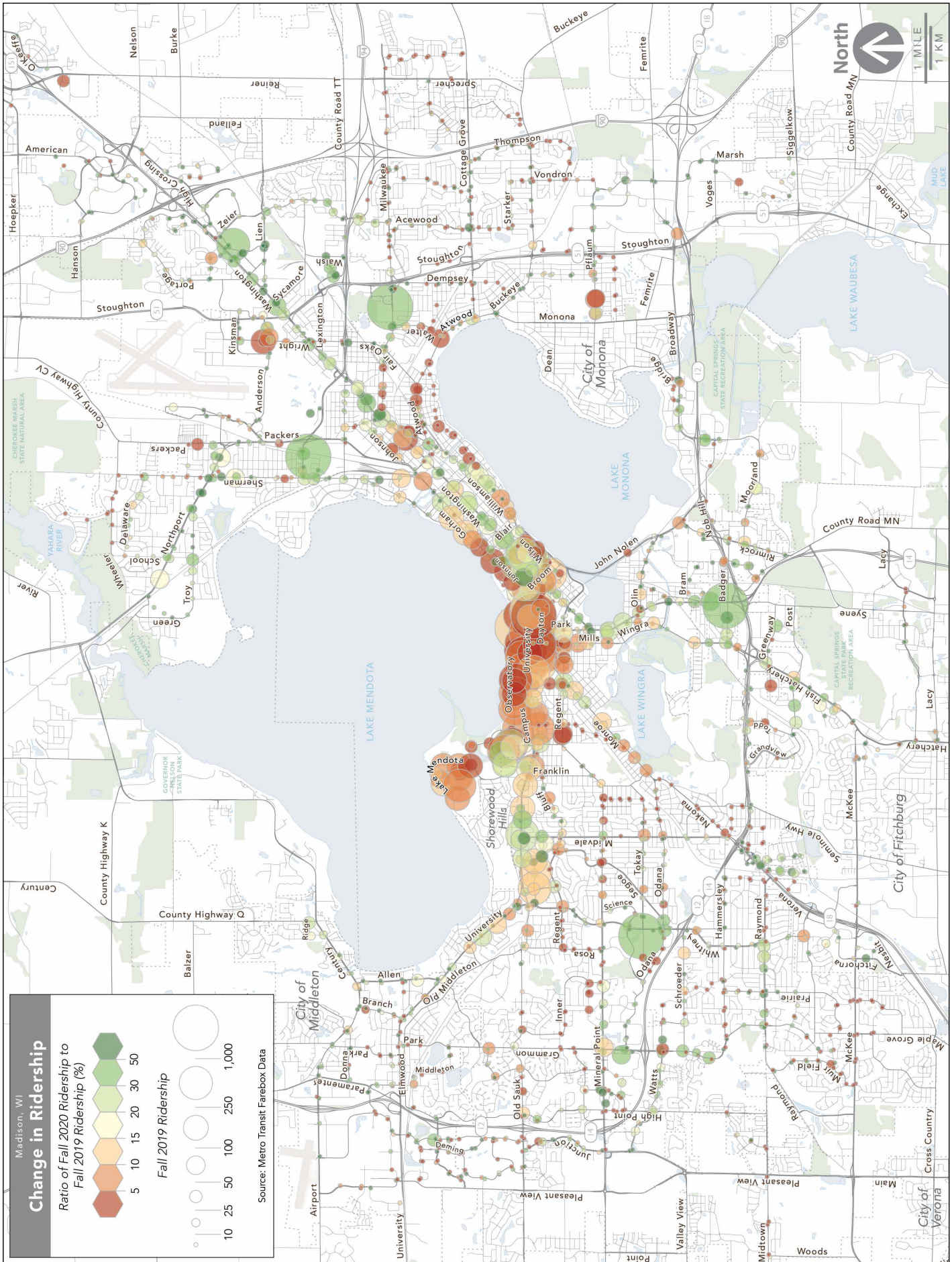Figure 11: How weekday ridership has changed from Fall 2019 to Fall 2020 in different parts of Madison.

Figure 12: The map above shows ridership changed from Fall 2019 to Fall 2020. Each dot represents one bus stop. The larger the dot, the more people used this bus stop in Fall 2019. Red and orange dots are stops where ridership fell the most from 2019 to 2020. Green dots are stops where ridership fell the least.

Change in Ridership

Madison, WI

Ratio of Fall 2020 Ridership to Fall 2019 Ridership (%)

- 50
- 30
- 20
- 15
- 10
- 5

Fall 2019 Ridership

- 1,000
- 250
- 100
- 50
- 25
- 10

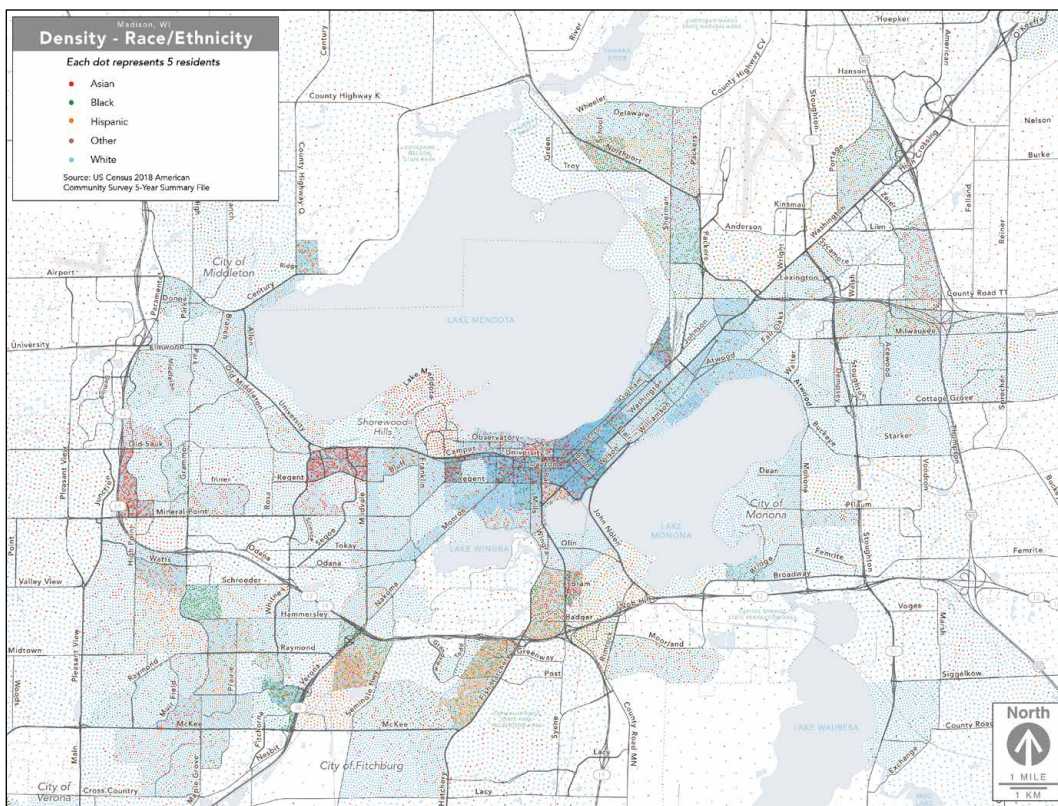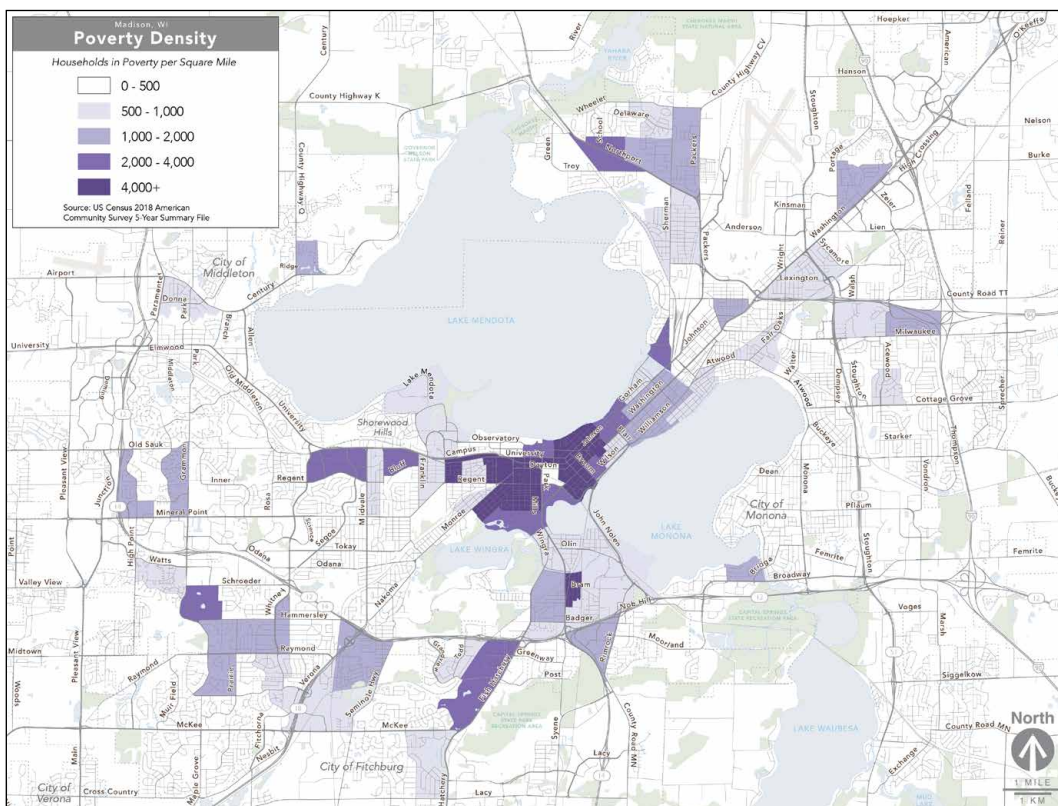Source: Metro Transit Farebox Data

Figure 13: The maps above show where people in poverty and people of different racial and ethnic groups live in Madison. It is clear from this map that (a) the strongest ridership drops were in the vicinity of the University of Wisconsin, and (b) there was the least change peripheral low-income areas, where people of color disproportionately live.

Key Choice: Ridership vs. Coverage

The Metro Transit Network Redesign is a unique opportunity to rethink the purpose of Madison's transit system, and how it relates to other ways of getting around such as cycling and driving.

The most basic choice is the degree to which the transit system should be pursuing ridership or coverage.

Designing a transit system for **high ridership** serves several popular goals, including:

- Competing more effectively with cars, so that the city can grow without increasing traffic congestion.

- Reducing the public subsidy needed for each ride by carrying more passengers.

- Minimizing climate impact by replacing single-occupancy vehicle trips with transit trips, reducing greenhouse gas emissions.

- Supporting dense and walkable development.

On the other hand, many other popular goals for transit don't require high ridership. Designing a transit system for **high coverage** serves these goals:

- Ensuring that everyone in the service area has access to some transit service, no matter where they live.

- Providing access for people without access to personal vehicles.

A transit agency 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. Every dollar that is spent providing high frequency along a dense corridor is a dollar that cannot be spent bringing transit closer to each person's home or reaching areas at the edge of the city, and vice versa.

How the Pandemic Changes This

Many people who used transit before are not during the pandemic. It's unclear when many people will once again consider transit as an option.

So a more frequent network might not result in higher ridership immediately. Those effects take time. For example, some people will choose where to live based on bus service, and only then begin to ride.

But regardless of ridership, a more frequent network would increase the amount of access provided between different parts of Madison, and make transit useful for more trips.

The key challenge remains whether it is acceptable for some people to walk further to reach their bus stop, or for some areas not to receive service.
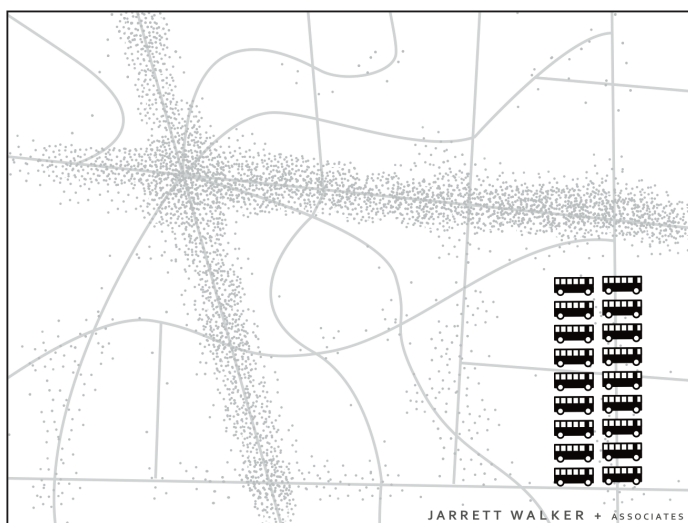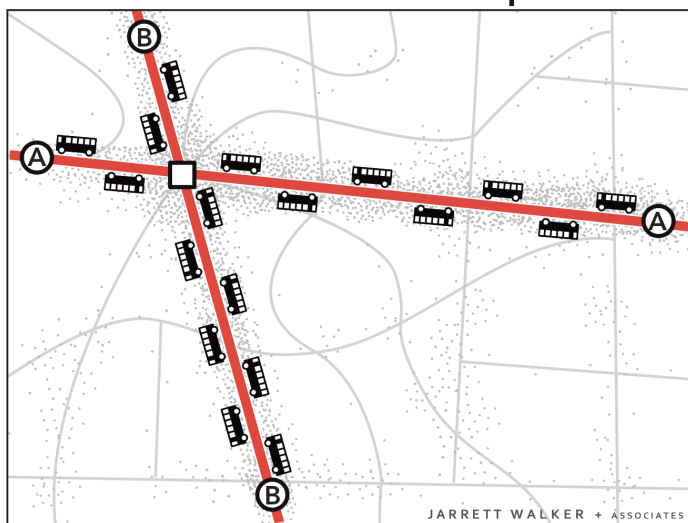
Imagine you are the transit planner for this fictional town.

The dots scattered around the map are people and jobs.

The 18 buses 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?

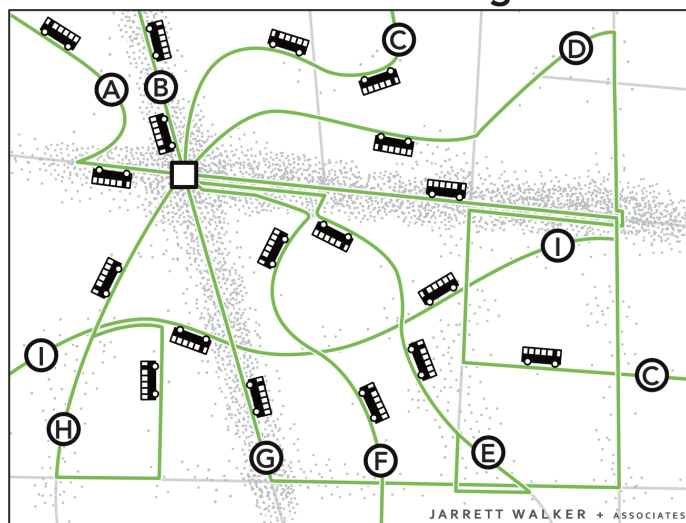## Maximum Ridership

Maximum Coverage

Figure 14: Comparing an imaginary town where transit is run with the goal of maximizing frequency and ridership (left) vs. the same town where transit is run with the goal of providing a little service near everyone (right). The maximum ridership (left) network has very frequent service, but only on the roads where the most people live and work. The maximum coverage network has service on every road, but it doesn't come very often. Madison's existing network looks more like the one on the right. Should a redesigned network focus more on frequency, even if some people will have to walk farther to reach service?

Is it more important for bus service to be very frequent, or for service to be available very nearby?

Key Choice: Walking vs. Waiting

Most people in Madison live and work close to bus service, but very little of that service is coming soon.

- 82% of residents and 89% of jobs in Madison are located within 1/4-mile of a bus stop.

- Only 11% of residents and 17% of jobs are near a route where the bus comes every 15 minutes or better throughout the day.

These two facts are connected. Metro Transit's network is designed to reach every neighborhood in the city, and to provide a bus stop within a 5 minute walk of most front doors. As a result, the network is stretched thin. Most routes run every 30 to 60 minutes, and many streets only have bus service in one direction.
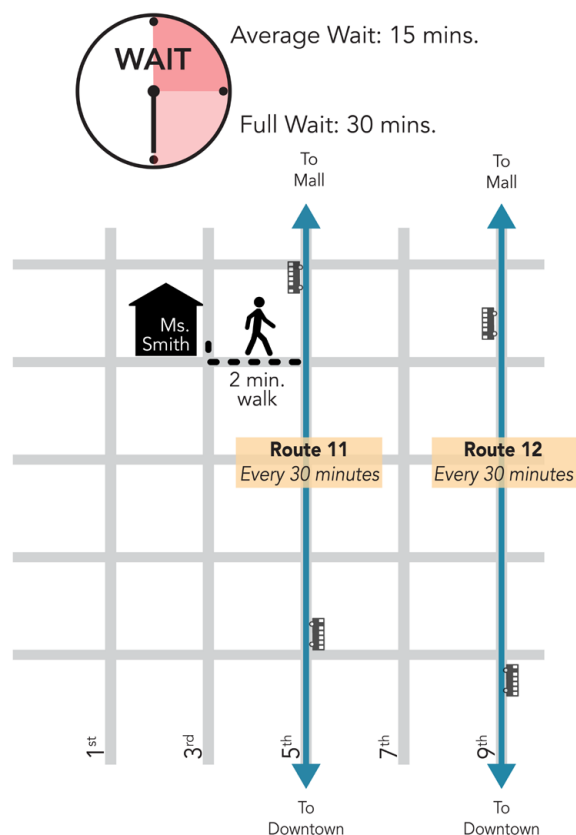
If Metro Transit planned a network around longer walks to service, more bus routes could operate frequently, every 15 minutes or better. In turn, many riders would wait less and would get to their destination sooner.

But longer walks can be challenging for many people, including some who really need transit. This includes some people who experience physical disabilities, but also people traveling with young children, older adults, or anyone carrying a large enough bag.

Frequent service that gets people where they are going sooner tends to generate higher ridership, even when it requires longer walks**.** This is one of the core principles underlying BRT. Should it be extended to more routes, or generalized?

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

WAIT
Average Wait: 15 mins.
Full Wait: 30 mins.

To Mall / To Mall

Ms. Smith
2 min. walk

Route 11 — *Every 30 minutes*
Route 12 — *Every 30 minutes*

1st 3rd 5th 7th 9th

To Downtown / To Downtown

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

WAIT
Average Wait: 7.5 mins.
Full Wait: 15 mins.

To Mall

Ms. Smith
6 min. walk

Route 1 — *Every 15 minutes*

1st 3rd 5th 7th 9th

To Downtown

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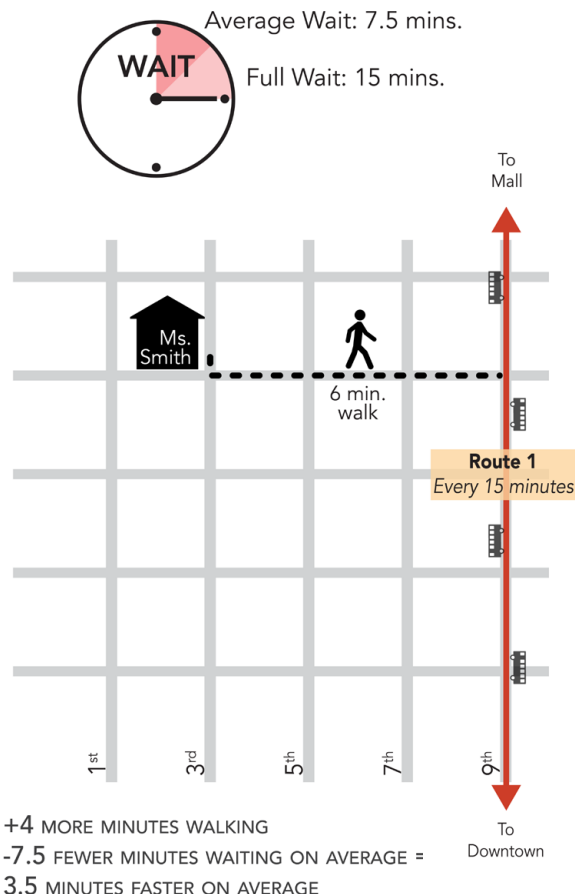3.5 MINUTES FASTER ON AVERAGE

Figure 15: In some situations, consolidating parallel routes onto fewer streets can make the average person's trip faster. There are many areas where Metro Transit could consider doing this, but only if people value shorter waits and longer spans of service more than they value shorter walks.

Key Choice: One-Seat Rides vs. Transfers

> **Is it more important to focus on one-seat trips to Downtown, or to plan a network that relies on people changing buses along the way?**

Metro Transit's existing network is built around the idea that people can use transit to travel in many directions if they are willing to change buses along the way. This is undermined by low frequency. **Who wants to take a short trip with a wait of up to 30 minutes, only to be delayed another 5 to 10 minutes by a transfer?**

The impacts of such long waits are disproportionately felt by low-income riders in outlying areas who have few if any alternatives.

Published schedules help, but aren't a cure-all: sometimes a bus is late, and people can't always control when they need to leave somewhere or arrive somewhere else.

But if Metro instead shifts to more one-seat rides[1], this would further increase the focus on Downtown and the University of Wisconsin. These two areas remain by far the largest hub of jobs and other destinations. Even though most trips in the city are going somewhere else, there are very few places in Madison where you would serve more trips by orienting service to go somewhere other than Downtown.

So a "one-seat ride" network would likely feature many more buses travelling through the Isthmus, and few if any improvements in direct service between outlying areas.

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1 A "One-Seat Ride" refers to a trip on public transit which does not require transfers and can be completed on a single vehicle.

Key Choice: Peak vs. All-Day Needs

Is it more important to provide high levels of service at rush hour, or to provide consistent levels of service all day and all week?

Prior to March 2020, in Madison:

- Twice as many Metro Transit buses operated at rush hours than in the middle of the day.

- Saturday and Sunday service levels were around 60% lower than on weekdays.

This matches the travel patterns of State government employees and UW students and staff. Both institutions generate huge numbers of 9-to-5 commutes and (prior to the pandemic) lots of transit riders.

However, running a bus only during the peak hour is expensive, because of three inefficiencies:

- Short shifts are less efficient for drivers.

- The agency must own many vehicles that it doesn't use very much.

- Peak demand tends to be in one direction, but the buses must all return empty in the other direction, because driver shifts must end where they began.

In addition, transit service that is much more convenient at peak times does not match the needs of many lower income people, whose jobs are more likely to have nontraditional work schedules, or to include work on weekends.

As the pandemic has proceeded, **the combined impact of remote learning and white-collar work-from-home has greatly reduced peak-hour transit ridership,** and reduced the difference between weekday and weekend travel patterns.

But the pandemic won't last forever. It's likely that a substantial fraction of University and white-collar ridership will return as schools and offices reopen. But no one knows exactly when this will happen, or what percentage of pre-pandemic ridership will come back.

So, in a post-pandemic environment:

- Should transit service once again focus most on weekday peak hours, so the capacity for high ridership is there if peak demand comes back?

- Or should Metro transit focus instead on providing the best possible service throughout the day and on weekends, even if that might result in more crowded buses- at rush hour if peak demand comes back?

Let us know what you think!

Project Timeline

The Metro Transit Network Redesign will combine technical analysis and broad-based community input to develop a public transit network for the future. This will include the following steps:

- **March 2021: Choices Report.** This report provides facts and analysis about the existing network, and describes the key choices for future service.

- **March – April 2021: Public Input on Key Choices**. This will include a combination of online resources, targeted focus groups, and a remote public meeting. Key information is available online at www.networkredesign.com

- **April – July 2021: Develop Alternatives.** The project team will develop up to four different network alternatives, illustrating real-world consequences of different key choices.

- **August-September 2021: Public Review of Alternatives.** The project team will reach out to the public for feedback on the alternatives. Members of the public can use these to make more informed judgements on the type of service they'd prefer.

- **Fall 2021: Draft Plan**. Based on community input and direction from the City's Transportation Policy and Planning Board (TPPB), the project team will develop a full draft of a redesigned network.

- **Winter 2022: Public Review of Draft Plan.** Taking into account public feedback, the TPPB will direct the project team on any changes to make to develop the Final Plan.

- **Spring-Summer 2022: Final Plan.** Depending on the amount of change, it could take more or less time to finalize and implement the network redesign.

- **Fall 2022: Partial implementation.** If the redesign process reveals clear consensus on the benefits of some transit network changes that can be isolated for early implementation, these changes may be put into place in Fall 2022.

- The City is targeting **full implementation for Fall 2023.**

Figure 16: Timeline for the first three phases of the Transit Network Redesign. The Final Plan will be developed in the first half of 2022. Depending on the degree and complexity of change involved, the redesigned network may be implemented in either 2022 or 2023.