# 2050 Metropolitan Transportation Plan

## TECHNICAL REPORT #4

Needs Assessment

December 2023

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# 1.0 Introduction

This report discusses transportation needs for the Clarksville Metropolitan Planning Area (MPA). It is informed by the analysis in *Technical Report #2: State of Current System* and an assessment of future needs based on:

- current and forecasted trends,
- existing plans, and
- public and stakeholder input.

# 2.0 Special Considerations

## 2.1 Resilience

In the context of this plan, "resilience" is the ability of transportation systems to withstand or recover from extreme or changing conditions and continue to provide reliable mobility and accessibility in the region. The impacts of weather, natural disasters, or fabricated events need to be considered.

The rising temperatures are not the only major impact that has been observed with the recent climate change. Storms have been rising in intensity with the shift in the climate and "Superstorms" such as Katrina, Sandy, and Harvey are becoming a more regular occurrence. Localized flooding has also worsened across the United States, and the Clarksville region was affected by a "Superflood" in 2010.

### Regional Considerations

The Clarksville Urbanized Area Metropolitan Planning Organization (CUAMPO) is responsible for the transportation policy development, planning, and programming for the MPA and considers transportation resiliency needs related to the following regional issues:

- **Floods:** Within the MPA, flooding hazards are typically in the form of flash flooding. Recent high intensity, short duration storms are becoming common and can result in flash floods. These events trap motorists and deposit large amounts of water on the impervious surfaces of the roadways, which eventually become surface runoff that can pool and damage a roadway's substructure. This impact is worse in karst areas, which make up the majority of the MPA, since the rock that composes them is soluble. As the soluble rock breaks down, it can lead to the development of sinkholes and other potential disasters that can negatively affect roadways and other infrastructure.
- **High Wind Events:** The Clarksville MPA can experience severe thunderstorms that produce damaging winds. Additionally, there is a risk for tornadoes within the MPA as it is located in the Southern United States, a region particularly vulnerable to tornadoes. Although the MPA is located inland from the Gulf of Mexico and the Atlantic Ocean, tropical systems can still bring high winds to the region which can affect transportation systems.
- **Snow and Ice:** The MPA, like most of the Southeastern United States, does not usually experience significant winter weather. However, even a small amount of

winter precipitation (snow and ice) can have a significant impact on the MPA's transportation system, such as road and bridge closures due to icy conditions. Many drivers lack driving experience in these conditions, increasing safety concerns.

- **Earthquakes:** Earthquakes can result in damages to transportation systems. Due to Clarksville's proximity to the New Madrid Fault line, Clarksville can be prone to a sizeable earthquake in the future.
- **Temperature Extremes:** The Clarksville MPA is classified as Humid, Subtropical (Cfa) according to the Köppen Climate Classification System, with average high temperatures reaching into the upper 90s in July and August, and temperatures in the single digits during January. Both temperature extremes can affect transportation systems. Extremely high temperatures affect the integrity of the pavement, and extremely low temperatures can result in road and bridge closures due to icy conditions.

## 2.2 Stormwater Mitigation

*Source: pxfuel.com*

As an area grows and changes, its land use and infrastructure change as well. These changes affect how precipitation events, which produce stormwater and eventually runoff, affect roadways, homes, ground water, rivers, streams, and more.

The overall effect of stormwater is heavily influenced by land use and development. Development removes previously pervious areas such as grass, wetlands, and wooded areas and replaces them with impervious surfaces such as:

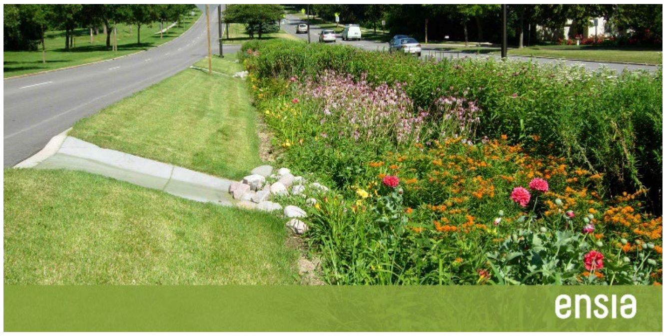
- new roadways,
- sidewalks,
- driveways and foundations in new subdivisions, and
- parking lots for businesses and shopping centers.

Increases in impervious surfaces can cause decreases in the runoff time and can lead to more flooding where existing drainage systems are poor or do not have enough capacity for the increased runoff. As a result, a significant rainfall event in an urban area within a short amount of time can lead to flooding for a municipality. Flooding can produce property damage, as well as environmental and public health hazards through the introduction of contaminants into new areas.

Without proper drainage and stormwater mitigation efforts, new transportation projects have the potential to worsen existing stormwater issues, which concerns the MPA due to its karst terrain. With well-planned, coordinated efforts and the use of "green infrastructure" design, transportation projects can be better integrated into the natural environment and decrease the chances of detrimental stormwater runoff issues. In some cases, stormwater drainage may even be improved.

## Green Infrastructure

Green infrastructure is a cost-effective approach to managing weather events, while providing benefits to the community.



*Source: ensia.com*

When rain falls onto impervious areas, stormwater must drain through gutters, storm sewers, and other man-made collection systems. This runoff may collect trash, bacteria, and other pollutants from the urban environment and introduce them to the community at large, creating health risks. Green infrastructure uses vegetation, soil, and other elements to mimic a more natural environment, treating stormwater at its source and using the ground and plants as filters to eliminate potential pollutants.

A natural environment approach to development positively affects a community's stormwater drainage system by slowing runoff and reducing stormwater discharge to mitigate flood risk. Green infrastructure may also decrease the size of the system neededand reduce the overall cost of materials, maintenance, and future repairs. **Figure 2.1**shows effective examples of green infrastructure including:

- permeable pavements,
- bioswales or vegetative swales, and
- green streets and alleys,
- green parking.

Additionally, green infrastructure can be applied not only to transportation development, but to commercial buildings and residential homes as well.

## Figure 2.1: Green Infrastructure Examples

Source: https://www.epa.gov/green-infrastructure/what-green-infrastructure

## Green Infrastructure Transportation Related Strategies

The following list includes some of the strategies that agencies can develop and implement to implement green infrastructure:

- During the project design, minimize impervious surfaces and alterations to natural landscapes.
- Promote the use of "green infrastructure" and other Low-Impact Development (LID) practices. Examples include:
    - rain barrels,
    - rain gardens,
    - buffer strips,
    - bioswales, and
    - replacement of impervious surfaces on property with pervious materials such as gravel or permeable pavers.
- Encourage local agencies to adopt ordinances that include stormwater mitigation practices, including landscaping standards, tree preservation, and "green streets".

- Develop a Standard Urban Stormwater Mitigation Plan (SUSMP) at multiple levels including state, region, and municipal.
    - A SUSMP is a useful tool where municipalities put into writing the requirements for stormwater control measures for development or even redevelopment.
- Incorporate LID practices into a SUSMP as an effective method of reducing a development's impact on its environment.

## Additional Stormwater Mitigation Strategies

- Educate residents, business owners, elected officials, and developers on the impacts of stormwater and how they can assist with stormwater runoff mitigation.
- Identify the areas most likely to flood during heavy storm events and prioritize mitigation efforts in those areas and areas upstream of them.
- Increase inspection of bridges and roadways to ensure that this infrastructure is structurally sound and that erosion from storms has not degraded it.
- Design drainage systems for the infrastructure and conduct regular inspections to ensure that roadways will not contribute to runoff that can damage karst areas or allow pooling.
- Adopt open space preservation plans which will balance land use and local developments with preservation and conservation of the existing open space.
- Establish stormwater fees to support the funding of stormwater management projects and practices.
- Reduce the number of impervious surfaces on residential, commercial, and public properties and offer incentives to encourage the use of pervious surfaces.

## Existing Policies and Considerations

The State of Tennessee has a statewide stormwater mitigation plan that has been published through the Tennessee Department of Transportation (TDOT). This plan outlines the planning, design, construction, and maintenance of Tennessee state roadways in order to minimize stormwater impacts. Currently, no local jurisdictions within the MPA have their own stormwater mitigation plans.

The development of a SUSMP by the CUAMPO and its partner agencies and jurisdictions would allow the MPA to mitigate the impacts from precipitation events, preserve the transportation system, reduce erosion, and promote health and safety. This development can be done in conjunction with the local jurisdictions, Kentucky Transportation Cabinet (KYTC), and TDOT.

The State of Tennessee and the Tennessee Department of Environmental Conservation (TDEC) provide state, regional, and online training free of cost. Additional information can be found at:

https://stormwaterone.com/tennessee-stormwater-management/permit-information

## 2.3 Tourism

Not all trips within the region are for the purposes of work, school, or shopping. Leisure and tourism trips often make use of the MPA's roadways, transit, and pedestrian facilities. Tourism promotes economic vitality and can be a driver of regional development. Many states are now encouraging people to "become a tourist within their own state" and to travel to other local areas. There are several potential means by which travel and tourism might be encouraged within the MPA.

### Tourism Overview

Tourism plays an increasingly important role in economies as jobs shift into the service and information sectors and an expanding middle class travels more frequently.[1] The Tennessee Department of Tourism maintains its own website (Tourist Development (tn.gov)) as well as a separate website, https://www.tnvacation.com/. This site introduces travelers to tourist destinations, identifies a variety of activities within the state, and provides trip planning resources. The City of Clarksville tourism webpage can be found at:

https://www.visitclarksvilletn.com

The State of Kentucky places an emphasis on tourism using a portion of the state website, devoting several sections to the various attractions within the state. The website provides links to related agencies, upcoming events, travel guides, and roadway maps. It can be found at: Tourism (kentucky.gov)

According to Clarksville Now in 2021, Clarksville-Montgomery County tourism accounted for over $340 million in spending within the region.[2] Additionally, Clarksville has plenty of natural beauty and cuisine, as well as historic preservation and craft culture that brings tourists to this city. Top attractions for the City of Clarksville include Customs House Museum & Cultural Center (1890), Roxy Regional Theatre (1947), and Beachhaven Vineyards & Winery (1986).

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[1] *OECD Tourism Trends and Policies*, 2018, Organization for Economic Cooperation and Development
[2] https://clarksvillenow.com/local/montgomery-county-visitor-spending-tops-340-million-in-2021-up-35/

## Welcome Centers

Welcome Centers are among the first sights that greet travelers when entering a new state. The MPA's location on the Kentucky-Tennessee State Line provides an opportunity to use these establishments to promote the region and encourage tourism and travel. There are two (2) Welcome Centers within the MPA:

- The I-24 Welcome Center in Clarksville/Montgomery County in Tennessee[3]
- The Christian County Welcome Center in Kentucky[4]

Both Welcome Centers are located on I-24, on either side of the State Line in the MPA and provide a variety of amenities, services, and resources.

## Tourism Attractions and Amenities

The region offers diverse tourist attractions and boasts a variety of cultural, outdoor, and retail venues. The City of Clarksville specializes in historical sites, restaurants, and live music. The City has ten (10) smaller arts and entertainment activities and a mixture of attractions such as the Roxy Regional Theatre, Beachaven Vineyards & Winery, Dunbar Cave State Park, and several activities within the Downtown Historical District.

The region also offers high-quality dining, trendy craft foods, and retail. The highest concentration of restaurants and bars are located within Downtown Clarksville.

As Clarksville is becoming trendier, several new hotels and Airbnbs have opened throughout the MPA within the last five (5) years, including:

- The Lucinda Loft,
- Industrial River Front Getaway, and
- DoubleTree By Hilton.

**Visitor & Convention Centers**

Clarksville Welcome Center

Montgomery County Multi-Purpose Event Center

Wilma Rudolph Event Center

[3] I-24 Welcome Center Clarksville/Montgomery County in Clarksville, TN - Tennessee Vacation (tnvacation.com)
[4] Christian County Welcome Center Westbound | Kentucky Tourism - State of Kentucky - Visit Kentucky, Official Site

## Tourism Needs

Many amenities and attractions are found near major roadways and are accessible by car. However, transportation upgrades can improve mobility for tourism activity. Several examples include:

- **Wayfinding**: Wayfinding materials such as signs and electronic maps can help visitors easily find their way around the region and can be used for different modes of transportation. Wayfinding can be particularly useful along pedestrian and bicycle paths and to guide drivers or pedestrians to other nearby tourist attractions.
- **Expanded Public Transportation**: There are many attractions located in Downtown Clarksville. With a large concentration of destinations, public transit plays an important role. While the Clarksville Transit System (CTS) currently serves this area, the service frequency could increase to make trips more convenient and quicker. Additionally, bus service could expand further into the region to reach retail and restaurant options in the surrounding suburban areas that may not be accessible to visitors without private cars.
- **Expanded Sidewalks and Bike Facilities**: The concentration of attractions and hotels in Downtown Clarksville makes walking and bicycling viable transportation modes. In less dense areas outside the inner city, recreational multi-use paths can attract visitors. Improving and expanding sidewalks, bike lanes, and pathways in major tourist areas will improve visitor mobility and reduce the need for additional vehicular traffic.

# 3.0 Emerging Trends

In recent years, travel patterns have changed dramatically due to demographic changes and technological advances. Many of these changes are part of longer-term trends, while others are newer, emerging trends.

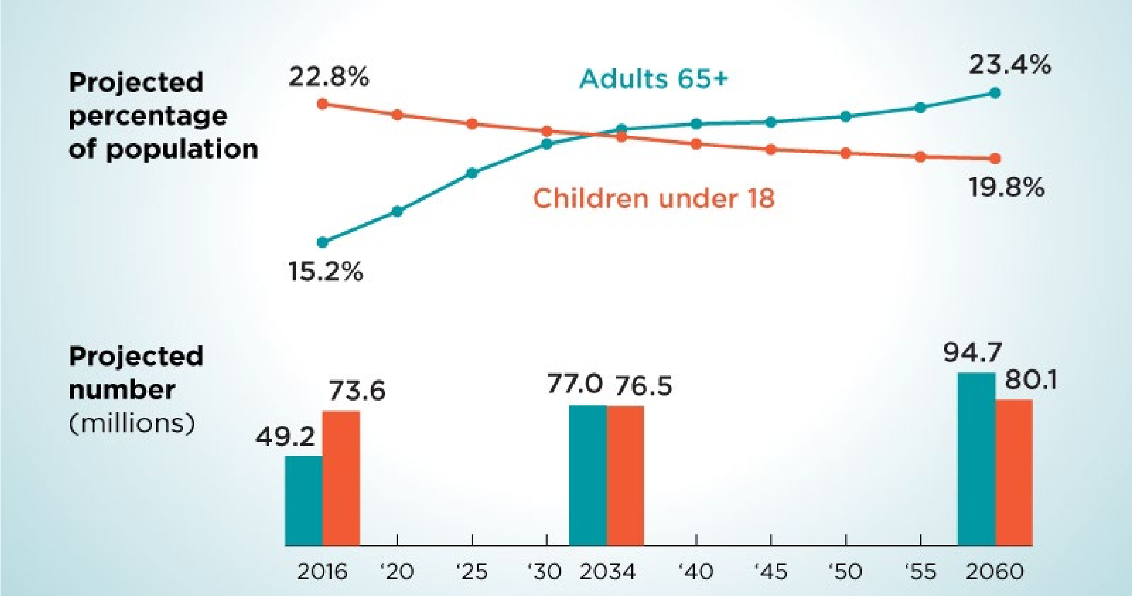
The data presented in this chapter is based upon national trends, as local data is not readily available.

## 3.1 Changing Demographics and Travel Patterns

### An Aging Population

The population aged 65 or older will grow rapidly over the next 25 years, as shown in **Figure 3.1**, nearly doubling from 2016 to 2060.[5] This growth will increase the demand for alternatives to driving, especially for public transportation to accommodate people with limited mobility or disabilities.

**Figure 3.1: Nationwide Growth in Senior Population**




Source: U.S. Census Bureau

[5] https://www.census.gov/data/tables/2017/demo/popproj/2017-summary-tables.html

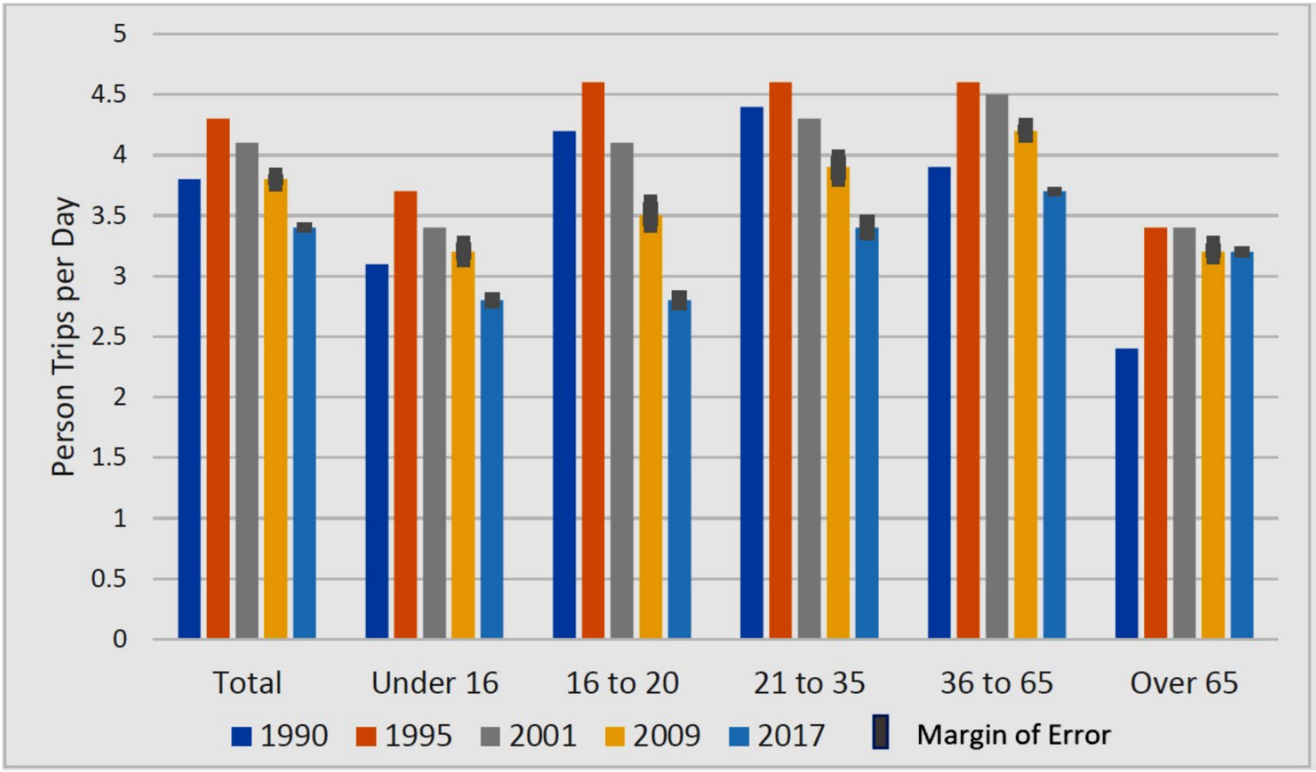
## Most People are Traveling Less

In general, people are making fewer trips per day than they have in the past. There are many factors driving this trend, including less face-to-face socializing, online shopping, and working from home. While travel patterns are returning to pre-COVID-19 pandemic levels, the pandemic appears to have reduced the overall levels of travel since a large number of jobs are expected to stay or become work-from-home in the future.

If this trend continues, travel demand may be noticeably impacted. Some major roadway projects may no longer be required, and smaller improvements, such as intersection or turn lane improvements, may be sufficient to meet these needs.

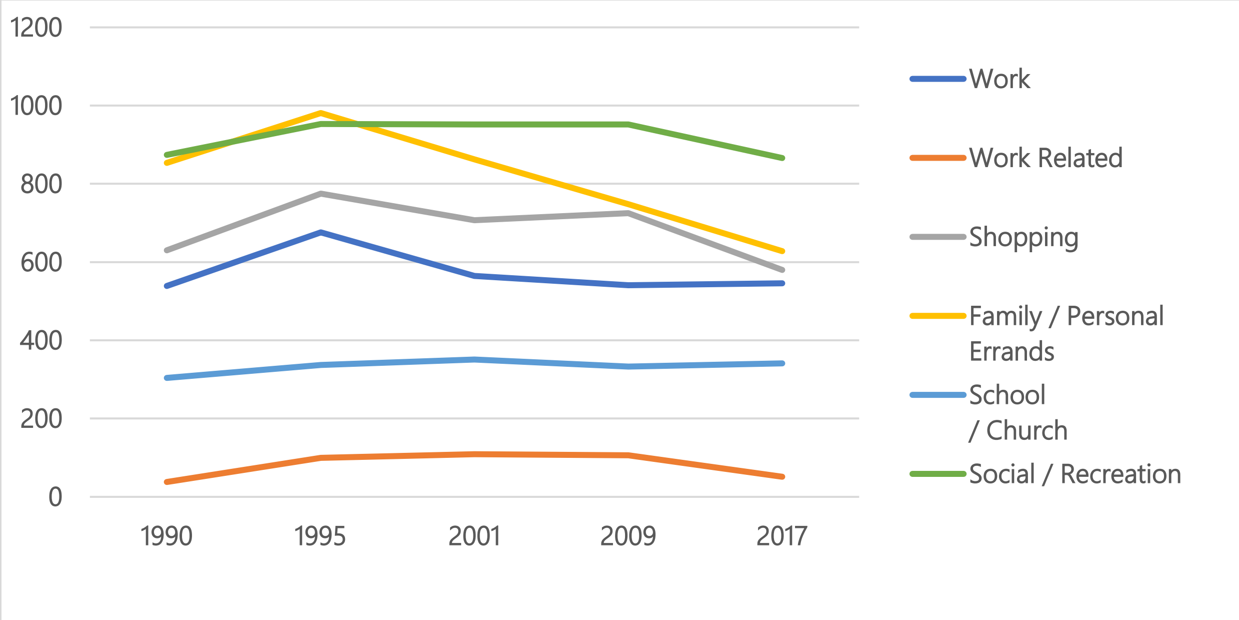
**Figures 3.2 and 3.3** illustrate some of these trends.

Figure 3.2: Trends in the Average Daily Person Trips by Age, Nationwide




Source: 2017 National Household Travel Survey

**Figure 3.3: Trends in the Average Annual Person Trips per Household in U.S.**




Source: 2017 National Household Travel Survey

## 3.2 Shared Mobility

Recent trends show that people are increasingly interested in car-free or car-lite lifestyles, particularly younger generations such as Millennials and Gen Z. In the short-term, people are paying premiums for walkable and bikeable neighborhoods and are more frequently using ride-hailing services, such as Uber and Lyft, and shared mobility (car-sharing/bike-sharing) services. These activities could result in a long-term decrease in car ownership rates, increasing the need for investments in bicycle, pedestrian, transit, and other mobility options.

A major impetus for the change in travel behavior and reduced reliance on cars is the emergence of shared mobility options. Broadly defined, shared mobility options are transportation services and resources that are shared among users, either concurrently or consecutively. They include:

- **Bike-sharing and Scooter-sharing (Micromobility)** – These systems can be dockless or dockstation-based where people rent bikes and scooters for short periods of time. Scooters are all-electric while bikes may or may not be electric. Examples include BCycle, Social Bicycles, Lime, Bird, and Jump.
- **Taxis** - Examples include Veterans Cab and Yellow Cab Co. Inc.
- **Ridesharing/Ride-hailing (Transportation Network Companies)** - Examples include Uber, Lyft, and Via.

- **Car-Sharing** – This option includes traditional car sharing, where people rent a company-owned vehicle or participate in peer-to-peer car sharing services. Examples include Zipcar and Turo.
- **Public Transit and Microtransit** – Public transit is itself a form of shared mobility and is evolving to incorporate new mobility options like Microtransit.

## Micromobility

Bike-sharing and scooter-sharing, collectively referred to as micromobility options, are relatively new mobility options and continue to evolve. In parts of the nation, modern, station-based bike-sharing emerged around 2010 and dominated the micromobility landscape from 2010 to 2016 until dockless bike-sharing systems, like Gotcha, emerged. In late 2017, electric scooter-sharing emerged and overlapped much of the dockless bike-sharing market.

Survey data from major U.S. cities shows the following micromobility trends[6]:

- Micromobility services are used for a variety of trip purposes.
- People use micromobility to travel relatively short distances (one (1) to two (2) miles) for short durations (10 to 20 minutes). However, infrequent users of station-based bike-sharing services tend to make longer distance and duration trips.
- Regular users of station-based bike-sharing services are more likely to be traveling to/from work or connecting to transit. They are also more likely to have shorter trip durations and cheaper trips.
- People using scooter-sharing services are more likely to be riding for recreational or exercise reasons.

Within the MPA, BCycle serves as a micromobility service and has added a docking station within the last few years. This service may increase as the region grows.

## Transportation Network Companies

Ride-hailing and ridesharing are the terms typically used to describe the services provided by Transportation Network Companies (TNCs) like Uber and Lyft. These TNCs emerged between 2010 and 2012 and have since grown rapidly, surpassing taxis in many metropolitan areas. Today, TNCs are operating in most urban areas in the United States. However, service is limited or non-existent outside of these urban areas. Even with growth into most urban areas, some

[6] https://nacto.org/wp-content/uploads/2019/04/NACTO_Shared-Micromobility-in-2018_Web.pdf

TNC services are still limited to larger markets (e.g., UberPool and Lyft Shared for shared rides) or are being tested in certain markets (e.g., Uber Assist for people with disabilities).

While TNCs continue to evolve, research suggests the following TNC trends[7]:

- Trips are disproportionately work-related and social/recreational.
- Customers are predominantly affluent, well-educated, and tend to be younger.
- The market for TNC trips overlaps the market for transit service.
- People appear to use TNC services as a replacement for transit when transit is unreliable or inconvenient, as a replacement for driving when parking is expensive or scarce, or to avoid drinking and driving.
- The heaviest TNC trip volumes occur in the late evening/early morning hours.
- Average trip lengths are around six (6) miles with a duration of twenty to twenty-five (20-25) minutes.
- Trips in large, densely populated areas tend to be somewhat shorter and slower while trips in suburban and rural areas tend to be somewhat longer and faster.

## Car-Sharing

Car-sharing allows people to conveniently live car-free or car-lite lifestyles and has been shown to increase walking and biking, reduce vehicle miles traveled, increase accessibility for formerly carless households, and reduce fuel consumption.[8]

Car-sharing has been around for decades and has continued to evolve in recent years. Today, there are three (3) models of car-sharing:

- **Roundtrip car-sharing (as station-based car-sharing):** This model accounts for the majority of all car-sharing activity. Services, such as Zipcar and Maven, serve a market for longer or day trips, particularly where carrying supplies is a factor (such as shopping, moving, etc.). These car-share trips are typically calculated on a per hour or per day basis.
- **One-way car-sharing (free-floating car-sharing):** This model allows members to pick up a vehicle at one location and drop it off at another location. These car-sharing operations, including car2go, ReachNow, and Gig, are typically calculated on a per minute basis.

[7] http://www.schallerconsult.com/rideservices/automobility.htm
[8] https://www.planning.org/publications/report/9107556/

- **Peer-to-Peer (P2P) car-sharing (personal vehicle sharing):** This model is characterized by short-term access to privately owned vehicles. An example of a P2P car-sharing operation is Turo.


Due to the varied car-sharing models, there are no typical usage patterns. Some car-sharing trips are short and local while others may be longer distance. Trips can be recurring or infrequent.

Outside of large urban areas, car-sharing is not that common. However, as connected and autonomous vehicles become more common, it is anticipated that car-sharing will become more widespread.

## 3.3 Connected and Autonomous Vehicles (CAV)

Today, most newer vehicles have some elements of both connected and autonomous vehicle technologies. These technologies are advancing rapidly and becoming more common. The types of CAVS are discussed in *Technical Report #2: State of Current System;* however, these vehicles have not seen widespread application within the MPA yet. It is expected that future developments of these technologies will eventually bring them to the roadways.

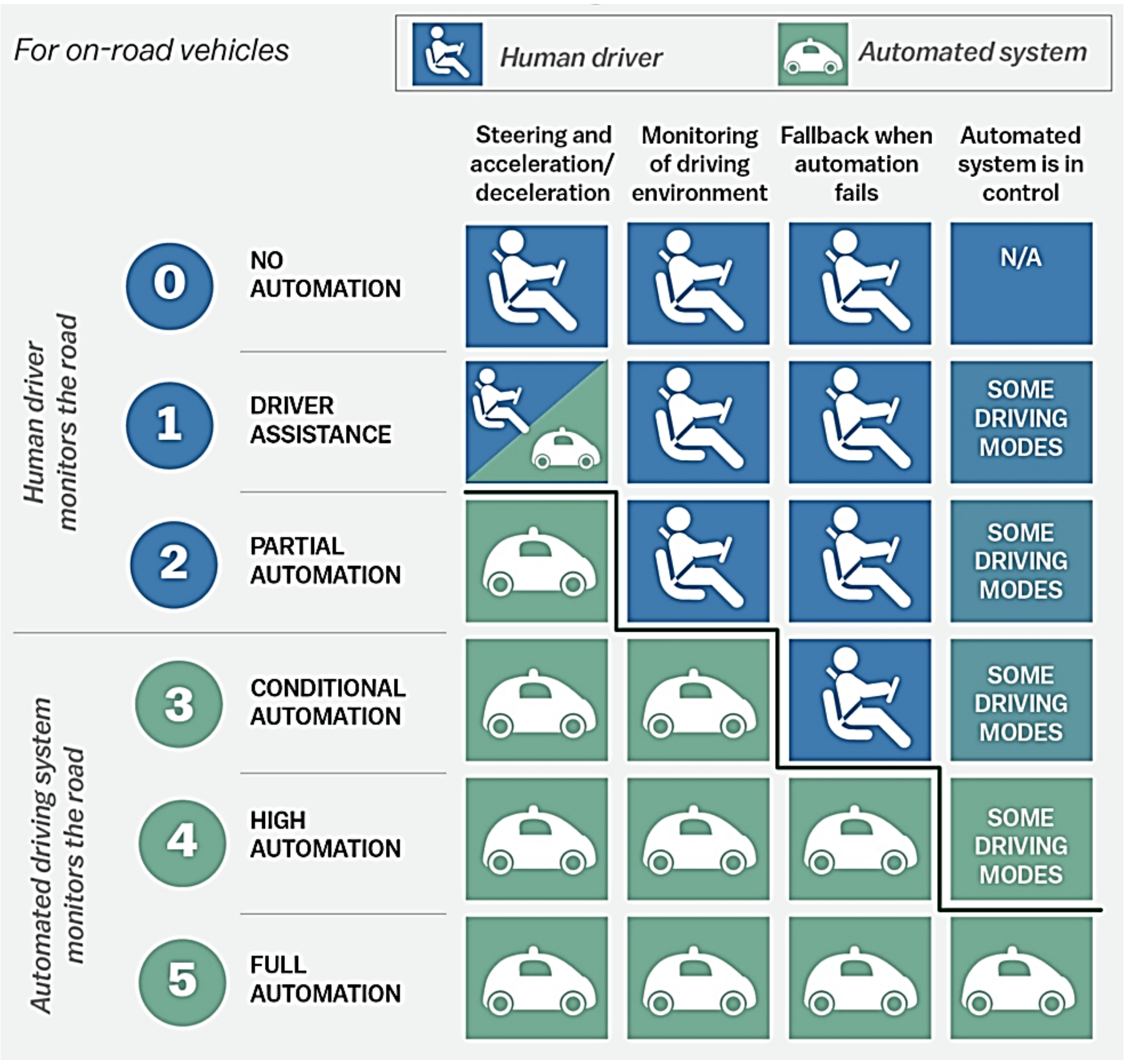
### Autonomous Vehicle Levels

According to the National Highway Traffic Safety Administration (NHTSA), there are five (5) levels of automation. These levels are illustrated in **Figure 3.4** and include:

- **Level 1:** An Advanced Driver Assistance System (ADAS) can sometimes assist the human driver with steering or braking/accelerating, but not both simultaneously.
- **Level 2:** An ADAS can control both steering and braking/accelerating simultaneously under some circumstances. The human driver must continue to always pay full attention and perform the rest of the driving tasks.
- **Level 3:** An Automated Driving System (ADS) on the vehicle can perform all aspects of driving under some circumstances. In those circumstances, the human driver must be ready to take back control at any time when the ADS requests the human driver to do so.

- **Level 4:** An ADS on the vehicle can perform all driving tasks and monitor the driving environment – essentially, do all the driving – in certain circumstances. The human need not pay attention to driving tasks in those circumstances.
- **Level 5:** An ADS on the vehicle can do all the driving in all circumstances. The human occupants are just passengers.

**Figure 3.4: Levels of Automation**




Source: SAE J3016 Levels of Automation (Photo from Vox)

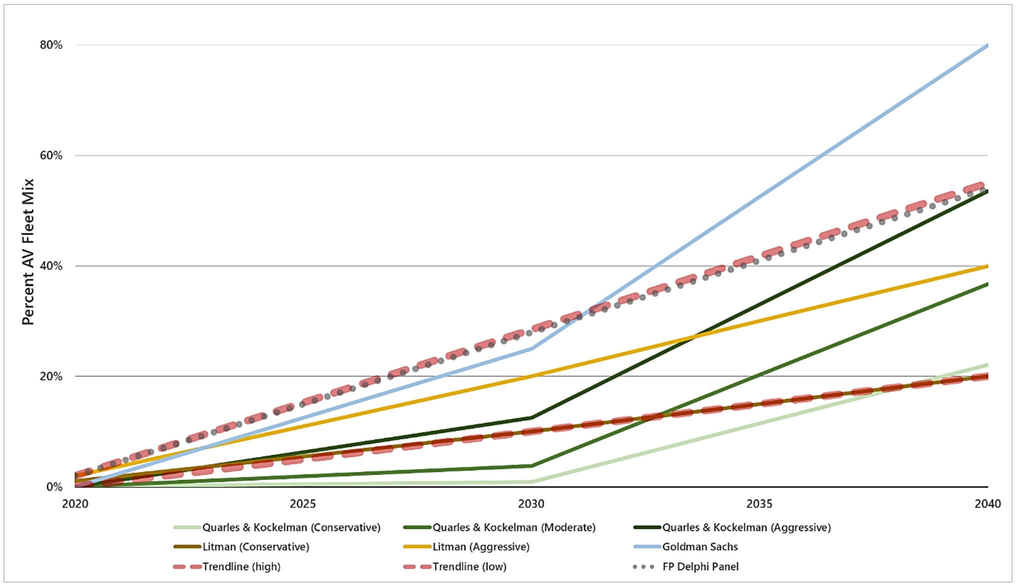
## Potential Timeline

While mid-level connected and autonomous vehicles are already on the market and traveling on our roadways, there is uncertainty about the long-term future of these vehicles, especially Level 5, fully autonomous vehicles. However, over the past couple of years, some level of consensus has emerged about the timeline over the next 20 years as shown in **Figure 3.5**. [9][10][11]

- Over the next five (5) years, partially automated safety features will continue to improve and become less expensive.
  - These features include lane keeping assist, adaptive cruise control, traffic jam assist, and self-park.
- By 2025, fully automated safety features, such as a "highway autopilot," are anticipated to be on the market.
- Through 2030, autonomous vehicles will continue to make up only a small percentage of all vehicles on the road due to the large number of legacy vehicles and slow adoption rates resulting from higher initial costs, safety concerns, and unknown regulations.
- By 2040, autonomous vehicles are expected to be more common, accounting for 20-50 percent of all vehicles.

[9] https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety
[10] http://library.rpa.org/pdf/RPA-New-Mobility-Autonomous-Vehicles-and-the-Region.pdf
[11] https://www.fehrandpeers.com/av-adoption/

**Figure 3.5: Potential Autonomous Vehicle Market Share, 2020 to 2040**




Source: Fehr and Peers

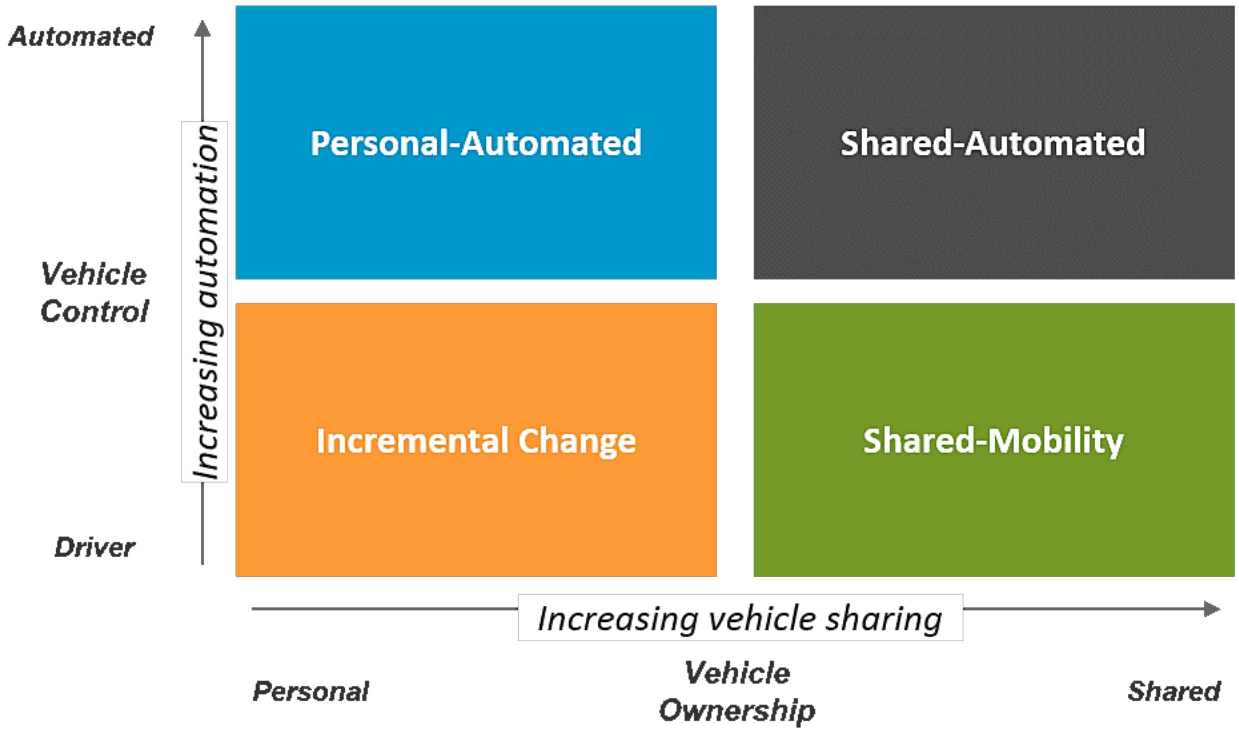
## Potential Impacts

The development of connected and autonomous vehicles will change travel patterns, safety, and planning considerations. Ultimately, the actual impact of these vehicles will depend on how prevalent the technology is and the extent to which vehicles are privately owned or shared.

As shown in **Figure 3.6**, there are four (4) potential scenarios, each with unique implications for transportation planning.

- **Personal-Automated scenario:** Vehicles are highly autonomous and mostly privately owned.
- **Shared-Automated scenario:** Vehicles are highly autonomous and mostly shared.
- **Incremental Change scenario:** Vehicles are not highly autonomous and are mostly privately owned.
- **Shared-Mobility scenario:** Vehicles are not highly autonomous and are mostly shared.

Figure 3.6: Future Mobility Scenarios




Source: U.S. Department of Energy/Deloitte

Safety

In the long-term, CAV technology is anticipated to reduce human error and improve overall traffic safety. CAVs are capable of sensing and quickly reacting to the environment via:

- External sensors (ultrasonic sensors, cameras, radar, lidar, etc.)
- Connectivity to other vehicles
- GPS

These features allow the CAV to create a 360-degree visual of its surroundings and detect lane lines, other vehicles, road curves, pedestrians, buildings, and other obstacles. The sensor data is processed in the vehicle's central processing unit and allows it to react accordingly. As this technology becomes more common on the roadways, it should result in increased safety by removing human error as a crash factor. Conversely however, CAV technology may decrease safety in the short term if drivers misuse partial automation and are not ready to take control of the vehicle in an emergency, particularly around work zones and interactions with bicyclists and pedestrians.

Traffic

Over time, CAVs may have the potential to improve overall traffic flow and reduce congestion; however, these benefits will take time to develop as the conditions for their implementation evolve. Additionally, these benefits can only be achieved when CAV saturation is very high.

In the early stages, CAVs are likely to increase Vehicle Miles Traveled (VMT) and may not contribute to congestion reduction. This increase would come in part from people making longer and potentially more frequent trips due to the increased comfort of traveling by car that is afforded through CAVs. People could replace driving with other tasks, such as work or entertainment, and longer trips would become opportunities to multitask. The increase in VMT would also come from "dead head" mileage, or the time that vehicles are driving on the road without passengers, before and after picking up people. The increase in VMT, without mitigation of the congestion, could instead result in longer travel times. Over time, as the vehicles evolve to use less congested routes or achieve a greater system-wide equilibrium, VMT and congestion may be reduced.

Transit

CAV technology has the potential to reduce the cost of operating transit in environments that are safe for autonomous transit. For many agencies, labor is their highest operating expense. While not all routes may be appropriate for autonomous transit, there may be opportunities to create dedicated lanes and infrastructure for autonomous transit and other vehicles. Even with some lines operating autonomously, costs can be lowered, and these savings can be used to increase and improve service. However, the implementation of CAV will also need to meet the needs of disabled persons and their limitations.

From a reliability standpoint, connected vehicle technology can also improve on-time performance and travel times through applications like Transit Signal Priority (TSP) and dynamic dispatching. TSP is an application that provides priority to transit at signalized intersections and along arterial corridors. Dispatching and scheduling could be improved with dynamic, real-time information that more effectively and efficiently matches resources to demand.

Even with the potential improvements to transit operations, transit ridership could decrease if transportation network companies (e.g., Uber/Lyft) become competitively priced. If autonomy allows these private transportation providers to eliminate drivers and reduce their operating costs, competitive pricing could result. It should be noted that these impacts can be reduced if transit service becomes more frequent, reliable, and serves an expanded schedule.

Freight

Both delivery and long-haul freight look to be early adopters of CAV technology, reducing costs and improving safety and congestion.

Freight vehicles will also benefit from CAV technology by traveling in small groups, known as truck platooning, an effect which will also be seen on the rural Interstate roadways. The use of CAV will safely decrease the amount of space between the platooning trucks thereby allowing consistent traffic flow. Platooning reduces congestion as vehicles travel at constant speed, with less stop-and-go, which results in fuel savings and reduces carbon dioxide emissions.

Land Use and Parking

Autonomous vehicles could dramatically reduce demand for parking, which could free up space for other uses. These vehicles could also utilize more efficient parking, and developments could potentially provide more compact parking spaces. However, they may also require new curbside and parking considerations and encourage urban sprawl.

Benefits and drawbacks of various parking strategies are as follows:

- **Shared-Automated:** If autonomous vehicles are mostly shared and not privately owned, there will be less need for parking as these vehicles will primarily move from dropping one passenger off to picking up or dropping off another passenger.
- **Personal-Automated:** If autonomous vehicles are mostly privately owned, it is also possible that they could return home or go to a shared parking facility that is not on site. In this scenario, some parking demand may simply shift from onsite parking to centralized parking; however, this change would result in increased VMT and congestion from a zero-occupancy vehicle.
- **Smart Parking:** Connected parking spaces allow communication from the parking lot to the vehicle, letting the vehicle know which spaces are available. This communication reduces the need for circling or idling in search of parking and improves parking management.

As a result, parking minimums could potentially be reduced in urban and suburban areas.

- In urban areas, this reduction could mean reallocating curb-side space for pedestrians while allowing for safe passage, pick-ups, drop-offs, and deliveries by AVs.

- In suburban areas, it could mean redeveloping large surface parking lots and revisiting parking requirements.

The benefits of CAV technology are also likely to make longer commutes more attractive and increase urban sprawl unless local land use policy and regulations discourage this technology. This scenario is more likely to occur in Personal-Automated use when compared to Shared-Automated use.

## 3.4 Electric and Alternative Fuel Vehicles

There has been growing interest and investment in alternative fuel vehicle technologies in recent years, especially for electric vehicles. This renewed interest has also included the transit and freight industries and has been a major push in the Infrastructure Investment and Jobs Act (IIJA).

Alternative Fuel Vehicles (AFVs) are defined as vehicles that are substantially non-petroleum, yielding high-energy security and environmental benefits. These vehicles are operatedby:

- electricity
- hybrid fuels
- hydrogen
- liquefied petroleum gas (propane)
- Compressed Natural Gas (CNG)
- Liquefied Natural Gas (LNG)
- 85% and 100% Methanol (M85 and M100)
- 85% and 95% Ethanol (E85 and E95) (not to be confused with the more universal E10 and E15 fuels which have lower concentrations of ethanol)

While the IIJA, also known as the Bipartisan Infrastructure Law (BIL), promotes the use of all alternative fuels, electricity is the main focus of the bill.

According to FHWA:

> "The BIL makes the most transformative investment in EV charging in United States (U.S.) history that will put us on a path to a nationwide network of 500,000 EV chargers that ensures a convenient, reliable, affordable, and equitable charging experience for all users. This national network will:
>
> - Accelerate equitable adoption of EVs, including for those who cannot reliably charge at home.
> - Reduce transportation-related greenhouse gas emissions and help put the U.S. on a path to net-zero emissions by no later than 2050.

- Position U.S. industries to lead global transportation electrification efforts and help create family-sustaining union jobs that cannot be outsourced."

The IIJA also calls for the development of an Alternative Fuel Corridors (AFC) network. Within the MPA, only I-24 is currently part of this network.[12]

## Growth Projections

Long-term projections for electric vehicles and other alternative fuels, shown in **Figure 3.7**, vary considerably. On the higher end, some projections estimate that electric vehicles will make up 30 percent of all cars in the United States by 2030.[13] The U.S. Energy Information Administration (USEIA) provides a more conservative outlook, projecting electric vehicles will make up approximately nine (9) percent of all light-duty vehicles by 2030 and approximately 17 percent by 2045. For freight vehicles, the USEIA projects only a two (2) percent market share for electric vehicles by 2045.

Outside of electric vehicles, which include both full and hybrid electric vehicles, the USEIA does not project other alternative fuels to grow significantly for light-duty vehicles. However, it does predict ethanol-flex fuel vehicles to grow significantly for light and medium freight vehicles.

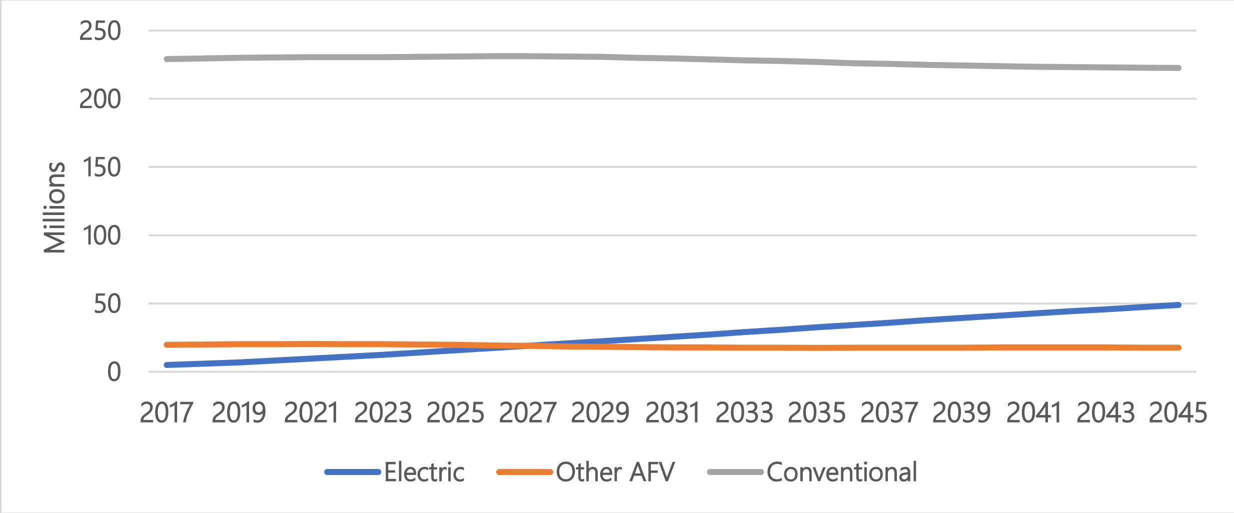
In the United States, electric buses are becoming more common as transit agencies pursue long-term operations and maintenance savings in addition to environmental and rider benefits (less air and noise pollution). While electric buses have a high initial cost, these prices are anticipated to go down and utilization is likely to become more widespread. By 2030, it is anticipated that between 25 and 60 percent of new transit vehicles purchased will be electric.[14]

[12] Electric Vehicle (EV-Round 1,2,3,4,5 and 6) - FHWA HEPGIS Maps (dot.gov)

[13] https://www.iea.org/publications/reports/globalevoutlook2019/

[14] https://www.reuters.com/article/us-transportation-buses-electric-analysi/u-s-transit-agencies-cautious-on-electric-buses-despite-bold-forecasts-idUSKBN1E60GS

Figure 3.7: Light-Duty Vehicles on the Road by Fuel Type, 2017 to 2045




Source: U.S. Energy Information Administration, 2019 Annual Energy Outlook

## Potential Impacts

Air Quality Improvement

Electric and other alternative fuel vehicles have the potential to reduce automobile related emissions, a key concern within the MPA. While these fuels still have environmental impacts, they can reduce overall lifecycle emissions and direct tailpipe emissions substantially which benefits the region as it seeks to maintain air quality conformity.

Direct emissions are released from the tailpipe through evaporation from the fuel system and during the fueling process. These emissions include smog-forming pollutants (such as nitrogen oxides), other pollutants harmful to human health, and Greenhouse Gases (GHGs).

Actions and strategies that can be implemented to improve air quality include:

- **Enforce stricter emission standards:** Air pollution could be greatly reduced by enforcing stricter emission standards on both diesel and petrol cars. Private and public vehicles could be tested more frequently based on real-world, rather than laboratory, emissions. However, these standards are governed by federal regulations unless the states choose to adopt stricter standards.
- **Reduce number of car trips:** Cities could encourage residents to make short trips through cycling or a combination of public transit and walking (otherwise known as active travel).
- **Focus on vulnerable populations:** Numerous studies, including several from the University of California, have shown that a vehicle occupant breathes in higher amounts of pollution than a cyclist or pedestrian on the same roadas they travel in

an enclosed space where pollutants remain trapped. This situation is especially problematic for children and people with underlying health conditions due to age or other illness. It has also been shown that the health benefits of walking and cycling outweigh the costs of inhaling pollution.

- **Make transit more attractive:** It is generally accepted that increased public transit ridership and cleaner public transport would greatly improve urban air quality. Shifting trip modes from private vehicles to public transit depends on making it attractive to potential users, especially as mobility and accessibility continue to be a challenge for most urbanized areas.
- **Encourage active travel:** Increasing active travel would not only improve air quality but reduce urban noise pollution as well as encourage healthy habits and more active lifestyles. However, encouragement for such activities requires adding connected bicycle lanes, sidewalks, and trails. To make cycling more appealing for commuting, and not just leisure, cities should consider the demand for cycling, accessibility of this mode of travel, and the destinations that can be accessed by bicycle.Network interruptions such as red lights, traffic, and pedestrians should also be considered.

Infrastructure Needs

The IIJA seeks to address the long-term need for public investment in vehicle charging stations to accommodate growth in electric vehicles and provides $7.7 billion in funds for the increased development of EV infrastructure. Consumers and fleets considering Plug-in Hybrid Electric Vehicles (PHEVs) and all-Electric Vehicles (EVs) benefit from access to charging stations, also known as EVSE (Electric Vehicle Supply Equipment). For most drivers, initial charging will be done at home or at fleet facilities. Charging stations at workplaces and public destinations may also bolster market acceptance.

Gas Tax Revenues

It should be noted that as adoption rates of alternative fuels increase substantially, gas tax revenues will be reduced, and new user fees may need to be considered to replace the lost revenue. Because electric and other alternative fuel vehicles use less or no gasoline compared to their conventional counterparts, their operation does not generate as much revenue from a gas tax. Currently, gas taxes are one of the primary means that Tennessee and Kentucky use to fund transportation projects. For this reason, many states have begun imposing fees on these vehicles to recoup lost transportation revenue and are considering pilot programs for taxes based on vehicle miles traveled.[15]

[15] http://www.ncsl.org/research/energy/new-fees-on-hybrid-and-electric-vehicles.aspx

# 4.0 Roadways and Bridges

## 4.1 Roadway Congestion Relief Needs

57.8%

Growth in person trips in the MPA and surrounding area from 2019 to 2050

Given the population and employment growth forecasted to occur by 2050, the Travel Demand Model (TDM) indicates that the number of person trips in the MPA and surrounding area will increase from 0.88 million per day in 2019 to 1.39 million per day in 2050.

**Table 4.1** shows that if the transportation projects that currently have committed funding are constructed, the centerline miles of the roadway network will not change since there are no new roadways being implemented. The table also shows the forecast change in Vehicle Miles Traveled (VMT), Vehicle Hours Traveled (VHT), and Vehicle Hours of Delay (VHD), if only the existing and committed projects are constructed. This data indicates that by 2050, the VMT will increase by just over 42 percent while the VHT will more than double. However, during this same period, the VHD will more than triple.

### Table 4.1: Travel Demand Impact of Growth and Existing and Committed Projects, 2019 to 2050

| Classification | 2019 (Existing) | 2050 (E+C Projects) | Change | Percent Difference |
|---|---|---|---|---|
| **Centerline Miles of Roadways** | | | | |
| Interstate | 27.6 | 27.6 | 0.0 | 0.00% |
| Principal Arterial | 53.7 | 53.7 | 0.0 | 0.00% |
| Minor Arterial | 114.8 | 114.8 | 0.0 | 0.00% |
| Major Collector | 106.5 | 106.5 | 0.0 | 0.00% |
| Minor Collector | 120.6 | 120.6 | 0.0 | 0.00% |
| Local | 171.8 | 171.8 | 0.0 | 0.00% |
| Total | **595.0** | **595.0** | **0.0** | **0.00%** |
| **Daily Vehicle Miles Traveled (VMT)** | | | | |
| Interstate | 1,381,216 | 1,837,629 | 456,413 | 33.04% |
| Principal Arterial | 1,318,249 | 1,743,582 | 425,333 | 32.26% |
| Minor Arterial | 1,436,072 | 2,119,526 | 683,454 | 47.59% |
| Major Collector | 478,789 | 748,899 | 270,110 | 56.42% |
| Minor Collector | 177,895 | 288,320 | 110,425 | 62.07% |
| Local | 314,535 | 531,046 | 216,511 | 68.84% |
| Total | **5,106,756** | **7,269,002** | **2,162,246** | **42.34%** |
| **Daily Vehicle Hours Traveled (VHT)** | | | | |
| Interstate | 33,731 | 102,224 | 68,493 | 203.06% |
| Principal Arterial | 43,666 | 73,345 | 29,679 | 67.97% |
| Minor Arterial | 49,280 | 89,212 | 39,932 | 81.03% |
| Major Collector | 16,773 | 32,752 | 15,979 | 95.27% |
| Minor Collector | 4,883 | 9,455 | 4,572 | 93.63% |
| Local | 11,540 | 23,248 | 11,708 | 101.46% |
| Total | **159,873** | **330,236** | **170,363** | **106.56%** |

**Table 4.1: Travel Demand Impact of Growth and Existing and Committed Projects, 2019 to 2050 Cont.**

| Daily Vehicle Hours of Delay (VHD) | | | | |
|---|---|---|---|---|
| Classification | 2019 (Existing) | 2050 (E+C Projects) | Change | Percent Difference |
| Interstate | 12,956 | 74,622 | 61,666 | 475.96% |
| Principal Arterial | 15,767 | 36,691 | 20,924 | 132.71% |
| Minor Arterial | 16,365 | 40,968 | 24,603 | 150.34% |
| Major Collector | 3,831 | 12,194 | 8,363 | 218.30% |
| Minor Collector | 390 | 1,887 | 1,497 | 383.85% |
| Local | 2,371 | 7,539 | 5,168 | 217.97% |
| Total | **51,680** | **173,901** | **122,221** | **236.50%** |

Note: Values above exclude ramps.

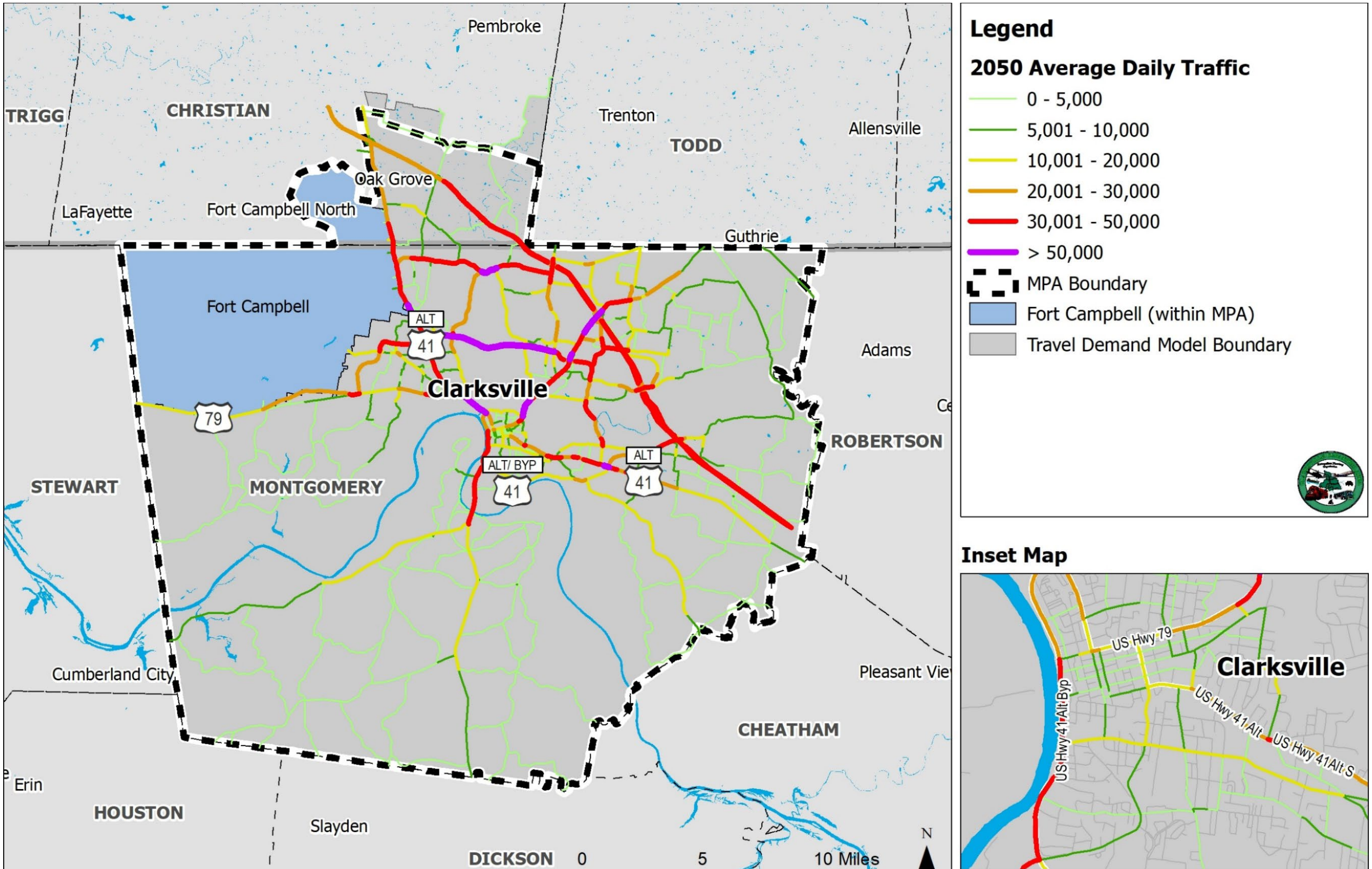
Source: Clarksville MPO Travel Demand Model.

**Figure 4.1** displays the vehicular traffic in the MPA for 2050 if only the E+C projects are implemented. The number of roadway segments that experience a Volume to Capacity (V/C) ratio of 1.0 or greater would increase significantly by 2050, as illustrated in **Figure 4.2**.

It is important to note that not all congested street and highway segments should be widened with additional through lanes or turning lanes. In urban settings, it may be more appropriate to consider ITS improvements or Travel Demand Management (TDM) strategies. Congestion may also be reduced by improving pedestrian, bicycle, and/or transit conditions that will encourage alternative means of transportation. These strategies are discussed further in *Technical Report #5: Plan Development*.

*Source: Microsoft Stock Images*

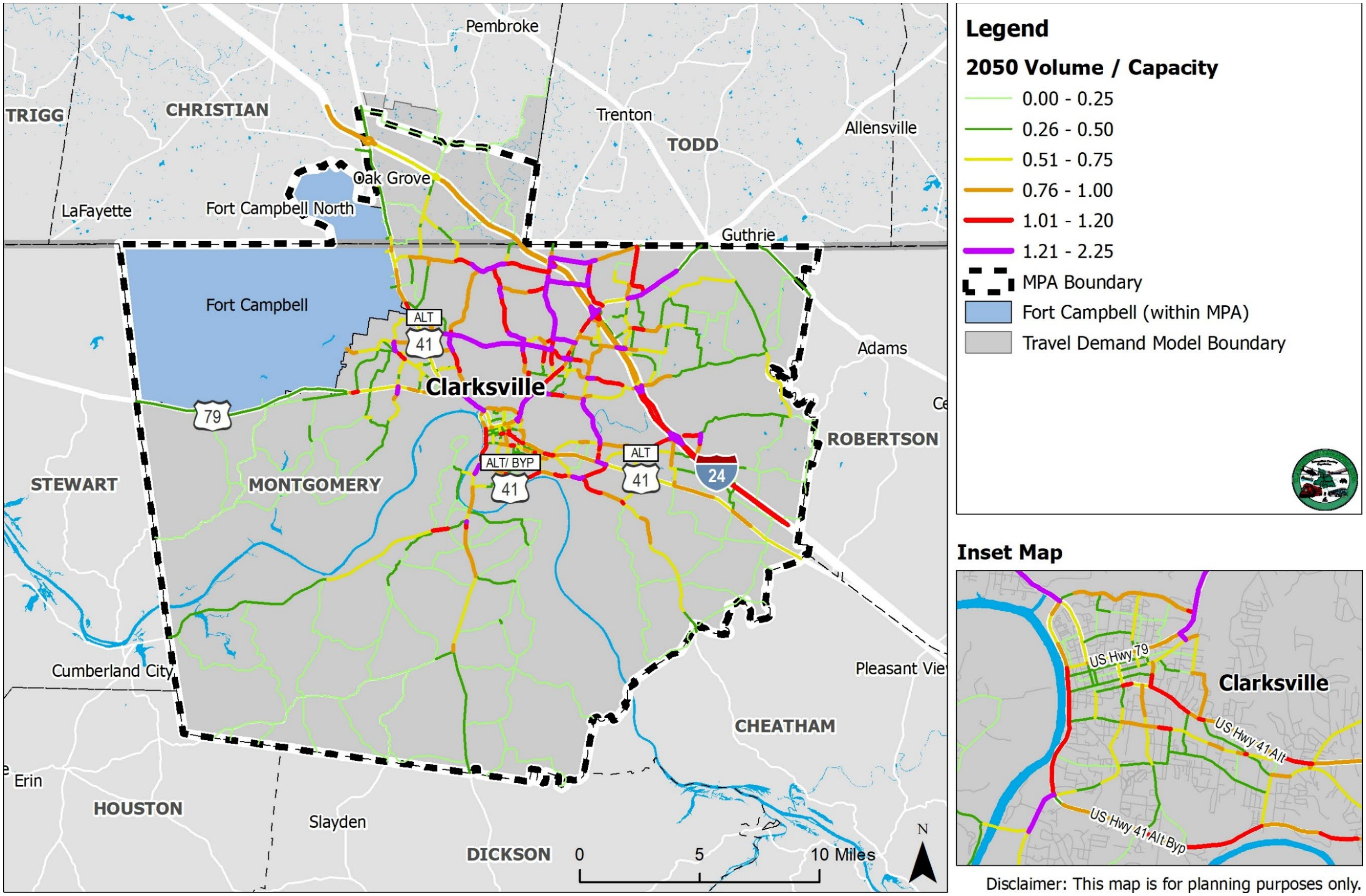
## Figure 4.1: Average Daily Traffic on Roadways, 2050




Disclaimer: This map is for planning purposes only.

Source: Energy Information Administration

## Figure 4.2: Future Volume to Capacity, 2050 (Existing + Committed)




Source: Energy Information Administration

## Public and Stakeholder Input

During the public and stakeholder involvement process, respondents were asked to identify the roadways and intersections they felt were most congested. The list below describes the areas that were most often identified.

- 101st Airborne Division Pkwy
- Madison St
- Tiny Town Rd
- Trenton Rd
- SR-374/Warfield Blvd
- US 79/Wilma Rudolph Blvd
- US 41-A/Fort Campbell Blvd
- 101st Airborne Division Pkwy @ Trenton Rd
- Madison St @ SR-76/MLK Jr Pkwy
- Riverside Dr @ US 79/Providence Blvd
- Tiny Town Rd @ Trenton Rd
- SR-374/Warfield Blvd @ Dunbar Rd

## Intersection and Corridor Recommendations

**Table 4.2** displays the locations identified through public involvement and engineering review, the observed issues, and recommendations to address the intersection needs.

Table 4.2: Recommended Intersection/Interchange Improvement Projects for Congestion

| Location | Segment/ Intersection | Observed Issues | Short-term Solution | Long-term Solution |
|---|---|---|---|---|
| 101st Airborne Division Pkwy | Segment | Congestion (significant congestion westbound between US 79/Wilma Rudolph Blvd and SR-48/Trenton Road during the Midday and PM peaks) | Extend westbound acceleration lane from on-ramp at US 79/Kraft St to SR-48/Trenton Road. | |
| Madison St | Segment | Congestion (between Crossland Avenue and Old Farmers Road) | Access management and/or driveway consolidation | |
| Tiny Town Rd | Segment | Congestion (significant congestion eastbound between Franklin Meadows Way and Peachers Mill Road during the PM peak) | Congestion could be due to lane closure east of Peachers Mill Road from road construction. Review signal timings at intersections. | |
| Trenton Rd | Segment | Congestion (significant congestion between Kennedy Road and Tiny Town Road and between SR-374 and Needmore Road, during the AM and PM peaks) | Widen Trenton Road to four lanes between Branson Way and approximately 1250 ft south of Needmore Road. | |
| SR-374/ Warfield Blvd | Segment | Congestion (significant congestion at the intersection with Rossview Road) | Signal timing modifications at the intersection with Rossview Road | Widen SR-374 to four lanes from Dunbar Cave Road to US 79/Wilma Rudolph Blvd |
| US 79/ Wilma Rudolph Blvd | Segment | Congestion throughout the entire segment during the AM, Midday, and PM peaks, especially at intersections | Turn lanes (Eastbound Right at E Old Trenton Road, Southbound Right at Needmore Rd); traffic signal coordination or modifications at signalized intersections | Access management along US 79/Wilma Rudolph Blvd from Kraft Street to I-24 |
| US 41-A/ Fort Campbell Blvd | Segment | Congestion throughout the entire segment during the Midday and PM peaks | Traffic signal coordination or modifications at signalized intersections | Access management along Fort Campbell Blvd from Dover Road/Providence Boulevard to SR-374 |
| 101st Airborne Division Pkwy @ Trenton Rd | Intersection | AM: Eastbound and Southbound approaches experiencing congestion<br>PM: All approaches experiencing congestion | 1) Signal Retiming<br>2) Construct right turn lanes along Trenton Road. Add left turn lane along southbound Trenton Road. | Widen Trenton Road to four lanes from US 79 to I-24. Extend westbound acceleration lane from on-ramp at US 79 to SR-48/Trenton Road on 101st Airborne Division Pkwy. |
| Madison St @ SR-76/MLK Jr Pkwy | Intersection | AM: Westbound Departing traffic from the intersection experiencing congestion due to school traffic | 1) Improve or update school circulation traffic (drop off/pick up) at Clarksville High School to avoid spill over onto Madison Street.<br>2) Signal retiming | Intersection improvements under construction (as of March 2023) |

| Location | Segment/ Intersection | Observed Issues | Short-term Solution | Long-term Solution |
|---|---|---|---|---|
| | | PM: Eastbound, Westbound, and Northbound traffic experiencing congestion | | Access management and/or driveway consolidation along Madison Street between Crossland Avenue and Excel Road/Old Farmers Road |
| **Riverside Dr @ US 79/Providence Blvd** | Intersection | PM: Northbound, Southbound, and Westbound traffic experiencing congestion | 1) Signal retiming<br>2) Construct a right turn along the westbound approach at the intersection of Providence Boulevard at Walnut Street. | Access management/driveway consolidation along Providence Boulevard between College Street and Dover Road |
| **Tiny Town Rd @ Trenton Rd** | Intersection | AM and PM: Congestion through, north, and south of the intersection<br>PM: Eastbound and Southbound approaches experiencing congestion | 1) Signal retiming<br>2) Construct an additional northbound left turn lane | 1) Widen Trenton Road to four lanes between Branson Way and approximately 1250 ft south of Needmore Road.<br>2) Access management |
| **SR-374/Warfield Blvd @ Dunbar Rd** | Intersection | PM: Southbound approach experiencing congestion | Signal retiming | Widen SR 374 to four lanes between Dunbar Cave Road and US 79 |

Source: Clarksville MPO, NSI

# 4.2 Roadway Maintenance Needs

## Pavement Maintenance

Few of the MPA's roadways have poor pavement conditions; however, all segments are likely to experience maintenance needs that will lead to decreased safety or emergency roadway repairs which can increase congestion. In addition, pavements in fair condition will eventually fall into poor condition before the plan's horizon year of 2050. **Figure 3.5** in *Technical Report #2: State of Current System* displays the pavement conditions of the NHS monitored roadways within the MPA. In the short-term, particular attention should be given to roadway segments with particularly long stretches of poor pavement. In the MPA, these segments include:

- I-24 within the Kentucky portion of the MPAand
- the interchange of US 41-A/Fort Campbell Blvd at I-24.

## Bridge Maintenance

The state of current system analysis revealed that, within the MPA, nearly five (5) percent of bridges are in poor condition, none of which are on the National Highway System.

Addressing the needs of these bridges will improve safety, reduce maintenance costs, and avoid future bridge shutdowns. Bridges are rated by the National Bridge Inventory based on the conditions of the following categories:

- Decks
- Superstructure
- Substructure
- Stream Channel and Channel Protection

A bridge is in Poor condition if any of the above categories are rated "Poor". Some of these deficient bridges may be improved via this plan through other transportation projects, such as a roadway widening. Other bridges could instead be improved through line-item funding for operations and maintenance. These bridges are recommended for improvements as funding becomes available.

## 4.3 Roadway Safety Needs

Within the MPA, nearly 34,000 crashes occurred between 2017 and 2021. During that timeframe, there were 136 fatal crashes and 671 serious injury or suspected serious injury crashes.

Recommendations for reducing the most common types of crashes are outlined below.

> The highest number of crashes in the MPA were rear-end crashes, comprising nearly a third of collisions.

### Reducing Rear-End Collisions

Rear-end collisions can be attributed to several factors, such as:

- driver inattentiveness,
- large turning volumes,
- slippery pavement,
- inadequate roadway lighting,
- crossing pedestrians.
- poor traffic signal visibility,
- congestion,
- inadequate signal timing,
- an unwarranted signal. and/or

In general, the recommendations for reducing rear-end crashes include:

- Analyzing turning volumes to determine if a right-turn lane or left-turn lane is warranted.
  - Providing a turning lane separates the turning vehicles from the through vehicles, preventing through vehicles from rear-ending turning vehicles.
  - If a large right-turn volume exists, increasing the corner radius for right-turns is an option.
- Checking the pavement conditions.
  - Rear-end collisions caused by slippery pavement can be reduced by lowering the speed limit with enforcementor by providing overlay pavement, adequate drainage, grooved pavement, and/or a "Slippery When Wet" sign.
- Ensuring roadway lighting is sufficient for drivers to see the roadway and surroundings.
- Determining if there is a large amount of pedestrian traffic.
  - Pedestrians crossing the roads may impede traffic and force drivers to stop suddenly.
  - If crossing pedestrians are an issue, options include installing or improving crosswalk devices and providing pedestrian signal indicators.

- Checking the visibility of the traffic signals at all approaches.
  - In order to provide better visibility of the traffic signal, options include installing or improving warning signs, overhead signal heads, installing 12" signal lenses, visors, back plates, or relocating/adding signal heads.
- Verifying that the signal timing is adequate to serve the traffic volumes at the trouble intersections.
  - Options include adjusting phase-change intervals, providing or increasing a red-clearance interval, providing progression, and utilizing signal actuation with dilemma zone protection.
- Verifying that a signal is warranted at the given intersection.

**Table 4.3** displays the roadway locations with the greatest frequency of rear end crashes within the MPA.

**Table 4.3: Top 10 Rear End Crash Locations and Recommendations**

| Location | Total Rear End Crashes (2017-2021) | Observation | Recommendation |
|---|---|---|---|
| SR-374/101st Airborne Division Parkway at Peachers Mill Road | 232 | High posted speed limit on SR-374 (55 MPH), only black backplates (or missing) on signals | Ensure adequate signal clearance intervals, add reflective backplates, add signal ahead warning beacons that activate when light is about to turn red |
| SR-374/101st Airborne Division Parkway at North Whitfield Road | 195 | High posted speed limit on SR-374 (55 MPH), only black backplates on signals, poor intersection lighting | Ensure adequate signal clearance intervals, add reflective backplates, offset left turn lanes, improve intersection lighting, add signal ahead warning beacons that activate when light is about to turn red |
| SR-374/101st Airborne Division Parkway at SR-48/Trenton Road | 139 | High posted speed limit on SR-374 (50 MPH), only black backplates (or missing) on signals, poor intersection lighting | Ensure adequate signal clearance intervals, add reflective backplates, improve intersection lighting, add signal ahead warning beacons that activate when light is about to turn red |
| SR-48/Trenton Road at SR-236/Tiny Town Road | 132 | Only black backplates (or missing) on signals, poor intersection lighting, poor pavement striping | Ensure adequate signal clearance intervals, add reflective backplates, improve intersection lighting, improve pavement striping |
| US 79 (SR-13)/Wilma Rudolph Boulevard at SR-48/Trenton Road | 131 | Only black backplates (or missing) on signals, poor intersection lighting | Ensure adequate signal clearance intervals, add reflective backplates, add additional signage indicating photo enforcement before intersection |
| SR-374/Warfield Boulevard at Memorial Drive | 105 | No signal backplates, poor intersection lighting | Ensure adequate signal clearance intervals, add reflective backplates, improve intersection lighting |
| US 41A (SR-76/SR-112)/Madison Street at US 41A Bypass (SR-76)/Ashland City Road/Martin Luther King Parkway | 88 | Only black backplates (or missing) on signals, poor intersection lighting | Ensure adequate signal clearance intervals, add reflective backplates; intersection improvements under construction |
| US 41A/US 79 (SR-12/SR-76)/North Second Street at US 41A Bypass/US 79 (SR-13)/North Riverside Drive/Kraft Street | 84 | Only black backplates (or missing) on signals, poor intersection lighting, poor pavement striping | Ensure adequate signal clearance intervals, add reflective backplates, improve intersection lighting, improve pavement striping |
| US 79 (SR-13)/Wilma Rudolph Boulevard at Holiday Drive/Westfield Court | 69 | Only black backplates (or missing) on signals, poor intersection lighting, poor pavement striping | Ensure adequate signal clearance intervals, add reflective backplates, improve intersection lighting |
| SR-76/Martin Luther King Parkway at Sango Road | 69 | Only black backplates on signals, poor intersection lighting, poor pavement striping | Ensure adequate signal clearance intervals, add reflective backplates, offset left turn lanes, improve intersection lighting |

## Reducing Side Impact / Angle Crashes

Angle crashes were second the most common within the MPA. These crashes can be caused by several factors, such as:

- restricted sight distance
- excessive speed
- inadequate roadway lighting
- poor traffic signal visibility
- inadequate signal timing
- inadequate advance warning signs
- running a red light
- large traffic volumes

In general, the recommendations for reducing side impact and angle collisions include:

- Verifying that the sight distance at all intersection approaches is not restricted.
  - Options to alleviate restricted sight distance include removing the sight obstruction and/or installing or improving warning signs.
- Conducting speed studies to determine whether speed was a contributing factor.
  - To reduce crashes caused by excessive speeding, the speed limit can be lowered with enforcement, the phase change interval can be adjusted, or rumble strips can be installed.
- Ensuring roadway lighting is sufficient for drivers to see the roadway and surrounding area.
- Checking the visibility of the traffic signal at all approaches.
  - To provide better visibility of the traffic signal, options include installing or improving warning signs, overhead signal heads, installing 12" signal lenses, visors, back plates, and/or relocating or adding signal heads.
- Verifying that the signal timing is adequate to serve the traffic volumes.
  - Options include adjusting phase change intervals, providing or increasing a red-clearance interval, providing progression, and/or utilizing signal actuation with dilemma zone protection.
- Verifying that the intersection is designed to handle the traffic volume.
  - If the traffic volumes are too large for the intersection's capacity, options include adding one or more lane(s) and retiming the signal.
- Conducting a roundabout study.
  - By design, roundabouts reduce the likelihood of angle collisions.

**Table 4.4** displays the roadway locations with the greatest frequency of angle crashes within the MPA.

**Table 4.4: Top 10 Angle Crash Locations and Recommendations**

| Location | Total Angle Crashes (2017-2021) | Observation | Recommendation |
|---|---|---|---|
| SR-48/Trenton Road at SR-236/Tiny Town Road | 107 | Only black backplates (or missing) on signals, poor intersection lighting, poor pavement striping | Ensure adequate signal clearance intervals, add reflective backplates, improve intersection lighting, improve pavement striping |
| SR-374/101st Airborne Division Parkway at Peachers Mill Road | 87 | High posted speed limit on SR-374 (55 MPH), only black backplates (or missing) on signals | Ensure adequate signal clearance intervals, add reflective backplates, add signal ahead warning beacons that activate when light is about to turn red |
| US 79 (SR-13)/Wilma Rudolph Boulevard at Holiday Drive/Westfield Court | 85 | Only black backplates (or missing) on signals, poor intersection lighting, poor pavement striping | Ensure adequate signal clearance intervals, add reflective backplates, improve intersection lighting, convert protected/permitted left turn phasing to protected left turn phasing |
| US 41A (SR-76/SR-112)/Madison Street at Memorial Drive | 77 | No signal backplates, poor intersection lighting | Ensure adequate signal clearance intervals, add reflective backplates, add flashing yellow arrow, improve intersection lighting |
| US 41A (SR-12)/Fort Campbell Boulevard at Britton Springs Road/Ringgold Road | 59 | No signal backplates, poor intersection lighting | Ensure adequate signal clearance intervals, add reflective backplates, improve intersection lighting, convert protected/permitted left turn phasing to protected left turn phasing |
| US 79 (SR-13)/Wilma Rudolph Boulevard at Needmore Road/Old Russellville Pike | 59 | Only black backplates (or missing) on signals, poor intersection lighting | Ensure adequate signal clearance intervals, add reflective backplates, improve intersection lighting, convert protected/permitted left turn phasing to protected left turn phasing |
| SR-76/Martin Luther King Parkway at Sango Road | 56 | Only black backplates on signals, poor intersection lighting, poor pavement striping | Ensure adequate signal clearance intervals, add reflective backplates, offset left turn lanes, add flashing yellow arrow, improve intersection lighting |
| SR-374/Warfield Boulevard at SR-237/Rossview Road | 51 | High posted speed limit on SR-374 (45 MPH), poor intersection lighting | Ensure adequate signal clearance intervals, add flashing yellow arrow, improve intersection lighting, add signal ahead warning beacons that activate when light is about to turn red |
| US 41A (SR-12)/Fort Campbell Boulevard at Jack Miller Boulevard/William C. Lee Road | 49 | No signal backplates, poor intersection lighting | Ensure adequate signal clearance intervals, add reflective backplates, improve intersection lighting |
| SR-374/101st Airborne Division Parkway at SR-48/Trenton Road | 47 | High posted speed limit on SR-374 (50 MPH), only black backplates on signals, poor intersection lighting | Ensure adequate signal clearance intervals, add reflective backplates, convert protected/permitted left turn phasing to protected left turn phasing for southbound approach, improve intersection lighting, add signal ahead warning beacons that activate when light is about to turn red |

## Reducing Other Collision Types

The remaining representative crash types can be attributed to incidents involving animals, backing up, bicycle/pedestrian encounters, fixed objects, head on collisions, jackknifing, rollovers, running off the road (the third most common crash type in the region), and vehicle defects. Recommendations for increasing the safety and reducing the number of crashes for these crash types include:

- Determining if the speed limit is too high or if vehicles in the area are traveling over the speed limit.
    - Reducing the speed can reduce the severity of crashes and make drivers more attentive to their surroundings.
- Verifying the clearance intervals for all signalized intersection approaches and ensuring that there is an "all red" clearance.
    - For larger intersections, it is particularly important to have a long enough clearance interval for vehicles to safely make it through the intersection before the light turns red.
- Checking for proper intersection signage, especially if the roadway geometry may be confusing for the driver.
- Verify that all one-way streets are marked "One-Way", and "No Turn" signs are placed at appropriate locations.
- Verifying that pavement markings are visible during day and night hours.
- Verifying that the roadway geometry can be easily maneuvered by drivers.
- Evaluating left and right turning volumes to determine if a right turn and/or left turn lane is warranted.
- Ensuring roadway lighting is sufficient for drivers to see roadway and surroundings.
- Checking the visibility of the traffic signals from all approaches.
- Verifying that lane are marked properly and provide turning and through movement directions, as well as signage that indicates lane configurations.
    - These directions will prevent cars from dangerously switching lanes at the last minute thereby reducing crash potential.

## Stakeholder and Public Input

During the public and stakeholder involvement process, respondents were asked to identify the roadways and intersections they perceived with the most safety issues. The locations that were most often identified are described below and are potential candidates for additional safety studies within the MPA.

- US 79/Wilma Rudolph Blvd
- US 41-A/Fort Campbell Blvd
- US 79/Providence Blvd
- Madison St
- 101st Airborne Division Pkwy @ Peachers Mill Rd
- I-24 Exit 1 (@ Trenton Rd)
- Trenton Rd @ Tylertown Rd
    - "Gary the Guardrail"[16]
- US 41-A/Madison St @ SR-76/MLK Jr Pkwy
- Tiny Town Rd @ Trenton Rd

[16] Gary the Guardrail drawing sympathy, supporters in north Clarksville | ClarksvilleNow.com

# 5.0 Freight Analysis and Needs

Freight needs, such as mobility, safety, and asset conditions, vary by mode. Freight projections indicate that commerce and trade will continue to grow throughout the MPA from 2019 to 2050, leading to an increase in freight traffic. This increase in freight traffic will lead to increased congestion and can cause degradation of the freight network. However, projects in the MPA that address freight needs can improve the region's safety and economic competitiveness.

## 5.1 Freight Truck Needs

This section summarizes future freight truck movement and needs. Freight projections indicate that the truck mode will experience an increase in freight tonnage and value between 2022 and 2050.  This growth will have an impact on the freight highway network, including increased truck traffic and congestion, worsening roadway pavement and bridge conditions, and an increased chance of crashes that involve a heavy vehicle.

### Mobility

The Freight Analysis Framework (FAF) data can be used to understand the projected growth in freight truck commodity flows between 2022 and 2050. This projected growth will lead to an increase in freight truck traffic on MPA's roadways, resulting in an increase in roadway traffic congestion and subsequent decrease in travel time reliability.

### Commodity Flow Growth

According to the Freight Analysis Framework 5, the truck mode accounted for 67 percent of the freight tonnage in Tennessee and 51 percent of freight tonnage in Kentucky in 2019. This corresponds to 88 percent and 63 percent of freight value moved into, out of, and within the states of Tennessee and Kentucky, respectively. By 2050, the freight truck tonnage share is projected to increase to 71 percent in Tennessee and 61 percent in Kentucky, while the freight truck value share is projected to decrease to 71 percent in Tennessee and increase to 73 percent in Kentucky.

In general, freight truck tonnage and values are expected to double in both states by 2050. The truck commodity flow growth for each state is displayed in **Table 5.1**.

Table 5.1: Changes in Commodity Flows by Truck, 2019 to 2050

| Tennessee | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Direction | Tons (Thousand) | | | | Value ($ million) | | | |
| | 2019 | 2050 | Change | Percent Change | 2019 | 2050 | Change | Percent Change |
| Inbound (Interstate) | 65,303 | 111,173 | 45,870 | 70% | 154,853 | 300,266 | 145,413 | 94% |
| Inbound (Intrastate) | 204,363 | 291,569 | 87,207 | 43% | 110,732 | 200,126 | 89,394 | 81% |
| Outbound (Interstate) | 80,059 | 141,255 | 61,196 | 76% | 196,487 | 412,987 | 216,500 | 110% |
| **Total** | **349,725** | **543,997** | **194,273** | **56%** | **462,072** | **913,378** | **451,306** | **98%** |
| **Kentucky** | | | | | | | | |
| Direction | Tons (Thousand) | | | | Value ($ million) | | | |
| | 2019 | 2050 | Change | Percent Change | 2019 | 2050 | Change | Percent Change |
| Inbound (Interstate) | 56,795 | 96,098 | 39,303 | 69% | 117,755 | 235,922 | 118,167 | 100% |
| Inbound (Intrastate) | 132,299 | 180,467 | 48,168 | 36% | 74,946 | 131,533 | 56,586 | 76% |
| Outbound (Interstate) | 57,848 | 94,970 | 37,122 | 64% | 115,957 | 223,998 | 108,041 | 93% |
| **Total** | **246,943** | **371,535** | **124,593** | **50%** | **308,659** | **591,453** | **282,794** | **92%** |

Source: FAF 5

## Roadway Capacity

The roadways with the highest freight truck traffic in 2019 are shown in *Technical Report #2: State of Current System*. These roadways are expected to see an increase in truck traffic between 2019 and 2050. **Figure 5.1** illustrates where growth in freight truck traffic is anticipated to be the highest while **Figure 5.2** shows the estimated 2050 truck volumes on the MPA’s roadway network.

The largest increases in freight truck traffic are on:

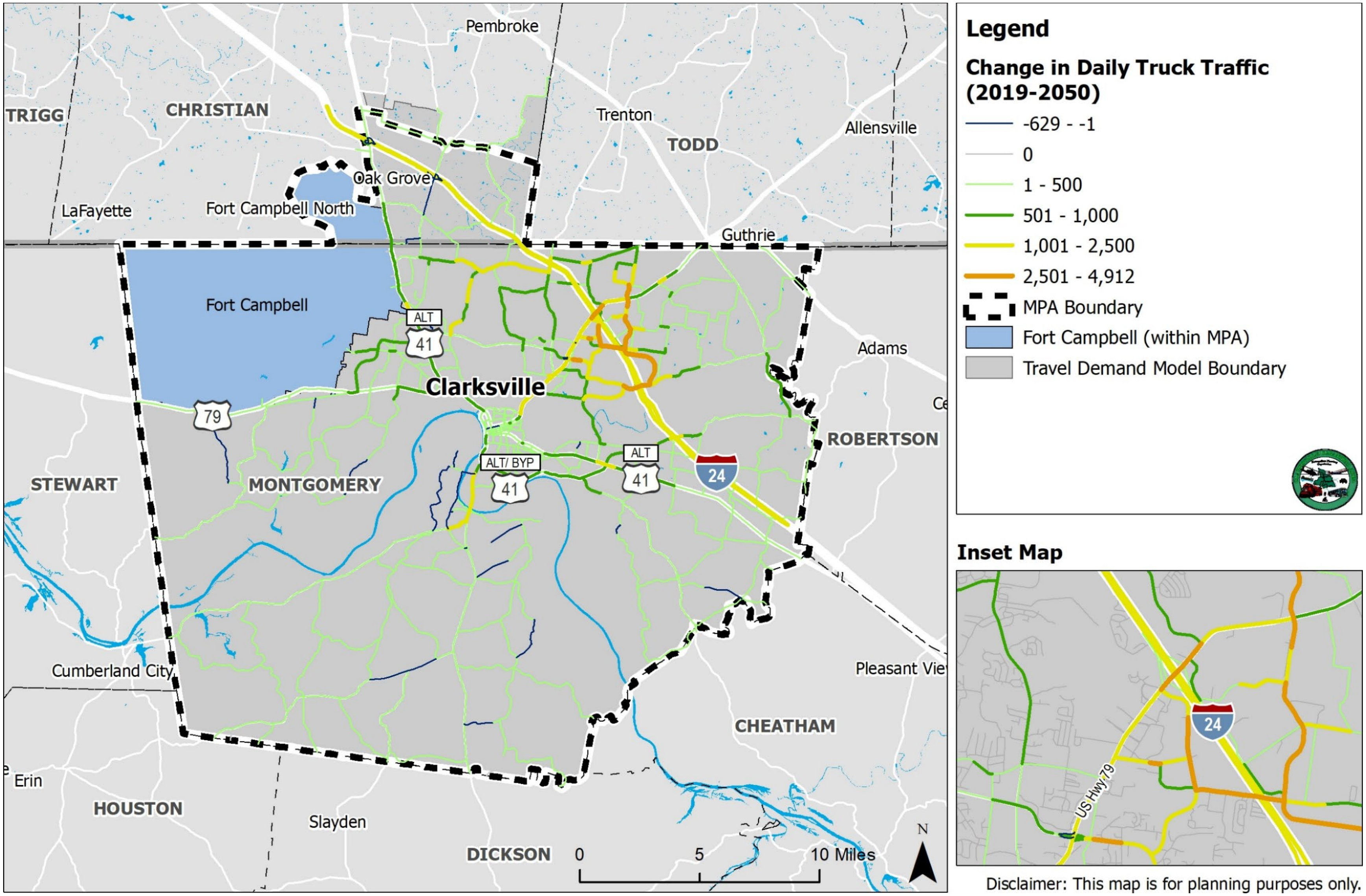
- I-24
- US 79/Wilma Rudolph Blvd from Old Trenton Rd to International Blvd
- International Blvd from SR-234 to US 79/Wilma Rudolph Blvd

**Figure 5.3** shows the roadway segments that accommodate a large number of daily truck trips (500 trucks or more) and experience peak period and/or daily congestion in the base year. These segments possess the greatest need for capacity/reliability improvements to improve future freight conditions in the short-term. **Figure 5.4** displays the roadway segments that are anticipated to have greater than 500 truck trips per day and experience a volume to capacity ratio of 1.0 or greater in 2050.

## Reliability

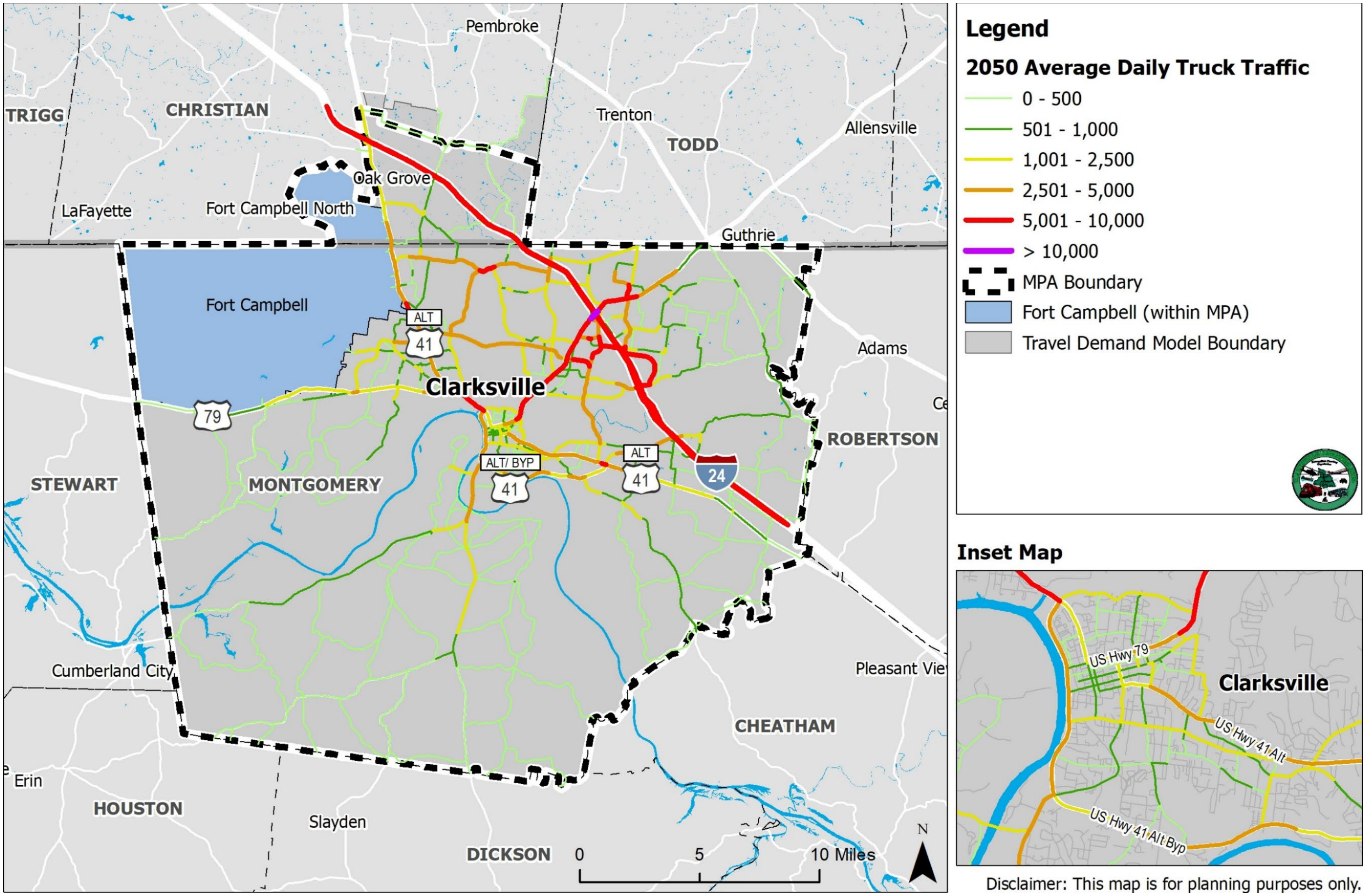
The Truck Travel Time Reliability (TTTR) index for Interstates in the MPA is summarized in *Technical Report #2: State of Current System* and *Technical Report #3: Transportation Performance Management*. Although future TTTR cannot be estimated, the interstates that currently experience reliability issues are projected to experience increased reliability issues in the future. Additionally, interstates that may not currently experience reliability issues may experience future reliability issues as truck traffic volumes and congestion continue to increase.

## Figure 5.1: Freight Truck Growth, 2019 to 2050




Source: Clarksville MPO Travel Demand Model

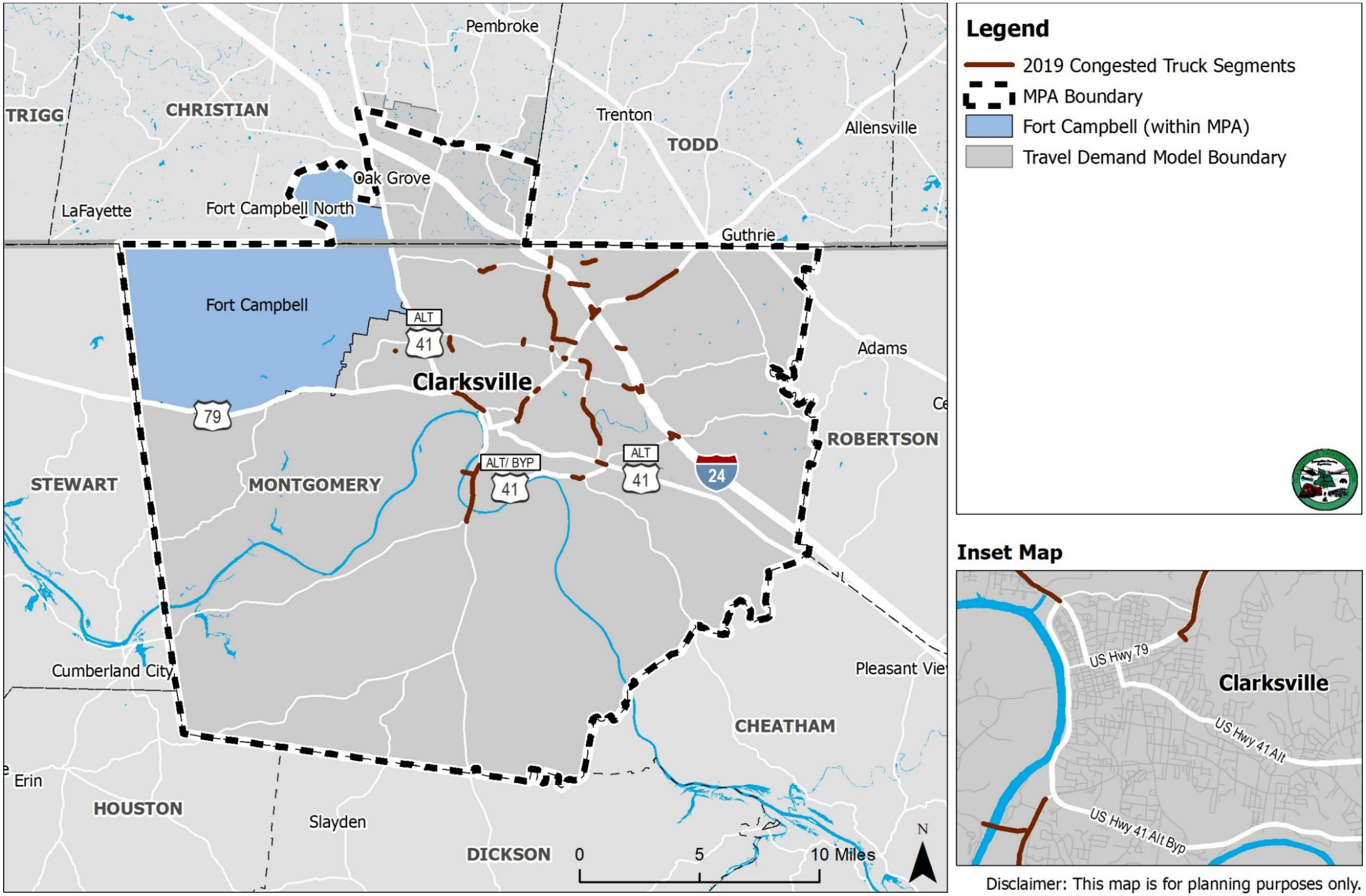
## Figure 5.2: Freight Truck Traffic, 2050




Disclaimer: This map is for planning purposes only.

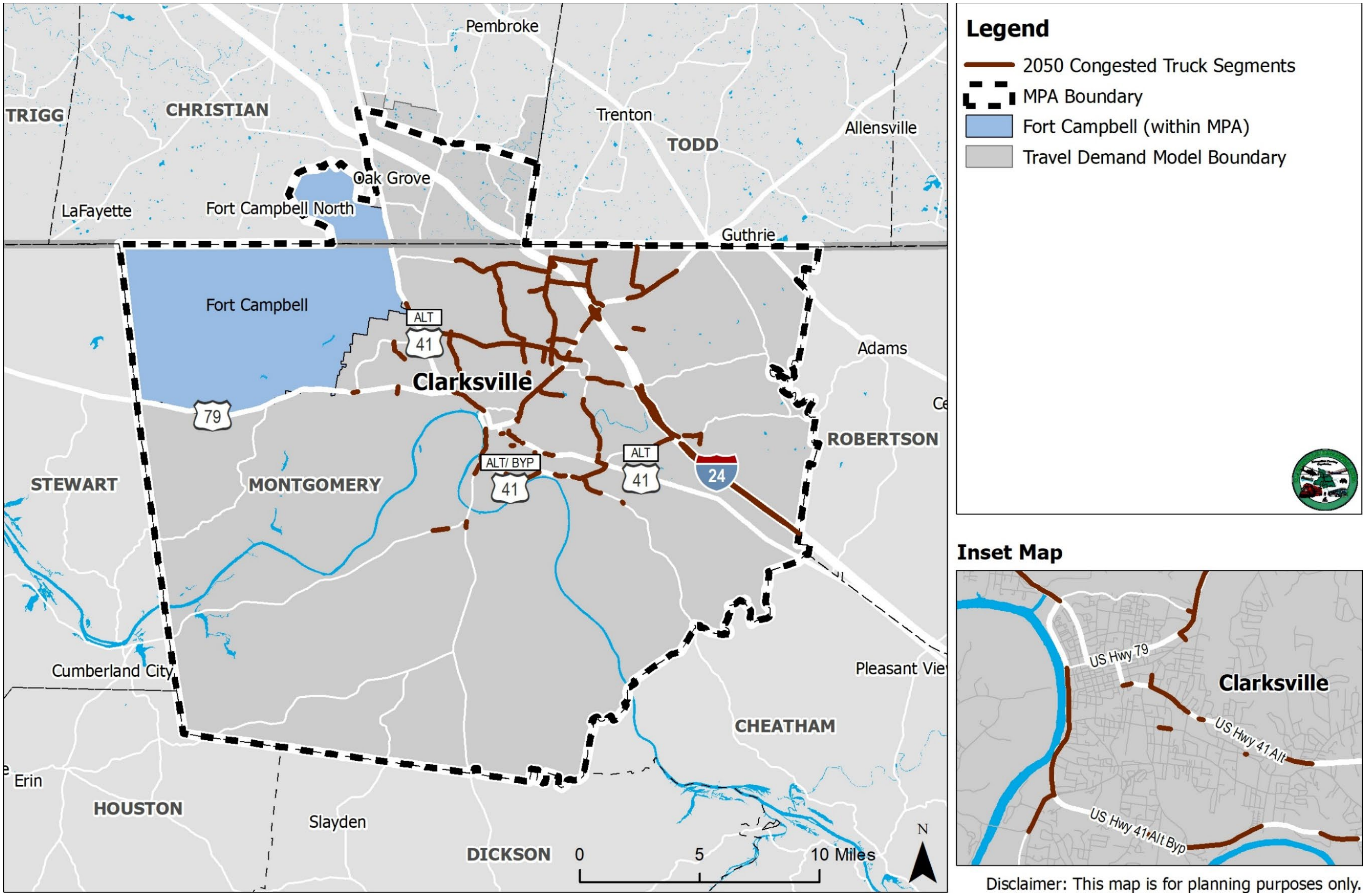
Source: Clarksville MPO Travel Demand Model

## Figure 5.3: Congested Freight Truck Corridors, 2019




Source: Clarksville MPO Travel Demand Model

## Figure 5.4: Congested Freight Truck Corridors, 2050




Disclaimer: This map is for planning purposes only.

Source: Clarksville MPO Travel Demand Model

### Non-Capacity Freight Truck Implications

Increases in freight truck traffic can adversely impact bridges, pavement, and safety. Those impacts can include, but are not limited to, increased vehicle wear and tear, increased operating costs, and an increased chance of heavy vehicle related crashes.

Bridge Condition

Bridge conditions should be monitored to ensure that bridges can handle the increases in freight traffic.  Additionally, bridges with low vertical clearances can require trucks to detour to avoid the risk of striking the bridge infrastructure, which can result in bridge and road closures.

Pavement Condition

Poor pavement conditions can result in increased wear and tear and operating costs for freight truck traffic. The Clarksville MPA network roadways in the MPA with "Poor" pavement conditions exist mostly on I-24 within the Kentucky portion of the MPO; however, there is a significant number of pavements within the MPA that are in “Fair” condition and will eventually become “Poor” condition without proper maintenance. Pavement conditions should be monitored to ensure that pavements can handle the increases in freight traffic.

Safety

The increases in truck traffic could potentially increase heavy vehicle crashes. All crashes can result in delays, and thus increased operating costs, for freight truck traffic. However, crashes involving heavy vehicles, especially those that involve hazardous chemicals, can result in extended delays. The heavy vehicle crashes are summarized in *Technical Report: #2 State of Current System*. Six (6) intersections experienced more than ten (10) heavy vehicle crashes during the study period (2017-2021). Within the MPA, all roadway segments that experienced the most heavy vehicle crashes between 2017 and 2021 were on I-24.

## 5.2 Freight Rail Needs

This section summarizes future freight rail movement and needs. Increases in freight rail commodity flows will lead to an increase in rail traffic on railroads. Within the MPA, there is one Class 1 railroad (CSXT) and one Class 3 railroad (RJCM). Additionally, one railroad connects the CSXT near Hopkinsville, KY to Fort Campbell.

## Mobility

The FAF data can be used to understand the projected growth in freight rail commodity flows between 2019 and 2050. This growth in commodity flows, as well as the existing rail infrastructure, can have an impact on future railroad conditions.

## Commodity Flow Growth

**Table 5.2** displays the growth in freight tonnage and freight value for rail in the states of Tennessee and Kentucky, as projected by the Freight Analysis Framework 5 (FAF5).

### Table 5.2: Changes in Commodity Flows by Rail, 2019 to 2050

| Tennessee | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Direction | Tons (Thousand) | | | | Value ($ million) | | | |
| | 2019 | 2050 | Change | Percent Change | 2019 | 2050 | Change | Percent Change |
| Inbound (Interstate) | 12,018 | 8,118 | -3,900 | -32% | 2,284 | 3,685 | 1,401 | 61% |
| Inbound (Intrastate) | 4,511 | 6,795 | 2,285 | 51% | 4,710 | 8,462 | 3,753 | 80% |
| Outbound (Interstate) | 10,909 | 8,598 | -2,311 | -21% | 2,880 | 5,245 | 2,365 | 82% |
| Total | **27,437** | **23,511** | **-3,926** | **-14%** | **9,874** | **17,393** | **7,519** | **76%** |

| Kentucky | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Direction | Tons (Thousand) | | | | Value ($ million) | | | |
| | 2019 | 2050 | Change | Percent Change | 2019 | 2050 | Change | Percent Change |
| Inbound (Interstate) | 15,593 | 12,445 | -3,148 | -20% | 1,919 | 3,631 | 1,712 | 89% |
| Inbound (Intrastate) | 4,741 | 2,356 | -2,385 | -50% | 2,545 | 3,218 | 673 | 26% |
| Outbound (Interstate) | 28,628 | 7,931 | -20,697 | -72% | 4,301 | 5,599 | 1,298 | 30% |
| Total | **48,962** | **22,732** | **-26,230** | **-54%** | **8,765** | **12,448** | **3,683** | **42%** |

Source: FAF 5

## Rail Capacity and Asset Management

Future rail capacity and needs can be measured in many ways. However, actual volumes and capacities are not known for all rail segments within the MPA. Consequently, it is difficult to forecast future capacity utilization rates and needs by segment, particularly since the tonnage of rail freight being moved is expected to decline, as shown in **Table 5.2.**

Weight Limits

Consistent railroad weight capacity is important to maintaining freight rail movement efficiency and cost advantage. Shippers on rail lines that exceed standard 286,000-pound gross carloads may either be forced to use trucks or to break loads inefficiently. The mainline railroads in the MPA accommodate the industry standard of 286,000 pounds. No information is available for lines that branch from the main lines.

Traffic Control and Signaling

A new traffic control system, Positive Train Control (PTC), is designed to automatically stop a train before certain incidents occur. The PTC systems are integrated command, control, communications, and information systems for controlling train movements with safety, security, precision, and efficiency. PTC must be designed to prevent the following:

- Train to train collisions
- Derailments caused by excessive speed
- Unauthorized movements by trains onto sections of track where maintenance activities are taking place
- Movement of a train through a track switch left in the wrong position

The Rail Safety Improvement Act of 2008 (RSIA) mandated that PTC be implemented across a significant portion of the Nation's rail industry by December 31, 2015.[17] However, this deadline was extended from 2015 to December 31, 2018. Currently, CSXT has requested an amendment to its PTC program.

## Safety

Between 2017 and 2021, there were no crashes involving an automobile and a train within the study area. In addition to injuries and fatalities that can result from these crashes, these incidents can result in significant delays for all road and rail users and increased operational

[17] https://railroads.dot.gov/train-control/ptc/positive-train-control-ptc-information-rd

costs for freight. The MPO can work with its local rail partners to continue maintaining railroad safety in the MPA.

### Highway-Railroad Crossings

*Technical Report #2: State of Current System* shows that there are 23 public highway-rail grade crossings within the MPA. Of those crossings, five (5) possess only passive warning devices which include cross bucks, warning signs, regulatory signs, and pavement markings. The MPO and its local rail partners can work together to add active crossing devices to these locations to improve safety. Active crossing devices include bells, flashing lights, and gates.

### Derailments

According to the Federal Rail Administration (FRA), there were no reported train derailments in the MPA between 2018 and 2022. The MPO's rail partners should work together to ensure that the rail infrastructure is maintained in good condition to avoid future derailments.

## 5.3 Air Network Needs

There is one public use airport in the MPA, the Clarksville Regional Airport, also known as Outlaw Field. The airport is located northwest of Downtown Clarksville and east of US 41A. The airport serves general aviation while the nearest airport with commercial service is Nashville International Airport in Nashville, TN.

### Airport Projects

Currently, there are no planned updates for the Clarksville Regional Airport.

## 5.4 Waterway Network Needs

This section summarizes future waterway freight conditions. Although the amount of freight shipped through waterways is low within the MPA, the goods are often high value. Within the MPA, there are four (4) single-purpose port facilities located along the Cumberland River.

### Commodity Flow Growth

According to U.S. Army Corps of Engineers (USACE) Waterborne Statistics, approximately 14.7 million tons of freight moved on the Cumberland River within the MPA in 2019. However, the amount of freight moved by each of the single-purpose port facilities is unknown and growth or decline of waterway freight within the MPA depends on these facilities. Based on FAF5 data, waterway freight, by tonnage, is expected to increase by eight (8) percent within Tennessee and decrease by fourteen (14) percent within Kentucky.

# 5.5 Pipeline Network Needs

This section summarizes future freight pipeline commodity flow movement and needs. The MPA's pipeline network currently consists of 60 miles of crude oil and refined petroleum products as of 2022. By length, approximately 54 percent of pipelines in the MPA carry crude oil, and the remaining 46 percent carry refined petroleum products.

## Capacity

Although information on needs and pipeline conditions is not publicly available, the FAF data can be used to understand the projected growth in pipeline commodity flow between 2019 and 2050.

## Commodity Flow Growth

**Table 5.3** displays the anticipated change in tonnage and value of pipeline freight from 2019 to 2050.

## Pipeline Conditions and Needs

Pipelines are typically private investments, and pipeline needs and conditions are not publicly available. Nonetheless, pipelines provide additional freight capacity since they handle liquid bulk, such as crude oil and natural gas, that would need to use other surface transportation modes if pipelines did not carry these commodities. Freight moved by pipeline is expected to increase by a moderate amount within both states from 2019 to 2050, which may result in additional capacity needs in the future.

### Table 5.3: Changes in Commodity Flows by Pipeline, 2019 to 2050

| Tennessee | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Direction | Tons (Thousand) | | | | Value ($ million) | | | |
| | 2019 | 2050 | Change | Percent Change | 2019 | 2050 | Change | Percent Change |
| Inbound (Interstate) | 59,078 | 67,685 | 8,607 | 15% | 12,497 | 13,116 | 619 | 5% |
| Inbound (Intrastate) | 9,843 | 15,895 | 6,052 | 61% | 1,936 | 2,786 | 851 | 44% |
| Outbound (Interstate) | 44,327 | 65,986 | 21,659 | 49% | 8,011 | 11,925 | 3,913 | 49% |
| Total | 113,248 | 149,566 | 36,318 | 32% | 22,444 | 27,827 | 5,383 | 24% |
| **Kentucky** | | | | | | | | |
| Direction | Tons (Thousand) | | | | Value ($ million) | | | |
| | 2019 | 2050 | Change | Percent Change | 2019 | 2050 | Change | Percent Change |
| Inbound (Interstate) | 65,109 | 78,967 | 13,858 | 21% | 14,450 | 16,074 | 1,624 | 11% |
| Inbound (Intrastate) | 12,201 | 14,709 | 2,508 | 21% | 4,709 | 5,748 | 1,039 | 22% |
| Outbound (Interstate) | 54,384 | 61,937 | 7,553 | 14% | 11,314 | 12,139 | 824 | 7% |
| Total | 131,693 | 155,612 | 23,919 | 18% | 30,473 | 33,960 | 3,487 | 11% |

# 6.0 Bicycle and Pedestrian

## 6.1 Infrastructure/Facility Needs

Within the MPA, there are over 200 miles of bike routes and sidewalks; however, these facilities are scattered throughout the MPA on functionally classified roadways and within local neighborhoods. Future bicycle and pedestrian facility needs were analyzed in the Clarksville *Transportation 2020+* plan. The projects displayed in **Table 6.1** include all proposed projects in the plan, which are identified as those most needed to improve the overall bicycle and pedestrian network within the MPA. These projects, once developed, will reduce gaps in the system and improve connectivity to the existing bicycle and pedestrian network, major employment and retail shopping centers, transit system, schools, colleges, and parks.

Recognizing the importance of pedestrian facilities, the CUAMPO supports the development of pedestrian focused facilities along all existing and proposed roadways as part of a Complete Streets initiative, as discussed in Section 5.5 in *Technical Report #2: State of Current System*. To accomplish this end, Local Public Agencies (LPAs) should begin annually setting aside funding to improve existing sidewalk infrastructure to meet ADA standards while "filling in the gaps" with new infrastructure. Improving and expanding infrastructure in high priority areas is essential to providing pedestrians and bicyclists with greater access to medical services, retail centers, public facilities, and services.

Table 6.1: *Transportation 2020+* Bicycle and Pedestrian Projects

| Project | Cost | Tier |
|---|---|---|
| Tiny Town Rd/10 Foot Multi-Use Path | $23,400,000 | 1 |
| Greenwood Ave/Edmonson Ferry Sidewalks | $4,200,000 | 1 |
| Jordan Road Sidewalk/5 Foot Sidewalks | $2,980,000 | 1 |
| North Senseney Circle/Barkers Mill School Sidewalks | $990,000 | 1 |
| Highway 48/13 Sidewalks/Crosswalks | $2,500,000 | 1 |
| Riverside Drive/Rehab existing/To Cumberland Drive | $7,500,000 | 2 |
| Vulcan Property to Greenway/Red River, Stacker, Hyman | $3,920,000 | 2 |
| Richview Road/Memorial to Madison Street | $3,600,000 | 2 |
| Peachers Mill Road/Dale Terrace to Providence Boulevard | $1,950,000 | 2 |
| Highway 48-13/Sidewalks & Crosswalks | $2,500,000 | 3 |
| Madison Street/10th Street to SR-76/Sidewalks | $15,000,000 | 3 |
| Outlaw Field Road/Tiny Town to Jack Mill/Both Sides | $4,060,000 | 3 |
| Ringgold Road/Fort Campbell Boulevard to RR Bridge | $5,700,000 | 3 |

Tier 1 is the highest priority in the *Transportation 2020+* plan and reflect the most immediate needs.

Source: Transportation 2020+

## 6.2 Maintenance

Maintenance is, and will always be, a major challenge for any type of transportation infrastructure. However, it is incumbent upon all jurisdictions responsible for these facilities to ensure their functional viability. As bicycle and pedestrian facilities are added to the MPA's transportation network, they must be designed in compliance with ADA requirements. Additionally, older facilities may require repairs, maintenance, and/or updates to comply with ADA requirements.

In addition to maintaining or developing maintenance schedules for bicycle and pedestrian facilities, local jurisdictions should begin identifying funding sources for annual maintenance of these facilities. Failure to have dedicated funding sources in place for maintenance of existing and future infrastructure can result in degradation of these facilities to the point of rendering them unusable, and thus useless to the traveling public who may depend on them to access everyday needs. If local jurisdictions determine there is a lack of available funding for maintenance, they should explore alternative maintenance strategies through partnerships with other organizations and the creation of maintenance programs, such as "Adopt-a-Trail". Adopt-a-Trail programs allow groups such as bicycling/running clubs and homeowner associations to be responsible for the maintenance of an identified segment of a bicycle or pedestrian facility.

## 6.3 Safety and Security Needs

### Safety

States and MPOs are required to set targets and report annual progress regarding the number of non-motorized fatalities and serious injuries to meet one (1) of their five (5) Federal Safety Measures. Over the five (5) year safety planning period (2017-2021), the Clarksville MPA averaged 10.0 non-motorized serious injuries per year and 4.4 non-motorized fatalities per year.

Pedestrian fatalities and serious injuries  were significantly higher than similar results occurring from bicycle incidents. These results are common since pedestrian activity is typically much higher than bicycle activity. Nationally, pedestrians account for over 17.5 percent of all fatalities in motor vehicle traffic crashes, and most of these deaths occur at uncontrolled crossing locations, such as mid-block or un-signalized intersections. These sites are among the most common locations for pedestrian fatalities due to inadequate or inconvenient pedestrian crossing opportunities which create barriers to safe, convenient, and complete pedestrian networks.

Traffic crashes between motorists and non-motorized users of the transportation system can be caused by the lack of effective safety infrastructure. However, distracted driving plays an even more significant role in these types of incidents. Distracted driving is any activity that diverts attention from driving, including:

- talking or texting on a phone or device,
- eating and drinking,
- talking to people in the vehicle,
- “rubber necking”,
- operating entertainment, or
- navigation systems

> Studies have shown that drivers who use handheld devices are four (4) times more likely to be involved in a crash resulting in serious injury.

In most cases addressing driver inattentiveness could have a more profound impact on reducing automobile crashes than infrastructure improvements.

Distracted walking has also been found to be a major factor in several crashes involving pedestrians. Texting and driving are a known danger, but distracted walking results in more injuries per mile than distracted driving. Consequences include bumping into walls, falling down stairs, tripping over obstacles, or stepping into traffic. Though injuries from car accidents involving texting are often more severe, physical harm resulting from texting and walking occurs more frequently. While motorists should not use their cell phones when driving due to the increased probability of a traffic accident, pedestrians have an equal responsibility to pay attention to their surroundings to reduce their chances of being involved in a crash.

To improve safety for both bicyclists and pedestrians, local jurisdictions within the Clarksville MPA should reach out to TDOT, KYTC, and local police departments to obtain detailed crash records to aid in identifying high crash locations and identify safety measures that, when implemented, will have the greatest impact on reducing the total amount and severity of crashes. In areas identified as high crash locations between motorists and bicyclists /pedestrians, assessments should be made to determine the primary causes for the repeated incidents, and appropriate safety countermeasures should be implemented to address the underlying causes of the problem, whether it is through traffic calming measures such as road diets or raised crosswalks, improved signage, pavement markings, signalization at intersections, or education programs designed to prevent these crashes from occurring in the future.

## Security

In addition to safety concerns, there are also numerous security concerns to a bicycle and pedestrian network. These include, but are not limited to:

- the possibility of criminal attack,
- theft, and
- vandalism.

These concerns are primarily along portions of shared use bicycle and pedestrian paths that are isolated from the roadway right of way. To provide a greater sense of security for users of shared use paths, project engineers and managers should strongly consider incorporating additional security features in the development of all new facilities which can include increased lighting, cameras, and emergency phone boxes placed at strategically located areas along each facility.

Priority should also be placed on consulting with local law enforcement agencies to request that officers periodically patrol these facilities. Increasing law enforcement presence is a major factor in deterring crime before it happens. Local advocates willing to participate should consider the feasibility of organizing bicycle and pedestrian safety watch groups to intermittently patrol the facilities. Even if law enforcement officials periodically patrol shared use facilities, there is no way to guarantee they will always be available in case of an emergency. A safety watch group provides a secondary deterrent to crime when law enforcement officials are unavailable.

Implementing prevention measures to aid in reducing theft and vandalism of support facilities along bicycle and pedestrian corridors is also a need. Installing Closed Circuit Television (CCTV) systems to constantly monitor high value support facilities would greatly diminish the potential of these assets from being stolen or vandalized. Additionally, providing physical barriers, such as fencing, limits access to these areas and serves as an additional security deterrent.

# 7.0 Public Transit

## 7.1 Service Needs

As documented in *Technical Report #2: State of Current System*, transit service in the region provides much more extensive transit service and cost efficiency when compared to its peers but is less productive in attracting riders and has a lower farebox recovery rate.

### Existing and Future Regional Transit Demand

The *Transportation 2020+* plan serves as the foundation for the Clarksville Transit System (CTS) needs and future projects.

The primary project within the plan is the replacement of the existing CTS transit center with a new facility, located in Downtown Clarksville. The new, larger facility will be constructed in an area less likely to produce traffic congestion and will have additional space for future transit expansions.

**Table 7.1: *Transportation 2020+* Transit Projects**

| Project | Cost | Tier |
|---|---|---|
| Main Transit Station Relocation | $10,000,000 | 1 |
| St. Bethlehem Hub | $750,000 | 2 |
| Northside Hub | $750,000 | 3 |

Tier 1 is the highest priority in the *Transportation 2020+* plan and reflects the most immediate needs.

Source: Transportation 2020+

## 7.2 Maintenance and Capital Needs

### Maintaining Existing Assets

The existing CTS fleet has few vehicles that are within the State of Good Repair (SGR) backlog. While actual vehicle lifespans may extend beyond the default Useful Life Benchmark (ULB) and maintain a SGR, older vehicles will still need to be replaced on a regular basis over the next 25 years due to local roadway and environmental conditions. Since funding is limited, efforts should be made to extend vehicle lifespans beyond their ULB through preventative maintenance.

CTS should carefully monitor the frequency of vehicle breakdowns and other road calls. It may become necessary to revisit standard operating procedures.

Maintenance of facilities should also be carefully monitored. CTS maintains two (2) administration buildings, two (2) maintenance facilities, and one (1) passenger facility as part of its system. Of these facilities, none rate below 3.0 on the Transit Economic Requirements Model (TERM) scale. To maintain this performance, CTS should continue performing regular maintenance and upgrades as needed.

### New Assets

As CTS maintains and expands its services and upgrades its transit stop amenities, new capital assets will be required. CTS should ensure that it acquires new assets in a sustainable manner so that they may be maintained in a SGR in the future. As CTS improves its rolling stock and equipment performance targets it must continue to upgrade its fleet by incorporating newer vehicles and phasing out older vehicles as needed.

## 7.3 Safety Needs

CTS has an average rate of safety and security events compared to other urban transit systems in the state or country, averaging 4.6 events per year. Additionally, CTS had zero incidents resulting in fatalities in the last five (5) years which reflects that incidents with CTS have not been severe.

# 8.0 Multi-modal Needs

## 8.1 Supply of Emerging Modes

This chapter focuses on the existing supply of emerging modes (which include ride hailing and micromobility services), while discussing their future application or other modes that will compliment them. The ability of emerging modes to support the region's transit and active transportation network is dependent on its ability to integrate with these networks through universal fare payment, pickup/drop-off locations at transit stops, and other methods. *Technical Report #2: State of Current System* outlines various conditions and characteristics of the existing transportation system in the Clarksville MPA, including. a detailed analysis of the existing bicycle and pedestrian facilities and public transportation networks in the region. Several subsections of the this "Supply of Emerging Modes" section borrow and build upon sections from *Technical Report #2: State of Current System*.

### Bicycle and Pedestrian Infrastructure

The Clarksville MPA consists of a limited network of bicycle and pedestrian facilities. These facilities provide broad coverage and connectivity for bicyclists and pedestrians within the urban core, but decrease sharply in coverage into the surrounding suburbs. The *Transportation 2020+*[18] *Plan* guides future bicycle and pedestrian infrastructure growth within the MPA.

### Public Transportation

Public transportation in the Clarksville MPA is provided by CTS and has been discussed in *Technical Report #2: State of Current System*.

### Transportation Network Companies (TNCs)

As outlined in *Technical Report #2: State of Current System*, a Transportation Network Company (TNC) is defined as a private company that matches passengers with vehicles via websites and mobile apps. Also referred to as ride-hailing services, the two (2) largest providers are Uber and Lyft, both of which currently operate within the Clarksville MPA. TNCs generally operate with a fare structure comprised of base fares combined with per-minute and per-mile fees.

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[18] Transportation 2020+ | Clarksville, TN (cityofclarksville.com)

### Micromobility

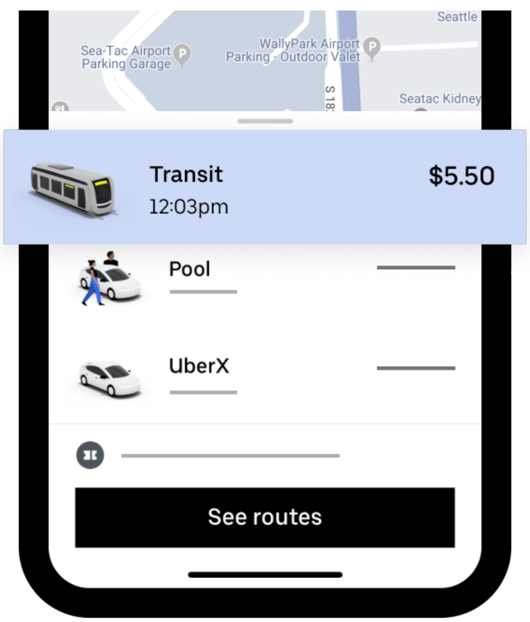
Micromobility differs from microtransit, as micromobility uses lightweight (usually electric) vehicles such as bicycles and scooters. They are available on-demand through self-service rental programs where customers pay a fare structure similar to TNCs – a combination of a base fare and a per-minute and/or per-mile rate. There is currently one (1) micromobility provider operating in the Clarksville MPA – BCycle. The service currently operates at five (5) strategic locations and provides access to 44 bicycles.

## 8.2 Integration with Regional Transit

Emerging modes of transportation have the potential to greatly increase mobility as they provide new modes of transport for commuting to work or school, tourism or recreational use, and other travel needs. Additionally, their on-demand nature means they can supplement existing modes of travel. While users may naturally choose the mobility options to best fit their travel needs, the following are strategies for integrating emerging modes with local transportation options.

### Integrated Payment and Trip Planning

Pre-trip planning and payment can be crucial for a traveler choosing a transportation mode. While roadway travel times are valuable information for drivers, public transportation or on-demand service arrival times are equally as important for transit riders. However, if public transportation schedules do not meet the needs of all users, or if users live outside of the transit network, they may instead opt to use emerging modes for a portion or the entirety of their trip. Generally, emerging modes are driven by each company's smartphone application, requiring a user to navigate between applications to compare travel options. Integrating emerging modes with public transportation applications, and vice versa, can potentially increase the usage of both services.




Source: GeekWire. https://www.geekwire.com/2020/uber-adds-seattle-area-transit-options-app-new-expansion-public-transportation-integration/

Uber is an example of an emerging mobility provider integrating public transportation into its application. In 2019, it implemented real-time information on public transportation in multiple major cities. Users are now able to see transit as an option, alongside Uber's ride hail offerings, as well as real-time arrival and travel times.

However, a limitation found by Uber and other services that have partnered with local transit, is the ability to pay for the public transportation option. While providing real-time trip planning for public transportation is important, equally as important is fare integration. In addition to encouraging the use of emerging modes to improve mobility and accessibility for public transport riders, fare integration also offers the potential for reduced fares for those who transfer from one service to another.

## Mobility Hubs

Part of the appeal of emerging modes is their on-demand nature. For instance, shared scooters and bicycles can be picked up and dropped off at almost any location that allows enough space to do so, enabling point-to-point travel and easing the first/last mile issue experienced with fixed-route public transport.

Considering that micromobility has largely been electric-powered, fixed stations can ensure that the scooters and bicycles are consistently charged, reducing the need for companies to remove them from service while being recharged. Fixed stations also provide a safe location for users to leave their devices, as opposed to occupying sidewalks or other shared pathways. Lastly, strategically located "mobility hubs" can allow for efficient transfer from one mode to another. For instance, a hub of shared scooters and bicycles at a busy bus terminal, such as the CTS Transit Center, provides micromobility options to public transit users to complete the first or last leg of their trip.

<u>Pickup/Dropoff Locations</u>

Similar to mobility hubs, pickup/dropoff locations (or zones) are a strategy for improving the efficiency of emerging modes, specifically for TNCs. Designating these locations can help separate TNC traffic from general traffic and ease congestion.

Another example is the inclusion of pickup/dropoff zones at transit stations that serve commuters who may need emerging modes of transportation. Transit agencies across the U.S. have already implemented strategies for facilitating the drop off and pick up of passengers via cars. Often referred to as "kiss and ride" facilities, these car parks or lots facilitate the seamless transfer from passenger vehicles to the transit station. While not originally built for TNC usage, they have been easily adopted for such use, facilitating the seamless integration between the two modes. Comparable to airport pickup/dropoff zones, they also improve efficiency, while minimizing the impact of TNCs on general traffic.

## Equity Programs

Emerging modes such as TNCs have the potential to effectively provide transportation services outside of fixed transit routes. As a result, some cities have taken advantage of public-private partnerships to use TNCs to advance their equity goals. A few prominent examples of such programs were implemented by the Pinellas Suncoast Transit Agency and the Massachusetts Bay Transportation Authority. In Pinellas County, Florida, the Pinellas Suncoast Transit Agency (PSTA) partnered with Uber to provide free rides for eligible economically disadvantaged riders and discounted rides for all riders within certain zones. In a similar program, the Massachusetts Bay Transportation Authority (MBTA), partnered with Uber and Lyft to create RIDE Flex, offering subsidized rides for disabled passengers. Through RIDE Flex, passengers pay as low as $3 per ride, with the MBTA subsidizing the remainder of the fare.


Source: Uber Blog. https://www.uber.com/blog/tampa-bay/psta-td/